U. S. Bureau of Commercial Fisheries.



U. S. DEPARTMENT OF COMMERCE

BUREAU OF FISHERIES

# REPORT

OF THE

# UNITED STATES COMMISSIONER OF FISHERIES

FOR THE FISCAL YEAR 1928

WITH

## APPENDIXES



IN TWO PARTS

PART I

HENRY O'MALLEY
Commissioner



UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1929

# National Oceanic and Atmospheric Administration

## Report of the United States Commissioner of Fisheries

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# DEPARTMENT OF COMMERCE

## BUREAU OF FISHERIES

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# REPORT OF THE COMMISSIONER OF FISHERIES [1]

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[1] Bureau of Fisheries Document No. 1038.

DEPARTMENT OF COMMERCE,
BUREAU OF FISHERIES,
*Washington, July 2, 1928.*

The honorable the SECRETARY OF COMMERCE.

DEAR MR. SECRETARY: I have the honor to submit the following report of the major operations of the Bureau of Fisheries during the fiscal year ended June 30, 1928.

The enlivening of the public conscience to the need for proper husbandry of our fisheries resources is the most heartening feature of the present fisheries situation. Greater interest in outdoor recreational pursuits and the development of strong organizations that are sponsoring the conservation of wild life have enlisted the active support of hundreds of thousands of our people in insuring the perpetuity of our fishery resources, as a result of which Federal and State agencies are expanding their facilities for handling and distributing fish and eggs for stocking streams in an effort to maintain the fish supply. The output of fish and eggs from the bureau's stations in 1927 exceeded 7,000,000,000, an increase of more than 550,000,000 over the high record of 1926. The number of cooperative fish nurseries increased from 55 in 1927 to 86 in 1928, distributed in 11 States. As a consequence of this expansion in hatching and rearing facilities, many more fish are reared to a length of 3 or 4 inches before being released in natural streams and ponds.

The commercial fisheries of the United States, too, apparently are in a stronger economic condition than those of any other large fish-producing country in the world to-day, and they have come to appreciate better the importance of proper husbandry to insure continuity of supply.

Coincident with these developments is the growth of a greater appreciation of the work of the scientist. By placing fisheries research on a more practical basis, the fisheries biologist has demonstrated the value of such research in determining the character of legislation needed, and thereby has created a greater demand for his services. A case in point is the strengthening of regulations in Alaska to insure an adequate escapement of salmon to the spawning grounds, as a result of scientific investigation of these fisheries, which is recognized generally as a sound economic development worthy of the support of all those interested in perpetuating these fisheries. The trained scientific aquiculturist has demonstrated the importance of studies of diseases, nutrition, selective breeding, fertilization of water areas, and many other problems encountered by the fish farmer, the grower of goldfish and other aquarium fishes, the oyster farmer, and those engaged in other branches of water farming. The technological section of the bureau has become more and more a postgraduate school for workers interested in such research, with the result that since the inception of this work a decade ago, each year has added to the number of technical workers and the facilities for technological research employed by the industry. In fact, it is believed that the strong economic position of the industry to-day is due in large measure to this development.

### NORTHERN PACIFIC HALIBUT CONVENTION

This convention, ratified on October 21, 1924, is of special interest (1) in that it is the first convention entered into by Canada as a nation and (2) it is the first effective treaty having for its object the conservation of an endangered high-seas fishery. As such it may be expected to serve as a precedent for international cooperative control of sea fisheries where such is needed.

The Pacific halibut fishery originated in 1888, soon after railway communication was established between the east and west coasts of the United States, near Cape Flattery at the entrance to Juan de Fuca Strait. It expanded rapidly and by 1910 had reached grounds off Cape Ommaney, Baranof Island, 600 miles to the north. Subsequent expansion extended coastwise a length of 1,800 miles. The annual catch exceeds 50,000,000 pounds, or about 60 per cent of world production, for which the fishermen receive about $7,000,000. It is, therefore, one of the most important fisheries in North American waters.

Formerly as many fish were taken from the 600-mile stretch as are procured now from the entire 1,800 miles. The catch on the older grounds south of Cape Ommaney decreased from more than 50,000,000 pounds in 1910 to about 21,000,000 pounds in 1926, and much greater effort was exerted to make the smaller catch. The present level of production of the whole fishery has been maintained by extending operations to new areas as the catch on the older grounds has decreased and by increasing the intensity of fishing effort. The use of two and one-half times the quantity of gear formerly employed on the older banks now yields a catch only about 40 per cent as great as formerly. Where in 1906 the catch per unit of fishing gear was nearly 300 pounds, in 1926 it was below 50 pounds; that is, it now takes six units of gear to catch as many fish as one unit caught in 1906. The new banks to the westward show the same trend, the catch having fallen from 160 pounds per unit of gear in 1923 to 100 pounds in 1926 and was still lower in 1927, while at the same time the number of second-grade fish increased.

The fishery is in a very serious condition and the banks can not long withstand the intensity of fishing to which they are subjected. In a report to the two interested governments, the International Fisheries Commission proposes certain measures of conservation not provided for in the original convention as the minimum requirements necessary to preserve this important fishery.

### LOSSES OF FISH IN IRRIGATION DITCHES

In March, 1895, Dr. C. H. Gilbert called to the attention of the Oregon Fish and Game Commission the loss of many thousands of young fish that passed into the irrigated fields along Wallowa Lake and tributaries and recommended legislation requiring screening to prevent fish from entering canals, mill races, and irrigation ditches. The losses are heaviest in Pacific coast streams, where the young salmon on their seaward migration find their way by the millions into these diversion channels and finally perish or are destroyed.

A survey along the Yakima River, Wash., in 1916 revealed 20 fish per acre on a 200-acre tract, or about 4,000 fish, of which 90 per cent were migrating salmon. As this condition may be multiplied many times during a season, the economic waste of young food fishes (salmon and trout) is very large. With respect to the Columbia River area, the bureau has stated previously that large numbers of young salmon on their seaward migration become lost in the irrigation ditches or impounded in the pools left in the main stream as the water is drawn off for irrigation, where they die as the water warms and evaporates. From 80,000,000 to 90,000,000 salmon fry are released in the Columbia River annually, while the annual catch of adult fish is about 3,000,000. It has been estimated that 90 per cent of the young salmon migrating seaward are lost in irrigation ditches.

While the States have laws requiring screening, the question is so involved that strict compliance therewith has not been required. The failure of screens to function satisfactorily and the number of areas under Federal control have increased the difficulties. An act of Congress, approved May 1, 1928, authorized an appropriation of $25,000 "to study, investigate, and determine the best means and methods of preventing the destruction of fish occasioned by ditches, canals, and other works constructed or maintained by the United States."

## PASSAMAQUODDY POWER PROJECT

Passamaquoddy Bay, including the estuary of the St. Croix River, covers about 100 square miles and is subject to a rise and fall of from 20 to 25 feet every 12 hours. Every 6 hours about 2,000,000,000 tons of water boil through the narrow passages at the mouth of the bay. According to Dr. A. G. Huntsman of the Biological Board of Canada, who made a careful study of the proposed damming of the mouths of Passamaquoddy and Cobscook Bays, at the entrance to the Bay of Fundy, for power purposes, the construction of dams will have a widespread and pronounced effect on the fisheries throughout the region. The production of fish food in the region generally will be reduced considerably, and the fisheries for sardines, clams, cod, and haddock of Passamaquoddy Bay may be wiped out, as well as the sardine and pollock fisheries of the neighboring coast.

## SALMON INVESTIGATIVE WORK UNDER NEW HEAD

The success of the bureau's salmon investigative program on the Pacific coast is due in large measure to the highly practical researches and intelligent directive effort of Dr. C. H. Gilbert, which won the confidence of scientists, administrators, canners, and fishermen alike. The tracing of the age and growth of salmons by studies of the concentric rings on their scales, and the determination of their migration routes to spawning areas by tagging, marking, etc., have contributed much needed information regarding the habits of these fishes, which has served as a basis for sound fishery legislation. With the death of Doctor Gilbert on April 20, 1928, Dr. Willis H. Rich, for many years his associate, assumed the direction of this work.

## GREAT LAKES FISHERIES SITUATION

The fisheries of the Great Lakes are a matter of State and provincial, national and international concern. The yieeld has been as high as 150,000,000 pounds per annum. The fisheries furnish employment to about 15,000 persons and the investment exceeds $15,000,000. Their value as a source of food is enhanced greatly by their central location, removed from the great coastal fisheries. They afford recreation to thousands of people and are a source of wealth to shore communities.

The average annual catch for the period 1913 to 1925 was 122,000,000 pounds, of which 86,000,000 pounds is credited to the United States and 36,000,000 to Canada. The location of Lake Michigan wholly within the United States accounts in part for the difference. Since 1918, there has been an alarming downward trend from 150,000,000 pounds to 100,000,000 in 1925. In 1927, according to reports of the fishermen, summer chub fishing in Lake Huron was the poorest experienced in years. In Saginaw Bay perch and suckers are disappearing fast, and even the supposedly inexhaustible herring was on the decline; in fact, the fishery has been a complete failure for two years. Even in Green Bay, one of the most productive herring waters, the species is declining noticeably. In Lake Michigan the trout, whitefish, and chub fisheries were failures. In Lake Erie, the worst slump in the history of its fisheries was experienced. It is well known that the cisco is disappearing, and now the perch and yellow pike appear to be growing scarce.

On February 6, 1928, at Cleveland, Ohio, a conference of investigators from private institutions and State officials was called by the bureau to develop a cooperative program of investigations for Lake Erie, and as a result a harmonized and well-rounded program of research has been developed. On February 8, 1928, the second meeting of the International Fisheries Conservation Council of the Great Lakes was held at Lansing, Mich., as a result of which an excellent beginning has been made toward inaugurating a system of collecting uniform statistics covering the fisheries of these lakes. These records will show the daily catch of each species, location and amount of gear used, type of net, and length of time fished. It was proposed, also, that representatives of the Dominion Government, the Province of Ontario, and the State of Michigan work out an informal plan for uniform regulation of the fisheries of Lake Huron.

## BIOLOGICAL INVESTIGATIONS

It is the duty of the Bureau of Fisheries, with regard to marine fisheries, to determine the variations in the supply of commercial species, together with the factors that regulate their abundance, and to encourage the application of this knowledge to their protection and wise use. The estimation of the actual abundance of the stock of fishes in the sea, of the drain to which they are subjected by the commercial fisheries, and of the strain of fishing that they will stand safely is the fundamental fisheries problem, for it is certain that we can not, by artificial means of propagation, maintain any of the true marine fishes if they be overfished. Fishes have been studied heretofore as individuals; that is, from the morphological and taxonomic standpoint. As a result of recent developments of fishery science, they now are studied as populations by methods similar to those developed in collecting vital statistics. The fishery itself is being studied, together with its effect upon the stock, in order to gauge the increase or decrease in available supply and to discover if these changes are due to natural causes, over which man may hope to have but little control, or to overfishing, and therefore subject to regulation. It is the aim of effective fish husbandry to afford proper regulation of the fishery so that the yield may reach its maximum without encroaching upon the spawning reserve.

The present state of America's fisheries should occasion real concern for their future welfare. While their total yield has increased steadily since 1880, until it now amounts to over 2,500,000,000 pounds annually, valued at more than $103,000,000, there is convincing evidence that many of our great fisheries are suffering actual depletion. The importance of sea food in the balanced dietary, the rapid increase in the population of the country, recent developments in refrigeration, preservation, and distribution of sea foods, together with revolutionary changes in methods of marketing, all show unmistakably that we are entering upon an era of exploitation of the fisheries greater than ever before. The urgency and importance of the practical problems of conservation, therefore, make it imperative that the bureau center the attention of its own research staff upon their earliest solution.

In reviewing the work of the division of scientific inquiry during the past fiscal year, the continuity of effort and aim applied to the major projects of investigations is a conspicuous characteristic that no doubt contributes toward the satisfying progress of the work. This condition is most favorable, for it is the result of the adoption of a carefully planned program of research together with freedom from interference and pressure from outside special interests that would result only in continual shift of project and personnel with consequent loss of efficiency.

The salmon investigations have continued to yield detailed information concerning the routes of migration and the success of spawning escapement in the various localities, facts that have been used directly as the basis for modifying or improving the regulations of the fishery in the interest of conservation. The causes and control of diseases that annually have taken heavy toll of the output of the many hatcheries throughout the country are yielding to continued research, and the pathologist has rendered valuable aid in advising hatchery superintendents in the prevention and cure of formerly devastating epidemics. Investigations of the marine fisheries of the Atlantic coast also are showing extremely promising results, especially in the case of the mackerel fishery, where the causes for extreme variation in abundance have been discovered in the great success or almost complete failure of spawning and survival in various years.

Two important new projects have been undertaken during the past year. These are the investigations of the fisheries of the Great Lakes, with special reference to Lake Erie, and of the fisheries of the middle Atlantic coast from Cape Cod to Delaware Bay.

### FISHERIES OF THE NORTH ATLANTIC

During the past year investigations of the migrations and other factors in the life history of the cod, pollock, and haddock progressed to such a stage that parts of the tagging program are virtually completed. The report on natural history of the Nantucket Shoals cod, which are characterized by rather definite migrations, size, and age composition, is also nearing completion. During the early part of the fiscal year additional studies on Georges Bank were undertaken. A cruise was made by the U. S. F. S. *Albatross II* to this locality in August, 1927, when 940 cod, 24 pollock, and 595 haddock were marked, but recaptures have been so few that additional studies will be required. During the spring the *Albatross II* again made a cruise to New Jersey waters with extremely disappointing results. Tagging trips also were made with commercial fishermen, but unfavorable weather and the resulting loss of gear caused considerable delay. In addition to experimental fishing off the New Jersey coast, tagging was undertaken on the Cholera Bank off western Long Island; and although the captures were few, very desirable data were collected in the form of temperatures and salinities of the water, plankton samples, and specimens taken on the bottom with otter trawls. The scanty results of the cod-tagging cruise may be attributed to an unusual migration of the cod during March and April from the deeper water into the shallow estuaries of Sandy Hook, Delaware, and Chesapeake Bays, in all probability in pursuit of shore species of fish, such as sand eels, which also occurred in unusual abundance.

Observations of the commercial run of mackerel as a part of a comprehensive plan for the investigation of the biology of the mackerel were continued throughout the commercial season in 1927 and begun again in the spring of 1928. The investigation has been directed more especially to discover as early as may be the occurrence of successful spawning years through a quantitative determination of the abundance of eggs and larvæ in the sea during the spawning period, and to study the factors responsible for such success or failure in survival of the young. For this purpose the steamer *Albatross II* made two cruises to the spawning areas in Massachusetts Bay and the middle Atlantic region south of Cape Cod, where a series of collection stations was ooccupied for tow netting and the taking of oceanographic data concerning temperature, currents, etc.

An investigation of the smelts of the north Atlantic coast (both salt-water and lake forms) is nearing completion. One report has been published and a second one, embracing the taxonomic history with a discussion of the relationships of the different numerous species, together with the age, growth, and racial peculiarities of the smelts in western North America, is also virtually completed. The smelts of Casco Bay, Me., evidently are greatly depleted, as shown by the dwindling catches in the commercial fishery in this region. The reasons are evident—lack of protection in the breeding season and the great destruction by the commercial fishery of the immature smelts in the open season.

Funds were made available at the beginning of the fiscal year for an investigation of the fisheries of the Middle Atlantic States. It is believed by many that the more valuable fish in this region are suffering depletion from excessive and destructive commercial fishing. Not enough is known concerning the real variations in abundance of these fishes or of their life histories and habits to explain the causes of fluctuations that may occur. It is the aim of the investigation to determine the safe maximum capacity of each species and to determine whether the fishery as it is conducted at present is exceeding this maximum. The fall fishing season of 1927 was given over largely to a survey of the region between southern Massachusetts and Delaware Bay to discover sources of unpublished statistical information, for observing the methods of the fishery, and for selecting suitable bases for detailed observations during the following season. Records of the trap-net catches and vessel logs, extending over many years, were collected for the purpose of tracing the fluctuations in yield that have occurred in the past. Inasmuch as the squeteague is the most important species taken here and is of interest to commercial fishermen and sportsmen alike, it is being given special attention. Detailed observations of the daily catches, consisting of measurements of samples of the catch, the collection of scales, and other material for biological studies, are being made at Wildwood and Long Branch, N. J., West Sayville and Montauk, N. Y., and Woods Hole, Mass.

In order to improve upon the statistical records and to obtain information suitable for studies of yield per unit of effort, so as to provide a measure of actual abundance of fish in the sea, statistical record blanks have been prepared and issued to the pound and trap operators in the entire region, to be filled in and forwarded monthly to the central office for filing and tabulation. As the intensive field work could not be undertaken until April of this year, no results are yet available.

### FISHERIES OF THE SOUTH ATLANTIC AND GULF STATES

Special attention has been given to the life history of the shore fishes, many of which are of great commercial value, but the early life history of most of the commercial fishes is unknown. The very young fish differ from adults in appearance and are extremely difficult to recognize, hence a preliminary step is the identification of the eggs and larvæ and the determination of their abundance and distribution. The program of systematic collections of these younger stages has been continued. For this purpose and for fish and oyster surveys in the inside waters of Pamlico, Core, and Bogue Sounds, a new shallow-draft, 46-foot, double-cabin, motor cruiser has been purchased. The vessel is equipped with electric winch for operating trawls and dredging equipment from davits on either side of the vessel, and the after cabin is fitted with water table and laboratory equipment, including running salt water for the preservation and incubation of eggs and larval fishes obtained in the nets. The species of fish receiving most attention are several species of flounders, spot, pinfish, and menhaden, all of which are of considerable economic value.

The investigations of the bay scallop in North Carolina are virtually completed. This fishery is limited to the vicinity of Beaufort but is so concentrated as to yield nearly $250,000 in products annually. Recommendations have been offered concerning the economic harvesting of the crop without endangering the supply and for increasing the yield by farming methods.

Although practical methods of terrapin culture have been developed at the Beaufort laboratory and production has been conducted upon a commercial scale through cooperation with the North Carolina conservation department, certain problems still remain to be solved in order to increase the efficiency of the station. These are concerned primarily with certain diseases that have taken a considerable toll of the terrapin reared during the winter in the heated brooder house. Two conditions are recognized, which may be distinct diseases—one resulting in softening of the shell and the other in production of cancerous sores on the tail, feet, and elsewhere. Preliminary investigations indicate that they are not bacterial diseases, but there is considerable evidence that they are nutritional disorders. Expert advice on the problem was offered by the Pepper Laboratory, School of Medicine of the University of Pennsylvania, and additional experiments are being undertaken to determine the cause of the disease and to effect a cure.

Field investigations on the fisheries of Texas were completed early in the fiscal year, and the remainder of the year was spent in analyzing the data collected. Special attention has been given the redfish, black drum, and spotted trout, each of which yields nearly 1,000,000 pounds annually. A report is nearly ready for publication summarizing the pertinent features of the life history of each of these species, describing their spawning, rate of development, and movements, and offering recommendations concerning their conservation and the development of additional fishing areas. Progress has been made on the taxonomic study of the fauna of the Texas coast.

### FISHERIES OF THE PACIFIC COAST AND ALASKA

The program of fishery investigation adopted in 1921 by the Pacific Salmon Investigation Federation has continued as the basis of the bureau's investigation of the entire salmon fisheries of the Pacific coast. The chief aim of this work is to discover how large a spawning reserve is necessary in order to maintain commercial runs in the waters of the Pacific Coast States and Alaska. As the bureau's responsibility is greatest in Alaska, where the salmon fishery is administered and regulated by the Department of Commerce, the chief attention has been given that region. Extensive tagging experiments were undertaken to determine the migration routes taken by the fish in the major fishing areas. In addition, weir counts have been continued on the Karluk and Chignik Rivers and age analyses of the entire run in these rivers have been made. The relation between spawning escapement and the total return has been observed for several years with such exactness that predictions of succeeding runs have been attempted with marked success. For example, the total run of red salmon to the Karluk River in 1927 was estimated in advance at about 1,500,000 fish. The actual run of 1,641,000 exceeded the estimate by less than 10 per cent, which is sufficiently close, considering the conditions, to be of direct economic benefit to the fishing industry. Further studies involving the marking of many thousands of young fish on their seaward migration have been continued, and special studies of the conditions on the spawning grounds in the Karluk region and the unusual productivity of Karluk Lake occupied the attention of investigators during the summer of 1927. During 1928 special attention is being given to the Chignik River in Alaska, where a study of the young red salmon in fresh water will be continued. The age composition of the catch is being ascertained, and observations on the spawning grounds will be made in addition to similar observations at Karluk. Analyses of the age composition of the catch will be extended to the Bristol Bay region also.

The first section of a report on the detailed statistical analysis of the salmon fisheries of Alaska since 1904, covering the western section, has been submitted for publication. While the report deals primarily with the total yield in the various districts, valuable information is given concerning the cyclic fluctuations in abundance and progressive depletion of the salmon stock that occurred up to the time of the adoption and enforcement of scientifically planned fishery regulations.

In the States, salmon investigations have been conducted chiefly on the Columbia River, where marking experiments to determine facts in the life history of the sockeye salmon in the interest of improved fish-cultural practices have been conducted for the past 10 years. A report summarizing the results of these studies has been prepared for publication. Studies on the embryology of the chinook and other salmons have been progressing satisfactorily, with results of direct application to hatchery technique.

Biological investigation of the herring fisheries of Alaska has progressed to such a stage that a report has been prepared for publication summarizing the life history of that fish. Since it has been determined that the stock of Pacific herring is divided into a number of nonmigratory local races, the danger of depletion and the need for local regulation have been given special attention. This fishery is of great importance in southeastern and central Alaska, not only because of the use of this fish for food but also for the valuable yield of meal and oil as by-products. Fear of the depletion of the herring has aroused the salmon and halibut fishermen to the danger of adverse effects of failure of the herring supply upon these more valuable fisheries. The studies have demonstrated, however, that in some cases variations in yield are due to natural causes and not necessarily to depletion, thus demonstrating the need for continued and more extensive study.

Investigations of the clam resources of the Pacific coast have been divided between the coast of Washington and Alaska, where extensive and highly productive beds of razor clams support a canning industry. An examination of the Washington beds after the largest pack in the history of commercial operations showed that the supply was generally depleted, and recommendations were offered to the

State authorities for modifying the present laws. The successful regulations now in effect on the Alaska beds are the result of similar surveys.

## INVESTIGATION OF INLAND FISHERIES

After a general survey of the various problems confronting the fishing industry of the Great Lakes, it was decided to concentrate all activity on Lake Erie, working on a solution of the problem of maintaining its dwindling fish supply. By means of experiments continued throughout the entire fishing season with both specially constructed and standard commercial gear, particular data are being obtained on their destructiveness to both commercial and game species, on the effectiveness of the present laws on size limits in protecting immature fish, and on the most desirable sizes of mesh to be recommended for commercial use in both traps and gill nets. Further observations are being made on the migrations of the fish, their rates of growth, age at maturity, and similar facts in their life history. In this undertaking the bureau is receiving excellent cooperation from other agencies, particularly the State of Ohio. Plans for further cooperation were made and an extensive program of investigation, with practical bearing on the fisheries, was undertaken before the close of the fiscal year.

For a number of years the bureau has cooperated with the Wisconsin Geological and Natural History Survey in limnological studies of certain lakes in northern Wisconsin, and in addition has undertaken a study of the factors influencing the growth of fish in various lakes of diverse character.

Work at the Fairport (Iowa) laboratory is concerned chiefly with the artificial propagation of fresh-water mussels, studies on the pond culture of fresh-water food fishes, and the development of the fish resources of the Upper Mississippi Wild-Life and Fish Refuge. The extremely important experiments in rearing the larval fresh-water mussels in nutrient solutions in the laboratory, thus eliminating the parasitic stage in the life history of these animals, were continued and perfected during the summer of 1927, and large-scale experiments on the production of young mussels in commercially significant quantities were undertaken during the summer of 1928. The program of surveys of mussel-supporting areas has been continued and close cooperation had with the conservation commissions of several States in perfecting the regulations governing the taking of mussels. Studies of the rate of growth are being made in order to determine the most productive areas where mussel farming can be developed and to judge the success of the system of areas closed to commercial operations.

A study is also being made of the aquatic resources of the Upper Mississippi Wild-Life and Fish Refuge area to determine the amount and character of life suitable for fish food and the kinds of fish with which the refuge should be stocked for breeding purposes.

## OYSTER INVESTIGATIONS

Oyster investigations covered four main lines of research, namely, a study of oyster bottoms, study of factors controlling spawning and setting, physiology of the oyster for experiments in seed-oyster production and collection, and life history and biology of the oyster drill. While these investigations were continued from last year, new problems under the same headings have been taken up in addition. Surveys of oyster bottoms were made in Mobile Bay, Ala., Mississippi Sound, Miss., Pamlico Sound, N. C., and various inshore areas in Long Island Sound, and definite recommendations for improving conditions on the beds and increasing the yield and the quantity of the product were offered to the interested persons. Special attention was given to the spawning and setting of oysters in Long Island Sound. It has been found that water temperature is the most important factor in controlling not only the development and ripening of spawn but also the time of spawning. It has been possible to predict, at least one month in advance, when spawning will occur, when the greatest number of oyster larvæ will attach or set, and the relative intensity of the set in certain localities. This information is most valuable to the oyster growers and advantage was taken of tentative predictions in the summer of 1928. Further study of the effects of currents on the distribution of the oyster larvæ and the means of controlling setting have been made and will continue during the present summer.

Study of the physiology of the oyster has been continued. The effect of temperature on the oyster, its feeding and movements, with its bearing on hibernation in northern water and the relation of possible pollution to public health were investigated, together with the study of the mechanism controlling spawning. The metabolism of the oyster and the absorption of heavy metals under various conditions are being investigated also. It was found that the green substance is due to the absorption from the sea water of large quantities of copper, and further experiments are being devised to discover means of prevention. The effects of chemicals, particularly of chlorine, used in purification of the oyster, also were investigated. It was found that relatively high concentrations were not harmful but improved their keeping qualities during shipment and served to remove disease bacteria from polluted oysters.

Experiments in increasing the production of seed oysters succeeded in increasing the yield at least ten times on the regular setting beds and have made possible the collection of set on beds formerly unproductive. This was accomplished through the use of wire-meshed bags, in which oyster shells for catching the spat were placed on the beds in piles so that attachment surfaces were provided above the bottom in the zone where larvæ are most abundant. In addition to catching an abundant set, the bags permit the shells to be handled more readily than by the old method of scattering them over the bottom. Moreover, the bags can be placed on bars that at present can not be utilized otherwise.

In the spring of 1928 an investigation of oyster-cultural methods in Georgia, in cooperation with the State tidewater commissioner, was undertaken in order to devise new means or adapt methods developed in New England waters to conditions obtaining in the South. The study of the life history and biology of the oyster drill is virtually completed and a report has been submitted in which the chief features of the life history and movement with relation to current, light, and other stimuli have been described, with recommendations for control.

### FISH-CULTURAL INVESTIGATIONS

These include studies on the salmon of the Columbia River, with special reference to determining the most effective time, place, and manner of planting the fry; studies on the embryology of the salmon as a guide in the handling of the eggs; studies on nutrition, breeding, and rearing of fresh-water trout; studies on the pond culture of warm-water species of food and game fishes; and studies on the cure and prevention of diseases in hatchery-reared fish.

Special attention has been given to observing the effects of various substitutes for fresh liver and heart on the growth of fry and fingerlings. It has been found that the dried animal foods can not be used alone successfully, but when combined with fresh liver or heart many of them give good results. An essential part of the experiments is the work on selective breeding, by means of which it is hoped to produce a superior strain of trout showing rapid growth, increased fecundity, and disease-resisting qualities.

The results obtained during the summer of 1927 in using forage fish as food for young large-mouthed black bass were particularly encouraging. The yield of young bass under optimum conditions exceeded 8,000 per acre, but it is believed that by the proper use of forage fishes the output of fingerlings can be increased greatly. Both the golden shiner and the black-head minnow have proved to be excellent forage fishes, and goldfish also have shown desirable qualities for this purpose. During 1928 the pond culture of smallmouth black bass is being undertaken, and experiments on increasing plankton production in ponds by means of various fertilizers have been begun. During June, by the addition of shrimp bran to the ponds, the total amount of plankton was increased four and one-half times over that in untreated ponds, with the result that the bass fry showed a material increase in length and weight in these ponds over those grown under natural conditions.

Investigations on the diseases of fish have been continued. One particularly troublesome disease, for which treatment and cure have been devised, is known as the "gill disease," which has broken out at various times with great virulence and destructiveness. Further studies were conducted on the "fin rot" disease, which also is very destructive. The cause of the disease (a rod-shaped bacterium) has been discovered, the symptoms described, and prevention and cure devised. A brief investigation was undertaken at the request of the American Railway Express Co. to determine the causes of the frequent heavy losses of goldfish during shipment. Experiments also were undertaken in the spring of 1928 on the feeding of goldfish fingerlings to determine the more important factors that influence their coloration. During the summer of 1927 studies on the life history of the tapeworm parasite, which causes sterilization of female bass, were undertaken at the Neosho (Mo.) hatchery, which is being continued in 1928 with the hope of discovering means of control.

## PROPAGATION AND DISTRIBUTION OF FOOD FISHES

During the past year the work of the division of fish culture has consisted in the rearing and distribution of larger numbers of fish and the rendering of assistance to other agencies engaged in the propagation of fish. An output of 7,036,317,000 fish and eggs, exceeding the record production of last year by more than 550,000,000, indicates that the facilities of the bureau are being utilized efficiently and fully.

An analysis of collections of eggs, upon which the output is based, reveals certain changes in the relative numbers of the various groups. A 100 per cent increase over last year in the number of shad eggs handled is particularly fortunate. On the other hand, the hatch of whitefish and ciscoes in the Great Lakes region declined considerably. While unfavorable weather during the spawning season was a factor in this decrease, yet the continued decline in numbers taken is ominous. While the 1928 collections of eggs of the important Pacific salmons were slightly smaller than those of last year, the normal annual fluctuation in the runs of these species will account for the differences. The lake or Mackinaw trout, another important commercial form, showed greater than a 17 per cent increase in egg collections. Operations with the pike perch likewise were markedly successful. Collections of eggs of the various species of game trout were virtually on a level with those of last year. A much larger number of cod eggs was handled as a result of the resumption of cod-collecting operations in Maine waters, but this gain was offset to some extent by a decline in the haddock and flounder work.

A new substation to the San Marcos (Tex.) station was completed during the year at Fort Worth, Tex., and the construction of a new combination trout and pond station, subsidiary to the Spearfish (S. Dak.) station, was begun at Crawford, Nebr., near the close of the fiscal year. Property was acquired, also, for a large bass hatchery at Valdosta, Ga., and construction will begin shortly.

A survey of the fish-feeding practices of various hatcheries throughout the country was made by questionnaire, which disclosed that 260 hatcheries fed about 6,880,000 pounds of 35 different materials at a cost of $270,800. Of these foods, sheep plucks were used most extensively, exceeding 1,000,000 pounds, while horse meat, beef liver, pig liver, beef lungs, fish, and cereal products followed in the order named.

### COOPERATIVE FISH-CULTURAL WORK

The division of fish culture has aided in the propagation of fish by outside agencies in several ways, chiefly under the cooperative nursery plan, whereby clubs and sportsmen's organizations receive and rear fish on a share basis. Eighty-six of these units are now cooperating with the bureau in the States of Pennsylvania, Massachusetts, Vermont, New York, New Jersey, Virginia, Minnesota, Wisconsin, Michigan, Colorado, and West Virginia, and the work is still expanding. These establishments were furnished about 2,675,000 fish during the year and their output of fish from the previous year's allotments amounted to about 50 per cent. Three groups (in Harrisburg, Pa., Windber, Pa., and Barneveld, N. Y.) have each provided a complete hatching plant, to each of which an employee of the bureau is detailed for the year to supervise operations. The nurseries are devoted largely to the culture of trout, which are easier than some other fish to handle under artificial conditions. A satisfactory site for a bass-rearing project is much more difficult to find, the construction of large artificial ponds is expensive, and adult brood fish are hard to obtain. Consequently, few successful bass nurseries have been established.

### COOPERATION WITH STATES AND FOREIGN GOVERNMENTS

By the operation of field egg-collecting stations in Federal reservations, such as the Yellowstone Park, or in State waters, the bureau has been able to secure surplus eggs of various species of trout, which have been turned over to most of the Western States for the bare cost of collection or even gratis. Particularly cordial relations were maintained with the State of North Carolina, and after a survey of the waters in the proposed national park in the western part of the State, the bureau allotted 200,000 rainbow trout as an initial step in improving the fishing. The bureau also reopened a striped-bass hatchery in this State, the only one of its kind there.

The bureau supervised the construction of a large bass pond established by the State of Montana on Government-owned land at Miles City. As usual, eggs were incubated by the State of West Virginia at the bureau's White Sulphur Springs station, and a distribution car was lent to that State and to Maryland. In Michigan and Minnesota, State hatcheries were available for incubating surplus eggs and the bureau was able to furnish extra space for handling State eggs.

The State of Arkansas is establishing a large fish hatchery, and the bureau helped by detailing an employee to assist in selecting a site and preparing plans. The lending of experienced men has enabled the States of New Jersey and Connecticut to initiate shad and flounder hatching, while in Florida the artificial propagation of the spiny lobster was begun under the direction of an employee of the bureau. The usual assignment of fish and fish eggs to various States was made, 104,348,000 having been distributed thus.

Cooperative operation of a pike-perch hatchery on Lake Champlain by the bureau and the States of Vermont and Pennsylvania was continued successfully. The State of Michigan has made the work of the bureau's hatcheries on Lakes Huron, Michigan, and Superior more effective by putting into effect regulations that oblige commercial fishermen to supply eggs for propagation and by lending its patrol force, boats, etc., in handling the eggs. Shipments of rainbow-trout and steelhead-salmon eggs or fingerling largemouth black bass were made to Hawaii, Italy, Germany, Switzerland, Ecuador, Peru, and Bermuda, besides top minnows for mosquito-control work.

The National Park Service has been helpful in the prosecution of hatchery operations in the Yellowstone Park and Glacier Park. So far as possible, the Forest Service and the Indian Service have been accommodated with assignments of fish and eggs for stocking waters within their jurisdiction.

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## UPPER MISSISSIPPI WILD-LIFE REFUGE

Contemporary with the acquisition of sufficient land, joint regulations for the administration of the Upper Mississippi Wild-Life Refuge, created under act of June 7, 1924, were issued by the Secretary of Agriculture and the Secretary of Commerce. The bureau has been acquiring boats and equipment for conducting the necessary work, and an exhaustive biological survey of the possibilities of the area in a fish-cultural way has been begun. It is the purpose of the bureau to propagate warm-water fishes in this region and thereby avoid the necessity of distributing rescued fish from the overflowed regions. Several sites for bass ponds have been selected and they will be developed as soon as possible.

## PROPAGATION OF PACIFIC SALMONS

The success of propagating the Pacific salmons has varied considerably. A larger output of some species at some of the stations was offset by reductions at other points, so that the total production of 139,719,600 was about normal (about 19,000,000 more than last year). All of the salmon-propagating stations are rearing fingerlings to capacity. One million sockeye fingerlings were fed at the Lake Crescent station of the State of Washington and later were released in the lake. In the Puget Sound region, chum-salmon eggs were available beyond the capacity of the hatcheries.

## MARINE SPECIES OF THE ATLANTIC COAST

The output of 5,793,481,000 cod, haddock, pollock, and winter flounders at the New England stations exceeded that of last year. Although pollock and winter flounder egg collections declined sharply, there was an increase of approximately 50 per cent in the cod-egg collections. Marine work includes not only the incubation of eggs and the distribution of fry, but also the planting of fertilized eggs on inaccessible offshore spawning grounds. The propagation of commercial marine species is a by-product recovery in the truest sense, as a very large proportion of the eggs is secured from fish caught for market, where the eggs would be wasted. The Woods Hole station has resumed the hatching of mackerel with considerable success.

## ANADROMOUS SPECIES OF THE ATLANTIC COAST

The output of shad increased over 100 per cent and amounted to 48,031,000. The shad run in the Potomac River was the heaviest in years, and the output from the Edenton (N. C.) station also showed quite an increase over those of recent years. About 7,000,000 striped-bass eggs were taken in the Roanoke River and hatched. About 1,500,000 Atlantic-salmon eggs were obtained from Canada for the Craig Brook (Me.) station. The salmon fingerlings planted from this station in recent years seem to have been effective in slightly increasing the abundance of this fast-disappearing species. The output of approximately 150,000,000 yellow perch was about normal. The collection of glut-herring eggs at the Edenton station also rose from 5,000,000 to 223,000,000.

### COMMERCIAL SPECIES OF INTERIOR WATERS

The output of whitefish and cisco from the Great Lakes stations again fell. Weather conditions on the whole were favorable, so that the decline must be ascribed to a shortage of fish. Every effort was made to secure eggs, but changing conditions, particularly in the vicinity of the Put in Bay (Ohio) station, have converted previously prolific spawning grounds into virtually barren areas. In this respect the bureau's whitefish and cisco egg collections for the last six years indicate the trend in this important fishery. The table below shows the downward course of the whitefish fishery, while the fluctuations in the cisco collections apparently indicate a more stable condition.

| Year | Whitefish egg collections | Cisco egg collections | Year | Whitefish egg collections | Cisco egg collections |
|---|---|---|---|---|---|
| 1923 | 537,546,000 | 76,800,000 | 1926 | 252,599,000 | 163,700,000 |
| 1924 | 481,018,000 | 200,790,000 | 1927 | 219,023,000 | 243,270,000 |
| 1925 | 252,925,000 | 187,800,000 | 1928 | 198,017,000 | 171,140,000 |

In almost all fields the collections of lake-trout eggs were noticeably larger. The eggs received at the Charlevoix (Mich.) substation were of poor quality, but operations at the Duluth (Minn.) and Cape Vincent (N. Y.) stations were successful. The regulations enacted by the State of Michigan relative to the taking of eggs by commercial fishermen during the spawning season were beneficial and should bring about material improvement in the future. Pike-perch operations on Lake Champlain were very successful, and 105,000,000 eggs of this species were secured on the Great Lakes, though their poor quality reduced the output of fry materially. There was a decline in the production of yellow perch, also, and carp hatching was almost a total failure. No attempt was made to hatch buffalofish eggs except in cooperation with the State of Arkansas.

### FISHES OF MINOR INTERIOR WATERS

Operations of the trout stations in the territory from New England to the Rocky Mountains surpassed all previous records in success. Collections of Loch Leven trout eggs at the Meadow Creek auxiliary of the Bozeman (Mont.) station reached a new high figure of 14,893,200. The York Pond (N. H.) substation has been developed to a point where it has become an important factor in satisfying the bureau's requirements for brook-trout eggs. Field collections of rainbow-trout eggs by the Utah, Colorado, and Wyoming stations also were very successful. The Bozeman station has extended its rearing facilities and most of the other stations are working on a plan to distribute fish of larger size.

In 1928, 51½ per cent of the bureau's output of trouts, salmons, grayling, and warm-water fishes, including sunfish, basses, crappie, pike, and pickerel, which are of chief interest to the angler and also of considerable commercial importance, was distributed as fingerlings. About 60,000,000 eggs were assigned to States or foreign Governments for rearing in their hatcheries.

### PONDFISH STATIONS

Varying results were achieved at the stations engaged in rearing warm-water fish in ponds. Certain of them surpassed previous records, as was the case at Tupelo, Miss., where the output exceeded 1,000,000. The San Marcos (Tex.) station also experienced a very successful year. Unfavorable weather conditions reduced the output at some of the other stations, however, so that the aggregate distribution was about normal. The Louisville (Ky.) station achieved about an average production of smallmouth black bass and distributed slightly over 500,000 to applicants.

### RESCUE OPERATIONS

During 1928 the work of rescuing stranded fishes in the States of Arkansas, Mississippi, and Louisiana was expanded greatly as a result of the great flood, and 25,980,000 fish were captured and returned alive to the waters of this region. This was in addition to the regular rescue work on the upper Mississippi, which latter brought the total number of fish rescued to 166,778,000. Approximately one-half of 1 per cent of the total number of fish handled in the rescue fields was shipped to other waters, which reduced somewhat the number of applications in arrears for warm-water species. The distribution service handled efficiently the extra burden of transporting this large output of fish, even though it was found necessary to discard one of the old wooden cars because of its age and obsolete equipment. Until a new car is made available the distribution service will be handicapped somewhat.

## COMMERCIAL FISHERIES AND FISHERY INDUSTRIES

According to the most recent statistics available, the fisheries of the United States and Alaska employ approximately 118,600 commercial fishermen and 4,300 persons on transporting vessels directly connected with the fisheries. The annual landings of fishery products amount to approximately 2,500,000,000 pounds, valued at about $103,000,000 to the fishermen. In 1927, the production of canned fishery products amounted to 475,655,000 pounds, valued at $81,384,000, and the output of by-products was valued at $12,793,000. The value of salted, dried, and smoked fishery products may be estimated at $12,000,000. Imports of fishery products were valued at $55,634,000, while exports aggregated $18,717,000.

The fisheries are subject to pronounced fluctuations. This, with the fragmentary nature of the available statistics, makes it very difficult to discuss trends in the fisheries with as great a degree of assurance and completeness as might be desired. It is pertinent, however, to point out some of the developments indicated by statistical data made available by the bureau during the past year.

Perhaps the most outstanding feature of 1927 developments on the Atlantic coast was the continued growth of the packaged-fish trade. This style of preparing fish for market has opened new channels of distribution because fish so marketed are handled readily by retailers and housewives. The growth of this industry is having an important effect on the complexion of the fisheries, which may be illustrated by the increase in landings of haddock at New England ports, the variety most used in the filleted and packaged form, which amounted to 37 per cent over 1926 and 84 per cent over 1922, when this method of preparation was first employed. The shore fisheries of the Middle Atlantic States appear to be declining in productiveness of certain important species, judged by a comparison of 1926 statistics with those for 1921, the last previous canvass in this section. The catches of bluefish, scup, and squeteagues suffered decreases of 72, 37, and 36 per cent, respectively, but the catch of butterfish increased 18 per cent. The shellfisheries registered moderately increased production.

The fish-canning industry of the Atlantic coast in 1927 produced the largest pack of shrimp on record and an increased oyster pack. The sardine pack of Maine was 26 per cent smaller than in the previous year. The menhaden industry experienced its third poor year in the last four years, with an output only half as large as has been considered normal in recent years.

On the Pacific coast the canned-salmon pack of 1927 was curtailed considerably through scarcity of fish. The California sardine pack continued to grow, being six times as large in 1927 as in 1921, when production was at a low level during the postwar depression. The canned-tuna output increased, chiefly because more of the striped and yellowfin varieties were packed. The halibut catch was slightly higher in 1927, in spite of the depleted condition of this fishery, but the increase probably can be accounted for by the greater intensity of fishing and its extension to the more westerly grounds.

## COLLECTION OF STATISTICS

The statistical program of the bureau is most intimately related to its primary function—discovering the depletion of food fishes, its causes and possible remedies. Inasmuch as statistical information is fundamental in the science of fisheries conservation, the bureau has striven to improve this branch of its work, which is admittedly inadequate at present. During the past four decades such statistics have been collected by canvassing the fisheries of nine geographical sections of the country, taking one at a time and completing the work as rapidly as possible with the personnel available. In recent years it has been possible to canvass each section about once every five years. This method has two fundamental defects. In the first place, the fishermen are reached a considerable time after the previous year's business has been closed, and unless they have kept a record of their operations and catch (a rare circumstance) the information received is but an approximate estimate rather than a definite record. Secondly, the fortunes of a fishery fluctuate so widely from year to year that data at five-year intervals are likely to be misleading, for they may represent a poor or a good year rather than a normal one. Annual statistics are essential to indicate accurately trends in fishery matters.

While the bureau's facilities are not adequate to collect annual statistics for the entire country, fortunately this may be done through cooperation with State agencies. Since early times the fisheries in State waters have been under State control, and several States have included the rendering of statistical returns as an obligation of commercial fishermen who exploit the State's resources. As reported in 1925 and subsequent years, the bureau's policy has been to cooperate with those States collecting statistics in such a manner as to render the data adequate for studies in fluctuations in abundance and to render the statistics of adjoining States comparable, so as to permit compilations over the entire commercial range of species inhabiting the waters of a number of contiguous States and to encourage the collection of statistics by those States not at present engaged in such activity. The results have been gratifying. By detailing one agent to the Pacific Coast States and employing temporary clerical assistance in that region, annual statistics, based on State returns, have been compiled and published since 1923. In the Great Lakes region it has been possible to compile State statistics annually since 1913. Collection of statistics in the remaining sections of the country is still on the periodical-canvass basis.

The collection of special statistics on the mackerel fisheries, with particular reference to the peculiar fluctuations of abundance, has been continued in conjunction with biological studies of the fish. The results have indicated that the unusually large catches of 1925 to 1927, inclusive, were due almost entirely to the abundance of the 1923 year class. As the data indicate that no subsequent year has contributed materially to the stock of mackerel, it can be predicted tentatively that the 1928 catch will be smaller than the 1927 catch. It is probable that the 1927 spawning will result in material increment to the mackerel stock, and if so, this increase should be felt in 1929. While these observations have not been continued through a sufficient number of years to assure success in forecasting, continued investigation promises to render invaluable aid to the industry by making possible reliable predictions of abundance.

## CANNED FISHERY PRODUCTS AND BY-PRODUCTS

Four hundred and seventy-one establishments were engaged in canning fishery products in 1927, the total production being 12,281,658 standard cases, or 475,655,000 pounds, net weight, valued at $81,384,133, to which may be added the value of by-products, $12,793,000, making a total of $94,177,133. The 4 per cent decrease, as compared with 1926, was due to the smaller pack of salmon and Maine sardines and not to a general slackening of the industry. Other products, including California sardines, tuna, shrimp, clams, and oysters, registered notable increases, varying between 19 and 58 per cent.

## TRADE IN FROZEN FISH

During 1927 there were 150 freezers and cold-storage establishments devoted wholly or partly to the storage of frozen fish. The average monthly holdings during the last three years have increased, amounting to 48,957,000 pounds in 1927, or 7 per cent more than those for 1926 and 18 per cent more than normal or the 5-year average. Amounts of fish frozen annually also have become greater during the past several years.

### NEW ENGLAND FISHERIES

Landings of fishery products by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., during 1927 amounted to 263,849,573 pounds, valued at $9,404,511, and exceeded the amount landed for any year for which statistics are available, while the value of the products was greater than any year except 1918.

### COD FISHERY ON THE EAST COAST OF NORTH AMERICA

During the last 30 years the total annual catch of cod on the east coast of North America by Newfoundland, France, Canada, the United States, and Portugal has averaged over 1,000,000,000 pounds. There have been fluctuations over this period, but on the whole the catch appears to have neither increased nor decreased. The full report on this fishery is published as Bureau of Fisheries Document No. 1034.

### PACIFIC COAST HALIBUT FISHERY

In spite of the serious decrease in abundance of halibut, and due to increased intensity of fishing, the 1927 catch on the Pacific coast was 3 per cent greater than that of 1926 and 11 per cent more than in 1925. The totals for both the Canadian and American fleets were approximately as follows: 1925, 49,844,000; 1926, 53,779,000; 1927, 55,175,000 pounds.

### SHAD AND ALEWIFE FISHERIES OF THE POTOMAC AND HUDSON RIVERS

In 1927 the shad fishery on the Potomac was prosecuted by 682 fishermen and yielded 222,321 fish that weighed 686,581 pounds, valued at $113,825 to the fishermen. The catch of alewives amounted to 11,608,067 fish, with a weight of 4,645,365 pounds, valued at $50,588 to the fishermen.

On the Hudson River the shad fishery was carried on by 268 fishermen and yielded 110,284 fish that weighed 358,055 pounds, valued at $63,650. This yield represents the largest catch in any year for which statistics are available, from 1910 to the present, but is less than half as large as for that year.

### FLORIDA SPONGE FISHERY

In 1927 the quantity of sponges sold on the sponge exchange, Tarpon Springs, Fla., was 414,417 pounds, valued at $865,510. Of the amount sold, 252,463 pounds, valued at $752,435, were large wool; 35,413 pounds, valued at $61,973, small wool; 65,429 pounds, valued at $32,714, yellow; 50,495 pounds, valued at $14,139, grass; and 10,617 pounds, valued at $4,249, wire.

### FISHERIES OF THE MIDDLE ATLANTIC STATES

In 1926 the fisheries of New York, New Jersey, Pennsylvania, and Delaware employed 9,953 fishermen, which is 3 per cent less than in 1921. The catch amounted to 168,012,495 pounds, valued at $12,456,256, which is a decrease of 50 per cent in amount and an increase of 7 per cent in value, as compared with the amount and value of the catch in 1921. The decrease in quantity was due almost entirely to a reduction in the menhaden catch, although bluefish, scup, and squeteagues also registered severe reductions.

Oysters, with a production of 39,511,192 pounds, or 5,644,456 bushels, valued at $6,171,429, were the most valuable fishery product of these States. Others in point of value were clams, 1,745,212 pounds or 207,931 bushels, valued at $722,422; flounders, 10,520,292 pounds, valued at $609,486; squeteagues or weakfish, 9,400,776 pounds, valued at $600,994; haddock, 17,023,230 pounds, valued at $497,432; scallops, 1,415,292 pounds, or 235,882 bushels, valued at $375,879; lobsters, 1,119,144 pounds, valued at $330,567; and butterfish, 4,088,702 pounds, valued at $320,250.

## FISHERIES OF THE GREAT LAKES, 1926

The fisheries of the Great Lakes produced 102,798,000 pounds of fish in 1926, which represents an increase of 3 per cent when compared with the production in 1925. Of the total production in 1926, the United States accounted for 75,300,000 pounds, which is an increase of 9 per cent over the previous year, and Canada accounted for 27,498,000 pounds, which represents a decrease of 12 per cent under a year ago.

The fisheries of Lake Erie ranked first, with a production of 33,809,000 pounds. The productions of Lakes Huron and Michigan were 20,615,000 and 20,495,000 pounds, respectively. The yield of Lake Superior amounted to 17,747,000 pounds, that of Lake Ontario to 5,015,000 pounds, and that of Lake of the Woods, Rainy Lake, and Namekan Lake to 5,117,000 pounds.

The catches of the more important species were as follows: Lake herring, 19,330,000 pounds; lake trout, 17,992,000 pounds; blue pike, 12,392,000 pounds; whitefish, 9,947,000 pounds; yellow perch, 7,363,000 pounds; and chubs, 7,043,000 pounds. The catch of lake herring was considerably more than in any year since 1920, that of lake trout has remained virtually constant during the past 10 years, that of blue pike has shown a slight decline since 1921, and that of whitefish has remained stable since 1913. The catch of yellow perch was the largest since 1921 and that of chubs the largest since 1918. The catch of cisco, which amounted to 3,022,000 pounds in 1926, was the smallest on record, representing a decrease of 47 per cent as compared with the previous year and 91 per cent as compared with 1924.

## TECHNOLOGICAL INVESTIGATIONS

The technological work of the bureau is dedicated to the elimination of loss in the fishery industries by utilizing the material generally wasted, making existing processes more economical or replacing them by new methods, or by making investigations and spreading information concerning new uses for fishery products. To do this, the bureau supplies the industry with the best scientific information available and conducts investigations that promise to be of general importance and which the bureau is equipped to prosecute. It has been necessary, however, to point out to the industry that while there are problems that the bureau can attack properly, there are others that the industry must solve for itself. The latter generally are not of a technological nature but are purely matters of management, wherein great savings may be made by applying sound business principles. The bureau's technologists are fitted to point out to the industry the sources of loss in a plant, but the prevention of the loss is a problem to be solved by the persons affected.

A prominent feature of this year's work has been the greater number of contacts made in the field, whereby the problems of the industry have been learned first hand. Manufacturers of equipment have been informed of opportunities to introduce their products to the fishing industries with mutual profit, and the bureau has itself tested equipment when advisable and practicable. A temporary field laboratory has been established at Reedville, Va., mainly to study the problems of the menhaden and by-products industries; another has been established at Brunswick, Ga., for the study of shrimp by-products problems; and a third at Erie, Pa., for investigations of net preservation on the Great Lakes.

During the fiscal year the entire personnel of the technological staff changed, which considerably interrupted the progress of work. Fortunately this was not a sheer loss, because most of these men took positions in the fishery industries, where their previous training is still of benefit to the fisheries; but the progress of the bureau's work has been disturbed seriously, none the less, principally because the bureau has been understaffed with technologists, particularly in the junior and assistant grades, more of whom are needed urgently to minimize such losses.

*Net preservation.*—The work on net preservatives has reached such a point, in the case of trap nets in salt water, that final tests will be made soon to determine the virtues of various treatments upon a cost basis alone. Nearly 100 differently treated samples of twine were exposed at the Beaufort (N. C.) station during the last year. Test panels containing 10 of the most promising treatments have been placed in commercial fishing locations in order to determine the cheapest and most efficient preservative. The results of these final tests and the experiments leading to them will be published as soon as warranted, for work of this nature is inevitably slow because of the time required to produce sufficient deterioration in the exposed samples. The formula of a satisfactory treatment has been published, pending further developments. This preservative is of very general utility and costs approximately one-third as much as the best commercial treatment heretofore available. It consists of cuprous and mercuric oxides and tar. The solvent is water-gas tar oil, which is cheap though not always easily available. No other solvent is quite as efficacious.

The problem of preserving nets in fresh water has not reached as satisfactory a stage as the work upon gear exposed in salt water. This is due, in part, to the lack of proper experimental conditions (which will be remedied by an investigation recently begun on Lake Erie) and in part to the more severe conditions encountered. The results of the bureau's previous investigations show that the working life of a net is less if it is exposed continuously than if it is immersed in the water intermittently for the same number of hours. In practice this means that frequent lifting, washing, and drying of nets is a very important procedure and nearly as valuable as the preservative treatment itself.

*By-products.*—The reduction of fish into oil and scrap or meal is a large industry of long standing, yet it still presents many formidable problems. In the case of the menhaden industry, the irregular supply is responsible for an excessive overhead cost. This year the technologists have striven to decrease labor costs by showing that appropriate machinery can be installed and by advocating the use of a simple cost system to detect unsuspected expensive operations. The relation between care in operation of existing equipment and the quality of the resulting oil has been emphasized. These points were stressed because they promised immediate profits to owners.

The salvage of small quantities of market waste and unmarketable or rough fish or of waste produced on shipboard is another problem to which attention was given. However, investigation indicates that existing machinery for this purpose is too expensive to be practical, and at present the only method of salvage is to make "acid scrap." Larger and more constant supplies, such as those originating from filleting plants, justify the use of a vacuum dryer, and a number have been installed. Experiments have been conducted upon vacuum drying and the best conditions for the process found. However, the design of commercial sized plants does not seem altogether satisfactory from the standpoint of economy of time and power and hence exhaustive studies of cost will be made. Another difficult problem is that resulting from the rapid accumulation of salmon waste in communities so isolated that labor is expensive and transportation costs high.

The white meal produced by the vacuum process from haddock and cod waste is a most excellent stock feed. It is valued highly abroad (especially in Germany, where it is used extensively for hog feeding) as a protein supplement for cereals, as it also produces a sturdy frame and prevents deficiency diseases because it brings with it from the sea elements necessary to normal life. Many elements are not found in proper proportions in the usual feed of farm animals; iodine, for instance, may be absent and goiter result, or calcium may be deficient and bone formation (and general health) be faulty as a consequence. There are many publications to show that fish meal prevents such results and the bureau has given them wide circulation and also supplied experimenters with material for trial. While American producers exported considerable fish meal in 1927, the 1928 production probably will be absorbed more freely in this country, and already some has been imported.

*Nutritive value of fish.*—The work in this field consisted mainly in "biological analyses" of the proteins of haddock and herring and indicates that these are excellent supplements for cereals, comparing favorably with steak, liver, or kidney. They do not supplement legumes well, however. Other metabolism studies will be made, as feeding experience has shown fish meal to be most effective in promoting growth.

*Improved handling of fresh fish.*—Important advances have been made in the marketing of fresh fish, notably in the development of the filleted and packaged product. The highly perishable nature of this commodity calls for the most careful handling on shipboard, in the wholesale houses, and in transit overland. Particular attention is being given the New England vessel fisheries through the establishment of an office on the Boston Fish Pier, where a technologist and an assistant are studying conditions both on shipboard and ashore. It is expected that this will result in the application of scientific principles to the handling of sea foods in such a way as to insure their delivery to inland consumers in the best condition. The immediate application of improved methods of caring for fresh fish is important, but the trend of developments in the fisheries indicates that the future need will be still greater as it becomes necessary to fish on more distant grounds. In six years the packaged-fish trade has grown to an industry utilizing about 75,000,000 pounds of fish annually. With expansion in fish consumption and the extension of the fishery will come the necessity for refrigeration and insulation on shipboard, in view of which there can be little doubt concerning the urgency of technological research in this field.

## MERCHANDISING FISHERY PRODUCTS

The bureau's program of surveying the trade in fishery products in the principal cities was continued during 1927 by surveys of St. Louis, Mo., Jacksonville, Fla., and Atlanta, Ga. Detailed results of these studies were published in Bureau of Fisheries Documents Nos. 1026, 1036, and 1039. In addition to these, a survey of the packaged-fish trade was completed and published as Economic Circular No. 63.

## TRADE IN PACKAGE FISH PRODUCTS

In September, 1921, a Boston firm began shipping fillets of fish wrapped in parchment paper and packed in wooden boxes holding about 20 pounds of fish. In February, 1922, another Boston firm began packing these parchment-wrapped fillets in tin containers packed in large wooden shipping cases surrounded with ice. Out of this departure from usual practices a great industry has grown. By 1926 about 40 firms were engaged in the business, which utilized about 46,000,000 pounds of fresh and frozen fish in the round and produced about 18,300,000 pounds of prepared products. In 1927 no less than 75,000,000 pounds of fresh fish were used in this trade. This is the most significant development in the fishing industry in a quarter of a century. Packaged fish have the advantage that they meet the requirements of the housewife, retail stores, and public eating places for a sanitary, cartoned, unit package, wholly edible, easily merchandised, and prepared for the table. Packaging fish reduces transportation costs to a minimum and concentrates the waste at the point of production, where it can be utilized economically. It opens the way to direct advertising of individual products, permitting the use of trade-marked wrappers, cartons, containers, and shipping cases, which may carry printed or lithographed trade names as well as the name and address of the producer. With the further development of rapid freezing processes, this innovation opens the markets of the world to fresh and frozen fish. Preparing and packaging fresh and frozen fishery products at points of production will make it possible to utilize edible, nutritious fish, whose qualities heretofore have not been known or fully appreciated. Ultimately it should be possible to market every edible fish taken in the commercial catch, and it is believed that much of the future of the trade in package fish rests in marketing these varieties.

## ALASKA FISHERIES SERVICE

### FISHERY LAWS AND REGULATIONS

Administration of the laws and regulations for the conservation of the fishery resources of Alaska in 1927 involved no change in policy from that followed since the passage of the fisheries act of June 6, 1924. The requirement of a minimum escapement of 50 per cent of the salmon necessitated additional restrictions on fishing operations in various localities. During the salmon-fishing season, the Commissioner of Fisheries spent several weeks in Alaska observing conditions and initiating modifications in the regulations necessary to meet changing requirements.

Revised fisheries regulations were issued December 12, 1927, to be effective in 1928. Further restrictions were placed on the use of traps in waters where these had threatened the depletion of the salmon runs. Seventeen additional localities were closed to commercial fishing, but five of those previously closed were opened to fishing with limited forms of gear or for part of the season.

Patrol of the fishing grounds was maintained throughout the season of 1927, and several violations were reported, most of them in connection with the taking of salmon for commercial purposes during weekly closed periods. There were 13 regular and 151 temporary employees identified with this work, besides the crews of 11 bureau vessels and 10 chartered boats. Several small launches also were used in the patrol. Markers were erected at the mouths of salmon streams and at the limits of other closed waters.

### SALMON HATCHERIES

At the Government hatcheries at Afognak and McDonald Lake, 24,465,400 red-salmon eggs were collected in 1927. In addition, about 1,000,000 steelhead-trout eggs were secured and shipped to Seattle. At the one privately owned hatchery operated during the year, 20,240,000 red-salmon eggs were collected. The operation of hatcheries by the Alaska Territorial Fish Commission has been discontinued, the work in 1927 consisting only of handling the eggs taken in the preceding year and the fry hatched therefrom.

### SPECIAL STUDIES AND INVESTIGATIONS

Ten weirs for the counting of salmon ascending to the spawning grounds were maintained as follows: Anan Creek, southeastern

Alaska; Karluk River, Chignik River, two streams tributary to Olga Bay, Morzhovoi Bay, Thin Point Lagoon, Chinik Creek, and English Bay in central Alaska; and Ugashik River in western Alaska. The data obtained permit the establishment of the ratio of escape to catch in a given season and, assembled for a period of years, furnish valuable information as to the probable return from a known escapement, or in other words, the number of spawning fish necessary to maintain the run at its normal size. Undetermined and extraordinary factors, of course, may influence the return, as indicated by the greatly diminished run of humpback salmon in southeastern Alaska in 1927, where a good yield had been predicted in view of the generally adequate escapement in 1925.

Further investigations were made in connection with salmon life-history studies, which included collections of scales and examination of the stomach contents of a number of red salmon. To secure information with reference to migration routes, 5,148 salmon, chiefly humpbacks, were tagged in southeastern Alaska and 700 at Uganik Bay, Kodiak Island. Studies of the herring and clam fisheries of Alaska likewise were continued.

## PRODUCTS OF THE FISHERIES

Although nearly all branches of the Alaska fishery industry in 1927 showed an increase in the number of plants operated and persons employed, there was a decrease of 26.5 per cent in the total value of the fishery products.

Canned salmon, the most important product, decreased from the record pack of 6,652,882 cases in 1926 to 3,572,128 cases in 1927, or approximately 46 per cent. The pack of cohos increased about 25 per cent and that of kings 34 per cent, while reds decreased nearly 39 per cent, chums approximately 44 per cent, and humpbacks 57 per cent. As compared with the average for the five years from 1922 to 1926, inclusive, the entire pack decreased 31 per cent. The chief cause of the decreased output was the inexplicable scarcity of humpback salmon in southeastern Alaska. A contributing factor was the lighter run of that species that occurs in central Alaska in alternate years, although it is noteworthy that the catch of humpback salmon in that district was about 80 per cent greater than that of 1925 and has been exceeded only by the catches of 1924 and 1926. Moreover, the runs of red salmon were smaller generally throughout the Territory than in the preceding year. The total value of the fishery products of Alaska in 1927 was $40,163,300. The value of the catch to the fishermen was approximately $13,812,000. There were 28,872 persons employed in the various branches of the industry, as compared with 28,052 in 1926.

The extent and condition of the Alaska fisheries in 1927 and of the activities of the bureau under the laws and regulations for the protection of the fisheries are covered in detail in the annual report of the Alaska service for that year.[2]

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[2] Alaska Fishery and Fur-Seal Industries in 1927. By Ward T. Bower. Bureau of Fisheries Document No. 1040.

## ALASKA FUR-SEAL SERVICE

The number of fur-seal skins taken at the Pribilof Islands was again materially larger than in the preceding year, and increased takes may reasonably be expected annually in the future. The constant growth in the fur-seal herd, as a matter of course, will be reflected in larger numbers of surplus males available for commercial use. Close attention was given to the fox herds on the Pribilof Islands, the work being incidental to sealing operations and productive of considerable revenue both to the Government and to the native inhabitants.

The work of constructing improved roads to shorten seal drives and facilitate transportation of the sealskins from the killing grounds to the salt houses was retarded somewhat as a result of the late spring, the presence of ice about the islands delaying the departure of temporary native workmen from Unalaska to assist in this project. A late start likewise was made in the construction of new buildings and other improvements, but fair progress was made during the season. Several houses for natives on both islands were completed, as well as a dwelling for white employees, a warehouse, and additions to the schoolhouse and garage on St. George Island. Some of these structures were begun in 1926.

Schools and medical service, in addition to food, fuel, clothing, and shelter, were provided for the native population of the islands, which now numbers 358 persons. In return, the natives perform the general work under the supervision of a staff of white employees. Special compensation was made, as heretofore, in the way of cash payments of 75 cents for each sealskin and $5 for each fox skin taken.

Through the cooperation of the Navy Department, the annual supplies for the Pribilof Islands were transported from Seattle, Wash., on the U. S. S. *Vega*, and the fur seal and fox skins then ready for shipment were brought to the States on the return voyage. Valuable service was rendered by the Coast Guard in connection with the fur-seal patrol.

### SEAL HERD

The computed number of animals in the Pribilof Islands fur-seal herd on August 10, 1927, was 808,870, an increase of 47,589, or 6.25 per cent, over the corresponding figure for 1926.

### TAKE OF SEALSKINS

In the calendar year 1927 there were taken on the Pribilof Islands 24,942 fur-seal skins, of which 19,000 were from St. Paul Island and 5,942 from St. George Island. This was an increase of 2,811 over the number taken in 1926. Aside from a few animals accidentally and unavoidably killed, commercial killings of fur seals were limited to 3-year-old males and 1,000 2-year-old males, the latter being taken to determine comparative values of skins from fur seals of these ages.

### MARKING RESERVED SEALS

The number of 3-year-old male seals marked in 1927 for the breeding reserve was 9,090, of which 6,847 were on St. Paul Island and 2,243 on St. George Island. With the exception of 200 seals that were branded with a hot iron on St. Paul Island, all were marked by shearing a patch of fur.

### SALE OF SEALSKINS

On October 3, 1927, at public auction at St. Louis, Mo., 7,280 black-dyed and 3,053 logwood brown-dyed skins were sold at a gross price of $336,529. At the same time 123 black-dyed and 9 raw-salted Japanese fur-seal skins sold for $2,881.50. These 132 skins were the United States Government's share of sealskins taken by the Japanese Government in 1926. In addition, 1 confiscated fur-seal skin, dyed black, was sold for $26.50, and 2 confiscated sea-otter skins were sold for $92.

At a second sale, held on May 14, 1928, 5,995 black-dyed and 2,987 logwood brown-dyed skins were sold for $381,572, as well as 3 confiscated sealskins (of which 2 were dyed black and 1 was dressed in hair), which brought $51.50.

### FOXES

The feeding of foxes on the Pribilof Islands, which is carried on when it appears that the natural food supply is insufficient, was continued on both St. Paul and St. George Islands in the winter of 1927–28, preserved seal meat and specially prepared food being used. Five hundred and eighty blue and 20 white fox skins taken in the season of 1925–26 were sold at public auction on October 3, 1927. The blue pelts brought $32,128 and the whites brought $948.50, a total of $33,076.50. On May 14, 1928, there were sold at public auction 758 fox skins taken in the season of 1926–27, of which 728 blues brought $44,657 and 30 whites brought $1,439, a total of $46,096.

In the season of 1927–28, 47 blue and 15 white fox skins were taken on St. Paul Island and 231 blues on St. George Island, a total of 293 skins. One hundred forty-nine foxes on St. Paul Island and 336 on St. George Island were trapped, marked, and released for breeding purposes. The breeding reserve also included animals that were not captured in the traps.

### FUR-SEAL SKINS TAKEN BY NATIVES

Under special privileges accorded them by the provisions of the North Pacific Sealing Convention of July 7, 1911, Indians took 282 skins in waters off the coast of Washington and 543 in southeastern Alaska waters during the spring migration of the fur-seal herd in 1927. Through the courtesy of the Department of the Interior, the superintendent of the Neah Bay Indian Agency authenticated the skins taken by Indians living on reservations in the State of Washington. A representative of the bureau at Sitka, Alaska, authenticated the skins taken in that vicinity. An official report stated that 1,476 fur-seal skins were taken by natives of British Columbia in 1927.

### FUR-SEAL PATROL

The usual patrol was maintained by vessels of the United States Coast Guard during the spring migration of the fur-seal herd through waters off the Pacific Coast States, British Columbia, and Alaska, and while the animals were in the vicinity of the Pribilof Islands. Two of the bureau's vessels were engaged in the patrol in southeastern Alaska while sealing operations were being carried on by Indians in that district, and the *Brant* was likewise employed off the coast of Washington.

### PROTECTION OF SEA OTTERS, WALRUSES, AND SEA LIONS

No change was made in the regulations for the protection of sea otters, which prohibit the killing of these animals at all times. Revised regulations for the protection of walruses and sea lions were issued as of May 1, 1928, extending the closed season on these animals for another two-year period. However, the regulations permit the killing of walruses and sea lions by natives for food or clothing, or by miners or explorers when in need of food, and the collection of specimens for scientific purposes under permits issued by the Secretary of Commerce. The killing of sea lions by anyone in the protection of property or while such animals are actually engaged in devastating runs of salmon is permitted.

### VESSEL NOTES

The *Albatross II* continued the fishery investigations in North Atlantic coastal waters during the summer and fall months, making nine cruises in the area between the capes of the Chesapeake and Mount Desert, on which 7,417 fish were taken, tagged, and liberated. During March and April the steamer was lent to the New York Zoological Society for an expedition to the Galapagos Islands, Ecuador, to obtain, for breeding purposes, a supply of the giant tortoises indigenous to those islands. Over 100 specimens were secured, which have been colonized in suitable places in the United States with the object of perpetuating the species, which is valuable for food. The expenses of the trip were met by the zoological society. During the year the *Albatross II* steamed 13,835 miles.

The steamer *Phalarope* has been used, as in past years, for fish-cultural work on the Potomac River and at Woods Hole, Mass., and in connection with the biological studies carried on at the latter point. The steamer *Shearwater* was operated on Lake Erie as a tender for the Put in Bay (Ohio) fish-cultural station.

Fourteen vessels of the Alaska service cruised more than 86,000 nautical miles in the fiscal year 1928. Of these, the *Brant* covered more than 12,000 miles and the *Eider* and *Widgeon* each more than 11,000 miles. The *Eider* continued as local tender for the Pribilof Islands with base at Unalaska. This vessel, however, by reason of long-continued service under severe ice and weather conditions, should be replaced by a new, larger, and more heavily powered craft.

Two new vessels, the *Teal* and the *Crane*, made their initial voyages in Alaska in May, 1928, the *Teal* for duty in the Cook Inlet district and the *Crane* in the Alaska Peninsula region. The *Teal*, which was completed at North Bend, Oreg., in 1927, is 78 feet in length and 18 feet in breadth, and has a 150-horsepower full Diesel engine. The *Crane* was completed at Port Blakely, Wash., in 1928 and is 90 feet in length, 20 feet in breadth, and equipped with a 200-horsepower full Diesel engine.

Installation of a new engine in the *Petrel* was completed in time for service in southeastern Alaska in September. Other vessels engaged in fishery protective work in this district were the *Auklet*, *Brant*, *Kittiwake*, *Murre*, and *Widgeon*. The *Kittiwake* and *Brant* were used in central Alaska, the former in Cook Inlet region during part of the 1927 season and in Prince William Sound in the spring of 1928; the *Brant* cruised as far west as Kodiak Island in connection with an investigation of fishery conditions. The *Blue Wing* was engaged in patrol work in the Kodiak-Afognak district, the *Ibis* at Chignik, the *Merganser* in the Alaska Peninsula region, the *Scoter* on Bristol Bay waters, and the *Tern* on the Yukon River.

In addition to their operations in connection with the fisheries, the *Auklet* and *Widgeon* alternated in the seal patrol in waters off the coast of southeastern Alaska during the spring migration of the fur-seal herd, and the *Brant* was similarly employed off the coast of Washington.

The *Eider*, *Murre*, and *Kittiwake* were given a general overhauling, and alterations to the pilot house were made on the *Brant*. The *Widgeon* was overhauled at Juneau and the *Auklet* at Wrangell.

The steamer *Halcyon*, built in 1917, was condemned and sold during November, 1927. The vessel was well built but of such peculiar design that experience had shown that she was not adapted for the bureau's needs under present conditions. During the year two worn-out motor boats were disposed of. A 46-foot motor "cruiser" was added to the equipment of the Beaufort (N. C.) biological station. The bureau's fleet now consists of 4 steamers, 3 auxiliary schooners, and 75 motor craft, ranging from 20 to 101 feet in length.

## APPROPRIATIONS

The appropriations for the bureau for the fiscal year aggregated $1,948,568, as follows:

| | |
|---|---|
| Salaries | $719, 668 |
| Miscellaneous expenses: | |
| Administration | 4, 400 |
| Propagation of food fishes | 487, 000 |
| Maintenance of vessels | 146, 000 |
| Inquiry respecting food fishes | 77, 000 |
| Fishery industries | 25, 000 |
| Protecting sponge fisheries | 2, 500 |
| Protecting seal and salmon fisheries of Alaska | 332, 000 |
| Upper Mississippi River fish-rescue station | 25, 000 |
| Power vessel for Alaska fisheries | 60, 000 |
| Fish-cultural station in Nebraska | 35, 000 |
| Fish-cultural station in Oklahoma | 35, 000 |
| | 1, 948, 568 |

In conclusion, tribute should be paid the efficiency of the bureau's personnel and the beneficial effects of reclassification in reducing turnovers and in encouraging the scientific personnel to accept such employment as a career.

Very truly yours,

HENRY O'MALLEY,
*Commissioner of Fisheries.*

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# TRADE IN FRESH AND FROZEN FISHERY PRODUCTS AND RELATED MARKETING CONSIDERATIONS IN JACKSONVILLE, FLA.[1]

By R. H. Fiedler
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CONTENTS



## INTRODUCTION

The present survey is the ninth of a series of trade investigations made by the Bureau of Fisheries, the cities previously canvassed being Louisville, Pittsburgh, Chicago, Minneapolis, St. Paul, Seattle, Boston, New York City, and St. Louis. The following report is based on the calendar year 1926 as to amounts of fishery products handled and the fall of 1927 for marketing conditions.

The writer wishes to express his appreciation to the fisheries trade in Jacksonville for its interest, cooperation, and many courtesies extended while this study was being made. Thanks are especially due the staff of the Southern Fisheries Association in Jacksonville for supplying valuable data and suggestions, which have contributed to the success of the undertaking.

The city of Jacksonville, Fla., popularly known as the "gateway to Florida," is situated in the northeastern section of the State on the St. Johns River, 18 miles from the Atlantic Ocean. By passenger train Jacksonville is 26 hours from New York City, 20 hours from Washington, D. C., and 39 hours from Chicago.

As the waters in the vicinity of Jacksonville support no extensive commercial fisheries the wholesale fish dealers there may be considered essentially as assemblers and distributors rather than producers. This is indicated by the fact that only 5 per cent of the fishery products handled by them are produced in the immediate vicinity and over 60 per cent of the products they receive are distributed to points outside the city. Possibly no other city in Florida is so favorably situated with respect to productive centers, transportation, and warehouse facilities as is Jacksonville. It seems to the writer that the wholesale fish trade here is just in its infancy and that one can look for greater expansion there in the future.

[1] Appendix I to the Report of the U. S. Commissioner of Fisheries for 1928. B. F. Doc. 1036.

## FINDINGS

It has been found that—

1. The fisheries of 11 States and 1 Canadian Province supply Jacksonville with fresh and frozen fishery products.
2. During 1926, 502,000 pounds of fish were landed at Jacksonville; 8,965,000 pounds were received overland, of which 5,724,000 pounds were reshipped, leaving 3,743,000 pounds consumed in Jacksonville.
3. Less-than-carload shipments from Florida producers are assembled by wholesalers and forwarded in car-lot shipments.
4. Wholesale dealers in Jacksonville distribute fresh and frozen fishery products to 25 States, the District of Columbia, and 1 Canadian Province.
5. The States of New York, Georgia, Florida, Pennsylvania, and Missouri receive 60 per cent of the fish distributed from Jacksonville.
6. Mullet, Spanish mackerel, sea trout, fresh-water bream, and shrimp constitute about 60 per cent of the fish distributed from Jacksonville.
7. Wholesale stores are located on the waterfront, on railroad spur tracks, and near local consumer trade.
8. Cold-storage facilities are available for freezing and storing about 1,800,000 pounds of fish. This can be expanded.
9. Ten varieties of fish constitute 75 per cent of the retail trade.
10. Fish retailers show apathy toward making window displays of fishery products.
11. Of the 24 retail fish stores handling fishery products every day in the week, 12 catered to the colored population, 4 to the white population, and 8 to trade of both races.
12. Sales in retail stores show that 68 per cent of the week's trading is done on Friday and Saturday.
13. Only a small number of grocery and meat stores handle fishery products.
14. Hawkers operate in the city streets from motor trucks and horse or hand drawn vehicles.
15. Barrels predominate as shipping containers.
16. Per capita consumption of fish in the round is 25 pounds and of the edible portion about 18 pounds.

## RECEIPTS AND SOURCES OF SUPPLY

The fisheries of 11 States and 1 Canadian Province contributed in supplying Jacksonville with 9,467,000 pounds of fishery products during 1926. Of this amount, 8,054,000 pounds, or 85 per cent, were salt-water varieties and 1,413,000 pounds, or 15 per cent, were fresh-water varieties. Of the total products received, Florida provided the largest supply, amounting to 8,445,000 pounds, or 89 per cent. This consisted of 1,412,000 pounds of fresh-water and 7,033,000 pounds of salt-water varieties and equals about one-tenth of the total annual production of edible fish in Florida. Virginia sent the second largest supply, amounting to 803,000 pounds, or 8.5 per cent, consisting entirely of salt-water varieties. Maryland was third and sent 118,000 pounds, or 1.2 per cent, made up wholly of salt-water varieties. Eight other States and one Canadian Province contributed the remainder, amounting to 101,000 pounds, or 1.1 per cent, which consisted of 100,000 pounds of salt-water varieties and 1,000 pounds of fresh-water varieties. Ranked in order of importance, they were

Georgia, British Columbia, New York, New Jersey, North Carolina, South Carolina, Texas, Louisiana, and Massachusetts.

TABLE 1.—*Fresh and frozen fishery products received in Jacksonville during 1926*

| Source of supply | Pounds | Per cent of total | Source of supply | Pounds | Per cent of total |
|---|---|---|---|---|---|
| Florida | [1] 8,445,000 | 89.2 | New York | 20,000 | 0.2 |
| Virginia | 803,000 | 8.5 | All other States | [2] 26,000 | .3 |
| Maryland | 118,000 | 1.2 | | | |
| Georgia | 30,000 | .3 | Total | 9,467,000 | 100.0 |
| British Columbia | 25,000 | .3 | | | |

[1] Includes fishery products landed direct at Jacksonville by vessels or fishermen.
[2] Includes fishery products produced in New Jersey, North Carolina, South Carolina, Texas, Louisiana, and Massachusetts, named in order of importance.

TABLE 2.—*Fishery products received in Jacksonville during 1926, and sources of supply*

| Products | Florida | Georgia | South Carolina | North Carolina | Virginia | Maryland | New Jersey | New York | Massachusetts | Louisiana | Texas | British Columbia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angelfish | x | | | | | | | | | | | |
| Bass, black | x | | | | | | | | | | | |
| Bluefish | x | | | | | | | | | | | |
| Blue runner | x | | | | | | | | | | | |
| Bream, fresh-water | x | | | | | | | | | | | |
| Bream, salt-water | x | | | | | | | | | | | |
| Butterfish | | | | | x | | | | | | | |
| Catfish | x | | | | | | | | | | | |
| Crappie, "perch" | x | | | | | | | | | | | |
| Crevallé | x | | | | | | | | | | | |
| Croaker | x | | x | x | x | | | | | | | |
| Drum, black | x | | | | | | | | | | | |
| Drum, red | x | | | | | | | | | | | |
| Flounder | x | | | | | | | x | | | | |
| Grouper | x | | | | | | | | | | | |
| Grunts | x | | | | | | | | | | | |
| Haddock | | | [1] x | | | | | x | x | | | |
| Halibut | | | | | | | | | | | | x |
| Herring | x | | | | | | | | | | | |
| Hickory shad | x | | | | | | | | | | | |
| Jewfish | x | | | | | | | | | | | |
| King mackerel | x | | | | | | | | | | | |
| King whiting | x | | | | | | | | | | | |
| Moonfish | x | | | | | | | | | | | |
| Mullet | x | | | | | | | | | | | |
| Permit | x | | | | | | | | | | | |
| Pompano | x | | | | | | | | | | | |
| Porgie (scup) | | | | | | | | x | | | | |
| Sailors choice | x | | | | | | | | | | | |
| Salmon | | | | | | | | | | | | x |
| Shad | x | x | | | | | | | | | | |
| Sheepshead, salt-water | x | | | | | | | | | | | |
| Snapper, mangrove | x | | | | | | | | | | | |
| Snapper, red | x | | | | | | | | | | | |
| Snook | x | | | | | | | | | | | |
| Spanish mackerel | x | | | x | | | | | | | | |
| Spot | x | | | | | | | | | | | |
| Trout, sea | x | | | | | | | | | | | |
| Clams | x | | | | | | | | | | | |
| Crabs, hard | x | x | | | x | | | | | | | |
| Crabs, soft | | | | x | | x | | | | | | |
| Crab meat | x | | | | x | | | | | | | |
| Spiny lobster | x | | | | | | | | | | | |
| Frogs | | | | | | | | | | x | | |
| Oysters | x | x | x | x | x | x | x | | | | | |
| Scallops | | | | | x | | | x | | | | |
| Shrimp | x | x | | | | | | | | | x | |
| Turtle meat | x | | | | | | | | | | | |

[1] Originated in Massachusetts.

*Production.*—The waters of the St. Johns River, near Jacksonville, support no extensive commercial fishery, but several boats and fishermen operating in near-by waters land their fares in Jacksonville. These fares are then sold to local wholesalers, retailers, and peddlers.

TABLE 3.—*Fishery products landed at Jacksonville during 1926*

| Product | Pounds | Product | Pounds |
|---|---|---|---|
| Black bass | 7,000 | Shad | 27,000 |
| Catfish | 37,000 | Crabs | 3,000 |
| Crappie, "perch" | 9,000 | Shrimp | 49,000 |
| Herring | 29,000 | Turtles | 4,000 |
| King whiting | 88,000 | | |
| Mullet | 222,000 | Total | 502,000 |
| Sea trout | 27,000 | | |

## RECEIVING POINTS AND METHODS OF TRANSPORTATION

Of the total fresh and frozen fishery products received in Jacksonville, 8,480,000 pounds, or 90 per cent, were carried by express, 887,000 pounds, or 9 per cent, by freight, and 100,000 pounds, or 1 per cent, by motor truck.

*Express shipments.*—The vast majority of express shipments (originating in Florida as well as from points in other States) were carried in less-than-carload lots. Those carried by the American Railway Express Co. are received at its terminal in the vicinity of Bay and Myrtle Streets, while those carried by the Southwestern Express Co. are received at its terminal in the vicinity of Bay and Jackson Streets. The former terminal is about 1¼ miles and the latter about 1 mile from the majority of the wholesale houses. Fish arriving by express by either of the two express companies is unloaded at the respective terminal. Following the general rule, less-than-carload lots are carted by the express carrier to the consignee's door without further charge than that included in the regular tariff rate. In some cases, if delivery by the express company is slow, consignees will call at the terminals for their shipments. No allowance is made to consignees for performing this cartage service. When express shipments arrive in carload lots and nondelivery from the terminal to the consignee's door is specified, a charge is made by the express company for intracity delivery. In some cases a carload shipment is composed of parcels for various consignees, in which case the express companies allow intracity delivery on the goods of one party without further charge. Consignees obtaining this service usually receive the largest shipment in the particular car; the other consignees are responsible for the cartage of their goods from the terminal to their establishments.

*Freight shipments.*—Freight shipments originate mainly at points on the Pacific coast, in Virginia, and a comparatively small quantity in Florida. They are received over three main routes from the north and three from the south or west. When freight shipments arrive in Jacksonville they are handled by a terminal railroad company, which transfers them from the carriers' terminals (situated in various sections of the city) to spur tracks at the wholesale market or cold-storage warehouse. The spur tracks at the wholesale market are owned by a certain railroad system, while those at the public cold-storage warehouse are owned by the firm that operates the warehouse.

Freight shipments that are to be unloaded at the wholesale market are taken there without further charge if carried by the railroad system owning the spur tracks or if the shipment originated at a point competitive with the railroad system owning the spur tracks. A charge of $2.25 per car is assessed in other cases. No charge is made for transferring a car to the spur tracks at the public cold-storage warehouse, as these spur tracks are owned by the company that operates the warehouse. Some carload freight shipments of fishery products passing through Jacksonville, billed from southern points to points east or west, are opened in Jacksonville and partly unloaded en route by local dealers. Sometimes quantities of fishery products are added. Freight charges on this type of shipment are assessed at the carload rate that applies from the first shipping point to final destination plus a stop-over charge of $6.30 per car. Only one such stop-over is allowed, and then only when the stop-over point is not out of route or at a point requiring back haul. This arrangement is advantageous to shippers, in that they obtain the benefit of a carload rate on shipments that ordinarily would move at the less-then-carload rate, thereby effecting a considerable saving in transportation charges and permitting a through carload rate on the remaining contents of the car from the point of origin to destination.

While Jacksonville has direct rail communication with most of the large fish-producing centers in Florida, comparatively little advantage is taken of these facilities for pooling less-than-carload shipments for several Jacksonville dealers into one carload shipment. In many instances various dealers will order shipments from the same dealer in a producing locality at the same time. These individual shipments are sent in less-than-carload lots with the subsequent higher tariff rate applying, when, if occasion warrants, they could be shipped by carload freight or express and billed to one consignee at destination, thereby obtaining the lower tariff rate applying on carload shipments.

*Motor-truck shipments.*—Motor-truck shipments originate at near-by production points, such as Fernandina, Mayport, and Fort George. Most of the products carried in these shipments are received by local wholesale firms, while in some instances they are sold by peddlers direct from trucks. Some retailers operate a regular motor service from production centers direct to their retail stores where the products are sold.

## RESHIPMENT AND DISTRIBUTION

Favorably situated with respect to production points and having ample rail facilities, Jacksonville has become an important distribution point for fishery products from Florida. Trunk-line railroads from the production centers on the east and west coasts and from central Florida converge there, while outgoing trunk lines extend to most of the important cities of the country to the west, north, and northeast. This makes it possible for Jacksonville dealers to assemble less-than-carload shipments originating in Florida into carload shipments and to bill direct to New York City, Philadelphia, Washington, and other points. Thus small Florida producers shipping only a few barrels at a time are able to obtain a carload rate on their products from Jacksonville to destination. Producers taking advantage of this arrangement usually ship on consignment, in which case charges for the less-than-carload transportation of their product to Jacksonville and for the carload transportation to destination are deducted from the selling price of the product. The saving to small producers is considerable compared with what the less-than-carload transportation charges from production points to destination might be.

During 1926 wholesale dealers in Jacksonville distributed 5,724,000 pounds of fishery products to 25 States, the District of Columbia, and one Canadian Province. Over 95 per cent of these products originated in Florida. Of the amount distributed, 3,924,000 pounds were reshipped by express and 1,800,000 pounds by freight.

Shipments to be transported by express in less-than-carload lots are carted by the express carriers from the shippers' establishment to their terminals at no cost to shippers. Carload express shipments are carted by express carriers from wholesale establishments to express terminals at no cost to shippers only when the tariff rate applying on the carload shipment is the regular less-than-carload commodity rate or the less-than-carload class rate.

Shipments to be transported by freight in carload or less-than-carload lots are privately carted by individual shippers between wholesale establishments and team tracks at freight yards or spur tracks.

Shipments can be loaded directly into freight or express cars switched to the spur tracks at the wholesale market or at the public cold-storage warehouse. The switching charges assessed by the terminal railroad company performing this service are $2.25 per car unless the shipment is destined for a point on the railroad owning the spur tracks or to a point competitive with the railroad owning the spur tracks, in which case there is no switching charge. No charges are assessed for switching from the spur tracks at the public cold-storage warehouse.

While Jacksonville has direct vessel transportation service with Baltimore and other Atlantic ports, there is no movement of fish on these steamers because they have no refrigeration. Unsuccessful efforts have been made to get the steamship lines to put in refrigeration necessary for the handling of fish shipments.

*Reshipment by States.*—The State of New York received the largest amount of fish distributed from Jacksonville in 1926, amounting to 1,324,000 pounds; Georgia ranked second, receiving 721,000 pounds; Florida was third with 671,000 pounds; Pennsylvania was fourth with 427,000 pounds; and Missouri was fifth with 330,000 pounds. Twenty other States, the District of Columbia, and a Canadian Province received 2,251,000 pounds.

As a rule those States immediately surrounding and including Florida represent the section where shipments are made direct to retailers or consumers. Usually these shipments are moved by express in less-than-carload lots. No comprehensive study was made of the number of towns in these States receiving fish from Jacksonville, but from general knowledge it is believed that virtually every town with a population of 10,000 or more in Florida, Georgia, and Alabama receives fish from Jacksonville.

In the States more remote to the north and west Jacksonville fish dealers make their contact mainly with wholesale fish dealers in the larger cities. These latter dealers in turn resell to retailers and consumers in their respective cities and to those in close proximity. In most instances the shipments moved from Jacksonville by freight in car lots are forwarded to points in the more remote States.

TABLE 4.—*Fresh and frozen fishery products distributed by Jacksonville wholesale fish dealers during 1926*

| State | Pounds | Per cent of total | State | Pounds | Per cent of total |
|---|---|---|---|---|---|
| New York | 1,324,000 | 23.1 | Tennessee | 188,000 | 3.3 |
| Georgia | 721,000 | 12.6 | Michigan | 102,000 | 1.8 |
| Florida | 671,000 | 11.7 | Illinois | 101,000 | 1.8 |
| Pennsylvania | 427,000 | 7.4 | Kentucky | 64,000 | 1.2 |
| Missouri | 330,000 | 5.8 | Louisiana | 34,000 | .6 |
| Alabama | 317,000 | 5.5 | Arkansas | 30,000 | .5 |
| Ohio | 262,000 | 4.6 | Indiana | 26,000 | .5 |
| District of Columbia | 226,000 | 3.9 | Oklahoma | 25,000 | .4 |
| North Carolina | 217,000 | 3.8 | All other | [1] 45,000 | .8 |
| Virginia | 213,000 | 3.7 | | | |
| Maryland | 211,000 | 3.7 | Total | 5,724,000 | 100.0 |
| South Carolina | 190,000 | 3.3 | | | |

[1] Includes fishery products distributed to Mississippi, Nebraska, Colorado, Texas, Kansas, Canada, and Wisconsin, named in order of importance.

*Reshipment by species.*—The leading varieties of fishery products reshipped are those that originated in the State of Florida. Mullet ranked first, with 1,370,000 pounds; Spanish mackerel second, with 662,000 pounds; squeteagues or "sea trout" third, with 654,000 pounds; fresh-water bream fourth, with 372,000 pounds; and shrimp fifth, with 340,000 pounds. Twenty-six other fishery products, amounting to 2,326,000 pounds, also were reshipped.

TABLE 5.—*Fresh and frozen fishery products distributed by Jacksonville wholesale fish dealers during 1926*

| Product | Pounds | Per cent of total | Product | Pounds | Per cent of total |
|---|---|---|---|---|---|
| Mullet | 1,370,000 | 23.9 | Bluefish | 84,000 | 1.5 |
| Spanish mackerel | 662,000 | 11.6 | Pompano | 82,000 | 1.4 |
| Sea trout | 654,000 | 11.5 | Snook | 82,000 | 1.4 |
| Bream, fresh-water | 372,000 | 6.5 | Shad | 77,000 | 1.3 |
| Shrimp | 340,000 | 5.9 | King whiting | 71,000 | 1.2 |
| Red snapper | 325,000 | 5.8 | Bream, salt-water | 62,000 | 1.1 |
| King mackerel | 305,000 | 5.3 | Sheepshead, salt-water | 32,000 | .6 |
| Croaker | 297,000 | 5.2 | Oysters | 31,000 | .5 |
| Catfish | 203,000 | 3.5 | Spiny lobster | 22,000 | .4 |
| Black bass | 185,000 | 3.2 | All other | [1] 71,000 | 1.2 |
| Red drum | 172,000 | 3.0 | | | |
| Crappie, "perch" | 124,000 | 2.2 | Total | 5,724,000 | 100.0 |
| Herring | 101,000 | 1.8 | | | |

[1] Includes quantities of the following products named in order of importance: Blue runner, permit, grouper, hickory shad, crevalle, mangrove snapper, black drum, turtle meat, and spot.

*Form in which fish are received and reshipped.*—The form in which the various fishery products are received in Jacksonville is shown in Tables 6, 7, and 8. Except for parchment-wrapped fillets of haddock and unwrapped skinned catfish, the majority of the products are received in the round or viscerated. Reshipments are made in the same form in which they are received. Dealers in fishery products in several inland cities have expressed a desire to have products prepared to a greater extent at points of production. Producers performing this service are finding a more ready sale for their products with these inland dealers.

*Shipping containers.*—Barrels with a capacity of 200 pounds of fish predominate in incoming and outgoing shipments of fresh fish at the Jacksonville market. Exceptions are halibut and salmon, which are received in 300 and 350 pound boxes, and shipments of fish to points in the Middle West which are forwarded in 100-pound boxes with handles. Shucked oysters are received and reshipped in gallon cans packed 10 to 20 cans to a barrel, in bulk, in returnable tubs, and in the shell in 270-pound barrels. Shrimp are received in 125-pound barrels, crawfish in 150-pound barrels, fillet of haddock in 20 and 30 pound tins in boxes, hard crabs in 150-pound barrels, crab meat in 1 and 5 pound tins in boxes or barrels, scallops in 1-gallon cans 10 to

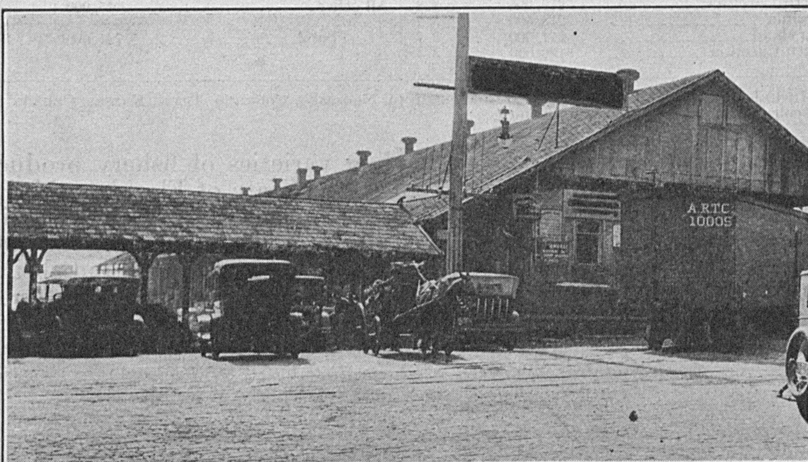

FIG. 1.—Wholesale fish establishment on Jacksonville water front and railroad spur track

20 to a barrel, soft crabs in the Chesapeake crab trunk, and shell clams in 270-pound barrels.

Outgoing shipments of fresh products in small lots are forwarded in 50 and 100 pound pine-board boxes, 100-pound veneer barrels, and 125 to 150 pound standard slat barrels. The 50-pound box is 24½ inches long, 10¾ inches wide, and 12 inches deep. It has cleats across the top of each end. The 100-pound box is 30 inches long, 20 inches wide, and 11 inches deep, with 4-inch handles extending from the side near the top of each end. Cleats are parallel with the vertical edges of each end. The 100-pound barrel is of a straight cylindrical type, 23 inches high and 20 inches in diameter. There are 3 wooden hoops around the circumference, 1 at each end and 1 in the middle. The top and bottom are of wood. The 125 or 150 pound barrel is of ordinary loose slat construction, 31 inches high, 19 inches in diameter at the top and bottom, and 22 inches in diameter at the bulge.

Outgoing frozen-fish shipments are forwarded in 100 and 150 pound pine boxes. The 100-pound box is of two sizes. One size is 26½ inches long, 16½ inches wide, and 13 inches deep, while the other is 26 inches long, 22 inches wide, and 11 inches deep. The 150-pound box is 26 inches long, 22 inches wide, and 15 inches deep. For reinforcement each type has cleats placed parallel with the two horizontal edges of each end.

Outgoing shipments of 200 pounds of fresh fish to one consignee are forwarded in the standard 200-pound barrels, which are usually about 31 inches high, 19 inches in diameter at top and bottom, and 22 inches in diameter at the bulge. It is estimated that over 90 per cent of the fishery products distributed from Jacksonville is forwarded in barrels of this type. Dealers say the barrel is less expensive than the box and that the greater expense of shipping in boxes would not be offset by any additional profit they might realize from shipments of better quality made in boxes. The barrel is popular, also, because it will hold a larger amount of ice than the box, as the usual custom is to place a large cake of ice in the top of the barrel in addition to the usual amount of crushed ice. As the ice melts the cloth covering recedes. It is claimed that the extra cake of ice could not be put into a box, as a cloth cover could not be placed on such a package. However, from the fact that some receivers desire shipments from Jacksonville to be made in boxes it is evident that these receivers, at least, are satisfied with the box as a shipping package. It is believed that in the future more shipments will be made from this city in boxes.

A new type of box is suitable for the shipment of southern fishery products to the North, possibly because of its insulation. It is used now by dealers in the Great Lakes district. It is built of wood boards put together in such a manner as to make a double wall with an air space on all four sides.

## WHOLESALE TRADE

In 1926 there were 10 wholesale establishments engaged in handling 9,467,000 pounds of 48 varieties of fresh and frozen fishery products having a wholesale value of about $1,420,000. The total investment in buildings and accessories was $273,200 and the cash or working capital amounted to $75,500. There were 68 persons engaged in the trade, receiving $93,000 in wages.

Of the 48 varieties of fishery products handled by wholesalers, 10, amounting to 7,200,000 pounds, constitute 75 per cent of the trade. Named in order of importance they are mullet, croaker, Spanish mackerel, sea trout, fresh-water bream, shrimp, red snapper, king mackerel, red drum, and crappie. Twelve products, amounting to 1,873,000 pounds, constitute 20 per cent of the wholesale trade. These are oysters, catfish, king whiting, black bass, herring, snook, salt-water bream, pompano, salt-water sheepshead, blue runner, bluefish, and shad, named in order of importance. Twenty-six other products, amounting to 394,000 pounds, constitute 5 per cent of the wholesale trade. Included in this group are miscellaneous species of mixed or bottom fish.

## WHOLESALE FISH STORES

The wholesale fish stores are conducted in the down-town business section almost solely within the block along the St. Johns River water front, between Ocean and Newnan Streets. Some of the establishments are in quarters on piers that extend into the river; others are across the street. A belt-line railroad occupies the middle of the street, with spur tracks leading to several of the fish piers. Being situated down town, the wholesale section is near to many of the hotels, restaurants, and retail fish stores. One private fish-freezing and cold-storage plant is in this section, although it does not make a practice of catering to the general wholesale trade; it manufactures and sells ice. Wholesalers have ample room for conducting their present business, and should conditions warrant additional space in the immediate vicinity is available for expansion.

The equipment and appurtenances of the majority of the wholesale fish stores are such that products can be handled in an efficient and sanitary manner. In most cases insulated cold rooms refrigerated with ice or mechanical devices are provided for holding fish. The floors are usually of concrete.

The majority of the products are marketed in the form in which received by wholesalers. However, some dealers prepare fillets, steaks, or other products for marketing to the restaurant and hotel trade.

Wholesalers make purchases from producers outright or on commission. Local sales are made over the telephone or by direct contact at a stated market price. Delivery of city sales is made free of charge by bicycle, motor cycle, or truck. Orders of this nature are wrapped in several layers of paper. They are delivered without refrigeration en route, although some dealers add a few pieces of crushed ice to the package.

Out-of-town sales are made by letter or telegraph. These shipments are forwarded, f. o. b. Jacksonville, in boxes and barrels refrigerated with ice. Sometimes out-of-town consignees are charged for containers. Occasionally shipments are made on consignment by wholesalers.

*Packing.*—Upon being received at the wholesale store the fish are dumped on raised-edge, metal-covered tables. Here they are sorted and any not in good condition are discarded. They are weighed and washed with ice water. In packing barrels a layer of crushed ice is put on the bottom, then alternate layers of fish and ice. The last layer of crushed ice is heaped about 5 inches above the rim. Within about an hour of the time the barrel is to be shipped (by this time the ice has melted somewhat and the contents has settled) ice, crushed or in 12-inch blocks, is added and the barrel is headed with matting, burlap, or burlap tarred to paper, which is fastened securely with a hoop nailed around the head. The same procedure is followed in packing boxes, except that it is not possible to add blocks of ice.

The requirements for the efficient handling of fish at a wholesale market of the type of that in Jacksonville may be summed as follows: It should be situated on the water front and have facilities for unloading fishing boats and vessels; it should have rail communications with main-line railroads; it should be near public cold-storage facilities and comparatively near consumer trade; it should have ample room for carrying on the present business and space for expansion; and business should be conducted under the most sanitary conditions. The Jacksonville wholesale fish market now fulfills many of these requirements; it is on the water front, has rail communication, is near consumer trade, has ample space for accomodation of the business, and business is conducted in a sanitary manner.

## COLD-STORAGE FACILITIES

There are two cold-storage and fish-freezing plants in Jacksonville. One is privately and the other publicly operated. These are the only plants in Florida that freeze fish, except two private plants at Pensacola. The plants in Jacksonville are situated on railroad spur tracks joining the main line where siding space is available for 12 freight

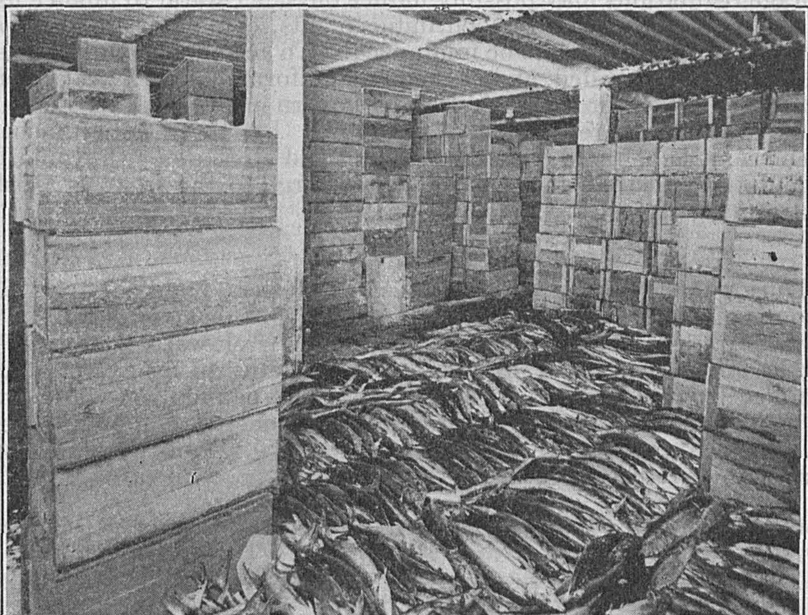

FIG. 2.—Fish in cold storage, Jacksonville, Fla.

cars at one time. The privately owned plant is near the foot of Ocean Street, in the wholesale fish-trade section. The public plant is about 2¾ miles from the wholesale section and about 3 miles from express terminals. Fishery products can be air frozen at each plant, while in addition the public plant has brine-freezing equipment. The plants are equipped to freeze about 35,000 pounds of fish per day. They can store about 1,800,000 pounds of frozen fishery products at one time. If conditions warrant, this can be expanded to store about 4,000,000 pounds. Species frozen include mullet, croaker, Spanish mackerel, pompano, sea trout, catfish, shrimp, and other varieties.

While Jacksonville has fish-freezing and cold-storage facilities, comparatively little advantage is taken of them. On the other hand, large quantities of Florida fish are shipped to northern markets and in the absence of immediate sale are frozen there. This would indicate that the trade will accept frozen Florida fish and that the freezing and storing of these fish might be done readily in Florida. Many times Florida producers cease fishing operations because the markets of the country are glutted with fish of their production. In instances of this nature, if the products were frozen near the place of production producers could continue fishing and freeze their catch, thereby avoiding glutting the consuming markets and at the same time laying aside a supply for future use.

Certain credit features enter into financing a cold-storage "pack." Fishermen must be paid on delivery of fish, gear must be paid for at time of purchase, and freezing and storage charges on the fish need to be paid monthly. Most producers are unable to enter into these financial obligations but must sell their fish at the prevailing market price or discontinue operations. The introduction of standard cold-storage regulations may possibly induce outside capital to finance fish in cold storage. To offer such inducements, capital desires that as far as possible risks of loss be minimized. To accomplish this the fish must be frozen, graded, and packed in a uniform manner. At present no special State or city regulations govern operations in Flordia. Should standard regulations be adopted by these governmental agencies, it is believed that the freezing and storing of fish would be stimulated and that Jacksonville would forge to the front as a fish-distributing center.

## RETAIL TRADE

During 1926 Jacksonville retail fish dealers handled 3,743,000 pounds of 48 varieties of fishery products. Of this amount 3,214,000 pounds were salt-water and 529,000 pounds fresh-water varieties.

*Important commercial products.*—Ten varieties of fishery products handled by retailers, amounting to 2,821,000 pounds, are considered as the important commercial products and constitute approximately 75 per cent of the retail trade. Virtually all of these, except croakers, were produced in Florida.

TABLE 6.—*Fishery products upon which approximately 75 per cent of the trade is based* [1]

| Rank | Product | Principal sources of supply | Form in which received | Usual containers |
|---|---|---|---|---|
| 1 | Mullet | Florida | Round | 200-pound barrels. |
| 2 | Croaker | Virginia, North Carolina, South Carolina.[2] | do | Do. |
| 3 | Bream, fresh-water | Florida | do | Do. |
| 4 | Shrimp | Florida, Georgia, Texas [2] | Green, headless, cooked, and cooked and peeled. | 125-pound barrels. |
| 5 | Oysters | Maryland, Florida, Georgia, New Jersey, South Carolina, North Carolina, Virginia.[2] | Shucked and in the shell. | Shell: 270-pound barrels. Shucked: 1-gallon cans 10 to 20 to a barrel, and in bulk in returnable containers. |
| 6 | King whiting | Florida | Round | 200-pound barrels. |
| 7 | Red snapper | Florida, Georgia [2] | Viscerated and viscerated and headless. | Do. |
| 8 | Crappie, "perch" | Florida | Round | Do. |
| 9 | Sea trout | do | Viscerated | Do. |
| 10 | Spanish mackerel | Florida, North Carolina[2] | do | Do. |

[1] Tables 6, 7, and 8 are to be considered together as regards the relative rank of importance of the product as a whole.
[2] Listed in order of importance.

As will be noted from the preceding table, the consumption of fishery products in Jacksonville is restricted largely to species of fish produced in Florida. Mullet ranks first in importance. Being inexpensive and relatively abundant, they are consumed largely by the colored population. Croakers (about equally as abundant and inexpensive) rank second and are used during the spring and summer months, when mullet are not available in sufficient quantities. This species is popular also with the colored trade. Other species in the commercially important class are liked on account of their quality or inexpensiveness and are quite plentiful.

*Moderately important commercial products.*—The 14 products of this group, amounting to 748,000 pounds, constitute approximately 20 per cent of the trade. They are of moderate importance largely because the supply is limited or seasonal. It is believed that in the future several of these products will rank among the important commercial species. The entire supply is received from points in Florida in 200-pound barrels, except crawfish, which are received in 150-pound barrels.

TABLE 7.—*Fishery products upon which approximately 20 per cent of the retail trade is based* [1]

| Rank | Product | Form in which received | Rank | Product | Form in which received |
|---|---|---|---|---|---|
| 11 | Herring | Round. | 18 | Pompano | Round. |
| 12 | Blue runner | Do. | 19 | Spiny lobster | Round, alive. |
| 13 | Snook | Viscerated. | 20 | Grouper | Viscerated. |
| 14 | Sheepshead, salt-water. | Round or viscerated. | 21 | Mangrove snapper | Round. |
| | | | 22 | Permit | Do. |
| 15 | Red drum | Do. | 23 | Catfish | Viscerated, headless, and skinned. |
| 16 | Bream, salt-water | Round. | | | |
| 17 | Crevalle | Do. | 24 | Black bass | Round or viscerated. |

[1] Tables 6, 7, and 8 are to be considered together as regards the relative rank of importance of the products as a whole.

NOTE.—All the products listed in this table originated in Florida and all arrived in barrels with a net weight of 200 pounds, except spiny lobster, which arrived in barrels with a net weight of 150 pounds.

*Slightly important commercial products.*—The 24 products of this group, amounting to 174,000 pounds, constitute only 5 per cent of the trade. It has been revealed that the sale of 9 of these products is retarded because of their relatively high price, 7 because they are not well known, 6 because the supply is limited, 5 because they are seasonal varieties, 5 because they are considered coarse, 3 because the main customers are hotels and restaurants, 1 because it is a poor shipper, 1 because the size of local variety is too large, and 1 because it is used mainly as a substitute.

TABLE 8.—*Fishery products upon which approximately 5 per cent of the trade is based* [1]

| Rank | Product | Principal sources of supply | Form in which received | Usual containers | Reasons for limited sale |
|---|---|---|---|---|---|
| 25 | King mackerel | Florida | Viscerated | 200-pound barrels | Relatively high priced. |
| 26 | Halibut | British Columbia | Viscerated and headless | 300 and 350 pound boxes | Not well known, used mainly by hotels and restaurants. |
| 27 | Porgie | New York | Round | 200-pound barrels | Not well known, used when other inexpensive varieties are not available. |
| 28 | Spot | Florida | do | do | Seasonal variety. |
| 29 | Angelfish | do | do | do | Not well known. |
| 30 | Sailors' choice | do | do | do | Seasonal variety. |
| 31 | Shad | Florida, Georgia [2] | do | do | Seasonal variety, relatively high priced. |
| 32 | Hickory shad | Florida | do | do | Considered a coarse fish. |
| 33 | Salmon | British Columbia | Viscerated and headless | 300 and 350 pound boxes | Not well known, used mainly by hotels and restaurants. |
| 34 | Turtles | Florida | Meat | 200-pound barrels | Limited supply, used mainly by hotels and restaurants. |
| 35 | Bluefish | do | Round or viscerated | do | Seasonal variety, limited supply, relatively high priced. |
| 36 | Black drum | do | do | do | Considered a coarse fish. |
| 37 | Haddock | Massachusetts, New York, South Carolina. [2] [3] | Round or fillets | Round, 200-pound barrels or fillets, 20 and 30 pound tin cans. | Not well known (increasing demand for fillets). |
| 38 | Moonfish | Florida | Round | 200-pound barrels | Limited supply, considered a coarse fish. |
| 39 | Crabs, hard | Florida, Georgia, Virginia [2] | Alive | 150-pound barrels | Limited local supply because they are not fished extensively, those from Chesapeake Bay too high in price. |
| 40 | Crab meat | Florida, Virginia [2] | Fresh | 1 and 5 pound tin cans | Do. |
| 41 | Flounder | Florida, New York [2] | Round | 200-pound barrels | Seasonal variety (local supply in good demand). |
| 42 | Jewfish | Florida | Round or viscerated | do | Considered a coarse fish (good for steaking). |
| 43 | Scallops | New York, Virginia [2] | Meat | 1-gallon tin cans | Relatively high priced. |
| 44 | Crabs, soft | Maryland, North Carolina [2] | Alive | Crab trunk | Limited local supply, those from north relatively high priced, poor shipper. |
| 45 | Grunts | Florida | Round or viscerated | 200-pound barrels | Considered a coarse fish. |
| 46 | Butterfish | Virginia | Round | do | Not well known. |
| 47 | Clams | Florida | In shell | 270-pound barrels | Size of local clam considered too large, northern supply relatively high priced. |
| 48 | Frogs | Louisiana | Viscerated and headless | 200-pound barrels | Not well known, relatively high priced (demand increasing). |

[1] Tables 6, 7, and 8 are to be considered together as regards the relative rank of importance of the products as a whole.
[2] Listed in order of importance.
[3] Originated in Massachusetts.

## RETAIL FISH STORES

During the survey 24 retail fish stores that handled fishery products every day in the week were in business in Jacksonville. Of these, 11 stores handled fishery products only and 13 handled these products in connection with poultry, eggs, or other merchandise.

*Interior construction.*—The interior construction, display fixtures, and appurtenances of the majority of the stores is much alike. Interior fixtures for fishery products usually consisted of a display case of wooden construction and metal lined. These measured about 5 to 8 feet in length, 2½ feet high, and 3 feet wide. Some cases had the top and front of glass while others had only a top of glass. The products were displayed on crushed ice in the case. In the absence of this type of case the products were displayed on ice held in raised-edge metal-covered tables, which were not covered. A wooden ice box of much the same construction as the display case usually was found in each store for holding reserve stock. Some stores used only their ice box for displaying the fishery products. A few firms have insulated cold rooms for holding reserve stock.

Near the fish-display counter are tables for cleaning and preparing the fishery products. Cages with live poultry or counters upon which other merchandise is displayed usually are opposite the fish displays in the stores that handle other products. The floors are concrete.

*Window displays.*—Window space was utilized in only six of the retail fish stores for displaying fishery products. Some of these stores utilized the space every day while others used it only occasionally, chiefly on Friday and Saturday. None of these displays are inclosed. Receptacles (in the windows of five of the stores) for holding the ice upon which the fish were displayed consisted of metal pans and one was of sunken tile. Inside displays, out of which retail sales were made, were arranged by six stores so that they were visible from the street, thus forming both an inside and a window display.

As a rule fish retailers have neglected to make full use of window space for displaying fishery products. As was noted above, only 6 of the 24 retail fish stores in Jacksonville had window displays. Compare these to retail stores handling most any other line of merchandise and it is found that in most every instance window space is utilized to the fullest advantage for display purposes. Experience has shown that persons will stop and look at interesting and attractive displays of fishery products and that interest aroused in onlookers usually has resulted in increased sale of fish at the store displaying the fishery products.

*Inside displays.*—Inside displays were made by 17 stores, of which 9 were in metal-lined display cases with glass top and (or) glass front. Usually the products were displayed in the case on crushed ice banked to within a few inches of the top. Eight stores arranged their inside displays on raised-edge metal-covered tables and one on a sunken-tile table. These were filled with crushed ice and the products were arranged so that the ice partly or fully covered them. Some products prepared as fillets or steaks were placed in porcelain pans on ice on the tables or in display cases. Earthen jars sunk neck deep in crushed ice on tables or in display cases were used for holding shucked oysters. Eight stores had no case or table displays and used an ice box with the lid left off during business hours for displaying the products. For holding a reserve supply of fishery products 16 stores used iceboxes.

*Wrapping paper.*—Standard white or brown paper was used by 2 firms for wrapping all packages of fish, 6 used newspaper only, while 16 used first a wrapper of standard brown or white paper and an outer wrapper of newspaper. Newspaper tends to impart an inky taste and odor to fish, hence the use of standard paper for the first wrapper.

*Payment of retail sales, delivery, and advertising.*—Retail sales for cash only were made in 10 stores, while 14 extended credit to regular customers. Retail purchases were delivered by 22 stores. For this purpose 11 retailers used bicycles only, 9 used motor trucks only, and 2 used both. Advertising was done by 9 stores, of which 6 used the daily papers at intervals, 2 used programs, and one used handbills distributed in the neighborhood of the store.

*Class of trade.*—That the retail fish stores cater to the colored population is revealed by the fact that 12 stated 75 per cent or more of their trade was with colored residents. Only 4 catered to the white population, while 8 served customers of both races. Of the 12 stores catering to the trade of the white or mixed population, 7 are situated in the down-town section of the city and 5 in outlying districts. Thus it is seen that Jacksonville has but 5 neighborhood fish stores handling fish every day and catering to the white population.

*Sanitary conditions.*—Sanitary conditions in the stores were rated as follows: Excellent, good, fair, poor, or very poor. According to the rating, the sanitary conditions of 8 were good, 7 were fair, 5 were poor, and 4 were very poor.

*Trade during the week.*—From study it was found that the retailer's sales on Monday averaged 8 per cent, Tuesday 7 per cent, Wednesday 8 per cent, Thursday 9 per cent, Friday 27 per cent, and Saturday 41 per cent of the total week's trade. As will be noted, these stores are open six days to do virtually only two days' business. Considered separately, those stores catering to the white or mixed trade reported making most of their sales on Friday and those catering to the colored trade reported Saturday as their busiest day. The majority of the colored working trade is paid on Saturday.

## GROCERY AND MEAT STORES

Fishery products are handled by a few grocery and meat stores that cater largely to white trade. Usually there is no display, the fish being kept in an icebox that is used only for holding fishery products. Some of these stores handle fishery products every day in the week and some on only one or two days a week. The larger fish usually are viscerated and the smaller are sold in the round. None of the products are wrapped, ready for sale, except fillets of haddock.

Grocery and meat stores are coming to be one of the important outlets for fresh and frozen fishery products. However, before extensive expansion takes place in this direction operators of these stores must be educated to the proper method of handling these products, so that consumers will be assured of obtaining fish of the best quality. Such education should be supplied by wholesalers whenever possible, inasmuch as in most cases they already are familiar with the proper method of handling fish. It will suffice here to say that the products should be kept refrigerated at all times in clean and sanitary receptacles away from insects, and that retailers should not be hesitant to discard fish that are not of the best quality.

### FISH PEDDLERS

There were 34 peddlers or hawkers selling fishery products in the city during 1927, the majority being negroes. They operate from motor trucks and horse or hand drawn vehicles. A box containing crushed ice is built on the body of each vehicle for holding the fish. The cover of the box is of wood or framed glass. An elaborate display case with glass top and sides is used by one peddler. Each vehicle is equipped with weighing devices. In general, the usual type of peddler's vehicle was none too attractive, although some appeared to be clean and sanitary.

It is the custom of peddlers to obtain enough fish for one day in the early morning from wholesale firms or direct from fishermen who have landed their fares at one of the central piers. Sometimes, however, fish remain unsold at the end of the day and these are iced and held over for sale on the following day. Several peddlers market the fish remaining unsold each day to individuals, restaurants, or retail fish stores. Only a nominal profit is realized. However, many consider this the best procedure, as it relieves them of providing ice for proper refrigeration of the fish during the night; it also makes it possible for these peddlers to offer only the freshest stock to purchasers. The majority of the peddlers canvass those sections of the city having colored residents, although a few canvass those sections having white residents. Mullet, croakers, and other species of inexpensive fish are the most important varieties handled by peddlers.

Various wholesale fish dealers in Jacksonville are of the opinion that peddlers give fishery products a wider distribution; others, while they agree with the foregoing, are of the opinion that peddlers' vehicles do not, as a rule, appear sanitary and that marketing fishery products from vehicles of this nature creates an unfavorable impression with potential consumers. Some wholesalers contend that peddlers do not keep their fish properly refrigerated while in the boxes on the vehicle or from one day to another, and also that peddlers, as a rule, are reluctant to discard fish not in strictly fresh condition.

Various fish retailers say that peddlers hinder the sale of fish in retail stores. Complaint is made by them that peddlers canvass the neighborhoods in which their retail stores are located, and on Friday and Saturday especially absorb a large portion of the trade that might go to the retail stores. Some retailers, realizing this competitive situation, have peddler vehicles of their own, which operate from the retail store as a base of supplies and canvass the adjacent neighborhood. Such operators hold the surplus fish remaining after each day's canvass in ice chests at the retail store.

If carried on in the proper manner, the practice of peddling fishery products should prove profitable and also tend to increase the consumption of these products. With mechanical refrigeration it is now possible to hold fish under the proper cooling condition on moving vehicles. The problem of keeping the vehicle clean and sanitary rests with the individual.

## ANNUAL PER CAPITA CONSUMPTION

According to the census by the Department of Agriculture of the State of Florida, the population of Jacksonville in 1925, after the extension of the city limits, was 135,886, consisting of 85,519 white, 50,335 colored, and 32 other inhabitants. On this basis it is estimated that the population of Jacksonville proper and the suburbs of Venetia, Ortega, and Norwood was about 150,000 in 1926.

During 1926, 3,743,000 pounds of fresh and frozen fishery products were consumed in Jacksonville and the immediate vicinity. The estimated population of this area during the same year was 150,000, making an annual per capita consumption of these products of 25 pounds. Considering only the edible portion of the fisheries products consumed, amounting to 2,686,000 pounds, the annual per capita consumption is 18 pounds.

The per capita consumption of fishery products in this city is influenced to a great extent, no doubt, by the large colored population, the many visitors, and to the fact that restaurants and other eating places feature fishery products on their menus; also, as in many other towns along the seaboard, the population appears to have developed a taste for fish. However, it is believed there are still many residents in Jacksonville, especially among the white population, that consume below the average, as shown above. Presenting fishery products in a more sanitary and attractive manner by filleting, steaking, or pan dressing, and then wrapping in individual units ready for purchase should encourage their more general use.

TABLE 9.—*Summary of Jacksonville market survey*

| Item | Quantity |
|---|---|
| Number of wholesale fish dealers | 10 |
| Number of retail dealers handling fish every day in the week | 24 |
| Number of products handled by wholesalers | 48 |
| Commercially important products (75 per cent) | 10 |
| Amount ... pounds | 7,200,000 |
| Moderately important products (20 per cent) | 12 |
| Amount ... pounds | 1,873,000 |
| Slightly important products (5 per cent) | 26 |
| Amount ... pounds | 394,000 |
| Number of products handled by retailers | 48 |
| Commercially important products (75 per cent) | 10 |
| Amount ... pounds | 2,821,000 |
| Moderately important products (20 per cent) | 14 |
| Amount ... pounds | 748,000 |
| Slightly important products (5 per cent) | 24 |
| Amount ... pounds | 174,000 |
| Reasons for limited sale— | |
| Relatively high in price | 9 |
| Not well known | 7 |
| Seasonal variety | 5 |
| Supply limited | 6 |
| Considered coarse | 5 |
| Used mainly by hotels and restaurants | 3 |
| Poor shipper | 1 |
| Local variety, too large in size | 1 |
| Used as a substitute | 1 |
| Principal containers: | |
| Boxes ... pounds | 50-100-150-300 |
| Barrels ... do | 100-125-150-200 |
| Quantity of products handled by wholesalers in 1926 ... do | 9,467,000 |
| Quantity shipped to other States (60 per cent) ... do | 5,724,000 |
| Quantity handled by retailers, consumed in Jacksonville ... do | 3,743,000 |
| Quantity consumed in Jacksonville, reduced to the edible portion ... do | 2,686,000 |
| Estimated population in Jacksonville, 1926 ... number | 150,000 |
| Per capita consumption fresh and frozen fishery products, 1926 (edible portion) ... pounds | 18 |
| Per capita consumption of fresh and frozen fishery products, 1926 (in the round) ... do | 25 |

## REGULATIONS GOVERNING RETAIL SALE OF FRESH FISH IN JACKSONVILLE

The retail sale of fresh fish in Jacksonville is regulated by city ordinances. Ordinance No. T–14, bill No. T–3, states, in part, as follows:

SEC. 2. (*a*) That the place of business wherein such fresh fish are kept and offered for sale shall be located within the sewered district of the city of Jacksonville and have connection with the public sewerage system of said city.

(*b*) That the place of business wherein such fresh fish are kept and offered for sale shall be well lighted, having windows equal in area to 10 per cent of the floor space. All windows, doors, and other openings shall be fully screened, and said place of business shall have good ventilation, and said premises shall be kept free from insects and vermin.

(*c*) That wherever there are sold or offered for sale undressed fish or fish that have not had their scales removed, but are dressed to the extent of having their gills and entrails taken out, an ice box shall be supplied within which the fish shall be kept with a layer of ice and a layer of fish alternating so that a temperature of 40° Fahrenheit shall at all times be maintained, and said ice box shall stand on a cement base raised 9 inches above the original floor to support said ice box and to afford connection to a sand trap, which shall be connected with the public sewer.

(*d*) That wherever there are sold or offered for sale fish that are completely dressed, i. e., fish that have been scaled and had the gills and entrails removed, there shall be supplied a double-compartment box having adequate insulation and having brine or mechanical refrigeration in one compartment in which said fish are kept; and said compartment in which the fish are kept shall maintain a temperature which shall at no time rise above 40° Fahrenheit; and all parts of said box shall be accessible for cleaning and the box shall have a faucet for removal of the brine or shall be connected with the public sewer.

(*e*) That no fish, except as held for sale under subparagraph (*c*) of section 2 hereof, shall be dressed on the premises, or cut up on meat blocks, or displayed in cases with other foods of any kind, and scales shall be maintained in said premises which shall be used for weighing fish only.

(*f*) That fish shall at no time be kept in meat boxes on said premises.

## REGULATIONS GOVERNING PEDDLING OF FRESH FISH IN JACKSONVILLE

Peddling of fishery products is regulated by city ordinance No. N–122, bill No. N–197, which states in part:

SECTION 1. No person shall anywhere within the city limits at any time hawk, peddle, or offer for sale at retail to consumers, from house to house, upon any street in the city, or from docks or boats within the city, any fish, oysters, crabs, or shrimp, unless such person has actually caught the same, except as hereinafter provided. Fish, oysters, shrimp, or crabs so hawked, peddled, or offered for sale must be kept in a closed and thoroughly sanitary receptacle, and they shall be kept at all times in ice and so screened as to exclude flies and dust.

No license tax shall be required for doing business under this ordinance by persons who hawk or peddle fish, oysters, shrimp, or crabs of his own catch, but each person desiring to hawk or peddle fish, oysters, shrimp, or crabs of his own catch must first obtain a permit from the mayor to conduct such business. The mayor shall have authority to revoke such permit at any time for a violation of any of the provisions of this ordinance.

SEC. 2. Each person who hawks or peddles fish, oysters, shrimp, or crabs not of his own catch must pay an annual license tax of five dollars, as now provided by ordinance, and if more than one vehicle is used he shall also pay a similar license for each vehicle so used.

## COMMON AND SCIENTIFIC NAMES OF FISHERY PRODUCTS HANDLED

Following is a list of common and scientific names of fishery products handled by the wholesale and retail trade in Jacksonville to which reference is made in this report:

| Common name | Other common names | Scientific name |
|---|---|---|
| Angelfish | Spadefish | *Chætodipterus faber.* |
| Bass, black | | Micropterus sp. |
| Bluefish | | *Pomatomus saltatrix.* |
| Blue runner | Hardtail | *Caranx chrysos.* |
| Bream, fresh-water | | Centrarchidæ sp. |
| Bream, salt-water | Sand bream, red bream | *Lagodon rhomboides.* |
| Butterfish | | *Poronotus triacanthus.* |
| Catfish | Bullhead | Ameiurus sp., Ictalurus sp. |
| Crappie | "Perch" | Pomoxis sp. |
| Crevallé | | Caranx sp. |
| Croaker | Hardhead | *Micropogon undulatus.* |
| Drum, black | | *Pogonias cromis.* |
| Drum, red | Red bass, spot bass | *Sciænops ocellatus.* |
| Flounder | | Pleuronectidæ sp. |
| Grouper | | *Epinephelus mycteroperca.* |
| Grunts | | Hæmulidæ sp. |
| Haddock | | *Melanogrammus æglifinus.* |
| Halibut | | *Hippoglossus hippoglossus.* |
| Herring | Alewife, river herring | Pomolobus sp. |
| Hickory shad | | *Pomolobus mediocris.* |
| Jewfish | | *Promicrops guttatus.*<br>*Promicrops itaiara.* |
| King whiting | Whiting | Menticirrhus sp. |
| King mackerel | Cero, kingfish | *Scomberomorus regalis.*<br>*Scomberomorus cavalla.* |
| Moonfish | | *Vomer setipinnis.*<br>*Selene vomer.* |
| Mullet | Jumping mullet<br>Silver mullet | *Mugil cephalus.*<br>*Mugil curema.* |
| Permit | Great pompano | *Trachinotus goodei.* |
| Pompano | | *Trachinotus carolinus.* |
| Porgie | Scup | *Stenotomus chrysops.*<br>Stenotomus sp. |
| Sailors choice | | Various species. |
| Salmon | Pacific salmon | Oncorhynchus sp. |
| Shad | | *Alosa sapidissima.* |
| Sheepshead, salt-water | | *Archosargus probatocephalus.* |
| Snapper, mangrove | "Mango" | *Lutianus griseus.* |
| Snapper, red | | *Lutianus blackfordi.* |
| Snook | Pike, sergeantfish | *Centropomus undecimalis.* |
| Spanish mackerel | | *Scomberomorus maculatus.* |
| Spot | Lafayette | *Leiostomus xanthurus.* |
| Trout, sea | Spotted trout, squeteague, weakfish. | *Cynoscion nebulosus.*<br>*Cynoscion regalis.*<br>*Cynoscion nothus.* |
| Clams | Hard clams, soft clams | *Venus mercenaria.*<br>*Mya arenaria.* |
| Crabs | Hard crab, soft crab, blue crab and stone crab. | *Callinectes sapidus.*<br>*Menippe mercenaria.* |
| Frogs | | Rana sp. |
| Oysters | | *Ostrea elongata.* |
| Scallops | Bay scallops, sea scallops | *Pecten irridians.*<br>*Pecten majellanicus.* |
| Shrimp | | *Peneus setiferus, P. brasiliensis.* |
| Spiny lobster | Lobster, crawfish | *Panulirus argus.* |
| Turtle | Green turtle, loggerhead | *Chelonia mydas.*<br>*Thalassochelys caretta.* |

TABLE 10.—*Directory of sea-food dealers in Jacksonville, Fla., 1927*

[W = wholesaler; R = retailer]

WHOLESALE AND RETAIL

| Dealers | Symbols | Fishery products handled: Fresh | Frozen | Oysters | Other shellfish | Canned | Cured | Poultry |
|---|---|---|---|---|---|---|---|---|
| American Fish Co., Foot of Ocean St | W | x | | | | | | |
| Booth Fisheries Co., Foot of Ocean St | W | x | x | x | x | | | |
| Florida Fish Co., 120 South Ocean St | W | x | | | | | | |
| Gantt Fish Co., Foot of Ocean St | WR | x | x | x | x | | x | |
| Jacksonville Car Line, Myrtle Ave. and Dennis St | W | x | | | | | | |
| Jacksonville Fish Co., Foot of Newnan St | WR | x | x | x | x | x | | |
| Southern Fisheries Co., Inc., Foot of Newnan St | W | x | x | x | x | | | |
| Standard Fisheries Co., Foot of Ocean St.[1] | W | x | x | x | x | | | |
| Trenary Fish Co., 10 South Newnan St | WR | x | x | x | x | | x | |
| Vanderpoel Fish Co., Foot of Ocean St | WR | x | x | x | x | | | |
| Atlantic Fish & Poultry Co., 360 Park St | R | x | x | x | x | | | x |
| Faines Fish Market, 1308 Davis St | R | x | x | x | | | | x |
| Gantt Fish Co., 1104 West Adams St | R | x | x | x | x | | | |
| Gantt Fish Co., 1125 Julia St.[2] | R | x | x | | x | | | |
| Gilliards Fish Market, 615 Davis St | R | x | x | x | x | | | x |
| Jaremiah Fish Market, 920 East Union St | R | x | x | x | x | | | |
| Keith Fish & Poultry Market, 1004 Kings Road | R | x | x | x | x | | | x |
| Leo's Fish Market, 522 Broad St | R | x | x | x | x | | | |
| Mangham Fish Market, 1614 Davis St | R | x | | x | | | | |
| Mayport Fish & Oyster Co., 33 South Ocean St | R | x | | x | x | | | |
| Mills Fish Market, 1303 Myrtle Ave | R | x | | x | | | | x |
| Myrtle Ave. Fish & Poultry Co., 1008 Myrtle Ave | R | x | x | x | | | | x |
| Reliable Fish Market, 829 East First St | R | x | | x | | | | |
| Riverside Fish Co., 315 Riverside Ave | R | x | x | x | x | | | x |
| Sterling Seafood and Poultry Market, 931 West Monroe St | R | x | x | x | x | | | x |
| Tawes Fish Market, 744 West Adams St | R | x | x | x | x | | | |
| Three Brothers Fish Co., 9 South Ocean St | R | x | x | x | x | | | |
| Two Brothers Fish and Poultry Co., 132 Broad St | R | x | | x | x | | | x |
| Wilson Fish Co., 505 Forest St | R | x | x | x | | | | x |
| Wilson Fish Market, 899 West Eighth St | R | x | | x | x | | | |

[1]Handles ice, also.

In connection with a grocery store.

TABLE 11.—*Short-line travel distance and freight and express rates on fresh and frozen fish and oysters from principal sources of supply to Jacksonville, Fla.*

[Prepared by the Interstate Commerce Commission, Bureau of Traffic. Distances shown were taken from War Department mileages or War Department mileages in connection with Official Railway Guide. Notes to reference symbols are grouped at end of Table 12]

| Point of origin | Short-line travel distance in miles | Rate in cents per 100 pounds | | | |
|---|---|---|---|---|---|
| | | Freight | | Express, any quantity | |
| | | Carload | Less than carload | Fish | Oysters |
| | | Fish | | | |
| DOMINION OF CANADA | | | | | |
| British Columbia: Vancouver | 3,438 | C 225 | 555 | (A) @ 1,105 | ** 1,105 |
| UNITED STATES | | | | | |
| Florida: | | | | | |
| Apalachicola | 247 | ♯ A 78 | .......... | X 109 | X 124 |
| Bradenton | 209 | ♯ A 67½ | .......... | X 109 | X 124 |
| Cedar Keys | 125 | ♯ A 54 | .......... | X 82 | X 97 |
| Fernandina | 36 | ♯ A 18½ | 35½ | X 64 | X 64 |
| Fort Pierce | 242 | .......... | .......... | X 109 | X 124 |
| Key West | 522 | .......... | .......... | X 172 | X 202 |
| Miami | 366 | .......... | .......... | X 131 | X 157 |
| Orlando | 147 | C 55½ | 104 | X 94 | X 109 |
| Palatka | 55 | C 38½ | 73½ | X 64 | X 64 |
| Panama City | 7 | ♯ A 78 | .......... | X 109 | X 124 |
| Pensacola | 369 | ♯ A 78 | 148½ | X 139 | X 169 |
| Punta Gorda | 283 | ♯ A 67½ | 146½ | X 120 | X 139 |
| St. Augustine | 37 | .......... | .......... | X 64 | X 64 |
| St. Petersburg | 267 | ♯ A 67½ | 142 | X 109 | X 124 |
| Sanford | 125 | C 49½ | 96 | X 94 | X 109 |
| Sarasota | 249 | ♯ A 67½ | 145½ | X 109 | X 124 |
| Tampa | 212 | ♯ A 61 | 135 | X 109 | X 124 |
| Titusville | 155 | .......... | .......... | X 82 | X 97 |
| West Palm Beach | 300 | .......... | .......... | X 120 | X 139 |
| Georgia: | | | | | |
| Brunswick | 91 | C 24½ | 70 | † 81 | † 81 |
| Savannah | 137 | C 24½ | 70 | † 112 | † 112 |
| Louisiana: | | | | | |
| Morgan City | 692 | C 132 | 240½ | @ 304 | @ 304 |
| New Orleans | 612 | C 66 | 162½ | † 232 | † 232 |
| Sorrento | 666 | C 66 | 162½ | @ 266 | @ 266 |
| Maryland: | | | | | |
| Annapolis | 791 | C 88 | 190½ | @ 296 | @ 296 |
| Baltimore | 795 | B 71 | 165½ | † 273 | † 273 |
| Crisfield | 784 | † B 75½ | 176½ | @ 296 | @ 296 |
| Massachusetts: Boston | 1,214 | C 79 | 183½ | @ 360 | @ 360 |
| New Jersey: Port Morris | 972 | C 77½ | 179½ | .......... | .......... |
| New York: New York City | 982 | C 75½ | 176½ | @ 319 | @ 319 |
| North Carolina: | | | | | |
| Beaufort | 604 | ♯ A 89½ | 160 | † 221 | † 221 |
| Elizabeth City | 671 | C 59½ | 137½ | † 232 | † 232 |
| Morehead City | 601 | ♯ A 89½ | 146½ | † 221 | † 221 |
| Wilmington | 479 | C 49½ | 115 | † 184 | † 184 |
| South Carolina: | | | | | |
| Columbia | 280 | C 47½ | 110½ | † 127 | † 127 |
| Port Royal | 191 | C 27 | 78 | † 127 | † 127 |
| Virginia: Norfolk | 658 | ♯ A 89½ | 137½ | † 232 | † 232 |
| Texas: Galveston | 1,031 | C 141 | 247½ | @ 352 | @ 352 |

TABLE 12.—*Short-line travel distance and freight and express rates on fresh and frozen fish and oysters to principal distributing centers, from Jacksonville, Fla.*

[Prepared by the Interstate Commerce Commission, Bureau of Traffic. Distances shown were taken from War Department mileage or War Department mileage in connection with Official Railway Guide. Notes to reference symbols are grouped at end of table]

| Destination | Short-line travel distance in miles | Rate in cents per 100 pounds | | | |
|---|---|---|---|---|---|
| | | Freight | | Express, any quantity | |
| | | Carload | Less-than-carload | Fish | Oysters |
| | | Fish | | | |
| Alabama: | | | | | |
| Anniston | 439 | C 58 | 131 | † 169 | † 169 |
| Birmingham | 443 | ♯ A 77½ | 131 | † 184 | † 184 |
| Dothan | 270 | C 52 | 117 | † 142 | † 142 |
| Eufaula | 272 | C 51 | 114½ | † 142 | † 142 |
| Huntsville | 527 | C 63 | 146½ | † 205 | † 205 |
| Mobile | 473 | C 67½ | 157 | † 195 | † 195 |
| Montgomery | 351 | ♯ A 69 | 126½ | † 169 | † 169 |
| Tuscaloosa | 456 | C 73½ | 168 | † 195 | † 195 |
| Arkansas: Little Rock | 882 | C 111 | 192 | @ 315 | @ 315 |
| Colorado: | | | | | |
| Colorado Springs | 1,794 | ♯ A 97½ to Memphis<br>C 129½ beyond | 178 to Memphis<br>273.3 beyond | @ 559 | @ 559 |
| Denver | 1,869 | do | do | @ 574 | @ 574 |
| District of Columbia: | | | | | |
| Washington | 755 | ♯ B 68½ | 158½ | † 267 | † 267 |
| Florida: | | | | | |
| Daytonia Beach | 110 | | | X 67 | X 75 |
| Fort Lauderdale | 341 | | | X 120 | X 139 |
| Lake City | 60 | C 33 | 62 | X 64 | X 75 |
| Miami | 366 | | | X 131 | X 157 |
| Ocala | 110 | C 42½ | 87½ | X 67 | X 75 |
| Pensacola | 369 | ♯ A 78 | 138 | X 139 | X 169 |
| West Palm Beach | 300 | | | X 120 | X 139 |
| Georgia: | | | | | |
| Athens | 343 | C 53½ | 121 | † 158 | † 158 |
| Atlanta | 331 | ♯ A 69 | 121 | † 158 | † 158 |
| Augusta | 261 | ♯ A 66 | 87½ | † 127 | † 127 |
| Columbus | 275 | ♯ A 64½ | 112½ | † 142 | † 142 |
| Dalton | 420 | C 58 | 131 | † 158 | † 158 |
| Eastman | 185 | C 45 | 101½ | † 127 | † 127 |
| Macon | 243 | ♯ A 64½ | 110 | † 127 | † 127 |
| Rome | 404 | C 56½ | 126½ | † 169 | † 169 |
| Savannah | 137 | ♯ A 54 | 70 | † 112 | † 112 |
| Thomasville | 152 | C 44 | 100½ | † 101 | † 101 |
| Illinois: Chicago | 1,065 | A 104½ to Cairo<br>C 40½ beyond | 187 to Cairo<br>80½ beyond | @ 341 | † 341 |
| Indiana: Indianapolis | 932 | A 104½ to Cairo<br>C 28½ beyond | 187 to Cairo<br>56½ beyond | @ 322 | @ 322 |
| Kansas: Hutchinson | 1,576 | A 97½ to Memphis<br>C 91½ beyond | 178 to Memphis<br>167 beyond | • 425 | @ 446 |
| Kentucky: | | | | | |
| Lexington | 725 | ♯ A 104½ | 187 | † 273 | † 273 |
| Louisville | 783 | ♯ A 104½ | 187 | † 273 | † 273 |
| Louisiana: | | | | | |
| New Orleans | 612 | C 73½ | 171 | † 232 | † 232 |
| Shreveport | 919 | C 115½ | 195 | † 304 | † 304 |
| Maryland: Baltimore | 795 | ♯ B 70½ | 165½ | † 273 | † 273 |
| Michigan: Detroit | 1,082 | ♯ A 104½ to Cincinnati<br>C 39½ beyond | 187 to Cincinnati<br>79 beyond | @ 356 | @ 356 |
| Mississippi: | | | | | |
| Greenwood | 630 | C 73½ | 171 | † 232 | † 232 |
| Greenville | 685 | C 75½ | 175 | | |
| Missouri: | | | | | |
| Kansas City | 1,233 | ♯ A 97½ to Memphis<br>C 48½ beyond | 178 to Memphis<br>121½ beyond | † 362 | † 362 |
| St. Louis | 929 | ♯ A 118 | 218½ | † 289 | † 289 |
| Springfield | 1,007 | ♯ A 97½ to Memphis<br>C 48½ beyond | 178 to Memphis<br>121½ beyond | † 335 | † 335 |
| Nebraska: Omaha | 1,380 | ♯ A 97½ to Memphis<br>C 52 beyond | 178 to Memphis<br>124½ beyond | • 403 | @ 450 |
| New York: New York City | 982 | ♯ B 82½ | 176½ | @ 319 | @ 319 |

TABLE 12.—*Short-line travel distance and freight and express rates on fresh and frozen fish and oysters to principal distributing centers, from Jacksonville, Fla.*—Continued

| Destination | Short-line travel distance in miles | Rate in cents per 100 pounds | | | |
|---|---|---|---|---|---|
| | | Freight | | Express, any quantity | |
| | | Carload | Less-than-carload | Fish | Oysters |
| | | Fish | | | |
| North Carolina: | | | | | |
| Asheville | 443 | C 61 | 139½ | † 195 | † 195 |
| Charlotte | 389 | # A 77½ | 110 | † 195 | † 195 |
| Greensboro | 483 | C 52 | 134 | † 205 | † 205 |
| High Point | 468 | C 51 | 126½ | † 195 | † 195 |
| Newbern | 566 | C 47 | 126½ | † 205 | † 205 |
| Salisbury | 433 | C 51 | 117 | † 195 | † 195 |
| Winston-Salem | 471 | C 52 | 134 | † 221 | † 221 |
| Ohio: | | | | | |
| Cincinnati | 805 | # A 104½ | 187 | † 294 | † 294 |
| Cleveland | 1,067 | # A 104½ to Cincinnati.<br>C 39 beyond | 187 to Cincinnati<br>77½ beyond | @ 341 | @ 341 |
| Oklahoma: | | | | | |
| Muskogee | 1,216 | C 131 | 312 | * 350 | @ 367 |
| Oklahoma City | 1,236 | C 131 | 312 | @ 386 | @ 386 |
| Tulsa | 1,220 | C 131 | 312 | @ 386 | @ 386 |
| Pennsylvania: | | | | | |
| Philadelphia | 890 | # B 76 | 174½ | @ 307 | @ 307 |
| Pittsburgh | 1,057 | C 84½ | 196 | @ 322 | @ 322 |
| South Carolina: | | | | | |
| Aiken | 269 | C 46 | 106 | † 127 | † 127 |
| Anderson | 371 | C 47 | 117 | † 158 | † 158 |
| Charleston | 268 | # A 64 | 56½ | † 142 | † 142 |
| Columbia | 280 | # A 67½ | 106 | † 127 | † 127 |
| Florence | 370 | # A 77½ | 114½ | † 169 | † 169 |
| Greenville | 400 | C 47 | 117 | † 158 | † 158 |
| Sumter | 349 | C 46 | 108½ | † 142 | † 142 |
| Tennessee: | | | | | |
| Knoxville | 528 | # A 82½ | 141 | † 205 | † 205 |
| Nashville | 620 | # A 88 | 146½ | † 232 | † 232 |
| Texas: | | | | | |
| Dallas | 1,127 | C 151½ | 237 | @ 356 | @ 356 |
| San Antonio | 1,183 | C 151½ | 237 | @ 401 | @ 401 |
| Virginia: | | | | | |
| Norfolk | 658 | # A 89½ | 137½ | † 232 | † 232 |
| Richmond | 639 | # A 89½ | 137½ | † 232 | † 232 |
| South Boston | 555 | C 52 | 141 | † 205 | † 205 |
| Wisconsin: | | | | | |
| Green Bay | 1,288 | A 118 to St. Louis<br>C 45½ beyond | 187 to Cairo<br>121½ beyond | @ 427 | @ 427 |
| Milwaukee | 1,173 | A 104½ to Cincinnati.<br>C 45½ beyond | 187 to Cincinnati<br>90 beyond | @ 367 | @ 367 |

EXPLANATION OF REFERENCE MARKS GOVERNING THE FREIGHT RATES

#. When ice is loaded in bunkers of the car no charge will be made for its transportation; but if ice is taken by consignee charges will be made on the actual weight of the ice in bunkers at destination and at the carload rate applicable on the freight which it accompanies; if not taken by consignee it becomes the property of the carrier.

When ice is loaded in the body of the car for protection of the freight no charge will be made for its transportation; but if taken by consignee charge will be made on the actual weight of the ice in the car at destination and at the rate applicable on the freight which it accompanies; if not taken by consignee it becomes the property of the carrier.

When ice is placed in the same package with the freight charges will be assessed on basis of the net weight of the freight and containers.

†. Where ice is placed in same package with the freight charges will be assessed on basis of the net weight of the freight and containers.

A. Minimum billing weight 12,000 pounds.
B. Minimum billing weight 20,000 pounds.
C. Minimum billing weight 24,000 pounds.

EXPLANATION OF REFERENCE MARKS GOVERNING THE EXPRESS RATES

†. *Applicable on interstate shipments of fresh and dry salt fish in barrels also on clams and oysters in shell.* Weight basis:

Fresh and dry salt fish rates named will apply on dry salt fish in barrels. They will also apply on fresh or dry salt fish in boxes when the net weight of the shipment is 150 pounds or more. The charges on fresh fish must be assessed on the net weight of the fish plus 25 per cent for ice.

*Charges on dry salt fish must be assessed on the basis of actual gross weight.*

Oysters in shell: Flour barrel, estimated weight 200 pounds per barrel. Sugar barrel, estimated weight 250 pounds per barrel.

Shipments of fresh or dry salt fish in sugar barrels when in lots of 10 barrels or more, and in boxes when net weight is 2,000 pounds or more from one consignor to one consignee.

(1). Shipments of fresh or dry salt fish in sugar barrels when in lots of 10 barrels or more from one consignee will be charged 10 per cent less than the charge determined at rates named. The charge will first be computed on the entire shipment at rates named, observing the weight basis defined above, and from the gross charge so ascertained 10 per cent thereof may be deducted.

(2). Shipments of fresh or dry salt fish in boxes when net weight is 2,000 pounds or more from one consignor to one consignee between stations in Alabama, District of Columbia, Florida, Georgia, Maryland, North Carolina, Virginia, and West Virginia, will be charged on same basis as when in sugar barrels, 10 barrels or more, as shown in paragraph (1).

*. Applicable on interstate shipments of fish in flour or sugar barrels.

Weight basis: Waybill at net weight plus 25 per cent for ice.

Shipments of fish in sugar barrels, when in lots of 10 or more from one consignor to one consignee, must be charged for at 10 per cent less per barrel than the charge upon a single barrel waybilling at net weight plus 25 per cent for ice.

X. Applicable on shipments of fresh and frozen fish and oysters shucked and in the shell. Weight basis: Fresh fish must be waybilled at net weight plus 25 per cent for ice.

Shell oysters must be waybilled at gross weight, but the minimum billing weight must not be less than 200 pounds per flour barrel or 250 pounds per sugar barrel.

Fish in standard sugar barrels, when in lots of 10 barrels or more, from one shipper to one consignee, charge 10 per cent less per sugar barrel than the rate applying per single sugar barrel.

@. Second-class rates. Classification weight basis: Fish, fresh, frozen, smoked, dried, salted, pickled, or otherwise preserved or cured. Charge on basis of gross weight, except that fresh or frozen fish shipped with ice, which is necessary for its preservation, must be charged for on the basis *of 25 per cent* added to the net weight of the fish, unless actual gross weight is less at time of shipment. The minimum billing weight of any iced shipment of fish under this rule is 40 pounds unless the gross weight is less. On mixed shipments of fish and oysters shipped with ice necessary for preservation, charge on the basis of 25 per cent added to the net weight of the fish, plus the weight of the oysters as specified hereunder. The minimum billing weight of *such a mixed shipment is 40 pounds, unless the gross weight is less, in which event* the gross weight will apply.

Oysters, clams, or scallops in shell, glass jars, canned, or in bulk:

When shipped in bulk estimate 12 pounds per gallon.

If forwarded in refrigerators weighing gross in excess of 200 pounds, charge on basis of rule 1 (h), Official *Express Classification*, I. C. C. *No.* 3280. (*Gross weight of the shipment at the time it is received for* transportation, provided, however, that when it is necessary to use ice for preservation, and it is used for that purpose only, an allowance of 25 per cent from the gross weight will be made from March to November, inclusive, and an allowance of 15 per cent from gross weight will be made from December to February, inclusive, but the weight must not be less than the gross weight of the shipment without ice.)

In glass jars *estimate 24 pints at 45 pounds, 36 pints at 65 pounds*, 48 pints at 90 pounds, and 48 half pints at 50 pounds.

The following estimated weights will apply to oysters in metal cans with or without ice, when packed in boxes: $\frac{1}{16}$-gallon can, $1\frac{1}{4}$ pounds each; pint cans, $1\frac{1}{2}$ pounds each; standard or $\frac{3}{4}$ cans, 2 pounds each; $\frac{1}{4}$-gallon cans, $2\frac{1}{2}$ pounds each; full quart cans, 3 pounds each; $\frac{1}{2}$-gallon cans, 6 pounds each; and gallon cans, 12 pounds each.

Gross weight at time of shipment will apply when less than the estimated weights shown above. The minimum billing weight for any single shipment of oysters, clams, or scallops is 30 pounds unless the actual gross weight is less or unless the percentage allowance from gross weight authorized in rule 1 (h) makes a lower billing weight. On mixed shipments of fish and oysters shipped with ice necessary for preservation charge on the basis of 25 per cent added to the net weight of the fish plus the weight of the oysters as specified above.

The minimum billing weight of such a mixed shipment is 40 pounds unless the gross weight is less, in which event the gross weight will apply. Oysters, clams, or scallops: On mixed shipments of shellfish, consisting of shellfish both shucked and in the shell, the minimum billing weight will be 40 pounds per shipment unless the actual gross weight is lower, in which event the actual gross weight will apply. (Does not apply on intrastate traffic between stations in Georgia.)

Carloads: Minimum billing weight 12,000 pounds, on the following basis:

When in the shell actual weight. Shucked oysters in carriers estimated at 12 pounds per gallon. Shucked oysters in naked cans without other packing, charge on the basis of actual weight of the oysters and containers.

No charge will be made for the transportation of necessary chopped ice packed on top or around the cans, nor when refrigerator cars are used will any charge be made for transportation of ice in the bunkers. The cost of all ice furnished by the express company must be paid by the shipper or consignee.

**. Shipments of oysters originating in Canada, Newfoundland, or Labrador will be subject to billing weight basis provided for in item 1 (h), Official Express Classification, I. C. C. No. 3280. (Item noted above.)

(A). On shipments of fresh salmon packed with ice or snow, from points in Canada the minimum billing weight will be 75 pounds per box unless the gross weight is less.

## LIST OF MARKET SURVEYS

The following publications of the Bureau of Fisheries relating to the marketing of fish in various cities in the United States have been published and may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the prices stated.

FIEDLER, R. H.
1928. Trade in fresh and frozen fishery products and related marketing considerations in Greater St. Louis, Missouri. Bureau of Fisheries Document No. 1026. Appendix VI, Report of the Commissioner of Fisheries for 1927, pp. 485–514, 2 figs. Washington. 10 cents.

FIEDLER, R. H., and J. H. MATTHEWS.
1926. Wholesale trade in fresh and frozen fishery products and related marketing considerations in New York City. Bureau of Fisheries Document No. 996. Appendix VI, Report of the U. S. Commissioner of Fisheries for 1925, pp. 183–217, 13 figs. Washington. 10 cents.

HOPKINSON, L. T.
1921. Trade in fresh and frozen fishery products and related marketing considerations in Louisville, Kentucky. Bureau of Fisheries Economic Circular No. 50, 7 pp. Washington. 5 cents.
1921. Trade in fresh and frozen fishery products and related marketing considerations in Pittsburgh, Pa. Bureau of Fisheries Economic Circular No. 52, 9 pp. Washington. 5 cents.
1921. Trade in fresh and frozen fishery products and related marketing considerations in Chicago, Ill. Bureau of Fisheries Economic Circular No. 54, 22 pp. Washington. 5 cents.
1922. Trade in fresh and frozen fishery products and related marketing considerations in Minneapolis and St. Paul, Minn. Bureau of Fisheries Economic Circular No. 55, 21 pp. Washington. 5 cents.
1923. Trade in fresh and frozen fishery products and related marketing considerations in Boston, Mass. Bureau of Fisheries Document No. 939. Appendix XVI, Report of the U. S. Commissioner of Fisheries for 1922, 27 pp., 2 figs. Washington. 5 cents.

HOPKINSON, L. T., and W. P. STUDDERT.
1922. Trade in fresh and frozen fishery products and related marketing considerations in Seattle, Wash. Bureau of Fisheries Document No. 930, 16 pp. Appendix VII, Report of the U. S. Commissioner of Fisheries for 1922. Washington. 5 cents.

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# FOOD OF BULLHEADS[1]

By Louella E. Cable

*Laboratory Aid, U. S. Bureau of Fisheries*

CONTENTS



## INTRODUCTION

Three species of bullheads are found in most of the small streams and lakes of the Mississippi River Valley. These are, according to the classification of Forbes and Richardson (1920), *Ameiurus natalis*, the yellow bullhead; *A. nebulosus*, the brown or spotted bullhead; and *A. melas*, the black bullhead. While not ranked as a game fish by sportsmen, the bullhead affords good fishing for a great number of people throughout this region and in actual monetary value is of great economic importance.

The two last-named species are those most commonly found in the lakes of eastern South Dakota, and of these, *A. melas* was found in much greater abundance than *A. nebulosus*. The department of game and fish of the State of South Dakota recognizes that the bullhead has the greatest value in dollars and cents of any fish in the State and has stocked certain of its waters with them.

In spite of the fact that bullheads are of such economic importance that lakes are being stocked with them, little is known of their food. It is the purpose of this paper, therefore, to contribute something to a field that hitherto has been given but scant attention.

Work on this subject was begun in the fall of 1926 and continued through the winter. Through the courtesy of the University of South Dakota all investigations were made in the zoology laboratory of that institution.

I gratefully acknowledge my indebtedness to Dr. E. P. Churchill, of the department of zoology of the University of South Dakota, for many valuable suggestions and especially for the material that he collected during the summer of 1926 and placed at my disposal. I wish to express my appreciation to Dr. Howard C. Abbott, of the department of botany of the University of South Dakota, and to

[1] Appendix II to the Report of the U. S. Commissioner of Fisheries for 1928. B. F. Document No. 1037.

W. H. Over, curator of the museum of the University of South Dakota, for identification of certain plant forms. I am also indebted to Mr. Over for unpublished information concerning the environment of those lakes from which specimens for this study were taken, and to Dr. L. O. Howard, chief of the United States Bureau of Entomology, for the identification of several of the insects found.

## HISTORICAL

There is very little available literature on the food of bullheads, and no thorough study has been made of this subject. The articles that have been written have been brief accounts included in longer works of a general character.

Forbes and Richardson (1920) examined 36 specimens of *Ameiurus melas* from Wisconsin lakes. They found the food of these fish to consist one-fourth of aquatic vegetation and one-fifth bivalve mollusks, snails, and aquatic insects; other important elements were crayfish and other crustaceans. Two of these bullheads had eaten other fish, sunfish and perch among them. They found the food of the *Ameiurus nebulosus* to consist of small bivalve mollusks, insect larvæ, distillery slops and accidental rubbish, and a few adult insects and snails. Some had eaten a few leeches.

Tracey (1910) declared the food of bullheads to be "all kinds of animal life," including the young and eggs of fishes. He examined specimens from waters in Rhode Island.

Pearse (1918) made a brief study of the food of bullheads at the time he was making a study of shore fish in certain Wisconsin lakes. He investigated the stomach contents of 15 specimens of *Ameiurus melas*, which were found to contain the following organisms: Diptera larvæ, damsel-fly nymphs, beetle larvæ, caterpillars, dipterous pupæ, adult insects, Hyalella, crayfish, ostracods, Cyclops, cladocerans, snails, oligochetes, plants, and algæ, in addition to silt and débris. He also examined 50 *A. nebulosus*. Forty-two and one-tenth per cent of the food of this species was composed of microscopic Crustacea and 34.7 per cent of insects. Pearse makes the statement that the brown bullhead feeds mostly on Entomostraca and insect larvæ while it is young, and when mature takes almost anything in the shape of animal food.

Evermann and Clark (1920) examined the stomachs of 20 bullheads from Lake Maxinkuckee, Ind. They found these bullheads had consumed fish flesh and seeds of the water lily (*Castalia odorata*), crayfish, soft-shelled mollusks, and the young of Unionidæ. In this same article Evermann and Clark reported that bullheads were said "to feed pretty extensively on the eggs of other species of fish."

Because of the high food value and the growing economic importance of the bullhead in South Dakota, the present study was made to obtain information as to their food and food habits in that State.

## ECONOMIC VALUE

Annual reports[2] from the State department of game and fish show that, among the rough fish seined out of South Dakota waters by licensed fishermen since 1916, the number of pounds of bullheads taken

[2] Annual reports for the years 1914 to 1925 were obtained by the writer through the kindness of O. H. Johnson, director of the State department of game and fish.

has been second only to the number of pounds of buffalo fish, and since 1918 it has been more than three times as great as the sum total of all other fish taken. Data obtained from these annual reports regarding the number of pounds of these fish seined and sold on the market are shown in the succeeding table.

TABLE 1

| Year | Buffalo fish | Bullheads | Year | Buffalo fish | Bullheads |
|---|---|---|---|---|---|
| 1916 | 320, 350 | 56, 378 | 1922 | 251, 668 | 1, 072, 161 |
| 1917 | 243, 463 | 140, 882 | 1923 | 205, 488 | 1, 384, 841 |
| 1918 | 339, 916 | 1, 151, 710 | 1924 | 289, 785 | 1, 273, 034 |
| 1920 | 354, 490 | 1, 236, 426 | 1925 | 293, 574 | 1, 320, 972 |
| 1921 | 179, 938 | 1, 496, 744 | 1926 [1] | | |

[1] "Exact figures have not been compiled, but the number of pounds taken probably compares favorably with those of previous years." Statement made by O. H. Johnson, director of the State department of game and fish, in a letter to the writer.

The relative importance of the bullhead and buffalo, South Dakota's two leading commercial fish, is brought out clearly in Figure 1.

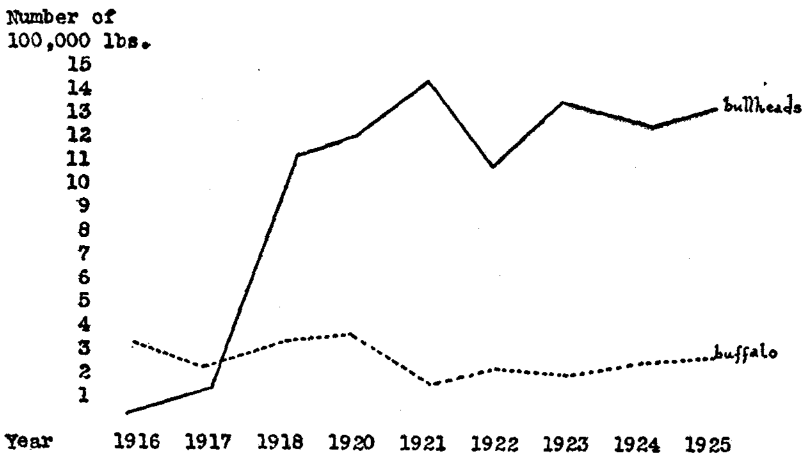


FIG. 1

O. H. Johnson, director of the State department of game and fish, says:

The bullhead ranks first in South Dakota among all fish taken by hook and line for food purposes. More people in South Dakota fish for the bullhead than any other single variety of fish, and it is safe to assume that more bullheads, taken by hook and line, are consumed within our State than are taken by seine and placed on the eastern markets. This last statement, however, we are unable to substantiate by figures available. The statement is based entirely on observation.

If Red Lake, in Brule County, may be taken as an example of the lakes of eastern South Dakota, where conditions were similar to those elsewhere during the period from 1917 (the year it was stocked with bullheads and several other species of fish) until it became dry in 1925, we may feel certain that Mr. Johnson's statements are correct. The writer often has seen hundreds of fishermen at this lake, some of whom had come from 50 to 75 miles to fish for bullheads. Many made catches of more than 100 bullheads in an afternoon.

Eight years after Red Lake was stocked, licensed fishermen seined out tons of bullheads each day during the fall season. At one time they reported a catch of 10 tons. This shows that under the ordinarily favorable conditions that existed there the bullhead reproduces in great numbers, which assures an abundant supply and gives it added economic value.

The bullhead is caught easily, a fact that increases its value to the general public. There is no need for an expensive outfit, and it makes little difference what kind of bait is used. Though ordinarily it chooses its food carefully, the bullhead apparently is not loath to accept unaccustomed food from a hook, as will be shown later in this paper.

South Dakota has recognized the value of bullheads to the extent that the department of game and fish has undertaken the stocking of many of its streams, lakes, and ponds with them. This work was begun in 1914. The fish were then obtained through the United States Bureau of Fisheries and were placed in waters both east and west of the Missouri River. Since 1915 the stocking has been accomplished by transferring fish from overstocked waters to barren waters.

The annual game and fish reports have not recorded the stocking of any of the lakes from which specimens for this study were taken, except Lake Andes, which received 1,300 adult bullheads in 1926. However, newspapers reported that 30,000 bullheads were put in under the ice at Lake Madison in January, 1927.

To make the stocking of lakes with bullheads most successful, their food must be known. Propagation can not be profitable in lakes where the food supply is insufficient and the fish are in a starving condition. In 1915 the bullheads in Lake Alice, Deuel County, were below normal size, the larger ones were thin, and many died. On investigation it was found they were starving; their stomachs were empty.

Exact information concerning the food of the bullhead will assist the State department of game and fish in estimating the number of fish the available foods in the lakes will maintain. Then bullheads need not be placed in lakes lacking essential foods, and these foods may be introduced into lakes where at present they are wanting.

## LOCATION OF LAKES

The lakes from which specimens were taken for study were representative of the lakes of eastern South Dakota. They are located in widely separated parts of that section of the State. The location of each lake, with a brief description, is given below in the order in which they were visited.

1. Lake Andes, Charles Mix County, is a long, narrow lake northeast of the town of Lake Andes. The water in this lake, as well as in most of the others, was several feet below normal during the summer of 1926. Bullheads were not common here. This is a fresh-water lake with a pebbly and muddy bottom. Being annuals, the water plants had made very little growth by the middle of June, when the fish were taken.

2. Lake Madison, Lake County, a few miles southeast of Madison, is smaller than Lake Andes. There is no outlet, and the water is only semifresh, due to partial stagnation, not salinity. The bottom is muddy. The plants growing here were Ruppia and rushes. Bullheads were found to be fairly common.

3. Lake Poinsett, Hamlin County, is a large, deep lake, 8 or 10 miles south of Castlewood. Bullheads, very common here, were caught with hook and line in water 6 to 12 feet deep. The bottom is sandy, and the water is semifresh. Ruppia, *Potamogeton pectinatus*, *Potamogeton interior* Ryd., and Spirogyra were abundant.

4. Lake Kampeska, Codington County, a large lake west of Watertown, has a sandy and pebbly bottom and a rocky shore line. Bullheads were not common, though one was taken with hook and line at the outlet. Algæ, rushes, and *Potamogeton interior* Ryd. made up the plant life here.

5. Cottonwood Lake, Spink County, 10 miles southwest of Redfield, supported very little vegetation in 1926, which may have been due to the abundance of carp. Algæ, rushes, and *Potamogeton interior* Ryd. were present in small quantities. The fish were small and apparently hungry. They took large pieces of minnow and crayfish from the hook.

6. Lake Byron, Beadle County, is a shallow lake 16 miles northeast of Huron. Very few fish were in this lake, many having smothered the previous winter. The bottom, where small amounts of vegetation exist, is pebbly and muddy. Fish were seined here, and nowhere was the water more than 4½ feet deep, and some of the fish were taken in 1 foot of water. Bullheads were not common, and those taken were very small.

7. Sand Lake, Brown County, 20 miles northeast of Aberdeen, is a fresh-water lake formed by the James River. Bullheads have been removed by commercial fishermen and are not at present abundant in this lake. The water is shallow and the bottom is muddy. *Potamogeton interior* Ryd. is the most common plant.

8. Clear Lake, Marshall County, a few miles east of Lake City, is one of the few lakes having wooded shores. There is plenty of vegetation for the support of insect life. Ruppia and *Potamogeton interior* Ryd. are the most important in the diet of the bullhead. The hook and line were used in taking bullheads, which were common in this lake. The water is semifresh.

9. North Red Iron Lake, Marshall County, is a short distance from Clear Lake. The water is semifresh; the bottom pebbly and muddy. Bullheads were fairly common. Only very small ones were taken, the minnow net being used for the purpose.

10. Lake Tetonkaha, Brookings County, 5 miles west of Bruce, has a very irregular shore line. This lake was lacking in vegetation. Bullheads were very common and were easily caught with the hook and line. Crayfish were used as bait. The water is semifresh; the bottom pebbly and muddy.

11. Lake Oakwood, Brookings County, a short distance east of Lake Tetonkaha, contains great numbers of bullheads. The water is semifresh, the bottom is pebbly and muddy. As at Lake Tetonkaha there is no great quantity of vegetation, Ruppia being that most often eaten by the bullheads.

## METHODS AND MATERIALS

The specimens were caught by Dr. E. P. Churchill during the summer of 1926 while engaged with W. H. Over in making a biological survey of the lakes mentioned in this paper. Three methods

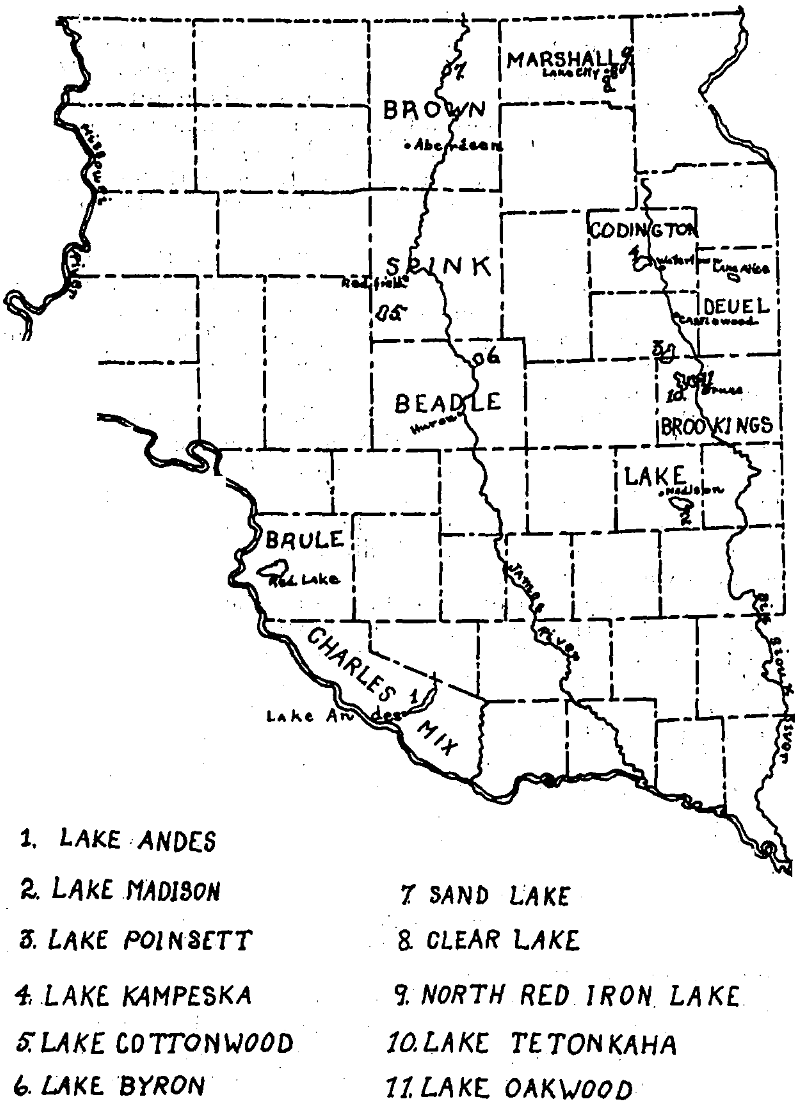


FIG. 2.—Eastern South Dakota

were employed in securing them—the hook and line, the seine, and the minnow net for fingerlings. Immediately after the adult fish were taken from the water they were identified, opened, and the alimentary tract carefully removed with scissors and placed in a 10 per cent solution of formaldehyde to check the process of digestion and preserve them for examination later. They were sealed in glass fruit jars with data consisting of the date and method of catching, depth of water, or other pertinent information. The fingerlings were preserved whole. This material was placed at the disposal of the writer in September.

In the laboratory the stomachs and intestines were opened separately and the contents spread out in watch glasses containing water. Examination was made under a binocular microscope, and the compound microscope was used for the examination of very small organisms. The contents were identified as nearly as possible and the specimens of each kind present were counted and the number recorded. Filamentous algæ, Copepoda, and Cladocera were measured in cubic centimeters by dropping them into small-bore glass graduates containing water and allowing them to settle to the bottom, which required from 30 to 45 minutes. By actual count it was found that the average number of *Daphnia longispina* was 1,000 and of the smaller Cladocera 1,750 per cubic centimeter, and there were 1,312 copepods per cubic centimeter. Plant stems were measured in centimeters of length. Larger crustaceans, mollusks, insect larvæ and pupæ, etc., were counted as they were lifted from one glass to another.

## DESCRIPTION OF FOODS

To obtain accurate knowledge of the food eaten by the bullheads from the lakes mentioned earlier in this paper, the alimentary tracts of 106 specimens from these lakes were examined. The data in the following tables are arranged according to the lakes investigated, which have been numbered consecutively with reference to the dates on which they were visited. These numbers correspond to the numbers of the lakes on the accompanying map. The number following the date of the collection indicates the length of the bullheads in that collection, measured from the tip of the snout to the posterior end of the caudal fin.

The tables have been compiled to show the approximate per cent in actual volume occupied by the various organisms comprising the food of the specimens examined. Bait, blood cells,[3] and parasites have not been included in the tables because they are not food in the sense in which the term is here used, though they were found in the alimentary tract and record was made of them wherever found. Unrecognizable fragments, which in most cases were well-digested bits of food of the same kinds as that which was still in a condition to be identified, also are omitted.

The per cent volume was obtained by using the Cladocera as a basis of computation. The number of Cladocera required to fill 1 cubic centimeter was learned by actual count. Each organism was assigned a number representing the number of Cladocera needed to make an equal mass volume. This number was then multiplied by the number of organisms of the same species and size. All numbers for organisms from the same fish were added together and the per cent volume of each organism found by dividing its number by the sum total for all the organisms found in the alimentary tract

[3] These cells would not be found in the alimentary tract under normal conditions. When the stomach and the intestine were removed from the specimen the blood escaped into both ends of the digestive tube.

of that fish. Œdogonium was measured wet in the same way as the Cladocera, and 1 cubic centimeter was therefore equal in volume to the number of Cladocera required to fill the same space.

TABLE 2.—*Lake Andes (1), June 18, 1926, 12 to 14 inches*

| Specimen | 1 | 2 | Average |
|---|---|---|---|
| Chironomus larvæ | 89 | 63 | 76 |
| Chironomus pupæ | 8 | | 4 |
| Damsel-fly nymphs | | 37 | 18 |
| Mycetobia larvæ | 2 | | 1 |
| Plant tissue | Trace. | | Trace. |

TABLE 3.—*Lake Madison (2), June 24, 1926, 12 inches*

[In this and subsequent tables "Tr." indicates that the organism named was found in very small quantities, a mere trace, though less than 1 per cent of the entire contents of the alimentary canal]

| Specimen | 1 | 2 | 3 | Average |
|---|---|---|---|---|
| Bivalves | 8 | | 25 | 11 |
| Chironomus larvæ | 66 | 50 | 74 | 63 |
| Chironomus pupæ | | 10 | | 3 |
| Damsel-fly nymphs | | 38 | | 13 |
| Hydrocarina | 2 | 2 | 1 | 2 |
| Mycetobia larvæ | 3 | | | 1 |
| Snails | 20 | | | 6 |
| Trichoptera larvæ | 1 | | | Tr. |

TABLE 4.—*Lake Poinsett (3), July 4 to 7, 1926, 14 inches*

| Specimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Amphipoda | 32 | | | 6 | | 3 | 1 | 1 | 14 | Tr. |
| Bivalves | | | | | | Tr. | | | | |
| Chara | | | | Tr. | | | | | | |
| Chironomus eggs | | | Tr. | | | Tr. | | | 1 | |
| Chironomus larvæ | 21 | | 2 | 6 | 3 | 1 | 4 | | 18 | 1 |
| Chironomus pupæ | | | Tr. | | Tr. | Tr. | | | | |
| Cladocera sp | Tr. | 99 | | | | | | | | |
| Daphnia longispina | | | 38 | 81 | 46 | 55 | Tr. | 97 | 45 | 8 |
| Diatoms | 1 | | 1 | 1 | | | 1 | | 1 | 1 |
| Diptera | | | Tr. | | | | | | | |
| Dragon-fly nymphs | | | | | | | | | | 6 |
| Ephemeridæ nymphs | | | | | Tr. | | 1 | | 1 | |
| Fish eggs | | | | | | | | | Tr. | |
| Hydrocarina | | 1 | | Tr. | 2 | Tr. | Tr. | Tr. | 1 | 1 |
| Mycetobia larvæ | | | | | 42 | Tr. | Tr. | | 1 | 6 |
| Nais | | | 4 | | | | Tr. | | | |
| Œdogonium | 30 | | | 1 | | 25 | 83 | Tr. | 2 | 5 |
| Orchestiidæ | | | | | | | | Tr. | | |
| Ostracoda | Tr. | | | | | 1 | Tr. | | | |
| Potamogeton | 15 | | 2 | 4 | 5 | Tr. | Tr. | Tr. | | |
| Ruppia | | | | | 2 | 9 | 3 | 1 | 1 | 31 |
| Sand grains | | | | | | | Tr. | | Tr. | 19 |
| Sisyra | | | | | | | | | Tr. | |
| Snails | | | Tr. | | Tr. | 4 | 4 | Tr. | 13 | 21 |
| Spirogyra | | | 50 | | | | | | | |

TABLE 4.—*Lake Poinsett (3), July 4 to 7, 1926, 14 inches*—Continued

| Specimen | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | Average |
|---|---|---|---|---|---|---|---|---|---|---|
| Amphipoda | 50 | 6 | | | 21 | | | 4 | | 7.2 |
| Bivalves | 1 | | 5 | | | 4 | | | | Tr. |
| Chara | | | Tr. | | | | | Tr. | | Tr. |
| Chironomus eggs | | Tr. | | 1 | | | | | | Tr. |
| Chironomus larvæ | | 5 | 2 | 4 | 2 | 7 | 64 | Tr. | 31 | 9.0 |
| Chironomus pupæ | | | Tr. | Tr. | Tr. | Tr. | | Tr. | 4 | Tr. |
| Cladocera sp | | | | | | | | | | 5.2 |
| Clam flesh | | | | | 66 | | | | | 3.4 |
| Corixidæ | | | | | | | | 1 | | Tr. |
| Damsel-fly nymphs | | 1 | | | | | | | | Tr. |
| Daphnia longispina | 42 | 33 | 40 | 31 | | | | 77 | 24 | 32.4 |
| Diatoms | 1 | | | 1 | | 1 | Tr. | | | .5 |
| Diptera | | | | | | | | | | Tr. |
| Dragon-fly nymphs | | | | | | | | | | Tr. |
| Ephemeridæ nymphs | Tr. | 6 | | | | | | | | Tr. |
| Fish eggs | | | | | | | | | | Tr. |
| Fish scales | | | | | | Tr. | | | | Tr. |
| Hydrocarina | Tr. | Tr. | 1 | Tr. | | Tr. | | Tr. | 1 | Tr. |
| Mycetobia larvæ | 1 | Tr. | | | Tr. | 21 | 32 | Tr. | | 5.4 |
| Nais | | | | | | | | | | Tr. |
| Œdogonium | | 42 | 40 | 54 | Tr. | | | 11 | Tr. | 15.4 |
| Orchestiidæ | | | | | | | | | | Tr. |
| Ostracoda | | Tr. | Tr. | Tr. | | | Tr. | | | Tr. |
| Potamogeton | Tr. | 1 | | | | | | | | 1.2 |
| Ruppia | 1 | | 5 | 8 | 10 | Tr. | | 1 | | 3.8 |
| Sand grains | 2 | 2 | Tr. | | | 22 | | 2 | | 2.4 |
| Sisyra | | Tr. | | | | | | | | Tr. |
| Snails | 1 | 2 | 6 | Tr. | | | 2 | 1 | 39 | 5.0 |
| Spirogyra | | | | | | | | | | 2.6 |
| Trichoptera larvæ | | | | | | 43 | | | | 2.2 |

TABLE 5.—*Lake Kampeska (4), July 7, 1926, 12 inches*

| Specimen | 1 | Specimen | 1 |
|---|---|---|---|
| Amphipoda | 30 | Insect eggs | 26 |
| Corixid wings | 1 | Nais | 3 |
| Filamentous algæ | 1 | Sand | 36 |
| Homoptera | 3 | | |

TABLE 6.—*Lake Cottonwood (5), July 10 and 11, 1926, 7½ to 8 inches*

| Specimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amphipoda | | Tr. | | | | 2 | 8 | | | | 1 | | 1 | | | | 0.8 |
| Beetle larvæ | | | | | | | | | | | | | 3 | | | | Tr. |
| Chætophora | 76 | 93 | | 10 | 89 | 96 | 79 | | | | | | Tr. | | | | 27.8 |
| Chironomus eggs | | | | 10 | | | | | | | | | | | | | .6 |
| Chironomus larvæ | Tr. | 1 | | 26 | 7 | | 1 | 3 | 15 | 68 | | 32 | 74 | 44 | 35 | 65 | 23.1 |
| Chironomus pupæ | | | | | | | | | 23 | | | | | | | | 1.0 |
| Cladocera | 7 | | 26 | Tr. | | | | 26 | | | | 26 | Tr. | 30 | 36 | | 9.2 |
| Clam flesh | | | | | | | | | | | | | | | 9 | | .5 |
| Corixidæ | | 2 | 3 | | | | | | | | 47 | | Tr. | | 8 | | 3.4 |
| Cyclops viridis | Tr. | Tr. | 74 | Tr. | | | | Tr. | | Tr. | | 39 | Tr. | | | | 7.0 |
| Diatoms | | 1 | | Tr. | | | 3 | 1 | | Tr. | | Tr. | | | Tr. | | Tr. |
| Dragon-fly nymphs | 9 | | | | | | | | | | | | | | | | .5 |
| Fish flesh | | | | | | | | | | | | Tr. | | 14 | | 34 | 3.0 |
| Fish scales | Tr. | | | | | | | | | | | | 2 | | Tr. | | Tr. |
| Formica | | | | | Tr. | | | | | | | | | | | | Tr. |
| Grasshopper legs | | | | | | | | | | | | | | | Tr. | | Tr. |
| Haliplus longulus | | | | | | | | | | | | Tr. | | | | | Tr. |
| Homoptera (small) | | | | | | | | | | | 37 | | | | | | 2.3 |
| Hordeum jubatum seed | | | | | Tr. | 2 | 1 | | 1 | | | | | | | | Tr. |
| Hydrocarina | | | | Tr. | | | | | | | | | Tr. | | | | Tr. |
| Hydroporus sp | | | | | | | | | | | | | | | 2 | | Tr. |
| Insect legs | | 2 | | | | | | | | | | | | | | | Tr. |
| May-fly nymph | | | | | | | | | | | | | Tr. | | | | Tr. |
| Mycetobia larvæ | | | | | | | | | | | | | Tr. | | | 1 | Tr. |
| Œdogonium | | | | | | | | 65 | 16 | 15 | | | | | | | 6.0 |
| Polygonum seeds | | | | | | | | | 12 | | | | | | | | Tr. |
| Potamogeton stems, leaves | 6 | 2 | | 50 | | 1 | 7 | 2 | 32 | 15 | Tr. | | Tr. | 25 | 9 | | 9.3 |
| Rotifers | | Tr. | | | | Tr. | | | | | | | | | | | Tr. |
| Sand grains | | 1 | | | | Tr. | | 1 | | | Tr. | | 4 | Tr. | 5 | | Tr. |
| Trichoptera | | | | | Tr. | Tr. | | | | | | | | | | | Tr. |
| Whirligig beetle | | | | | | | | | | | 14 | | | | | | Tr. |

TABLE 7.—*Lake Byron (6), July 15 to 20, 1926, 8 inches*

| Specimen | 1 | 2 | 3 | 4 | 5 | 6 | Average |
|---|---|---|---|---|---|---|---|
| *Chironomus* larvæ |  | 29 | 84 | 34 | 32 | 30 | 34.6 |
| *Chironomus* pupæ |  | 21 | 2 |  | 64 | 70 | 26.1 |
| Corixidæ | 100 | 50 | 14 | 66 | 4 |  | 39 |

TABLE 8.—*Sand Lake (7), July 22, 1926, 6 inches*

| Specimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 [1] | 10 | 11 | 12 [1] | 13 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amphipoda |  | 3 |  | 3 |  | Tr. |  | 18 |  |  |  |  | Tr. | 2.4 |
| Animal tissue |  |  |  |  |  |  |  |  |  | 49 |  |  |  | 4.9 |
| Chironomus larvæ |  |  |  |  |  |  |  |  |  |  | 18 |  |  | 1.8 |
| Chironomus pupæ |  |  |  | 3 |  | 88 |  |  |  | 3 | 14 |  |  | 10.8 |
| Corixidæ | 6 |  | 16 | 15 |  | 3 |  | 14 |  |  | 24 |  |  | 7.7 |
| Cyclops viridis | 6 |  |  | 15 |  |  |  | Tr. |  |  |  |  |  | 2.1 |
| Damsel-fly nymphs |  | 12 |  | 63 | 100 | 7 |  |  |  |  | 39 |  |  | 22.1 |
| Daphnia longispina |  |  |  |  |  |  |  |  |  |  |  |  | Tr. | Tr. |
| Diatoms | Tr. | 1 | 1 | 1 |  | 1 | Tr. | 1 |  |  |  |  | 1 | .6 |
| Filamentous algæ |  |  |  |  |  |  |  |  |  |  |  |  | 99 | 9.9 |
| Haliplus longulus |  |  |  |  |  |  |  |  |  |  | 5 |  |  | .5 |
| Hydrocarina | 1 |  |  |  |  | Tr. |  |  |  |  |  |  |  | Tr. |
| Œdogonium |  |  |  |  |  |  |  | Tr. |  |  |  |  |  | Tr. |
| Plant tissue |  |  |  |  |  |  |  | 66 |  |  |  |  |  | 6.6 |
| Potamogeton | 87 | 84 | 83 |  |  |  |  |  |  | 48 |  |  |  | 30.2 |
| Rotifers |  |  |  |  |  |  | Tr. |  |  |  |  |  |  | Tr. |

[1] Empty.

TABLE 9.—*Clear Lake (8), July 26 to 30, 1926, 9 to 12 inches*

| Specimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amphipoda | 6 | 1 | 33 |  | 3 |  | 7 | 32 |  | 45 | 31 | 14.3 |
| Arctiidæ halisidota |  |  |  |  |  |  | 2 |  |  |  |  | Tr. |
| Beetle larvæ |  |  | Tr. |  |  |  | 72 | Tr. |  | 54 | 39 | 15 |
| Bivalves | 10 | Tr. |  |  |  |  |  |  | 80 |  |  | 8.1 |
| Chironomus larvæ | Tr. | 83 |  | 52 | Tr. | 89 | 13 | 7 | 10 |  | 24 | 25.2 |
| Chironomus pupæ | Tr. | 3 |  | 17 | Tr. | 2 | 3 | 5 |  |  | 1 | 2.8 |
| Cladocera | 81 | 10 |  |  |  |  |  | 27 |  |  |  | 10.7 |
| Dermestid larvæ | 1 |  |  |  |  |  |  |  |  |  |  | Tr. |
| Diatoms | 1 | 2 |  | Tr. |  | 1 |  | Tr. | 1 |  |  | Tr. |
| Hydrocarina |  |  |  | Tr. |  | Tr. |  | Tr. |  | Tr. |  | Tr. |
| Hydroporus |  |  | 12 |  |  |  | 1 |  |  |  |  | 1.1 |
| Neuropteroids |  |  | 9 |  |  |  |  |  |  |  | Tr. | Tr. |
| Ostracoda |  |  | 10 | Tr. | 82 |  | 2 | 27 |  | Tr. | Tr. | 11 |
| Oxyethira |  |  |  |  | Tr. |  |  |  |  |  |  | Tr. |
| Potamogeton |  | Tr. | 31 | 28 |  | 2 |  | Tr. |  | Tr. | 2 | 5.7 |
| Sand |  |  |  |  |  |  | Tr. |  | 9 | Tr. | Tr. | Tr. |
| Snail |  |  | 4 |  | 11 | 5 |  |  |  |  | Tr. | 1.8 |

TABLE 10.—*North Red Iron Lake (9), July 27, 1926, 1¼ inches*

| Specimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amphipoda |  |  |  | 9 |  |  |  |  | 21 |  | 27 |  |  |  | 4 |
| Beetle larvæ |  |  | 14 |  |  |  |  |  |  |  |  |  |  |  | 1 |
| Chironomus larvæ |  |  |  |  | 13 |  | 16 |  | 8 |  |  | 8 | 40 |  | 6 |
| Cladocera | 46 | 34 | 53 | 23 | 43 |  | 6 | 77 | 3 | 41 |  | 35 | 26 | 20 | 29 |
| Cladocera eggs |  | 7 |  | 21 |  |  |  | 23 |  | 17 |  | 8 |  |  | 5.4 |
| Colonial protozoa |  |  |  | 10 | 19 |  |  |  |  |  |  |  |  |  | 2 |
| Cyclops viridis | 35 | 59 | 33 | 37 | 25 | 100 | 75 |  | 26 | 42 | 21 | 23 | 34 | 80 | 42.1 |
| Cyclops viridis eggs |  |  |  |  |  |  |  |  |  |  | 16 | 26 |  |  | 3 |
| Filamentous algæ |  |  |  |  |  |  |  |  |  |  |  |  |  | Tr. | Tr. |
| Insect eggs | 19 |  |  |  |  |  |  |  |  |  |  |  |  |  | 1.3 |
| Polygonum seeds |  |  |  |  |  |  |  |  | 43 |  |  |  |  |  | 3 |
| Potamogeton |  |  |  |  |  |  |  |  |  |  | 36 |  |  |  | 2 |
| Trichoptera |  |  |  |  |  |  | 3 |  |  |  |  |  |  |  | Tr. |

TABLE 11.—*Lake Tetonkaha (10), August 9, 1926, 12 inches*

| Specimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beetle larvæ |  | 1 |  |  |  |  |  |  |  |  |  |  |  |  | Tr. |
| Chironomus larvæ | 84 | 4 |  | 1 |  |  |  | 6 |  | 2 |  | Tr. | 73 | 66 | 16.8 |
| Chironomus pupæ | 8 | 15 | 4 | 13 | 1 |  | 10 |  |  | Tr. | 7 | 1 | 24 | 12 | 6.8 |
| Cladocera | Tr. | 80 | 72 | 63 | 63 | 23 | 66 | 66 | 57 | 87 | 76 | 98 | 14 |  | 54.6 |
| Corethra sp.? | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  | Tr. |
| Corixidæ | 4 |  |  |  |  |  |  |  |  |  | 7 |  |  |  | Tr. |
| Cyclops viridis |  | Tr. | 23 | 12 | 36 | 75 | 18 | 27 | 42 | 10 | 9 |  |  |  | 18 |
| Diatoms | Tr. |  |  |  |  |  |  |  |  |  |  |  | Tr. |  | Tr. |
| Elodea leaves |  |  |  |  |  |  |  |  |  |  | Tr. |  |  |  | Tr. |
| Fish scales |  |  |  |  |  |  |  | Tr. | Tr. |  |  |  |  |  | Tr. |
| Hydrocarina |  |  | Tr. |  |  |  |  |  | Tr. |  |  |  |  |  | Tr. |
| Hydrophilidæ |  |  |  | Tr. |  |  |  |  |  |  |  |  |  |  | Tr. |
| Insect eggs |  |  |  | 10 |  |  |  |  |  |  |  |  |  |  | Tr. |
| May-fly nymph | 3 |  |  |  |  | Tr. |  |  | Tr. | Tr. |  | Tr. |  |  | Tr. |
| Parasitic flatworms |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  | Tr. |
| Plant material |  |  |  |  |  | Tr. |  | Tr. |  |  |  |  |  | 4 | Tr. |
| Potamogeton |  |  |  |  |  |  |  |  |  |  |  |  | Tr. |  | Tr. |
| Protozoa |  |  |  |  |  |  |  | Tr. |  |  |  |  |  |  | Tr. |
| Reproductive organs of insects |  |  |  |  |  |  |  |  |  | Tr. |  |  |  |  | Tr. |
| Ruppia |  |  |  |  |  |  | 15 |  |  |  |  |  |  |  | 1 |
| Vorticella |  |  | Tr. |  |  |  |  |  |  |  |  |  |  |  | Tr. |
| Sand |  |  |  |  |  |  | Tr. |  |  |  |  |  |  | 18 | 1 |

TABLE 12.—*Lake Oakwood (11), August 11, 1926, 8 inches*

| Specimen | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9[1] | Average |
|---|---|---|---|---|---|---|---|---|---|---|
| Beetle larvæ |  |  |  |  |  |  | 9 |  |  | 1.1 |
| Bivalves | 3 |  |  |  |  |  |  |  |  | Tr. |
| Chironomus larvæ | 93 | 96 | 84 |  | 3 | 1 | 83 | 61 |  | 52.6 |
| Chironomus pupæ |  | 3 |  | 89 | Tr. | 97 |  | 38 |  | 28.3 |
| Cladocera |  |  |  |  |  |  | 6 |  |  | Tr. |
| Cyclops viridis | 3 |  |  |  |  |  |  |  |  | Tr. |
| Diatoms |  |  | Tr. | Tr. | 1 | Tr. |  |  |  | Tr. |
| Filamentous algæ | Tr. |  |  |  |  |  |  |  |  | Tr. |
| Hydrocarina |  |  |  | Tr. |  |  |  |  |  | Tr. |
| Ichneumon fly |  |  |  | 10 | Tr. | Tr. |  |  |  | 1.2 |
| Mycetobia larvæ |  |  | 16 |  |  |  |  |  |  | 2.0 |
| Plant material |  | Tr. |  |  |  |  | Tr. | Tr. |  | Tr. |
| Potamogeton |  | Tr. |  |  | 95 |  |  |  |  | 11.8 |

[1] Empty.

TABLE 13.—*Average per cent volume of the principal foods*

| Number of lake | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amphipoda |  |  | 7.2 | 22 | 0.8 |  | 2.4 | 14.3 | 4.0 |  |  | 4.6 |
| Beetle larvæ |  |  |  | 3 | Tr. |  |  | 15.0 | 1.0 | Tr. | 1.1 | 1.8 |
| Bivalves |  | 11 | Tr. |  |  |  |  | 8.1 |  |  | Tr. | 1.6 |
| Chætophora |  |  |  |  | 27.8 |  |  |  |  |  |  | 2.5 |
| Chironomus larvæ | 76 | 63 | 9.0 |  | 23.1 | 34.6 | 1.8 | 25.2 | 6.0 | 16.8 | 52.6 | 28.4 |
| Chironomus pupæ | 4 | 3 | Tr. |  | 1.0 | 26.1 | 10.8 | 2.8 |  | 6.8 | 28.3 | 7.5 |
| Cladocera |  |  | 37.6 |  |  |  | Tr. | 10.7 | 34.4 | 54.6 | Tr. | 12.5 |
| Corixidæ |  |  | Tr. | 1 | 3.4 | 39.0 | 7.7 |  |  | Tr. |  | 4.6 |
| Cyclops viridis |  |  |  |  | 7.0 |  | 1.6 |  | 43.1 | 18 | Tr. | 6.3 |
| Damsel-fly nymphs | 18 | 13 | Tr. |  | Tr. |  | 21.8 |  |  |  |  | 4.8 |
| Mycetobia larvæ | 1 | 1 |  | Tr. |  |  |  |  |  |  | 0.2 | 1.0 |
| Œdogonium |  |  | 15.4 |  | 6.0 |  | Tr. |  |  |  |  | 2.0 |
| Ostracoda |  |  | Tr. |  |  |  |  |  |  |  | 11.0 | 1.0 |
| Potamogeton |  |  | 1.2 |  | 9.3 |  | 28.4 | 6.7 | 2.0 | Tr. | 11.8 | 4.8 |
| Snails |  | 6 | 5.0 |  |  |  |  | 1.8 |  |  |  | 1.0 |

The preceding data show that bullheads have a decided preference for animal food in the form of crustaceans and insect larvæ. Bivalve mollusks and snails are quite common in their diet. Depending on the lake, from 89 to 99 per cent of the food eaten by bullheads in the following lakes was animal: Andes, Madison, Byron, Clear, North Red Iron, Tetonkaha, and Oakwood. Two-thirds of the stomach content of the single specimen from Lake Kampeska was animal. These lakes, except Tetonkaha and Oakwood, were filled with abundant vegetation. This vegetation, however, is the favorite haunt of most of the insects and crustaceans. In these cases, where both plant and animal foods have been available, the bullheads have taken the animal food and rejected the plant material. In the last two lakes both vegetation and the animal life usually supported by it were scarce, and the stomachs of most of the fish were either empty or contained little save bits of hardened mucus. It was found that some specimens had taken large pieces of unaccustomed food, such as parts of cray fish, whole minnows, and pieces of perch that were used as bait.

In only three lakes—Poinsett, Cottonwood, and Sand—had the fish eaten enough plant material to make it an important part of the diet. In Sand Lake 45 per cent of the stomach content was plant; in Cottonwood, 37.1 per cent; and in Poinsett 23.5 per cent. A large part of this plant food was filamentous algæ, Potamogeton, and Ruppia.

## ALTERNATIVE FOODS

If it were not for the fact that the plant tissue was digested, at least partly so, and that there was such a large proportion of it, it might be supposed that the fish had not eaten it for food, but rather by accident when browsing about for larvæ, pupæ, snails, and crustaceans crawling about over the Ruppia and Potamogeton (not many were found on the algæ). The writer is inclined to believe that bullheads do not take food in any such haphazard manner, but that they deliberately select certain foods and reject others. Several years ago, at the writer's home, a number of bullheads were kept in a tank during the summer months. Water plants were growing on the bottom of the tank, and the bullheads were observed to snatch up mouthfuls of the plant material in which water beetles were hiding. Then perhaps the bullheads remained quietly in the same place or swam leisurely away, but after a moment they opened their mouths and the plant material was ejected. Considering these facts, it is difficult to understand why bullheads will take almost anything from a hook that normally they do not include in their diet.

Vegetation was abundant in Lake Poinsett and Sand Lake, which in a sense accounts for such a large percentage of it being consumed by the fish. This does not account for the fact that though much animal life was present in the lake it composed little more than one-half of the food found in the specimens from these lakes. There was very little vegetation in Cottonwood Lake and almost a total absence of crustaceans. As the bullheads consumed a large per cent of plant material, it would appear that they are able to choose this food as an alternative to animal tissue under certain conditions. Insufficient data are at hand, however, to determine exactly what these conditions are, for under similar conditions at Lake Tetonkaha and Lake Oakwood the bullheads were found to have eaten animal food almost exclusively.

## FOOD HABITS

The bullhead is referred to in general as a bottom feeder. It does feed upon many forms of life at the bottom, it is true, but it has also been seen to feed at the surface and at varying depths wherever food is to be had. Food found in both the stomach and the intestines of many specimens were grouped or sorted as to kinds, as though the fish had eaten of one kind for a time and then passed on to another.

There was a greater proportion of vegetable matter in the intestines than in the stomach. Examination of stomach contents revealed the fact that the majority of the fish had taken into the stomach proportionately larger quantities of animal food than plant food. Even granting that the bullheads took equal amounts of plant and animal foods, this would indicate that animal food was digested early, probably in the stomach, and was absorbed rapidly upon reaching the small intestine. Very little food ever was found in the duodenum. It passes through quickly into the lower part of the small intestine.

Quartz sand grains were present often. The question arises whether sand particles are incidental to bottom feeding or are taken for other reasons, such as aiding in digestion; data at hand do not indicate. Some stomachs examined contained snails and bivalves, without sand and others sand and no snails and bivalves.

### RELATION TO SIZE

Schools of fingerlings, usually accompanied by an old bullhead, feed near the surface. At a short distance they resemble a dark shadow on the water. Fourteen specimens, 1¼ inches in length, were taken in a minnow net at North Red Iron Lake the latter part of July. Examination showed that the stomachs of these tiny bullheads contained 42.1 per cent *Cyclops viridis*, 29 per cent young Cladocera, 5.4 per cent Cladocera eggs, and some insect eggs, beetle larvæ, Amphipoda, colonial Protozoa, Trichoptera, and a trace of plant tissue.

Though of the same kinds, the animal forms eaten by these bullheads were younger and much smaller than those eaten by the adult fish. The Cladocera were about one-half the size of those found in the stomachs of the adult fish at Lake Cottonwood, and the *Cyclops viridis* could be seen only under the binocular microscope. Larvæ were those that had not attained full size.

### DEPTH OF WATER

Bullheads are shore fish. Parent bullheads usually are found in shallow, weedy water, and others in deeper water, though, as a general rule, none are far from shore—in other words, not far from the source of their food supply. The greatest depth recorded from which specimens were taken for this study was 12 feet. Other depths ranged from 12 feet at Lake Poinsett to 3 or 4 feet in Cottonwood, 1½ feet in Sand Lake, and 1 foot in Lake Byron.

Cladocera and chironomus larvæ and pupæ were found to have been eaten by fish at all these depths and in nearly all the lakes. Other forms were common in a number of the lakes. Their quantity in the diet of the bullhead apparently did not depend on the depth of the water but upon other factors discussed elsewhere in this paper.

## INFLUENCE OF ENVIRONMENT

In many places bullheads are looked upon as scavengers of unclean food habits. This is mainly because in those localities unclean animal wastes are dumped into the water. As noted in the introduction, Forbes and Richardson (1920) found distillery slops making up a part of the diet of the bullheads they examined from Wisconsin lakes. The type and quantity of the vegetation in the water influence the insect life, the crustaceans, and in like manner the kind of food taken by the fish. Pollutions of the sort just mentioned tend to kill the clear-water vegetation and to drive out the forms of animal life dependent upon it. Under these conditions bullheads have no choice of foods but must take what they can get. This study shows that there is such a slight variation in the environment of the lakes of eastern South Dakota that it does not affect the diet of the bullheads materially.

The evidence gained from the investigations described would indicate that as long as our South Dakota lakes are kept clean (that is, not allowed to become polluted with refuse, sewage, and trade wastes) the bullheads in these lakes will continue to be of the same fine quality enjoyed at present.

## INFLUENCE OF SEASON

The season of the year influences the food available to the bullhead to a marked degree. Nearly all the vegetation in these lakes is of the annual type—that is, it dies in winter. To the present time no study has been made of the food consumed by bullheads in the fall and winter seasons.

The first fish obtained for this study were taken at Lake Andes on June 18, 1926. Besides chironomus larvæ and pupæ, these fish were found to have eaten damsel-fly nymphs, Mycetobia larvæ, and the merest trace of plant material. At this season water plants were just beginning to appear. At Poinsett, 3 weeks later, vegetation was very abundant, and examination of specimens showed that one-fourth of the diet of these fish was composed of plant tissue—Chara, Spirogyra, Ruppia, and Œdogonium. Insects, their larvæ, pupæ, and nymphs, and crustaceans were of greater variety. There were, besides the forms already named for Lake Andes, Amphipoda, both Gammarus and Hyalella, bivalves, Corixidæ, Diptera, dragon flies, Ephemeridæ nymphs, Nais, Ostracoda, Sisyra, snails, and Trichoptera. A small amount of clam flesh had been eaten by one fish, and two other specimens contained a few fish eggs and fish scales. Fish taken from Lake Kampeska on July 7 and from Lake Cottonwood on July 10 and 11 had eaten about the same foods as had those taken earlier in the season, with the addition of the plant form, Chætophora, beetles and beetle larvæ, and *Cyclops viridis*. The last catch of the season was at Lake Oakwood on August 11, 1926. There was little change in the diet of the bullheads in the various lakes during the intervening weeks.

## SUMMARY

The bullhead is of greater economic importance than all other South Dakota fish, both as a domestic food and a commercial product. Efforts should be made, therefore, to provide this fish with the optimum food supply. This can be accomplished to the best advantage only when a full knowledge of the more essential foods has been obtained.

The present paper is based on data secured by the examination of 106 specimens taken from 11 lakes of eastern South Dakota. The facts learned are presented below:

1. Bullheads prefer animal food in the form of insect larvæ, pupæ, and nymphs, crustaceans, bivalve mollusks, and snails, but are able to take other foods in the absence of these.
2. There are strong indications that animal tissue is digested and assimilated more readily by bullheads than plant tissue.
3. Bullheads do not eat the eggs nor the young of other fish, except occasionally in very small amounts.
4. Juvenile bullheads eat virtually the same kinds of food as adults, very small bullheads taking only younger and much smaller animals.
5. The food supply is limited by seasonal conditions.
6. Bullheads select certain foods and reject others.
7. There is insufficient food to support the present number of bullheads, both at Lake Tetonkaha and at Lake Oakwood. Fish here were below normal size, were starving, and should be moved to other waters.[4]
8. Bullheads are now scarce in Lake Andes, where there is abundant food to support this species.
9. Bullheads were found to be eating only clean food in all the lakes.

## BIBLIOGRAPHY

EVERMANN, BARTON WARREN, and H. WALTON CLARK.
1920. Lake Maxinkuckee: A physical and biological survey. Department of Conservation, State of Indiana. Vol. II, pp. 325–330. Indianapolis.

FORBES, STEPHEN ALFRED, and ROBERT EARL RICHARDSON.
1920. The fishes of Illinois. Second edition, pp. 185–192. State of Illinois, Department of Registration and Education, Division of Natural History Survey. Springfield.

OVER, WILLIAM H., and EDWARD P. CHURCHILL.
1927. A preliminary report of a biological survey of the lakes of South Dakota. Series XXVII, No. 6, March, 1927, South Dakota Geological and Natural History Survey. Circular 29, pp. 1–18. Vermilion, S. Dak.

PEARSE, A. S.
1918. The food of the shore fishes of certain Wisconsin lakes. Bulletin, U. S. Bureau of Fisheries, Vol. XXXV, 1915–1916 (1918), pp. 253–254. Bureau of Fisheries Document No. 856. Washington.

TRACEY, HENRY C.
1910. Annotated list of fishes known to inhabit the waters of Rhode Island. Fortieth Annual Report, Commissioners of Inland Fisheries, State of Rhode Island and Providence Plantations, 1910, pp. 35–182. Providence.

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[4] Such a procedure was followed in the case of Lake Alice, mentioned on p. 30. See Seventh Annual Report of the Department of Game and Fish of South Dakota.

# TRADE IN FRESH AND FROZEN FISHERY PRODUCTS AND RELATED MARKETING CONSIDERATIONS IN ATLANTA, GA.[1]

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CONTENTS



## INTRODUCTION

The present survey is the tenth of a series of trade investigations made by the Bureau of Fisheries, the cities previously canvassed being Louisville, Ky.; Pittsburgh, Pa.; Chicago, Ill.; Minneapolis and St. Paul, Minn.; Seattle, Wash.; Boston, Mass.; New York City; St. Louis, Mo.; and Jacksonville, Fla. The following report is based on the fiscal year December 1, 1926, to November 30, 1927 (this will be referred to as the year 1927), for amount of fish handled, and the late fall of 1927 for marketing conditions.

The writer wishes to thank the trade in Atlanta for aid and cooperation given him while the study was being conducted. Thanks are especially due Thomas Anderson, of the Fulton Market Co., for valuable data and suggestions, which have made the work more complete.

Atlanta, known as the "Gate City of the South," has an estimated population of over 325,000.[2] The city is situated in the north-central part of Georgia and is surrounded by 69 towns of over 1,000 population each. Ten trunk-line railroads converge here and offer facilities that make the city one of the important distribution centers of the Southeast. In 1923 there were 993 retail grocery outlets and in 1925 there were 25 wholesale grocery outlets.[3] By passenger train (making no allowance for stop-overs), Atlanta is 9 hours from Jacksonville, 9 hours from Pensacola, 10 hours from Savannah, 21 hours from Norfolk, 24 hours from Baltimore, 28 hours from New York City, 35 hours from Boston, and 33 hours from Chicago.

In the fisheries trade Atlanta might be considered primarily as a consuming center rather than a point for the production, assembling, or distribution of fresh and frozen fishery products. This may be observed by the fact that no productive commercial fishery is to be found near by, and only 8 per cent of the fishery products received during 1927 were reshipped to points outside the metropolitan area.

[1] Appendix III to the Report of the U. S. Commissioner of Fisheries for 1928. B. F. Doc. 1039.
[2] Estimated by Atlanta Chamber of Commerce as of January 1, 1927.
[3] According to the Atlas of Wholesale Grocery Territories, U. S. Department of Commerce.

## FINDINGS

Through this study it has been found that—

1. Atlanta is furnished with fresh and frozen fishery products by 15 States and 1 Canadian Province.
2. Dealers received 5,070,000 pounds of 57 varieties of fresh and frozen fishery products during 1927.
3. Wholesale fishery firms are relatively near terminal team tracks of the various railroads or have spur tracks adjoining their establishments.
4. About 94 per cent of the fresh and frozen fishery products received during 1927 arrived by less-than-carload express.
5. About 90 per cent of the fishery products are received in barrels.
6. Dealers at producing centers compete with dealers in Atlanta in supplying the territory surrounding Atlanta with fresh and frozen fishery products.
7. Dealers distributed fresh and frozen fishery products only to points in Georgia and Alabama, amounting to 387,000 pounds in 1927.
8. Consumption of fresh and frozen fishery products in metropolitan Atlanta during 1927 amounted to 4,683,000 pounds.
9. Fresh and frozen fishery products are marketed by wholesalers in the form in which they are received.
10. The annual per capita consumption of fresh and frozen fish in the round in metropolitan Atlanta amounts to 14 pounds and in the edible portion to 11 pounds.
11. Five species of fish constitute 80 per cent of the retail trade.
12. Fifty-two fishery products constitute 20 per cent of the retail trade.
13. Fresh and frozen fishery products were handled daily by only 12 stores.
14. Fully 50 per cent of the grocery stores handle fresh or frozen fishery products one or more days each week.
15. Retail fish stores cater to both the white and colored populations.
16. Retail fish stores make 69 per cent of the week's sales on Friday and Saturday.
17. Methods of displaying and handling fresh and frozen fishery products in retail grocery stores show little or no improvement over methods usually in vogue in fish stores.
18. Consumers are reluctant to use frozen fishery products when similar varieties are available in the fresh condition.
19. No public cold-storage or freezing facilities are available in the city for fishery products, although three firms operate private cold-storage plants capable of holding about 250,000 pounds of fishery products.

## RECEIPTS AND SOURCES OF SUPPLY OF FISHERY PRODUCTS

Inasmuch as no commercial fishery of any importance is prosecuted at Atlanta or within a radius of several hundred miles, the dealers in Atlanta must depend entirely upon other cities for their supply of fishery products. During 1927 fish dealers there received 5,070,000 pounds of fresh and frozen fishery products from 15 States and 1 Canadian Province, with a wholesale value in Atlanta of about $862,000. Of the amount received, 4,801,000 pounds, or 95 per cent, consisted of salt-water varieties and 269,000 pounds, or 5 per cent, were fresh-water varieties. Florida contributed the largest supply, amounting to 3,073,000 pounds, of which 2,983,000 were salt-water and 90,000 fresh-water varieties. Virginia ranked second and sent 1,152,000 pounds of salt-water products. Alabama was third with 131,000 pounds of salt-water varieties. Maryland was fourth with 114,000 pounds of salt-water varieties. North Carolina was fifth with 86,000 pounds of salt-water varieties. Ten other States and one Canadian Province forwarded 414,000 pounds, consisting of 235,000 pounds of salt-water varieties and 179,000 pounds of fresh-water varieties. Ranked in order of importance, these were Georgia, Illinois, Mississippi, Manitoba, New Jersey, Tennessee, Massachusetts, Ohio, New York, Pennsylvania, and Louisiana.

TABLE 1.—*Fresh and frozen fishery products received in Atlanta during 1927*

| Where produced | Pounds | Per cent of total | Where produced | Pounds | Per cent of total |
|---|---|---|---|---|---|
| Florida | 3,073,000 | 61 | Illinois | 69,000 | 1 |
| Virginia | 1,252,000 | 25 | Mississippi | 59,000 | 1 |
| Alabama | 131,000 | 3 | Manitoba, Canada | 55,000 | 1 |
| Maryland | 114,000 | 2 | All other States | [1] 157,000 | 3 |
| North Carolina | 86,000 | 2 | | | |
| Georgia | 74,000 | 1 | Total | 5,070,000 | 100 |

[1] Includes products produced in the following States, named in order of importance: New Jersey, Tennessee, Massachusetts, Ohio, New York, Pennsylvania, and Louisiana.

In Tables 2, 3, and 4, the sources of supply of the various fishery products received in Atlanta are shown. In most cases where the same product is produced in more than one State, dealers in Atlanta usually derive their supply from the nearest State. Oysters are the exception. As a rule, these are sent by more remote producing localities in the North Atlantic States, while at the same time oysters of good quality and grade are produced in the South Atlantic and Gulf States. In fact, Georgia produces oysters, although at the present time it is believed production is not sufficient to supply the demand. However, introduction of southern oysters into southern markets should lead ultimately to the development of southern oyster beds and increased production.

## RECEIVING POINTS AND METHODS OF TRANSPORTATION

Fish are transported to Atlanta by express and freight. During 1927, 4,760,000 pounds, or 94 per cent of the amount received, was carried by express and 310,000 pounds, or 6 per cent, by freight. This would indicate that most of the shipments are made in less-than-carload lots, as in most cases express shipments are of that nature.

*Express shipments.*—Express shipments are carried by the American Railway Express Co. and the Southeastern Express Co. Those for Atlanta are loaded and unloaded at the express terminals of these companies at the terminal station, about ½ mile from the majority of the wholesale houses. Less-than-carload express shipments are carted between terminals and establishments, free of charge, by express companies. Carload express shipments are carted at the expense of receivers or shippers, unless the shipment is made at the less-than-carload tariff express rate.

It is understood that various firms in Atlanta and other near-by southern cities receive weekly shipments from Boston by less-than-carload express, and that express companies have found that trade to be of sufficient magnitude to warrant devoting an entire car to the business. However, individual consignees are charged the less-than-carload tariff rate, while express companies make the shipments in carlots. It is interesting to note that forwarding firms have representatives in Boston and New York City that make a business of assembling less-than-carload shipments of fishery products destined for the same general locality and forwarding in carload lots at the corresponding lower transportation tariff rate. Southern dealers who receive less-than-carlot shipments from Boston and New York City might find it to their advantage possibly to pool their shipments into carlots. Car-opening privileges en route make this method of shipping especially desirable.

*Freight shipments.*—Freight shipments may be received over five main routes. The terminal team tracks of these routes are from within one-fourth mile to 1 mile of the majority of the wholesale houses. Three wholesale firms have spur tracks beside their establishments, and carload shipments may be handled directly between freight cars and their shipping rooms. Cartage service between terminal team tracks and fish dealers' stores is performed by shippers or receivers when necessary.

Several dealers in Atlanta are making use of a combination water and rail route from points of production in an effort to reduce transportation costs. By this method products from Boston are transported by boat to Norfolk, Va. Here they are combined with products from Norfolk and forwarded in carlots to Atlanta, where the car is partly or entirely unloaded. If partly unloaded, the rest of the shipment is sent to points farther south or west.

## DISTRIBUTION

During 1927 fish dealers in Atlanta distributed 387,000 pounds, or about 8 per cent of the fishery products that they received. Of this amount, 202,000 pounds was sent to the district within 25 miles of Atlanta, 145,000 pounds to more remote sections of Georgia, and 40,000 pounds to Alabama. All were forwarded by less-than-carload express. Products reshipped consisted mainly of mullet, croaker, sea trout, and Spanish mackerel.

From this it is seen that while Atlanta is considered one of the important distribution centers in the South for various forms of merchandise, fish dealers distribute but a small amount of fishery products outside of the city limits. This condition did not always exist, for in former years dealers in Atlanta distributed large quantities of fish over a wide area. At that time producers were not prone to ship their products in small lots to inland dealers. However, with speedier and more regular transportation service between producing centers and consuming localities, producers in the South Atlantic and Gulf States especially have begun to act as their own distributors and forward in lots as small as 15 pounds to inland points. In this way the producer is able to trade direct with the retailer or consumer, and the differential in costs to the trade makes it attractive. In some instances producers will deal with both wholesalers and retailers in the same city.

## WHOLESALE TRADE

In 1927 there were five wholesale establishments engaged in handling fresh and frozen fishery products in Atlanta. Some of these firms handle only fish, while others are operated in connection with wholesale fruit and vegetable commission houses. The total investment in buildings and accessories of the wholesale firms was $108,000, and their cash working capital amounted to $28,000. There were 39 persons engaged in the trade, receiving $44,000 in wages.

The wholesale fisheries trade is conducted in the downtown section of the city, in the vicinity of the Union Depot. Several of the firms have spur tracks beside their establishments. These connect with the main-line railroads. As a rule, rooms of the establishments in which fish are handled have cement floors. Compartments refrigerated with ice or mechanical cold-storage facilities are provided for holding fish.

In most cases the products are marketed in the form in which received, and therefore the quarters required for packing, grading, or cleaning are not large. Trading is done mainly with hotels, restaurants, and retail stores in the city and near-by suburbs.

Usually fish are purchased outright by wholesalers, although in some instances they are handled on consignment. In some cases producers ship the same varieties of fish to two dealers in Atlanta at the same time, and one of the wholesalers will handle the products on consignment while the other will buy outright. In instances of this kind the dealers who buy outright sometimes are unable to dispose of their product at a reasonable profit, for the reason that the dealer who handles fish on consignment will undersell him.

Local sales are made by telephone, canvassing, or by purchasers calling at the wholesale establishments. Out-of-town sales are made through letter or telegram. City sales are packed in containers of various descriptions or wrapped in paper. These are delivered free by motor truck within the metropolitan area. Out-of-town sales are made f. o. b. Atlanta. They are shipped in boxes and barrels of various sizes and are refrigerated with ice. Usually the boxes are those that have been used previously for holding other merchandise.

## COLD-STORAGE FACILITIES

Atlanta has no public facilities for freezing or storing fishery products. However, two wholesale firms have such facilities on their premises for private use, and another has facilities at a local cold-storage warehouse. The combined storage capacity of these three plants is about 250,000 pounds. A comparatively small amount of fishery products is frozen in Atlanta, as cold-storage stocks usually are received frozen. Stocks in cold storage consist largely of mullet, croaker, Spanish mackerel, and sea trout. Other species of fish sold in a frozen condition are listed in Tables 2, 3, and 4.

That Atlanta consumers prefer fresh fishery products is borne out by the fact that more extensive facilities are not available for freezing and storing fishery products. It is the general opinion among dealers that the trade will accept the frozen stock only when fresh fish are not available; and even then there appears to be a reluctance to accept frozen fish if a suitable fresh substitute is available. Educating consumers to the merits of properly frozen fish may increase the sales of the frozen product. Handling frozen fish also may tend to stabilize the trade, as it has done in various other cities.

## FORM IN WHICH FISH ARE RECEIVED AND MARKETED

The form in which the various fishery products are received in Atlanta is shown in Tables 2, 3, and 4. The majority of the fish are received in the round, exceptions being dressed red snapper, sea trout, snook, sheepshead, catfish, grouper, salmon, halibut, bluefish, and fillets of haddock. Products are marketed by wholesalers in the form in which received. Some retailers make a practice of cutting various fish into fillets and steaks or pan-dressed fish. No fish are wrapped preparatory to retail sale, except fillets of haddock and pan-dressed sea trout. These two fish are gaining in popularity in Atlanta, which may be attributed to their being prepared and wrapped ready for retail sale. It is possible that other varieties, perhaps some that are now of limited importance, would find a more general sale if prepared and packaged.

## CONTAINERS

It is estimated that over 90 per cent of the fishery products received in Atlanta are shipped in sugar, flour, or apple barrels. In some cases the barrel used was new, but generally it had been used previously in shipping some other product. Round or dressed fish from the North or South Atlantic and the Gulf coast points arrive in barrels containing a net weight of about 200 pounds of fish; while shipments of round or dressed fish from the Great Lakes district and the North Pacific arrive in boxes that contain a net weight of 100, 150, 200, or 350 pounds of fish. Boxes originating in the Great Lakes district usually are provided with handles that extend from each end of the box, which facilitates handling en route. Smelt from the North Atlantic are received in boxes holding 10, 15, or 25 pounds. Green shrimp are received in barrels with a net weight of about 125 pounds, and spiny lobsters come in barrels with a net weight of about 150 pounds. All shipments of fresh fish in boxes or barrels are refrigerated with crushed ice, except carload shipments of frozen fish in boxes, which obtain refrigeration from the cold in the fish and refrigerants in the car. Boxes containing frozen shipments usually are lined with heavy brown paper for insulation. For additional insulation, the fish in these shipments sometimes are wrapped individually in heavy brown paper.

Fillets of haddock and dressed sea trout that have been wrapped individually for protection are packed in tin cans holding a net weight of 20 pounds. The tins of haddock fillets arrive in boxes holding 1, 2, or 3 of the tins, while the tins of wrapped dressed sea trout usually are received in boxes and barrels holding a varying number of tins. Shipments of prepared fish are refrigerated with crushed ice.

Shucked oysters are packed in tin cans holding 1 pint, 1 quart, or 1 gallon. These cans are received in barrels holding from 8 to 20 of the 1-gallon cans. Scallop meats are packed in tin cans holding 5 gallons, cooked shrimp in tin cans holding 5 pounds, and crab meat in tin cans holding 1 and 5 pounds. These tins in turn are received in boxes and barrels of various sizes, which have been refrigerated with crushed ice.

Live soft crabs are received in the Chesapeake crab trunk, which holds a varying number of crabs, depending upon their size. The crabs are evenly imbedded in moist sea grass, which covers the trays in the trunk, and are refrigerated with a small amount of finely crushed ice. Live hard crabs are received in boxes with a net content of about 50 pounds. They may or may not be refrigerated with ice. Usually moist sea grass is found in the top of each box.

Clams in the shell are received in sacks holding a net weight of about 90 pounds, boxes holding a net weight of 180 pounds, and barrels holding a net weight of 270 pounds. Sometimes they are refrigerated with large cubes of ice. Turtle meat is received packed loose in boxes holding a net weight of about 50 pounds. These shipments are refrigerated with crushed ice.

Outgoing shipments usually are sent in the container in which they arrived in Atlanta. Small shipments are made in boxes of no standard dimension, the boxes used usually being those that have already served their purpose for shipping other forms of merchandise.

## RETAIL TRADE

During 1927 Atlanta retail fish dealers handled 4,683,000 pounds of 57 varieties of fresh and frozen fishery products. These consisted of 4,427,000 pounds of salt-water varieties and 256,000 pounds of fresh-water varieties. The majority of these products were purchased from local wholesale dealers, although some retailers purchased direct from producers.

*Important commercial products.*—Five species of fish, amounting to 4,063,000 pounds, are considered as the important commercial fish in this city and constitute approximately 80 per cent of the retail trade. Florida and Virginia supply the majority of these fish. All were received in 200-pound barrels, except headless and viscerated sea trout, which at times were received in 20-pound tins.

The large consumption of mullet and croaker in the city is due mainly to their being used by the colored trade. These varieties of fish are comparatively inexpensive. The other three species of fish in the important commercial group are considered to be of good quality, and although somewhat higher in price than mullet or croaker find a ready sale, especially with the white residents. The fish in this group are fairly abundant.

TABLE 2.—*Fishery products upon which approximately 80 per cent of the trade is based* [1]

| Rank | Product | Sources of supply [2] | Form in which received | Fresh or frozen | Reasons for sale |
|---|---|---|---|---|---|
| 1 | Mullet | Florida, Alabama, Mississippi, North Carolina, and Georgia. | Round | Fresh; frozen. | Inexpensive; used largely by colored trade. |
| 2 | Croaker | Virginia, North Carolina, Maryland, and Georgia. | do | do | Do. |
| 3 | Red snapper | Florida, Georgia, Mississippi, and Alabama. | Round; headless and viscerated. | Fresh | Good quality. |
| 4 | Trout, sea | Florida, Virginia, North Carolina, Mississippi, Georgia, and Alabama. | Viscerated; headless and viscerated. | do | Good quality; also because it is pan dressed and individually wrapped in some cases. |
| 5 | Spanish mackerel. | Florida, Virginia, North Carolina, and Georgia. | Viscerated | do | Good quality. |

[1] Tables 2, 3, and 4 are to be considered together as regards the relative rank of importance of the products as a whole.
[2] Listed in order of importance.
NOTE.—The above fish are received in 200-pound barrels, and in addition, sea trout that has been dressed is received in 20-pound tins.

TABLE 3.—*Fishery products upon which approximately 15 per cent of the trade is based* [1]

| Rank | Product | Sources of supply [2] | Form in which received | Fresh or frozen | Usual containers | Reason for moderate sale |
|---|---|---|---|---|---|---|
| 6 | Oysters | Virginia, Maryland, New Jersey, Florida, Georgia, Mississippi, New York, Alabama, and North Carolina. | Shucked | Fresh | 1 pint, 1 quart, and 1 gallon cans. | Seasonal variety. |
| 7 | Spot | Florida, Virginia, and North Carolina | Round | do | 200-pound barrels | Do. |
| 8 | Suckers | Canada, Tennessee,[3] Illinois, and Ohio | do | Frozen | 100 and 150 pound boxes. | Substitute for mullet. |
| 9 | Snook | Florida and Mississippi | Round, viscerated | Fresh | 200-pound barrels | Too perishable (inexpensive). |
| 10 | Sheepshead, salt-water. | do | do | do | do | Not attractive in round. |
| 11 | Shrimp | Georgia, Florida, Mississippi, and Alabama. | Cooked | do | 5-pound cans | Relatively high priced. |
| 12 | Catfish | Florida and Mississippi | Viscerated and skinned | do | 200-pound barrels | Not well known. |
| 13 | Haddock | Virginia,[4] Massachusetts, and Maryland [4] | Fillets | do | 20-pound tins | Not well known (gaining favor). |
| 14 | Pompano | Florida and Georgia | Round | Fresh; frozen | 200-pound barrels | Limited supply, relatively high priced. |
| 15 | Grouper | Florida | Viscerated | Fresh | do | Unpopular (inexpensive). |
| 16 | Pike, yellow | Ohio and Illinois [5] | Round | Fresh; frozen | 100 and 150 pound boxes. | Substitute for southern varieties. |
| 17 | Pike, blue | Tennessee,[5] Ohio, and Illinois [5] | do | do | do | Do. |
| 18 | Drum, red | Florida | do | Fresh | 200-pound barrels | Too much waste. |
| 19 | Flounder | Massachusetts, New York, Florida, and Virginia. | do | do | do | Not well known. |
| 20 | Snapper, mangrove | Florida | do | do | do | Substitute for popular varieties. |

[1] Tables 2, 3, and 4 are to be considered together as regards the relative rank of importance of the products as a whole.
[2] Listed in order of importance.
[3] Originated in Canada.
[4] Originated in Massachusetts.
[5] Originated in Ohio.

TABLE 4.—*Fishery products upon which approximately 5 per cent of the trade is based* [1]

| Rank | Product | Sources of supply [2] | Form in which received | Fresh or frozen | Usual containers | Reasons for limited sale |
|---|---|---|---|---|---|---|
| 21 | Bream, fresh-water | Florida | Round | Fresh | 200-pound barrels | Small size. |
| 22 | Halibut | Illinois [3] and Ohio [3] | Headless and viscerated | Fresh; frozen | 200 and 350 pound boxes | Used mainly by hotels and restaurants. |
| 23 | King whiting | Florida | Round | Fresh | 200-pound barrels | Considered a coarse fish. |
| 24 | Cisco | Illinois [4] and Tennessee [4] | do | Fresh; frozen | 100-pound boxes | Substitute for southern varieties. |
| 25 | Crappie | Florida and Georgia | do | Fresh | 200-pound barrels | Small size. |
| 26 | Bream, salt-water | do | do | do | do | Small size (inexpensive). |
| 27 | Bass, black | do | do | do | do | Used mainly by hotels and restaurants. |
| 28 | Perch, white | Illinois | do | do | do | Substitute for southern varieties. |
| 29 | Shad | Florida, Georgia, Virginia, and Maryland. | do | do | do | Seasonal variety, relatively high priced. |
| 30 | Carp | Illinois, Ohio, and North Carolina | do | do | 200-pound barrels; 100-pound boxes. | Used mainly by Hebrew trade. |
| 31 | Crevalle | Florida | do | do | 200-pound barrels | Considered a coarse fish. |
| 32 | Whitefish | Illinois, Ohio, Pennyslvania, and Tennessee.[4] | Round, viscerated | Fresh; frozen | 100-pound boxes | Relatively high priced; substitute for southern varieties. |
| 33 | Hickory shad | Georgia and Florida | Round | Fresh | 200-pound barrels | Considered a coarse fish. |
| 34 | Trout, lake | Illinois and Tennessee [4] | do | Fresh; frozen | 100-pound boxes | Substitute for southern varieties. |
| 35 | Shrimp | Georgia | Headless, green | Fresh | 125-pound barrels | Prefer cooked product. |
| 36 | Crabs, soft | North Carolina and Maryland | Round (alive) | do | Crab trunk | Poor shipper, relatively high priced. |
| 37 | Cod | Massachusetts | Round | do | 200-pound barrels | Substitute for southern varities. |
| 38 | Frogs | Louisiana | Headless and viscerated | Fresh; frozen | do | Used mainly by hotels and restaurants. |
| 39 | Salmon | Illinois [3] and Ohio [3] | do | do | 200-pound boxes | Do. |
| 40 | Angelfish | Florida | Round | Fresh | 200-pound barrels | Considered a coarse fish; small size. |
| 41 | Smelt | New York and Massachusetts | do | Frozen | 10, 15, and 25 pound boxes. | Seasonal variety. |
| 42 | Clams | North Carolina, Maryland, and New York. | In shell | Fresh | 270-pound barrels; 180-pound boxes; 90-pound sacks. | Used mainly by hotels and restaurants. |
| 43 | Crabs, hard | Florida, Mississippi, and Georgia | Round (cooked) | Fresh (cooked) | 60-pound boxes | Poor keepers. |
| 44 | Scallops | Florida, Virginia, and Maryland | Shucked | Fresh | 5-gallon cans | Used mainly by hotels and restaurants; relatively high priced. |
| 45 | Blue runner | Florida | Round | do | 200-pound barrels | Considered a coarse fish. |
| 46 | King mackerel | do | do | do | do | Relatively high priced. |
| 47 | Perch, yellow | Illinois and Ohio | do | do | 100-pound boxes | Substitute for southern varieties. |
| 48 | Crab meat | Georgia and North Carolina | Meat | do | 1 and 5 pound cans | Used mainly by hotels and restaurants. |
| 49 | Spiny lobster | Florida | Round; some alive | do | 150-pound barrels | Seasonal variety; relatively high priced. |
| 50 | Bluefish | do | Viscerated | do | 200-pound barrels | Do. |
| 51 | Butterfish | North Carolina | Round | do | do | Substitute for southern varieties. |
| 52 | Drum, black | Florida | do | do | do | Considered a coarse fish. |
| 53 | Herring, sea | North Carolina | do | do | do | Not well known. |
| 54 | Herring, lake | Illinois | do | Fresh; frozen | 100-pound boxes | Substitute for southern varieties. |
| 55 | Moonfish | Florida | do | Fresh | 200-pound barrels | Considered a coarse fish. |
| 56 | Sailors choice | do | do | do | do | Seasonal variety; considered a coarse fish. |
| 57 | Turtles | do | Meat | do | 50-pound boxes | Used mainly by hotels and restaurants. |

[1] Tables 2, 3, and 4 are to be considered together as regards the relative rank of importance of the products as a whole.
[2] Listed in order of importance. [3] Originated at Seattle, Wash. [4] Originated in Ohio.

*Moderately important commercial products.*—In this group are 15 products, amounting to 754,000 pounds. They constitute 15 per cent of the retail trade. Table 3 shows that some of the products in this group are used mainly as substitutes for southern varieties. At periods during the year southern fish are not available in sufficient quantities to supply demands, and therefore other sources must be drawn upon and the fish substituted for the regular varieties. Usually the substitute is some species of fresh-water fish. Several other varieties are of moderate importance for the reason that they are not well known. It is believed that some of these and several others of this group will gain favor in time and may be expected to rank among the commercially important products. The products of this entire group as a rule are fairly abundant.

*Slightly important commercial products.*—Limited quantities of 37 fishery products, amounting to 253,000 pounds, constitute about 5 per cent of the retail trade in Atlanta. Reference to Table 4 reveals that these products have a slight sale in Atlanta for the reason that they are relatively too high priced for the trade, are considered coarse fish, are used mainly by hotels or restaurants or are used as substitutes for more popular and plentiful products. Preparing and packaging some products considered coarse or of too small size may lead to increased sale of these products.

## RETAIL FISH STORES

During this survey 12 stores were engaged in handling fishery products daily. In no case were these stores operated strictly for the marketing of fish, as other products, such as poultry, meats, fruits, vegetables, and groceries, also were handled.

*Window display.*—Seven of these stores had window displays of fish, of which two were inclosed. Four stores used raised-edge metal pans for holding fish displayed in windows, two used sunken tile, and one hung the fish from a string extending across the window space. Fruit, vegetables, groceries and other merchandise were usually displayed along with the fishery products.

*Inside display.*—Nine stores used a metal-lined wooden case for displaying fishery products, two firms used a metal-lined composition-marble case with nickel trimmings, and one used a raised-edge metal-covered table. Products were displayed on crushed ice, which was heaped to the top of the case or on the table. Displays were covered all the time in two stores, only part of the time in two more and at no time in eight others. Prepared products were displayed by eight stores in porcelain pans, which were placed on the ice in the display cases. Shucked oysters were held in earthen or glass jars, which were sunk neck deep in the crushed ice. Case displays occupied space in the storeroom equal to about one-fifth to one-half of the floor space, and were arranged at various places in the store room. The floors of eight of these stores were of tile or concrete and those of four were of wood. Ten stores used ice chests in which to hold reserve stock, and two had no provision for reserve stock. In addition to ice chests, two firms had insulated cold rooms for holding reserve stocks.

*Wrapping paper.*—Standard white or brown paper was used by five retail fish stores for wrapping all packages of fish. Seven used first a wrapper of white or brown paper and then an outside wrapper of newspaper. Newspaper tends to impart an inky flavor or odor to fish, thus the prevalence of using standard paper for the first wrapper. In wrapping retail purchases, some retailers place a few lumps of ice in the package for refrigeration en route to the home.

*Payment for retail sales, delivery, and advertising.*—Retail sales were made for cash only in four stores; the other eight stores, in addition to selling for cash, intimated that credit was extended to regular customers. Delivery of retail purchases was made by four stores. Advertising was done by three stores, of which one used the daily papers about three times weekly and two used circulars distributed in the neighborhood.

*Class of trade and location of retail fish stores.*—Nine retailers stated that their trade was about equally divided between the white and colored races, and three stated that 75 per cent or more was with the white population. Eight of the retail stores were located in the downtown business section and four in outlying areas.

*Sanitary conditions.*—Sanitary conditions of the stores were noted as follows: First, excellent; second, good; third, fair; fourth, poor; fifth, very poor. According to the rating, the sanitary condition of four was excellent, three were good, four were fair, and one was poor.

*Trade during the week.*—Inquiry was made as to trade during the week, and the retailer was asked to state the percentage of each week's business done on each of the six working days of the week. From the study it was found that on the average the sales on Monday were 7 per cent; Tuesday, 7 per cent; Wednesday, 8 per cent; Thursday, 9 per cent; Friday, 30 per cent; and Saturday, 39 per cent of the total week's trade. As in most cities surveyed, the bulk of the trade in the retail fish stores in Atlanta is done on Friday and Saturday. Sales on Saturday are greater in Atlanta for the reason that the majority of the negro population is paid on that day.

## GROCERY STORES

One of the most striking features revealed by the survey of the fish trade in Atlanta was that a large number of retail grocery stores make a practice of marketing fish. While no extended survey was made of these outlets for fishery products, it is believed that fully 50 per cent of the grocery stores carry fish on one or more days each week. This may account for the small number of retail fish stores that sell fish daily.

Fishery products marketed in grocery stores usually are displayed in a metal tub or raised-edge metal pan. These are filled with crushed ice. Other receptacles are provided for catching the water from the melting ice.

Usually a sufficient quantity of fish is obtained for only one day's sales and generally amounts to only about 75 pounds. It is the opinion that most grocery stores carry fish only as a convenience to customers, which is corroborated somewhat by the fact that the average margin of profit to the grocer is only about 3 cents per pound. In a large measure this may be due to the types of products handled and the method of display. Few grocers appear to be acquainted with the proper methods for displaying and handling fishery products. Facilities are such that only round or dressed fresh fish can be handled, and these products require almost immediate disposal. Thus, the goods remaining unsold near the close of the day's business are marketed at little or no profit, rather than that the expense of holding them over night be incurred. However, some dealers will hold fish from day to day, usually under adverse conditions, and fish so marketed are not always of the best quality. Marketing fish of inferior quality will not create a demand for fish, nor will it increase their consumption.

The more or less unsightly method of marketing fishery products practiced in the past should not be introduced into grocery stores. Methods should be found to market fish in the most sanitary and attractive manner possible with a perishable article. Unless this be done, consumers will still be of the impression that fish are being handled by antiquated methods, the only change being that the generally unsightly fish market has moved into the grocery store. While the writer believes that grocery stores in the future will become one of the main outlets for fish, he also believes that the grocery trade generally is not making an attempt to improve handling methods. This may be due in part to wholesalers who, as a rule, have not as yet sensed the responsibility that rests upon them in respect to improvements in this class of marketing.

Selling fishery products as a side line should not be encouraged; and until fish is considered a staple article for marketing in grocery stores, it follows that little profit will accrue from their sales in such stores. Wholesalers marketing fish to retailers should inquire as to the manner in which they will be displayed and as to the facilities for holding the surplus supply. In the absence of proper equipment in retail stores for carrying on this trade, wholesalers should offer such aid as will insure the product being handled in the most sanitary and attractive manner.

## ANNUAL PER CAPITA CONSUMPTION

The metropolitan area of Atlanta has been estimated, by the Atlanta Chamber of Commerce, to have had a population of 325,000 as of January 1, 1927. The metropolitan area includes (besides the city of Atlanta) the suburbs of Decatur, East Point, Marietta, College Park, and Hapeville. Approximately 70 per cent of the population is white and 30 per cent colored.

During 1927, 4,683,000 pounds of fresh and frozen fishery products in the round were consumed in the metropolitan area of Atlanta. On the basis of a population of 325,000, the per capita consumption is about 14 pounds annually. Considering only the edible portion (amounting to 3,562,000 pounds), the per capita consumption is 11 pounds annually. This compares favorably with that for the entire United States, which averages about 15 pounds annually for all forms of fresh, frozen, cured, or canned fishery products.

TABLE 5.—*Summary of Atlanta market survey*

| Item | Number |
|---|---|
| Wholesale fish dealers | 5 |
| Retail fish dealers handling fish 6 days a week | 12 |
| Products handled | 57 |
| Commercially important products (80 per cent) | 5 |
| Amount pounds | 4, 063, 000 |
| Moderately important products (15 per cent) | 15 |
| Amount pounds | 754, 000 |
| Slightly important products (5 per cent) | 37 |
| Amount pounds | 253, 000 |
| Reason for limited sale— | |
| Used mainly by hotels and restaurants | 8 |
| Considered coarse | 8 |
| Substitute for southern varieties | 8 |
| Relatively high priced | 7 |
| Seasonal variety | 5 |
| Small size | 4 |
| Used mainly by Hebrew trade | 1 |
| Prefer product cooked | 1 |
| Poor shipper | 1 |
| Poor keeper | 1 |
| Not well known | 1 |
| Principal containers: | |
| Boxes with a capacity of pounds | 100–150–200–350 |
| Barrels with a capacity of do | 125–150–200 |
| Quantity of products handled by wholesalers in 1927 do | 5, 070, 000 |
| Quantity shipped to other States (8 per cent) do | 387, 000 |
| Quantity handled by retailers (consumed in Atlanta) do | 4, 683, 000 |
| Quantity consumed in Atlanta, reduced to the edible portion do | 3, 562, 000 |
| Estimated population of Atlanta, 1927 | 325, 000 |
| Per capita consumption of fresh and frozen fishery products, 1927 (edible portion) pounds | 11 |
| Per capita consumption of fresh and frozen fishery products, 1927 (in the round) do | 14 |

## ORDINANCES GOVERNING THE HANDLING AND SALE OF FISH

The handling and sale of fish in Atlanta is subject to regulation by certain ordinances, as stated in the Charter and Ordinances of the City of Atlanta, Code of 1924.

Section 2119 states, in substance, that it shall be unlawful to peddle or offer for sale upon the streets of the city, or from house to house, at retail, fresh meat of any kind (fish) from wagons or baskets or otherwise.

Section 1404 states, in substance, that it shall be unlawful for any person, firm, or corporation to display or offer for sale any meat, fish, pickles, dates, prunes, figs, or fruits (such as are not washed or peeled before eating), or other article of food that would collect dust and dirt, making same unfit for food, on the sidewalk of any building or place of business.

Section 1417 states, in substance, no license shall be issued to any person, firm, or corporation for the purpose of conducting a fish stand or meat market, where such stand or market is constructed so as to front or open or abut on the sidewalk where sales are made to customers standing upon the sidewalk.

Section 1408 provides for the screening of fish markets to prevent the ingress and egress of flies or other insects. As an alternate, certain prescribed fans may be used for warding off flies.

Section 2131 states, in substance, that restaurants or other eating places along the edge of sidewalks or on sidewalks or on the streets, in which fish or other articles of food are cooked and offered for sale, must be screened so that flies or other insects do not have access to the food products while the latter are being cooked or offered for sale.

Section 1395 states, in substance, that sanitary inspectors of the city shall condemn all unsound, tainted, offensive, or unwholesome fish or other articles of food kept or stored in any box or refrigerator, held or offered for sale at any market in the city, or offered for sale from any car on any railroad track in the city. Goods condemned by the sanitary inspectors must be removed from the city as garbage. (Owners of fish that have been condemned are given a receipt showing that the fish were condemned.)

Section 1420 states, in substance, that it shall be unlawful for any person, firm, or corporation, their agents or employees, to sell or offer for sale shell or shucked oysters to which more than 10 per cent water has been added either directly or in the form of melted ice.

Section 918 states, in substance, that it shall be unlawful for any butcher, grocer, or dealer in fresh meats, vegetables, fish, oysters, fruits, or melons to keep open doors in said city on the Sabbath day or send out that day to his customers any such goods previously sold.

Section 893 states, in substance, that it shall not be unlawful to deliver to hotels and restaurants on Sunday perishable meats, fish, and oysters within the limits of the City of Atlanta.

## COMMON AND SCIENTIFIC NAMES OF FISHERY PRODUCTS HANDLED

The following is a list of the common and scientific names of fishery products handled by the wholesale and retail trade in Atlanta to which reference is made in this report:

| Common name | Other common names | Scientific name |
|---|---|---|
| Angelfish | Spadefish | *Chætodipterus faber.* |
| Bass, black | Trout | Micropterus sp. |
| Bluefish | | *Pomatomus saltatrix.* |
| Blue runner | Hardtail | *Caranx chrysos.* |
| Bream, fresh-water | | Centrarchidæ sp. |
| Bream, salt-water | Sand bream, red bream | *Lagodon rhomboides.* |
| Butterfish | | *Poronotus triacanthus.* |
| Carp | | *Cyprinus carpio.* |
| Catfish | Bullhead | Ameiurus sp., Ictalurus sp. |
| Cisco (Lake Erie) | | Leucichthys sp. |
| Cod | | *Gadus callarias.* |
| Crappie | | Pomoxis sp. |
| Crevalle | | Caranx sp. |
| Croaker | Hardhead | *Micropogon undulatus.* |
| Drum, black | | *Pogonias cromis.* |
| Drum, red | Red bass, spot bass | *Sciænops ocellatus.* |
| Flounders | | Pleuronectidæ sp. |
| Grouper | | *Epinephelus mycteroperca.* |
| Haddock | | *Melanogrammus æglifinus.* |
| Halibut | | *Hippoglossus hippoglossus.* |
| Herring, lake | | Leucichthys sp. |
| Herring, sea | | *Clupea harengus.* |
| Hickory shad | | *Pomolobus mediocris.* |
| King mackerel | Cero, kingfish | *Scomberomorus regalis.*<br>*Scomberomorus cavalla.* |
| King whiting | Whiting | Menticirrhus sp. |
| Moonfish | | *Vomer setipinnis.*<br>*Selene vomer.* |
| Mullet | | *Mugil cephalus.*<br>*Mugil curema.* |
| Perch, white | | *Morone americana.* |
| Perch, yellow | | *Perca flavescens.* |
| Pike, blue | | *Stizostedion glaucum.* |
| Pike, yellow | | *Stizostedion vitreum.* |
| Pompano | | *Trachinotus carolinus.* |
| Sailor's choice | | Various sp. |
| Salmon | | Oncorhynchus sp. |
| Shad | | *Alosa sapidissima.* |
| Sheepshead, salt-water | White perch | *Archosargus probatocephalus* |
| Smelt | | Osmerus sp. |
| Snapper, mangrove | "Mango" | *Lutianus griseus.* |
| Snapper, red | | *Lutianus blackfordi.* |
| Snook | Sergeantfish | *Centropomus undecimalus.* |
| Spanish mackerel | | *Scomberomorus maculatus.* |
| Spot | | *Leiostomus xanthurus.* |

| Common name | Other common names | Scientific name |
|---|---|---|
| Suckers | Fresh-water mullet | Catostomidæ sp. |
| Trout, lake | | *Cristivomer namaycush.* |
| Trout, sea | Spotted trout | *Cynoscion nebulosus, Cynoscion regalis, Cynoscion nothus.* |
| Whitefish | | *Coregonus clupeaformis.* |
| Clams | Hard clams, soft clams | *Venus mercenaria.* *Mya arenaria.* |
| Crabs | Hard crabs, soft crabs, crab meat, stone crab. | *Callinectes sapidus,* *Menippe mercenaria.* |
| Frogs | | Rana sp. |
| Oysters | | *Ostrea elongata.* |
| Scallops | Bay scallops, sea scallops | *Pecten irridians,* *Pecten majellanicus.* |
| Shrimp | | *Penus setiferus.* |
| Spiny lobster | Crawfish | *Panulirus argus.* |
| Turtles | Green turtle, loggerhead | *Chelonia mydas,* *Thalassochelys caretta.* |

TABLE 6.—*Directory of sea-food dealers in Atlanta, Ga., 1927*

[W=wholesale; B=broker; R=retailer]

| Dealers | Symbols | Products handled: Fish | Oysters | Other shell-fish | Poultry | Meats | Fruits and vegetables | Groceries |
|---|---|---|---|---|---|---|---|---|
| Bradshaw Fish Co., 843 Gordon St | R | x | x | x | x | ---- | x | ---- |
| Bradshaw Fish Co., 1019 Peachtree St | R | x | x | x | x | x | x | ---- |
| Central Market,[1] 16 North Broad St | R | x | x | x | x | x | x | ---- |
| Capital Market, 306 Capitol Ave | R | x | x | ---- | ---- | x | ---- | x |
| Fugazzi, A. & Co., 7 Produce Row | W | x | x | ---- | ---- | ---- | x | ---- |
| Fulton Market Co.,[2] 27 East Alabama St | WR | x | x | x | x | x | x | ---- |
| Green & Milam, 1 Produce Row | W | x | x | ---- | ---- | ---- | x | ---- |
| Hensen & Freeland, 137 Central Ave | W | x | x | x | ---- | ---- | ---- | ---- |
| James, George C., 418 Healy Bldg | B | x | x | x | ---- | ---- | ---- | ---- |
| Kistner Market, 29 South Broad St | R | x | x | x | x | x | ---- | x |
| Lanford, J. M., 118 South Forsyth St | R | x | x | x | ---- | x | ---- | x |
| Manos Market, 20 North Broad St | R | x | x | x | x | x | x | ---- |
| National Seafood Co.,[1] 31 South Broad St | R | x | x | x | x | ---- | x | x |
| Palm Market, 23 South Broad St | R | x | x | x | x | x | x | ---- |
| Sanders Fish Co., 999 Peachtree St | R | x | x | x | x | ---- | x | ---- |
| Southern Grocery Co., 588 Whitehall St | R | x | x | x | ---- | ---- | x | x |
| Sprayberry Fish Co., 103 Decatur St | WR | x | x | x | ---- | x | ---- | ---- |

[1] Also handles canned and cured fish.
[2] Also handles bakery goods.

TABLE 7.—*Short-line travel and freight and express rates on fresh and frozen fish and oysters from principal sources of supply to Atlanta, Ga.*

[Prepared by the Interstate Commerce Commission, Bureau of Traffic. Distances shown were taken from War Department mileages or War Department mileages in connection with Official Railway Guide. Notes to reference symbols are grouped at end of table]

| Points of origin | Short-line travel, distance in miles | Rate in cents per 100 pounds | | | |
|---|---|---|---|---|---|
| | | Freight | | Express | |
| | | Carload | Less-than-carload | Any quantity | |
| | | Fresh or frozen fish | Fresh or frozen fish | Fresh or frozen fish | Oysters |
| DOMINION OF CANADA | | | | | |
| Manitoba: Winnipegosis | 1,535 | D226 | 473½ | (A)@750 | **750 |
| UNITED STATES | | | | | |
| Alabama: Mobile | 354 | #A 83½ | 137 | @199 | @199 |
| Florida: | | | | | |
| Apalachicola | 409 | #A 83½ | 157½ | X169 | X169 |
| Bradenton | 531 | #B106½ | 221½ | X205 | X205 |
| Cedar Keys | 369 | #B 93 | 213½ | X158 | X158 |
| Fernandina | 358 | #B 69 | 121 | X158 | X158 |
| Fort Pierce | 570 | #B124 | 240½ | X221 | X221 |
| Gulfport | 594 | D114 | 208½ | | |
| Jacksonville | 331 | #B 69 | 121 | X158 | X158 |
| Key West | 853 | #B141 | 213½ | X289 | X289 |
| Miami | 694 | #B141 | 258 | X252 | X252 |
| Orlando | 482 | D118½ | 219½ | X195 | X195 |
| Palatka | 389 | D 83 | 152 | X184 | X184 |
| Panama City | 374 | #A 83½ | 251½ | X142 | X142 |
| Pensacola | 338 | #A 83½ | 137 | X158 | X158 |
| Punta Gorda | 576 | #B106½ | 246½ | X221 | X221 |
| St. Augustine | 368 | #B 80½ | 172 | X184 | X184 |
| St. Petersburg | 598 | #B106½ | 208½ | X205 | X205 |
| Sanford | 456 | B 91½ | 173 | X195 | X195 |
| Sarasota | 590 | #B106½ | 221½ | X205 | X205 |
| Tampa | 543 | #B100 | 191 | X205 | X205 |
| Titusville | 482 | D105½ | 222½ | X205 | X205 |
| West Palm Beach | 627 | #B136 | 247½ | X232 | X232 |
| Georgia: | | | | | |
| Savannah | 260 | D 57½ | 132½ | @146 | @146 |
| Brunswick | 275 | | | @146 | @146 |
| Illinois: Chicago | 733 | (1) | (2) | @277 | @277 |
| Louisiana: | | | | | |
| Rayne | 671 | D131 | 263 | @285 | @285 |
| Sorrento | 547 | D 65 | 151 | X205 | X205 |
| Maryland: | | | | | |
| Baltimore | 689 | D 77 | 178½ | X247 | X247 |
| Crisfield | 723 | †C 73½ | 189 | @281 | @281 |
| Massachusetts: Boston | 1,108 | D 84 | 196½ | @334 | @334 |
| Mississippi: Biloxi | 414 | D 62 | 153½ | X169 | X169 |
| New Jersey: Port Morris | 865 | D 83 | 192 | | |
| New York: | | | | | |
| New York City | 876 | D 81 | 189 | @304 | @304 |
| Sayville | 928 | D 84½ | 197½ | @304 | @304 |
| North Carolina: | | | | | |
| Beaufort | 561 | D 58½ | 134 | X205 | X205 |
| Elizabeth City | 651 | D 58½ | 134 | X221 | X221 |
| Morehead City | 558 | #B 84 | 134 | X205 | X205 |
| Ohio: | | | | | |
| Cincinnati | 476 | D 65 | 151 | X205 | X205 |
| Lorain | 728 | D115½ | 226 | @281 | @281 |
| Pennsylvania: Erie | 827 | D 88½ | 219 | @304 | @304 |
| Tennessee: Nashville | 289 | D 49½ | 112½ | X158 | X158 |
| Virginia: | | | | | |
| Cape Charles City | 470 | C 73½ | 189 | @274 | @274 |
| Norfolk | 446 | #B 84 | 141 | X221 | X221 |
| Old Point Comfort | 458 | D 61 | 141 | X221 | X221 |

[1] D54 to Cincinnati; D65 beyond.

[2] 80½ to Cincinnati; 151 beyond.

EXPLANATION OF REFERENCE MARKS GOVERNING THE FREIGHT RATES—TRANSPORTATION OF ICE SHIPMENTS

# When ice is loaded in bunkers of the car, no charge will be made for its transportation; but if ice is taken by consignee, charges shall be made on the actual weight of the ice in bunkers at destination and at the carload rate applicable on the freight it accompanies; if not taken by consignee it becomes the property of the carrier.

When ice is loaded in the body of the car for protection of the freight, no charge will be made for its transportation; but if taken by consignee, charge shall be made on the actual weight of the ice in the car at destination and at the rate applicable on the freight which it accompanies; if not taken by consignee it becomes the property of the carrier.

When ice is placed in the same package with the freight, charges will be assessed on basis of the net weight of the freight and containers.

† When ice is placed in same package with the freight, charges will be assessed on basis of the net weight of the freight and containers.

A. Minimum billing weight 8,000 pounds.
B. Minimum billing weight 12,000 pounds.
C. Minimum billing weight 20,000 pounds.
D. Minimum billing weight 24,000 pounds.

EXPLANATION OF REFERENCE MARKS GOVERNING THE EXPRESS RATES

X Applicable on interstate shipments of fresh and dry salt fish in barrels; also on clams and oysters in shell.

Weight basis: Fresh and dry salt fish—rates named will apply on dry salt fish in barrels. They will also apply on fresh or dry salt fish in boxes when the net weight of the shipment is 150 pounds or more. The charges on fresh fish must be assessed on the net weight of the fish plus 25 per cent for ice.

Charges on dry salt fish must be assessed on the basis of actual gross weight.

Oysters in shell: Flour barrel, estimated weight 200 pounds per barrel. Sugar barrel, estimated weight 250 pounds per barrel.

Shipments of fresh or dry salt fish in sugar barrels when in lots of 10 barrels or more and in boxes when net weight is 2,000 pounds or more from one consignor to one consignee.

(a) Shipments of fresh or dry salt fish in sugar barrels when in lots of 10 barrels or more from one consignor to one consignee will be charged 10 per cent less than the charge determined at rates named.

The charge will first be computed on the entire shipment at rates named, observing the weight basis defined above, and from the gross charge so ascertained 10 per cent thereof may be deducted.

(b) Shipments of fresh or dry salt fish in boxes when net weight is 2,000 pounds or more from one consignor to one consignee between stations in Alabama, District of Columbia, Florida, Georgia, Maryland, North Carolina, Virginia, and West Virginia will be charged on same basis as when in sugar barrels; 10 barrels or more, as shown in paragraph (a).

@ Second-class rates.—Classification weight basis: Fish, fresh, frozen, smoked, dried, salted, pickled or otherwise preserved or cured. Charge on basis of gross weight, except that fresh or frozen fish, shipped with ice, which is necessary for its preservation, must be charged for on the basis of 25 per cent added to the net weight of the fish, unless actual gross weight is less at time of shipment. The minimum billing weight of any iced shipment of fish under this rule is 40 pounds unless the gross weight is less. On mixed shipments of fish and oysters shipped with ice necessary for preservation, charge on the basis of 25 per cent added to the net weight of the fish, plus the weight of the oysters, as specified hereunder. The minimum billing weight of such a mixed shipment is 40 pounds, unless the gross weight is less, in which event the gross weight will apply.

Oysters, clams or scallops: In shell, glass jars, canned or in bulk. When shipped in bulk, estimate 12 pounds per gallon.

If forwarded in refrigerators weighing gross in excess of 200 pounds, charge on basis of rule 1 (h), Official Express Classification, ICC No. 3280. (Gross weight of the shipment at the time it is received for transportation, provided, however, that when it is necessary to use ice for preservation, and it is used for that purpose only, an allowance of 25 per cent from the gross weight will be made from March to November, inclusive, and an allowance of 15 per cent from gross weight will be made from December to February, inclusive, but the weight must not be less than the gross weight of the shipment without ice.)

In glass jars, estimate 24 pints at 45 pounds, 36 pints at 65 pounds, 48 pints at 90 pounds, and 48 half pints at 50 pounds.

The following estimated weights will apply to oysters in metal cans with or without ice, when packed in boxes: 1/10-gallon can, 1¼ pounds each; pint cans, 1½ pounds each; standard or ¾ cans, 2 pounds each; 1/5-gallon cans, 2½ pounds each; full quart cans, 3 pounds each; 1/2-gallon cans, 6 pounds each; and gallon cans, 12 pounds each.

Gross weight at time of shipment will apply when less than the estimated weights shown above. The minimum billing weight for any single shipment of oysters, clams, or scallops is 30 pounds, unless the actual gross weight is less or unless the percentage allowance from gross weight authorized in rule 1 (h) makes a lower billing weight. On mixed shipments of fish and oysters shipped with ice necessary for preservation, charge on the basis of 25 per cent added to the net weight of the fish, plus the weight of the oysters, as specified above.

The minimum billing weight of such a mixed shipment is 40 pounds, unless the gross weight is less, in which event the gross weight will apply. Oysters, clams, or scallops: On mixed shipments of shellfish, consisting of shellfish both shucked and in the shell, the minimum billing weight will be 40 pounds per shipment unless the actual gross weight is lower, in which event the actual gross weight will apply. (Does not apply on intrastate traffic between stations in Georgia.)

Carloads: Minimum billing weight, 12,000 pounds on the following basis:

When in the shell, actual weight. Shucked oysters in carriers, estimated at 12 pounds per gallon. Shucked oysters in naked cans without other packing, charge on the basis of actual weight of the oysters and containers.

No charge will be made for the transportation of necessary chopped ice, packed on top or around the cans, nor when refrigerator cars are used will any charge be made for transportation of ice in the bunkers. The cost of all ice furnished by the express company must be paid by the shipper or consignee.

** Shipments of oysters originating in Canada, Newfoundland, or Labrador will be subject to billing weight basis provided for in item 1 (h), Official Express Classification, ICC No. 3280. (Item noted above.)

(A) On shipments of fresh salmon, packed with ice or snow, from points in Canada, the minimum billing weight will be 75 pounds per box, unless the gross weight is less.

## LIST OF MARKET SURVEYS

The following is a list of the publications of the Bureau of Fisheries relating to marketing fish in various cities in the United States, which may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the prices stated:

FIEDLER, R. H.
1928. Trade in fresh and frozen fishery products and related marketing considerations in Jacksonville, Fla. In press.
1928. Trade in fresh and frozen fishery products and related marketing considerations in Greater St. Louis, Mo. U. S. Bureau of Fisheries Document No. 1026, pp. 485–514. Appendix VI, Report of the Commissioner of Fisheries for 1927. Washington. 10 cents.
FIEDLER, R. H., and J. H. MATTHEWS.
1926. Wholesale trade in fresh and frozen fishery products and related marketing considerations in New York City. U. S. Bureau of Fisheries Document No. 996, pp. 183–217. Appendix VI, Report of the Commissioner of Fisheries for 1925. Washington. 10 cents.
HOPKINSON, L. T.
1921. Trade in fresh and frozen fishery products and related marketing considerations in Louisville, Ky. U. S. Bureau of Fisheries Economic Circular No. 50, 7 pp. Washington. 5 cents.
1921. Trade in fresh and frozen fishery products and related marketing considerations in Pittsburgh, Pa. U. S. Bureau of Fisheries Economic Circular No. 52, 9 pp. Washington. 5 cents.
1921. Trade in fresh and frozen fishery products and related marketing considerations in Chicago, Ill. U. S. Bureau of Fisheries Economic Circular No. 54, 22 pp. Washington. 5 cents.
1922. Trade in fresh and frozen fishery products and related marketing considerations in Minneapolis and St. Paul, Minn. U. S. Bureau of Fisheries Economic Circular No. 55, 21 pp. Washington. 5 cents.
1923. Trade in fresh and frozen fishery products and related marketing considerations in Boston, Mass. U. S. Bureau of Fisheries Document No. 939, pp. 1–27. Appendix XVI, Report of the Commissioner of Fisheries for 1922. Washington. 5 cents.
HOPKINSON, L. T., and W. P. STUDDERT.
1922. Trade in fresh and frozen fishery products and related marketing considerations in Seattle, Wash. U. S. Bureau of Fisheries Document No. 930, pp. 1–16. Appendix VII, Report of the Commissioner of Fisheries for 1922. Washington. 5 cents.

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# ALASKA FISHERY AND FUR-SEAL INDUSTRIES IN 1927 [1]

By Ward T. Bower, *Administrative Officer*

## CONTENTS



[1] Appendix IV to the Report of the U. S. Commissioner of Fisheries for 1928. B. F. Doc. 1040.

## INTRODUCTION

The work of the Bureau of Fisheries in Alaska includes two distinct lines of activity—the conservation of the salmon and other fisheries of Alaska and the protection and management of the Pribilof Islands fur-seal herd.

The most important fishery in Alaska is for the salmon. The perpetuation of this great resource depends largely upon the escapement of a proper supply of breeding salmon to the spawning grounds. To bring this about each year and at the same time permit proper utilization of salmon for food requires regulations based on thorough knowledge of local conditions, a comprehensive understanding of the natural history of the salmons, and as complete data as can be obtained in regard to the methods and intensiveness of fishery operations in the past and the present. Regulations must be reviewed constantly and revised from time to time to meet existing conditions. The regulations effective in 1926 were revised very carefully for 1927, and supplementary regulations were issued from time to time. Commissioner O'Malley was in Alaska during the greater part of the salmon fishing season, keeping in personal touch with the various problems that required immediate administrative action.

About 200 persons were employed for varying periods to enforce the fishery laws and regulations. A fleet of 11 vessels belonging to the bureau was engaged in patrol work, and in addition a number of other vessels were chartered for brief periods to assist in the patrol. Scientific studies, principally in connection with salmon, herring, and clams, were continued.

Ten weirs were maintained in various streams of Alaska, at which counts of salmon escaping to the spawning grounds were made for comparison with the commercial take. Observations were made of the numbers of breeding salmon in various important streams where weirs were not maintained.

Detailed statistics of the fisheries of Alaska are published herewith.

At the Pribilof Islands 24,942 fur-seal skins were taken—2,811 more than in the preceding year. An adequate number of 3-year-old male seals was reserved from the killing operations to maintain the breeding stock. The computation of fur seals in the herd indicated 808,870 animals, an increase of 47,589 over the figures of the previous year. In the foxing season of 1927–28 on the Pribilofs 278 blue and 15 white fox skins were taken. A patrol of the waters frequented by Pribilof Islands fur seals was maintained by the United States Coast Guard.

Very satisfactory progress was made in the construction of new dwellings for the natives on the Pribilof Islands. Nearly all the dwellings, built many years ago when the islands were under lease, require replacement. Progress also was made in the construction of roadways, so urgently needed in connection with sealing operations. The annual shipment of general supplies for the Pribilofs was made on the U. S. S. *Vega*, detailed for the work through the courtesy of the Navy Department.

Two public auction sales of fur-seal skins were held in the year. At one of these fox skins from the Pribilofs were sold also.

Acknowledgment is made of the assistance rendered by members of the bureau's staff in the compilation and preparation of this document.

### VISIT OF THE COMMISSIONER OF FISHERIES AND OTHER OFFICIALS TO ALASKA

On June 27, 1927, Commissioner O'Malley, accompanied by Congressman T. D. McKeown, of Oklahoma, a member of the House Committee on Merchant Marine and Fisheries, and Congressman F. G. Lanham, of Texas, proceeded to Alaska from Seattle on the *Brant*. Among the places visited by the party were Ketchikan, Juneau, Kodiak, Seward, and Cordova. An inland trip was made to Fairbanks.

For almost two months Commissioner O'Malley remained in Alaska personally investigating conditions regarding the fisheries, particularly in the southeastern district, where the failure in the run of salmon in many localities necessitated decisive regulatory measures to insure an adequate escapement to the spawning grounds. Following his departure from Alaska, the commissioner devoted some time to an investigation of fishery matters in the Pacific Coast States, and arrived in Washington on September 24.

## FISHERY INDUSTRIES

As in corresponding reports for previous years, the Territory of Alaska is here considered in the three coastal geographic sections generally recognized, as follows: (1) Southeast Alaska, embracing all that narrow strip of mainland and the numerous adjacent islands from Portland Canal northwestward to and including Yakutat Bay; (2) central Alaska, the region on the Pacific from Yakutat Bay westward, including Prince William Sound, Cook Inlet, and the southern coast of Alaska Peninsula, to Unimak Pass; and (3) western Alaska, the north shore of the Alaska Peninsula, including the Aleutian Islands westward from Unimak Pass, Bristol Bay, and the Kuskokwim and Yukon Rivers. These divisions are solely for statistical purposes and do not coincide with areas established in departmental regulations.

Detailed reports and statistical tables dealing with the various fishery industries are presented herewith, and there are also given the important features of certain subjects that were the objects of special investigation or inquiry.

### NEW FISHERY REGULATIONS

The regulations for the protection of the fisheries of Alaska, issued December 22, 1926, were amended by the following regulations issued by the Acting Secretary of Commerce under the dates indicated:

[*February 17, 1927*]

#### KODIAK AREA

*Salmon fishery.*—The use of traps for the capture of salmon is prohibited (*a*) in all waters of Kodiak Island between Cape Ugat and Broken Point; (*b*) in waters of the Noisy Islands, and (c) in the waters along the northwest end of Uganik Island between markers approximately 3 miles southwest and approximately 2 miles northeast of Cape Uganik.

#### COOK INLET AREA

*Salmon fishery.*—The use of traps for the capture of salmon is prohibited within 2 statute miles of the mouth of the Chuit River.

PRINCE WILLIAM SOUND AREA

*Salmon fishery.*—The use of traps for the capture of salmon is prohibited in the waters of the mainland shore along the west coast of Prince William Sound, including all bays, between Cape Puget and the point where the 148th meridian of west longitude intersects the north shore of Granite Bay.

The use of traps for the capture of salmon is prohibited within a line from the light on the south shore of the entrance to Port Nellie Juan to the nearest point on the mainland on the west side of the southern entrance to Culross Passage.

The use of traps for the capture of salmon is prohibited within a line from the outer extremity of the mainland point at the west side of the north entrance to Culross Passage to the outer extremity of land at the north side of the entrance to Pigot Bay.

The use of traps for the capture of salmon is prohibited in the waters of Evans, Elrington, Latouche, Flemming, Knight, Ingot, Eleanor, Perry, Esther, Glacier, Green, and Smith Islands.

BERING RIVER AREA

*Salmon fishery.*—In the Bering River area all commercial fishing for salmon is prohibited at all times: *Provided,* That this prohibition shall not prevent the taking of fish for local food requirements or for use as dog feed.

*Steelhead fishery.*—In the Bering River area all commercial fishing for steelhead trout is prohibited at all times: *Provided,* That this prohibition shall not prevent the taking of fish for local food requirements or for use as dog feed.

SOUTHEASTERN ALASKA AREA

*Herring fishery.*—Seines used in commercial fishing, including bait fishing, for herring in Klawak Harbor, within a true east and west line passing through the northern extremity of Klawak Island, shall not exceed 90 fathoms hung measure in length, nor 500 meshes in depth. For the purpose of determining depths of such seines measurements will be upon the basis of 1½ inches stretched measure between knots. No such seine shall have a mesh of less than 1½ inches stretched measure between knots.

[*March 17, 1927*]

PRINCE WILLIAM SOUND AREA

*Salmon fishery.*—Regulation No. 6 is amended to read as follows: Commercial fishing for salmon, except by trolling, is prohibited prior to 6 o'clock antemeridian June 6 and all commercial fishing for salmon is prohibited after 6 o'clock antemeridian September 21 in each year.

[*April 22, 1927*]

SOUTHEASTERN ALASKA AREA

*Icy Strait–Cross Sound District*

*Salmon fishery.*—Regulation No. 8 is amended to read as follows: In Port Frederick, northern shore of Chichagof Island, commercial fishing for salmon is prohibited in all waters east of a line from Inner Point Sophia to Game Point and in all waters south of 58 degrees 4 minutes north latitude, except that trolling will be permitted from November 1 to June 1, both dates inclusive. A portion of the waters closed is in the central district.

[*May 4, 1927*]

COOK INLET AREA

*Salmon fishery.*—The use of traps for the capture of salmon is prohibited within 1 statute mile of the mouth of the Chuit River.

[*June 1, 1927*]

KODIAK AREA

*Herring fishery.*—Regulation No. 4 is amended so as to permit commercial fishing for herring from 6 o'clock postmeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following.

COOK INLET AREA

*Herring fishery.*—Regulation No. 6 is amended so as to permit commercial fishing for herring from 6 o'clock postmeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following.

[*June 23, 1927*]

BRISTOL BAY AREA

*Salmon fishery.*—Regulation No. 11 is amended so as to extend the 36-hour weekly closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, to include the period from 6 o'clock antemeridian of Saturday of each week to 6 o'clock antemeridian of the Tuesday following, making a weekly closed period of 72 hours.

In the waters of Kvichak Bay between a line from Etolin Point to Cape Chichagof and the line extending across Kvichak Bay from the marker at Graveyard Point, near the mouth of Graveyard Creek, to the marker on the opposite side between the mouths of Squaw and Russian Finn Creeks, the 36-hour weekly closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week to 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

[*June 29, 1927*]

PRINCE WILLIAM SOUND AREA

*Salmon fishery.*—Regulation No. 4 is amended so as to prohibit the use of purse seines, as well as traps and beach seines, in commercial fishing for salmon in the waters along the western coast from the outer point on the north shore of Granite Bay (known as Granite Bay Point) to the light on the south shore of the entrance to Port Nellie Juan.

[*July 1, 1927*]

BRISTOL BAY AREA

*Salmon fishery.*—Supplementary regulation No. 251–13–6, dated June 23, 1927, extending the weekly closed period 12 hours in certain waters of the Bristol Bay area is hereby canceled.

[*July 15, 1927*]

BRISTOL BAY AREA

*Salmon fishery.*—Commercial fishing for salmon is prohibited in all waters of the Bristol Bay area from 6 o'clock postmeridian July 16 through December 31, 1927.

[*July 18, 1927*]

BRISTOL BAY AREA

*Salmon fishery.*—Supplementary Regulation No. 251–13–9, dated July 15, 1927, prohibiting commercial fishing for salmon after 6 o'clock postmeridian July 16, is hereby canceled.

[*July 19, 1927*]

BRISTOL BAY AREA

*Salmon fishery.*—Regulation No. 7 is amended so as to prohibit commercial fishing for salmon in the period from 6 o'clock postmeridian July 19 to 6 o'clock antemeridian August 6, after which date commercial fishing for salmon during the remainder of the year is permitted.

[*July 26, 1927*]

PRINCE WILLIAM SOUND AREA

*Herring fishery.*—Regulation No. 1 is amended so as to prohibit commercial fishing for herring from October 15 to December 31, 1927, both dates inclusive.

Regulation No. 3 is amended so as to permit commercial fishing for herri from 6 o'clock postmeridian of Saturday of each week until 6 o'clock antemeridi of the Monday following.

[*August 8, 1927*]

ALASKA PENINSULA AREA

*Salmon fishery.*—Regulation No. 11 is amended so as to permit commerc fishing for salmon with beach seines and gill nets from September 5 to Septemb 30, 1927, both dates inclusive.

[*August 13, 1927*]

SOUTHEASTERN ALASKA AREA

*Southern District*

*Salmon fishery.*—Regulation No. 4 is amended so as to prohibit commerc fishing for salmon, except by trolling, in the period from 6 o'clock postmeridi August 13 to 6 o'clock postmeridian September 14, and for the remainder of t calendar year after 6 o'clock postmeridian October 15, 1927.

[*August 16, 1927*]

PRINCE WILLIAM SOUND AREA

*Salmon fishery.*—Regulation No. 7 is amended so as to prohibit commerci fishing for salmon from 6 o'clock antemeridian August 5 through August 30, 192 except in the waters along the western coast from the outer point on the nor shore of Granite Bay (known as Granite Bay Point) to the light on the sou shore of the entrance to Port Nellie Juan.

[*August 18, 1927*]

SOUTHEASTERN ALASKA AREA

*Prince of Wales Island District*

*Salmon fishery.*—Regulation No. 5 is amended so as to prohibit commerci fishing for salmon, except by trolling, in the period from 6 o'clock postmeridi August 18 to 6 o'clock postmeridian September 14, and for the remainder of tl calendar year after 6 o'clock postmeridian October 15, 1927.

[*August 19, 1927*]

PRINCE WILLIAM SOUND AREA

*Salmon fishery.*—Regulation No. 7 is further amended so as to prohibit con mercial fishing for salmon from August 20 to August 30, 1927, both dates incl sive, in the waters along the western coast from the outer point on the nort shore of Granite Bay (known as Granite Bay Point) to the light on the sout shore of the entrance to Port Nellie Juan.

[*August 27, 1927*]

SOUTHEASTERN ALASKA AREA

*Prince of Wales Island District*

*Salmon fishery.*—In addition to existing prohibitions commercial fishing f salmon, except by trolling, is prohibited throughout the remainder of the ca endar year after 6 o'clock postmeridian September 14.

*Southern District*

*Salmon fishery.*—In addition to existing prohibitions commercial fishing f salmon, except by trolling, is prohibited throughout the remainder of the ca endar year after 6 o'clock postmeridian September 14.

[*August 30, 1927*]

PRINCE WILLIAM SOUND AREA

*Salmon fishery.*—In addition to existing prohibitions all commercial fishing for salmon is prohibited throughout the remainder of the calendar year after August 30 in the waters along the western coast from the outer point on the north shore of Granite Bay (known as Granite Bay Point) to the light on the south shore of the entrance to Port Nellie Juan.

[*September 10, 1927*]

KODIAK AREA

*Salmon fishery.*—Commercial fishing for salmon in the waters of Kodiak Island between Cape Karluk and Cape Uganik is prohibited from 6 o'clock postmeridian September 10 through December 31, 1927.

[*October 6, 1927*]

SOUTHEASTERN ALASKA AREA

*Herring fishery.*—Regulation No. 2 is amended so as to permit commercial fishing for herring with gill nets not less than 2¼ inches stretched measure between knots from October 6 through December 31, 1927, both dates inclusive, in waters otherwise open to fishing.

[*October 11, 1927*]

KODIAK AREA

*Herring fishery.*—Regulation No. 1 is amended so as to permit commercial fishing for herring with purse seines from October 15 to November 10, 1927, both dates inclusive.

COOK INLET AREA

*Herring fishery.*—Regulation No. 1 is amended so as to permit commercial fishing for herring with purse seines from October 15 to November 10, 1927, both dates inclusive.

PRINCE WILLIAM SOUND AREA

*Herring fishery.*—Regulation No. 1 is further amended so as to permit commercial fishing for herring with purse seines from October 15 to November 5, 1927, both dates inclusive, and with gill nets of not less than 2½ inches stretched measure between knots from October 15 to December 15, 1927, both dates inclusive.

Revised regulations covering the fisheries of Alaska were issued by the Secretary of Commerce under date of December 12, 1927, as follows:

By virtue of the authority vested in the Secretary of Commerce, fishing areas are hereby set apart and regulations governing fishing therein are made effective, as follows:

I. YUKON-KUSKOKWIM AREA

The Yukon-Kuskokwim area is hereby defined to include all Territorial coastal and tributary waters of Alaska from Cape Newenham northward to the parallel of 64 degrees north latitude.

1. In the Yukon-Kuskokwim area all commercial fishing for salmon is prohibited at all times: *Provided*, That this prohibition shall not prevent the taking of fish for local food requirements or for use as dog feed.

II. BRISTOL BAY AREA

The Bristol Bay area is hereby defined to include all Territorial coastal and tributary waters of Alaska from Cape Newenham to a point on the coast 3 statute miles south of Cape Menshikof.

*Salmon fishery.*—1. Commercial fishing for salmon is prohibited except within the following described districts:

(*a*) Nushagak district: Waters of Nushagak Bay within a line from Point Protection to Etolin Point.

(*b*) Kvichak-Naknek district: Waters of Kvichak Bay within a line from Etolin Point to Middle Bluff on the eastern side of Kvichak Bay at approximately 58 degrees 30 minutes north latitude.

(*c*) Egegik district: Waters between an east and west line 8 statute miles north of South Spit, Egegik Bay, and an east and west line 10 statute miles south of South Spit.

(*d*) Ugashik district: Waters between an east and west line 3 statute miles north of Cape Greig and the southern limit of the area at a point on the coast 3 statute miles south of Cape Menshikof.

2. Commercial fishing for salmon shall be conducted solely by drift gill nets and stake nets. The use of all other forms of fishing gear is prohibited.

3. Stake nets shall be operated in substantially a straight line.

4. Commercial fishing for salmon with stake nets shall be limited to beach areas between high and low water marks and shall be confined to the following places:

(*a*) Nushagak Bay.

(*b*) Along the beach in front of Koggiung Indian village on Kvichak Bay.

(*c*) Along the beach on the east and west side of Egegik near the Indian village.

(*d*) Along the beach on Ugashik Bay near the Indian village below the Alaska Packers Association cannery.

5. The total aggregate length of stake nets used by any individual shall not exceed 75 fathoms measured on the cork line.

6. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 200 fathoms hung measure, except in the Nushagak district where the length shall not exceed 150 fathoms hung measure.

7. King salmon nets shall have a mesh of at least 8½ inches stretched measure between knots, and red salmon nets shall have a mesh of at least 5½ inches stretched measure between knots as measured when actually in use. No red salmon nets shall be over 28 meshes deep.

8. Prior to 6 o'clock antemeridian June 25 in each year commercial fishing for salmon with nets of mesh less than 8½ inches stretched measure between knots is prohibited.

9. Commercial fishing for salmon is prohibited in the period from 6 o'clock postmeridian July 23 to 6 o'clock antemeridian August 6.

10. The trailing of web behind any fishing boat is prohibited above the markers fixing closed waters.

11. The use of motor-propelled fishing boats in catching salmon is prohibited.

12. The use of smelt nets is prohibited in localities where young salmon are migrating.

13. In the waters of Kvichak Bay between the line extending across the bay from the marker on a high point on the east bank of Prosper Creek, about 700 yards above the Koggiung cannery of the Alaska Packers Association, to the marker on the opposite side, the course being about north, 44 degrees west, magnetic, and the line extending across the bay from the marker at Graveyard Point, near the mouth of Graveyard Creek, to the marker on the opposite side between the mouths of Squaw and Russian Finn Creeks, the course being about north, 48 degrees west, magnetic, the 36-hour weekly closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Saturday of each week to 6 o'clock antemeridian of the Tuesday following, making a weekly closed period of 60 hours.

14. All commercial fishing for salmon is prohibited as follows:

(*a*) Nushagak Bay: All waters northward of a line from Bradford Point through the southern end of Williams Island to a point on the opposite shore near the old cannery site of the Alaska Packers Association south of Kanulik village, except that stake nets limited to beach areas between high and low water marks will be permitted north of 59 degrees north latitude to the old prohibitive markers located at Snag Point.

(*b*) Kvichak Bay: All waters above a line extending at right angles across Kvichak Bay from the marker on a high point on the east bank of Prosper Creek, about 700 yards above the Koggiung cannery of the Alaska Packers Association, to the marker on the opposite side, the course being about north, 44 degrees west, magnetic.

(*c*) Ugashik River and Bay: All waters above a line extending at right angles across said river 500 yards below the mouth of King Salmon River.

*Steelhead fishery.*—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

### III. ALASKA PENINSULA AREA

The Alaska Peninsula area is hereby defined to include all Territorial coastal and tributary waters of the Alaska Peninsula from a point on the coast 3 statute miles south of Cape Menshikof on the Bering Sea shore, extending in a southwesterly direction to Unimak Pass, thence in a northeasterly direction along the Pacific side of the Alaska Peninsula to Castle Cape (Tuliumnit Point). The waters of Unimak, the Sanak, the Shumagin, and all other adjacent islands are included.

*Salmon fishery.*—1. In the waters of Nelson Lagoon, and thence along the coast to Cape Seniavin, including Nelson Lagoon, Herendeen Bay, Port Moller, and the fishing grounds off the Bear, Sandy, and Ocean Rivers, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the periods from 6 o'clock antemeridian of Wednesday of each week until 6 o'clock antemeridian of the following Thursday, and from 6 o'clock antemeridian of Friday of each week until 6 o'clock antemeridian of the following Saturday, making a weekly closed period in these waters of 84 hours, which shall be effective throughout the entire salmon fishing season of each year.

2. In all other waters of this area the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Wednesday of each week until 6 o'clock postmeridian of the Thursday following, making a weekly closed period of 60 hours: *Provided,* That this extension of 24 hours closed period each week shall not be effective after 6 o'clock antemeridian of July 25 in each year.

3. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 200 fathoms hung measure.

4. Stake and anchored gill nets shall be operated in substantially a straight line.

5. The use of floating traps for the capture of salmon is prohibited.

6. The use of any trap for the capture of salmon is prohibited, as follows:

(*a*) From a point 3 statute miles south of Cape Menshikof to Cape Seniavin.

(*b*) From Lagoon Point to Cape Sarichef, including the waters of adjacent islands and of Bechevin Bay and its tributaries north of the latitude of Nichols Point.

(*c*) From Cape Sarichef to Cape Pankof.

(*d*) In the waters of False Pass (Isanotski Strait) within lines determined by markers erected for that purpose.

(*e*) In Pavlof Bay north of 55 degrees 20 minutes north latitude except along the east side southward of the south point of the entrance to Canoe Bay.

(*f*) The Shumagin Islands, the Sanak Islands, and all other islands lying between or adjacent to these two groups, with the exception of the east side of Unga Island between Unga Cape and West Head.

7. In all waters along the shores of the Alaska Peninsula west of the longitude of Cape Aliaksin, and in the waters of Unga Island, the distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1 statute mile.

8. The use of purse seines for the capture of salmon is prohibited, except that (*a*) in the waters of the Shumagin Islands seines not to exceed 100 fathoms in length and 150 meshes in depth may be used, and (*b*) purse seines are permitted in waters open to commercial fishing between Lagoon Point and Cape Seniavin.

9. In Port Heiden waters the catch of red salmon shall not exceed 35,000 in any calendar year.

10. Commercial fishing for salmon is prohibited prior to 6 o'clock antemeridian June 1 in each calendar year and during the remainder of each calendar year after 6 o'clock postmeridian August 15, except that beach seines and gill nets may be used from September 5 to September 30, both dates inclusive.

11. All commercial fishing for salmon is prohibited in Morzhovoi Bay east of 163 degrees 5 minutes west longitude prior to July 25 in each year.

12. All commercial fishing for salmon is prohibited in Cold Bay within a line extending from the eastern extremity of Thin Point to Vodapoini Point prior to July 25 in each year.

13. All commercial fishing for salmon, except by beach seines not exceeding 65 fathoms in length, is prohibited (*a*) in all waters between Cape Tachilni and the southern extremity of Bold Cape and (*b*) in all waters from Cape Tolstoi to Cape Aliaksin.

14. Commercial fishing for salmon by means of gill nets, including drift nets, stake nets, and set nets, is prohibited west of 161 degrees west longitude, exclusive of waters along the Bering Sea coast.

15. Commercial fishing for salmon is prohibited in the Waters of Pavlof and Volcano Bays and their branches within a line from the outer extremity of Moss Cape to the outer extremity of Cape Tolstoi prior to July 5 in each year.

16. All commercial fishing for salmon is prohibited, as follows:

(*a*) Within 1 statute mile of the mouths of Bear, Sandy, and Ocean Rivers.

(*b*) Thin Point Lagoon, Long John Lagoon, Kinzaroff Lagoon, Mortensen Lagoon, Swanson Lagoon, Big Lagoon, and Middle or Lambsport Lagoon: All waters within the lagoons and their streams and within a distance of 500 yards outside the entrances to the lagoons.

(*c*) Canoe Bay, tributary to Pavlof Bay.

(*d*) Stepovak Bay and Balboa Bay: All waters of these bays and of their branches and arms, excepting Orzinski (Orzenoi) Bay, within a line from the outer extremity of Kupreanof Point to the outer extremity of Cape Aliaksin. In Orzinski (Orzenoi) Bay beach seines only may be used, and the catch of red salmon shall not exceed 25,000 in any calendar year.

(*e*) All waters between Kupreanof Point and Cape Ikti.

*Steelhead fishery.*—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

*Herring fishery.*—1. Commercial fishing for herring is prohibited in the period from January 1 to May 31, both dates inclusive, and from December 1 to December 31, both dates inclusive, in each calendar year.

2. During the period from June 1 to October 1, both dates inclusive, commercial fishing for herring is prohibited in all waters closed throughout the year to salmon fishing.

3. The closed seasons herein specified for commercial herring fishing shall not apply to the taking of herring for bait purposes in waters otherwise open to fishing.

4. Commercial fishing for herring, except for bait purposes, is prohibited from 6 o'clock postmeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following.

5. Gill nets used in catching herring shall not be of smaller mesh than 3 inches stretched measure.

6. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

*Clam fishery.*—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

## IV. ALEUTIAN ISLANDS AREA

The Aleutian Islands area is hereby defined to include all territorial coastal and tributary waters of the Aleutian Islands westward of and including Unimak Pass.

1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat shall not exceed 200 fathoms hung measure.

2. Stake and anchored gill nets shall be operated in substantially a straight line.

3. Commercial fishing for salmon is prohibited during the period from 6 o'clock postmeridian August 20 to 6 o'clock postmeridian October 1 in each year.

4. The use of traps and purse seines for the capture of salmon is prohibited.

*Steelhead fishery.*—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

## V. CHIGNIK AREA

The Chignik area is hereby defined to include the territorial coastal and tributary waters of Alaska along the mainland shore from Castle Cape (Tuliumnit Point) to Cape Kumnik.

*Salmon fishery.*—1. The use of purse seines and floating traps for the capture of salmon is prohibited.

2. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 200 fathoms hung measure.

3. Stake and anchored gill nets shall be operated in substantially a straight line.

4. The use of motor-propelled gill-net boats in catching salmon is prohibited.

5. The take of salmon within waters in which the runs are tributary to the Chignik River shall not exceed 50 per cent of the total run as determined at the weir in Chignik River operated by the Bureau of Fisheries.

6. Commercial fishing for salmon is prohibited prior to 6 o'clock antemeridian June 1 and after 6 o'clock postmeridian October 1 in each year.

7. Commercial fishing for salmon is prohibited in the waters surrounding Nakchamik and Chankliut Islands.

8. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1 statute mile, except in Chignik Lagoon, where there shall be a distance interval of not less than 10 statute miles laterally between any two traps on the north shore or on the south shore of Chignik Lagoon. Chignik Island shall be considered as a part of the south shore of the lagoon.

*Steelhead fishery.*—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

*Clam fishery.*—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

### VI. KODIAK AREA

The Kodiak area is hereby defined to include the waters of the mainland shore extending from Cape Douglas southwestward to Cape Kumnik and the territorial coastal and tributary waters of Alaska surrounding Kodiak and adjacent islands, but excluding the waters embraced within the Afognak Forest and Fish Culture Reserve established by presidential proclamation of December 24, 1892.

*Salmon fishery.*—1. The use of purse seines and floating traps for the capture of salmon is prohibited.

2. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 200 fathoms hung measure.

3. Stake and anchored gill nets shall be operated in substantially a straight line.

4. Commercial fishing for salmon in Alitak Bay and all its branches within a line from Cape Trinity to Cape Alitak prior to 6 o'clock antemeridian June 15 in each year is prohibited.

5. Commercial fishing for salmon within a line from Cape Trinity to Cape Alitak shall be conducted solely by beach seines and traps, but no fishing for salmon shall be permitted inside a line from Bun Point through Turn Island at the entrance of Moser Bay to Akhiok village.

6. The take of salmon within waters in which the runs are tributary to Olga Bay shall not exceed 50 per cent of the total run as determined at the weirs on tributary waters of Olga Bay operated by the Bureau of Fisheries.

7. Commercial fishing for salmon in Karluk waters, extending from Cape Karluk to West Point, prior to 6 o'clock antemeridian June 1 and after 6 o'clock postmeridian October 1 in each year is prohibited. The take of red salmon in these waters shall not exceed 50 per cent of the total run as determined at the weir in Karluk River operated by the Bureau of Fisheries.

8. Commercial fishing for salmon between Cape Karluk and Cape Uyak, except by beach seines, and between Cape Uyak and Uyak Postoffice, except by beach seines and gill nets, is prohibited.

9. Commercial fishing for salmon in East Arm, Uganik Bay, within a line from Mink Point to Rock Point and including the sand spit locally known as "The Packer's Spit," is prohibited prior to 6 o'clock antemeridian July 21 in each calendar year.

10. Commercial fishing for salmon in all waters of Kizhuyak Bay within a line from Kekur Point to Inner Point is prohibited prior to 6 o'clock antemeridian July 21 in each calendar year.

11. Commercial fishing for salmon in all waters of Ugak Bay within a line from Gull Point to Narrow Cape is prohibited prior to 6 o'clock antemeridian July 21 in each calendar year.

12. Commercial fishing for salmon in all waters of Kiliuda Bay within a line from Right Cape to Left Cape is prohibited prior to 6 o'clock antemeridian July 21 in each calendar year.

13. The distance by most direct water measurement from any part of one trap to any part of another trap, except in those waters of Alitak Bay in which the runs are tributary to streams where counting weirs are maintained, shall not be less than 1 statute mile.

14. The use of any trap for the capture of salmon is prohibited, as follows:

(*a*) Uyak, Larsen, and Zachar Bays: All waters of these bays within a line from the southern extremity of the point of land at the north side of the entrance to Larsen Bay to the northern extremity of Amook Island, thence to the northern extremity of land at the west side of the entrance to Zachar Bay, thence due east to the east side of Zachar Bay; also all waters of Spiridon Bay or northeast arm of Uyak Bay.

(*b*) Cape Ugat to Cape Uganik: (1) All waters of Kodiak Island between Cape Ugat and Broken Point, (2) in waters of the Noisy Islands, and (3) in the waters along the northwest end of Uganik Island between markers approximately 3 statute miles southwest and approximately 2 statute miles northeast of Cape Uganik.

(*c*) Uganik Bay: All waters of Uganik Bay, including Uganik Passage and other tributaries and arms, within a line from West Point to Uganik Island passing through the northern extremity of East Point.

(*d*) Terror and Viekoda Bays: All waters south of 57 degrees 54 minutes north latitude.

(*e*) Ugak Bay to Kizhuyak Bay, inclusive: All waters of Kodiak Island and adjacent islands eastward and northward from Gull Point, Ugak Bay, to Inner Point, Kizhuyak Bay.

(*f*) Kiliuda Bay: All waters of Kiliuda Bay, including Shearwater Bay, except along the south shore of Kiliuda Bay east of 153 degrees 3 minutes west longitude.

(*g*) Sitkalidak Strait: All waters of Kodiak Island from Left Cape to a point on the shore of Kodiak Island 1 statute mile westward of Sitkalidak or Old Harbor Narrows.

(*h*) Sitkalidak Island and the Trinity Islands: All waters of Sitkalidak Island, the Trinity Islands, and the intervening islands.

(*i*) Barling and other bays: All waters within lines from headland to headland of Barling, Three Saints, Kanignak, Kiavak and Kaguyak Bays.

(*j*) Alitak Bay: All waters of Alitak Bay, including Lazy Bay and Kempff Bay, between a line from Cape Trinity to Cape Alitak and a line from a point on the east shore at 154 degrees 2 minutes west longitude to Akhiok Village; also all waters of Deadman Bay north of 57 degrees north latitude and all waters of Portage Bay east of 153 degrees 54 minutes west longitude.

15. All commercial fishing for salmon is prohibited, as follows:

(*a*) Western shore of Kodiak Island: All waters along the western shore of Kodiak Island between Cape Alitak and Cape Karluk.

(*b*) Karluk River: All waters within Karluk River and within 100 yards of its mouth where it breaks through Karluk Spit into Shelikof Strait.

(*c*) Kaflia Bay, on north shore of Shelikof Strait: All waters within a line from Cape Ugyak to Cape Gull.

*Steelhead fishery.*—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

*Herring fishery.*—1. Commercial fishing for herring is prohibited during the period from January 1 to July 14, both dates inclusive.

2. Commercial fishing for herring, except by gill nets, is prohibited from November 1 to December 31, both dates inclusive.

3. During the period from July 15 to October 1, both dates inclusive, commercial fishing for herring is prohibited in all waters closed throughout the year to salmon fishing.

4. The closed seasons herein specified for commercial herring fishing shall not apply to the taking of herring for bait purposes in waters otherwise open to fishing.

5. Gill nets used in catching herring shall not be of smaller mesh than 2½ inches stretched measure.

6. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

*Clam fishery.*—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

### VII. COOK INLET AREA

The Cook Inlet area is hereby defined to include Cook Inlet, its tributary waters, and all adjoining waters north of Cape Douglas and west of Point Gore. The Barren Islands are included within this area.

*Salmon fishery.*—1. Commercial fishing for salmon is prohibited from 6 o'clock postmeridian August 10 to 6 o'clock antemeridian August 25, and for the remainder of each year after 6 o'clock postmeridian September 30.

2. The use of purse seines and floating traps for the capture of salmon is prohibited.

3. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 2,500 feet.

4. Twenty-five feet of the heart walls on each side next to the pot and the bottom strip of wire of the pots of all hand traps shall be removed during the closed season for commercial salmon fishing from 6 o'clock postmeridian August 10 to 6 o'clock antemeridian August 25 of each calendar year.

5. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 200 fathoms hung measure.

6. Stake and anchored gill nets shall be operated in substantially a straight line.

7. The use of any trap for the capture of salmon is prohibited within 2 statute miles of the mouths of Chuit River and Bishop and Swansons Creeks.

8. The use of any trap for the capture of salmon is prohibited in Kachemak Bay within a line from Nubble Point to the outermost point of Homer Spit.

9. All commercial fishing is prohibited, as follows:

(*a*) Within 2 statute miles of the mouths of Kasilof and Kenai Rivers, and within 1 statute mile of all other salmon streams.

(*b*) Turnagain Arm and Knik Arm: All waters above a line from Point Possession to the western limit of the closed area around the mouth of the Susitna River.

(*c*) Chinik Inlet, Kamishak Bay: All waters within the inlet.

(*d*) Kachemak Bay: All waters above a line from Indian Island to a point on the opposite shore one-half mile below the mouth of Swift Creek.

*Steelhead fishery.*—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

*Herring fishery.*—1. Commercial fishing for herring is prohibited during the period from January 1 to July 14, both dates inclusive, in each calendar year. Commercial fishing for herring, except by set and drift gill nets, is also prohibited from November 1 to December 31, both dates inclusive, in each calendar year.

2. Commercial fishing for herring in Halibut Cove, including the waters within a line from the western end of Ismailof Island to the outermost point on Glacier Spit, is limited to gill nets.

3. Commercial fishing for herring in Halibut Cove Lagoon is limited to set gill nets not exceeding 50 fathoms in length, hung measure. All such nets shall be anchored in a substantial manner not less than 150 yards apart.

4. Nets operated within areas marked at the north and south ends of Halibut Cove Lagoon shall be anchored at right angles to the line joining the markers. Nets operated between these areas shall be anchored in a general direction paralleling the shore line.

5. The closed seasons herein specified for commercial herring fishing shall not apply to the taking of herring for bait purposes in waters otherwise open to fishing.

6. The maintaining of a herring pound or the dumping of offal and dead herring in the waters of Halibut Cove and Lagoon is prohibited.

7. Gill nets used in catching herring shall not be of smaller mesh than 3 inches stretched measure.

8. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

*Clam fishery.*—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

### VIII. RESURRECTION BAY AREA

The Resurrection Bay area is hereby defined to include all territorial coastal and tributary waters of the Gulf of Alaska between Point Gore on the west and Cape Fairfield on the east.

*Salmon fishery.*—1. The use of any trap for the capture of salmon is prohibited.

2. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 200 fathoms hung measure.

3. No set or anchored gill net shall exceed 300 yards in length, and each shall be set in substantially a straight line: *Provided,* That not to exceed 20 yards of each net may be used as a hook. Only one such hook is permitted on a net. There shall be a distance interval of at least 200 yards, both endwise and laterally, at all times between all set or anchored gill nets operated.

4. King salmon nets shall have a mesh at least 8½ inches stretched measure between knots, and red salmon nets shall have a mesh at least 5½ inches stretched measure between knots, as measured when actually in use.

5. Prior to 6 o'clock antemeridian June 6 in each year commercial fishing for salmon with nets of mesh less than 8½ inches stretched measure between knots is prohibited.

6. Commercial fishing for salmon is prohibited during the remainder of each calendar year after 6 o'clock postmeridian September 23.

7. In the waters of Resurrection Bay, within a line from Cape Resurrection to the western side of Bear Glacier at its mouth, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Friday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 60 hours: *Provided,* That this extension shall not be effective after August 23 in each year.

8. Commercial fishing for salmon within 1,000 yards of the mouths of Bear Creek and Resurrection River is prohibited at all times; and in the period from June 7 to August 23, both dates inclusive, commercial fishing for salmon is prohibited within 1,700 yards of the mouths of these streams.

*Steelhead fishery.*—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

*Clam fishery.*—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

### IX. PRINCE WILLIAM SOUND AREA

The Prince William Sound area is hereby defined to include all territorial coastal and tributary waters of the Gulf of Alaska between Cape Fairfield on the west and Point Whitshed on the east.

*Salmon fishery.*—1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 200 fathoms hung measure.

2. No salmon-fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. No purse seine shall be less than 125 meshes nor more than 150 meshes in depth, nor less than 90 fathoms nor more than 150 fathoms in length measured on the cork line. For the purpose of determining depths of seines, measurements will be upon the basis of 3½ inches stretched measure between knots. No extension to any seine in the way of leads will be permitted.

3. No set or anchored gill net shall exceed 300 yards in length, and each shall be set in substantially a straight line: *Provided,* That not to exceed 20 yards of each net may be used as a hook. Only one such hook is permitted on a net. There shall be a distance interval of at least 200 yards both endwise and laterally at all times between all set or anchored gill nets operated.

4. The use of purse seines and beach seines for the capture of salmon is prohibited in the waters along the western coast from the outer point on the north shore of Granite Bay (known as Granite Bay Point) to the light on the south shore of the entrance to Port Nellie Juan.

5. The 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours: *Provided,* That this extension shall not be effective after 6 o'clock antemeridian August 23 in each year.

6. Commercial fishing for salmon, except by trolling, is prohibited prior to 6 o'clock antemeridian June 6 in each calendar year: *Provided*, That in Drier Bay, below Williams Creek, this prohibition shall not apply to commercial fishing for salmon after May 19 in each calendar year.

7. Commercial fishing for salmon is prohibited during the remainder of each calendar year after 6 o'clock postmeridian August 5, except that in the waters along the western coast from the outer point on the north shore of Granite Bay (known as Granite Bay Point) to the light on the south shore of the entrance to Port Nellie Juan commercial fishing for salmon by trolling and gill netting is permitted through August 15.

8. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1½ statute miles.

9. Commercial fishing for salmon in the waters of Port Fidalgo east of 146 degrees 20 minutes west longitude is prohibited after 6 o'clock antemeridian July 11 in each year.

10. The use of any trap for the capture of salmon is prohibited except as follows:

(*a*) Along the coast of Squire Island within ½ statute mile of its southern extremity.

(*b*) Eastern coast of Chenega Island from its northern extremity to Chenega village.

(*c*) The coast within 1 statute mile eastward of the point where the one hundred and forty-eighth meridian of west longitude intersects the north shore of Granite Bay, west coast of Prince William Sound.

(*d*) Eastern coast of Applegate Island between the southern and northern extremities of the island.

(*e*) Eastern coast of Culross Island from a point on the southeast coast at 148 degrees 8 minutes 45 seconds west longitude to the southern point of entrance to Culross Bay, excluding Hidden Bay.

(*f*) Within 1 statute mile eastward of the southwestern extremity of Naked Island and within 1 statute mile eastward of the southwestern extremity of land on the eastern section of the island.

(*g*) Along the mainland eastward and northward from Point Pellew to 60 degrees 52 minutes 30 seconds north latitude.

(*h*) Along the mainland within 1 statute mile of the outer extremity of Granite Point, near Fairmount Island.

(*i*) Western side of Valdez Arm from Point Freemantle to 60 degrees 59 minutes 30 seconds north latitude.

(*j*) From the north side of the entrance to Sawmill Bay to a point 1 statute mile southwestward of Potato Point.

(*k*) Bligh Island south of 60 degrees 49 minutes 45 seconds north latitude.

(*l*) From the outer extremity of the point on the east coast of Boulder Bay just south of 60 degrees 51 minutes north latitude to a point ½ statute mile eastward of the southwestern extremity of Bidarka Point; and from a point on the west side of Landlocked Bay at 60 degrees 49 minutes north latitude to a point on the north shore of Port Fidalgo at 146 degrees 32 minutes west longitude.

(*m*) Within ½ statute mile of the northern extremity of the land between Two Moon Bay and Snug Corner Cove.

(*n*) Within ½ statute mile of Porcupine Point.

(*o*) Goose Island: West coast between the northern and southern extremities of the island.

(*p*) Mainland coast from a point due east of the southern extremity of Goose Island to a point east of Knowles Head at 146 degrees 37 minutes west longitude.

(*q*) Within 1 statute mile of Red Head.

(*r*) Within 2 statute miles of the light at Gravina Point.

(*s*) Within 1 statute mile of Makaka Point, Hawkins Island.

(*t*) Bear Cape northward and eastward to a point opposite Hawkins Island at 60 degrees 28 minutes north latitude.

(*u*) From a point on the south side of Port Etches 146 degrees 38 minutes west longitude to the light on Cape Hinchinbrook.

(*v*) Western coast of Montague Island from Cape Cleare to a point on the south side of Macleod Harbor at 147 degrees 50 minutes west longitude.

(*w*) Western coast of Montague Island from Point Woodcock to a point on the south side of Hanning Bay at 147 degrees 42 minutes 40 seconds west longitude.

(*x*) Western coast of Montague Island from the north side of the entrance to Hanning Bay to the southern entrance of Port Chalmers.

(*y*) Northern coast of Montague Island from Graveyard Point to Montague Point.

11. All commercial fishing for salmon is prohibited, as follows:

(*a*) Constantine Harbor, northwest arm of Port Etches: All waters within the harbor and its tributary waters and within 100 yards outside the narrows at the entrance to the harbor.

(*b*) Port Etches: All waters within 2 statute miles of the mouth of the salmon stream flowing into the head of Port Etches.

(*c*) Boswell Bay, indenting Hinchinbrook Island: All waters in the bay west of 146 degrees 8 minutes west longitude.

(*d*) Twin Lake Creek: All waters within 1,000 yards of the mouth of Twin Lake Creek flowing into the southeast arm of Simpson Bay.

(*e*) Gravina River: All waters within 1 statute mile of the mouth of the river.

(*f*) Port Fidalgo: All waters within 1,000 yards of the mouth of the stream at the head of Port Fidalgo.

(*g*) Robe River, Lowe River, and other unnamed streams flowing into Port Valdez in the immediate vicinity of Valdez: All waters within 1 statute mile of the mouths.

(*h*) Columbia Bay, Long Bay, and their tributaries, indenting mainland on north shore of Prince William Sound: All waters within 1,000 yards of the mouth of any salmon stream.

(*i*) Unakwik Inlet, indenting mainland on north shore of Prince William Sound: All waters north of an east and west line passing through the northern side of the entrance to Jonah Bay and all waters of the inlet within 1,000 yards of the mouth of any salmon stream.

(*j*) Coghill River, tributary to College Fiord: All waters within 2,000 yards outside of the mouth of the river.

(*k*) Long Bay, tributary to Culross Passage: All waters within the bay.

(*l*) Gumboot Creek, on northwest shore of Eshamy Bay: All waters within 1,000 yards of the mouth of the creek.

(*m*) Eshamy Lagoon and its tributary waters: All waters within the lagoon and its tributaries and within 100 yards outside the narrows at the entrance to the lagoon.

(*n*) Jackpot Bay: All waters within 3,000 yards of the mouth of the red salmon stream at the head of the bay.

(*o*) Port Bainbridge: All waters in the middle north arm of Port Bainbridge.

(*p*) Crab Bay, on north shore of Evans Bay, Evans Island: All waters within 1,000 yards of the mouth of any salmon stream.

(*q*) Bay of Isles, indenting east shore of Knight Island: All waters within the west arm of the bay.

*Steelhead fishery.*—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

*Herring fishery.*—1. Commercial fishing for herring is prohibited during the period from January 1 to June 26, both dates inclusive, and from November 1 to December 31, both dates inclusive, except that gill nets of not less than 2½ inches stretched measure between knots may be used from November 1 to December 15, both dates inclusive.

2. The closed seasons herein specified for commercial herring fishing shall not apply to the taking of herring for bait purposes in waters otherwise open to fishing.

3. During the period from June 25 to October 1, both dates inclusive, commercial fishing for herring is prohibited in all waters closed throughout the year to salmon fishing.

4. Gill nets used in catching herring shall not be of smaller mesh than 2¼ inches stretched measure.

5. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

*Clam fishery.*—1. It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

2. The taking of clams for commercial purposes is prohibited from 6 o'clock postmeridian July 15 to 6 o'clock postmeridian August 31 in each calendar year.

*Crab fishery.*—DUNGENESS CRAB (*Cancer magister*).—No female of this species shall be taken at any time, and no male of this species measuring less than 6½ inches in greatest width shall be taken for commercial purposes.

### X. COPPER RIVER AREA

The Copper River area is hereby defined to include all territorial coastal and tributary waters of Alaska between Point Whitshed on the west and Point Martin on the east, including Egg Islands and the other islands between these points.

*Salmon fishery.*—1. Commercial fishing for salmon is prohibited from 6 o'clock postmeridian July 5 to 6 o'clock antemeridian August 10 in each year.

2. Prior to 6 o'clock antemeridian May 15 in each year commercial fishing with nets of mesh less than 8½ inches stretched measure between knots is prohibited.

3. From May 15 to July 5, both dates inclusive, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

4. Except as specifically permitted herein, commercial fishing for salmon shall be conducted solely by drift gill nets.

5. Prior to 6 o'clock antemeridian August 10 in each calendar year the total aggregate length of drift gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 250 fathoms hung measure: *Provided*, That during the period from 6 o'clock antemeridian May 15 to 6 o'clock postmeridian May 31 any gill-net boat on the Copper River flats may carry and operate not to exceed 100 fathoms of net of mesh not less than 8½ inches stretched measure between knots in addition to 250 fathoms of smaller mesh net.

6. Prior to 6 o'clock antemeridian August 10 in each calendar year commercial fishing for salmon by means of gill nets attached to anchored boats or other anchored floating equipment is prohibited.

7. Commercial fishing for salmon is prohibited within 500 yards of the Grass Banks, except that after 6 o'clock antemeridian August 10 in each calendar year such fishing is permitted within 500 yards of the Grass Banks by means of gill nets and stake nets not exceeding 350 fathoms each in length: *Provided*, That all stakes used in connection therewith shall be removed at or before the end of the fishing season. All fishing is prohibited at all times within the sloughs and within 500 yards of their mouths.

8. Stake and anchored gill nets shall be operated in substantially a straight line.

*Steelhead fishery.*—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

*Clam fishery.*—1. It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

2. The taking of clams for commercial purposes is prohibited from 6 o'clock postmeridian July 15 to 6 o'clock postmeridian August 31 in each calendar year.

*Crab fishery*—DUNGENESS CRAB (*Cancer magister*).—No female of this species shall be taken at any time, and no male of this species measuring less than 6½ inches in greatest width shall be taken for commercial purposes.

### XI. BERING RIVER AREA

The Bering River area is hereby defined to include all territorial coastal and tributary waters of Alaska between Point Martin on the west and Cape Suckling on the east.

*Salmon fishery.*—1. In the Bering River area all commercial fishing for salmon is prohibited prior to 6 o'clock antemeridian August 10 in each year: *Provided*, That this prohibition shall not prevent the taking of fish for local food requirements or for use as dog feed.

2. Stake and anchored gill nets shall be operated in substantially a straight line.

*Steelhead fishery.*—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

*Clam fishery.*—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

## XII. SOUTHEASTERN ALASKA AREA

The southeastern Alaska area is hereby defined to include all territorial coastal and tributary waters of Alaska extending from Dixon Entrance on the south to and including Yakutat Bay on the north.

*Salmon fishery.*—This area is subdivided into the following districts, wherein regulations shall be effective as follows:

*Yakutat district.*—All waters of this area west of the one hundred and thirty-eighth meridian of west longitude.

1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 250 fathoms hung measure.
2. Stake and anchored gill nets shall be operated in substantially a straight line.
3. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1½ statute miles.
4. Commercial fishing for salmon by means of any beach seine less than 75 fathoms hung measure in length or less than 4 fathoms hung measure in depth is prohibited. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots.
5. No salmon fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. No purse seine shall be less than 175 meshes nor more than 250 meshes in depth nor less than 150 fathoms nor more than 200 fathoms in length measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots. No extension to any seine in the way of leads will be permitted.
6. The 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Friday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 60 hours.
7. Commercial fishing for salmon in Dry Bay is prohibited prior to May 21 in each year.
8. Commercial fishing for salmon is prohibited for the remainder of each calendar year after September 30.
9. All commercial fishing for salmon is prohibited, as follows:

(*a*) Ankau Creek and Inlet.
(*b*) Akwe or Ahquay River.
(*c*) The "Basin" above Dry Bay.

*Icy Strait-Cross Sound district.*—All waters of this area north of the fifty-eighth parallel of north latitude and east of the one hundred and thirty-eighth meridian of west longitude.

1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 250 fathoms hung measure.
2. Stake and anchored gill nets shall be operated in substantially a straight line.
3. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1½ statute miles.
4. Purse seines are prohibited in Lynn Canal and contiguous waters north of 58 degrees 26 minutes north latitude.
5. No salmon fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. No purse seine shall be less than 175 meshes nor more than 250 meshes in depth nor less than 150 fathoms nor more than 200 fathoms in length measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots. No extension to any seine in the way of leads will be permitted.
6. Commercial fishing for salmon, except by trolling, is prohibited prior to 6 o'clock antemeridian June 15 in each calendar year: *Provided*, That this prohibition shall not apply to the use of gill nets in Taku Inlet after 6 o'clock antemeridian May 10.
7. Commercial fishing for salmon, except by trolling, is prohibited for the remainder of each calendar year after 6 o'clock postmeridian August 6: *Provided*, That such fishing may be carried on by gill nets from 6 o'clock antemeridian September 5 to 6 o'clock postmeridian September 30 in waters open to fishing.
8. Commercial fishing for salmon in Lynn Canal and contiguous waters north of the south end of Kochu Island is prohibited, except that in these closed waters, including Chilkat Inlet outside of a line from Green Point passing across the southern shore of Pyramid Island and Chilkoot Inlet 1,000 yards outside the mouth of

Chilkoot River, such fishing is permitted by gill nets from 6 o'clock antemeridian September 5 to 6 o'clock postmeridian September 30 in each year.

9. Commercial fishing for salmon, except by gill nets, is prohibited in Dundas Bay north of 58 degrees 21 minutes north latitude.

10. Commercial fishing for salmon by means of any seine is prohibited in Idaho Inlet south of 58 degrees 8 minutes 12 seconds north latitude.

11. Commercial fishing for salmon is prohibited in Port Frederick, northern shore of Chichagof Island, in all waters east of a line from Inner Point Sophia to Game Point and in all waters south of 58 degrees 4 minutes north latitude, except that trolling will be permitted from November 1 to June 1, both dates inclusive. A portion of the waters closed is in the central district.

12. The use of any trap for the capture of salmon is prohibited, except as follows:

(*a*) Mainland: From the west side of Dundas Bay at 58 degrees 20 minutes north latitude to Point Wimbledon.

(*b*) Mainland: From the east side of Dundas Bay at 58 degrees 20 minutes north latitude to Point Dundas.

(*c*) Inian Islands: Coast north of 58 degrees 15 minutes 42 seconds north latitude, exclusive of the east end of the northeastern island.

(*d*) George Islands: That island of the George Islands group located at 58 degrees 12 minutes 18 seconds north latitude.

(*e*) Three Hill Island, Cross Sound: West coast between the northern and the southern extremities.

(*f*) Chichagof Island: East coast of Port Althorp between 58 degrees 9 minutes 42 seconds and 58 degrees 11 minutes north latitude.

(*g*) Chichagof Island: From Point Lavinia eastward to a point on the west side of Idaho Inlet at 58 degrees 12 minutes 18 seconds north latitude.

(*h*) Chichagof Island: From a point on the east side of Idaho Inlet at 58 degrees 12 minutes 18 seconds north latitude northward and eastward to 136 degrees 6 minutes 18 seconds west longitude.

(*i*) Chichagof Island: North coast from Eagle Point westward to a point on the east side of Mud Bay at 58 degrees 12 minutes 6 seconds north latitude.

(*j*) Lemesurier Island: Northwest coast between the western and the northern extremities of the island.

(*k*) Mainland: From Point Gustavus to 135 degrees 50 minutes west longitude.

(*l*) Pleasant Island: Southern coast from the western extremity of the island to Noon Point.

(*m*) Mainland: From a point on the east side of Excursion Inlet at 58 degrees 23 minutes north latitude southward to 135 degrees 8 minutes 40 seconds west longitude.

(*n*) Chichagof Island: Northeastern coast from Point Sophia to North Passage Point, exclusive of False Bay. A part of these waters is in the central district.

(*o*) Mansfield Peninsula: West coast from Point Retreat to the southern extremity of the peninsula at the north side of the entrance to Hawk Inlet, exclusive of Funter Bay.

(*p*) Admiralty Island: West coast from Parker Point to 58 degrees 3 minutes north latitude. A part of these waters is in the central district.

(*q*) Douglas Island: West coast from Middle Point to Outer Point.

(*r*) Mainland: From the south side of Limestone Inlet at 58 degrees 1 minute 45 seconds north latitude southward to a point ½ statute mile northwest of Point Styleman. A part of these waters is in the central district.

13. All commercial fishing for salmon is prohibited, as follows:

(*a*) Glacier Bay: All waters within a line from Point Carolus to Point Gustavus.

(*b*) Hawk Inlet, west coast of Admiralty Island: All waters of the inlet and its tributaries.

(*c*) Taku Inlet: All waters to the eastward of a line beginning on the shore northward of Taku Point at 133 degrees 59 minutes west longitude, thence running due north to the opposite shore, thence following the shore line to the mouth of the Taku River.

*Central district.*—All waters of this area between the fifty-seventh and fifty-eighth parallels of north latitude.

1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 250 fathoms hung measure.

2. Stake and anchored gill nets shall be operated in substantially a straight line.

3. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1 statute mile.

4. No salmon fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat.

No purse seine shall be less than 175 meshes nor more than 250 meshes in depth, nor less than 150 fathoms nor more than 200 fathoms in length measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots. No extension to any seine in the way of leads will be permitted.

5. Commercial fishing for salmon, except by trolling, is prohibited prior to 6 o'clock antemeridian June 20 in each calendar year and for the remainder of each calendar year after 6 o'clock postmeridian August 11.

6. Commercial fishing for salmon, except by trolling prior to July 1 in each year, is prohibited in Tenakee Inlet and Freshwater Bay within a line from North Passage Point to South Passage Point.

7. Commercial fishing for salmon is prohibited in Port Frederick, northern shore of Chichagof Island, in all waters east of a line from Inner Point Sophia to Game Point, and in all waters south of 58 degrees 4 minutes north latitude, except that trolling will be permitted from November 1 to June 1, both dates inclusive. A portion of the waters closed is in the Icy Strait-Cross Sound district.

8. The use of any trap for the capture of salmon is prohibited, except as follows:

(*a*) Chichagof Island: North side of Salisbury Sound from Point Leo eastward to 135 degrees 43 minutes west longitude.

(*b*) Baranof Island: Northwest coast, beginning at a point 1,000 yards southward of Point Kakul and extending southward ½ statute mile.

(*c*) Chichagof Island: Northeastern coast from Point Sophia to North Passage Point, exclusive of False Bay. A part of these waters is in the Icy Strait-Cross Sound district.

(*d*) Chichagof Island: Eastern coast from South Passage Point to Point Hayes, exclusive of Basket Bay and within ½ statute mile of each side of its entrance.

(*e*) Baranof Island: From Point Thatcher to Point Lull.

(*f*) Baranof Island: East coast from South Point to the north side of the entrance to Kasnyku Bay, exclusive of Cosmos Cove.

(*g*) Baranof Island: East coast from a point at the south side of the entrance to Kasnyku Bay at 57 degrees 12 minutes north latitude to Point Turbot.

(*h*) Admiralty Island: West coast from Parker Point to 58 degrees 3 minutes north latitude. A part of these waters is in the Icy Strait-Cross Sound district.

(*i*) Admiralty Island: West coast from Village Point to Distant Point.

(*j*) Admiralty Island: West coast from Woody Point to Rocky Point.

(*k*) Admiralty Island: West coast from a point north of Wilson Cove at 57 degrees 10 minutes 30 seconds north latitude to Point Caution.

(*l*) Admiralty Island: Southeast coast from Point Pybus to False Point Pybus.

(*m*) Admiralty Island: Southeast coast from a point at 57 degrees 13 minutes north latitude southward to Deepwater Point.

(*n*) Admiralty Island: Southeast coast from Point Brightman to Walker Point.

(*o*) Kupreanof Island: Northwest coast from a point ½ statute mile southeast of the outer extremity of Point Macartney northward to a point on the north shore at 133 degrees 50 minutes west longitude.

(*p*) Mainland: From the south side of Limestone Inlet at 58 degrees 1 minute 45 seconds north latitude southward to a point ½ statute mile northwest of Point Styleman. A part of these waters is in the Icy Strait-Cross Sound district.

(*q*) Mainland, east side of Stephens Passage: From a point on the north side of Windham Bay at 133 degrees 33 minutes west longitude to Point League.

(*r*) Mainland, between Hobart Bay and Windham Bay: From a point at 57 degrees 26 minutes north latitude to a point at 57 degrees 30 minutes north latitude.

(*s*) Mainland: From Point Hobart southeastward 3,000 yards.

(*t*) Mainland, Frederick Sound: From Cape Fanshaw to Bay Point.

9. All commercial fishing for salmon is prohibited as follows:

(*a*) Port Houghton, indenting mainland: All waters in Sanborn Canal.

(*b*) Windham Bay, indenting mainland: All waters of the bay within a line 1,000 yards outside the mouth of the narrows.

(*c*) Portage Bay, north end of Kupreanof Island: All waters within the bay and all waters within 1 statute mile outside the entrance to the bay. A portion of the waters closed is in the southern district.

(*d*) Gambier Bay, east coast of Admiralty Island: All waters west of 134 degrees west longitude.

(*e*) Wilson Cove, southwestern shore of Admiralty Island: All waters within the cove.

(*f*) Whitewater Bay, southwestern shore of Admiralty Island: All waters within a line from Point Caution to Woody Point.

(*g*) Chaik Bay, southwestern shore of Admiralty Island: All waters east of 134 degrees 29 minutes west longitude.

(*h*) Warm Spring Bay, eastern shore of Baranof Island: All waters within the bay.

(*i*) Kelp Bay, east coast of Baranof Island: All waters in Middle Arm, and all waters in South Arm west of 134 degrees 57 minutes west longitude.

(*j*) Hanus Bay, northeast shore of Baranof Island: All waters in the bay south of a line from Point Hanus to Point Moses.

(*k*) Rodman Bay, northeast coast of Baranof Island: All waters west of 135 degrees 22 minutes west longitude.

(*l*) Sitkoh Bay, southeast shore of Chichagof Island: All waters within 1,000 yards of the mouths of all salmon streams.

(*m*) Basket Bay, east coast of Chichagof Island: All waters within the bay.

(*n*) Salt Lake Lagoon, Takanis Bay, southwest shore of Yakobi Island: All waters in the lagoon and within 500 yards of its mouth.

*Stikine River district.*—All waters within a line from Babbler Point on the mainland to Woronkofski Point on Woronkofski Island, thence to Middle Craig Point on Zarembo Island, thence to Point Howe on Mitkof Island, thence to Frederick Point on Mitkof Island, thence across Frederick Sound to Horn Cliffs on the mainland, thence along the mainland to Babbler Point.

1. Commercial fishing for salmon shall be conducted solely by trolling and by drift gill nets which shall not exceed 250 fathoms in length each.

2. Commercial fishing for salmon, except by trolling, is prohibited during the period from 6 o'clock postmeridian June 10 to 6 o'clock postmeridian June 30 in each year and for the remainder of each year after 6 o'clock postmeridian September 30.

3. From April 1 to September 30, both dates inclusive, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week to 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

*Prince of Wales Island district.*—All waters of the west coast of Prince of Wales Island and adjacent islands from Cape Chacon northward to Point Baker and within a line from Point Baker to Point Colpoys, thence to Middle Craig Point on Zarembo Island, thence to Woronkofski Point on Woronkofski Island, thence to Babbler Point on the mainland, thence to Watkins Point on Cleveland Peninsula, thence following the watershed between Ernest Sound and Behm Canal to and including Lemesurier Point, thence to Tolstoi Point on Prince of Wales Island, thence following the watershed on Prince of Wales Island to Cape Chacon.

1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 250 fathoms hung measure.

2. Stake and anchored gill nets shall be operated in substantially a straight line.

3. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1 statute mile.

4. No salmon fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. No purse seine shall be less than 175 meshes nor more than 250 meshes in depth nor less than 150 fathoms nor more than 200 fathoms in length, measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots. No extension to any seine in the way of leads will be permitted.

5. Commercial fishing for salmon, except by trolling, is prohibited prior to 6 o'clock antemeridian July 15 in each calendar year, from 6 o'clock postmeridian August 22 to 6 o'clock postmeridian September 14 in each year, and for the remainder of each year after 6 o'clock postmeridian October 15.

6. Commercial fishing for salmon, except by trolling, is prohibited in Anita Bay, opening into Zimovia Strait, Etolin Island.

7. The use of any trap for the capture of salmon is prohibited, except as follows:

(*a*) Prince of Wales Island: Northwest coast from a point at 56 degrees 17 minutes north latitude southward to a point at 56 degrees 13 minutes north latitude, excluding the coast within ½ statute mile of either side of Hole in the Wall.

(*b*) Barrier Island, near northwest coast of Prince of Wales Island.

(c) Kosciusko Island: Western coast between the southern extremity of land at the west side of Halibut Harbor northward to Ruins Point at 133 degrees 40 minutes west longitude.
(d) Warren Island, near Kosciusko Island: Warren Island, exclusive of Warren Cove and False Cove.
(e) Kosciusko Island: Eastern coast from a point ½ statute mile west of Van Sant Cove to a point ½ statute mile east of the east side of the entrance to Edna Bay.
(f) Cap Island, near Tuxekan Island: West side of Cap Island from the southern extremity to a point on the north shore at 133 degrees 21 minutes west longitude.
(g) Tuxekan Island: Western coast from a point at 55 degrees 52 minutes 50 seconds north latitude to a point ¼ statute mile northwest of the southern extremity.
(h) Heceta Island: Northeast end from a point at 55 degrees 48 minutes north latitude in a northwesterly direction for a distance of 1 statute mile.
(i) Heceta Island: Northern shore from a point on the east side of Port Alice at 55 degrees 49 minutes 45 seconds north latitude to the point at approximately 55 degrees 49 minutes 10 seconds north latitude and 133 degrees 31 minutes west longitude.
(j) Heceta Island: Western and southern coasts from Cape Lynch to a point at 55 degrees 44 minutes north latitude and approximately 133 degrees 29 minutes 20 seconds west longitude.
(k) Heceta Island: Southern coast between 133 degrees 23 minutes west longitude and 133 degrees 26 minutes west longitude.
(l) Culebra Island: Coast west of 133 degrees 26 minutes 30 seconds west longitude.
(m) St. Philip Island: Coast west of 133 degrees 25 minutes west longitude.
(n) Blanquizal Island: Coast west of 133 degrees 24 minutes west longitude.
(o) Prince of Wales Island: Coast along San Christoval Channel from a point at 55 degrees 37 minutes north latitude southward to 133 degrees 16 minutes west longitude.
(p) Point Ildefonso: Within ¼ statute mile of the western extremity.
(q) Esquibel Island: East coast from the southern extremity of the island to a point at 55 degrees 38 minutes 40 seconds north latitude.
(r) St. Joseph Island, north of Noyes Island.
(s) Noyes Island: West and north coast between Cape Addington and 133 degrees 40 minutes west longitude.
(t) San Fernando Island: Northern coast from Point Garcia to Point Santa Lucia.
(u) San Fernando Island: Southeastern coast from Fern Point to Point Amargura.
(v) Entrance Point Island, near Klawak Inlet: West coast between the northern and southern extremities.
(w) San Juan Bautista Island: Coast south of 54 degrees 25 minutes 45 seconds north latitude.
(x) Baker Island: East coast from Point San Roque to Pepper Point and from Point Maria to Point Capones.
(y) Suemez Island: Northern coast from the north side of the entrance to Port Santa Cruz to a point at 55 degrees 20 minutes north latitude and approximately 133 degrees 19 minutes west longitude.
(z) Prince of Wales Island: Coast between Point Providence and Point Lomas.
(aa) Dall Island: East coast from 54 degrees 57 minutes 40 seconds north latitude to 55 degrees north latitude.
(bb) Dall Island: From Kaigani Village to a point on the coast 1 statute mile northwestward.
(cc) Long Island, east of Dall Island: Coast south of 54 degrees 47 minutes north latitude.
(dd) Sukkwan Island: Southwestern coast from 55 degrees 2 minutes 30 seconds north latitude to the southern extremity of the island, exclusive of the waters of Kasook Inlet and its tributaries and branches.
(ee) Prince of Wales Island: From Point Webster to Shipwreck Point, exclusive of the waters of Kassa Inlet and its tributaries and branches.
(ff) Prince of Wales Island: From the extremity of land at 54 degrees 43 minutes 5 seconds north latitude, 132 degrees 13 minutes 35 seconds west longitude, to a point west of Nichols Bay at 132 degrees 8 minutes west longtitude and approximately 54 degrees 41 minutes 20 seconds north latitude.

(*gg*) Prince of Wales Island: From a point near Nichols Bay at 132 degrees 5 minutes west longitude eastward and northward to a point at approximately 54 degrees 45 minutes north latitude, 132 degrees west longitude. A part of these waters is in the southern district.

(*hh*) Prince of Wales Island: North coast between Point Baker and 133 degrees 20 minutes west longitude.

(*ii*) Prince of Wales Island: North coast from Pine Point to Point Colpoys.

(*jj*) Zarembo Island: West coast from Point St. John to a point southward of McNamara Point at 132 degrees 58 minutes 20 seconds west longitude. A part of these waters is in the southern district.

(*kk*) Etolin Island: West coast from 56 degrees 18 minutes north latitude southward to Steamer Point.

(*ll*) Etolin Island: West coast from 56 degrees 9 minutes 15 seconds north latitude southward to 56 degrees 3 minutes north latitude, 132 degrees 38 minutes 40 seconds west longitude.

(*mm*) Marsh Island, off west coast of Etolin Island: West coast of Marsh Island between the northern and the southern extremities.

(*nn*) East Island: East coast between the northern and the southeastern extremities.

(*oo*) Blashke Island: Coast west of 132 degrees 55 minutes west longitude.

(*pp*) Coffman Island: East coast between the northern and the southern extremities.

(*qq*) Prince of Wales Island: Within ½ statute mile southeastward of the extremity of land at approximately 56 degrees 1 minute 16 seconds north latitude, 132 degrees 49 minutes 40 seconds west longitude.

(*rr*) Prince of Wales Island: East coast from a point ½ statute mile northwest of Luck Point to a point at 55 degrees 46 minutes 30 seconds north latitude, exclusive of ½ statute mile each side of the mouth of Eagle Creek.

(*ss*) Onslow Island: West coast from Gull Point to Ernest Point.

(*tt*) Brownson Island: From the southern extremity of the island eastward and northward to 55 degrees 59 minutes north latitude.

(*uu*) Cleveland Peninsula: West coast from ½ statute mile east of Watkins Point southward to a point ½ statute mile north of Emerald Bay. A part of these waters is in the southern district.

(*vv*) Cleveland Peninsula: From Lemesurier Point to a point at 55 degrees 34 minutes 30 seconds north latitude near the south side of the entrance to Smugglers Cove. A part of these waters is in the southern district.

8. All commercial fishing for salmon is prohibited as follows:

(*a*) Thorne and Tolstoi Bays, indenting the eastern shore of Prince of Wales Island: All waters within a line from Tolstoi Point to Thorne Head.

(*b*) McHenry Inlet, southwest coast of Etolin Island: All waters within 1,000 yards of the salmon streams emptying into the head of McHenry Inlet.

(*c*) Rocky Bay, west coast of Etolin Island: All waters within 1 statute mile of the head of the bay.

(*d*) Thoms Place, indenting the southwestern shore of Wrangell Island, Zimovia Strait.

(*e*) Olive Cove, indenting the northeastern shore of Etolin Island.

(*f*) Eagle Creek, about 1 mile south of Luck Point, northeast coast of Prince of Wales Island: All waters within ½ statute mile of the mouth of the creek.

(*g*) Barnes Lake, at head of Lake Bay, northeast coast of Prince of Wales Island: All waters in Barnes Lake and within 50 yards outside its entrance.

(*h*) Whale Passage, northeast coast of Prince of Wales Island: All waters within 1,000 yards from mouths of all salmon streams.

(*i*) Salmon Bay, northeast coast of Prince of Wales Island: All waters within the bay and all waters within 1 statute mile of the mouth of the bay.

(*j*) Red Bay, north shore of Prince of Wales Island: All waters south of a true east and west line passing through the north shore of Dead Island.

(*k*) Hole in the Wall, west coast of Prince of Wales Island: All waters within the outermost points of the cove.

(*l*) Shipley Bay, west coast of Kosciusko Island: All waters east of 133 degrees 32 minutes 30 seconds west longitude.

(*m*) Sarkar Cove, west coast of Prince of Wales Island, tributary to El Capitan Passage: All waters inside of a line across the entrance.

(*n*) Naukati Bay, west coast of Prince of Wales Island: All waters within the bay.

(*o*) Staney Creek, west coast of Prince of Wales Island: All waters within 1 statute mile of the mouth of the creek.

(*p*) Trocadero Bay, west coast of Prince of Wales Island: All waters in the bay east of a true north and south line passing through the eastern extremity of the peninsula just south of Copper Mine.

(*q*) North Bay, northeast coast of Dall Island: All waters within 1,000 yards of the mouths of all salmon streams.

(*r*) Kasook Inlet, southern coast of Sukkwan Island: All waters within 1 statute mile of head of inlet.

(*s*) Hetta Inlet, west coast of Prince of Wales Island: All waters north of a line running east, magnetic, from Eek Point to the opposite shore.

(*t*) Nutkwa Lagoon, west coast of Prince of Wales Island: All waters within the lagoon and within 500 yards of the foot of the rapids at the outlet of the lagoon at mean low water.

(*u*) Hunter Bay, southwest coast of Prince of Wales Island: All waters of the bay and its tributaries within a line from Turn Point to the southwestern extremity of Gusdagane Point.

*Southern district.*—All waters south of the fifty-seventh parallel of north latitude, exclusive of the Stikine River and Prince of Wales Island districts herein described.

1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 250 fathoms hung measure.

2. Stake and anchored gill nets shall be operated in substantially a straight line.

3. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1 statute mile.

4. No salmon fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. No purse seine shall be less than 175 meshes nor more than 250 meshes in depth nor less than 150 fathoms nor more than 200 fathoms in length measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots. No extension to any seine in the way of leads will be permitted.

5. Commercial fishing for salmon, except by trolling, is prohibited prior to 6 o'clock antemeridian June 25 in each calendar year, from 6 o'clock postmeridian August 18 to 6 o'clock postmeridian September 14 in each year, and for the remainder of each calendar year after 6 o'clock postmeridian October 15.

6. The use of any trap for the capture of salmon is prohibited, except as follows:

(*a*) Kuiu Island: Within ¼ statute mile of the western extremity of Cornwallis Point.

(*b*) Kuiu Island: Northwest coast from a point 1 statute mile north of the north side of the entrance to Washington Bay northward to the point at the east side of the entrance to Band Cove.

(*c*) Kuiu Island: East coast of peninsula between Port Beauclerc and Reid Bay from 56 degrees 17 minutes north latitude northward to 56 degrees 20 minutes north latitude.

(*d*) Kuiu Island: East coast from Point Amelius northward to 56 degrees 13 minutes 20 seconds north latitude.

(*e*) Kuiu Island: Southern extremity of Kuiu Island from a point west of Cape Decision at 134 degrees 9 minutes west longitude to a point northeast of Cape Decision near the entrance to Port Arthur at 56 degrees 3 minutes north latitude.

(*f*) Kupreanof Island: Southern coast from Point Barrie to a point outside of Totem Bay at 133 degrees 25 minutes 30 seconds west longitude.

(*g*) Zarembo Island: West coast from Point St. John to a point southward of McNamara Point at 132 degrees 58 minutes 20 seconds west longitude. A part of these waters is in the Prince of Wales Island district.

(*h*) Prince of Wales Island: East coast from the eastern end of Grindall Point at 55 degrees 27 minutes 30 seconds north latitude northward to Tolstoi Point.

(*i*) Grindall Island, off Grindall Point, Prince of Wales Island.

(*j*) Prince of Wales Island: East coast from the northern extremity of Clover Point to Skowl Point.

(*k*) Prince of Wales Island: East coast from 55 degrees 8 minutes 20 seconds north latitude to the northern extremity of Chasina Point, including Wedge Island.

(*l*) Prince of Wales Island: East coast from Point Halliday to Adams Point.

(*m*) Prince of Wales Island: East coast from Ingraham Point to Rip Point, including Polk Island.

(*n*) Prince of Wales Island: East coast from 54 degrees 57 minutes north latitude to the south side of the entrance to Ingraham Bay.

(*o*) Prince of Wales Island: From the outer point of land on the north side of Kendrick Bay at approximately 131 degrees 58 minutes 30 seconds west longitude northward to 54 degrees 55 minutes 10 seconds north latitude.

(*p*) Prince of Wales Island: From Island Point northward to a point on the south side of Kendrick Bay at 132 degrees west longitude.

(*q*) Prince of Wales Island: East coast from McLean Point to a point ½ statute mile southward.

(*r*) Prince of Wales Island: From a point near Nichols Bay at 132 degrees 5 minutes west longitude eastward and northward to a point at approximately 54 degrees 45 minutes north latitude, 132 degrees west longitude. A part of these waters is in the Prince of Wales Island district.

(*s*) Deer Island: West coast from a point at 56 degrees 3 minutes north latitude to Kuakan Point.

(*t*) Cleveland Peninsula: West coast from ½ statute mile east of Watkins Point southward to a point ½ statute mile north of Emerald Bay. A part of these waters is in the Prince of Wales Island district.

(*u*) Cleveland Peninsula: From Lemesurier Point to a point at 55 degrees 34 minutes 30 seconds north latitude near the south side of the entrance to Smugglers Cove. A part of these waters is in the Prince of Wales Island district.

(*v*) Revillagigedo Island: West coast from 55 degrees 40 minutes north latitude southward to Indian Point.

(*w*) Betton Island: West coast between the northern and southern extremities of the island.

(*x*) Guard Island.

(*y*) Gravina Island: Western and southern coasts from South Vallenar Point to a point at 55 degrees 11 minutes 30 seconds north latitude near the south side of the entrance to Bostwick Inlet, including Bronaugh Island.

(*z*) Gravina Island: East coast from Bostwick Point northward to the outer extremity of Blank Point.

(*aa*) Annette Island: West coast from a point 1½ statute miles south of Walden Point to Davison Point.

(*bb*) Annette Island: East coast from Reef Point to a point 1 statute mile northeast of Annette Point.

(*cc*) Revillagigedo Island: Southwest coast from Carroll Point southward and eastward to a point on the west side of Moth Bay due west of the southern extremity of Moth Point.

(*dd*) Revillagigedo Island: From Cone Point eastward and northward to Sharp Point, including Cone Island.

(*ee*) Mainland peninsula between Smeaton Bay and Boca de Quadra: From Point Nelson westward and southward to a point near Quadra Point at 131 degrees west longitude.

(*ff*) Mainland south of Boca de Quadra: From a point south of Kah Shakes Cove at 55 degrees 1 minute 54 seconds north latitude, 131 degrees west longitude, southward to Kirk Point.

(*gg*) Mainland south of Very Inlet: From within 1 statute mile northward and eastward of Foggy Point to the southern extremity of Cape Fox.

(*hh*) Duke Island: East coast from a point on the north side of Ray Anchorage at 54 degrees 56 minutes 35 seconds north latitude northward to the outer extremity of Flag Point.

(*ii*) Duke Island: East coast from a point on the south shore near Kelp Island at 131 degrees 15 minutes 12 seconds west longitude northward to a point on the south side of Ray Anchorage at 131 degrees 13 minutes west longitude.

(*jj*) Duke Island: Southwest coast from a point on the east side of Hall Cove at 54 degrees 53 minutes 24 seconds north latitude to the southern extremity of Cape Northumberland.

(*kk*) Kelp Island: Southern coast between the eastern and western extremities of the island.

(*ll*) The Lord Islands.

(*mm*) Kanagunut Island: West coast between the northwestern extremity of the island and Garnet Point.

7. All commercial fishing for salmon is prohibited, as follows:

(*a*) Hidden Inlet, indenting mainland: All waters in the inlet north of 55 degrees north latitude.

(*b*) Fillmore Inlet, indenting mainland: All waters east of 130 degrees 30 minutes west longitude.

(*c*) Ray Anchorage, east coast of Duke Island: All waters in Ray Anchorage.

(*d*) Very Inlet, indenting mainland: All waters within the inlet.

(*e*) Boca de Quadra, indenting mainland: All waters within 1 statute mile of the mouth of Sockeye Creek.

(*f*) George Inlet, southern coast of Revillagigedo Island: All waters north of a line from Bat Point to Tsa Cove.

(*g*) Smeaton Bay, indenting mainland: All waters in Wilson and Bakewell Arms east of 130 degrees 40 minutes west longitude.

(*h*) Rudyerd Bay, indenting mainland: All waters in the north arm within 2 statute miles of the mouths of all salmon streams.

(*i*) Walker Cove, indenting mainland, tributary to Behm Canal: All waters within a line from Ledge Point to Hut Point.

(*j*) Chickamin River: All waters within a line from Fish Point to Trap Point.

(*k*) Yes Bay, Cleveland Peninsula: All waters within the bay and all waters outside the entrance within 1,000 yards of a line from Bluff Point to Syble Point.

(*l*) Shrimp Bay, west coast of Revillagigedo Island: All waters east of a line running south from Dress Point to the opposite shore.

(*m*) Traitors Cove, west coast of Revillagigedo Island: All waters of the cove within a line 50 yards outside the neck of the salt-water lagoon.

(*n*) Naha and Moser Bays, west shore of Revillagigedo Island: The waters of Long Arm and Moser Bay inside of a line from Cod Point to the opposite shore at 131 degrees 40 minutes west longitude and the waters of Naha Bay inside of a line extending due north from Cod Point.

(*o*) Moira Sound, east coast of Prince of Wales Island: All waters in South Arm, Frederick Cove, Kegan Cove, and within 1,000 yards of the mouths of all salmon streams in Johnson Cove.

(*p*) Cholmondeley Sound, east coast of Prince of Wales Island: All waters in Dora Bay and Sunny Cove.

(*q*) Skowl Arm, Prince of Wales Island: All waters within a line from Old Kasaan village to Khayyam Point.

(*r*) Kasaan Bay, east coast of Prince of Wales Island: All waters north of a line from Sandy Point to the east shore of the bay.

(*s*) Bradfield Canal: All waters of Bradfield Canal between a line from Point Warde to the point at the east side of the entrance to Fools Inlet and a north and south line at 131 degrees 47 minutes west longitude.

(*t*) Blake Channel: All waters of Blake Channel south of 56 degrees 14 minutes 30 seconds north latitude.

(*u*) Wrangell Narrows: All waters between Point Alexander and Prolewy Point.

(*v*) Portage Bay, north end of Kupreanof Island: All waters within the bay and all waters within 1 statute mile outside the entrance to the bay. A portion of the waters closed is in the central district.

(*w*) Barrie Creek, north of Point Barrie, southwest shore of Kupreanof Island: All waters within 1 statute mile of the mouth of the creek.

(*x*) Hamilton Bay, west coast of Kupreanof Island: All waters east of 133 degrees 49 minutes west longitude.

(*y*) Three Mile Arm, east coast of Kuiu Island: All waters within 1,000 yards of the mouths of all salmon streams.

(*z*) Seclusion Harbor, east coast of Kuiu Island: All waters within the outermost points of the harbor.

(*aa*) Port Beauclerc, southeastern coast of Kuiu Island: All waters within 1,000 yards of the mouths of all salmon streams tributary to Port Beauclerc.

(*bb*) Affleck Canal, southeastern coast of Kuiu Island: All waters within 1,000 yards of the mouths of all salmon streams tributary to Affleck Canal.

(*cc*) Tebenkof Bay, west coast of Kuiu Island: All waters in north arm of bay.

(*dd*) Bay of Pillars, west coast of Kuiu Island: All waters in south arm of bay.

(*ee*) Security Bay, northwest shore of Kuiu Island: All waters within 1,000 yards of all salmon streams.

(*ff*) Saginaw Bay, northwest coast of Kuiu Island: All waters of the bay inside of a line beginning at the point of land at the northwest side of the entrance to Halleck Harbor and passing in a southwesterly direction at right angles to the general trend of the bay to the opposite shore.

(*gg*) Red Bluff Bay, east coast of Baranof Island: All waters in the bay; the waters of Falls Creek Bay are included.

(*hh*) Gut Bay, east coast of Baranof Island: All waters of the bay.

(*ii*) Little Port Walter, east coast of Baranof Island: All waters in Little Port Walter.

(*jj*) Redfish Bay, southwest shore of Baranof Island: All waters above a true east and west line passing through the southern end of the Second Narrows.

(*kk*) Still Harbor, west coast of Baranof Island: All waters in the harbor.

(*ll*) Port Banks, off Whale Bay, west coast of Baranof Island: All waters in Port Banks.

(*mm*) Redoubt Bay, west coast of Baranof Island: All waters within 1,000 yards of the mouth of the stream flowing from Redoubt Lake.

*Steelhead fishery.*—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

*Herring fishery.*—1. During the period from June 1 to October 15, both dates inclusive, commercial fishing for herring is prohibited in all waters closed throughout the year to salmon fishing.

2. Commercial fishing for herring is prohibited during the period from January 1 to May 31, both dates inclusive, and from October 1 to December 31, both dates inclusive, in each calendar year.

3. The closed seasons herein specified for commercial herring fishing shall not apply to the taking of herring for bait purposes in waters otherwise open to fishing.

4. Commercial fishing for herring, except for bait purposes, is prohibited from 6 o'clock postmeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following.

5. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

6. All commercial fishing, including bait fishing, for herring is prohibited throughout the year in the waters of Kanalku Bay, Admiralty Island.

7. Seines used in commercial fishing, including bait fishing, for herring in Klawak Harbor within a true east and west line passing through the northern extremity of Klawak Island shall not exceed 90 fathoms hung measure in length nor 500 meshes in depth. For the purpose of determining depths of such seines measurements will be upon the basis of 1½ inches stretched measure between knots. No such seine shall have a mesh of less than 1½ inches stretched measure between knots.

*Clam fishery.*—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

*Shrimp fishery.*—Commercial fishing for shrimps is prohibited in the period from March 15 to April 30, both dates inclusive, in each year.

*Crab fishery*—DUNGENESS CRAB (*Cancer magister*).—No female of this species shall be taken at any time, and no male of this species measuring less than 6½ inches in greatest width shall be taken for commercial purposes.

## GENERAL REGULATIONS

By virtue of the authority conferred by the acts approved June 6, 1924, and June 26, 1906, the following regulations shall be effective in all waters of Alaska, including the special areas already described above:

1. During closed periods all salmon traps within the areas affected shall be closed in accordance with the method prescribed by section 5 of the act of June 6, 1924, and in addition the spillers of all driven traps shall be raised to within 4 feet of the capping and the spillers of floating traps shall be raised to within 4 feet of the surface within 36 hours after the beginning of any seasonal closed period. Within 36 hours after the beginning of any seasonal closed period the tunnels from pots to spillers of all traps shall be entirely disconnected. In respect to traps not provided with spillers, the requirements in regard to spillers shall apply to the pots.

2. All persons engaged in fishery operations are warned to give due regard to all markers erected by the Department of Commerce.

3. In waters where a rack or weir is maintained by the Bureau of Fisheries for the purpose of counting salmon ascending to the spawning grounds, records of the catch of salmon shall be furnished daily by all operators to the local representative of the Bureau of Fisheries in charge, and upon notification by the Commissioner of Fisheries or his authorized representative that an excessive proportion of the run is being taken so that the escapement of any species is less than the 50 per cent specified by section 2 of the act of June 6, 1924, all commercial fishing operations shall at once be discontinued and shall not be resumed until permission therefor is granted by the Commissioner of Fisheries or his duly authorized representative. And if in any year it shall appear that the run

of salmon in such waters has diminished there shall be required a correspondingly increased escapement, and upon notification by the Commissioner of Fisheries or his authorized representative all commercial fishery operations shall cease and shall not be resumed until such increased escapement has been secured.

4. The driving of salmon downstream and the causing of salmon to go outside the protected area at the mouth of any salmon stream are expressly prohibited.

5. During the inspection of the salmon fisheries by the agents and representatives of this department they shall have at all times free and unobstructed access to all canneries, salteries, and other fishing establishments and to all hatcheries.

6. All persons, companies, or corporations owning, operating, or using any stake net, set net, trap net, pound net, or fish wheel for taking salmon or other fishes shall cause to be placed in a conspicuous place on said trap net, pound net, stake net, set net, or fish wheel the name of the person, company, or corporation owning, operating, or using same, together with a distinctive number, letter, or name which shall identify each particular stake net, set net, trap net, pound net, or fish wheel, said lettering and numbering to consist of black figures and letters, not less than 6 inches in length, painted on white ground.

7. If in the process of curing salmon bellies the remaining edible portion of the fish is not used, such action will be regarded as wanton waste within the meaning of section 8 of the act of June 26, 1906, and those who engage in this practice will be reported for prosecution as provided for in the act.

8. These regulations do not apply to the Afognak Reservation, fishing within which is prohibited, except by resident natives, by the terms of the law and Executive order creating it.

9. The taking of salmon for fox feed shall be considered as commercial fishing and subject to all of the limitations in respect thereto.

10. Any increase in the amount of fishing gear employed or any expansion of fishery operations in any district in any season shall, in the discretion of the Secretary of Commerce, result in the immediate imposition of such additional restrictions as may appear necessary.

11. These regulations shall be subject to such change or revision by the Secretary of Commerce as may appear advisable from time to time. They shall be in full force and effect immediately from and after January 1, 1928.

## AFOGNAK RESERVE

Local permits for salmon-fishing in Afognak Reserve waters in 1927 were granted to 56 native residents of Afognak Island and 30 of Spruce Island, a total of 86. A fisheries warden supervised all commercial operations, which were confined solely to beach seines and carried on in eight localities. Fishing commenced on June 6, except at Paramanof Bay, where it was not allowed until June 22. No commercial fishing was permitted in Litnik Bay. The total commercial catch was 241,490 salmon, or 56,248 less than in 1926, the largest catch of record in the reservation. The catch of reds decreased 117,415, while that of cohos increased 1,027, chums 1,415, humpbacks 58,553, and kings 172. The fish were sold to the Grimes Packing Co., Kadiak Fisheries Co., Katmai Packing Co., Kodiak Island Fishing & Packing Co., and Pajoman and Trout. Several thousand salmon caught and used for food by the natives are not included in the above figures.

The escapement of salmon into the various streams of the reservation, while not large, was proportionate to the run. Because of very low water in the majority of the spawning streams bears destroyed more fish than usual.

A weir for fish-cultural purposes was maintained on Litnik River below the Afognak hatchery. The first ascending red salmon passed through on June 20 and the last on August 10, after which date none was observed in the river below the weir. On August 31 the weir was closed to prevent the further ascent of cohos to the lake. The total number of red salmon counted through the weir was 7,491.

In view of the requirement that all commercial fishing in the reserve be done by resident natives, herring packers recruited some 35 men (comprising seven herring-seining crews) among the Afognak natives, who earlier in the season had been engaged in the salmon fishery. Little success was attained, partly due to lack of experience but chiefly because the herring did not enter the waters of the reserve in great numbers during the season of 1927.

## ANNETTE ISLAND FISHERY RESERVE

The Annette Island Packing Co. again operated in the Annette Island Fishery Reserve in 1927 under its lease from the Department of the Interior. Data regarding fishery operations have been furnished by the Bureau of Education of that department, which administers the affairs of the reserve for the benefit of the Metlakatla Indians residing there.

In 1927 the total number of fish taken from traps within the reserve was 120,954 of all species, on which the minimum royalty of $6,000 was paid. If royalties based on the number of fish actually taken had been paid the amount would have been but $1,917.58. The case tax on canned salmon under the Territorial law, which is payable to the Metlakatla Indians, amounted to $468.94; trap fees on six traps, at $200 each, amounted to $1,200; and rental of cannery buildings was $3,000. In addition, $21,674.33 was paid to 152 natives for labor, $3,051.73 for lumber and piling, and $2.30 for fish taken by seines, making a grand total of $35,397.30 disbursed by the Annette Island Packing Co. to the natives for 1927 operations. The corresponding disbursements during the preceding year were $73,465.65.

## ALASKA FISHERY INTELLIGENCE SERVICE

As in former years, the bureau continued to report by telegraph to the important points in southeastern and central Alaska the prices of fresh fish (chiefly halibut) at Ketchikan. This service was discontinued during the halibut closed season, as only small quantities of other fresh fish are sold during that period.

## STREAM MARKING

A consistent plan of stream marking to show waters not open to fishing is being carried out each year, and all bureau boats in the Alaska service are engaged in that work from time to time, but chiefly during the early spring. Most of the salmon streams have been marked, but it is necessary to inspect each district in order to replace markers that have disappeared or become defaced and to move those showing the limits of closed areas changed by regulations.

## STREAM GUARDS

The bureau employed 151 men in 1927 as stream guards and special employees in connection with law-enforcement duties. Of these, 79 were stationed in southeastern Alaska, 51 in central, and 21 in western Alaska. Some of the temporary workers were engaged for only a few days, but the period of employment of the stream guards ranged from two to five months.

In southeastern Alaska 37 furnished their own launches and were assigned to patrol larger bodies of water or in the vicinity of several streams. The guards with ordinary camping equipment and rowboat (the latter in many cases equipped with outboard motor) were assigned to smaller areas and to important individual salmon streams. Four guards were placed on chartered patrol boats.

In central Akaska 13 guards were stationed at various points in the Seward-Katalla district, 11 on Cook Inlet (one of whom furnished his own launch), 14 in the Kodiak-Afognak district, 4 at Chignik, and 9 in the Ikatan-Shumagin district.

In western Alaska 18 guards were on Bristol Bay waters and 3 in the Yukon-Kuskokwim district.

Five special employees were engaged in scientific work—one on herring in central Alaska, three on salmon investigations in the central district, and one tagging troll-caught salmon in southeastern Alaska.

In addition to the foregoing there were 13 regular statutory employees, 36 men on the bureau's vessels, and 17 on the 10 chartered boats. These, together with the stream guards, make a total of 222 persons identified with fishery protective work in Alaska in 1927, as compared with 216 in 1926.

## VESSEL PATROL

Eleven vessels owned by the bureau were operated in fishery-patrol work in Alaska in 1927. Of these, the *Brant* and the *Kittiwake* were used in southeastern and central Alaska, the latter patrolling in Cook Inlet until the first part of September, when it was transferred to the west coast of Prince of Wales Island. The *Widgeon*, *Murre*, *Auklet*, and *Petrel* were used in southeastern Alaska, the *Petrel* for that part of the season after September 20 only, its late arrival being due to delay in installing a new engine; the *Blue Wing* at Kodiak and Afognak Islands; the *Ibis* at Chignik; the *Merganser* in the Ikatan-Shumagin region; the *Scoter* in Bristol Bay; and the *Tern* on the Yukon River. Seven launches and a dory transferred to the bureau by Bristol Bay salmon packers were used incidentally in fishery patrol in that district.

The following chartered vessels were used in fisheries patrol: *Valkyrie*, *Gloria*, *Pheasant*, *Anona*, and *Yakobi* in southeastern Alaska; *Pilot* and *Prospector* in Prince William Sound; *Auk* in the Ikatan-Shumagin district; and *Robin* on the Kuskokwim River. In addition, the *T-433* was chartered for work in tagging troll-caught salmon in the southeastern district.

A new patrol vessel, the *Teal*, was built at North Bend, Oreg., in 1927 but was not ready for service in Alaska during the season. The *Teal* is 78 feet long and has a beam of 18 feet and a draft of 6½ feet. A 6-cylinder 150-horsepower Diesel engine gives an ordinary cruising speed of 9½ knots. The vessel has complete modern auxiliary equipment and excellent accommodations, including cabin, messroom, galley, and master's stateroom in the deck house, while below aft there are two 3-berth staterooms for passengers and forward a large forecastle and two double staterooms for the crew.

## COMPLAINTS AND PROSECUTIONS

During the season of 1927 two salmon traps in southeastern Alaska were seized for fishing illegally in weekly closed periods. The watchman on a trap owned by Steve Selig and situated on a small island off

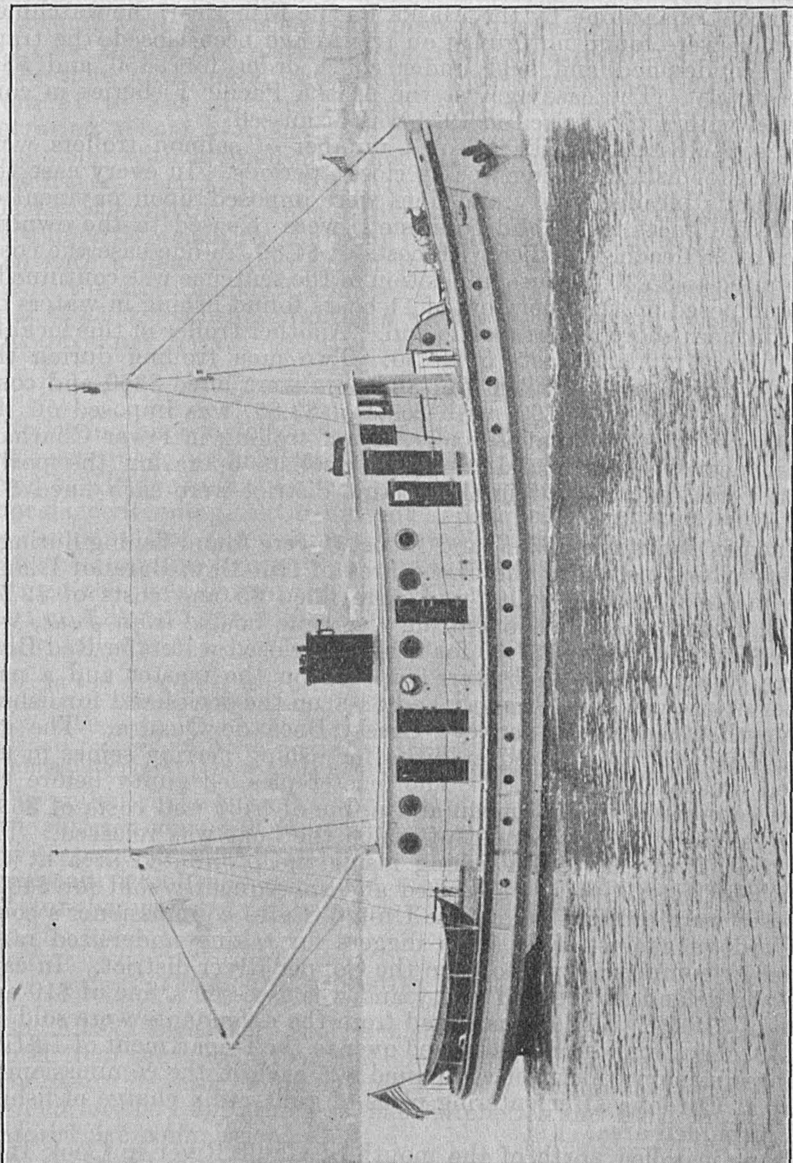

FIG. 1.—Alaska fisheries patrol vessel *Teal*

the west coast of Duke Island pleaded guilty before the United States commissioner, assuming all responsibility, and was fined $600. The other trap belonged to the North Pacific Trading & Packing Co., and was located on the northwest shore of Heceta Island. The superintendent of the company, through his attorney, pleaded guilty in the United States district court and was fined $1,000 and costs of $8. The traps were released to the owners.

Two cases that have been before the court at Juneau since July 13, 1926, in connection with the seizure of traps (one owned by P. E. Harris & Co. and one by the Alaska Pacific Fisheries), the watchmen of which were found not guilty on trial, have been closed, the traps being condemned and sold under court order for $450 and $80, respectively. The case against the Alaska Pacific Fisheries in connection with a trap seized in 1924 was dismissed.

In southeastern Alaska, also, a number of salmon trollers were arrested for fishing during weekly closed periods. In every case the defendants pleaded guilty and fines were imposed, upon payment of which the boats, gear, and equipment were released to the owners. Fines of $60 each, together with costs of $4.80 (in one case the costs amounted to $5.30 because imposition of the sentence was continued), were imposed on the operators of 11 boats found fishing in waters off the southern shore of Baranof Island. Another troller in this locality was fined $110 and costs of $5.80. Two men trolling during the weekly closed period on the *Elk* and *Olga* were fined $350 and costs of $6.35. A fine of $100, with costs of $3.85, was imposed on the operator of the gas boat *Islander*, found trolling in lower Chatham Strait near Woden Island; and two trollers operating the power boats *Olive* and *T-1505* in the Stikine district were each fined $10 and costs of $7.70.

The gas boats *Era 202-T* and *Mabel C* were found fishing during a weekly closed period in the closed area of Gut Bay, Baranof Island. The masters pleaded guilty and were fined $5 and costs of $2.50. W. C. Lewis, an Indian operating the seine boat *Vivian June*, was fined $400 and costs of $7.60 for fishing in closed waters in Red Bluff Bay. Fines of $150 each were imposed on the master and a part owner of the gas boat *Stranger* and $100 on the deck hand for fishing above the markers at Sockeye Creek, Boca de Quadra. The gas boat *Sveta Ana* was seized at Sitka for fishing herring seines in the closed area of Redfish Bay. The master pleaded guilty before the court commissioner at Juneau and a fine of $400 and costs of $6.85 were assessed, upon payment of which the boat was released. The gas boat *M & M*, found fishing inside the prohibited area at the mouth of Hetta Creek, was seized and subsequently sold for $460.

Cases were brought before the United States commissioner's court at Cordova against three clam diggers for taking undersized razor clams for commercial purposes in the Copper River district. In each case the defendant pleaded guilty and was assessed a fine of $10 and costs of $12.50. The clams seized from the defendants were sold for $32.30, check for which was turned over to the Department of Justice.

Three salmon fishermen were fined $25 each in the commissioner's court at Cordova after entering pleas of guilty to a charge of fishing in a forbidden area.

Traps installed north of the mouth of Chuit River in Cook Inlet by the Alaska General Fisheries and Frank Smith were found to be less than the required distance interval of 1 mile apart. The owners were notified that on completion of the second trap both would be illegal structures, subject to seizure and confiscation. The Alaska General Fisheries applied to the district court at Anchorage for an order restraining Frank Smith from fishing his trap, and a temporary injunction was issued restraining him from fishing and ordering that webbing be removed from the trap.

Difficulties were experienced in connection with alleged illegal herring fishing in Afognak waters, and the Coast Guard cutter *Algonquin* visited the island to conduct an investigation of the matter.

In the Bristol Bay district 11 natives were arrested for fishing with stake nets at Ekuk during weekly closed periods. Fines ranging from $1 to $43 and aggregating $156 were imposed. Two men operating a boat of the Alaska Packers Association and fishing off Ekuk Spit with a small-mesh net before the opening of the fishing season were fined $25 each, and two others fishing with a boat of the Alaska Salmon Co. 2 miles above markers in the Nushagak River were fined $25 each by the local United States commissioner. Two men with a boat of the Alaska Packers Association and two with one of the Red Salmon Canning Co.'s boats were fined $75 each, a total of $300, for fishing during a weekly closed period at the mouth of the Naknek River.

### ROBBERY OF FISH TRAPS

Following his conviction by the court at Ketchikan in September, 1926, for robbery of fish from a trap belonging to the Pure Food Fish Co., Val Klemm sued out a writ of error in the Ninth Circuit Court of Appeals, contending that it did not appear from the indictment that the company had any property in the fish confined in the trap and that therefore no crime was committed. Circuit Judge Rudkin affirmed the judgment of the district court, citing the opinion of the court in Miller *v.* United States (C. C. A.), 242 F.907, L. R. A. 1918A, 545, as follows:

> Fish in the Atlantic Ocean belong to nobody until they have been reduced to possession. After this has been done, the individual that has acquired the possession gains a qualified right of property that may be the subject of larceny. They are reduced to possession when the individual so confines them within his immediate power that they can not escape and resume their natural liberty.

The action of the Circuit Court of Appeals in affirming the decision of the district court will be a further deterrent to the larceny of fish from traps in Alaskan waters. It will further correct the erroneous impression, which had prevailed more or less generally, that trap operators had no legal rights in fish impounded in traps until removed from the water.

### TERRITORIAL FISHERY LEGISLATION

The Alaska legislature, at its biennial session in 1927, repealed chapter 75 of the laws of 1917 and chapter 30 of the laws of 1919, with amendments thereto, including chapter 38 of the laws of 1919, which provided for the establishing of fish hatcheries and the creating of a territorial fish commission.

An act was passed authorizing the Territorial Board of Road Commissioners to lease or otherwise care for all property in possession of the Territorial Fish Commission and to carry on the work formerly conducted by the commission, provided that all such work should be terminated on or before October 1, 1927, and making an appropriation of $3,000 therefor. The act further provided for engaging A. J.

Sprague to continue the duties of preparing and submitting a report on certain subjects in connection with the salmon fisheries and to carry on experiments of fish culture, appropriating $12,000 for these purposes.

Another act amended the license tax law of 1921, as amended in 1923 and 1925, by providing for the taxing of fish traps under two classifications—(1) hand-driven or stake traps on tide lands, $50 per annum; and (2) pile-driven or floating traps, including so-called "dummy" traps, $200 per annum.

For the purpose of protecting the salmon runs against the depredations of hair seals, a measure was adopted on May 3, 1927, effective immediately upon approval, placing a bounty of $2 on every hair seal inhabiting the inland waters and all waters adjacent to the southern coast of Alaska and east of the one hundred and fifty-second meridian.

An act approved May 2, 1927, authorized the territorial treasurer to refund to Libby, McNeill & Libby the sum of $200 paid for license of a certain trap in 1925, which could not be operated because of prohibitive regulations issued by the Federal Government after the securing of the license.

## TERRITORIAL LICENSE TAX

Fisheries license taxes were collected by the Territory under the general revenue law of 1921, as amended in 1923, 1925, and 1927. A statement from W. G. Smith, Territorial treasurer, under date of April 14, 1928, gives the collections made to that date for the year 1927. It was stated that collections under the several schedules were fairly complete, with the exception of pack taxes due from a few of the smaller canneries and salteries and the sum of $8,619.37 due under the whale-oil and fertilizer tax schedule.

*Fishery license taxes collected by Territory for fiscal year ended December 31, 1927*

| Schedule | Division No. 1 | Division No. 2 | Division No. 3 | Total |
|---|---|---|---|---|
| Salmon canneries (pack) | $48,561.07 | $20.00 | $248,658.17 | $297,239.24 |
| Clam canneries |  |  | 281.37 | 281.37 |
| Salteries | 3,351.78 | 48.95 | 3,073.69 | 6,474.42 |
| Cold-storage plants | 1,720.00 |  | 510.00 | 2,230.00 |
| Fresh-fish dealers | 4,948.55 |  | 4.37 | 4,952.92 |
| Fish-oil works and fertilizer and fish-meal plants | 17,423.40 |  | 865.25 | 18,288.65 |
| Fish traps | 121,953.91 |  | 49,163.07 | 171,116.98 |
| Gill nets | 681.38 | 20.00 | 5,155.30 | 5,856.68 |
| Seines | 5,835.00 |  | 2,335.00 | 8,170.00 |
| Total | 204,475.09 | 88.95 | 310,046.22 | 514,610.26 |
| Salmon canneries (net income), not possible of segregation as to judicial division |  |  |  | 21,152.07 |
| Total collections |  |  |  | 535,762.33 |

## BRISTOL BAY DISTRICT

Activities of the bureau in the Bristol Bay region during the season of 1927 were along the same general lines as in the preceding year, consisting of a patrol of the waters during closed periods, the gathering of data on the commercial fishery, collection of salmon scales in connection with scientific studies, construction of weirs for the counting of salmon at Kvichak and Ugashik Rivers, observations of the salmon run and escapement to the spawning grounds, and destruction of predatory fishes. All work was organized and supervised by Agent Dennis Winn, who remained in the district throughout the summer.

During the latter part of April and the first of May transportation for Agent Dennis Winn, Warden Arnie J. Suomela, and 25 special employees was afforded on vessels of the Alaska Packers Association, Alaska-Portland Packers Association, Columbia River Packers Association, Nakat Packing Corporation, Naknek Packing Co., and Libby, McNeill & Libby. These vessels also carried supplies and equipment for the bureau to the Bristol Bay district and furnished return passage for 14 men at the end of the season. Eleven of the special employees returned via Dillingham, Kanatak, and Iliamna Lake, passage to the States being secured on regular transportation steamers.

After completion of a general overhauling of all boats and equipment at the bureau's marine ways at Naknek, a party of nine men, headed by Henry McFadden, proceeded on two launches to Ugashik to install a salmon-counting weir at a point below the first Ugashik Lake in the same location as last season. A report on the work at the weir is included in the special section covering weir operations.

A crew, with G. Severson in charge, was dispatched to the Kvichak River to begin the counting of salmon by the construction of a new weir at that place. Early in July, however, before the work was completed, all five tunnels and some of the piling were washed away, due to pressure of high water resulting from an accumulation of a quantity of fine, grassy material brought downstream from heavy beaver workings. The webbing was removed and the remaining piles were pulled up and stored.

Prior to the opening of the red-salmon season at 6 a. m., June 24, all arrangements were made for patrol of the commercial fishing grounds. Warden Suomela's report on operations during the season is as follows:

### GENERAL REPORT OF SEASON'S OPERATIONS

#### PATROL

During the fishing season of 1927 the patrol vessel *Scoter*, seven launches, and one dory were used in the patrol of the waters of Bristol Bay. Fifteen cases of violation of the Alaska fisheries laws and regulations were reported and tried before the local United States commissioner. The patrol fleet was assigned to the various sections of Bristol Bay, as follows:

*Ugashik River and Bay.*—Launch *No. 6*, C. M. Hatton and R. Blyberg; and launch *No. 8*, Henry McFadden and W. Haynes, when not engaged in connection with operation of the Ugashik weir.

*Egegik.*—Clarence Olsen with a dory.

*Naknek River.*—Launch *No. 2*, Alf Christensen and Louis Strong. This launch also assisted in patrol of lower Kvichak Bay.

*Kvichak Bay and River.*—Launch *No. 1*, George Stevenson and Walter Russell; and launch *No. 7*, Gus Seversen and Arthur Mesford, when not occupied with work at the Kvichak weir.

*Nushagak Bay and River.*—Launch *No. 3*, Eric Fenno and Walter J. Kelly. On duty from the beginning of the king salmon season early in June.

*Igushik River.*—Launch *No. 5*, Hector McAllister. On patrol duty from the beginning of the king salmon season early in June.

The *Scoter*, with Warden A. J. Suomela on board, patrolled all waters of Bristol Bay.

Work of bureau employees concurrent with the patrol included the collecting of 5,619 samples of salmon scales from various districts, as follows: Naknek, 1,134; Ugashik, 900; Kvichak, 1,185; Nushagak, 1,200; and Egegik, 1,200. Data were gathered in regard to fishing operations and the runs of salmon in the several rivers. In all, 912 fishing boats were operated by the canneries and 106 by independent fishermen, local whites, and natives, who sold the catches to the canneries. Of these independent fishermen, 43 natives operated boats belonging to the packers and the remaining 63 owned the boats and gear that they used. The number of stake nets operated by local residents for commercial purposes was 67, an increase of 47 over the preceding year.

### RUNS OF SALMON

*Kvichak-Naknek Rivers.*—Very light catches of salmon were made from the opening of the season on June 24 until July 6, when a slight increase in the run occurred. Middle Bluffs, between Naknek and Egegik Rivers, was the center of all early fishing, operations being carried on during one tide only. Very few fish escaped the nets at Middle Bluffs; therefore, very little fishing was conducted in the upper Kvichak Bay until later in the season. A light escapement occurred in the Naknek River on the evening tides of July 6 and 7. On July 8 fishing was irregular, some boats making good catches while others took virtually nothing. Several good catches were made in the vicinity of Libbyville, and a few boats made fair catches in the upper bay. The first run of any size passed by the weir at Kaskonak Flats on July 9, lasting only one day. A fair run materialized on July 12, while on July 16 the run was virtually over. On the 18th and 19th catches were very light, and the season was closed at 6 p. m. on July 19. On the 20th salmon again appeared in lower Kvichak Bay, and some were observed passing up the Naknek River on the night tides on July 21 and 22. A fair run occurred on July 25, after which only small numbers appeared.

*Egegik River.*—Salmon appeared in the Egegik River in June, the run being rather light until June 25, when a fair run started, which lasted only a few days. The numbers diminished, until on July 4 and 5 virtually no fish were entering the river, but on July 6 the heavy run began, continuing until the 20th, or four days after the commercial fishing season closed. This was the latest run since the season of 1917. The escapement up the Egegik River was considered very good and almost equal to that of the 1926 season.

*Ugashik River.*—At the beginning of the season very few fish were taken, either in stake nets or drift gill nets, in the outside waters. Red salmon began to appear in the river on July 2, and from that date on the count of salmon through the Ugashik weir was very irregular. A slight increase in the number of fish was noted in the lower river on July 11, and on the 12th these salmon appeared at the weir. The run continued irregular, although increasing, until the peak of the run was reached on July 24. From July 24 to August 25 there was a gradual decrease in the number of fish passing up the river.

*Nushagak River.*—When the season opened on June 24 there were almost no red salmon in the river, the scarcity continuing for a week, with only about 3,200 cases being packed to July 2. The following week there was a slight increase with indications of a run on July 7, which, however, did not materialize. Only a very few boats made good catches, but the majority took practically nothing. The numbers of red salmon continued to increase, until the peak of the run was attained on July 13 and 14, although the schools were small and scattered; after which a decrease was noted until July 23 and 24, when the last of the stragglers entered the river. Not many red salmon were caught in the set nets after July 27, although a few were taken occasionally until about August 20. The king-salmon run was good throughout the entire season and until about the middle of August.

### WOOD RIVER DISTRICT

Observations made by Eric D. Fenno, who arrived on July 28 at Igulawok River, the second lake river, indicated that a very small run of salmon had materialized. Few fish were seen in the lake and at the outlet of the river, where in normal years good numbers are found spawning. The total number of salmon counted to August 16 ascending Igulawok River was 38,673.

Natives were compelled to carry on intensified fishing, employing additional gear, in an effort to secure sufficient salmon for their winter supply of dog feed. In the native village on the southern shore of the lake, situated about 4 miles from the outlet, the highest catch for a net during a day was 44, with very few salmon taken up to August 29. Two white settlers also were engaged in catching salmon for dog feed, meeting with no better success than the natives.

Taking into consideration the numbers of salmon counted ascending the Igulawok River, the number of fish taken by local whites and natives, and the observations on the spawning grounds, it was estimated that the escapement was about 80 per cent less than that of a normal year.

### BECHAROF LAKE DISTRICT

Examination of the Becharof Lake system by Clarence Olsen indicated that the escapement in 1927 was 20 per cent less than that of 1926.

### INSPECTION OF ILIAMNA AND LAKE CLARK SPAWNING AREAS IN 1927

The following report was made by Agent Dennis Winn covering his trip of inspection during the month of August:

In accordance with practice for the last several years, the writer, accompanied by Warden A. J. Suomela, at the close of the commercial fishing season in Bristol Bay proceeded to inspect the spawning areas of the Iliamna and Lake Clark region. On August 5 ascent of the Kvichak River was made, where no salmon were seen except a few small schools of pinks in the vicinity of Kaskonak Flats.

As the launch approached Iliamna Lake a head wind held it in the river overnight. Three families of native reindeer herders near-by were curing salmon for home consumption. Although they were still fishing, they reported that nearly all salmon had passed. About 500 red salmon were drying on the racks and some had been taken to winter quarters. Little information could be obtained from these natives as they spoke no English.

The wind having abated somewhat by the following morning, a trip was made to Belinda Creek. Four native families in camp (reindeer herders who come here each year) had from 1,500 to 1,800 red salmon in process of curing for their winter supply. There were no fish in the caches, which at this date in previous years usually contained from 4,000 to 5,000 cured fish. However, from the appearance of their set nets just hauled ashore, and considering the number of salmon seen milling in and near the stream mouth, it was felt that they would have little difficulty in securing enough for their use, at the same time permitting a fair escapement of fish to the spawning grounds. From all indications no appreciable number of salmon had reached the lake before the commercial season closed.

The trip was continued up the lake toward Big Mountain, but the wind increased to such an extent that it was necessary to anchor and await more favorable conditions. On the morning of August 8 the wind had subsided sufficiently to permit proceeding to Iliamna village, where arrangements were made for the transportation of five bureau employees over the trail to Iliamna Bay, there to embark on the patrol boat *Kittiwake* en route to the States.

On August 9 an inspection of Kokhonak Creek was begun. Both in the stream and at the mouth fair numbers of salmon were noticed, which, according to reports of the natives, had arrived only five days before. The examination was continued for about a mile upstream and then postponed until the following day, progress being difficult because of high water. Some fish were noticed on the beds, although in small numbers, and very little spawning was in progress. The natives camped at the stream mouth, comprising three families of reindeer herders from the vicinity, had about 500 red salmon drying on the racks. These families each require about 50 bundles (2,000 salmon) for their winter use.

On the morning of August 10 a trip was made to Kokhonak Creek Lake in order that conditions might be observed there and in the stream on the return. No fish had entered the lake, but a small school of about 200 red salmon was scattered over approximately 70 by 150 feet of creek bottom at the lake outlet. On the return a few small schools containing from 100 to 300 fish each were noticed in various eddies from the upper portion of the creek downstream as far as the Bluffs, about 2 miles from the stream mouth, where fair numbers were seen schooling in deep pools. One school here contained about 2,500 red salmon, which was the largest school seen, except at the stream mouth and milling outside the entrance. Very little spawning was noted anywhere. It was estimated that the total number of red salmon in the creek and those milling outside (which it is assumed were destined for the creek) was approximately 75,000, or about 37 per cent of last year's run. The number may have been increased later from the lake, but from all indications no appreciable increase could be expected. The fish were all of exceptionally large size, as was the case a year ago. The numbers noticed schooling were almost equal to those of former good years, but spawning and dead fish, which in good years are in evidence on this date, were wholly lacking this year.

About 3,000 salmon were scattered over 1½ miles of spawning area along the lake shore in front of the site of old Kokhonak Indian village, east of Kokhonak Creek. Natives reported that the salmon first appeared in the lake on July 15, but few in number and remaining far out, so that none were taken. They were very likely part of those first noted passing up the Kvichak River on July 9, which inrush lasted but one day.

The next morning, in very heavy weather, a trip was made to the Copper River area. A few small schools were noticed in the slough and at the mouth of the river, but all appearances indicated that most of the salmon had passed upstream. This was verified as the ascent continued, and good schools were seen milling in every suitable hole and eddy in the river for a distance of almost 10 miles. The schools generally numbered from 100 to 2,000 salmon, and at one point, in a deep meadow slough measuring about 15 by 600 feet, a school of approximately 10,000 red salmon was encountered. No spawning was in progress, but small numbers of fish were working on the beds in preparation.

FIG. 2.—Native type of fish wheel on Copper River, Alaska

Copper River is comparable to Kokhonak Creek, in that ordinarily it has harbored a good number of early-run salmon. In former seasons at this date the beds were well covered and also many spent fish were noted. This year there was no early spawning, but the schooling of late spawners in the streams was nearly equal to that of good years on the same date. The high waters had created various sloughs and channels, where the salmon were gathering to spawn. When the water recedes to normal these channels will be dry, with consequent loss of eggs or fry. The number of red salmon seen in this river was estimated at about 75,000, including those schooling in the slough and at the stream mouth, or 30 per cent of last year's estimated escapement.

Early in the morning of August 12 a trip to Roadhouse Portage was begun, but a heavy southeaster made it necessary to take shelter in Intricate Bay for the remainder of the day and overnight. The wind had abated somewhat the following morning and the journey was made across the lake, although increasing wind made rough passage before the destination was reached. It was learned from the people here that the salmon were just appearing in Lake Clark and that only within the last week or 10 days had any noticeable number reached the vicinity of the Portage and Newhalen River. Good numbers were observed in the vicinity, but according to the local whites and natives they were in no way comparable to the runs last year. At the mouth of the Newhalen River three families of Tularic natives were curing salmon for home use and dog feed. They stated also that the run was considerably less than in 1926, with almost no early fish. However, they had no difficulty in catching enough for their own needs. A trader at the Portage in close touch with the situation advised that the salmon had reached only the head of the Newhalen River, but were there in good numbers. From reports of those who fish in the vicinity each year for home use it was estimated that the numbers here were about 75 per cent of last year. As nothing could be gained by an inspection of Newhalen River, inasmuch as the water was so high and roily that the fish could not be seen, the examination was continued along the north shore areas of Iliamna Lake.

While the salmon this year did not appear in as great numbers in certain localities, notably early spawning areas, as in former years, they were more evenly distributed over the various spawning grounds, especially small streams along the north shore of Iliamna Lake, including Iliamna River and to the westward. All of these creeks and rivers, with the exception of Chekok Creek, had better numbers than were shown last year. In Chekok Creek, about one-half mile from the mouth, there was encountered a beaver dam, which prevented the salmon from passing upstream. About 50 red salmon were spawning below the dam and some 300 more were noticed in the stream. The dam was removed and the salmon immediately passed up. This stream appeared to be diminishing in size, the cause of which, it was learned, was a break back in the valley, which diverts the greater part of the water into Kokotano Creek. The latter stream was fairly well supplied with salmon and about 300 fish were seen milling near its mouth. Virtually all of these small creeks carried salmon in excess of last year, but in no case were sufficient numbers noted to represent 60 per cent of the possible capacity.

Youngs Creek, which contained very few fish in the last three years, showed a fair run for its size this season, and local residents at the mouth of the stream were putting up dog feed. At the time of the visit (August 17) they had about 200 fish in process of curing. They stated that they had caught from 50 to 75 red salmon each night for the past few nights in a set-net about 100 feet long. A fair school was milling near the mouth of the stream, but few fish had passed up.

At Woody Island but one school of about 50 red salmon was seen, which was along the outside island shore.

A trip up Iliamna River for about 15 miles was made on August 20. There were good numbers of salmon in the lower portion of the river, from a mile or so above the mouth to a little beyond the Indian village, a distance of about 2 miles. During the ascent, small schools of salmon were seen at various points for the first 3 miles, then none for about 4 miles, after which small numbers were noticed scattered over an excellent spawning bottom for about 5 miles. It was estimated that the upper part of the river harbored about 2,500 red salmon scattered over extensive beds and that approximately 15,000 were in the lower portion, or about 57 per cent more than last year. This stream, like nearly all others along the north shore (notably Pedro Bay, Knutson, Kenny, Kokotano, Eagle Bay, and Portage Creeks) was better seeded this year than last, but the escapement covering the Iliamna and Lake Clark district as a whole was about 25 per cent less than the total escapement last year.

## KUSKOKWIM RIVER

Commercial fishing for salmon for export from Alaska is prohibited in the Kuskokwim River and the area off its mouth. From June 10 to September 10 Stream Guard Charles McGonagall was stationed on the river to observe operations. No violations of the law or regulations were reported. The run of salmon began about 10 days later than in the preceding year and at no time did it attain any great size.

As a result of a "flu" epidemic in the spring, very few of the natives did much fishing during the summer, and almost all of the white fishermen went to Nushagak to fish for the canneries, inasmuch as there was no commercial market for fish on the Kuskokwim. Although the catch of salmon was only about half that of 1926, it was believed that no lack would be felt by the natives, as whitefish and blackfish may be secured all winter from the lakes.

Operations included only the salting of king salmon and the drying of chums for dog feed. The amounts of these products were 16 barrels of pickled kings and 186 tons of dried chums. One white fisherman and 137 natives were engaged in the fishery. Apparatus in use consisted of 16 wheels, 130 gill nets of 5,500 fathoms, and miscellaneous small boats.

### YUKON RIVER

Fishing in the Yukon River is carried on for local food requirements and to supply the market for dried salmon for dog feed throughout the interior of Alaska, commercial fishing for export from the Territory being prohibited in this area. Inspector C. F. Townsend and one stream guard were again on duty at the fishing grounds throughout the season.

During July there was a large run of king and chum salmon in the Yukon and Tanana Rivers, which lasted for more than three weeks.

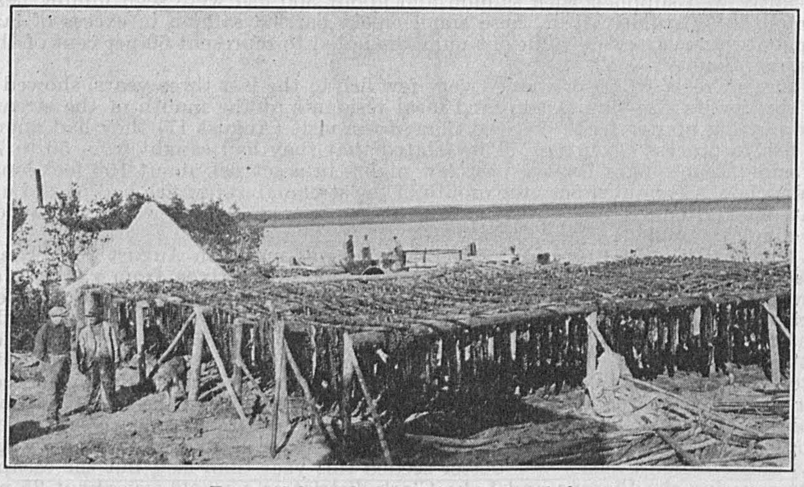

FIG. 3.—Salmon drying, Yukon River, Alaska

Kwiguk Slough, which in former years always had large runs of kings and chums, had no run in 1927. All the fish entered the river by the Kwikluak and Apoon mouths, the latter containing the first large run ever noted there by Inspector Townsend. At the time he made a trip up the Yukon to Anvik in July, the racks in every camp were full of fish. Although there was little rain during the month, several severe wind storms occurred, which wrecked a number of the fish wheels. Good catches of salmon were taken on the Tanana River, in which the water was unusually low.

Products of the Yukon and Tanana fisheries were as follows: 330 cases of kings canned, 31 barrels of king salmon and 19 barrels of chums pickled, 3,000 pounds of kippered kings, 720 pounds of beleke from kings, 7,000 pounds of dried kings, and 679,000 pounds of dried chums. Apparatus consisted of 182 wheels, 66 gill nets of 661 fathoms, 2 launches, and a number of small boats. There were 18 whites and 242 natives engaged in the fishery.

## KARLUK SALMON COUNT

Construction of a weir near the mouth of the Karluk River in the same location as in previous seasons was completed on May 12. The following morning a few red salmon were seen in the river below the weir, although no fish passed upstream until May 23, when five kings ascended. The first red salmon were counted through the weir on May 25, but no appreciable numbers appeared until June 7. Counting continued through October 9, when the total escapement was 872,538 red salmon, 10,343 kings, and 18,281 cohos. During the latter part of September the run was very light, the tally of red salmon being less than 500 daily from September 21 to 30, inclusive. A good run started on October 1, and from that date through October 9 more than 80,000 red salmon were counted, after which no salmon came to the weir until it was removed on October 14, although there were still a few in the lagoon and some were seen jumping in the river mouth as late as October 18. Considerable difficulty was experienced in removing the weir because of ice in the river.

Commercial fishing for salmon in Karluk waters began on June 16, the light escapement having made it necessary to change the opening date from June 5, as specified in departmental regulations, and the season closed at 6 p. m., September 10. The reported commercial catch of red salmon from the Karluk run was 600,778, or approximately 41 per cent of the total.

Salmon fingerlings migrating downstream appeared at the weir on June 1, the migrations continuing until June 22 in numbers comparable to those of former good seasons. Predatory trout numbering 26,122 were captured prior to June 15, but few were seen after the red-salmon run started.

The Karluk weir was visited by Commissioner O'Malley and party on July 13.

Counting operations at the weir were in charge of Ray S. Wood under the direction of H. H. Hungerford.

## ALITAK SALMON COUNT

Weirs primarily for the counting of red salmon were maintained as in previous years at two streams tributary to Olga Bay, the one at the upper station being completed on May 13 and that at the cannery station on May 14. No salmon were seen in the streams at that time, although natives near the cannery reported having caught several during the spring. Dolly Varden trout were rather plentiful and about 1,000 were caught in the cannery stream and destroyed.

The first red salmon were counted through the cannery station weir on May 25 and through the upper weir on May 29, only a few showing at either place. During the first part of June a considerable number of red salmon entered both streams, but it was difficult to count them because the water was high and at times very muddy. Counting was continued through September 30, the number of red salmon counted at the upper station weir being 497,619 and at the cannery station 87,949, a total of 585,568. In addition, 12,494 cohos, 4,154 humpbacks, 11 kings, and 14 chums were counted through the weirs. It was estimated that the number of red salmon that entered Horse Marine Lagoon was at least 30,000, and that

Silver Salmon Lake contained about 5,000, which brings the total escapement of reds in Alitak Bay waters to considerably more than 600,000.

Several streams at the head of Deadman Bay, which were visited the latter part of August, were found choked with humpbacks and chums, and all the humpback-salmon streams in the district were seeded heavily.

Inasmuch as the count of red salmon at the two weirs through June 10 was less than 13,000, the canning companies at Alitak postponed setting the Moser Bay traps until July 18. The season would have opened normally on June 15. As the commercial catch exceeded the weir count on August 4, trap fishing was stopped and it was not resumed until August 15. The total reported catch of red salmon in the district was 272,169. No commercial fishing was carried on after September 21.

Warden Howard H. Hungerford was in charge of operations for the bureau.

### CHIGNIK SALMON COUNT

The site of the weir at Chignik in 1927 was about 10 rods below its location the previous season, the river at this point being about 460 feet wide and from 2 to 5 feet deep. Work of setting the tripods was started on May 3. Four counting gates 22 inches wide and a 74-inch gate to permit the passage of small boats were established as in former years. By May 17 the work had progressed so that the river was closed to the passage of salmon, and on May 20 the weir was completed. It was reported that the river was the lowest it had been at that season since the first weir was installed in 1922.

While construction work was going on no salmon were seen ascending the river. A few fingerlings were noted going downstream, which migration continued light until the latter half of June, when it increased somewhat, although no large schools were seen at any time. More Dolly Varden trout were seen above the weir than during any previous season since the counting experiment has been in progress, and 6,827 were caught during the month of May. At that time, apparently, they were not feeding, as the stomachs examined were found to be entirely empty.

Red salmon began to pass through the weir on June 6, but no appreciable numbers appeared until June 12. By the end of June 912,202 red salmon had ascended. The counting was continued through October 13, when 1,256,007 red salmon, 1,823 kings, and 145,390 cohos had been counted. Humpback salmon were not counted, but the escapement was good, considering that it was an off year for this species.

Six traps for the capture of salmon were operated in Chignik Bay and Lagoon by the three canneries that have engaged in the industry in this district during previous seasons. The first catch was made on June 17, stormy weather in the spring having delayed the completion of the trap installations beyond the opening of the commercial fishing season on June 15. All fishing was discontinued September 15 in accordance with the regulations. The total commercial catch of red salmon from the Chignik run was 434,141. Operations at the Chignik weir were in charge of Warden Charles Petry.

## MORZHOVOI SALMON COUNT

As an experiment, the inner ends of the Morzhovoi Bay weir were not removed in the fall of 1926, inasmuch as they are covered with water only at flood stages of the stream. In the spring of 1927 they were found in as good condition as when left the previous fall, and the time required for installing the weir was but three days—from May 19 to 21, inclusive. The work was expedited also by reason of low water in the stream.

The first red salmon passed through the weir on July 1 and the last on September 13, when 23,932 reds, as well as 1,586 cohos and 252 humpbacks, had been counted. The counting gate was left open after September 13, at which time a few red salmon were still in the creek, spawning below and above the weir. On October 1 Wallace R. Newcomb made a trip to the weir and removed the pickets from the frame, leaving the tripods and inshore work as in the preceding season, a 25-foot open channel in the stream being deemed sufficient to accommodate excess floods. Examination of the creek from the lagoon to the lake revealed a few coho salmon spawning at that time. Operations at the weir were under the supervision of Assistant Agent L. G. Wingard.

## THIN POINT LAGOON SALMON COUNT

A weir for the counting of salmon ascending to spawn was established at Thin Point Lagoon in approximately the same location as in the preceding season. Weir materials were transported on the *Merganser* early in May, and the preliminary work of putting in all posts, braces, stringers, and capping was finished on May 15. Work at this weir, as well as at Morzhovoi, was started early in order to take advantage of low water in the streams, and very little difficulty was experienced in its erection.

The weir was put in operation and a stream guard stationed there on July 1, but the first red salmon passed through on August 9, although they had been in the lagoon for some time and many had spawned on the flats. By August 22 a total of 3,220 red salmon had been counted through the weir, besides 22 cohos.

Heavy rains in August caused the lake to rise almost 2 feet, making considerable current at the weir site in the lake outlet. This condition, together with strong winds, undermined the weir. Efforts to repair the damage were unsuccessful, and the weir was removed on August 22.

Work at this place was under the supervision of Assistant Agent L. G. Wingard.

## CHINIK CREEK SALMON COUNT

A new weir 38 feet in length, with one counting gate, was installed at Chinik Creek, Kamishak Bay, in 1927, the materials for which were transported on the *Kittiwake*. Construction was started June 13 and completed June 23. From July 5, when the first salmon entered the stream, to August 18 when the weir was removed, the total count was 7,069 red salmon. Operations here were carried on by Alex Lind.

## ENGLISH BAY SALMON COUNT

The counting of salmon ascending to spawning grounds was inaugurated at English Bay, Cook Inlet, in 1927, by the construction of a weir on the river at the head of the bay. Work of installation was begun on May 17 and finished on May 23. The weir, which is 111 feet in length, is situated about a quarter of a mile above the lagoon, where the average lowest depth of the river is from 8 to 16 inches. The first red salmon passed through on May 30, and the total number counted through August 4 was 19,197, including an estimated escapement of 250 each on June 7 and 8, when high water prevented an actual count. In addition to the red salmon, 153 humpbacks were counted through the weir. A cloudburst on

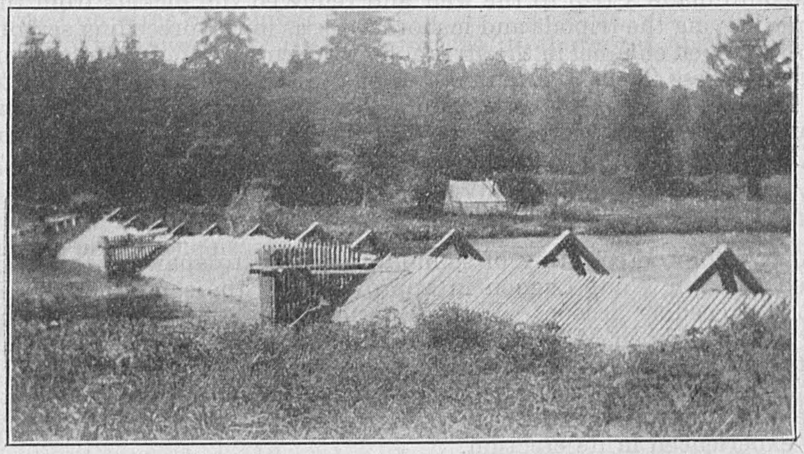

FIG. 4.—Salmon-counting weir, English Bay, Cook Inlet, Alaska

August 3 and 4 caused a rise of 20 inches in the river and put an end to the weir operations for the season. Jack Tansy was in charge of the bureau's work at this place.

## SALMON COUNT AT KALGIN ISLAND STREAM

No weir is maintained in the salmon stream on Kalgin Island, but a stream guard was stationed there near the mouth in 1927 to count the ascending salmon, destroy predatory trout, and keep the stream open, as the action of the tides often closes it with sand and gravel. From May 27 to June 12, 10,770 trout were taken. Salmon began to appear at the mouth of the creek on June 13 and to pass upstream to the spawning grounds on June 15. From that date through August 6 there were counted 9,415 red salmon ascending the stream on the day tides, and it was believed that fully as many more went up on the night tides, which would make a total of 18,830. It was reported that the escapement at this creek in 1926 was about 100,000.

Alex Lind was stationed at the stream in the beginning of the season until June 3, when he was transferred to Chinik Creek and James Hart took over the work.

### UGASHIK SALMON COUNT

A weir for the counting of ascending spawning salmon was again maintained on the Ugashik River in 1927, at the same location as in the previous year. The first red salmon were tallied on June 23, and counting continued through August 15, when a total of 443,283 had ascended. In addition, 22 kings, 26 humpbacks, 89 chums, and 22 cohos were counted during the season. In the work of exterminating predatory enemies of salmon, 29,200 Dolly Varden trout were taken from Ugashik streams, including a few from Becharof Lake.

Commercial fishing began June 23 and stopped July 16. The reported catch of red salmon from the Ugashik run was 311,995.

Operations at the weir were in charge of Henry McFadden.

### ANAN SALMON COUNT

Installation of the weir at Anan Creek was begun on May 16 and completed on May 30, progress having been hampered considerably because of high water. On the date of completion 49 steelheads passed through the weir, but the first humpback salmon did not appear until June 22. The numbers ascending the stream gradually increased until July 7, on which date 988 humpback salmon were counted. A decline followed for a few days, and again the run increased, reaching its peak on July 29, when 1,859 salmon passed through. From that time on there was a decrease to September 24, when all fish ceased running. The total count of humpbacks until the weir was removed on September 24 was 44,936. Other species counted through were 2,002 cohos, 280 chums, 132 reds, 69 kings, and 685 steelheads. Walter J. Larson was in charge of the construction of the weir and of counting operations throughout the season.

### SALMON TAGGING

To develop further information regarding migration routes, and especially to extend the investigation to districts in southeastern Alaska not previously covered, the tagging and releasing of salmon was again undertaken in 1927. The scarcity of fish, however, and the consequent short commercial season in certain districts prevented carrying on the work to the extent originally planned. The total number tagged in southeastern Alaska was 5,148, of which 4,668 were from traps and 480 were troll-caught fish.

The numbers of salmon tagged and released from traps in the various localities were as follows: Inian Islands, 500; Pleasant Island, 498; Parker Point, 299; Marble Bluffs, 200; Hourigan Point, 699; Carroll Island, 75; Cape Bendel, 499; Point Hobart, 200; Point Colpoys, 999; Cape Decision, 299; Dall Head, 150; and Nelson Cove, 250; a total of 4,668. Of these, 747 were red salmon, 901 chums, 208 cohos, 2,795 humpbacks, and 17 kings. Warden F. G. Morton was in charge of the work, which continued from July 1 through August 6.

The tagging of salmon taken in trolling operations was carried on by Hugo W. Frederickson in waters on the west coast of Baranof Island. During the season 480 salmon were tagged, of which 382 were kings and 98 cohos.

Late reports indicate that there have been 1,424 recaptures, or about 30 per cent, of salmon tagged and released from traps. Recaptures of troll-taken salmon numbered 38, of which 22 were taken entering the Columbia River, thus again showing the great distance traveled by king salmon. Full particulars of the tagging experiment will be published in a separate document.

In addition to the salmon-tagging operations in southeastern Alaska, 700 red salmon were tagged on August 19 and 20 at the Broken Point trap of the San Juan Fishing & Packing Co. at Uganik Bay by Dr. Willis H. Rich in connection with his studies of the Karluk salmon. Of these tagged fish, 86 were counted ascending through the

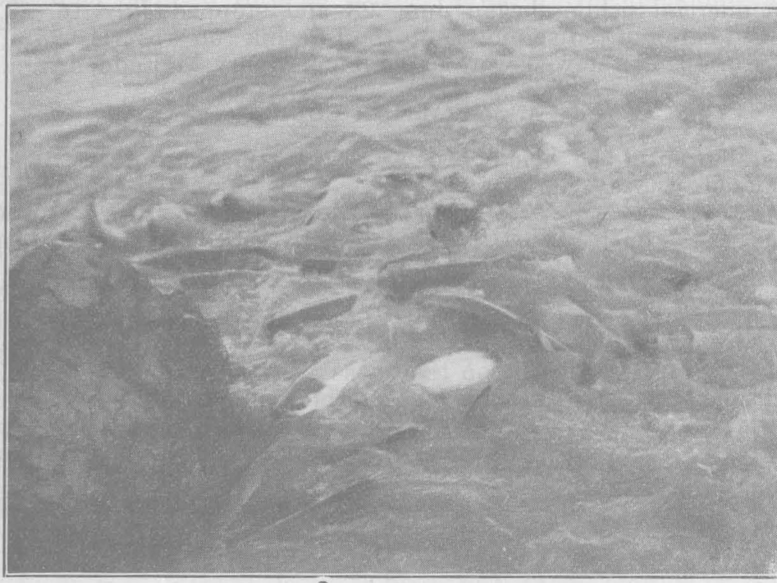

FIG. 5.—Salmon ascending Alaska stream

weir at Karluk between August 27 and September 20 and 317 others were reported recaptured. Complete data on the experiment will be found in a publication concerning the Karluk investigation.

## SALMON LIFE-HISTORY STUDIES

Further investigations in connection with life-history studies of the Pacific salmons, particularly the red salmon, were conducted in 1927 by Dr. C. H. Gilbert, of Stanford University, Calif., and Dr. Willis H. Rich, chief investigator of salmon fisheries, assisted by Seymour P. Smith. This work centered in the Karluk region and in addition to important salmon migration studies included collections of scales of red salmon, an examination of the stomach contents of all species except kings, and collections of a number of small migrating salmon. Report of the investigations is published in a separate document.

## OBSERVATIONS ON THE ESCAPEMENT OF SALMON

To comply with the intent of Congress, as expressed in the act of June 6, 1924, that not less than 50 per cent of the salmon be allowed to escape to the spawning grounds, careful observations of the escapement were made in all districts by bureau employees, and reports were submitted so that adequate regulatory measures might be issued.

*Southeastern Alaska.*—In the Icy Strait-Cross Sound district the run was light, and very few salmon entered the creeks until the close of the fishing season, after which there was a good escapement. Similar conditions prevailed in the central district, with a fair escapement into certain creeks after the close of the fishing season, especially on the west coast of Chichagof Island and in the vicinity of Salisbury Sound, Sitka, and Peril Strait.

In waters south of the fifty-seventh parallel, north latitude, the runs, with few exceptions, were very light, that in the Wrangell district being the smallest on record. This was particularly true of the humpback and chum salmon, which commercially are the most important species in this section. The runs of reds and cohos were but little smaller than in other recent years, and king salmon were more numerous in many localities than for a long period, especially on the west coast of Prince of Wales Island. The runs of all species except kings were unusually late throughout the district, almost no pink and chum salmon reaching the streams until the beginning of the closed season, and then only in small numbers. For a short period during the latter part of July and the first of August the water was very low in nearly all of the island streams, but it is thought that this condition will have little effect on future runs, as very few salmon were about the mouths of the streams at that time. Heavy rains later made the streams unusually high by the time the pinks and chums finally arrived, and they experienced no difficulty in reaching the spawning grounds. The salmon, however, came only in small schools, entirely insufficient for adequate seeding, even in the few streams having comparatively large runs.

Various reports of heavy runs were received after the closure of commercial fishing, but investigation proved them wholly unfounded. After a two-weeks survey of the spawning grounds, during which 25 of the principal streams of the district were examined, a cannery representative with years of practical experience in the salmon fishery, who accompanied the bureau's employees on the trip, stated that in his opinion the escapement into all the streams examined was less than 25 per cent of that of a normal year. It is believed that the early closing of the fishing season, with no reopening to fall fishing, was the saving factor in the whole escapement situation. In view of the extent of the run, the escapement was considered very satisfactory and encouraging.

*Prince William Sound and Copper River region.*—In the Copper River area the run of cohos was the best in many years, and Bering River also had good numbers of this species. The run of red salmon, however, was small. Examination of salmon streams in Prince William Sound showed a much better escapement than in the preceding year, particularly on the west coast, and the spawning salmon were more evenly distributed. The run of pink salmon (the predominating species of this locality) was very good for the alternating off year, and the pack in the district was much larger than had been anticipated. The escapement in the district generally was very satisfactory.

*Cook Inlet district.*—Red salmon did not begin to run in any appreciable numbers until July 15, prior to which date there was a very light run of this species. A second heavy run appeared above Anchor Point on July 28, continuing until August 7, although on a diminishing scale after August 1. A good run of pink and chum salmon followed. Areas in the vicinity of Kachemak Bay, Seldovia Bay, Port Graham, and lower inlet points were especially well supplied with pinks and chums. It was reported that the escapement to spawning grounds tributary to the Kenai and Kasilof Rivers was above the average. Investigations made by Temporary Warden J. E. Wilson covering various streams tributary to Knik Arm indicated a good escapement, although recent forest fires had caused numerous obstructions in the streams, making it difficult for the salmon to reach the spawning beds. As many of these obstructions as possible were removed during the course of the investigations.

*Kodiak-Afognak district.*—Examination of the spawning grounds of the Kodiak-Afognak district by Warden Howard H. Hungerford showed a light escapement in many of the streams, while others were adequately seeded. Heavy runs of pink and chum salmon entered Alitak Bay, Old Harbor stream, Kiliuda Bay, Shearwater Bay, and Ugak Bay, but the red salmon runs were generally light, particularly at Karluk. At Eagle River, in Ugak Bay, however, there was an increase in reds over the preceding year, and Kiliuda Bay also had a good run of this species. In the streams of Afognak Island the runs of red salmon were very light. There was a good run of pinks in Paramanof Bay, and of cohos in Litnik Bay. The runs of pinks and chums on the mainland shore were much smaller than in 1926.

*Alaska Peninsula district.*—Reports of investigations by Assistant Agent L. G. Wingard in the Alaska Peninsula district indicate that the escapement to the local streams of the peninsula was good. Although red salmon did not appear in anything like the numbers anticipated, the runs of humpback and chum salmon were better than the average for an off year. Stormy weather with heavy rains during the latter part of the fishing season curbed commercial operations to some extent and thus permitted a larger escapement of salmon to the spawning grounds. All streams visited were well seeded.

*Bristol Bay district.*—Examination of the spawning areas in the Iliamna–Lake Clark region was made by Agent Dennis Winn during August after the close of commercial fishing operations. Although the fish did not appear in the early spawning areas in such numbers as in previous years, they seemed to be more uniformly distributed, especially in the smaller streams on the north shore of Iliamna Lake, including Iliamna River and to the westward, where there were more salmon in 1927 than in the preceding year. The natives were having little difficulty in putting up their winter supply of fish. It was estimated that the total escapement was 75 per cent of that in 1926.

The run of salmon in the Wood River Lakes district was small, and the natives were compelled to carry on intensive fishing, employing additional gear, in order to obtain their winter supply of dog feed. The escapement here was estimated at about 20 per cent of that of a normal year. Full reports of observations made in the district by Agent Winn and Warden A. J. Suomela are printed elsewhere in this document.

## HATCHERIES

### EXTENT OF OPERATIONS

Salmon propagation in Alaska, exclusive of Territorial activities, was carried on at two Government-owned hatcheries (at Afognak and McDonald Lake) and at two privately owned hatcheries—that of the Alaska Packers Association at Heckman Lake and that of the Northwestern Fisheries Co. at Hugh Smith Lake. Operation of the Heckman Lake hatchery of the Alaska Packers Association was brought to a close in 1927, the work during the year consisting only of handling the eggs taken in 1926 and the fry hatched therefrom.

*Operations of Federal and private hatcheries in Alaska in 1927*

| Location of hatchery | Red or sockeye salmon | | |
|---|---|---|---|
| | Eggs taken in 1926 | Salmon liberated in 1926-27 | Eggs taken in 1927 |
| Afognak | 21, 250, 000 | 14, 400, 000 | [1] 4, 225, 408 |
| McDonald Lake | 30, 760, 000 | 20, 467, 000 | 20, 240, 000 |
| Heckman Lake (Fortmann) | 21, 420, 000 | [2] 18, 830, 384 | |
| Hugh Smith Lake (Quadra) | 20, 000, 000 | 19, 340, 000 | 20, 240, 000 |
| Total | 93, 430, 000 | 73, 037, 384 | 44, 705, 408 |

[1] Also 1,090,000 steelhead-trout eggs were collected, and the resulting eyed eggs (790,400) were shipped to Seattle.
[2] At the Fortmann hatchery 2,490,000 humpback-salmon fry were released in 1926-27.

### AFOGNAK

Of the 21,250,000 red-salmon eggs collected at the Federal salmon hatchery at Afognak in 1926, 3,402,000 eyed eggs were shipped to Seattle in October, and from the remaining eggs 14,400,000 No. 1 fingerlings were produced and liberated in Litnik Lake and its tributaries. The net loss on the total take, therefore, was 16.2 per cent. In the fall of 1926, also, a shipment of 3,617,000 eyed humpback-salmon eggs from the 4,212,000 eggs collected during the season was forwarded to Seattle. From April 27 to May 25, 1927, 1,090,000 steelhead-trout eggs were collected at Litnik Lake, and the resulting eyed eggs (790,400) were shipped to Seattle in June for distribution. The collection of red-salmon eggs began August 7, 1927, and ended September 28, with a total take of 4,225,408.

As a result of the work of exterminating predatory fish at this station during recent years, comparatively few Dolly Varden trout were observed in the spring of 1927.

### M'DONALD LAKE

At the Federal salmon hatchery on McDonald Lake 19,000,000 red-salmon fingerlings No. 1 were released from April through July, 1927, and 1,467,000 fingerlings No. 2 were released in August from the 30,760,000 eggs taken in 1926. In addition, a shipment of 5,241,130 eyed eggs had been made to Seattle and 1,717,760 to the Territorial hatchery at Ketchikan in the fall of 1926, making the net loss on the total take 10.8 per cent.

A shipment of 60,000 eastern brook-trout eggs was received from Seattle for incubation. Of the 35,000 fry hatched therefrom, 5,800 fingerlings No. 3 were shipped in September and 7,357 fingerlings No. 4 in October, 1927, to Juneau for planting in Auk Lake.

Egg taking in 1927 began on September 5 and ended on October 6, with a total take of 20,240,000 red-salmon eggs. One thousand one hundred and thirty predatory fish, almost entirely Dolly Varden trout, were destroyed during the season.

### HECKMAN LAKE (FORTMANN)

The Alaska Packers Association liberated 18,830,384 red-salmon fry from its Fortmann hatchery on Heckman Lake in 1927, which were hatched from 21,420,000 eggs taken in 1926, a loss of 12.1 per cent. In addition, 2,490,000 humpback-salmon fry hatched from 2,640,000 eggs collected in 1926 were released in November and December of that year. It is contemplated that no further operations are to be carried on at this hatchery.

### HUGH SMITH LAKE (QUADRA)

The Northwestern Fisheries Co. liberated 19,340,000 red-salmon fry from its hatchery near Boca de Quadra in 1927, hatched from 20,000,000 eggs taken in 1926, a loss of 3.3 per cent. In 1927 the take of red-salmon eggs was 20,240,000.

### TERRITORIAL HATCHERIES

In accordance with legislation passed at the eighth regular session of the Territorial Legislature, the operation of fish hatcheries by the Territory of Alaska has been discontinued, the work carried on in 1927 consisting only of handling the eggs collected in the preceding year and the fry hatched therefrom. Information in regard to the terminating work of the Territorial Fish Commission and subsequent operations at the Ketchikan hatchery during the year has been furnished through the office of the Governor of Alaska and from other sources, as follows:

At the Ketchikan hatchery 1,524,000 humpback-salmon fry were liberated from 1,660,000 eggs—574,000 in the hatchery creek, free swimming, and 950,000 to the salt-water feeding pond at Duke Island, where 33,720 were marked before liberating.

Accidental shutting off of the water supply caused the loss of 200,000 chum-salmon fry of the 425,000 hatched from 451,000 eggs collected in 1926 at Ward Cove. The remaining 225,000 fry were liberated free swimming in Hatchery Creek.

Of the fry hatched from 3,337,760 red-salmon eggs (of which 1,620,000 were received green from Quadra and Ward Cove and 1,717,760 in the eyed stage from Yes Bay), 2,625,000 fingerlings were released in Hatchery Creek and about 400,000 were held for feeding.

Of the fry hatched from 2,000,000 king-salmon eggs received from the State of Washington, 1,819,000 fingerlings were released in Hatchery Creek, 50,000 being marked before liberating.

On March 9, 1927, fire destroyed the Seward hatchery, together with all stock on hand, representing 3,164,000 red-salmon eggs and 56,000 humpback-salmon eggs partly hatched.

### HATCHERY REBATES

The owners of private salmon hatcheries in Alaska who are also packers of canned salmon receive a rebate on license fees and taxes of every nature on their catch and pack of salmon at the rate of 40 cents per 1,000 king or red salmon fry liberated by them in Alaskan waters.

*Rebates credited to private salmon hatcheries, fiscal year ended June 30, 1927*

| Owner | Location | Red-salmon fry liberated | Rebate due |
|---|---|---|---|
| Alaska Packers Association | Heckman Lake | 18,830,384 | $7,532 |
| Northwestern Fisheries Co | Hugh Smith Lake | 19,340,000 | 7,736 |
| Total | | 38,170,384 | 15,268 |

### GENERAL STATISTICS OF THE FISHERIES

The total number of persons engaged in the fisheries of Alaska in 1927 was 28,872, or 820 more than in 1926. Products of the fisheries were valued at $40,163,300, a decrease of $14,506,582, or 26.5 per cent. The amount of investment in the industry has not been included for the reason that it is practically impossible to secure complete data, and the figures, if used, would be inaccurate. For years past the Bureau of the Census and other governmental agencies have discontinued publishing figures showing investments in various industries, and this practice is to be followed hereafter in respect to the fisheries of Alaska.

*Summary of persons engaged and products of the Alaska fishery in 1927*

| Items | Southeast Alaska | | Central Alaska | | Western Alaska | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Number | Value | Number | Value | Number | Value | Number | Value |
| PERSONS ENGAGED | | | | | | | | |
| Whites | 8, 296 | | 4, 172 | | 4, 504 | | 16, 972 | |
| Natives | 2, 933 | | 1, 174 | | 750 | | 4, 857 | |
| Chinese | 377 | | 255 | | 470 | | 1, 102 | |
| Japanese | 785 | | 325 | | 243 | | 1, 353 | |
| Filipinos | 1, 715 | | 492 | | 675 | | 2, 882 | |
| Mexicans | 65 | | 66 | | 1, 242 | | 1, 373 | |
| Negroes | 2 | | 39 | | 213 | | 254 | |
| Kanakas | 35 | | 7 | | 2 | | 44 | |
| Porto Ricans | 2 | | 4 | | 11 | | 17 | |
| Koreans | 4 | | | | 14 | | 18 | |
| Total | 14, 214 | | 6, 534 | | 8, 124 | | 28, 872 | |
| PRODUCTS | | | | | | | | |
| Salmon: | | | | | | | | |
| Canned ... cases | 1, 052, 193 | $7, 439, 908 | 1, 571, 103 | $11, 675, 863 | 948, 832 | $10, 900, 493 | 3, 572, 128 | $30, 016, 264 |
| Mild-cured ... pounds | 6, 990, 400 | 1, 564, 901 | 52, 800 | 5, 940 | | | 7, 043, 200 | 1, 570, 841 |
| Pickled ... do | 33, 000 | 3, 600 | 193, 400 | 20, 242 | 540, 000 | 68, 870 | 766, 400 | 92, 712 |
| Fresh ... do | 2, 213, 635 | 213, 550 | 3, 700 | 445 | | | 2, 217, 335 | 213, 995 |
| Frozen ... do | 3, 194, 034 | 308, 393 | | | | | 3, 194, 034 | 308, 393 |
| Dried, smoked, and dry-salted ... do | 21, 400 | 2, 011 | 2, 025 | 222 | 1, 061, 720 | 116, 046 | 1, 085, 145 | 118, 279 |
| Eggs for caviar ... do | 34, 900 | 698 | | | | | 34, 900 | 698 |
| Fertilizer ... do | 413, 588 | 10, 763 | 519, 246 | 16, 172 | | | 932, 834 | 26, 935 |
| Oil ... gallons | 13, 162 | 5, 580 | 19, 212 | 8, 070 | | | 32, 374 | 13, 650 |
| Halibut: | | | | | | | | |
| Fresh ... pounds | 22, 241, 599 | 2, 459, 609 | 83, 304 | 7, 140 | | | 22, 324, 903 | 2, 466, 749 |
| Frozen ... do | 9, 938, 708 | 1, 161, 190 | 2, 227, 672 | 177, 149 | | | 12, 166, 380 | 1, 338, 339 |
| Herring: | | | | | | | | |
| Fresh, for bait ... do | 2, 801, 385 | 20, 734 | 336, 250 | 3, 989 | | | 3, 137, 635 | 24, 723 |
| Frozen, for bait ... do | 4, 612, 270 | 54, 985 | | | | | 4, 612, 270 | 54, 985 |
| Pickled, for bait ... do | | | 292, 000 | 4, 270 | | | 292, 000 | 4, 270 |
| Pickled, for food— | | | | | | | | |
| Scotch cure ... do | 3, 353, 000 | 284, 623 | 11, 050, 390 | 1, 149, 279 | 139, 000 | 15, 625 | 14, 542, 390 | 1, 449, 527 |
| Norwegian cure ... do | 165, 925 | 11, 533 | 19, 000 | 1, 520 | | | 184, 925 | 13, 053 |
| Kippered ... do | 14, 630 | 1, 689 | | | | | 14, 630 | 1, 689 |
| Spiced ... do | 4, 400 | 570 | | | | | 4, 400 | 570 |
| Dry-salted ... do | | | 15, 750 | 100 | | | 15, 750 | 100 |
| Meal ... do | 13, 883, 590 | 420, 671 | 590, 980 | 17, 401 | | | 14, 474, 570 | 438, 072 |
| Oil ... gallons | 1, 948, 145 | 827, 183 | 86, 522 | 36, 651 | | | 2, 034, 667 | 863, 834 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Cod: | | | | | | | | |
| Dry-salted, pounds | | | 1, 256, 193 | 54, 141 | | | 1, 256, 193 | 54, 141 |
| Stockfish, do | | | 31, 846 | 3, 396 | | | 31, 846 | 3, 396 |
| Tongues, do | | | 600 | 60 | | | 600 | 60 |
| Frozen, do | 3, 650 | 183 | | | | | 3, 650 | 183 |
| Whale: | | | | | | | | |
| Oil, gallons | 700 | 140 | 719, 900 | 350, 838 | 385, 300 | 192, 650 | 1, 105, 900 | 543, 628 |
| Sperm oil, do | | | | | 10, 500 | 4, 200 | 10, 500 | 4, 200 |
| Fertilizer, pounds | 2, 000 | 40 | 1, 682, 000 | 38, 325 | 1, 342, 000 | 32, 760 | 3, 026, 000 | 71, 125 |
| Whalebone, do | | | | | 23, 175 | 1, 040 | 23, 175 | 1, 040 |
| Pickled meat, do | | | | | 53, 775 | 2, 419 | 53, 775 | 2, 419 |
| Clams, cases | | | 23, 865 | 146, 735 | | | 23, 865 | 146, 735 |
| Crabs: | | | | | | | | |
| Canned, do | | | 7 | 84 | | | 7 | 84 |
| Meat, pounds | 76, 420 | 30, 569 | 21, 970 | 8, 338 | | | 98, 390 | 38, 907 |
| Whole in shell, dozen | 354 | 708 | 115 | 230 | | | 469 | 938 |
| Shrimp, pounds | 491, 825 | 196, 732 | | | | | 491, 825 | 196, 732 |
| Trout: | | | | | | | | |
| Fresh, do | 27, 627 | 3, 708 | 6, 300 | 756 | | | 33, 927 | 4, 464 |
| Frozen, do | 6, 589 | 659 | 17, 430 | 1, 473 | | | 24, 019 | 2, 132 |
| Sablefish: | | | | | | | | |
| Fresh, do | 164, 018 | 7, 841 | | | | | 164, 018 | 7, 841 |
| Frozen, do | 1, 087, 885 | 61, 088 | | | | | 1, 087, 885 | 61, 088 |
| Pickled, do | 87, 278 | 4, 172 | | | | | 87, 278 | 4, 172 |
| Rockfishes, frozen, do | 31, 471 | 1, 099 | | | | | 31, 471 | 1, 099 |
| Flounders, frozen, do | 5, 600 | 56 | | | | | 5, 600 | 56 |
| Smelt: | | | | | | | | |
| Fresh, do | 175 | 21 | | | | | 175 | 21 |
| Frozen, do | 9, 677 | 1, 161 | | | | | 9, 677 | 1, 161 |
| Total | | 15, 100, 368 | | 13, 728, 829 | | 11, 334, 103 | | [1] 40, 163, 300 |

[1] These figures represent the value of the manufactured product. It is estimated that the value of the catch to the fishermen was approximately $13,812,000. The round weight of the salmon catch landed by the fishermen was approximately 300,565,699 pounds, and the corresponding figures for herring were approximately 111,493,992 pounds. The cod figures given above do not include the offshore catch from waters adjacent to Alaska, which amounted to 5,334,135 pounds of dry-salted cod and 17,600 pounds of tongues, having a total value of $305,144, landed at ports of the Pacific Coast States.

## SALMON

In 1927 the catch of salmon in Alaska as a whole showed a decrease of 50 per cent from that of 1926, partly because of the small catch of red salmon in western Alaska but chiefly due to the greatly diminished run of humpback salmon in the southeastern district. A contributing factor also was the smaller run of humpback salmon that occurs in central Alaska in alternate years, although it may be noted that while the catch of this species was considerably less than in 1926 and 1924, it was larger than for any year prior to 1924 and far in excess of any previous off-year catch in the district. The catch in southeastern Alaska decreased 67 per cent, in central Alaska 35 per cent, and in western Alaska 41 per cent.

There was a decrease of about 4 per cent for the whole of Alaska in the number of fathoms of seines used, while the number of fathoms of gill nets increased about 2 per cent, and the number of traps operated increased 25 per cent. Of the additional traps, approximately 59 per cent were in the southeastern district and 41 per cent in central Alaska. In comparison with the number operated in 1926, however, southeastern Alaska showed an increase of about 20 per cent, while in central Alaska the increase was approximately 44 per cent. A considerable number of the traps in the latter district, especially in the Cook Inlet region, were hand driven or stake traps located on tide lands, on which, under the provisions of recent Territorial legislation, a much smaller license tax was imposed than on the pile driven and floating traps. In southeastern Alaska there is a continued trend toward the use of floating traps instead of driven traps.

The number of independent traps operated by other than salmon canneries increased at a slightly higher rate than did the number operated by canneries. Of the 575 traps operated in southeastern Alaska in 1927, 170 were independent traps, as compared with 141 out of a total of 481 operated there in 1926. For all of Alaska, out of a total of 799 traps used in the salmon industry in 1927, 604 were operated by salmon canneries and 195 by individuals and companies not operating canneries. The comparable total of these independent traps in 1926 was 152.

### CATCH AND APPARATUS

The total number of seines used in the salmon industry of Alaska in 1927 was 593, of which 97 were beach seines and 496 purse seines. The beach seines aggregated 13,570 fathoms of webbing and the purse seines 81,663 fathoms. The number of gill nets used was 3,037, having a total length of 301,763 fathoms. There were 282 driven traps and 517 floating traps—a total of 799.

Southeastern Alaska was accredited with 396 seines, or a total of 72,458 fathoms of webbing, a decrease of 13 seines but only 198 fathoms from the number in 1926; also with 199 gill nets, aggregating 25,979 fathoms, an increase of 15 nets or 929 fathoms; and with 101 driven and 474 floating traps, 13 fewer driven traps but 107 more floating traps than were operated in 1926.

Corresponding figures for central Alaska show 185 seines or 20,175 fathoms, as compared with 210 seines or 24,045 fathoms in 1926;

1,065 gill nets or 55,223 fathoms, as compared with 993 gill nets or 55,045 fathoms in 1926; and 178 driven and 43 floating traps, as compared with 136 and 18, respectively, in 1926.

In western Alaska 12 seines, or 2,600 fathoms of webbing, were used, a decrease from the number operated in 1926 of one 200-fathom seine. There were 1,773 gill nets used, having an aggregate length of 220,561 fathoms, a decrease of 5 nets but an increase of 4,092 fathoms in quantity of webbing used. Three driven traps were operated, one less than in 1926.

Seines caught 18 per cent of the salmon taken in 1927, gill nets 31 per cent, and traps 48 per cent, while lines and wheels took the remaining 3 per cent.

*Percentage of salmon caught in each Alaska district, by principal forms of apparatus*

| Apparatus | Southeast Alaska | | Central Alaska | | Western Alaska | |
|---|---|---|---|---|---|---|
| | 1926 | 1927 | 1926 | 1927 | 1926 | 1927 |
| Seines | 24 | 16 | 32 | 29 | 5 | 4 |
| Gill nets | 1 | 6 | 3 | 8 | 91 | 92 |
| Traps | 73 | 70 | 65 | 63 | 1 | 1 |
| Lines | 2 | 8 | | | | |
| Wheels | | | | | 3 | 3 |

The total catch of salmon in 1927 was 48,222,671, a decrease of 48,684,956, or 50 per cent, from the number taken in 1926. Southeastern Alaska showed a decline of 27,828,591, while central Alaska declined 11,573,125, and western Alaska 9,283,240. The catch by species shows that cohos increased 509,621 and kings 378,652, while chums decreased 5,049,629, humpbacks 31,709,019, and reds 12,814,581.

*Salmon taken in 1927, by apparatus and species, in each geographic section of Alaska*

| Apparatus and species | Southeast Alaska | Central Alaska | Western Alaska | Total |
|---|---|---|---|---|
| Seines: | | | | |
| Coho, or silver | 146,470 | 159,786 | 20 | 306,276 |
| Chum, or keta | 634,682 | 852,318 | 53,783 | 1,540,778 |
| Humpback, or pink | 1,143,303 | 4,539,036 | 334,575 | 6,016,914 |
| King, or spring | 905 | 12,641 | 11,172 | 24,718 |
| Red, or sockeye | 247,219 | 574,669 | 171,669 | 993,557 |
| Total | 2,172,579 | 6,138,445 | 571,219 | 8,882,243 |
| Gill nets: | | | | |
| Coho, or silver | 308,171 | 488,724 | 1,942 | 798,837 |
| Chum, or keta | 65,536 | 85,775 | 619,670 | 770,981 |
| Humpback, or pink | 113,154 | 380,516 | 3 | 493,673 |
| King, or spring | 21,914 | 52,004 | 101,234 | 175,152 |
| Red, or sockeye | 275,388 | 681,303 | 11,671,485 | 12,628,176 |
| Total | 784,163 | 1,688,322 | 12,394,334 | 14,866,819 |
| Traps: | | | | |
| Coho, or silver | 413,850 | 671,278 | 104 | 1,085,232 |
| Chum, or keta | 1,507,856 | 1,590,981 | 33,180 | 3,132,017 |
| Humpback, or pink | 6,760,487 | 7,979,695 | | 14,740,182 |
| King, or spring | 25,999 | 90,468 | 5,323 | 121,790 |
| Red, or sockeye | 925,747 | 2,951,671 | 75,698 | 3,953,111 |
| Total | 9,633,939 | 13,284,093 | 114,300 | 23,032,332 |

*Salmon taken in 1927, by apparatus and species, in each geographic section of Alaska*—Continued

| Apparatus and species | Southeast Alaska | Central Alaska | Western Alaska | Total |
|---|---|---|---|---|
| Lines: | | | | |
| Coho, or silver | 477,417 | | | 477,417 |
| Chum, or keta | 766 | | | 766 |
| Humpback, or pink | 854 | | | 854 |
| King, or spring | 624,918 | | | 624,918 |
| Red, or sockeye | 1,477 | | | 1,477 |
| Total | 1,105,432 | | | 1,105,432 |
| Wheels: | | | | |
| Chum, or keta | | | 315,134 | 315,134 |
| King, or spring | | | 20,711 | 20,711 |
| Total | | | 335,845 | 335,845 |
| Total: | | | | |
| Coho, or silver | 1,345,908 | 1,319,788 | 2,066 | 2,667,762 |
| Chum, or keta | 2,208,840 | 2,529,069 | 1,021,767 | 5,759,676 |
| Humpback, or pink | 8,017,798 | 12,899,247 | 334,578 | 21,251,623 |
| King, or spring | 673,736 | 155,113 | 138,440 | 967,289 |
| Red, or sockeye | 1,449,831 | 4,207,643 | 11,918,847 | 17,576,321 |
| Grand total | 13,696,118 | 21,110,860 | 13,415,698 | 48,222,671 |

## CANNING

### CHANGES IN CANNERIES

The Nakat Packing Corporation renewed, for a 3-year period, its lease on the Heceta Island plant of the Swift-Arthur-Crosby Co. and also leased the cannery of the Pure Food Fish Co. at Ketchikan, giving it a total of five canneries in southeast Alaska. The plant of the George Inlet Packing Co. was leased by Libby, McNeill & Libby, this action being taken as a result of the loss of the latter's floating cannery, which was driven on the rocks near Ketchikan during a heavy storm in March. The floating plant *Pioneer*, of the Stuart Corporation at Ketchikan, was purchased by the Far North Fisheries (Inc.), and moved to Hydaburg, where a warehouse was built on shore. The Hood Bay Canning Co. took over the cannery of Hidden Inlet Canning Co. at Hood Bay at the beginning of the year. The lease of the cannery formerly operated by the Point Warde Fisheries at Point Warde was taken over by the Whitworth Fisheries (Inc.). The Peril Straits Packing Co. purchased the cannery buildings of the former Todd Packing Co. on Peril Strait, which had not been in use since 1920; machinery for a 1-line outfit was secured, the original equipment having been sold to the Sunrise Packing Co. in 1923 and transferred to its cannery at Ketchikan.

The Alaska Sanitary Packing Co., which had lost its plant at Wrangell by fire in 1924 and had since operated jointly with the Alaska Packers Association, leased the Wrangell cannery of that company and operated independently in the 1927 season. The Diamond K Packing Co. purchased the floater that had been operated by the Dobbins Packing Co. at Petersburg in 1922 and 1923 and used it as a floating cannery at Wrangell during the early run of salmon, later moving to Hoonah for the fall fishing season. The New England Fish Co. expanded its production facilities in southeast Alaska, erecting a modern new 2½-line cannery at Ketchikan to replace its

1-line cannery operated since 1923, and also adding a complete new tall line to the Noyes Island plant, doubling its equipment there. The Sunny Point Packing Co. erected a large up-to-date cannery near Ketchikan to replace its plant destroyed by fire in March. It was in operation during the season.

The Snug Harbor Packing Co. took over and operated the cannery at Snug Harbor, Chisik Island, last used as a salmon cannery in 1923 by Pioneer Canneries (Inc.) and in 1924 operated by the Chisik Island Corporation for the packing of clams exclusively. The Premier Salmon Co. purchased the Moore Packing Co.'s plant at Orca Bay. The Gorman Packing Corporation took over the old cannery of the Central Alaska Fisheries on Drier Bay, recently operated as a herring plant by the Knight Island Packing Co., its lease on the Prince Packing Co.'s cannery in that locality having terminated. The Cordova plant of the Carlisle Packing Co. was sold to the New England Fish Co., whose operations had been limited previously to southeast Alaska. Pajoman and Trout completed the

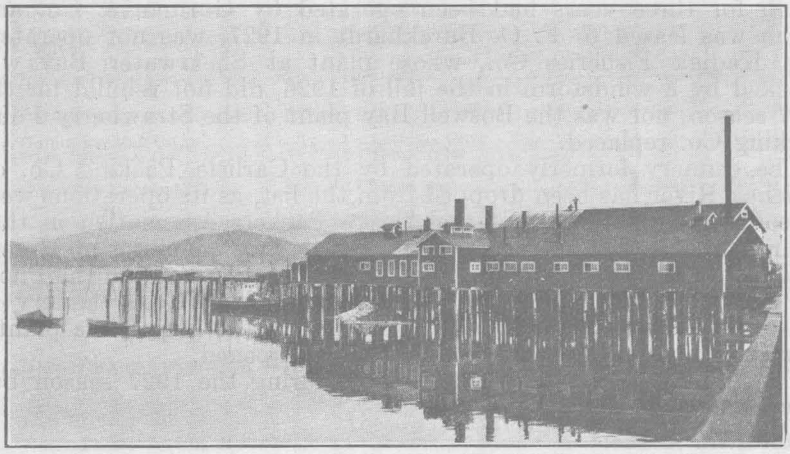

Fig. 6.—Typical salmon cannery, central Alaska

installation of equipment in their new building at Raspberry Island and again put up a pack of canned salmon, the first since 1924. The Arctic Packing Co., whose cannery on Cook Inlet had not been operated since 1924, moved from the old location on English Bay to Port Graham and put up a small pack during the 1927 season. The plant of the Hemrich Packing Co. at Kukak Bay was leased again and operated by the Seashore Packing Co.

The Alaska Packers Association reopened its two canneries on the Naknek River and Nushagak Bay, which had been closed during the 1926 season. This company also purchased the cannery of the Carlisle Packing Co. on the Kvichak River and consolidated it with its other operations in the vicinity.

NEW CANNERIES

The Independent Salmon Canneries, a recently organized firm, operated a one-line cannery in a leased building at Ketchikan.

Three new canneries were operated in the central district in 1927. These include Nordin and Wik, who put up a small pack at their hand cannery at Nikishka. The Kenai River Packing Co. built and operated a one-line cannery on the Kenai River, Cook Inlet. The Grimes Packing Co. installed a one-line outfit on the dock of O. L. Grimes at Uzinki, near Kodiak.

### CANNERIES NOT OPERATED

The Tongass Packing Co., which built a new cannery at Nakat Inlet in 1926, went into receivership, and the plant was not operated during the 1927 season. The floating cannery of Libby, McNeill & Libby at Ketchikan was wrecked by a storm in March and was not replaced.

Canneries in central Alaska closed during the year because of the expectation of poor runs in certain areas were the Uyak plant of the Northwestern Fisheries Co. and the Unakwik Inlet plant leased by Pacific American Fisheries. The Hoonah Packing Co. did not operate its plant on Bering River on account of the closure of that area to commercial fishing. The Drier Bay cannery of the Prince Packing Co., which for three years had been operated by Gorman & Co. and which was leased to F. O. Burckhardt in 1927, was not operated. The Kadiak Fisheries Co., whose plant at Shearwater Bay was wrecked by a windstorm in the fall of 1926, did not rebuild for the 1927 season, nor was the Boswell Bay plant of the Strawberry Point Packing Co. replaced.

The cannery formerly operated by the Carlisle Packing Co. on Kvichak River has been dropped from the list, as its operations were consolidated with others of the Alaska Packers Association in that vicinity at the time the sale was effected. Two canneries at Herendeen Bay, belonging to the Fidalgo Island Packing Co. and the Phoenix Packing Co., and the Nelson Lagoon Packing Co.'s cannery at Nelson Lagoon have also been dropped from the list of idle plants, there being little likelihood of their being reopened.

The following canneries were closed during the 1927 season but may be reopened:

| | |
|---|---|
| Southeastern Alaska: | |
| Alaska Herring and Sardine Co. | Port Walter. |
| Alaska Sanitary Packing Co. | Cape Fanshaw. |
| Hoonah Packing Co. | Hoonah.<br>Gambier Bay. |
| Northwestern Fisheries Co. | Roe Point.<br>Santa Ana. |
| Tongass Packing Co. | Nakat Inlet. |
| Central Alaska: | |
| Prince Packing Co. | Drier Bay. |
| Alaska Packers Association | Kasilof. |
| Hoonah Packing Co. | Bering River. |
| Kodiak Island Fishing & Packing Co. | Seward. |
| Northwestern Fisheries Co. | Seldovia.<br>Orca.<br>Uyak. |
| Pacific American Fisheries | Unakwik Inlet. |
| Western Alaska: Alaska Salmon Co. | Kvichak Bay. |

### TOTAL CANNERIES OPERATED

There were 135 canneries operated in Alaska in 1927—62 in southeastern, 44 in central, and 29 in western, which is one more in each district than in 1926, a net gain of 3 plants.

*Companies that canned salmon in Alaska, number and location of canneries operated, and number of traps owned by each, 1927*

[New canneries indicated by (*)]

| Company | Canneries | | Traps | | |
|---|---|---|---|---|---|
| | Number | Location | Driven | Floating | Total |
| Southeast Alaska: | | | | | |
| Alaska Consolidated Canneries | 6 | Boca de Quadra | 2 | 7 | 9 |
| | | Chomly | 2 | 3 | 5 |
| | | Pybus Bay | 2 | 6 | 8 |
| | | Rose Inlet | | 5 | 5 |
| | | Tenakee | 1 | 7 | 8 |
| | | Yes Bay | 1 | 8 | 9 |
| Alaska Packers Association | 1 | Loring | 1 | 2 | 3 |
| Alaska Sanitary Packing Co. | 1 | Wrangell | | 8 | 8 |
| Annette Island Packing Co. | 1 | Metlakatla | 6 | 5 | 11 |
| Astoria & Puget Sound Canning Co. | 1 | Excursion Inlet | 3 | 5 | 8 |
| F. C. Barnes Co. | 1 | Lake Bay | 1 | 3 | 4 |
| Bayview Packing Co. | 1 | Klawak | | | |
| Beegle Packing Co. | 1 | Ketchikan | 1 | 3 | 4 |
| Burnett Inlet Packing Co. | 1 | Burnett Inlet | | 6 | 6 |
| Deep Sea Salmon Co. | 1 | Port Althorp | | 17 | 17 |
| Demmert Packing Co. | 1 | Klawak | | 5 | 5 |
| Diamond K Packing Co. | 1 | Wrangell and Hoonah (floating) | | 5 | 5 |
| Douglas Island Packing Co. | 1 | Douglas. | | | |
| Fair North Fisheries (Inc.) | 1 | Hydaburg (floating) | | 3 | 3 |
| Fidalgo Island Packing Co. | 2 | Bay of Pillars | 8 | | 8 |
| | | Ketchikan | 4 | 4 | 8 |
| Haines Packing Co. | 1 | Letnikof Cove | | | |
| P. E. Harris & Co. | 1 | Hawk Inlet | 1 | 7 | 8 |
| Hetta Packing Co. | 1 | Coppermount | | 1 | 1 |
| Hood Bay Canning Co. | 1 | Hood Bay | | 7 | 7 |
| Independent Salmon Canneries | 1 | Ketchikan * | | | |
| Karheen Packing Co. | 1 | Karheen | 4 | 2 | 6 |
| Libby, McNeill & Libby | 3 | George Inlet | 2 | 7 | 9 |
| | | Taku Harbor | 10 | 4 | 14 |
| | | Yakutat | | | |
| Mountain Point Packing Co. (P. F. Harley). | 1 | Wrangell Narrows | | | |
| Geo. T. Myers & Co. | 1 | Chatham | 3 | 3 | 6 |
| Nakat Packing Corporation, The | 5 | Heceta Island | | 10 | 10 |
| | | Hidden Inlet | | 8 | 8 |
| | | Ketchikan | 2 | 2 | 4 |
| | | Union Bay | | 8 | 8 |
| | | Waterfall | | 10 | 10 |
| New England Fish Co. | 2 | Ketchikan | | 9 | 9 |
| | | Noyes Island | | 8 | 8 |
| North Pacific Trading & Packing Co. | 1 | Klawak | | 6 | 6 |
| Northwestern Fisheries Co. | 5 | Boca de Quadra | 2 | 5 | 7 |
| | | Dundas Bay | | 5 | 5 |
| | | Hunter Bay | | 10 | 10 |
| | | Kasaan | 3 | 5 | 8 |
| | | Shakan | 1 | 5 | 6 |
| Pacific American Fisheries | 1 | Excursion Inlet | 5 | 5 | 10 |
| Peril Straits Packing Co. | 1 | Todd | | 4 | 4 |
| Petersburg Packing Co. | 1 | Petersburg | 5 | 8 | 13 |
| Pyramid Packing Co. | 1 | Sitka | | 7 | 7 |
| Red Salmon Packers Association | 1 | Dry Bay and Situk River (floating). | | | |
| Sea-Coast Packing Co. | 1 | Craig | | 10 | 10 |
| Sebastian-Stuart Fish Co. | 1 | Tyee | 2 | 6 | 8 |
| J. L. Smiley & Co. | 1 | Ketchikan | 4 | 8 | 12 |
| Starr-Collinson Packing Co. | 1 | Moira Sound | | 4 | 4 |
| Straits Packing Co. | 1 | Skowl Arm | | | |
| Stuart Corporation, The | 1 | Ketchikan | 2 | 5 | 7 |
| Sunny Point Packing Co. | 3 | Funter Bay | | 14 | 14 |
| | | Kake | | 12 | 12 |
| | | Ketchikan | 2 | 9 | 11 |
| Superior Packing Co. | 1 | Tenakee | 3 | 2 | 5 |
| Ward's Cove Packing Co. | 1 | Ward Cove | | 2 | 2 |
| Whitworth Fisheries (Inc.) | 1 | Point Warde | | 2 | 2 |
| Central Alaska: | | | | | |
| Alaska General Fisheries | 1 | Anchorage | 6 | | 6 |
| Alaska Packers Association | 3 | Alitak | 2 | | 2 |
| | | Chignik | 4 | | 4 |
| | | Karluk | 2 | | 2 |
| Alaska Year Round Canneries Co. | 1 | Seldovia | 6 | | 6 |
| Alitak Packing Co. | 1 | Lazy Bay | 3 | | 3 |

*Companies that canned salmon in Alaska, number and location of canneries operated, and number of traps owned by each, 1927*—Continued

[New canneries indicated by (*)]

| Company | Canneries: Number | Canneries: Location | Traps: Driven | Traps: Floating | Traps: Total |
|---|---|---|---|---|---|
| Central Alaska—Continued. | | | | | |
| Arctic Packing Co | 1 | Port Graham | 1 | | 1 |
| Columbia River Packers Association. | 1 | Chignik | 3 | | 3 |
| Cook Inlet Packing Co | 1 | Seldovia | 7 | | 7 |
| Copper River Packing Co | 1 | McClure Bay | 2 | 9 | 11 |
| Cordova Packing Co | 1 | Cordova | | | |
| Crosby Fisheries (Inc.) | 1 | Kodiak Island (floating) | 4 | | 4 |
| Emel Packing Co | 1 | Valdez | 1 | 3 | 4 |
| Fidalgo Island Packing Co | 1 | Port Graham | 9 | | 9 |
| Gorman & Co | 1 | Anchorage | 6 | | 6 |
| Gorman Packing Corporation | 1 | Drier Bay | | 3 | 3 |
| Grimes Packing Co | 1 | Uzinki* | | | |
| P. E. Harris & Co | 1 | Isanotski Strait | 9 | | 9 |
| Kodiak Fisheries Co | 1 | Kodiak | 4 | | 4 |
| Katmai Packing Co | 1 | Uzinki | | | |
| W. A. Keller | 1 | Deep Creek | 1 | | 1 |
| Kenai River Packing Co | 1 | Kenai River* | 7 | | 7 |
| Kodiak Island Fishing & Packing Co. | 1 | Uganik Bay | 5 | | 5 |
| Libby, McNeill & Libby | 1 | Kenai | 15 | | 15 |
| New England Fish Co | 1 | Cordova | 4 | 2 | 6 |
| Nordin & Wik | 1 | Nikishka* | | | |
| North Coast Packing Co | 1 | Ninilchik | 5 | | 5 |
| Northern Light Packing Co | 1 | Mountain Slough | | | |
| Northwestern Fisheries Co | 2 | Chignik | 3 | | 3 |
| | | Kenai | 9 | | 9 |
| Orca Packing Co | 1 | Cordova (floating) | | | |
| Pacific American Fisheries | 2 | Ikatan | 5 | | 5 |
| | | King Cove | 13 | | 13 |
| Pajoman & Trout | 1 | Iron Creek | | | |
| Pioneer Packing Co | 1 | Cordova | | 5 | 5 |
| Pioneer Sea Foods Co | 1 | do | | 2 | 2 |
| Premier Salmon Co | 1 | Orca Bay | 2 | 1 | 3 |
| Robinson Packing Corporation | 1 | Zachar Bay (floating) | 2 | | 2 |
| San Juan Fishing & Packing Co | 2 | Evans Bay | 10 | | 10 |
| | | Uganik Bay | 4 | | 4 |
| Seashore Packing Co | 1 | Kukak Bay | | | |
| Shepard Point Packing Co | 1 | Shepard Point | | 7 | 7 |
| Shumagin Packing Co | 1 | Squaw Harbor | 3 | | 3 |
| Snug Harbor Packing Co | 1 | Snug Harbor | 7 | | 7 |
| Western Alaska: | | | | | |
| Alaska Packers Association | 9 | Egegik River | | | |
| | | Kvichak Bay (2) | | | |
| | | Naknek River (3) | | | |
| | | Nushagak Bay (2) | | | |
| | | Ugashik River | | | |
| Alaska-Portland Packers Association | 2 | Naknek River | | | |
| | | Nushagak Bay | | | |
| Alaska Salmon Co | 1 | Wood River | | | |
| Bristol Bay Packing Co | 1 | Kvichak Bay | | | |
| Columbia River Packers Association. | 1 | Nushagak Bay | | | |
| Everett Packing Co | 1 | Herendeen Bay | | | |
| International Packing Co | 1 | Ugashik River and Makushin Bay (floating). | | | |
| Libby, McNeill & Libby | 6 | Egegik River | | | |
| | | Ekuk | | | |
| | | Koggiung | | | |
| | | Libbyville | | | |
| | | Lockanok | | | |
| | | Nushagak | | | |
| Nakat Packing Corporation, The | 1 | Nakeen | | | |
| Naknek Packing Co | 1 | Naknek River | | | |
| Northwestern Fisheries Co | 2 | do | | | |
| | | Nushagak | | | |
| Pacific American Fisheries | 1 | Port Moller | 3 | | 3 |
| Red Salmon Canning Co | 2 | Naknek River | | | |
| | | Ugashik River | | | |

LOSSES AND DISASTERS

The cannery of the Sunny Point Packing Co. at Charcoal Point near Ketchikan was destroyed by fire on March 23, 1927, but was rebuilt and ready for operation in June. The loss was reported to be $207,000. The floating cannery that had been operated by Libby, McNeill & Libby since 1924 was driven on the rocks near Ketchikan during a heavy storm about the middle of March. The Quiet Harbor Fish Co.'s power vessel *Iowa*, valued at $2,000, was burned near Ketchikan, and the seine boat *Ruth*, operated by P. A. Olson and valued at $1,000, was lost. Other losses of fishing gear, fish, small boats, and buildings in southeastern Alaska amounted to $34,905. One fisherman was drowned and four shoresmen died of disease.

FIG. 7.—Sluicing salmon from lighter at cannery, southeast Alaska

In the central district the cannery building of the Northern Light Packing Co. was damaged by ice, the loss being $3,000. Loss from fire on the motor vessel *Tokeh Lou*, belonging to the same company, amounted to $1,900. On April 20 fire broke out on the Crosby Fisheries' floating salmon cannery *Salmon King* while it was docked at Seattle, the damage amounting to $5,900. Repairs were made immediately and the vessel returned to Zachar Bay, Kodiak Island, the latter part of June. Losses of a scow, small boats, gear, and fish, having a total value of $3,465, also were reported. Seventeen lives were lost—4 shoresmen by accident and 6 by disease, 3 fishermen by drowning, 3 by disease, and 1 by accident.

In western Alaska Libby, McNeill & Libby's gas boat *Nuten*, valued at $7,200, was destroyed by fire. Three fishing boats valued at $1,050 and gill nets and boat gear valued at $8,217 were lost. Eight shoresmen and 3 fishermen died of disease, 2 shoresmen were killed accidentally, and 1 fisherman was drowned.

Summarizing the foregoing, the total number of lives lost in the Alaska salmon-canning industry in 1927 was 36—24 by disease, 5 by drowning, and 7 by other accident. The total property loss reported was $275,637.

## STATISTICS

In 1927, 135 canneries were operated in Alaska, 3 more than in 1926. Employment was given to 22,131 persons, as compared with 21,906 in 1926, an increase of 225. White employees increased 261, Filipinos 263, and Mexicans 315, while natives decreased 337, Chinese 16, Japanese 202, negroes 9, Porto Ricans 3, Kanakas 20, and miscellaneous (including Koreans) 27.

The total pack of canned salmon was 3,572,128 cases, valued at $30,016,264. This was a decrease from 1926 of 3,080,754 cases, or 46.3 per cent, and a decrease in value of $16,063,740, or approximately 35 per cent. The output in southeastern Alaska decreased from 3,058,055 cases to 1,052,193, or nearly 66 per cent; central Alaska from 2,146,485 cases to 1,571,103, or about 27 per cent; and western Alaska from 1,448,342 cases to 948,832, or slightly over 34 per cent. The decline was attributable partly to the smaller run of reds in all districts but chiefly to the inexplicable scarcity of humpback salmon in southeastern Alaska. In Alaska as a whole the pack of cohos increased from 202,527 to 253,044 cases, or about 25 per cent, and that of kings from 52,476 to 70,391 cases, or 34 per cent. The pack of chums decreased from 902,443 to 507,723 cases, or 43.7 per cent; humpbacks from 3,338,349 to 1,420,775 cases, or 57.4 per cent; and reds from 2,157,087 to 1,320,195 cases, or 38.8 per cent.

*Persons engaged, wages paid, and operating units, Alaska salmon canning industry, 1927*

| Items | Southeast Alaska | Central Alaska | Western Alaska | Total |
|---|---|---|---|---|
| PERSONS ENGAGED | | | | |
| Fishermen: | | | | |
| Whites | 1,330 | 1,023 | 2,090 | 4,443 |
| Natives | 1,277 | 462 | 121 | 1,860 |
| Japanese | 1 | | | 1 |
| Filipinos | 7 | | | 7 |
| Mexican | 1 | | | 1 |
| Kanakas | 2 | | | 2 |
| Total | 2,618 | 1,485 | 2,211 | 6,314 |
| Shoresmen: | | | | |
| Whites | 2,239 | 1,254 | 1,877 | 5,370 |
| Natives | 1,137 | 543 | 170 | 1,850 |
| Chinese | 369 | 255 | 465 | 1,089 |
| Japanese | 737 | 321 | 241 | 1,299 |
| Filipinos | 1,693 | 489 | 675 | 2,857 |
| Mexicans | 59 | 65 | 1,242 | 1,366 |
| Negroes | | 39 | 213 | 252 |
| Kanakas | 33 | 7 | 2 | 42 |
| Porto Ricans | 1 | 4 | 11 | 16 |
| Koreans | 3 | | 14 | 17 |
| Total | 6,271 | 2,977 | 4,910 | 14,158 |

*Persons engaged, wages paid, and operating units, Alaska salmon canning industry, 1927*—Continued

| Items | Southeast Alaska | Central Alaska | Western Alaska | Total |
|---|---|---|---|---|
| PERSONS ENGAGED—continued | | | | |
| Transporters: | | | | |
| Whites | 839 | 355 | 372 | 1,566 |
| Natives | 17 | 34 | | 51 |
| Chinese | 7 | | 5 | 12 |
| Japanese | 18 | 3 | 2 | 23 |
| Filipinos | 4 | 1 | | |
| Porto Rican | 1 | | | 1 |
| Korean | 1 | | | 1 |
| Total | 887 | 393 | 379 | 1,659 |
| Total: | | | | |
| Whites | 4,408 | 2,632 | 4,339 | 11,379 |
| Natives | 2,431 | 1,039 | 291 | 3,761 |
| Chinese | 376 | 255 | 470 | 1,101 |
| Japanese | 756 | 324 | 243 | 1,323 |
| Filipinos | 1,704 | 490 | 675 | 2,869 |
| Mexicans | 60 | 65 | 1,242 | 1,367 |
| Negroes | | 39 | 213 | 252 |
| Kanakas | 35 | 7 | 2 | 44 |
| Porto Ricans | 2 | 4 | 11 | 17 |
| Koreans | 4 | | 14 | 18 |
| Grand total | 9,776 | 4,855 | 7,500 | 22,131 |
| Wages paid shoresmen | $2,464,183 | $1,529,546 | $1,725,699 | $5,719,428 |
| Wages paid transporters | $449,600 | $225,014 | $153,025 | $827,639 |
| OPERATING UNITS | | | | |
| Plants: | | | | |
| Shore canneries | 59 | 41 | 28 | 128 |
| Floating canneries: | | | | |
| Power vessels | 1 | 1 | 1 | 3 |
| Net tonnage | 245 | 1,100 | 1,424 | 2,769 |
| Sailing vessel | | 1 | | 1 |
| Net tonnage | | 480 | | 480 |
| Barges | 2 | 1 | | 3 |
| Net tonnage | 1,580 | 200 | | 1,780 |
| Total plants operated | 62 | 44 | 29 | 135 |
| Vessels: | | | | |
| Power, over 5 tons | 413 | 125 | 90 | 628 |
| Net tonnage | 9,618 | 4,893 | 30,282 | 44,793 |
| Sailing | 1 | 2 | 4 | 7 |
| Net tonnage | 876 | 3,015 | 9,824 | 13,715 |
| Barges | 2 | | | 2 |
| Net tonnage | 1,581 | | | 1,581 |
| Launches | 224 | 204 | 34 | 462 |
| Power dories | 31 | 1 | | 32 |
| Gill net boats | 73 | 107 | 1,096 | 1,276 |
| Seine skiffs | 137 | 179 | 12 | 328 |
| Other rowboats and skiffs | 1,098 | 566 | 134 | 1,798 |
| Lighters and scows | 362 | 258 | 162 | 782 |
| Houseboats | 30 | 4 | 32 | 66 |
| Pile drivers | 52 | 40 | 24 | 116 |
| Pile pullers | 8 | 1 | | 9 |
| Rigging scows | 22 | | | 22 |
| Apparatus: | | | | |
| Purse seines | 388 | 99 | 9 | 496 |
| Fathoms | 71,208 | 8,230 | 2,225 | 81,663 |
| Beach seines | 8 | 81 | 3 | 92 |
| Fathoms | 1,250 | 11,470 | 375 | 13,095 |
| Gill nets | 192 | 1,060 | 1,539 | 2,791 |
| Fathoms | 25,529 | 54,773 | 207,500 | 287,802 |
| Traps, driven | 101 | 176 | 3 | 280 |
| Traps, floating | 474 | 43 | | 517 |

*Output and value of canned salmon in Alaska in 1927* [1]

| Product | Southeast Alaska | | Central Alaska | | Western Alaska | | Total | |
|---|---|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| Coho, or silver: | | | | | | | | |
| ½-pound flat | 6,887 | $85,081 | 3,218 | $36,183 | | | 10,105 | $121,264 |
| 1-pound flat | 10,119 | 86,266 | 4,928 | 35,731 | | | 15,047 | 121,997 |
| 1-pound tall | 97,964 | 798,223 | 129,888 | 1,112,121 | 40 | $351 | 227,892 | 1,910,695 |
| Total | 114,970 | 969,570 | 138,034 | 1,184,035 | 40 | 351 | 253,044 | 2,153,956 |
| Chum, or keta: | | | | | | | | |
| ½-pound flat | 8,235 | 64,532 | 1,179 | 8,962 | | | 9,414 | 73,494 |
| 1-pound flat | | | 1,449 | 6,977 | | | 1,449 | 6,977 |
| 1-pound tall | 216,198 | 1,180,774 | 250,569 | 1,352,724 | 30,093 | 163,511 | 496,860 | 2,697,009 |
| Total | 224,433 | 1,245,306 | 253,197 | 1,368,663 | 30,093 | 163,511 | 507,723 | 2,777,480 |
| Humpback, or pink: | | | | | | | | |
| ½-pound flat | 43,125 | 388,373 | 7,330 | 57,826 | | | 50,455 | 446,199 |
| 1-pound flat | 8,367 | 50,331 | 6,295 | 32,253 | | | 14,662 | 82,584 |
| 1-pound tall | 536,799 | 3,160,552 | 803,913 | 4,573,832 | 14,946 | 75,523 | 1,355,658 | 7,809,907 |
| Total | 588,291 | 3,599,256 | 817,538 | 4,663,911 | 14,946 | 75,523 | 1,420,775 | 8,338,690 |
| King, or spring: | | | | | | | | |
| ½-pound flat | 1,756 | 25,670 | 8,772 | 144,417 | | | 10,528 | 170,087 |
| 1-pound flat | 2,504 | 29,239 | 8,537 | 112,708 | 330 | 2,300 | 11,371 | 144,247 |
| 1-pound tall | 3,771 | 35,818 | 26,161 | 253,867 | 18,560 | 187,634 | 48,492 | 477,319 |
| Total | 8,031 | 90,727 | 43,470 | 510,992 | 18,890 | 189,934 | 70,391 | 791,653 |
| Red, or sockeye: | | | | | | | | |
| ½-pound flat | 30,998 | 498,117 | 38,788 | 635,645 | 19,088 | 330,263 | 88,874 | 1,464,025 |
| 1-pound flat | 21,083 | 265,771 | 32,709 | 396,245 | 3,979 | 43,554 | 57,771 | 705,570 |
| 1-pound tall | 64,387 | 771,161 | 247,367 | 2,916,372 | 861,796 | 10,097,357 | 1,173,550 | 13,784,890 |
| Total | 116,468 | 1,535,049 | 318,864 | 3,948,262 | 884,863 | 10,471,174 | 1,320,195 | 15,954,485 |
| Grand total | 1,052,193 | 7,439,908 | 1,571,103 | 11,675,863 | 948,832 | 10,900,493 | 3,572,128 | 30,016,264 |

[1] Cases containing ½-pound cans have been reduced one-half in number, and thus, for the purpose of affording fair comparison, all are put upon the basis of forty-eight 1-pound cans to the case.

*Output of canned salmon in Alaska, in cases, 1922 to 1927* [1]

| Product | 1922 | 1923 | 1924 | 1925 | 1926 | Average for 5-year period, 1922–1926 | 1927 | Percentage of increase or decrease in 1927, as compared with 5-year average |
|---|---|---|---|---|---|---|---|---|
| Coho, or silver: | | | | | | | | |
| ½-pound flat | 22,237 | 13,866 | 8,059 | 7,145 | 10,354 | 12,332 | 10,105 | −18.06 |
| 1-pound flat | 12,099 | 10,151 | 5,403 | 7,223 | 16,625 | 10,300 | 15,047 | +46.09 |
| 1-pound tall | 141,657 | 140,090 | 170,139 | 146,642 | 175,548 | 154,815 | 227,892 | +47.20 |
| Total | 175,993 | 164,107 | 183,601 | 161,010 | 202,527 | 177,447 | 253,044 | +42.60 |
| Chum, or keta: | | | | | | | | |
| ½-pound flat | 3,698 | 6,356 | 346 | 3,051 | 1,367 | 2,964 | 9,414 | +217.61 |
| 1-pound flat | 6,185 | 16 | 630 | | 48,982 | 11,162 | 1,449 | −87.02 |
| 1-pound tall | 556,035 | 519,250 | 1,027,512 | 1,075,629 | 852,094 | 806,104 | 496,860 | −38.36 |
| Total | 565,918 | 525,622 | 1,028,488 | 1,078,680 | 902,443 | 820,230 | 507,723 | −38.10 |
| Humpback, or pink: | | | | | | | | |
| ½-pound flat | 42,736 | 29,363 | 21,365 | 34,005 | 59,835 | 37,461 | 50,455 | +34.69 |
| 1-pound flat | 30,879 | 9,428 | 13,095 | 185 | 82,161 | 27,150 | 14,662 | −46.00 |
| 1-pound tall | 1,584,808 | 2,409,338 | 2,566,823 | 2,076,403 | 3,196,353 | 2,366,745 | 1,355,658 | −42.72 |
| Total | 1,658,423 | 2,448,129 | 2,601,283 | 2,110,593 | 3,338,349 | 2,431,356 | 1,420,775 | −41.56 |
| King, or spring: | | | | | | | | |
| ½-pound flat | 3,770 | 5,466 | 1,501 | 2,755 | 3,324 | 3,363 | 10,528 | +213.05 |
| 1-pound flat | 3,967 | 7,281 | 9,500 | 8,828 | 11,125 | 8,140 | 11,371 | +39.69 |
| 1-pound tall | 22,923 | 25,596 | 22,647 | 38,395 | 38,027 | 29,518 | 48,492 | +64.28 |
| Total | 30,660 | 38,343 | 33,648 | 49,978 | 52,476 | 41,021 | 70,391 | +71.60 |
| Red, or sockeye: | | | | | | | | |
| ½-pound flat | 171,896 | 121,775 | 31,947 | 68,901 | 82,181 | 95,340 | 88,874 | −6.79 |
| 1-pound flat | 121,449 | 159,271 | 110,352 | 28,757 | 104,329 | 104,832 | 57,771 | −44.89 |
| 1-pound tall | 1,777,313 | 1,578,450 | 1,305,596 | 962,018 | 1,970,577 | 1,518,791 | 1,173,550 | −22.73 |
| Total | 2,070,658 | 1,859,496 | 1,447,895 | 1,059,676 | 2,157,087 | 1,718,963 | 1,320,195 | −23.20 |
| Grand total | 4,501,652 | 5,035,697 | 5,294,915 | 4,459,937 | 6,652,882 | 5,189,017 | 3,572,128 | −31.16 |

[1] The number of cases shown has been put upon the common basis of forty-eight 1-pound cans per case.

*Relative importance of each species of canned salmon within each district in 1927*

| District | Coho | Chum | Hump-back | King | Red | Total, all species |
|---|---|---|---|---|---|---|
| | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* |
| Southeast Alaska | 10.9 | 21.3 | 55.9 | 0.8 | 11.1 | 100 |
| Central Alaska | 8.8 | 16.1 | 52.0 | 2.8 | 20.3 | 100 |
| Western Alaska | .0 | 3.2 | 1.6 | 2.0 | 93.2 | 100 |
| All Alaska | 7.1 | 14.2 | 39.8 | 2.0 | 36.9 | 100 |

*Relative importance of each district in the production of each species of salmon canned in 1927*

| District | Coho | Chum | Hump-back | King | Red | Total, all species |
|---|---|---|---|---|---|---|
| | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* |
| Southeast Alaska | 45.4 | 44.2 | 41.4 | 11.4 | 8.8 | 29.4 |
| Central Alaska | 54.6 | 49.9 | 57.5 | 61.8 | 24.2 | 44.0 |
| Western Alaska | .0 | 5.9 | 1.1 | 26.8 | 67.0 | 26.6 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Average annual price per case of forty-eight 1-pound cans of salmon, 1917 to 1927*

| Product | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 | 1924 | 1925 | 1926 | 1927 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Coho, or silver | $8.76 | $9.15 | $11.27 | $9.13 | $5.63 | $5.47 | $5.74 | $6.83 | $9.72 | $8.40 | $8.51 |
| Chum, or keta | 6.14 | 6.27 | 6.82 | 4.19 | 3.68 | 3.98 | 4.65 | 4.68 | 4.44 | 5.01 | 5.47 |
| Humpback, or pink | 6.44 | 6.58 | 8.35 | 5.47 | 4.21 | 4.34 | 4.86 | 4.93 | 5.28 | 5.39 | 5.87 |
| King, or spring | 10.40 | 9.85 | 13.13 | 10.97 | 10.22 | 8.08 | 8.56 | 8.89 | 11.91 | 10.37 | 11.25 |
| Red, or sockeye | 9.48 | 9.44 | 12.98 | 13.05 | 8.96 | 9.24 | 9.27 | 9.53 | 13.12 | 9.89 | 12.08 |

## PACK IN CERTAIN DISTRICTS

Statistics of the salmon pack are again presented for subdivisions of the three main districts of Alaska, and comparison is made with similar statistics for 1926. These districts are described as follows:

*Bristol Bay.*—The Bering Sea shore, east and north of the Ugashik River.

*Port Moller and Herendeen Bay.*—Port Moller, Herendeen Bay, and Nelson Lagoon.

*Ikatan–Shumagin Islands.*—False Pass, Ikatan Bay, King Cove, and the Shumagin Islands.

*Chignik.*—Three canneries located at Chignik, except that the pack by the Alaska Packers Association of fish transferred from Alitak is omitted.

*Kodiak–Afognak Islands.*—Kodiak, Spruce, and Raspberry Islands, and includes the pack at Chignik from fish transferred from Alitak.

*Cook Inlet.*—The shores of Cook Inlet.

*Prince William Sound.*—Extends from Resurrection Bay to Point Whitshed, except that the pack of fish taken in the Copper River district by canneries at and near Cordova is omitted.

*Copper and Bering Rivers.*—Extends from Point Whitshed to Bering River and includes the pack by canneries at Cordova from fish not credited to Prince William Sound.

*Yakutat and Dry Bay.*—Extends from Yakutat Bay to and including Dry Bay.

*Icy Strait–Lynn Canal.*—West coast of Baranof and Chichagof Islands, the shores of Cross Sound, Icy Strait, Lynn Canal, and Stephens Passage, south to Taku Harbor. Only part of the pack at

Taku Harbor is credited to this district, as some of it originated elsewhere.

*Chatham Strait–Frederick Sound.*—Includes part of the Taku cannery pack and the Petersburg Packing Co.'s pack, in addition to the packs of all canneries on both shores of Chatham Strait and its bays from Point Augusta to Cape Ommaney, and through Frederick Sound and its bays northward to Taku Harbor, including Kake.

*Sumner Strait–Dixon Entrance.*—Extends southward from Petersburg and eastward from Port Beauclerc to Cape Chacon and Dixon Entrance, and includes all canneries on the mainland and intervening islands from the Stikine River to Portland Canal.

*West coast, Prince of Wales Island.*—Territory west and south of a line from Cape Chacon to Point Baker and Cape Ommaney. A part of the Petersburg Packing Co.'s pack is credited to this district.

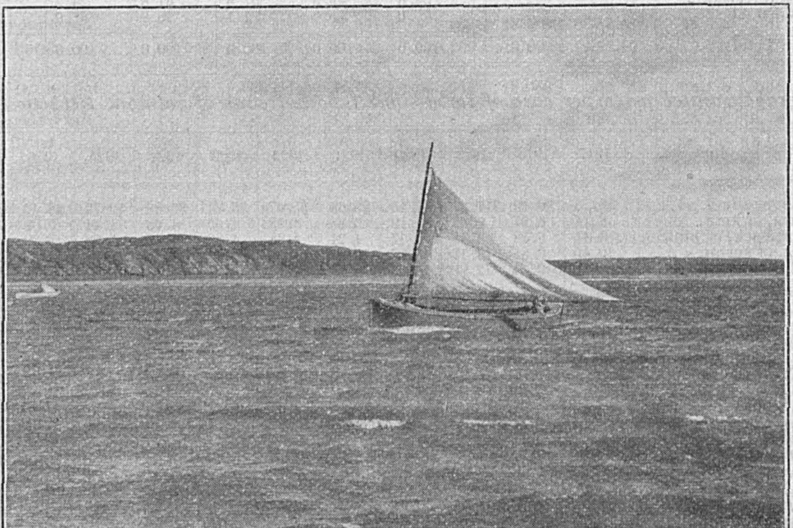

FIG. 8.—Gill-net salmon fishing boat, western Alaska

*Pack of canned salmon in Alaska in 1927, by districts* [1]

| District | Coho | Chum | Humpback | King | Red | Total | Percentage of increase or decrease from 1926 |
|---|---|---|---|---|---|---|---|
| | *Cases* | *Cases* | *Cases* | *Cases* | *Cases* | *Cases* | |
| Bristol Bay | 31 | 22, 751 | ---------- | 16, 509 | 867, 303 | 906, 594 | −33. 57 |
| Port Moller and Herendeen Bay | 7 | 7, 342 | ---------- | 2, 381 | 16, 472 | 26, 202 | −57. 00 |
| Ikatan-Shumagin Islands | 11, 616 | 128, 368 | 96, 044 | 2, 108 | 53, 155 | 291, 291 | −48. 44 |
| Chignik | 10, 560 | 16, 072 | 11, 996 | 211 | 41, 691 | 80, 530 | −26. 32 |
| Kodiak-Afognak Islands | 16, 979 | 39, 887 | 303, 681 | 726 | 84, 542 | 445, 815 | −16. 62 |
| Cook Inlet | 32, 282 | 7, 025 | 14, 894 | 27, 530 | 102, 643 | 184, 374 | −4. 90 |
| Prince William Sound | 19, 108 | 61, 845 | 405, 869 | 1, 029 | 12, 930 | 500, 781 | −29. 00 |
| Copper and Bering Rivers | 47, 491 | ---------- | ---------- | 11, 866 | 24, 991 | 84, 348 | +38. 49 |
| Yakutat and Dry Bay | 37, 345 | 93 | 7, 929 | 2, 390 | 17, 481 | 65, 238 | +35. 28 |
| Icy Strait-Lynn Canal | 30, 377 | 72, 069 | 222, 760 | 2, 727 | 40, 599 | 368, 532 | −31. 80 |
| Chatham Strait-Frederick Sound | 12, 737 | 78, 920 | 144, 906 | 444 | 9, 585 | 246, 592 | −60. 33 |
| Sumner Strait-Dixon Entrance | 27, 102 | 54, 954 | 173, 194 | 2, 271 | 41, 279 | 298, 800 | −78. 91 |
| West coast, Prince of Wales Island | 7, 409 | 18, 397 | 39, 502 | 199 | 7, 524 | 73, 031 | −83. 06 |
| Total | 253, 044 | 507, 723 | 1, 420, 775 | 70, 391 | 1, 320, 195 | 3, 572, 128 | −46. 31 |

[1] Pack reduced to the basis of forty-eight 1-pound cans per case.

### MILD CURING

Salmon mild-cure operations in Alaska showed a decided increase in 1927, the production being the largest in the history of the industry. The business was carried on almost exclusively in southeastern Alaska, where an unprecedented run of king salmon, together with a good catch of cohos, contributed to the success of the operations. Employment was given to 1,769 persons (1,432 whites and 337 natives), or 220 more than the number employed in 1926.

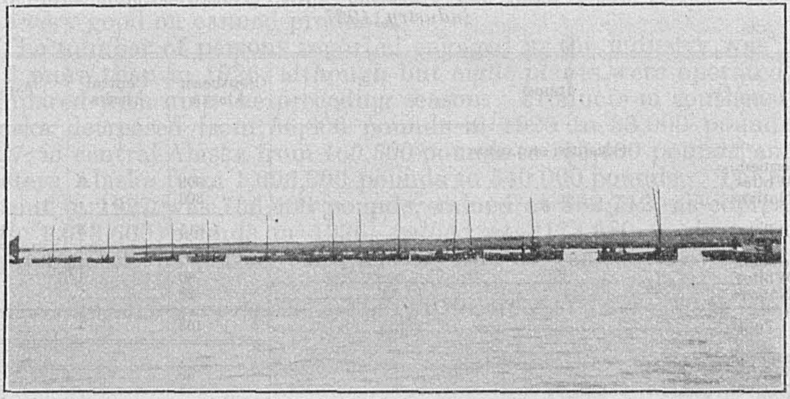

FIG. 9.—Salmon gill-net boats leaving for fishing grounds, Bristol Bay, Alaska

The Baranof Mild-Cure Co.'s floating plant *Comet* sank after having struck a rock in Hole in the Wall on the northwest coast of Prince of Wales Island, but was later refloated. The loss, including the value of 49 tierces of cohos, was $19,960.

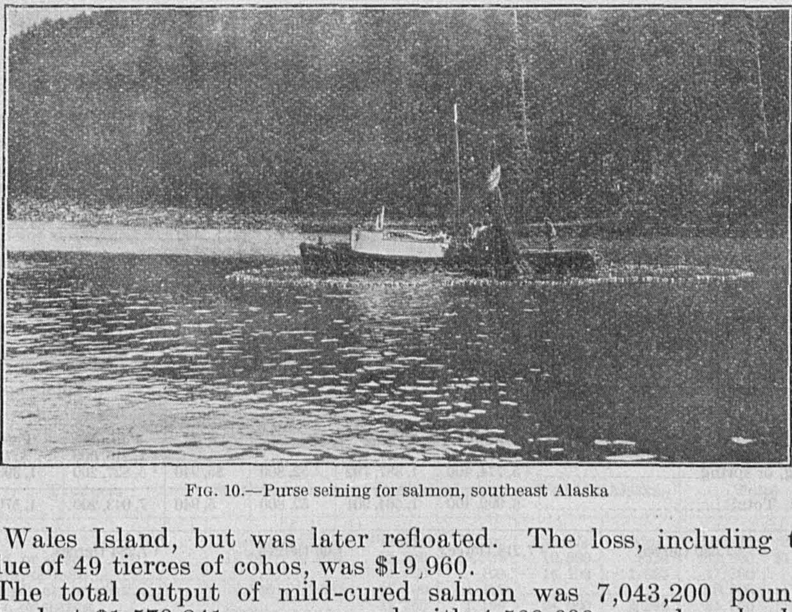

FIG. 10.—Purse seining for salmon, southeast Alaska

The total output of mild-cured salmon was 7,043,200 pounds, valued at $1,570,841, as compared with 4,569,600 pounds valued at $1,070,316 in 1926, an increase of 2,473,600 pounds in quantity and

$500,525 in value. The pack consisted of 1,216,000 pounds of cohos and 5,827,200 pounds of kings, all of which was produced in southeastern Alaska except 52,800 pounds of kings, which were produced in the central district. In units of 800-pound tierces, the pack consisted of 1,520 tierces of cohos and 7,284 tierces of kings.

*Persons engaged, wages paid, and operating units, Alaska salmon mild-curing industry, 1927*

| Items | Southeast Alaska | Central Alaska | Total |
|---|---|---|---|
| PERSONS ENGAGED | | | |
| Fishermen: | | | |
| Whites | 1,309 | 3 | 1,312 |
| Natives | 306 | | 306 |
| Total | 1,615 | 3 | 1,618 |
| Shoresmen: | | | |
| Whites | 80 | 1 | 81 |
| Natives | 28 | | 28 |
| Total | 108 | 1 | 109 |
| Transporters: | | | |
| Whites | 39 | | 39 |
| Natives | 3 | | 3 |
| Total | 42 | | 42 |
| Grand total | 1,765 | 4 | 1,769 |
| Wages paid shoresmen | $84,843 | $625 | $85,468 |
| Wages paid transporters | $37,454 | | $37,454 |
| OPERATING UNITS | | | |
| Plants: | | | |
| Shore | 7 | | 7 |
| Floating— | | | |
| Power vessels | 3 | | 3 |
| Net tonnage | 198 | | 198 |
| Barges | 2 | | 2 |
| Net tonnage | 214 | | 214 |
| Scows | 5 | 1 | 6 |
| Total plants operated | 17 | 1 | 18 |
| Vessels: | | | |
| Power, over 5 tons | 29 | | 29 |
| Net tonnage | 456 | | 456 |
| Launches | 856 | | 856 |
| Gill-net boats | 5 | | 5 |
| Rowboats | 302 | | 302 |
| Lighters and scows | 3 | | 3 |
| Apparatus: | | | |
| Gill nets | 7 | | 7 |
| Fathoms | 450 | | 450 |
| Traps (driven) | | 2 | 2 |
| Lines | 6,725 | | 6,725 |

*Products of Alaska salmon mild-curing industry in 1927*

| Product | Southeast Alaska | | Central Alaska | | Total | |
|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Coho, or silver | 1,216,000 | $177,109 | | | [1] 1,216,000 | $177,109 |
| King, or spring | [2] 5,774,400 | 1,387,792 | [3] 52,800 | $5,940 | [4] 5,827,200 | 1,393,732 |
| Total | 6,990,400 | 1,564,901 | 52,800 | 5,940 | 7,043,200 | 1,570,841 |

[1] 1,520 tierces. [2] 7,218 tierces. [3] 66 tierces. [4] 7,284 tierces.

## PICKLING

The production of pickled salmon, which is carried on chiefly in western Alaska, showed a marked decline in all parts of Alaska in 1927. This was due largely to the light runs of red salmon throughout the region. Another factor that contributed to the smaller pack was the sale of fish by the saltery operators to the canneries, as the market was very good on canned products.

The number of persons reported engaged in the industry was 108, or 6 more than in 1926, although but eight plants were operated, as compared with nine the preceding season. Products in southeastern Alaska decreased from 56,800 pounds in 1926 to 33,000 pounds in 1927, in central Alaska from 460,500 pounds to 193,400 pounds, and in western Alaska from 1,096,300 pounds to 540,000 pounds. The total output in 1927 was 766,400 pounds, valued at $92,712, as compared with 1,613,600 pounds in 1926, valued at $173,680, a decrease of approximately 53 per cent in quantity and 47 per cent in value.

*Persons engaged, wages paid, and operating units, Alaska salmon-pickling industry, 1927*

| Items | Central Alaska | Western Alaska | Total |
|---|---|---|---|
| PERSONS ENGAGED | | | |
| Fishermen: | | | |
| Whites | 8 | 32 | 40 |
| Natives | 11 | 23 | 34 |
| Japanese | 1 | | 1 |
| Total | 20 | 55 | 75 |
| Shoresmen: | | | |
| Whites | 1 | 2 | 3 |
| Natives | 2 | 28 | 30 |
| Total | 3 | 30 | 33 |
| Grand total | 23 | 85 | 108 |
| Wages paid shoresmen | $250 | $4,596 | $4,846 |
| OPERATING UNITS | | | |
| Plants (shore) | 5 | 3 | 8 |
| Vessels: | | | |
| Launches | 8 | 1 | 9 |
| Gill-net boats | 2 | 16 | 18 |
| Seine skiffs | 5 | | 5 |
| Rowboats | 8 | | 8 |
| Scow | 1 | | 1 |
| Apparatus: | | | |
| Beach seines | 5 | | 5 |
| Fathoms | 475 | | 475 |
| Gill nets | 5 | 39 | 44 |
| Fathoms | 450 | 6,920 | 7,370 |
| Wheels | | 3 | 3 |

*Products of Alaska salmon-pickling industry in 1927*

| Products | Southeast Alaska | | Central Alaska | | Western Alaska | | Total | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Coho, or silver | 17,600 | $1,800 | 95,200 | $8,934 | 10,000 | $950 | 122,800 | $11,684 |
| Chum, or keta | | | 1,000 | 100 | 16,100 | 1,623 | 17,100 | 1,723 |
| Humpback, or pink | 1,800 | 100 | 18,700 | 1,419 | | | 20,500 | 1,519 |
| King, or spring | | | 11,700 | 1,109 | 24,000 | 3,246 | 35,700 | 4,355 |
| Red, or sockeye | 13,600 | 1,700 | 66,800 | 8,680 | 489,900 | 63,051 | 570,300 | 73,431 |
| Total | 33,000 | 3,600 | 193,400 | 20,242 | 540,000 | 68,870 | 766,400 | 92,712 |

## FRESH SALMON

The fresh-salmon business in Alaska, which is largely incidental to the mild-curing of salmon and freezing of halibut, was on about the same scale in 1927 as in the preceding year. Two dealers in the southeastern district, whose chief product was fresh salmon, gave employment to six white shoresmen. The total production was 2,217,335 pounds of all species, valued at $213,995, comparable with 2,274,123 pounds, valued at $221,771, in 1926, a decrease of about 2.5 per cent in quantity and 3.5 per cent in value. Of this total, all but 3,700 pounds, valued at $445, was produced in southeastern Alaska.

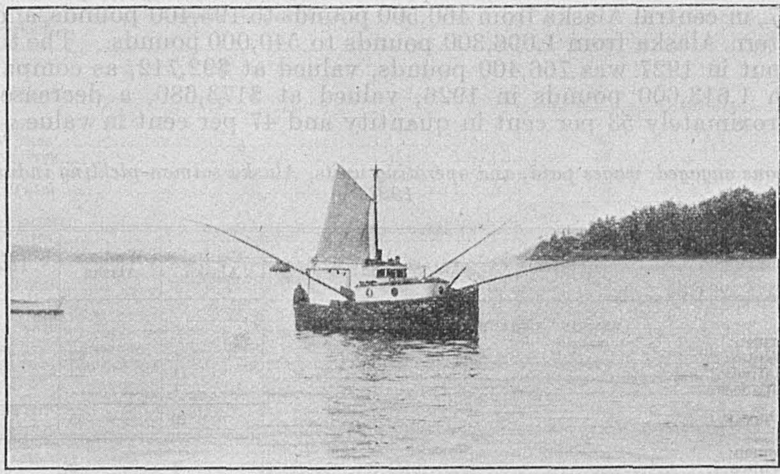

FIG. 11.—Salmon trolling, southeast Alaska

*Products of the Alaska fresh-salmon industry in 1927*

| Species | Pounds | Value |
|---|---|---|
| Coho, or silver | 592, 733 | $42, 598 |
| Chum, or keta | 9, 518 | 571 |
| King, or spring | 1, 609, 924 | 170, 389 |
| Red, or sockeye | 5, 160 | 437 |
| Total | 2, 217, 335 | 213, 99 |

## FREEZING

Operations in the salmon-freezing business in 1927 were carried on only in southeastern Alaska and were incidental to other branches of the fishery industry. The output decreased approximately 15 per cent in quantity and 13 per cent in value from that of the previous year, the total production being 3,194,034 pounds, valued at $308,393, as against 3,769,645 pounds, valued at $356,060, in 1926.

*Products of the Alaska frozen-salmon industry in 1927*

| Species | Pounds | Value |
|---|---|---|
| Coho, or silver | 1,226,591 | $113,242 |
| Chum, or keta | 290,544 | 18,078 |
| Humpback, or pink | 42,570 | 1,149 |
| King, or spring | 1,634,204 | 175,911 |
| Red, or sockeye | 125 | 13 |
| Total | 3,194,034 | 308,393 |

DRY-SALTING, DRYING, AND SMOKING

In southeastern Alaska two companies prepared dry-salted salmon, and in central Alaska one firm dried a small quantity of humpbacks, these operations being entirely incidental to other lines of the industry. In the fishery of the Yukon, Tanana, and Kuskokwim Rivers, which is carried on principally by natives, 1,058,000 pounds of salmon were dried, valued at $115,230; and in addition 3,000 pounds of kippered kings, valued at $600, and 720 pounds of beleke from kings, valued at $216, were prepared. In this western district 19 whites and 375 natives engaged in the fishery, and the apparatus used consisted of 195 wheels, 195 gill nets of 6,141 fathoms, 23 rowboats and skiffs, 4 gill-net boats, and 3 launches.

*Production of dry-salted, dried, and smoked salmon in Alaska in 1927*

| Product | Southeast Alaska | | Central Alaska | | Western Alaska | | Total | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Dry-salted: | | | | | | | | |
| Coho, or silver | 17,545 | $1,611 | | | | | 17,545 | $1,611 |
| Chum, or keta | 1,944 | 136 | | | | | 1,944 | 136 |
| Humpback, or pink | 135 | 11 | | | | | 135 | 11 |
| King, or spring | 336 | 50 | | | | | 336 | 50 |
| Red, or sockeye | 1,440 | 203 | | | | | 1,440 | 203 |
| Total | 21,400 | 2,011 | | | | | 21,400 | 2,011 |
| Dried: | | | | | | | | |
| Chum, or keta | | | | | 1,051,000 | $114,710 | 1,051,000 | 114,710 |
| Humpback, or pink | | | 2,025 | $222 | | | 2,025 | 222 |
| King, or spring | | | | | 7,000 | 520 | 7,000 | 520 |
| Total | | | 2,025 | 222 | 1,058,000 | 115,230 | 1,060,025 | 115,452 |
| Kippered: King, or spring | | | | | 3,000 | 600 | 3,000 | 600 |
| Beleke: King, or spring | | | | | 720 | 216 | 720 | 216 |
| Grand total | 21,400 | 2,011 | 2,025 | 222 | 1,061,720 | 116,046 | 1,085,145 | 118,279 |

EGGS FOR CAVIAR

Under a special agreement, one of the salmon canneries in the Icy Strait region of southeast Alaska sold 34,900 pounds of chum salmon eggs, valued at $698, for shipment to Japan, to be used in the production of caviar. It was said that a greater output might have been secured had there been adequate facilities for handling the eggs on the peak delivery days of chum salmon. Whether any further development of this business will materialize is doubtful, although the undertaking in 1927 indicates the possibility of obtaining a fair market for a product not heretofore utilized for commercial purposes in the Alaska fishery.

## BY-PRODUCTS

The Marine Products Corporation again used its schooner *Meteor* as a reduction plant for the manufacture of salmon by-products in the vicinity of Ketchikan, and one other company in southeastern Alaska also engaged primarily in this business. Employment was given to 18 white shoresmen and 2 white transporters. A herring-reduction plant in the southeastern district and four salmon canneries in central Alaska likewise manufactured salmon oil and fertilizer. The total production was 932,834 pounds of fertilizer, valued at $26,935, and 32,374 gallons of oil, valued at $13,650, as compared with 1,477,300 pounds of fertilizer, valued at $38,339, and 53,004 gallons of oil, valued at $21,850, in 1926, or a decrease in 1927 of approximately 37 per cent in amount of fertilizer and 39 per cent in quantity of oil.

*Production of salmon oil and fertilizer in Alaska in 1927*

| District | Oil | | Fertilizer | |
|---|---|---|---|---|
| | *Gallons* | *Value* | *Pounds* | *Value* |
| Southeast Alaska | 13,162 | $5,580 | 413,588 | $10,763 |
| Central Alaska | 19,212 | 8,070 | 519,246 | 16,172 |
| Total | 32,374 | 13,650 | 932,834 | 26,935 |

## HERRING

The herring industry in Alaska in 1927 was marked by a further decline in comparison with operations of recent years. Notwithstanding the fact that the production of pickled herring in southeastern Alaska was more than twice the amount prepared in that district in the preceding season, the failure of the runs in the central district caused the pack for Alaska as a whole to fall about 7 per cent below that of 1926. Only short spurts of good fishing were experienced in Prince William Sound and the Kodiak-Afognak region, and the runs, in general, throughout the Territory were smaller than in previous years. The production of Scotch-cured herring was the lowest since 1923, while the output of oil and meal was the smallest for three years.

The number of floating plants in operation was augmented by the S. S. *Peralta* and the S. S. *Lake Miraflores* in southeastern Alaska. As in the preceding year, the Puget Sound Reduction Co. used its barge, the *Fort Union*, as a herring-reduction plant in the vicinity of Port Armstrong. With the exception of the *ZR3*, of the Nassau Fish Co., which was not operated, and the addition of the schooner *Alice Cooke* (781 tons) of the Aurora Fish Co., a newly organized firm, the same floating plants were used in central Alaska as in the season of 1926, namely, the *Rosamond* (1,035 tons), operated by the North American Fisheries; the *Esther* (222 tons), by Ottar Hofstad; the *Salvator* (385 tons), by Libby, McNeill & Libby; the *Donna Lane* (1,597 tons), by the Utopian Fisheries Co.; and the *La Merced* (1,342 tons), by the Nassau Fish Co. In addition to the foregoing, several small floating plants were operated by a number of other concerns in various localities.

Agitation to eliminate herring-reduction plants in southeastern Alaska continues, the argument being that these operations are destroying the available supply of herring and consequently depleting the natural food for king salmon, on which the troll fishermen and fresh and mild-cure plants depend. Comparison of conditions during the last two years, however, does not bear out this argument, as in 1926, when troll fishing was a failure, there was an abundance of

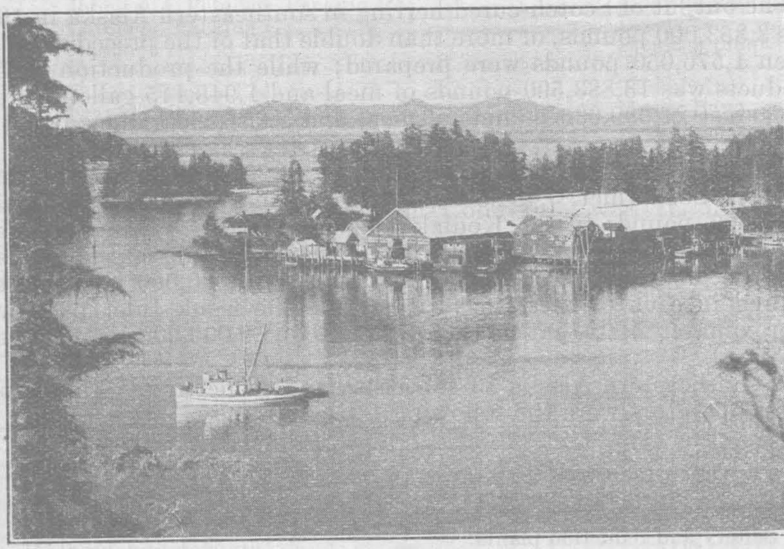

FIG. 12.—Fish-reduction plant, southeast Alaska

FIG. 13.—Floating fish-reduction plant, southeast Alaska

herring, and in 1927, when herring were scarce, the troll fishermen experienced one of their best seasons.

In southeastern Alaska, where the production of oil and meal is chiefly centered, only five operators did not pack Scotch-cured herring in connection with the manufacture of by-products. Of these, the Alaska Consolidated Canneries, Killisnoo Fisheries, and Marine Packing & Reduction Co. had contracted with others for the handling of that portion of their catch that was suitable for curing, thus leaving but two plants engaged exclusively in reduction operations.

The output of Scotch-cured herring in southeastern Alaska in 1927 was 3,353,000 pounds, or more than double that of the preceding year, when 1,576,050 pounds were prepared; while the production of by-products was 13,883,590 pounds of meal and 1,948,145 gallons of oil, as against 21,699,635 pounds of meal and 2,857,299 gallons of oil in 1926.

Of the herring cured in central Alaska, 4,320,390 pounds were prepared in Cook Inlet, 3,484,500 pounds in Prince William Sound, and 3,245,500 pounds in the Kodiak-Afognak district. Prince William Sound and the Kodiak-Afognak district showed a substantial increase over the preceding year, when approximately 2,500,000 pounds were secured in each of these localities; while the Cook Inlet pack was approximately half that of 1926, when about 9,000,000 pounds were produced.

In southeastern Alaska 33 concerns handled herring. Among the larger operators were the following:

| | |
|---|---|
| Reduction plants: | |
| Ocean Industries (S. S. *Peralta*) | Floating plant. |
| Puget Sound Reduction Co | Do. |
| Saltery: Ness Fish Co | Petersburg. |
| Saltery and reduction plants: | |
| Alaska Consolidated Canneries | Saginaw Bay. |
| Alaska Herring & Sardine Co | Little Port Walter. |
| Arentsen & Co | Big Port Walter. |
| Atlas Packing Corporation | Deep Cove. |
| Baranof Packing Co | Red Bluff Bay. |
| Buchan & Heinen Packing Co | Port Armstrong. |
| Chatham Strait Fish Co | New Port Walter. |
| Fidalgo Island Packing Co | Bay of Pillars. |
| Killisnoo Fisheries | Killisnoo. |
| S. S. *Lake Miraflores* | Floating plant. |
| Marine Packing & Reduction Co | Washington Bay. |
| Northwestern Herring Co | Port Conclusion. |
| Ocean Products Co. (formerly National Fish Co.) | Hood Bay. |
| Storfold & Grondahl Packing Co | Washington Bay. |
| United States-Alaska Packing Co. (formerly Warm Springs Bay Packing Co.) | Port Herbert and Warm Springs Bay. |

Included in the above list are the three companies that engaged only in the reduction business but at whose plants Scotch-cured herring was prepared by separate individuals or companies. W. E. Bawden carried on such operations at the plant of the Marine Packing & Reduction Co., Davis & Weer (Inc.) at the plant of the Killisnoo Fisheries, and the Nassau Fish Co. at the plant of the Alaska Consolidated Canneries.

Six cold-storage plants froze herring for bait and three outfits were engaged solely in producing fresh herring for bait.

In central Alaska operations were carried on mainly in three localities, namely, Prince William Sound, with 10 operators; Cook Inlet, with 40 operators; and the Kodiak-Afognak district, with 15 operators. In the Prince William Sound district the following companies operated:

| | |
|---|---|
| Reduction plant: Alaska By-Products Co | Sawmill Bay. |
| Salteries: | |
| Enterprise Packing Co | Do. |
| Johnson & Peterson Packing Co | Floating plant. |
| Latouche Packing Co | Latouche. |
| Nassau Fish Co | Floating plant. |
| Saltery and reduction plants: | |
| Everett-Pacific Fisheries | Thumb Bay. |
| Franklin Packing Co | Evans Bay. |
| W. J. Imlach Packing Co | Port Benny. |
| San Juan Fishing & Packing Co | Evans Bay. |
| S. Sklaroff & Sons | Crab Bay. |

The more important operators in Cook Inlet were the following, all of whom prepared Scotch-cured herring:

| | |
|---|---|
| Aurora Fish Co | Floating plant. |
| Colberg Bros. & Co | Seldovia. |
| Crescent Herring Co | Floating plant. |
| Drier Bay Packing Co | Halibut Cove. |
| Enterprise Packing Co | Do. |
| Everett-Pacific Fisheries | Seldovia. |
| S. Feinson | Do. |
| Fidalgo Island Packing Co | Port Graham. |
| E. A. Gissberg & Co | Halibut Cove. |
| Jack Gjoen | Do. |
| Herring Bay Packing Co | Seldovia. |
| Ottar Hofstad | Floating plant. |
| Ed. Jacobsen & Co | Halibut Cove. |
| Jacobsen & Stemland | Do. |
| Johnson & Peterson Packing Co | Floating plant. |
| Kodiak Herring Co | Do. |
| Latouche Packing Co | Halibut Cove. |
| Libby, McNeill & Libby | Floating plant. |
| Malcolm-Thompson & Co | Seldovia. |
| Nassau Fish Co | Floating plant. |
| North American Fisheries | Do. |
| North Coast Packing Co | Halibut Cove. |
| Pedersen & Esterlund | Do. |
| E. Sandvik | Do. |
| San Juan Fishing & Packing Co | Tutka Bay. |
| Shuyak Packing Co | Halibut Cove. |
| S. Sklaroff & Sons | Seldovia. |
| Utopian Fisheries | Floating plant. |
| Fritz Waage | Halibut Cove. |

The chief operators in the Kodiak-Afognak district were the following, all of whom prepared Scotch-cured herring:

| | |
|---|---|
| Karl Armstrong | Floating plant. |
| Aurora Fish Co | Do. |
| Blue Island Packing Co | Blue Fox Bay. |
| Caw Packing Co | Three Saints Bay and Iron Creek. |
| A. Coel | Shuyak Island and Uzinki. |
| Crescent Herring Co | Floating plant. |
| Enterprise Packing Co | Shuyak Island. |
| Herring Bay Packing Co | Shuyak Strait. |
| Ottar Hofstad | Floating plant. |
| Johnson & Peterson Packing Co | Do. |
| Nassau Fish Co | Do. |
| North American Fisheries | Do. |
| Shuyak Packing Co | Shuyak Strait. |
| S. Sklaroff & Sons | Shearwater Bay. |
| Utopian Fisheries | Floating plant. |

Certain losses were reported in the herring industry in 1927. In southeastern Alaska seines and gear valued at $6,000 were lost and one transporter died of disease. The *Donna Lane*, a floating plant operated in the central district by the Utopian Fisheries Co., was damaged by fire just before leaving Seattle for Alaska, the loss being estimated at $40,000. The power boats *Trio*, valued at $5,000, and *Minneapolis*, which with gear was valued at $6,500, were lost, the former by fire and the latter by foundering near Yukon Island in Cook Inlet during a storm in late October. Other losses of fishing gear and small boats amounted to $1,825. Two shoresmen met death by accident.

Further investigations were carried on by George A. Rounsefell, scientific assistant of the bureau, in connection with the study of Alaska herring which has been in progress since 1925.

## STATISTICAL SUMMARY

The herring industry in Alaska employed 2,110 persons in 1927, as compared with 2,101 in 1926, and the number of plants increased from 61 to 68. Products were valued at $2,850,823 in 1927, as compared with $3,554,489 in the preceding year, a decrease of $703,666, or about 20 per cent. Scotch-cured herring declined from 15,629,230 pounds in 1926 to 14,542,390 pounds, or slightly less than 7 per cent, while herring for bait increased from 2,234,938 pounds in 1926 to 8,041,905 pounds in 1927. Meal or fertilizer decreased approximately 36 per cent in quantity and 32 per cent in value and oil about 31 per cent in quantity and 35 per cent in value from the production in 1926.

*Persons engaged, wages paid, and operating units, Alaska herring industry, 1927*

| Items | Southeast Alaska | Central Alaska | Western Alaska | Total |
|---|---|---|---|---|
| PERSONS ENGAGED | | | | |
| Fishermen: | | | | |
| Whites | 451 | 388 | | 839 |
| Natives | 31 | 35 | 12 | 78 |
| Total | 482 | 423 | 12 | 917 |
| Shoresmen: | | | | |
| Whites | 570 | 476 | | 1,046 |
| Natives | 24 | 51 | 10 | 85 |
| Total | 594 | 527 | 10 | 1,131 |
| Transporters: | | | | |
| Whites | 22 | 38 | | 60 |
| Natives | | | 1 | 1 |
| Negro | 1 | | | 1 |
| Total | 23 | 38 | 1 | 62 |
| Grand total | 1,099 | 988 | 23 | 2,110 |
| Wages paid shoresmen | $304,821 | $229,894 | $1,260 | $535,975 |
| Wages paid transporters | $19,911 | $16,411 | $514 | $36,836 |
| Plants: | | | | |
| Shore | 16 | 39 | 1 | 56 |
| Floating— | | | | |
| Power vessels | 2 | 3 | | 5 |
| Net tonnage | 2,172 | 2,948 | | 5,120 |
| Sailing vessels | | 4 | | 4 |
| Net tonnage | | 2,423 | | 2,423 |
| Barge | 1 | | | 1 |
| Net tonnage | 3,300 | | | 3,300 |
| Scows | | 2 | | 2 |
| Total plants operated | 19 | 48 | 1 | 68 |

*Persons engaged, wages paid, and operating units, Alaska herrring industry, 1927*—Continued

| Items | Southeast Alaska | Central Alaska | Western Alaska | Total |
|---|---|---|---|---|
| OPERATING UNITS | | | | |
| Vessels: | | | | |
| Power, over 5 tons | 77 | 64 | 1 | 142 |
| Net tonnage | 2,182 | 1,271 | 5 | 3,458 |
| Launches | 7 | 34 | 1 | 42 |
| Gill net boats | 2 | 48 | 7 | 57 |
| Seine skiffs | 53 | 33 | | 86 |
| Other rowboats and skiffs | 28 | 46 | | 74 |
| Lighters and scows | 21 | 18 | 1 | 40 |
| Houseboats | | 2 | | 2 |
| Pile drivers | 3 | 3 | | 6 |
| Apparatus: | | | | |
| Purse seines | 68 | 41 | | 109 |
| Fathoms | 12,210 | 6,695 | | 18,905 |
| Beach seines | 5 | 4 | | 9 |
| Fathoms | 325 | 360 | | 685 |
| Gill nets | 3 | 378 | 45 | 426 |
| Fathoms | 75 | 17,310 | 675 | 18,060 |
| Pound seines | | 16 | | 16 |
| Pounds | 2 | 29 | | 31 |

*Products of Alaska herring industry in 1927*

| Items | Southeast Alaska | | Central Alaska | | Western Alaska | | Total | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Fresh, for bait | 2,801,385 | $20,734 | 336,250 | $3,989 | | | 3,137,635 | $24,723 |
| Frozen, for bait | 4,612,270 | 54,985 | | | | | 4,612,270 | 54,985 |
| Pickled, for bait | | | 292,000 | 4,270 | | | 292,000 | 4,270 |
| Pickled, for food: | | | | | | | | |
| Scotch cure | 3,353,000 | 284,623 | 11,050,390 | 1,149,279 | 139,000 | $15,625 | 14,542,390 | 1,449,527 |
| Norwegian cure | 165,925 | 11,533 | 19,000 | 1,520 | | | 184,925 | 13,053 |
| Kippered | 14,630 | 1,689 | | | | | 14,630 | 1,689 |
| Spiced | 4,400 | 570 | | | | | 4,400 | 570 |
| Dry-salted | | | 15,750 | 100 | | | 15,750 | 100 |
| Meal | 13,883,590 | 420,671 | 590,980 | 17,401 | | | 14,474,570 | 438,072 |
| Oil | [1] 14,611,088 | 827,183 | [2] 648,915 | 30,651 | | | [3] 15,260,003 | 863,834 |
| Total | 39,446,288 | 1,621,988 | 12,953,285 | 1,213,210 | 139,000 | 15,625 | 52,538,573 | 2,850,823 |

[1] 1,948,145 gallons. [2] 86,522 gallons. [3] 2,034,667 gallons.

## HALIBUT

Despite the handicap of severe storms early in the season and a temporary shortage of bait toward the end of September and in the first part of October, production in the halibut industry was maintained at a high level in 1927 as a result of increased efforts and more intensive fishing. Market conditions, however, were not particularly favorable, and considerable quantities of frozen fish were on hand at the end of the year. Operations on banks to the westward continued, and while there was no marked development west of Kodiak Island, a number of boats fished around Trinity Islands and as far west as the Semidi Islands, and some prospecting was done in the Shumagin region, indicating that the fishery is tending to extend in that direction.

A disturbing feature is the heavy increase in the catch of young halibut, and further protective measures may be necessary, in addition to the present three months closed period from November 16 to February 15, for the adequate conservation of the fishery.

Further scientific investigations were conducted by the International Fisheries Commission under the direction of Will F. Thompson. Because of stormy weather early in the year the work was attended with considerable hardship, culminating in the loss on February 23, 1927, of the chartered vessel *Scandia* in a wreck off Kodiak Island.

All members of the scientific staff and the crew were rescued, but much valuable equipment was lost, and it was impracticable to outfit another vessel for the work before fall. The vessel *Dorothy* was chartered subsequently and a cruise from Seattle to the Portlock banks was begun the latter part of October. Later a trip was made to the Yakutat banks, yielding much important information.

Public hearings were held by the commission in November and December at Ketchikan, Alaska, Prince Rupert and Vancouver, British Columbia, and Seattle, Wash., to place before those engaged in the industry the facts learned about the fishery and to obtain a full expression of their views as to what action should be taken. Determination of the extent of protection required necessitates continued research and further observations of effects of any protective measures that may be adopted.

A number of losses to the halibut fleet occurred during the year in Alaska waters, in addition to that of the *Scandia*, mentioned above. On February 12 the schooner *Cape Clear* struck a rock and was wrecked off Langara Island; the *Venus* was badly damaged in a storm off Kodiak Island on February 15; the *Majestic* sank April 17 after striking a reef north of Douglas Island during a blinding snowstorm, but was subsequently raised; as the result of an explosion the *Jenny* sank May 16 while docked at Juneau; the *Wabash* was burned at Ketchikan on June 14; and the *Stranger* was wrecked in Rocky Pass late in October.

There were 1,365 persons engaged in the halibut industry in 1927, an increase of 494 over the number reported for the preceding year, and the products totaled 34,491,283 pounds, valued at $3,805,088. This production represents the total catch of the Alaska halibut fleet, under which designation are included all American vessels landing more than one-half of their catch in Alaska or British Columbia ports rather than in the States. Heretofore the products shown for the Alaska halibut industry consisted only of the landings in Alaska. Of the total catch of the American halibut vessels (including the Alaska and the Washington fleets), 15,052,404 pounds, valued at $1,533,528, were landed in Alaska, as compared with 14,390,397 pounds valued at $1,622,554 in 1926, a gain of 4.6 per cent in quantity but a decline of 5.5 per cent in value.

*Persons engaged, wages paid, and operating units, Alaska halibut industry, 1927*

| Items | Southeast Alaska | Central Alaska | Total |
|---|---|---|---|
| PERSONS ENGAGED | | | |
| Fishermen: Whites | 1,252 | | 1,252 |
| Shoresmen: | | | |
| Whites | 88 | 16 | 104 |
| Natives | 9 | | 9 |
| Total | 97 | 16 | 113 |
| Grand total | 1,349 | 16 | 1,365 |
| Wages paid shoresmen | $128,021 | $22,449 | $150,470 |
| OPERATING UNITS | | | |
| Vessels: | | | |
| Power, over 5 tons | 149 | 2 | 151 |
| Net tonnage | 3,886 | 21 | 3,907 |
| Launches | 27 | 1 | 28 |
| Dories | 149 | 2 | 151 |
| Skates of lines | 7,165 | | 7,165 |

*Products of the Alaska halibut fishery in 1927*

| Products | Southeast Alaska | | Central Alaska | | Total | |
|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Fresh (including local) | 22, 241, 599 | $2, 459, 609 | 83, 304 | $7, 140 | 22, 324, 903 | $2, 466, 749 |
| Frozen | 9, 938, 708 | 1, 161, 190 | 2, 227, 672 | 177, 149 | 12, 166, 380 | 1, 338, 339 |
| Total | 32, 180, 307 | 3, 620, 799 | 2, 310, 976 | 184, 289 | 34, 491, 283 | 3, 805, 088 |

## COD

In Alaskan waters cod fishing is conducted both from shore stations and by an offshore fleet, which operates entirely from ports in the States. In the following statistics Alaska is credited only with the operations from shore stations and with vessels that land their catches in Alaska or engage in transporting products from the shore stations.

The number of vessels in the shore-station fleet in 1927 dwindled to but one—the *City of Papeete,* a schooner of 370 tons. This vessel belonged to the Alaska Codfish Co. and served the Eagle Harbor and Unga shore stations in the Shumagin Islands. Several other small shore stations were operated by local inhabitants of the Shumagin Islands, who depend on transportation companies for shipment of their products. The offshore fleet, which is listed elsewhere, comprised seven vessels in all—three belonging to the Union Fish Co. and one each to the Alaska Codfish Co., Pacific Coast Codfish Co., Robinson Fisheries Co., and Capt. J. A. Matheson. The *Glendale*, operated last year by the Alaska Codfish Co., was not used this season, and the *Charles R. Wilson* of the Pacific Coast Codfish Co. and the *Beulah* of the Union Fish Co. likewise were not operated. The Robinson Fisheries Co., which in 1926 operated its own schooner, the *Wawona,* and the *John A* under charter from the Pacific Coast Codfish Co., operated only the *Wawona* in 1927. The *William H. Smith* of the Union Fish Co. replaced the *Golden State,* which was transferred to tuna operations in California waters.

### STATISTICAL SUMMARY

The cod industry gave employment to 112 persons in 1927, 18 more than in 1926. The increase was due to the fact that many residents of the Shumagin Islands region entered the business in a small way. All operations were carried on in central Alaska, except that 3,650 pounds of frozen cod, valued at $183, were prepared incidentally to other fishery activities in southeast Alaska. Dry-salted and frozen cod, stockfish, and tongues aggregating 1,292,289 pounds, valued at $57,780, were the products of the cod industry. Comparable figures for 1926 are 1,332,714 pounds, valued at $78,317. The products of the offshore fishery were reported to be 5,351,735 pounds of dry-salted cod and tongues, valued at $305,144. The offshore fishery employed 247 persons.

*Persons engaged, wages paid, and operating units, Alaska cod industry, 1927*

| Items | Number | Items | Number |
|---|---|---|---|
| PERSONS ENGAGED | | OPERATING UNITS | |
| Fishermen: | | Shore stations | 23 |
| Whites | 93 | Vessels: | |
| Natives | 13 | Sailing | 1 |
| Mexican | 1 | Net tonnage | 370 |
| Total | 107 | Launches | 6 |
| | | Power dories | 33 |
| Shoresmen: Whites | 5 | Rowboats | 41 |
| Grand total | 112 | Apparatus: | |
| | | Trawl lines | 25 |
| Wages paid shoresmen | $3,450 | Hooks | 8,100 |
| | | Hand lines | 161 |

*Products of Alaska cod industry in 1927*

| Items | Pounds | Value |
|---|---|---|
| Dry-salted cod | 1,256,193 | $54,141 |
| Stockfish | 31,846 | 3,396 |
| Tongues | 600 | 60 |
| Frozen | 3,650 | 183 |
| Total | 1,292,289 | 57,780 |

*Offshore cod fleet in 1927*

| Name | Rig | Net tonnage | Operator |
|---|---|---|---|
| Maweema | Schooner | 392 | Alaska Codfish Co., San Francisco, Calif. |
| Fanny Dutard | do | 252 | J. A. Matheson, Anacortes, Wash. |
| C. A. Thayer | do | 390 | Pacific Coast Codfish Co., Seattle, Wash. |
| Wawona | do | 413 | Robinson Fisheries Co., Anacortes, Wash. |
| Galilee | do | 339 | Union Fish Co., San Francisco, Calif. |
| Louise | do | 328 | Do. |
| William H. Smith | do | 353 | Do. |

## WHALES

The American Pacific Whaling Co. operated its plants at Akutan and Port Hobron as in the preceding year, using four steam whalers in connection with the former and three with the latter. A new operator in Alaskan waters was the California Sea Products Co., whose floating plant *Lansing* and three whaling vessels were engaged in the vicinity of Kodiak Island.

Included in the following statistics are the products of a humpback whale caught accidentally in the salmon trap of the Petersburg Packing Co. at Point Colpoys and utilized at the reduction plant of the Petersburg By-Products Co. at Petersburg.

Employment was given to 316 whites and 10 natives, a total of 326, which is a decrease of 29 persons from the number reported engaged in the industry in 1926. There were 718 whales taken, consisting of 122 finbacks, 554 humpbacks, 35 sulphur bottoms, 3 sperm, 1 right, and 3 sei whales. This is an increase of 137 over the number caught in the preceding year.

The products of the whale fishery were as follows: 1,105,900 gallons of whale oil, valued at $543,628; 10,500 gallons of sperm oil, valued at $4,200; 858½ tons of fertilizer from meat, valued at $51,490; 654½ tons of bone fertilizer, valued at $19,635; 53,775 pounds of pickled meat, valued at $2,419; and 23,175 pounds of whalebone, valued at $1,040; a total value of products of $622,412. The production of whale oil increased 103,950 gallons, sperm oil 5,350 gallons, and bone fertilizer 173½ tons, while fertilizer from meat decreased 70½ tons. While the output as a whole showed a considerable increase, the total value of the products was approximately 8 per cent less than in 1926, when the products were valued at $679,814.

## CLAMS

Dr. F. W. Weymouth, of Stanford University, assisted by H. C. McMillin, continued studies of the Alaska clams during the summer of 1927 to secure data for the completion of reports already in progress and to determine the regulatory measures necessary for the conservation and protection of the clam resources. Observations were made of clam beds at Kukak Bay, Uganik, Seward, and Cordova.

A further decline in production was experienced by the clam packers of Alaska during 1927. As in the preceding year, all operations were carried on in central Alaska. Three plants were engaged exclusively in canning clams and three packed both salmon and clams. These operations were confined to the Cordova district, with the exception of those at Kukak Bay, Alaska Peninsula, by the Seashore Packing Co., and at Snug Harbor, Cook Inlet, by the Snug Harbor Packing Co.

The number of persons employed was 260, of which 248 were whites and 12 natives. The output in 1927 was 23,865 cases, containing 634,752 pounds, valued at $146,735, a decrease of almost 36 per cent in quantity and 42 per cent in value from the production in 1926, when 38,422 cases totaling 985,056 pounds, valued at $254,236, were packed.

*Products of the Alaska clam industry in 1927*

| Items | Cases | Pounds | Value |
|---|---|---|---|
| Minced: | | | |
| ½-pound cans (48 to case) | 13,533 | 324,792 | $76,583 |
| 10-ounce cans (48 to case) | 10,291 | 308,730 | 69,578 |
| Whole: | | | |
| 10-ounce cans (48 to case) | 41 | 1,230 | 574 |
| Total | 23,865 | 634,752 | 146,735 |

## SHRIMP

Further studies of the shrimp fishery of Alaska were made by Warden Frank W. Hynes in the summer of 1927. The report of his investigations, which have been carried on since 1924, will be published as a separate document.

Operations in the industry were on about the same level as in the preceding year, three small plants again being operated in southeastern Alaska. Two of these were situated at Wrangell and one at Petersburg, near which places the more important grounds are located.

Employment was given to 172 persons, of whom 24 were whites, 101 natives, 1 Chinese, 29 Japanese, 11 Filipinos, 5 Mexicans, and 1 negro. Products for the 1927 season consisted of 491,825 pounds of shrimp meat valued at $196,732, an increase of 1,640 pounds in quantity and $904 in value over the preceding year, when 490,185 pounds valued at $195,828 were prepared.

## CRABS

Crab products were prepared at three plants in southeastern Alaska—the Alaskan Glacier Sea Food Co., Petersburg, and the Reliance Shrimp Co. at Wrangell handling crabs incidentally to their shrimp operations, while the Northern Sea Food Co. operated solely in the crab fishery at Petersburg and Kasaan. In central Alaska one plant, the Cordova Shellfish Co., engaged only in crab operations at Cordova. There were 99 persons employed in the industry, of whom 86 were whites, 11 natives, and 2 Filipinos. Products consisted of 98,390 pounds of cold packed meat, valued at $38,907; 469 dozen crabs in the shell, valued at $938; and 7 cases of ½-pound cans, valued at $84. The total value of products in 1927 was $39,929, as compared with $61,616 in 1926, a decline of 35 per cent.

## TROUT

Trout operations in Alaska in 1927 were incidental to other branches of the fishery industry. The products were as follows: Dolly Vardens, 17,430 pounds frozen, valued at $1,473, and 24,277 pounds fresh, valued at $3,517; steelheads, 6,589 pounds frozen, valued at $659, and 9,650 pounds fresh, valued at $947. The total production of both species was 57,946 pounds, valued at $6,596, as against 84,594 pounds, valued at $10,256, in 1926, a decrease of 31.5 per cent in quantity and 35.7 per cent in value.

## MISCELLANEOUS FISHERY PRODUCTS

Several species of fish of minor commercial importance are taken in small quantities, chiefly in connection with the halibut fishery, and landed at Alaskan ports and at Seattle. Such products landed in Alaska in 1927 were as follows: Sablefish, 164,018 pounds fresh, valued at $7,841; 1,087,885 pounds frozen, valued at $61,088; and 87,278 pounds pickled, valued at $4,172; rockfishes, 31,471 pounds frozen, valued at $1,099; flounders, 5,600 pounds frozen, valued at $56; and smelt, 9,677 pounds frozen, valued at $1,161, and 175 pounds fresh, valued at $21. All of these products were from southeastern Alaska.

# FUR-SEAL INDUSTRY

## PRIBILOF ISLANDS

### GENERAL ADMINISTRATIVE WORK

In the calendar year 1927, 24,942 fur-seal skins were taken on the Pribilof Islands, of which 19,000 were from St. Paul Island and 5,942 from St. George Island. Nine thousand three hundred and eighty-three of the skins taken on St. Paul Island were blubbered there. A suitable number (9,090) of 3-year-old male seals were marked and reserved from killing in order that they might pass into the general breeding stock. As in previous years, attention was given to the feeding and general supervision of the foxes on St. Paul and St. George Islands.

Progress was made on the construction of new buildings for the natives and for the general purposes of the stations; progress also was made on new roads. The presence of ice about St. Paul Island until unusually late in the spring made it impossible to land temporary laborers as early as planned, with the result that construction work was retarded.

The Navy Department detailed the U. S. S. *Vega* to transport the general annual shipment of supplies from Seattle to the Pribilof Islands. Small quantities of freight were transported by commercial vessels and by the bureau's power schooner *Eider*.

The United States Coast Guard maintained a patrol in Bering Sea and other waters of the North Pacific for the protection of the Pribilof Islands fur-seal herd. In connection with this patrol the Coast Guard cooperated with the bureau in the work at the Pribilof Islands.

The United States' share of sealskins taken by the Japanese Government in 1926 was delivered to the bureau. Great Britain and Japan continued the practice of having their shares of Pribilof Islands fur-seal skins sold by the United States.

### PURCHASE AND TRANSPORTATION OF SUPPLIES

In 1927 the general supplies for the Pribilof Islands and for the power schooner *Eider* were transported by the U. S. S. *Vega*, departure from Seattle occurring on July 22. The stores for the *Eider*, consisting of about 41 tons of general supplies and 25 tons of coal, were discharged at Dutch Harbor. The *Vega* reached the Pribilof Islands on July 30, where approximately 842 tons of general supplies, 950 tons of coal, and 372,000 feet of lumber were discharged. After taking aboard the fur-seal and fox skins then ready for shipment and some miscellaneous freight the *Vega* left the Pribilofs on August 18 and arrived at Bremerton, Wash., on August 25.

About 24 tons of supplies, chiefly perishable foodstuffs, for the Pribilof Islands and the *Eider*, were forwarded from Seattle on the S. S. *Victoria* on May 10 for delivery at Akutan. Another shipment of approximately 48 tons, consisting of perishable food supplies and certain emergency items for the Pribilof Islands and the *Eider*, was made at Seattle on October 11 on the S. S. *Alameda* for delivery at Unalaska. The *Eider* completed delivery of these supplementary shipments at the Pribilof Islands.

## POWER SCHOONER "EIDER"

At the beginning of the year the *Eider* was at Unalaska. In January a trip was made to islands westward of Unalaska to deliver and receive mail and afford transportation to a representative of the Bureau of Education, who was making an investigation of conditions among the natives. Return was made by way of the Pribilof Islands, where mail was delivered. Early in March a trip was made to the Pribilofs for the purpose of transporting from St. Paul Island a naval employee suffering from a serious nervous disorder.

In April the *Eider* proceeded to Ikatan, where passengers and freight were taken aboard from the S. S. *Redwood*, and then returned to Unalaska to await conditions favorable for proceeding to the Pribilofs. Ice conditions about the Pribilofs made it impossible to go there promptly and in the meantime a trip was made to Akutan to receive freight and passengers from the S. S. *Victoria*. On May 28 the *Eider* left Unalaska for the Pribilofs. No ice was found at St. George Island. Ice about St. Paul Island made navigation hazardous, and while freight and passengers were successfully landed the work was attended with considerable danger, the vessel having to work through ice that closed in about it.

The month of June was occupied in the transportation of freight and passengers to the Pribilofs. The first part of July was devoted to an investigation in regard to the presence of sea otters about the Shumagin and Sanak Islands. Fog and unfavorable weather prevailed and no sea otters were observed. Later in the month the *Eider* assisted with the annual computation of the fur-seal herd. In the latter part of July and the first part of August the vessel was engaged in work connected with discharging cargo from the U. S. S. *Vega*, which had brought from Seattle the general shipment of the year's supplies for the fur-seal service.

On August 20, while off St. George Island, the main crankshaft broke, making it necessary for the vessel to be towed to Unalaska by the Coast Guard cutter *Algonquin*.

In the latter part of October and the first part of November the *Eider* was engaged in transporting cargo and passengers between Unalaska and the Pribilofs, and on November 4 left the Pribilofs for Seattle to undergo necessary repairs. Seattle was reached on December 4. While on this trip assistance was rendered in refloating and docking the M. S. *Sierra*, which, en route from Nome to Seattle, had stranded near Unalaska. During the year the *Eider* traveled 8,577 nautical miles.

## ROADS

*St. Paul Island.*—In the spring of 1927 ice remained about St. Paul Island until well in June, a very unusual occurrence. The records show that on May 20 the island was completely surrounded by ice. On May 29 the Coast Guard cutter *Haida* arrived after having pushed through about 5 miles of ice. As late as June 10 ice was recorded inshore. It was not until the arrival of the *Haida* on May 29 that temporary native workmen from Unalaska and elsewhere could be landed, with the result that very little road work was possible before the beginning of commercial sealing operations. Most of the work accomplished, therefore, was done after the regular sealing season.

Work was confined to the roadway between the village and Northeast Point. Beginning at the village, that portion of the road previously constructed was resurfaced with scoria, and new con-

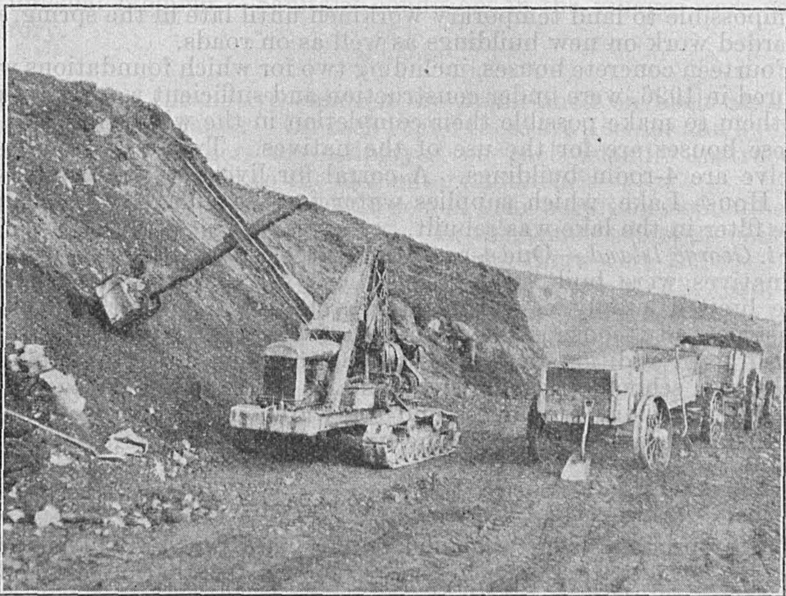

FIG. 14.—Road construction work, Pribilof Islands, Alaska

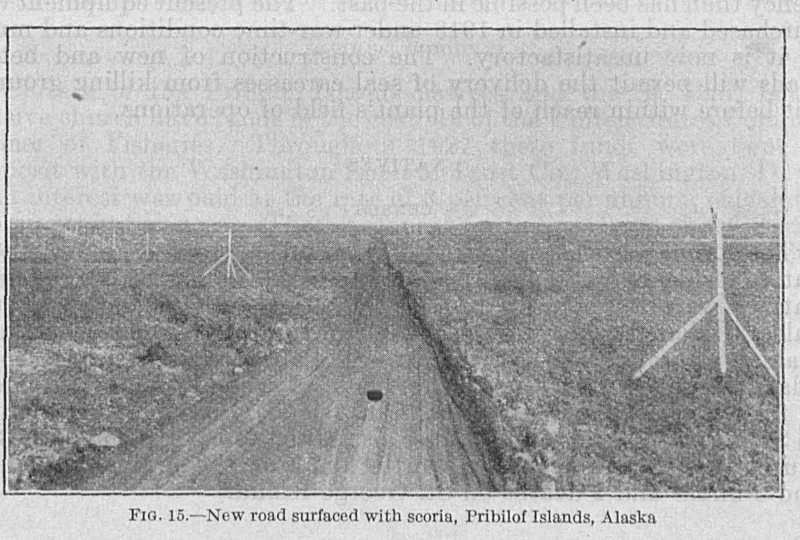

FIG. 15.—New road surfaced with scoria, Pribilof Islands, Alaska

struction was extended as far as Stony Point Lake, a distance of about 3½ miles.

A power shovel was purchased and used during this season's work. A new truck of sufficient capacity to render efficient service in road-building work was placed in service at the same time.

*St. George Island.*—Aside from the getting out of some material for surfacing, road work was not continued this year.

### NEW BUILDINGS AND OTHER IMPROVEMENTS

*St. Paul Island.*—The presence of ice about the island, which made it impossible to land temporary workmen until late in the spring, also retarded work on new buildings as well as on roads.

Fourteen concrete houses, including two for which foundations were poured in 1926, were under construction and sufficient work was done on them to make possible their completion in the winter of 1927–28. These houses are for the use of the natives. Two are 5-room and twelve are 4-room buildings. A corral for livestock was built, and Ice House Lake, which supplies water for the village, was cleaned. The filter in the lake was rebuilt.

*St. George Island.*—One 4-room and three 5-room houses for the use of natives were built. These buildings are of wood construction. The limited supply of sand and gravel makes it impracticable to construct any considerable number of concrete buildings on this island. An addition was built to the schoolhouse, to accommodate the junior school. An addition was also made to the garage. The dwelling for white employees and the warehouse, which were begun in 1926, were completed. The warehouse contains a Frigidaire installation.

### BY-PRODUCTS PLANT

No by-products were prepared at the plant on St. Paul Island in 1927. Consideration is being given to the installation of modern machinery in the plant with the view of operating with greater efficiency than has been possible in the past. The present equipment was purchased and installed in 1918 under war-time conditions and much of it is now unsatisfactory. The construction of new and better roads will permit the delivery of seal carcasses from killing grounds not before within reach of the plant's field of operations.

### NATIVES

#### CENSUS

The annual census, taken as of December 31, 1927, showed 189 native residents on St. Paul Island, and in addition 4 St. Paul Island natives were temporarily residing on St. George Island, 4 at the Salem Indian School, Chemawa, Oreg., and 18 at various places, making a total of 215 accredited to St. Paul Island. On St. George Island there were 148 native residents, of whom 5 were temporary (1 from Unalaska and 4 from St. Paul Island), leaving 143 accredited to St. George. The total number accredited to both islands was 358. During the year there were 11 births and 7 deaths on St. Paul Island and 3 births and 2 deaths on St. George Island.

### MEDICAL SERVICES

The usual medical services and facilities were available to the Government employees and to the natives. A physician was detailed to St. Paul Island and another to St. George Island throughout the year. The health situation among the natives presented nothing of unusual moment. Sanitary conditions in the villages were satisfactory.

### SCHOOLS

Schools for the native children are maintained on both St. Paul and St. George Islands. On each island there are a senior and a junior school. Two teachers are employed on each island. Instruction necessarily is confined to the elementary branches.

*St. Paul Island.*—The 1926–27 school year began on September 7, 1926, and closed on May 13, 1927. In the senior school 25 children were in attendance and in the junior school there were 29.

*St. George Island.*—The school year began September 13, 1926, and the senior school closed April 22 and the junior school March 3, 1927. The senior school had an attendance of 25 pupils and the junior school 14. The earlier closing of the junior school was due to the necessary temporary absence of one of the teachers.

### ATTENDANCE AT SALEM INDIAN SCHOOL, CHEMAWA, OREG.

On January 1, 1927, five natives of St. Paul Island (three girls and two boys) were in attendance at the Salem Indian School at Chemawa, Oreg. There were no new enrollments during the year. One boy, Mamant Emanoff, returned to his home on St. Paul Island. The four in attendance at the end of 1927 were Mariamna Merculieff, Kleopatra Krukoff, Tatiana Krukoff, and Abraham S. Merculieff.

### SAVINGS ACCOUNTS

Certain of the Pribilof Islands natives and the St. Paul Island native church have funds in the custody of the United States Commissioner of Fisheries. Throughout 1927 these funds were kept on deposit with the Washington Loan & Trust Co., Washington, D. C., and interest was paid at the rate of 3 per cent per annum, calculated on monthly balances. Three accounts for natives were closed during the year. A summary of the accounts as a whole for the year 1927 is shown in the statement that follows:

| | |
|---|---|
| On hand, Jan. 1, 1927 | $12, 719. 71 |
| Interest earned from Jan. 1 to Dec. 31, 1927 | 366. 00 |
| | 13, 085. 71 |
| Withdrawn by natives in 1927 | 1, 449. 51 |
| On hand, Dec. 31, 1927 | 11, 636. 20 |

An itemized statement of the funds, showing the individual accounts, follows:

*Funds of the Pribilof Islands natives and the St. Paul Island native church in the custody of the United States Commissioner of Fisheries, as trustee, December 31, 1927*

| | | | |
|---|---|---|---|
| Borenien, Zoya [1] | $290.56 | Merculief, jr., George | $353.66 |
| Bourdukofsky, Martha | 111.17 | Merculief, Joseph | 212.40 |
| Bourdukofsky, Peter | .90 | Merculief, Nicolai G | 238.84 |
| Fratis, Martha [2] | 114.27 | Merculief, Polyxenia | 135.59 |
| Fratis, Iuliania [2] | 114.27 | Merculief, Tatiana | 595.24 |
| Gromoff, Iuliana | 313.41 | Pankoff, Agrippina | 161.38 |
| Kochutin, Alexandra | 4,390.07 | Pankoff, Maria M[elovidov] | 8.94 |
| Krukoff, Ekaterina | 57.22 | St. Paul Island native church | 1,553.05 |
| Lekanof, Sophia M | 342.28 | Sedick, Lavrenty | 58.93 |
| Lestenkof, Michael | 333.07 | Sedick, Leonty [1] | 58.93 |
| Mandregan, Alexandra M | 12.50 | Sedick, Marina | .38 |
| Melovidov, Anton | 4.47 | Shane, Michael | 105.28 |
| Merculieff, Mariamna [2] | 79.19 | Tetoff, Vikenty M[elovidov] | 132.04 |
| Merculief, Alexandra | 350.81 | Zacharof, Emanuel | .45 |
| Merculief, Daniel | 595.24 | | |
| Merculief, Erena | 595.24 | | |
| Merculief, George | 316.42 | Total | 11,636.20 |

[1] Deceased.
[2] Not living on island in 1927.

PAYMENTS FOR TAKING FUR-SEAL SKINS

The resident natives of the Pribilof Islands were paid in cash for their work in taking sealskins. A flat rate of 75 cents was allowed for each sealskin taken, and bonuses were allowed for special work. As the work of taking sealskins is collective in character, the amount earned on each island, on the basis of 75 cents per skin, was divided among the resident native sealers in accordance with ratings based on skill and ability. The men were divided into classes, each man in a given class receiving an equal amount. Payments were made as shown below:

*St. Paul Island.*—For the 19,000 sealskins taken on St. Paul Island, $14,250 was paid, and in addition $50 each was allowed two foremen for special services. A statement of the earnings follows:

*Payments to St. Paul Island natives for taking fur-seal skins, calendar year 1927*

| Classification | Number of men | Share of each | Total |
|---|---|---|---|
| First class | 29 | $298.50 | $8,656.50 |
| Second class | 18 | 237.00 | 4,266.00 |
| Third class | 7 | 182.25 | 1,275.75 |
| Fourth class | 1 | 32.25 | 32.25 |
| Fifth class | 1 | 19.50 | 19.50 |
| Foreman (additional compensation) | | | 50.00 |
| Do | | | 50.00 |
| Total | | | 14,350.00 |

*St. George Island.*—For the 5,942 sealskins taken on St. George Island $4,456.50 was paid, and in addition a total of $100 was allowed two foremen for special services. Three men, who were detailed temporarily to St. Paul Island to assist with sealing operations, were paid $50 each in addition to their shares in the disbursement made for taking sealskins on St. George Island. A statement of the earnings follows:

*Payments to St. George Island natives for taking fur-seal skins, calendar year 1927*

| Classification | Number of men | Share of each | Total |
|---|---|---|---|
| First class | 21 | $147.00 | $3,087.00 |
| Second class | 5 | 117.75 | 588.75 |
| Third class | 6 | 96.00 | 576.00 |
| Fourth class | 2 | 74.25 | 148.50 |
| Fifth class | 1 | 41.25 | 41.25 |
| Sixth class | 1 | 15.00 | 15.00 |
| Foreman (additional compensation) | | | 55.00 |
| Do | | | 45.00 |
| Additional amount paid for sealing work on St. Paul Island, 3 men at $50 each | | | 150.00 |
| Total | | | 4,706.50 |

## PAYMENTS FOR TAKING FOX SKINS

The natives are paid $5 in cash for each fox skin taken on the Pribilof Islands. For the season of 1926–27 these payments amounted to $725 for the 145 skins taken on St. Paul Island and $3,065 for the 613 skins taken on St. George Island, a total of $3,790.

## FUR SEALS

### QUOTA FOR KILLING

Plans for sealing operations in 1927, as approved by the Department of Commerce, provided for the marking of a breeding reserve of 10,000 3-year-old males and the killing of as many of the remaining males of this age as could be secured in the regular sealing periods. Eight thousand animals of the breeding reserve were to be marked on St. Paul Island and 2,000 on St. George Island. Subsequent arrangements provided for the killing of 1,000 2-year-old males for the purpose of determining the comparative values of skins from seals of that age with those from older seals.

### KILLINGS

In 1927, 24,942 seals were killed, of which 19,000 were on St. Paul Island and 5,942 on St. George Island. Of these, 1,282 were listed as 2-year-old males and 23,305 as 3-year-old males. Details in regard to the killings are shown in the following tabulations:

*Seal killings on Pribilof Islands in 1927*

ST. PAUL ISLAND

| Date | Serial No. of drive | Hauling ground | Skins secured |
|---|---|---|---|
| June 3 | 1 | Sea Lion Rock (Sivutch) | 39 |
| 16 | 2 | Reef and Gorbatch | 42 |
| 17 | 3 | Tolstoi, Lukanin, and Kitovi | 55 |
| 18 | 4 | Polovina, Polovina Cliffs, and Little Polovina | 30 |
| 19 | 5 | Vostochni and Morjovi | 264 |
| 20 | 6 | Zapadni and Little Zapadni | 58 |
| 21 | 7 | Reef and Gorbatch | 296 |
| 22 | 8 | Polovina, Polovina Cliffs, and Little Polovina | 38 |
| 23 | 9 | Vostochni and Morjovi | 342 |
| 24 | 10 | Tolstoi, Lukanin, and Kitovi | 93 |
| 25 | 11 | Zapadni and Little Zapadni | 116 |
| 26 | 12 | Reef and Gorbatch | 863 |
| 27 | 13 | Polovina, Polovina Cliffs, and Little Polovina | 94 |
| 28 | 14 | Vostochni and Morjovi | 675 |
| 29 | 15 | Tolstoi, Lukanin, and Kitovi | 341 |
| 30 | 16 | Zapadni and Little Zapadni | 294 |
| July 1 | 17 | Reef and Gorbatch | 1,514 |
| 2 | 18 | Polovina, Polovina Cliffs, and Little Polovina | 35 |
| 3 | 19 | Vostochni and Morjovi | 1,461 |
| 4 | 20 | Tolstoi, Lukanin, and Kitovi | 252 |
| 5 | 21 | Zapadni and Little Zapadni | 255 |
| 6 | 22 | Reef and Gorbatch | 1,068 |
| July 7 | 23 | Polovina, Polovina Cliffs, and Little Polovina | 232 |
| 8 | 24 | Vostochni and Morjovi | 1,824 |
| 9 | 25 | Tolstoi, Lukanin, and Kitovi | 782 |
| 10 | 26 | Zapadni and Little Zapadni | 464 |
| 11 | 27 | Reef and Gorbatch | 1,746 |
| 12 | 28 | Polovina, Polovina Cliffs, and Little Polovina | 318 |
| 13 | 29 | Vostochni and Morjovi | 1,000 |
| 14 | 30 | Tolstoi, Lukanin, and Kitovi | 352 |
| 15 | 31 | Zapadni and Little Zapadni | 529 |
| 16 | 32 | Reef and Gorbatch | 2,218 |
| 17 | 33 | Polovina, Polovina Cliffs, and Little Polovina | 163 |
| 18 | 34 | Vostochni and Morjovi | 262 |
| 19 | 35 | Tolstoi, Lukanin, and Kitovi | 306 |
| 21–28 | -------- | Skins from seals that died in connection with branding operations | 26 |
| Oct. 20 | 36 | Reef and Gorbatch | 67 |
| 21 | 37 | Tolstoi, Lukanin, and Kitovi | 130 |
| 22 | 38 | Zapadni and Little Zapadni | 94 |
| 27 | 39 | Polovina, Polovina Cliffs, and Little Polovina | 36 |
| 28 | 40 | Vostochni and Morjovi | 129 |
| 29 | 41 | Reef and Gorbatch | 37 |
| | | Total | 19,000 |

ST. GEORGE ISLAND

| Date | Serial No. of drive | Hauling ground | Skins secured |
|---|---|---|---|
| June 10 | 1 | North | 38 |
| 20 | 2 | do | 58 |
| 21 | 3 | East Cliffs | 120 |
| 22 | 4 | Staraya Artil | 80 |
| 25 | 5 | North | 125 |
| 26 | 6 | East Reef and East Cliffs | 192 |
| 27 | 7 | Staraya Artil | 194 |
| 30 | 8 | North | 240 |
| July 1 | 9 | East Reef and East Cliffs | 223 |
| 2 | 10 | Staraya Artil | 119 |
| 5 | 11 | North | 197 |
| 7 | 12 | East Reef, East Cliffs, and Staraya Artil | 238 |
| 10 | 13 | North | 478 |
| 11 | 14 | East Reef and East Cliffs | 393 |
| July 12 | 15 | Staraya Artil | 226 |
| 15 | 16 | North | 250 |
| 16 | 17 | East Reef and East Cliffs | 566 |
| 17 | 18 | North and Staraya Artil | 619 |
| 20 | 19 | East Reef and East Cliffs | 497 |
| 21 | 20 | North and Staraya Artil | 794 |
| 22 | 21 | Zapadni | 32 |
| Oct. 20 | 22 | North, East Reef, and East Cliffs | 20 |
| 22 | 23 | North | 110 |
| 27 | 24 | do | 133 |
| | | Total | 5,942 |

## AGE CLASSES

The age class of a male seal belonging to the Pribilof Islands herd is determined from the length of its body. The classification was derived from measurements of a large number of pups branded in 1912 and killed in subsequent years. The limits of the various age classes are shown in the table following:

*Age classes of male seals, Pribilof Islands*

| Age | Length of summer seals | Length of fall seals | Age | Length of summer seals | Length of fall seals |
|---|---|---|---|---|---|
| | *Inches* | *Inches* | | *Inches* | *Inches* |
| Yearlings | Up to 36.75 | Up to 38.75 | 4-year-olds | 46 to 51.75 | 48 to 53.75 |
| 2-year-olds | 37 to 40.75 | 39 to 42.75 | 5-year-olds | 52 to 57.75 | 54 to 59.75 |
| 3-year-olds | 41 to 45.75 | 43 to 47.75 | 6-year-olds | 58 to 63.75 | 60 to 65.75 |

*Ages of seals killed on Pribilof Islands, calendar year 1927*

[On basis of classification shown in preceding table]

| Age | Summer (Jan. 1 to Aug. 5) | | | Fall (Aug. 6 to Dec. 31) | | | Total for year | | |
|---|---|---|---|---|---|---|---|---|---|
| | St. Paul | St. George | Total | St. Paul | St. George | Total | St. Paul | St. George | Total |
| Yearling males | 3 | | 3 | | | | 3 | | 3 |
| 2-year-old males | 1,069 | 63 | 1,132 | 87 | 63 | 150 | 1,156 | 126 | 1,282 |
| 3-year-old males | 17,265 | 5,434 | 22,699 | 406 | 200 | 606 | 17,671 | 5,634 | 23,305 |
| 4-year-old males | 161 | 159 | 320 | | | | 161 | 159 | 320 |
| 5-year-old males | 2 | | 2 | | | | 2 | | 2 |
| Cows [1] | 7 | 23 | 30 | | | | 7 | 23 | 30 |
| Total | 18,507 | 5,679 | 24,186 | 493 | 263 | 756 | 19,000 | 5,942 | 24,942 |

[1] Cows unavoidably and accidentally killed.

It should be stated that some of the seals recorded in the above tabulation as 2-year-olds or 4-year-olds probably were 3-year-olds. With the exception of one thousand 2-year-old males killed in the regular sealing season and a few of the same class killed for food in the fall, the killings were confined, as far as possible, to 3-year-old males. Not all the male seals of a given age fall within the length limits assigned for the males of that age.

## RESERVING OPERATIONS

As in previous years, further provision was made in 1927 for the maintenance of the male breeding stock by reserving from killing an adequate number of 3-year-old males. On St. Paul Island 6,847 animals and on St. George 2,243 were marked for the reserve. With the exception of 200 seals that were branded with a hot iron on St. Paul Island, all were marked by shearing a patch of fur. The actual reserve of 3-year-old males in 1927 included other animals than those marked, because not all the animals of that age class are taken up in the sealing drives.

*Marking of 3-year-old male seals for breeding reserve, Pribilof Islands, 1927*

ST. PAUL ISLAND

| Date | Hauling ground driven | Number of seals marked | Date | Hauling ground driven | Number of seals marked |
|---|---|---|---|---|---|
| July 20 | Zapadni and Little Zapadni | 473 | July 28 | Gorbatch | 381 |
| 21 | Reef | 605 | 29 | Polovina, Polovina Cliffs, and Little Polovina | 178 |
| 22 | Gorbatch | 1,163 | 30 | Vostochni and Morjovi | 383 |
| 23 | Polovina, Polovina Cliffs, and Little Polovina | 121 | 31 | Gorbatch | 379 |
| 24 | Vostochni and Morjovi | 1,356 | Aug. 1 | Reef | 231 |
| 25 | Tolstoi, Lukanin, and Kitovi | 410 | | | |
| 26 | Zapadni | 537 | | Total | 6,847 |
| 27 | Reef | 630 | | | |

ST. GEORGE ISLAND

| Date | Hauling ground driven | Number of seals marked | Date | Hauling ground driven | Number of seals marked |
|---|---|---|---|---|---|
| June 24 | Zapadni | 19 | July 26 | Staraya Artil | 413 |
| July 4 | do | 217 | 28 | North | 397 |
| 13 | do | 271 | | | |
| 22 | do | 326 | | Total | 2,243 |
| 25 | East Reef and East Cliffs | 600 | | | |

## COMPUTATION OF HERD

In 1927 a very satisfactory increase was shown in the size of the Pribilof Islands herd. As of August 10, after the close of the regular sealing season, it contained over 800,000 animals. The increase over the corresponding date of the preceding year was close to 50,000, or 6.25 per cent. The computation was made by Edward C. Johnston, who had had immediate charge of this work in the preceding six years. His report for 1927 will be found on pages 166 to 171 of this document. Following is a comparative statement of the numerical strength of the various elements of the seal herd in the years 1916 to 1927, inclusive:

*General comparison of computations of the seal herd on the Pribilof Islands, 1916 to 1927*

| Classes | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 |
|---|---|---|---|---|---|---|
| Harem bulls | 3,500 | 4,850 | 5,344 | 5,158 | 4,066 | 3,909 |
| Breeding cows | 116,977 | 128,024 | 142,915 | 157,172 | 167,527 | 176,655 |
| Surplus bulls | | 8,977 | 17,110 | 9,619 | 6,115 | 3,301 |
| Idle bulls | 2,632 | 2,706 | 2,444 | 2,239 | 1,161 | 747 |
| 6-year-old males | 11,167 | 15,397 | 13,755 | 8,991 | 4,153 | 3,991 |
| 5-year-old males | 15,494 | 14,813 | 11,941 | 5,282 | 5,007 | 4,729 |
| 4-year-old males | 15,427 | 16,631 | 7,114 | 5,747 | 5,667 | 6,780 |
| 3-year-old males | 19,402 | 19,507 | 9,117 | 13,596 | 10,749 | 14,668 |
| 2-year-old males | 24,169 | 26,815 | 30,159 | 33,081 | 39,111 | 41,893 |
| Yearling males | 33,645 | 38,013 | 41,595 | 46,444 | 51,074 | 50,249 |
| 2-year-old cows | 24,245 | 26,917 | 30,415 | 33,287 | 39,480 | 43,419 |
| Yearling cows | 33,646 | 38,018 | 41,608 | 46,447 | 51,081 | 54,447 |
| Pups | 116,977 | 128,024 | 142,915 | 157,172 | 167,527 | 176,655 |
| Total | 417,281 | 468,692 | 496,432 | 524,235 | 552,718 | 581,443 |

| Classes | 1922 | 1923 | 1924 | 1925 | 1926 | 1927 |
|---|---|---|---|---|---|---|
| Harem bulls | 3,562 | 3,412 | 3,516 | 3,526 | 4,034 | 4,643 |
| Breeding cows | 185,914 | 197,659 | 208,396 | 226,090 | 244,114 | 263,566 |
| Surplus bulls | 2,346 | 1,891 | 2,043 | 3,558 | 2,002 | 4,827 |
| Idle bulls | 508 | 312 | 390 | 311 | 423 | 972 |
| 6-year-old males | 3,771 | 4,863 | 8,489 | 4,105 | 13,434 | 18,450 |
| 5-year-old males | 6,080 | 10,612 | 5,132 | 16,792 | 16,812 | 16,073 |
| 4-year-old males | 11,807 | 5,710 | 18,670 | 18,692 | 17,872 | 14,448 |
| 3-year-old males | 7,459 | 22,786 | 21,551 | 21,185 | 17,189 | 9,730 |
| 2-year-old males | 40,920 | 43,112 | 45,685 | 43,515 | 38,183 | 41,252 |
| Yearling males | 52,988 | 55,769 | 59,291 | 52,091 | 56,514 | 61,026 |
| 2-year-old cows | 46,280 | 48,801 | 51,359 | 49,786 | 44,415 | 48,186 |
| Yearling cows | 57,413 | 60,422 | 64,240 | 57,309 | 62,175 | 67,131 |
| Pups | 185,914 | 197,659 | 208,396 | 226,090 | 244,114 | 263,566 |
| Total | 604,962 | 653,008 | 697,158 | 723,050 | 761,281 | 808,870 |

#### PHOTOGRAPHS OF SEAL ROOKERIES

Photographs of the fur-seal rookeries were taken in July. Similar ones were taken in 1922 and in 1917. The taking of these photographs at 5-year intervals provides a valuable record of seal life and of general rookery conditions, supplementing counts of animals and other data of a scientific character. Foggy weather at the time that the work had to be done in some instances prevented securing satisfactory negatives in 1927.

#### FOXES

On both St. Paul and St. George Islands the foxes are fed throughout the winter season. Preserved seal meat and cooked rations prepared from cereals and other foodstuffs are used. The feeding is continued so long as it appears that the natural supply of food is inadequate to meet requirements. In the summer season the foxes subsist on birds, birds' eggs, and miscellaneous animal life washed up on the beaches.

#### TRAPPING SEASON OF 1927–28

During the season of 1927–28, 278 blue and 15 white fox pelts were taken, of which 47 blue and 15 white pelts were taken on St. Paul Island and 231 blue pelts on St. George Island. There were also trapped, marked, and released for breeding purposes 149 foxes on St. Paul Island and 336 on St. George Island. These figures understate the reserved stock of breeders, for not all the animals in the herds are taken in the traps.

#### REINDEER

A census of the reindeer herds, taken at about the close of the year, showed approximately 250 animals in the St. Paul Island herd and 50 on St. George Island. From January to September, inclusive, nine reindeer were used for food on St. Paul Island.

### FUR-SEAL SKINS

#### SHIPMENTS

Only one shipment of fur-seal skins was made from the Pribilof Islands in the calendar year 1927. This consisted of 25,006 skins, as follows: From St. Paul Island 546 taken in the calendar year 1926 and 18,499 taken in 1927; from St. George Island 282 taken in the calendar year 1926 and 5,679 taken in 1927. The shipment was made from the islands in August on the U. S. S. *Vega*, which arrived at Bremerton, Wash., on August 25. The skins were shipped from Bremerton on August 27 via Puget Sound Navigation Co., Union Pacific Railroad, and Wabash Railway to St. Louis, Mo., where they were delivered to the bureau's selling agents on September 6.

#### SALES

In 1927 a total of 23,561 fur-seal skins taken on the Pribilof Islands were sold at two public auction sales. There also were sold at special sales 57 fur-seal skins taken on those islands. In the detailed statements, which follow, the sales of other fur-seal skins sold by the

Department of Commerce for the account of the Government are included in order that the records may be complete.

*Public auction sale, May 23, 1927.*—At this sale 13,137 fur-seal skins taken at the Pribilof Islands, dressed, dyed, and machined, sold for $436,535.50; 91 other fur-seal skins taken at the Pribilof Islands, consisting of 79 raw salted, faulty, 4 dressed, and 8 washed and dried, sold for a total of $30.70; a grand total of $436,566.20. Of the dressed, dyed, and machined skins, 11,611 were dyed black and 1,526 logwood brown (Bois de Campêche).

*Public auction sale, October 3, 1927.*—At this sale 10,333 fur-seal skins taken at the Pribilof Islands, dressed, dyed, and machined, sold for $336,529; 1 confiscated skin, dressed, dyed, and machined, for $26.50; 123 Japanese skins, dressed, dyed, and machined, for $2,877; and 9 raw salted Japanese skins for $4.50; a grand total of $339,437. Seven thousand two hundred and eighty of the Pribilof Islands skins

FIG. 16.—Hauling freshly taken fur-seal skins to salthouse, Pribilof Islands, Alaska

were dyed black and the other 3,053 logwood brown (Bois de Campêche). The confiscated skin and the 123 dyed Japanese skins were dyed black.

The 132 Japanese fur-seal skins sold on October 3, 1927, were the United States Government's share of sealskins taken by the Japanese Government in 1926, delivered pursuant to the provisions of the North Pacific Sealing Convention of July 7, 1911.

*Special sales.*—In the calendar year 1927, 57 dressed, dyed, and machined fur-seal skins were sold at special sales for $2,803.98. All were taken at the Pribilof Islands. Fifty were dyed black and 7 logwood brown (Bois de Campêche).

The following tables give further details in regard to all sales of fur-seal skins by the Department of Commerce for the account of the Government in 1927:

*Sale of fur-seal skins at St. Louis, Mo., May 23, 1927*

11,611 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED BLACK

| Lot No. | Number of skins | Trade classification | Price per skin | Total for lot |
|---|---|---|---|---|
| 1 | 40 | Extra large | $64.00 | $2,560.00 |
| 2 | 80 | Large | 51.00 | 4,080.00 |
| 3 | 80 | do | 57.00 | 4,560.00 |
| 4 | 80 | do | 56.00 | 4,480.00 |
| 5 | 80 | do | 59.00 | 4,720.00 |
| 6 | 80 | do | 57.00 | 4,560.00 |
| 7 | 80 | do | 58.00 | 4,640.00 |
| 8 | 80 | do | 57.50 | 4,600.00 |
| 9 | 40 | do | 60.00 | 2,400.00 |
| 10 | 80 | Large; scarred, faulty, etc | 38.00 | 3,040.00 |
| 11 | 35 | do | 37.50 | 1,312.50 |
| 12 | 90 | Medium | 45.00 | 4,050.00 |
| 13 | 90 | do | 45.00 | 4,050.00 |
| 14 | 90 | do | 45.00 | 4,050.00 |
| 15 | 90 | do | 44.00 | 3,960.00 |
| 16 | 90 | do | 44.00 | 3,960.00 |
| 17 | 90 | do | 44.00 | 3,960.00 |
| 18 | 90 | do | 43.00 | 3,870.00 |
| 19 | 90 | do | 43.50 | 3,915.00 |
| 20 | 90 | do | 48.50 | 4,365.00 |
| 21 | 90 | do | 47.00 | 4,230.00 |
| 22 | 90 | do | 48.00 | 4,320.00 |
| 23 | 90 | do | 45.50 | 4,095.00 |
| 24 | 90 | do | 46.50 | 4,185.00 |
| 25 | 90 | do | 46.00 | 4,140.00 |
| 26 | 90 | do | 46.00 | 4,140.00 |
| 27 | 45 | do | 45.50 | 2,047.50 |
| 28 | 90 | Medium; scarred, faulty, etc | 32.50 | 2,925.00 |
| 29 | 90 | do | 33.00 | 2,970.00 |
| 30 | 90 | do | 33.50 | 3,015.00 |
| 31 | 90 | Small medium | 33.00 | 2,970.00 |
| 32 | 45 | do | 34.50 | 1,552.50 |
| 33 | 80 | 28 medium, 52 small medium; scarred, faulty, etc | 25.00 | 2,000.00 |
| 34 | 35 | Extra extra large | 63.50 | 2,222.50 |
| 35 | 30 | Extra extra large; scarred, faulty, etc | 35.00 | 1,050.00 |
| 36 | 70 | Extra large | 51.50 | 3,605.00 |
| 37 | 49 | do | 51.00 | 2,499.00 |
| 38 | 70 | Extra large; scarred, faulty, etc | 32.50 | 2,275.00 |
| 39 | 53 | do | 33.50 | 1,775.50 |
| 40 | 80 | Large | 51.00 | 4,080.00 |
| 41 | 80 | do | 50.00 | 4,000.00 |
| 42 | 80 | do | 49.00 | 3,920.00 |
| 43 | 80 | do | 46.50 | 3,720.00 |
| 44 | 80 | do | 45.50 | 3,640.00 |
| 45 | 80 | do | 42.50 | 3,400.00 |
| 46 | 80 | do | 44.00 | 3,520.00 |
| 47 | 76 | do | 43.50 | 3,306.00 |
| 48 | 80 | Large; scarred, faulty, etc | 25.00 | 2,000.00 |
| 49 | 80 | do | 24.50 | 1,960.00 |
| 50 | 80 | do | 23.50 | 1,880.00 |
| 51 | 80 | do | 24.00 | 1,920.00 |
| 52 | 80 | do | 24.00 | 1,920.00 |
| 53 | 80 | do | 24.50 | 1,960.00 |
| 54 | 59 | do | 24.50 | 1,445.50 |
| 55 | 90 | Medium | 38.50 | 3,465.00 |
| 56 | 90 | do | 38.50 | 3,465.00 |
| 57 | 90 | do | 37.00 | 3,330.00 |
| 58 | 90 | do | 37.00 | 3,330.00 |
| 59 | 90 | do | 36.00 | 3,240.00 |
| 60 | 90 | do | 37.00 | 3,330.00 |
| 61 | 90 | do | 35.00 | 3,150.00 |
| 62 | 90 | do | 33.50 | 3,015.00 |
| 63 | 90 | do | 34.00 | 3,060.00 |
| 64 | 90 | do | 33.00 | 2,970.00 |
| 65 | 90 | do | 34.00 | 3,060.00 |
| 66 | 90 | do | 32.50 | 2,925.00 |
| 67 | 90 | do | 33.50 | 3,015.00 |
| 68 | 90 | do | 33.00 | 2,970.00 |
| 69 | 90 | do | 34.00 | 3,060.00 |
| 70 | 90 | do | 32.50 | 2,925.00 |
| 71 | 90 | do | 32.00 | 2,880.00 |
| 72 | 90 | do | 32.50 | 2,925.00 |
| 73 | 90 | do | 32.50 | 2,925.00 |
| 74 | 90 | do | 33.00 | 2,970.00 |
| 75 | 90 | do | 35.00 | 3,150.00 |
| 76 | 90 | do | 33.00 | 2,970.00 |

*Sale of fur-seal skins at St. Louis, Mo., May 23, 1927*—Continued

11,611 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED BLACK—Continued

| Lot No. | Number of skins | Trade classification | Price per skin | Total for lot |
|---|---|---|---|---|
| 77 | 90 | Medium | $35.00 | $3,150.00 |
| 78 | 90 | do | 35.50 | 3,195.00 |
| 79 | 90 | do | 33.50 | 3,015.00 |
| 80 | 90 | do | 34.50 | 3,105.00 |
| 81 | 90 | do | 33.50 | 3,015.00 |
| 82 | 90 | do | 33.50 | 3,015.00 |
| 83 | 90 | do | 33.50 | 3,015.00 |
| 84 | 90 | do | 33.50 | 3,015.00 |
| 85 | 40 | do | 40.50 | 1,620.00 |
| 86 | 90 | Medium; scarred, faulty, etc | 21.50 | 1,935.00 |
| 87 | 90 | do | 21.50 | 1,935.00 |
| 88 | 90 | do | 21.00 | 1,890.00 |
| 89 | 90 | do | 21.00 | 1,890.00 |
| 90 | 90 | do | 21.50 | 1,935.00 |
| 91 | 90 | do | 21.00 | 1,890.00 |
| 92 | 90 | do | 21.50 | 1,935.00 |
| 93 | 90 | do | 21.00 | 1,890.00 |
| 94 | 90 | do | 21.00 | 1,890.00 |
| 95 | 90 | do | 21.00 | 1,890.00 |
| 96 | 90 | do | 19.50 | 1,755.00 |
| 97 | 90 | do | 19.50 | 1,755.00 |
| 98 | 90 | do | 20.00 | 1,800.00 |
| 99 | 90 | do | 20.00 | 1,800.00 |
| 100 | 90 | do | 20.50 | 1,845.00 |
| 101 | 90 | do | 19.50 | 1,755.00 |
| 102 | 90 | do | 19.50 | 1,755.00 |
| 103 | 90 | do | 19.50 | 1,755.00 |
| 104 | 90 | do | 18.50 | 1,665.00 |
| 105 | 90 | do | 18.00 | 1,620.00 |
| 106 | 90 | do | 19.00 | 1,710.00 |
| 107 | 90 | do | 18.00 | 1,620.00 |
| 108 | 90 | do | 19.00 | 1,710.00 |
| 109 | 90 | do | 19.50 | 1,755.00 |
| 110 | 90 | do | 18.00 | 1,620.00 |
| 111 | 52 | do | 18.50 | 962.00 |
| 112 | 50 | do | 19.00 | 950.00 |
| 113 | 90 | Small medium | 21.00 | 1,890.00 |
| 114 | 90 | do | 19.50 | 1,755.00 |
| 115 | 90 | do | 19.50 | 1,755.00 |
| 116 | 90 | do | 19.00 | 1,710.00 |
| 117 | 90 | do | 23.00 | 2,070.00 |
| 118 | 90 | do | 20.50 | 1,845.00 |
| 119 | 90 | do | 20.00 | 1,800.00 |
| 120 | 90 | do | 20.50 | 1,845.00 |
| 121 | 90 | do | 21.00 | 1,890.00 |
| 122 | 90 | do | 24.50 | 2,205.00 |
| 123 | 90 | do | 25.00 | 2,250.00 |
| 124 | 51 | do | 25.00 | 1,275.00 |
| 125 | 90 | Small medium; scarred, faulty, etc | 16.00 | 1,440.00 |
| 126 | 90 | do | 16.50 | 1,485.00 |
| 127 | 90 | do | 16.00 | 1,440.00 |
| 128 | 90 | do | 17.00 | 1,530.00 |
| 129 | 90 | do | 17.00 | 1,530.00 |
| 130 | 90 | do | 17.00 | 1,530.00 |
| 131 | 90 | do | 17.00 | 1,530.00 |
| 132 | 90 | do | 17.00 | 1,530.00 |
| 133 | 90 | do | 17.50 | 1,575.00 |
| 134 | 90 | do | 17.00 | 1,530.00 |
| 135 | 90 | do | 17.50 | 1,575.00 |
| 136 | 90 | do | 17.50 | 1,575.00 |
| 137 | 90 | do | 17.50 | 1,575.00 |
| 138 | 60 | do | 17.50 | 1,050.00 |
| 139 | 48 | do | 18.50 | 888.00 |
| 140 | 41 | III; 2 wig, 1 extra extra large, 4 extra large, 13 large, 21 medium | 5.00 | 205.00 |
| 141 | 42 | III; 26 medium, 16 small medium | 5.00 | 210.00 |
| | 11,611 | | | 361,496.00 |

*Sale of fur-seal skins at St. Louis, Mo., May 23, 1927*—Continued

1,526 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED LOGWOOD BROWN (BOIS DE CAMPÊCHE)

| Lot No. | Number of skins | Trade classification | Price per skin | Total for lot |
|---|---|---|---|---|
| 151 | 35 | 3 extra large, 32 large | $64.00 | $2,240.00 |
| 152 | 40 | Large | 62.00 | 2,480.00 |
| 153 | 34 | 3 extra large, 31 large | 62.50 | 2,125.00 |
| 154 | 40 | Large | 60.00 | 2,400.00 |
| 155 | 40 | do | 62.00 | 2,480.00 |
| 156 | 35 | do | 62.50 | 2,187.50 |
| 157 | 35 | do | 64.00 | 2,240.00 |
| 158 | 45 | Medium | 50.00 | 2,250.00 |
| 159 | 45 | do | 49.50 | 2,227.50 |
| 160 | 40 | do | 47.50 | 1,900.00 |
| 161 | 40 | do | 48.00 | 1,920.00 |
| 162 | 40 | do | 51.50 | 2,060.00 |
| 163 | 35 | do | 49.00 | 1,715.00 |
| 164 | 45 | do | 49.50 | 2,227.50 |
| 165 | 45 | do | 50.00 | 2,250.00 |
| 166 | 45 | do | 50.00 | 2,250.00 |
| 167 | 45 | do | 50.00 | 2,250.00 |
| 168 | 45 | do | 49.00 | 2,205.00 |
| 169 | 45 | do | 47.00 | 2,115.00 |
| 170 | 45 | do | 48.00 | 2,160.00 |
| 171 | 45 | do | 47.50 | 2,137.50 |
| 172 | 45 | do | 47.00 | 2,115.00 |
| 173 | 45 | do | 50.50 | 2,272.50 |
| 174 | 45 | do | 52.00 | 2,340.00 |
| 175 | 40 | do | 49.50 | 1,980.00 |
| 176 | 40 | do | 51.50 | 2,060.00 |
| 177 | 40 | do | 51.00 | 2,040.00 |
| 178 | 40 | do | 50.50 | 2,020.00 |
| 179 | 40 | do | 49.00 | 1,960.00 |
| 180 | 39 | do | 47.50 | 1,852.50 |
| 181 | 30 | 5 large, 20 medium, 5 small medium; scarred, faulty, etc | 33.00 | 990.00 |
| 182 | 30 | 13 large, 17 medium; scarred, faulty, etc | 37.00 | 1,110.00 |
| 183 | 31 | 22 medium, 9 small medium; scarred, faulty, etc | 34.00 | 1,054.00 |
| 184 | 48 | Small medium | 37.00 | 1,776.00 |
| 185 | 45 | do | 39.50 | 1,777.50 |
| 186 | 45 | do | 41.50 | 1,867.50 |
| 187 | 37 | Small medium; scarred, faulty, etc | 29.50 | 1,091.50 |
| 188 | 22 | 2 large, 11 medium, 9 small medium | 41.50 | 913.00 |
| | 1,526 | | | 75,039.50 |

91 MISCELLANEOUS PRIBILOF ISLANDS SKINS

| Lot No. | Number of skins | Trade classification | Price per skin | Total for lot |
|---|---|---|---|---|
| 190 | 79 | Raw salted; faulty | $0.30 | $23.70 |
| 191 | 4 | Dressed | 1.25 | 5.00 |
| 192 | 8 | Washed and dried | .25 | 2.00 |
| | 91 | | | 30.70 |

*Sale of fur-seal skins at St. Louis, Mo., October 3, 1927*

7,280 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED BLACK

| Lot No. | Number of skins | Trade classification | Price per skin | Total for lot |
|---|---|---|---|---|
| 1 | 70 | Extra large | $46.00 | $3,220.00 |
| 2 | 70 | do | 43.00 | 3,010.00 |
| 3 | 70 | do | 42.50 | 2,975.00 |
| 4 | 70 | do | 41.00 | 2,870.00 |
| 5 | 35 | do | 47.50 | 1,662.50 |
| 6 | 70 | Extra large; scarred, faulty, etc | 25.50 | 1,785.00 |
| 7 | 50 | do | 28.00 | 1,400.00 |
| 8 | 80 | Large | 34.00 | 2,720.00 |
| 9 | 80 | do | 35.00 | 2,800.00 |
| 10 | 80 | do | 36.00 | 2,880.00 |
| 11 | 80 | do | 36.50 | 2,920.00 |
| 12 | 80 | do | 37.50 | 3,000.00 |
| 13 | 80 | do | 37.50 | 3,000.00 |
| 14 | 80 | do | 37.50 | 3,000.00 |

*Sale of fur-seal skins at St. Louis, Mo., October 3, 1927*—Continued

7,280 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED BLACK—Continued

| Lot No. | Number of skins | Trade classification | Price per skin | Total for lot |
|---|---|---|---|---|
| 15 | 80 | Large | $37.50 | $3,000.00 |
| 16 | 80 | do | 39.00 | 3,120.00 |
| 17 | 80 | do | 37.50 | 3,000.00 |
| 18 | 80 | do | 38.50 | 3,080.00 |
| 19 | 80 | do | 38.00 | 3,040.00 |
| 20 | 80 | do | 38.50 | 3,080.00 |
| 21 | 80 | do | 39.00 | 3,120.00 |
| 22 | 80 | do | 39.00 | 3,120.00 |
| 23 | 80 | do | 39.00 | 3,120.00 |
| 24 | 80 | do | 39.50 | 3,160.00 |
| 25 | 80 | do | 40.00 | 3,200.00 |
| 26 | 80 | do | 40.50 | 3,240.00 |
| 27 | 80 | do | 41.00 | 3,280.00 |
| 28 | 80 | do | 40.00 | 3,200.00 |
| 29 | 80 | do | 42.00 | 3,360.00 |
| 30 | 80 | do | 42.00 | 3,360.00 |
| 31 | 80 | do | 42.00 | 3,360.00 |
| 32 | 80 | do | 42.50 | 3,400.00 |
| 33 | 80 | do | 41.50 | 3,320.00 |
| 34 | 80 | do | 43.00 | 3,440.00 |
| 35 | 80 | Large; scarred, faulty, etc | 19.50 | 1,560.00 |
| 36 | 80 | do | 21.50 | 1,720.00 |
| 37 | 80 | do | 22.50 | 1,800.00 |
| 38 | 80 | do | 22.50 | 1,800.00 |
| 39 | 80 | do | 23.50 | 1,880.00 |
| 40 | 80 | do | 23.50 | 1,880.00 |
| 41 | 80 | do | 23.50 | 1,880.00 |
| 42 | 80 | do | 23.50 | 1,880.00 |
| 43 | 80 | do | 24.00 | 1,920.00 |
| 44 | 80 | do | 23.50 | 1,880.00 |
| 45 | 80 | do | 23.50 | 1,880.00 |
| 46 | 80 | do | 23.75 | 1,900.00 |
| 47 | 80 | do | 22.00 | 1,760.00 |
| 48 | 80 | do | 22.50 | 1,800.00 |
| 49 | 80 | do | 23.50 | 1,880.00 |
| 50 | 35 | do | 27.00 | 945.00 |
| 51 | 90 | Medium | 32.50 | 2,925.00 |
| 52 | 90 | do | 31.00 | 2,790.00 |
| 53 | 90 | do | 34.00 | 3,060.00 |
| 54 | 90 | do | 35.00 | 3,150.00 |
| 55 | 90 | do | 34.00 | 3,060.00 |
| 56 | 90 | do | 34.50 | 3,105.00 |
| 57 | 90 | do | 35.50 | 3,195.00 |
| 58 | 90 | do | 37.00 | 3,330.00 |
| 59 | 90 | do | 34.50 | 3,105.00 |
| 60 | 90 | do | 37.50 | 3,375.00 |
| 61 | 90 | do | 36.50 | 3,285.00 |
| 62 | 90 | do | 35.50 | 3,195.00 |
| 63 | 90 | do | 35.50 | 3,195.00 |
| 64 | 90 | do | 35.50 | 3,195.00 |
| 65 | 90 | do | 37.50 | 3,375.00 |
| 66 | 90 | do | 36.50 | 3,285.00 |
| 67 | 90 | do | 36.00 | 3,240.00 |
| 68 | 90 | do | 36.00 | 3,240.00 |
| 69 | 90 | do | 38.00 | 3,420.00 |
| 70 | 90 | do | 37.50 | 3,375.00 |
| 71 | 90 | do | 36.50 | 3,285.00 |
| 72 | 90 | do | 37.00 | 3,330.00 |
| 73 | 60 | do | 37.50 | 2,250.00 |
| 74 | 90 | Medium; scarred, faulty, etc | 21.00 | 1,890.00 |
| 75 | 90 | do | 21.50 | 1,935.00 |
| 76 | 90 | do | 21.00 | 1,890.00 |
| 77 | 90 | do | 21.50 | 1,935.00 |
| 78 | 90 | do | 21.50 | 1,935.00 |
| 79 | 90 | do | 21.50 | 1,935.00 |
| 80 | 90 | do | 21.00 | 1,890.00 |
| 81 | 90 | do | 21.50 | 1,935.00 |
| 82 | 90 | do | 21.00 | 1,890.00 |
| 83 | 90 | do | 21.50 | 1,935.00 |
| 84 | 90 | do | 21.50 | 1,935.00 |
| 85 | 90 | do | 21.75 | 1,957.50 |
| 86 | 90 | do | 21.75 | 1,957.50 |
| 87 | 90 | do | 21.50 | 1,935.00 |
| 88 | 90 | Small medium | 22.50 | 2,025.00 |
| 89 | 60 | Small medium; scarred, faulty, etc | 16.50 | 990.00 |
| | 7,280 | | | 232,342.50 |

*Sale of fur-seal skins at St. Louis, Mo., October 3, 1927*—Continued

3,053 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED LOGWOOD BROWN (BOIS DE CAMPÊCHE)

| Lot No. | Number of skins | Trade classification | Price per skin | Total for lot |
|---|---|---|---|---|
| 91 | 80 | 1 extra extra large, 3 extra large, 76 large | $47.00 | $3,760.00 |
| 92 | 80 | 17 extra large, 63 large | 53.50 | 4,280.00 |
| 93 | 42 | 1 extra extra large, 10 extra large, 31 large; scarred, faulty, etc | 31.00 | 1,302.00 |
| 94 | 40 | Large | 45.50 | 1,820.00 |
| 95 | 38 | do | 52.00 | 1,976.00 |
| 96 | 60 | Large; scarred, faulty, etc | 32.00 | 1,920.00 |
| 97 | 40 | do | 28.00 | 1,120.00 |
| 98 | 40 | do | 29.00 | 1,160.00 |
| 99 | 48 | 19 large, 29 medium | 47.00 | 2,256.00 |
| 100 | 90 | Medium | 43.50 | 3,915.00 |
| 101 | 90 | do | 43.50 | 3,915.00 |
| 102 | 90 | do | 43.50 | 3,915.00 |
| 103 | 50 | do | 46.00 | 2,300.00 |
| 104 | 50 | do | 47.00 | 2,350.00 |
| 105 | 90 | do | 45.00 | 4,050.00 |
| 106 | 90 | do | 46.50 | 4,185.00 |
| 107 | 90 | do | 46.50 | 4,185.00 |
| 108 | 90 | do | 47.00 | 4,230.00 |
| 109 | 45 | do | 46.50 | 2,092.50 |
| 110 | 45 | do | 49.00 | 2,205.00 |
| 111 | 45 | do | 49.00 | 2,205.00 |
| 112 | 40 | do | 49.50 | 1,980.00 |
| 113 | 90 | Medium; scarred, faulty, etc | 23.50 | 2,115.00 |
| 114 | 90 | do | 22.00 | 1,980.00 |
| 115 | 50 | do | 25.00 | 1,250.00 |
| 116 | 45 | do | 28.00 | 1,260.00 |
| 117 | 45 | do | 24.50 | 1,102.50 |
| 118 | 90 | do | 24.50 | 2,205.00 |
| 119 | 90 | do | 23.50 | 2,115.00 |
| 120 | 90 | do | 23.50 | 2,115.00 |
| 121 | 90 | do | 23.50 | 2,115.00 |
| 122 | 50 | do | 23.50 | 1,175.00 |
| 123 | 50 | do | 22.75 | 1,137.50 |
| 124 | 45 | do | 23.50 | 1,057.50 |
| 125 | 45 | do | 22.50 | 1,012.50 |
| 126 | 90 | Small medium | 36.50 | 3,285.00 |
| 127 | 50 | do | 37.00 | 1,850.00 |
| 128 | 50 | do | 37.50 | 1,875.00 |
| 129 | 90 | do | 36.00 | 3,240.00 |
| 130 | 60 | do | 36.50 | 2,190.00 |
| 131 | 60 | do | 34.00 | 2,040.00 |
| 132 | 90 | Small medium; scarred, faulty, etc | 19.50 | 1,755.00 |
| 133 | 60 | do | 18.50 | 1,110.00 |
| 134 | 90 | do | 18.50 | 1,665.00 |
| 135 | 90 | do | 19.50 | 1,755.00 |
| 136 | 40 | do | 21.50 | 860.00 |
| 137 | 40 | do | 20.00 | 800.00 |
| | 3,053 | | | 104,186.50 |

1 CONFISCATED SKIN, DRESSED, DYED, AND MACHINED, DYED BLACK

| | | | | |
|---|---|---|---|---|
| 139 | 1 | Wig; scarred, faulty, etc | $26.50 | $26.50 |

123 SKINS RECEIVED FROM JAPANESE GOVERNMENT UNDER TREATY PROVISIONS, DRESSED, DYED, AND MACHINED, DYED BLACK

| | | | | |
|---|---|---|---|---|
| 140 | 63 | 1 extra extra large, 16 extra large, 42 large, and 4 medium | $29.00 | $1,827.00 |
| 141 | 60 | 10 extra large, 43 large, and 7 medium; scarred, faulty, etc | 17.50 | 1,050.00 |
| | 123 | | | 2,877.00 |

9 SKINS RECEIVED FROM JAPANESE GOVERNMENT UNDER TREATY PROVISIONS RAW SALTED

| | | | | |
|---|---|---|---|---|
| 150 | 9 | Skins | $0.50 | $4.50 |

*Special sales of Pribilof Islands sealskins in 1927*

| Date | Number of skins | Description | Price per skin | Total |
|---|---|---|---|---|
| | | *Dressed, dyed, and machined, black* | | |
| Jan. 31 | 50 | Medium | $50.36 | $2,518.00 |
| | | *Dressed, dyed, and machined, logwood brown (Bois de Campêche)* | | |
| Feb. 28 | 3 | Medium | 45.02 | 135.06 |
| 28 | 4 | Small medium | 37.73 | 150.92 |
| | 57 | | | 2,803.98 |

*Comparative values, by sizes and grades, with percentages each size, of Pribilof sealskins sold at public auction in 1927*

| Classes and sales | Grade | Number | High | Low | Average | Total | Total number | Average price | Total price | Percentage |
|---|---|---|---|---|---|---|---|---|---|---|
| DYED BLACK | | | | | | | | | | |
| Wig: May 23 | III | 2 | $5.00 | $5.00 | $5.00 | $10.00 | 2 | $5.00 | $10.00 | 0.02 |
| Extra extra large: May 23 | I and II | 35 | 63.50 | 63.50 | 63.50 | 2,222.50 | | | | |
| | Scarred, faulty, etc. | 30 | 35.00 | 35.00 | 35.00 | 1,050.00 | 66 | 49.66 | 3,277.50 | .57 |
| | III | 1 | 5.00 | 5.00 | 5.00 | 5.00 | | | | |
| Extra large: | | | | | | | | | | |
| May 23 | I and II | 159 | 64.00 | 51.00 | 54.49 | 8,664.00 | | | | |
| | Scarred, faulty, etc. | 123 | 33.50 | 32.50 | 32.93 | 4,050.50 | 286 | 44.53 | 12,734.50 | 2.46 |
| | III | 4 | 5.00 | 5.00 | 5.00 | 20.00 | | | | |
| Oct. 3 | I and II | 345 | 47.50 | 41.00 | 43.61 | 13,737.50 | 435 | 38.90 | 16,922.50 | 5.98 |
| | Scarred, faulty, etc. | 120 | 28.00 | 25.50 | 26.54 | 3,185.00 | | | | |
| Large: | | | | | | | | | | |
| May 23 | I and II | 1,236 | 60.00 | 42.50 | 51.48 | 63,626.00 | | | | |
| | Scarred, faulty, etc. | 654 | 38.00 | 23.50 | 26.66 | 17,438.00 | 1,903 | 42.63 | 81,129.00 | 16.39 |
| | III | 13 | 5.00 | 5.00 | 5.00 | 65.00 | | | | |
| Oct. 3 | I and II | 2,160 | 43.00 | 34.00 | 39.04 | 84,320.00 | 3,395 | 33.19 | 112,685.00 | 46.63 |
| | Scarred, faulty, etc. | 1,235 | 27.00 | 19.50 | 22.97 | 28,365.00 | | | | |
| Medium: | | | | | | | | | | |
| May 23 | I and II | 4,135 | 48.50 | 32.00 | 38.12 | 157,612.50 | | | | |
| | Scarred, faulty, etc. | 2,650 | 33.50 | 18.00 | 21.33 | 56,522.00 | 6,832 | 31.38 | 214,369.50 | 58.84 |
| | III | 47 | 5.00 | 5.00 | 5.00 | 235.00 | | | | |
| Oct. 3 | I and II | 2,040 | 38.00 | 31.00 | 35.67 | 72,765.00 | 3,300 | 30.22 | 99,720.00 | 45.33 |
| | Scarred, faulty, etc. | 1,260 | 21.75 | 21.00 | 21.39 | 26,955.00 | | | | |
| Small medium: | | | | | | | | | | |
| May 23 | I and II | 1,176 | 34.50 | 19.00 | 22.80 | 26,812.50 | | | | |
| | Scarred, faulty, etc. | 1,330 | 25.00 | 16.00 | 17.36 | 23,083.00 | 2,522 | 19.82 | 49,975.50 | 21.72 |
| | III | 16 | 5.00 | 5.00 | 5.00 | 80.00 | | | | |
| Oct. 3 | I and II | 90 | 22.50 | 22.50 | 22.50 | 2,025.00 | 150 | 20.10 | 3,015.00 | 2.06 |
| | Scarred, faulty, etc. | 60 | 16.50 | 16.50 | 16.50 | 990.00 | | | | |
| All classes: | | | | | | | | | | |
| May 23 | | | | | | | 11,611 | 31.13 | 361,496.00 | 100.00 |
| Oct. 3 | | | | | | | 7,280 | 31.92 | 232,342.50 | 100.00 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **DYED LOGWOOD BROWN (BOIS DE CAMPÊCHE)** | | | | | | | | | | |
| Extra extra large: | | | | | | | | | | |
| Oct. 3 | I and II | 1 | 47.00 | 47.00 | 47.00 | 47.00 | 2 | 39.00 | 78.00 | .07 |
| | Scarred, faulty, etc | 1 | 31.00 | 31.00 | 31.00 | 31.00 | | | | |
| Extra large: | | | | | | | | | | |
| May 23 | I and II | 6 | 64.00 | 62.50 | 63.25 | 379.50 | 6 | 63.25 | 379.50 | .39 |
| Oct. 3 | I and II | 20 | 53.50 | 47.00 | 52.53 | 1,050.50 | 30 | 45.35 | 1,360.50 | .98 |
| | Scarred, faulty, etc | 10 | 31.00 | 31.00 | 31.00 | 310.00 | | | | |
| Large: | | | | | | | | | | |
| May 23 | I and II | 255 | 64.00 | 41.50 | 62.18 | 15,856.00 | 273 | 60.45 | 16,502.00 | 17.89 |
| | Scarred, faulty, etc | 18 | 37.00 | 33.00 | 35.89 | 646.00 | | | | |
| Oct. 3 | I and II | 236 | 53.50 | 45.50 | 49.29 | 11,631.50 | 407 | 41.26 | 16,792.50 | 13.33 |
| | Scarred, faulty, etc | 171 | 32.00 | 28.00 | 30.18 | 5,161.00 | | | | |
| Medium: | | | | | | | | | | |
| May 23 | I and II | 990 | 52.00 | 41.50 | 49.26 | 48,764.00 | 1,049 | 48.43 | 50,801.00 | 68.74 |
| | Scarred, faulty, etc | 59 | 37.00 | 33.00 | 34.53 | 2,037.00 | | | | |
| Oct. 3 | I and II | 934 | 49.50 | 43.50 | 45.92 | 42,890.50 | 1,804 | 35.22 | 63,530.50 | 59.09 |
| | Scarred, faulty, etc | 870 | 28.00 | 22.00 | 23.72 | 20,640.00 | | | | |
| Small medium: | | | | | | | | | | |
| May 23 | I and II | 147 | 41.50 | 37.00 | 39.42 | 5,794.50 | 198 | 37.16 | 7,357.00 | 12.98 |
| | Scarred, faulty, etc | 51 | 34.00 | 29.50 | 30.64 | 1,562.50 | | | | |
| Oct. 3 | I and II | 400 | 37.50 | 34.00 | 36.20 | 14,480.00 | 810 | 27.69 | 22,425.00 | 26.53 |
| | Scarred, faulty, etc | 410 | 21.50 | 18.50 | 19.38 | 7,945.00 | | | | |
| All classes: | | | | | | | | | | |
| May 23 | | | | | | | 1,526 | 49.17 | 75,039.50 | 100.00 |
| Oct. 3 | | | | | | | 3,053 | 34.13 | 104,186.50 | 100.00 |
| **MISCELLANEOUS** | *Description* | | | | | | | | | |
| May 23 | Dressed | 4 | 1.25 | 1.25 | 1.25 | 5.00 | 91 | 0.34 | 30.70 | 100.00 |
| | Raw salted | 79 | .30 | .30 | .30 | 23.70 | | | | |
| | Washed and dried | 8 | .25 | .25 | .25 | 2.00 | | | | |

## DISPOSITION OF SKINS TAKEN AT PRIBILOF ISLANDS

On January 1, 1927, 31,289 fur-seal skins taken at the Pribilof Islands were on hand. Of these, 828 were at the Pribilof Islands, 30,438 at St. Louis, Mo., and 23 at Washington. In 1927, 24,942 Pribilof skins were secured at the islands and 23,618 were disposed of, leaving 32,613 on hand at December 31, 1927. The following tables show further details in regard to fur-seal skins taken on the Pribilof Islands as well as details in regard to other Government-owned fur-seal skins under the control of the Department of Commerce.

*Summary of Government-owned fur-seal skins in the custody of Fouke Fur Co., St. Louis, Mo., calendar year 1927*

| Source | On hand Jan. 1 | Receipts in 1927 | Disposed of in 1927 | On hand Dec. 31 |
|---|---|---|---|---|
| Taken on Pribilof Islands: | | | | |
| Calendar year 1925 | 9,135 | [1] 12 | [2] 9,146 | 1 |
| Calendar year 1926 | 21,303 | [3] 828 | [2] 14,472 | 7,659 |
| Calendar year 1927 | | [3] 24,178 | | 24,178 |
| United States' share of Japanese fur-seal skins, season of 1926 | | 132 | [2] 132 | |
| Confiscated fur-seal skins | | 4 | [2] 1 | 3 |
| Total | 30,438 | 25,154 | 23,751 | 31,841 |

[1] Returned from Washington.
[2] Sold.
[3] Received from Pribilof Islands.

*Summary of all fur-seal skins handled on Pribilof Islands, calendar year 1927*

| Island | On hand, Jan. 1 | Number taken | Total handled | Number shipped | On hand Dec. 31 |
|---|---|---|---|---|---|
| St. Paul | 546 | 19,000 | 19,546 | 19,045 | 501 |
| St. George | 282 | 5,942 | 6,224 | 5,961 | 263 |
| Total | 828 | 24,942 | 25,770 | 25,006 | 764 |

*Summary of all Government-owned fur-seal skins under control of Department of Commerce, calendar year 1927*

| Source | On hand Jan. 1 | Receipts in 1927 | Sales in 1927 | On hand Dec. 31 |
|---|---|---|---|---|
| Taken on Pribilof Islands: | | | | |
| Calendar year 1918, held for reference purposes | 7 | | | 7 |
| Calendar year 1923 | 3 | | | 3 |
| Calendar year 1924 | 1 | | | 1 |
| Calendar year 1925 | 9,147 | | 9,146 | 1 |
| Calendar year 1926 | 22,131 | | 14,472 | 7,659 |
| Calendar year 1927 | | 24,942 | | 24,942 |
| Miscellaneous skins held for reference purposes | 4 | | | 4 |
| United States' share of Japanese sealskins, season of 1926 | | 132 | 132 | |
| Confiscated skins | | 4 | 1 | 3 |
| Total | 31,293 | 25,078 | 23,751 | [1] 32,620 |

[1] 764 skins at Pribilof Islands, 31,841 in custody of Fouke Fur Co.; 15 in custody of Washington office Bureau of Fisheries.

## SHIPMENT AND SALE OF FOX SKINS

The 118 blue and 27 white fox skins taken on St. Paul Island in the season of 1926–27 and the 610 blue and 3 white fox skins taken on St. George Island in the same season were placed aboard the U. S. S. *Vega* for shipment in August. These 758 skins reached Bremerton, Wash., on August 25 and were then forwarded by express to St. Louis, Mo., to the bureau's selling agents. None of these skins was sold in the calendar year 1927.

There were sold at public auction at St. Louis on October 3, 1927, the remaining 580 blue and 20 white pelts of the Pribilof Islands' take of the season of 1925–26, 125 blue pelts of that season's take having been sold October 11, 1926. The 580 blue pelts sold for $32,128, an average of $55.39 per skin, the maximum price obtained being $136 for a single skin. The 20 white pelts sold for $948.50, an average of $47.43 per skin. At the last preceding public auction sale of Pribilof Islands blue-fox skins (October 11, 1926) the average price obtained was $53.20. The last previous sale of Pribilof Islands white-fox skins was on September 24, 1925, when the average price was $37.14 per skin. Further details are given in the following table:

*Sale of 580 blue and 20 white fox skins at St. Louis, Mo., October 3, 1927*

| Lot No. | Number of skins | Trade classification | Price per skin | Total for lot |
|---|---|---|---|---|
| | | BLUE-FOX SKINS | | |
| 301 | 1 | Extra extra fine, silvery | $136.00 | $136.00 |
| 302 | 1 | Extra extra fine | 120.00 | 120.00 |
| 303 | 1 | do | 92.00 | 92.00 |
| 304 | 5 | Extra fine | 108.00 | 540.00 |
| 305 | 2 | do | 98.00 | 196.00 |
| 306 | 4 | do | 100.00 | 400.00 |
| 307 | 6 | do | 81.00 | 486.00 |
| 308 | 3 | Fine | 80.00 | 240.00 |
| 309 | 4 | Fine silvery | 96.00 | 384.00 |
| 310 | 3 | Fine | 75.00 | 225.00 |
| 311 | 6 | do | 80.00 | 480.00 |
| 312 | 3 | do | 83.00 | 249.00 |
| 313 | 1 | do | 66.00 | 66.00 |
| 314 | 4 | I part II dark | 57.00 | 228.00 |
| 315 | 7 | I dark | 70.00 | 490.00 |
| 316 | 4 | I | 69.00 | 276.00 |
| 317 | 3 | do | 71.00 | 213.00 |
| 318 | 7 | I and II | 65.00 | 455.00 |
| 319 | 2 | III | 11.00 | 22.00 |
| 320 | 2 | Extra extra fine | 100.00 | 200.00 |
| 321 | 5 | Fine | 82.00 | 410.00 |
| 322 | 9 | Fine dark | 80.00 | 720.00 |
| 323 | 7 | I dark | 69.00 | 483.00 |
| 324 | 10 | I rusty | 48.00 | 480.00 |
| 325 | 8 | I blue | 59.00 | 472.00 |
| 326 | 9 | I silvery | 65.00 | 585.00 |
| 327 | 12 | II dark | 46.00 | 552.00 |
| 328 | 8 | II silvery | 56.00 | 448.00 |
| 329 | 14 | II pale | 40.00 | 560.00 |
| 330 | 10 | III and IV | 9.00 | 90.00 |
| 331 | 2 | Extra extra fine | 120.00 | 240.00 |
| 332 | 5 | Extra fine | 100.00 | 500.00 |
| 333 | 7 | Fine dark | 80.00 | 560.00 |
| 334 | 8 | I dark | 71.00 | 568.00 |
| 335 | 6 | I silvery | 72.00 | 432.00 |
| 336 | 10 | I blue | 51.00 | 510.00 |
| 337 | 7 | I and II silvery | 57.00 | 399.00 |
| 338 | 10 | II dark | 43.00 | 430.00 |
| 339 | 10 | do | 42.00 | 420.00 |
| 340 | 14 | Extra large blue | 48.00 | 672.00 |
| 341 | 7 | II pale rusty | 37.00 | 259.00 |
| 342 | 12 | III and IV | 5.50 | 66.00 |

*Sale of 580 blue and 20 white fox skins at St. Louis, Mo., October 3, 1927*—Con.

| Lot No. | Number of skins | Trade classification | Price per skin | Total for lot |
|---|---|---|---|---|
| | | BLUE-FOX SKINS—continued | | |
| 343 | 2 | Extra extra fine | $105.00 | $210.00 |
| 344 | 4 | Extra fine | 96.00 | 384.00 |
| 345 | 7 | Fine dark | 89.00 | 623.00 |
| 346 | 9 | I dark | 71.00 | 639.00 |
| 347 | 8 | I silvery | 83.00 | 664.00 |
| 348 | 10 | I blue | 59.00 | 590.00 |
| 349 | 4 | do | 66.00 | 264.00 |
| 350 | 7 | I pale | 52.00 | 364.00 |
| 351 | 8 | II dark | 43.00 | 344.00 |
| 352 | 10 | II blue | 49.00 | 490.00 |
| 353 | 9 | II part I | 46.00 | 414.00 |
| 354 | 16 | II low part II | 30.00 | 480.00 |
| 355 | 2 | Extra extra fine | 115.00 | 230.00 |
| 356 | 2 | Extra fine | 104.00 | 208.00 |
| 357 | 7 | Fine | 74.00 | 518.00 |
| 358 | 10 | I dark | 62.00 | 620.00 |
| 359 | 11 | do | 61.00 | 671.00 |
| 360 | 10 | I blue | 60.00 | 600.00 |
| 361 | 10 | I | 53.00 | 530.00 |
| 362 | 3 | I silvery | 67.00 | 201.00 |
| 363 | 5 | II silvery | 54.00 | 270.00 |
| 364 | 16 | II blue | 45.00 | 720.00 |
| 365 | 14 | II low | 25.00 | 350.00 |
| 366 | 14 | do | 30.00 | 420.00 |
| 367 | 2 | Extra extra fine | 108.00 | 216.00 |
| 368 | 4 | Extra fine | 105.00 | 420.00 |
| 369 | 6 | I dark | 78.00 | 468.00 |
| 370 | 10 | do | 66.00 | 660.00 |
| 371 | 8 | I | 67.00 | 536.00 |
| 372 | 10 | I blue | 67.00 | 670.00 |
| 373 | 11 | I silvery | 66.00 | 726.00 |
| 374 | 8 | Rusty | 37.00 | 296.00 |
| 375 | 4 | II part I silvery | 60.00 | 240.00 |
| 376 | 6 | II dark | 39.00 | 234.00 |
| 377 | 14 | II blue | 37.00 | 518.00 |
| 378 | 14 | II low | 24.00 | 336.00 |
| 379 | 12 | do | 25.00 | 300.00 |
| 380 | 14 | do | 25.00 | 350.00 |
| | 580 | | | 32,128.00 |
| | | WHITE-FOX SKINS | | |
| 390 | 8 | I and II | 54.00 | 432.00 |
| 391 | 11 | do | 43.50 | 478.50 |
| 392 | 1 | Skin | 38.00 | 38.00 |
| | 20 | | | 948.50 |
| | 600 | | | 33,076.50 |

## SALE OF SEA-OTTER SKINS

Two sea-otter skins, which had been unlawfully taken in the vicinity of Sanak Island, Alaska, were sold at public auction on October 3, 1927, for $92.

## FUR-SEAL PATROL

### UNITED STATES COAST GUARD

A patrol of the North Pacific Ocean, including Bering Sea, was maintained by the United States Coast Guard during the spring migration of the Pribilof Islands fur-seal herd and while the animals were in the waters about those islands. The cutters *Algonquin, Haida, Snohomish, Unalga,* and *Northland* were engaged in this work. The *Algonquin* and *Haida* patrolled the waters along the Alaskan

Peninsula, the Aleutian Islands, and in Bering Sea. The *Snohomish* was employed from the southern boundary of Washington to Dixon Entrance, southeastern Alaska; the *Unalga* from Dixon Entrance to Unalaska and about the Aleutian Islands and in Bering Sea. The *Northland*, which replaced the *Bear*, patrolled waters frequented by the fur seals while on its trip to the Arctic Ocean. The patrol extended as far as Attu Island, the westernmost island of the Aleutian Chain, and was continued as long as the circumstances required.

### BUREAU OF FISHERIES

The bureau's patrol vessel *Brant* was detailed to guarding fur seals in the vicinity of Sitka and was employed on this work from the middle of April to the end of May.

### SEALING PRIVILEGES ACCORDED ABORIGINES

The North Pacific Sealing Convention of July 7,1911, permits Indians and other aborigines dwelling on the coasts of the waters designated by the convention to take fur-seal skins under certain specified conditions. There have been authenticated by the Government 825 fur-seal skins taken in 1927 by Indians in the waters off the coasts of Washington and southeast Alaska. The details are as follows:

*Washington.*—The take along the coast of Washington consisted of 282 skins, of which 95 were from male seals, 178 from females, and 9 from unborn pups. These skins were authenticated by Dr. Carl B. Boyd, superintendent of the Neah Bay Indian Agency, Neah Bay, Wash., who has done this work for the bureau for several years.

*Alaska.*—Five hundred and forty-three skins were taken in the vicinity of Sitka, Alaska, of which 336 were from male seals, 158 from females, and 49 from unborn pups.

One thousand four hundred and seventy-six fur-seal skins were taken by natives from the waters off the coast of British Columbia in 1927.

### JAPANESE SEALSKINS DELIVERED TO THE UNITED STATES

The North Pacific Sealing Convention of July 7, 1911, provides that 10 per cent of the sealskins taken by the Japanese Government within the areas defined by the convention shall be turned over to the United States Government, unless the number of seals frequenting the Japanese islands falls below 6,500, enumerated by official count.

In May there was delivered at St. Louis, Mo., the United States Government's share of fur-seal skins, consisting of 132, taken by the Japanese Government in 1926. They were sold at public auction on October 3, 1927. One hundred and twenty three were sold dressed, dyed, and machined; the other nine raw salted. Details of the sale are given on page 159.

The United States Government's share of fur-seal skins taken by the Japanese Government in 1927 was 161 skins. They were received at St. Louis on March 28, 1928.

## COMPUTATION OF FUR SEALS, PRIBILOF ISLANDS, 1927

By Edward C. Johnston

The computation of the number of animals in the various classes in the fur-seal herd was based on a count of the harem and idle bulls present at approximately the height of the breeding season, a count of the pups on one rookery, and data available from the work of previous years.

The count of the harem and idle bulls was made at about the same time as in previous years. During the week following July 16, annually, there are found the greatest number of bulls holding harems, and it is during this period that they are enumerated. On St. Paul Island, Lagoon, Tolstoi, Zapadni, Little Zapadni, Zapadni Reef, Kitovi, and Lukanin rookeries were counted on July 16; Gorbatch, Ardiguen, and Reef rookeries on July 17; and Polovina, Polovina Cliffs, Little Polovina, Morjovi, and Vostochni rookeries on July 18.

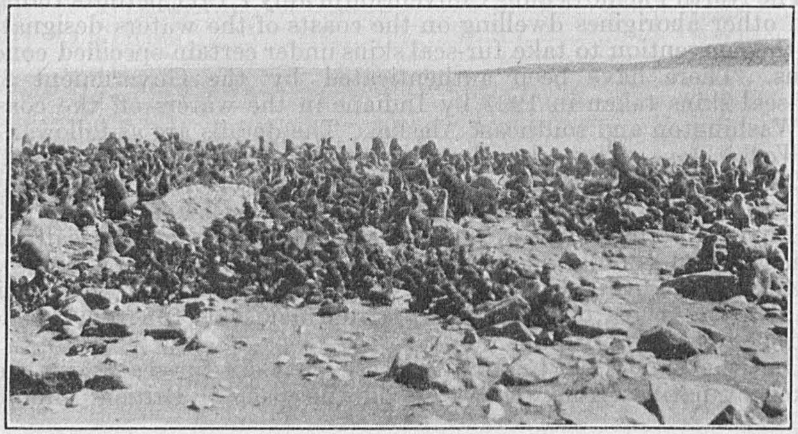

Fig. 17.—Group of fur seals, Pribilof Islands, Alaska

On St. George Island, East Reef, and East Cliffs rookeries were counted on July 20; North and Staraya Artil rookeries on July 21; and South and Zapadni rookeries on July 22. Sivutch rookery, which is situated on a small islet off St. Paul Island, could not be counted at the proper time on account of inclement weather.

### BULLS

The idle-bull class showed a satisfactory gain in numbers in 1927. The proportion of idle bulls to harem bulls should be between 20 and 25 per cent. The virgin cows do not come ashore until near the end of the breeding season or at about the time the regular harem bulls are ready to withdraw from the harems for their much-needed rest. As the harem bulls leave the harems the idle bulls move in. There are normally about one-fifth as many virgin cows as there are adults. Consequently, there should be one-fifth as many idle bulls as harem bulls, and if it is considered that the period during which the virgin cows come ashore is shorter than the breeding period of the mature cows it is probable that the proportion should be a little more than one to five.

*Number of harem and idle bulls, approximate ratio of idle bulls to harem bulls, and average harem, 1927*

| Rookery | Date | Harem bulls | Idle bulls | Total | Approximate ratio of idle bulls to harem bulls | Average harem |
|---|---|---|---|---|---|---|
| St. Paul Island: | | | | | | |
| Kitovi | July 16 | 232 | 48 | 280 | 1:5 | 37.58 |
| Lukanin | do | 89 | 10 | 99 | 1:9 | 47.37 |
| Gorbatch | July 17 | 328 | 94 | 422 | 1:3 | 67.50 |
| Ardiguen | do | 41 | 6 | 47 | 1:7 | 51.07 |
| Reef | do | 712 | 156 | 868 | 1:5 | 62.46 |
| Sivutch | | 319 | 60 | 379 | 1:5 | 42.66 |
| Lagoon | July 16 | 1 | 0 | 1 | | 40.00 |
| Tolstoi | do | 391 | 75 | 466 | 1:5 | 66.95 |
| Zapadni | do | 338 | 89 | 427 | 1:4 | 74.43 |
| Little Zapadni | do | 204 | 43 | 247 | 1:5 | 62.86 |
| Zapadni Reef | do | 18 | 6 | 24 | 1:3 | 24.72 |
| Polovina | July 18 | 180 | 42 | 222 | 1:4 | 50.23 |
| Polovina Cliffs | do | 129 | 20 | 149 | 1:6 | 38.37 |
| Little Polovina | do | 48 | 7 | 55 | 1:7 | 37.56 |
| Morjovi | do | 95 | 27 | 122 | 1:4 | 34.12 |
| Vostochni | do | 791 | 163 | 954 | 1:5 | 45.61 |
| Total | | 3,916 | 846 | 4,762 | 1:5 | 54.90 |
| St. George Island: | | | | | | |
| North | July 21 | 290 | 54 | 344 | 1:5 | 60.50 |
| Staraya Artil | do | 156 | 24 | 180 | 1:7 | 84.74 |
| Zapadni | July 22 | 57 | 14 | 71 | 1:4 | 32.74 |
| South | do | 19 | 6 | 25 | 1:3 | 23.00 |
| East Reef | July 20 | 57 | 8 | 65 | 1:7 | 70.54 |
| East Cliffs | do | 148 | 20 | 168 | 1:7 | 77.55 |
| Total | | 727 | 126 | 853 | 1:6 | 66.80 |
| Total (both islands) | | 4,643 | 972 | 5,615 | 1:5 | 56.77 |

In 1926 there were 3,478 harem bulls on St. Paul Island, and in 1927, 3,916, an increase of 438. On St. George Island there were, in 1926, 556 harem bulls, and in 1927, 727, an increase of 171. On both islands the increase was 609. The number of idle bulls increased on St. Paul Island 478; on St. George, 71; an increase for the whole herd of 549 or 130 per cent.

The approximate ratio of idle to harem bulls in 1926 on St. Paul Island was 1 to 9, on St. George Island 1 to 10, and for the whole herd 1 to 10. In 1927, on St. Paul Island, the ratio was approximately 1 to 5, St. George Island 1 to 6, and for the whole herd 1 to 5.

During the counting of the bulls 6 dead were noted.

## AVERAGE HAREM

Although the average harem decreased for each island, there were seven rookeries on St. Paul Island (Lukanin, Ardiguen, Lagoon, Tolstoi, Zapadni, Zapadni Reef, and Little Polovina) that showed an increase. On North rookery, St. George Island, the average harem dropped from 85.05 to 60.50, a decrease of 24.55.

*Computation of breeding cows, based on annual increase of 8 per cent, and of average harems, in 1927*

| Rookery | Breeding cows | | Harem bulls, 1927 | Average harem | | |
|---|---|---|---|---|---|---|
| | 1926 | 1927 | | 1927 | 1926 | Increase (+) or decrease (−) in 1927 from 1926 |
| St. Paul Island: | | | | | | |
| Kitovi | 8,073 | 8,719 | 232 | 37.58 | 38.08 | −.50 |
| Lukanin | 3,904 | 4,216 | 89 | 47.37 | 41.53 | +5.84 |
| Gorbatch | 20,499 | 22,139 | 328 | 67.50 | 74.27 | −6.77 |
| Ardiguen | 1,939 | 2,094 | 41 | 51.07 | 51.03 | +.04 |
| Reef | 41,176 | 44,470 | 712 | 62.46 | 68.06 | −5.60 |
| Sivutch | 12,599 | 13,607 | 319 | 42.66 | 45.16 | −2.50 |
| Lagoon | [1] 109 | [1] 40 | 1 | 40.00 | 36.33 | +3.67 |
| Tolstoi | 24,240 | 26,179 | 391 | 66.95 | 64.47 | +2.48 |
| Zapadni | 23,294 | 25,158 | 338 | 74.43 | 72.34 | +2.09 |
| Little Zapadni | 11,874 | 12,824 | 204 | 62.86 | 64.18 | −1.32 |
| Zapadni Reef | 412 | 445 | 18 | 24.72 | 22.89 | +1.83 |
| Polovina | 8,371 | 9,041 | 180 | 50.23 | 50.43 | −.20 |
| Polovina Cliffs | 4,583 | 4,950 | 129 | 38.37 | 38.84 | −.47 |
| Little Polovina | 1,669 | 1,803 | 48 | 37.56 | 37.09 | +.47 |
| Morjovi | 3,001 | 3,241 | 95 | 34.12 | 34.49 | −.37 |
| Vostochni | 33,403 | 36,075 | 791 | 45.61 | 51.07 | −5.46 |
| Total | 199,146 | 215,001 | 3,916 | 54.90 | 57.26 | −2.36 |
| St. George Island: | | | | | | |
| North | 16,244 | 17,544 | 290 | 60.50 | 85.05 | −24.55 |
| Staraya Artil | 12,240 | 13,219 | 156 | 84.74 | 90.00 | −5.26 |
| Zapadni | 1,728 | 1,866 | 57 | 32.74 | 41.14 | −8.40 |
| South | 405 | 437 | 19 | 23.00 | 27.00 | −4.00 |
| East Reef | 3,723 | 4,021 | 57 | 70.54 | 79.21 | −8.67 |
| East Cliffs | 10,628 | 11,478 | 148 | 77.55 | 85.02 | −7.47 |
| Total | 44,968 | 48,565 | 727 | 66.80 | 80.88 | −14.08 |
| Total (both islands) | 244,114 | 263,566 | 4,643 | 56.77 | 60.51 | −3.74 |

[1] Pups counted in 1926 and 1927.

The average harem for St. Paul Island in 1927 was 54.90, for St. George Island 66.80, and for the whole herd 56.77. The greatest decrease on St Paul Island was 6.77 on Gorbatch rookery and the greatest increase was 5.84 on Lukanin rookery. On St. George Island the average harem on each rookery decreased. The decrease for the whole herd was 3.74.

## PUPS AND COWS

In 1917 a complete pup count was made, and again in 1922. During this period there was no indication that the seal herd did not make a normal growth. The pups and cows increased annually at the rate of approximately 8 per cent. Since 1922, with no abnormal conditions, it has been assumed that the annual increase was 8 per cent. In 1927 pups were counted upon Lagoon rookery only. There was only 1 harem with 40 cows.

The number of dead pups observed during the harem-bull count appeared to be about the same as normally appear each year. Consequently the same percentage of dead animals has been applied to each rookery.

*Distribution of pups on the Pribilof Islands, August 10, 1927, and comparison with distribution in 1926*

| Rookery | 1927 | | | | 1926 | 1927 |
|---|---|---|---|---|---|---|
| | Living pups | Dead pups | Total pups | Per cent dead pups | Total pups | Increase |
| St. Paul Island: | | | | | | |
| Kitovi | 8,591 | 128 | 8,719 | 1.47 | 8,073 | 646 |
| Lukanin | 4,125 | 91 | 4,216 | 2.17 | 3,904 | 312 |
| Gorbatch | 21,949 | 190 | 22,139 | .86 | 20,499 | 1,640 |
| Ardiguen | 2,044 | 50 | 2,094 | 2.39 | 1,939 | 155 |
| Reef | 43,821 | 649 | 44,470 | 1.46 | 41,176 | 3,294 |
| Sivutch | 13,275 | 332 | 13,607 | 2.44 | 12,599 | 1,008 |
| Lagoon | 40 | | 40 | | 109 | −69 |
| Tolstoi | 25,815 | 364 | 26,179 | 1.39 | 24,240 | 1,939 |
| Zapadni | 24,725 | 433 | 25,158 | 1.72 | 23,294 | 1,864 |
| Little Zapadni | 12,503 | 321 | 12,824 | 2.50 | 11,874 | 950 |
| Zapadni Reef | 441 | 4 | 445 | .80 | 412 | 33 |
| Polovina | 8,903 | 138 | 9,041 | 1.53 | 8,371 | 670 |
| Polovina Cliffs | 4,858 | 92 | 4,950 | 1.85 | 4,583 | 367 |
| Little Polovina | 1,758 | 45 | 1,803 | 2.51 | 1,669 | 134 |
| Morjovi | 3,176 | 65 | 3,241 | 2.02 | 3,001 | 240 |
| Vostochni | 35,325 | 750 | 36,075 | 2.08 | 33,403 | 2,672 |
| Total | 211,349 | 3,652 | 215,001 | 1.70 | 199,146 | 15,855 |
| St. George Island: | | | | | | |
| North | 17,298 | 246 | 17,544 | 1.40 | 16,244 | 1,300 |
| Staraya Artil | 12,878 | 341 | 13,219 | 2.58 | 12,240 | 979 |
| Zapadni | 1,845 | 21 | 1,866 | 1.12 | 1,728 | 138 |
| South | 429 | 8 | 437 | 1.72 | 405 | 32 |
| East Reef | 3,960 | 61 | 4,021 | 1.51 | 3,723 | 298 |
| East Cliffs | 11,307 | 171 | 11,478 | 1.49 | 10,628 | 850 |
| Total | 47,717 | 848 | 48,565 | 1.75 | 44,968 | 3,597 |
| Total (both islands) | 259,066 | 4,500 | 263,566 | 1.71 | 244,114 | 19,452 |

There was an increase in total pups on St. Paul Island of 15,855, on St. George Island, 3,597—a total increase of 19,452. Dead pups computed for St. Paul Island numbered 3,652, for St. George Island, 848—a total of 4,500. The per cent dead was approximately 1.71.

## COMPLETE COMPUTATION

Following is a summary of the method used for computing the number of animals in the Pribilof Islands fur-seal herd in 1927, together with a recapitulation of the herd by classes. It will be noted that the increase in the total number of seals over 1926 was 47,589, or 6.25 per cent. The increase in 1926 over 1925 was 38,231, or 5.29 per cent.

*Complete computation of fur seals, Pribilof Islands, as of August 10, 1927*

| Class | St. Paul Island | St. George Island | Total |
|---|---|---|---|
| Pups, estimated | 215,001 | 48,565 | 263,566 |
| Breeding cows, 3 years old and over, by inference | 215,001 | 48,565 | 263,566 |
| Harem bulls, counted | 3,916 | 727 | 4,643 |
| Idle bulls, counted | 846 | 126 | 972 |
| Yearlings, male and female, estimated: | | | |
| Females born in 1926 | 99,573 | 22,484 | 122,057 |
| Natural mortality, 45 per cent | 44,808 | 10,118 | 54,926 |
| Yearling females, August 10, 1927 | 54,765 | 12,366 | 67,131 |

*Complete computation of fur seals, Pribilof Islands, as of August 10, 1927*—Continued

| Class | St. Paul Island | St. George Island | Total |
|---|---|---|---|
| Yearlings, male and female, estimated—Continued. | | | |
| Males born in 1926 | 99, 573 | 22, 484 | 122, 057 |
| Natural mortality, 50 per cent | 49, 786 | 11, 242 | 61, 028 |
| Yearling males beginning 1927 | 49, 787 | 11, 242 | 61, 029 |
| Yearling males killed 1927 | 3 | | 3 |
| Yearling males, August 10, 1927 | 49, 784 | 11, 242 | 61, 026 |
| 2-year-olds, male and female, estimated: | | | |
| Yearling females, August 10, 1926 | 50, 724 | 11, 451 | 62, 175 |
| Natural mortality, 22.5 per cent | 11, 413 | 2, 576 | 13, 989 |
| 2-year-old females, August 10, 1927 | 39, 311 | 8, 875 | 48, 186 |
| Yearling males, August 10, 1926 | 46, 104 | 10, 410 | 56, 514 |
| Yearling males killed fall 1926 | 2 | | 2 |
| Yearling males end of 1926 | 46, 102 | 10, 410 | 56, 512 |
| Natural mortality, 25 per cent | 11, 526 | 2, 602 | 14, 128 |
| 2-year-old males beginning 1927 | 34, 576 | 7, 808 | 42, 384 |
| 2-year-old males killed 1927 | 1, 069 | 63 | 1, 132 |
| 2-year-old males, August 10, 1927 | 33, 507 | 7, 745 | 41, 252 |
| 3-year-old males, estimated: | | | |
| 2-year-old males, August 10, 1926 | 31, 490 | 6, 693 | 38, 183 |
| 2-year-old males killed fall 1926 | 31 | | 31 |
| 2-year-old males end 1926 | 31, 459 | 6, 693 | 38, 152 |
| Natural mortality, 15 per cent | 4, 719 | 1, 004 | 5, 723 |
| 3-year-old males beginning 1927 | 26, 740 | 5, 689 | 32, 429 |
| 3-year-old males killed 1927 | 17, 265 | 5, 434 | 22, 699 |
| 3-year-old males, August 10, 1927 | 9, 475 | 255 | 9, 730 |
| 4-year-old males, estimated: | | | |
| 3-year-old males, August 10, 1926 | (1) | (1) | 17, 189 |
| 3-year-old males killed fall 1926 | | | 780 |
| 3-year-old males end of 1926 | | | 16, 409 |
| Natural mortality, 10 per cent | | | 1, 641 |
| 4-year-old males beginning 1927 | | | 14, 768 |
| 4-year-old males killed 1927 | | | 320 |
| 4-year-old males, August 10, 1927 | | | 14, 448 |
| 5-year-old males, estimated: | | | |
| 4-year-old males, August 10, 1926 | 17, 068 | 804 | 17, 872 |
| 4-year-old males killed fall 1926 | 11 | | 11 |
| 4-year-old males end of 1926 | 17, 057 | 804 | 17, 861 |
| Natural mortality, 10 per cent | 1, 706 | 80 | 1, 786 |
| 5-year-old males beginning 1927 | 15, 351 | 724 | 16, 075 |
| 5-year-old males killed 1927 | 2 | | 2 |
| 5-year-old males, August 10, 1927 | 15, 349 | 724 | 16, 073 |
| 6-year-old males, estimated: | | | |
| 5-year-old males, August 10, 1926 | 15, 124 | 1, 688 | 16, 812 |
| 5-year-old males killed fall 1926 | | | |
| 5-year-old males end of 1926 | 15, 124 | 1, 688 | 16, 812 |
| Natural mortality, 20 per cent | 3, 025 | 337 | 3, 362 |
| 6-year-old males beginning 1927 | 12, 099 | 1, 351 | 13, 450 |
| 6-year-old males killed 1927 | | | |
| 6-year-old males, August 10, 1927 | 12, 099 | 1, 351 | 13, 450 |

[1] Owing to the apparent irregular hauling of 3-year-old males on St. Paul and St. George Islands, these seals were not distributed between these islands in 1926, and as a result the 4-year-old males can not be distributed in 1927.

*Complete computation of fur seals, Pribilof Islands, as of August 10, 1927*—Continued

| Class | St. Paul Island | St. George Island | Total |
|---|---|---|---|
| Surplus bulls, 7 years and over, estimated: | | | |
| 6-year-old males, August 10, 1926 | 12,037 | 1,397 | 13,434 |
| 6-year-old males killed fall 1926 | | | |
| 6-year-old males end 1926 | 12,037 | 1,397 | 13,434 |
| Natural mortality, 20 per cent | 2,408 | 279 | 2,687 |
| 7-year-old males beginning 1927 | 9,629 | 1,118 | 10,747 |
| 7-year-old males killed 1927 | | | |
| 7-year-old males, August 10, 1927 | 9,629 | 1,118 | 10,747 |
| Surplus bulls, August 10, 1926 | 1,972 | 30 | 2,002 |
| Natural mortality, 30 per cent | 592 | 9 | 601 |
| Remaining surplus for 1927 | 1,380 | 21 | 1,401 |
| Breeding bulls of 1926 | 3,846 | 611 | 4,457 |
| Natural mortality, 30 per cent | 1,154 | 183 | 1,337 |
| 1926 bulls remaining, 1927 | 2,692 | 428 | 3,120 |
| Breeding bulls, 1927 | 4,762 | 853 | 5,615 |
| 1926 bulls remaining, deducted | 2,692 | 428 | 3,120 |
| Increment of new bulls in 1927 | 2,070 | 425 | 2,495 |
| 7-year-old males computed for 1927 | 9,629 | 1,118 | 10,747 |
| Surplus bulls computed for 1927 | 1,380 | 21 | 1,401 |
| Total theoretical surplus bull stock, 1927 | 11,009 | 1,139 | 12,148 |
| New increment of breeding bulls deducted | 2,070 | 425 | 2,495 |
| Surplus bulls in 1927 | 8,939 | 714 | 9,653 |
| 50 per cent deducted for losses due to fighting, natural causes, and errors in loss percentage in previous years | 4,469 | 357 | 4,826 |
| Surplus bulls, August 10, 1927 | 4,470 | 357 | 4,827 |

RECAPITULATION

| | |
|---|---|
| Pups | 263,566 |
| Cows | 263,566 |
| Harem bulls | 4,643 |
| Idle bulls | 972 |
| Yearling females | 67,131 |
| Yearling males | 61,026 |
| 2-year-old females | 48,186 |
| 2-year-old males | 41,252 |
| 3-year-old males | 9,730 |
| 4-year-old males | 14,448 |
| 5-year-old males | 16,073 |
| 6-year-old males | 13,450 |
| Surplus bulls | 4,827 |
| Total, 1927 | 808,870 |
| Total, 1926 | 761,281 |
| Numerical increase, 1927 | 47,589 |
| Per cent increase, 1927 | 6.25 |

# SCALLOP INDUSTRY OF NORTH CAROLINA[1]

By James S. Gutsell
*Associate Aquatic Biologist, U. S. Bureau of Fisheries*

CONTENTS



## IMPORTANCE OF THE SCALLOP FISHERY

The scallop fishery holds a very important place among the mollusk fisheries of North Carolina, for three reasons: (1) The scallop commands a relatively high price and so gives a high return per unit of quantity. (2) Scallop fishing is active when other fisheries in the immediate neighborhood are slack. (3) The fishery generally is confined to one county (Carteret), so that fluctuations are felt keenly by a large portion of the population.

## HISTORICAL ACCOUNT[2]

The scallop is one of the most famous of edible bivalve mollusks, a true rival of the oyster in historical interest. In medieval times it became a symbol of holy pilgrimage, was much used in coats of arms, and was even called "pilgrim shell." "The scallop shell his cap did deck," wrote Sir Walter Scott. Another famous Sir Walter—Raleigh—first to attempt to establish settlements in North Carolina, referred to the scallop thus: "Give me my scallop shell of quiet, my staff of faith to walk upon." To this day the scallop is known in Germany as "Pilgermuschel," or "pilgrim mussel." Other names of other lands are escallope (French); mantel

[1] Appendix V to the Report of the U. S. Commissioner of Fisheries for 1928. B. F. Doc. No. 1043.
[2] For this section the writer is particularly indebted to J. H. Potter and G. L. Arthur, pioneer dealers of Beaufort and Morehead City, and to The Oyster, Scallop, Clam, Mussel, and Abalone Industries, by Ernest Ingersoll, Pt. XX, Sec. V, vol. 2, of The Fishery Industries of the United States; 1887.

(Dutch); fan shell, squinn, scallop, and escallop (English); and clam (Scotch). Scallop and escallop seem to be the only names commonly used in this country. Besides furnishing a highly prized article of food, the scallop has provided drinking cups, cooking dishes, lamps, and ornaments.

In America the scallop was eaten by man long before the arrival of Europeans, as evidenced by great numbers of scallop shells in kitchen middens, or heaps of shells and other nonperishable kitchen refuse. The Indians not only appreciated the scallop as an article of food but also chose the shell for use in various ceremonies.

It is to be supposed that local consumption by white people in North Carolina began with the settling of the region in which scallops are found. Later, as the State grew and prospered, Beaufort, in the heart of the scallop country, became a favored summer resort for the people of the State. Not the least of the charms for inland folk was the sea food, among which the scallop (doubtless owing partly to the dread of summer oysters) was prominent. Thus, a considerable local summer trade, probably at its height about 1860, was developed. Although this was changed greatly by the war, scallop fishing at Beaufort and Morehead City was for many years decidedly a local summer industry. Scallops were raked on near-by flats and peddled about town. Until recent times the standard price was 10 cents per quart.

Shipment of scallops seems to have begun in the seventies from Morehead City, then at railhead. George N. Ives, from the region in Connecticut in which a substantial scallop industry first developed, is credited by G. J. Arthur not only with bringing to North Carolina the first of the type of boat famous as the New Haven or Connecticut "sharpie," but also with starting the North Carolina scallop-shipping industry. He is said to have bought them by the bushel and paid for the opening, instead of buying the scallop meats by the gallon, a custom generally established by 1897. Shipments were made to New York and possibly to Philadelphia and other northern points. Then, as now, shipment within the State was negligible. Ingersoll states that shipment reached its height in 1876–77, when several thousand gallons were sent to northern markets, and then nearly stopped. This about coincides with the occurrence of the "August storm" of 1879, described as a southeastern gale of a violence not known before or since in the region. It is supposed to have destroyed scallops and scallop grounds so that recovery was a matter of years.

At some time in the eighties J. H. Potter, of Beaufort, began sending scallop meats by the barrel, iced, to New York. Thereafter there were periods of activity, but apparently the business was not sufficiently well organized to be well maintained. If a shipment brought a sufficient price, it would be repeated, perhaps on a larger scale; if a poor price, no further shipments were made for a time. A similar state of affairs seems to have continued till about 1912 or 1913, when the modern industry began to develop and to spread to include all scallop-producing areas.

In the first report (biennial) of the North Carolina State Fisheries Commission Board, published in 1916, it is stated that large quantities of scallops were taken from Bogue Sound, the vicinity of Harkers Island, the mouth of Newport River, and other sections, and were shipped daily from Beaufort and Morehead City in the winter months at good prices. In the second report (1918), after data from tax returns had become available, the scallop industry is described as one of the leading shellfish industries. In the single season of 1917–18 more than 54,000 gallons of scallop meats were shipped in spite of the dearth of scallops from the neighborhood of Harkers Island, long an important source of supply. Bogue Sound is stated to be the principal source and to have suffered comparatively little diminution from the long, hard freeze of the winter of 1917–18, which was highly destructive in the Harkers Island section. The price one shipper received (1917–18) varied from $2.25 to $4.82 per gallon. There were 612 licensed scallop fishermen. The modern industry evidently was well under way.

## EXTENT AND VALUE OF THE PRESENT-DAY FISHERY

State fishery statistics are reported biennially. Figures for quantity of scallops are not estimates, but are calculated from the tax paid per gallon. Naturally they are not greater than they should be. Scallops used locally, for which no tax is paid, are not included. Data given, unless otherwise stated, are for a 2-year period. From December, 1917, to May, 1928, the quantity varied from 38,607 to 165,338 gallons, and the value, according to State estimates, from $115,821 to $496,014.

In the State report for 1922–1924 it is estimated that 2,000 men and women found employment in the scallop industry. This probably is a conservative estimate. The average number of scallop fishermen employed during this 2-year period, as shown by paid license fees, was 707 per year. The estimated dollar value of boats and apparatus actually in use in the scallop fishery, as shown by the third, fourth, fifth, and sixth reports, was as follows. A lower estimate does not mean a smaller investment, but simply fewer boats used in the fishery during the period. It is also to be noted that the boats used in the scallop fishery are used for crabbing and fishing also.

*Estimated value of boats and apparatus used in scallop fishery (from State reports)*

| County | 1918–1920 | | 1920–1922 | | 1922–1924 | | 1924–1926 | |
|---|---|---|---|---|---|---|---|---|
| | Boats | Apparatus | Boats | Apparatus | Boats | Apparatus | Boats | Apparatus |
| Carteret | 3,725 | 4,151 | 108,243 | 7,847 | 76,559 | 5,112 | 18,429 | 3,856 |
| Hyde | | | 1,750 | 68 | | | | |
| Onslow | | | 190 | 21 | | | | |

## NATURAL HISTORY OF THE SCALLOP[3]

### SHELL

The peculiar shell outline, nearly circular except for the built-out or "eared" hinge section (see photographs of scallop shell, figs. 1 and 2), generally is sufficient to characterize a bivalve as a scallop. The ribs or rays, spreading fanlike from the umbos, or beaks, and not so much thickenings as corrugations, help to give strength with lightness to the thin but hard shell. The upper or left valve or half shell is cupped less deeply and is much darker than the lower or right valve, sometimes termed the "breast" by scallop fishermen. The valves are secured, one to the other, at the long, straight hinge

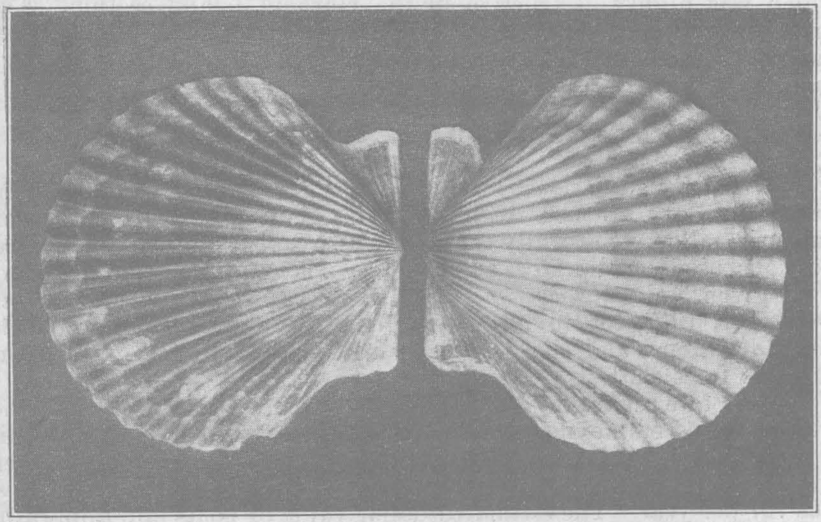

FIG. 1.—Exterior view of left and right valves of a scallop shell. The lower or right valve, shown at the right, contains the byssal notch

by a flexible strip, the ligament, and, in part, by the thick, pyramidal cartilage, the principal function of which is, springlike, to open the shell when it is not held closed by the adductor muscle.

### SOFT PARTS

The general shape and arrangement of a number of the soft parts are shown in the accompanying photograph. (Fig. 3.) In general, it may be noted that the spread-out arrangement, the lack of fusion into a relatively homogeneous mass, is unusual in food mollusks. The mantle, one lobe of which lines each valve, is notable for its muscular border with numerous tentacles and eyes.

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[3] For more detailed accounts the reader is referred to A Report upon the Scallop Fishery of Massachusetts, by D. L. Belding, Boston, 1910; Shellfish Industries, by J. L. Kellogg, Henry Holt & Co., New York, 1910; and A Contribution to Our Knowledge of the Morphology of Lamellibranch Mollusks, by J. L. Kellogg, Bull., U. S. Fish Commission, vol. 10, 1892. The Habits, Anatomy, and Embryology of the Giant Sea Scallop (*Pecten tenuicostatus* Mighels), by G. A. Drew (University of Maine Studies No. 6, 1906), is excellent for this allied form.

HABITAT

The bay scallop in North Carolina frequents chiefly grassy flats and shallow sloughs in sounds, harbors, and estuaries where the water is relatively salt. Occasionally it is found in open, muddy places, and even in the ocean. It grows faster and to a larger size near the outlets and other places where there is a good flow of water. The consistent variation in size for near-by areas affords evidence that, after an early stage of growth, extensive shifting of scallops, if it occurs at all, is unusual. Even large scallops swim, but only for short distances.

SWIMMING

The ability of the scallop to swim is one of its most interesting characteristics and probably is responsible for its economic impor-

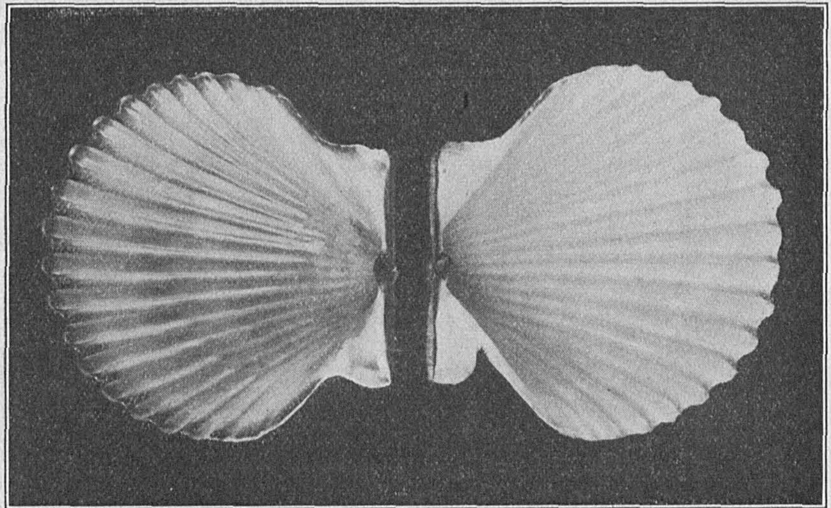

FIG. 2.—Scallop shell. Interior view of left and right valves

tance. Observation reveals the fact that in swimming a scallop does not move with the hinge foremost, as would be expected from the action of clapping the shell, but with the free or ventral margin forward, as if the animal was biting its way through the water. This method of progression results from the action of the scallop in closing the mantle around most of the free margin of the shell just before it is closed, so that two jets of water are directed hingeward and the animal is forced in the opposite direction. To give these jets sufficient force, the adductor muscle (the "edible" portion of the scallop) has been developed to a great size. Hence, if it were not for its habit of swimming, the scallop doubtless would be used as little for food in this country as are various neglected shellfish.

The habit is to swim to the surface and then along it for a little way. Occasionally a scallop, when disturbed, will close its shell with a snap without first closing the mantle and dart a short distance along the bottom, hinge foremost. This process is not repeated and is not seen often. With this species and in this region swimming would seem to be more a means of protection than of transportation after an early stage of growth. On numerous occasions the writer has failed to secure half-grown scallops because of their habit of swimming seemingly for the purpose of escape.

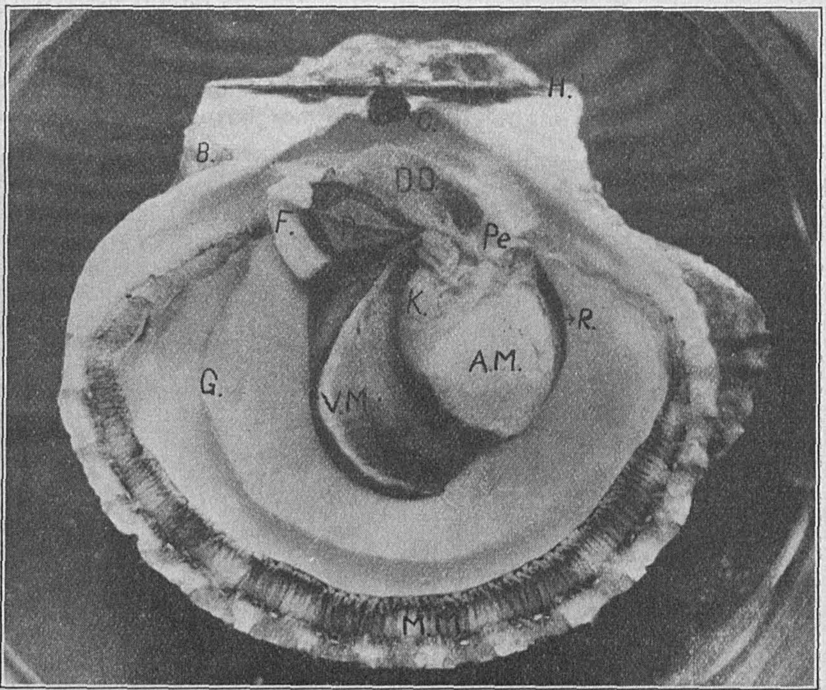


FIG. 3.—A bay scallop lying on its right side, with the left valve, left gill, and most of the left mantle lobe removed. *AM*, adductor muscle; *B*, byssal notch (overgrown by small oyster); *C*, cartilage; *DD*, digestive diverticula overlying stomach; *F*, foot; *G*, gill; *H*, hinge; *K*, excretory organ or kidney; *MM*, mantle margin with eyes and tentacles along outer edge and other tentacles at inner edge; *Pa*, palps; *Pe*, pericardium; *R*, rectum; *VM*, visceral mass, containing male and female genital organs and several folds of the intestine

## VISION

The possession of sight is hardly less interesting than the ability to swim. The functioning of the numerous, beautiful eyes seems to be limited to the perception of movement. It was observed [4] that a sudden increase in illumination (as by flashing a light on a scallop when its shell was open at night) produced no effect, but that if an object was so moved that its shadow fell on the eyes of the scallop, the shell was closed quickly. When a starfish was placed in one glass aquarium and a scallop in another adjacent,[5] the scallop, although its

[4] See Memoir on Pecten, by W. J. Dakin, Appendix, Report for 1908, Lancashire Sea-fisheries Laboratory, Liverpool, 1909.

[5] See Studien Über den Tons. VI. Die Pilgermuschel, by J. von Uexkull, 112. Zeit. Biol., 58.

enemy stood before it, gave no reaction until the starfish moved. The scallop then thrust out its long sensory tentacles to investigate. Experimental study of the vision of scallops is difficult because the animal quickly becomes accustomed to stimuli and fails to respond. It is reasonable to suppose that vision has been developed or improved in connection with the ability to swim, which would render it especially useful for protection.

### FEEDING

Scallops, like oysters, clams, and other bivalve mollusks, feed upon minute organisms obtained from water drawn into the shell. The active beating of the minute, hairlike cilia on the gill filaments produces water currents that, when the shell is open, cause a steady circulation of water into the shell, through the gills, and out of the shell. The gills strain food from the water, pass it to the palps, through which it is drawn, still by ciliary currents, into the mouth, esophagus, and stomach.

### BREATHING

Respiration or aeration of the blood occurs not only in the gills but also in the mantle lobes, which are very thin and well supplied with blood vessels. Both gills and mantle are bathed with the current of water drawn in by the action of gill cilia.

### REPRODUCTION

In the bay scallop both sexes are present in one individual. Eggs and sperms are to be found in the tissue of the visceral mass, but in separate areas. In mass, the sperms are white or cream colored, the eggs pink or even red. To observe the gonads it may be necessary to rub off the epithelium, which often is pigmented so heavily as to obscure the underlying tissue. Although the writer has secured, experimentally, the fertilization of eggs of one individual by sperms of the same individual, it is supposed that self-fertilization occurs seldom. Spawning may be considered to be autumnal, although it begins as early as midsummer and continues as late as January. Both eggs and sperms are cast into the water, in which the eggs drift and the sperms swim actively. When a sperm comes in contact with an egg, fertilization occurs and development begins.

### DEVELOPMENT

After fertilization, the minute egg, about three-thousandths of an inch in diameter (0.08 millimeter), divides and becomes a 2-celled embryo. In a few hours repeated divisions develop a complex mass of cells, the outer of which possess cilia that, by their beating, cause the embryo to swim about. Soon after this a primitive mouth appears at one end and a whiplike appendage at the other. This stage may be attained in less than a day. Development up to this point has been wholly differentiation. No outside nourishment has been secured and no growth made.

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From the swimming embryo an even more actively swimming larva develops, eventually with a somewhat clamlike bivalve shell (the larval or prodissoconch shell) and a highly developed swimming organ, the velum. Although different organs are involved, feeding is essentially like that of adults.

The succeeding stage corresponds to the early "spat" or "set" stage of the oyster. However, the scallop is smaller than the oyster during this period of development and is not permanently attached but able to crawl, swim (in the manner of the adult), and float on the surface film with foot extended. By means of the byssal gland in the foot, it is able to attach itself by threads (the byssus) to eel grass or other objects. It can break and remake the byssus at will. During this period simple gills, a few eyes, and a shell more like that of the adult, with long, straight hinge but without the ribs, are developed. Ribs appear and the adult shell begins to form when the animal is about one twenty-fifth of an inch (1 millimeter) in diameter. Gills become more complex, eyes more numerous. The foot becomes relatively small and insufficient for locomotion but retains the byssal gland and, to a late stage, the ability to secret a byssus.

## GROWTH

Among economic bivalves the scallop is remarkable for its rapid growth. Marketable size is attained in a year or even less. In the more favorable areas a diameter of 3 inches may be attained in a year. Nearly all of the commercial crop consists of scallops from a year to 20 months old.

## LENGTH OF LIFE

The bay scallop is decidedly a short-lived form, but the full, natural length of life in North Carolina is not known definitely. Doctor Belding,[c] working in Massachusetts, found the limit to be 30 months, and that very few live to be 2 years old. Under present conditions few live to be 2 years old in North Carolina. However, that means little, for nearly all are caught by the time they are 18 or 20 months old. A few scallops live to be 2 years or more old. Extreme destruction of adult scallops by scallop fishermen makes it difficult to tell what proportion would survive if spared by man. There is some indication that a considerable proportion would survive to be 2 or nearly 2 years of age.

## ENEMIES AND DESTRUCTIVE AGENCIES

The principal natural enemy of the scallop seems to be the starfish. The scallop falls a comparatively easy prey to this persistent predacean. Protection for the scallop lies in its power of perception and locomotion. The starfish annually destroys large numbers of scallops in North Carolina but is not known to be a menace in any locality.

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[c] A Report upon the Scallop Fishery of Massachusetts, by D. L. Belding. Boston, 1910.

The oyster drill (Urosalpinx) is named by Belding as one of the principal enemies of the scallop. Comparatively little evidence of destruction by this form has been noted in North Carolina. Through a large portion of the scallop-producing areas it is distinctly uncommon. Large gastropods destroy commercial bivalves but are relatively harmless to the scallop because of the latter's quickness and swimming ability.

Ducks and other water birds sometimes are destructive of small scallops. Whether this destruction is ever serious in North Carolina is not known. One bird, the herring gull, destroys many large scallops, which it catches at low tide. The scallop is cracked open by being dropped from a considerable height onto the beach. From fall to spring it is a common sight to see herring gulls in flocks waiting over the scallop beds or busily catching and cracking them when the water over the flats has become sufficiently shallow.

Scallop embryos and larvæ are preyed upon by the usual predatory microscopic forms associated with them and by plankton feeders. Destruction by enemies presumably is much greater in these stages than later, but is unavoidable, unless in artificial culture.

It is probable that some fish are somewhat destructive of small juvenile scallops, but the principal enemy of the bay scallop is man.

Destructive agencies other than enemies are freshets and cold. Heavy freshets may be very destructive. Severe cold weather, especially if accompanied by low ebb tides, sometimes does much damage. Trade wastes or heavy sewage discharges are not yet serious factors in destruction in North Carolina scallop waters.

## FOOD VALUE

Because only the adductor muscle is eaten, the nutritive properties of scallops differ considerably from those of oysters and clams. Protein content is higher—more than twice as high as that of oysters and the highest of any of the food mollusks of real commercial importance in this country. The content of glycogen or "animal starch" generally is good, about equal to that of oysters. Fats, never prominent in bivalves, are very low in analyses of scallops. Many substances present in small amounts in various parts of the body, including vitamins, are lost with the parts discarded.

The accompanying table of analyses by Atwater and Bryant is taken from Marine Products of Commerce (Tressler). The total solids content is thus seen to vary from 17.2 per cent to 22.2 per cent and to average 19.7 per cent, which probably is fairly representative for North Carolina scallops. However, a great decrease in salinity may be accompanied by a decrease in total solids to about 14 per cent. Examination of the table shows that on a dry basis the protein content varies from about 65 per cent to about 90 per cent and averages 75 per cent. This abundance of protein makes the relative glycogen content (excellent on a wet basis and indicative of the food value to the consumer) low. On the assumption that substantially all the carbohydrate content is glycogen it works cut at about 5 to 25 per cent, with an average of 17 per cent.

*Chemical analysis of scallops (Atwater and Bryant)*

| | Water | Protein N×6.25 | Fat | Total carbo-hydrates | Ash | Fuel value per pound |
|---|---|---|---|---|---|---|
| | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Calories* |
| Minimum | 77.8 | 14.5 | | 1.1 | 1.3 | 305 |
| Maximum | 82.8 | 15.1 | 0.3 | 5.6 | 1.5 | 385 |
| Average | 80.3 | 14.8 | .1 | 3.4 | 1.4 | 345 |

Scallops usually are served fried. In North Carolina they also are stewed and creamed and are excellent so, if not made tough by too long cooking. Scallop fishermen and some others, including the writer, enjoy them raw.

## DISTRIBUTION OF SCALLOP GROUNDS

Scallop grounds ordinarily worked commercially are confined to Carteret County and extend from the neighborhood of Davis Island, in Core Sound, to the western part of Bogue Sound. Well-known grounds are Great Shoal, Horsepen Slough, Great Marsh Slough, and Harris Lump in Core Sound; Shell Point, lying between Core Sound and Back Sound; Twelve o'Clock Shoal and Bottle Rum Point in Back Sound; North River; Carrot Island, Town Marsh, and Pivers Island in Beaufort Harbor; Gallants Point, Great Shoal, and Oyster Shoal in Newport River; Tar Landing Bay, Hicks Slough, Hicks Shoal, Blind Island, and Sally Bell Shoal in lower Bogue Sound; and Drum Shoal, Dog Island, Wood Island, Long Island, Jim Shoal, and Lovetts Marsh in central and western Bogue Sound. The larger scallops are found in Beaufort Harbor, Newport River, and lower Bogue Sound.

In the season of 1916–17 scallops were taken in considerable numbers near Ocracoke (Hyde County) and Hatteras (Dare County). Again, some time between 1920 and 1922 scallops were taken near Ocracoke, and they were reported from Hatteras in 1927–28, but as not being taken commercially. Commissioner Nelson states that scallops reported for Onslow County during this later period must have been Bogue Sound scallops, presumably handled through Swansboro.

Recently scallop distribution in Carteret County has been extended considerably. In the season of 1926–27 scallops were taken in Core Sound off Atlantic, off Cedar Island, and as far as Harbor Island. Again, in 1927–28 they are being taken commercially as far north as Atlantic.

## APPARATUS AND METHODS FOR TAKING SCALLOPS

Scallops are taken by dredging and raking. In parts of the area raking alone is allowed. In the remainder dredging is permitted and is almost the sole means of capture. The rake used is a narrow one with six long tines, the type known in some parts of the country as a potato digger, but here is called a peanut digger. A small wire screen or basket may be fitted to the rake to aid in the retention of scallops. The dredge is a light one, of about 2 bushels capacity, without teeth and fitted with a twine bag, in the upper portion of which large gaps are left for the passage of excess eelgrass, etc.

The raker wades over the flats while the tide is not too high, raking as he goes. After him he drags, by means of a line tied to his waist, a washtub, commonly of galvanized iron. (See figs. 4 and 5.) The scallops are dropped from the rake into the tub. On an exposed flat, at low tide, the scallops may be dropped first into a bucket. From the tub the scallops are dumped into a flat-bottomed skiff anchored near by. Generally the rakers, wearing hip or thigh boots or breast-high wading pants, work only from mid-ebb to mid-flood tide. However, occasionally they work right through high water from one low water to the next.

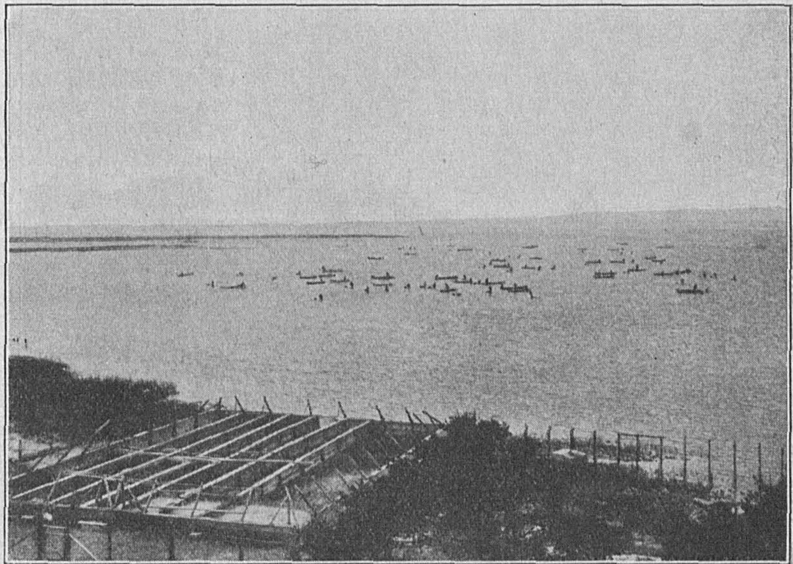

FIG. 4.—Scallop rakers wading on the scallop flats at Beaufort, N. C. Skiffs are anchored near-by and tubs are towed from the waist. The bureau's terrapin pounds are to be seen in the foreground

Nearly all dredging is now done with motor boats. These vary from flat-bottomed, open skiffs, fitted with the smallest of 1-cylinder engines, to V-bottomed (dead rise), cabined craft about 35 feet long, with engines of considerable power ("long-haul" boats; figs. 6 and 7). Rarely dredges of the usual size are worked from skiffs by poling the skiffs. In the past it was the custom to operate very small dredges from rowboats.

According to present practice, dredge lines are not attached directly to the dredge boat but to a pole, which is fastened across the boat while dredging is in progress and is stowed lengthwise at other times. Four dredges are most common. Small boats sometimes use three or only two (fig. 8). Large boats, in addition, tow a skiff, which carries a pole with four dredges. The Core Sound dredger fastens the pole forward, so that the dredges, with lines of equal length, trail about even with the boat's stern. By means of small lines running to the dredge lines he lifts the dredges with comparative ease. Great skill, however, is required, for the shallowness of the water, which gives this system its great advantage, introduces a special hazard in loss of the dredge or more serious trouble from entanglement of line or dredge bag with the propeller. Accordingly the Bogue Sound dredger prefers to place the pole pretty well aft and the dredges well astern and to endure the consequent greater labor and time spent hauling the dredges.

Tonging for scallops is not allowed in the raking area and is not practiced to any important extent in the other areas. Scoop nets are reported as having been in use for taking scallops in 1897.

FIG. 5.—Scallop rakers at work on a flat left bare at low ebb tide. Pivers Island and the bureau's laboratory in the distance

## PREPARATION FOR MARKET

Scallops are brought in alive and opened or "shucked" ashore or in scallop houses over the water. Sometimes the opening is done at home, more frequently in small buildings constructed for the purpose (fig. 9). The better of these are equipped with benches and special stall-like "boxes," in which the shucker stands (fig. 10). If the scallop fisherman and his family do not do the opening, he hires it done at the rate of 50 cents per gallon of meats.

The scallop seems to be unique among land and water animals in that only one muscle (the adductor muscle of biologists, the "heart" of scallop fishermen) is eaten. This is practicable because of the relatively huge size of this muscle. Other parts presumably are discarded because their appearance is not considered attractive. Doubtless the tough mantle margin and possibly the gill axis would prove undesirable, but why other parts should not be edible is not plain. In some countries all of the soft parts are used. Americans who have eaten them prepared have pronounced them excellent.

Shucking or opening is much as follows: A scallop is held, top side up, in the left hand with the hinge away from the shucker. The knife, usually a wooden-handled oyster knife, inserted at the side not far from the hinge, cuts the adductor muscle close to the upper shell, and throws this shell back. The region of the stomach is then seized between knife and thumb and the undesired soft parts removed in one motion in such a way as to leave the muscle standing by itself. The muscle is then cut off close to the lower shell and dropped into a container. The rejected soft parts may be cast into a tub to be used for fertilizer or thrown with the shells and dumped with them into the water. The chief knack in scallop shucking lies in removing the undesired soft parts deftly, without tearing, in one motion. Severing the muscle close to the shell, top and bottom, also is important.

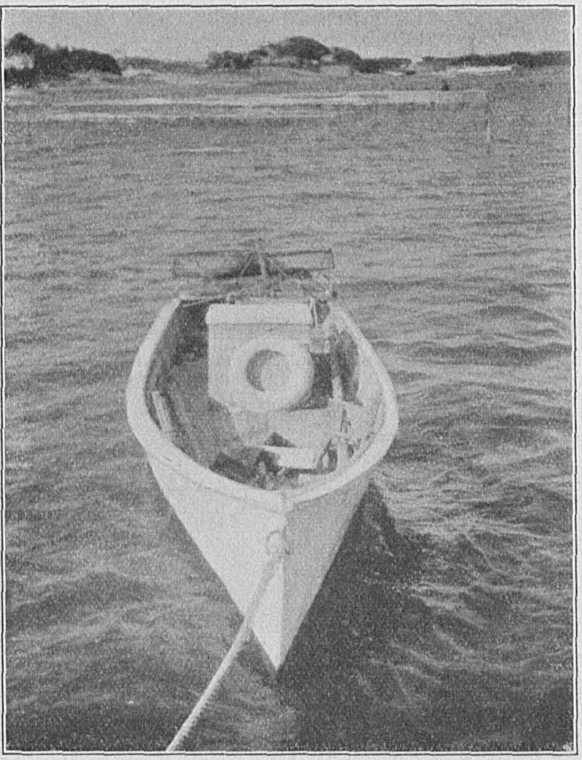

FIG. 6.—Small scallop boat with two dredges aft and the pole lying along the port side

Scallop meats ordinarily are sold under three grades, known as "mediums," "large mediums" or "extra mediums," and "large." The term "jumbos" sometimes is applied to the largest sizes. Very small scallop meats are termed "smalls." There seems to be no definite basis for separating the different grades. In one sample count made by the writer 224 meats were found in a quart of "mediums," 180 in a quart of "extra mediums," and 113 in a quart of "large." In another count 127 were found in a quart of "extra mediums," and in a third (in March) 241 in a quart of "mediums" and only 63 in a quart of "large."

To restrict responsibility for soaking or swelling, scallop meats are now (1928) held unwashed till sold to the dealer, who thus assumes entire responsibility in this matter.

In the past it has been necessary to ship scallop meats by boat from the various points on Core and Bogue Sounds to Beaufort and

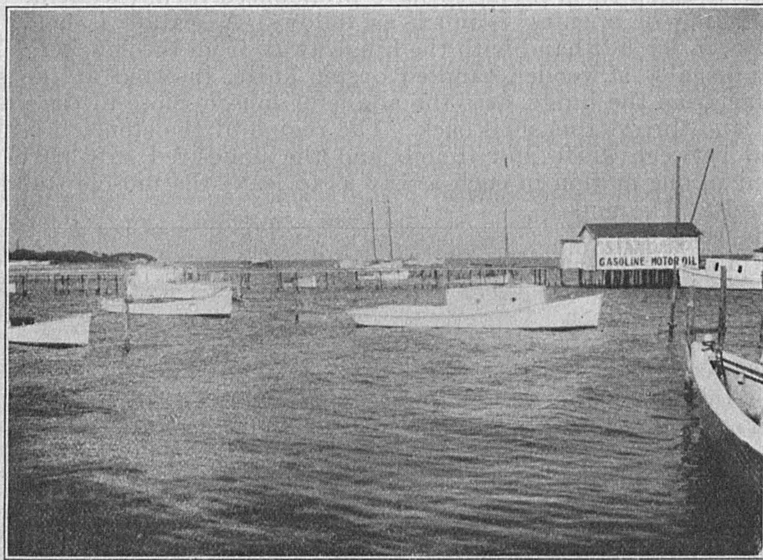


FIG. 7.—Small, medium, and large scallop dredge boats at anchor; oyster schooner in the distance

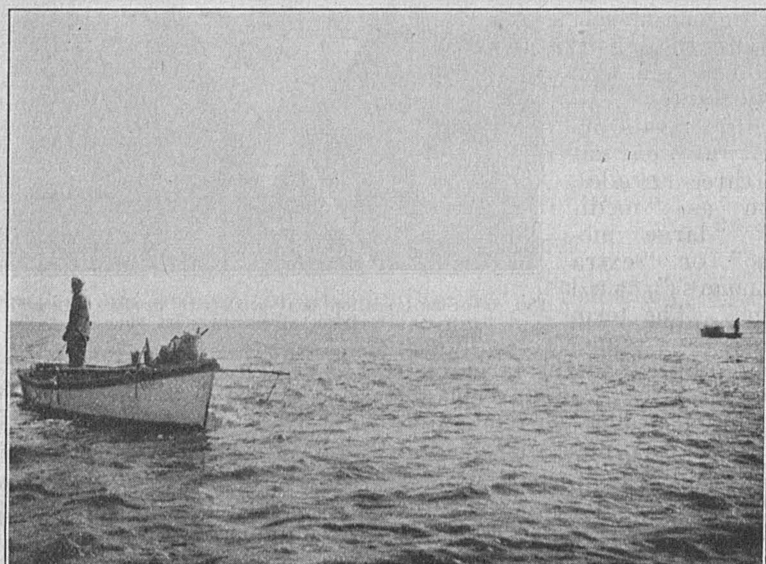

FIG. 8.—Small scallop boat with ropes from two dredges attached to the pole

Morehead City, where nearly all the dealers are located. The boats brought the buyers, who purchased for some dealer. Other dealers had local men buy for them and shipped by freight boats. Generally, several buyers would be present at a time and bid for the scallops. Great improvement in roads now makes it possible to ship by truck. This is done from Marshallberg, Atlantic, and other points on Core Sound. At these points scallops may be auctioned as of yore or trucked to Beaufort or Morehead City to be sold to the dealer who will pay highest for them. At present (1928) there is a local dealer at Marshallberg.

The dealer washes and drains the scallop meats and places them in tin gallon containers. For shipment, the containers are packed with

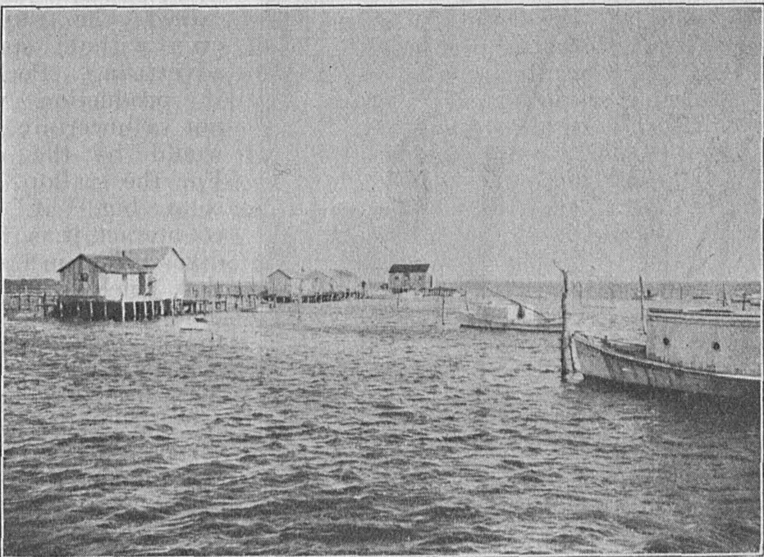

FIG. 9.—Scallop houses and scallop boats at Marshallberg, on Core Sound

chipped ice in barrels, fish boxes, half boxes, or (for hotels, restaurants, etc.) in special packing cases that hold 3 to 8 gallons.

## MARKETING

Nearly all shipments of scallops are made to northern cities, of which New York and Boston are the most important. It has been stated that New York is the better market for the larger grades and Boston for the smaller. Scallops are sent both on order and on consignment. Only a small quantity is shipped within the State.

From this it is evident that marketing, although it is affected greatly by local conditions, is not a local problem. Competition from other sections must be met. On the other hand, Carolina production bulks large enough to affect northern prices. When local production has been low prices have been high, and when local production was high prices have been lower. Although Carolina scallops were plentiful in the fall of 1927, it was thought that prices would be high, because northern bay scallops were reported to be scarce. These high prices were not realized, whether because of high local production, abundance of Nova Scotian and other sea scallops, a better yield of northern bay scallops than was anticipated, or some other factor or factors, the writer is not prepared to state.

It would seem that proper advertising could be made so to expand the scallop market that there would be no danger of overproduction. In a country as large as this an annual output from a principal producing area of 75,000 or 100,000 gallons of choice sea food should not cause a "glut." The demand should exceed the supply, even without special advertising. Perhaps if production were not so uncertain, this would be the case. For the scallop, that is a big "if." To counteract it, a more diversified market that includes many inland towns (as does the oyster market) seems desirable. Many inland towns are little or no farther away than Boston. Under these circumstances, New York and Boston dealers, retaining the principal trade, would not be called upon to take more scallops than the demand warrants, an advantage to them, the shippers, the scallop fishermen, and so, in the end, to the public. It seems that this greater market can not be obtained without advertising. With modern containers and methods of packing, etc., it seems within reach.

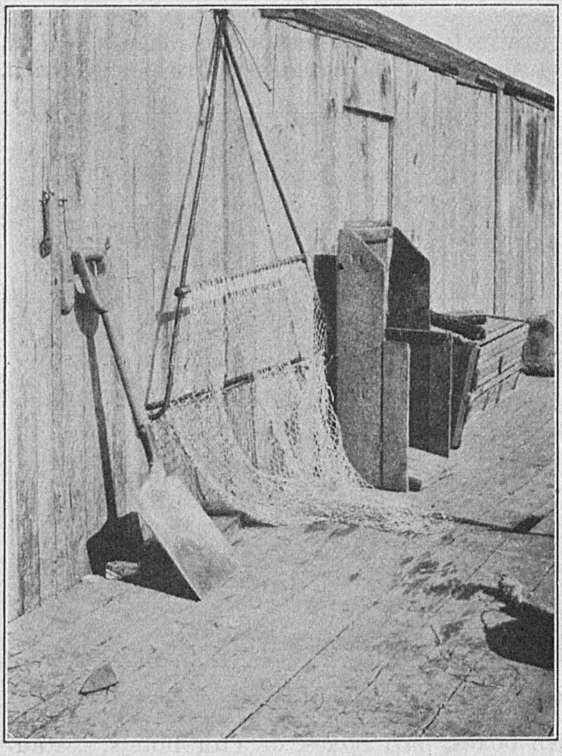

FIG. 10.—Ext rior of scallop house with shovel, scallop dredge, and opener's box. The large gashes in the dredge bag are for the escape of vegetation. The box protects the opener from the wet floor and from shells and refuse cast thereon

## PRICES AND WAGES

There is comparatively little information as to shippers' prices for scallops. In the State report it is stated that the largest dealer in 1917–18 received from \$2.25 to \$4.82 per gallon. Wholesale prices are said to have been as high as \$5 or \$5.50 in recent years. During the present season (1927–28), up to mid-February, prices ranged about as follows: Mediums, \$1.50 to \$2.25 (chiefly \$1.75 to \$2.25);

large mediums, \$2.50 to \$3.25 (chiefly \$2.50 to \$3); and large, \$3.50 to \$4. Prices increased somewhat after this time.

In the very early days of the shipping industry the scallop fishermen sold their catch to dealers by the bushel. The price is said to have been as low as 25 cents. Apparently, by 1897 they sold generally by the gallon. For that year the price paid to the scallop fishermen is given as 40 to 45 cents. Since then there has been a great increase in price. In February, 1928, one of the largest shippers furnished the following data as to prices paid the fishermen during the season: Mediums, \$1 to \$1.20; large mediums, \$1.50 to \$2; and large, \$2.25 to \$2.50. Since then, large scallops have brought as high as \$2.75 and even \$3. Prices have not been as high this year as in some recent years.

At the beginning of the season a raker might take enough scallops to shuck 4 to 6 gallons. These would bring him from \$6 to \$15, depending upon the percentage of large mediums or of large meats, the current price, and the quantity. The charge for shucking would be \$4 to \$6. The wage return for a day's scallop fishing thus figured would be \$4 to \$12. By mid-February of this year, the catch per man per day dropped, according to various reports, to about 1 gallon, which brought \$2.25 to \$2.50. Somewhat larger or smaller catches may be taken. By mid-March or even earlier catches as small as half a gallon are not at all unusual.

Dredging is a more complicated matter, because the cost of operation and the wage for the boat should be considered, and these vary greatly. If, with scallops plentiful, one man with a dredge boat catches 40 bushels of scallops, which yield 15 gallons of meats worth \$1 a gallon, which cost him \$7.50 for shucking, \$7.50 is left for gasoline and oil, wear and tear of gear, and wages for boat and man. If a gallon of meats were to be obtained from 2 bushels of scallops, the return for expenses and wage of boat and man would be \$10 for a day of almost frantically hard work. A better price helps even more than a better yield, for it does not affect the charge for shucking. Although catches up to about 60 bushels a day may occur now and then, 40 bushels is a good day's work. Small scallops from dredging areas, and which the writer shucked about the time the season opened, yielded from 2½ to a little over 3 pints per bushel. Because scallop fishermen know the areas where scallops giving the best yield of meats are to be found, doubtless many large catches of scallops that yield half a gallon to the bushel are taken early in the season. Later yield per bushel, size, and price improve but the catch becomes much smaller. Sample catches made on February 27, 1928, by Marshallberg dredgers and sold there for \$2.50 a gallon were in gallons, as follows: 6⅛, 2⅛, 5 (2 men), 7 (2 men), 3, 7½, 12 (2 men), 3⅛, 1¾, 15⅛ (2 men), 5½ (2 men), 7½ (2 men), 4 (2 men). The gross return per man thus varied from \$5 to \$18.75 a day. The deduction for shucking reduces these figures to \$4 and \$15, respectively, to cover expenses, wear and tear, overhead, and wage.

The standard pay for opening scallops (1927–28) is 50 cents per gallon of meats. This is an increase of 10 cents a gallon over the rate prevalent a few years ago and of 37½ to 40 cents over that reported for the seventies and eighties. An expert may open a bushel of scallops an hour, or possibly a little more, if they are large. These may yield as much as a gallon per bushel, or only 2½ pints, possibly even less. The demand for hired shuckers occurs principally early in the season when catches are large, and from the dredgers, who make much larger catches than do the rakers. At this time a bushel yields less than it does later in the season. The average size of scallops taken by dredgers is small, so that, even if they give a good yield per bushel, many must be opened in order to make a gallon. Therefore, the rôle of the professional shucker can scarcely be a well-paying one; although he or she might make $5 a day, probably $2 to $3 would be more representative.

## LEGAL REGULATION OF THE FISHERY

The act of 1915, chapter 85, established the Fisheries Commission Board, placing upon it not only the usual responsibility for law enforcement but also the unusual duty of fisheries regulation, making it virtually a fisheries legislature. In 1917 scallop regulation was initiated both by act of the assembly and by rule of the board. The assembly provided for a dealer's license fee of $5, an individual scallop fisherman's fee of $1, and a dealer's tax of 10 cents per gallon of scallops (later reduced to 5 cents a gallon, effective December, 1922). In July, 1917, the board passed a rule providing for a closed season on taking scallops (except for local consumption) from April 15 to December 1, making it obligatory to return to the water immediately all scallops measuring less than 2 inches from hinge to "mouth," forbidding the soaking or swelling of scallops or the selling or offering for sale of soaked scallops, and restricting the number of dredges per boat and man. In October, 1919, the board further regulated the fishery by prohibiting dredging or tonging in an area extending from Spooners Point, in Bogue Sound, to the east end of Carrot Island, in Beaufort Harbor. From 1922 to 1924 an additional closed season during the last 15 days in December was put into effect.

In the summer of 1925, because of the general great scarcity of scallops, the writer advised that the usual taking of scallops for local consumption be prohibited. Accordingly, this was done, and an indefinite closed season was established. In January, 1926, on the further advice of the writer, the season was opened for a short period, sufficient for harvesting the crop of market scallops. The next scallop-fishing season opened on January 3, 1927, and closed on April 15. The present season opened December 1, 1927, and closed May 1, 1928.

## CONSERVATION

Fisheries conservation may be either active or regulatory. Regulatory conservation seeks to conserve by restricting the season, establishing size limits, specifying type or size of gear, and creating fishery zones. Probably there are few important fisheries that do not have and need regulation. Regulatory conservation should be based on knowledge of the biology of the species involved and of practical fisheries considerations. Active conservation seeks to counteract the work of man and of other enemies or destructive agents by taking physical measures to improve propagation, growth, and survival. It is applied extensively to oysters and to a limited extent to clams. As far as the writer knows, it has not been attempted to protect scallops on a scale of any great consequence.

## ACTIVE CONSERVATION

Active conservation of commercial bivalve mollusks may be either public or private. In northern States conservation of the oyster is left mainly to private enterprise (oyster culture). In the South, so far as it is carried on, it is chiefly a State enterprise. Whether public or private, it consists essentially in planting "cultch" for the attachment of matured larvæ, the distribution of young or "seed" to the growing grounds, the provision or maintenance of spawners, and protection against enemies or destructive agencies. Active conservation may be very elaborate, especially as a private enterprise, and become merged with work that is not strictly conservational but intended rather to improve the market product.

The most striking and probably the most important phase of oyster culture (except the provision or maintenance of a supply of spawners) is the provision of cultch, for which, in England and America, oyster shells are used chiefly. In general, this planting of cultch can not be done advantageously for the scallop, which attaches itself by a byssus principally to eelgrass. Transplanting for growth and the provision or maintenance of spawners offer the best means for improvement.

Certain areas produce large and valuable scallops. If these become depleted, probably they could be stocked advantageously with young scallops from less-favored growing areas, particularly if the latter are well stocked. It is even possible that, when scallops are crowded on a given area, it would be wise to thin them (to plant areas no more favorable for growth). The planting of areas already well stocked is not recommended.

Maintenance of a supply of spawners over a large area is merely the maintenance (as by proper regulation) of the supply of commercial scallops. Because of the shortness of their life, spawners can not be maintained by setting a quantity aside, as may be done with longer-lived forms. However, it is possible that, when areas are depleted, it would prove advantageous to stock them with even a limited quantity of scallops to act as spawners. Belding believed that on one occasion he was very successful in doing this on a small, nearly inclosed area. It is probable that he was, but it is by no means certain that such success may be expected even in such a favorable area as that in which he experimented, still less in an open one. Little or no "set" may result, or it may be carried elsewhere.[7] Nevertheless, providing scallops for spawning in extensive depleted

[7] In the summer of 1924, before spawning had more than begun, substantially all the North Carolina scallops except those on the beds off Morehead City were killed. In 1925 there were almost no year-old scallops there, but there was an abundance of them at Pivers Island, 2 or 3 miles away, and enough for commercial purposes at more distant points in Beaufort Harbor and in one place in upper Bogue Sound. Thus, if these scallops off Morehead City did propagate successfully, it was to the benefit of other areas.

areas, if stocking to obtain a commercial crop is not practicable, is worth trying.

Protection of the scallop from its natural enemies is a difficult matter. Starfish can be caught on oyster beds or on bare or shelly bottom with a "star mop" or "tangle," but not on a scallop bed unless the vegetation is scarce. The only known really effective method of fighting the drill is to clean the bottom, taking up drills and all, culling out and replanting shellfish of value, and letting the rest remain on the shore till all the drills are dead. This, again, is generally impracticable with scallops. Of course, if scallop culture ever becomes as highly developed as northern or Old World oyster culture, the situation will be changed greatly and these or other means of fighting the enemies may be found to be applicable. Scallops on shallow flats might receive some protection from the occasional shooting of herring gulls, but this enemy is protected by the migratory bird act. Happily, the harm done by all these enemies is moderate.

Destructive agencies other than enemies are freshets and severe cold. Wastes, particularly industrial wastes, in some places very destructive to shellfish, are not a menace to scallops in North Carolina. In the future, this condition may be altered and the need for protective measures may arise. If the danger from severe cold were sufficiently serious some economic protection might be obtained by first taking scallops from shallow water or flats exposed at low tide. Transfer of scallops from such areas to deeper waters is not practicable under present conditions. Protection from freshets could be had only by providing some sort of dam across estuaries, etc. (which is not practicable), and by improving channels, cutting additional inlets, or enlarging present ones (which could give only a measure of relief).

The principal deterrent to private scallop culture seems to be the fear of loss from extensive migration. Because they possess the ability to swim, it can not be said positively that scallops will not, under some circumstances, make extensive migrations. It can only be stated that in the region studied scallops habitually shift little after their first growth period, and that, consequently, movement from a suitable area is not to be expected. One difficulty encountered is the briefness of the period that scallops will survive out of water. It would be necessary to shift "seed" quickly and in neither too cold nor too hot weather. The shortness of their life offers special hazards, particularly if one depended upon reproduction by his private stock. Another danger is the loss of small scallops from the shifting of eelgrass, particularly in autumn. Probably the greatest danger from natural causes is from freshets.

In addition to these inherent difficulties are those of law or custom. Presumably, areas that even occasionally produce scallops in paying quantities could not be set aside permanently for private use. There would seem, however, to be no reason why an area bare of scallops should not be leased on an annual basis until the immediate region in which it lies again produces naturally. Danger of loss from inroads of scallops, especially in areas near public beds or centers of population, must be considered.

Against these difficulties, certain striking advantages are opposed. Scallop growth is so rapid as to be without parallel among commercial bivalves. Seed planted in the spring would be marketable the next winter after increasing several fold in bulk. It is this fact that makes annual leasing practicable. The relatively high price of scallops obviously is an attractive feature. If the scallop farmer were not too dependent upon scallops for his current income, while the naturally produced product remained the chief source of supply, advantage could be taken of the market and top prices obtained. In addition, it might prove feasible to ship direct to hotels, restaurants, and retailers and so absorb wholesalers' and jobbers' profits.

### CONSERVATION BY REGULATION

Although occasional small-scale attempts have been made to establish or reestablish scallops in various areas in various regions, substantially all really serious attempts to conserve scallops have been by regulation. In North Carolina these have consisted in the establishment of a closed season, of a minimum size, of zones (one where raking only is allowed and others where dredges may be used), and in limiting the width of the rake and the number of dredges that may be operated per boat and man.

With regard to zoning and limitation of equipment, the investigator has little comment to make. Their value probably lies more in their appeal to the scallop fishermen and their effect upon rate of marketing than in their ability strictly to bring about conservation. Under certain circumstances regulation as to minimum size might be very important. The most important feature is the limitation put upon the duration of the scallop-fishing season. This varies considerably from year to year. The present season, as stated elsewhere, opened December 1, 1927, and closed May 1, 1928. The number of open days per week varied from two to six. In addition to a winter season, it is customary to allow scallop fishing for local consumption during summer months. Fortunately, the biology of the bay scallop in North Carolina is such that all that can be done by regulation can be done very simply by the establishment of an open season, which begins when scallops about 1 year old have completed spawning and closes before the younger generation has attained sufficient size to induce marketing. If such a season be established, regulation as to type of gear and open days per week (through their effect upon rate of catch and exhaustion of the crop, very important for profitable marketing) and the establishment of a minimum size become of no importance for conservation. It is only when the season is longer that regulation as to minimum size may be helpful, and then the difficulties are serious.[8]

Because scallop spawning continues into January, an open season, to be fully effective, should not begin before the middle of January. However, ordinarily comparatively little harm results from opening the season immediately after January 1. If the season is to be opened

[8] When considering conservation regulations for a commercial species it is well to bear in mind that their primary purpose is economic and, therefore, that conservation that in the long run is not economic is not justified. In order that it may not defeat its very purpose, it may be necessary to reduce its effectiveness to some extent.

earlier, December 15 would be an appreciably better date than December 1. If the season is to open early in December, it would be advantageous for purposes of conservation and probably of marketing to restrict scallop fishing to two or even one day per week. Later, for effective marketing and good average employment, it would be desirable to limit the catch while scallops are abundant, presumably by regulating the number of open days.

Unless protection be based largely on a minimum-size limit (a very difficult matter because of variations in size between individual scallops and between the scallops of various areas and because of the problems of enforcement), the scallop-fishing season should be closed sufficiently early to prevent the marketing of the young scallops. This is something that can not be determined definitely from a knowledge of scallop growth or other aspects of scallop biology. The human factor enters into the problem. To learn something of this, the writer examined commercial catches early and late in April and has found no evidence of appreciable utilization of young scallops. It therefore seems that the extension of the open season through April is not dangerous.

Due vigilance should be exercised by officials having regulatory power. Thus, if either the crop of market scallops or of young is very small, the season should not be opened, regardless of immediate financial loss, till observation shows that spawning has been completed. If at any time there seems danger of serious destruction of the young, the season should be closed early, even though many marketable scallops would thereby be left.

From the conservation standpoint, summer scallop fishing is decidedly dangerous to the welfare of the fishery. It results in the destruction of scallops before they have spawned to an important extent and is an attack upon the only year class present in any abundance. The small size and general lack of "fatness" of the summer scallop means that relatively large numbers are needed to provide a given bulk of meats. A great increase in "total yield" is prevented. At present, the industry is sustaining this harmful practice. If the region increases in popularity as a summer resort, the drain may become too great. Whether this happens or not, if scallops become scarce, summer fishing should be stopped entirely.

It can scarcely be emphasized too much that scallops of not more than 2-year classes are present in quantity at one time and that if these are destroyed in any region the race of scallops in that region is obliterated.

It is recommended that a regulation be put in force closing the scallop-fishing season from some time in the spring (May 1 seems not too late) until January 1. A close watch should be kept on scallop conditions in order that emergency measures may be adopted when necessary. If the season is opened in December, the rate of catch during this month should be kept low, preferably by limiting the number of open days to two or even one day a week.

## NEW INLETS

Probably no topic arouses more interest among scallop fishermen than that of new inlets. The writer believes that the creation of new inlets is urged by the scallop fishermen less in the hope that new territory will thus be added or that scallops will become more numerous than in the belief that a superior article of commerce, a larger scallop, will be produced. This has been especially the case, during the present (1927–28) season, with scallop fishermen of upper Bogue Sound, where scallops are abundant but generally small. It is claimed that an inlet, by increasing the strength of the tide, would result in the production of larger scallops.

The evidence seems clear, indeed, that the desired tidal improvement would result in larger scallops. However, there are many things to consider. The expense of cutting a new inlet would be large; whether or not it would remain open is uncertain; and what the result and effect would be if it were to remain open is doubtful.

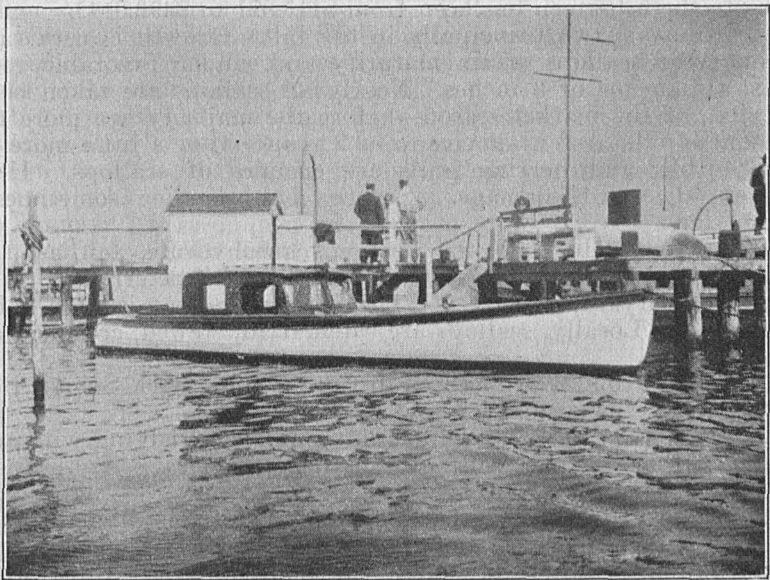

FIG. 11.—A scallop protector ready for work. Swift State boat used in scallop patrolling

An inlet may have little effect upon the tides (as seems to be the case in Pamlico Sound). If strong tides develop, the bottom may be changed greatly and areas suitable for scallops be reduced correspondingly. If the bottom itself is not changed greatly, biological bottom conditions may be. Thus if, on the opening of a new inlet, a scallop flat regularly were left bare at low tide, it might be transformed into an oyster rock. Although, doubtless, in individual cases considerable benefit would result from the existence of effective new inlets, it should not be forgotten that the special wealth of the sounds is due to the fact that they are largely shut off from the sea and that therefore too numerous tidal inlets are to be avoided. In the case of upper Bogue Sound, some increase in tidal flow may be expected from the enlargement of the inland waterway channel.

## SUMMARY

1. Because scallop fishing generally is confined to one county (Carteret), is active when other fisheries are slack, and yields a high-priced product, the scallop industry is very important locally.

2. Scallops were used by Indians before the coming of white men. Many years ago a considerable local summer trade was developed at Beaufort, possibly reaching its height in 1860. Shipment of scallops, begun in the seventies, did not become an important, regular industry until about 1912 or 1913.

3. Since 1917, the return from the "gallon tax" has furnished reliable statistics as to quantity of scallops shipped. From December, 1917, to May, 1928, the quantity for a 2-year period varied from 38,607 to 165,338 gallons. According to State estimates, the biennial value to the fishermen has been from $115,821 to $496,014.

4. Scallops spawn principally in the fall. Growth is very rapid. In one year scallops attain maturity and, under favorable conditions, a diameter of 3 inches. Nearly all scallops are taken before the close of the market season—before the majority are more than 20 months old. A few survive to be 2 years old or a little more.

5. Starfish and herring gulls are enemies of scallops. Heavy freshets do much damage. Severe cold weather sometimes is destructive.

6. The fuel value and the protein, carbohydrate, fat, ash, and water content of scallops (adductor muscles), as determined by Atwater and Bryant, are given. The protein content is high—about 15 per cent. Locally, scallops are eaten fried, stewed, creamed, and, by some, raw.

7. Scallop grounds are located in Core Sound, Back Sound, Beaufort Harbor, Newport River, and Bogue Sound.

8. Scallops are taken by hand raking and by dredging with small dredges from motor boats of small or moderate size. Special methods of rigging the dredges are employed.

9. Scallops are opened ashore, either at home or in small scallop houses, by the fishermen and their families or by "openers" paid by the gallon. Scallops are auctioned locally or shipped to Beaufort or Morehead City to be sold to the dealer who will pay the most. Trucks are replacing boats for local transportation. Dealers wash, pack, ice, and ship the scallops to northern markets.

10. The majority of scallops are shipped to New York and Boston. Prices vary greatly, apparently largely because of fluctuations in the local supply. It seems reasonable that if a more diversified market could be made available, as by proper advertising, much of the fluctuation in price might be avoided.

11. Wholesale prices are said to have been as high as $5 or $5.50 per gallon in recent years. During the present season (1927–28) shippers received as little as $1.50 per gallon for "mediums" and up to $4, perhaps more, for "large" scallops. Scallop fishermen received from $1 to $3 per gallon during the 1927–28 season. This might mean $1.25 to $12 a day for rakers and $4 to $15 a day for dredgers, depending upon the catch and the price. At 50 cents a gallon, openers ordinarily make from $2 to $3 a day, $5 being about the maximum.

12. Legal regulation of the scallop fishery is recent (1917) and includes a closed season, a minimum size, a rule against soaking scallops, and the establishment of raking and dredging areas. The fee for a dealer's license is $5 and for a scallop fisherman's license $1. A tax of 10 cents a gallon on shipped scallops was reduced later to 5 cents.

13. Conservation may be either regulatory or active. Especially favorable growing areas might be stocked advantageously by transplanting commercial numbers of small scallops to them, which will spawn before being taken up. If this is not practicable, planting with a small quantity for spawning purposes only holds some hope of justification.

Factors favorable to private culture are rapid growth and high price. Unfavorable factors are danger of loss from natural causes, danger of destruction by fishermen, lack of suitable grounds that are not natural scallop ground, and, possibly, public sentiment. Danger of loss from the migration (swimming) of scallops probably would be the least hazard to be faced.

All or nearly all that may be accomplished by regulatory conservation may be performed by a proper closed season. This should start in the spring before the young scallops are marketable and end when they have completed spawning. A closed season from May 1 to January 1 is recommended.

The cutting of new inlets frequently is urged by scallop fishermen. These are very expensive and their effect is uncertain.

# PROGRESS IN BIOLOGICAL INQUIRIES, 1927 [1]

By Elmer Higgins

*Assistant in Charge of Scientific Inquiry*

(With the collaboration of investigators)

CONTENTS



## INTRODUCTION

A conspicuous characteristic of the work of the division of scientific inquiry during 1927 is the continuity of effort and aim applied to the major investigations undertaken. These have been largely a continuation of work begun in previous years along the main lines laid down at the beginning of each investigation. Rather than indicating a lack of initiative, however, this condition is most favorable, for it indicates (1) the adoption of a carefully planned program of research designed to solve the problems of the fisheries and (2) freedom from interference or pressure from outside special interests that require continual shift of project and personnel, with consequent disruption of program and loss of efficiency, which so often characterizes research in Government institutions. Fishery problems are so complex and the investigations necessarily are so intricate that only persistent and continued work by a competent staff of investigators can hope to secure results of practical application, and the present combination of circumstances—a well-organized staff of enthusiastic and contented workers, supported by public appreciation of their efforts and of the results obtained—is extremely favorable for continued productive work of great value.

[1] Appendix VI to the Report of the U. S. Commissioner of Fisheries for 1928. B. F. Doc. 1044.

The present state of the bureau's biological investigations may be shown by the following list of projects continued and completed. The titles given are not descriptive but merely indicate the field in which work is conducted. Details of the investigations may be gained from the following pages.

Projects continued:
- Cod.
- Mackerel.
- Smelts.
- Larval fishes.
- Texas shore fisheries.
- Alaska salmon.
- Columbia River salmon.
- Alaska herring.
- Trout culture.
- Pond culture.
- Pathology of fishes.
- Wisconsin lakes.
- Oysters.
- Clams.
- Scallops.
- Mussels.
- Terrapin.
- Summer laboratory work by voluntary workers.

Projects completed:
- Oceanography of the Gulf of Maine.
- Food habits of sharks.
- Coregonidæ of Great Lakes.
- Pollution in upper Mississippi.
- Keokuk Dam and fishes of upper Mississippi.
- Chesapeake Bay fishes.

During the past year several lines of investigation have shown unusual success in the application of scientific principles to practical problems.

The salmon investigations have continued to yield detailed information concerning the routes of migration and the success of spawning escapement in the various localities, which has been used as the basis for modifying or improving the regulations of the fishery in the interest of conservation.

The investigations on the diseases of fish are continuing to prove their practical importance. The causes of diseases that annually have taken heavy toll of the output of many hatcheries throughout the country are yielding to continued research, and the pathologist has rendered valuable aid in advising hatchery superintendents in the prevention of devastating epidemics.

Investigations of the marine fisheries of the Atlantic coast are showing extremely promising results, especially in the case of the mackerel fishery, where the causes for extreme variation in abundance have been discovered in the great success or almost complete failure of spawning and survival in various years. Although these factors appear to be beyond the control of man, the prediction of their occurrence (which, as a result of these studies, appears to be possible) will be of great economic benefit to the industry.

Another outstanding accomplishment of the year was the perfection of methods of artificial propagation of the fresh-water mussel, a shellfish that yields the raw material for millions of dollars worth of pearl buttons manufactured annually from the shells. Natural processes of propagation are extremely wasteful, and until now artificial methods have been almost equally hazardous and doubtful of results. The new process of cultivation, in which the parasitic stage has been eliminated entirely, makes possible the production of commercially significant quantities of young mussels grown to a stage at which survival is fairly certain. Moreover, the process can be controlled, a desirable stock can be selected for spawning, and the progeny can be planted in the most favorable localities, either on public grounds or on privately controlled beds, making mussel farming by private enterprise possible and assuring an abundant supply of raw material for the button industry of the Middle West.

Two important projects were undertaken during the past year, both of them major investigations, although each undoubtedly will develop into a number of subordinate and related investigations during the coming year. These are an investigation of the fisheries of the Great Lakes, with special reference to Lake Erie, and an investigation of the fisheries of the Middle Atlantic coast from Cape Cod to Delaware Bay. The appropriation for "inquiry respecting food fishes" was increased by $10,000 for the purpose of investigating the condition of the fisheries of the Great Lakes to discover the causes of the alleged decline in productiveness and to devise corrective measures. Dr. John Van Oosten, who has had several years' experience in herring work on Lake Huron, was placed in charge of this inquiry and with assistants began a general survey of the Great Lakes in July, 1927. Because of the urgency of the problems found in Lake Erie and the economic importance of the fisheries in that lake, a program of observation and experimental fishing was undertaken there with the intention of extending the investigation to other lakes later.

A similar increase was made in the appropriation for an investigation of the fisheries in the Middle Atlantic region, with special reference to the pound-net and weakfish fisheries on the Long Island and New Jersey coasts. R. A. Nesbit began a survey of the region in July, 1927, and later made detailed observations of the landings at several points during the course of the fall fishery. During the winter the collection and analysis of past records of the fishery were undertaken to determine the seasonal changes in the fishery and the variations in abundance that may be expected. It is hoped to discover the causes of these variations and, if they be due to destructive or immoderate fishing rather than to natural causes, to offer recommendations to State legislatures for an effective system of fishery regulation. Plans have been made for stationing observers at several important ports of landing throughout the region, where systematic studies of the fishery will be conducted throughout the season.

The demand for new investigations has continued to exceed the facilities of the bureau, but is significant in reflecting public appreciation of its work. The appropriations for scientific investigations have nearly doubled in the past four years; the appropriations for the fiscal year ending June 30, 1928, exceed those for 1924 by 92 per cent. The expansion in activities of the division may be judged by the annual appropriations, which are shown in thousands of dollars in the following table:

| Year | Inquiry respecting food fishes | Salaries | Total | Increase | Per cent increase |
|---|---|---|---|---|---|
| 1924 | 40 | 51 | 91 | | |
| 1925 | 38 | 80 | 118 | 27 | 30 |
| 1926 | 43 | 86 | 129 | 11 | 9 |
| 1927 | 56 | 88 | 144 | 15 | 12 |
| 1928 | 83 | 92 | 175 | 31 | 22 |

A further index to the growing realization on the part of the public of the need for technical advice in the management of fishery resources may be found in the greater tendency shown by State governments and other organizations to cooperate with the bureau in its investigations. Such cooperation has increased materially both in extent and effectiveness. During 1927 the States of North Carolina, Georgia, Alabama, Texas, Minnesota, Michigan, Wisconsin, Ohio, Washington, Oregon, and California offered such cooperation.

In addition, contact with the fishery departments of foreign governments has been maintained through the agency of the North American Committee on Fishery Investigations, an international body including representatives of Canada, Newfoundland, France, and the United States. Two regular meetings of the committee were held during the year—the twelfth meeting, held in Washington, D. C., on April 28, and the thirteenth, held in Toronto, Canada, October 19, 1927. At each of these meetings representatives of Canada, Newfoundland, and the United States were present, and matters pertaining to the fisheries of the North Atlantic region (especially those for cod, haddock, and mackerel), as well as general investigations of the oceanography of the region, were considered in detail. Late in the year there appeared, as the first publication of the committee, a paper on the "Statistics of the catch of cod off the east coast of North America," by O. E. Sette, which embodies the record of the yield of this fishery in the western North Atlantic from 1880 to 1926.

Despite the expansion of the activities of the division of inquiry and the increased appropriations that make this greater service possible, there is urgent need for the adoption of a definite and carefully organized plan for the extension of activities that will cover a sufficient period of time so that the work may be coordinated in the interest of efficiency so as to produce maximum results. It is extremely desirable that congressional sanction be secured for a far-reaching program designed to include, within the next five years, additional projects of research on the major fisheries in virtually all sections of the country. With such assurance of a permanent program of development, opportunist methods could be abandoned, fortuitous expansion avoided, and future sound development would be assured.

An essential part of this program of development should include provision for increasing the permanent staff of the division. The acquisition of competent and experienced investigators is of utmost importance in maintaining a high standard of efficiency. Fishery investigations require men of specialized and highly technical training. Unlike other technical branches of the Federal service, in which experts may be secured from among the graduates and faculties of agricultural, engineering, and technical colleges, the Bureau of Fisheries must depend largely upon investigators who come to the service with little or no practical experience in fishery research. Highly trained biologists, such as professors and graduate students in universities, among whom the bureau's investigators must be sought, are not tempted by offers of temporary employment, regardless of the salary paid. It is imperative, therefore, that a permanent staff of senior investigators be maintained intact in order to carry to successful conclusion and practical application the intricate and extended investigations required.

The following progress reports, covering the more important investigations conducted by the division during the calendar year 1927, were prepared in the main by the investigators.

## ATLANTIC AND GULF COAST INVESTIGATIONS

### COD, POLLOCK, AND HADDOCK

The investigation dealing with the habits of the cod, pollock, and haddock was continued by means of tagging experiments throughout 1927. The total number of fish tagged was 11,028. A statistical summary of operations up to the present time is given in the following tables:

*Cod, pollock, and haddock tagged from 1923 to 1927*

| | 1923 | 1924 | 1925 | 1926 | 1927 | Total |
|---|---|---|---|---|---|---|
| Number of cruises | 7 | 9 | 16 | 4 | 11 | 47 |
| Days of actual fishing | 43 | 51 | 76 | 23 | 64 | 257 |
| Hours of actual fishing | 333 | 320.5 | 461 | 167 | 428.7 | 1,710.2 |
| Number of cod tagged | 7,618 | 6,209 | 10,420 | 3,565 | 8,851 | 36,663 |
| Number of pollock tagged | 2,215 | 916 | 949 | 39 | 413 | 4,532 |
| Number of haddock tagged | 411 | 3,223 | 3,891 | 641 | 1,764 | 9,930 |
| Total number of fish tagged | 10,244 | 10,348 | 15,260 | 4,245 | 11,028 | 51,125 |
| Number of fish recaptured up to Dec. 31, 1927 | 332 | 548 | 1,072 | 141 | 184 | 2,227 |

*Catch of tagged fish, according to localities*

| Locality | 1923 | 1924 | 1925 | 1926 | 1927 | Total |
|---|---|---|---|---|---|---|
| New York | | | | | 167 | 167 |
| Massachusetts: | | | | | | |
| South of Cape Cod | 10,231 | 4,384 | 6,143 | 1,730 | 6,123 | 28,611 |
| North of Cape Cod | 13 | 163 | 314 | | 68 | 558 |
| New Hampshire | | 8 | 5 | | | 13 |
| Maine | | 5,793 | 8,798 | 1,412 | 1,839 | 17,842 |
| Georges Bank | | | | 1,103 | 726 | 1,829 |
| Cashes Ledge | | | | | 546 | 546 |
| Browns Bank | | | | | 1,559 | 1,559 |
| Total | 10,244 | 10,348 | 15,260 | 4,245 | 11,028 | 51,125 |

In addition to the 2,227 fish with tags that were recaptured, 108 with tag "marks" were taken by the vessels *Halcyon* and *Albatross II*. These latter fish had lost their tags but showed unmistakable evidence of having been tagged. A summary of all fish recaptured is given in the following table:

*Summary of recaptured fish reported up to December 31, 1927*

| | Recaptured | | | | | |
|---|---|---|---|---|---|---|
| | 1923 | 1924 | 1925 | 1926 | 1927 | Total |
| Cod tagged: | | | | | | |
| 1923 | 159 | 90 | 34 | 4 | 2 | 289 |
| 1924 | | 206 | 250 | 35 | 5 | 496 |
| 1925 | | | 615 | 347 | 51 | 1,013 |
| 1926 | | | | 50 | 111 | 161 |
| 1927 | | | | | 134 | 134 |
| | 159 | 296 | 899 | 436 | 303 | 2,093 |

*Summary of recaptured fish reported up to December 31, 1927*—Continued

| | Recaptured | | | | | |
|---|---|---|---|---|---|---|
| | 1923 | 1924 | 1925 | 1926 | 1927 | Total |
| Pollock tagged: | | | | | | |
| 1923 | 11 | 25 | 7 | 2 | | 45 |
| 1924 | | 4 | 21 | 1 | | 26 |
| 1925 | | | 7 | 7 | 2 | 16 |
| 1926 | | | | | 3 | 3 |
| 1927 | | | | | | |
| | 11 | 29 | 35 | 10 | 5 | 90 |
| Haddock tagged: | | | | | | |
| 1923 | | 5 | 1 | | | 6 |
| 1924 | | 14 | 39 | 2 | 3 | 58 |
| 1925 | | | 34 | 31 | 5 | 70 |
| 1926 | | | | 4 | 11 | 15 |
| 1927 | | | | | 3 | 3 |
| | | 19 | 74 | 37 | 22 | 152 |
| Grand total | 170 | 344 | 1,008 | 483 | 330 | 2,335 |

There are records of 44 cod recaptured a second time, the first recapture having been made by one of the tagging vessels, which returned the fish to the water. No marked pollock or haddock were caught more than once, with the single exception of pollock No. 16418, mentioned in previous reports, which was recaptured three times.

Not included in the preceding tables are 946 cod tagged at Woods Hole, Mass., on January 6 and 7, 1926, of which 20 have been recaptured; and 422 cod tagged on January 3, 1927, of which 8 have been recaptured. These fish were caught near by during November and held for their spawn at the bureau's biological station.

Scale samples have been taken from all fish tagged during and since 1924, and about 1,000 of these have been studied. Although it appears possible to secure from the scales desirable data on age and growth, definite conclusions as to these factors can not yet be stated. One of the chief difficulties encountered in the study of cod scales lies in the interpretation of evidence of early growth. To assist this study, quite a number of small cod, 2 to 9 inches long, were taken by bottom trawls in the vicinity of the tagging grounds. It is very likely that a careful study of this material will be of value in determining the age of older fish.

Tagging from 1923 to 1925 was done by the *Halcyon* on the shore grounds from Nantucket Shoals to Mount Desert, Me. The *Albatross II*, a larger and more seaworthy vessel, replaced the *Halcyon* in 1926. Operations did not commence that year until August, when the first cruise was made offshore to the northeastern part of Georges Bank and Browns Bank and Cashes Ledge were fished. In November, a tagging cruise was made to the Cholera Bank, between northern New Jersey and western Long Island.

One of the chief difficulties encountered in the present investigation has been the great loss of tags from the fishes' tails, even during the first year. Two years ago this loss was conservatively estimated at about 60 per cent for the first year, but more recent data have raised this to 70 per cent. This loss made it imperative to modify the present method of tagging. Beginning in October, 1927, therefore, certain fish were tagged on the lower jaw, in a place where the tag penetrates between the dentary and articular bones. It is thus held rigidly and can not drop off as the result of softening and wearing away of the tissue, as happens in the case of the tail. Unfortunately, the jaw bones of large cod grow so close together that a tag can not penetrate, so that this method is confined chiefly to fish less than 30 inches in length.

The outstanding results of the fish tagging up to December, 1927, were as follows:

*Nantucket Shoals.*—This has been one of our most important tagging grounds each year from 1923 to 1927. Each fall the cod here have migrated to the shore waters of Rhode Island, Long Island, and New Jersey. Many have been recaptured in the Chatham Ground–South Channel region, but only stragglers have been reported from north of Cape Cod or on Georges Bank. A large proportion of the fish were recaptured on Nantucket Shoals (where they were tagged) one or two years afterwards.

*Cholera Bank, N. Y.*—The first cod-marking in the present investigation, west of the New England States, took place on this bank November 14 to 21, 1927, when 166 fish were tagged. This was done to learn something of the cods' movements after they had migrated here in the fall from the grounds off southern Massachusetts. Four of these cod had been reported recaptured up to the end of December, as follows: November 17, Jones Inlet, N. Y.; November 21, Bradley Beach, N. J.; December 11, Ambrose Channel Lightship, N. Y.; December 26, Easthampton, N. Y. The recapture made off Easthampton is of particular interest, for it is the first evidence obtained showing that some cod that migrate to western Long Island in the early fall return eastward before the end of the year.

*Stellwagon Bank, Massachusetts Bay.*—A few cod have been tagged here each year since 1923 (except 1926), the total being 156; of these, two were recaptured off Cape Ann, two off Rockaway, N. Y., and one off Atlantic City, N. J. There is an indication, therefore, of a migration both north and south of Stellwagon.

*Portland to Boothbay Harbor, Me.*—Cod were tagged within this sector from 1923 to 1925. As has been stated in a previous report, most of the recaptures were local, but a few tagged cod migrated offshore to Jeffreys Ledge and Platts Bank, while one each was taken at Dennis (southern Massachusetts), Stellwagon Bank, and Grand Manan, New Brunswick.

*Platts Bank.*—Cod were tagged on this bank each year since 1923, with the exception of 1926. There have been recaptured 19.2 per cent of the 218 cod tagged in 1924 and 19.3 per cent of the 604 tagged in 1925. All of the 159 recaptures were taken locally except nine, which migrated, one each to Harpswell, Me., Chatham, Mass., Nantucket Shoals, and South Channel; there were two each to Cashes Ledge and Jeffreys Ledge. On the basis of these returns, very little migration from Platts Bank was noted, although local intensity of fishing must have been great.

No cod were tagged on Platts Bank in 1926, and when fishing was resumed there in 1927 it was found that fish were very scarce. Instead of tagging from 50 to 150 cod per day, as was done prior to 1926, the following results were obtained in 1927: April 25, in 7 hours 35 cod were tagged; July 14, in 1 hour 2 cod were tagged; July 25, in 6 hours 5 cod were tagged; October 1 and 2, in 9 hours 37 cod were tagged, all caught with 6 lines fishing. An effort will be made to determine the cause for the apparent depletion in the stock of cod in this locality.

*Mount Desert.*—A large proportion of the cod have been tagged in this region each year since 1924, inclusive. Nearly all recaptures were made locally, but enough records have been received to show that a small migration to Nova Scotia occurs each year. Only one cod tagged here was taken as far south as Nantucket Shoals, and only a straggler has been reported recaptured from as far down as Ipswich Bay. Local fishing is intense, for 36.3 per cent of 308 cod tagged in April, 1925, and 24.4 per cent of 1,303 tagged in May were recaptured. However, the returns from tagging done here at other times are somewhat smaller than these figures.

*Cashes Ledge.*—The first fish marking was done here during 1927, when 321 cod, 128 pollock, and 97 haddock were tagged from September 29 to October 3.

*Georges Bank.*—Operations commenced here in August, 1926, when 1,014 cod, 23 pollock, and 66 haddock were tagged on the northeast part of the bank. Another cruise to the same vicinity was made in September, 1927, when 477 cod, 42 pollock, and 207 haddock were tagged. The returns from the cod are as follows: Of those tagged in 1926, four were recaptured—two on Georges Bank (one on the southeastern part), one on Browns Bank, and one off Block Island, R. I. Of those tagged in 1927, two were recaptured—one on Georges and one on La Have Bank. Although these returns are small from so many fish tagged, they suggest that Georges Bank cod migrate in all directions. The bank is so large, however, that the results of this experiment, carried out on the northeastern part, may not obtain for the bank as a whole.

*Browns Bank.*—The first tagging was done here in August, 1927, when 940 cod, 24 pollock, and 595 haddock were marked. Only one recapture, a cod, had been reported up to the end of December. This fish was taken on the east coast of Nova Scotia off Iron Bound Island, Lunenburg County.

Information concerning the migration of pollock is not sufficient to permit of definite conclusions. The 90 returns of fish tagged from 1923 to 1927 show that 69 were recaptured locally (in many cases a year or more after tagging), 7 were recaptured about 20 to 30 miles away, and 14 had made long migrations. Of these latter, 11 tagged on Nantucket Shoals migrated as follows: Georges Bank, 2; Cashes Ledge, 1; vicinity of Cape Ann, 3; Penobscot Bay, 1; Petit Manan, 1; and Nova Scotia, 3. Jeffreys Ledge pollock migrated, one each, to Matinicus and Sable Island, and a Portland fish migrated to Mount Desert.

Of 152 haddock records, a number were incomplete, 23 fish had made long migrations, and the rest were taken locally. From haddock tagged on Nantucket Shoals, four were taken around Cape Ann, one on Georges Bank, one on Platts Bank, and one off New Brunswick. Quite a few were caught in South Channel, these being regarded here as local recaptures. From fish tagged off Mount Desert, Me., long migrations were made as follows: South Channel, 2; Georges Bank, 1; Jeffreys Ledge, 1; Portland, 1; Platts Bank, 3; and New Brunswick, 2. Other miscellaneous migrations include Boothbay Harbor, Me., to Platts Bank, Stellwagon, and Georges Banks; Boone Island to Boston Lightship; and Stellwagon Bank to Platts Bank and Chatham.

This work was efficiently conducted by William C. Schroeder under the general direction of Dr. H. B. Bigelow, of the Museum of Comparative Zoology, Harvard University. It is planned to continue the investigation in 1928.

### SMELTS OF NEW ENGLAND

Early in the year an illustrated paper entitled "The Smelts," by William C. Kendall (Bureau of Fisheries Doc. No. 1015), was published. It comprised a general account of the natural history, fish-cultural propagation, and conservation of the Atlantic smelt, with a history of the smelt fisheries. Prior to and at the time of publication of this document a suplemental paper by the same author was in process of preparation. This second paper embodies additional facts pertaining to these fish. It embraces the important points in their taxonomic history, a discussion of the relationship of the different nominal species of the genus Osmerus, age, growth, and racial peculiarities of the salt and fresh water smelts of eastern North America. The problem of relationship of the smelts, particularly those of fresh water, is very complicated and perplexing. Some ichthyologists have regarded the European and American smelts as specifically identical. Others have pronounced them distinct species, although admitting that they are very closely related. As concerns the American marine smelt, the conclusion is reached that only one species can be recognized, notwithstanding the group differences that are shown only by averages of the individual variations.

The smelt of fresh waters present a still more difficult problem. The smelt of each lake are peculiar to their particular lake, in that they show structural differences from those of other lakes. With them, too, the range of individual variation is wide; but the differences (shown only by averages of individual variations) can not be regarded as even admitting them as subspecies, for there is not the requisite intergradation but rather an apparent medley of differences.

From a fish-cultural standpoint, the most important question to answer is that of the relationship of the two size classes of smelts that occur in some lakes and not in others. However, sufficient material representing the various localities has not been available to solve the problem positively. It is questionable, even, whether it could be solved by any amount of preserved or dead material. Experimentation with living fish would seem to yield more satisfactory results. However, there is evidence that there have been two lines of development in fresh-water smelt, which began with the divergence from the ancestral common stock before the fish became landlocked. The group variations of each lake are what might be expected to result from isolation and restricted interbreeding.

The situation is paralleled by several other kinds of fish; for example, the "yellow pike" (*Stizostedion vitreum* Mitchill) and the blue pike (*S. glaucum* Hubbs), two whitefishes of northern Maine (*Coregonus clupeaformis* Mitchill and *C. stanleyi* Kendall), the large and "dwarf" long-nosed suckers (*Catostomus catostomus* Forster and *C. nanomyzon* Mather), and the large and "dwarf" common sucker (*C. commersonii* Lacépède and *C. utawana* Mather). Very probably there are others that have not been recognized. The evidences of divergence are:

1. Sharply distinct range in size of adult breeding fish.
2. Difference in spawning time.
3. Difference in character of food (at least in one lake, where the food of each class has been studied).
4. Age of the fish, as determined by scale reading. The "small" breeding smelt are 2 and 3 years old, and the "large" smelt are 3 years old and upward to 5 or 6 years.
5. There are a number of small structural differences that distinguish the "small" smelt from the "large" smelt of each lake, but both the large and small smelt of each lake differ somewhat from those of other lakes (the two size classes of only two lakes, Sebago and Green, have been studied).

In view of the foregoing facts, which are discussed in detail in the report now about completed, the logical procedure in fish-cultural distribution is to regard each of the two size classes as distinct species, whether or not the facts and figures permit them to be regarded so taxonomically.

During the spring of 1927 collections of both large and small smelt were received from Green Lake through the division of fish culture. The large smelt were collected from May 8 to 11 and were the last of the run. There were 275 specimens, ranging from 131 to 285 millimeters in total length. Of these, 49 were females ranging in length from 173 to 285 millimeters and averaging 224.4 millimeters. They were 3, 4, 5, and possibly 6 years old. No 2-year fish were present.

Of the large collection of small smelt taken in the last part of April and first part of May, a run of only 6 days, 1,463 individuals were measured and examined. They ranged from 71 to 106 millimeters in total length. There were only 94 females in the lot. The fish were 2 and 3 years old. The largest 2-year-old fish was 100 millimeters and the smallest 3-year-old was 90 millimeters long. Many spent fish had their stomachs gorged with smelt eggs.

In the spring of 1927 there was virtually no run in the brooks, which for several years have been under observation during the spawning run of salt-water smelt. Although the usual number of boys and men were on the brooks almost every night, quite positively not over 100 smelts in all were taken.

A peculiarity of the run that did occur was the fact that most of the fish, even at the beginning of the run, were large 3 and 4 year old females, whereas usually the fish are comparatively small and chiefly 2-year-old males at the beginning of the season. This fact suggests that either but few eggs of the spring of 1925 hatched or else the fish did not survive. So far as the two brooks under observation are concerned, the probability is that there was no hatch, inasmuch as the intensive and abusive fishery each year must prevent many fish from breeding. During the session of the Maine Legislature last winter an effort was made to secure the passage of a bill providing adequate protection for the smelts of Maine in the fresh-water portions of brooks frequented by salt-water smelt for breeding, a thing which they never have had. The bill did not reach the committee, although it was approved and recommended by the United States Commissioner of Fisheries.

## MACKEREL

During 1927 the investigations on the mackerel fishery, in cooperation with the division of fishery industries, were continued by O. E. Sette, assisted by E. W. Bailey. R. A. Nesbit, R. A. Goffin, and Thomas Quast also were engaged on this investigation during the season. As in the previous year, the program consisted principally of the simultaneous collection of biological and statistical data on the mackerel fishery to provide information as to the life history of the species, the fluctuations in abundance, and the cause of such fluctuations.

During the 1927 season observers were stationed in the principal mackerel-receiving ports, where they interviewed the vessel fishermen and secured data on locality, dates, and size of catch, and measurements of samples of the mackerel landed. During this period 1,181 trips of mackerel seiners were recorded and samples from 1,135 of these were measured. This constituted catch data on approximately 75 per cent of the quantity of mackerel landed and measurements of samples from 74 per cent. Similar data were collected from the mackerel netters. In all, 36,263 measurements were made and scales were collected from 2,898 specimens.

An incomplete analysis of the 1927 data indicates that during the past season the mackerel of the 1923 year class continued dominant in the catches. This is the third season in which this dominance has been well marked, leading to the conclusion that spawning seasons since 1923 so far have failed to produce sufficient mackerel to make an appreciable showing in the commercial catch. Also, the 1923 age group is beginning to decline in abundance, as indicated by a slightly smaller catch in 1927, the decrease, compared with 1926, being approximately 12 per cent. Thus this investigation is providing an accumulation of information as to the number of years in which good catches may be made of the offspring of an unusually good year class, and by collecting this information we are beginning to understand the effects on the commercial fishery of unequal birth rates from year to year and the mortality in subsequent years.

The steamer *Albatross II* was detailed to the mackerel work for about two weeks in May and was engaged in making tow-net hauls and taking other oceanographic data along the coast between Cape May and Cape Cod. Forty-one stations, distributed on the continental shelf between the coast and the 1,000-fathom contour, were visited. Remarkably good catches of mackerel eggs and larvæ were made at virtually all stations. The greatest concentration was found between the 20 and 40 fathom contours and in the area off New Jersey and Long Island. The greatest number of mackerel eggs taken in the one-half-hour tow of a 1-meter tow net with No. 0 mesh was 156,000. The greatest number of larvæ was 7,500. The average number per one-half-hour tow was 17,300 eggs and 695 larvæ. During June and July additional collections were made by the *Albatross II* incidental to the cod-tagging program in the Gulf of Maine. These tows were taken too late in the season to yield a large number of eggs, but good catches of postlarval forms were taken. Judging from these results, the spawning season was fairly satisfactory; whether it was worse or better than normal can not be determined, for we have no data for other years for comparison.

The appearance of unusual numbers of juvenile mackerel in the pound nets near Newport, Woods Hole, Nantucket, and Provincetown leads us to believe that the production of mackerel in 1927 and their survival through the embryo and larval stages were unusually successful. These will have reached "tinker" size in 1928 and in 1929 should be of good commercial size. Future observations will show whether or not the abundance of eggs and larvæ and the unusual appearance of juvenile mackerel in the pound nets presage an important year class in the commercial fishery.

Tagging operations were virtually discontinued in 1927. The tags used in previous seasons were found to have undesirable effects on the fish, and therefore we have attempted, unsuccessfully so far, to develop a more suitable tag.

### FISHERIES OF THE MIDDLE ATLANTIC STATES

Funds were made available at the beginning of the fiscal year ended June 30, 1928, for an investigation of the fisheries of the Middle Atlantic States. Very little is known concerning the extent to which the catch of the important food fishes in this region is subject to fluctuations from year to year, nor are the life histories of these fishes sufficiently well known to make it possible to determine the causes of such fluctuations as occur. The object of the investigations now being conducted is to determine the safe maximum capacity to withstand depletion that is provided by each natural population unit of each species studied, and to determine whether the fishery as it is conducted is exceeding this maximum. This involves observation of the seasonal and annual fluctuations in abundance over a period of years at a number of localities within the range of each species. It involves, further, appropriate biological observations in order to determine the causes of such fluctuations, with particular reference to distinguishing between the effects of natural causes and the effects of the fishery.

As the squeteague is the most important species taken in the Middle Atlantic region and is of interest to commercial fishermen and sportsmen alike, it is being given especial attention. Data bearing on other species, such as butterfish, summer flounders, croaker, sea bass, bluefish, and scup, are being collected as far as is practicable. During the 1927 fishing season observations were limited to the territory between Delaware Bay and Nantucket, Mass. This is not the full range of some of the species observed, and therefore it may become necessary to extend the territory under observation. A preliminary survey was undertaken by R. A. Nesbit to discover sources of unpublished statistical information, to observe the methods of the fishery, and to select suitable observation bases for the future collection of biological data. In addition length-frequency and sex-ratio observations were made and scale samples were collected. These should be of value for comparison with corresponding data collected in succeeding seasons. Nine thousand fish were measured, including 7,000 squeteague, and 1,200 scale samples collected, 850 of which were from squeteague. Fishermen were interviewed, traps were visited, and trips were made on fishing vessels at Wildwood, Manasquan, and Long Branch, N. J.; West Sayville and Montauk, N. Y.; Stonington, Conn.; Newport, R. I.; and Woods Hole and Nantucket, Mass.

In October, 1927, Harry A. Hanson, temporary assistant, was assigned to the duty of collecting and transcribing vessel logs and records of pound and trap net catches. These data are now being analyzed at the Woods Hole laboratory, and should be of great value as illustrating the sort of phenomena that the investigation must seek to explain.

A collection of squeteague scales made in Pamlico Sound, N. C., during 1925 has been mounted and is now being examined at the Woods Hole laboratory. It is hoped that comparison of these scales with samples collected in the northerly part of the range of these fish will cast light on the unity or distinctness of the populations concerned. A collection of scales made in Sandy Hook by investigators of the New York Aquarium has been turned over to the bureau for study.

During the 1928 fishing season observers will be stationed at a number of localities, where regular collections of data on the following subjects are to be made: Length-frequency samples, sex ratios, condition of gonads, food habits, and racial determination. Efforts are being made to render the statistical records in future years more complete and more adaptable to the purposes of scientific investigations.

The work on the fishes of Chesapeake Bay, mentioned in previous progress reports and prepared by Dr. Samuel F. Hildebrand and William C. Schroeder, has been issued. This book contains 366 pages and many illustrations and may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., bound in buckram, for $1.50.

## LARVAL FISHES

Perhaps the basic problem in general fishery investigation is the discovery of the causes of the fluctuations in abundance, which have such a profound effect on the fishing industry. It is agreed generally that these fluctuations are determined largely by the mortality that occurs in the early stages of development, and hence a study of the survival of eggs and larvæ of commercial fishes is of utmost importance. The early life history of most of our commercial fishes is virtually unknown, however; indeed, the very young, which are so different in appearance from the adults, are extremely difficult of recognition. A preliminary step in a study of the biology of survival is the ready identification of the eggs and larvæ of the species under consideration. It is the purpose of the bureau, therefore, to give particular attention to the larval fauna of each region studied, in order to develop, if possible, methods of ready identification of fish larvæ and to gain such facts concerning their development, habits, and distribution as may bear upon the problems of fishery conservation.

This work, which heretofore has been done at the Woods Hole laboratory, is now being conducted at the Beaufort laboratory. Each week, the weather permitting, one trip of about 40 miles is made outside Beaufort Inlet. On this course not less than six stations are covered, at each of which both bottom and surface towings with meter nets are made. Often two nets of different mesh are operated at the surface at each station, and otter trawls also are used. The collections are supplemented by towings taken weekly within the harbor. In addition to young fish and fish eggs, numerous invertebrate forms are taken, which are preserved for future study; and there is on hand for study, in addition, a collection of young fish taken by the U. S. F. S. *Fish Hawk* in 1913 and 1914. This work is in charge of Dr. Samuel F. Hildebrand, director of the fisheries laboratory at Beaufort, N. C., who is assisted in the study of the specimens by Louella E. Cable and in the collection of specimens by James S. Gutsell and Charles Hatsel.

During the summer several pelagic species, including Seriola, Naucrates, and flying fishes (three species), of which the adults are rather rare locally, were common or numerous in the tows. Flatfish larvæ of several species (mostly as yet unidentified) were common in the bottom tows throughout the year. During the spring and early summer the young of the pigfish (*Orthopristis chrysopterus*) and white perch (*Bairdiella chrysura*) predominated in the catches. Sea robins, gobies, and blennies were common during the summer and autumn, but in the winter the spot (*Leiostomus xanthurus*) and the menhaden (*Brevoortia tyrannus*) were most numerous in the catches both inside and outside the harbor. It was disappointing that the eggs and young of such common and important commercial species as the weakfishes (Cynoscion) and mullets (Mugil) did not appear in the catches.

Late in the year various collections of young fish on hand at the Washington office and Woods Hole station were sent to Beaufort for study. Descriptions and drawings of various stages in the development of several species have been prepared, and it is purposed to publish these from time to time with information on rate of growth, food, habits, etc.

### TEXAS SHORE FISHERIES

Field studies of the shore fisheries of Texas were concluded in the spring of 1927 by J. C. Pearson, temporary assistant, and a comprehensive report is ready for printing. Not only was definite information obtained as to the spawning grounds of the three leading food fish of the Texas coast—the redfish, black drum, and spotted trout—but necessary data on rate of growth, age at first spawning, and other facts requisite to intelligent consideration of fishery regulation were acquired. The much-debated question as to whether the redfish, drum, and spotted trout spawn within the bays or in the Gulf of Mexico itself has been given attention. All the evidence indicates that the redfish and black drum spawn in the Gulf, but that the spotted trout spawns in the shallow, grassy lagoons and bays that line the coast.

Soon after hatching, the young of the redfish, drum, croaker, and spot swarm voluntarily or are carried by the currents through the passes into the bays, where they spend their early life. At times the concentration of larval and postlarval fishes around the passes is remarkable, thousands often being obtainable in a few square feet of water area.

Detailed studies of growth, based on length-frequency and scale analyses, have yielded interesting results in the case of several fishes. The redfish (*Sciænops ocellatus*), spawned in late September or early October, reaches a modal length of about 34 centimeters by the end of its first year of life and about 55 centimeters by the end of the second year. Fish at these ages and sizes are excellent for market; the 1-year-old fish weigh about 1½ pounds and the 2-year-olds about 4 pounds. The black drum, while not showing the same rate of growth as the redfish, nevertheless reaches marketable size by the end of its first year. The annual growth of this species for the first six years and of the spotted trout for the first nine years has been determined also.

A systematic study of the entire fish fauna of the Texas coast was undertaken early in the year by Isaac Ginsburg. This study is based largely on collections made incidental to the study of the life histories of the commercially important species and the collections made by the *Grampus* in the coastal waters in the Gulf in 1916. These latter, while not extensive enough for a complete study, so far have yielded interesting information. Identification has shown that they comprise about 135 distinct species, a few apparently new. This is probably only about two-thirds of the entire number of species actually existing on the coast of Texas. Tentatively it may be stated that the fish fauna of the Texas coast is similar to that of the coast of the Carolinas. The majority of species are the same, and the dominant species in each region are the red drum, black drum, mullet, croaker, spot, spotted weakfish, and pigfish.

The fish fauna of the Gulf coast is very interesting from a distributional standpoint. Nearly all of the species that give character to the fauna in both regions (with the notable exception of the cosmopolitan mullet) do not occur in southern Florida. So far as migration from the one region to the other is concerned, the subtropical waters of southern Florida serve as an effective barrier.

The sand trout, which is very common on the Gulf coast and is marketed to some extent, but is not common on the Atlantic coast, has received special study, which has shown that there are two distinct forms that differ decidedly in the number of rays in the dorsal and anal fins. These two forms have been designated tentatively as *Cynoscion nothus* and *Cynoscion thalassinus* Holbrook. The common form on the Texas coast is not *C. nothus*, but the other species.

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## PACIFIC COAST AND ALASKA INVESTIGATIONS

### ALASKA SALMON

One of the greatest responsibilities resting upon the bureau is that of advising the Secretary of Commerce in the administration, under the White Act of 1924, of the fisheries of Alaska. If these fisheries fail, the bureau is responsible in large degree; if they prosper, the credit must be given to the wisdom and knowledge employed in drafting the fishery code and to the courage and faithfulness with which the regulations are being enforced. The bureau has made great strides during the last decade in acquiring that exact and intimate knowledge of the biology of the salmon necessary for the wise husbanding of the supply.

Although many workers were engaged in the early investigations, undoubtedly the greatest contribution was made by the late Dr. C. H. Gilbert through his studies on the biology of the various species of salmon; and although the investigations in recent years have developed along more practical lines than formerly, each year's work has been a continuation of that for which comprehensive plans were made several years ago, and each year finishes one more chapter in a continued story. The aim of the investigation up to the present time is concisely given in Doctor Gilbert's own words, as follows:

> The principal aim of this work is to ascertain what relation exists between spawning colonies of varying size and the number of progeny that they furnish. For this crucial experiment we have chosen, as most favorable, the Karluk and Chignik Rivers and the streams entering Olga Bay. The annual weir counts give us the size of the spawning colonies, and the weir counts plus the commercial catches give us the total returns to these streams. But as the progeny of any year mature at various ages, it becomes necessary, in order to ascertain the returns from any single spawning, to analyze the runs to the experimental streams and to determine in what proportions fish of different ages appear in these runs. To do this, it is necessary to examine extensive samples taken at frequent intervals during the runs, making age determinations through the miscroscopic structure of the scales, and by the results thus obtained to compute how many 3, 4, 5, 6, and 7 year fish comprise the run of each year. When that is carried out over a term of years, it becomes possible to sum the total progeny of any spawning, which have appeared as fish of different ages in a series of successive runs.
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> From time to time it is possible to sum the results and draw conclusions that are believed to have both scientific and practical value. Such an attempt was made last year by Doctor Rich and me for the investigations made to date in the Karluk watershed. (See Doc. No. 1021.) We announced in this paper, tentatively, a rate of increase from spawning parents to progeny of approximately three to one and on this basis ventured a prophecy that the total run of red salmon to the Karluk River in 1927 should not exceed 1,500,000 fish. The run that actually occurred, including weir count plus commercial catch, was approximately 1,641,000. (The run of 1926 had exceeded 4,600,000.) We do not believe it possible to predict as closely as this the runs of successive years, but we do believe that by this method a more reliable basis for prediction may be ascertained than has been available in the past.
>
> The work done annually in connection with these experiments is of a highly routine nature—the examination of many thousands of salmon scales, the tabulation of the results, and the attempt to draw from these such generalizations of value as seem warranted by the facts. In addition to the above, we are attempting to ascertain, for all the principal red-salmon streams in Alaska and especially for those in Bristol Bay, the prevailing age cycle of each, so as to determine what were the brood years for each successive run.

*Tagging experiments.*—Additional tagging experiments in the channels of southeastern Alaska were conducted during 1927 under the general direction of Dr. W. H. Rich. On account of the scarcity of fish in this region the work was especially difficult and slow, so that only about 4,000 fish were tagged. The results are now being tabulated, and it is expected that a report will be submitted for publication within a few months. During the year a report by Doctor Rich and Arnie J. Suomela, warden in the Alaska service, dealing with the tagging experiments of 1926 was published and may be summarized as follows:

During 1926 a special effort was made to supplement the experiments of 1924 and 1925 in southeastern Alaska. Therefore, the tagging done early in the season of 1926 occurred in localities where it had been done late in other years, and vice versa. The general routes of migration were the same as outlined in the previous report. Fish entering Icy Strait are distributed mainly to waters tributary to Icy Strait, Chatham Strait, Frederick Sound, and Stephens Passage. Those entering Sumner Strait go mainly to Sumner Strait, Clarence Strait, Ernest Sound, Behm Canal, and Revillagigedo Channel; and those entering at Dixons Entrance are distributed to the west coast of Prince of Wales Island, the lower part of Clarence Strait, Behm Canal, Ernest Sound, and to the streams of northern British Columbia. In general, it appears that the fish enter the channels of southeastern Alaska through the entrance that provides the most direct route to the streams in which they will spawn eventually, and that they follow this most direct route without wide wandering. Certain differences are shown in the distribution of red salmon tagged early in the season as compared with salmon tagged later at the same place. No such differences are plain in the case of the other species. In the case of red salmon tagged near Cape Fox, the early fish appear to go chiefly to Boca de Quadra and the Nass River, but apparently a larger percentage of the fish found in the region of Cape Fox later in the season originated in the streams of British Columbia. The experiments have shown conclusively that the early run of reds in the region of Icy Strait contains a large number from the large rivers at the head of Lynn Canal. The later run contains few, if any, Lynn Canal fish but do contain many fish bound for Taku Inlet that were not represented at all earlier in the season. As in previous experiments, the distribution of the pink salmon and chums is shown to be predominantly to places within a comparatively short distance from the point of tagging. This probably is due to the habit of these two species of spawning in all of the numerous small creeks of this region. The red salmon range more widely, but the cohos appear to range farthest of any of the species tagged. As in 1924 and 1925, about 27 per cent of the tagged fish were recaptured.

The tagging of chinook and silver salmon caught by troll along the Pacific coast was continued in connection with the program of tagging initiated by the International Pacific Salmon Investigation Federation. In southeastern Alaska this work was done by the bureau, but along the coasts of Oregon, Washington, and California the State fish and game commissions cooperated with the bureau in the tagging. The results show conclusively that a large percentage of the chinook salmon taken by troll along the coasts of Oregon, Washington, British Columbia, and southeastern Alaska belongs to the Columbia River run. Apparently not many of the salmon found along the coast of California are Columbia River fish, although the data are too few to warrant final conclusions.

*Statistics of the Alaska salmon fisheries.*—The tabulation and analysis of detailed statistics of the Alaska salmon fisheries from 1904 (when the collection of statistics by the Bureau of Fisheries began) to the present time was begun two years ago. Sufficient progress has been made to warrant the preparation of a report on the work in all sections of Alaska except southeastern Alaska. The work is being carried on by Doctor Rich and E. M. Ball, assistant, Alaska Service.

*Marking experiments at Karluk.*—In connection with the intensive investigation of the Karluk River red salmon that is being carried on by Dr. C. H. Gilbert and Dr. W. H. Rich, 50,000 seaward migrants were marked during June, 1927. This phase of the work was begun in 1926 and has as its purpose the ultimate determination of the number of seaward migrants each year. Future runs of adult fish will be sampled, and from the samples the percentage of marked fish in each age group will be determined. At the same time the total number of fish of each age group will be determined by scale readings. With these data at hand, the number of seaward migrants may be determined by means of the following proportion: The percentage of marked fish in a given age group is to 100 as the number of fish marked is to the total number migrating seaward. Twenty-four of the fish marked in 1926 were recovered as adults (grilse) in 1927. These formed 0.357 per cent of the total number of grilse. As 47,000 seaward migrants were marked in 1926, the proportion becomes: 0.357 : 100 : : 47,000 : x (the total number of migrants in 1926). According to this calculation, there were about 13,000,000 seaward migrants in 1926, but the probable error of this determination necessarily is large because of the comparatively few marked grilse recovered. It is expected that more adequate returns will be secured in 1928, when most of the fish that migrated in 1926 will return, and that a more accurate calculation of the number of seaward migrants in 1926 can be made then.

*Observations on the spawning grounds at Karluk Lake.*—These were continued by Doctor Rich, assisted by S. P. Smith, temporary assistant. Conditions on the spawning grounds and in the lake were strikingly different from those found in 1926. The summer of 1927 was much colder, with a heavier rainfall. As a result, the water in the spawning streams remained high throughout the summer and apparently provided more favorable spawning conditions. At the same time the spawning escapement was much lower than in 1926, as a result of which the spawning beds never were crowded and there was no such mortality of unspawned fish as was recorded in 1926. Conditions in the lake were equally different. The surface temperature of the lake remained below 12° C., which was about 5° C. below the maximum surface temperature recorded in 1926. No thermocline was established, while in 1926 a well-defined thermocline was maintained throughout the summer. Further investigations will be necessary in order that the effect such varied conditions have upon the hatching of the eggs and the survival and growth of the young salmon during their life in the lake may be determined. A good collection of young salmon was made in Karluk Lake with a special net. It never has been possible before to secure young red salmon during their sojourn in the lake, and this collection should be valuable in solving some of the difficult problems that arise in reading adult scales. Dr. George Kemmerer, of the University of Wisconsin, made a chemical survey of Karluk Lake and the tributary streams as a basis for a more thorough understanding of the ecological conditions that apparently make this lake especially favorable for the growth of young red salmon.

*Tagging red salmon in Uganik Bay.*—Another experiment was made in Uganik Bay, Kodiak Island, Alaska, where Doctor Rich tagged 700 red salmon taken from a trap near Broken Point. These proved to be chiefly Karluk River fish, as a very large percentage of the tags were recovered from the fishery at the mouth of this river or from points intermediate between there and the place of tagging.

### COLUMBIA RIVER SALMON

Observations on the returns from salmon-marking experiments conducted on the Columbia River have been continued by H. B. Holmes. Approximately 600 mature salmon, which had been marked when they were liberated from the hatcheries as fingerlings, were recovered when they returned to the Columbia River to spawn. Approximately 450 chinook salmon have now been recovered from a marking of 100,000 fingerlings liberated at the Big White Salmon River hatchery during the spring of 1923. This is the greatest number recovered from an experiment with chinook salmon. In experiments with sockeye salmon, however, ten times this number of mature fish were recovered, but the reason for the difference in survival in the two species remains undiscovered.

Returns from experiments with sockeye salmon indicate that the age at which these fish reach maturity is determined by heredity; that is, fish whose parents spawned in their fourth year will mature predominantly in their fourth year, whereas 5-year-old parents produce a predominance of fifth-year spawners. The data concerning this question are as yet too meager to be considered as conclusive. Additional information is to be expected from future returns from experiments now in progress.

Two new marking experiments were begun during the year. One of these was designed to give further evidence of the relative influence of heredity and early environment upon the habits of the fish. Information on this subject is of great practical importance in connection with the practice of transferring eggs from one hatchery to another. The information received to date would tend to discourage this practice. For example, records obtained in the past season have shown that when eggs taken on one of the lower tributaries of the Columbia were transferred to a station in the headwaters the fish that developed from them did *not* return to the tributary in which the eggs were taken, and they started their migration too late in the season to allow time for the long migration to the headwaters. As a result, it is possible that none of these fish succeeded in spawning. On the other hand, salmon that are planted in their native tributary almost invariably return to it to spawn.

### EMBRYOLOGY OF THE CHINOOK SALMON

A study of the development of the chinook salmon was undertaken during the year by Dr. G. C. Price, of Stanford University. Particular attention was paid to the influence of temperature on the rate of development, and it has been shown that the so-called "temperature-unit system," which is in common use in salmon hatcheries for keeping account of the development of the eggs, does not state this relationship correctly. Instead of a simple, direct relationship between temperature and the rate of development, as called for by the temperature-unit system, it has been found that the rate of development is accelerated with an increase of temperature, at least during the range of temperature covered by the available observations. In using the temperature-unit system for calculating the time of hatching, the error thus introduced is sufficient to throw the calculation off by approximately 10 per cent at moderate extremes of temperature.

### ALASKA HERRING

The use of herring for oil and meal or fertilizer in southeastern Alaska and Prince William Sound has developed so rapidly in recent years that it is assuming alarming proportions. In 1926 these two districts produced over six times as much herring oil as in 1922, but the yield of pickled herring, in spite of good prices for the product, amounted to only one-eighth that in the earlier year. The manufacture of these by-products, at first a side line to utilize the wastage of the salteries, has now become the chief object of the fishery in these districts. These facts, together with a decline in abundance of herring in certain regions, have aroused the fear of depletion in the minds of the herring fishermen themselves as well as in the salmon and halibut fishermen, who are indirectly dependent upon the herring supply.

Investigations of the herring fishery, begun in 1925 by George A. Rounsefell, have been continued. Most of the work has been done in central Alaska, where conditions are most favorable for studying the life history of the herring. Of direct bearing upon the problem of depletion is the discovery of natural variations in abundance due to varying success of spawning, and the existence or nonexistence of dominant age groups, such as are conspicuously present in the Atlantic herring, and which cause enormous fluctuations in abundance, have been studied. Although more information on this point is required and is being collected, present studies show conclusively that this phenomenon does occur. To discover the effect of such dominant age groups on the commercial catch, detailed statistics showing the time and place of each catch and the amount of gear required are being collected for later analysis.

Previous studies have demonstrated that the herring population in Alaska is composed of segregated units or local races inhabiting well-defined areas and subject to depletion from overfishing in each locality. It has been shown that local races occur in Prince William Sound, Dogfish Bay, Kachemak Bay, Shuyak Strait, Chignik, the Shumagin Islands, Golovin Bay, and the Bering Sea. Growth rates have been calculated for a few localities. Herring in Halibut Cove, Kachemak Bay, and Shuyak Strait make the same rate of growth, but the Prince William Sound fish grow much more slowly, reaching a length of but 23 centimeters when six years old, compared with 25 centimeters for fish in the other localities.

A tagging experiment to define local migrations was begun in the spring of 1927, when 3,000 herring were tagged at Halibut Cove; but no returns have been received. It is likely that a new type of tag will be required for a fish as small and delicate as the herring.

For the past two seasons weights of herring have been recorded in order to show changes in the amount of fat and the condition of the fish. In these two seasons, even, a variation of at least two weeks occurred in the date at which the fish attained a condition suitable for pickling. The investigation is being extended to southeastern Alaska, where many samples of herring have been collected and preserved. These are being analyzed for racial characteristics, age, weight, etc. A report on the investigation to date is almost completed for publication.

## INVESTIGATIONS OF INTERIOR WATERS

### GREAT LAKES

After careful consideration of the numerous and varied problems that confront the fishing industry of the Great Lakes, it was decided to concentrate work on Lake Erie in an attempt to solve the many disputed problems that engage the commercial fishermen there. The dissension among the Erie fishermen has reached such a state that any attempt to effect immediate cooperation by framing regulatory measures would be doomed to failure. It is essential that an impartial investigation be made of all the matters in dispute, no matter how insignificant they may appear or how little value their settlement may have from a scientific point of view. In working out a program for Lake Erie, therefore, first consideration was given those problems that were of interest to the fishermen, in the hope that their solution might pave the way for uniform fishing laws on this lake, and possibly on other lakes, and for improvements in regulations. Provision was made for the acquisition of data of scientific value also.

The Lake Erie program was initiated in August, 1927, at Vermilion, Ohio, under the immediate direction of Dr. John Van Oosten. At first the lifts of the commercial nets of gill-net tugs and of trap-net boats were studied on alternate days. The gill-net fish were measured and weighed and samples of their scales taken. Similar data were obtained from some of the trap-net fish, but virtually all the work on trap nets was concerned with the classification and enumeration of the number of legal and illegal fish of each species taken, and the number of dead or seriously injured and of the apparently uninjured illegal fish taken. This program was continued until mid-September, when the study of the samples from experimental nets was begun.

The experimental gill nets fished at Vermilion, Ohio, had stretched mesh of the following sizes: $2\frac{3}{4}$, $2\frac{7}{8}$, $3\frac{1}{16}$, $3\frac{1}{8}$, $3\frac{1}{4}$, and $3\frac{1}{2}$ inches; each special net was placed between two commercial nets, of 3-inch mesh. Length, weight, and scales of each fish taken in each of the 13 nets were studied. The special experimental trap nets fished at Sandusky, Ohio, had backs with mesh of the following sizes: $2\frac{1}{2}$, $2\frac{3}{4}$, $2\frac{7}{8}$, 3, and $3\frac{1}{4}$ inches. Each special net was placed between two commercial nets, thus making 11 experimental nets in all.

These observations provide data on the species composition of the catch of each kind of net, fluctuations in relative abundance and size of each species, changes in age and sex composition of the daily catches, the growth rates by species and sex, age and size at sexual maturity, and the percentage of immature fish in the commercial catch. In addition to these data, precise records are obtained of the total weight, number, and average size of legal and illegal or undersized fish in each net, and the percentage abundance of illegal fish and game fish. From this it may be seen that an attempt is being made to obtain critical data on the destructiveness of trap nets, bull nets, shallow gill nets, and seines to commercial and game species; on the effectiveness of the present laws on size limits to protect immature fish; and on the size of mesh in gill nets and trap nets that is most desirable for commercial fishing—that is, a mesh that will retain the greatest number of legal-sized fish with the least destruction to the others. It is hoped that the experiments on the selectivity of meshes of various sizes and the work on the size of fish at sexual maturity may form the basis for uniform laws on Lake Erie.

The State of Ohio is cooperating with the bureau by carrying on a series of biological studies on the condition of fish life in the lake, making determinations of temperatures, dissolved oxygen, carbon dioxide, nitrogen, hydrogen-ion concentration, plankton, and bottom fauna. In addition, much work was done on the external and internal parasites and on the stomach content (food) of the more important commercial species. As little opportunity has been afforded so far to work up the vast number of data obtained, it is not safe at present to draw any definite conclusions, but rapid progress is being made in the analyses.

#### WISCONSIN LAKES

The investigations of the Wisconsin geological and natural history survey on the lakes of northern Wisconsin for the past three years have made possible a study of the growth rates of fishes in relation to the physical, chemical, and biological conditions in the lakes. During the summer of 1927 about 1,800 fish were taken from five lakes that were selected on the basis of limnological diversity. The growth rates of these fish are being studied by the scale method by Stillman Wright, temporary assistant. The food of certain of the species will be studied later. Perch and white suckers make up the bulk of the collection, but the indications at the present are that the Centrarchidæ will serve better for the purpose of this investigation. Further collecting, particularly of the small fish, will be necessary before the data can be considered adequate. It is hoped that results will be obtained finally that will have a bearing on the problem of planting fish in inland lakes.

### INVESTIGATIONS OF SHELLFISH AND TERRAPIN

#### SURVEYS OF OYSTER BOTTOMS

At the request of the commissioner of the department of game and fisheries of Alabama, a survey of oyster bottoms in Mobile Bay was made in April, 1927, by Dr. P. S. Galtsoff. Oyster-producing bottoms in Alabama are confined to the lower part of Mobile Bay and the eastern part of Mississippi Sound. Because of the different hydrographical conditions in these two localities, it is desirable to discuss them separately.

*Mobile Bay.*—The oyster-bearing bottoms in this bay can be grouped into two distinct classes. The first comprises the reefs extending along the western shore of the bay from Fowl River to Grant Pass, a distance of 12 miles, and for 4 miles more in a southeasterly direction and parallel to the northern shore of Little Dauphin Island. These reefs are confined almost entirely to the area lying between the 6-foot and 12-foot depth curves. The surrounding bottom is of soft mud on the eastern side of the reefs and of sand between the shore line and the western edge of the reefs. The area between the 6-foot and 12-foot curves from Fowl River to the eastern end of Little Dauphin Island comprises about 20,000 acres, but the actual extent of the natural beds or reefs amounts to 2,245 acres. The oyster growth on these reefs may be characterized as dense. In many instances the reefs of this group produce only "coon" oysters of inferior quality, due entirely to the extreme abundance of the set, which covers the adult oysters and causes the formation of clusters of oysters, preventing their normal development and growth. The reefs between Cedar Point and Fowl River Point are 10 or 12 feet deep and are exposed to rough seas on the north, east, and south. Consequently very little tonging is done on these grounds and is possible only on exceptionally calm days.

The second group comprises the ground along the eastern shore of Bon Secours Bay. These reefs are few in number, with sparse growth, but produce single oysters of good quality. The depth of the water over the beds varies from 6 to 8 feet, and the beds are surrounded by a soft mud. Between the 6-foot curve and the shore is an area of hard, sandy bottom, a large part of which is suitable for cultivating oysters. The total area of the natural bed is about 500 acres. The bottom of the bay, although generally soft, contains large areas of sticky mud suitable for oyster planting.

*Mississippi Sound.*—The natural oyster beds in the eastern part of Mississippi Sound, Mobile County, cover 4,000 acres. Most of the beds are to be found at the junction of Mobile Bay and the sound, but a few are in Portersville Bay and vicinity. About one-third of the area supports a dense growth and produces cluster or coon oysters. The depth of water over the reefs varies from 2 to 8 feet. The character of the bottom is different in various localities, varying from fine, soft ooze to sticky or hard mud. There are considerable stretches of barren bottom, especially in Grand Bay, Portersville Bay, and around Goffel Island that are suitable for oyster planting. Hard bottom is found in the middle of the sound and along the northern shore of Dauphin Island also. The general plan for increasing production and improving the quality of the oysters in these waters is as follows:

1. Return a large quantity of shells to the natural beds.
2. Extend the natural beds by planting shells on adjacent firm bottoms.
3. Plant seed and adult oysters on depleted beds.
4. Close depleted areas until they are restored to a self-sustaining basis.

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5. Collect seed oysters on shells or other collectors in areas where heaviest setting occurs and transplant these oysters to suitable bottoms where setting does not occur or is light, so they will develop as single, better-shaped oysters.

6. Apply improved methods of oyster culture to oysters under private control.

Seed oysters can be obtained in large quantities near Grant's Pass, at the entrance to Heron Bay, and along the shores of Portersville Harbor. The best method of obtaining them is to plant clean shells, which should be scattered over the firm bottoms or planted (just before the oysters set) in bags 12 inches in diameter and 3 feet long, made of galvanized chicken wire of 1½ or 2 inch mesh. In the fall the bags are taken up and the shells dumped on firm bottom in deep water. The best locality in which to plant seed is Bon Secours Bay, where setting is light and the oysters would not be overcrowded. The productivity of overcrowded reefs can be improved by removing small oysters and planting them elsewhere. Before transplanting, large clusters should be broken apart. It is not necessary to break the clusters into separate shells, but small bunches of five or six shells can be left unbroken. The best time to plant is in the fall or winter, when the temperature is low. Then mortality would not be as great as in summer.

Future progress in the oyster industry in Alabama waters depends upon the development of oyster farming. It can be promoted by encouraging leasing of grounds to private citizens, giving protection to public and private oyster bottoms, and introducing modern methods of oyster culture. Individuals and companies engaged in growing oysters should be permitted to use modern equipment for dredging and handling oysters on their own grounds, but the use of such apparatus should not be permitted on the natural public beds except under strict supervision by the State.

*Mississippi Sound.*—The investigation of the oyster bottoms in Mississippi Sound was completed in September by J. H. Weatherby. The purpose of the survey was to determine the causes of the decrease in productivity of the natural beds and to devise methods for maintaining and increasing their productivity. The following conclusions were reached after one year's study:

1. The chief cause of decreasing production in the sound and its tributaries is overfishing, followed by insufficient planting of cultch and seed. That this region is well suited to oyster culture is indicated best by the fact that all available material upon which larvæ can attach themselves is covered by an abundance of spat every year, and that generally oysters reach marketable size in two years.

2. From 50,000 to 60,000 barrels of shells are planted annually over an area of approximately 20 square miles, which produces 200,000 to 300,000 barrels of oysters. When considered in relation to the amount of planting done, this production is all that may reasonably be expected; but when considered in relation to the total area involved, it is very small. Comparative figures show that 200,000 to 300,000 barrels annually is about 10 per cent of the amount that an area of the same size, but cultivated according to modern methods of oyster culture, could reasonably be expected to produce.

3. According to data obtained during 1927, the spawning season begins in the latter part of April or first of May and extends through August and sometimes into September, depending upon various factors. During this period there occur two distinct periods of great spawning activity and sometimes others less pronounced. In 1927 the first of these began about June 22 and lasted until July 1. The second, less distinct than the first, began about July 15 and lasted until July 22. In this year a third period, still less distinct than either of the others but quite apparent, began about August 7 and lasted until August 17.

The fact that oysters may be found on the piles that support beacons, lighthouses, and the like, or on any other place of attachment that was observed in the sound, indicates that the distribution of larvæ is very general. This fact should make feasible the establishing of reefs on what is at present barren bottom.

4. The salinity in Mississippi Sound as a whole is subject to wide seasonal fluctuation. Except for a maximum period of three months, the salinity in the west end of the sound (which produces the bulk of the oysters) was below 20. Several of the reefs in this region were covered by fresh water during the spring months. In the Back Bay of Biloxi, which generally is considered one of the best oyster-producing regions on the Mississippi coast, the salinity was above 20 for a period of three months, and then in only one-third of the bay. The duration of the existence of fresh water, or very low salinity, is shorter in the Pascagoula region than in any other oyster-producing section of the sound. For a period of eight to nine months the salinity here is between 20 and 30. In spite of this fact and the abundance of suitable bottom, this region is the most neglected of all as far as planting operations are concerned.

5. The area of bottom in Mississippi Sound that is either suitable at present or may be made suitable by the proper application of cultch is approximately 100 square miles in extent. Of this amount, about 23 square miles produces oysters in marketable quantities at this time.

6. Planting, particularly of seed oysters, often is done carelessly or improperly. No attempt is made to separate clusters of seed into single individuals.

*Pamlico Sound, North Carolina.*—With the cooperation of the State fisheries commission, a hydrographic survey of oyster bottoms in Pamlico Sound and adjacent waters was carried out by H. R. Seiwell. The results of this investigation, which lasted from October, 1926, until September, 1927, may be summarized as follows:

1. The daily and seasonal variation of salinity in Pamlico Sound depends upon the direction and velocity of the winds.

2. The highest salinities are encountered in the eastern side of the sound and the lowest in the northern part.

3. The average salinity in Pamlico Sound is 19.4 parts per thousand.

4. The direction and velocity of the currents, except those in the inlets, are determined by the direction and velocity of the winds as well as by the location of the area in question.

5. The turbidity of the water is directly dependent upon the depth and character of the bottom.

6. The nature of the bottom is variable. Generally it is soft to sticky in the shallow bays and estuaries on the western side and in the deep offshore water, while it is hard on the shoal areas.

7. The fattest and best quality oysters are growing on sticky bottoms in the various indentations on the western side south of Long Shoal and on the hard bottom in the paths of strong currents.

8. Natural oyster beds are found in the water below low-tide mark and on a few of the tidal flats close to Ocracoke Inlet.

9. Excellent supplies of seed oysters can be obtained from the tidal flats near Ocracoke Inlet (Shell Castle) and in northern Roanoke Sound opposite Naggs Head.

10. "Setting" occurs in deep water as well as on the tidal flats near Ocracoke Inlet.

11. The natural oyster beds can be restored and considerably extended by making shell plants according to a well-devised plan.

12. High-grade single oysters can be cultivated in the areas described if the oysters are not allowed to become overcrowded and grow in clusters.

13. Some oyster areas, such as Wyesocking Bay and Mount Pleasant Bay, are overcrowded.

14. The soft bottom of Bay River, in the vicinity of Vandemere, is unsuited for the production of high-grade oysters, unless the bottom be hardened by shell plants.

15. The oyster grounds north of Long Shoal are subject to freshets and do not compare favorably with other oyster grounds in the State in the production of high-grade oysters.

In order to increase oyster production and produce high-quality oysters in Pamlico Sound and its tributaries, the following recommendations are offered:

1. Shell planting on favorable oyster grounds should be increased.
2. At the end of the first year the plants, if the "set" has been thick, should be thinned by transplanting in order to prevent overcrowding.
3. Shells should not be planted among marketable oysters but should be placed a short distance from the main bed in the path of the strongest current.
4. The cull law, prohibiting the removal of shells and young oysters from the bottom, should be enforced.
5. The overcrowded oyster beds in Wyesocking Bay, Mount Pleasant Bay, and Rains Bay should be thinned by dredging.
6. Private oyster farming should be encouraged.

*Florida*.—In compliance with the request of the engineering director of the National Research Council, a survey of the inshore waters of Florida was made by Dr. P. S. Galtsoff, with a view to ascertaining whether conditions suitable for cultivation of pearl oysters exist in Florida waters. Upon considering the location of different bays, the character of the bottom, salinity of water, its pH, and general ecological conditions, it has been found that Blackwater Sound is a suitable place in which to experiment with pearl oysters.

*Inshore areas of Long Island Sound*.—In order to determine the location and extent of areas in Connecticut suitable for seed-oyster production, H. F. Prytherch made a cruise of over 50 miles in August along the coast from Stamford to the Thimble Islands. In the numerous bays, harbors, and river mouths thousands of acres of bottom were found that could easily and profitably be developed for producing seed oysters. In former times most of these areas were prolific natural oyster beds. For example, in 1887 they produced over 240,000 bushels of oysters, most of which were seed, but at present they are depleted to such an extent that it is difficult to find a few oysters on them. It was found that modern cultural methods could be applied to about 6,000 acres in the harbors. Just outside of these harbors are thousands of acres of natural beds that have been neglected sadly and are practically unproductive. The most important of these is the Bridgeport and Stratford natural bed, comprising 3,391 acres, which should be leased to the oyster growers, who are capable of producing, by cultural methods, 10 times as many oysters here as nature ever produced at the best. A chart of the Connecticut coast is being prepared, showing the areas suitable for seed-oyster production and the distribution of salinity in these inshore waters.

### STUDY OF THE FACTORS THAT CONTROL OYSTER SPAWNING AND SETTING

H. F. Prytherch continued this study in Long Island Sound in 1927. The production of seed oysters on both natural and cultivated beds has fluctuated tremendously from year to year; for example, from more than 1,000,000 bushels in 1925 to virtually none in 1926 and 1927. In analyzing the various factors that may be responsible for this, water temperature has been found to have the most important effect in the control not only of the development and ripening of the spawn but also of the time when spawning takes place. A striking correlation between the success or failure of setting and changes in temperature has been found. During the last six years setting has been good when the temperature has been above normal and has failed when it was below normal. The intensity of the set produced each year depends largely upon the number and age of the oysters on the beds, the temperature of the water just prior to spawning, and an increase in water temperature to a degree that will produce copious spawning. Recent studies indicate that daily and weekly fluctuations in water temperature are controlled chiefly by the tide, and that the maximum temperature necessary for spawning occurs when the moon is full and the range of the tide greatest.

A comparison of conditions in Long Island Sound each year with those of preceding years has made it possible to determine, at least one month in advance, when spawning will take place, when the greatest number of oyster larvæ will attach or set, and the intensity of the set that will occur. Likewise, it can be determined in advance how many shells should be planted in order to take advantage of good sets, how rapidly the shells should be planted in order that the work may be completed before setting occurs, and what beds will be most favorable to obtaining a set under existing natural conditions. This method has been tested during the past three years and has proved to be reliable and of considerable help to the industry.

The investigations at Milford have disclosed the chief factors that control oyster propagation; and by systematically collecting representative data each year, this method can be perfected and more accurate deductions made for the control of oyster-cultural operations in Milford waters.

## PHYSIOLOGY OF THE OYSTER

Physiological investigations were carried on at the fisheries biological stations at Woods Hole, Mass., and Beaufort, N. C.

*Effect of temperature on the activity of the oyster.*—The experiments on the effect of temperature on feeding of the oyster, carried on by Dr. P. S. Galtsoff since 1926, were completed and two manuscripts on the subject were submitted for publication. The results of the work prove that feeding is controlled by the temperature. At 41° F., and below, the oyster ceases to feed and remains in an inactive state as long as the temperature remains below this critical point. Long exposure to low temperature does not produce adaptation, and oysters taken from cold water in winter begin and cease to strain water at the same temperatures as they do in the summer when they are chilled suddenly.

A study of shell movements made with self-registering apparatus, based on an analysis of 134 records, has shown that the oyster tends to keep its valves open as long as possible—on an average the shell is open 17 hours and 5 minutes in 24 hours. There is no relation between the opening and closing of the shell and the time of day, as has been suggested by some investigators. The experimental study of the effect of temperature on the activity of the ciliary motion confirms the theory of hibernation advanced 18 years ago by Gorham and Pease. The revision of the methods of sanitary control of oysters, made by the United States Public Health Service, brought up again the question of hibernation; the experimental study on the physiology of the gills settles it; and as a result of this investigation the committee appointed by the United States Public Health Service has recognized hibernation as an additional safeguard in the sanitary control of oysters.

*Spawning reaction.*—Study of the spawning reaction was continued by Doctor Galtsoff during July and August. Attempts were made to isolate the substance (discharged by the male oyster) that produces typical spawning reactions in the female. It has been found that extracts of sperm are as active as the live sperm. The active agent is destroyed by heating for 30 minutes at 44° C.

*Green oysters.*—Since July, 1927, Drs. P. S. Galtsoff and Samuel Lepkovsky have been engaged in a study of causes that produce the green color that develops in the oysters of certain parts of Long Island Sound and renders them unmarketable. The annual loss to the industry from this cause amounts to many thousands of dollars. The problem of greenness is very complex and, in spite of the extensive literature on the subject, not well understood. Undoubtedly the green color of the American oyster is associated with the increased copper content of its body, but the question whether it is due to direct absorption of copper from trade wastes discharged into the water or to such a change in the metabolism of the oyster that results in an accumulation and storage of copper taken from unpolluted water remain open. In order to devise a method to improve green oysters and make them marketable it is necessary to understand the chemical nature of the green-copper compound. It was attempted to isolate the green substance, and for this purpose about 1 liter of green extract was prepared from 1,500 oysters. The investigation (which is not completed) shows that the green substance is not a hæmocyanin, as has been suggested by some previous investigators. Further investigations have shown that the green color is not a protein compound, but has a simpler chemical composition.

The distribution of copper in the tissues of oysters was studied also. It was found that there is copper in the blood cells and in the mucus that accumulates on the surface of gills and mantle.

*Effect of chemicals.*—A study of the effect of salts, which constitute the bulk of the dissolved matter in natural sea water, was made by Dr. A. E. Hopkins at Beaufort, N. C. He found that salts have a marked effect upon oysters when added to the water in very small quantities. Similar studies are being made of the effect of foreign substances in solution. In this manner it is hoped that exact knowledge may be gained of the toxic effect of all substances in sea water, both the dissolved matter normally present in the sea and other material, such as factory waste.

In addition, a quantitative analysis of the glycogen in oysters is being made in order to learn the nutritive value of the product and the conditions under which "fattening" occurs.

*Chlorination.*—A study of the effect of free chlorine on oysters was made at the Woods Hole Station by J. B. Clancy, of Pease Laboratories (Inc.), New York City. The method of purification by chlorinated water is being adopted gradually by the industry, and it is desirable to understand better the effect of free chlorine on the activity of the oyster. The experiments consisted in measuring the strength of the current and the shell movements of oysters kept in chlorinated water, employing the methods developed by Doctor Galtsoff.

The main part of the investigation dealt with the effect of chlorine on ciliary activity of the oyster. Both liquid chlorine and hypochrite in the form of zonite were used. The amount of water passed through the oyster was reduced by means of a mere trace of free chlorine. With a chlorine concentration of about 0.3 ppm., only about half as much water passed through, while the current was stopped almost entirely by about 1 ppm. Various concentrations of chlorine were used to determine the amount that would be detrimental to the oyster. It was found that a concentration as high as 50 ppm. had little, if any, harmful effect. Oysters were held for two weeks in a continuous flow of chlorinated water of about 0.5 ppm. free chlorine without deleterious effect. After the treatment, such oysters exhibited excellent keeping qualities.

## SEED-OYSTER PRODUCTION AND COLLECTION

The improved method of collecting spat developed in 1926 was tested again, on a small commercial scale, in Milford Harbor, Conn., and at Onset, Mass. The work in Connecticut was done by H. F. Prytherch; the experiments at Onset were made by Dr. Earle B. Perkins, under the direction of Doctor Galtsoff.

*Milford Harbor.*—On the tidal flats in Milford Harbor 900 bushels of oyster shells were planted in wire bags and 1,000 bushels of loose shells were scattered over the bottom. The bags were made of chicken wire, of 2-inch mesh, having a capacity of 1 bushel. Two types of bags were used—one, cylindrical in shape, 36 inches long and 12 inches in diameter, and the other, pyramidal in shape, with a wooden bottom 12 inches square, which adapts them for planting shells on soft-mud bottoms. Three hundred bushels of the shells were put out in the latter type of container, which was designed by Capt. Charles E. Wheeler, manager of the Connecticut Oyster Farms Co.

A representative sample of ½ bushel of shells was taken from more than 25 of the bags, and the number of oyster spat per shell was counted. The results obtained are as follows:

1. An average of 2,450 oyster spat was collected in the cylindrical bags and of 1,500 spat in the pyramidal type.
2. An average of 9 spat per shell was caught, giving the crop commercial value.
3. The maximum number of spat attached to a single shell was 50.
4. The set was distributed very evenly in the bags, and over 95 per cent of the shells had spat attached to them.
5. The number of spat collected in the bags varied from 1,500 to 3,500, according to their location in the harbor and position in relation to low-water mark.

In comparison with the commercial practice of scattering shells over the bottom, the bags proved to be far superior and collected over twice as many seed oysters per bushel and over ten times as many for a given area of bottom. By stacking the shell bags in tiers, as many as 20 bushels of shells can be planted per square yard, depending on the depth of the water and the zone in which setting takes place. Experiments of this kind were made in Great South Bay, Long Island, where 150 bags were planted in tiers of six in water 8 to 10 feet deep. Virtually every shell caught a set, and most of them were well covered with from 50 to 100 spat. The successful use of the shell bags in this body of water is significant, because it has demonstrated a practical method for fully utilizing the heavy sets that occur here, and especially for keeping them alive by elevating them above the bottom. Another important feature of this method is that the shells in the bags are kept cleaner and offer nearly twice as much surface per shell or per bushel as those scattered on the bottom.

*Onset Harbor.*—The method of planting shells in wire bags instead of scattering them over the flats was tested in Onset Harbor. Nine hundred and fifty bags similar in shape and size to those used in Milford were set out at various places near and on the established shell beds and in localities where it was impossible for shell beds to be maintained. The bags were placed singly on the bottom, stacked six or eight to a group, and piled irregularly in places where the current was strong.

At the end of the summer they were in as good condition as when planted and the set had penetrated to the deeper shells. About 90 per cent of the shells in a bag had spat, although the deeper shells bore only a few, but nevertheless a commercial number. An average number of 6,000 spat per bushel was found in the bags and about the same number on the established shell beds, but the bags could be stacked so that the yield per square yard of available ground could be increased proportionately to the depth of the water. Whereas the shell beds utilized only two dimensions of space, the bags utilized three dimensions, for they utilize the whole vertical range in which the larvæ will set. In Onset this was found to be from 2 feet below high-water mark to several feet below low-water mark.

Observations were made on the larvæ by making daily tows with a plankton net at various water levels and at all stages of the tide. Daily records were kept of the water temperature and salinity in the neighborhood of the spawning and shell beds, a survey was made of the distribution of salinity over the whole harbor, and the velocity of the tide at all stages of ebb and flood was determined. The results may be summarized as follows:

1. The water temperature ranged from 65° to 79.5° F., with an average for most of the summer of 75°.
2. Spawning took place about July 12, and the young straight-hinge larvæ were seen July 14.
3. Larvæ were found in the water at all stages of the tide. They were most abundant near the surface, gradually diminishing in number at the lower water levels, and at the bottom were very few in number or entirely absent.
4. As the water is being stirred constantly by the action of the tide, and as very little fresh water enters the harbor, the salinity is virtually constant and is the same at the bottom as at the surface. The range of salinity was from 25 to 29.65 parts per thousand through July, August, and September, with an average of 26. There was no observed effect of these changes in salinity on the distribution of the larvæ.
5. The first setting took place on August 1, and setting continued at intervals of a few days until August 19.

The investigations show that the wire bags are superior to methods commonly used for catching spat and make available ground which at present is not employed for this purpose.

Three years of experimenting have proved definitely that inshore areas, such as Milford Harbor and Onset, can be developed as oyster-seed producing areas by establishing spawning beds and planting suitable set collectors on the tidal flats. The wire bags filled with shells have proved to be an efficient, cheap, and practical means for collecting oyster set and are suitable for use on a large commercial scale.

### OYSTER DRILL

The study of the life history and biology of the oyster drill (*Urosalpinx cinerea*) was carried out by Dr. H. Federighi in the United States Public Health Laboratory at Craney Island, Norfolk, Va. The investigation for the past year included the following: (1) A study of the distribution of the drill in Hampton Roads; (2) survey of the damage done by it in the region of Hampton Roads; (3) study of the life history of the animal; (4) laboratory and field experiments on its behavior, habits, and feeding; and (5) study of its migrations.

The survey of the distribution of the oyster drill in Hampton Roads showed that it is limited to localities having salinities higher than 12. It was observed that it was more numerous on cultivated beds than on natural beds. The animal never is found on muddy bottoms, but inhabits hard bottoms ("natural" rocks and planted grounds) at depths between 5 and 25 feet.

The depredations caused by the oyster drill are not as great as has been claimed, the percentage of deaths due to "drills" rarely exceeding 20 per cent. Usually it lies between 3 and 8 per cent.

The animals remain inactive in winter and do not feed. They begin to feed and spawn when the temperature of the water reaches approximately 70° F. (about May 15 to 20). Spawning occurred from May 20 to September 15 in 1927, being most intense during June and July. Each female was observed to spawn but once. The average number of egg cases laid by a single female is 25 and the average number of eggs in a case is 8. Thus, each female lays about 200 eggs. About half of these hatch in 35 to 40 days. The drill stops spawning as soon as the temperature drops below 70° F. It feeds almost continuously during the summer. The rate of "drilling" into oyster shells is 0.40 millimeters per day. Although the perforation may be made anywhere on either valve, examination discloses that 74 per cent of the holes occur on or near the place of muscle attachment. Besides oysters, the oyster drill has been observed feeding on small crabs, barnacles, clams, mussels, and Crepidula.

Studies on the behavior of *Urosalpinx cinerea* give the following results:

1. The animal is negatively geotropic. When placed in a dish, the drill will creep upward until it reaches the surface of the water. This reaction undoubtedly is effective to keep mud from the mantle chamber. It is important in spawning, also. It was observed that the eggs always were laid on some object off the bottom. This would prevent their suffocation by the mud.
2. The oyster drill is rheotropic. When placed in a current, the animal will orient so as to point its siphon upstream and then move against the current. This behavior may be of importance in the distribution of the animal, but it seems probable that in a region like Hampton Roads, where the currents are tidal, it can not have great effect.

In studying the migration of the drill, 577 tagged animals were released in different localities and on various bottoms. Only those placed on oyster beds yielded information. Of these, 28 were recovered. They showed that the oyster drill migrates very little, the greatest distance traveled being 200 feet in one month.

## SCALLOPS

Scallop investigations in North Carolina, begun in July, 1925, by J. S. Gutsell at the request of the Fisheries Commission Board of North Carolina, were continued in 1927. Spawning, growth, longevity, and distribution were studied. It was found that in 1927 spawning continued through January, and that probably it began early in August or even July in 1926. Very young scallops occur in the collections early in August, become numerous by mid-August, and abundant early in September. Spawning appeared to have ceased earlier in 1927 than in the previous winter, but the two seasons correspond fairly well. With lamellibranchs, fall spawning is believed to be unusual in cases where it ceased completely in the late winter, spring, and early summer.

Studies of growth show clearly that the bulk of the market catch through the winter consists of scallops about 1 year old. Therefore, information as to the natural life span of the scallop is of great importance. If scallops die soon after attaining their second winter of life, it would be desirable to catch them for market before that happens. However, if they live to spawn in the season following their second winter, it would be distinctly advantageous to the industry to permit some of them to escape capture. In view of the uncertainty as to the exact length of life of the scallop, it is important to fix the dates limiting a closed season against scallop fishing so as to protect the young scallops of marketable size but that have not had an opportunity to spawn once.

To determine the natural life span of scallops, various tagging and penning experiments were carried out, with some valuable results. It was shown that very few of the adult scallops that remained in the spring at the close of the fishing season survived until December. Unfortunately, in spite of efforts made to protect them, so many of the scallops on the flats near the laboratory were taken by the fishermen during the scallop season that it was impossible to tell how many might have survived if unmolested.

Mature scallops from various areas vary considerably in size. In general, they are smaller in water of low salinity. Heretofore, therefore, it was thought that small size was indicative of an environment unsuited to growth, but recent studies have shown that race or variety may have bearing on size. Therefore, tentative arrangements have been made with the department of conservation and development of the State of North Carolina to transfer young scallops from seemingly unfavorable regions to others apparently better suited to them in an attempt to determine whether this would improve their size, and also in order to stock with scallops of large size sections that now produce only small scallops.

In the course of scallop collecting some histological material was obtained, as well as notes on the state of development of the gonads of *Ostrea equestris*, the small oyster found to be viviparous and hermaphroditic. In some areas this oyster incrusts the shells of scallops so heavily as to be a nuisance, and it is even held by some persons to be an enemy of the scallop.

## ALASKA CLAMS

During 1927 investigation of the Pacific razor clam was continued by Dr. F. W. Weymouth, of Stanford University, and H. C. McMillin. The measuring of shells collected previously from commercial beds was completed, and norms of growth were calculated for all important localities.

Examination of the Washington beds after the largest pack in the history of commercial operations had been made showed them to be greatly depleted. The number of diggers had increased, but the catch per man was lower than the average of recent years. All sizes of clams were taken, but the class of 1923 (4 years old) composed over half of the total. The pack of the Alaska canneries was below average, due partly to economic conditions. Examination of the beds indicated that they support only small, slow-growing clams.

Data on the change in body proportions and weight during the life of the clam were collected. The clams are nearly circular in the early adult stage, but when 4 centimeters long the width is but 35 per cent of the length. The width increases gradually throughout life, that of large clams averaging 42 per cent of the length. Study shows that there are slight differences in growth in the two sexes.

As a result of these studies, the clam industry in Alaska has been regulated more wisely and recommendations for the protection of the beds have been offered to the fishery authorities of the State of Washington.

### ALASKA SHRIMP

With the cooperation of Warden Frank Hynes, Doctor Weymouth and Mr. McMillin made a preliminary investigation of the shrimp industry at Petersburg, Alaska. Over 20 species were obtained on the summer trawling grounds. A similar collection made in winter should increase this number, as the work is carried on at different places and depths. In summer the daily catch is limited arbitrarily to ten 200-pound boxes per boat, as this amount will supply the summer markets. Although unrestricted fishing is carried on intensively during the winter, the catch per boat has not declined since the beginning of the fishery. Trawls can be operated on comparatively smooth bottom only. Such places are of small extent and difficult to find. Therefore, the actual fishing area covers only a small part of the range of the shrimp, and depletion is not to be expected.

### FRESH-WATER MUSSELS

During the past year the bureau's investigations on the fresh-water mussels of the Mississippi River Valley have developed along new lines that promise practical results as valuable as any attained heretofore in this field. One notable achievement has been the development of methods of artificial propagation of the species most valuable to the button manufacturers, and another has been the study of rates of growth by precise methods that make possible a careful check of the effects of environment on growth, an important step in the development of sound methods of mussel farming.

In nature, mussel glochidia are parasitic on the gills of certain species of fish, where they undergo metamorphosis and are distributed by falling from the fish when the proper stage of development is reached. Those that fall by chance in favorable localities survive, but countless numbers perish. In 1926 Dr. Max M. Ellis, special investigator for the bureau, succeeded in carrying individual glochidia through the same metamorphosis in a nutrient solution, in which larvæ developed successfully from normally parasitic organisms to free-living young mussels able to exist on river bottoms. These experiments were repeated in the summer of 1927 at the Fairport station, and the work progressed to the point where dozens, hundreds, and finally thousands of mussels were reared artificially to the juvenile stage. During the coming year it is purposed to cultivate mussels on a much larger scale, and it is expected that eventually artificial propagation will reach such magnitude as to make it of importance in rehabilitating formerly productive mussel grounds. The control of mussel propagation will place the production of mussels on a farming basis, where selective breeding, choice of producing grounds, crop management, and economic marketing will play their parts in stabilizing the industry and insuring an abundance of raw material.

The second line of investigation deals with the study of production in various areas by methods for determining precisely the age of mussels. T. K. Chamberlain, director of the Fairport (Iowa) fisheries biological station, has applied the methods developed by Dr. F. W. Weymouth, of Stanford University, to the study of rates of growth of mollusks and has been able to determine accurately the age of mussel shells of several important commercial species. Mr. Chamberlain is extending his studies to other localities, in order to determine the condition and composition of the stock of mussels in any given locality and to discover those localities in which the greatest growth is made. The results of such studies will be of value in planting juvenile mussels produced by the new method of culture.

Mr. Chamberlain continued a system of mussel surveys initiated several years ago, completing during the summer a survey of mussel resources of Lake Pepin, a widened portion of the Mississippi River between Wisconsin and Minnesota, which, for its area, has been unusually productive and for that reason has long been the object of special study by the bureau. These investigations are well received by the button manufacturers, who are beginning to feel the scarcity of the more suitable varieties of mussel shells.

### TERRAPINS

In 1924 the Fisheries Commission Board of North Carolina began to cooperate with the bureau in its work on diamond-back terrapin culture. A larger brood stock was secured, and each year a larger number of terrapins is hatched. It is hoped in this way to rehabilitate the supply of terrapins in the marshes of the State. The practice of former years of liberating young animals not desired at the station for experimental purposes when they have attained a length of about 2 inches has been continued.

In 1926, 3,889 animals were hatched at the station. The number hatched in 1927 to January 10, 1928, was 6,319. This number may be increased by several hundred, perhaps, next spring, when additional young may be found in the egg beds. During 1927, 2,437 young terrapins that had attained a length of about 2 inches were liberated.

An exceptionally heavy mortality occurred among the young animals during the summer of 1927, due to cancerous sores. It is believed that the disease was caused by using improper tanks, and steps have been taken to avoid a recurrence.

## INVESTIGATIONS PERTAINING TO FISH-CULTURAL OPERATIONS

The present well-organized program of research in this field, under the direction of Dr. H. S. Davis, includes three major researches—experimental trout culture, pond culture, and the pathology of hatchery fish, including, respectively, the breeding, feeding, and rearing of trout; the culture and management of warm-water species of fish in ponds; and the conquest of fish diseases.

In the latter part of September Dr. W. C. Kendall, ichthyologist of the bureau, visited a semiprivate trout preserve in the Saddleback Mountains in Maine, in order to supplement observations that have been made every year since 1922, inclusive. It was interesting to find that since 1926, when "fresh-water shrimp" (mostly *Gammarus fasciatus*) were introduced, great improvement had occurred in part of one small pond. In 1926 the largest trout observed were not over 7 inches in length, white-meated, and in poor condition generally, all of which was attributed to lack of suitable food. In 1927 some trout nearly half a pound in weight were observed, and all were plump and red-meated.

At the request of a sportmen's association of Bath, Me., a pond below Phippsburg, on Cape Small Point, was examined early in the summer to ascertain whether or not it was suited to the introduction of brook trout, and, except for the limited extent of the spawning areas, it was pronounced capable of supporting a small number of trout. In June "fresh-water shrimp" (chiefly *Hyalella knickerbockeri*, but some *Gammarus fasciatus*) and samples of water were collected from a stream in North Windham for the Board of Fisheries and Game of Connecticut. In July the Craig Brook station was inspected to determine the advisability of constructing rearing ponds for young salmon and trout, and in November the old canal at Grand Lake Stream station was inspected with a view to utilizing it as a retaining inclosure for young landlocked salmon.

### EXPERIMENTAL TROUT CULTURE

During the summer of 1927 experiments in feeding fingerling and yearling trout were continued at the Holden (Vt.) experiment hatchery by R. F. Lord under the supervision of Doctor Davis. In previous years the experimental work to discover fish foods that produce rapid growth but low mortality has been handicapped seriously by a gill disease which killed many fish and obscured the effect of the various foods. Methods were developed to control this disease, so that this season the results will show the relative value of the different foods uncomplicated by any effects of gill disease.

Each ration was fed to both brook and rainbow fingerlings for a period of 127 days, the fish being held in standard hatchery troughs in lots of 1,000. Beef liver, beef heart, and sheep liver were selected as food for the control lot, as these meats are considered standard diets for fish in hatchery practice. The other lots were fed these meats in combination with clam meal, soy-bean meal, or Mexican beans, in the proportion of three parts of fresh meat to one part of the substitute. The soy-bean meal and Mexican beans were cooked to the consistency of thick mush and the clam meal was mixed with hot water to a similar consistency. In addition to the liver and heart mixtures with beans and clam meal a mixture of equal parts of beef liver and beef heart was fed to both the brook and the rainbow trout. The results of the experiments with the brook trout were very consistent, but in the case of the rainbows the data are confusing in some respects. However, it is believed that the results obtained with both species justify the following conclusions:

Possibly the most striking result of the experiments was the evident superiority of the mixture of beef heart and beef liver to either heart or liver alone. With respect to growth, the superiority of the mixture over beef liver is not pronounced, but in the tests with both brook and rainbow trout there was a striking decrease in mortality among the fish fed the liver and heart mixture. When fed alone, beef liver brought about much better growth than beef heart, but the mortality of the fish on the latter diet was a great deal lower than among those fed liver. As regards mortality, beef heart was on a par with the heart and liver mixture.

Sheep liver gave by far the poorest results of any of the meat foods used and resulted in relatively poor growth and high mortality among both brooks and rainbows. The experiments of previous years also indicate the inferiority of sheep liver, and it is believed that this food should not be fed to fingerling trout.

The relative value of the substitute foods used is not as clear as in the case of the strictly meat diets, but it is evident that of the three clam meal is by far the most promising. With brook trout mixtures of clam meal and beef liver gave results comparable to those obtained from feeding the beef liver and heart mixture. However, this mixture did not make quite as good a showing with rainbow trout.

Turning to the vegetable products, it was found that mixture of beef products with soy-bean meal and Mexican beans gave results inferior to those obtained with clam-meal mixtures. With brook trout the soy-bean meal mixtures were better than those containing Mexican beans, while with the rainbow trout the reverse was true. On the whole, the results of the feeding experiments at Holden indicate that it is inadvisable to feed cereals or beans to fingerling trout.

Feeding experiments with yearling trout were less satisfactory, owing largely to inadequate facilities and the small number of brook trout of this age available for experimental purposes. It was necessary to conduct the experiments in raceways where the fish were exposed to various enemies, which resulted in considerable loss. These losses, combined with those resulting from cannibalism and gill disease, make it difficult to interpret the results correctly. Sheep liver was selected for the diet of the controls, as frequently (owing to its lower price) it is fed to yearlings and brood fish. The other experimental lots were fed sheep liver in combination with soy-bean meal, Mexican beans, wheat middlings, shrimp bran, or "clam heads." The wheat middlings, beans, and soy-bean meal were cooked before being mixed with the liver.

On the whole, a ration of 50 per cent sheep liver and 50 per cent "clam heads" gave the best results. The fish grew rapidly and were exceptionally active and vigorous, with good color. "Clam heads" is the dried refuse from clam canneries and is composed almost entirely of fragments of the siphon. For feeding, it was soaked in warm water for a short time and then mixed with the ground liver. Very good results were obtained with a mixture of 40 per cent sheep liver, 50 per cent soy-bean meal, and 10 per cent shrimp bran, which produced more rapid growth than a mixture of equal parts of sheep liver and soy-bean meal. A mixture of 75 per cent sheep liver with 25 per cent wheat middlings produced surprisingly rapid growth; in fact, the average percentage of daily increase in weight in the lot fed this combination of foods was greater than that of any of the other experimental lots. The fish showed a tendency to be "pot bellied," however, and were fatter than those in the other lots. It is not believed that such short, thick-bodied fish are as desirable as those that approximate wild fish in shape. Furthermore, the presence of a number of exceptionally large fish in this lot at the end of the experiment indicates that considerable cannibalism occurred.

Straight sheep liver does not appear to be a more satisfactory food for yearlings than for fingerlings, at least on the basis of growth alone, as in this respect the controls were much smaller than the other experimental lots, with the single exception of the fish fed sheep liver and Mexican beans. A mixture of equal parts of Mexican beans and sheep liver produced less growth in the brook trout than any other of the experimental diets; but with rainbows the same mixture produced much more rapid growth, exceeding sheep liver in effectiveness. Unfortunately, no rainbow trout were fed the liver and soy-bean meal mixture, so that we have no evidence as to whether the relative value of soy-bean meal and Mexican beans would be reversed as in the fingerlings.

An essential part of the experiments at Holden is the work on selective breeding, by means of which, it is confidently believed, it will be possible to produce a superior strain of trout. Owing to inadequate facilities and the short time the Holden station has been used for experimental work, it has not been possible to make much progress in this direction. Selective-breeding experiments require a great deal of space, owing to the many small lots of fish that must be kept separate from each other.

During the season of 1927 six pairs of brook trout were mated and the progeny reared in separate compartments. As the parents all were selected fish, it is not surprising that the young made much better growth than do average fingerlings from the common brood stock. The comparatively slight variation in size in individual fish in each lot was especially striking. As every fish culturist knows, ordinarily there is considerable difference in the rate of growth of individual fish in a mixed lot of fingerlings of the same age, and it is necessary to grade them frequently to prevent cannibalism; but in fish having the same parents there was surprisingly little difference in size throughout the summer; in fact, in some instances they were more uniform than fingerlings that were graded carefully.

Although the progeny of the selected pairs were held in crowded quarters in hatchery troughs for several months, the losses in some instances were remarkably small. In one lot the combined loss of eggs, fry, and fingerlings up to September 30 was only 9 per cent, and in another lot it was 12 per cent. It is planned to select the best fish from such lots as these for further breeding experiments. These experiments, of course, are only a start in the right direction, and it is hoped to increase the scope of the work greatly as soon as adequate facilities become available.

### POND CULTURE

The experiments in pond culture, initiated in 1926 at the Fairport (Iowa) biological station, were continued in 1927 by A. H. Wiebe and the station staff, under the general supervision of Dr. H. S. Davis. On the whole the experimental work was very successful, and the average production of fish was increased materially over that of the previous season. As during the summer of 1926, special emphasis was placed on the propagation of largemouth black bass. In this connection the results obtained with forage fish were particularly encouraging, and it is believed that by the proper use of such fish the output of fingerling bass can be increased. Several species of forage fish were used in the Fairport ponds, but best results were obtained with the golden shiner (*Notemigonus crysoleucas*) and the blackhead minnow (*Pimephales promelas*). Both of these fish feed to a considerable extent upon vegetable matter and débris in addition to the smaller animals of the plankton, food that is not taken by the bass fingerlings. It is not possible to obtain a forage fish that does not compete directly with the young bass for food for a short time; but this does not appear to be as serious as might be supposed, as the rapidly growing bass soon reach a stage where they prefer insects and small fish to the small Crustacea of the plankton.

In some respects the golden shiner appears to be best for forage purposes, but the investigations have not yet reached a stage where it is possible to determine definitely the relative value of various species for this purpose. Both the golden shiner and blackhead minnow are hardy species, well adapted to pond conditions. Of special value is their habit of laying eggs over an extended period, which insures a continuous supply of small fish for the rapidly growing bass fingerlings. The larger size of the adult shiner is a distinct advantage, as it renders it immune to injury by fingerling bass. In the case of the blackhead minnow, all adults and young may be captured by the young bass before the end of the season. Goldfish also have proved valuable as forage fish and possibly may prove to be superior to shiners or minnows in ponds that contain brood bass. On the other hand, goldfish do not continue spawning over so long a period as the other two species and are more omnivorous in their feeding habits, even eating small fish occasionally. Furthermore, they roil the water, which is objectionable.

The Fairport experiments indicate that much better results can be obtained by rearing the fry in ponds reserved for that purpose than by attempting to hold both brood fish and fingerlings in the same pond. This is exemplified by pond D–7, which has an area of 1.087 acres. About 150 blackhead minnows were liberated in this pond on May 7, and a month later (June 13) the pond was stocked with 25,585 advanced bass fry. When the pond was drained on October 10 it yielded 8,622 No. 3 fingerlings, a survival of approximately 33.7 per cent. Probably better results would have been obtained had not the pond been understocked with forage fish, as shown by the fact that only three minnows were recovered.

A much higher percentage of survival was obtained in a small pond known as E-2. This pond, with an area of 0.128 acre, was stocked on June 13 with 1,833 bass fry. The pond was drained October 4 and yielded 1,022 fingerling bass, a survival of approximately 55.7 per cent. This high percentage of survival doubtless was due largely to the fact that through a misunderstanding the pond was overstocked with goldfish, so that an abundance of forage fish was available throughout the season. An adjoining pond (E-3), having the same area but understocked with forage fish, produced 742 bass fingerlings out of 1,833 fry, a survival of approximately 40.7 per cent.

The results of two seasons' experiments at Fairport indicate that when rearing ponds are properly fertilized and supplied with forage fish they should be stocked with 20,000 to 25,000 largemouth-bass fry per acre, 30 to 40 per cent of which, at least, should survive until the ponds are drained in the fall.

The bass fry were taken from the spawning pond by means of a Hesen fry trap, which is designed to capture them when they rise from the nest and begin to swim around the pond. The efficiency of this trap is shown by the fact that over 70,000 fry were captured in about four hours. It also appears that better results can be obtained by using fewer brood fish than has been the practice in the past. When fingerlings are to be reared in the same pond with the brood fish, not more than 15 to 20 pairs of medium-sized brood fish should be used per acre. If the young are to be removed as fry, a larger number of brood fish may be used. One pond was stocked with bass and bluegill sunfish in the hope that the bluegills would make a satisfactory forage fish for the bass, but the results were disappointing. The pond produced only about 1,900 No. 3 bass fingerlings and 28,000 bluegill fingerlings per acre, which is a relatively small yield.

In 1926, and again in 1927, an attempt was made to propagate the gizzard shad (*Dorosoma cepedianum*) in ponds for forage purposes, but without results. In each case the fish failed to spawn, and no further attempts will be made to raise them at Fairport. Owing to its feeding habits, this species would seem to be an ideal forage fish, but the Fairport experiments indicate that it is not adapted to small ponds. Other objections are the fact that it does not have an extended spawning season and that it is not eaten as readily by the bass as are many of the minnows.

In 1926 a mixture of bone meal and dried sheep manure was applied to several of the ponds at the Fairport station at frequent intervals during the spring and early summer in an experiment in the use of fertilizers in ponds, but the results were not conclusive. During the past summer (1927) superphosphate was used instead of bone meal, with very encouraging results. Several applications of a mixture composed of one part superphosphate to three parts dried sheep manure, by weight, were made in the early part of the season, and in every case the production in fertilized ponds was much greater than in those not fertilized. The increased production of fertilized ponds is evidenced best by the E series of ponds, as the results are directly comparable. There are four of these, situated close together and of nearly the same size. Two of them were fertilized, and each produced approximately the same weight in fish per unit area. Their yield was about four times as great, per unit area, as that of one of the unfertilized ponds and three times as great as that of the other.

Experiments also were conducted in small concrete ponds that contained no fish, to determine the effect of various fertilizers on plankton production. The fertilizers tried were sheep manure, superphosphate, and soy-bean meal. The results show that soy-bean meal increases production more than either sheep manure or superphosphate. The last two are about equally effective in increasing plankton production.

A study of a number of factors that may influence plankton production directly and fish production indirectly also was made. These were dissolved oxygen, free carbon dioxide, half-bound and bound carbon dioxide, dissolved phosphorus, organic phosphorus, hydrogen-ion concentration, chlorides, four forms of nitrogen (nitrite, nitrate, ammonia, and organic nitrogen), dissolved silica, temperature, and turbidity of water. In addition, a quantitative study of the total plankton production of a number of ponds was continued during the summer. The voluminous data acquired as a result of these investigations have not yet been studied sufficiently to justify drawing any definite conclusions.

## PATHOLOGY OF FISHES

Investigations on disease of the gills of trout were continued by the pathologist at Holden (Vt.) station. This disease frequently is the cause of serious losses, especially among advanced fry and fingerlings. As shown in the report for 1926, the disease is caused by a bacterial growth on the surface of the gills. In the case of fry, and probably young fingerlings, the bacteria may develop on the fins and body as well, but appear to produce no noticeable effect other than greater secretion of mucus. Infection of the gills is much more serious and usually results in a noticeable thickening of the gill filaments, caused by proliferation of the epithelial cells. In large fingerlings and yearlings this may be followed by infection with fungus. Experience with the disease in 1926 led to the opinion that it would not prove to be a serious menace to trout culture, but several serious outbreaks in 1927 showed conclusively that this view was too optimistic. It now appears that the gill disease may cause heavy losses among both fingerling and yearling trout, and there can be little doubt that it was the cause of several obscure epidemics that occurred at various hatcheries in recent years.

For a number of years heavy losses have been suffered annually among the trout fry at the Holden Station at about the time when they were beginning to feed. Until recently it has been the practice at this station to hatch the eggs in brook water or in a mixture of brook and spring water. However, it was found that if the eggs were held in spring water the fry did not suffer from the usual mortality, which in some cases reached 100 per cent. During the spring of 1927 it was discovered that virtually all of the fry held in brook water contracted the gill disease, whereas no bacteria could be found on the gills of fry hatched in spring water. Consequently, there can be little doubt that the annual spring mortality at this station has been due to gill disease.

Later in the season there was an outbreak of gill disease in a lot of 15,000 rainbow fingerlings that were being held in a small, spring-fed pond. The disease made its appearance very suddenly, and in a few days nearly all of the fish were dead. Apparently they were infected with a virulent strain of the bacteria, inasmuch as in all previous outbreaks among fingerlings the mortality increased gradually and there was no sudden onset of the disease, as in this case.

The pond containing the rainbow fingerlings drained into a similar pond containing 33,000 brook-trout fingerlings, which were in excellent condition prior to the outbreak of the disease in the upper pond. Although these fish were removed immediately, it was too late, and nearly all died of the disease within a few days. The disease appeared in several other lots of brook-trout fingerlings also, but in these it was checked before it had caused such heavy losses as in the other lots mentioned. It also appeared in several lots of yearling trout, and while the losses were not as great as among the fingerlings, it is evident that, if not controlled, it is quite capable of causing serious mortality among older fish.

Until recently the disease was definitely known to occur only at the Holden hatchery, but during 1927 it caused heavy losses in a hatchery near Barneveld, N. Y.; and there is evidence that it is prevalent in New England, New York, and Pennsylvania. Fortunately, in the case of fingerlings and older fish it can be controlled readily if proper precautions are taken before the fish become badly infected. Further experience with the copper-sulphate treatment has confirmed the results of last year, when it was found that two treatments with a 1 to 2,000 solution of the sulphate will completely destroy all bacteria on the fish. The fish should be placed in the solution for one minute and then be transferred quickly to running water. If the treatment be carried out properly there should be very little loss, unless the fish have been weakened already by the disease. Unfortunately, the disease usually develops gradually and becomes firmly established before its presence is suspected. The stricken fish exhibit no characteristic symptoms, and the only certain way to diagnose it is to demonstrate the presence of bacteria on the gills. This requires considerable experience, because the bacteria are transparent and difficult to distinguish.

Studies of fin disease have shown that it is evidently identical with the so-called "fin rot" or "tail rot," which recently caused considerable mortality at a number of widely separated hatcheries. It has been confused sometimes with the fin disease caused by Gyrodactylus, a small flatworm that occurs on the fins and body. Fin rot evidently is of bacterial origin, and although the specific organism has not yet been isolated there is good reason to believe that a long, rod-shaped bacterium is the cause of the disease. This bacterium has been found in large numbers in all cases of fin rot from several localities, and apparently it is the only organism uniformly present. Fin rot is characterized by disintegration of the fins, which often are destroyed entirely. In most cases the dorsal fins are affected first, the others being involved later, but this is not the invariable rule.

Sometimes the pectoral fins are attacked first, and may be destroyed almost entirely before the others are affected. This seems to be true most generally of small fingerlings. In still other cases the disease may attack chiefly the caudal fin.

Usually the first noticeable indication of the disease is a more or less distinct white line along the outer margin of the fin. This white streak moves gradually toward the base of the fin, while at the same time the outer margin of the fin becomes badly frayed. This continues until the entire fin may be destroyed. In late stages of the disease sores filled with a glistening white pus may develop at the base of the fin, and occasionally such lesions occur in the skin some distance from the fin. Due to discharge of the pus into the water, these lesions may appear as small, usually circular depressions, which extend for some distance into the underlying muscles. The sides of such lesions are defined so sharply as to look as though a small piece of the tissue had been removed with a sharp instrument. The extent to which sores develop at or near the base of the fins depends largely on the size and age of the fish. In very young fingerlings death usually occurs before the tissues at the base of the fins become infected, so that the occurrence of lesions on the body is rare. Larger fish, being more resistant, may live for some time after one or more fins have been destroyed entirely, and therefore there is more opportunity for lesions to develop in the adjoining tissues.

The bacteria develop not only on the surface of the fins but also penetrate the tissues. Apparently they attack the connective tissues chiefly. In their growth through the tissues the bacteria follow the lymph channels and thus eventually reach the connective and muscular tissues at the base of the fins, where they cause the formation of the sores or ulcers previously referred to.

The disease can be controlled by dipping the fish in a solution of copper sulphate, but owing to the fact that the bacteria can not be reached so readily by the solution, more treatments are necessary than in the case of the gill disease. Obviously, to be effective the treatment must be applied before the bacteria penetrate the tissues to any depth, as in late stages of the disease they can not be reached by the chemical baths. All fish in which the disease is well advanced should be destroyed, and the rest should be given several treatments with the copper-sulphate solution.

A visit to the bureau's Drumlin hatchery, near Barneveld, N. Y., disclosed that heavy mortality among fingerling and yearling trout was due to furunculosis, but that both gill disease and "fin rot" were present and caused a considerable percentage of the mortality.

During the past year the pathologist was consulted by a number of State and commercial hatcheries regarding mortality from furunculosis or other disease. At the request of the American Railway Express Co., preliminary investigations were undertaken to determine the causes of the frequent heavy losses of goldfish during shipment. The express company shipped some fish from Maryland to Washington, D. C., where they were held in cans for several days and then returned to the express company. The fish were graded into four sizes, and the number allotted to each can was in accordance with usual practice in making commercial shipments. It was found that virtually the entire oxygen content of the water in the cans was exhausted in a very short time, while the carbon-dioxide content increased rapidly. During most of the time the oxygen content ranged from 0.24 to 0.56 part per million and the carbon-dioxide content from 13 to 25 parts per million.

Except for a short period immediately after the water was changed, the fish swam at the surface continuously and sucked in air, which passed out over the gills, enabling them to get oxygen from this source rather than from the water. Inasmuch as the mortality in each lot was low, it is evident that goldfish can live for some time under such conditions. Toward the end of the experiment, the fish began to show signs of low vitality, which evidently was due more to the accumulation of excrement, mucus, and other wastes, than to a deficiency of oxygen. From the experiment it appears that in ordinary commercial shipments of goldfish the removal of waste matter from the cans is more important than aeration.

An investigation into the life history of *Proteocephalus ambloplitis*, a cestode parasite of bass, was carried on by Dr. George W. Hunter at the Neosho (Mo.) station. The larvæ of this tapeworm sometimes occur in such numbers in the ovaries of the host as to prevent effectually the development of the ova. Adult tapeworms are found in the intestines of bass and allied species. It was found that tapeworm eggs may develop in several species of Cyclops (a genus of small crustacean common in the plankton of ponds). When ingested by the proper species of Cyclops, the eggs hatch and the larvæ bore through the intestinal wall into the body cavity of their host. When the infested Cyclops is eaten by a fingerling bass, the parasites encyst in its body cavity or viscera, where they may remain for months or possibly years. If infested bass are eaten by larger bass, the parasite is carried to the intestine, where it completes its development. It is probable that the larval stages of the parasite may occur in other small fishes as well as bass. Doctor Hunter's studies have not been completed but will be continued during the coming summer.

## STUDIES ON INTERIOR LAKES

During the past several years the Bureau of Fisheries has been cooperating with the Wisconsin Geological and Natural History Survey in detailed and highly technical limnological studies of lakes in northeastern Wisconsin, conducted by employees of the State. Their purpose is the discovery of the real causes of unequal productivity of the various lakes, with the hope of eventually being able to increase the production of fish in lakes now depleted and to establish fish life in waters now barren. Painstaking investigation of the chemistry of waters is just as necessary for promoting aquiculture as similar studies on the chemistry of soils are in agriculture. Because of the fundamental scientific importance of these studies and their far-reaching ultimate application to aquiculture in inland waters, the full report of activities submitted by Prof. Chancey Juday is given below:

During the summer of 1927 limnological studies on the lakes of northeastern Wisconsin were continued. Laboratories were provided by the State conservation commission, which gave to the survey the use of two buildings at the forestry headquarters on Trout Lake. The first members of the field party went to Trout Lake on June 17. About a week was needed to equip the buildings for use as laboratories and to set up the apparatus. The first observations of the season were made on June 24 and the last on August 28. In this interval observations were made on 233 lakes situated in Vilas and Oneida Counties. Ten lakes were visited twice and one lake three times. Of the 233 lakes, 79 had been examined in 1925 or 1926, or in both years; 154 were visited for the first time in 1927; and 5 lakes that were examined in 1926 were omitted this year.

The field party consisted of E. A. Birge and Chancey Juday, biologists; Rex J. Robinson, Henry M. Stark (to August 1), and F. H. L. Taylor, chemists; Lloyd Setter (also a chemist) and Mrs. F. H. L. Taylor (during August), general utility members. Another chemist, B. L. Browning, remained at Madison, giving full time to the determination of organic carbon in the dry residues from lake water. In addition, work on the fish of the lakes was carried on directly by the Bureau of Fisheries through Stillman Wright, aided by an assistant, C. E. Juday. Mr. Wright will make direct report of his work to the bureau.

The limnological work was along lines followed in 1926 and reported in that year. Only one important new line of observation was started in 1927. The University of Wisconsin provided the party with a motor-driven Sharples supercentrifuge, and with this 38 relatively large samples of plankton were obtained from 24 different lakes, using from 30 to 100 liters of water for each sample. These samples are to be analyzed by the chemists.

The regular observations on each lake included the following:

(1) On the lake, the temperature and transparency of the water.

(2) In the laboratory, (*a*) two physical items—the color and conductivity (total electrolytes) of the water; (*b*) 12 chemical items—hydrogen-ion concentration, free and fixed carbon dioxide, oxygen, four forms of nitrogen (free ammonia, nitrite, nitrate, and organic), soluble and organic phosphorus, silica, and chlorides; and (*c*) one biological item—the amount of dry organic matter in the centrifuge plankton.

(3) Also in the laboratory, the securing and preserving of material for future study, including (*a*) tow-net catches of plankton Crustacea, (*b*) quantitative catches of net plankton wherever a series of samples was taken, (*c*) specimens of the centrifuge plankton in all cases where the organic matter was determined, and (*d*) the dry residue from samples of water evaporated on the sand bath at a temperature of about 75°.

During the summer about 500 determinations of the hydrogen-ion concentration were made, representing all of the lakes examined and several depths in many of them. About 400 determinations of organic matter were made in the centrifuge plankton. The determinations of oxygen and carbon dioxide are about as numerous as those of hydrogen-ion, and those of nitrogen, phosphorus, silica, and chlorides are comparable with those of plankton. There are 408 samples of dry residue for chemical analysis, each representing ordinarily from 2.5 to 4 liters of water. A number of larger samples also were evaporated for use in mineral analyses, and from six lakes large amounts of water were sent to the university at Madison for evaporation in a vacuum pan. These were from the lakes that had the smallest quantity of inorganic matter, and each was about 115 liters of water.

During 1926 the main attention of the field party was directed to gathering series of samples from different levels in the deeper lakes, or at least samples from surface and bottom in the case of shallower lakes. Eighty-nine such series were obtained from 46 different lakes in 1925 and 1926. During the past summer 43 series were taken from 41 different lakes, including 11 lakes not so examined before. Altogether, 57 lakes have been examined in this way, and there are 132 sets of observations of this kind. The lakes include most of the deeper lakes within 20 miles of Trout Lake.

In 1927 the main attention of the party was given to securing data from as many as possible of the larger lakes that could be reached from the laboratories. The practical limit of distance was 20 to 30 miles, as work had to be carried on continuously. The lake must be reached, the work done on it, and samples of water must be obtained and brought back to the laboratory in time for the completion of the chemical and biological work during the day, or at latest before the new samples of water came in the next day.

Almost all of the larger lakes have been visited in an area of roughly 1,000 square miles, extending from the Michigan boundary to the north line of Town XXXVII and lying between the Wisconsin River on the east and the Flambeau on the west. A small number of lakes have been examined to the east of the Wisconsin. The work of 1927 included about one-third of the area of the northeastern lake district and about the same proportion of its lakes, if the very small bog lakes are omitted from consideration. For the area studied there can be prepared maps showing the distribution of the items observed along the several lakes, and thus can be shown the regional limnology of the area in a way that has not been possible before.

There is no reason to believe that the lakes of the rest of the district differ widely from those of its central area, which has been covered by our study. It was found that the lakes in the more distant parts of the area were like those nearer to Trout Lake; the lakes still more distant are like the others in area and depth, and their contents are probably also similar.

In 1926 the Bureau of Fisheries published a report on the organic content of lake water (Bulletin of the Bureau of Fisheries, Vol. XLII; Doc. No. 1012), giving the results reached by us in the examination of the organic content of dry residues obtained from large samples of lake water—50 to 525 liters each. These quantities of water from lakes of southeastern Wisconsin yielded dry residue in amounts varying from 1,000 to 10,000 milligrams. It was manifestly impossible to evaporate such large quantities of water from large numbers of lakes, and it was also impossible to handle such quantities in temporary field laboratories. The survey therefore has applied to the study of lake residues the methods of microanalysis whose principles were worked out by Professor Pregl, of Graz, Austria. These methods are employed extensively in Europe, but have received little or no attention in America, either in the teaching of chemistry or in practice. Their essence lies in the use of refined methods and of a very sensitive and accurate balance, so that only 5 to 10 milligrams of the substance need be used for an analysis. This survey imported such a balance in 1925 and also Pregl's apparatus for carbon and nitrogen determinations. It appeared that the apparatus had to be modified considerably before it was suited to the special problems offered by lake residues, and it was not until 1926 that it could be put to active use. Up to October 1, 1927, about 325 determinations of the organic nitrogen in residues were made by microanalytical methods, and about 525 determinations of organic carbon. This work on the residues from the summers of 1925 and 1926 is now nearly complete; 225 determinations of carbon have been made on residues of 1927, and 183 remain to be done. There are fewer than 100 samples whose nitrogen must be determined. In most cases during the past summer the organic nitrogen was determined directly from the water.

The employment of these refined methods of analysis have made it possible to secure sufficient material by evaporating relatively small quantities of water. During the past summer from 2 to 4 liters of water constituted a sample. The amount of residue ranged from a minimum of 9.2 milligrams per liter to a maximum of 95.4 milligrams. The average for 408 samples was almost exactly 40 milligrams per liter. It may be of interest to note that during the field season of 1927 more than 1½ tons of water from the northern lakes was evaporated, leaving a total dry residue of about 2.1 ounces. The amount of kerosene oil required as fuel for the evaporation was nearly as great as the amount of water.

The study of these residues will be continued actively during the current academic year. The University of Wisconsin has provided funds for four research assistants, who will give half time to chemical work on the lakes, chiefly on these residues. The main work of one man is on the organic carbons. He will complete the work on the samples from the northern lakes and also will analyze samples from southern lakes for comparison. He will determine carbon in plankton samples, also. We estimate that about 600 such determinations will be needed. A second assistant studies the nitrogen and phosphorus of the residues. He will complete the examination of the samples and will check the colorimetric methods used in the field. If time permits, he will check, in a similar way, the methods of determining soluble silica. A third assistant is making mineral analyses of residues. He begins with the larger samples, using macroanalytical methods. He will go on with micro methods, especially for the determination of potassium and sulphates. While micro methods for these last substances reduce the amount of material needed, they do not cut down the time required for analysis. It will not be possible, therefore, with the means at our command, to examine all or even the greater part of our samples in this way. The fourth assistant is analyzing the bottom deposits of the lakes, both as to organic and inorganic content. In addition, apparatus is being constructed to work out micro methods for the determination of ether extract (fat) from the residues.

On the biological side, an assistant for Mr. Juday has been provided who will aid in the study of the preserved samples of plankton by the microscope. It is hoped that a report on the organic content of the lakes may be made during the current year. The determination of organic carbon and nitrogen ought to be completed by Christmas, and a report on organic matter may be based on these. It is impossible to predict the amount of time required to perfect the apparatus for microdetermination of fats, but it is not likely that this item can be determined for any great number of lakes before the end of the calendar year. Whether a similar report can be prepared on the mineral content of the lakes will depend on the progress made in the analyses; and as these involve some experimental work and new methods, it is not safe to predict the progress they will make.

## FISHERIES BIOLOGICAL LABORATORIES AND FIELD STATIONS

During 1927 the bureau operated three of its biological laboratories throughout the entire year, and in addition field stations are maintained, with varying degrees of permanence, at various places in the United States. Temporary laboratory quarters have been provided by the College of Fisheries of the University of Washington at Seattle, the University of Michigan at Ann Arbor, the Natural History Museum at Stanford University, Calif., and by the city of Corpus Christi, Tex.

The laboratory at Woods Hole opened for the summer season on June 20, 1927, with its facilities again completely utilized by the bureau's staff and private investigators. Elmer Higgins, in charge of the division of inquiry, acted as director. The work of Dr. P. S. Galtsoff, Dr. Samuel Lepkovsky, Dr. E. B. Perkins, Dr. A. E. Hopkins, O. E. Sette, E. W. Bailey, R. A. Nesbit, and several temporary student assistants, with oysters and mackerel, has already been discussed. J. C. Pearson, temporary assistant, continued his studies on the life histories of Texas fishes, and Dr. F. G. Hall, of Duke Univerity, and Richard L. Pearse, temporary assistants, continued their studies on respiration in fishes.

The customary space was occupied by Dr. N. A. Cobb, of the Department of Agriculture, with several assistants, in continuing a study of the nematode fauna of the Woods Hole region. Dr. Barnett Cohen, chemist of the Hygienic Laboratory, United States Public Health Service, was engaged in oxidation-reduction studies throughout the season; Paul S. Conger, of the Carnegie Institution, continued his diatom investigations. The university tables were occupied as follows: Princeton, Samuel E. Hill, hemolysis of blood of fishes; Harvard, Gordon E. Gates, annelids, and E. F. B. Fries, xanthophors of Fundulus; Johns Hopkins, Dr. John C. Hemmeter, comparative histology of the spleen of Lophius. Among the independent investigators who occupied tables at the laboratory were Dr. Edwin Linton and Dr. G. A. MacCallum, working on helminth parasites of fishes; Dr. C. B. Wilson, on copepods of the Woods Hole region; Dr. Arch E. Cole, metabolism in clams; Dr. Haldane Gee, bacteriology of fish muscle; Joseph B. Glancy and Horace B. Pease, effects of chlorine on oysters; Florencio Talavera, Crustacea and Mollusca of Woods Hole; George H. Kennedy, histology of muscle tissue of cod. Dr. H. M. Smith, director of fisheries at Bangkok, Siam, and former United States Commissioner of Fisheries, continued his studies on the local fish fauna throughout the summer.

The work of the Beaufort (N. C.) biological station has been mentioned in the section of this report dealing with the investigations on larval fishes, oysters, scallops, and diamond-back terrapins. The working efficiency of the station was increased through the addition to the personnel of a scientific illustrator, a clerk-stenographer, and a boatman. Dr. S. F. Hildebrand, the director, with the aid of Louella E. Cable, illustrator, pursued as his principal line investigation of the egg and larval development of fishes, and he has also accumulated many data on the rate of growth of several important commercial species. Doctor Hildebrand, assisted by the foreman of the station, Charles Hatsel, is also conducting an extended series of experiments in breeding diamond-back terrapin. James S. Gutsell has continued his study of the life history and habits of the scallop, and H. R. Seiwell and Dr. A. E. Hopkins were engaged during a portion of the year in a study of the oyster.

The following independent investigators availed themselves of the use of the station for varying lengths of time: Prof. H. V. Wilson, of the University of North Carolina, assisted by J. T. Penny, made an investigation concerning the cellular biology of sponges. Dr. Bartgis McGlone, of the University of Pennsylvania school of medicine, continued studies of the two previous summers on the effects of hydrogen-ion concentration upon fertilization of the eggs of the sea urchin, *Lytechinus variegatus*. Dr. Ferdinand A. Ries, of the University of Maryland school of medicine, conducted similar studies intended to parallel or check those of Doctor McGlone. Dr. W. C. George, of the University of North Carolina, conducted studies on the histology of the blood of two ascidians, *Phallusia hygomiana* and *Stylea plicata*, and of Balanoglossus. C. L. Ferguson, Doctor George's student, made some studies on the blood of the sea urchin, *Arbacia punctulata*. Dr. Elinor H. Behre, of the University of Louisiana, continued her studies of the previous summer on color changes in fishes under the stimulus of varying light wave lengths. The foolfish (*Monacanthus hispidus*) and the blenny (*Hypleurochilus germinatus*) were the principal species used in the experiments. Dr. Bert Cunningham, of Duke University, was engaged for a short period in studying the embryology of diamond-back terrapins, but, due to the necessity of shipping the eggs to his laboratory, incubation progressed unsatisfactorily and comparatively little headway was made. Luang Choola, of the Department of Fisheries of Bangkok, Siam, spent about six weeks at the station, principally to acquaint himself with the diamond-back terrapin-cultural methods followed at the station and to become familiar with some of the commoner forms of aquatic animals of the vicinity. M. W. de Laubenfels, of Oberlin College, visited the station to acquaint himself with Professor Wilson's work on sponges and to obtain information from him.

Studies on the fouling of ships' bottoms, which were carried on at the Beaufort station for a number of years by the Navy Department and the Chemical Warfare Service, have largely been discontinued, although a few tests are still under way.

The Fairport biological station has been mentioned already in connection with the work on fresh-water mussels and pond culture.

T. K. Chamberlain, director, has had charge of the bureau's investigations on fresh-water mussels and has been particularly active in cooperating with the various States and with private organizations concerned with the conservation of aquatic resources of the upper Mississippi River region. The pond-cultural investigations have been under the supervision of Dr. H. S. Davis. A. H. Wiebe, temporary assistant, made all chemical determinations and plankton studies necessary in the work, as well as studies of the biology of the various fish used. A conference on pond culture was held at the station on October 6 and 7, 1927. The meeting was called at that time to enable those in attendance to observe the methods employed in handling the ponds and also to obtain some idea of the results attained. The actual work of removing the vegetation, draining the ponds, and collecting, sorting, and counting the fish was observed during the two days, and the evenings were spent in discussing the methods employed and principles involved.

The Key West (Fla.) laboratory was not operated during the year because laboratory facilities are inadequate.

The four field stations occupied by bureau investigators during the year consisted of laboratory and office facilities kindly donated for indefinite but temporary use. The University of Michigan has provided several rooms for the use of Dr. John Van Oosten and his assistants, who are engaged in Great Lakes investigations. For a number of years Stanford University has furnished laboratory quarters for bureau workers and recently provided additional space for Dr. W. H. Rich, H. B. Holmes, H. C. McMillin, and temporary assistants. In addition to housing the staff of the International Fisheries Commission, which is engaged in the halibut investigations, the College of Fisheries of the University of Washington has provided quarters for George A. Rounsefell and his temporary assistants for herring investigations. Field headquarters for the Texas fishery investigation were maintained at Corpus Christi, where the city donated offices and laboratory space. The advantages of maintaining headquarters for field workers in universities, where laboratory facilities are excellent and access may be had to great libraries, are obvious, and the cooperation of such institutions is appreciated greatly.

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# THE PUBLIC AQUARIUM[1]

## ITS CONSTRUCTION, EQUIPMENT, AND MANAGEMENT

By Charles Haskins Townsend

*Director, New York Aquarium*

CONTENTS



## INTRODUCTION

The writer has had long experience in the management of the aquarium in New York City and has assisted in planning certain aquariums already built as well as others projected. He was connected with the National Commission of Fisheries during the period when that organization maintained temporary aquariums at the great industrial expositions held in this country and observed some of them in operation. Millions of people saw those aquariums of the past, while other millions enjoy the few that exist here at present.

Having supplied information recently to a score of cities that contemplate constructing aquariums, the writer has felt it incumbent upon him to set forth the essentials of the matter for the guidance of an increasing number of inquirers. The present discussion is based largely on the methods of the large aquarium in New York City, which has been in operation for 30 years and is now undergoing extensive modernization.

The public-aquarium idea persists in the municipal mind to a degree that indicates a further and early development of the insti-

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[1] Appendix VII to the Report of the United States Commissioner of Fisheries for 1928. B. F. Doc. No. 1045.

tution in this country. No other form of public museum is of greater interest to the people. The plentifully stored aquarium is an ever-changing exhibition of beautiful and useful living things not seen easily in their natural habitat. It quickly becomes a center of recreation for the masses, contributing always toward a wholesome appreciation of nature. It has great educational value, stimulating constant inquiry respecting our heritage of the waters, which a wasteful civilization must take still greater pains to conserve.

The public aquarium, with its exhibits of living aquatic animals, is an institution that has come into existence during comparatively recent years. There are few existing aquariums that date back as far as 50 years. In some European cities the aquarium is a feature of the zoological garden, while in others it is a separate institution. An aquarium usually is established in connection with the work of a biological laboratory, as at the notable zoological station at Naples and the oceanographic museum and laboratory at Monaco. The aquarium in New York City is maintained by the city, its management being in the hands of the New York Zoological Society, which provides all exhibits from its private funds. The aquariums in Boston and Detroit are municipal institutions, controlled in each case by a department of parks. The aquarium in San Francisco, built with private funds and under the control of the California Academy of Sciences, is maintained with funds provided by the city. An aquarium larger than any now in existence is being planned in the city of Chicago, to be built with private funds, managed by a scientific organization, and maintained by the city. An aquarium has long been maintained at the headquarters of the United States Bureau of Fisheries in Washington. There are a few small aquariums in European and American cities that are conducted entirely as private business enterprises. There are probably more than 40 aquariums in various parts of the world to which the public is admitted, exclusive of several small ones connected with biological laboratories.

It was long the custom of the National Commission of Fisheries to operate large temporary aquariums at American industrial expositions.[2] These splendid governmental exhibits were successful in the highest degree. A few of the aquarium buildings were architecturally beautiful. It is a remarkable fact that at the world fairs of Chicago, Atlanta, St. Louis, Buffalo, Omaha, Charleston, Nashville, and other cities the aquarium attracted, in each case, more visitors than any other single exhibit of the exposition. The larger permanent aquariums of the world usually attract the attention and patronage of the people to a greater extent than do zoological gardens or museums of natural history or art. Possessing attractiveness to such a degree, the aquarium should be more than an exhibition of interesting things. It has undeveloped possibilities for educational usefulness and has long occupied an important position in the field of scientific research.

The collections of the larger public aquariums consist of living marine and fresh-water animals. It is the character of the exhibits—whether of marine or fresh-water forms—that determines the cost of maintenance in an institution of this kind. An aquarium with exhi-

[2] Descriptions of some of these aquariums, with illustrations, will be found in the reports of the United States Commission of Fisheries for the years 1888, 1894, 1896, 1901, and 1904, and the volume of the bulletin of the commission for the year 1893.

bition tanks requiring nothing more complicated than mere connections with a city water system obviously can be operated at less expense than one requiring pumps for the circulation of sea water. It would be possible for any inland city, not too remote from suitable collecting waters, to maintain exhibits of fresh-water fishes and amphibians at small cost as compared with marine forms requiring stored sea water. The flow of fresh water being automatic, the equipment for operation can be reduced to very simple terms. With marine exhibits the equipment and cost of maintenance would be altogether different. The piping, if for permanent use with salt water, would be specially constructed of vulcanized rubber, lead, or other nonrusting material, with valves and other fittings to match. An underground reservoir for the storage of sea water would be necessary, together with rust-proof pumps of bronze for its circulation. Filters would be required for the clearing of the water constantly flowing back to the reservoir. With the use of pumps, which must run day and night, there would follow an increase in the number of employees, some of them being mechanicians requiring special compensation. If tropical forms of life were added, water-heating equipment would be required to insure their safety in winter. Cold water is necessary for northern forms of life in summer. A large aquarium in the latitude of New York, for instance, requires a decidedly complicated equipment if its aquatic exhibits include both northern and tropical fresh-water and marine forms.

The construction of a reservoir for pure sea water is imperative even if the aquarium be located on the seashore. Experience has shown that the water supply must be maintained in uniformly good condition, unaffected by storms, changes in salinity, winter and summer temperatures, and the impurities of harbors. Unfavorable variations in the water supply can not be avoided where water is pumped directly from the sea.

The prime requisite for keeping aquatic animals in captivity is a plentiful supply of their natural element, to which everything else is subordinate. No completeness of mechanical equipment can make up for deficiencies in this respect. The water supply must be pure and abundant, whether for marine or fresh-water exhibits.

The fresh-water supply of most cities is good enough for aquarium purposes as it comes from the pipes, but during long-continued rains or necessary alterations of the system by the city from time to time the water may become murkey and remain so for weeks. Filters are necessary, therefore, to insure the clearness of water desirable for exhibition purposes. The filters receive the water before it is delivered to exhibition tanks. In the case of permanently stored sea water filters are also necessary, but they are so installed as to receive the drainage of the exhibition tanks and return the water to the reservoir clear and free from the impurities created by the feeding of animals.

Animal wastes in fish tanks are less injurious to the water supply than bits of unconsumed food. All visible wastes should be siphoned from the tanks before any disintegration takes place. Stored sea water, like the freely flowing fresh water, must be kept in motion in the exhibition tanks, which renders necessary the continuous operation of pumps.

City waters that are treated with chlorine are not suitable for aquarium purposes. The United States Bureau of Fisheries has proposed a method of treatment for removal of chlorine from city water for use in aquariums. (See Appendix B.)

The distribution of water throughout the building must be arranged so that it can be supplied to exhibition tanks in considerable volume if necessary. Some species of fishes require a stronger flow than others, and all crowded tanks need it. The supply to each tank can be reduced easily by means of valves to suit the demand and might not be sufficient if the distributing lines of pipe were too small.

The reservoir should be constructed with two or more compartments to facilitate periodical cleaning and to give the body of water not in use a period of rest, such treatment having a clarifying effect. All equipment tending to facilitate the distribution of stored water and to preserve its purity is desirable, as its vitiation, even in small degree, may result in serious losses of animal life. The living occupants of the aquarium have no choice but to remain in the tanks where they are placed. Lack of food can be endured long, but the impairment of their natural element is immediately fatal, whether from actual fouling or mere lack of oxygen. They may long survive overcrowding if the supply of water is abundant. The loss of many marine exhibits may prove less expensive to an inland aquarium than the restoration of a damaged water supply.

There need be little deterioration of stored water if it is managed properly; circulation, filtration, and periods of rest for the precipitation of sediment will keep it in fair condition for a long time. Additions to the supply will be necessary occasionally to replace losses from leakage and evaporation. Even after years of use the increase in salinity from evaporation is negligible, and this can be corrected by the addition of fresh water. Aeration is automatic, as the surface of the water is exposed to air both in the reservoir and exhibition tanks, and the water is aerated further in falling from the various levels to which it is pumped.

Stored sea water should be protected against discoloration from iron rust, but this is not difficult if the pumps and piping are made of nonrusting materials. Its action on iron pumps and piping is destructive, and galvanizing affords only temporary protection.

The care of the water supply of any large aquarium is an ever-present responsibility that must be kept in mind by each employee of the institution during his hours of duty. While many of the operations relative to it are accomplished by mechanical means, the feeling of personal responsibility can not be relaxed.

Pure water being the lifeblood of the aquarium organism, the mechanical means for securing its circulation and preservation are next in importance. The circulating pump, piping, and filters may be compared to heart, arteries, and lungs. The mechanical department of the institution is responsible for the continuous flow of water, its temperature, aeration, and filteration. A considerable amount of machinery is necessary in a large aquarium, the principal features of which are pump, air compressor, filter, refrigerating machine, and water heater. In most large aquariums the pumping machinery is installed in duplicate as a safeguard against accidents, but the practice of driving air to the exhibition tanks having proved effective when for any reason it is necessary to stop the flow of water, the reserve pumps are used seldom. A large air compressor has been used at the New York aquarium for several days at a time with satisfactory results when circulating pumps stopped.

FIG. 1.—Head of a 200-pound jewfish, photographed close to the glass front of the tank. This specimen has lived 10 years in the New York Aquarium

## EXHIBITS

The public aquarium is an institution that exists under the necessity of procuring its living exhibits directly from nature's sources of supply, the animal dealer having but a limited list of aquatic forms of life to offer. There being no commercial purveyors, the collector for the aquarium must be prepared to go afield whenever specimens are needed for exhibition, and in northern latitudes enough collecting must be done in summer to provide against accidents that may occur in winter. Fresh-water forms can not be had when lakes and streams are frozen, and the winter season is unfavorable for the transportation of collections from the Tropics.

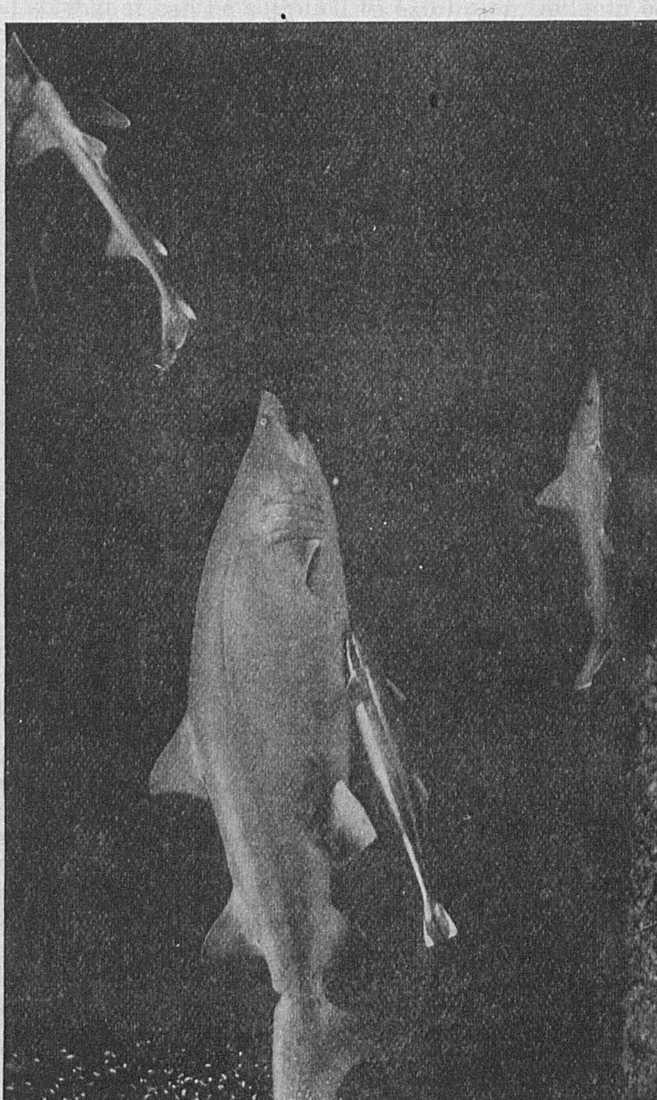

FIG. 2.—Sand shark with shark sucker attached. This remarkable exhibit, the only one in the world, has been maintained at the New York Aquarium for many years. Sometimes pilot-fishes, which also accompany sharks, are added

Exchanges of specimens with other aquariums are helpful only in varying the exhibits, as each must do its own collecting. Aquariums in the United States are few in number and so located as to be subject to certain geographic and climatic limitations.

The collecting of aquatic animals involves their transportation in weighty tanks of water, which, moreover, must be kept pure in transit. This compulsory procedure is both expensive and troublesome. Experience has shown that the handling of fishes and other strictly aquatic creatures intended for exhibition alive seldom can be intrusted to fishermen. The untrained collector fails to appreciate the importance of taking those precautions in capture and shipment that are necessary for success. Aquatic animals must reach their destination not merely alive but able to endure the conditions of captivity, always more or less unfavorable to wild creatures. In addition to the necessity of guarding the water supply of an aquarium every hour of the 24 and the daily care of the living exhibits, the

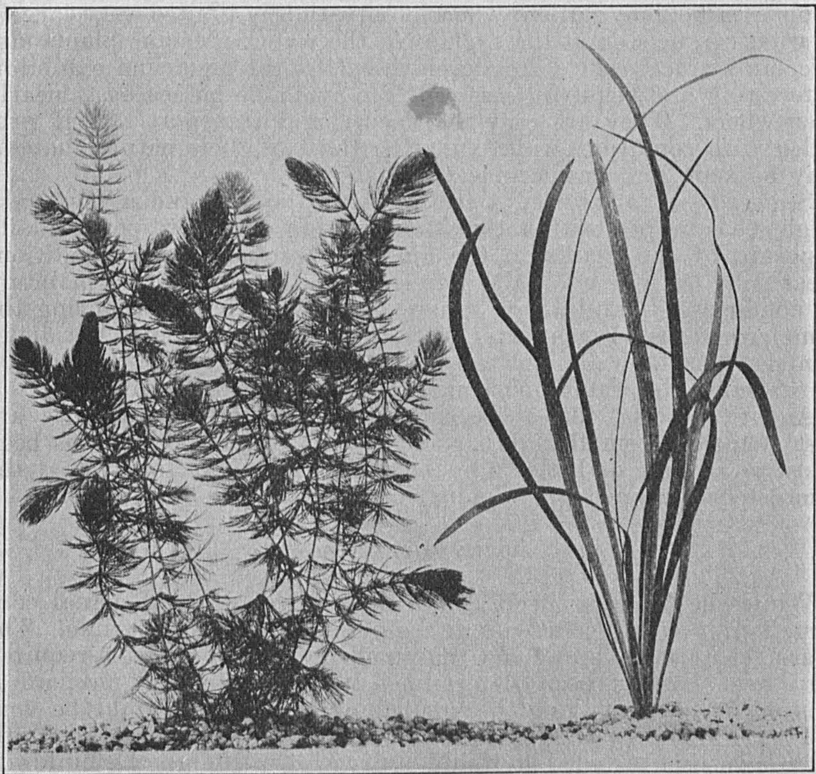

FIG. 3.—Water plants, as seen in an aquarium. Hornwort and eelgrass

staff of a large aquarium has the additional duties of a public museum. There are crowds of visitors to be looked after, supplies to be purchased, machinery to be kept in repair, and a correspondence with the public, the schools, the press, and with zoologists working in many lines to be conducted. There are also labels, circulars, and pamphlets to be prepared. In the matter of assistance to teachers of biology, it may be stated that the New York Aquarium has stocked small marine aquaria in more than 300 schools in greater New York. The seashore collecting for this work goes on from early spring until late in fall.

The exhibits of a public aquarium are popularly supposed to consist chiefly of fishes, aquatic reptiles, and some of the more conspicuous invertebrates, but this conception is a narrow one. The name "aquarium" admits of a much more comprehensive interpretation. The collections of an ideally equipped establishment for the exhibition of living aquatic forms might properly include representatives of the entire aquatic fauna and flora, so far at least as the forms selected are capable of living in shallow water. No aquarium has yet attempted a comprehensive display of fresh-water plants in properly lighted, glass-fronted tanks. The character and the beauty of aquatic plants can not be seen to full advantage in the pools of a botanic garden, where observation is limited very largely to what can be seen at the surface of the water. Marine plants also offer an attractive field for development by the aquarium exhibitor. Interesting and beautiful seaweeds are available on seacoasts nearly everywhere. They are easy to procure and transport and if provided with conditions approximating those of their natural habitat may be kept for considerable periods.

Seaweeds in tanks need a strong flow of water, and a few tanks might be equipped with automatic emptying devices to permit daily exposure of the plants to the air, thus providing the conditions created by the rise and fall of tides. Whether difficult to maintain or not, seaweed exhibits are renewed easily and cheaply during the summer months. Fresh-water plants are equally attractive but die in winter when the water becomes cold. This difficulty can be obviated by warming the water sufficiently to keep the plants growing.

Aquatic insects, like the smaller fresh-water invertebrates, are best adapted to small table aquaria, but their availability has been taken advantage of little. On the whole, it is safe to say that the completely equipped public aquarium has not yet been planned.

## THE BUILDING

While the building itself comes first in the work of actual construction, it should come last in the planning of the aquarium. The character of the exhibits and the number and size of tanks required for them having been determined, the complicated mechanical equipment necessary for the control of the water should be considered in detail by an engineer. These are the vital matters. Until they have been decided it would be unwise to design the building. The aquarium manager called upon to adapt his equipment and exhibits to a building erected chiefly for architectural effect is at a disadvantage from which full recovery may never be possible.

A beautiful building can be designed as readily after the problems of equipment have been solved. In a case like this the building is merely the shell of the complicated mechanism that makes the aquarium possible. Architectural beauty, while always desirable, has little to do with the successful operation of such an institution. The success of an aquarium depends solely upon the attractiveness of its living exhibits, and these, in turn, are wholly dependent upon facilities for maintaining them in good condition from day to day. The New York Aquarium has had 50,000,000 visitors during

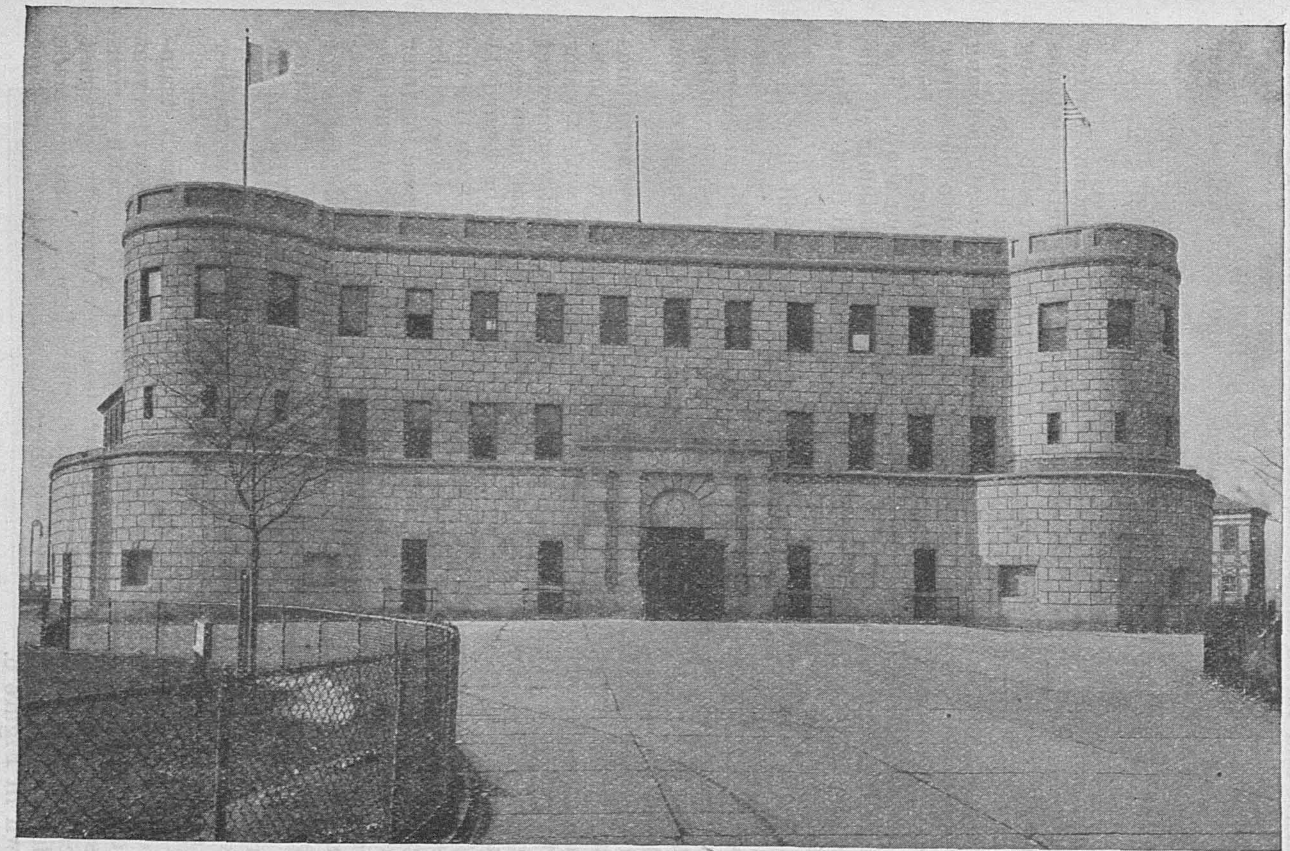

*Fig. 4.—Exterior view of the New York Aquarium.* Offices, laboratory, and library on the third floor; distributing tanks on second floor of circular end towers; beneath them the filter is at the left and the feed room at the right; repair shop and storage rooms in the middle section of the second floor; aquaria and floor pools on main floor

the past 25 years. The building, a 100-year-old fort, has been criticized as unsightly until altered by recent improvements. Its extensive and varied exhibits alone constitute its unfailing attraction for the people.

The vital point to be insisted upon in planning the building is that there should be skylights of ample size above the tanks of water containing the exhibits.

## EXHIBITION TANKS

The collections of the public aquarium, with the exception of a few large forms kept in open pools, are exhibited in large stationary tanks of masonry or wood, with glass on one side only—the side fronting on the hall or corridor open to visitors. The tanks are built in rows, end to end, their glass fronts being in line with the wall inclosing the public hall, their rear sides extending backward into the service passage used by the caretakers. The visitor facing the glass front sees the interior of the tank only, which is lighted from above. The public hall receives no light from the skylights that illuminate the tanks, being kept rather dim in contrast with the well-lighted tanks containing the exhibits.

An aquarium having a darkened public hall with well-lighted exhibition tanks, such as that of the London Zoological Society, permits very satisfactory views of the living exhibits. Such an interior arrangement would be impracticable in an always free aquarium like that of New York City, however, where the Sunday attendance alone frequently exceeds 20,000 persons.

Glass-fronted exhibition tanks, as constructed in the few aquariums existing in this country, are of rather limited size, the inside dimensions of the larger tanks averaging perhaps 6 by 6 feet, with a water depth of 4 feet. In European aquariums they are usually somewhat larger. Most of the tanks in the New York Aquarium have been enlarged recently, the rear walls having been moved backward 11 feet from the glass fronts. This is about as far back from the the glass as objects in clear water can be seen distinctly. Large tanks permit the exhibition of more specimens, while the increase in water space greatly improves the conditions under which the occupants live in captivity. Glass-fronted tanks of smaller size, such as those occupying the balcony in the New York Aquarium, are desirable for invertebrates and are satisfactory for small and inactive vertebrates, but most fishes (and these constitute the bulk of the exhibits of the average aquarium) need swimming space. Large fishes should not be kept in small tanks, where they find neither room for exercise nor the display of their habits and activities.

All exhibition tanks in an aquarium must be supplied with strainers of some sort in their top overflows and bottom drains to prevent the escape of small fishes and the clogging of waste pipes with various substances. In salt-water tanks, where metal and wire strainers rust quickly, their renewal involves considerable expense. Strainers made of lead or rattan have obviated these troubles. Several types are shown in Figure 6.

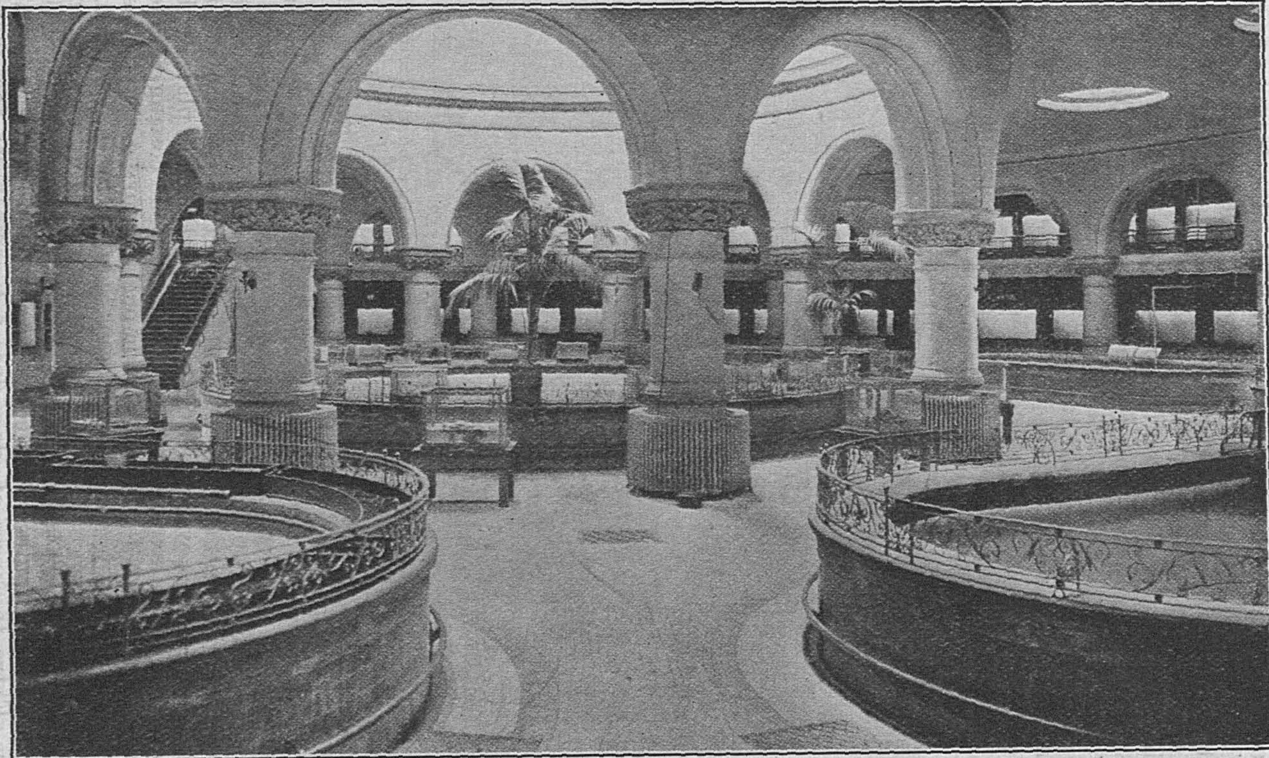

FIG. 5.—Interior view of the New York Aquarium. The building is circular. There is a large pool in the center of the main floor, with other pools outside the central columns; glass-fronted tanks on the main floor; and a balcony beyond the outer circle of columns. Small aquaria are mounted on the coping of the central pool and fish-hatching troughs on the coping of the pool at the left

PLACING THE GLASS FRONTS

The tank fronts of polished plate glass are very heavy, being 1 or 1¼ inches thick. The plate is set against a frame of 3-inch angle iron built into the masonry or concrete of the tank. In some aquariums the glass is set in a detachable iron frame, which is bolted against the iron frame of the tank from the outside. In the New York Aquarium it is set from the inside, without the use of bolts, being held in position chiefly by the pressure of the water when the tank is filled. When put in place, the plate is secured by a light strip of wood at each end, which is held by brass screws to woodwork firmly set in the concrete of the tank. The lower edge of the plate rests on a strip of wood laid on the angle iron. Between the glass and the iron frame a flat rubber strip 1 inch wide by ⅛ inch thick is placed to serve both as a cushion for the glass and an aid in making the edge of the glass water-tight all around. As a further precaution

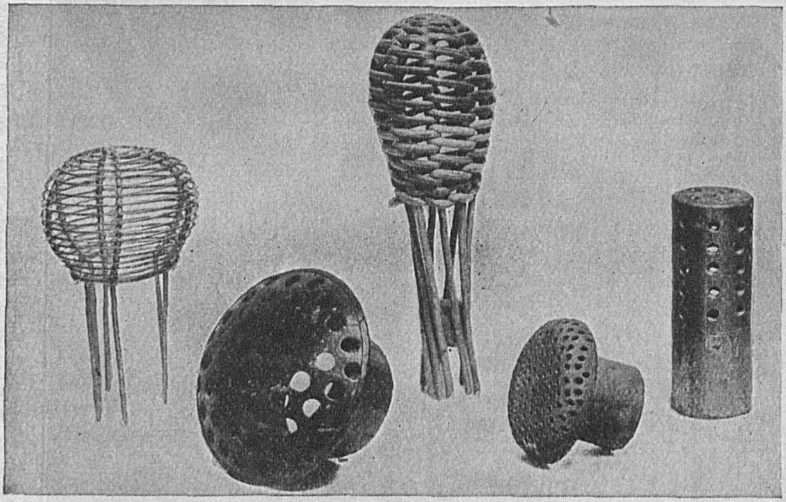

FIG. 6.—Strainers for aquarium tanks. Above, overflow strainers of wire, rattan, and lead; below, bottom strainers of galvanized iron and lead

against leakage the border of the plate is packed with flexible aquarium cement. Whether set from the inside or bolted on in front, it is absolutely necessary that the glass and its rubber cushion be flat and true against the iron frame; otherwise cracks will develop under water pressure and the plate be ruined. It is no easy matter, even for experienced aquarium men, to set the glass so "true" that it will be perfectly supported at every part of its border. Polished plate of the thickness required is expensive, at the present time costing $75 for one measuring 4 by 5 feet, and $85 for one measuring 4 by 7 feet. While our share of breakage has been reduced to the minimum through long experience, it is a frequent source of annoyance and expense among the new aquariums of the country, judging from the many letters of inquiry received respecting the details of glass setting. Extra thickness of glass does not compensate for uneven pressure against the supporting iron frame. A little crack starting at the edge of the plate will extend clear across it in a few weeks, and the troublesome and expensive process will have to be repeated with painstaking care.

There are many 1-inch, 7-foot glass plates in the New York Aquarium that have been in position for 30 years, testifying to the care

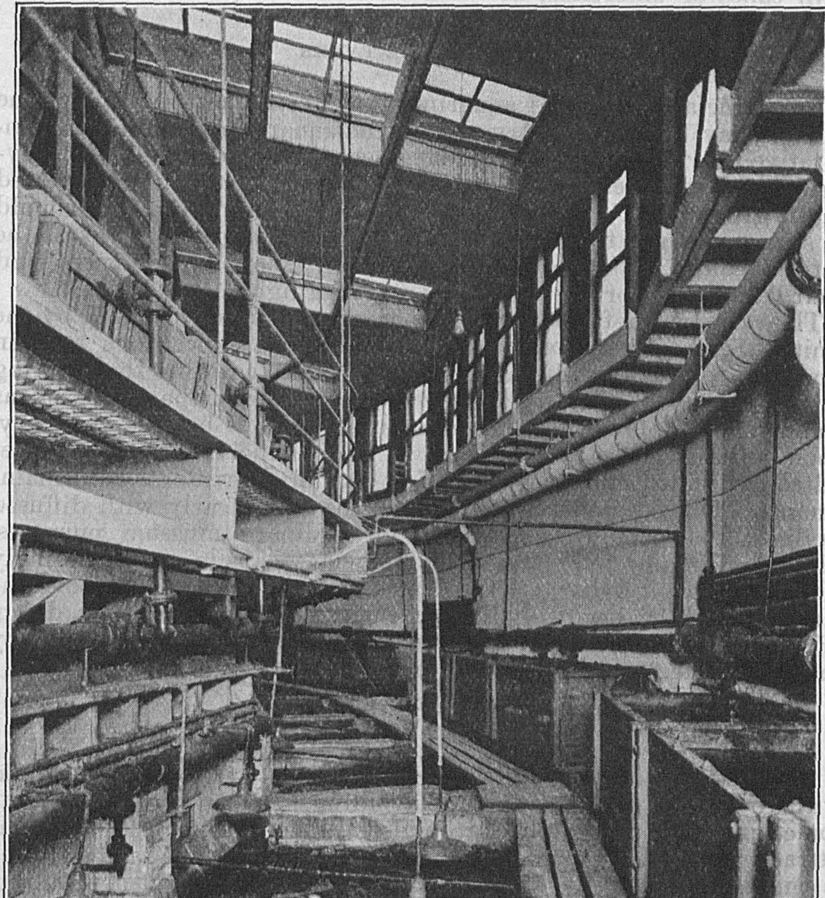

FIG. 7.—Section of the service passageway in the New York Aquarium. Above, skylights; below, exhibition tanks; at right, reserve tanks; at left above, rear sides of exhibition tanks fronting on balcony. The exhibition tanks shown below extend from the glass fronts at left to the wall at right, a distance of 11 feet. The skylights are not large enough; on dark days the lights over the tanks must be turned on. The vertical windows above are of little value in lighting the tanks

with which they were placed originally. Occasional breakages in long-set glass may be traceable to gradual rusting in some part of the supporting iron frame, the slow deterioration of the rubber strip, or a gradual hardening of the flexible cement packing around the border of the plate. These conditions can not be ascertained without removing the glass, a troublesome procedure that would necessitate the temporary emptying of numerous well-stocked tanks. With a total of 455 linear feet of plate glass, mostly in this condition, the outlook is not reassuring. Visitors should not be permitted to tap the glass with canes or umbrellas, as when under water pressure cracks are started easily.

### LIGHTING THE TANKS

No artificial lighting of aquarium tanks can take the place of the light of day. In the construction of the aquarium building it is imperative that skylights be made large enough to admit diffused daylight in abundance. As aquarium tanks nearly always are located on the ground floor, usually many feet below the roof, the light should be strong enought to show what the tanks contain and to reveal the natural colors of the occupants. Natural colors are obscured and their values more or less altered by artificial light.

The principal defects in the temporary aquariums operated by the United States Fish Commission at industrial expositions held in American cities were essentially those connected with the lighting of the tanks. While the architects insisted that the skylights as planned would furnish sufficient natural light, it became necessary, upon installation of the exhibits, to add artificial light, which resulted in decided impairment of effect as well as greater cost of maintenance. Objects under water can not be seen clearly with diffused daylight that would be sufficient for ordinary museum purposes, while the illumination of water by artificial means is correspondingly more difficult. Skylights located at a considerable height above the tanks should be decidedly larger than when placed lower down. When light is stronger than necessary it can be reduced easily by shading. Direct sunlight on the water is undesirable.

### ROCKWORK

At most public aquariums it is customary to line some of the tanks with rockwork, with the view of avoiding monotony and providing something like natural backgrounds. When this is well done the attractiveness of the exhibits is enhanced greatly. The material used is cemented to the walls of the tanks. It is possible, by such means, to produce the effect of reefs and grottoes, but the success of underwater pictures created in this way is dependent upon good taste and a knowledge of what is appropriate in each case. It is not the kind of work that can be left to the contractor. In some cases artificial submarine views are not very convincing.

Coral rock from Florida or Bermuda reefs is good material to work with. A fair substitute is the calcareous tufa used about greenhouses and by gardeners in the construction of rude fountains. Masses of hard, cavernated bowlder clay rock of a dark shade, obtained along the coast at low tide, have been found suitable for producing the effect of sea-worn rocks. Conglomerate rock is permissible for both fresh and salt-water tanks. It is easier to find the materials than the genius to combine them so as to produce natural effects. In the lining of fresh-water tanks attempts have been made to reproduce the rocky banks of streams and lakes. A ledge of columnar basalt

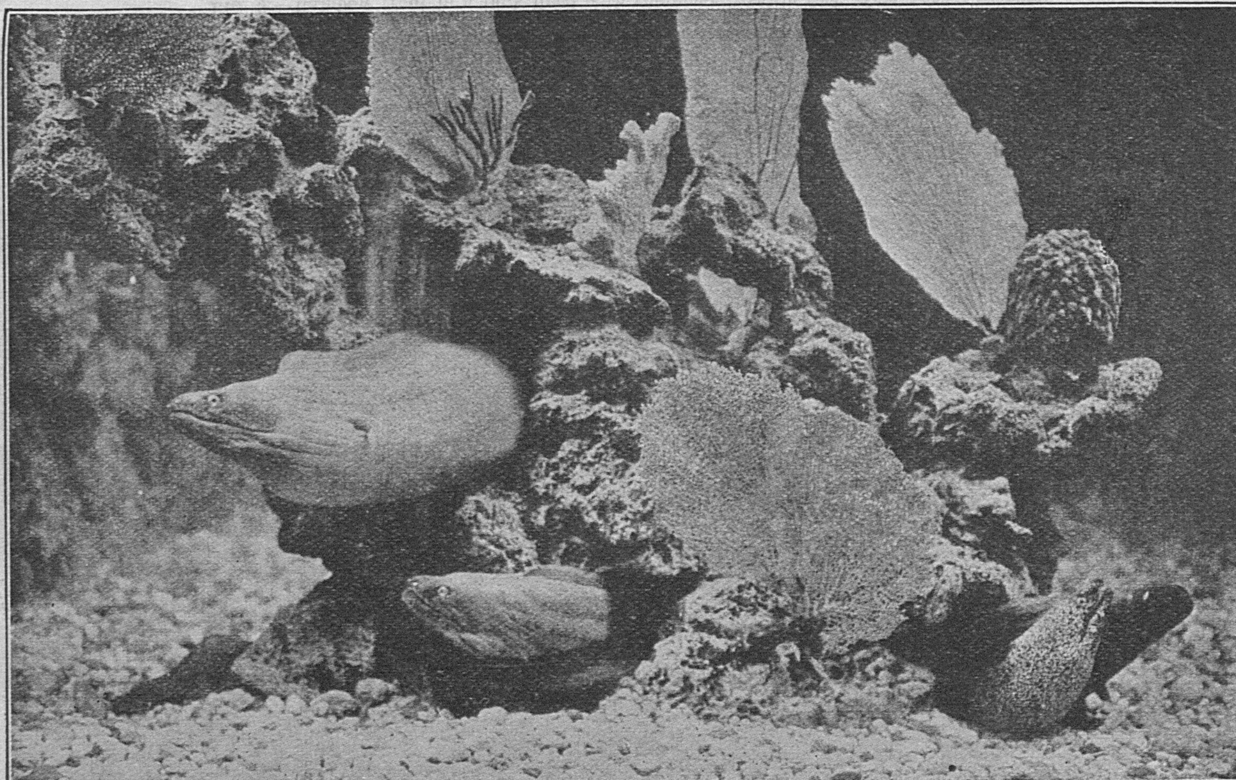

FIG. 8.—Rockwork in the moray tank, New York Aquarium. For fishes inclined to hide, but constructed so that entire concealment is prevented. Position near front of tank. Built of calcareous tufa, not coral rock. A few stony corals and sea fans have been attached

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FIG. 9.—Rainbow trout in a tank lined with columnar basaltic rock, New York Aquarium

on the bank of a stream in New Jersey suggested the use of that material in the New York Aquarium.

After a few months' exposure to the water, artificial backgrounds of rock acquire tones that are agreeable to the eye and help to secure the effects sought. Rockwork linings undoubtedly contribute to the comfort of the animal forms kept in the tanks. Fishes take an interest in exploring the crannies in the rocks, swimming through the arches and resting under them, while crabs and other invertebrates find good places to climb and cling.

## WOODEN EXHIBITION TANKS

Glass-fronted exhibition tanks of moderate size sometimes are made of wood with iron frames to hold the heavy plates of glass. In the aquarium at Detroit the tanks are constructed of steel. Those on the balcony of the New York Aquarium are built of 2-inch pine, strongly bolted. These wooden tanks have been made durable and sanitary by lining with cement laid on wire lath securely stapled to the wood. The cement surface makes a good foundation for the attachment of rockwork. They are 4 feet in vertical depth, with outward sloping rear walls 3 feet back from the glass fronts, and vary in length from 3½ to 5 feet. Experience has shown that tanks of such limited dimensions are not suitable for any fishes of active habit even if of small size. A group of Chætodons or other equally lively small fishes turned loose in a big tank will outlive the same number in a small tank.

## RESERVE TANKS

Every aquarium needs some tanks to hold specimens not on exhibition and for other purposes. They are generally located along the service passageway in the rear of the exhibition tanks. In the New York Aquarium they are placed above the rear ends of the latter, their overflows draining into them. Reserve tanks, as they are called, are about 3 feet in width and depth and vary from 6 to 8 feet in length. The New York Aquarium has 26 tanks of this kind, most of which are in constant use. They contain fishes for replacing losses that may occur in exhibition tanks, injured fishes under treatment, small fishes used as live food, and quantities of invertebrates used by school-teachers for classroom study.

## FLOOR POOLS

Floor pools are desirable for crocodilians, aquatic mammals and birds, turtles, and fishes too large to be kept in glass-fronted tanks. Seals, manatees, and porpoises do as well in them as any other lung breathers subjected to indoor confinement. The larger such pools can be constructed the better for their occupants. Seals and porpoises need all the room for exercise they can get. Even when well provided for in this respect, their endurance in captivity depends upon the behavior of the individual animals. Those that are lively and active may live for years, while the lazy and sleepy individuals may not survive more than a few months. The New York Aquarium has kept certain harbor and West Indian seals 5 years and a California sea lion 19 years, but in each case these were unusually active individuals, habitualy swimming many hours a day. The aquarium in Washington, D. C., kept a pair of fur seals nine years.

FIG. 10.—A floor-pool exhibit. Young elephant seals at the New York Aquarium

Manatees are sluggish in habit and do not often avail themselves of the space afforded for exercise. Success in keeping them depends chiefly upon suitable water temperature and pure air. The aquarium has kept the brackish-water manatee of Florida 17 months and the fresh-water manatee of the Amazon over two years.

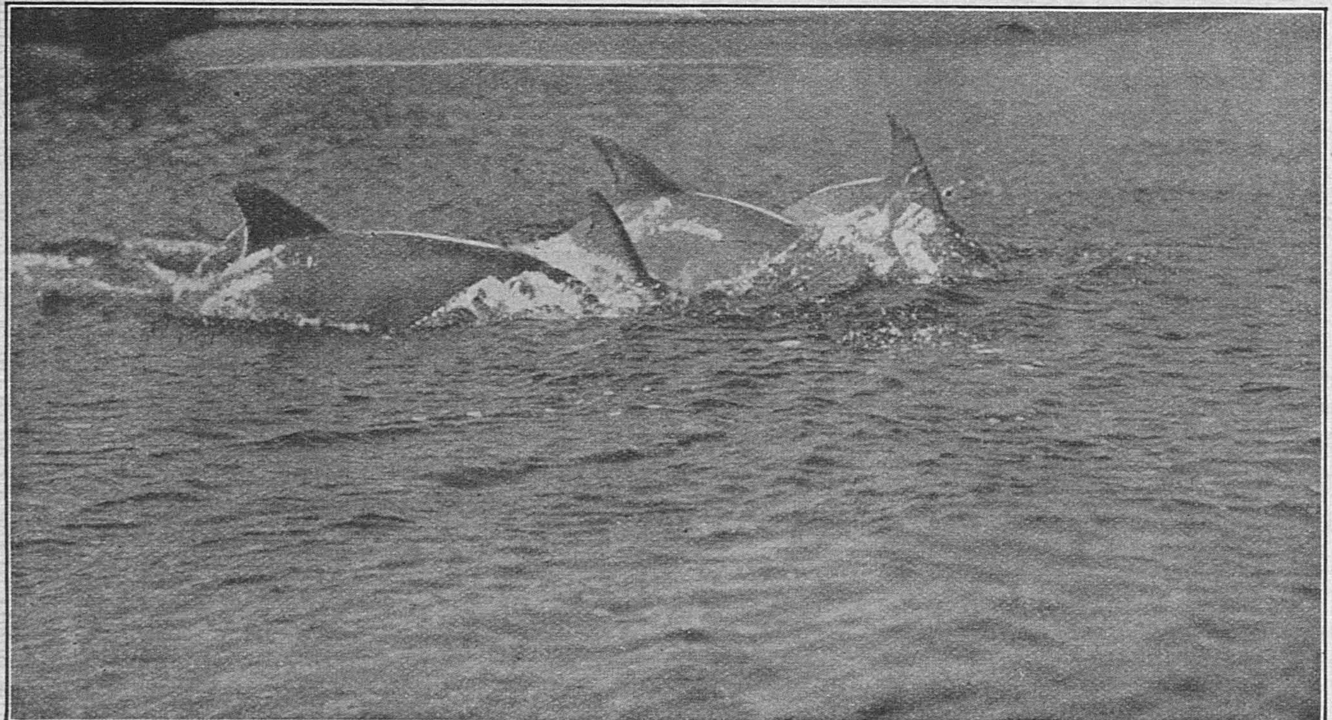

FIG. 11.—A floor-pool exhibit. Porpoises (*Tursiops truncatus*) in the New York Aquarium. The pool is 37 feet in diameter and 7 feet deep

Crocodilians are long-lived in captivity, and so are the giant snapping turtles (Macrochelys) of the lower Mississippi River, which are kept in the same pool with them.

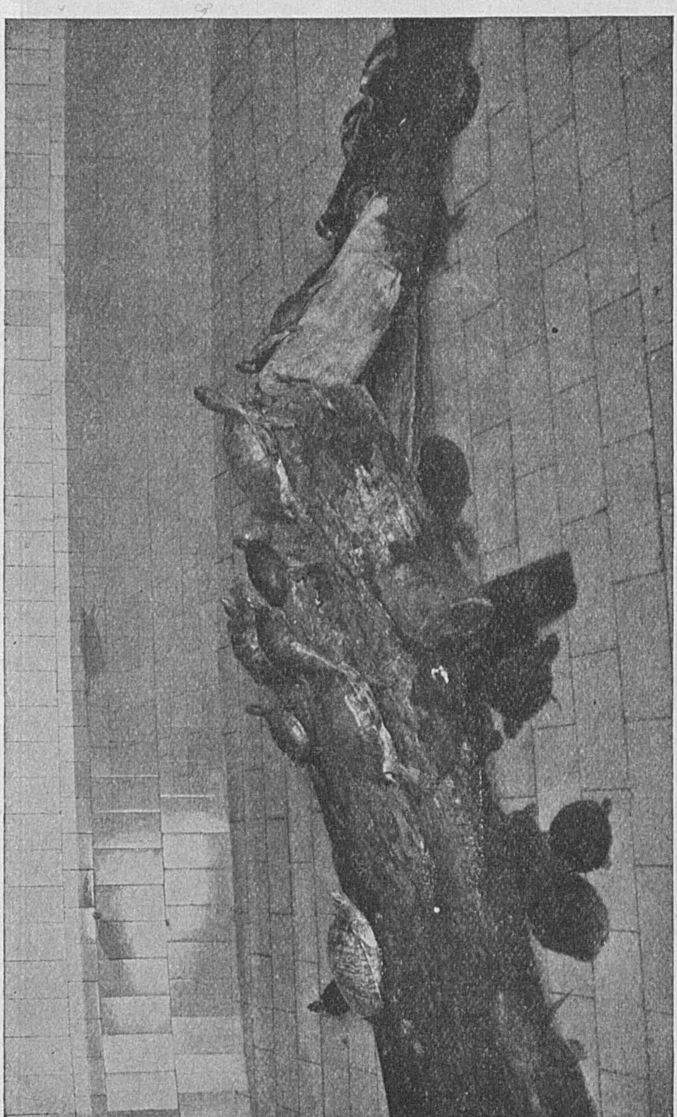

FIG. 12.—Turtles drying off in one of the fresh-water floor pools of the New York Aquarium

Porpoises are active day and night, but none of those brought to the aquarium lived longer than two years. All mammals kept continuously indoors suffer for lack of pure air, as the building must be heated in winter and often is densely crowded with visitors. Maintaining the purity of the air at all times is difficult, and such animals become tender and are liable to die suddenly of pneumonia.

Six of the floor pools in the New York Aquarium are oval in shape, 28 feet long by 3 feet deep. They are sunk in the floor about one-fourth their depth. A circular pool 38 feet in diameter and 7 feet deep has been used for porpoises. The floor pools, containing seals, crocodilians, fresh-water turtles, or other animals that often leave the water, are provided with sloping platforms, which they can ascend at will. Sea turtles in the New York Aquarium never attempted to leave the water, although kept for years in a pool with a sloping platform.

The length of life of seals and porpoises in captivity might be greater could they be provided with sea water of normal ocean density. In the New York Aquarium these animals from necessity have been kept in filtered water of low salinity pumped from the harbor. Being heavy feeders that deposit considerable waste matter, the water supply must obviously be separate from that of the more delicate organisms that require absolutely pure water. It is probable that seals, porpoises, and manatees could be kept many years if aquariums were provided with outdoor pools to which they could be removed in summer. This should serve to renew their vitality for the trying winter life indoors.

## FISH HATCHERY

An interesting and instructive exhibit for a public aquarium can be made with a small equipment of jars and troughs for the hatching of fish eggs. The methods employed in national and State fish hatcheries can be shown with little difficulty, and the equipment can be condensed to occupy but little space. The fish-hatching jars and troughs in the New York Aquarium are carried on the broad stone coping of one of the floor pools. As the eggs of fishes can be secured from early spring until late in the autumn, it is possible to show fish eggs and young fry in various stages of development and growth during most months of the year. The eggs of trout can be stripped from large fishes in the exhibition tanks. Yellow perch deposit their masses of eggs in the tanks, and these, when fertile, are shifted easily to the hatching jars. The eggs of several kinds of food fishes can be secured from State or national fish hatcheries by making special arrangements. The eggs of whitefish, pike perch, yellow perch, shad, and other species, which should be kept in motion while hatching, require hatching jars of glass; those of trout and salmon are placed on wire trays suspended near the surface in narrow wooden troughs. Hatching troughs for exhibition purposes need not be large or numerous, as in fish-hatchery buildings. Those used in the New York Aquarium are 5½ feet long, 1 foot wide, and 6 inches deep. It is customary to paint such troughs inside and out with black asphaltum paint, which is not only a protection against decay but renders them sanitary. For aquarium purposes they may be painted inside with white enamel to make the eggs or young fish more easily visible. The shallow trays bearing the eggs are inserted temporarily until all eggs are hatched. They are merely wooden frames with wire bottoms, measuring a little less than 12 inches square. They are held in position near the surface by small wedges of wood. A constant flow of water through the hatching troughs is supplied by ½-inch pipe. Glass hatchery jars of the McDonald type are used for eggs that need to be kept in motion.

The methods employed in the hatching of fish eggs of various species are of decided interest to visitors. The hatchery has been

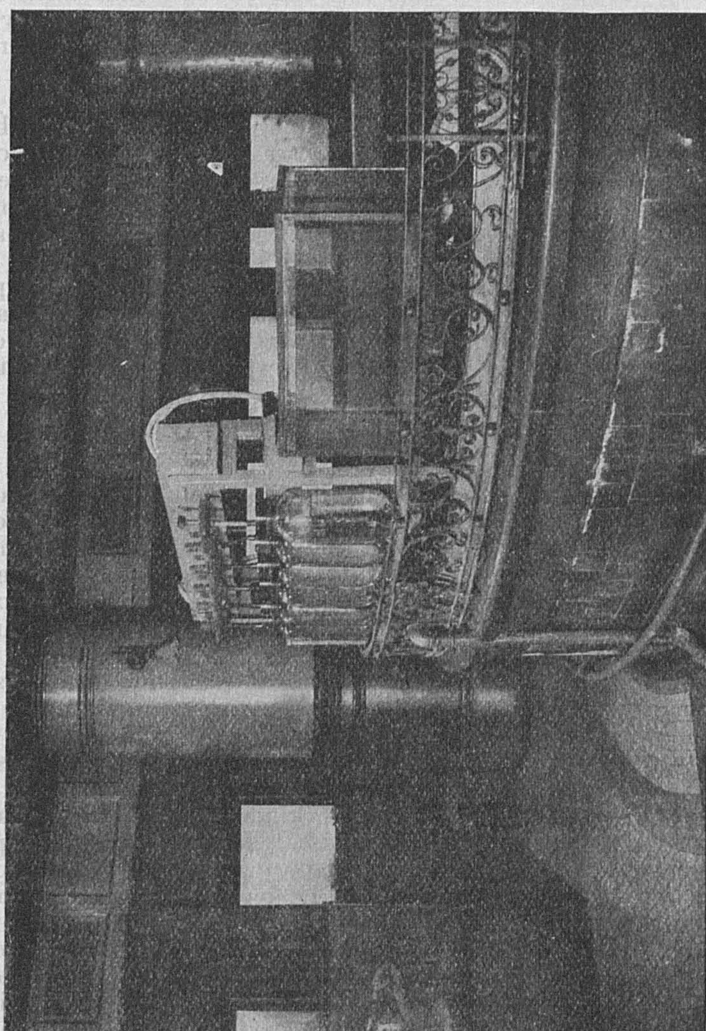

FIG. 13.—Side view of hatching battery for the incubation of glutinous fish eggs. Receiving tanks at the right

operated virtually without expense to the aquarium, fish eggs being supplied from national hatcheries by the Bureau of Fisheries, and the young fry removed to public waters by the State fish-culturist, who is always ready to accept them. The yearly output of fry at the New York Aquarium since 1903 has averaged between 4,000,000 and 5,000,000.

During recent years all trout fry produced in the aquarium have been used in stocking streams in the Palisades Interstate Park. Other kinds of young fishes usually have been distributed in the lakes of New York and New Jersey.

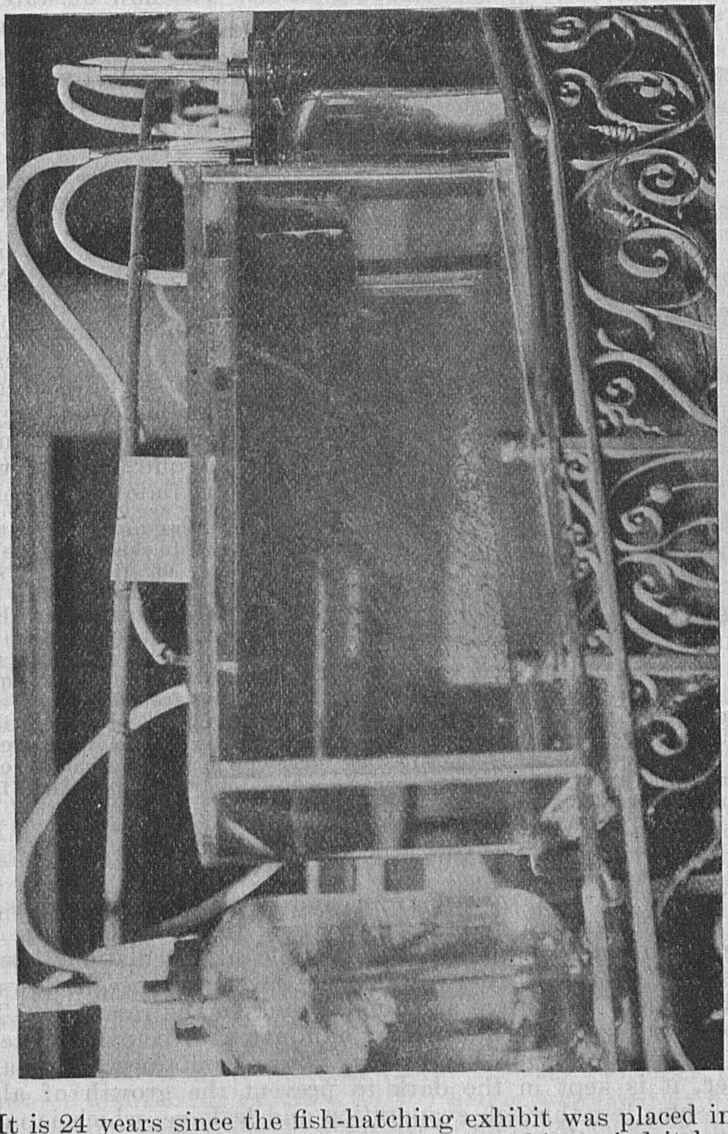

FIG. 14.—A portion of the fish hatchery, New York Aquarium, showing the hatching jars and receiving tank into which the young fishes flow after hatching. A cloud of young fishes may be seen in the tank

It is 24 years since the fish-hatching exhibit was placed in operation at the New York Aquarium. During this period it has shown the eggs and young of many kinds of food fishes in different stages of development, from the appearance of the dark eyespots in the transparent eggs, through the process of breaking of the shell and the absorption of the yolk sac, to the active swarming of the fry in the rearing troughs and glass tanks.

A large information chart placed near the hatchery shows the spawning seasons of fishes and the periods of incubation of the eggs of different species.

Figure 13 shows some of the automatic hatching jars and their connections with one of the receiving tanks. The flow of water in the jars is so arranged that the young fishes rise to the surface after hatching and are automatically floated into the adjacent receiving tanks.

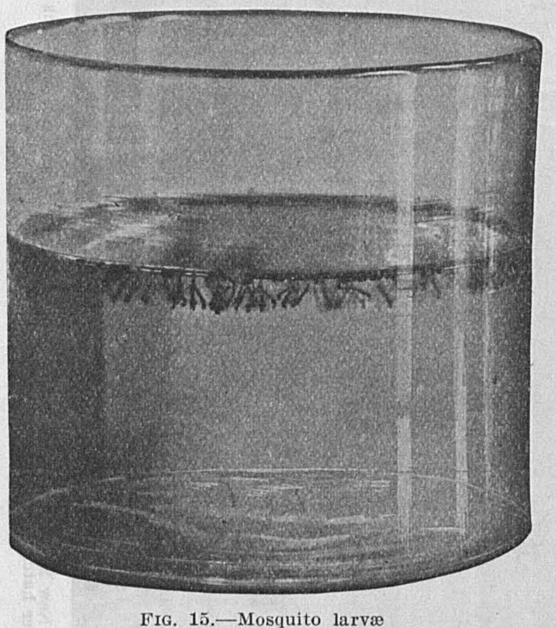

FIG. 15.—Mosquito larvæ

## AN OBJECT LESSON ON MOSQUITOES

An instructive summer exhibit in the New York Aquarium and cordially approved by the board of health is a wire-screened, 8-gallon, round, glass aquarium containing mosquito larvæ, with the following label:

Mosquitoes lay their eggs in clusters on the surface of still water, such as is found in rain barrels, cisterns, ditches, stagnant ponds, undrained swamps, and marshes. Each female mosquito lays from 150 to 400 eggs, which, in about a week, hatch into larvæ or "wrigglers." About a week later the "wrigglers" become mosquitoes. The mosquito is the only known source of malaria and yellow fever. If the breeding places of mosquitoes can be obliterated, malaria and yellow fever can be wiped out and annoyance from mosquito bites avoided.

## RESERVOIR FOR SEA WATER

Sea water, as used in American and European aquariums, is stored in underground reservoirs adjacent to or underneath the aquarium building. It is used as a "closed circulation," being pumped continuously to the distributing levels, whence it flows to exhibition tanks and filters and finally back to the reservoir. The filtration process that keeps it clear eliminates, of course, whatever minute forms of marine life it may have contained originally. Moreover, it is kept in the dark to prevent the growth of algæ. There is some loss through evaporation and leakage, which is made up from time to time by small additions to the original supply. The increase in salinity resulting from evaporation appears to be negligible. After years of service the stored supply suffers little deterioration if properly managed. There is an increase in its acidity, resulting from the wastes from the numerous animals that live in it. Such deteroriation as takes place is counteracted to some extent by the occasional additions of pure sea water of ocean salinity.

As the New York Aquarium makes exchanges of marine animals for fresh-water species of other aquariums, the reservoir supply necessarily is drawn upon for water used in shipment. This procedure, which necessitates small annual additions of pure sea water, is helpful in maintaining the purity of the stored supply. New supplies of sea water are obtained by sending a tank boat outside the harbor to be filled on a rising tide. For this purpose tank boats engaged in supplying merchant vessels with fresh water are available.

The underground reservoir of the New York Aquarium was installed in 1908 after experience had shown that the brackish and sewage-laden water pumped from the harbor was not suitable for the keeping of marine animals. The original supply of stored sea water has been in use ever since. This reservoir, which is of reinforced concrete and 100,000 gallons capacity, is divided into four adjoining chambers of equal size, connected with each other by valve-controlled equalizing pipes. Water returning from the filters is discharged into the first of the series and pumped from the last. A small central valve chamber is equipped so that water may be pumped from and returned to any desired combination of the four chambers. As any three of the reservoir chambers may be made to hold all of the supply of water, it is possible to empty them in turn for such cleansing as may be necessary. This has been found necessary only seldom, apparently owing to the constant filtration of returned water.

A reservoir should be of sufficient capacity to hold at least twice the quantity contained in the entire series of exhibition tanks that it serves. A large supply gives the body of water in the reservoir more opportunity for precipitating the finer particles of matter in suspension. In winter the necessary temperature can be maintained to better advantage with a large body of water. The location of the 22,000-gallon reservoir of the new Bermuda aquarium, which supplies 27 tanks, is located above the level of the exhibition tanks and 30 feet above sea level.

In the construction of the reservoir precautions should be taken against leaks, which may eventually entail expense for renewals. In the course of time the concrete walls and bottom of the New York Aquarium have developed minute leaks, which caused a somewhat greater loss of water than could be accounted for otherwise. It finally became necessary to empty the sections of the reservoir in turn and make repairs. In several places the concrete was found to have deteriorated.

An analysis of the long-stored water supply was made in 1927, which showed it little changed except that its alkalinity had disappeared and the high nitrate (70.00) had accumulated by oxidation of the nitrogenous refuse of the fishes. The most effective procedure under the circumstances was believed to be the renewal of the entire supply, and accordingly this was done.

The aquarium at Naples, Italy, renews the supply of stored water occasionally at favorable times when the water of the bay is clearest. At Plymouth, England, it is renewed every six months, pumping from the sea being done at times of highest tides. When renewals can be made with little expense the practice is desirable, of course.

*Analysis of sea water at the New York Aquarium reservoir, installed in 1908, with additions made later. Date of collection May 12, 1927; sample number 187857*

[Analysis by bureau of water supply, city of New York, Dr. Frank E. Hale, director of laboratories]

| Analyses | Reservoir | Sea water [1] |
|---|---|---|
| Physical examination: | | |
| Turbidity (p. p. m. silica) | 1 | 1 |
| Color (p. p. m. platinum) | 11 | 7 |
| Odor | 0 | [2] 1 v |
| Chemical examination: | | |
| Albuminoid ammonia (p. p. m. nitrogen) | .545 | .075 |
| Free ammonia (p. p. m. nitrogen) | .155 | .075 |
| Nitrite (p. p. m. nitrogen) | .012 | .005 |
| Nitrate (p. p. m. nitrogen) | 70.00 | .25 |
| Total solids (p. p. m.) | 42,900 | 40,000 |
| Chlorine (p. p. m.) | 18,650 | 18,500 |
| Hardness (p. p. m. calcium carbonate) | 7,300 | 6,000 |
| Alkalinity (p. p. m. calcium carbonate) | 8 | 60 |
| Iron (p. p. m.) | .30 | .30 |

[1] Typical composite of deep-sea water. [2] The vindicates vegetable.

## DISTRIBUTING TANKS

The water supply of an aquarium flows to the exhibition tanks from large distributing tanks situated at a higher level. If there are both salt and fresh water supplies, there will be two sets of distributing tanks. It is necessary to have two or more such tanks for each supply if different water temperatures are required. One of the salt-water tanks will be fitted with a steam coil to provide a temperature suitable for tropical exhibits. One of the fresh-water tanks will be used for the distribution of refrigerated water.

Two of the three fresh-water distributing tanks in the New York Aquarium are equipped as gravity filters to insure as great clarity of water as possible. This in no way lessens their serviceability as distributing tanks. The filtering equipment in the bottom of these two tanks is similar to that used for sea water, described elsewhere. The three fresh-water distributing tanks are cylindrical and made of wood, averaging 8 feet in diameter by 5 in depth. The four tanks used for sea water are of similar construction, two of them being somewhat larger. The proper water levels in the distributing tanks are maintained automatically by float-controlled valves.

## AERATION

Aerating the water as it is distributed to each exhibition tank has been found helpful. It permits some reduction of flow, which is worth while economically if circulating pumps have to be driven at full capacity. It helps in clarification, and if the aeration is managed properly, it makes the inflowing current, charged with fine air particles, visible. A supply pipe fitted for aeration is extended to the bottom of the tank, whence the air-charged water rises like a fountain, adding an element of liveliness to the picture, otherwise quiet except for the movement of the living exhibits. It also simplifies the work of inspection during the hourly examination of the tanks at night, the water flow being visible.

Such aeration is accomplished by perforating the supply pipe at a connection a few inches above the surface of the water and inserting a 2-inch tube of slightly smaller diameter in the manner shown in the accompanying diagram. Without the smaller tube the air would rise to the surface in useless large bubbles; with it the air escapes in a way that gives it the appearance of a fine white mist. Liberated into the bottom of the tank in this way the air carries with it to the surface the finer particles of dirt in suspension, which float off through the overflow pipe. In some European aquariums the water is supplied at the surface by a strong jet directed into a pipe leading to the bottom, where the water escapes finely aerated. The same effect may be produced by plugging the outlet of an air pipe with porous wood, preferably linden, through which the air from the compressor escapes as a "mist" visible everywhere in the water of the tank. In the aquarium at Washington, D. C., "filtros" plugs are used in air pipes, being less likely to become swollen and clogged.

Aeration in this way is more effective than through the water pipe, but it necessitates the continuous operation of the compressor. In the New York Aquarium the air compressor is seldom used except when pumps are stopped and water flow is cut off temporarily. At such times mechanical aeration is imperative until the flow of water is restored.

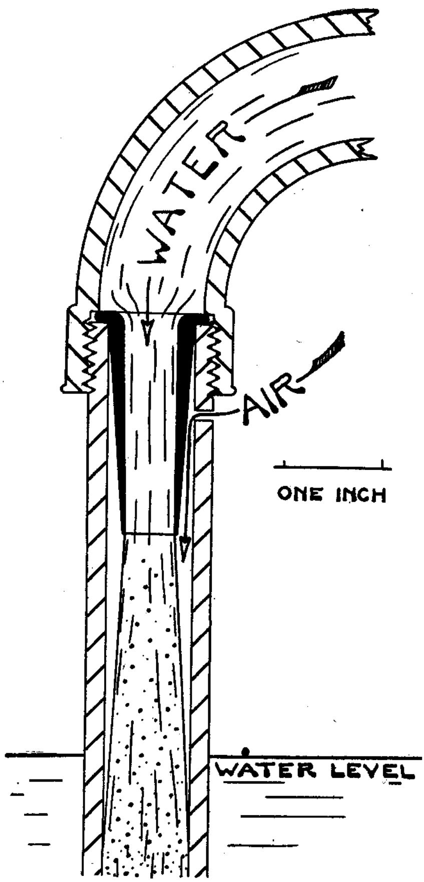

FIG. 16.—Aerating device, showing position of soft lead tube inserted in supply pipe above water level

PUMPS, PIPING, AND VALVES

The circulation of fresh water in an aquarium is accomplished by simple and easily arranged methods. The supply derived from the city water system flows through either pressure or gravity filters into elevated distributing tanks, from which lead the lines of piping that carry it to the exhibition tanks, whence it is drained to the sewer line. Galvanized piping in all sizes is satisfactory for the distribution of fresh water. That in the New York Aquarium is still in use after 30 years of service.

The circulation of stored sea water through exhibition tanks and of sea water into pools not connected with a reservoir is accomplished by mechanical methods that are not only expensive but require constant attention. Pumps driven by steam and gas engines and by electric motors have been employed satisfactorily for this purpose. The electrically driven pumps in use at the New York Aquarium are rotary pumps that draw water from the reservoir and from the harbor through 4-inch pipes. The water ends of these pumps are of admiralty bronze. The electric rotary pumps used in summer for circulating fresh water from the refrigerating tank have

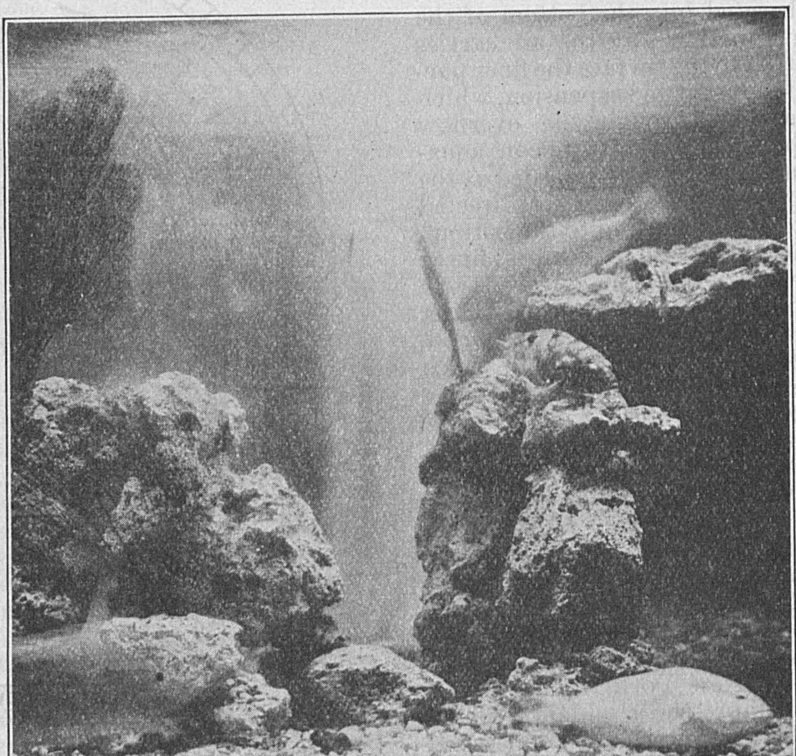

FIG. 17.—Fountainlike effect of aerated water in an exhibition tank, New York Aquarium

water ends of cast iron. All of these pumps are installed in duplicate as a safeguard against accident. An additional rotary pump is in use at times as an air compressor.

The piping connected with the reservoir system is lead lined; that connected with the harbor system is of galvanized iron. The reservoir supply is distributed in a part of its course (the section passing over the exhibition tanks) through a 4-inch line of hard-rubber pipe installed many years ago. This material is ideal for the distribution of water that flows by gravity, but it is expensive now. Piping of pure or chemical lead is safe and serviceable for aquarium purposes, especially in the smaller sizes. Iron pipe, lead lined, is expensive

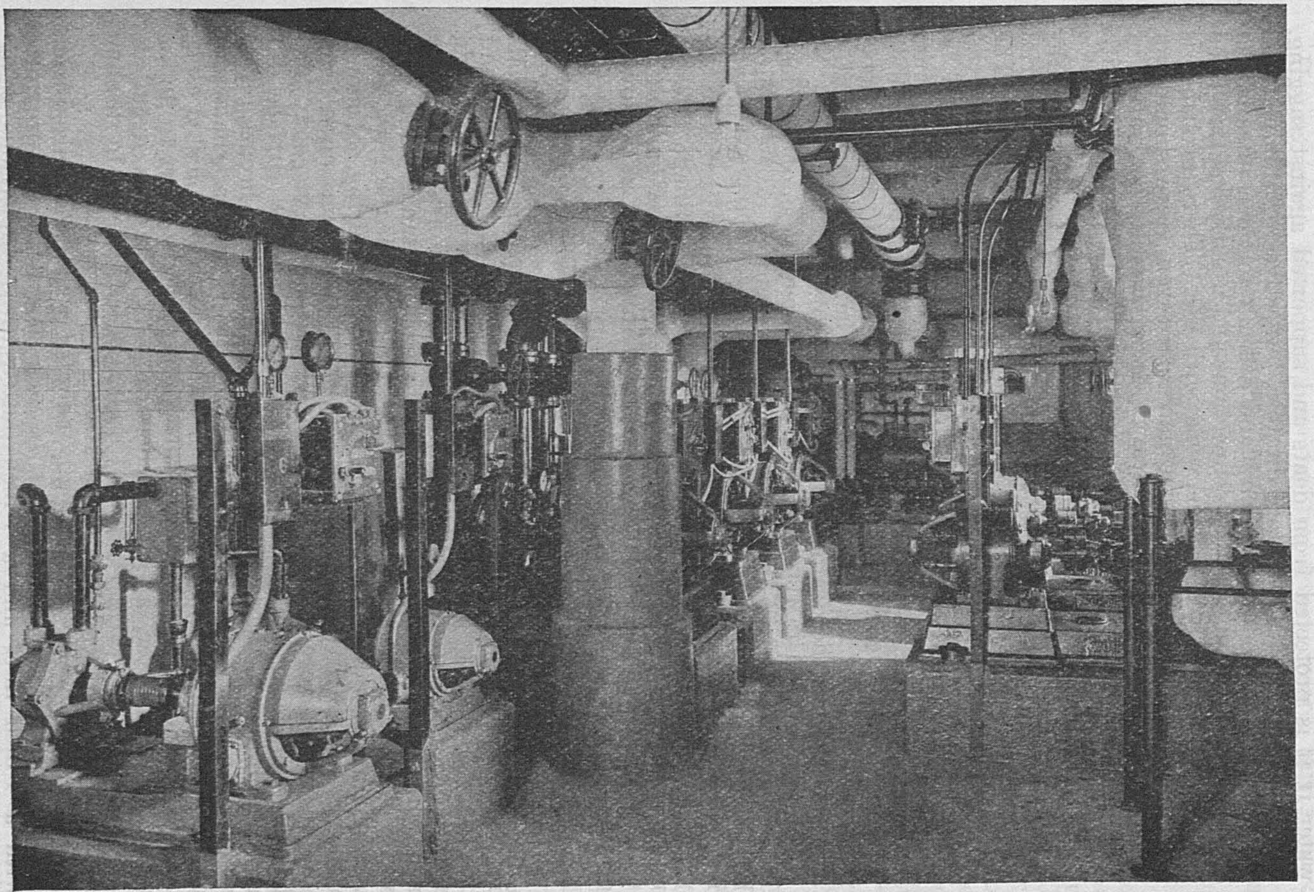

FIG. 18.—Electric pumps, New York Aquarium. The two pumps at the left are air compressor and vacuum primer. The next four are salt-water pumps. Those at the right circulate refrigerated water

and eventually becomes rust pitted. Piping of pure lead is durable and probably will come into greater use for the distribution of sea water if it is protected from dents and supported against sagging. Hard or chemical lead is more durable, but valves of this material tend to become fixed or " frozen " and difficult to turn. Lead-lined piping should be flanged at all connections and usually has lead-lined valves, but such valves become worn with use. There probably is no reason why the less-expensive galvanized-iron valve should not be used and renewed when necessary. It is possible that valves of vulcanized rubber could be used more cheaply in connection with lead piping of the smaller sizes.

Piping of hard lead with flanged joints will be used for all salt-water lines in the aquarium planned for Chicago, this material having given satisfactory service in the aquarium at Boston. The valves will be of hard lead (8 per cent antimonial), with a few special ball cocks of Government bronze. Heavy rubber gaskets will be placed in all joints where bronze and lead meet. The new aquarium in Bermuda is being fitted with piping of iron, glass lined, to be used with hard-rubber cocks. The larger valves are of regulus metal, much used in acid factories in England. The base of this metal is lead. Overflows and drains will be of soft lead.

The piping used in the aquarium at Philadelphia is of soft lead in several sizes up to 5-inch, a 6-inch line extending over the filter bed. The valves are of iron lined with bronze. This equipment is reported to have given satisfactory service. Glazed earthenware piping ought to come into more general use for drainage lines to reservoir and sewer. If properly installed when the building is under construction, it would be a permanent investment at the lowest original cost.

## HEATERS FOR STORED SEA WATER

As in northern latitudes it is necessary to keep tropical animals in warm water during the winter months, means must be found for maintaining the temperature to which they were accustomed in nature. Stored sea water used as a closed circulation is warmed by a heating coil in one of the elevated distribution tanks. The galvanized-iron coils originally used for this purpose in the New York Aquarium were a source of trouble and expense, requiring occasional removal for regalvanizing. The action of sea water upon iron appears to be more destructive when warm than when cold. The heating coil being charged with steam, its galvanized surface did not remain long in sound condition. A heating coil of bronze pipes, which proved somewhat more durable, also failed to resist the action of hot steam and salt water and soon became pitted and leaky, especially at the numerous threaded connections. In the effort to find a more durable heater, a coil of chemical lead pipe was installed. This heater lasted three years, and its use at least served to demonstrate the value of lead for this purpose.

The form of water heater finally adopted was a galvanized-iron kitchen boiler, entirely incased in ⅛-inch sheet lead and provided with a 4-inch inlet and a 1-inch outlet, these connections being incased similarly in sheet lead. The heater lies on the bottom of a wooden tank 11 feet in diameter by 6 feet deep. It is supplied with steam from the heating plant at about 5 pounds' average pressure. Having given satisfactory service for several years, this form of water heater is recommended as effective and durable.

The sea water supplied to the entire series of tanks containing tropical fishes is easily kept at a temperature of about 72° F.

### HEATER FOR FLOOR POOLS

Some of the lung-breathing marine animals, such as sea turtles, sea lions, West Indian seals, manatees, porpoises, and sea birds that go south in winter, can not thrive in water of low winter temperature. For most of these the temperature should be kept at 60° or 65° F. Sea turtles do not feed at all when kept in chilly water.

The heater used in the New York Aquarium for warming water pumped from the harbor is a spiral iron coil covered with 1/8-inch sheet lead closely fitted to the coil. The 1 1/2-inch pipe has a 3/4-inch outlet. The harbor water is of low salinity, but the animals kept in it, being lung-breathers, do not actually require water of ocean salinity, although they might be benefited by it. Some of them are heavy feeders, and the water soon becomes foul and must be drawn off every evening. Seals and sea birds can be kept for months in fresh water but eventually suffer for lack of sea water. Sea birds must sooner or later have sea water to drink. The water pumped from the harbor, being more or less fouled with sewage, is filtered as well as warmed before being supplied to the floor pools.

### HEATER FOR FRESH WATER

The water supply for pools containing pond turtles and alligators requires warming in winter before such animals will feed freely. For this purpose a galvanized-iron cylinder provided with a spiral copper steam coil is used. The coil is of 1 1/4-inch size with 1/2-inch outlet. The winter temperature of water for alligators and crocodiles is maintained at about 85° F.; that for fresh-water turtles is 10° lower.

### REFRIGERATING PLANT

In providing equipment for cooling fresh water, the aquarium builder has numerous types of refrigerators from which to choose. The New York Aquarium has a two-cylinder, 7 by 7 inch, electrically driven ammonia compressor of 15 tons daily refrigerating capacity. Its control is automatic, the temperature being regulated at the switchboard.

The double-pipe ammonia condensers are in two series of 12 pipes each and 19 feet 6 inches in length. The outer tubes are of 2-inch size, the inner 1 1/4-inch. The refrigerating tank is 14 feet long, 4 feet wide, and 5 feet deep. It carries four stacks of 1 1/4-inch galvanized pipe, 14 feet long, making a total of 1,600 feet of pipe. The ammonia-receiving tank is 7 feet long, with a diameter of 16 inches, holding 250 pounds of ammonia. The plant as a whole is known as the "direct-expansion" system.

The use of a refrigerating plant involves the keeping of cold-water fishes in a "closed circulation." None of the Salmonidæ thrive under such conditions, as the quantity of cold water in use is not large and soon acquires a high nitrate, which causes losses. The aquarium in Philadelphia carries Salmonidæ through the warm months successfully by using water from an artesian well, which has a uniform temperature of 57° F., and never has resorted to refrigeration.

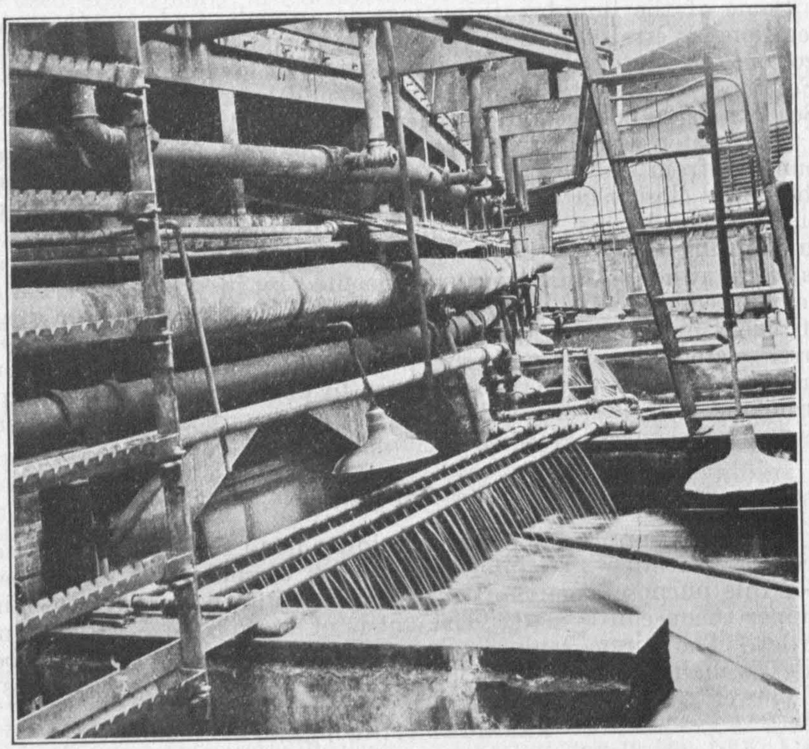

FIG. 19.—Battery of aerating and cooling jets, New York Aquarium, used on trout tanks in summer, without refrigeration

## AERATING AND COOLING BY OTHER MEANS

Finding it difficult to get satisfactory results with refrigerated water used as a closed circulation, another method of treating water for cold-water fishes is under trial at the New York Aquarium. Three lines of 1-inch pipe have been carried horizontally across the top of each large tank containing trout, salmon, whitefish, and other species naturally inhabiting cool waters. These pipes are raised 1 foot above the surface of the water, their under sides being perforated with ⅛-inch holes 3 inches apart. The numerous small streams thus provided strike the water with force enough to penetrate about 3 inches, supplying considerable aeration and at the same time being appreciably cooled in falling through the air. The jets can be directed so as to maintain a current in the tank. The results have been such as to indicate that this method of aerating and cooling may safely supplant the ordinary method of cooling by refrigeration with a closed circulation. Good aeration apparently is of more importance to Salmonidæ than mere cooling. The natural limit of endurable temperature can not be disregarded, of course. With an electric fan blowing on the numerous jets the temperature can be lowered about 4° at any time. The fan seldom is used, and only when summer water temperatures are highest. In addition to the aeration by strong jets at the surface, each trout tank has the usual water supply at the bottom.

## GRAVITY FILTER FOR SEA WATER

The Jackson gravity filter installed in 1908 in connection with the reservoir of stored sea water has proved satisfactory in every way.

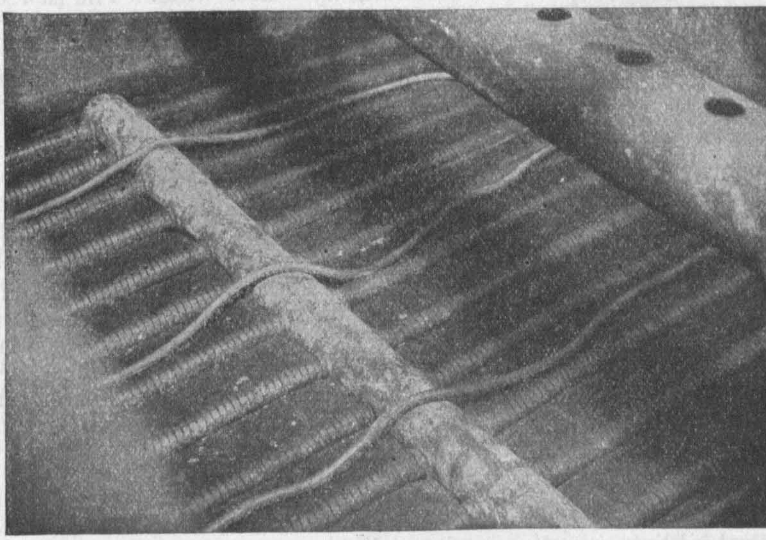

FIG. 20.—Filter bed of lead pipes half bedded in cement, the exposed surfaces having innumerable fine crosswise saw cuts to secure rapid drainage. Three of the small air pipes are visible

It would be difficult to find a simpler and more effective type for aquarium purposes. It continually carries off the overflow of 55 exhibition and reserve tanks, returning the water to the reservoir cleared of all matter likely to affect its purity or transparency. The entire floor in each of the 2-section, concrete, filtering chambers is covered with closely laid horizontal pipes of lead, half sunk in the concrete of the floor. The exposed upper surface of each pipe has many crosswise cuts made with fine $\frac{1}{32}$-inch fret saws, which permit a rapid drainage of water without loss of the overlying quartz sand. There is a central line or header of 4-inch lead pipe in each section, with 42 branches of 1½-inch pipe extending to the wall on each side.

The drainage from the exhibition tanks is carried in a 4-inch pipe across each filter above the bed of sand, the water escaping through numerous 2-inch holes along the upper side, thus distributing its fall more widely. The filters being in two sections, the sand bed in each can be cleaned in turn, the other temporarily carrying all the water. Cleaning is effected by closing the top or supply line until the filter is drained, when the bottom line is closed and the flow reversed by admitting fresh water at the bottom until all waste matter on top of the sand bed has overflowed into a sewer line. The fresh water is then drained off to the sewer, the sea water turned on, and the filter again put in operation. The sand bed in each section is 2 feet deep, of No. 8 cut quartz. To facilitate cleaning, four small and finely perforated air lines of lead pipe across the bottom are connected with an air compressor. When the flow is reversed and the compressor put in operation the combined lifting power of water and air serves to stir up and clean the sand bed. Each section of the filter is 10 feet long by 6 feet wide. The saw cuts in each branch average about two per inch run. The Jackson Filter Co., of St. Louis, appears to have passed out of existence. Other aquariums using this type have copied that in the New York Aquarium.

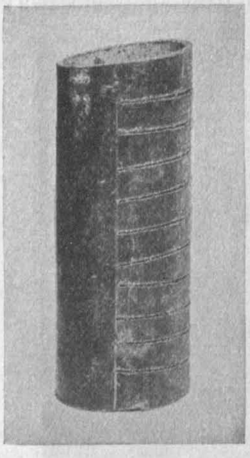

FIG. 21.—Lead filter pipe with saw cuts

### FILTERS FOR FRESH WATER

The two bronze pressure filters that have always been in use at the New York Aquarium are cylindrical in form and measure 6 feet in diameter and depth. The bottom in each filter is fitted with 80 closely set strainer heads with minutely perforated copper caps. The quartz sand bed in each is 4 feet deep. All fresh water used in the exhibition tanks and pools of the aquarium passes through these filters.

### VENTILATING SYSTEM

In a building sometimes of peculiar construction, like that of an aquarium, and often crowded with visitors, artificial ventilation frequently is necessary. The air circulation in the New York Aquarium is provided by a 6-foot motor-driven fan, drawing air through a wire-screened window. The air passes through a stack of steam-heated coils, the steam being cut off in summer. It is distributed through large, galvanized, sheet-iron ducts suspended under the balconies on each side of the building. The ventilating system is in operation only during the hours when the building is open to the public.

### COLLECTING THE SPECIMENS

Large fishes are difficult to transport as well as to catch. Tanks containing sufficient water to keep them alive during shipment are enormously heavy, and, as water animals can not endure the delays of freight service, the bills for expressage are large. Very few living fishes can be shipped without attendance. They must be " personally conducted," which adds passenger fares to express rates. Where a circulation of water can not be kept up en route, as on steamers, the tanks must be aerated artificially and water added by any means available. It costs more to transport one big sturgeon or shark than 500 small fishes, and the chances of having something to exhibit in the end are much less. Is is cheaper and safer to send a lot of king crabs to England than to bring one large-sized sturgeon from the Delaware River.

The public aquarium must collect its living exhibits with its own apparatus of capture, as there are no purveyors for an institution of this kind. For the most part the exhibits are procured from the lakes, streams, and coasts of the region in which the aquarium is located. If there are other aquariums within a day's railway journey, profitable exchanges of specimens can be made. Long hauls are unfavorable.

In the work of collecting from local waters the haul seine is the chief reliance. There must be a supply of portable tanks for the transportation of specimens. Food and game fishes are obtained, to some extent, from State and national fish hatcheries, especially if the aquarium maintains a small fish-cultural exhibit and can offer quantities of young fry in exchange. Specimens of many kinds can be obtained by cooperation with local net fishermen, but the aquarium collector should receive and care for all specimens when they are taken from the nets, as market fishermen do not realize the necessity of careful handling. Fishes intended for exhibition should reach their destination not merely alive but uninjured, if they are to survive in captivity. A 5-foot boat-shaped floating crate is of great service in holding the catch while the work of seining is in progress. When filled it is towed by a skiff to the well boat or to the shipping tanks on the beach. With a painter at each end it is hoisted aboard the boat and the catch spilled into the well. Fishes taken in gill nets generally are injured and worthless for exhibition, but those selected from haul seines, pound nets, and fyke nets usually are in sound condition. Fishes captured with hook and line need not be injured if unhooked carefully.

During transportation the shipping tanks require constant attention. If specimens are crowded, the water must be aerated with an air pump or by lifting with a dipper and pouring back slowly. In warm weather the temperature of fresh water may be kept down with ice, which, however, should not be put in the water but allowed to drip from a piece of netting or burlap. Some of the common freshwater fishes in the New York Aquarium are taken with seines in the lakes of the various city parks. In fact, the aquarium has stocked some of the lakes with bass, perch, sunfish, roach, and other common species as sources of supply. In collecting these fishes the seines, dip nets, and tanks are loaded into a wagon and the lakes visited in turn by a seining party of four men. As long as the wagon is in motion the splash of water in the tanks is usually sufficient for aeration without the use of the dipper. Shipping tanks should not be crowded if the best results are to be attained.

When more distant waters are visited the collecting outfit is sent by train to the point selected, where a wagon is hired for the day's work. In shipping by train the aerating dippers are kept in constant use by the attendants. On long trips where there are several tanks to care for a hand-operated air pump, with rubber-tube connections to each tank, is used. The free end of each tube is plugged with linden wood, through which the air enters the water as a fine mist instead of useless large bubbles. Filtros plugs, which do not swell as wood does, are also used for this purpose.

In collecting marine fishes the same care in handling is required, and the use of ice is not necessary. A well boat or small vessel with a water compartment, to which sea water has access, is ideal for the transportation of marine specimens. There are many such vessels in use along the Atlantic coast wherever it is customary to carry fishes and lobsters to market alive. Many of the local sea fishes are procured from the large pound nets used for market fishing along the coast of New Jersey and about Long Island. The loaded tanks can be brought in on the decks of the returning market boats or by motor trucks from points not too distant. The New York Aquarium has a well boat for this work, which permits great extension of the collecting field and gives excellent results.

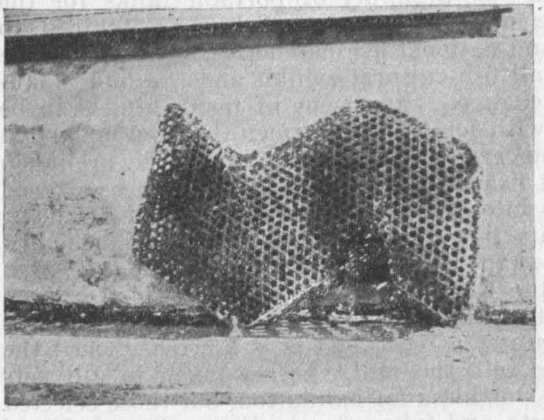

FIG. 22.—Wicker fish trap, used throughout the West Indies

The tropical fishes in the aquarium are brought from Bermuda or Florida. Many of them are captured in the wicker or rattan fish trap, a form of fishing apparatus in common use in Florida and throughout the West Indies. It is ideal for the purposes of the aquarium collector. Many Florida fishermen now make this trap of wire. Those made by the writer of ½-inch-mesh wire on board the U. S. F. S. *Albatross* gave good service during a voyage in Polynesia. The fish trap may be useful in fresh waters, but information is lacking. The larger fishes are taken with hook and line. Such fishes are carried in well boats from the fishing grounds to the collector's base, where they are kept in floating crates and fed daily until 24 hours before the date of shipment by steamer.

The wooden tanks used in transporting fishes by steamer are of greater capacity than the metal tanks used in shipping by wagon or train. They are of substantial construction, measuring 4 by 2 feet, with a depth of 2½ feet—all inside measurements. These tanks are made of 1½-inch cypress and are bolted strongly. The tanks are arranged in a row on shipboard, fitted with a pipe along the top, and supplied with flowing sea water during most of the voyage northward, being connected with one of the ship's pumps. There are separate supplies to each tank from the top line, the outlets draining overboard.

With a strong flow of sea water and the tanks not crowded a large number of fishes can be carried safely. By using 14 tanks of this size, 800 good-sized fish can be transported from Bermuda or Florida to New York with less than 5 per cent loss. Feeding during shipment (which would foul the water) fortunately is not necessary, except in the case of chætodonts and other small fishes, which annoy each other when hungry.

There is an advantage in carrying each lot of fishes in as large a body of water as possible. Wooden shipping tanks strongly bolted together are almost indestructible in ordinary use, while metal tanks are dented easily and rendered leaky by the rough usage they get on shipboard when empty. Sea water eventually rusts them, even when galvanized.

On shipboard it is not always possible to have tanks carried between decks, and in the cold weather of spring or fall, when placed on the open deck, tropical fishes may become chilled. Wooden tanks keep the water warmer than it can be kept in metal tanks, and the

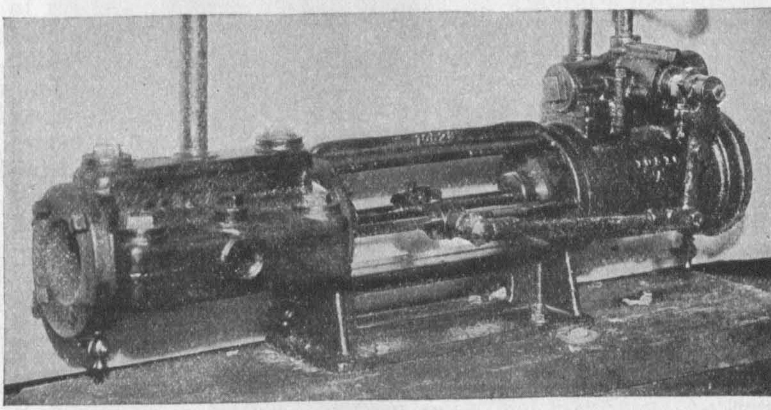

FIG. 23.—Steam-driven air compressor for the aeration of tanks on shipboard

fish may be protected further with tarpaulins. Their cost is less than half that of metal tanks, and their great weight when loaded is not objectionable, as they are hoisted by steam power.

As tropical fishes being transported northward can not endure a lower temperature than that to which they have been accustomed, it is unsafe to pump sea water into the tanks during the latter part of the voyage to New York. The circulation of water, therefore, is cut off before the vessel passes north of the warm Gulf Stream, and a circulation of air is substituted by means of a steam-operated air compressor carried along for the purpose.

Manatees and porpoises, being heavy and entirely aquatic in habit, can not be shipped without the support of water. They are warm-blooded and soon become overheated without this cooling as well as supporting medium. Each porpoise or manatee is shipped in a rough wooden tank sufficiently large to contain it without discomfort and with enough water to float it. The water soon becomes too warm and must be renewed every three or four hours while in transit. With such treatment they can be shipped long distances without danger.

Half-grown sharks can be transported with no more difficulty than other large fishes and may live three or four years, but so far mature sharks have resisted attempts at domestication.

Sea turtles are hardy and live long in captivity. While they are always shipped dry and kept on their backs, they would doubtless be

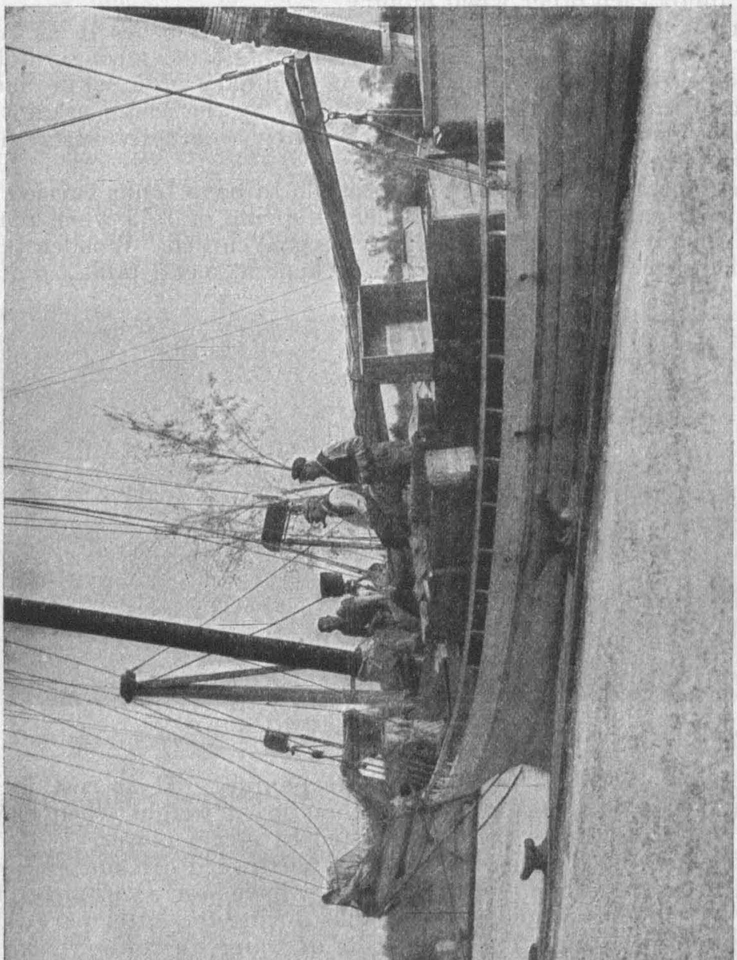

FIG. 24.—Deck load of tanks containing porpoises

more comfortable in shallow tanks of water. When carried on their backs a roll of burlap or other support for the head is desirable. Sea turtles may die during transportation unless laid on their backs, their great weight causing suffocation. Hard-shelled pond turtles are easily shipped in boxes with slatted tops, but the soft-shelled species should rest on moss or other packing to prevent chafing, and each of these should have a compartment to itself to avoid injury. Large salamanders of the Necturus and Cryptobranchus genera should be shipped in water, but the smaller native species can be packed in damp moss and forwarded by express. The large fresh-water crayfishes of Pacific coast streams have been packed in damp moss and forwarded to New York successfully by parcel post at small cost.

### COLLECTING BOAT

One of the most important features in the collecting equipment of a large aquarium is a well boat, in which fishes intended for exhibition can be transported without injury. With such a vessel the most favorable collecting localities can be visited at leisure and the catch retained in safety until the well is filled. Through the munificence of the New York Zoological Society the aquarium has had the use of such a vessel for the past eight years. In the gathering and transporting of marine fishes from adjacent coastal waters it has proved invaluable. A return to the laborious and wasteful method of shipping in tanks seems inconceivable. The supply is greater, both for exhibition and feeding purposes, while the surplus is important in making exchanges with inland aquariums for fresh-water fishes. With an equipment of haul seines, dredge, tow net, dip net, and other devices on board, the catch is made easily. The dimensions of this vessel—the *Seahorse*—are as follows: Length, 35 feet; beam, 11 feet; draught, 3½ feet; length of forward cabin, 10 feet; length of after cabin, 7 feet. The well amidships is 10 feet long at the bottom and has the width of the boat, with a water depth of 2 feet. There are fold-up berths for four men, a galley, and a lavatory. The boat is sloop rigged, has a 25-horsepower engine, and is staunch and seaworthy.

By visiting the large pound nets, numerous in New York and New Jersey bays, it is possible to secure many species difficult of capture with other forms of apparatus. While the boat is usually provisioned for a two or three day cruise, the well often is filled in a single day, the catch consisting sometimes of as many as 400 fishes, large and small, with quantities of invertebrates and an occasional sea turtle or sea bird.

### EMPTYING THE WELL

Removing fishes from the well with dip nets is rather difficult and causes needless disturbance. This operation is avoided now by sinking a stout, fine-meshed net lining into the central part of the well before any specimens are introduced. The net is sunk and spread at the bottom by a rectangle of light galvanized-iron rod. Its top is hung on hooks around the sides and ends of the well. The catch is removed as a whole simply by hoisting the net until all specimens are within easy reach, when they are transferred to the tanks of the aquarium with the minimum of disturbance. The roomy well space at each side of the removable net is available for skates, sharks, sturgeons, or other extra-large specimens.

### COLLECTING EQUIPMENT

In the capture of aquatic forms for exhibition the aquarium collector depends chiefly upon nets, the haul seine being the most im-

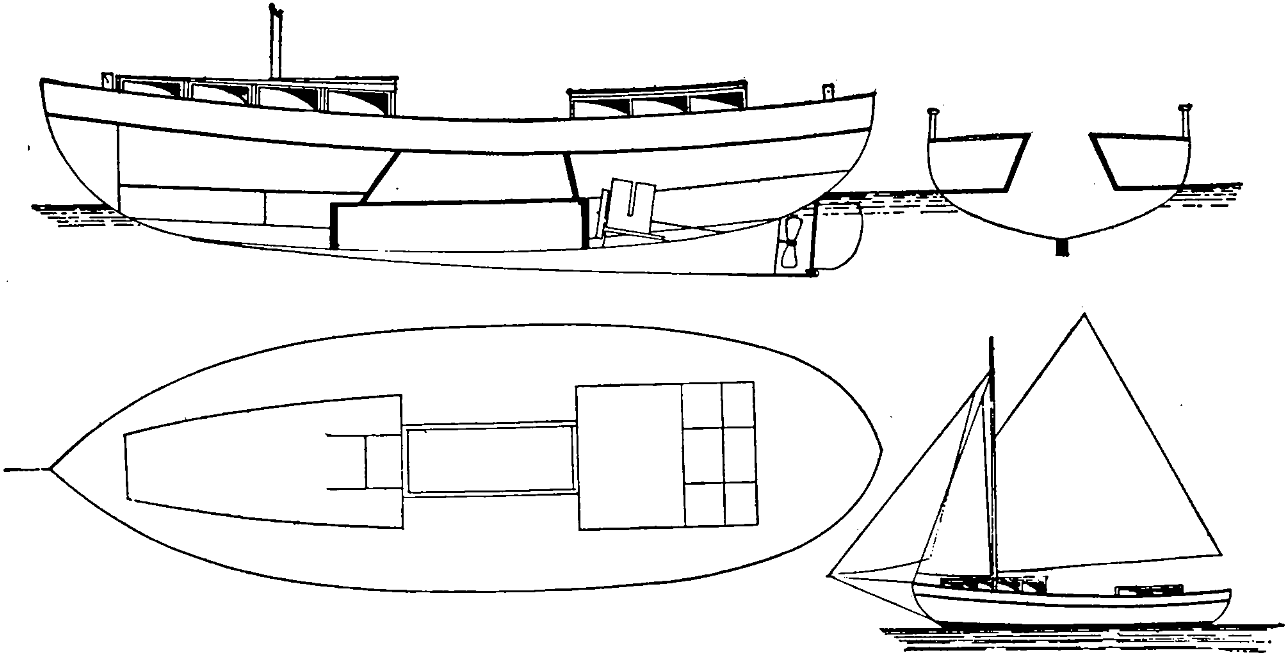

FIG. 25.—Plan of the well boat *Seahorse*

portant feature of his apparatus. Seines of two or more sizes are necessary according to the waters to be fished. The seine employed most frequently for collecting in fresh waters is 100 feet long, 12 feet wide at center, tapering to 4 feet at the ends. It is usually of

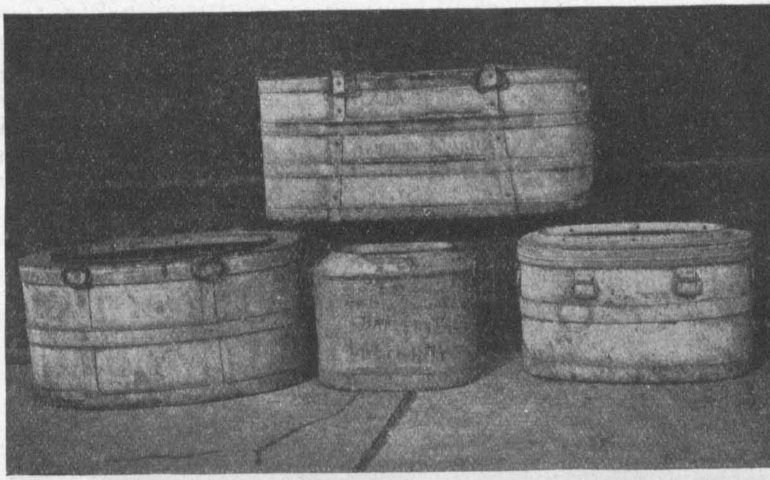

FIG. 26.—Oval shipping tanks of galvanized metal

1-inch mesh. For use in brooks and ponds a 50-foot seine is more convenient. In wide waters and for use on sea beaches a seine 300 feet in length is necessary. The seine is thrown out from a boat, one of the haul ropes being held by a man on shore while the

FIG. 27.—Narrow tank for fishes of extra length. Hoisting a shark from the well boat for transfer to the aquarium

other is passed ashore after the seine is laid. Collecting seines, as used by naturalists, are made with enough slack in the center to form more or less of a bag, which facilitates landing the catch. This part of the seine is preferably of smaller mesh than the wings.

The fish taken may be placed in portable metal tanks immediately for transportation, or in the well of the collecting boat. The seine usually brings in some invertebrates, such as crayfishes, crabs, and mollusks, which are desirable both for exhibition and for feeding purposes.

In regions where stationary pound nets are employed in the commercial fisheries the aquarium collector may benefit by a method of fish catching more effective than any other. Such nets are sure, sooner or later, to take specimens of all species inhabiting adjacent waters. These can be purchased from the fishermen at market prices when the nets are lifted. Fishes taken in fyke nets are equally desirable, but those captured in gill nets usually are injured and worth-

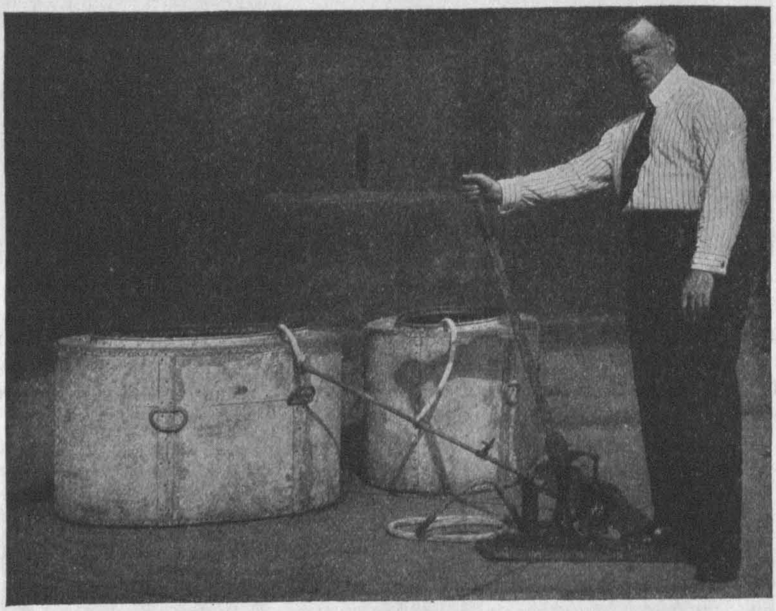

FIG. 28.—Hand air compressor for the aeration of shipping tanks

less for exhibition. Fyke nets of small size can be purchased. As fish catchers they are useful in regions where large pound nets are not available.

For fishes of small or medium size, cans of heavy tin, such as are used for shipping milk, serve the purpose of the collector very well. Large fishes that require more room during shipment are carried in cans of greater diameter and less depth. These are made of galvanized iron and may be round or oval, the latter being preferable. In the transportation of large fishes a few extra-long tanks of oval shape are required. The largest of those used at the New York Aquarium is 3 feet 6 inches long, 2 feet wide at center, and 2 feet deep. Ordinary ash cans, well soldered, are cheap and may be used for medium-sized specimens but are not as convenient as milk cans with narrowed tops, which prevent the splashing out of the water.

Tanks containing live fishes must be aerated during shipment, and this is accomplished usually by frequent lifting of water with a dipper and pouring back slowly. The amount of aeration necessary depends upon the number of specimens in the tank. Crowding is dangerous. During railway trips the use of a hand-operated air pump, with rubber-tube connections to each tank, serves to lighten the labor of aeration. The air pump in use at the New York Aquarium has two cylinders 3 by 2 inches, the upright lever being between and above the cylinders.

FIG. 29.—Introducing oxygen from the steel cylinder into the glass jar

## TRANSPORTING FISHES WITH THE AID OF OXYGEN

The use of oxygen should not be overlooked in connection with the transportation of aquarium specimens. We have employed it successfully on many occasions. Numerous small fishes and invertebrates have been sent from the New York Aquarium to Germany—a nine-day trip—in wide-mouthed glass jars without loss.[3] Sixteen 3-liter glass jars were filled with water and the specimens introduced. The jars were then inverted under water and oxygen gas introduced to replace the water until the jars were about one-third full of the oxygen. The jars were then corked tightly and covered with parchment to prevent any escape of the gas.

Large numbers of trout fry have been sent from the aquarium in open shipping tanks fitted with rubber tubes connected with an

[3] Bulletin, New York Zoological Society, November, 1910, pp. 701–702.

oxygen cylinder. Hundreds of large fresh-water fishes have been brought in by the same method. A shipment of marine fishes was made recently from the New York Aquarium to San Francisco—a four-day journey by rail—with small loss.[4] In this case the specimens were in charge of a messenger. G. Friedrichs has used oxygen very successfully in transporting large numbers of food fishes to the New York markets. The admission of oxygen into the water must be controlled carefully by valves, as it is under high pressure.

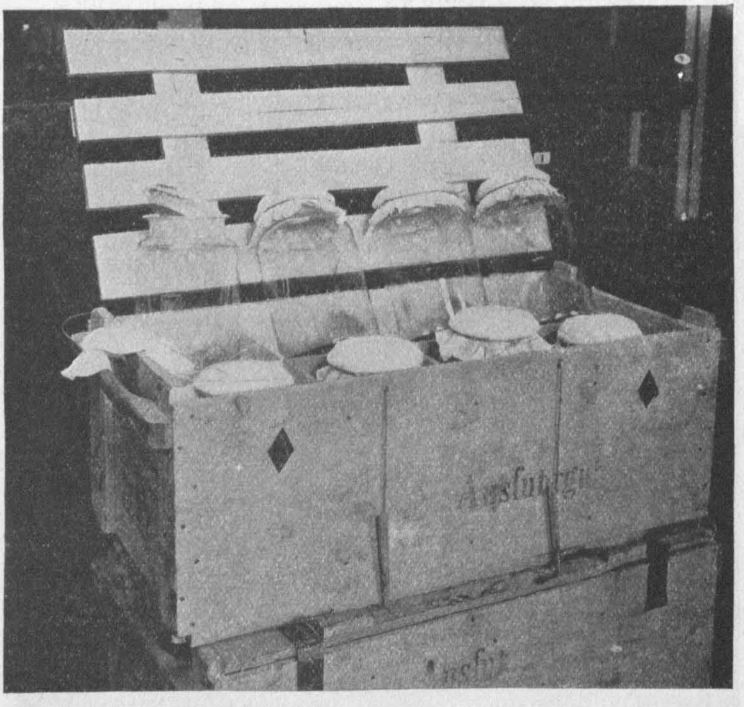

FIG. 30.—Shipping crate with jars containing oxygen

## FEEDING

The feeding of a large collection of fishes is a matter involving no small amount of labor and expense. Formerly, when the collections in the New York Aquarium were fed daily, one attendant devoted about half of each day to the preparation of the food. Equally good results are secured now by feeding every other day, and the labor is lessened. Usually, there are about 5,000 fishes of all sizes in the tanks. The food consists of fish, clams, and meats, which are sliced, chopped, or minced, as may be necessary to suit the size of the specimens. The whole collection is fed carefully in order that there may not be food left unconsumed, which would have to be removed to prevent its affecting the water supply. Most of the food used in an aquarium is obtained in the markets and consists largely of food fishes such as cod and herring. Preference naturally is

[4] Bulletin, New York Zoological Society, May–June, 1927.

given to the cheaper kinds of fish when the supply of such is abundant and when they are of such a character that they can be cut and prepared to advantage. Very little meat is required, but clams are used in great quantities. During the month of January, 1927 (selecting from the food bills at random), the food obtained from the markets consisted of the following: Herring, 2,160 pounds; clams, 5,200; shrimp, 39 pounds; butterfish, 25 pounds; beef heart, 28 pounds. The cost was $322.53. This is merely the amount of food purchased. During the summer months live food is brought in from the adjacent bays and shores by the collecting boat, consisting of minnows, shrimps, crabs, mussels, marine worms, small soft clams, and "beach fleas" or amphipods.

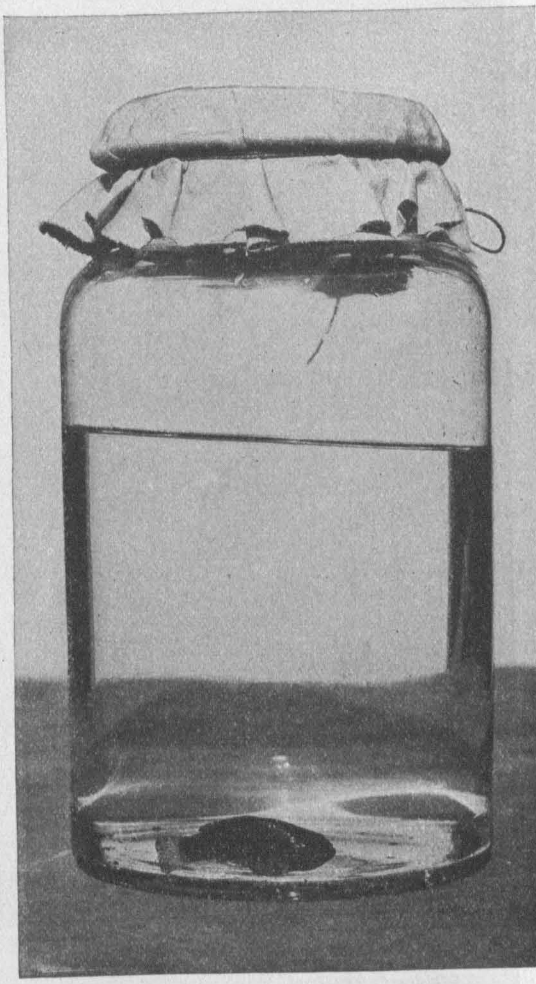

FIG. 31.—Shipping jar, with specimen. The upper one-third of the jar contains pure oxygen

Live food usually is kept on hand in reserve tanks. In summer, when live food is obtained readily, more of it is used. In winter a larger amount of market food necessarily is consumed. Salt-water minnows, when procured in abundance, are used at the rate of 10 or 12 quarts daily and are simply thrown alive into the tanks. Live shrimps are used to about the same extent when available; mussels, 4 or 5 bushels a year; small crabs of various kinds, by the hundred. Beach fleas or amphipods (the small crustaceans generally called sand hoppers, of the genus Gammarus) are used in considerable quantity. Sometimes the collector secures them by spreading a sheet on the beach at night and placing a lantern on it. When a sufficient number have been attracted by the light the sheet is picked up by the corners and the catch spilled into a bucket. More often they are secured by gathering bunches of fine sea moss, in which they hide.

The sea horses, usually to be found at the aquarium, can be kept to good advantage only when they are well supplied with Gammarus. In winter it is often difficult to supply sea horses with a sufficient amount of this food. The aquarium in Philadelphia uses Daphnia and fresh-water Gammarus, obtained in the waters of Fairmount

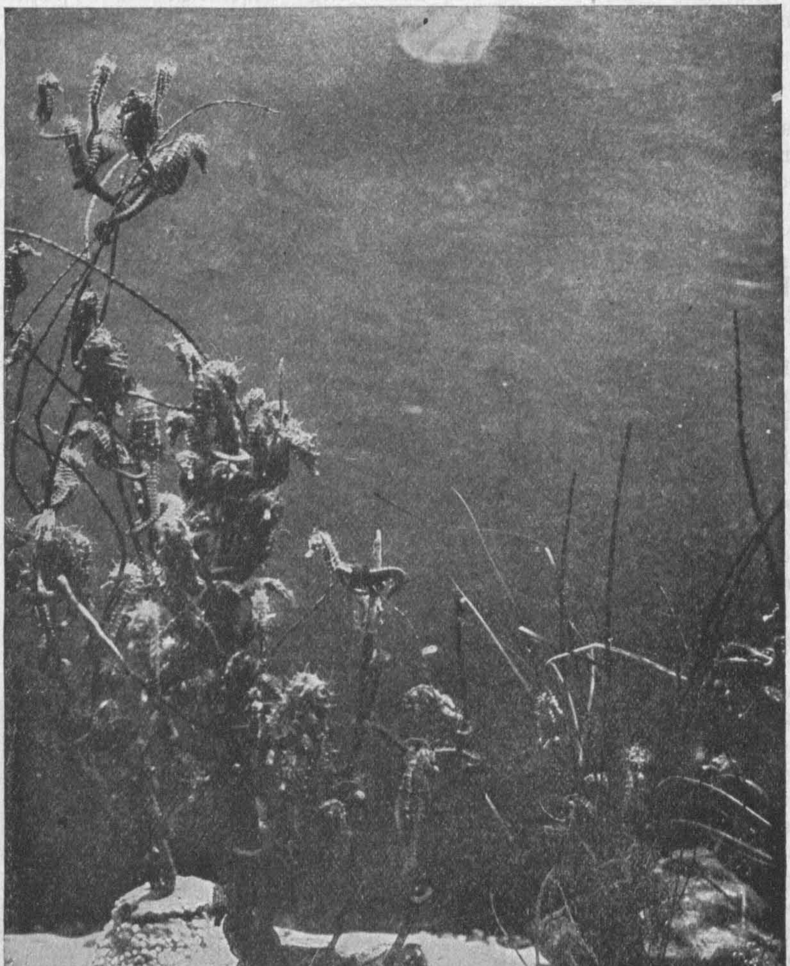

FIG. 32.—Sea horses in the New York Aquarium

Park, as food for sea horses and many of the tropical fresh-water fishes kept in small aquaria.

Young trout and salmon in the fish hatchery are fed successfully on minced liver and beef heart, the latter giving the best results, as there is less fouling of the water. A small amount of fresh fish can be ground with it. They are also fond of herring roe, which has

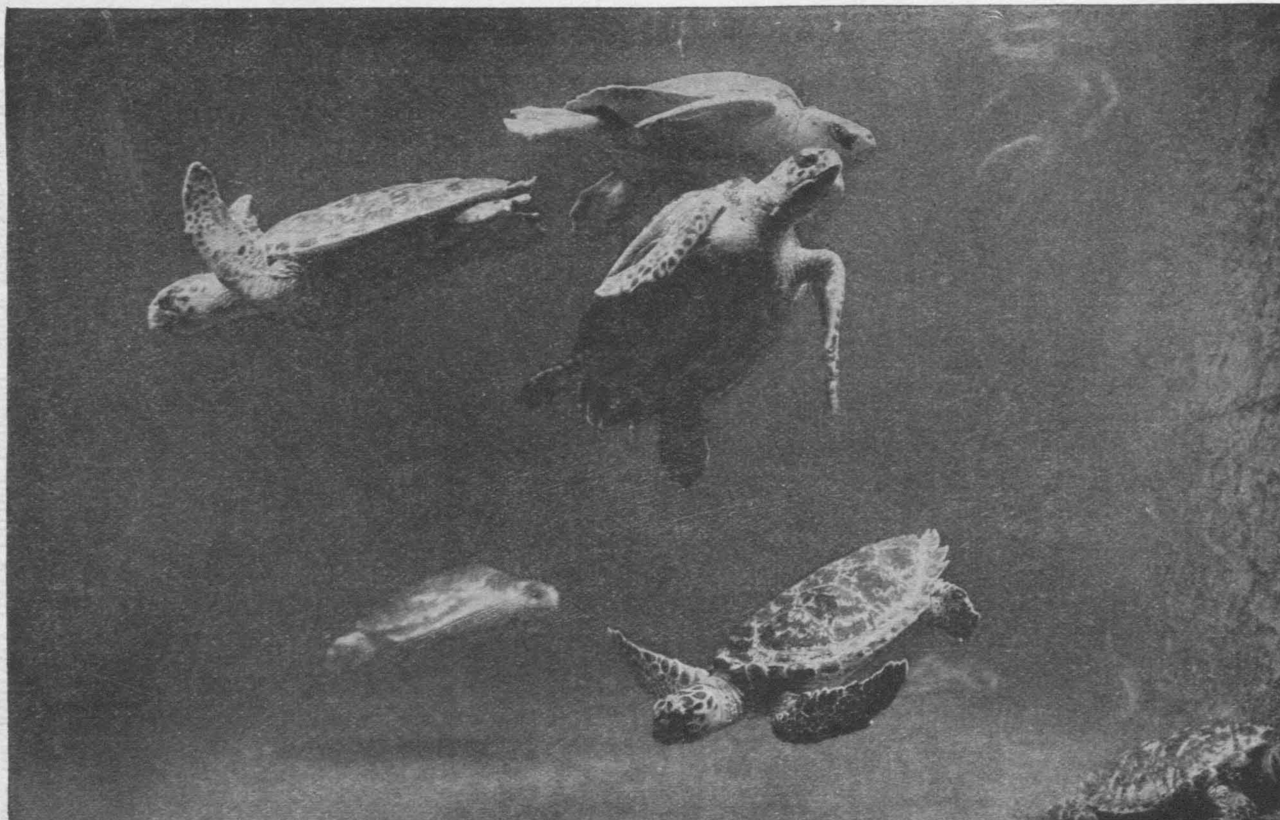

FIG. 33.—Green and hawkbill turtles. Small or medium size turtles may be kept in the larger glass-fronted tanks, where their swimming motions may be seen best

proved to be an excellent food for young whitefishes, also. By feeding at first on herring roe and afterwards on the larvæ of mosquitoes, the aquarium has succeeded in carrying whitefish through the period of infancy and has reared many specimens to the age of 10 years. The larvæ of mosquitoes are excellent for feeding whitefish fry and yearling trout and are, in fact, devoured by many kinds of small fishes, but this food is now less available than formerly, when mosquito-breeding pools about the city were neglected.

Nearly all fish food from the markets is headed and sometimes eviscerated before being cut up. The cost of the market food used at the aquarium during the past five years has averaged about $2,800 a year. The various kinds of live food procured in connection with the work of capturing specimens for exhibition might be valued at a quarter of that amount. Fresh menhaden, always abundant in coastwise pound nets in summer, is fat and should be used sparingly as food. Its cheapness makes it a desirable food for large animals kept in floor pools.

The sea cow, or manatee, which is a hearty feeder, eats some lettuce and cabbage trimmings but greatly prefers a diet of salt-water eelgrass. The manatee can also be fed a limited amount of fresh bread. One manatee consumed exactly 90 bushels of eelgrass and 20 of pondweeds during the five months that it lived in the aquarium. Carp are largely vegetable feeders but will eat all of the foods provided for other kinds of fishes also. They are fed to some extent on soaked corn or wheat, cooked corn meal, and the trimmings of vegetables.

The sea turtles are fed chiefly on cut fish but will eat clams and small mollusks. Sometimes they are supplied with cabbage leaves, seaweed, sea lettuce, and eelgrass. Sea turtles are fond of whelks and other large mollusks, the shells of which should be crushed. Fresh-water turtles will take cut fish, meat, and pond snails and should also be supplied at times with pondweeds.

A useful guide in the work of feeding at the aquarium is a carefully compiled catalogue of the natural foods of fishes and other aquatic vertebrates. Many of these foods are not available during the winter months, and the living exhibits suffer for lack of them. The quantity and cost of the food used depend, of course, upon the number and size of the specimens exhibited. These items rise in proportion to the number of heavy-feeding animals in floor pools, such as seals, porpoises, and manatees. The accompanying table shows the cost of food at the New York Aquarium during recent years:

| Year | Number of specimens | Cost | Year | Number of specimens | Cost |
|---|---|---|---|---|---|
| 1921 | 4, 188 | $3, 150 | 1924 | 5, 521 | $2, 306 |
| 1922 | 5, 236 | 3, 000 | 1925 | 3, 123 | 2, 992 |
| 1923 | 4, 431 | 2, 581 | 1926 | 3, 770 | 3, 306 |

Fishes in captivity have rather limited space for exercise and can not assimilate as much food as they might if at liberty. A number of large fishes lost at various times were found, upon dissection, to be excessively fat, and these were believed to have been overfed. One of the weak points in the management of all aquariums is the matter of feeding. The food of aquatic animals in captivity undoubtedly should be varied as much as possible. Efforts should be made to supply them with some of their natural foods, which include virtually all of the small aquatic fauna. Crabs, crayfish, shrimps, clams, mussels, snails, whelks, and squid are all of great value in varying the otherwise monotonous rations of the aquarium. The extensive studies of Prof. S. A. Forbes have shown the great variety of invertebrates consumed by fresh-water fishes. Among these are included Entomostraca, aquatic worms, and insects, on which young fishes subsist chiefly.

In feeding alligators, crocodiles, and sharks, fish may be supplied without being headed or, if fresh, without being eviscerated. Formerly it was difficult to maintain a tank of dogfish or dog sharks for more than a few months, until it was discovered that they really needed more bony material in their food. They are now fed largely on the heads and skeletal portions of fish, from which the fleshy parts are roughly trimmed in the feed room, with the gratifying result that the length of life in these fishes is measured by years instead of months.

## OTHER MATTERS OF CARE

The necessity of pure water, abundant swimming space, and careful feeding have already been considered, but there are other necessities to be provided for which often are overlooked.

Fishes in captivity suffer from parasites, some of which can be guarded against. Parasitic worms attached to the gills are responsible for the loss of many angel and butterfly fishes in captivity. Experience has shown the desirability of keeping sand in a corner of the fish tank. Many fishes have the habit of sucking fine sand into the mouth and throwing it out through the gills, an act that apparently contributes to the cleansing of the gills. Fishes in captivity may often be seen making quick motions against the bottom of the tank to rub their sides or other parts of the body, and many fishes settle down at times into the sand, showing little more than their eyes. It is the habit of some fishes, like flounders and skates, to hide in this manner for hours while watching for their prey. Others do it for short periods, perhaps merely for temporary comfort. Some of the small tropical wrasses seek the sand in the evening and remain hidden through the night. Fresh-water turtles are benefited by having sand to hide in. Formerly it was difficult to keep soft-shelled turtles in captivity, but experiment showed that they were fond of burying themselves in sand. Two buckets of clean sand were poured into one corner of the tank, into which these mud-loving turtles could burrow for the purpose of cleaning themselves and hiding when at rest. They were very active, frequently chasing each other about the tank and occasionally climbing out on a floating log. These are the most active of all our native turtles. They took to the sand quite naturally, darting into it, and with a few quick movements covering themselves completely. Frequently the entire lot would be under the sand, their small heads and long slim necks alone protruding. Since these changes were made the turtles have fed freely and none of the specimens has been lost. A supply of sand to hide in seems to be a necessity with this species. Upon such apparently insignificant details of management the successful keeping of wild creatures in captivity depends. All captive animals should be under the care of keepers interested in their welfare.

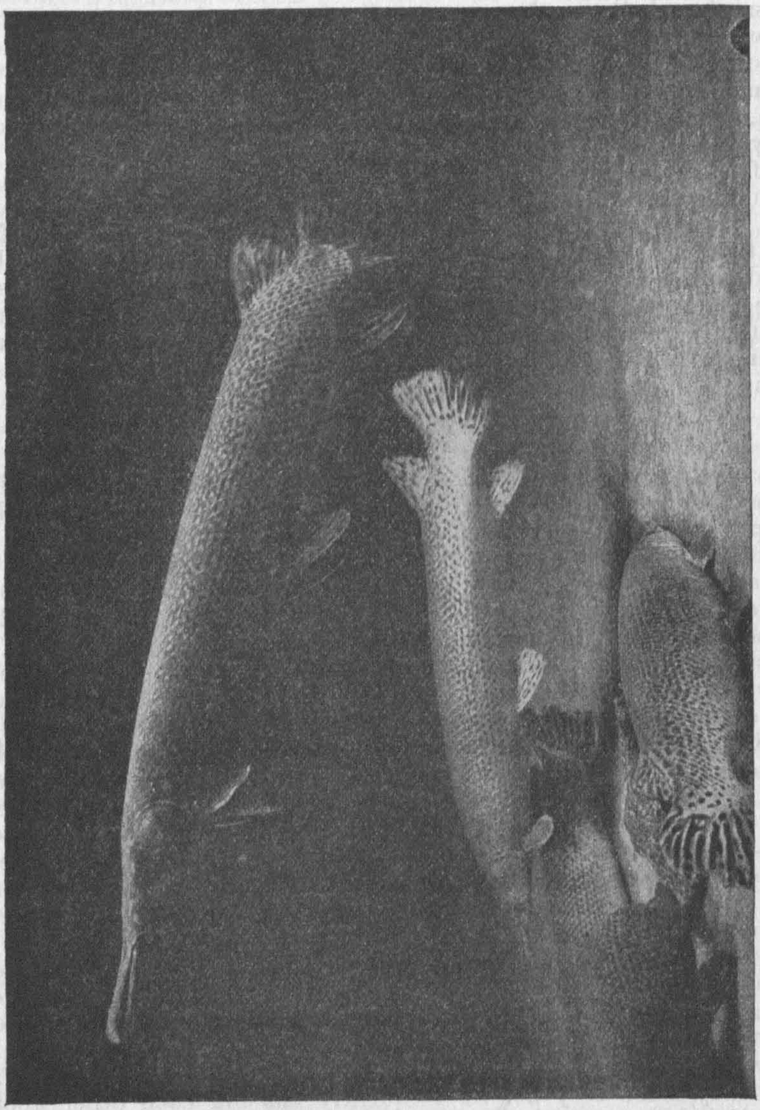

FIG. 34.—Giant garfishes (*Lepisosteus tristoechus*) from Louisiana. Presented to the aquarium by Henry D. Whiton, of New York

Turtles and other cold-blooded reptiles need direct sunlight during at least a part of the day and will not feed in winter unless kept in warm water.

The conditions for keeping mud-loving animals for long periods doubtless would be improved if they could be supplied with genuine

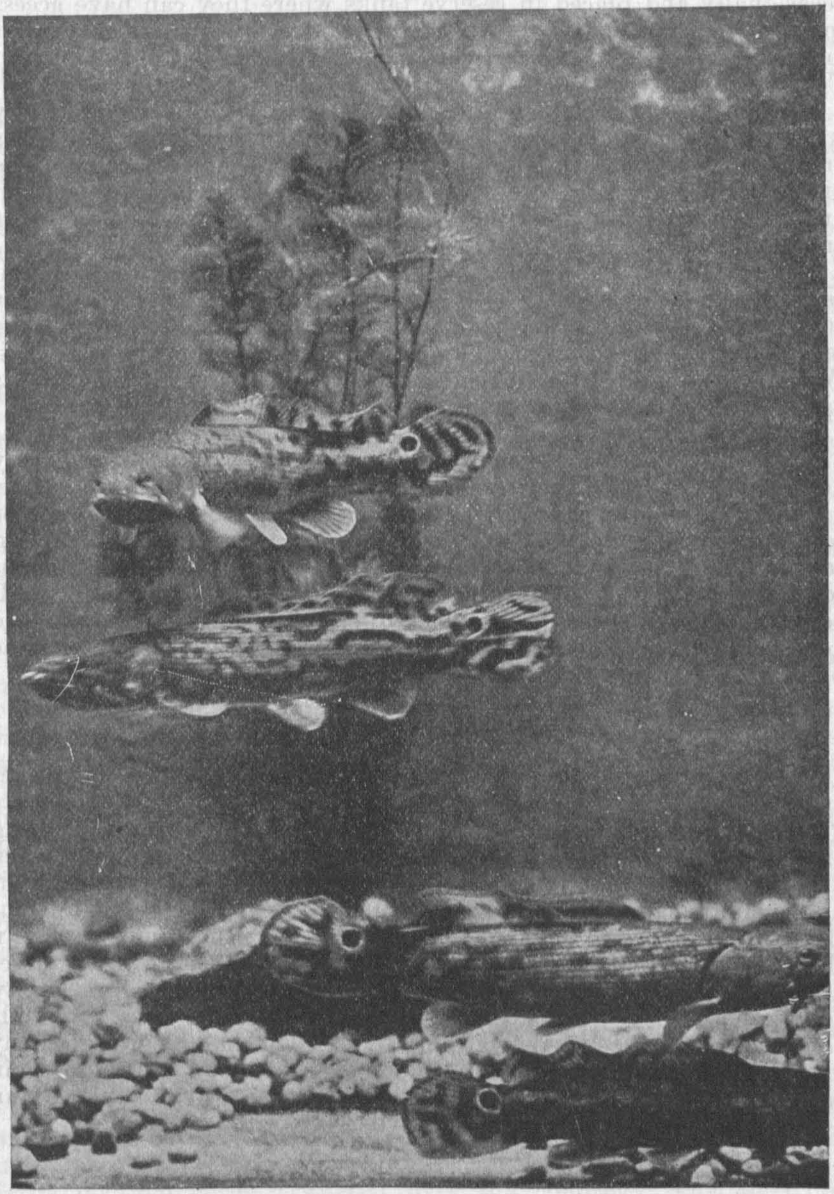

FIG. 35.—Bowfin or mudfish (*Amia calva*). Specimens have lived 24 years in the New York Aquarium

mud, but this material clouds the water and conceals the animals entirely. However, there is no reason why sturgeons and other mud-loving fishes should not be removed from the exhibition tanks occasionally and placed in reserve tanks where they can have access to mud for short periods. An emaciated fresh-water sturgeon that had long refused food was sent to a small mud-bottomed lake in Central Park a year ago, where it survived several months.

At times there are sudden losses among trout that can be checked by transferring all specimens to muddy water. The relationship of fishes and other aquatic forms to their various environments can not be disregarded, therefore, by those who would succeed in keeping them under such artificial conditions as obtain in the tanks and pools of an aquarium.

Fishes that are doing well should be shifted or otherwise disturbed as little as possible. A "well-set" tank of fishes may thrive for years if undisturbed. Mere additions may start trouble, with serious results to the new arrivals. This is especially true among sea fishes. We have seen a large queen triggerfish set upon by small fishes of its kind and disabled in a few minutes.

Additions to groups of tropical fishes are made more safely at night in certain cases. Some fishes, in fact, feed by night and may not get their share of the food that is thrown into a tank in daytime.

Aquarium employees are liable to drift into routine methods of feeding and tank cleaning that lead to unnecessary losses. The best results can not be secured without careful attention to all operations connected with the needs of things living in the aquarium. All aquariums suffer losses through lack of study of individual cases. No general method applies to all species. Mere rules can not take the place of daily inspections by the manager.

## COMBINATIONS OF SPECIES

The common aquarium practice of devoting a tank to each species as far as practicable is not always best for the fishes. Many kinds are gregarious and when grouped according to their capacity for dwelling amicably with other species of similar size often do better than when kept separately. The labeling of groups of species thus combined is not so simple, and they are not identified so easily by the visitor, but the exhibit is sure to be a livelier one, and the fishes find interest in their more varied surroundings sufficient to prolong their lives appreciably. Under such treatment they are not fed so easily. Active feeders may thrive at the expense of those that feed slowly. Suitable combinations can be arrived at only by experiment. There are many kinds of familiar little fishes that flock together about the wharves in tropical waters and that can be kept together in the tanks of an aquarium to better advantage than when separated by species.

## INJURY AND DISEASE

Frequently there are fishes in an aquarium that have become unsightly because of injuries, fungous growths, or ailments less susceptible of treatment. Fishes of the pike family may lacerate each other with their sharp teeth but will recover if isolated. Fishes with fins damaged in capture or transportation can regenerate them. Sea fishes frequently are blinded by fighting and, being useless for exhibition, must be destroyed.

Fungous growths may be checked or even cured by the use of salt, permanganate of potash, peroxide of hydrogen, or mercurochrome. Diseased specimens should be removed and the tank sterilized with a strong solution of copper sulphate. A 2 per cent solution of mercurochrome is effective when painted on fungous spots of fishes. Two applications will cure turtles suffering from closed eyes.

"Water mold" (Saprolegnia), a fungus, is kept in check sometimes by adding a small stream of sea water to the flowing fresh water. Occasionally it is desirable to use permanganate of potash, 1 part to 1,000 of water, flooding the tank with this light solution for several hours. Water mold sometimes is removed by brushing the spots with kerosene. Sea fishes fortunately are free from fungus troubles.

Costia, caused by a protozoan parasite, usually is controllable by placing a large piece of rock salt in the tank, against which the fishes are inclined to rub themselves. Strong solutions of lime water in the tanks have been found useful in the treatment of Ichthyophthirius.

Goldfishes suffering through failure of the slime organs to function have been restored by dipping them in kerosene for a minute. Angelfishes that have become blinded by minute flukes have been treated successfully with silvol. Gars covered with crustacean parasites (Argulus) have been cleared of the pests by dipping in a solution of mercurochrome. Some parasitic attacks have been combated successfully with vinegar baths.

It is not the intention to enter into details here as to the treatment of ailing fishes in the large tanks of the public aquarium. With the common and easily obtainable fishes the usual practice in this country is to destroy those that are unsightly and replace them with fresh specimens. This procedure may be convenient, but it is wasteful and evades the difficulty altogether. The flow of water, its temperature, filtration, and aeration, and the methods of feeding and tank cleaning may need attention. Overcrowding is a frequent cause of trouble. The isolation of newly arrived fishes until their condition can be ascertained is desirable. The fishes may be benefited by sand, in which they often rub themselves. Caretakers may be unequal to the diagnosis and treatment of disease, but with the help of a biologist the difficulties often may be overcome. The numerous books written by fish fanciers on the care of fishes kept in small aquaria usually contain suggestions on treatment that are worth trying, but the handling of large numbers of fishes in a public aquarium is more difficult.

Aquarium managers are exchanging opinions on the results of their experiments, and there is evidence that progress is being made. The annual publications of the United States Bureau of Fisheries contain many articles by biologists who have studied similar troubles in the large fish hatcheries scattered over the country. The aquarium should be provided with these papers, most of which have been issued separately and may be had upon application. The diagnosis of the disease is less difficult, however, than its treatment.

## HIBERNATION

Many of our native fresh-water fishes cease to feed when the water becomes cold, some of them lying torpid for months. A moderate warming of the fresh water before it is supplied to the fish tanks induces the occupants to feed occasionally, with the result that they are less weakened by long semihibernation. Losses among captive fishes are greater in spring than at other seasons of the year. Wild fishes captured early in the spring are subject to the same fungus troubles that afflict captive fishes after hibernation, and the losses among them are greater.

We do not subscribe to the theory that hibernation is beneficial to northern animals merely because it is natural. In reality it is an unavoidable test of endurance by which undoubtedly they are weakened more or less. Nature eliminates those individuals whose vitality is not equal to the rigid conditions that she imposes. The survival of the hardier under natural conditions would be less certain if the hibernating period were to be prolonged unnaturally. The flying squirrels that sought winter protection in my deserted mountain cabin failed to survive in the uncovered heaps of clothing where they hid. They would have been warmer in the deep hollows of trees. We have found ground squirrels frozen under similar conditions. Virtually nothing is known about winter losses among pond turtles, frogs, and salamanders that fail to dig deep enough for safety. Captive box tortoises that winter safely in cellars doubtless survive because such situations are at least as warm as those they are able to find out of doors. An early springtime must be of saving power to some of the hibernating animals. There can be little doubt that most of the fresh-water fishes and the larger salamanders would winter in better condition in the aquarium if the water temperatures were maintained at about 60°. Water of normal winter temperature is satisfactory for Salmonidæ and other fishes that continue to feed when water temperatures are lowest.

## LONGEVITY OF FISHES IN CAPTIVITY

A fair proportion of the species of fishes exhibited in public aquariums survives under the restrictions of captivity for many years. A larger proportion, being less hardy, is more difficult to provide for; while some kinds, needing foods not readily procurable or altogether unobtainable in winter, do not live longer than a few months. Tropical fishes kept in northern aquariums can not be supplied with the variety of foods obtainable among their native reefs. The restricted amount of live food available probably has as much to do with losses as any factor in aquarium management.

In the New York Aquarium, which is well supplied in summer with small marine invertebrates, losses are reduced to the minimum during more than half the year. With most aquariums the food supply, especially in winter, is dependent upon what can be found in the markets; nevertheless, many of them have records for certain kinds of fishes that indicate a high average of success in keeping them.

The New York Aquarium has kept specimens of gar (*Lepisosteus*), mudfish (*Amia*), and striped bass (*Roccus*) for 24 years. Many of these are still living. Among fishes that have lived 12 years or longer are three species of sunfish (*Lepomis*), rock bass (*Amblo-plites*), calico bass (*Pomoxis*), and perch (*Perca*). There is a 200-pound jewfish (*Promicrops*) that has been living in one of the tanks for nine years. There is a similar record for the nurse shark (*Ginglymostoma*), although it has not yet reached a length of 3 feet. Many species of groupers (*Mycteroperca*), hinds (*Epinephelus*), and grunts (*Hæmulon*) are living in the tanks after more than eight years of captivity. The list of long-lived fishes could be extended greatly. A sea lion (*Zalophus*) lived 19 years in one of the large pools, and a giant salamander (*Cryptobranchus*) is still living after 13 years. On the whole, the records for aquarium exhibits are probably as good as those of the average zoological garden. They can undoubtedly be made much better with improved methods of feeding.

## CLEANING TANKS

All tanks containing living exhibits require cleaning at times. This procedure causes disturbance that is more or less harmful to the occupants. No fixed rule on cleaning can be laid down, owing to the varied conditions that prevail in a series of tanks. Some of the larger fishes are affected but little, while many of the smaller kinds become alarmed.

Tanks of small or medium size usually are cleaned by siphoning with a 1-inch hose, with only partial lowering of the water. At times it is desirable to use a long-handled brush in cleaning the inner surface of the glass. The rockwork lining of the tank requires occasional brushing, which can also be done without lowering the water. Crevices in the rockwork can be reached only by using a hose with a strong flow after the tank has been drawn as low as safety permits.

The large tanks are half emptied for cleaning by opening the bottom drains. While the water is flowing out wastes and sediments are swept carefully toward the drain. Frequent use of the hose siphon serves to reduce the necessity of frequent cleaning with the brush.

Frightened fishes are liable to injure themselves if tank cleaning is left to careless persons. In cleaning fresh-water tanks the waste water goes to the sewer line; in tanks containing stored sea water, to the filter. Fresh-water tanks need frequent cleaning at times when Saprolegnia is troublesome. This fungus forms quickly on bits of unconsumed food that have not been removed.

The keeping of numerous crabs, crayfishes, or lobsters with such fishes as are not inclined to disturb them is desirable. They are not only of value as exhibits but assist in the removal of unconsumed food. Floor pools, being occupied by heavy feeders, should be emptied daily and cleaned with long-handled brushes if they are to be kept in sanitary condition.

## LABELING AQUARIUM EXHIBITS

Cardboard labels of the ordinary museum type are not suited to the needs of an aquarium, where there is always considerable dampness. The subject matter of labels sometimes is painted on small pieces of plate glass. These can be suspended in front of the aquarium tanks, where they are read easily by the light transmitted through the water. They are expensive to prepare, however, and are broken easily when removed for the cleaning of the tank fronts. Labels of enameled iron are equally expensive and eventually become rusty from moisture. They are not read easily in the rather dim light of aquariums as usually constructed.

Labels painted on panes of ground glass and inserted into openings in the wall above the tanks are satisfactory but expensive. When such labels are placed just below the glass fronts of the tanks and illuminated by artificial light they are also satisfactory, but the cost of inclosing them and of electric current must be considered as well as the cost of painting them. Transparent labels of some sort are desirable, however, for all aquarium exhibits kept in glass-fronted tanks.

The printed labels of the New York Aquarium are used as transparencies by being placed between panes of clear glass and inserted into openings above the tanks. The transparency of the labels, which are printed on white sheets of the thickness of writing paper, can be improved by dipping in paraffin, which serves also to protect them from moisture. The panes of glass containing them are held together by adhesive waterproof tape. Good transparencies can also be secured by printing on thin sheets of celluloid, but the cost is greater and they do not endure repeated cleanings like glass.

When two or more species are exhibited in the same tank, the addition of a cut of the fish or other object to the label makes identification simple.

In the preparation of the labels the character of the questions ordinarily asked by visitors should be kept in mind. Such questions relate chiefly to name, geographical distribution, abundance, size attained, method of capture, whether artificially propagated, commercial value, importance as game, and duration of life in the aquarium. It has been found that lengthy labels are read by comparatively few persons. They have been condensed as much as possible, therefore. Each statement on the 6 by 12 inch label has been reduced to a single line and made easy for the eye to read by the use of large type. The information they contain has been compiled from recent authorities, supplemented by extracts from the records of the aquarium.

## LABORATORY AND LIBRARY

The public aquarium, being a kind of natural history museum, should have one or more rooms available for laboratory work. Its small tanks contain many forms of aquatic life that are of special interest to teachers and biologists. As a public institution it should be able to furnish to schools some of the common and easily procurable invertebrates used by teachers in classroom instruction. Small aquaria being necessary for keeping some of these animals alive, the laboratory should be equipped with such aquaria in order that teachers may be instructed in their management.

A large aquarium requires photographs of its living exhibits, the demands for which come from many sources. The photographs made by E. R. Sanborn, of the New York Zoological Society, have been used widely by publishers and the press. Those showing the collections in the large exhibition tanks are all made by flash light at night. Hundreds of "portraits" have been made by placing single fishes in a small, narrow aquarium to be carried out of doors for instantaneous exposures. The specially constructed aquarium used for this purpose measures 18 inches in length and depth by 3 inches in width. The object to be photographed can not get out of focus, and the work is done quickly. A photographic tank constructed in this way is a necessary adjunct to the laboratory equipment of the public aquarium.

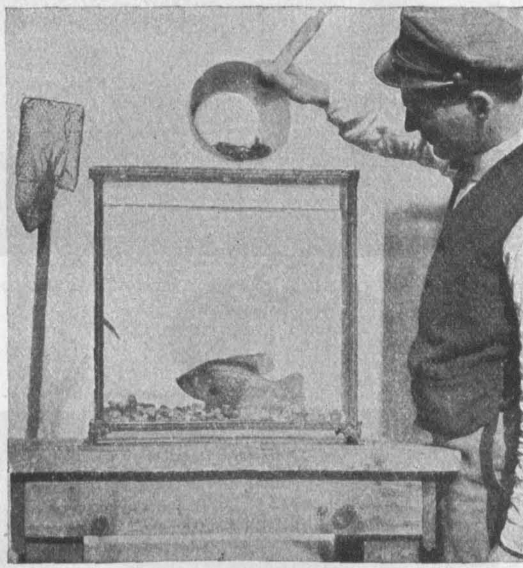

FIG. 36.—Narrow, portable aquarium used in photographing aquatic animals and plants. Size 18 by 18 by 3 inches

As the aquarium can not avoid inquiry concerning the local aquatic fauna, it should be prepared to render the educational service demanded by such correspondence. In connection with such service to the public a library of standard works on aquatic life is indispensable.

An aquarium with a laboratory and a fish hatchery is in a position to deal with some of the practical problems connected with the restoration of the fisheries. It is needless to add that a large aquarium can not secure the best results without the services of a biologist to study the needs of its delicate living exhibits.

## BEAUTY IN THE AQUARIUM

Many persons are attracted to the aquarium by beauty alone. There are found form and motion and color not to be seen elsewhere. Much of the reputation of the aquarium at Naples is due to its display of small but colorful living things from the Bay of Naples. Artists, naturalists, authors, anglers, and children often express pleasure over many things that the crowds of sightseers overlook because they are not big or unusual. Many tropical fishes have colors that rival those of butterflies or flowers. Objects of graceful form or those displaying strange activities in their watery element arrest the attention. Great

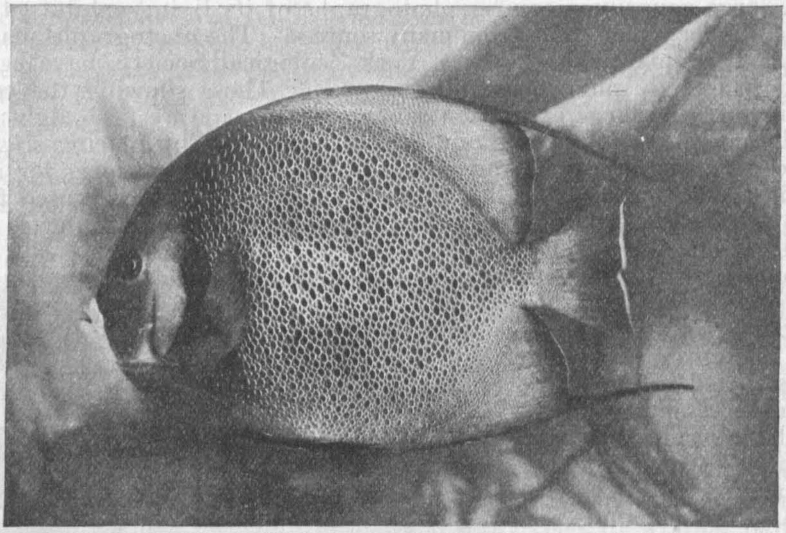

FIG. 37.—A "portrait" of the black angel

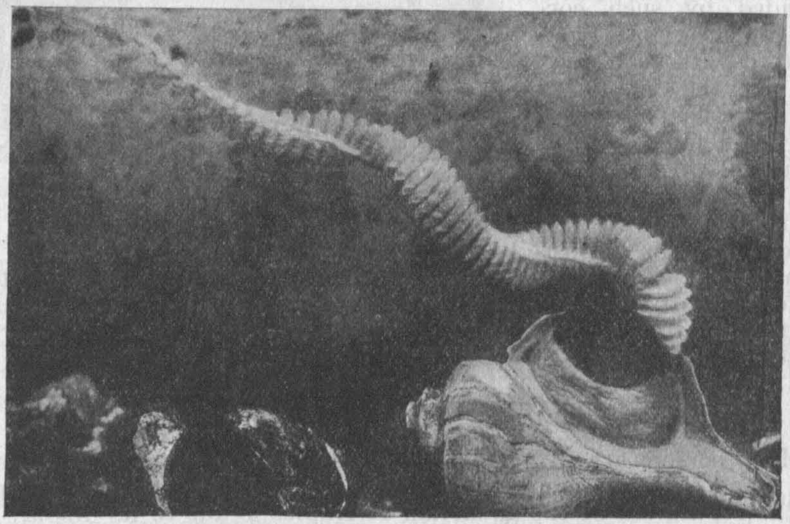

FIG. 38.—Channeled whelk spawning, eighth day. New York Aquarium. The egg cases are shown extending diagonally across the picture

beauty is to be found in the displays of invertebrate animals in some of the aquariums of Europe, as at Naples and Monaco.

### CREATING AN AQUARIUM

As previously stated, the writer has had inquiries from many cities in the United States respecting the proper procedure to follow in establishing an aquarium. Only a few of these cities have carried such a project to completion. The communications coming from local chambers of commerce, commissioners of parks, or groups of citizens were answered at first at considerable length, but the information desired was not such as could be imparted satisfactorily by letters, however long. The spokesman for one of these cities sent a long list of questions, calculated, as he supposed, to call forth all the information that would be necessary for the builder of the proposed aquarium. Few of the questions touched the essentials of the matter. It became necessary to advise applicants seeking such information to send an engineer to New York to study

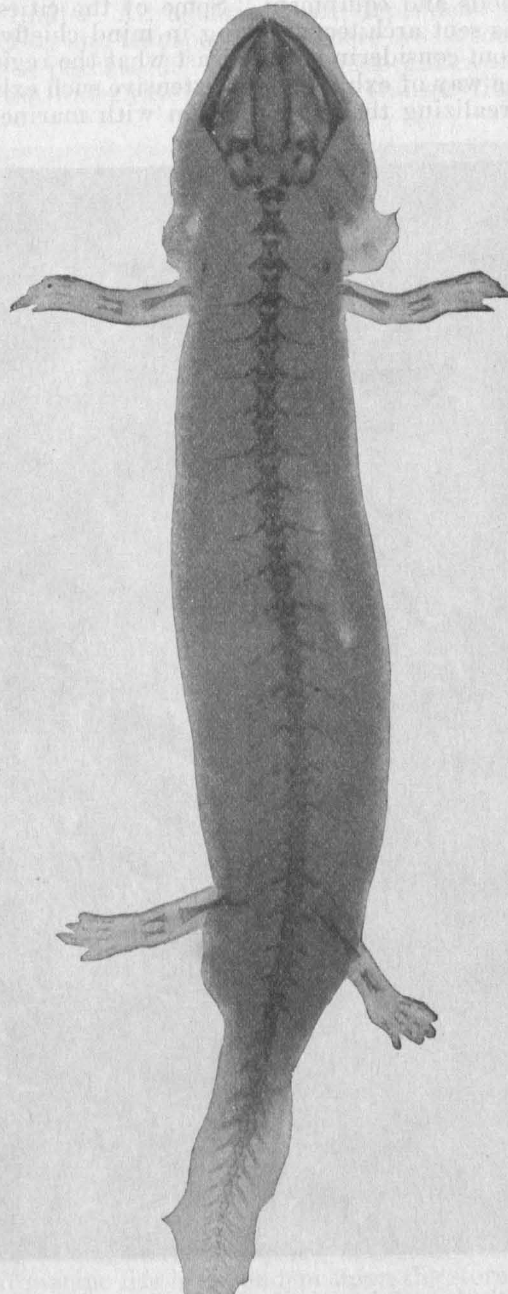

FIG. 39.—Radiograph of a mud puppy (*Necturus maculatus*). Many valuable radiographs of aquatic animals have been made in the laboratory of the New York Aquarium

methods and equipment. Some of the cities that established aquariums sent architects, having in mind chiefly an attractive building, without considering in the least what the region in questions afforded in the way of exhibits, how extensive such exhibits were to be, or without realizing that an aquarium with marine as well as fresh-water

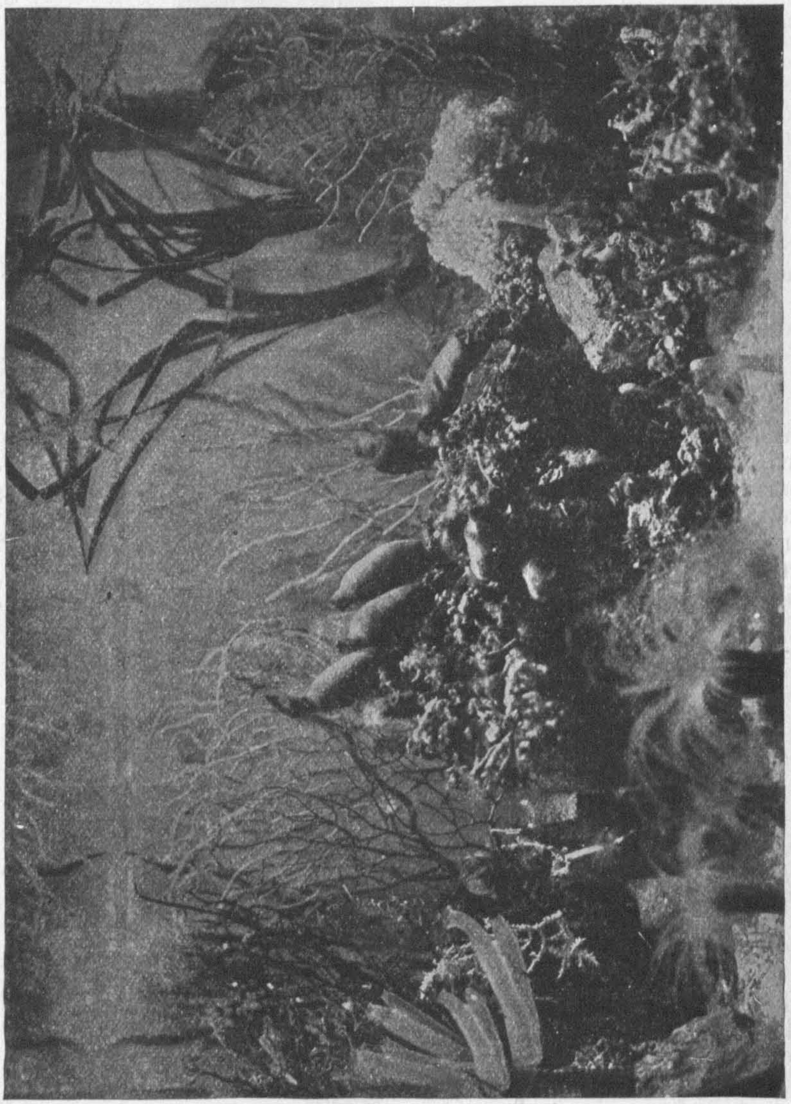

FIG. 40.—Aquarium at Monaco. Gorgonian corals, sea anemones, egg masses of mollusks and other forms. (Courtesy of the Oceanographic Museum)

collections requires a complicated mechanical equipment. Some of the aquariums that were founded eventually depend for their tropical exhibits upon exchanges with the New York Aquarium.

The first points to be determined are those connected with the living exhibits, whether they are to consist of fresh-water or marine life, or both, and how many kinds are available within reasonable collecting and shipping limits. All aquariums are dependent upon their own efforts in collecting and transporting. There are no sources from which exhibits may be purchased. Many inland localities afford but limited variety in fresh-water exhibits, while the transporting of

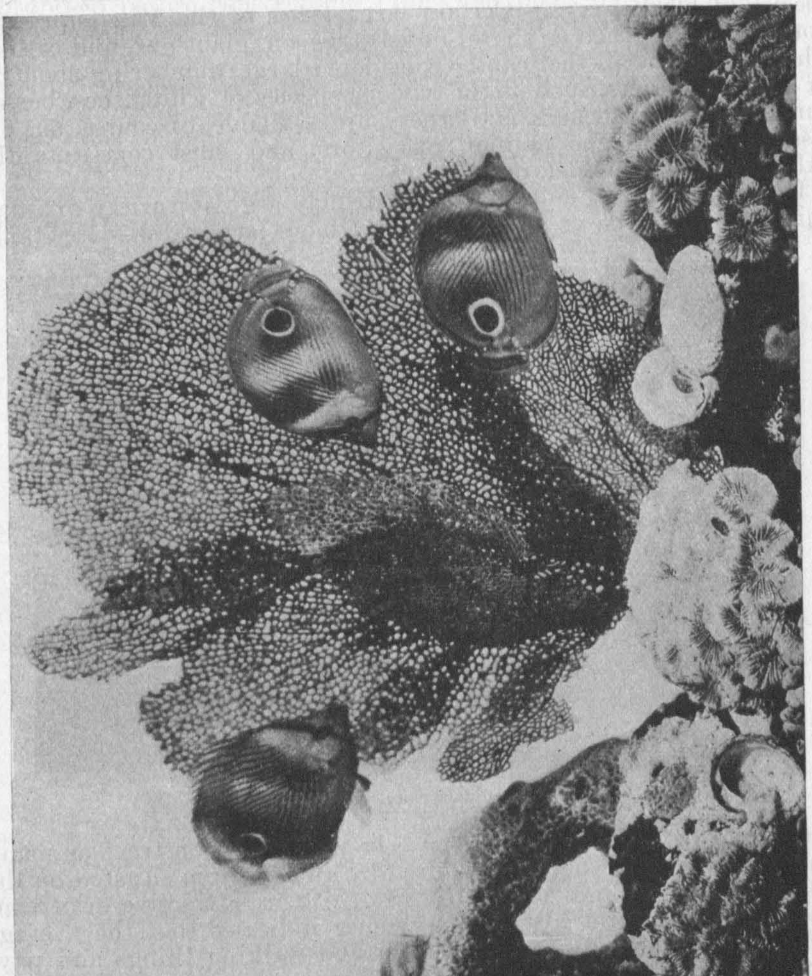

Fig. 41.—Showy tropical fishes. "Four-eye" (*Chætodon capistratus*) at the New York Aquarium

marine life by rail involves considerable expense and some losses in transit. The keeping of marine life is dependent upon the storage of sea water, its circulation and filtration, as well as heating in winter if exhibits are derived from tropical waters. The keeping of fresh-water forms is comparatively simple and inexpensive as compared with those requiring sea water.

Let us consider briefly the list of the more conspicuous fresh-water fishes available for a large aquarium situated, for instance, on the Great Lakes. Among those for which large tanks would be desirable are muskellunge, pike, pickerel, pike perch; lake, rainbow, brook, and other trouts; Atlantic salmon, lake sturgeon, fresh-water drum, buffalo fish, long and short nosed gars, burbot, bowfin, and two species of black basses. Certain large fishes of the Mississippi are obtainable also, such as shovel-nosed sturgeon, giant gar, and catfish. These are about all that can be considered large, numbering about 20 in all. All others, such as the various species of whitefishes, basses, sunfishes, chubs, suckers, and others, are available, of course, but are less striking, in the opinion of visitors, and must constitute the exhibits of the smaller tanks.

Unless the inland aquarium is to display a great variety of small things, it would be unwise to construct more large fresh-water tanks

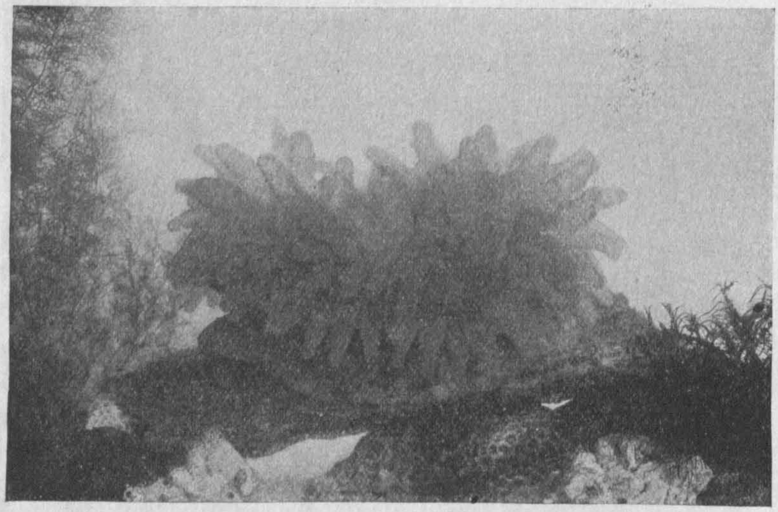

FIG. 42.—Crimson anemone (Tealia)

than could be filled. It would also be unwise to construct as many sea-water tanks as would be required by an aquarium situated on the seacoast. While small aquatic forms of life are attractive to persons interested in natural history, experience indicates that the average aquarium visitor likes to see the big and striking things and pays decidely less attention to those of small size.

An exhibit of fresh-water fishes, however varied, is of rather monotonous coloration. The brilliantly colored fishes from Florida and Bermuda undoubtedly lead in attractiveness with visitors to the New York Aquarium, while northern sea fishes are a close second. An inland aquarium would find its marine tropical exhibits more difficult to maintain than would one located on the seacoast where transportation by steamer, in tanks constantly supplied with flowing sea water, makes shipment safe and inexpensive as compared with shipment by rail.

Fishes still constitute the bulk of the exhibits in all aquariums, the number of aquatic reptiles, batrachians, mammals, and invertebrates usually being rather limited, although they are entitled to the same consideration. The inland aquarium builder should therefore consider very fully the character and availability of the exhibits proposed before constructing tanks and pools of such number and size as would be difficult and expensive to stock and maintain.

The next points for consideration are those connected with the equipment necessary for the safe-keeping of the aquatic forms brought together with so much difficulty and so quickly lost when the conditions of captivity are unfavorable. The possession of a large and beautiful building designed by an ambitious architect does not imply, by any means, that the conditions necessary to successful operation have been considered and provided. Judging from some of the sketches submitted to the writer, the proposed aquarium building

FIG. 43.—Astrangia and Tubularia

would serve equally well for a library or an art gallery. It is highly desirable, therefore, that the equipment of the aquarium be studied by an engineer or an experienced aquarist, after which the architect may be called upon to provide suitable housing; and this is possible with a very simple but well-lighted building.

Fresh water may be taken from city supplies except in cases where such water is treated with chlorine or otherwise made unfavorable to fish life. Sea water must be stored in sufficient quantity to fill both reservoir and exhibition tanks. Its purity must be safeguarded by filtration. The mechanical equipment includes pumps for the circulation of sea water, filters capable of cleansing the entire overflow of the exhibition tanks on its way back to the reservoir, elevated distributing tanks above the level of the exhibition tanks, heaters for winter use in the water system carrying all tropical collections, and means for cooling fresh water carrying northern fishes in summer. Sea-water pumps and piping should be of nonrusting material.

If marine collections are not to be included, the matter of equipment becomes at once a simple one, as pumps, salt-water filters, and distributing tanks, heaters, coolers, and reservoirs are all omitted and the number of employees thus reduced by at least two-thirds.

Mississippi Catfish

FIG. 44

The lighting of the building by skylights over the exhibition tanks is a matter of decided importance. Water is not easily lighted, and the size of skylights, if left to the judgment of an architect, is never large enough to afford satisfactory views of the living occupants of the tanks. Too much light on bright days can be reduced with shades, while on dark days light can not be too abundant. Artificial light is a most unsatisfactory substitute. The line of skylights above the exhibition tanks should be almost continuous and should be as large as the superficial area of the tanks if the latter are to be lighted properly.

There are other matters of importance that should not be overlooked in building an aquarium. The mere setting of the heavy plate-glass fronts of exhibition tanks by inexperienced persons has resulted in much unnecessary breakage in all aquariums known to us. Water pressure will crack heavy glass that is not supported evenly on every part of its margin.

Persons contemplating the construction of an aquarium, therefore, are urged to undertake the initial expense of a careful study of some public aquarium known to be in successful operation and thus avoid mistakes that will result in much greater expense for necessary alterations. This should be done by an engineer. The New York Aquarium has had its full share of expensive alterations during the past 25 years, an experience that a new aquarium should be spared.

## COST OF CONSTRUCTION AND EXHIBITS

The construction of an aquarium with its complete mechanical equipment naturally is a less expensive undertaking than the establishment of a zoological garden with its numerous buildings and extensive acreage. Its living exhibits, derived chiefly from home waters, cost little to procure as compared with the expense of obtaining the larger animals necessary for a zoological garden. Many of these are procurable only from dealers whose valuations are based on difficulty of capture and transportation from foreign countries. The annual cost of keeping up the collections of the New York Aquarium, probably the largest institution of the kind, is less than the cost of a single giraffe, rhinoceros, or elephant. The cost of food is negligible as compared with that for a zoological garden.

The building is seldom of large size, its compactly arranged exhibits occupying little space as compared with those of a museum of natural history. The aquarium is therefore a comparatively inexpensive institution to establish and maintain, while its popularity is likely to exceed that of any other form of public museum. The maintenance fund of the New York Aquarium is less than one-fifth that of the zoological park or any of the great museums in the city.

Usually the first question asked by persons interested in the creation of an aquarium relates to the actual cost of construction. This the writer is unable to answer. The New York Aquarium was installed within the heavy walls of a century-old fort 30 years ago. Moreover, it has undergone radical alterations at various times. Its cost, if exact figures were to be gathered from city archives, would be of little service to-day. An estimate of present cost should be based on that of some aquarium built within recent years, such as that of Boston, Detroit, or San Francisco. Information on this point no doubt is obtainable in these cities. The size of the building, the character of its equipment and exhibits, and the public service required of the aquarium would all be determining factors. If the proposed aquarium were to undertake more or less service to the public of the character rendered by a museum of natural history on educational and scientific lines—maintain a library, a laboratory, a small staff of biologists, give radio talks, supply small forms of marine life to public schools, and issue publications relative to its functions—the cost of maintenance would be much greater than otherwise. The New York Aquarium, with much public service of this character demanded of it, is maintained (1927) at a cost of $65,228, nearly three-fourths of which is for personal service. No other aquarium maintains such intimate relations with the people. Some of its publications, sold at little more than their cost, have passed through two or more editions. The number of employees averages 28. It is open, free, every day in the year, and has an annual attendance of about 2,000,000 persons.

It will be seen readily that an aquarium that restricts its functions to the maintenance of exhibits alone and its employees to caretakers only can be operated at less cost than one undertaking additional services to the public.

# APPENDIX A

## CARE OF SMALL AQUARIA

The keeping of small aquaria is now practiced so extensively and there are so many books available on their management that little more need be considered here than the principles involved. Aquaria suitable for the biological laboratory or the home are available in cities everywhere. Dealers can supply them in so many forms and sizes that it is unnecessary to describe their construction. In most public aquariums table space is provided somewhere for the keeping of aquatic animals of small size that do not require flowing water. The aquaria used for such exhibits are provided with aquatic plants, which serve to aerate the water. Success with them is dependent upon a proper balance between the animal and plant life they contain.

An aquarium holding 8 or 10 gallons of water will be easier to maintain in good condition than one of small size and will care for a larger number of fishes with a greater degree of safety. An aquarium of rectangular shape is best for permanent use. It should be of strong, clear glass—preferably plate glass—set in a metal framework, and have a slate bottom.

Aquaria of rectangular form made wholly of glass can be purchased and are cheaper, but the glass is never quite clear, and they crack more readily from changes in temperature. Cylindrical glass aquaria are still cheaper, but they distort the forms of the objects they contain to some extent and are also liable to crack. However, aquaria made wholly of glass have the advantage of being absolutely water-tight while they remain in sound condition, whereas metal-framed aquaria may develop leaks.

Globes are unsatisfactory. Good results can not be expected with them. The small opening of a globe permits too small an amount of water surface to be exposed to the air. The more surface exposed for the absorption of air the better.

The aquarium should be placed where the amount of light reaching it can be controlled. Sunlight should not be allowed to fall directly on it except for an hour or two a day in the winter, as it stimulates the growth of algæ and may overheat the water, the temperature of which should be kept steady, not rising above 75° or falling below 45°. A temperature of 50 to 60° is best, and it should not be allowed to vary. Warm water holds less air than cold water, so that a high temperature is more to be guarded against than a low one.

Water plants are necessary in the aquarium for the aeration of the water, as under proper conditions of light and temperature they give off oxygen, which animals require, while the latter exhale carbonic gas. Too much plant growth can be checked by reducing the amount of light. At times a greenish film of algæ or confervæ will develop rapidly on the glass and obscure the contents of the aquarium. It will have to be rubbed off occasionally, but it is just as well to let it grow on the side next the window, where it will serve to restrict the light and also to aerate the water. The growth of algæ may be lessened by placing the aquarium in a more shaded position. Pond

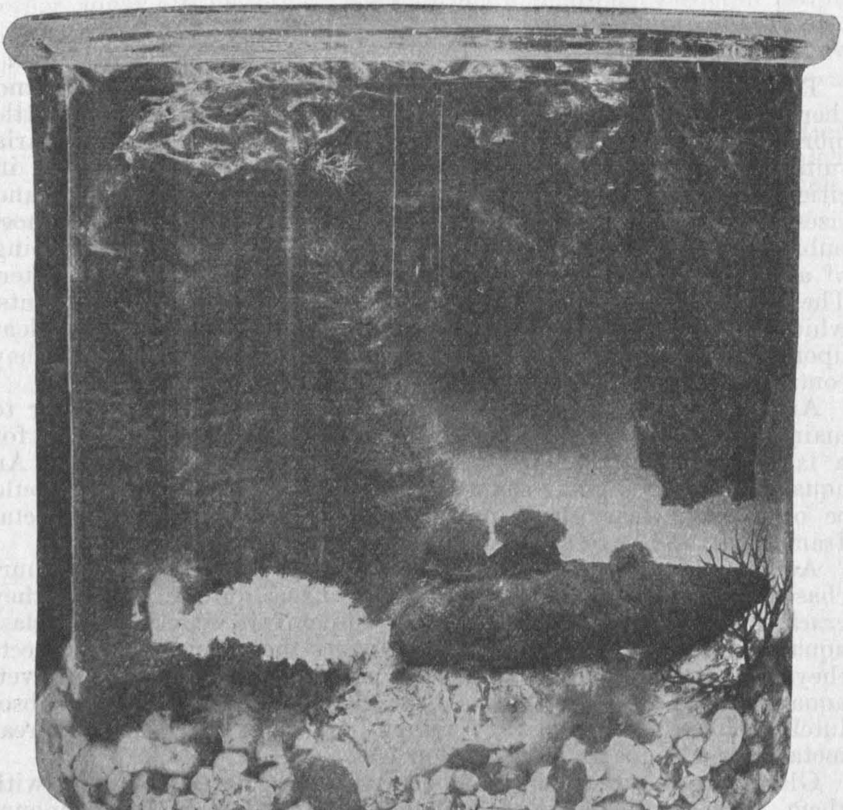

FIG. 45.—Round glass aquarium containing marine plants and invertebrates. Three hundred similar aquaria in the public schools have been stocked by the New York Aquarium

snails eat algæ rapidly and should be introduced for that purpose and also because their eggs serve as food for small fishes.

The aquarium should be allowed to absorb air from its plant life and from the surface of the water for a day or two before the fishes are put in, and these should be few in number at first. Snails may be added later. Dealers in aquarium supplies usually keep plants, snails, tadpoles, newts, and other small creatures, as well as fishes.

The following-named water plants are those most frequently used by aquarists: Milfoil (*Myriophyllum*), hornwort (*Ceratophyllum*), fanwort (*Cabomba*), water weed (*Anacharis*), tape grass (*Vallisneria*), arrowhead (*Sagittaria*), and pondweed (*Potamogeton*). Many other species will serve the purpose. Plants may be anchored by pressing them down into the sand or gravel. Thin strips of lead wound loosely about their roots will hold them securely.

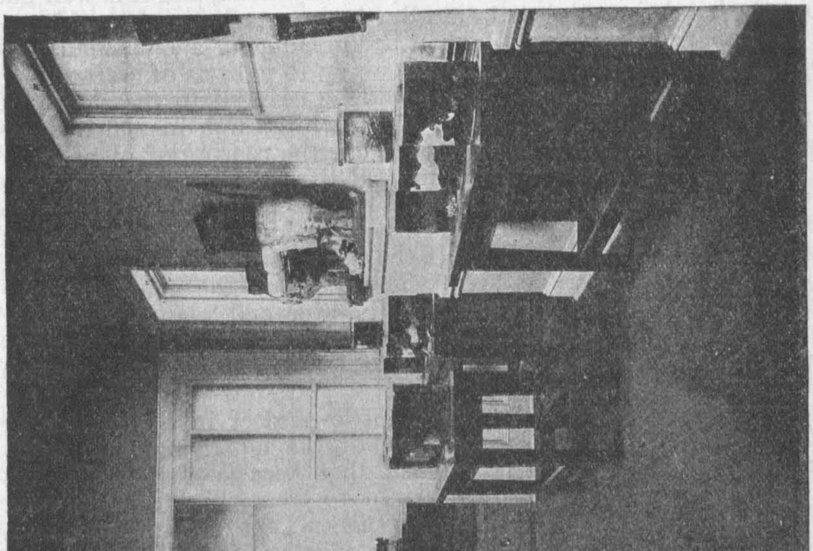

FIG. 46.—Fresh and salt water balanced aquaria, New York Aquarium laboratory. These are used by teachers in the public schools, who bring their classes here for study

In a well-balanced aquarium the water should not be changed at all. In fact, it is better without any addition other than that required to replace what is lost by evaporation. Water should not be added until it has been kept in the same room with the aquarium long enough to acquire the same temperature.

In siphoning water from the bottom of the aquarium to clear off sediment or refuse the water should be saved and strained back. The supply of water may be aerated at times by lifting it with a clean dipper and letting it fall back slowly. A sprinkling can will also serve for this purpose. All vessels and apparatus used in connection with the aquarium should be perfectly clean, and it is well not to put the hands into the water at all. Assistance in the way of keeping the aquarium clean may be had by introducing a few small tadpoles to act as scavengers, say one to every 15 gallons of water.

The bottom of the aquarium should be covered to the depth of about 2 inches with fine gravel or clean white sand, in which fishes may rub themselves; it is also essential for the rooting of plants.

There should not be too much animal life in the aquarium. The fewer and smaller the fishes the less likely is the air in the water to become exhausted. Two or three small goldfishes to each gallon of water is a safe rule to go by if the aquarium is large. If small, the proportion must be reduced. The question the aquarium presents, when it has been supplied with water and plants, is simply how many fishes or other air-consuming creatures can be accommodated in the quantity of water available. Overstocking may disturb the balance within an hour.

It is probably safe to say that a little neglect in the matter of feeding is better for the permanence of the aquarium than over-attention. It must not be presumed that because fishes will live for months without feeding it is right to treat them in that way. Fishes left without food are simply fishes kept hungry and in a condition of slow starvation, which can only be described as cruelty. When there is a large supply of plants in the aquarium the fishes survive longer, the very small ones, especially, getting some nourishment from the young shoots of Anacharis and other plants.

Many aquarists feed every day, carefully removing all uneaten food, which soon decays and fouls the water. Prepared foods sold by aquaria dealers are generally safe and may be supplied every other day. Finely crushed vermicelli is also used. Some of the ordinary household cereals are available as goldfish food, but the beginner should experiment with them cautiously. Other foods are desirable at times, too. Once a week pieces of very small earth worms or bits of fresh beef should be furnished. If they can be given to each fish on the tip of a broom straw the chances of contaminating the water by waste food will be lessened. All uneaten food must be picked, dipped, or siphoned out, or foul water and a disturbance of the delicate balance of the aquarium will result. A milky appearance of the water usually is a warning of careless feeding. Nearly all diseases that occur among goldfishes indicate that the aquarium needs looking after. The unsightly growth of fungus on fishes, caused by the plant parasites, Saprolegnia and Devœa, indicate careless handling of the fishes or bad conditions prevailing in the aquarium. When the conditions are right diseases are not likely to appear. Too high a temperature favors the growth of fish fungus.

This disease is hard to deal with, and infected fishes should be removed at once and kept by themselves, where, under proper conditions, they may possibly recover. A pinch of salt put in the water with them may arrest the disease, but when in bad condition a teaspoonful of salt to each gallon of water will be necessary. If other fishes are obtainable, it is just as well to destroy diseased specimens, as the fungus roots penterate into the flesh and can not be destroyed if the growth is far advanced. External parasites on fishes should be picked off after the fish has been lifted carefully in the dip net.

One of the first indications of trouble in the aquarium is the presence of the fishes at the surface with their mouths out of the water, showing that they are suffering for lack of air. The water may be dipped up and allowed to fall back slowly, but the relief afforded will be merely temporary. The temperature of the aquarium should be observed and some of the fishes removed. It may be necessary to increase the quantity of plant life or stimulate its growth by admitting more light. If the weather is not cold and the window can be opened, air blowing across the surface of the water will be helpful, as it may only be necessary to aerate the water and lower the temperature somewhat. There may be refuse at the bottom, which should be removed, of course.

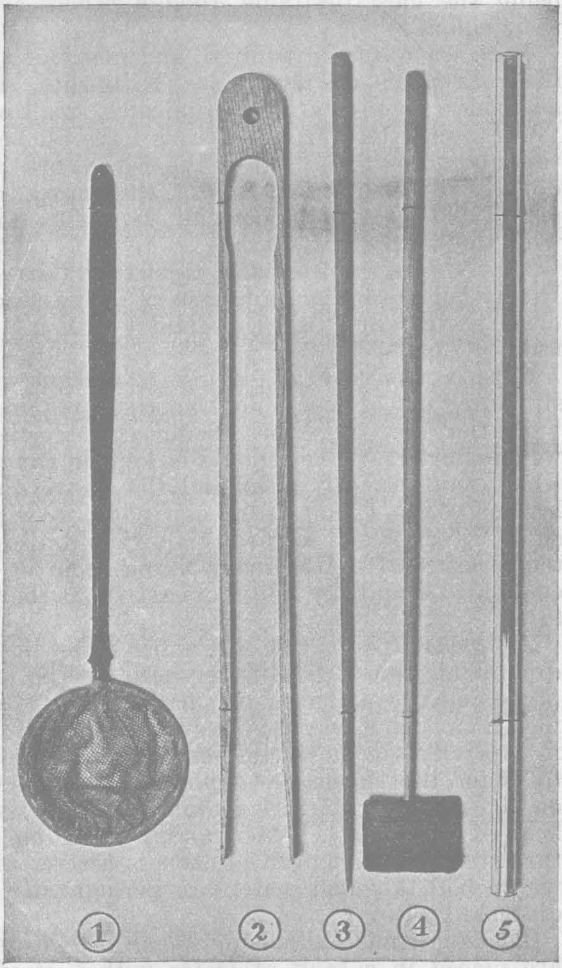

FIG. 47.—Aquarium implements. 1, net; 2, forceps; 3, stick for feeding; 4, swab for cleaning glass; 5, tube for taking up refuse

In taking care of the aquarium a few simple implements, such as a half-inch rubber tube for siphoning out the water, a glass "dip tube" for removing small particles of dirt from the bottom, a shallow dip net of cheesecloth for lifting fishes, and a cloth-covered pad or rubber scraper with a long handle for cleaning the glass, will be necessary. The dip tube is operated by closing the top opening with the finger to admit or exclude the water as desired. A pair of long wooden forceps and a slim stick are also useful for moving plants and other objects without putting the hands into the water.

Sea-water aquaria are managed according to the methods applicable to aquaria for fresh-water animals. There must be a similar balance between the marine animals and plants that they contain. Seaweeds here take the place of pondweeds, green sea lettuce (Ulva) being the most desirable, though others are used principally for their colors.

Pure sea water is required, and many of the small inhabitants of the rock pools are available. Killifishes, shrimps, crabs, hermits, anemones, young starfishes, tunicates, small mollusks, northern coral (Astrangia), and marine worms have all been kept successfully in the laboratory collection of the New York Aquarium. Planting is done as in fresh-water aquaria, the seaweeds being anchored in the gravel and sand of the bottom. Sea lettuce is floated at the surface with the support of corks.

Marine aquaria need more light than those containing fresh water. Finely cut fresh clam and mussel is the principal food, but bits of dried shrimp and fish (unsalted), with a little fresh fish, may be used.

Care is necessary in feeding. Aeration with the dipper and the siphoning out of refuse are sometimes required.

Turtles and alligators, being cold-blooded reptiles, must have warm quarters. They should be kept in aquaria or other vessels into which sunlight can enter and the vessel placed where it will not become cold. If kept near a window in winter to receive the sunshine, which is life to them, they should also be near a heater. The temperature of the ordinary living room in winter is scarcely high enough to keep baby alligators active, as they need a warmth of 80° to 85°.

Alligators require not only warm water but a place where they can dry off at times. The water need not be more than a few inches deep, and the platform or small log on which they rest should be placed in such a way that they can climb upon it easily. Alligators in captivity are most comfortable and active when they have access to water that is nearly tepid, and it is their habit to float much on the surface. Turtles require not only warm water but also the heat of the sun. The temporary warming of torpid alligators or turtles in boxes set near a heater is useless. If they can not be kept where both air and water are permanently warm, they should be dispensed with.

The numerous chilled and weak alligators sent to the aquarium are placed in a tank of water with a steam pipe in it. After a thorough warming up in water of 85° temperature, they begin to feed and will grow rapidly. Forcing cold alligators to eat by cramming food into their mouths is admissible only temporarily.

Alligators and snapping turtles are flesh eaters and may be provided with small minnows, frogs, tadpoles, worms, grubs, crayfish, shrimps, and small crabs, either dead or alive. When these can not be had they will eat fresh chopped meat, fish, clams, and oysters. Many kinds of turtles will eat all of the above-named foods as well as snails and insects. Others like very tender, green vegetables, such as tomatoes, lettuce, celery, and various water plants.

The food of some species consists largely of the buds of sedges (Cyperus), while with others it is chiefly small water mollusks. Some of the turtles are active fish eaters and will do well if supplied with live minnows. The "wood" turtle and other species that forage on land as well as in the water are fond of berries, mushrooms, and many kinds of fruits and vegetables, while nearly all kinds will eat grubs. The tortoises eat berries, mushrooms, and some garden vegetables as well as grubs and worms.

Turtles should be provided with a variety of foods until the kinds suited to each species are ascertained. Many species of turtles feed only under water, consequently it is absolutely necessary for them to have access to it when fed. If their surroundings can be made to approach natural conditions—that is, if they can have access to a compartment in their quarters where there is dry sand, earth, and sods, where grubs, worms, and other food can be thrown in abundance—success in keeping them will be more likely to follow.

Most salamanders and frogs, while leading strictly aquatic lives during their gill-breathing stages, eventually develop lungs and take to the land. In keeping them provision must be made for the life out of water but with water a few inches deep accessible. A roomy aquarium with a sod-covered platform in one end will enable them to lead their amphibian lives with fair chances for survival in captivity. Frogs will spend much time in the shallow water, but salamanders usually will seek hiding places under damp moss or leaves. Both are carnivorous and may be fed on earthworms, meal worms, insects and their larvæ, small crustaceans, and mollusks, with bits of meat and fish.

# APPENDIX B

## TREATMENT FOR REMOVAL OF CHLORINE FROM CITY WATER FOR USE IN AQUARIA

By R. S. Taylor, *formerly Technologist*, and Milton C. James, *Assistant Chief, Division of Fish Culture, U. S. Bureau of Fisheries*

### INTRODUCTION

The admitted advantages of chlorination as a means of purification of municipal water supplies appear to have overshadowed a minor difficulty that has accompanied the use of this method. This disadvantage manifests itself in the injurious effects exerted on fish life by chlorinated water. Wherever treated water is used as a supply for aquaria or for fish hatcheries serious losses may be expected ultimately. As an example of the extent of the damage, the following report of conditions at the central station aquarium of the Bureau of Fisheries following chlorination of the Washington water supply is quoted. The aquarium supply is taken directly from the city mains.

> Beginning Thursday morning, March 16, 1922, large numbers of fish of several species died in the exhibition aquaria and hatching troughs of the bureau at the central station in Washington, D. C. The fingerling fish were lost, and many half-grown and adult fish, including two sturgeon about 3½ feet long, which had been kept in aquaria 14 years. For the number of individual fish and the number of species affected the mortality was without precedent at this station. Nearly all the fish died during the night.
>
> Through inquiry of the water department it was learned that chlorination was begun on the day preceding the mortality (Wednesday, March 15), liquid chlorine being added to the water after filtration at a fixed rate, based on the average daily flow (0.3 part per million). While chlorine in this proportion might not have been injurious to fish, it is obvious that the actual proportion of chlorine would vary widely during the course of the day, according to the flow of the water. The effects would also be different if water, after chlorination, were discharged into the reservoir, as is true of the water supply for a large part of the residential district, instead of passing directly into the mains, as is understood to be the case with water reaching the portion of the city in which the bureau's aquarium is located. The consumption of water must be very low during the hours between midnight and 6 o'clock a. m., and the proportion of chlorine would accordingly be very much higher than the computed theoretical ratio of 0.3 part per million. It is significant that virtually all deaths of fish occurred during the night. It is understood that chlorine had not hitherto been used in treating the water supply of the District.

In succeeding years a recurrence of this situation has confronted the bureau.

That the difficulty is not purely local is shown by the fact that the Michigan State Hatchery at Bay City has experienced trouble in hatching whitefish with chlorinated water from the Bay City system. The Bureau of Fisheries' substation at Alpena, Mich., likewise suffered egg losses (seriously restricting its usefulness at certain periods) by using a chlorinated water supply. Discontinuance of the practice in 1922 was followed by the restoration of normal conditions at this hatchery. The Bureau of Fisheries has received numerous inquiries that show that similar troubles are encountered in many places.

That the mortalities are due to chlorine is incontestable. The experimental evidence, the correspondence of the inception and disappearance of the trouble to periods of chlorination and nonchlorination, and the augmenting of losses contemporary with known chlorine surges in the water, all render it unnecessary to elaborate proof. The purpose of this paper is to indicate remedial measures.

## CHARACTERISTICS OF CHLORINE POISONING

A multitude of conflicting factors renders it impossible to offer a description of a typical case of chlorine poisoning. The species and age of the eggs or fish, the filtration or nonfiltration and organic content of the water, the probabilities of sudden heavy increases in the residual chlorine content, temperature, etc., are conditions that must be known to permit any prophecy as to what reactions may occur in a given case.

While the experience at the central station has been that the eggs of whitefish and salmonids are largely unaffected until the hatching stage, at the hatcheries cited above it is reported that whitefish and lake-trout eggs were injured during incubation. In all cases it is noted that the most serious inroads are apparent following hatching, when an acceleration of the physiological activity of the fry occurs. At this stage the latter are highly susceptible.

In comparison of the fingerlings and the older stages it is observed that the former are more vulnerable to chlorine poisoning. Rainbow-trout fingerlings No. 1 and yearlings were shipped to the central aquarium at the same time from one of the hatcheries; the fingerlings commenced to show mortality immediately., and, although there were more of them, they failed to survive as long as the older individuals. The latter succumbed only after an interval over the week end, when presumably there was a marked increase in the residual chlorine, and one of the six survived this increase. Attempts to hold brook trout and salmon have revealed a comparable condition.

The comparative susceptibility of different species seems to be roughly correlated with their tolerance of other poisons and of adverse environmental conditions. Goldfish and other cyprinids, while not unaffected, maintain themselves fairly well under ordinary dosage; the sunfishes and basses show considerable resistance as well. The trout, salmon, and whitefish will be the first victims when chlorine makes its appearance in the water supply.

A variation in susceptibility among individuals of the same species exists, as would be expected. Among the more resistant forms, as the goldfish, a few will succumb early; and it will be found that these individuals are marked by poor condition, parasitic infections, etc.

On the other hand, from a lot of trout a few of the most vigorous will outlive the majority.

Little characteristic change in the activities and appearance of the fish will be noted during the progress of chlorine poisoning. Where the quantity of chlorine is insufficient to kill quickly a certain sluggishness is evident among fingerlings and older specimens. In the later stages of the poisoning there is a tendency to collect at the surface of the water. No other superficial reactions are evident, and in the sac fry no special symptoms can be noted.

As the deaths from heavier concentrations occur generally at night, no records from the aquarium under these conditions have been made. In experimental work rainbow-trout fingerlings subjected to heavier concentrations (approximately 0.3 part per million) show a moderate restlessness, with slight dyspnœa (rapid breathing) and loss of equilibrium, followed by death in two hours or less. A greater quantity of chlorine tends to increase the rate of respiration rapidly and to accentuate the other symptoms. It will be seen that these responses might follow the action of a number of chemical agents other than chlorine. An important consideration lies in the fact that fish whose "gassing" has progressed to a serious stage generally do not recover when transferred to water from which the toxic agent has been eliminated.

In regard to the concentrations of chlorine involved in the process of purification of civic water supplies, more is said in another section in the discussion of the chemistry of the subject. It should be stated here that the earlier conjecture ("chlorine in this proportion—0.3 part per million—might not have been injurious to fish") does not represent the facts. Experiments can be cited to show that 0.3 part per million chlorine will show its effect on yearling rainbow trout within 15 minutes and kill within 2 hours. A smaller amount (0.25 part per million) is fatal to fingerlings of the same species in 4 to 5 hours, but a solution of equal strength leaves goldfish apparently unaffected at the end of 42 hours. It is apparent that the foregoing concentrations are not maintained regularly in the water as received from the mains, but too much emphasis can not be placed on the fact that periodical "surges" or "pulses" at times may elevate the chlorine content above these levels.

Compilations of the toxicities of fish life to various chemicals make no mention of chlorine. The only available reference to this phase is that to the work of Rushton,[5] who experimented with chloros, a commercial sterilizing agent supposed to exert its effects by the action of free chlorine. He cited a 1 to 400,000 parts free chlorine solution as being virtually harmless to trout; but his chlorine determinations were made by the silver-nitrate method, which shows only chloride-ion and not $Cl_2$. Hence, no admissible estimate of the gaseous content of the water is given. Utilizing pure chlorine water, he made further experiments on trout, but here no statement of actual analyzed chlorine content is made; computation from his data indicates that his specimen was uninjured at a possible maximum of 0.4 part per million. How far this was the actual content can only be guessed.

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[5] Rushton, W., Salmon and Trout Magazine, October, 1921, p. 296, et seq., and January, 1922, p. 46. London.

An interesting phase, illustrating the linking of residual chlorine with the character and use of the water, is shown at the Bay City hatchery. The whitefish battery is so arranged that the jars of eggs are placed in superimposed tiers, with the fresh water entering the topmost series and passing through the whole battery, to be discharged ultimately in the overflow of the lowest tier. It was found that the mortality was highest in the upper sections, diminishing progressively, until the final group was largely unaffected. Manifestly, in exerting its toxic action the chlorine reduces its concentration until it becomes innocuous to succeeding lots of eggs. The same aspect is shown in experiments when a rainbow trout of 18 centimeters length reduced an initial chlorine content of 0.3 part per million to 0.05 part per million in one hour. The dose was fatal, however, without further increment of chlorine. Other practical instances of the cumulative action of chlorine appear when a lot of fingerlings without previous subjection to chlorine was divided. One group was placed in a trough supplied with the regular flow of constantly chlorinated water as fed to the whole aquarium. The others were placed in 6 liters of water from the same source in glass jars and maintained by aerating the water artificially and by infrequent changes. Within a week the specimens in running water were dead, while from the other lot there were survivors at the end of three weeks, the majority having been utilized in experiment. A nonlethal concentration thus becomes lethal under constant administration.

The process of autoneutralization exemplified in the successful preservation of fingerlings in the jars indicates that chlorinated water may be used with little hesitancy for the balanced home aquarium, where changes are made only at rare intervals. If the tap water is allowed to stand several days, residual chlorine should ordinarily be far below the critical concentration. The same action, of course, is observed in the presence of nonliving organic matter, which may act as a reducing agent, but the marked decrease of the chlorine content with fish may probably be credited to physiological factors as well as interaction with organic matter, such as the mucus of the fish. A quantitative determination of the relative importance of the two influences is lacking at present.

## CHEMICAL ASPECTS OF CHLORINE REMOVAL

Very small concentrations of free chlorine, if maintained, are toxic to fish. However, larger doses exhibit their toxic effects more rapidly, and a fish whose "gassing" has progressed to a serious stage generally will not recover even if transferred to water to which no chlorine has been added. Hence, in studying methods for counteracting or removing the chlorine it was decided to use fish in small aquaria and to introduce chlorine only once but in sufficient quantities that there would be no doubt as to the effect. Rainbow-trout fingerlings seem to be most susceptible to chlorine and for this reason were used in all the experiments.

The chlorine used was generated by the action of hydrochloric acid on potassium permanganate, washed to remove acid and dissolved in water to form a concentrated chlorine solution. This was then stored in glass-stoppered bottles in the dark until needed. Two methods of ascertaining the amount of chlorine introduced were used. First, measured quantities of the concentrated chlorine solution were added to 10-liter batches of water, and the chlorine present was determined by comparison with standards[6] using orthotolidine reagents as described by Ellms and Hauser.[7] This was not found to be as satisfactory as the method later used—namely, the analysis of the strong chlorine solution using 0.1/N-sodium thiosulphate with the starch iodide indicator and the addition of known amounts of this solution. In all cases the analysis of the strong chlorine solution was made immediately before using. Ten liters of water were used in each trial. Chemicals were added to the water and stirred a very short time. Five fingerling trout were then added. No food was given the fish during any one experiment, and new, healthy fish were used for each experiment. This was to prevent the results from being affected by unknown factors, such as water pollution or condition of fish.

Inasmuch as the chlorine was added in quantities much greater than those encountered in city waters, and as the amounts of chemicals used to counteract this are also correspondingly larger than will ordinarily be needed, it is felt that the results obtained should constitute an excellent indication as to what will happen to the fish when exposed to smaller quantities of these chemicals for longer periods of time. Also, as the rainbow trout seems to be most susceptible to poisons of this sort, it is reasonable to assume that the results obtained will apply to other species of fish.

The experimental results may be summarized as follows: Excepting ferrous sulphate, none of the reagents used for removing chlorine were toxic to the fish. Activated charcoal will remove chlorine, but due to the fact that the removal is a surface phenomenon it will not be complete unless special care is taken. This seems to render charcoal undesirable. Silica gel would be open to the same difficulties. The chemical reducing agents tried are efficient in the following order: Sodium bisulphite, sodium thiosulphate, and sodium nitrite. Although there were fewer experiments carried out using sodium bisulphite than with the other two reagents, it has been placed first not only because it is the cheapest of the three salts but also because other observers[8] have found this to be efficient.

The maximum daily dose of chlorine introduced into the water supply of Washington during the past two years was, according to the waterworks records, 0.32 part of chlorine per million parts of water. Considering sodium bisulphite as the chosen antichlor, about 0.5 part of this chemical per million parts of water would react with all the chlorine introduced. However, it is certain that this quantity is not needed, as a portion of the chlorine is always consumed in oxidizing organic matter before the water has been carried very far from the chlorination plant. Nevertheless, in order to care for accidental surges, it is thought best to use one part of sodium bisulphite in a million parts of water. This is still only one-tenth of the quantity used in the test experiments. If sodium thiosulphate is used, it is best to use a concentration of two or three parts per million of

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[6] An expression of appreciation is due Mr. Lauter, of the Washington waterworks, for lending his standards to us for use in this work.

[7] Jour. Ind. and Eng. Chem., vol. 5, No. 11, November, 1913.

[8] "The effect of free chlorine on the gudgeon." Anonymous. L'Eau, 16, No. 7, p. 81, 1923. Also Chem. Abs. 17, No. 21, p. 3559, 1923.

water. Concerning the chlorine usually present in the water as delivered to the bureau, a few tests were made using orthotolidine indicator. In no case were more than 0.02 part per million of chlorine present. However, at the time the experiments were made very little difficulty was being encountered in the large aquaria, so the tests are not very significant.

## SUGGESTED PROCEDURES FOR CHLORINE REMOVAL

Having decided on a means for counteracting the chlorine in city water, one next has the problem of finding a means of introducing the chemical chosen into the water supply. For aquaria using large amounts of water (100,000 gallons a day) it seems best to insert directly in the main a mixing chamber consisting of a large pipe filled with coke or other similar material. A solution of the chemical is then pumped into the main before the water reaches this mixing chamber. To do this requires a very small piston pump suitable for handling, say, 0.01 to 0.03 gallon of solution a minute and capable of continuously operating against a back pressure of 50 pounds. Such a pump can be purchased or can be built easily. It should be calibrated when working against the main-line pressure and the strength of solution made up to suit. If the variation in amount of water used is relatively small, no control of this pump should be needed, and the only attention required would be lubrication of the small electric motor and pump and refilling the chemical-supply tank. The size of the pump and the concentration of the solution should be such that the supply tank need be refilled very seldom.

For smaller aquaria using a continuous flow of water it will be simpler to use a mixing chamber consisting of a trough with baffles. This trough is mounted above the aquaria and delivers its effluent to the aquaria by gravity. The chemical may be pumped into the trough as before or may be fed in by gravity from a storage tank above the trough. If it is desired to make large variations in the flow of water used, it may be desirable to use a machine designed for such treatment.[9]

For aquaria in which water is not circulated continuously, but which are drained and refilled periodically, the problem is merely one of adding the required amount of chemical and stirring. As mentioned earlier, the necessity for treatment disappears in small household aquaria where it is possible to let the water stand for a time before the fish are introduced.

The cost of treating 100,000 gallons of water a day with sodium bisulphite should not exceed 10 cents a day for chemical and 20 cents a day for power if the piston pump mentioned above is used.

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[9] Chemical Dosing Apparatus. Charles F. Wallace, assignor to Wallace & Tierman Products (Inc.), Newark, N. J. U. S. Patent No. 1593109.

# APPENDIX C

The first table of information was published in 1924 and listed 24 aquariums. There are 32 represented here, all revised as of 1927 excepting Leipzig, which failed to send new data. Aquariums at Helgoland, Dresden, and Nuremberg in Germany, Goteborg in Sweden, Batavia in Java, and Adelaide in Australia failed to return questionnaires. The director of the aquarium in Palma de Mallorca, Spain, reported that his institution, connected with the Marine Biological Laboratory of El Terreno, is temporarily closed pending reconstruction or removal. With the proposed Shedd Aquarium in Chicago, there will be 45 public aquariums in the world that are known to us, and probably there are 4 or 5 unknown to us.

## TABLE OF INFORMATION REGARDING THE AQUARIUMS OF THE WORLD IN 1927

Compiled by IDA MELLEN, of the New York Aquarium

United States and territory

| City | Boston, Mass. | Chicago, Ill. | Detroit, Mich. | Honolulu, Hawaii |
|---|---|---|---|---|
| Institution | Boston Aquarium | Lincoln Park Aquarium. | Belle Isle Aquarium. | Honolulu Aquarium. |
| Presiding officer | Wm. J. O'Brien | Floyd S. Young | John E. Timmons. | F. A. Potter. |
| When opened | November, 1912 | May 31, 1923 | 1904 | Mar. 17, 1904. |
| Owned by | City | State of Illinois | City | Territory of Hawaii. |
| Controlled by | Park commission | Lincoln Park Commissioners. | Department Parks and Boulevards. | University of Hawaii. |
| Shape of building | L-shaped | Oblong | Grotto style | Cross-shaped. |
| Size of building | 150 by 100 feet | 75 by 150 feet | 240 by 74 feet | 100 by 24 feet long + 80 by 24 feet. |
| Cost to build | $150,000 | $250,000 | $175,000 | $15,000. |
| Annual maintenance cost. | $40,000 | $45,000 | $28,000 | $7,500. |
| Exhibition tanks | 62 | 48 | 58 | 32. |
| Capacity of tanks | 45 to 1,500 gallons | 25 to 2,000 gallons | 200 to 1,200 gallons | 12,000 gallons. |
| Pools | 1 | 1 | 4 | 2. |
| Capacity of pools | 4,500 gallons | | 3,000 gallons each | 25,000 gallons. |
| Reserve tanks | 31 | 16 | 26 | 4. |
| Total capacity reserve tanks. | 6,500 gallons | 4,000 gallons | 5,200 gallons | |
| Reservoirs | 2 | 4 | 2 | 2. |
| Capacity of reservoirs. | 128,000 gallons total. | 1,200 gallons total | 35,000 gallons each | 14,000 gallons. |
| Linear feet glass permanent wall tanks. | 165 | 160 | 280 | 180. |
| Linear feet glass floor tanks. | 80 | 135 | 48 | |
| Gallons water in tanks, salt. | 17,400 | None | 20,000 | 24,000. |
| Gallons water in tanks, fresh. | 15,600 | 50,000 | 30,000 | 1,000. |
| Gallons used daily, salt. | 90,200 | None | 45,000 | 40,000. |
| Gallons used daily, fresh. | 100,700 | 30,000 | 50,000 | |
| Number of exhibits (1927). | 3,904 | | 4,837 | 306. |
| Fishes | 2,835 | 102 varieties | 4,600 | 300. |
| Mammals | 4 | None | 4 | None. |
| Reptiles | 20 | 36 | 145 | 2. |
| Amphibians | 25 | 30 | 88 | None. |

*Table of information regarding the aquariums of the world in 1927*—Continued

United States and territory

| City | Boston, Mass. | Chicago, Ill. | Detroit, Mich. | Honolulu, Hawaii |
|---|---|---|---|---|
| Invertebrates | 20 | 18 | None | None. |
| Open every day | Yes | Yes | Yes | Yes. |
| Between what hours. | 10 to 5 | 9 to 5 | 9 to 6 | 10 to 5 (Sunday, 1 to 5). |
| Entrance fee | None | None | None | Yes. |
| Visitors a day | 844 | 4,800 | 6 575 | 80. |
| Visitors a year | 308,078 | 1,752,000 | 2,400,000 | 30,000. |
| Persons employed | 16 | 12 | 6 (and 4 part time) | 4. |
| In what capacity | Director, matron, 4 engineers, 3 firemen, 1 engineer (part time), 1 mechanic, 5 attendants. | Manager, 4 engineers, 4 aquarists, 2 hatchery men, 1 janitor. | Director, 2 aquarists, 7 attendants. | |
| Cards, specimens, pamphlets. | No | No | No | Post-card folder. |
| Balanced aquaria | 18 | 58 | 16 | None. |
| Total capacity | 300 gallons | | 250 gallons | |
| Water systems | 4 (fresh, fresh-refrigerated, salt, salt-heated). | 2 (fresh-refrigerated, fresh-heated). | 4 (fresh, fresh-heated, fresh-refrigerated, salt-heated). | Direct from ocean. |
| Fish hatchery | Yes | Yes | Yes | |
| Salt or fresh water | Fresh water | Fresh water | Fresh water | |
| Number fry hatched annually. | 5,000 | 35,000,000 | 10,000 | |
| Disposition of same | Exhibition and public waters. | State waters | Aquarium and public waters. | |

| City | La Jolla, Calif. | New Orleans, La. | New York City, N. Y. | Philadelphia, Pa. |
|---|---|---|---|---|
| Institution | Scripps Institution | Odenheimer Aquarium. | New York Aquarium. | Fairmount Park Aquarium. |
| Presiding officer | T. Wayland Vaughn | Frank E. Neelis | Chas. H. Townsend | William E. Meehan. |
| When opened | 1916 | Feb. 3, 1924 | Dec. 10, 1896 | Nov. 24, 1922, complete.[1] |
| Owned by | University of California. | City | City | City. |
| Controlled by | Regents of university. | Audubon Park Commissioners. | New York Zoological Society. | Fairmount Park Commission. |
| Shape of building | Rectangular | Circular | Circular | |
| Size of building | 24 by 47 feet | 50 feet diameter | 205 feet diameter | 320 feet. |
| Cost to build | | $60,000 | Reconstructed fort | Reconstructed ($500,000?). |
| Annual maintenance cost. | | $6,000 | $70,000 | $30,453. |
| Exhibition tanks | 19 | 25 | 89 | 114. |
| Capacity of tanks | 60 to 231 gallons | 1,560 gallons each | 310 to 4,590 gallons | 125 to 15,000 gallons. |
| Pools | | 1 | 7 | None. |
| Capacity of pools | | 9,000 gallons | 15,000 to 73,000 gallons. | |
| Reserve tanks | 4 | 5 | 29 | 35. |
| Total capacity reserve tanks. | 3,382 gallons | 15,000 gallons | 7,596 gallons | 22,250 gallons. |
| Reservoirs | 2 | 2 | 1 | 3. |
| Capacity of reservoirs. | 15,000 and 30,000 gallons. | 20,000 gallons each | 100,000 gallons | 74,134 gallons. |
| Linear feet glass permanent wall tanks. | 72 | 125 | 455 | 511. |
| Linear feet glass floor tanks. | | | 50 | 272. |
| Gallons water in tanks, salt. | | | 100,000 | 85,000. |
| Gallons water in tanks, fresh. | 8,000 | 27,400 | 100,000 | 50,000. |
| Gallons used daily, salt. | | 15,000 closed circuit | 214,000 | 500,000. |

[1] Tropical house opened June 15, 1915; temporary aquarium opened Nov. 24, 1911.

*Table of information regarding the aquariums of the world in 1927*—Continued

| United States and territory | | | | |
|---|---|---|---|---|
| City | La Jolla, Calif. | New Orleans, La. | New York City, N. Y. | Philadelphia, Pa. |
| Gallons used daily, fresh. | | | 200,000 | |
| Number of exhibits (1927). | 1,350 | 514 | 3,700 | 2,749. |
| Fishes | 1,300 | 500 | 2,700 | 2,438. |
| Mammals | None | None | 2 | None. |
| Reptiles | None | 25 | 120 | 31. |
| Amphibians | None | 6 | 35 | 279. |
| Invertebrates | 50 | 3 | 839 | 1. |
| Birds | None | None | 4 | None. |
| Open every day | Yes | Yes | Yes | Yes. |
| Between what hours | 8 to 5 | 8 to 5 or 6 | 9 to 4 or 5 | 9 to 5. |
| Entrance fee | None | None | None | None. |
| Visitors a day | | 3,571 | 4,700 | 1,000. |
| Visitors a year | 8,000 | | 1,722,000 | 400,000. |
| Persons employed | 3 | 2 (additional for emergency). | 29 | 21. |
| In what capacity | Curator-collector, engineer, attendant. | | Director and 4 officers, 1 matron, 1 foreman, 1 telephone operator, 3 engineers, 1 collector, 3 firemen, 14 attendants. | Superintendent and 2 assistants, 3 engineers, collector, matron, janitor, 10 attendants, 2 laborers. |
| Cards, specimens, pamphlets. | | No | All three | No. |
| Balanced aquaria | 1 | No | None since 1921 | None. |
| Total capacity | | | 42 planned; 500 gallons. | |
| Water systems | | 2 (fresh, salt) | 5 (fresh, fresh-heated, harbor (brackish), harbor-heated, pure salt-heated). | 3 (fresh, fresh-heated, salt-heated). (Plan fresh and salt refrigeration.) |
| Fish hatchery | | Yes | Yes | |
| Salt or fresh water | | Fresh and salt | Both | |
| Number fry hatched annually. | | | Average 1,000,000 | |
| Disposition of same | | Aquarium and park lakes. | Local public waters. | |

| United States and territory | | South America | | |
|---|---|---|---|---|
| City | San Francisco, Calif. | Washington, D. C. | Rio de Janeiro, Brazil | Rio de Janeiro, Brazil |
| Institution | Steinhart Aquarium. | Aquarium, United States Bureau of Fisheries. | Passeio Publico Acuarium. | Quinta da Boa Vista Aquarium. |
| Presiding officer | Barton W. Evermann. | L. G. Harron | Carlos Moreira | Carlos Moreira. |
| When opened | Sept. 29, 1923 | 1888 | 1905 | 1910. |
| Owned by | City | U. S. Government | City municipality | City municipality. |
| Controlled by | California Academy of Sciences. | United States Bureau of Fisheries. | do | Do. |
| Shape of building | | Installed in office buildings. | Moor style | Rustic-cavernlike. |
| Size of building | 116 feet by 182 feet | 56 feet by 103 feet. Annex 28 feet by 75 feet. | 180 square meters | 16 meters diameter. |
| Cost to build | $305,257.42 | $6,000 | | |
| Annual maintenance cost. | $40,000 | $6,000 | | |

*Table of information regarding the aquariums of the world in 1927*—Continued

| | United States and territory | | South America | |
|---|---|---|---|---|
| City | San Francisco, Calif. | Washington, D. C. | Rio de Janeiro, Brazil | Rio de Janeiro, Brazil |
| Exhibition tanks | 58 | 27 | 22 | 28. |
| Capacity of tanks | 1,280 to 1,400 gallons | 70 to 700 gallons | 2,000 to 4,500 liters | 2,500 to 5,300 liters. |
| Pools | 5 and 1 swamp | 1 | | |
| Capacity of pools | 2,800 to 82,000 gallons. | 13,000 gallons | | |
| Reserve tanks | 14 | 1 (3 compartments) | | |
| Total capacity reserve tanks. | 5,739 gallons | 300 gallons | | |
| Reservoirs | 5 and 4 cisterns | 2 | 6 | 1. |
| Capacity of reservoirs. | 10,000 to 100,000 gallons. | 12,500 gallons total | 58,000 liters | 20,000 liters. |
| Linear feet glass permanent wall tanks. | 308 | 143 | | |
| Linear feet glass floor tanks. | None | 8 | | |
| Gallons water in tanks, salt. | 33,040 | | 49,000 liters | |
| Gallons water in tanks, fresh. | 30,600 | 97,500 | | |
| Gallons used daily, salt. | 30,000 | None | Continuous flow | No salt water. |
| Gallons used daily, fresh. | 30,000 | 360,000 | No fresh water | |
| Number of exhibits (1927). | 8,100 | 2,000 | 238 | 305. |
| Fishes | 7,570 | 2,000 | 210 | 270. |
| Mammals | 10 | None | None | None. |
| Reptiles | 114 | None | 3 | 15. |
| Amphibians | 57 | None | None | None. |
| Invertebrates | 348 | None | 25 | 20. |
| Birds | 1 | None | None | None. |
| Open every day | Yes | Yes | Except Mondays | Except Fridays. |
| Between what hours. | 10 to 5 | 9 to 4.30 | 10 to 6 | 10 to 6. |
| Entrance fee | None | None | Yes | Yes. |
| Visitors a day | 4,040 | No record | 310 | |
| Visitors a year | 1,470,705 | do | 112,000 | 100,000. |
| Persons employed | 14 (and 4 part time) | 2 (and 2 skilled part time). | 4 | 2. |
| In what capacity | Director, superintendent, assistant superintendent, aquarist, collector, carpenter, 3 engineers, 2 janitors, doorman, relief man, 3 feeders and attendants. | | | |
| Cards, specimens, pamphlets. | Plan selling cards | No | No | No. |
| Balanced aquaria | 57 | 2 | Yes | |
| Total capacity | 1,100 gallons | 150 gallons | | |
| Water systems | 5 (fresh, fresh-heated, fresh-refrigerated, salt, salt-heated). | City supply | Salt water (natural temperature). | Fresh water (direct or filtered). |
| Fish hatchery | Yes | For exhibition only | No | No. |
| Salt or fresh water | Fresh water | Fresh water | | |
| Number fry hatched annually. | 130,000 | 5,000,000 | | |
| Disposition of same | To parties in State | Distributed | | |

*Table of information regarding the aquariums of the world in 1927*—Continued

| | Asia | Africa | |
|---|---|---|---|
| City | Madras, India | Salammbo, Tunis, Africa | Cairo, Egypt |
| Institution | Madras Marine Aquarium. | Oceanographique Station. | Gezira Aquarium. |
| Presiding officer | B. Sundara Raj | Henri Heldt | F. W. Borman. |
| When opened | Oct. 21, 1909 | February, 1926 | Nov. 21, 1902. |
| Owned by | Madras Government Development Department. | Government | Government. |
| Controlled by | Director of Fisheries, Doctor Raj. | Department of Public Works. | Egyptian Zoological Service. |
| Shape of building | Rectangular, 35½ feet by 50½ feet. | Rectangular | Grotto style. |
| Size of building | Main exhibition hall 1,770 square feet. | 35 by 45 meters | |
| Cost to build | Rs 30,000 | | Not known.[1] |
| Annual maintenance cost | Rs 7,000 | | LE. 900, approximately. |
| Exhibition tanks | 25 | 29 | 20. |
| Capacity of tanks | 5,600 gallons | 30 to 5,800 liters | 450 to 2,273 gallons. |
| Pools | 2 | 1 | None. |
| Capacity of pools | 2,000 gallons | 300 liters | |
| Reserve tanks | | 12 | None. |
| Total capacity reserve tanks. | 20 gallons | 27,000 liters | |
| Reservoirs | 2 | 2 | None. |
| Capacity of reservoirs | 783.6 gallons | 140,000 liters | |
| Linear feet glass, permanent wall tanks. | 70 | 50 meters | 67.92 square meters. |
| Linear feet glass floor tanks | 25 | | None. |
| Gallons water in tanks, salt | 5,040 | 33,000 liters | None. |
| Gallons water in tanks, fresh | 560 | | 14,900. |
| Gallons used daily, salt | 3,134.4 | | |
| Gallons used daily, fresh | 560.6 | | Continuous flow. |
| Number of exhibits (1927) | 116 | | 248. |
| Fishes | 100 | Yes | 247. |
| Mammals | None | | None. |
| Reptiles | 4 | Yes | 1. |
| Amphibians | 2 | | None. |
| Invertebrates | 10 | Yes | None. |
| Birds | None | Yes | None. |
| Open every day | Yes | No; Thursday and Sunday. | Yes. |
| Between what hours | 7 a. m. to 7 p. m | 2 to 5 | 9 a. m. to sunset. |
| Entrance fee | Yes | On one Sunday a month. | Yes. |
| Visitors a day | 308 | 400 | 126. |
| Visitors a year | 111,931 | 41,600 | 46,200. |
| Persons employed | 10 | 11 | 4. |
| In what capacity | Assistant in charge, 3 keepers, 1 door man, 5 helpers. | Director, assistant, preparator, mechanic, 3 collectors, 4 helpers. | Director, 3 keepers |
| Cards, specimens, pamphlets. | Cards, guide, in English and Tamil. | Guide cards, illustrated catalogue. | Plan of gardens. |
| Balanced aquaria | 2 | | None. |
| Total capacity | | | |
| Water systems | | | Filtered Nile water. |
| Fish hatchery | None | Not yet | None. |
| Salt or fresh water | | | |
| Number fry hatched annually. | | | |
| Disposition of same | | | |

[1] Originally part of Palace Garden of Khedive Ismail Pacha.

*Table of information regarding the aquariums of the world in 1927*—Continued

Europe

| City | Amsterdam, Netherlands | Antwerp, Belgium | Berlin, Germany | Blackpool, England |
|---|---|---|---|---|
| Institution | Amsterdam Aquarium. | Antwerp Aquarium. | Berliner Aquarium. | Blackpool Aquarium. |
| Presiding officer | C. Kerbert | M. L'hoest | O. Heinroth | M. R. Johnston. |
| When opened | 1882 | June, 1911 | Aug. 18, 1913 | 1871. |
| Owned by | Koninklyk Zoologisch Genootschap Natura Artis Magistra | R. Z. S. of Antwerp | Consolidated Association of Zoological Gardens. | Blackpool Tower Co. (Ltd.). |
| Controlled by | do | R. Z. S. board directors. | do | Do |
| Shape of building | L-shaped | Modern style | Grotto style | Grotto style. |
| Size of building | 2,735 square meters | 70 by 18 meters | 53 by 35 meters | 150 by 70 feet. |
| Cost to build | $200,000 | 1,200,000 Belgian francs. | $250,000 | $200,000. |
| Annual maintenance cost. | 20,000 florins | 85,000 Belgian francs. | 125,000 marks | $15,000. |
| Exhibition tanks | 23 | 22 | 100 (20 artificial sea water). | 50. |
| Capacity of tanks | 61,000 to 85,000 liters. | 170.20 cubic meters. | 10 liters to 170 tons | 24,000 gallons. |
| Pools | | 3 | | |
| Capacity of pools | | 85 cubic meters or tons. | | |
| Reserve tanks | 13 | 12 | | None. |
| Total capacity reserve tanks. | 24.48 cubic meters | 32.25 cubic meters | 500 tons fresh and salt. | |
| Reservoirs | 3 | 2 | | 2. |
| Capacity of reservoirs. | 564,000 liters | 140 cubic meters | 500 tons | 25,000 gallons salt, direct from sea. |
| Linear feet glass permanent wall tanks. | 50.50 square meters | 35.112 square meters | | 250. |
| Linear feet glass floor tanks. | 27 square meters | | | |
| Gallons water in tanks, salt. | 98,000 liters | 80 cubic meters or tons. | About 20 tons | |
| Gallons water in tanks, fresh. | 76,000 liters | 60 cubic meters or tons. | About 80 tons | |
| Gallons used daily, salt. | 77,000 liters | 35 cubic meters or tons. | About 120 tons | 25,000 gallons. |
| Gallons used daily, fresh. | 32,000 liters | 25 cubic meters or tons. | About 100 tons | 15,000 gallons. |
| Number of exhibits (1927). | | 2,470 | 4,460 | |
| Fishes | 192 varieties | 2,470 | 2,000 | |
| Mammals | None | | None | |
| Reptiles | None | | 300 | |
| Amphibians | 11 varieties | | 160 | |
| Invertebrates | 27 varieties | | 2,000 | |
| Birds | None | | None | |
| Open every day | Yes | Yes | Yes | Yes, except some Sundays. |
| Between what hours. | 9 to 6 | 8 or 9 to 4 or 6.30 | 9 to 6 or 7 (1 hour longer Sundays). | 9 to 10.30 p. m. |
| Entrance fee | Yes | Yes | Yes | Yes. |
| Visitors a day | 1,200 summer, 50 winter. | | 200 winter, 2,200 other times. | |
| Visitors a year | 140,000 | 850,000 + schools and subscribers; 11,000 families. | 225,000 + schools. | 1,000,000 summer. |
| Persons employed | 4 | 4 | 20 | 8. |
| In what capacity | Director, inspector, 2 keepers. | Director, 2 keepers, 1 stoker. | Custodian, inspector, secretary, 2 engineers, 8 attendants, 3 cleaning women, 4 ticket takers | Manager, 4 keepers, engineer, electrician, cleaner. |
| Cards, specimens, pamphlets. | No | Album, card folder. | Guides, cards | |
| Balanced aquaria | 12 to 16 | 49 | 30 (also 85 terraria and 66 insectaria). | None. |
| Total capacity | 6,400 liters | 9 cubic meters | | |
| Water systems | 4 (fresh, fresh-heated, salt, salt-heated). | 4 (fresh, fresh-heated, salt, salt-heated). | 4 (fresh, fresh-heated, salt-artificial, salt-heated). | 2 (fresh-refrigerated, salt-refrigerated). |
| Fish hatchery | Yes | | No | No. |
| Salt or fresh water. | Fresh water | | | |

*Table of information regarding the aquariums of the world in 1927*—Continued

Europe

| City | Brighton, England | Budapest, Hungary | Busum, Germany | Frankfurt, Germany |
|---|---|---|---|---|
| Institution | Brighton Aquarium. | Budapest Aquarium. | Aquarium der Zoo'l Sta. | Frankfurter Aquarium. |
| Presiding officer | George W. Weller | Rudolph v. Hilbert | S. Müllegger | Kurt Priemel. |
| When opened | 1872 | May 25, 1912 | 1919 | 1872. |
| Owned by | Brighton Corporation. | Town of Budapest | S. Müllegger | Zoological Garden. |
| Controlled by | Brighton Aquarium committee. | do | Zoological Station, Busum. | Do. |
| Shape of building | Corridor style | Oval | Grotto style | Grotto style. |
| Size of building | 715 feet long, 100 feet wide. | 240 meters | 12 by 30 meters | 33 by 22 meters |
| Cost to build | £120,000 [1] | 130,000 pengös | 20,000 marks | 300,000marks. |
| Annual maintenance cost. | £4,500 | 3,000 pengös | | 35,000 marks. |
| Exhibition tanks | 50 | 101 | 34 | 91. |
| Capacity of tanks | 650,000 gallons total. | 190,000 liters total | 50 cubic meters, salt. | 10 to 500 liters. |
| Pools | 2 | None | 4 | 3. |
| Capacity of pools | 5,000 gallons | | | |
| Reserve tanks | 2 | 8 | | 8. |
| Total capacity reserve tanks. | | 10,000 liters | | |
| Reservoirs | 5 | 2 | 1 | 6 (3 salt, 3 fresh). |
| Capacity of reservoirs. | 500,000 gallons, direct from sea. | 18,000 liters | 75 cubic meters | 75 cubic meters. |
| Linear feet glass permanent wall tanks. | 561 | 240 | | |
| Gallons water in tanks, salt. | 575,000 gallons | 70,000 liters | | 35 cubic meters. |
| Gallons water in tanks, fresh. | 75,000 gallons | 120,000 liters | 25 | Do. |
| Gallons used daily, salt. | Variable supply | None | | 60 cubic meters. |
| Gallons used daily, fresh. | do | 25,000 liters | | Do. |
| Number of exhibits (1927). | Plus 10,000 | 5,337 | 3,500 | 1,404 plus invertebrates. |
| Fishes | 10,000 | 4,000 | 1,500 | 980. |
| Mammals | 2 | None | None | 3. |
| Reptiles | 6 | 95 | None | 254. |
| Amphibians | 6 | 42 | None | 166. |
| Invertebrates | Numerous | 1,200 | 2,000 | Several thousand in season. |
| Birds | None | None | None | 1. |
| Open every day | Yes | Yes | Yes (May to September). | Yes. |
| Between what hours. | 10 to 10, summer; to dark, winter. | 8 to 6 | 8 to 8 | 7 till dark. |
| Entrance fee | Yes | Yes | Yes | Yes. |
| Visitors a day | | 160 winter, 1,330 other times. | 100 | 293 plus schools and subscribers. |
| Visitors a year | 275,000 plus schools. | 237,153 | 14,000 | 106,945 plus schools and subscribers. |
| Persons employed | 12 | 7 | 5 | 6 (including insect house and hospital). |
| In what capacity | Manager, superintendent, tank attendants, toll keeper, engineer, electrician, general attendants. | 2 inspectors, 4 stokers, 1 officer. | Director, 2 keepers, secretary, ticket taker. | Director, inspector, 4 attendants. |
| Cards, specimens, pamphlets. | Guide, post cards | None | Guides, cards | |
| Balanced aquaria | | None; 23 terraria | 40 | 48 (also 57 insectaria and 70 terraria). |
| Water systems | 3 (fresh, fresh-heated, sea water). | 3 (fresh, fresh-heated, salt). | 1 | 4 (fresh, fresh-heated, salt, salt-heated). |
| Fish hatchery | | Yes | No | |
| Salt or fresh water | | Fresh water, heated. | | |
| Number fry hatched annually. | | 3,000 to 4,000 tropical fishes. | | |
| Disposition of same | | Aquaria | | |

[1] Aquarium site to be reconstructed, 1929, at a cost of $500,000.

*Table of information regarding the aquariums of the world in 1927*—Continued

Europe

| City | Hamburg, Germany | Leipzig, Germany | Lisbon, Portugal |
|---|---|---|---|
| Institution | Hamburg Aquarium | Leipzig Aquarium | Aquario Vasco da Gama. |
| Presiding officer | Baron von Uexküll | Doctor Gebbing | A. Ramalho. |
| When opened | 1884 | | 1898. |
| Owned by | Zoological Garden and University. | | Portuguese State. |
| Controlled by | Baron von Uexküll | Doctor Gebbing | Do. |
| Shape of building | Subterranean | Oblong | |
| Size of building | 40 by 12 meters | 40 meters long, 20 meters deep, 10 meters high. | |
| Cost to build | | | |
| Annual maintenance cost | 17,000 marks | 20,000 marks | $6,300. |
| Exhibition tanks | 22 | 100 (67 aquaria, 33 terraria). | 96. |
| Capacity of tanks | 22 cubic meters | 0.30 to 3.50 meters | 34 cubic meters. |
| Pools | | 2 | 8. |
| Capacity of pools | | 4 to 12 meters | 36 cubic meters. |
| Reserve tanks | 4 | 6 | 4. |
| Total capacity reserve tanks | 2½ cubic meters | 15 cubic meters total | 12 cubic meters total. |
| Reservoirs | 4 | 5 | 5. |
| Capacity of reservoirs | 125 cubic meters | 150 cubic meters | 276 cubic meters. |
| Linear feet glass permanent wall tanks. | | 1 to 2.50 meters broad; 1 to 2 meters high. | 124 meters. |
| Linear feet glass floor tanks | | 1 to 2.50 meters broad and 1 to 2 meters deep. | |
| Gallons water in tanks, salt | 20 cubic meters | 60 cubic meters | 24 cubic meters. |
| Gallons water in tanks, fresh | 2 cubic meters | 100 cubic meters | 10 cubic meters. |
| Gallons used daily, salt | 40 cubic meters | 20 cubic meters | 130 cubic meters. |
| Gallons used daily, fresh | 8 cubic meters | 50 cubic meters | 2 cubic meters. |
| Number of exhibits (1927) | | Varying | |
| Fishes | 35 species | Yes | 50 species. |
| Mammals | None | Yes | No species. |
| Reptiles | None | Yes | 3 species. |
| Amphibians | 3 species | Yes | 10 species. |
| Invertebrates | 45 species | Yes | 20 species. |
| Birds | 1 species | No | No species. |
| Open every day | Yes | Yes | Yes. |
| Between what hours | 8 to 6, summer; 9 to 4, winter. | 7 a. m. to 7 p. m. | 11 a. m. to sunset. |
| Entrance fee | Yes | 1 mark for zoo and aquarium. | Yes, except schools. |
| Visitors a day | 150 | Varying | 60 (Sundays, 500). |
| Visitors a year | 60,000 | 350,000 | 46,874. |
| Persons employed | 4 | 3 | 14. |
| In what capacity | Director, assistant, attendant, cashier. | Director, 2 warders | President, engineer, director, treasurer, assistant, preparateur, 3 guards, 4 fishermen, assistant engineer. |
| Cards, specimens, pamphlets. | | Post cards | Cards and specimens. |
| Balanced aquaria | 2 | | |
| Total capacity | 3 cubic meters | | |
| Water systems | 2 (fresh, salt) | 2 (heated, refrigerated) | Continual circulation, filtered. |
| Fish hatchery | | Yes (2 rooms) | No, but connected with fishery bureau. |
| Salt or fresh water | | Fresh water | |

*Table of information regarding the aquariums of the world in 1927*—Continued

**Europe**

| City | London, England | Monaco | Naples, Italy |
|---|---|---|---|
| Institution | London Aquarium | Monaco Aquarium | Naples Aquarium. |
| Presiding officer | E. G. Boulenger | Jules Richard | R. Dohrn. |
| When opened | Apr. 7, 1924 | 1905 | 1874. |
| Owned by | Zoological Society of London. | Foundation Prince Albert I. | A corporation. |
| Controlled by | do | Council of Administration. | |
| Shape of building | Crescentic | Rustic | Grotto style. |
| Size of building | 450 feet long | | |
| Cost to build | $275,000 | | 1,000,000 gold francs. |
| Annual maintenance cost | £6,500 | | 220,000 lire. |
| Exhibition tanks | 90 | 47 to 49 | 26. |
| Capacity of tanks | 40,000 gallons total | 60 liters to 3 cubic meters | 300 tons. |
| Pools | 1 | 2 | None. |
| Capacity of pools | 1,000 gallons | 7 meters, 3 | |
| Reserve tanks | 9 | 17 | None. |
| Total capacity reserve tanks | 4,200 gallons | 13 meters, 3 | |
| Reservoirs | 3 | 3 | 3. |
| Capacity of reservoirs | 180,000 gallons | 18 meters, 3; 47 meters, 3; and 44 meters, 3. | 350 tons. |
| Linear feet glass permanent wall tanks. | 500 | 63 meters | 57. |
| Gallons water in tanks, salt | 20,000 gallons | 61 meters, 3 | |
| Gallons water in tanks, fresh | do | No fresh water | |
| Gallons used daily, salt | 50,000 gallons | 12 meters, 3 | |
| Gallons used daily, fresh | 30,000 gallons | | |
| Number of exhibits (1927) | 3,580 | | |
| Fishes | 2,000 | 77 species | |
| Mammals | None | None | |
| Reptiles | 25 | 3 | |
| Amphibians | 25 | None | |
| Invertebrates | 1,500 | 182 species | |
| Birds | None | None | |
| Open every day | Except Christmas Day. | Yes | Yes. |
| Between what hours | From 11 a. m. | 10 to 12; 2 to 4 or 5 | 8 to 6. |
| Entrance fee | Yes | Yes | Yes. |
| Visitors a day | 2,000 | | |
| Visitors a year | | 120,000 | 50,000. |
| Persons employed | 10 | 8 | 6. |
| In what capacity | Director, overseer, engineer, 4 keepers, 3 stokers. | Director, assistant director, 2 attendants, 2 collectors, 2 young assistants. | |
| Cards, specimens, pamphlets. | Guides | Guides, textbooks, pictures, cards. | Guides, specimens, cards. |
| Balanced aquaria | None | 6 to 20 | None. |
| Total capacity | | 360 to 1,500 liters | |
| Water systems | 4 (fresh, fresh-heated, salt, salt-heated). | Use only natural sea water, unfiltered; continuous circulation. | |
| Fish hatchery | | No | |

*Table of information regarding the aquariums of the world in 1927*—Continued

Europe

| City | Nice, France | Paris, France | Plymouth, England |
|---|---|---|---|
| Institution | Aquarium de Nice | Trocadero Aquarium | Plymouth Aquarium. |
| Presiding officer | Doctor Dida | Mr. Grandjean | E. J. Allen. |
| When opened | 1921 | 1878 | 1888. |
| Owned by | Doctor Dida | City of Paris | Marine Biological Association. |
| Controlled by | do | | Director, Marine Biological Association. |
| Shape of building | Rectangular | Grotto style | |
| Size of building | 50 by 100 feet | Gardens and grotto, 21,600 square feet. | 34½ by 70 feet, exhibition room. |
| Cost to build | 400,000 francs | | |
| Annual maintenance cost | | 80,000 francs | |
| Exhibition tanks | 15 | 24 | 12. |
| Capacity of tanks | 55,000 liters | 5,300 to 21,200 gallons | 21,800 gallons. |
| Pools | None | None | 5. |
| Capacity of pools | | | 780 gallons. |
| Reserve tanks | 10 | | 14 (private). |
| Reservoirs | 3 | | 2. |
| Capacity of reservoirs | 50,000 liters | General canalization of Paris. | 50,000 gallons each. |
| Linear feet glass permanent wall tanks. | 110 feet | 380 | 137½. |
| Gallons water in tanks, salt | 48,000 liters | | 21,400 gallons. |
| Gallons water in tanks, fresh | 7,000 liters | 5,300 to 21,200 gallons (river water only). | 1,000 gallons. |
| Gallons used daily, salt | 25,000 to 50,000 liters | | 50,000 gallons. |
| Gallons used daily, fresh | 7,000 liters | 200,000 to 265,000 gallons | |
| Number of exhibits (1927) | | 3,000 | Varying. |
| Fishes | 70 to 80 varieties | 3,000 | Yes. |
| Mammals | None | None | No. |
| Reptiles | 4 | None | No. |
| Amphibians | 2 | None | No. |
| Invertebrates | 20 | None | Yes. |
| Birds | None | None | No. |
| Open every day | Yes | Except Monday | Except Sunday. |
| Between what hours | 9 to 6 | 10 to 5 | 10 to 6. |
| Entrance fee | Yes, except schools | Free | Yes. |
| Visitors a day | 50 to 300 | | |
| Visitors a year | 40,000 | 200,000 | 21,300. |
| Persons employed | 3 | 6 | 10. |
| In what capacity | Director, keeper, cleaning man. | | 2 attendants, 8 collecting staff. |
| Cards, specimens, pamphlets. | Cards, pamphlets, specimens. | No | Guides, specimens, apparatus. |
| Balanced aquaria | 6 to 10, 1 terrarium | | |
| Total capacity | 300 liters | | |
| Water systems | 2 (fresh-heated, salt-filtered-heated). Water pumped from sea 3 times a day. | Fresh | 2 (fresh, salt). |
| Fish hatchery | | Yes | |
| Salt or fresh water | | Fresh | |
| Number fry hatched annually. | | 300,000 to 500,000, chiefly trout. | |
| Disposition of same | | Special establishment near Fontainebleau. | |

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# PROPAGATION AND DISTRIBUTION OF FOOD FISHES, FISCAL YEAR 1928

By Glen C. Leach, *Assistant in Charge, Division of Fish Culture*

CONTENTS



[1] Appendix VIII to the Report of the U. S. Commissioner of Fisheries for 1928. B. F. Doc. No. 1049.

**Part 2.—Distribution of Fish and Fish Eggs**

## INTRODUCTION

During the fiscal year 1928 the bureau was more than ordinarily successful in its work of hatching, rearing, and distributing food and game fishes. From all parts of the country it has received reports of greater production of fish in waters stocked by the bureau, particularly in Pennsylvania, New York, and other Eastern States, where anglers state the trout fishing has improved greatly.

In several sections of the country, it is true, the output of the Government hatcheries has been insufficient to rehabilitate declining commercial fisheries, but it is hoped that all of the obstacles that so far have prevented the complete success of the bureau's work at such places may be overcome soon.

The greatest improvement in fishing conditions has taken place in the localities where cooperative fish nurseries are being operated by the sportsmen themselves, as well as by other organizations, in rearing fish provided by the Bureau of Fisheries. Many delighted owners of small natural or artificial ponds and lakes that have been stocked with fish from Federal hatcheries have reported that, though some of them contained no fish life whatever before being stocked by the bureau, they have provided an astonishing number of food and game fishes.

The efficacy of artificial propagation is evidenced in the rehabilitation of the runs of the commercially valuable salmons of the Pacific coast and Alaska. By making heavy plants of eggs of these species over a period of years, streams that had no native population of the more valuable forms have become self-supporting. The same has been done with the lake trout in certain sections of the Great Lakes. The maintenance of the remnant of the Penobscot salmon run and such slight improvement as it has shown in recent years can be traced to the work of the hatchery at Craig Brook, Me. In the Madison Valley in Montana a magnificent run of Loch Leven trout has been built up to the point where 60 per cent of the eggs produced can be removed and planted in other waters, the remaining 40 per cent being sufficient to provide an adequate stock of fish for the parental waters.

Following is a detailed statement of the progress made in this branch of the bureau's work during the year ended June 30, 1928:

# Part 1.—FISH PRODUCTION: PROPAGATION AND RESCUE WORK

## SPECIES HANDLED

During the year the propagation and rescue work of the bureau affected 46 species of fish, as follows:

CATFISHES (SILURIDÆ):
- Catfishes (Ictalurus sp. and Leptops sp.).
- Horned pout (*Ameiurus nebulosus*).

SUCKERS (CATOSTOMIDÆ): Buffalo fish (Ictiobus sp.).

PADDLEFISHES (POLYDONTIDÆ): Paddlefish (*Polydon spathula*).

CARP (CYPRINIDÆ):
- Common carp (*Cyprinus carpio*).
- Goldfish (*Carassius auratus*).

SHAD AND HERRING (CLUPEIDÆ):
- Shad (*Alosa sapidissima*).
- Glut herring (*Pomolobus æstivalis*).

SALMON, TROUTS, AND WHITEFISHES (SALMONIDÆ):
- Common whitefishes (Coregonus sp.).
- Cisco (*Argyrosomus artedi*).
- Chinook, king, or quinnat salmon (*Oncorhynchus tschawytscha*).
- Chum salmon (*Oncorhynchus keta*).
- Humpback salmon, pink salmon (*Oncorhynchus gorbuscha*).
- Silver salmon, coho salmon (*Oncorhynchus kisutch*).
- Sockeye, blueback, or red salmon (*Oncorhynchus nerka*).
- Steelhead salmon (*Salmo gairdneri*).
- Atlantic salmon (*Salmo salar*).
- Landlocked salmon (*Salmo sebago*).
- Rainbow trout (*Salmo shasta*).
- Black-spotted trout, redthroat trout (*Salmo lewisi*).
- Loch Leven trout (*Salmo levenensis*).
- Lake trout, Mackinaw trout (*Christovomer namaycush*).
- Brook trout (*Salvelinus fontinalis*).

GRAYLINGS (THYMALLIDÆ): Montana grayling (*Thymallus montanus*).

PIKES (ESOCIDÆ): Common pickeral (*Esox lucius*).

SUNFISHES, BLACK BASSES, AND CRAPPIES (CENTRARCHIDÆ):
- Crappie (*Pomoxis, annularis* and *P. sparoides*).
- Largemouth black bass (*Micropterus salmoides*).
- Smallmouth black bass (*Micropterus dolomieu*).
- Rock bass (*Ambloplites rupestris*).
- Warmouth bass, goggle-eye (*Chænobryttus gulosus*).
- Green sunfish (*Apomotis cyanellus*).
- Red-breasted bream (*Lepomis auritus*).
- Bluegill sunfish (*Lepomis incisor*).
- Common sunfish (*Eupomotis gibbosus*).

PERCHES (PERCIDÆ):
- Pike perch (*Stizostedion vitreum*).
- Yellow perch, ringed perch (*Perca flavescens*).

STRIPED BASSES (SERRANIDÆ):
- Striped bass (*Roccus lineatus*).
- White perch (*Morone americana*).
- White bass (*Roccus chrysops*).

DRUMS (SCIÆNIDÆ): Fresh-water drum, lake sheepshead (*Aplodinotus grunniens*).

CODS (GADIDÆ):
- Cod (*Gadus callarias*).
- Haddock (*Melanogrammus æglifinus*).
- Pollock (*Pollachius virens*).

FLOUNDERS (PLEURONECTIDÆ): Winter flounder, American flatfish (*Pseudopleuronectes americanus*).

MACKEREL (SCOMBRIDÆ): Common mackerel (*Scomber scombrus*).

## COOPERATION WITH STATES AND PRIVATE INDIVIDUALS

At the present time the work of the division of fish culture has two major subdivisions—(1) the routine delivery of fish upon individual applications, together with station distributions of commercial varieties, and (2) cooperation with State and private conservation agencies. It is probable that the latter phase is fully as important as the former as a means of restocking public waters.

The exchange of eggs with many of the States has become routine practice. So far as is possible eggs have been furnished to the States free of cost, particularly in the West, where large harvests have been obtained at field collecting stations. The bureau has operated a pike-perch hatchery on Lake Champlain jointly with the States of Vermont and Pennsylvania. After an inspection of the waters of the States, approximately 200,000 rainbow trout were furnished the State of North Carolina for distribution in the region surrounding the proposed new national park in the Great Smoky Mountains. The services of the bureau's employees were lent to the State of New Jersey for the purpose of carrying on shad work in the Delaware River; to Florida to aid in developing the artificial propagation of the spiny lobster; and to Arkansas for the purpose of establishing a large new hatchery. A close liaison has been maintained with the State of Michigan as a means of making more effective the rehabilitation of the commercial fisheries of that State. The bureau has incubated eggs for West Virginia, and the bureau's cars have aided that State and Maryland in distributing the output of their hatcheries. Close and profitable relations have been maintained with the State of Montana. An important item in this connection was the completion of a large bass and pondfish establishment at Miles City, Mont., under the joint auspices of the bureau and the State.

On the Pacific coast the important work of propagating the Pacific salmons has been facilitated by cooperation in various ways with the States of Oregon and Washington. The bureau is aiding the State of Virginia by furnishing fish for a system of public rearing pools established by that Commonwealth. Connecticut has taken up the propagation of flounders with the assistance of one of the bureau's employees experienced in marine work. The bureau has also received important concessions from many of the States, enabling it to carry on its activities more efficiently. There appears below a table that is indicative of the extent to which the bureau has been able to benefit many States by the outright assignment of fish and eggs.

*Assignments of fish eggs to State and Territorial fish commissions, fiscal year 1928*

| State and species | Number |
|---|---|
| California: Black-spotted trout | 75,000 |
| Colorado: Rainbow trout | 50,000 |
| Connecticut: Pike perch | 2,000,000 |
| Hawaii: | |
| Chinook salmon | 15,000 |
| Rainbow trout | 29,000 |
| Steelhead salmon | 40,000 |
| Idaho: Rainbow trout | 150,000 |
| Illinois: Rainbow trout | 144,000 |
| Iowa: | |
| Lake trout | 50,000 |
| Rainbow trout | 309,000 |
| Maine: Lake trout | 100,000 |
| Maryland: Loch Leven trout | 50,000 |
| Massachusetts: Loch Leven trout | 100,000 |
| Michigan: Lake trout | 1,753,000 |
| Minnesota: Lake trout | 1,982,000 |
| Missouri: Rainbow trout | 97,000 |
| Montana: | |
| Black-spotted trout | 1,006,000 |
| Loch Leven trout | 2,699,000 |
| Nebraska: Loch Leven trout | 100,000 |
| Nevada: | |
| Brook trout | 202,000 |
| Rainbow trout | 500,000 |
| New Hampshire: | |
| Lake trout | 600,000 |
| Rainbow trout | 137,000 |
| New Mexico: | |
| Loch Leven trout | 1,500,000 |
| Steelhead salmon | 75,000 |
| New York: | |
| Lake trout | 400,000 |
| Steelhead salmon | 125,000 |
| North Carolina: Rainbow trout | 596,000 |
| Ohio: Rainbow trout | 201,000 |
| Oregon: | |
| Black-spotted trout | 500,000 |
| Brook trout | 464,000 |
| Chinook salmon | 11,592,000 |
| Silver salmon | 925,000 |
| Sockeye salmon | 3,528,000 |
| Steelhead salmon | 870,000 |
| Pennsylvania: | |
| Loch Leven trout | 500,000 |
| Pike perch | 54,210,000 |
| Rainbow trout | 205,000 |
| South Dakota: | |
| Loch Leven trout | 513,000 |
| Steelhead salmon | 75,000 |
| Utah: | |
| Black-spotted trout | 150,000 |
| Brook trout | 550,000 |
| Loch Leven trout | 1,002,000 |
| Washington: | |
| Black-spotted trout | 1,304,000 |
| Chinook salmon | 5,000,000 |
| Chum salmon | 3,000,000 |
| Lake trout | 250,000 |
| Sockeye salmon | 828,000 |
| West Virginia: Loch Leven trout | 200,000 |
| Wisconsin: Lake trout | 1,145,000 |
| Wyoming: | |
| Black-spotted trout | 550,000 |
| Brook trout | 255,000 |
| Loch Leven trout | 925,000 |
| Rainbow trout | 722,000 |
| Total | 104,348,000 |

The bureau has also cooperated with the Department of Agriculture and the Department of the Interior. Heavy assignments of fish have been made to the waters of many of the national forests, under control of the former, and the bureau deems this feature an important part of its duties. The relations with the Interior Department in the conduct of fish-cultural operations in Glacier and Yellowstone National Parks have been mutually helpful. A new hatchery building is being laid out in the Yellowstone Park, and the facilities in that reservation are being further augmented by the construction of rearing ponds at Mammoth Springs. Generous assignments of trout fingerlings for Rainier National Park have been made possible by the willingness of certain game commissioners of the State of Washington to rear the fish at their hatcheries. The bureau has also made plants of fish in waters under the control of the Reclamation Service and the Irrigation Service. An interesting

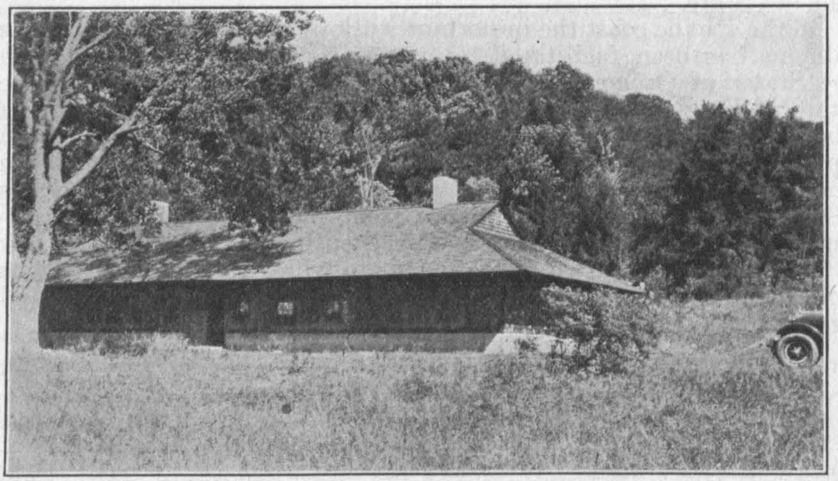

FIGURE 1.—Cooperative fish hatchery at Barneveld, N. Y.

feature has been the supplying to the Chemical Warfare Service of thousands of tadpoles for experimental work.

Cooperation with private individuals and organizations has largely consisted in work with rearing pools and nursery ponds. There appears below a tabulation of this activity showing the number of nurseries in operation, their geographical distribution, and the number of fish assigned. In addition to the two complete hatchery units conducted by a detached employee of the bureau, which were in operation last year, a new establishment of a similar nature was opened near Windber, Pa. The work has been extended to several other States, including Virginia, Massachusetts, and New Jersey. There has been an increase from 55 to 86 in the number of nurseries established by the bureau during the past year. A number of sites that proved to lack proper conditions were inspected, and some sites that were approved have not yet been developed. Advice and suggestions relative to all phases of the nursery pond have been given freely, and in some cases, based upon this information, nurseries have been constructed and operated in conjunction with certain of the

States. The total allotments of fish amounted to 2,675,000, an increase of about 175,000 over last year's assignments.

*Cooperative nurseries and rearing ponds established by the bureau in 1928*

| Locality | Number of fish supplied | Kind |
|---|---|---|
| Colorado: Salida | 25,000 | Brook trout. |
| Massachusetts: Westfield | 8,000 | Do. |
| Michigan: | | |
| Turtle Lake | 300,000 | Do. |
| Tustin | 20,000 | Do. |
| Gaylord | 48,000 | Do. |
| Metamora | 15,000 | Do. |
| Ishpeming | 25,000 | Do. |
| Alpena | 21,000 | Do. |
| Do | 4,000 | Rainbow trout. |
| Rogers City | 300,000 | Lake trout. |
| Minnesota: | | |
| Eyota | 8,100 | Brook trout. |
| La Crescent | 400 | Do. |
| Lake City | 20,100 | Do. |
| Lewiston | 15,000 | Rainbow trout. |
| Red Wing | 3,000 | Do. |
| Do | 3,000 | Loch Leven trout. |
| Do | 10,200 | Brook trout. |
| Rochester | 60,000 | Loch Leven trout. |
| Rushford | 12,000 | Rainbow trout. |
| St. Charles | 19,200 | Do. |
| Do | 6,000 | Loch Leven trout. |
| Winona | 45,000 | Rainbow trout. |
| Do | 43,000 | Brook trout. |
| New Jersey: Paterson | 10,000 | Do. |
| New York: | | |
| Barneveld | 50,000 | Brook-trout eggs. |
| Do | 238,650 | Rainbow trout. |
| Do | 30,000 | Lake trout. |
| Watertown | 116,000 | Brook trout. |
| Malone | 40,000 | Do. |
| Oneonta | 39,000 | Do. |
| Arena | 21,000 | Do. |
| Pennsylvania: | | |
| Camp Hill | 60,000 | Do. |
| Windber | 100,000 | Do. |
| Chester | 10,000 | Loch Leven trout. |
| Renovo | 30,000 | Brook trout. |
| Williamsport | 35,000 | Do. |
| Myersdale | 25,000 | Do. |
| Connellsville | 30,000 | Do. |
| Ligonier | 10,000 | Do. |
| Do | 10,000 | Rainbow trout. |
| Do | 7,200 | Do. |
| Ridgeway | 10,000 | Brook trout. |
| Muncy | 40,000 | Do. |
| Belleville | 20,000 | Do. |
| Altoona | 15,000 | Do. |
| Do | 5,000 | Rainbow trout. |
| Do | 15,000 | Loch Leven trout. |
| Uniontown | 10,000 | Do. |
| Do | 10,000 | Rainbow trout. |
| Do | 10,000 | Do. |
| Scranton | 40,000 | Loch Leven trout. |
| Somerset | 25,000 | Brook trout. |
| Do | 10,000 | Rainbow trout. |
| Williamsport | 10,000 | Brook trout. |
| Johnstown | 10,000 | Do. |
| Do | 10,000 | Rainbow trout. |
| Trout Run | 50,000 | Brook trout. |
| Pittston | 10,000 | Do. |
| Williamsport | 20,000 | Do. |
| Clearfield | 25,000 | Do. |
| Do | 8,000 | Do. |
| Hazleton | 20,000 | Do. |
| Boswell | 4,000 | Do. |
| Sharon | 4,000 | Do. |
| Conneaut Lake | 3,000 | Smallmouth black bass. |
| Vermont: | | |
| Averill | 24,500 | Brook trout. |
| Do | 30,000 | Landlocked salmon. |

*Cooperative nurseries and rearing ponds established by the bureau in 1928*—Con.

| Locality | Number of fish supplied | Kind |
|---|---|---|
| Virginia: | | |
| Independence | 2,000 | Brook trout. |
| Galax | 2,000 | Do. |
| Lynchburg | 3,000 | Do. |
| Shawsville | 5,000 | Rainbow trout. |
| West Virginia: | | |
| Durbin | 25,000 | Brook trout. |
| Do | 5,000 | Rainbow trout. |
| Tunnelton | 15,000 | Brook trout. |
| Wisconsin: | | |
| Arcadia | 9,100 | Do. |
| Athelstane | 4,500 | Do. |
| Boscobel | 15,000 | Do. |
| Eau Claire (2 ponds) | 20,000 | Rainbow trout. |
| Do | 5,000 | Brook trout. |
| Ellsworth | 19,900 | Rainbow trout. |
| Do | 10,100 | Brook trout. |
| Elmwood | 5,100 | Do. |
| Elroy | 2,000 | Do. |
| Do | 4,000 | Rainbow trout. |
| Galesville | 9,900 | Brook trout. |
| Glenwood City | 5,000 | Do. |
| Holmen (2 ponds) | 8,000 | Do. |
| Independence | 10,000 | Do. |
| La Crosse (2 ponds) | 15,000 | Do. |
| Marathon | 12,900 | Do. |
| Merrill | 22,700 | Do. |
| Osseo | 10,500 | Do. |
| Plum City | 8,100 | Do. |
| Rothschild | 9,900 | Do. |
| Schofield | 3,900 | Do. |
| Sparta | 3,000 | Rainbow trout. |
| Do | 3,000 | Brook trout. |
| Stanley | 5,000 | Do. |
| Stevens Point | 20,000 | Rainbow trout. |
| Do | 3,200 | Loch Leven trout. |
| Tomah | 20,100 | Brook trout. |
| Tomahawk | 9,900 | Do. |
| Tunnel City | 6,000 | Do. |
| Viroqua | 8,000 | Loch Leven trout. |
| Wausau | 9,900 | Brook trout. |
| Westby | 8,000 | Loch Leven trout. |
| | 2,675,050 | |

Cooperative fish-cultural projects, involving as they do the selection of sites, inspections from time to time while the fish are being fed, assistance in the distribution of fish, and general supervision, have developed beyond the ability of the present staff to care for them properly. No additional personnel has been available, and all the necessary details have been attended to by the field force and the staff of the Washington office in addition to their regular duties. Proper administration of this work would require the exclusive attention of several new employees.

While the bureau has exacted the provision, in all agreements for the establishment of nurseries, that 50 per cent of the output may be claimed by the Government for filling its applications, there has been no need to insist upon strict compliance with this ruling to date. The number of fish taken from cooperative nurseries for distribution to other than local waters has been negligible, and the sponsors of the various projects have received almost 100 per cent benefit from the output. There has been a tendency to increase the number of nursery projects in a single locality unduly, the success of a pioneer project inducing the formation of new ones in the near vicinity. This tends to defeat the purpose of the nursery plan, as it results in a very unequal distribution of fish. The present need is not for more nurseries in fields already provided for, but for nurseries in new fields. The furthering of the private rearing pools is becoming one of the important activities of the division of fish culture, and the movement is developing strongly in many of the States. The bureau can not issue general instructions for the guidance of those desiring to establish nursery pools in various parts of the country. Each proposed project must be considered on its merits and the plans adapted to local conditions rather than to an inflexible design. Personal inspection by an experienced fish-culturist should always precede actual initiation of work upon a nursery enterprise.

The experience of the past two or three years has shown that bass ponds of the proper type are exceedingly rare, and it is difficult to find suitable sites for them. There will be opportunity to construct 20 good trout pools for every satisfactory bass pond. In many sections the establishment of a first-class nursery for warm-water fish is virtually impossible except at inordinate expense. Consequently, the bureau has held that where facilities for bass rearing are suitable they should, by all means, be utilized; but that mere desire is not justification for initiation of work with this fish when natural advantages are lacking.

## OUTPUT

The aggregate output of fish and eggs is the only criterion available at the present time for judging the efficiency of the bureau's fish-cultural activities. It is therefore gratifying to report that the distribution of 7,036,317,200 eggs, fry and fingerlings for 1928 brings the production above the high record of the previous year by about 550,000,000. Segregation of the various items making up the total shows a distribution of 261,634,200 fingerlings, representing a 37 per cent increase over last year's figures, as the bureau's response to the demand for larger fish. Strictly game species comprised only 2.7 per cent of the total output, although the bureau's work is largely viewed by the general public as being limited to the propagation of the latter species. The proportions of marine commercial species, commercial species of interior waters, and commercial anadromous forms in the total were relatively about the same as in previous years, being 8.2, 8.3, and 4.1 per cent, respectively, while the percentage of the commercial salmons of the Pacific coast was increased from 1.9 to 2.9.

*Summary, by species, of the output of fish and fish eggs during the fiscal year ended June 30, 1928*

| Species | Eggs | Fry | Fingerlings | Total |
|---|---|---|---|---|
| Paddlefish |  |  | 33,000 | 33,000 |
| Catfish |  |  | 87,181,600 | 87,181,600 |
| Buffalo fish | 29,150,000 | 8,392,000 | 2,320,600 | 39,862,600 |
| Carp | 29,250,000 | 5,500,000 | 3,839,900 | 38,589,900 |
| Shad |  | 48,031,000 |  | 48,031,000 |
| Glut herring |  | 55,000,000 |  | 55,000,000 |
| Whitefish | 20,000 | 117,188,000 |  | 117,208,000 |

*Summary, by species, of the output of fish and fish eggs during the fiscal year ended June 30, 1928*—Continued

| Species | Eggs | Fry | Fingerlings | Total |
|---|---|---|---|---|
| Cisco | 8,000,000 | 89,125,000 | | 97,125,000 |
| Chinook salmon | 19,033,000 | 343,000 | 38,531,900 | 57,907,900 |
| Chum salmon | 3,000,000 | 20,669,000 | | 23,669,000 |
| Silver salmon | 1,025,000 | 10,852,000 | 2,073,500 | 13,950,500 |
| Sockeye salmon | 4,410,000 | 13,562,000 | 19,101,600 | 37,073,600 |
| Humpback salmon | | 2,387,000 | | 2,387,000 |
| Steelhead salmon | 1,360,000 | 1,183,000 | 2,188,600 | 4,731,600 |
| Atlantic salmon | 350,000 | | 1,202,400 | 1,552,400 |
| Landlocked salmon | 78,000 | | 325,500 | 403,500 |
| Rainbow trout | 6,166,000 | 710,000 | 6,906,300 | 13,782,300 |
| Black-spotted trout | 7,156,000 | 175,000 | 7,214,500 | 14,545,500 |
| Loch Leven trout | 8,290,000 | 1,726,000 | 1,845,300 | 11,861,300 |
| Lake trout | 7,364,000 | 28,496,000 | 1,824,700 | 37,684,700 |
| Brook trout | 2,196,000 | 2,880,000 | 14,413,400 | 19,489,400 |
| Grayling | | 725,000 | 100 | 725,100 |
| Pike and pickerel | 210,000 | | 2,363,900 | 2,573,900 |
| Mackerel | | 5,212,000 | | 5,212,000 |
| Crappie | | | 23,482,500 | 23,482,500 |
| Largemouth black bass | | 954,000 | 1,634,800 | 2,588,800 |
| Smallmouth black bass | | 598,000 | 120,400 | 718,400 |
| Rock bass | | | 111,400 | 111,400 |
| Warmouth bass | | | 1,000 | 1,000 |
| Sunfish | | | 32,829,300 | 32,829,300 |
| Pike perch | 56,210,000 | 201,170,000 | | 257,380,000 |
| Yellow perch | | 175,825,000 | 1,569,200 | 177,394,200 |
| Striped bass | | 7,231,000 | | 7,231,000 |
| White perch | | | 2,400 | 2,400 |
| White bass | | | 10,200 | 10,200 |
| Fresh-water drum | | | 272,500 | 272,500 |
| Cod | 1,914,734,000 | 660,251,000 | | 2,574,985,000 |
| Haddock | 143,885,000 | 118,658,000 | | 262,543,000 |
| Pollock | | 138,373,000 | | 138,373,000 |
| Winter flounder | 11,357,000 | 2,806,223,000 | | 2,817,580,000 |
| Miscellaneous fishes | | | 10,233,700 | 10,233,700 |
| Total | 2,253,244,000 | 4,521,439,000 | 261,634,200 | 7,036,317,200 |

## EGG COLLECTIONS

In spite of the greater output of fish, there was a slight decline in the egg collections for the year. The total was 7,883,670,160, a recession of 67,841,170 from the figures of last year. This shortage is more than accounted for in the smaller number of flounder eggs—one of the marine fishes of lesser importance. This decline is partly offset by a more than 100 per cent increase in shad-egg collections and by substantial gains among the commercially important lake trout and pike perch. Collections of whitefish and cisco eggs in the Great Lakes again showed a decline, however, traceable in part to unfavorable weather conditions during the spawning season. An increase of almost 10,000,000 eggs was recorded by the resumption of striped-bass hatching operations in North Carolina. The total collections of cod, haddock, and winter-flounder eggs exceeded the figures of last year. The tabulation below gives the statistical details of the egg collections. It may be added that the only eggs purchased at the present time are those of the brook trout, and the number is negligible. Plans are being made for developments that will make it unnecessary to purchase any eggs in the near future.

*Comparison of egg collections, fiscal years 1928 and 1927*

| Species | 1928 | 1927 | Species | 1928 | 1927 |
|---|---|---|---|---|---|
| Buffalo fish | 10, 200, 000 | 3, 000, 000 | Black-spotted trout | 23, 115, 000 | 4, 176, 000 |
| Carp | 7, 500, 000 | 24, 750, 000 | Loch Leven trout | 15, 767, 800 | 15, 426, 000 |
| Shad | 51, 473, 000 | 23, 104, 000 | Lake trout | 85, 911, 340 | 73, 241, 290 |
| Glut herring | 223, 444, 000 | 5, 160, 000 | Brook trout | 18, 509, 290 | 20, 762, 290 |
| Whitefish | 198, 709, 500 | 219, 023, 000 | Smelt | | 9, 250, 000 |
| Cisco | 172, 822, 500 | 243, 870, 000 | Mackerel | 6, 237, 000 | |
| Chub | | 400, 000 | Pike perch | 729, 610, 000 | 570, 980, 000 |
| Chinook salmon | 58, 792, 800 | 60, 649, 600 | Yellow perch | 184, 890, 000 | 221, 595, 000 |
| Chum salmon | 25, 247, 000 | 24, 557, 000 | Striped bass | 9, 415, 000 | |
| Humpback salmon | 2, 625, 000 | 4, 212, 000 | Cod | 2, 373, 459, 000 | 1, 427, 912, 000 |
| Silver salmon | 15, 452, 000 | 6, 334, 000 | Haddock | 331, 417, 000 | 423, 637, 000 |
| Sockeye salmon | 44, 495, 000 | 64, 606, 800 | Pollock | 213, 867, 000 | 1, 048, 534, 000 |
| Steelhead salmon | 4, 729, 500 | 3, 859, 000 | Winter flounder | 3, 054, 153, 000 | 3, 434, 777, 000 |
| Landlocked salmon | 767, 950 | 773, 700 | | | |
| Rainbow trout | 21, 060, 480 | 16, 921, 650 | Total | 7, 883, 670, 160 | 7, 951, 511, 330 |

As an explanation of the sources from which the bulk of the eggs are derived, there is given below a list of the temporary collecting plants operated by the various stations. These are utilized merely for the collection and fertilization of eggs for immediate transfer to the hatcheries and are distinct from the auxiliary field stations, which may incubate as well as take the eggs. Upon the more intensive development of these collecting stations, in capacity or number, is based the very marked increase in output of the past two years.

*Egg-collecting stations*

| Station | Period of operation | Species handled |
|---|---|---|
| Baker Lake, Wash.: | | |
| Brinnon, Wash | Sept. 12–Sept. 28 | Chum salmon (early run). |
| Do | Nov. 24–Jan. 10 | Chum salmon (late run). |
| Boothbay Harbor, Me.: | | |
| Boothbay Harbor, Me | Mar. 1–June 20 | Cod and winter flounder. |
| Ebenoook Harbor, Me | Mar. 1–Apr. 30 | Winter flounder. |
| Johns Bay, Me | do | Do. |
| Linekins Bay, Me | do | Do. |
| Little River, Me | do | Do. |
| Mill Cove, Me | do | Do. |
| Pig Cove, Me | do | Do. |
| Townsend Gut, Me | do | Do. |
| West Harbor, Me | do | Do. |
| Cape Vincent, N. Y.: | | |
| Amherst Island, Ontario | Oct. 25–Nov. 8 | Lake trout. |
| Bowmanville, Ontario | Nov. 4–Nov. 15 | Whitefish. |
| Brighton, Ontario | Nov. 2–Nov. 15 | Do. |
| Charity Shoals, N. Y | Oct. 24–Nov. 14 | Lake trout. |
| Chaumont Bay, N. Y | Nov. 12–Dec. 1 | Whitefish and cisco. |
| Cobourg, Ontario | Nov. 4–Nov. 15 | Whitefish. |
| Consecon, Ontario | Oct. 25–Nov. 24 | Lake trout and cisco. |
| Fair Haven, N. Y | Nov. 22–Dec. 2 | Cisco. |
| Gardenville, N. Y | Nov. 15–Nov. 23 | Do. |
| Indian Point, Ontario | Oct. 25–Nov. 18 | Lake trout and whitefish. |
| Pigeon Island, Ontario | Oct. 24–Nov. 10 | Lake trout. |
| Port Hope, Ontario | Nov. 10–Nov. 18 | Whitefish. |
| Simcoe Island, Ontario | Oct. 25–Nov. 16 | Lake trout and whitefish. |
| Sodus Point, N. Y | Nov. 20–Nov. 27 | Cisco. |
| Stoney Island, N. Y | Oct. 24–Nov. 4 | Lake trout. |
| Clackamas, Oreg.: | | |
| Lemhi River, Idaho | Aug. 14–Sept. 14 | Chinook salmon. |
| Williams Lake, Idaho | Apr. 23–May 19 | Rainbow trout. |
| Craig Brook, Me.: | | |
| Craig Pond, Me | Oct. 20–Nov. 25 | Brook trout. |
| Toddy Pond, Me | Oct. 20–Oct. 31 | Landlocked salmon. |
| Duluth, Minn.: | | |
| Au Train, Mich | Oct. 17–Nov. 3 | Lake trout. |
| Baraga, Mich | do | Do. |
| Calumet Water Works, Mich | Oct. 17–Oct. 26 | Do. |
| Copper Harbor, Mich | Oct. 1–Oct. 12 | Do. |
| Grand Marais, Mich | Oct. 17–Nov. 6 | Do. |

*Egg-collecting stations—Continued*

| Station | Period of operation | Species handled |
|---|---|---|
| Duluth, Minn.—Continued. | | |
| Huron Island, Mich | Oct. 16-Nov. 2 | Lake trout. |
| Isle Royale ports, Mich | Oct. 1-Nov. 13 | Lake trout and whitefish. |
| Keystone, Mich | Oct. 17-Oct. 27 | Lake trout. |
| Little Girls Point, Mich | Oct. 15-Oct. 31 | Do. |
| Manitou Island, Mich | Oct. 15-Oct. 23 | Do. |
| Marquette, Mich | Oct. 17-Nov. 5 | Do. |
| Munising, Mich | Oct. 17-Nov. 1 | Do. |
| Portage Entry, Mich | Oct. 18-Nov. 3 | Do. |
| Portage Lake Canal, Mich | Oct. 12-Nov. 1 | Do. |
| Gloucester, Mass.: | | |
| Boars Head, N. H | Mar. 1-May 15 | Cod. |
| Marblehead, Mass | Feb. 1-Mar. 15 | Do. |
| Plymouth, Mass | Nov. 1-May 15 | Cod and pollock. |
| Rockport, Mass | do | Cod, pollock, and haddock. |
| Leadville, Colo.: | | |
| Bolts Lake, Colo | Apr. 30-May 17 | Rainbow trout. |
| Engelbrecht Lakes, Colo | Sept. 19-Nov. 25 | Brook trout. |
| Hermosa Lake, Colo | Nov. 18-Dec. 15 | Do. |
| Hosselkus Lakes, Colo | Apr. 30-July 1 | Rainbow trout. |
| Mount Massive Club Lakes, Colo | Oct. 19-Dec. 12 | Brook trout. |
| Turquoise Lake, Colo | Oct. 18-Dec. 3 | Brook and Loch Leven trout. |
| Wurts Lakes, Colo | Oct. 4-Dec. 3 | Brook trout. |
| Nashua, N. H.: Lebanon, N. H | Apr. 29-May15 | Rainbow trout. |
| Northville, Mich.: | | |
| Alcona, Mich | Oct. 29 | Lake trout. |
| Alpena, Mich | Oct. 21-Dec. 3 | Lake trout and whitefish. |
| Bay City, Mich | Nov. 21 | Whitefish. |
| Do | Apr. 8-Apr. 30 | Pike perch. |
| Black River, Mich | Oct. 29-Nov. 1 | Lake trout. |
| Cheboygan, Mich | Oct. 14-Oct. 29 | Do. |
| Epoufette, Mich | Nov. 17-Nov. 25 | Whitefish. |
| Greenbush, Mich | Nov. 13-Nov. 16 | Do. |
| Hammonds Bay, Mich | Nov. 13 | Do. |
| Harbor Beach, Mich | Oct. 26-Nov. 14 | Lake trout. |
| Middle Island, Mich | Oct. 13-Nov. 5 | Do. |
| Oscoda, Mich | Oct. 28-Nov. 1 | Do. |
| Presque Island, Mich | Oct. 25-Oct. 27 | Do. |
| Rockport, Mich | Oct. 23-Nov. 26 | Lake trout and whitefish. |
| Rogers City, Mich | Oct. 29 | Lake trout. |
| St. Ignace, Mich | Oct. 26-Oct. 29 | Do. |
| Put in Bay, Ohio: | | |
| Catawba Island, Ohio | Nov. 9-Nov. 30 | Whitefish. |
| Middle Bass, Ohio | Nov. 9-Nov. 27 | Do. |
| North Bass, Ohio | do | Do. |
| Port Clinton, Ohio | Nov. 9-Dec. 2 | Do. |
| Do | Apr. 6-May 8 | Pike perch and yellow perch. |
| Do | June 7-June 25 | Carp. |
| Toledo, Ohio | Nov. 10-Nov. 25 | Whitefish. |
| Do | Apr. 7-May 7 | Pike perch. |
| St. Johnsbury, Vt.: Lake Dunmore, Vt | Nov. 2-Nov. 12 | Lake trout. |
| Saratoga, Wyo.: | | |
| Big Creek Lakes, Colo | Sept. 12-Nov. 10 | Brook trout. |
| Lost, Sage, and Canon Creeks, Wyo | Mar. 22-July 2 | Rainbow trout. |
| Springville, Utah: | | |
| Fish Lake, Utah | Nov. 3-Dec. 6 | Brook trout. |
| Do | Apr. 9-May 30 | Rainbow trout. |
| Woods Hole, Mass.: | | |
| Newport, R. I | November | Cod. |
| Waquoit, Mass | January to April | Winter flounder. |

## FISH-RESCUE WORK

The total of 145,176,900 fish handled in the rescue work of the 1928 season represents a noticeable increase over last year and a return to the conditions that prevailed in earlier years. The greater magnitude of the 1928 operations is due to the fact that water conditions on the upper Mississippi were such as to permit and necessitate widespread seining and to the fact that the disastrous floods on the lower Mississippi required much work in a field that ordinarily needs little attention. In the States of Arkansas, Mississippi, and Louisiana (covered by the bureau's Mammoth Spring (Ark.) and Tupelo (Miss.) stations) 25,981,900 fish were handled. Almost all were returned to parental waters. The usual negligible proportion (less than 1 per cent) of the fish rescued in the upper Mississippi territory was distributed by car or messenger to other sections. The continual requests for carload shipments of rescued fish are a source of embarrassment in view of the fact that the present negligible diversion of fish from the Mississippi occasion considerable criticism from the States whose waters are being seined. Mindful of the fact that such diversions can not be continued indefinitely, the bureau is taking steps to propagate warm-water fishes on land under Federal jurisdiction in the Upper Mississippi Wild Life Refuge. Several sites were selected during the past year, and these will be put on a productive basis as fast as circumstances permit. A summary of the rescue work appears below.

*Number and disposition of fish rescued, fiscal year 1928*

| Locality and species | Delivered to applicants | Restored to original waters | Total number of fish rescued |
|---|---|---|---|
| Homer, Minn.: | | | |
| Black bass | 8,120 | 60,500 | 68,620 |
| Buffalo fish | | 2,045 | 2,045 |
| Carp | | 220,320 | 220,320 |
| Catfish | 13,600 | 5,219,500 | 5,233,100 |
| Crappie | 54,385 | 7,810,140 | 7,864,525 |
| Fresh-water drum | | 10,495 | 10,495 |
| Pike and pickerel | | 1,713,823 | 1,713,823 |
| Sunfish | 36,400 | 8,788,800 | 8,825,200 |
| White bass | | 1,470 | 1,470 |
| Yellow perch | 6,370 | 1,453,675 | 1,460,045 |
| Miscellaneous | | 2,478,968 | 2,478,968 |
| Total | 118,875 | 27,759,736 | 27,878,611 |
| La Crosse, Wis.: | | | |
| Black bass | 17,096 | 11,170 | 28,266 |
| Buffalo fish | | 316,000 | 316,000 |
| Carp | | 383,000 | 383,000 |
| Catfish | 8,700 | 5,901,300 | 5,910,000 |
| Crappie | 10,250 | 1,127,050 | 1,137,300 |
| Fresh-water drum | | 1,000 | 1,000 |
| Pike and pickerel | | 270,100 | 270,100 |
| Sunfish | 16,170 | 1,968,210 | 1,984,380 |
| White bass | | 1,300 | 1,300 |
| Yellow perch | 3,750 | 41,145 | 44,895 |
| Miscellaneous | | 1,413,800 | 1,413,800 |
| Total | 55,966 | 11,434,075 | 11,490,041 |
| Lynxville, Wis.: | | | |
| Black bass | 27,314 | 9,465 | 36,779 |
| Buffalo fish | | 19,000 | 19,000 |
| Carp | | 101,000 | 101,000 |
| Catfish | 38,731 | 19,025,300 | 19,064,031 |
| Crappie | 4,942 | 3,008,312 | 3,013,254 |
| Pike and pickerel | | 216,800 | 216,800 |
| Sunfish | 41,435 | 2,226,005 | 2,267,440 |
| Yellow perch | 3,210 | 19,740 | 22,950 |
| Miscellaneous | | 2,283,500 | 2,283,500 |
| Total | 115,632 | 26,909,122 | 27,024,754 |
| Marquette, Iowa: | | | |
| Black bass | 55,805 | 23,950 | 79,755 |
| Buffalo fish | | 207,005 | 207,005 |
| Carp | | 684,950 | 684,950 |
| Catfish | 33,825 | 35,119,175 | 35,153,000 |
| Crappie | 5,900 | 6,439,370 | 6,445,270 |
| Fresh-water drum | | 400 | 400 |
| Pike and pickerel | | 153,527 | 153,527 |
| Rock bass | 120 | | 120 |
| Sunfish | 18,540 | 7,350,730 | 7,369,270 |
| White bass | | 4,092 | 4,092 |
| Yellow perch | 3,250 | 36,625 | 39,875 |
| Miscellaneous | | 90,000 | 90,000 |
| Total | 117,440 | 50,109,824 | 50,227,264 |

*Number and disposition of fish rescued, fiscal year 1928*—Continued

| Locality and species | Delivered to applicants | Restored to original waters | Total number of fish rescued |
|---|---|---|---|
| Bellevue, Iowa: | | | |
| Black bass | 17,115 | 7,675 | 24,790 |
| Buffalo fish | | 585,900 | 585,900 |
| Carp | | 646,400 | 646,400 |
| Catfish | 38,850 | 7,111,150 | 7,150,000 |
| Crappie | 17,115 | 416,955 | 434,070 |
| Fresh-water drum | | 211 | 211 |
| Pike and pickerel | | 6,712 | 6,712 |
| Sunfish | 44,755 | 277,620 | 322,375 |
| White bass | | 832 | 832 |
| Yellow perch | 590 | 250 | 840 |
| Miscellaneous | | 671,510 | 671,510 |
| Total | 118,425 | 9,725,215 | 9,843,640 |
| Rock Island, Ill.: | | | |
| Black bass | | 3,625 | 3,625 |
| Buffalo fish | | 45,945 | 45,945 |
| Carp | | 133,650 | 133,650 |
| Catfish | | 5,010,300 | 5,010,300 |
| Crappie | | 3,010,900 | 3,010,900 |
| Pike and pickerel | | 1,240 | 1,240 |
| Sunfish | | 2,839,075 | 2,839,075 |
| Miscellaneous | | 3,289,500 | 3,289,500 |
| Total | | 14,334,235 | 14,334,235 |
| Simmesport, La.: | | | |
| Black bass | 440 | 463 | 903 |
| Buffalo fish | | 682,500 | 682,500 |
| Carp | 115 | 928,185 | 928,300 |
| Catfish | | 1,426,000 | 1,426,000 |
| Crappie | 430 | 538,070 | 538,500 |
| Fresh-water drum | | 260,400 | 260,400 |
| Paddlefish | | 32,975 | 32,975 |
| Sunfish | 9,625 | 492,325 | 501,950 |
| White bass | | 430 | 430 |
| Miscellaneous | | 6,400 | 6,400 |
| Total | 10,610 | 4,367,748 | 4,378,358 |
| Friars Point, Miss.: | | | |
| Black bass | 21,630 | 467,800 | 489,430 |
| Buffalo fish | | 462,125 | 462,125 |
| Carp | | 742,200 | 742,200 |
| Catfish | 100 | 2,212,455 | 2,212,555 |
| Crappie | 9,260 | 987,925 | 997,185 |
| Pike and pickerel | | 1,700 | 1,700 |
| Sunfish | 57,540 | 8,012,550 | 8,070,090 |
| White bass | | 2,075 | 2,075 |
| Total | 88,530 | 12,888,830 | 12,977,360 |
| All stations: | | | |
| Buffalo fish | | 2,320,520 | 2,320,520 |
| Carp | 115 | 3,839,705 | 3,839,820 |
| Catfish | 113,806 | 81,025,180 | 81,158,986 |
| Crappie | 102,282 | 23,338,722 | 23,440,104 |
| Fresh-water drum | | 272,506 | 272,506 |
| Largemouth black bass | 147,520 | 584,648 | 732,168 |
| Paddlefish | | 32,975 | 32,975 |
| Pike and pickerel | | 2,363,902 | 2,363,902 |
| Rock bass | 120 | | 120 |
| Sunfish | 224,465 | 31,955,315 | 32,179,780 |
| White bass | | 10,199 | 10,199 |
| Yellow perch | 17,170 | 1,551,435 | 1,568,605 |
| Miscellaneous | | 10,233,678 | 10,233,678 |
| Total | 625,478 | 157,528,785 | 158,154,263 |
| Summary, by stations: | | | |
| Homer, Minn | 118,875 | 27,759,736 | 27,878,611 |
| La Crosse, Wis | 55,966 | 11,434,075 | 11,490,041 |
| Lynxville, Wis | 115,632 | 26,909,122 | 27,024,754 |
| Marquette, Iowa | 117,440 | 50,109,824 | 50,227,264 |
| Bellevue, Iowa | 118,425 | 9,725,215 | 9,843,640 |
| Rock Island, Ill | | 14,334,235 | 14,334,235 |
| Simmesport, La | 10,610 | 4,367,748 | 4,378,358 |
| Friars Point, Miss | 88,530 | 12,888,830 | 12,977,360 |
| Total | 625,478 | 157,528,785 | 158,154,263 |

## SHIPMENTS TO FOREIGN COUNTRIES

The bureau frequently receives requests from foreign governments for fish or eggs for acclimatization in their waters. Whenever it seems possible that our fishes may become established and eggs or fish are available the bureau endeavors to send an assignment sufficiently large to become the nucleus of a breeding stock. The top minnow, Gambusia, has been in great demand for mosquito-control work in foreign countries. Shipments of this fish to Italy and Bermuda were reported to have arrived in good condition. Following is a list of shipments made during the past year in response to formal diplomatic requests.

*Shipments of fish and fish eggs to foreign countries, fiscal year 1928*

| Country and species | Number of eggs | Number of fish |
|---|---|---|
| Costa Rica: Rainbow trout | 25,000 | |
| Cuba: Largemouth black bass | | 500 |
| Ecuador: Steelhead salmon | 50,000 | |
| Germany: Rainbow trout | 50,000 | |
| Peru: Rainbow trout | 50,000 | |
| Switzerland: Rainbow trout | 50,000 | |
| Total | 225,000 | 500 |

## PRODUCTION AT STATIONS AND SUBSTATIONS

The output of fish and eggs cited above was derived from 38 main stations and 35 substations or auxiliaries. Many of the latter are operated during part of the year only with a force detailed from one of the main stations. A few of the substations, however, constitute plants almost as large as the headquarters station and are listed as auxiliaries for administrative reasons only. The roster of the bureau's stations shows that the location of the Federal hatcheries is such that many sections can not be served except at heavy expense for the transportation of fish. The nature and extent of operations at these agencies is indicated in the following table:

*Stations and substations operated and output of each, fiscal year 1928*

[Asterisk (*) denotes transfer of eggs. See table, p. 358]

| Stations, substations, and species | Eggs | Fry | Fingerlings, yearlings, and adults | Total |
|---|---|---|---|---|
| Afognak, Alaska: Sockeye salmon | | 225,000 | 3,450,000 | 3,675,000 |
| Baird, Calif.: Chinook salmon | | | 1,642,000 | 1,642,000 |
| Battle Creek, Calif.: Chinook salmon | (*) | | 1,811,200 | 1,811,200 |
| Mill Creek, Calif.: Chinook salmon | * 954,000 | | 2,152,500 | 3,106,500 |
| Baker Lake, Wash.: | | | | |
| Silver salmon | | 3,225,000 | | 3,225,000 |
| Sockeye salmon | (*) | 1,291,000 | 1,594,000 | 2,885,000 |
| Birdsview, Wash.— | | | | |
| Carp | | | 10 | 10 |
| Chinook salmon | | | 1,120,650 | 1,120,650 |
| Humpback salmon | | 1,085,000 | | 1,085,000 |
| Silver salmon | 100,000 | 885,000 | 573,400 | 1,558,400 |
| Sockeye salmon | | | 158,000 | 158,000 |
| Steelhead salmon | * 290,000 | 613,000 | 972,000 | 1,875,000 |

*Stations and substations operated and output of each, fiscal year 1928*—Contd.

[Asterisk (*) denotes transfer of eggs. See table, p. 358]

| Stations, substations, and species | Eggs | Fry | Fingerlings, yearlings, and adults | Total |
|---|---|---|---|---|
| Baker Lake, Wash.—Continued. | | | | |
| Duckabush, Wash.— | | | | |
| Chinook salmon | | | 537,800 | 537,800 |
| Chum salmon | 1,500,000 | 13,140,000 | | 14,640,000 |
| Humpback salmon | | 1,160,000 | | 1,160,000 |
| Silver salmon | | 274,800 | 79,700 | 354,500 |
| Quilcene, Wash.— | | | | |
| Chinook salmon | | 50,000 | 484,500 | 534,500 |
| Chum salmon | 1,500,000 | 7,529,000 | | 9,029,000 |
| Humpback salmon | | 81,000 | | 81,000 |
| Silver salmon | | 2,336,000 | | 2,336,000 |
| Steelhead salmon | | | 190,500 | 190,500 |
| Sultan, Wash.— | | | | |
| Chinook salmon | | 292,500 | 40,700 | 333,200 |
| Humpback salmon | | 61,000 | | 61,000 |
| Silver salmon | | 3,432,400 | 50,900 | 3,483,300 |
| Steelhead salmon | | 474,500 | 59,500 | 534,000 |
| Berkshire trout hatchery, Mass.: | | | | |
| Brook trout | | | 313,620 | 313,620 |
| Lake trout | | | 8,200 | 8,200 |
| Rainbow trout | | | 17,830 | 17,830 |
| Boothbay Harbor, Me.: | | | | |
| Cod | 1,689,330,000 | | | 1,689,330,000 |
| Winter flounder | | 2,022,829,000 | | 2,022,829,000 |
| Bozeman, Mont.: | | | | |
| Black-spotted trout | | | 1,217,610 | 1,217,610 |
| Brook trout | | | 652,150 | 652,150 |
| Grayling | | | 40 | 40 |
| Loch Leven trout | *2,840,000 | | 11,010 | 2,851,010 |
| Rainbow trout | | | 725,400 | 725,400 |
| Glacier Park, Mont.— | | | | |
| Black-spotted trout | | | 944,000 | 944,000 |
| Grayling | | 725,000 | | 725,000 |
| Rainbow trout | | | 476,000 | 476,000 |
| Meadow Creek, Mont.— | | | | |
| Black-spotted trout | 160,000 | 175,000 | 840,000 | 1,175,000 |
| Loch Leven trout | *5,450,000 | 1,726,300 | 804,000 | 7,980,300 |
| Rainbow trout | *526,000 | | 698,000 | 1,224,000 |
| Cape Vincent, N. Y.: | | | | |
| Brook trout | | 217,500 | 368,430 | 585,930 |
| Cisco | *8,000,000 | 86,950,000 | | 94,950,000 |
| Lake trout | 500,000 | 3,064,000 | 49,600 | 3,613,600 |
| Loch Leven trout | | | 12,950 | 12,950 |
| Rainbow trout | | | 43,700 | 43,700 |
| Whitefish | | 16,040,000 | | 16,040,000 |
| Yellow perch | | 2,000,000 | | 2,000,000 |
| Swanton, Vt.— | | | | |
| Pike perch | 56,210,000 | 40,500,000 | | 96,710,000 |
| Yellow perch | | 21,100,000 | | 21,100,000 |
| Central Station, Washington, D. C.: | | | | |
| Largemouth black bass | | | 60 | 60 |
| Brook trout | | | 102,000 | 102,000 |
| Catfish | | | 200 | 200 |
| Chinook salmon | | | 7,000 | 7,000 |
| Cisco | | 1,300,000 | | 1,300,000 |
| Crappie | | | 250 | 250 |
| Rainbow trout | | | 56,500 | 56,500 |
| Rock bass | | | 30 | 30 |
| Smallmouth black bass | | 25,000 | 20 | 25,020 |
| Sunfish | | | 150 | 150 |
| Bryans Point, Md.— | | | | |
| Shad | | 40,981,500 | | 40,981,500 |
| Yellow perch | | 138,320,000 | | 138,320,000 |
| Lakeland, Md.— | | | | |
| Largemouth black bass | | | 30,360 | 30,360 |
| Crappie | | | 17,730 | 17,730 |
| Sunfish | | | 19,620 | 19,620 |
| Clackamas, Oreg.: | | | | |
| Brook trout | *464,000 | | 267,000 | 731,000 |
| Chinook salmon | | | 2,610,000 | 2,610,000 |
| Rainbow trout | | | 100,000 | 100,000 |
| Steelhead salmon | | | 46,000 | 46,000 |
| Applegate, Oreg.— | | | | |
| Silver salmon | 925,000 | | 1,369,500 | 2,294,500 |
| Steelhead salmon | *1,070,000 | | 797,700 | 1,867,700 |
| Big White Salmon, Wash.— | | | | |
| Brook trout | | | 175,000 | 175,000 |
| Chinook salmon | *8,523,000 | | 7,959,000 | 16,482,000 |
| Rainbow trout | | | 72,000 | 72,000 |
| Steelhead salmon | | 95,000 | | 95,000 |

*Stations and substations operated and output of each, fiscal year 1928*—Contd.

[Asterisk (*) denotes transfer of eggs. See table, p. 358]

| Stations, substations, and species | Eggs | Fry | Fingerlings, yearlings, and adults | Total |
|---|---|---|---|---|
| Clackamas, Oreg.—Continued. | | | | |
| Little White Salmon, Wash.— | | | | |
| Brook trout | | | 181,000 | 181,000 |
| Chinook salmon | *9,541,000 | | 11,093,000 | 20,634,000 |
| Sockeye salmon | | | 26,500 | 26,500 |
| Steelhead salmon | | | 86,000 | 86,000 |
| Rogue River, Oreg.— | | | | |
| Chinook salmon | | | 1,499,000 | 1,499,000 |
| Sockeye salmon | | | 71,000 | 71,000 |
| Salmon, Idaho: Chinook salmon | | | 5,043,000 | 5,043,000 |
| Snake River, Idaho: Chinook salmon | | | 2,306,500 | 2,306,500 |
| Cold Springs, Ga.: | | | | |
| Largemouth black bass | | 163,000 | 131,950 | 294,950 |
| Catfish | | | 7,040 | 7,040 |
| Sunfish | | | 102,920 | 102,920 |
| Craig Brook, Me.: | | | | |
| Atlantic salmon | 350,000 | | 1,202,400 | 1,552,400 |
| Brook trout | (*) | 60,000 | 1,439,030 | 1,499,030 |
| Landlocked salmon | *50,000 | | 68,930 | 118,930 |
| Smallmouth black bass | | | 160 | 160 |
| White perch | | | 2,400 | 2,400 |
| Grand Lake Stream, Me.— | | | | |
| Brook trout | | 218,500 | 44,270 | 262,770 |
| Landlocked salmon | (*) | | 242,200 | 242,200 |
| Green Lake, Me.— | | | | |
| Landlocked salmon | 28,000 | | | 28,000 |
| Smallmouth black bass | | | 160 | 160 |
| Duluth, Minn.: | | | | |
| Brook trout | | | 208,000 | 208,000 |
| Cisco | | 875,000 | | 875,000 |
| Lake trout | *3,785,700 | 12,855,000 | 1,515,000 | 18,155,700 |
| Pike perch | | 10,670,000 | | 10,670,000 |
| Rainbow trout | | | 15,750 | 15,750 |
| Whitefish | | 548,000 | | 548,000 |
| Edenton, N. C.: | | | | |
| Largemouth black bass | | 12,000 | 35,140 | 47,140 |
| Crappie | | | 600 | 600 |
| Glut herring | | 55,000,000 | | 55,000,000 |
| Shad | | 7,050,000 | | 7,050,000 |
| Sunfish | | | 6,400 | 6,400 |
| Yellow perch | | 10,760,000 | 1,280 | 10,761,280 |
| Weldon, N. C.: Striped bass | | 7,230,800 | | 7,230,800 |
| Erwin, Tenn.: | | | | |
| Largemouth black bass | | 20,000 | 21,880 | 41,880 |
| Brook trout | | | 303,050 | 303,050 |
| Rainbow trout | | | 480,800 | 480,800 |
| Rock bass | | | 27,450 | 27,450 |
| Steelhead salmon | | | 27,740 | 27,740 |
| Sunfish | | | 14,190 | 14,190 |
| Fairport, Iowa: | | | | |
| Largemouth black bass | | 1,620 | 24,370 | 25,990 |
| Crappie | | | 5,090 | 5,090 |
| Smallmouth black bass | | | 1,780 | 1,780 |
| Sunfish | | | 51,500 | 51,500 |
| Gloucester, Mass.: | | | | |
| Cod | 221,753,000 | 481,252,000 | | 703,005,000 |
| Haddock | 143,885,000 | 118,658,000 | | 262,543,000 |
| Pollock | | 138,373,000 | | 138,373,000 |
| Winter flounder | | 199,287,000 | | 199,287,000 |
| Homer, Minn.: | | | | |
| Largemouth black bass | | | 68,620 | 68,620 |
| Buffalo fish | | | 2,040 | 2,040 |
| Carp | | | 220,320 | 220,320 |
| Catfish | | | 5,233,100 | 5,233,100 |
| Crappie | | | 7,864,530 | 7,864,530 |
| Fresh-water drum | | | 10,490 | 10,490 |
| Pike and pickerel | | | 1,713,820 | 1,713,820 |
| Sunfish | | | 8,825,200 | 8,825,200 |
| White bass | | | 1,470 | 1,470 |
| Yellow perch | | | 1,460,050 | 1,460,050 |
| Miscellaneous | | | 2,478,970 | 2,478,970 |
| La Crosse, Wis.: | | | | |
| Largemouth black bass | | | 28,270 | 28,270 |
| Brook trout | | | 755,020 | 755,020 |
| Buffalo fish | 15,300,000 | 8,392,000 | 316,000 | 24,008,000 |
| Carp | 16,750,000 | | 383,000 | 17,133,000 |
| Catfish | | | 5,910,000 | 5,910,000 |
| Crappie | | | 1,137,300 | 1,137,300 |
| Fresh-water drum | | | 1,000 | 1,000 |
| Loch Leven trout | | | 135,850 | 135,850 |

*Stations and substations operated and output of each, fiscal year 1928*—Contd.

[Asterisk (*) denotes transfer of eggs. See table, p. 358]

| Stations, substations, and species | Eggs | Fry | Fingerlings, yearlings, and adults | Total |
|---|---|---|---|---|
| La Crosse, Wis.—Continued. | | | | |
| Pike and pickerel | 210,000 | | 270,100 | 480,100 |
| Rainbow trout | | | 263,700 | 263,700 |
| Sunfish | | | 1,984,380 | 1,984,380 |
| White bass | | | 1,300 | 1,300 |
| Yellow perch | | | 44,900 | 44,900 |
| Miscellaneous | | | 1,413,800 | 1,413,800 |
| Bellevue, Iowa— | | | | |
| Largemouth black bass | | | 24,790 | 24,790 |
| Buffalo fish | 13,850,000 | | 585,900 | 14,435,900 |
| Carp | 12,500,000 | | 646,400 | 13,146,400 |
| Catfish | | | 7,150,000 | 7,150,000 |
| Crappie | | | 434,070 | 434,070 |
| Fresh-water drum | | | 210 | 210 |
| Pike and pickerel | | | 6,710 | 6,710 |
| Sunfish | | | 322,380 | 322,380 |
| White bass | | | 830 | 830 |
| Yellow perch | | | 840 | 840 |
| Miscellaneous | | | 671,510 | 671,510 |
| Lynxville, Wis.— | | | | |
| Largemouth black bass | | | 37,240 | 37,240 |
| Buffalo fish | | | 19,000 | 19,000 |
| Carp | | | 101,000 | 101,000 |
| Catfish | | | 25,064,030 | 25,064,030 |
| Crappie | | | 3,013,250 | 3,013,250 |
| Pike and pickerel | | | 216,800 | 216,800 |
| Sunfish | | | 2,267,440 | 2,267,440 |
| Yellow perch | | | 22,950 | 22,950 |
| Miscellaneous | | | 2,283,500 | 2,283,500 |
| Marquette, Iowa— | | | | |
| Largemouth black bass | | | 79,760 | 79,760 |
| Buffalo fish | | | 207,000 | 207,000 |
| Carp | | | 684,950 | 684,950 |
| Catfish | | | 35,153,000 | 35,153,000 |
| Crappie | | | 6,445,270 | 6,445,270 |
| Fresh-water drum | | | 400 | 400 |
| Pike and pickerel | | | 153,530 | 153,530 |
| Rock bass | | | 120 | 120 |
| Sunfish | | | 7,369,270 | 7,369,270 |
| White bass | | | 4,090 | 4,090 |
| Yellow perch | | | 39,870 | 39,870 |
| Miscellaneous | | | 90,000 | 90,000 |
| Rock Island, Ill.— | | | | |
| Largemouth black bass | | | 3,630 | 3,630 |
| Buffalo fish | | | 45,940 | 45,940 |
| Carp | | | 133,650 | 133,650 |
| Catfish | | | 5,010,300 | 5,010,300 |
| Crappie | | | 3,010,900 | 3,010,900 |
| Pike and pickerel | | | 1,240 | 1,240 |
| Sunfish | | | 2,839,080 | 2,839,080 |
| Miscellaneous | | | 3,289,500 | 3,289,500 |
| Simmesport, La.— | | | | |
| Largemouth black bass | | | 900 | 900 |
| Buffalo fish | | | 682,500 | 682,500 |
| Carp | | | 928,300 | 928,300 |
| Catfish | | | 1,426,000 | 1,426,000 |
| Crappie | | | 538,500 | 538,500 |
| Fresh-water drum | | | 260,400 | 260,400 |
| Paddlefish | | | 32,970 | 32,970 |
| Sunfish | | | 501,950 | 501,950 |
| White bass | | | 430 | 430 |
| Miscellaneous | | | 6,400 | 6,400 |
| Yellowstone, Wyo.: Black-spotted trout | * 6,996,000 | | 3,833,000 | 10,829,000 |
| Leadville, Colo.: | | | | |
| Black-spotted trout | | | 188,800 | 188,800 |
| Brook trout | * 600,000 | | 4,218,600 | 4,818,600 |
| Lake trout | | | 83,500 | 83,500 |
| Loch Leven trout | | | 184,000 | 184,000 |
| Rainbow trout | 200,000 | | 481,000 | 681,000 |
| Louisville, Ky.: | | | | |
| Largemouth black bass | | | 2,800 | 2,800 |
| Catfish | | | 100 | 100 |
| Rock bass | | | 3,250 | 3,250 |
| Smallmouth black bass | | 510,000 | 4,630 | 514,630 |
| Mammoth Spring, Ark.: | | | | |
| Largemouth black bass | | | 70,580 | 70,580 |
| Catfish | | | 600 | 600 |
| Rock bass | | | 46,500 | 46,500 |

*Stations and substations operated and output of each, fiscal year 1928*—Contd.

[Asterisk (*) denotes transfer of eggs. See table, p 358]

| Stations, substations, and species | Eggs | Fry | Fingerlings, yearlings, and adults | Total |
|---|---|---|---|---|
| Mammoth Spring, Ark.—Continued. | | | | |
| Smallmouth black bass | | | 68,000 | 68,000 |
| Sunfish | | | 35,230 | 35,230 |
| Manchester, Iowa: | | | | |
| Brook trout | | | 401,000 | 401,000 |
| Rainbow trout | *358,000 | | 98,050 | 456,050 |
| Nashua, N. H.: | | | | |
| Brook trout | | | 398,270 | 398,270 |
| Catfish | | | 370 | 370 |
| Landlocked salmon | | | 12,770 | 12,770 |
| Rainbow trout | | 10,000 | 63,330 | 73,330 |
| Smallmouth black bass | | 15,500 | | 15,500 |
| Neosho, Mo.: | | | | |
| Largemouth black bass | | | 11,280 | 11,280 |
| Catfish | | | 900 | 900 |
| Crappie | | | 2,510 | 2,510 |
| Rainbow trout | *639,000 | | 274,100 | 913,100 |
| Rock bass | | | 7,330 | 7,330 |
| Sunfish | | | 13,170 | 13,170 |
| Yellow perch | | | 180 | 180 |
| Bourbon, Mo.: Rainbow trout | *1,750,000 | | 29,500 | 1,779,500 |
| Langdon, Kans.: | | | | |
| Largemouth black bass | | | 45,750 | 45,750 |
| Catfish | | | 9,000 | 9,000 |
| Crappie | | | 12,900 | 12,900 |
| Rock bass | | | 180 | 180 |
| Sunfish | | | 26,930 | 26,930 |
| Northville, Mich.: | | | | |
| Brook trout | | | 699,300 | 699,300 |
| Lake trout | 600,000 | | | 600,000 |
| Rainbow trout | | | 264,900 | 264,900 |
| Smallmouth black bass | | 39,000 | 44,600 | 83,600 |
| Alpena, Mich.: | | | | |
| Lake trout | *2,478,000 | 2,554,000 | 168,000 | 5,200,000 |
| Rainbow trout | | | 4,000 | 4,000 |
| Whitefish | 20,000 | 18,500,000 | | 18,520,000 |
| Charlevoix, Mich.: | | | | |
| Lake trout | | 10,000,000 | | 10,000,000 |
| Whitefish | | 19,700,000 | | 19,700,000 |
| Orangeburg, S. C.: | | | | |
| Largemouth black bass | | 90,200 | 69,030 | 159,230 |
| Catfish | | | 660 | 660 |
| Crappie | | | 300 | 300 |
| Sunfish | | | 27,170 | 27,170 |
| Warmouth bass | | | 650 | 650 |
| Put in Bay, Ohio: | | | | |
| Carp | | 5,500,000 | | 5,500,000 |
| Pike perch | | 150,000,000 | | 150,000,000 |
| Smallmouth black bass | | | 370 | 370 |
| Whitefish | | 62,400,000 | | 62,400,000 |
| Yellow perch | | 3,645,000 | | 3,645,000 |
| Quinault, Wash.: | | | | |
| Brook trout | 100,000 | 104,500 | | 204,500 |
| Chinook salmon | * 15,000 | | 225,070 | 240,070 |
| Silver salmon | (*) | 699,000 | | 699,000 |
| Sockeye salmon | * 4,410,000 | 12,046,000 | 835,100 | 17,291,100 |
| St. Johnsbury, Vt.: | | | | |
| Brook trout | | 1,854,240 | 1,270 | 1,855,510 |
| Lake trout | | 23,290 | 2,360 | 25,650 |
| Landlocked salmon | | | 1,610 | 1,610 |
| Loch Leven trout | | | 2,500 | 2,500 |
| Holden, Vt.: Brook trout | | | 29,750 | 29,750 |
| York Pond, N. H.: Brook trout | * 25,000 | 125,000 | 5,610 | 155,610 |
| San Marcos, Tex.: | | | | |
| Largemouth black bass | | | 246,350 | 246,350 |
| Catfish | | | 3,440 | 3,440 |
| Crappie | | | 5,430 | 5,430 |
| Rock bass | | | 1,240 | 1,240 |
| Sunfish | | | 98,680 | 98,680 |
| New Braunfels, Tex.: | | | | |
| Largemouth black bass | | | 11,350 | 11,350 |
| Sunfish | | | 18,300 | 18,300 |
| Saratoga, Wyo.: | | | | |
| Black-spotted trout | | | 191,000 | 191,000 |
| Brook trout | | 300,000 | 561,000 | 861,000 |
| Loch Leven trout | | | 141,050 | 141,050 |
| Rainbow trout | 438,000 | 700,000 | 351,000 | 1,489,000 |
| Lost Creek, Wyo.: Rainbow trout | * 1,001,000 | | | 1,001,000 |

*Stations and substations operated and output of each, fiscal year 1928*—Contd.

[Asterisk (*) denotes transfer of eggs. See table below]

| Stations, substations, and species | Eggs | Fry | Fingerlings, yearlings, and adults | Total |
|---|---|---|---|---|
| Spearfish, S. Dak.: | | | | |
| Brook trout | | | 1,067,770 | 1,067,770 |
| Loch Leven trout | | | 96,700 | 96,700 |
| Rainbow trout | | | 278,050 | 278,050 |
| Steelhead salmon | | | 9,300 | 9,300 |
| Springville, Utah: | | | | |
| Brook trout | * 1,007,000 | | 134,000 | 1,141,000 |
| Rainbow trout | 129,000 | | 978,460 | 1,107,460 |
| Tupelo, Miss.: | | | | |
| Largemouth black bass | | 583,500 | 164,790 | 748,290 |
| Catfish | | | 210 | 210 |
| Crappie | | | 600 | 600 |
| Sunfish | | | 237,300 | 237,300 |
| Warmouth bass | | | 320 | 320 |
| Friar Point, Miss.— | | | | |
| Largemouth black bass | | | 489,430 | 489,430 |
| Buffalo fish | | | 462,130 | 462,130 |
| Carp | | | 742,200 | 742,200 |
| Catfish | | | 2,212,550 | 2,212,550 |
| Crappie | | | 997,190 | 997,190 |
| Pike and pickerel | | | 1,700 | 1,700 |
| Sunfish | | | 8,070,090 | 8,070,090 |
| White bass | | | 2,070 | 2,070 |
| White Sulphur Springs, W. Va.: | | | | |
| Largemouth black bass | | | 32,070 | 32,070 |
| Brook trout | | | 1,907,730 | 1,907,730 |
| Loch Leven trout | | | 461,250 | 461,250 |
| Rainbow trout | [1] 1,130,000 | | 551,230 | 1,681,230 |
| Rock bass | | | 7,450 | 7,450 |
| Woods Hole, Mass.: | | | | |
| Cod | 3,651,000 | 178,999,000 | | 182,650,000 |
| Mackerel | | 5,212,000 | | 5,212,000 |
| Winter flounder | 11,357,000 | 584,107,000 | | 595,464,000 |
| Wytheville, Va.: | | | | |
| Largemouth black bass | | 83,250 | 5,900 | 89,150 |
| Brook trout | | | 156,980 | 156,980 |
| Catfish | | | 70 | 70 |
| Rainbow trout | | | 600,700 | 600,700 |
| Rock bass | | | 17,900 | 17,900 |
| Smallmouth black bass | | 8,000 | 850 | 8,850 |
| Sunfish | | | 110 | 110 |
| Yes Bay, Alaska: | | | | |
| Brook trout | | | 54,760 | 54,760 |
| Sockeye salmon | | | 12,967,000 | 12,967,000 |

## TRANSFER OF EGGS BETWEEN STATIONS

The following table lists the species and numbers of eggs transferred between stations. The object of such transfers is to effect the widest possible distribution of the various species at a minimum cost and to relieve the pressure on those stations that take eggs in excess of their capacity to develop.

*Transfer of eggs between stations, fiscal year 1928*

| Species | Number of eggs | From— | To— |
|---|---|---|---|
| Black-spotted trout | 256,000 | Yellowstone Park, Wyo | Leadville, Colo. |
| | 200,000 | do | Saratoga, Wyo. |
| Brook trout | 254,000 | Clackamas, Oreg | Big White Salmon, Wash. |
| | 206,000 | do | Little White Salmon, Wash. |
| | 100,000 | Craig Brook, Me | Grand Lake Stream, Me. |
| | 100,000 | Leadville, Colo | Bozeman, Mont. |
| | 300,000 | do | Saratoga, Wyo. |
| | 300,000 | York Pond, N. H | Nashua, N. H. |
| | 100,000 | do | Craig Brook, Me. |
| | 490,000 | Springville, Utah | Saratoga, Wyo. |

*Transfer of eggs between stations, fiscal year 1928*—Continued

| Species | Number of eggs | From— | To— |
|---|---|---|---|
| Chinook salmon | 2,050,000 | Big White Salmon, Wash | Clackamas, Oreg. |
| | 1,161,000 | Little White Salmon, Wash | Birdsview, Wash. |
| | 1,081,000 | do | Quilcene, Wash. |
| | 3,000,000 | do | Salmon, Idaho. |
| | 12,000 | Quinault, Wash | Central Station, Washington, D.C. |
| | 378,000 | Battle Creek, Calif | Baird, Calif. |
| | 252,000 | Mill Creek, Calif | Do. |
| Cisco | 1,360,000 | Cape Vincent, N. Y | Central Station, Washington, D.C. |
| Lake trout | 219,000 | Alpena, Mich | Charlevoix, Mich. |
| | 3,528,000 | Duluth, Minn | Do. |
| | 50,000 | do | Leadville, Colo. |
| Landlocked salmon | 15,000 | Craig Brook, Me | St. Johnsbury, Vt. |
| | 50,000 | Grand Lake Stream, Me | Craig Brook, Me. |
| Loch Leven trout | 200,000 | Bozeman, Mont | White Sulphur Springs, W. Va. |
| | 350,000 | Meadow, Mont | La Crosse, Wis. |
| | 300,000 | do | Bozeman, Mont. |
| Rainbow trout | 20,000 | do | Holden, Vt. |
| | 50,000 | do | Cape Vincent, N. Y. |
| | 125,000 | do | Glacier Park, Mont. |
| | 25,000 | White Sulphur Springs, W. Va. | Central Station, Washington, D.C. |
| | 134,000 | Manchester, Iowa | La Crosse, Wis. |
| | 112,000 | do | Northville, Mich. |
| | 320,000 | Neosho, Mo | Do. |
| | 113,000 | do | La Crosse, Wis. |
| | 87,000 | Bourbon, Mo | Do. |
| | 478,000 | Lost Creek, Wyo | Saratoga, Wyo. |
| | 26,000 | do | San Marcus, Tex. |
| | 100,000 | do | Neosho, Mo. |
| Silver salmon | 1,017,000 | Quinault, Wash | Puget Sound Stations, Wash. |
| | 84,000 | do | Clackamas, Oreg. |
| Sockeye salmon | 50,000 | do | Rogue River, Oreg. |
| | 753,000 | do | Birdsview, Wash. |
| | 100,000 | Baker Lake, Wash | Do. |
| Steelhead salmon | 50,000 | Applegate, Oreg | Clackamas, Oreg |
| | 25,000 | Birdsview, Wash | Charlevoix, Mich. |

## GENERAL FISH-CULTURAL NOTES

### NEW STATIONS

No new stations were operated during the year. However, a new substation at Fort Worth, Tex., auxiliary to the San Marcos station, has been virtually completed in respect to pond and water-supply construction. It is situated on property donated by the city. The ponds were completed too late to be used this season, but they will be on a productive basis in 1929. There are five ponds with a total water area of 17.59 acres. The station will be used largely for the propagation of bass and crappie. The work was carried on under a special appropriation of $18,000.

At the close of the year work had just been started on a combination trout and pond station at Crawford, Nebr. This will be operated as an auxiliary to the Spearfish (S. Dak.) station. It is to be built on park property donated by the city of Crawford, and work will also be conducted on Federal land belonging to the Fort Robinson Military Reservation. Trout will be propagated chiefly, but the station will serve as headquarters for directing cooperative rearing of warm-water fishes in the surrounding territory. An appropriation of $35,000 was made available July 1, 1927, and has been continued for the coming year.

At the close of the year the bureau acquired title to a large tract of land near Valdosta, Ga., on which it will build a hatchery to be subsidiary to the Warm Springs (Ga.) station. Eventually this will be one of the largest pond stations in the country. A large lake basin can be flooded to give over 200 acres of water area. Plans are being made for the immediate development of the project.

During the year negotiations were under way for the acquisition of property by gift at Creede, Colo., for a trout station and for the purchase of land near Reagon, Okla., for a pond station. The former will be under the direction of the Leadville (Colo.) station and the latter will be an auxiliary of the Neosho (Mo.) station. As soon as title to these tracts is secured, construction will begin. Appropriations of $30,000 and $35,000, respectively, are available for the work.

The close of the year also marked the termination of shad-hatching operations on the Potomac River at Bryans Point, Md. The hatchery

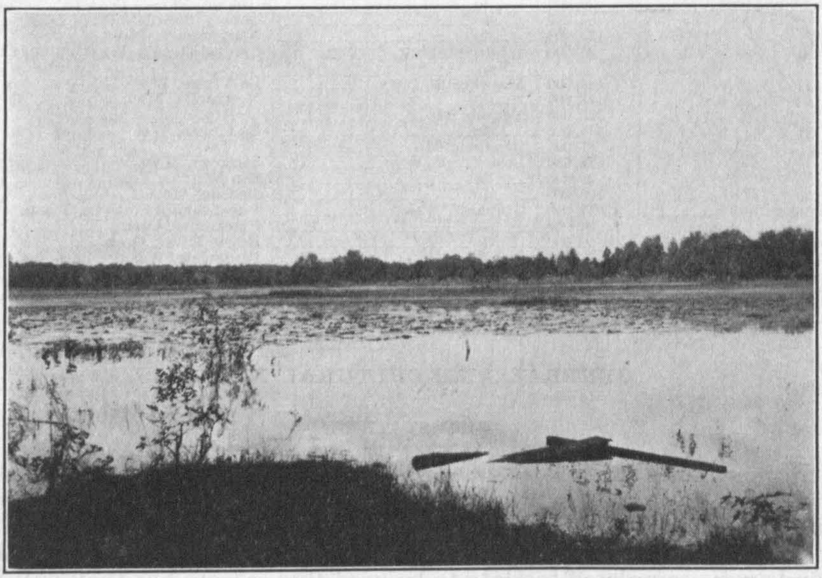

FIGURE 2.—Site of a new fish hatchery at Valdosta, Ga.

is being transferred to a new site on Government-owned land in the Fort Humphreys (Va.) reservation, a short distance down the river, where new buildings are being erected. A new location will be more advantageous with respect to the collection of eggs.

Fish-cultural facilities in the Yellowstone Park are being augmented by the construction of rearing pools at Mammoth Springs.

## CLAM HEADS AS FISH FOOD

The feeding of dried clam heads and clam meal to trout has virtually passed the experimental stage, and this material is being used regularly at several of the stations. The superintendent of the St. Johnsbury (Vt.) station has placed an order for several tons of it. It is a by-product, is relatively inexpensive, and appears to be valuable as an article of diet, especially for larger fish. The chief drawback at present is the fact that the supply is limited.

### SPINY LOBSTERS

At the request of the Florida shellfish commissioner, an employee of the Boothbay Harbor (Me.) station was detailed to Florida to initiate artificial propagation of the spiny lobster, *Panulirus argus*. The work was conducted at Key West with equipment furnished by the State, and several million eggs were hatched. The State of Florida defrayed all the expenses of the undertaking. This is the first record of the successful propagation of this shellfish on a large scale.

### HESEN FRY TRAP

The fry-collecting device developed at the Fairport (Iowa) biological station in connection with experimental pond-cultural work has been utilized at other stations. The basic principle of this apparatus is the same as that of the ordinary commercial pound net or salmon trap. A leader to the shore diverts the migrating fry into two "hearts," from whence they pass, by means of a funnel, into an inclosure that retains them. Being continuous in operation, the trap will catch all of the fry in a pond within a short time. Several of the pond stations have tested this trap and have found it to be very useful.

### PENNING LAKE TROUT

The superintendent of the Cape Vincent (N. Y.) station reported a collection of lake-trout eggs virtually twice as large as that taken the previous year and credits the increase to the fact that a larger number of fish had been penned. The quality of the eggs was superior to the average secured by commercial fishermen.

## COMMERCIAL FISHES

The original purpose of the Bureau of Fisheries was to propagate the food fishes, and in accordance with this design the bulk of the output of the fish-cultural stations consists of species of commercial value. During the past year 97.3 per cent of the total output was composed of species that are not classed as game fish. Emphasis is placed upon the work with the strictly marine forms, such as cod, pollock, and haddock, and upon the anadromous fishes, particularly the shad and herring and to some extent the Pacific salmons. This constitutes a recovery of a by-product and replaces a resource that otherwise would be lost. All of these forms are caught for market, and in many cases the eggs would constitute a total loss were it not for the bureau's spawn takers and hatchery men. Mackerel and striped-bass eggs were incubated during the past year, these operations having been resumed after a cessation of several years.

### PACIFIC SALMONS

The periodicity of the runs of the five species of salmon is responsible for yearly fluctuations in output. Consequently there were recessions in the output of certain varieties, such as the sockeye salmon, but increases in the production of other varieties permitted a total output slightly greater than that of last year. The various stations and substations are situated on the more important salmon streams from California to Alaska.

### AFOGNAK (ALASKA) STATION

(FRANK L. SNIPES, Superintendent)

The chief improvement at this station was the conversion of a storeroom into an office and the addition of three rooms to one of the fish-culturist cottages. The escapement of sockeye salmon into Letnik Lake was very small. Of the approximately 5,000 fish that entered the lake, 1,679 females produced slightly more than 4,000,000 eggs. A satisfactory number of these hatched, and the majority of the young fish were liberated as fingerlings in June. During the spawning season the adult fish were uniformly smaller than in past years, but apparently this did not affect the virility of their eggs. Persistent seining in Letnik Lake for the past three years has virtually ridded it of the predatory Dolly Varden trout. There was a satisfactory downstream migration of yearling sockeyes during May and June in 1928.

### YES BAY (ALASKA) STATION

(A. T. LOOFF, Superintendent)

A considerable amount of repairing and replacement has been necessary to keep the station in first-class condition. The entire water-supply line, including penstock and flume, was recaulked and the trestle repaired. Material has been obtained preparatory to rebuilding the penstock and flume. Shortage of water during the winter necessitated the construction of a temporary brush dam in the river in order to divert water to the intake. An entirely new foundation was built under the woodshed. The floor in the boiler room was renewed. Bad piles in the foundation of the boathouse were replaced, and the metal roof on the ice house was replaced by one of shingles. Considerable painting was done also. The reconstruction of the tramway to the landing was completed, and an addition was made to the tramway used for hauling wood. A vat in which nets will be treated was built. The launch *Puffin*, which had been out of use, was overhauled and has given good service. All other boats were thoroughly overhauled and repaired where necessary.

The year opened with over 10,000,000 sockeye fingerlings on hand. These were planted during July and August. Collecting operations yielded a total of slightly over 20,000,000 sockeye-salmon eggs. Water conditions were good, and it is believed that eggs were secured from virtually every salmon that entered the lake. The hatch was satisfactory, and at the close of the year over 16,000,000 fingerlings were retained in the ponds for feeding. The station also incubated a number of brook-trout eggs, the fry of which were distributed in southeastern Alaska waters. A number of predatory trout were destroyed by seining.

### BAKER LAKE (WASH.) STATION AND SUBSTATIONS

(JOSEPH KEMMERICH, Superintendent)

Favorable weather conditions prevailed in this field during the various spawning seasons, and the aggregate of the collections of eggs at all points covered exceeded that of the past two years. This increase was effected in spite of the fact that the run of sockeye salmon to Baker Lake has been negligible since the erection of the power dam at Concrete. The superintendent has given considerable thought to the establishment of a run of salmon in streams that are now poorly stocked. Ten streams and the lakes that feed some of them were inspected at various times during the year. In some of the waters there seemed to be little prospect of establishing a run of fish, but in others it was concluded to make systematic plants of fingerlings until favorable results are achieved or the futility of such attempts becomes evident. A very satisfactory run of chinook and humpback salmon ascended Puget Sound streams during the fall of 1927, and it is thought that these species are increasing in numbers. The fish ladder at the Concrete dam in Baker River was observed carefully and, as had been noted previously, sockeye salmon again found difficulty in making the ascent. Certain changes were made in the racks, which permitted a small number to reach the tramcar for transfer over the dam. However, in the latter part of the season it was found necessary to collect the fish from the lower part of the lake by hand and carry them to the tramcar. A study was made of the effect of the dam on downstream migrants, but no definite conclusions were reached. It appears that some losses occurred, but the extent of these was indeterminate.

*Baker Lake (Wash.) station.*—Only minor repairs, such as repainting roofs of the station buildings, were made. A bridge over Thunder Creek Canyon, on the station trail, collapsed in August, and it was necessary to construct a new bridge in cooperation with the Forest Service. In the course of the 1927 run of sockeye salmon in Baker River 1,597 brood fish were secured. These were retained for ripening, and 1,810,000 eggs were obtained from them. The fry were fed, and a large number were being carried when the fiscal year closed. At the opening of the year 422,400 sockeye fingerlings from the previous year's hatch were on hand and were liberated shortly afterwards. A fair run of silver salmon reached the trap in Baker Lake, and nearly 3,500,000 eggs were taken. These were incubated at the Baker Lake station instead of being shipped, as in past years, to Birdsview, and the fry were liberated in Baker River.

*Birdsview (Wash.) substation.*—Minor repairs to the water-supply conduit and the station buildings were made from time to time. The old flume water supply was replaced by a wooden pipe line in July and August. During unusually high water in January a flood in Grandy Creek washed out the water-supply intake dam and headgate, necessitating pumping operations for the next few days. As soon as the water receded sufficiently, a temporary intake was constructed. A permanent dam will be installed within a short time. The water-supply line to the residence was replaced by a pipe of larger dimensions. Considerable trouble was experienced from the deposition of gravel in the creek channel through the station grounds and above the trap. The washing away of the creek banks during the high water in January also necessitated the construction of a temporary jetty in order to protect the pipe line.

This station handled sockeye, chinook, humpback, silver, and steelhead salmon during the year, as well as the eastern brook trout. Cutthroat-trout eggs to the number of 185,000 were incubated for the Skagit County Game Commission. Some trouble was experienced with fungus on trout. Feeding experiments were being conducted at the close of the year with the view of determining the most satisfactory food for replacing the expensive beef liver. The run of chinook salmon in the Skagit River was below normal. All sockeye eggs handled were transferred from other stations. The collection of humpback-salmon eggs was the largest since 1915. A temporary wire trap was installed in Phinney Creek, and a very satisfactory number of eggs of this species was collected. The small collection of chinook eggs was augmented later by a large shipment transferred from the Little White Salmon station. In addition to a short run of silver salmon, the above-mentioned flood put the trap out of commission, making it impossible to secure all the fish that ascended Grandy Creek, and less than 1,000,000 eggs of this species were taken. Shipments from other stations permitted the liberation of 885,000 advanced fry and over 500,000 fingerlings of various sizes; 12,000 fingerlings were on hand at the close of the year. Four hundred and thirty-four thousand fingerling steelheads were liberated in July and August. The run of steelheads in the spring of 1928 gave a collection of eggs exceeding any since 1918. The fish entered the creek during the flood in January, and it is possible that a few hundred thousand eggs were lost, due to the fact that the trap could not be operated until February. Many of the fish were still in the green state, making it necessary to pen them until they ripened, and some injuries resulted as well as considerable fungus. A rather high percentage of eggs proved to be infertile, probably due to the long time the fish were held in pens. A number of shipments of steelhead eggs were made, including 40,000 to Hawaii and 50,000 to Ecuador. While 100,000 brook-trout eggs were hatched with considerable success, a heavy mortality took place among the fingerlings. A shipment of 87 fancy Japanese goldfish, donated by the Japanese Government, was received, and the fish are being retained at the station.

*Duckabush (Wash.) substation.*—A fish-food house with a concrete floor was constructed, and repairs to other buildings were made. The old permanent trap in Duckabush River was torn out because it had not been properly constructed and had become dilapidated. It will be replaced by a new trap. A temporary rack and trap were built in the Duckabush River during July and August for intercepting the runs of humpback and chum salmon.

Extensive operations with the chum salmon were carried on at this station and at the Quilcene station. After 8,778,000 eggs had been collected, fishing operations were discontinued, due to the fact that the water supply available was limited. Eggs taken at the temporary trap between September 27 and October 13 were sent to the Quilcene station, and operations were terminated on that date. Most of the fish hatched were liberated as advanced fry. The late run of chum salmon in the Duckabush River was of little consequence, but this run of fish yielded a capacity collection of eggs at the Walcott Slough trap at Brinnon. The Duckabush station received 6,776,000 eggs from this source. These were transferred to the hatchery in the milt in cans. A collection of 1,279,000 humpback-salmon eggs, made while the chum-salmon eggs were being collected, represents the largest take of eggs of that species for a number of years. The resulting fish were planted in the fry stage in the Duckabush, Lyre, and Docewallops Rivers. The only silver-salmon eggs handled were 358,800 received from the Quinault station. The product, in the advanced fry and fingerling stages, was deposited in the Duckabush River. The planting of chinook-salmon fingerlings in the Duckabush River was carried on with the object of establishing a run of this species in that river.

*Lake Crescent (Wash.) substation.*—With the object of establishing a run of sockeye salmon in the Lyre River, the bureau has continued to rear large numbers of fingerlings of that species at the Lake Crescent hatchery, operated by the State of Washington. From 828,000 eggs received from the Quinault station, 826,000 fry were obtained and placed in two large rearing ponds for feeding. They were fed from April 20 to June 16 and then liberated in Lake Crescent.

*Quilcene (Wash.) substation.*—A new permanent trap was constructed in the Little Quilcene River, replacing an old and dilapidated affair. Temporary racks and pens also were built in August in time to catch the run of chum salmon. It was necessary to construct a jetty about 100 feet long in the Quilcene River to prevent washing away of the bank.

Chum-salmon egg collections were made in the Quilcene River and also in the Duckabush River after the Duckabush station had become filled. At the Walcott Slough trap, operated by the Duckabush and Quilcene stations, 5,391,000 eggs were collected from the late-run chum salmon, and a smaller number was obtained from the Little Quilcene River. A total of 7,577,000 fry resulted from all collections of this species. Further plants of chinook-salmon fingerlings were made in the big Quilcene River from eggs shipped in from the Little White Salmon station. The collection of silver-salmon eggs was considerably larger than those of the past few years. This is probably attributable to the improved condition of the permanent traps in the Big and Little Quilcene Rivers. Over 2,000,000 eggs were collected, and 358,000 eyed eggs were received from the Quinault station. Due to shortage of space it was necessary to liberate a large number of these as advanced fry. A few humpback-salmon eggs were secured in conjunction with the collection of chum-salmon eggs of the early run in the Duckabush River. The same conditions that gave a larger collection of silver-salmon eggs was held to be responsible for a larger take of steelhead eggs. At the close of the year 366,000 fingerlings of this species were on hand, as well as 135,900 fry.

*Sulton (Wash.) substation.*—A temporary wire trap that had been built in the creek was washed out before the fish began running, and it was impossible to reconstruct it before the end of the season. While the run of chinook and humpback salmon probably was as large as usual, the above-mentioned conditions prohibited the taking of eggs. The run of silver salmon was quite large, and an average number of eggs was obtained. As many of the fish were green, it was necessary to pen a number of them. A total of 3,710,000 eggs was obtained. As this station has no rearing ponds it was necessary to liberate the resulting fish as advanced fry and a very small number of fingerlings. The number of steelhead eggs taken on Elwell Creek was above recent records, and it was also necessary to pen the resulting fish and distribute most of them as advanced fry. At the close of the year 112,000 fry and 138,000 fingerlings of this species were being retained.

### QUINAULT (WASH.) STATION

(MARCUS S. MEYER, Superintendent)

While no extensive improvements were made to buildings or ponds, the discontinuance of the use of dirt ponds necessitated the construction of screen inclosures in Falls and Merriman Creeks to maintain the rearing capacity of the station. A new rack was built in Big Creek to replace the old trap. A total of 18,218,000 sockeye-salmon eggs was taken by seining between October 20 and December 5. During the same period nearly 3,000,000 silver-salmon eggs were obtained, but in order to relieve congestion in the hatchery the majority of these were transferred to other stations. A few chinook-salmon eggs also were secured in conjunction with this work. A number of shipments of sockeye and silver salmon eggs were made to State hatcheries in Washington and Oregon as well as to other stations of the bureau. Of a shipment of 209,000 eastern brook-trout eggs received in early December, 100,000 were planted in the eyed stage in isolated lakes and streams. All fry produced from the remainder, with the exception of about 2,000, were distributed by the United States Forest Service. The fiscal year closed with approximately 1,000,000 sockeye-salmon fingerlings on hand.

### CLACKAMAS (OREG.) STATION AND SUBSTATIONS

(PHILO B. HAWLEY, Superintendent)

The eggs collected in this field, including the main stations and its substations, aggregated over 4,000,000 in excess of those taken in the previous year. Chinook salmon and silver salmon, as well as the steelhead, rainbow trout, and brook trout, were the species handled.

*Clackamas (Oreg.) station.*—The 19 rearing ponds at this point were equipped with frameworks of 1¼-inch galvanized-iron pipe to serve as a support for vines planted at the sides to provide shade in order to maintain a lower temperature during the summer months. It is hoped that this novel expedient will prove to be effectual as well as being inexpensive and ornamental. In the early fall the prospect for a satisfactory collection of chinook-salmon eggs appeared good. In late September, however, the water was extremely high, and débris soon collected on the rack, backing up the water and threatening damage to shore property. To avoid this it was necessary to dynamite a portion of the rack, and the continuation of high water prevented any attempt to reconstruct it. Consequently no eggs were collected.

A number of shipments were received from the State of Oregon and from substations of the bureau and a fair production of fingerlings resulted. Brook-trout eggs and steelhead eggs also were transferred to the Clakamas station during the year as well as 137,500 rainbow-trout eggs. Some of these were retransferred, but the majority were held for hatching, and the output was distributed in the fingerling stage. There were on hand at the close of the year 46,000 steelhead trout. The station was materially assisted during the year by the cooperation afforded by the Oregon Fish Commission and the Oregon Game Commission in connection with the distribution of fish and the transfer of eggs.

*Little White Salmon (Wash.) substation.*—Plans have been made to construct a cold-storage plant at this station for keeping the supply of fish food needed for all the bureau's hatcheries in this field. The foundation has been laid, and when completed the plant will have a storage capacity of about 70 tons. Two woodsheds were erected during the year, and minor repairs were made to buildings and grounds. The station is being equipped with fry trays as fast as possible. A number of skiffs were constructed for use at this and other stations. At the beginning of the year approximately 90,000 fingerling steelhead and sockeye salmon were on hand, which were distributed later in local waters. Favorable fishing conditions during the egg-collecting season permitted a take of 26,600,000 chinook-salmon eggs, approximately the capacity of the hatchery. It is estimated that 40,000,000 could have been secured had fishing been continued to the end of the season. A normal hatch was secured, and the fry were reared to the 1½ and 2 fingerling stages before being distributed in the Little White Salmon River. A shipment of brook-trout eggs was received in November, and the product was distributed as fingerlings No. 1, some to applicants and the remainder in waters in the Cascade Mountains.

Seventy barrels of salmon flesh were salted for fish food, and a considerable quantity of horse meat also was fed. The latter apparently is proving to be a very satisfactory diet.

*Big White Salmon (Wash.) substation.*—A combination workshop and garage was constructed during the year. This constitutes the only work of major importance in the way of improvements. A new cedar head trough was installed in the hatchery building, and steps were taken to provide an additional supply of fry trays. The collection of chinook-salmon eggs from the Big White Salmon River was the largest in recent years, a total of 14,906,000 being secured. The eggs were transferred from the racks to the hatchery in the green state, being carried by truck. Excellent results followed this method, and the hatch was normal. A number of eggs were carried successfully in this manner to the Clackamas station, a distance of nearly 75 miles. Spring Creek yielded more than 5,000,000 eggs, which was very satisfactory. This stream has been built up as a salmon stream entirely by artificial propagation, and it probably constitutes one of the most dependable and inexpensive sources for eggs in the Oregon field. Most of the chinook fry were reared to the No. 2 fingerling size before they were liberated in the river. A considerable amount of salted salmon, as well as 3½ tons of horse meat, was used in feeding this stock. The marking experiment initiated last year was unsuccessful, but the work was again taken up with the idea of ascertaining the benefits to be derived from holding fall chinook-salmon fingerlings over a considerable period. This station handled a number of brook-trout eggs and distributed 49,000 fingerlings of that species. The work of the station also included the incubation of 100,000 steelhead eggs and 75,000 rainbow-trout eggs for the Klickitat County (Wash.) Game Commission.

*Rogue River (Oreg.) substation.*—Minor repairs were made to the plant here. The collection of chinook-salmon eggs was only about half as large as that of the previous year, although fishing started on August 13 and was conducted continuously to September 26. No other eggs were taken at this station, but a consignment of sockeye-salmon eggs was transferred here from the Quinault field and a number of sockeye fingerlings resulting from the previous year's transfer were distributed.

*Applegate Creek (Oreg.) substation.*—Late in August temporary repairs were made to the fish barrier across Applegate Creek. A 60-foot break in the west end of the dam was repaired, and a new trap and pens were constructed. The satisfactory condition of the water during the spawning season of the silver salmon made possible a collection of eggs over three times as large as that of the preceding year. Favorable conditions prevailed during the steelhead run, also, though few fish entered the creek, and in spite of the reconstruction of the barrier the total number of eggs taken was below that of last year. After making the usual shipments of steelhead eggs in the eyed stage, the fry and the remaining eggs were transferred to the Butte Falls hatchery of the Oregon Game Commission for further development. This permitted the closing of the Applegate Creek station for several months and resulted in a reduction in the cost of operations.

*Salmon (Idaho) substation.*—At the beginning of the year 285,000 chinook-salmon fingerlings were being carried. Part of these were distributed, and the remainder were held for a marking experiment. While the run of salmon in the Lembi River was a month late, 4,000,000 eggs were taken. A number of fish apparently spawned in the river below the rack. The eggs taken in this river were eyed locally and were then transferred to the Salmon (Idaho) hatchery for futher development. Sixty thousand fall and 65,500 spring chinook-salmon fingerlings were marked and liberated in the experiment mentioned above. No fish were liberated from the station until they had reached a length of 2 inches.

In connection with the work in this field a new collecting station for rainbow-trout eggs was opened at Williams Lake, Idaho. From April 23 to May 19 over 1,000,000 eggs of this species were secured, and after developing them to the eyed stage they were transferred to the Salmon hatchery.

### Baird (Calif.) Station and Substations

(W. K. Hancock, Superintendent)

The major improvements made at the Baird station were the painting of several of the buildings and minor alterations and repairs. The fall run of chinook salmon in the McCloud River was very light, and a number of those that ascended escaped through a hole in the rack. Egg collections were negligible, therefore. The small number taken were hatched in outside troughs fed by a spring, thereby obviating pumping. Over 1,500,000 eyed eggs were transferred from the substations to make up the shortage. High water during the winter washed out the intake dam. After part of the fish were planted, preparations were made to take care of the spring run of chinooks by rebuilding racks and traps. Shortage of water made the planting of the remaining fingerlings necessary. At the close of the season a few fish were in the traps.

*Battle Creek (Calif.) substation.*—A new power boat and a shed to house it were constructed during the year, and minor improvements were made. It was necessary to replace the racks at this point almost entirely. Fishing started October 2 and alternated between Battle Creek and the Sacramento River until high water stopped operations. About 2,000,000 eggs were taken. Late in November the racks were washed out, making further attèmpts to secure eggs useless. As usual, muddy water during the incubation season caused considerable difficulty. Fingerlings were planted intermittently until March, when high water made it necessary to plant a large number and transfer others to the rearing ponds. All of the stock was distributed by June.

*Mill Creek (Calif.) substation.*—Racks were installed and fishing began on October 29. Prospects were favorable until high water washed over the tops of the racks and liberated most of the fish that had been taken. A total of 3,405,000 chinook-salmon eggs was obtained, and it is probable that some 3,000,000 or 4,000,000 were lost due to the above-mentioned cause. Muddy water at this point also necessitated constant attention to eggs and fry. By early March over 1,000,000 fish were planted to provide room in the hatchery. During the latter part of the month a storm clogged the water-supply ditch, and all stock in the hatchery was distributed. Thereafter, until the close of the year, the station was inactive.

## FISHES OF THE GREAT LAKES

In this field the number of whitefish and lake trout taken was smaller than ever. However, there was a considerable increase in the number of lake trout handled. Conditions in Lake Erie have changed so in recent years that the Put in Bay (Ohio) station is able to secure only a very limited number of eggs from what were formerly its most productive fields. Pike perch, yellow perch, and carp also are handled in conjunction with the propagation of the more important varieties at the four stations in this field.

### DULUTH (MINN.) STATION

(S. P. WIRES and WARD A. COOK, in charge)

In addition to painting the hatchery building and outbuildings, considerable work was done in replacing flumes, drains, etc., which had rotted. A new 20-horsepower tubular boiler was installed. Fish-cultural operations were conducted on a somewhat larger scale than previously. Due to a misunderstanding with the State fish warden, arrangements for the collection of whitefish eggs were not made until bad weather had affected the fish, and as a consequence the collections of eggs from this species did not meet expectations. An attempt was made in an experimental way to hatch a few lake herring. Satisfactory results were experienced with lake trout, over 27,000,000 eggs being collected and a fair hatch secured. A number of shipments of lake-trout eggs were made to other stations. A few fingerlings were being held at the close of the year. The usual cooperative arrangements were made with the State of Minnesota for the propagation of pike perch. The eggs were collected at the field station near Bemidji, Minn., and the bureau's share amounted to over 11,000,000 eyed eggs. A very good hatch was secured, and the resulting fry were distributed in local waters and to applicants in various parts of the State. The station also received 450,000 brook-trout eggs. A considerable number of fry died, but over 200,000 fingerlings were distributed and more than 15,000 were on hand at the close of the year. Reports received indicate that the work of stocking with lake-trout fry and fingerlings is showing effective results and that more small trout are being seen each year.

## NORTHVILLE (MICH.) STATION AND SUBSTATION

(W. W. THAYER, Superintendent)

At the main station a larger number of trout eggs was handled than in recent years. During the year 2,164,740 brook and rainbow trout eggs were received. The fry and fingerlings resulting from these were distributed to applicants and to the cooperative nurseries operated in conjunction with the Northville station. These agencies alone received 408,000 rainbow-trout fry and fingerlings. While the trout operations met with average success, the work with the pondfishes, particularly the smallmouth bass, was retarded by a heavy loss among the brood stock. A number of these fish died during the winter, and virtually every one of a shipment of 220 adults received in the spring perished. The total distribution of bass for the year was slightly over 75,000. A few bluegill sunfish were distributed, and there is indication that the present season's hatch will produce a larger number.

*Alpena (Mich.) substation.*—In general, the operations in this field were satisfactory, and an extension of the work is foreseen for the future. Favorable weather conditions, coupled with cordial cooperation by the State of Michigan in allowing an extension of the fishing season and in detailing wardens to assist in making the collections, permitted the taking of 32,117,000 whitefish eggs. It is reported that previous plantings of whitefish in the vicinity of Alpena and Thunder Bay are showing satisfactory results in an abundance of young whitefish in these waters. The State also assisted by incubating surplus eggs at the Harrisville hatchery and in the distribution of the whitefish fry. A new field station was opened at Greenbush. The hatchery was filled to capacity with lake-trout eggs, but a rather heavy mortality was brought about by the chlorine in the water supply. The policy of planting lake-trout fingerlings in Devil River at Ossineke was continued, and it appears that an important fishery is being developed at that point. A lake-trout nursery with a capacity of 300,000 fingerlings has been established by fishermen's organizations. The fishermen have also rendered material assistance by lending equipment to be used in the distribution work.

A limited number of rainbow-trout and brook-trout eggs was handled at the station for distribution to nursery pools in the vicinity. Heavy losses were experienced with the rainbow trout, but the brook trout were placed in the ponds with only a normal mortality. An attempt to hatch chub eggs (Leucichthys sp.) was unsuccessful, virtually none of them producing fry. Although a large number of pike-perch eggs was secured, the hatch proved to be almost a total failure, due to very low water temperatures during the early part of the incubation period. There is every indication that this branch of the work can be developed to much greater proportions by assigning a larger crew for its prosecution. It is probable that other field collecting stations for whitefish, pike perch, lake trout, and cisco can be located in Lake Huron when the capacity of the Alpena hatchery has been expanded sufficiently to care for all eggs that may be secured. An attempt made to pen whitefish and lake trout was largely unsuccessful, there being a tendency for both species to become badly fungused, whether held in pens or in floating live cars in more or less open waters. Only a negligible quantity of eggs was secured from this source. The whitefish and lake-trout hatching equipment has been temporarily repaired so that it may be used pending the completion of extensive improvements to be undertaken in the coming year. An addition 30 by 85 feet in dimensions was made to the hatchery building, and a fresh-water supply pipe line was extended out into the bay. It is evident that the latter will have to be extended somewhat farther to insure a satisfactory water supply. Several acres of land adjoining the hatchery were leased during the year and will be used to improve the appearance of the station and permit the construction of auxiliary rearing facilities.

*Charlevoix (Mich.) substation.*—While this station handled a large number of eggs, the results of the season's work were not as satisfactory as might be desired. Most of the 42,700,000 lake-trout eggs collected were of very poor quality, and an inordinately low percentage of hatch was obtained. Eggs from Lake Superior fields gave the highest percentage of hatch, although they were shipped the greatest distance. It is probable that inexperience or unwillingness on the part of the fishermen to take the eggs was responsible to some degree for the poor success attained, as the bureau's employees and the State wardens made every effort to improve the quality of the take. Eggs from gill-netted fish apparently are much poorer than from those from fish taken in pound nets. More than 35,000,000 whitefish eggs were collected, and almost 20,000,000 fry were distributed. The State fish car assisted during the spring in distributing the station stock of whitefish and lake trout. In collecting the eggs the State employees acted as messengers, delivering the eggs to rail points, and a much more expeditious delivery was effected in this way. A shipment of pike-perch eggs from Bay City, Mich., was received in such bad condition that virtually none hatched. Twenty-five thousand steelhead eggs were received in June, and the resulting fry were on hand at the close of the year. Minor improvements were made to the station property, and a new storage building was built.

### Put in Bay (Ohio) Station

(David Davies, Superintendent)

No extensive improvements or alterations were made to the station plant. Painting, replanking the wharf, constructing a septic tank, and making extensive repairs on the steamer *Shearwater* were among the most important items. The propagation of whitefish was marked by the smallest number of eggs collected in recent years. The field stations at North Bass, Middle Bass, Put in Bay, Catawba Island, Port Clinton, and Toledo were opened, but the catch of fish was limited. While unfavorable weather prevailed during part of the season, weather conditions as a whole were not a great handicap, and no cause other than scarcity of fish can be assigned for the shortage. Whitefish seem to have left this end of the lake. The collections totaled 104,000,000 eggs, and all of the resulting fish were planted as fry. The spring pike-perch work was much more successful, and an abundance of fish was reported. The first eggs were received on April 8 and, while unfavorable weather was encountered, almost 500,000,000 eggs were obtained. As usual, the percentage of hatch was low, running around 38. Yellow perch were handled also, but the fishermen did not furnish many eggs of this species. About 4,000,000 eggs were put in wire baskets floating near the hatchery, and about 90 per cent of them hatched. The carp work in the Port Clinton field during the spring failed because eggs were secured from June 12 to June 25 only, and then only in very small numbers. The fishermen did not take many fish in their nets, and it is probable that high water permitted the fish to enter the creeks, where they could not be reached by nets. The usual collections of adult smallmouth black bass for brood stock at other stations of the bureau were made during the spring.

### Cape Vincent (N. Y.) Station

(J. P. Snyder, Superintendent)

The most important improvements made were the construction of a new garage and the replacement of defective timbers in the dock. Work was started on a large bass pond on property owned by the bureau near the station. Due to the fact that the work was begun very late in the season and that there was a shortage of funds, the work planned was not completed. A pipe line was laid from the hatchery to the site of the future water supply. The engines in the boat *Curlew* were replaced by a Diesel power plant, and extensive repairs and alterations were made.

The lake-trout work was highly successful, and the number of eggs taken was virtually double that of any preceding year. The success was due partly to the penning of over 400 females at Carlton Island and Stony Island until their eggs ripened. The run of fish was normal, but favorable weather helped the spawn takers to collect 5,700,000 eggs. Some of the eggs were of very high quality, and after deducting 500,000 eggs shipped away there were hatched 3,220,160 fry. The number of whitefish eggs taken again dropped below the previous season's figures, the total number taken amounting to about 25,500,000. The collecting season was marked by a small run of fish and unfavorable weather conditions. The only area in which a scarcity of fish was not apparent was in Canada in the Bay of Quinte. The collection of 171,000,000 cisco eggs represented a moderately successful season, but here, too, it appeared that there was a decrease in the number of fish. Most of these eggs were collected in New York waters. One million three hundred and twenty-five thousand brook-trout eggs were received from commercial hatcheries and by exchange.

The fry were allotted to the various substations and to the five cooperative nurseries under the direction of this station or were distributed to applicants in New York. During the spring a shipment of rainbow-trout eggs was received from Michigan and incubated for subsequent distribution. A few Loch Leven trout also were handled.

*Watertown (N. Y.) cooperative substation.*—This plant, consisting of a battery of troughs, grinding house, and cottage is sponsored by the Jefferson County Fish and Game Association. In return for the use of the property and certain monetary assistance for fish food, etc., the bureau allotted 100,000 trout fry to the association. At the close of the year the bureau was carrying about 750,000 brook and rainbow trout for its own needs.

*Barneveld (N. Y.) cooperative substation.*—This is a large hatchery project leased by the Utica (N. Y.) chapter of the Izaak Walton League and operated by the bureau. At the beginning of the year over 250,000 brook, rainbow, lake, and Loch Leven trout fingerlings and yearlings were on hand. During the early fall a severe epidemic broke out, and as it seemed to be beyond remedy it was decided to dispose of all the stock on hand, either by distribution or by destroying the infected individuals. The plant was then thoroughly disinfected, and about 300,000 brook and rainbow trout eggs and lake-trout fry were shipped in during the winter. At the close of the year the fish were doing well, and there was little indication of a recurrence of the mortality of the previous year.

The Cape Vincent station also administered four smaller nurseries situated in Vermont and New York. These were uniformly successful.

*Swanton (Vt.) substation.*—In the fall of 1927 a 5-year agreement between the State of Vermont, the State of Pennsylvania, and the Bureau of Fisheries for the continued operation of the Swanton substation was entered into. As usual, the bureau was in full charge of the work. The expenses were prorated among the cooperative agencies, and the fry were allotted on an equitable basis, 40 per cent being returned to parental waters, 40 per cent being allotted the State of Pennsylvania, 10 per cent to the bureau, and 10 per cent for general applications held by the State of Vermont. A new 30-foot motor boat was constructed, and a number of live cars for holding fish until ripe were provided.

Preparations for work were begun on March 15, and it was found necessary to conduct extensive seining operations under the ice, as it appeared that the fish were ripening in advance of the break-up. No trap nets were used until April 20, and a large percentage of the fish had spawned by that time. Collections were continued until May 6, when 3,275 pike had been penned. These produced 137,060,000 eggs, and slightly less than 100,000,000 fry were hatched and distributed according to the agreement. In conjunction with this work, eyed yellow-perch eggs were collected and hatched. The majority of the fry were planted in Lake Champlain, but a small percentage was distributed in other waters in New England and New York.

## RESCUE OPERATIONS

This division carries on rescue work on the upper Mississippi River and is charged with responsibility for the bureau's activities in the Upper Mississippi Wild Life Refuge. Propagation of carp and buffalo fish in the lower Mississippi is also part of its duties. At the headquarters at La Crosse, Wis., large numbers of trout are now propagated. General supervision of all the fish-cultural work carried on between the Rockies and the Appalachian Mountains is delegated to this division.

### La Crosse (Wis.) Station and Substations

(C. F. Culler, in charge)

Several rowboats, a house boat, and a 32-foot cruiser were built during the year for use in the Upper Mississippi River Wild Life Refuge. Buffalo fish were not propagated in Louisiana during the year, but a crew carried on some experimental hatchery work with this species in cooperation with the State of Arkansas. The territory covered was more extensive than last year, and the number of fish handled was greater. Extensive trout-hatching operations are now conducted at the La Crosse station. Brook-trout and rainbow-trout eggs were obtained from the bureau's stations in Missouri and Iowa and from the Pend Oreille County Fish and Game Commission through exchange. A number of Loch Leven-trout eggs also were incubated, but the fry suffered a rather heavy mortality. The demand for this species in Wisconsin and Minnesota appears to be increasing. The Lincoln Park Aquarium at Chicago incubated a number of rainbow-trout eggs, the fry from which were distributed under the direction of the La Crosse station. Inasmuch as the capacity of the La Crosse station is insufficient to handle the full number of fish needed, the surplus is transferred to the substation at La Crosse and to the Lynxville auxiliary pending distribution.

Much of the time of the La Crosse station personnel is taken up in administering the many cooperative nurseries in that territry. Thirty-nine nursery projects, having a total of 49 ponds or tanks, are now in operation under the bureau's direction in Minnesota and Wisconsin. The rescue operations were very successful. In the upper Mississippi River field 145,176,900 fish were handled. The usual small percentage, amounting to four-tenths of 1 per cent, was distributed to other waters on application. The rest of the fish were returned to parental waters. The cost of the work amounted to approximately $0.126 per thousand fish rescued. Certain areas formerly handled by the bureau were covered by the States of Wisconsin and Iowa. In connection with the rescue work, almost 2,000,000,000 larval mussels were released in the parasitic stage on rescued fish. The aggregate number of trout hatched was over 1,500,000.

*Homer (Minn.) substation.*—The construction of new boats and equipment and the overhauling of engines, machinery, boats, and trucks were the important features of the work at this substation. Fish-cultural operations are confined to rescue work, as the water supply is unsatisfactory and inadequate for the successful hatching of eggs. This work is limited, however, and the station is used chiefly as headquarters for construction and repair work on boats and as a center for work in the upper Mississippi River wild life refuge. It is planned to build propagating ponds in the refuge, and then the location of the Homer substation will make it the logical headquarters for the supervision of that work.

*Marquette (Iowa) substation.*—During the year this substation rescued more than 50,000,000 fish, the territory covered including areas around Guttenberg and Buena Vista, Iowa. Mussel-infection work also was carried on.

*Bellevue (Iowa) substation.*—In addition to the usual rescue work eggs of the buffalo fish and carp were collected, fertilized, and planted, and some mussel-infection work was done.

*Lynxville (Wis.) substation.*—Ten galvanized-iron holding tanks, capable of holding about three carloads of fish, were added to the equipment of this station. These will be of material assistance to the distribution work during periods of low water. Electric-light lines also were installed. The work at this substation consists chiefly of rescuing the commercial species and the catfish. It also collects mussels and sends them to the field crews for infection. During April, May, and June surplus trout from the La Crosse station were handled at Lynxville. The results of this work are described in the section of this report dealing with the La Crosse station.

### Mussel Infection

[Conducted by the Fairport (Iowa) and La Crosse (Wis.) stations in conjunction with the rescue of landlocked fishes]

The customary work of infecting rescued fishes with the larvæ obtained from gravid mussels of the commercial varieties was continued. At La Crosse 1,915,435,750 glochidia of various species were released on fishes, while at the Fairport biological station 139,069,400 young mussels were planted in connection with the rescue of 2,405,194 fishes and the hatching of over 80,000. This large number of larvæ was handled at a cost ranging at from a little over 1⅙ to 43¼ cents per thousand, depending upon the location of the work. The total output surpassed that of the previous year, though it did not reach that of some of the earlier years.

### MARINE SPECIES

Aggregate collections of cod, haddock, and winter-flounder eggs at the two stations in Massachusetts and the station in Maine exceeded the total for last year. There was a decline in the number of pollock eggs taken, but approximately 50 per cent more cod eggs were handled than in previous years. Fertilized cod eggs were planted directly on the fishing grounds because it is impracticable to incubate them in the hatcheries. This work is prosecuted in the Massachusettes offshore fishery and at the Boothbay Harbor (Me.) station.

#### BOOTHBAY HARBOR (ME.) STATION

(E. E. HAHN, Superintendent, and J. R. B. ROGERS, Acting Superintendent)

A number of the buildings at this station, including the hatchery and residences, were painted, and minor repairs were made to the lobster pound at Pemaquid. In addition, the work necessary to maintain the extensive equipment of boats, docks, and pumps was done. During the winter ice caused considerable damage to the pound. The steamer *Gannett* was again out of commission pending the provision of a new boat to replace it. The usual summer exhibit of seals, fish, and other aquatic life was maintained. The fish-cultural work consisted of hatching flatfish and fertilizing and planting cod eggs on the spawning grounds. While collections of eggs of the former were not so large as in some previous years, the percentage of hatch was above normal and the work was very successful. An open winter made it possible to set fyke nets for brood fish from March 1 to April 30. Over 2,000,000,000 fry were hatched from the 2,136,970,000 eggs handled, a percentage of over 94. The hatchery was filled to capacity at the end of 16 days' fishing, and it was necessary to hatch the surplus in floating boxes moored off the dock. Very successful results attended this method. On April 1 chartered vessels took up the collection, impregnation, and liberation of cod eggs off the harbor. The latter work was resumed last year after a lapse of several years. Over 1,250,000,000 eggs of this species were handled.

#### GLOUCESTER (MASS.) STATION

(C. G. CORLISS, Superintendent)

During the summer, when no fish-cultural work was in progress, the station boilers were retubed, and extensive repairs, amounting virtually to reconstruction, were made to the marine railway. The station buildings were cleaned and painted, also. The collections of pollock eggs were the smallest in many years, and while the weather was responsible for this condition to some extent there is no explanation as to why the catches of fish were so small.

Cod-egg collections began late, but the take of eggs was satisfactory, and the total number secured was above the average of recent years. While comparatively few cod were caught on the inshore grounds, a very large percentage of them contained ripe eggs, and to this fact may be attributed the success of the work. It was possible to hatch all eggs collected prior to April 28, but, as usual, variations in the density of the water after that time necessitated the planting of the eggs immediately after fertilization. A total of 741,915,000 cod eggs was handled.

There was no large body of haddock on the inshore grounds, so that the slightly more than 250,000,000 eggs taken during the season were derived chiefly from one boat. The spring flounder-fishing operations resulted in a catch of 523 adults in fyke nets. From these 221,480,000 eggs were secured. A very satisfactory number hatched, and the fry were planted locally.

Arrangements to fertilize cod eggs on the offshore fishing grounds were made during February and March. Three spawn takers did this work, and the results were about the same as in recent years. Some haddock eggs were handled also in connection with this field work. It is notable that the haddock eggs were taken by otter-trawl vessels, while the majority of the cod eggs were secured by hand trawlers.

### Woods Hole (Mass.) Station

(G. R. Hoffses, Suprintendent)

In addition to its regular work with cod and winter flounder, the station again undertook the propagation of mackerel during the spring. Sheathing and painting of walls, rearrangement of the chemical laboratory for more efficient utilization of the space, and the partitioning of two more laboratory rooms were done during the year. A rusted steel beam in the foundation of the building was replaced with a wooden one. Additional toilet facilities were installed in the residence building. All roofs were thoroughly overhauled, and the gas line was extended into the buildings. Bituminous coal was used satisfactorily in firing all of the boilers instead of the expensive hard coal heretofore used. A new engine was installed in launch *No. 30*.

A stock of brood cod was secured from traps at Newport, R. I., and from local hand-line fishermen. Fish to the number of 3,456, virtually the capacity of the retaining pool, were obtained. A boat equipped with a well was chartered for transferring the fish from Newport, and the losses hitherto experienced were largely eliminated by simply reducing the speed of the vessel to about twice the normal running time. Over 230,000,000 eggs were taken, which proved to be of average quality. Egg collections were slightly smaller than those of last year, though a larger number of fish was on hand. In January the first fyke nets were set at Waquoit, Mass., to catch winter flounder. Operations with this species in Rhode Island waters were discontinued because changing conditions have rendered it difficult and unprofitable to work in this field. A stock of 3,979 flounders was secured, and from January 25 to March 15 over 695,000,000 eggs were taken from them. Hardening of the eggs was again the cause of considerable mortality. An attempt was made to fertilize the eggs by the incision method, but with little success. The flounder eggs as well as the cod eggs showed a slightly higher mortality under a closed-circulation water supply than when the open system was employed. Eggs of the mackerel were obtained from near-by traps, which were visited regularly for the purpose of securing specimens. Over 6,000,000 eggs were secured and incubated. Observations on alewives and white perch in near-by waters were made with the object of obtaining data as to the practicability of propagating these forms. The findings indicate that the probable results would not be commensurate with the effort involved. The usual exhibit of live fish was maintained during the summer and attracted considerable attention.

## ANADROMOUS SPECIES, ATLANTIC COAST

An unusually heavy run of shad in the Potomac River and a much larger number of eggs taken at the Edenton (N. C.) station made it possible to increase the number of fish hatched by 100 per cent over last year. The hatching of striped bass on the Roanoke River at Weldon, N. C., was carried on by the Edenton station. Propagation of the Atlantic salmon in Maine was made possible by a continuance of the practice of obtaining the eggs from the Canadian Government on an exchange basis.

### Bryan's Point (Md.) Substation

(L. G. Harron, Superintendent)

The largest catch of shad for a number of years in the Potomac River was reflected in a very successful season at the bureau's most important shad station. The station was opened in March, as usual, and a sufficient stock of adult yellow perch was secured from fishermen to produce over 138,000,000 fry for distribution in Potomac waters. The run of shad was somewhat late in starting, but fish were very abundant when the run became established. Over 43,000,000 eggs were obtained by the close of the season late in May, which yielded nearly 41,000,000 healthy fry. This output was virtually 100 per cent greater than that of the previous year.

At the close of fish-cultural operations the work of dismantling the station was begun preparatory to transferring it to a new site at Fort Humphreys, Va., on the opposite side of the river. At the close of the year all preliminary work at the new site, including the construction of docks, was completed, and the necessary buildings were in course of erection.

### EDENTON (N. C.) STATION AND SUBSTATION

(WILLIAM S. VINCENT, Superintendent)

Herring-collecting operations closely approximated the work of former years. Weather conditions were somewhat adverse, but over 220,000,000 eggs were taken. Only about 20 per cent of these hatched, but this is about the average of former years. It is very gratifying to report that the production of shad was larger than usual. The station depends upon a single fishery for its supply of eggs. This year only about 20,000 fish were taken, 5,000 less than last season. However, there was a much larger percentage of ripe roe shad in this number, and about 8,000,000 eggs were obtained. On several occasions the collecting launch was unable to reach shore, which made it necessary to fertilize the eggs and plant them immediately. Shad fishing in upper Albemarle Sound was better than for several years past. It is difficult to explain this condition, in view of the very poor catches of the past few years.

From a stock of 800 adult yellow perch over 11,000,000 eggs were obtained, and a very large percentage of them hatched. At this station, brood yellow perch are placed in the ponds and bundles of small branches are distributed at various depths. The eggs deposited adhere to these branches, which are then collected and the eggs transferred to hatching jars for incubation.

*Weldon (N. C.) substation.*—The hatching of striped bass at this point, which had been discontinued since 1923, was resumed on May 1, 1928. Hatching equipment from the Edenton station was transferred to Weldon, and other necessary apparatus was furnished by the State of North Carolina, which cooperated in the work. The Roanoke River was extremely high, the weather was unfavorable, and the fluctuation in water level seriously hampered fishing operations. Consequently the collection of eggs was not as large as had been anticipated. A very good percentage of hatch was secured, however, and no trouble was experienced from polluted water, which was the deciding factor when the work was discontinued in 1923. About 7,000,000 fish were hatched and planted in the Roanoke River adjacent to Weldon.

## FISHES OF MINOR INTERIOR WATERS

This numerically insignificant proportion of the bureau's output consumes a disproportionate share of the funds and facilities provided for fish-cultural work. Virtually every mile of stream in the country and every pond or lake of an area greater than 1 acre is a potential depository for Government fish, not only once but continually, in view of the constant drain on fish life imposed by heavy fishing.

It is obvious that the product of 23 hatcheries must fall short of meeting such a demand. The bureau recognizes further that the efficiency of a station can not be measured by the number of fish produced alone, but by the size and condition of the fish as well. The various trout and pond stations have therefore been put to the necessity of devising expedients for the production of larger fish at the same time that they are producing more of them. In most instances, where physical limitations permit, this requirement has been met, as the constantly increasing records of production will show.

While trout can not be reared at strictly pond stations, the warm-water varieties can be propagated in conjunction with other forms. Consequently these stations are able to distribute a limited number of bass in addition to the trout they produce. The supply, however, is insufficient to compensate for the general shortage of warm-water varieties, and the bureau is obliged to fill requests for 15 or 20 cans of fish with one-third that number.

## ROCKY MOUNTAIN TROUT STATIONS

This group of stations, six in number, maintains a high rate of production but is required to take care of a very extensive range of territory from the coast ranges to the Middle West. As headquarters for field operations, they are able to divert surplus eggs to State hatcheries and other bureau hatcheries. Several of these hatcheries have attained new high records of production during the past year.

### BOZEMAN (MONT.) STATION AND SUBSTATIONS

(W. T. THOMPSON, Superintendent)

Extensive development of the main station and its substations took place in this field during the year. A new 18-inch water-supply line was run from the spring to the hatchery and pond systems. This work was not entirely completed at the close of the year, but it will soon be finished. A number of rearing ponds were remodeled entirely. Extensive improvements to the superintendent's and foreman's residences were made, and still more work along this line remains to be done. The old wooden bridge on the station reservation was replaced with a new steel and concrete structure. The food house was moved and placed on a new concrete foundation.

The fish-cultural work has been exceeded by the record of one year only, and in certain respects, particularly in the Loch Leven-trout work, the past year's operations constitute a record. The development of Octomitus among the brook-trout fingerlings was the most serious setback of the year. Fully one-half the stock was lost due to this disease. The use of warmer spring water than heretofore resulted in more rapid growth of the black-spotted and rainbow trouts, and these fish were of a suitable size for distribution at an earlier date than in any previous year.

Much of the success in the Bozeman field is due to the hearty cooperation extended by the State of Montana. Many exchanges of eggs have been effected, and arrangements were made in some cases for distributing fish from the State hatcheries, thereby effecting considerable saving in the bureau's work. The State also made an outright donation of over 2,000,000 grayling eggs. All brook-trout eggs were received by purchase or exchange or by transfer from other stations of the bureau. The fingerlings on hand at the opening of the year exceeded 500,000, and these were distributed during the remainder of the year.

There was also established on Federal land, controlled by the livestock experiment station at Miles City, Mont., an 80-acre bass pond. The work was carried on jointly by the State of Montana and the bureau's employees, the State furnishing all money needed for the construction. While this pond has received no brood stock as yet, it will be completed in time to produce fish next year.

*Meadow Creek (Mont.) substation.*—A small cabin for the accommodation of spawn takers was constructed at Odell Creek during the year, and a 2-car garage was provided for the substation on Meadow Creek. This station has been equipped with an electric-power line and is now wired for both light and machinery. The number of Loch Leven-trout eggs collected at this point again exceeded previous records, with a total of almost 15,000,000 eggs. Nearly half of them were transferred by truck to Bozeman and other stations in the green stage, this method of shipment proving satisfactory in every way. Over 7,500,000 eyed eggs were shipped later, and the output of eggs in the green and eyed stages amounted to 96½ per cent of the total collection. The season's operations with the rainbow trout were somewhat disappointing. Weather conditions during the spawning season were not markedly unfavorable, but the run of fish was small, and less than 2,500,000 eggs were taken. These were of excellent quality, and 90 per cent were brought to the eyed stage. Nearly 700,000 fingerlings of this species were returned to the parental waters. This station also handled native black-spotted trout, which were furnished by the State to be planted on a cooperative basis. At the opening of the year 1,500,000 eggs of this species were on hand, and the resulting fry were planted in near-by waters. A consignment of 730,000 eggs was received in June and was on hand at the close of the year. Grayling eggs furnished by the State were hatched also, and 1,850,000 fry of that species were produced and distributed.

*Glacier Park (Mont.) substation.*—The 1,500,000 black-spotted and rainbow-trout eggs on hand at the opening of the fiscal year were hatched, and the resulting fry and fingerlings were distributed in Glacier Park waters under the cooperation of the park service. Grayling fry to the number of 725,000 were also planted in the waters of the park. Twenty-five thousand eyed eggs of the golden trout of California were furnished to this substation late in the year through the courtesy of the California Fish and Game Commission. These will be hatched and the product planted in high-altitude lakes.

### LEADVILLE (COLO.) STATION

(C. H. VAN ATTA, Superintendent)

The extensive equipment of the Leadville station enables the station force to accomplish important development work without recourse to outside assistance. During the year the water-power line was extended to the new shop building and connected with a water wheel for operating a sawmill and other machinery. The shop building, which is 36 by 50 feet and has two stories, was virtually completed, and foundations were laid for a large garage building. A sawmill outfit was purchased, and over 30,000 feet of logs were cut into flooring, sheathing, and molding.

Seven field stations, consisting of private lakes of varying size and number, were worked for brook or rainbow trout eggs. These operations are conducted on a share basis, the bureau generally supplying the men and equipment and allotting a portion of the eggs taken to the owner of the property. Almost 7,000,000 eggs of the two species mentioned above were secured in this manner. In addition to the work with these species, the Leadville station received shipments of black-spotted, Loch Leven, and lake trout eggs from other stations. One hundred thousand Loch Leven and 190,000 block-spotted trout fingerlings were on hand at the close of the year.

### YELLOWSTONE NATIONAL PARK (WYO.) SUBSTATION

(C. F. CULLER, in charge)

Inasmuch as a crew was unable to reach the station until June 4, the major portion of the work in this field was done in the fiscal year 1929. The season was unduly late in starting, and the first eggs were taken about a month later than last year. Aside from the usual repairs required by buildings unused a great part of the year, a new pipe line almost a mile long was laid from the head of Soldier Creek to the site of the new hatchery to be built during the 1928 season. An intake dam was constructed and fenced and the water conducted to a collecting basin about halfway to the hatchery site. The hatchery dock also was extended and repaired.

The take of eggs, amounting to 13,300,000, was below normal, although it slightly exceeded that of the previous year. Over 50 per cent of the eggs were secured from streams of the South Arm, although 12 streams were fished. Distribution of fry to distant points on Yellowstone Lake was facilitated by placing troughs on the boat and utilizing a small artificial pump for the water supply. The fry can thus be transferred without loss while they are still on the trays. The incubation of the eggs was more successful than last year, approximately 88 per cent having been fertile. A continuation of the plan followed last year of detailing a park employee to conduct parties through the hatchery and explain its operations has resulted in a minimum loss of time from fish-cultural work from interruptions. Thanks are due to the superintendent and other officials of the park staff for their aid and cooperation in facilitating the operations of the bureau.

### SARATOGA (WYO.) STATION

(S. M. AINSWORTH, Superintendent)

Only minor repairs were made to the water-supply system, station buildings, and grounds, as it was anticipated that more extensive improvements would be made under the special appropriation that will be available during the coming year. The collections of brook-trout eggs made by the field station at Big Creek Lakes were somewhat smaller than in previous years and fell short of last year's figures by approximately 100,000. The station brood stock of brook trout yielded about 300,000 eggs, and a number of eggs were received from other stations, which made possible a satisfactory spring distribution and left 738,000 fingerlings on hand at the close of the year. Considerable trouble was experienced with the eggs taken in Big Creek Lakes, and the losses were heavier than normal. A fairly satisfactory number of eggs was derived from the Loch Leven brood stock, although a serious loss occurred among these fish just at the opening of the spawning season, due to the clogging of a supply pipe to one of the ponds. In the Lost Creek field 3,272,000 rainbow-trout eggs were collected, approximately 800,000 of which will be used for stocking parent waters. A shipment of black-spotted trout eggs was received from the Yellowstone Park in July, 1927, and the resulting fry were distributed during the fall. A shipment of early black-spotted trout eggs was received in April, 1928, from the State of Nevada, to be replaced later with eggs from the Yellowstone Park field. In this way fish are brought to the fingerling size much earlier, making it possible to handle them in conjunction with the distribution of brook and rainbow trout. The Saratoga station carries over a large stock of all three species, as its distribution begins late and is carried on through the end of the fiscal year.

### SPEARFISH (S. DAK.) STATION

(D. C. BOOTH, Superintendent)

The pond system at this station was enlarged and improved. A pipe line will be laid from the source of supply in the city park to the concrete ponds in order to increase the volume of water. A substantial concrete wall was built along both sides of the main-entrance driveway. The usual cooperative fish-cultural work was carried on with the State of South Dakota. The State paid for approximately 2,000,000 brook-trout eggs purchased from commercial dealers, and the station furnished a number of Loch Leven trout eggs, which were repaid with brook-trout eggs from this shipment. Over 1,220,000 fingerling trout were distributed in various parts of the State under this arrangement, and it is felt that the results obtained justify a continuation of such work. A number of commercial fish-cultural projects have been established recently in the Black Hills territory, and the station personnel has been able to render some assistance and advice in this work. A satisfactory take of eggs from the station stock of brook, Loch Leven, and rainbow trout was secured. Almost 1,500,000 trout of the three species were distributed from the bureau's stock of fish.

### SPRINGVILLE (UTAH) STATION

(CLAUDIUS WALLICH, Superintendent)

In addition to painting all the station buildings, certain repairs were made to some of the station ponds. The station brood stock of rainbow trout produced over 1,500,000 eggs, of which about 70 per cent hatched. The distribution of the young fish resulting from these eggs was in progress at the close of the year. At the opening of the year there were on hand almost 500,000 rainbow-trout fry hatched from eggs taken at Fish Lake during the preceding spring. By June 30, 1928, all of these had been distributed with the exception of 10,000, which are being reared to replenish the brood stock.

Wild rainbow-trout eggs were taken on April 10 at Twin Creeks. As this collecting field is conducted in cooperation with and under the supervision of the State of Utah, the total number of eggs collected (about 6,000,000) was divided between the two agencies, the bureau receiving 1,523,000 eggs of average quality as its share. A number of eggs were shipped to Honolulu, and the fry from the remaining stock are being reared for fall distribution. While the rainbow-trout eggs were being taken, a number of fish that appeared to be silver salmon were noted. These fish were in poor condition, and a number of eggs that were taken and fertilized failed completely to show any development.

Brook-trout eggs were collected in the Twin Creeks field in October and November. The run of fish was good, and 2,606,000 eggs were secured for the bureau's work in addition to about 4,300,000 allotted to the State. All but

800,000 of the bureau's eggs were shipped to other points. A great many of the fry hatched from the eggs retained at this station died, but those that survived developed well and were reared to fingerling No. 2 size and distributed in the spring. Eggs from the same lot shipped to the Saratoga station failed to develop this trouble, and the heavy mortality can not be explained.

On July 28, 1927, a cloudburst caused the Rock Canon Creek to overflow its banks and flood the station grounds, which were covered with a thick layer of mud; but the water supply was so situated that it was not affected, and apparently no fish were lost.

### NEW ENGLAND TROUT AND SALMON STATIONS

The intensive drain upon waters of the populous northeastern section must be counteracted by the output from the hatcheries situated in Maine, New Hampshire, Vermont, and Massachusetts. The Craig Brook (Me.) station is the only agency in the United States, outside of several of the Maine State hatcheries, that handles the Atlantic salmon. It is also one of the few hatcheries that propagates the landlocked salmon.

#### HARTSVILLE (MASS.) STATION

(E. P. THOMPSON, Acting Superintendent)

Attention to routine work and necessary maintenance and repairs to buildings, equipment, and grounds constituted the only activity, outside of fish-cultural work, of the Berkshire hatchery. The spring-water supply was above normal in abundance during the spring months, and it is believed this was the cause of producing a very satisfactory output of fry and fingerling fish. The station brood stock of brook trout yielded approximately 275,000 eggs, and from these and a lot of eggs purchased from a commercial fish-culturist approximately 300,000 fry were obtained. A number of rainbow-trout fingerlings held over from the previous season were distributed, as were a lot of lake-trout fingerlings. The station received 500 adult horned pout and about 100 smallmouth black bass. Weather conditions during the spring appeared to militate against obtaining favorable results from the latter. In contradiction to the usual situation at this station, there was only a normal loss of fry after hatching, and the fingerlings showed good growth and only slight losses at the close of the year. A carload shipment of brook trout to Pennsylvania was made during the spring, and the station distribution was carried on intermittently to the close of the year.

#### CRAIG BROOK (ME.) STATION AND SUBSTATIONS

(GEORGE N. MONTGOMERY, Superintendent)

Extensive improvements to the buildings, grounds, and water supply were made during the year. A sluiceway was constructed in Craig Brook to handle the brook flow, and a flume was built to conduct water from the intake tank at the brook for the south ponds. Four ponds in the above system that had been out of service for a number of years were dug out and cement inlets and outlets supplied. On the west side of this system five similar ponds were likewise put in usable condition. A dam across Craig Brook near the lower hatchery was completed, and by the installation of racks and screens a raceway capable of handling at least 50,000 fish was formed. Repairs were made to the main cement supply dam, and the reservoir above this is now available as a rearing pond. In addition to this and other work, which materially increased the station's capacity, the buildings were kept in good repair and many minor improvements effected.

Brook-trout eggs obtained from the station brood stock amounted to almost 1,500,000, and more than 1,100,000 of these hatched. All of these fish were distributed at various ages, with the exception of 73,600 that are being held over for distribution in the fall. A number of brook-trout eggs from commercial sources and from exchanges also were handled, giving additional fingerlings for distribution. The station opened the year with more than 250,000 brook-trout fingerlings carried over from the previous year. These were distributed in the fall of 1927, with the exception of the small number reserved to keep up the station brood stock. All of the 42,070 landlocked salmon on hand at the beginning of the year were distributed. A small number of landlocked-salmon eggs were obtained during the fall collections at Green Lake and Grand Lake Stream auxiliaries, as well as over 200,000 from the State hatchery at Caribou, Me. Slightly over 100,000 fingerlings of this species remained on hand on June 30 for distribution later in the year.

A few Atlantic-salmon fingerlings on hand at the beginning of the year were distributed. Over 1,500,000 eggs of this species were received during the winter from the Canadian Government. Several shipments of 50,000 eggs were made to various State hatcheries in Maine. The fingerlings resulting from the eggs retained at the station exceeded 1,000,000, and these were distributed during the spring by the fisheries car and by the State wardens in suitable streams in eastern Maine. Small numbers of smallmouth black bass and white perch were secured in Green Lake and furnished to applicants in other parts of the State. The collection of humpback-salmon eggs from Dennys River was discontinued, as it was felt that the small demand for these fish could be adequately taken care of through natural reproduction.

*Grand Lake Stream (Me.) substation.*—The development of this station into an important auxiliary of the Craig Brook station has continued. Three new rearing ponds were constructed in an old canal. Each one, being approximately 25 by 100 feet, will carry 65,000 to 75,000 trout or salmon fingerlings. Similar ponds previously constructed have given splendid results. A new woodshed was constructed.

During the early part of the year 160,000 landlocked-salmon fingerlings held over from the previous year were distributed. Collections of eggs of this species were begun in October, but as usual the closing of the gates at Grand Lake Dam dispersed the fish and reduced the size of the take somewhat. The final figures showed a total of 739,550 eggs. Among the fish taken was a very large number of young males weighing about a pound and a number of small females spawning for the first time. This is a source of gratification, as it indicates the effectiveness of the stocking done in the past. In late November a heavy mortality of eggs occurred, particularly among the older ones. Treatment with glacial acetic acid was effective in immediately checking the loss. One hundred and seventy-five thousand fingerlings were placed in the rearing ponds, and the remaining survivors were distributed during the spring. The year opened with 50,000 brook-trout fingerlings on hand. These were distributed shortly afterwards, because the rising temperature of the water made it inexpedient to hold them. The station received 350,000 brook-trout eggs from commercial dealers in the fall. The majority of the fish hatched from these were liberated as advanced fry, but over 100,000 were retained in the rearing ponds for subsequent distribution as larger fingerlings. All reports indicate that past stocking has been effective and that catches of brook trout are very satisfactory. This substation has only one statutory employee, and the increase in the number of fish handled emphasizes the need for another permanent man.

*Green Lake (Me.) substation.*—With the exception of the collection of approximately 25,000 landlocked-salmon eggs and a few bass, this station was on an inactive basis. The old boathouse was torn down.

## St. Johnsbury (Vt.) Station

(A. H. Dinsmore, Superintendent)

The November floods damaged the intake for the water supply from Sleeper River. It was necessary to make temporary repairs on the dam in order to operate the hatchery during the winter, and permanent repairs will be made as soon as possible. At the main station a large number of brook-trout eggs secured from the York Pond substation and from commercial dealers by purchase or exchange were hatched and the fish resulting therefrom distributed in the advanced-fry stage. Approximately 600,000 brook-trout eggs were hatched for two local fish and game associations. A few steelhead eggs of poor quality were taken from station stock, and a small number of salmon eggs transferred here were hatched. The station also cooperated with the State of Vermont in taking lake-trout eggs at Lake Dunmore, but the results were not up to expectations.

*York Pond (N. H.) substation.*—The construction of a commodious extension to the mess camp was begun at this station. In continuation of the extension of the pond and ditch system, several thousand feet of new pipe line were laid to the power house and hatchery and to a proposed new pond. One of the canals was extended and strengthened. Two new ponds were constructed and a third started. New raceways were laid out, and the hatchery capacity was augmented by three new double troughs.

With regard to fish-cultural work, 1,600,000 brook-trout eggs were collected, which is about three times as many as were taken last year. The brood stock was carried through with virtually no loss. Approximately 10,000 wild fish were caught by hook and line and reserved for future brood stock. Adult fish were removed from the stock ponds with traps, seines, and by the use of quicklime to stupefy them after the ponds had been drawn down. An unusual degree of success attended the rearing of the young fish. It is thought that losses among them were held to a minimum because it was possible to control the temperature of the water by means of a new supply from Cold Brook. At the close of the season many fish were being held in water having a temperature of 65°, with no detrimental effect. Small females were left in the raceways and allowed to spawn naturally, with the result that a considerable number of fry were secured in this manner.

### NASHUA (N. H.) STATION

(J. D. DEROCHER, Superintendent)

One of the major items of repair work at this station was the completion of the upper supply pond by grading the shores. Part of the pipe line from this pond to the nursery ponds was laid, and a new bass pond was completed with the exception of placing sand and gravel along its margins. The station carried a brood stock of both brook and rainbow trout, and during the fall the former yielded 136,160 eggs while 315,190 eggs were obtained from the latter. A small number of rainbow-trout eggs also was taken from wild fish at the Lebanon (N. H.) collecting station in the spring. Over 1,000,000 brook-trout eggs were obtained from commercial hatcheries and by exchange. Extremely heavy losses were experienced with both the brook and the rainbow trout, so that the distribution was somewhat limited. However, the distribution of the brook trout as a whole for the year was fairly satisfactory, and the fiscal year opened with 522,245 fingerlings No. 2 on hand. There were also almost 100,000 fry and fingerling rainbows in stock at that time. All fingerlings of both species were distributed in the fall of 1927. During July, 1927, about 15,000 smallmouth bass fry were collected from near-by waters. A few catfish also were handled. Almost 10,000 landlocked-salmon fingerlings were on hand at the close of the year.

## COMBINATION TROUT AND POND STATIONS

The production of warm-water species at this group of five stations is supplemental to the propagation of trout. They are situated near the border line for cold-water fish and consequently meet a demand for fish adapted to widely varying conditions. The individual reports show that a high rate of production of incompatible species at the same hatchery can not be maintained.

### ERWIN (TENN.) STATION

(A. G. KEESECKER, Superintendent)

During the year the station plant was improved by the construction of approximately 500 feet of concrete wall to protect the pond embankments. Two terra-cotta pipe lines were laid to provide additional water for some of the ponds. The construction of a new highway through the station grounds has caused the surface wash to enter the supply canal and ponds. Wooden outlets and drains were replaced with new ones of concrete. Several thousand cubic feet of mud and filth deposited by this wash were removed from three of the ponds. A new galvanized-iron roof was put on the carpenter shop. While the improvements made during the past year have to some extent offset the damage caused by the new road, it will be necessary to make further changes and particularly to build a concrete basin for retaining the water before the trouble can be eliminated completely.

Over 1,000,000 rainbow-trout eggs were taken from the station brood stock between the months of November and February. Two lots of brown-trout eggs were incubated at the station for private parties. All brook-trout eggs handled were purchased from commercial dealers, and an average number of fingerlings was produced. The output of rainbow trout was considerably larger than usual. With regard to the production of pond fish, heavy rains retarded the distribution and probably cut down the output. Approximately 34,000 fry and fingerling largemouth bass were distributed, and it is estimated that about 20,000 remained in the ponds at the close of the year. An average production of rock bass and sunfish is expected. The station cooperated with other departments of the Government by furnishing large numbers of tadpoles to the Chemical Warfare Service at Edgewood, Md., and to the Pharmacological Service in Washington, D. C.

### MANCHESTER (IOWA) STATION

(G. H. GILL, Superintendent)

Over twice the number of rainbow-trout eggs that were secured in the previous year were taken from the station brood stock this season. A particularly interesting occurrence was the production of a large number of eggs of the highest quality by the 2½-year-old trout. Operations with the smallmouth black bass and other pond species were not very successful. During the year 785,000 brook-trout eggs were procured from commercial hatcheries, but an epidemic of gill disease occurred among the resulting fingerlings. At the close of the year approximately 100,000 rainbow-trout fingerlings and 235,000 brook-trout fingerlings were on hand. The ponds for the warm-water fishes were lined during the season, and four new metal hatching troughs were added to the station equipment. Considerable work was accomplished in the construction of cement walks, steps, etc., and the pond system was improved by the construction of dikes and the building of cement supply cribs and outlets.

### NEOSHO (MO.) STATION AND SUBSTATION

(W. H. THOMAS, Superintendent)

In December a special appropriation became available for making improvements to the Neosho station. The superintendent's residence was repaired extensively both inside and outside; the house was rewired and the interior refinished. Improvements were made to the annex building, also. The grounds were beautified by planting trees and flowers, the entrance approach was widened, and new concrete walks were constructed where needed. A diminution in the spring-water supply is ascribed to the clogging of the line with sediment. Some difficulty has been experienced with the drain lines from the ponds. Extensive improvements were made to the pond system.

The rainbow-trout brood stock was segregatde according to age, and it was found that eggs from the younger fish were of much better quality than the others. All rainbow brood stock over the age of 3 years was planted. Infection with the parasite gyrodactylus gave rise to considerable trouble among the fingerlings, but treatment served to bring it under control. The station distributed about 233,000 rainbow and Loch Leven fingerlings and handled several million eggs from the station brood stock and from Bourbon substation. There was a continuation of the difficulty arising through seepage from the ponds containing warm-water fish. It was attempted to make the ponds more productive by fertilizing them and allowing them to remain dry several weeks during the winter. The production of bass during the spring of 1928 was rather disappointing. Approximately 17,500 fingerlings were collected, but the muddy water rendered it impossible to determine how many more remained in the ponds. Rock bass, crappie, and sunfish also were handled, but it is evident that the production will be limited. Sixty adult channel catfish were transferred to the station in the hope that they would propagate. The majority were lost during the winter, and it was necessary to plant the rest in local waters.

*Bourbon (Mo.) substation.*—This cooperatively operated substation produced rainbow-trout eggs of good quality, the season's collection being the largest since the bureau began to operate at this point. Parasitism by gyrodactylus caused trouble with the fingerlings at this substation. Heavy rains in June caused the water to rise and resulted in the loss of some fingerlings. It is possible, also, that a few of the larger fish escaped. At this station horse meat was fed instead of the usual sheep liver.

*Langdon, (Mo.) substation.*—The number of warm-water fish obtained from the ponds at this station exceeded that of the previous year, but it did not equal earlier records. This may be due partly to the fact that the ponds were flooded in August, during which time many fingerlings escaped.

### White Sulphur Springs (W. Va.) Station

(Edward M. Haynes, Superintendent)

The year's work reached a new high level in the number of eggs and fish handled, which totaled 6,238,000 and was 1,416,000 in excess of the number handled in the previous year. No changes or expansions of importance were made to the plant. The painting of most of the buildings constituted the most important work in the way of routine maintenance. One cooperative trout nursery was operated under the supervision of this station. The usual cooperative arrangement with the State of West Virginia, whereby the bureau incubated over 1,000,000 eggs for the State in return for a share of the fry, was continued. Virtually all the brook-trout eggs handled were purchased or received by exchange. From the 2,400,000 received, 2,000,000 fish were had for distribution. Some feeding experiments with brook trout were conducted. The station has built up a brood stock of Loch Leven trout, which supplied over 375,000 eggs of high quality. A shipment of this species from the Bozeman (Mont.) field was handled for the State of West Virginia, and some were kept to meet the bureau's needs. The Loch Leven brood stock will be increased until it is large enough to take care of the needs of this station.

All rainbow-trout eggs were taken from the station brood stock, which has been built up so that it yields over 3,000,000 eggs. The eggs are secured from 2, 3, and 4 year old fish. The quality of the eggs was hardly up to that of former years, but a good output of fish for distribution was attained and a number of egg shipments were made, including four to Costa Rica, Peru, Switzerland, and Germany. A noteworthy carload shipment of 315 pails, carrying 465,000 fish, was made during the distribution of the fish belonging to the State of West Virginia.

The pondfish work was again affected by extreme variations in the weather. A moderate production of rock bass of the previous season's hatch was secured during the fall distribution. As has been the case for several years, there was no production of sunfish of any consequence in spite of every effort to secure them. The same unfavorable climatic conditions affected the production of bass, limiting the spring distribution to about 32,000 fish. It is believed that at least 20 nests were lost from this cause. It is hoped that a fair stock of fingerlings remains in the ponds.

### Wytheville (Va.) Station

(C. B. Grater, Superintendent)

The usual work of keeping the station and grounds in good condition was done by the station force. This work would have cost about $2,000 if it had been performed by employees especially hired for the purpose. Considerable success attended the fish-cultural work, and an unusually large number of rainbow-trout eggs of high quality was obtained. The season's work was marked by the absence of an outbreak of octomitiasis, which usually appears during the spring. Consequently, an excellent stock of fry and fingerlings was obtained. An epidemic of octomitiasis attacked the yearling fish retained for brood stock. After thorough sterilization of equipment the trouble seemed to have been checked, but it was necessary to replace the lost fish with 3,000 from the Erwin (Tenn.) station. There was also some loss of adult brood fish during the spawning season due to an attack of furunculosis. Treatment with potassium permanganate served to abate this in some degree.

This station has engaged in the development of cooperative nurseries in conjunction with the State of Virginia, and several of these units were established and supplied with fish, while sites for several others were inspected. Fish already distributed were from 80 per cent of the eggs collected, while 3.34 per cent remained on hand at the close of the year. The brook-trout eggs purchased from a commercial producer were unsatisfactory in that the losses of fry amounted to about one-third of the total number. Sufficient fingerlings were obtained, however, to meet the normal demands and to provide a small stock for several of the rearing pools adapted to this species.

Although the brood stock of largemouth bass was increased considerably, only a limited number of fish was produced, because climatic conditions were not right. Five thousand nine hundred fish produced in the previous year were distributed. The conditions affecting the largemouth variety also militated against a satisfactory production of the smallmouth form and likewise retarded the development of daphnia, which is food for the young. Only about 6,000 fish were distributed, but a number of fry were held over for distribution in the fall. A considerable number of rock bass were handled, as well as limited quantities of sunfish and catfish.

## PONDFISH STATIONS

Some of the hatcheries in the Southern States again exceeded previous records. Pond stations, however, are particularly susceptible to unfavorable weather, which has reduced the output in several instances. The pond area has been extended and the water supply improved wherever possible.

### COLD SPRING (GA.) STATION

(CHARLES A. BULLOCK, Superintendent)

A number of the ponds at this station were enlarged, some were consolidated, while in others the old wooden overflows were replaced by a new device made of concrete. Several hundred feet of concrete flume, 3 feet in diameter inside, were constructed with the view of consolidating two of the ponds. A ditch leading to a highway culvert had been washed out, and it was necessary to construct a concrete flume to take its place. This flume is over 500 feet long, and the inside diameter is 4½ feet. Leaks in the water-supply system made other improvements necessary. Most of the station buildings were painted. All ponds were heavily limed during the winter, and as a result there has been a marked diminution in the growth of detrimental plants, and several of the ponds, which had been virtually worthless previously, produced a number of fish. While no new adult brood bass were secured during the year, the production was kept up by the addition of some cull stock and some young fish taken from the station rearing ponds. The year's output of largemouth bass was slightly less than 300,000.

The Harris substation was maintained as usual except that the former practice of feeding the adult fish was abandoned. By drawing the ponds down quickly and eliminating seining operations a very satisfactory production of bream was secured and at a much lower cost as compared with previous years. Due to the depredations of bass that escaped into one of the bream ponds, the production of bream at the main station was small, the yield being about 53,000 from the two ponds devoted to that work. A similar accident reduced the production of catfish, only about 7,000 fingerlings having been obtained from a brood stock of 100 adults.

### EDENTON (N. C.) STATION

(W. S. VINCENT, Superintendent)

A new wire fence was placed along the boundary of the station grounds adjoining the new State highway, which connects the hatchery directly with the town of Edenton. The electric-light line, formerly conducted under the creek by a submarine cable, was replaced by a line carried along the new highway. Considerable repairing of the station vessels was necessary to keep them in running order.

The fish-cultural work of the past season was quite successful, although the pondfish work did not produce as good results as could be desired. Small shipments of sunfish and crappie were made, but the bass work in the spring of

1928 was below normal, due to unfavorable weather conditions. The first collections of fry were made 30 days later than usual, and the spring shipments numbered only about 47,000. The fish were somewhat larger than usual, and it is expected that when the ponds are drawn in the fall it will be found that the production of fingerlings was satisfactory.

### Louisville (Ky.) Station

(Charles W. Burnham, Superintendent)

This station, which is the bureau's chief agency for the propagation of smallmouth bass, was operated successfully, although the output of fish did not equal the record of some earlier years. It was found necessary to build a concrete foundation under the hatchery building in order to prevent the complete settling of the structure. The residence buildings were painted, and other minor improvements to the buildings were made. Some new concrete walks were laid, and the station roads and driveways were regraded and made passable in wet weather. This station had a brood stock of 100 adult largemouth bass, but the output of fingerlings, for some unexplainable reason, was very small. However, the brood stock of 400 adult smallmouth bass, divided among four ¾-acre ponds, produced over 500,000 fry and almost 5,000 fingerlings. While this does not constitute a record output, it is well up to the average. Efforts to augment the brood stock by transferring adults from Lake Erie were hindered by heavy mortality experienced shortly after the fish were received. The station has one pond devoted to the production of sunfish, but virtually every fish of this species was lost, due to an epidemic of some sort, which apparently was introduced with stock brought from the Mississippi River. A small number of rock bass was produced, and a few channel catfish were collected for filling applications.

### Mammoth Springs (Ark.) Station

(Dell Brown, Superintendent)

Outside of painting and the construction of concrete floors and porches, few improvements were made to the buildings. One of the ponds was deepened and extended, and a new pond was virtually completed at the end of the year. The latter will be supplied from a new well by means of a pump capable of furnishing 100 gallons per minute.

Although an excellent stock of adult smallmouth bass was on hand, spawning was retarded by extremely unseasonable weather in the spring. A few nests established late in the spring produced about 68,000 fingerlings, approximately one-third the number that should have been obtained. A little better success attended the hatching of the largemouth bass, particularly those nests that lay in deeper water. About 66,000 fingerlings were shipped and 40,000 remained for fall distribution, a normal season's output. A satisfactory distribution of rock bass was made from the previous season's hatch. A brood stock of 100 sunfish also produced about 35,000 fingerlings for distribution.

This station engaged in rescue work in the overflowed area in Arkansas following the big flood. This work was carried on in cooperation with the State of Arkansas, and over 8,500,000 fish were returned to parental waters. At the close of the year the superintendent was detailed to supervise the construction of a large bass hatchery that is being established by the State of Arkansas.

### Orangeburg (S. C.) Station

(G. W. N. Brown, Superintendent)

The most important improvement made during the year was the building of a concrete tank to hold fish before shipping them. The water was taken from a spring previously used for holding such fish, its flow having been increased materially by excavating. An electric pump was installed to pump water into a storage tank, which is to be utilized to increase the flow of water while the fish are being held.

Weather conditions were very unfavorable to the propagation of pondfishes. Fish hatched early in March apparently were killed by a sudden cold spell. Heavy rains in April increased the handicap, with the result that only 167,430 bass could be distributed. It is believed, however, that a considerable number of fingerlings remained in the ponds, which may be shipped later.

The fall distribution of bream was satisfactory, and many applications for them were filled. The brood stock was increased, and it is expected that the output from the spring hatch will come close to making a record for this station. A few warmouth bass, crappie, and catfish also were hatched and supplied to applicants.

### San Marcos (Tex.) Station

(O. N. Baldwin, Superintendent)

At the San Marcos station many improvements were made during the year. The roof of the superintendent's residence was reshingled, and the interior was refinished. The foundation of the apprentice fish-culturist's cottage was reset, a new porch was built, some new roofing put on, and preparations were made to repaint it. The most important work was the reconstruction and enlargement of the ponds. Six ponds were consolidated or enlarged by deepening or raising the banks, by which several acres more of water surface were secured. A ditch was constructed and an embankment raised to prevent highway drainage from flooding the grounds and ponds. A new entrance gateway was constructed, and the piping in several ponds was relaid to provide individual connection with a concrete reservoir and improving the system materially.

A rack was started in a slough of the San Marcos River with the object of utilizing the area as a bass pond. It was necessary to remove considerable vegetation. The dwellings were wired for electric lights, and plans were made to extend this service to all the buildings as soon as possible.

A stock of brood bass was obtained from a fishing club in return for a stock of fingerling bass to be supplied later. The station has concentrated on the work of raising a larger number of fingerlings than heretofore, and the production of such fish increased approximately 30 per cent over earlier years. A smaller number of fish was obtained, but there were more cans of fish and more applications were filled. The output of sunfish has been reduced, due to lack of pond space. Few crappie are raised at the station, the majority being obtained from stock ponds in the adjacent country. The drying up of one of these ponds materially reduced the output during the past year. A brood stock of rock bass was reared at the station, and it appears that the spring hatch may permit a large output of fingerlings in the fall. Warmouth bass also are being produced in limited quantities. Other species handled were the green sunfish and the so-called Rio Grande perch.

*New Braunfels (Tex.) substation.*—This substation, sponsored by the town of New Braunfels, was moderately successful, having produced an output of almost 30,000 bass and sunfish.

*Medina Lake (Tex.) substation.*—This field station handles rainbow trout as well as pondfish. Due to the bad condition of the ponds, with attendant difficulty in holding water, the usefulness of the substation is questionable. The season's output was limited, and unless considerable work can be done in the way of reconstruction, it would be advisable to cease operations here.

*Fort Worth (Tex.) substation.*—At this station, which is newly established, five ponds have been built. This work required raising of over 1 mile of embankment. Several thousand feet of piping were laid, and the new banks were sodded with Bermuda grass. Heavy rains were detrimental to the latter work. At the close of the year there remained to be completed concrete outlets and intake boxes. The plant probably will be ready for the production of fish in 1929.

### Tupelo (Miss.) Station

(Charles R. Wiant, Superintendent)

During the year three new ponds having a total area of 8.77 acres were put into use. With these ponds, the previous pond acreage of the station has been more than doubled. A new centrifugal pump connected with a new well 432 feet deep was installed for feeding the pond system, and by means of this equipment a water supply exceeding 500 gallons a minute was made available. A new pump house was constructed. A new heating system was installed in the superintendent's residence, and minor repairs were made. The output of black bass exceeded the highest previous record by over 100,000. The year's distribution amounted to over 1,000,000, Tupelo being the first of the bureau's pond stations to attain this figure. Observations of the bass indicate that the age and vigor of the brood fish rather than the number available is the most influential factor in determining the output. It appears, however, that 50 bass to the acre is productive of the best results. Twenty thousand bass fry are being retained for fall distribution.

A number of reports were received indicating that plants of fry in new ponds gave very satisfactory results. Two species of sunfish were propagated in two special ponds and in the bass ponds, and 57,000 more than were needed to fill applications were obtained. A few warmouth bass and catfish also were handled. During the year, 728 separate applications were filled and a surplus of catfish was distributed.

A new substation at a leased pond near Aliceville, Ala., was established in the course of the year for the production of bass and sunfish, and a man was detailed there during the latter part of the year. The fish-rescue station at Friars Point, Miss., was in operation from July to October, and a somewhat larger number of fish than usual was handled, due to the terrific spring floods.

### Lakeland (Md.) Ponds

[Under direction of Washington office]

The operation of these leased ponds was more successful than for several years past. All fish were distributed as fingerlings, and over 75,000 good-sized fish were secured from the five ponds comprising the tract. Approximately 30,000 of these were largemouth bass, and the rest were sunfish and crappie. The ponds were heavily stocked with golden shiners and goldfish as forage fish, and this abundant food supply brought about splendid growth as forage fish. At the conclusion of the distribution in late October, the ponds were left bare for the winter and the brood stock was increased to 525 bass, about 70 crappie, and 50 bluegill sunfish from the Mississippi River. These wintered well and were distributed in the various ponds in the spring. For some unknown reason spring spawning appeared to be limited, and the stock of fingerlings in the ponds at the close of the year was considerably smaller than in the summer of 1927.

### CENTRAL STATION AND AQUARIUM, WASHINGTON, D. C.

[L. G. Harron, in charge]

For the benefit of the visiting public, efforts were made during the season to keep on hand a supply of the various species of fish eggs propagated by the bureau. These were from chinook salmon, rainbow trout, and cisco. A total of 1,396,275 of these eggs was received, and 1,320,000 fry obtained from them were distributed. The following fishes, produced at Lakeland, Md., and other stations or collected from the Potomac River, were received and distributed: 29,885 largemouth black bass, No. 3 fingerlings; 22,975 crappie, Nos. 2 and 3 fingerlings; 36,025 sunfish, No. 2 fingerlings; 16 adult smallmouth bass; 1,500 catfish, fingerlings No. 2; 265 yellow-perch yearlings; and 800 yearling roach. One thousand nine hundred and fifty-two fish of 35 species were exhibited in the aquarium during the year.

## Part 2.—DISTRIBUTION OF FISH AND FISH EGGS

[E. C. Fearnow, Superintendent of Fish Distribution]

The output of the bureau's stations—7,036,317,200 fish and fish eggs—exceeded that of last year by over half a billion. Increased outputs were had of some of the most valuable species, such as the shad and cod. Over 71,000 more fingerlings were produced in 1928 than in 1927, also. The increased output of fingerlings represents 15,000 cans of fish, or approximately 30 carloads. To transport the entire output for the year would require nearly 125,000 regulation containers, or 2,500 carloads. A large proportion of the fry and fingerlings were planted in waters in the vicinity of the hatcheries or released from the rearing stations into streams without resorting to shipment by rail. This is particularly true of the commercial species and rescued fishes.

Shipments of fish eggs were made to Costa Rica, Cuba, Ecuador, Germany, Peru, and Switzerland. About 95 per cent of the year's output consisted of eggs and fry of the commercial species, and virtually all of these, with the exception of the comparatively few furnished State fish commissions, were planted in the waters from which the eggs were obtained. Included in this classification are the glut herring, whitefish, cisco, salmon, pike, perch, yellow perch, carp, buffalo fish, cod, haddock, and winter flounder. The species distributed to interior waters are the brook trout, rainbow trout, black-spotted trout, and Loch Leven trout, the smallmouth black bass, largemouth black bass, crappie, rock bass, bream, and catfish. While the number of other fishes delivered represents but a small percentage of the entire output, at the time of shipment such fish were quite large and the distribution was a difficult problem. Fry of the commercial species are carried 50,000 to 100,000 to the pail, while not more than one hundred and fifty 3-inch fish can be carried in one of the regulation containers.

The trout distribution has become exceedingly heavy at the bureau's trout-producing stations, due to the establishment of a large number of cooperative nurseries in a number of the States. Small trout are delivered during May and June and are reared until they are 3 or 4 inches in length, when they are planted in suitable local waters. In addition to the general distribution to applicants during the spring and early summer, approximately 15 carloads of trout were delivered to cooperative projects in Pennsylvania, West Virginia, New York, Virginia, Minnesota, and Wisconsin.

The following table shows in summarized form the distribution of fish and fish eggs during the fiscal year to applicants in the United States and its territories. It also shows the plants of fish made by the bureau in public waters of the country in connection with the propagation of commercial fishes and the salvage of fish from temporary public lands.

*Summary, by species, of the distribution of fish, fiscal year 1928*

| State and species | Number |
|---|---|
| Alabama: | |
| Catfish | 920 |
| Crappie | 3,780 |
| Largemouth black bass | 223,890 |
| Sunfish | 72,875 |
| Alaska: | |
| Sockeye salmon | 12,967,000 |
| Brook trout | 28,000 |
| Arizona: | |
| Rainbow trout | 6,000 |
| Brook trout | 10,000 |
| Largemouth black bass | 1,000 |
| Sunfish | 225 |
| Arkansas: | |
| Catfish | 1,250 |
| Buffalo fish | 8,392,000 |
| Arkansas—Continued. | |
| Rainbow trout | 37,400 |
| Crappie | 1,850 |
| Largemouth black bass | 91,715 |
| Smallmouth black bass | 35,000 |
| Rock bass | 42,200 |
| Sunfish | 32,275 |
| Yellow perch | 100 |
| California: Chinook salmon | 6,559,700 |
| Colorado: | |
| Catfish | 8,000 |
| Rainbow trout | 548,750 |
| Black-spotted trout | 254,600 |
| Loch Leven trout | 206,000 |
| Lake trout | 166,000 |
| Brook trout | 4,548,100 |

*Summary, by species, of the distribution of fish, fiscal year 1928*—Continued

| State and species | Number |
|---|---|
| Colorado—Continued. | |
| Crappie | 1,200 |
| Largemouth black bass | 3,695 |
| Sunfish | 555 |
| Connecticut: | |
| Catfish | 800 |
| Loch Leven trout | 3,000 |
| Brook trout | 9,500 |
| Crappie | 75 |
| Largemouth black bass | 3,585 |
| Sunfish | 6,900 |
| Delaware: | |
| Rainbow trout | 2,000 |
| Loch Leven trout | 102 |
| Crappie | 3,400 |
| Largemouth black bass | 88 |
| Sunfish | 50 |
| District of Columbia: | |
| Rainbow trout | 22 |
| Loch Leven trout | 5 |
| Brook trout | 33 |
| Georgia: | |
| Catfish | 6,515 |
| Rainbow trout | 65,500 |
| Brook trout | 24,750 |
| Largemouth black bass | 188,550 |
| Rock bass | 1,000 |
| Sunfish | 72,000 |
| Idaho: | |
| Chinook salmon | 7,349,500 |
| Rainbow trout | 63,300 |
| Black-spotted trout | 173,900 |
| Brook trout | 7,000 |
| Illinois: | |
| Catfish | 5,011,550 |
| Buffalo fish | 45,945 |
| Carp | 133,650 |
| Brook trout | 900 |
| Pike and pickerel | 1,240 |
| Crappie | 3,016,590 |
| Largemouth black bass | 13,230 |
| Sunfish | 2,841,300 |
| Yellow perch | 240 |
| Miscellaneous fishes | 3,289,500 |
| Indiana: | |
| Catfish | 7,800 |
| Rainbow trout | 21,200 |
| Brook trout | 28,010 |
| Crappie | 7,600 |
| Largemouth black bass | 18,310 |
| Smallmouth black bass | 163,600 |
| Sunfish | 14,250 |
| Yellow perch | 1,070 |
| Iowa: | |
| Catfish | 42,236,625 |
| Buffalo fish | 792,905 |
| Carp | 1,331,350 |
| Rainbow trout | 21,650 |
| Loch Leven trout | 25,000 |
| Brook trout | 90,700 |
| Pike and pickerel | 160,230 |
| Crappie | 6,866,240 |
| Largemouth black bass | 65,330 |
| Smallmouth black bass | 1,785 |
| Sunfish | 7,660,550 |
| Yellow perch | 37,265 |
| White bass | 4,920 |
| Fresh-water drum | 600 |
| Miscellaneous fishes | 761,510 |
| Kansas: | |
| Rainbow trout | 80 |
| Largemouth black bass | 2,575 |
| Sunfish | 600 |
| Kentucky: | |
| Catfish | 200 |
| Rainbow trout | 4,400 |
| Crappie | 1,480 |
| Largemouth black bass | 3,600 |
| Smallmouth black bass | 370,625 |
| Rock bass | 3,250 |
| Sunfish | 370 |
| Yellow perch | 120 |
| Louisiana: | |
| Catfish | 612,000 |
| Buffalo fish | 682,605 |
| Crappie | 538,320 |
| Largemouth black bass | 256 |
| Sunfish | 500,450 |
| Fresh-water drum | 122,900 |
| Miscellaneous fishes | 6,400 |
| Maine: | |
| Atlantic salmon | 1,082,400 |
| Landlocked salmon | 441,540 |
| Brook trout | 1,915,980 |
| Crappie | 600 |
| Largemouth black bass | 1,350 |
| Smallmouth black bass | 26,296 |
| White perch | 1,200 |
| Winter flounder | 1,843,209,000 |
| Maryland: | |
| Catfish | 200 |
| Shad | 15,468,300 |
| Chinook salmon | 7,000 |
| Rainbow trout | 34,400 |
| Loch Leven trout | 400 |
| Brook trout | 111,700 |
| Crappie | 9,577 |
| Largemouth black bass | 6,986 |
| Sunfish | 9,240 |
| Yellow perch | 69,160,110 |
| Massachusetts: | |
| Catfish | 6,100 |
| Rainbow trout | 28,835 |
| Loch Leven trout | 1,000 |
| Lake trout | 8,200 |
| Brook trout | 187,300 |
| Crappie | 725 |
| Largemouth black bass | 4,575 |
| Smallmouth black bass | 8,500 |
| Mackerel | 5,212,000 |
| Cod | 884,008,000 |
| Sunfish | 5,000 |
| Haddock | 259,691,000 |
| Pollock | 138,373,000 |
| Winter flounder | 776,556,000 |
| Michigan: | |
| Catfish | 500 |
| Whitefish | 37,498,000 |
| Cisco | 875,000 |
| Rainbow trout | 185,000 |
| Lake trout | 23,217,000 |
| Brook trout | 684,050 |
| Crappie | 520 |
| Largemouth black bass | 1,960 |
| Smallmouth black bass | 43,070 |
| Sunfish | 4,040 |
| Yellow perch | 150 |
| Pike perch | 4,200,000 |
| Minnesota: | |
| Catfish | 5,222,200 |
| Buffalo fish | 2,045 |
| Carp | 220,320 |
| Rainbow trout | 97,750 |
| Loch Leven trout | 69,000 |
| Lake trout | 1,154,500 |
| Brook trout | 237,600 |
| Pike and pickerel | 255,218 |
| Crappie | 7,813,505 |
| Largemouth black bass | 66,950 |
| Sunfish | 9,810,970 |
| Pike perch | 3,480,000 |
| Yellow perch | 1,454,155 |
| White bass | 1,470 |
| Fresh-water drum | 500 |
| Miscellaneous fishes | 1,878,968 |
| Mississippi: | |
| Catfish | 2,217,765 |
| Buffalo fish | 462,125 |
| Carp | 742,200 |
| Pike and pickerel | 1,460,305 |
| Crappie | 1,017,590 |
| Largemouth black bass | 1,129,997 |
| Warmouth bass | 315 |
| Sunfish | 8,269,100 |

*Summary, by species, of the distribution of fish, fiscal year 1928*—Continued

| State and species | Number |
|---|---|
| Mississippi—Continued. | |
| White bass | 2,050 |
| Yellow perch | 1,440 |
| Missouri: | |
| Catfish | 1,732 |
| Rainbow trout | 512,274 |
| Crappie | 9,100 |
| Largemouth black bass | 14,539 |
| Rock bass | 2,000 |
| Sunfish | 13,465 |
| Yellow perch | 530 |
| Montana: | |
| Rainbow trout | 1,041,550 |
| Black-spotted trout | 3,376,250 |
| Loch Leven trout | 2,530,300 |
| Brook trout | 492,575 |
| Grayling | 725,000 |
| Largemouth black bass | 300 |
| Nebraska: | |
| Rainbow trout | 79,900 |
| Loch Leven trout | 21,000 |
| Brook trout | 171,000 |
| Nevada: | |
| Rainbow trout | 98,000 |
| Brook trout | 29,000 |
| New Hampshire: | |
| Catfish | 370 |
| Landlocked salmon | 15,175 |
| Rainbow trout | 57,280 |
| Loch Leven trout | 1,500 |
| Lake trout | 8,285 |
| Brook trout | 449,004 |
| Largemouth black bass | 4,450 |
| Smallmouth black bass | 5,000 |
| Pike perch | 600,000 |
| Yellow perch | 750,000 |
| New Jersey: | |
| Catfish | 500 |
| Loch Leven trout | 3,000 |
| Brook trout | 24,750 |
| Crappie | 1,050 |
| Largemouth black bass | 2,213 |
| Smallmouth black bass | 16 |
| Sunfish | 6,580 |
| Yellow perch | 175 |
| New Mexico: | |
| Catfish | 2,800 |
| Rainbow trout | 31,000 |
| Black-spotted trout | 900 |
| Brook trout | 44,000 |
| Crappie | 1,950 |
| Sunfish | 8,040 |
| Yellow perch | 1,825 |
| Largemouth black bass | 7,055 |
| New York: | |
| Catfish | 28,375 |
| Whitefish | 16,040,000 |
| Cisco | 85,950,000 |
| Rainbow trout | 40,200 |
| Loch Leven trout | 29,250 |
| Lake trout | 3,109,190 |
| Brook trout | 813,364 |
| Crappie | 3,160 |
| Largemouth black bass | 8,385 |
| Sunfish | 4,100 |
| Pike perch | 600,000 |
| Yellow perch | 2,801,310 |
| North Carolina: | |
| Catfish | 26 |
| Shad | 7,050,000 |
| Glut herring | 55,000,000 |
| Steelhead salmon | 27,742 |
| Rainbow trout | 285,307 |
| Brook trout | 227,000 |
| Crappie | 2,145 |
| Largemouth black bass | 80,806 |
| Rock bass | 13,535 |
| Warmouth bass | 200 |
| Sunfish | 19,875 |
| Yellow perch | 10,981,285 |
| Striped bass | 7,230,750 |
| North Dakota: Loch Leven trout | 4,900 |
| Ohio: | |
| Catfish | 3,422 |
| Carp | 5,500,000 |
| Whitefish | 62,400,000 |
| Rainbow trout | 31,700 |
| Loch Leven trout | 4,000 |
| Brook trout | 52,000 |
| Crappie | 825 |
| Largemouth black bass | 6,634 |
| Smallmoth black bass | 9,000 |
| Rock bass | 679 |
| Sunfish | 11,075 |
| Pike perch | 160,000,000 |
| Yellow perch | 3,645,000 |
| Oklahoma: | |
| Catfish | 3,900 |
| Rainbow trout | 510 |
| Crappie | 9,050 |
| Largemouth black bass | 29,035 |
| Rock bass | 180 |
| Sunfish | 8,617 |
| Yellow perch | 190 |
| Oregon: | |
| Chinook salmon | 4,109,000 |
| Silver salmon | 1,369,500 |
| Sockeye salmon | 71,000 |
| Steelhead salmon | 261,000 |
| Rainbow trout | 125,000 |
| Brook trout | 537,400 |
| Pennsylvania: | |
| Catfish | 25,375 |
| Cisco | 1,300,000 |
| Rainbow trout | 192,150 |
| Loch Leven trout | 230,405 |
| Lake trout | 3,000 |
| Brook trout | 1,268,038 |
| Largemouth black bass | 26,625 |
| Smallmouth black bass | 7,640 |
| Rock bass | 34 |
| Sunfish | 16,380 |
| Yellow perch | 3,580 |
| Crappie | 9,782 |
| Rhode Island: Black bass | 150 |
| South Carolina: | |
| Catfish | 205 |
| Rainbow trout | 92,250 |
| Brook trout | 14,250 |
| Crappie | 170 |
| Largemouth black bass | 123,470 |
| Warmouth bass | 510 |
| Sunfish | 16,922 |
| South Dakota: | |
| Catfish | 5,000 |
| Steelhead salmon | 6,000 |
| Rainbow trout | 184,275 |
| Loch Leven trout | 63,800 |
| Brook trout | 805,670 |
| Crappie | 300 |
| Largemouth black bass | 3,745 |
| Sunfish | 5,650 |
| Yellow perch | 320 |
| Tennessee: | |
| Catfish | 1,800 |
| Steelhead salmon | 7,942 |
| Rainbow trout | 193,100 |
| Brook trout | 87,600 |
| Crappie | 3,330 |
| Largemouth black bass | 55,485 |
| Smallmouth black bass | 15,000 |
| Rock bass | 19,000 |
| Sunfish | 71,430 |
| Yellow perch | 300 |
| Texas: | |
| Catfish | 3,735 |
| Rainbow trout | 5,000 |
| Crappie | 6,776 |
| Largemouth black bass | 256,490 |
| Rock bass | 1,235 |
| Sunfish | 116,965 |
| Utah: | |
| Rainbow trout | 952,360 |
| Brook trout | 117,500 |

*Summary, by species, of the distribution of fish, fiscal year 1928*—Continued

| State and species | Number | State and species | Number |
|---|---|---|---|
| Vermont: | | West Virginia: | |
| Catfish | 1,200 | Catfish | 778 |
| Landlocked salmon | 36,639 | Rainbow trout | 366,330 |
| Rainbow trout | 26,000 | Loch Leven trout | 212,200 |
| Loch Leven trout | 24,000 | Brook trout | 797,400 |
| Lake trout | 53,360 | Crappie | 5,630 |
| Brook trout | 1,222,242 | Largemouth black bass | 13,360 |
| Largemouth black bass | 150 | Smallmouth black bass | 3,000 |
| Smallmouth black bass | 1,700 | Rock bass | 400 |
| Sunfish | 2,250 | Sunfish | 4,938 |
| Pike perch | 44,740,000 | Wisconsin: | |
| Yellow perch | 17,550,000 | Catfish | 31,814,506 |
| White perch | 1,200 | Buffalo fish | 335,000 |
| Virginia: | | Carp | 1,412,185 |
| Catfish | 1,168 | Rainbow trout | 266,300 |
| Shad | 25,513,200 | Loch Leven trout | 75,750 |
| Rainbow trout | 435,100 | Lake trout | 1,000,000 |
| Loch Leven trout | 22,000 | Brook trout | 887,700 |
| Brook trout | 231,085 | Pike and pickerel | 3,237,806 |
| Crappie | 3,685 | Crappie | 5,361,917 |
| Largemouth black bass | 151,052 | Largemouth black bass | 35,628 |
| Smallmouth black bass | 10,800 | Sunfish | 4,550,085 |
| Rock bass | 24,000 | Yellow perch | 67,595 |
| Sunfish | 3,575 | White bass | 1,730 |
| Yellow perch | 69,400,000 | Fresh-water drum | 138,500 |
| Washington: | | Miscellaneous fishes | 3,697,300 |
| Chinook salmon | 21,803,216 | Wyoming: | |
| Chum salmon | 22,609,000 | Catfish | 4,600 |
| Silver salmon | 11,555,500 | Rainbow trout | 1,161,100 |
| Sockeye salmon | 15,950,600 | Black-spotted trout | 4,128,000 |
| Humpback salmon | 2,387,080 | Loch Leven trout | 103,050 |
| Steelhead salmon | 2,494,500 | Brook trout | 1,130,425 |
| Black-spotted trout | 51,200 | Crappie | 650 |
| Brook trout | 365,500 | Largemouth black bass | 1,765 |
| Rainbow trout | 77,500 | Sunfish | 390 |

## METHOD OF DISTRIBUTION

In its distribution of fish, the bureau first considers the waters from which the eggs were obtained. After such waters have been properly stocked, fish are shipped to other suitable public and private waters. It is the aim of the bureau to apportion the output of its hatcheries so as to obtain the best results, giving special attention to depleted and nearly depleted waters in which it is apparent the fish would find suitable conditions for reproduction. Anyone desiring fish should communicate with his representative in Congress or write to the Bureau of Fisheries. The name of the water in which the fish are to be planted should be stated. Upon receipt of a request for fish, the bureau mails the applicant a blank on which the request may be made in a formal manner. These blanks call for a description of the waters to be stocked, and from the information furnished by the applicant the bureau can determine what species seems likely to produce the best results.

Applicants are notified immediately upon the receipt of their applications concerning the species that will be sent them and the approximate time the delivery will be made. They are also sent instructions for receiving and caring for the fish. Prior to the date of shipment a second notice is given, usually by telegram, stating the exact time the consignment will arrive at the railroad station indicated on the application. Deliveries of fish are made at the railroad stations of applicants without expense to them. However, applicants are required to meet the train with receptacles for receiving the fish and to plant the consignment properly in the waters specified on the application.

The bureau has five specially equipped distribution cars that travel over the various railroads. Each car is equipped with cooling compartments, in which the fish are carried, and air compressors and pumps for forcing compressed air into the water to renew the supply of oxygen. Deliveries on the main lines of railroads as a rule are made direct from the bureau's distribution car while the train is making its customary stops.

Detached trips are made quite frequently from the distribution cars, each shipment being in care of an employee of the car. For example, a messenger leaves the car at a designated point with 25 or 30 pails of fish, proceeds to such places as can not be reached conveniently by the car, delivers 8 or 10 consignments of fish, and then

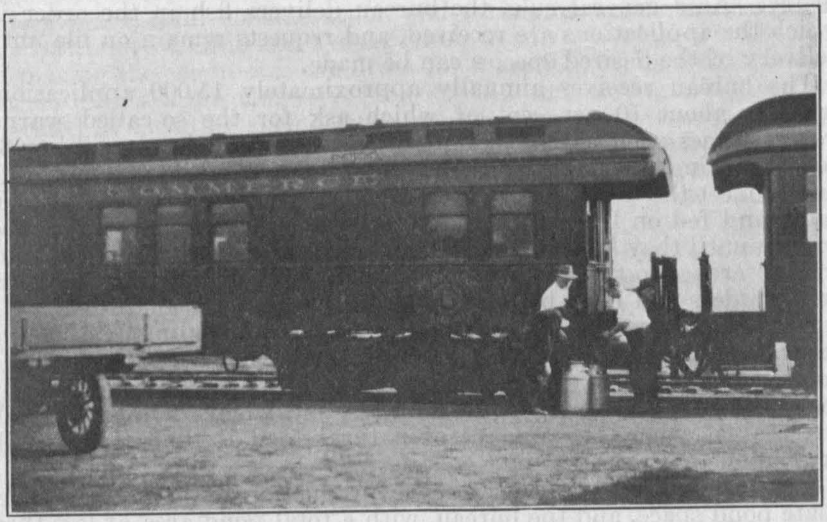

FIGURE 3.—Delivering fish to an applicant while the train makes its customary stop

returns to the car at some point farther down the line. As a rule, fish are delivered to applicants either by the bureau's distribution cars or by a messenger traveling in a baggage car.

Within recent years many fish have been delivered by automobile trucks to points within 50 or 60 miles of the propagating stations. Many of the States have adopted the bureau's method of transporting fish and have provided pails to replace the old-fashioned milk cans. The State of Pennsylvania has seven 2 to 3 ton heavily built trucks with bodies 12 by 6 feet. On each truck is arranged a double carrier forming an aisle through the middle, which permits the carrying of 80 pails of fish. The longest trips made by these trucks is 300 miles, a 15-hour drive, which is being done with perfect safety to the fish even during the hot summer months. The pail will carry fully as many fish as a 10-gallon can.

After loading a truck, if the weather is warm, the ice hopper of each pail is filled with ice and a tarpaulin cover put over the top of the truck. When an allotment is small and the applicant lives off the main line of the railroad, the shipment is sometimes forwarded in care of the train baggage-master. In a few instances shipments are made by express.

In making allotments of fish on applications the bureau takes into consideration the area of water to be stocked, size and number of fish available for distribution, and the distance the fish can be transported. The fish are distributed by the bureau as fingerlings or yearlings. However, in some instances it is necessary to distribute a portion of the output before this stage is reached in order to prevent overcrowding. Pondfishes, such as bass and bream, are distributed from three weeks to several months after they are hatched. Basses usually range from 2 to 6 inches and sunfishes from 2 to 4 inches in length at time of delivery. The commercial species, such as whitefish and pike perch, are produced in large numbers and necessarily are handled as fry. As a general rule, the bureau delivers fish in the order in which the applications are received, and requests remain on file until delivery of the desired species can be made.

The bureau receives annually approximately 15,000 applications for fish, about 70 per cent of which ask for the so-called warm-water species such as bass, crappie, and bluegill, the remaining 30 per cent being for the various species of trout. While it is not difficult to meet the demand for trout, since they can be artificially incubated and fed on liver until they are large enough to be distributed or even until they have reached a legal size for catching, the situation with reference to the warm-water fishes is quite different, as they are nest builders and must be bred under nearly natural conditions.

Sudden changes in temperature during the breeding season and other factors over which there is no control make the output of a pond station uncertain. Moreover, the spiny-rayed fishes, especially the basses, are predatory in their habits, and when confined to small water areas where the amount of natural food is limited they will prey upon their own young.

The primary requirement for the production of pondfish is adequate pond space, and the bureau, with a total pond area of less than 200 acres, must spread the output of these ponds over hundreds of thousands of acres of open waters. It is therefore apparent that the bureau, with its limited facilities, can not furnish applicants many fish. In fact, the custom is to deliver merely the nucleus of a brood stock for waters in need of restocking, with the understanding that the fish will be planted and given an opportunity to reproduce. The bureau could not undertake to furnish enough fish annually to compensate for those taken by anglers, so after the fish are received by the applicant the work of conservation should begin, as no agency, either public or private, can successfully maintain good fishing in a body of water in which unrestricted fishing is allowed.

Delivery of fish to an applicant in a remote section of the country can not be made until a sufficient number of applications have been received from that section to warrant the expense of making a messenger shipment. Shipments of trout from the bureau's eastern stations are usually made during May and June, and applications received after March 1 are carried on file for attention in the following year. In the Rocky Mountain regions the distribution of trout from stations is made from May to October, and applications from that section should be received prior to May 1 in order to assure early delivery. Requests for bass, sunfish, and crappie should be on file in the bureau prior to May 1, as deliveries of such species are made between May and December.

During the year the bureau's cars traveled 112,533 miles, of which 4,591 were free. Detached messengers traveled 298,065 paid and 87,420 free miles, a total of 498,018.

## NEW DISTRIBUTION CAR

Reference was made in last year's report to the need for two distribution cars to take the place of cars Nos. 3 and 4. During the year the condition of car No. 4 became so bad that it was considered unsafe to keep it in commission. The matter of repairing this car was given careful consideration, and estimates were obtained from the Baltimore & Ohio and Pennsylvania Railroads relative to the cost of placing the car in safe condition for traveling. The Pennsylvania estimate was approximately $25,000. As the bureau did not feel justified in spending such a large sum on a wooden car with a carrying capacity only about 60 per cent as great as that of a new steel car, car No. 4 was placed on a siding at Lakeland, Md., and is being used as a home for the employees who operate the Lakeland Pond station.

An appropriation has been obtained from Congress for one new steel car, and its construction will begin early in the fiscal year with the view of having the car completed and ready for distribution work during the spring months. While the bureau needs two steel cars, the one allowed by Congress will be a valuable aid for the time being in the expeditious distribution of fish. However, in the interest of safety the operation of wooden cars in first-class trains should be discontinued as soon as possible. The remaining wooden car, No. 3, carries but 150 pails of fish, while a modern steel car will carry from 250 to 300 pails.

## SHIPPING FISH BY AIRPLANE

On May 10 a shipment of 15,000 brook trout and 12,000 rainbow trout was made by airplane from Northville, Mich., to Dayton, Ohio. The fish were planted in streams of Wright Field. Lieut. George D. Tourtellot and R. E. Selff called at the bureau in the early spring and arranged to receive a shipment of fish for stocking the trout waters on the flying field at Dayton. A letter received from Lieutenant Tourtellot under date of May 22 reads as follows:

> We received our trout last week and brought them by airplane from Michigan to Dayton, Ohio, and deposited them in the streams at Wright Field. They came through in fine shape, and there was not a dead fish in the 20 cans when I landed here.

There are many inland streams that can not be properly stocked with fish due to lack of transportation facilities. In many sections of the West the United States Forest Service uses pack horses to transport fish from railroad stations to the headwaters of streams in the mountains. It is possible that in the future the airplane will be the means of taking more fish to streams than it will carry away.

## EXPANSION OF WORK

The distribution from the rescue stations was delayed until about the middle of the fall months, but when the work of collecting began there were fish enough for distribution in large numbers, which necessitated quick action on the part of the distribution cars. At no time in the bureau's history were as many carloads of warm-water fish moved within a period of two months as were shipped during October and November, 1927. Fish were sent to virtually every State in the Union, and the cars were kept busy day and night for over two months. The fish distributed ranged in length from 3 to 8 inches. Had the collecting season remained open one week longer, the bureau would have been able to fill virtually every application

FIGURE 4.—Planting trout in a stream on Wright Field, Dayton, Ohio. The fish were transported by airplane from the bureau's hatchery at Northville, Mich.

for warm-water fishes it received. Rescue operations were discontinued late in the fall on account of the extremely cold weather.

A great deal of extra work and much additional expense has fallen to the distribution department on account of the extension of the bureau's activities. In addition to the general distribution to applicants, approximately 15 carloads of fish were required during the year for stocking cooperative nurseries. The expenses of distribution during the fiscal year were therefore considerably greater than last year's expenses.

## DISTRIBUTION CARS

### CAR NO. 3

(E. R. WIDMYER, Captain)

On July 5 car No. 3 made a shipment of rainbow trout and brook trout from La Crosse to Red Granite, Wis. Two car trips and a number of messenger shipments were made during the month of July, by which sixty-seven thousand

3-inch brook trout were delivered to cooperative nurseries and seventy-five thousand three hundred and fifty 3-inch brook trout and seven thousand eight hundred 2-inch rainbow trout to applicants.

During the latter part of July and first part of August the crew went over the Fearnow pails, cleaning and restenciling them. The aerating equipment and machinery also were gone over and placed in readiness for distribution work. The distribution of the warm-water species was begun on August 30, when a carload of bass, bream, and yellow perch was taken to Chicago and delivered to applicants in Wisconsin, Illinois, and Indiana. During September four car trips and a number of messenger shipments were made from the river stations to points in Wisconsin, Illinois, Indiana, Michigan, Pennsylvania, and Virginia.

The car left the Mississippi River stations on September 23 with a carload of warm-water species for Pennsylvania applicants. After completing the trip to Pennsylvania the car was ordered to Washington, D. C., to take up the distribution of fish from the Lakeland (Md.) ponds. The distribution work from the Lakeland ponds was completed late in October.

The car was in Washington from September 28 to October 22 and during this time delivered to applicants in New Jersey, Delaware, Virginia, West Virginia, Maryland, and Pennsylvania the following number and species of fish: Smallmouth black bass, 16 yearlings; largemouth black bass, 1,128 yearlings, 30 adults, and 22,250 fingerlings; crappie, 13,350 fingerlings; bream, 10,900 fingerlings; and rock bass, 1,850 fingerlings. The car left Washington October 22 for Harrisburg, Pa., with trout from the Camp Hill (Pa.) station. The car was ordered from Harrisburg to Bellevue, Iowa, to resume the distribution of warm-water fishes from the rescue stations.

From October 24 until late in November the car was busily engaged in the distribution of warm-water species to applicants in Wisconsin,, Minnesota, Pennsylvania, and New York. Heavy snowfalls in northern Wisconsin and Minnesota, together with severe cold weather, which froze over the lakes and streams, brought the distribution to a sudden close on November 29. The car was parked on a steam track of the Milwaukee Railroad at North Side, La Crosse, Wis., during the winter.

During January and February, while the car was not being used in distribution work, the crew made all necessary interior repairs, such as overhauling steam air compressor, water pump, laying new floors in office and wash room, relining ice box, repairing side partitions and deck sash, making new grates for ice box, removing old bronze and paint from water and steam pipes, cleaning sides and ceiling, repainting pipes in boiler room, bronzing pipes in wash room and body of car; painting kitchen-aisle floor, and varnishing interior of car, including chairs, tables, and office desk. The car was then placed in the Milwaukee shops for overhauling of trucks and making a few exterior repairs. The cost of repairs furnished by the shops was $195.61. The shop costs would probably have been $2,000 had the interior repairs been included. Upon the completion of the shop repairs the car was returned to La Crosse and its equipment placed in readiness for distribution. The pails were overhauled and restenciled, and the aerating equipment was changed to accommodate 200 pails.

On April 6 the car transferred 183,000 brook trout from La Crosse to Lynxville, Wis., returning to La Crosse on completion of the trip. The car left La Crosse on May 16 with twenty-seven thousand two hundred and fifty 3-inch fingerling rainbow trout, twenty-two thousand five hundred 3-inch fingerling brook trout, and fifteen thousand 2-inch Loch Leven trout for applicants in Wisconsin, Minnesota, and Michigan. On completion of this trip the car proceeded to Duluth, Minn., to take up the distribution of lake trout, pike perch, and rainbow and brook trouts. Eight car trips, five boat trips, and a number of messenger shipments were made from Duluth, delivering 11,085,000 lake-trout fry, 7,950,000 pike-perch fry, one hundred and ninety thousand 1-inch brook trout, and seventeen thousand two hundred and fifty 3-inch rainbow trout.

Immediately on completion of the Duluth distribution the car was ordered to La Crosse to make a distribution of trout to cooperative nurseries. During the last few weeks in June fifty-four thousand 3-inch rainbow trout, twelve thousand 3-inch brook trout, and three thousand one hundred and fifty 3-inch Loch Leven trout were delivered to cooperative rearing stations in Wisconsin.

During the fiscal year 1928 car No. 3 made 24 trips, traveled 16,664 miles, and delivered 20,866,219 fish. Messengers made 96 side trips and traveled approximately 30,000 miles. The following table shows the number, size, and species of fish delivered by the car and its crew.

| Species | Fry | Fingerlings Nos. 1 to 6 | Yearlings | Adults |
|---|---|---|---|---|
| Catfish |  | 7,700 |  |  |
| Rainbow trout |  | 109,500 |  |  |
| Loch Leven trout |  | 18,150 |  |  |
| Lake trout | 11,320,000 | 765,000 |  |  |
| Brook trout |  | 553,775 |  |  |
| Crappie |  | 35,075 | 5,100 |  |
| Largemouth black bass |  | 55,200 | 1,128 | 210 |
| Smallmouth black bass |  |  | 16 |  |
| Rock bass |  | 1,850 |  |  |
| Sunfish |  | 23,090 | 16,370 |  |
| Pike perch | 7,950,000 |  |  |  |
| Yellow perch |  | 500 | 3,555 |  |
| Total | 19,270,000 | 1,569,840 | 26,169 | 210 |

## CAR NO. 4

(F. W. A. Engelhardt, Acting Captain)

From July 1, 1927, to June 30, 1928, car No. 4 distributed fish from the bureau's stations at Northville, Mich.; Leadville, Colo.; Neosho, Mo.; Bellevue, Manchester, and Marquette, Iowa; Homer, Minn.; La Crosse, Wis. and Lynxville, Wis. The car made 22 trips with fish, traveling 18,072 miles over 22 different railroads, and sent out 50 side trips, altogether delivering 1,413,229 fingerlings and 23,390 yearlings in 12 States. In addition to the above, 1,184 adult brood fish were moved between the bureau's hatcheries. The total cost of car travel was $6,663.01. The following table shows the species and numbers of fish delivered during the year:

| Species | Fingerlings | Yearlings | Adults |
|---|---|---|---|
| Catfish | 13,560 |  |  |
| Rainbow trout | 211,625 |  |  |
| Black-spotted trout | 24,000 | 10,400 |  |
| Loch Leven trout | 20,000 |  |  |
| Brook trout | 1,033,200 | 10,000 |  |
| Crappie | 13,515 | 300 |  |
| Largemouth black bass | 61,105 | 495 | 184 |
| Rock bass | 1,259 |  |  |
| Sunfish | 34,370 | 760 | 1,000 |
| Yellow perch | 595 | 1,435 |  |
| Total | 1,413,229 | 23,390 | 1,184 |

Besides the 50 side trips made from the car, its messengers made 30 trips with fish direct from hatcheries at a cost of $741.69. The following table shows the number, species, and size of fish the messengers thus handled:

| Species | Fingerlings | Yearlings |
|---|---|---|
| Catfish | 150 |  |
| Rainbow trout | 319,100 |  |
| Black-spotted trout | 72,300 | 35,500 |
| Loch Leven trout | 81,000 |  |
| Brook trout | 1,075,500 |  |
| Crappie | 200 |  |
| Largemouth black bass | 4,925 |  |
| Smallmouth black bass | 8,650 |  |
| Rock bass | 1,200 |  |
| Sunfish | 900 |  |
| Total | 1,561,925 | 35,500 |

## CAR NO. 7

(E. M. Lamon, Captain)

The distribution from the Upper Mississippi River collecting stations was taken up by this car on August 25, when 15,000 pondfishes were obtained from the Marquette and Bellevue (Iowa) stations for distribution to points in Iowa. From August 25 to October 28 the car made trips from the upper river stations to Waterloo, Iowa, St. Louis, Mo., Scranton, Pa., Indianapolis, Ind., Tuscaloosa, Ala., Albany, N. Y., and Nashville, Tenn., distributing 125,890 pond fishes. After completing the trip to Nashville the car proceeded to Tupelo, Miss., and obtained 57,000 fingerling bream, which were transported to Sheffield, Ala., and planted in Wilson Lake at Muscle Shoals.

On November 15 the car loaded at Lynxville, Wis., and proceeded to Syracuse, N. Y. A total of 15,980 pond fishes was distributed to applicants by messengers operating out of Syracuse. The car returned from Syracuse to Dubuque, Iowa, arriving at that point on November 21. On November 23 the distribution was brought to a close and the crew detailed to fish-cultural stations for the winter.

The car was placed in the Illinois Central Railroad shops at Chicago early in February, 1928, for repairs. The repair work was completed in March and the car returned to Dubuque, where part of the crew was assembled to assist in overhauling the car's equipment.

The spring distribution from the Manchester (Iowa) and La Crosse (Wis.) stations was taken up on May 8. On May 9, 300 adult black bass were forwarded from the Fairport (Iowa) station to Miles City, Mont., by one of the messengers from this car. During May and June two trips were made from Manchester, three from La Crosse, two from Lynxville, and one from Lincoln Park Aquarium at Chicago to points in Minnesota and Wisconsin. A number of detached shipments also were forwarded from La Crosse during May and June by messengers operating from the car. Fish were distributed from these stations as follows: Manchester, 224,000 brook trout and 55,400 rainbow trout; La Crosse, 173,100 brook trout, 45,500 rainbow trout, and 95,400 Loch Leven trout; Lynxville, 119,500 brook trout; Lincoln Park Aquarium, Chicago, 56,500 rainbow trout and 7,300 Loch Leven trout.

During the year the car made 18 trips and traveled 17,139 miles. Messengers operating from the car made 87 trips and traveled 17,724 miles. The numbers and species of fish distributed by the car during the year are shown in the following table:

| Species | Fingerlings No. 1 | Fingerlings No. 2 | Fingerlings No. 3 | Fingerlings No. 4 | Fingerlings No. 5 | Fingerlings No. 6 | Yearlings |
|---|---|---|---|---|---|---|---|
| Catfish | | 27,700 | 4,200 | 12,000 | | | 300 |
| Rainbow trout | 111,900 | | 45,500 | | | | |
| Loch Leven trout | 32,200 | 70,500 | | | | | |
| Brook trout | | 224,000 | 292,600 | | | | |
| Crappie | | 22,100 | 2,520 | | | 840 | 3,025 |
| Large-mouth black bass | | 2,030 | 19,605 | 13,120 | 3,430 | 1,140 | 360 |
| Sunfish | 68,950 | 8,325 | 2,180 | 660 | | | 4,010 |
| Yellow perch | | 200 | 1,600 | | | 320 | 555 |
| Total | 213,050 | 354,855 | 368,205 | 25,780 | 3,430 | 2,300 | 8,250 |

## CAR NO. 8

(E. K. Burnham, Captain)

At the beginning of the fiscal year car No. 8 was at Nashua, N. H. Early in July a trip was made to Scranton, Pa., and one to Williamsport, Pa., the car proceeding from the last-named point to Northville, Mich. The distribution of trout and smallmouth black bass from the Northville station necessitated shipments to points in Indiana, Pennsylvania, and West Virginia. Upon completion of the Northville distribution the car proceeded to Watertown, N. Y., and took up the distribution of trout from the substation at that point, making shipments to various places in New York, Pennsylvania, and Vermont. The car returned to Nashua for a load of trout, which was delivered to the bureau's cooperative station near Harrisburg, Pa.

After completing the trout distribution in the East the car proceeded to La Crosse, Wis., and Dubuque, Iowa, to assist in the distribution of fish from the Mississippi River collecting stations. Trips were made from the collecting stations to the following points: Engel, N. Mex.; Fort Wayne, Ind.; Conover, Wis.; Marinette, Wis.; Jersey City, N. J.; Williamsport, Pa.; and Louisville, Ky. At Louisville minor repairs were made to the car.

On February 19, 1928, the car left Louisville for White Sulphur Springs, W. Va., to take up the distribution of trout from that station. The first shipment was to Elkins, W. Va., with a load of 446,000 trout. From White Sulphur the car went to Wytheville, Va., where it obtained trout for applicants in the vicinity of Abingdon and Roanoke, Va., and Knoxville, Tenn. From Knoxville the car proceeded to Erwin, Tenn., and distributed three carloads of trout from that station to points in Tennessee, North Carolina, South Carolina, and Georgia.

Leaving Erwin with a load of yearling rainbow trout for delivery to the Wytheville station, the car proceeded to White Sulphur Springs, where a load of trout was taken on board for distribution en route to Washington, D. C., and various points in Maryland, Pennsylvania, and West Virginia. The car returned to Washington on April 9, where minor repairs were made. Upon completion of the repairs the car returned to White Sulphur Springs and obtained a load of trout and proceeded to Great Barrington, Mass., distributing its cargo en route to applicants in Pennsylvania, New Jersey, and Connecticut.

A carload shipment of trout was moved from the Berkshire station near Great Barrington to the bureau's cooperative nursery at Windber, Pa., the car then proceeding to Nashua, N. H., where it made a shipment of trout to Portland, Me., proceeding from Portland to Bucksport, Me., where 8 carload shipments of trout and salmon were made from the Craig Brook (Me.) station to points in the State of Maine.

During the fiscal year the car made 35 trips and traveled 23,737 miles. Detached messengers made 127 trips and traveled 30,079 miles. Altogether, 1,950 applications were filled. The distribution carried the car or its employees into the following States: Maine, New Hampshire, Vermont, New York, Pennsylvania, Michigan, Wisconsin, New Mexico, Texas, Illinois, Ohio, Kentucky, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama, Maryland, New Jersey, Connecticut, and Massachusetts. The following table shows the number and size of the species delivered during the year:

| Species | Finger-lings No. 1 | Finger-lings No. 2 | Finger-lings No. 3 | Finger-lings No. 4 | Finger-lings No. 5 | Finger-lings No. 6 | Yearlings and adults |
|---|---|---|---|---|---|---|---|
| Catfish | | 7,700 | 13,000 | 9,125 | | | |
| Atlantic salmon | 1,073,500 | | | | | | |
| Rainbow trout | 529,000 | 372,200 | 17,000 | | | | 3,000 |
| Loch Leven trout | 110,000 | 16,950 | | | | | |
| Lake trout | | 23,500 | | | | | |
| Brook trout | 1,458,100 | 1,014,750 | 476,000 | | 1,700 | | |
| Crappie | | 3,190 | 700 | | 840 | 6,710 | |
| Largemouth black bass | | | 4,700 | 11,555 | 1,705 | 210 | 75 |
| Smallmouth black bass | 34,740 | | | | | | |
| Sunfish | | 6,900 | 1,980 | 3,450 | 9,615 | 50 | |
| Yellow perch | | | | 1,050 | 210 | 260 | 3,045 |
| Total | 3,205,340 | 1,445,190 | 513,380 | 25,180 | 14,070 | 7,230 | 6,120 |

## CAR NO. 9

(H. F. Johnston, Captain)

On July 1 the car was ordered to proceed from Chicago to Manchester, Iowa, for the purpose of obtaining a load of brook trout and rainbow trout, which were assigned to applicants in Wyoming. The car left Manchester on July 5 and upon completion of the Wyoming distribution continued to Bozeman, Mont., to handle the output of trout from the bureau's hatchery at that point. The car arrived at Bozeman on July 9, and left on the same day with a special shipment of brook trout assigned to the various streams of the Glacier National

Park. During July car trips were made to Lander, Wyo., Lewistown, Missoula, Billings, and Gardner, Mont., and a second trip to Glacier Park.

The black-spotted trout distribution from Bozeman was about a month later than the rainbow-trout and brook-trout distributions, and as the latter were completed by the last of July the car was detailed to assist the Montana Fish Commission with its distribution of trout pending the development of the black-spotted trout fry. The distribution for the Montana Fish Commission continued throughout the month of August and was completed by September 2. Besides handling eight carloads of trout from the various Montana State hatcheries, the car moved one carload of trout for the Idaho State Fish Commission from Ashton to St. Maries, Idaho. The car returned to Bozeman on September 7 and at once took up the distribution of the black-spotted trout, completing the work by October 4.

Returning to Dubuque, Iowa, on October 11, the car loaded with warm-water fishes and left at once for Denver, Colo., supplying warm-water fishes to applicants in Wyoming, Colorado, and New Mexico. Carloads of the same sort of fishes were distributed to applicants in Massachusetts, New York, Connecticut, Vermont, New Hampshire, Maine, Rhode Island, Minnesota, Wisconsin, and Pennsylvania, the destination of the trips being as follows: Springfield, Mass., Ashland, Wis., St. Paul, Minn., Harrisburg, Pa., and Washington, D. C. The fall distribution was completed by December 10, after which members of the crew were detailed to the bureau at Washington and to stations in the field. Annual repairs to the car were made at the Pennsylvania Railroad shops at Wilmington, Del., during January.

The spring distribution for 1928 was taken up on March 10, at which time the car was detailed to the White Sulphur Springs (W. Va.) station. From March 10 until June 10 the car remained on the White Sulphur Springs distribution and during this time handled 12 carloads of trout, supplying applicants in Pennsylvania, Virginia, West Virginia, and Maryland. Upon completion of the White Sulphur Springs distribution the car made one carload shipment for the Maryland Conservation Commission. After the Maryland distribution the car returned to Washington, D. C., and remained there until the close of the fiscal year.

During the fiscal year the car made 46 trips, traveling 32,330 paid miles and 4,591 free miles. It handled 5,206,713 fish, delivering 3,651,676 directly to the applicants, and the remaining 1,555,037 were carried by detached messengers from the car to the applicants. The messenger distribution amounted to 139 shipments. To complete the distribution necessitated the movement of 9,063 Fearnow pails and two hundred and seventy 10-gallon cans of fish. During the year the car filled 2,314 individual applications widely scattered in 29 States. The number and size of fish delivered by the car and its screw during the past fiscal year are shown in the following table:

| Species | Fingerlings No. 1 | Fingerlings No. 2 | Fingerlings No. 3 | Fingerlings No. 4 | Adults |
|---|---|---|---|---|---|
| Catfish |  | 12,000 | 21,000 |  |  |
| Rainbow trout | 968,400 | 88,200 | 46,000 | 475 |  |
| Black-spotted trout | 2,185,470 |  |  | 4,000 | 7 |
| Loch Leven trout | 193,400 | 29,250 |  |  | 113 |
| Brook trout | 363,000 | 814,175 | 395,425 |  | 24 |
| Grayling |  |  |  |  | 30 |
| Crappie |  | 1,500 |  |  | 10,814 |
| Largemouth black bass |  |  | 11,625 | 3,935 | 1,435 |
| Sunfish | 25,625 |  | 1,995 | 720 | 15,330 |
| Yellow perch |  |  |  | 600 | 320 |
| Miscellaneous fishes |  | 11,775 |  |  | 70 |
| Total | 3,735,895 | 956,900 | 476,045 | 9,730 | 28,143 |

# FISHERY INDUSTRIES OF THE UNITED STATES, 1927 [1]

By

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## CONTENTS



## FOREWORD

This report constitutes a yearbook on fishery statistics of the United States as well as a summary of activities of the division of fishery industries. As its name indicates, this division of the Bureau of Fisheries is concerned with the activities and welfare of the fishery industries, including the commercial fisheries, the trade in fishery products, and the fish canning and preserving industries. Its functions are the collection and publication of fishery statistics, the prosecution of research designed to solve the technical problems of the industry, and the dissemination of authoritative and practical information to the fishery industries and the public. Results of technological investigations and marketing studies are published in separate documents as each project is completed. The information obtained from statistical surveys is published in part 2 of this report, which includes all the detailed statistical information that has become available since

[1] Appendix IX to the Report of the U. S. Commissioner of Fisheries for 1928. Bureau of Fisheries Doc. No. 1050.

the issuance of the previous report,[2] together with such summarized statements and interpretations of the statistics as are deemed significant and useful. In the preparation of this report numerous members of the division's staff have taken part, and their assistance is appreciatively acknowledged.

Some changes as to scope and arrangement of statistics have been incorporated in this report. In all cases the statistics on value of property and cash capital have been discontinued, except for the Middle Atlantic States for 1926, the statistics for which were collected before this policy was adopted. Although the value of such statistical information is appreciated fully, the difficulty of collecting reliable and comparable data has been insurmountable; and since comparisons, both with one region and another and with one year and another, might be grossly misleading, it has been considered necessary to omit such items. All statistical statements applicable to the country as a whole appear in the first part of the report, and the statistics pertaining to particular localities and regions are taken up by geographical sections in the following order: New England States, Middle Atlantic States, Chesapeake Bay States, South Atlantic States, Gulf States, Pacific Coast States, Great Lakes States, and Mississippi River and tributaries. In all cases there is given a summary of the most recent statistics pertaining to the section as a whole, together with references to the previous publication that contains the detailed statements. This is followed by such detailed statistics on the particular localities of the region as have become available since the previous annual report.

## PART 1.—OPERATIONS OF THE DIVISION

### COLLECTION OF STATISTICS

Fishery statistics, unlike other statistical data, must serve not only as trade information but as the material that the biologist must have in studying the problems of conservation. Since statistical information is fundamental in this respect, it is highly important to achieve progress in this branch of work, which is admittedly inadequate at the present time. During the past four decades fishery statistics have been collected by canvassing the fisheries of eight geographical sections of the country, taking one at a time, and completing them as rapidly as possible with the personnel available for this purpose. In recent years it has been possible to reach each section about once every five years. This method, while the best possible under existing conditions, had two fundamental defects. First, the fisherman were reached a considerable time after the previous year's business had been closed, and unless they kept a record of their operations and catch (a rare circumstance) the information received was but an approximate estimate rather than a definite record. Second, the fortunes of a fishery fluctuate so widely from year to year that data acquired at intervals of five years are likely to be misleading, for they may represent a poor or a good year rather than a normal one. Annual statistics are essential to indicate accurately the trends in fishery matters.

[2] Fishery industries of the United States, 1926. By Oscar E. Sette. Appendix V, Report, U. S. Commissioner of Fisheries, 1927, pp. 337–483. Bureau of Fisheries Doc. No. 1025.

While the bureau's facilities are not adequate to collect annual statistics for the entire country, fortunately there is another means of accomplishing this end—that is, through cooperation with State agencies. Since early times, the fisheries in State waters have been under State control, and a number of States have included the rendering of statistical returns as an obligation of commercial fishermen who exploit the State's resources. As reported in 1925 and subsequent years, the bureau's policy has been to cooperate with those States that collect statistics in such a manner as to render the data adequate to form the material for studies in fluctuations in abundance and to render the statistics of adjoining States comparable so as to permit compilation over the entire commercial range of species inhabiting the waters of a number of contiguous States; and to encourage the collection of statistics by those States not at present doing so.

The results of this policy have been gratifying. By detailing one agent to the Pacific Coast States and employing temporary clerical assistance in that region, annual statistics based on State returns have been compiled and published since 1923. In the Great Lakes region it has been possible to compile State statistics annually since 1913. Certain improvements in the method of securing returns on the Great Lakes were necessary to make them adequate, and through several conferences of State officials of that region an agreement properly to revise collections was reached and will be effective for the calendar year 1928. Collection of statistics in the remaining sections of the country is still on the periodical canvass basis.

During the past year, statistics on the Middle Atlantic States for the calendar year 1926 were collected and published. With the completion of this canvass and the State cooperation above mentioned, the latest statistics available on each geographical section are as follows: New England States, 1924; Middle Atlantic States, 1926; Chesapeake Bay States, 1925; South Atlantic and Gulf States, 1923; Pacific Coast States, 1926; Great Lakes, 1926; Mississippi River and tributaries, 1922.

In addition to the general statistics, the series of statistics on special subjects was continued during 1927 as follows: The collection and monthly publication of the statistics of the landings of fish by vessels at the ports of Boston and Gloucester, Mass., Portland, Me., and Seattle, Wash., and landings of halibut at North Pacific coast ports, and publication of annual bulletins summarizing these landings for the year; monthly publication of statistics on the cold-storage holdings of frozen and cured fish collected by the Bureau of Agricultural Economics, Department of Agriculture; quarterly collection of the statistics of production, consumption, and holdings of oils in the fishery industries for the use of the Bureau of the Census; collection and publication of statistics on the production of canned fishery products and by-products by the United States and Alaska for 1927; collection and publication herewith of statistics on the shad and alewife fisheries of the Potomac and Hudson Rivers for 1927; the securing and publishing herewith of statistics on the quantity and value of sponges handled by the Tarpon Springs sponge exchange in 1927; the securing and publishing herewith of statistics on the quantity of fishery products handled at the municipal fish wharf and market, Washington, D. C., in 1927; the tabulation and publication herewith of statistics obtained by the Bureau of Foreign and Domestic Commerce, Department of Commerce, on the United States import and export trade in fishery products during 1927; and the collection and publication herewith of the 1927 fishery statistics of Lakes Keokuk and Pepin.

The special statistical observations on the mackerel fishery have been of particular interest and are beginning to bear fruit of unusual importance to the industry. The project involves the collection of data on the size, date, and locality of capture of each fare of mackerel landed at the principal mackerel-receiving ports; also the measuring of a sample of 20 or more fish from each fare. These data, together with biological analyses, in which the division of scientific inquiry has had an important share, have made possible an understanding of the fluctuations in abundance of this notoriously erratic species. During the years 1925, 1926, and 1927 the commercial catch has been dominated almost completely by fish of the 1923 spawning season. In other years either spawning has been a failure or infant mortality has been so high as to have virtually prevented significant contribution to the stocks of mackerel in the sea. Knowing that for three years the commercial fishery has been drawing on a stock of mackerel that has had virtually no increase from natural reproduction it is possible to estimate the trend for at least a year in the future. The 1923 year class came into commercial importance in 1925, and the consequent increase in abundance caused a commercial catch exceeding any since 1885. In 1926 the catch was still larger, but in 1927 the catch decreased about 12 per cent. Evidently, mortality, both natural and artificial (removal of the commercial catch from the stocks in the sea), by that time had offset the increase due to growth in size of individual mackerel. Thus it has been possible to predict that the 1928 catch will fall below the 1927 catch by more than 12 per cent. Such predictions will be of inestimable value to fishermen and fish dealers when their reliability has been tested sufficiently through a number of years.

## TECHNOLOGICAL INVESTIGATIONS

The technological work of the bureau is directed toward the elimination of loss in fishery industries by the utilization of material generally wasted, by making existing processes more economical or replacing them with new methods, or by making investigations and spreading information concerning new uses of fishery products. To do these things, the bureau supplies the industry with the best scientific information available and conducts investigations that promise to be of general importance and that are of such nature that the bureau can hope to prosecute them profitably with the personnel and funds available. It has been necessary, however, to point out to the industry that there are problems that the bureau is qualified to attack and can do so properly, but that there are other problems that industry must solve for itself. The latter generally are not of a technological nature but are purely matters of management, whereby great savings may be effected by applying sound business principles. The technologists are fitted to point out to the industry the sources of loss in a plant, but the solution of these problems is an individual matter best solved by the persons involved.

A prominent feature of this year's work is the greater number of contacts made in the field, through which the problems of the industry have been learned first hand. Manufacturers of equipment were told of opportunities to introduce their products to the fishing industries with mutual profit, and the bureau itself tested equipment when advisable and practicable. A temporary field laboratory was established at Reedville, Va., mainly in order to study the problems of the menhaden and by-products industries.

Many of the bureau's technologists have left the service since last year. Nearly all of them have taken positions in the fishery industries, hence they are not lost to this field and can continue to help its progress. The bureau has had to train new men (which seems to be one of the ways in which to help the fisheries) and therefore its progress has been retarded somewhat this year. Nevertheless, a great deal of work has been done, as is indicated in the following paragraphs.

*Net preservation.*—Experience in recent years has established the fact that no single net preservative can be applied successfully to all forms of gear. For this reason the past year's experiments were directed toward determining the best treatment for pound nets fished in salt water. Samples of twine treated with nearly 100 different preservative mixtures were exposed at the Beaufort (N. C.) station last year, and test panels containing 10 of the most promising treatments were placed in commercial fishing localities. As a result of these tests the formula for a satisfactory preservative was developed and released. This costs approximately one-third as much as the best commercial treatment previously available and consists of cuprous and mercuric oxides and tar dissolved in water-gas tar oil. No other solvent has proved quite as efficacious as this, which is cheap though not always easily available.

*By-products.*—The reduction of fish into oil and scrap, or meal, is a large industry of long standing, yet it still presents many formidable problems. In the case of the menhaden industry the situation is particularly acute, due to the maladjustment of capacities in the plants. This is the outgrowth of an oversized organization to take care of previous periods of abundant supply. As a result, when the menhaden catch falls below a certain rather high level, as it has in recent years, the factories operate at a loss. The remedy is readjustment to present conditions, and our technologists have devoted much attention to the problem by showing where appropriate machinery can be installed and advocating the detection of excessive expenditures by the use of simple cost systems. The production of better meal and oil through care in operation of equipment has been demonstrated and will help to remedy the situation. These points were stressed because they promised immediate relief, whereas the investigations of a more technical nature, begun in 1927, though showing progress, can not be concluded in so short a time.

Another problem concerns the salvaging of small quantities of market waste, unmarketable or trash fish, and the waste produced on shipboard. Various angles of it were studied during the past year, especially the vacuum process of handling the waste resulting from filleting operations. Data on hand are not sufficiently complete to offer a solution of the problem. This and other experiments in the same field are being continued.

The field that holds the most promising future in the by-products industry lies in producing a fish meal suitable for feeding purposes.

White meal produced by the vacuum process from haddock and cod waste is a most excellent stock feed and is valued highly. This meal is greatly appreciated abroad (especially in Germany, where it is used for feeding hogs) as a protein supplement for cereals. It produces a sturdy frame in animals and prevents deficiency diseases because it brings with it from the sea elements necessary to normal life. In the usual feed for farm animals, many elements are not found in the proper proportions; iodine, for instance, may be absent and goiter result, or calcium be deficient and bone formation (and general health) faulty as a consequence. It is recognized that all animals require 30 elements for normal life processes. Many occur in very small quantities, but all are essential. Minerals obtained from organic sources are assimilated best. In some cases the soil has been depleted, so that land food may be deficient; but since the sea has not been depleted of its minerals, sea food is "balanced" and, when used by humans or lower animals, supplements deficient land food. For these reasons the production of fish meal for feeding purposes should be increased, and its more extensive use in this country will bring profit to the fish by-products industries and farmers alike.

*Improved handling of fresh fish.*—Progress has been made in marketing fresh fish, notably in the development of the filleted and packaged product. However, there are many phases of handling that are in serious need of improvement. The highly perishable nature of this commodity requires the most careful handling on shipboard, in the wholesale houses, and in transit overland. This problem is being surveyed in all its aspects. Particular attention is being given the New England vessel fisheries. To this end an office has been established on the Boston Fish Pier, where a technologist and an assistant are studying local conditions on shipboard and ashore. It is expected that this undertaking will make possible the application of scientific principles to the handling of sea foods in such a way as to insure their delivery to inland consumers in the best condition. The immediate adoption of improved methods of caring for fresh fish is highly important, but the trend of development in the fisheries indicates that the future need will be still greater as it becomes necessary to fish on more distant grounds. In six years the packaged-fish trade has grown to be an industry that utilizes more than 50,000,000 pounds of fish annually. While no one can estimate the limits of productivity of the fishing grounds, there is little doubt but that the exploitation of more distant waters will follow the expansion in fish consumption; and with the extension of the fishery will come the necessity for refrigeration and insulation on shipboard. In view of this, there can be little doubt concerning the urgent need for technological research in this field.

*Nutritive value of fish.*—The nutritive value of sea food for human consumption is a matter of national importance. Fish and meats are the principal sources of protein, and, in addition to its protein value, fish contains minerals and vitamins to an unusual degree. Nutrition experts appreciate the difference in various proteins and the importance of minerals and vitamins in the diet. The exact status of fish food in supplying such elements is not known, and to secure this information the bureau has been conducting research on the subject. During the past year it was determined that the proteins of haddock and herring are an excellent supplement for cereals, comparing favorably with steak, liver, or kidney. They do not supplement legumes well, however. Further work will concern other metabolism studies, since feeding experience has shown fish meal to be most effective in promoting growth. This is probably due to the fact that it contains an easily available source of calcium and phosphorus, though it also may be due to the fact that the fish come from the sea, where there is no deficiency of other raw materials.

## MARKET SURVEYS

During 1927 the bureau continued to make studies of the wholesale and retail fishery trade in representative cities and conducted these surveys in St. Louis, Mo., Jacksonville, Fla., and Atlanta, Ga. The complete reports are published as Bureau of Fisheries Documents Nos. 1026, 1036, and 1039, respectively. These may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

*Greater St. Louis.*—This city is situated on the Mississippi River near the geographical center of the United States, the center of population, the center of agricultural production, and the center of many of the sources of raw materials. Being neither eastern nor western, northern nor southern, its population might be expected to represent a typical cross section of American life.

During 1926, the 12 wholesale firms in St. Louis handled 13,000,000 pounds of 74 varieties of fresh and frozen fishery products, with a wholesale value of about $3,200,000. Over one-half of these products were received from Massachusetts, Florida, Washington, and Louisiana, while 24 other States and 4 Canadian Provinces contributed the remainder. Of the amount received, about 1,000,000 pounds were reshipped or distributed, largely to the States immediately adjoining Missouri. The remainder was consumed in Greater St. Louis, which had a population of about 1,026,000. Thus, the annual per capita consumption of fresh and frozen fishery products in this area is about 12 pounds in the round or 9 pounds of the edible portion. If the amount of canned or cured fish consumed in this area were to be added, it is believed that the annual per capita consumption of all fishery products would amount to about 15 pounds, which is the average for the entire United States.

The bulk of the trade (75 per cent) is based on whiting, halibut, buffalofish, catfish, oysters, and haddock, named in order of importance. Fifteen other products constitute 20 per cent, and 53 products make up the remaining 5 per cent of the trade.

During late years, consumers have changed their preference for various well-liked local species of diminishing supply in the fresh condition to others of abundance and fine quality, frozen, which are obtained from more remote sections. This change, especially the growth in preference for frozen fish, has been an important factor in stabilizing the fisheries trade in St. Louis. Market gluts or famines of fishery products are almost unknown, prices are more uniform over the year, and the trade during the summer months is more active. By this change of preference whiting has entered the trade and now ranks first in volume and value. These fish are taken along the Atlantic coast, frozen there, and shipped in standard boxes to St. Louis, where they are held in storage until needed. They are skinned and beheaded and sold as whiting sticks, in which form they are ready for cooking. Whiting have become popular because they may be handled easily by consumers, can be purchased by a certain number to a pound, are comparatively inexpensive, are a palatable food, and are virtually boneless. They are used extensively in hot-fish shops, where they are served as hot-fish sandwiches, which sell for 15 cents.

During 1927 there were 62 retail fish stores in Greater St. Louis that handled fish daily. In addition, there were many grocery stores, meat markets, and other retail stores that handled fishery products one or more days a week.

Of the strictly retail fish stores, 75 per cent cater to the Hebrew, Italian, and colored trade, while the remaining 25 per cent cater to the gentile white trade. The latter appear to confine their purchases of fish to grocery and meat stores or have eliminated fish from their diet.

Inquiry as to the trade during the week in strictly retail fish stores showed that on Monday, Tuesday, and Wednesday trade is dull and on Thursday, Friday, and Saturday it is brisk. Some stores remain open on Sunday and reported trade on that day to be mediocre. Stores catering to the Hebrews are busiest on Thursday, while those catering to the gentile trade reported Friday the busiest day. The stores catering to the colored trade reported Saturday and Sunday as the most active days.

Incoming and outgoing transportation facilities at Greater St. Louis are adequate for efficient and speedy handling of fishery products. Fish are received over four trunk-line routes from the East, three from the West, and three from the South. Terminal team tracks near the majority of the wholesale establishments make loading and unloading of car-lot shipments easy. Car-lot shipments of frozen fish usually are unloaded at one of the public cold-storage plants, which are near the wholesale area where siding space is available for 20 freight cars at one time. Cold-storage stocks held during 1926 amounted to about 6,700,000 pounds.

*Jacksonville, Fla.*—As the waters in the vicinity of Jacksonville support no extensive commercial fisheries, the wholesale dealers of this city merely assemble and distribute rather than produce fishery products. Only 5 per cent of the fishery products received in the city in 1926 were produced in the immediate locality, and 60 per cent were distributed to points outside the city.

Possibly no other city in Florida is situated so favorably with respect to Florida production centers and transportation and warehouse facilities. Trunk-line railroads from all the important fish-producing centers of Florida converge here and then spread out to the more important fish-consuming cities of the country. Warehouse facilities are such that both fresh and frozen fishery products can be handled efficiently and regularly.

In 1926, the 10 wholesale dealers handled nearly 10,000,000 pounds of fresh and frozen fishery products of 48 varieties with a wholesale value of about $1,500,000. Florida supplied about 85 per cent of these products, and the remainder was received from 10 other States and 1 Canadian Province. Most of the products received from Florida are reshipped to other markets, while those from other States are consumed largely in Jacksonville. Of the total received, 6,000,000 pounds were distributed to other cities, two-thirds by express and one-third by freight. Freight shipments, which are forwarded to New York, Philadelphia, and other large northern cities, are made up largely of less-than-carload express shipments from Florida producers. Producers making shipments of this nature via Jacksonville usually send their products on consignment; and inasmuch as it is customary for consignors to pay transportation charges to destination, this arrangement is advantageous for the reason that they obtain a car-lot freight rate on their products from Jacksonville to the consuming market.

About 3,750,000 pounds of fresh and frozen fishery products were consumed in Jacksonville in 1926. Based on a population of about 150,000 for that year, the annual per capita consumption of fish amounted to about 25 pounds in the round or 18 pounds of the edible portion. This is slightly higher than the average for the United States and is due mainly to consumption by colored and transient residents and to the fact that restaurants and other eating places feature fishery products on their menus.

The bulk of the trade (75 per cent) is based on mullet, croaker, fresh-water bream, shrimp, oysters, king whiting, red snapper, crappie, sea trout, and Spanish mackerel, named in order of importance. Fourteen other products constitute 20 per cent of the trade, and 24 products make up the remaining 5 per cent of the trade.

During 1926, there were 24 retail stores in Jacksonville that marketed fish every day in the week. Twelve of these catered almost entirely to colored residents, four to white residents, and eight to customers of both races. Of the stores catering to white residents, seven were located downtown and five in outlying districts. In other words, only five neighborhood fish stores that cater to the white trade are conducted in Jacksonville. This would indicate that there is opportunity for the sale of fish in neighborhood grocery stores, in which package fish could be handled easily. A few grocery stores and meat markets now handle fishery products, but their number is almost negligible. In the strictly retail fish store, business is dull on Monday, Tuesday, Wednesday, and Thursday, on Friday it is mediocre, and on Saturday it is brisk. Those catering to white customers reported Friday their busiest day, and those catering to colored customers reported Saturday as the busiest day.

Fresh and frozen fishery products are marketed by peddlers, also, who operate from motor trucks and horse or hand drawn vehicles. They usually canvass those sections of the city having colored residents.

The wholesale trade is conducted along the St. Johns River and is served by a belt-line railroad with spur tracks leading to most of the wholesale houses. Express terminals and downtown hotels, restaurants, and retail stores are near at hand. A private cold-storage plant is in this area and a public cold-storage plant is about 1 mile from the section. The combined equipment of these plants is sufficient to freeze about 35,000 pounds of fish per day, and storage space is available for about 2,000,000 pounds of frozen fish. This can be expanded to accommodate 4,000,000 pounds. Siding space at these plants is available to accommodate 12 freight cars at one time. Comparatively little advantage is taken of these cold-storage facilities, although it is believed the trade would be in a more stable and prosperous condition if more attention were given to the freezing of fish, especially during market gluts when the runs of fish are at their height.

*Atlanta, Ga.*—In the fisheries trade, this city might be considered primarily as a consuming center rather than a place of production, assembling, or distribution of fresh and frozen fishery products. This may be observed by the fact that no productive commercial fishery is located near by, and only 8 per cent of the fishery products received during 1927 was reshipped to points outside the metropolitan area.

During 1927, fish dealers in Atlanta received 5,070,000 pounds of 57 varieties of fresh and frozen fishery products, with a wholesale value of about $862,000, from 15 States and 1 Canadian Province. Of this amount, only 387,000 pounds were reshipped. The remainder, amounting to 4,683,000 pounds, was consumed within the metropolitan area of Atlanta, which in 1927 had an estimated population of about 325,000. Thus, the annual per capita consumption of fresh and frozen fishery products in this area is about 14 pounds in the round or 11 pounds of the edible portion. This compares favorably with the per capita consumption of fish for the entire United States, which averages about 15 pounds annually for all forms of fresh, frozen, cured, or canned fishery products.

The bulk of the trade (80 per cent) is based on mullet, croaker, red snapper, sea trout, and Spanish mackerel, listed in order of importance. Fifteen other products constitute 15 per cent of the trade, and 37 products make up the remaining 5 per cent.

The five wholesale establishments engaged in handling fresh and frozen fishery products in Atlanta are located in the downtown section near the Union Depot. Some have spur tracks connecting with the main-line railroads.

There are no public cold-storage plants in Atlanta where fish can be stored or frozen, although private plants are operated by some wholesalers. These can accommodate about 250,000 pounds of frozen fish.

Indications are that consumers in Atlanta desire fresh fish and accept the frozen article only when the fresh is not available. No doubt, this has tended to retard the erection of cold-storage plants or the installation of facilities for freezing or storing fishery products at existing cold-storage plants. Educating consumers to the merits of properly frozen fish may increase the sales of such products. This, in turn, may stabilize the trade, as it has done in various other cities.

In 1927, Atlanta had only 12 retail fish stores that handled fishery products daily. In every case these stores handled other products, such as poultry, meat, fruits, vegetables, or groceries. The fish trade was confined to Friday and Saturday, which days accounted for 69 per cent of the week's trade. In addition to the regular retail fish stores there are a large number of grocery stores that make a practice of handling fishery products on one or more days a week. Fully 50 per cent of the grocery stores in Atlanta carry on such a business.

## PUBLICATIONS OF THE DIVISION

During the calendar year 1927 the following publications, prepared by this division, were issued. This list does not include the monthly statistical bulletins for the landings of fish at Boston and Gloucester, Mass., Portland, Me., and Seattle, Wash., nor the monthly publications of the cold-storage holdings of frozen fish. The documents may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the prices shown. The statistical bulletins are distributed free of charge upon request. Persons interested in securing the statistical bulletins as released may have their names placed on the bureau's mailing list upon request.

### DOCUMENTS

Pacific cod fisheries. By John N. Cobb. 8°, 115 pp., 17 figs. Document No. 1014. 25 cents.

Refrigeration of fish. By Harden F. Taylor. 8°, 133 pp., 50 figs. Document No. 1016. 30 cents.

Preparation of fish for canning as sardines. By Harry R. Beard. 8°, 157 pp., 30 figs. Document No. 1020. 30 cents.

### STATISTICAL BULLETINS

Statement, by fishing grounds, of quantities and values of certain fishery products landed at Seattle, Wash., by American fishing vessels during the calendar year 1926. Statistical Bulletin No. 728.

Statement, by months, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the calendar year 1926. Statistical Bulletin No. 729.

Statement, by fishing grounds, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the calendar year 1926. Statistical Bulletin No. 730.

Canned fishery products and by-products of the United States and Alaska, 1926. Statistical Bulletin No. 737.

Fisheries of Alaska, 1926. Statistical Bulletin No. 741.

Fisheries of Maryland and Virginia, 1925. Statistical Bulletin No. 745.

Fisheries of the Pacific Coast States, 1925. Statistical Bulletin No. 747.

# Part 2.—FISHERY STATISTICS

## REVIEW

According to the most recent statistics available, the fisheries of the various geographical sections of the United States and Alaska employ approximately 118,600 commercial fishermen and 4,300 persons on transporting vessels directly connected with the fisheries. The annual landings of fishery products amount to nearly 2,500,000,000 pounds, valued at about $103,000,000 to the fishermen. In 1927 the production of canned fishery products amounted to 475,655,000 pounds, valued at $81,384,000, and the output of by-products was valued at $12,793,000. Imports of fishery products were valued at $55,634,000, while exports aggregated $18,717,000.

In a discussion of trends in the fisheries, we are seriously handicapped by the fragmentary nature of the available statistical data. An attempt to glean some idea of recent developments may result in errors of omission where data are lacking, but at least it can bring significant developments to light where statistics are available.

*Fisheries, by sections, of the United States and Alaska*

| Sections | Fishermen | Fishing vessels | Fishing boats | Persons on transporters | Transporting vessels | Products | |
|---|---|---|---|---|---|---|---|
| | *Number* | *Number* | *Number* | *Number* | *Number* | *Pounds* | *Value* |
| New England States, 1924 | 15, 007 | 615 | 10, 022 | 278 | 162 | 406, 822, 165 | $18, 818, 132 |
| Middle Atlantic States, 1926 | 9, 953 | 617 | 4, 489 | 107 | 63 | 168, 012, 495 | 12, 456, 256 |
| Chesapeake Bay States, 1925 | 24, 793 | 574 | 16, 895 | 985 | 523 | 333, 205, 769 | 13, 948, 060 |
| South Atlantic States, 1923 | 10, 094 | 177 | 5, 934 | 180 | 103 | 228, 747, 930 | 5, 087, 340 |
| Gulf States, 1923 | 10, 576 | 349 | 6, 809 | 339 | 143 | 160, 324, 042 | 8, 096, 650 |
| Pacific Coast States, 1926 | 18, 597 | 703 | 7, 129 | 475 | 172 | 521, 286, 418 | 18, 914, 733 |
| Mississippi River States, 1922 | 12, 310 | | 15, 538 | 30 | 13 | 105, 733, 734 | 4, 503, 521 |
| Lake States, 1926 | 6, 233 | 504 | 3, 756 | 162 | 103 | 75, 300, 268 | 6, 642, 392 |
| Alaska, 1927 | 11, 030 | 504 | 6, 781 | 1, 773 | 481 | 470, 022, 050 | 14, 434, 630 |
| Total various years, 1922-1927 | 118, 593 | 4, 043 | 77, 353 | 4, 329 | 1, 763 | 2, 469, 454, 871 | 102, 901, 714 |

NOTE.—In the statistics for the Pacific Coast States, the number of transporters and persons on transporters are for 1922. For the Lake States, all persons engaged, boats, and vessels are for 1922.

*Production, by States, of the fisheries of the United States and Alaska* [1]

[Expressed in thousands of pounds and thousands of dollars—that is, 000 omitted]

| States | Marine and coastal rivers | | Mississippi River and tributaries | | Lakes [2] | | Total | |
|---|---|---|---|---|---|---|---|---|
| | *Quantity* | *Value* | *Quantity* | *Value* | *Quantity* | *Value* | *Quantity* | *Value* |
| Alabama | 7, 631 | $342 | 1, 243 | $28 | | | 8, 874 | $370 |
| Arkansas | | | 22, 794 | 760 | | | 22, 794 | 760 |
| California | 398, 651 | 7, 904 | | | | | 398, 651 | 7, 904 |
| Connecticut | 25, 770 | 2, 007 | | | | | 25, 770 | 2, 007 |
| Delaware | 33, 258 | 1, 030 | | | | | 33, 258 | 1, 030 |
| Florida | 160, 162 | 5, 746 | | | | | 160, 162 | 5, 746 |
| Georgia | 39, 897 | 668 | | | | | 39, 897 | 668 |
| Illinois | | | 22, 598 | 1, 078 | 381 | $56 | 22, 979 | 1, 134 |
| Indiana | | | 12, 577 | 437 | 626 | 96 | 13, 203 | 533 |
| Iowa | | | 6, 761 | 326 | | | 6, 761 | 326 |
| Kansas | | | 615 | 26 | | | 615 | 26 |
| Kentucky | | | 2, 893 | 167 | | | 2, 893 | 167 |
| Louisiana | 34, 835 | 1, 961 | 10, 486 | 573 | | | 45, 321 | 2, 534 |
| Maine | 116, 707 | 4, 137 | | | | | 116, 707 | 4, 137 |
| Maryland | 56, 978 | 4, 863 | | | | | 56, 978 | 4, 863 |
| Massachusetts | 243, 363 | 10, 799 | | | | | 243, 363 | 10, 799 |
| Michigan | | | | | 26, 989 | 2, 629 | 26, 989 | 2, 629 |
| Minnesota | | | 5, 660 | 230 | 10, 552 | 503 | 16, 212 | 733 |
| Mississippi | 25, 032 | 986 | 3, 328 | 191 | | | 28, 360 | 1, 177 |
| Missouri | | | 1, 566 | 104 | | | 1, 566 | 104 |
| Nebraska | | | 135 | 16 | | | 135 | 16 |
| New Hampshire | 447 | 56 | | | | | 447 | 56 |
| New Jersey | 73, 299 | 6, 254 | | | | | 73, 299 | 6, 254 |
| New York | 60, 721 | 5, 129 | | | 3, 429 | 263 | 64, 150 | 5, 392 |
| North Carolina | 95, 192 | 2, 414 | | | | | 95, 192 | 2, 414 |
| Ohio | | | 702 | 30 | 15, 934 | 1, 517 | 16, 636 | 1, 547 |
| Oklahoma | | | 363 | 31 | | | 363 | 31 |
| Oregon | 32, 998 | 3, 068 | | | | | 32, 998 | 3, 068 |
| Pennsylvania | 735 | 43 | 49 | 2 | 5, 001 | 484 | 5, 785 | 529 |
| Rhode Island | 20, 535 | 1, 819 | | | | | 20, 535 | 1, 819 |
| South Carolina | 6, 763 | 285 | | | | | 6, 763 | 285 |
| South Dakota | | | 101 | 4 | | | 101 | 4 |
| Tennessee | | | 5, 494 | 188 | | | 5, 494 | 188 |
| Texas | 19, 560 | 782 | 184 | 19 | | | 19, 744 | 801 |
| Virginia | 276, 228 | 9, 085 | | | | | 276, 228 | 9, 085 |
| Washington | 89, 637 | 7, 943 | | | | | 89, 637 | 7, 943 |
| West Virginia | | | 95 | 8 | | | 95 | 8 |
| Wisconsin | | | 8, 090 | 286 | 12, 388 | 1, 094 | 20, 478 | 1, 380 |
| Alaska | 470, 022 | 14, 435 | | | | | 470, 022 | 14, 435 |
| Total | 2, 288, 421 | 91, 756 | 105, 734 | 4, 504 | 75, 300 | 6, 642 | 2, 469, 455 | 102, 902 |

[1] Statistics of the New England States are for the year 1924: Middle Atlantic States, 1926; Chesapeake Bay States, 1925; South Atlantic and Gulf States, 1923; Pacific Coast States, 1926; Mississippi River and tributaries, 1922; Lake States, 1926; and Alaska, 1927.

[2] Includes Lake Ontario, Lake Erie, Lake Huron, Lake Michigan, Lake Superior, Rainy Lake, Namekan Lake, and Lake of the Woods.

In the New England States the development of the packaged-fish trade has been remarkable. The degree of this development is shown in no uncertain terms by the 37 per cent increase in landings at New England ports of haddock—the fish used most in this trade. The demand for haddock seems beyond the capacity of the present fishing fleet to supply, even though the steam trawlers averaged more trips with larger fares and a larger total catch per vessel in 1927 than in previous years. Fishing concerns are endeavoring to enlarge the fleets; vessels are being built and old vessels are being reconditioned. It is not impossible that the size of the fleet may be doubled by 1929. Flounder draggers also are turning to haddock fishing, though the catch of flounders has increased notably. Meanwhile, the shore facilities for handling the fish are being enlarged and improved. There is a decided tendency to consolidate fishing companies and to erect large plants for use in the filleting and packaging of haddock. Other branches of the New England fisheries show no marked developments. The sardine-canning season in Maine was poorer than for some years past, suffering a 27-per cent decrease in output in 1927 as compared with the previous year.

The situation in the Middle Atlantic States is not as encouraging. Though New York City shared in the increases in the vessel landings that feed the packaged-fish market, the shore fisheries, which are predominant in this section, do not appear to be increasing in productivity. Though 1927 statistics are not available for these fisheries, the 1926 statistics are published in this report. They show alarming decreases in some of the staple fishes of the region as compared with the preceding canvass of 1921. The yield of bluefish declined 72 per cent; scup, 37 per cent; and squeteague or weakfish, 36 per cent. The catches of other important species, while not lower than in 1921, are still far below those of former years. A few species show greater catches, notably the butterfish, which registered an 18 per cent increase over 1921. The yield of oysters and scallops has increased moderately.

No very recent general statistics are available on the fisheries of the Chesapeake Bay States, but it should be remarked here—and this applies to the entire Atlantic coast—that the menhaden industry experienced another very poor year. The output of the factories was slightly better than in 1926 but was still about half of what has been considered normal in recent years. This was the third poor season in the last four years and, in consequence, some of the firms have gone out of business.

In the South Atlantic and Gulf States recent general statistics also are lacking. Judging from the pack of canned oysters and shrimp in 1927, a good year was experienced in this branch of the industry, for the oyster pack was greater than last year's by 8 per cent in quantity and 17 per cent in value, and the shrimp pack was the highest on record, exceeding that of 1926 by 16 per cent in quantity and 29 per cent in value.

On the Pacific coast the smaller pack of salmon in Alaska was the outstanding feature of 1927. The decline was 46 per cent as compared with 1926. It should be said, however, that 1926 was an unusually successful year, and when compared with an average for the previous five years the pack of 1927 was only 36 per cent smaller. The catch of halibut in 1927 was greater than last year in spite of the depleted condition of this fishery. The increase can be explained by the greater intensity of fishing and the extension of fishing to the westward. The pack of sardines in California in 1927 was 22 per cent larger than in the previous year and 6 times as large as in 1921, when the industry was at a low level due to the postwar depression. The tuna pack also was much larger, due mainly to the greater output of the striped and yellowfin varieties.

The 1926 statistics of the Great Lakes fisheries show that there has been only slight recovery from the sharp decline suffered in 1925, when a 14 per cent decrease in total catch was registered and some of the choicer species showed far greater decreases. The catch of ciscoes, on Lake Erie in particular, declined 92 per cent in that year and was still lower in 1926. A noticeable gain in total catch has occurred on Lake Superior.

## CANNED FISHERY PRODUCTS AND BY-PRODUCTS

The output of canned fishery products in the United States and Alaska in 1927 was valued at $81,384,133 and the fishery by-products at $12,793,256, making the total value of the output $94,177,389. This is 4 per cent less than a year ago and 1 per cent less than in 1925, while it exceeds the output for 1921 by 71 per cent. The decrease under a year ago is due mostly to the smaller pack of canned salmon in Alaska.

Fishery products were canned at 471 establishments in the United States and Alaska in 1927. The combined output of these canneries equaled 12,281,658 standard cases,[3] or a net weight, in the can, of 475,655,039 pounds.

Canned fishery products and by-products were prepared in 23 States and Alaska during 1927. Alaska ranks first in value of products and by-products prepared and produced 34 per cent of the total. California ranks second with 22 per cent of the value, while Washington is third with 12 per cent. Considering the output by geographical sections, the Pacific Coast States and Alaska accounted for 74 per cent of the total value of canned products and by-products and 85 per cent of the total weight of canned products.

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[3] Fishery products are sealed hermetically in tin and glass containers of many sizes. For the sake of uniformity these various sizes of containers have been converted to standard cases, which represent a net weight of 48 pounds to the case for salmon, sardines canned in California, alewives and alewife roe, shad and shad roe, crabs, and miscellaneous fish and shellfish; 25 pounds to the case for sardines canned in Maine and Massachusetts; 24 pounds to the case for tuna and tunalike fishes; 15 pounds to a case for whole and minced clams and 30 pounds to the case for other clam products; and 15 pounds to the case for shrimp and oysters.

*Canned fishery products and by-products of the United States and Alaska, 1927*

SUMMARY OF PRODUCTION: BY COMMODITIES

| Products | Number of plants | Standard cases | Pounds | Value |
|---|---|---|---|---|
| Canned products: | | | | |
| Salmon— | | | | |
| United States | 64 | 1,504,451 | 72,213,648 | $15,712,497 |
| Alaska | 135 | 3,572,128 | 171,462,144 | 30,016,264 |
| Sardines— | | | | |
| Maine and Massachusetts | 38 | 1,262,124 | 31,553,100 | 5,249,030 |
| California | 29 | 2,563,146 | 123,031,008 | 9,268,784 |
| Tuna and tunalike fishes | 19 | 1,255,818 | 30,139,632 | 8,368,227 |
| Alewives | 10 | 21,327 | 1,023,696 | 64,577 |
| Alewife roe | 31 | 45,168 | 2,168,064 | 252,120 |
| Shad | 17 | 11,569 | 555,312 | 61,842 |
| Shad roe | 15 | 767 | 36,816 | 21,890 |
| Miscellaneous fish, caviar, roe, and eggs | 34 | 215,334 | 10,336,032 | 1,842,874 |
| Oysters | 55 | 447,297 | 6,709,455 | 2,367,949 |
| Clam products | 51 | 525,286 | 12,255,240 | 2,744,954 |
| Shrimp | 74 | 852,764 | 13,955,900 | 5,321,652 |
| Crabs | 4 | 1,009 | 48,432 | 26,988 |
| Miscellaneous shellfish | 5 | 3,470 | 166,560 | 64,485 |
| Total | [1] 471 | 12,281,658 | 475,655,039 | 81,384,133 |

| | Quantity | Value |
|---|---|---|
| By-products: | | |
| Shell products ........ tons | 310,519 | $2,601,050 |
| Scrap, meal, and bran ........ do | 91,866 | 4,321,082 |
| Fish and marine-animal oils ........ gallons | 10,874,113 | 4,905,021 |
| Miscellaneous by-products | | 966,103 |
| Total | | 12,793,256 |
| Grand total | | 94,177,389 |

VALUE OF PRODUCTION: BY STATES

| State | Canned products | By-products (including menhaden) | Total |
|---|---|---|---|
| Maine | $5,998,683 | $231,357 | $6,230,040 |
| Massachusetts | 1,359,895 | 1,331,641 | 2,691,536 |
| Rhode Island, Connecticut, New York, New Jersey, Indiana, and Wisconsin | 911,039 | 368,376 | 1,279,415 |
| Pennsylvania and Delaware | | 472,560 | 472,560 |
| Maryland | 208,852 | 578,960 | 787,812 |
| Virginia | 253,034 | 1,964,072 | 2,217,106 |
| North Carolina | 120,210 | 859,206 | 979,416 |
| South Carolina | 653,039 | 188,827 | 841,866 |
| Georgia and Florida | 1,574,879 | 753,554 | 2,328,433 |
| Alabama | 776,167 | 50,768 | 826,935 |
| Mississippi | 2,068,467 | 204,548 | 2,273,015 |
| Louisiana | 2,190,382 | 1,130,276 | 3,320,658 |
| Texas | 425,388 | 36,055 | 461,443 |
| Washington | 11,239,109 | 106,015 | 11,345,124 |
| Oregon | 5,613,625 | 56,680 | 5,670,305 |
| California | 17,828,281 | 2,495,458 | 20,323,739 |
| Alaska | 30,163,083 | 1,964,903 | 32,127,986 |
| Total | 81,384,133 | 12,793,256 | 94,177,389 |

[1] Exclusive of duplication.

*Value of canned fishery products and by-products of the United States and Alaska, 1921 to 1927*

| Year | Canned products | By-products (including menhaden) | Total |
|---|---|---|---|
| 1921 | $46,634,706 | $8,351,827 | $54,986,533 |
| 1922 | 60,464,947 | 11,390,693 | 71,855,640 |
| 1923 | 72,445,205 | 12,634,590 | 85,079,795 |
| 1924 | 72,164,589 | 10,308,990 | 82,473,579 |
| 1925 | 80,577,138 | 14,600,198 | 95,177,336 |
| 1926 | 86,193,240 | 12,133,110 | 98,326,350 |
| 1927 | 81,384,133 | 12,793,256 | 94,177,389 |

## CANNED PRODUCTS

The value of the canned products in 1927 was 6 per cent lower than in the previous year. Salmon was the most important item and contributed 56 per cent of the total value; sardines were next with 18 per cent; and tuna followed with 10 per cent; while oysters, shrimp, clam products, and miscellaneous products made up the remaining 16 per cent.

*Value of canned fishery products, 1921 to 1927*

| Year | Salmon | Sardines | Tuna | Oysters | Shrimp | Clams | Other | Total |
|---|---|---|---|---|---|---|---|---|
| 1921 | $28,867,169 | $6,307,362 | $3,074,626 | $2,179,271 | $3,804,781 | $1,166,507 | $1,234,990 | $46,634,706 |
| 1922 | 38,420,717 | 9,111,589 | 4,511,873 | 2,423,616 | 3,064,087 | 1,716,365 | 1,216,700 | 60,464,947 |
| 1923 | 45,533,573 | 9,896,796 | 6,914,760 | 2,720,073 | 4,381,534 | 1,710,616 | 1,287,853 | 72,445,205 |
| 1924 | 42,401,602 | 12,636,599 | 5,756,586 | 2,478,044 | 4,608,950 | 2,161,389 | 2,121,419 | 72,164,589 |
| 1925 | 47,369,507 | 13,097,318 | 8,499,080 | 3,721,159 | 3,782,819 | 1,850,378 | 2,256,877 | 80,577,138 |
| 1926 | 56,219,306 | 14,534,792 | 5,282,283 | 2,026,569 | 4,122,092 | 2,004,650 | 2,003,548 | 86,193,240 |
| 1927 | 45,728,761 | 14,517,814 | 8,368,227 | 2,367,949 | 5,321,652 | 2,744,954 | 2,334,776 | 81,384,133 |

*Salmon.*—In 1927, salmon were packed at 135 plants in Alaska, 40 in Washington, 19 in Oregon, and 5 in California. Compared with the previous year, there was an increase of 3 in Alaska, 9 in Washington, 1 in Oregon, and 3 in California. The combined output of the 199 plants amounted to 5,076,579 cases, valued at $45,728,761. Of the total, 1,504,451 cases, valued at $15,712,497, were packed in the Pacific Coast States and 3,572,128 cases, valued at $30,016,264, were packed in Alaska. The pack in Alaska was 3,080,754 cases, or 46 per cent smaller than in the previous year, and is less than for any year since 1921. The decrease is due principally to the smaller packs of red, pink, and Keta salmon. On the other hand, the pack for the Pacific Coast States increased by 668,713 cases, or 80 per cent, due mainly to the greater pack of pink salmon. The increase in the Pacific Coast States is not surprising, for the run is marked by alternating good and poor years, 1927 having been the good year. Compared with 1925, the previous good year, there was a decrease of over 3 per cent.

*Pack of canned salmon, Pacific Coast States and Alaska, 1927*

| Products | Pacific Coast States | | | | | | Alaska, southeast | |
|---|---|---|---|---|---|---|---|---|
| | Washington | | Oregon and California | | Total | | | |
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| King, chinook, or spring: | | | | | | | | |
| 1-pound tall | 22,092 | $186,863 | 15,228 | $115,082 | 37,320 | $301,945 | 3,771 | $35,818 |
| 1-pound flat | 38,604 | 532,536 | 83,710 | 1,196,557 | 122,314 | 1,729,093 | 2,504 | 29,239 |
| 1-pound oval | 2,665 | 43,305 | 5,317 | 90,389 | 7,982 | 133,694 | ........ | ........ |
| ½-pound flat and oval | 87,797 | 1,422,551 | 149,906 | 2,605,085 | 237,703 | 4,027,636 | 1,756 | 25,670 |
| Total | 151,158 | 2,185,255 | 254,161 | 4,007,113 | 405,319 | 6,192,368 | 8,031 | 90,727 |
| Red or sockeye: | | | | | | | | |
| 1-pound tall | 11,483 | 142,389 | ........ | ........ | 11,483 | 142,389 | 64,387 | 771,161 |
| 1-pound flat | 18,527 | 259,378 | ........ | ........ | 18,527 | 259,378 | 21,083 | 265,771 |
| ½-pound flat | 89,770 | 1,687,698 | 4,046 | 80,920 | 93,816 | 1,768,618 | 30,998 | 498,117 |
| Total | 119,780 | 2,089,465 | 4,046 | 80,920 | 123,826 | 2,170,385 | 116,468 | 1,535,049 |
| Coho or silver: | | | | | | | | |
| 1-pound tall | 68,655 | 618,081 | 16,092 | 151,265 | 84,747 | 769,346 | 97,964 | 798,223 |
| 1-pound flat | 24,874 | 248,740 | 24,370 | 243,700 | 49,244 | 492,440 | 10,119 | 86,266 |
| ½-pound flat | 43,140 | 523,381 | 33,406 | 427,596 | 76,546 | 950,977 | 6,887 | 85,081 |
| Total | 136,669 | 1,390,202 | 73,868 | 822,561 | 210,537 | 2,212,763 | 114,970 | 969,570 |
| Humpback or pink: | | | | | | | | |
| 1-pound tall | 520,641 | 3,332,102 | ........ | ........ | 520,641 | 3,332,102 | 536,799 | 3,160,552 |
| 1-pound flat | 25,959 | 181,713 | ........ | ........ | 25,959 | 181,713 | 8,367 | 50,331 |
| ½-pound flat | 39,998 | 351,982 | ........ | ........ | 39,998 | 351,982 | 43,125 | 388,373 |
| Total | 586,598 | 3,865,797 | ........ | ........ | 586,598 | 3,865,797 | 588,291 | 3,599,256 |
| Chum or keta: | | | | | | | | |
| 1-pound tall | 70,823 | 396,609 | 51,371 | 287,678 | 122,194 | 684,287 | 216,198 | 1,180,774 |
| 1-pound flat | 6,408 | 38,448 | 44 | 264 | 6,452 | 38,712 | ........ | ........ |
| ½-pound flat | 11,461 | 89,229 | 5,249 | 39,892 | 16,710 | 129,121 | 8,235 | 64,532 |
| Total | 88,692 | 524,286 | 56,664 | 327,834 | 145,356 | 852,120 | 224,433 | 1,245,306 |
| Steelhead: | | | | | | | | |
| 1-pound tall | 1,749 | 17,980 | 1,892 | 19,676 | 3,641 | 37,656 | ........ | ........ |
| 1-pound flat | 1,523 | 16,753 | 8,855 | 97,405 | 10,378 | 114,158 | ........ | ........ |
| ½-pound flat and oval | 4,838 | 68,480 | 13,958 | 198,770 | 18,796 | 267,250 | ........ | ........ |
| Total | 8,110 | 103,213 | 24,705 | 315,851 | 32,815 | 419,064 | ........ | ........ |
| Grand total | 1,091,007 | 10,158,218 | 413,444 | 5,554,279 | 1,504,451 | 15,712,497 | 1,052,193 | 7,439,908 |

| Products | Alaska | | | | | | Grand total | |
|---|---|---|---|---|---|---|---|---|
| | Central | | Western | | Total | | | |
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| King, chinook, or spring: | | | | | | | | |
| 1-pound tall | 26,161 | $253,867 | 18,560 | $187,634 | 48,492 | $477,319 | 85,812 | $779,264 |
| 1-pound flat | 8,537 | 112,708 | 330 | 2,300 | 11,371 | 144,247 | 133,685 | 1,873,340 |
| 1-pound oval | ........ | ........ | ........ | ........ | ........ | ........ | 7,982 | 133,694 |
| ½-pound flat and oval | 8,772 | 144,417 | ........ | ........ | 10,528 | 170,087 | 248,231 | 4,197,723 |
| Total | 43,470 | 510,992 | 18,890 | 189,934 | 70,391 | 791,653 | 475,710 | 6,984,021 |
| Red or sockeye: | | | | | | | | |
| 1-pound tall | 247,367 | 2,916,372 | 861,796 | 10,097,357 | 1,173,550 | 13,784,890 | 1,185,033 | 13,927,279 |
| 1-pound flat | 32,709 | 396,245 | 3,979 | 43,554 | 57,771 | 705,570 | 76,298 | 964,948 |
| ½-pound flat | 38,788 | 635,645 | 19,088 | 330,263 | 88,874 | 1,464,025 | 182,690 | 3,232,643 |
| Total | 318,864 | 3,948,262 | 884,863 | 10,471,174 | 1,320,195 | 15,954,485 | 1,444,021 | 18,124,870 |
| Coho or silver: | | | | | | | | |
| 1-pound tall | 129,888 | 1,112,121 | 40 | 351 | 227,892 | 1,910,695 | 312,639 | 2,680,041 |
| 1-pound flat | 4,928 | 35,731 | ........ | ........ | 15,047 | 121,997 | 64,291 | 614,437 |
| ½-pound flat | 3,218 | 36,183 | ........ | ........ | 10,105 | 121,264 | 86,651 | 1,072,241 |
| Total | 138,034 | 1,184,035 | 40 | 351 | 253,044 | 2,153,956 | 463,581 | 4,366,719 |

*Pack of canned salmon, Pacific Coast States and Alaska, 1927*—Continued

| Products | Alaska—Continued | | | | | | Grand total | |
|---|---|---|---|---|---|---|---|---|
| | Central | | Western | | Total | | | |
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| Humpback or pink: | | | | | | | | |
| 1-pound tall | 803, 913 | $4, 573, 832 | 14, 946 | $75, 523 | 1, 355, 658 | $7, 809, 907 | 1, 876, 299 | $11,142,009 |
| 1-pound flat | 6, 295 | 32, 253 | | | 14, 662 | 82, 584 | 40, 621 | 264, 297 |
| ½-pound flat | 7, 330 | 57, 826 | | | 50, 455 | 446, 199 | 90, 453 | 798, 181 |
| Total | 817, 538 | 4, 663, 911 | 14, 946 | 75, 523 | 1, 420, 775 | 8, 338, 690 | 2, 007, 373 | 12, 204, 487 |
| Chum or keta: | | | | | | | | |
| 1-pound tall | 250, 569 | 1, 352, 724 | 30, 093 | 163, 511 | 496, 860 | 2, 697, 009 | 619, 054 | 3, 381, 296 |
| 1-pound flat | 1, 449 | 6, 977 | | | 1, 449 | 6, 977 | 7, 901 | 45, 689 |
| ½-pound flat | 1, 179 | 8, 962 | | | 9, 414 | 73, 494 | 26, 124 | 202, 615 |
| Total | 253, 197 | 1, 368, 663 | 30, 093 | 163, 511 | 507, 723 | 2, 777, 480 | 653, 079 | 3, 629, 600 |
| Steelhead: | | | | | | | | |
| 1-pound tall | | | | | | | 3, 641 | 37, 656 |
| 1-pound flat | | | | | | | 10, 378 | 114, 158 |
| ½-pound flat and oval | | | | | | | 18, 796 | 267, 250 |
| Total | | | | | | | 32, 815 | 419, 064 |
| Grand total | 1, 571, 103 | 11, 675, 863 | 948, 832 | 10, 900, 493 | 3, 572, 128 | 30, 016, 264 | 5, 076, 579 | 45, 728, 761 |

NOTE.—The pack of salmon has been reduced to the equivalent of forty-eight 1-pound cans to the case.

*Pack of canned salmon in the Pacific Coast States, 1921 to 1927*

| Year | King, chinook, or spring | | Red or sockeye | | Coho or silver | | Humpback or pink | |
|---|---|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| 1921 | 335, 854 | $4, 527, 711 | 104, 954 | $1, 905, 647 | 111, 643 | $806, 678 | 402, 846 | $1, 732, 847 |
| 1922 | 314, 126 | 4, 572, 607 | 97, 927 | 1, 816, 901 | 204, 252 | 1, 533, 173 | 3, 551 | 18, 546 |
| 1923 | 384, 705 | 5, 790, 419 | 105, 336 | 1, 955, 549 | 245, 548 | 1, 608, 627 | 445, 175 | 2, 211, 742 |
| 1924 | 349, 014 | 4, 599, 759 | 85, 800 | 1, 478, 698 | 231, 139 | 1, 774, 078 | 12, 778 | 79, 436 |
| 1925 | 432, 638 | 5, 990, 019 | 118, 387 | 2, 065, 975 | 307, 567 | 3, 313, 060 | 551, 375 | 3, 152, 342 |
| 1926 | 349, 600 | 5, 281, 404 | 75, 711 | 1, 474, 722 | 228, 141 | 2, 223, 499 | 2, 608 | 19, 609 |
| 1927 | 405, 319 | 6, 192, 368 | 123, 826 | 2, 170, 385 | 210, 537 | 2, 212, 763 | 586, 598 | 3, 865, 797 |

| Year | Chum or keta | | Steelhead | | Total | |
|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| 1921 | 35, 132 | $127, 659 | 12, 519 | $133, 883 | 1, 002, 948 | $9, 234, 425 |
| 1922 | 87, 583 | 365, 303 | 25, 797 | 326, 994 | 733, 246 | 8, 633, 524 |
| 1923 | 154, 342 | 769, 839 | 32, 157 | 324, 390 | 1, 367, 263 | 12, 660, 566 |
| 1924 | 247, 858 | 1, 192, 156 | 32, 073 | 270, 340 | 958, 662 | 9, 394, 467 |
| 1925 | 133, 368 | 641, 310 | 15, 278 | 217, 270 | 1, 558, 613 | 15, 379, 976 |
| 1926 | 148, 732 | 758, 843 | 30, 946 | 381, 225 | 835, 738 | 10, 139, 302 |
| 1927 | 145, 356 | 852, 120 | 32, 815 | 419, 064 | 1, 504, 451 | 15, 712, 497 |

*Pack of canned salmon in Alaska, 1921 to 1927*

| Year | King, chinook, or spring | | Red or sockeye | | Coho or silver | |
|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| 1921 | 44, 994 | $459, 897 | 1, 765, 798 | $15, 841, 404 | 106, 555 | $600, 140 |
| 1922 | 30, 660 | 247, 673 | 2, 070, 658 | 19, 135, 696 | 175, 993 | 962, 790 |
| 1923 | 38, 343 | 328, 270 | 1, 859, 496 | 17, 253, 792 | 164, 107 | 943, 318 |
| 1924 | 33, 648 | 299, 009 | 1, 447, 895 | 13, 803, 932 | 183, 601 | 1, 254, 551 |
| 1925 | 49, 978 | 595, 041 | 1, 059, 676 | 13, 904, 599 | 161, 010 | 1, 565, 759 |
| 1926 | 52, 476 | 544, 246 | 2, 157, 087 | 21, 328, 739 | 202, 527 | 1, 700, 563 |
| 1927 | 70, 391 | 791, 653 | 1, 320, 195 | 15, 954, 485 | 253, 044 | 2, 153, 956 |

*Pack of canned salmon in Alaska, 1921 to 1927*—Continued

| Year | Humpback or pink | | Chum or keta | | Total | |
|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| 1921 | 423,984 | $1,788,778 | 255,495 | $942,525 | 2,596,826 | $19,632,744 |
| 1922 | 1,658,423 | 7,189,494 | 565,918 | 2,251,540 | 4,501,652 | 29,787,193 |
| 1923 | 2,448,129 | 11,899,956 | 525,622 | 2,447,671 | 5,035,697 | 32,873,007 |
| 1924 | 2,601,283 | 12,837,346 | 1,028,488 | 4,812,297 | 5,294,915 | 33,007,135 |
| 1925 | 2,110,593 | 11,137,102 | 1,078,680 | 4,787,030 | 4,459,937 | 31,989,531 |
| 1926 | 3,338,349 | 17,987,527 | 902,443 | 4,518,929 | 6,652,882 | 46,080,004 |
| 1927 | 1,420,775 | 8,338,690 | 507,723 | 2,777,480 | 3,572,128 | 30,016,264 |

*Pack of canned salmon in the United States and Alaska, 1921 to 1927*

| Year | Pacific Coast States | | Alaska | | Total | |
|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| 1921 | 1,002,948 | $9,234,425 | 2,596,826 | $19,632,744 | 3,599,774 | $28,867,169 |
| 1922 | 733,246 | 8,633,524 | 4,501,652 | 29,787,193 | 5,234,898 | 38,420,717 |
| 1923 | 1,367,263 | 12,660,566 | 5,035,697 | 32,873,007 | 6,402,960 | 45,533,573 |
| 1924 | 958,662 | 9,394,467 | 5,294,915 | 33,007,135 | 6,253,577 | 42,401,602 |
| 1925 | 1,558,613 | 15,379,976 | 4,459,937 | 31,989,531 | 6,018,550 | 47,369,507 |
| 1926 | 835,738 | 10,139,302 | 6,652,882 | 46,080,004 | 7,488,620 | 56,219,306 |
| 1927 | 1,504,451 | 15,712,497 | 3,572,128 | 30,016,264 | 5,076,579 | 45,728,761 |

*Sardines.*—In 1927, packs of sardines were reported by 37 plants in Maine, 1 in Massachusetts, and 29 in California. This is an increase of two plants in Maine and a decrease of one in California. The production in Maine and Massachusetts amounted to 1,262,124 standard cases of one hundred ¼-pound cans, valued at $5,249,030, which is a decrease of 27 per cent in quantity and 22 per cent in value as compared with the previous year. In California the production amounted to 2,563,146 standard cases of forty-eight 1-pound cans, valued at $9,268,784, which is an increase of 22 per cent in amount and 19 per cent in value. The California pack has increased continuously and markedly since 1921, when the pack was less than one-sixth as large as in 1927.

*Pack of canned sardines, 1927*

| Sardines (herring) | Maine and Massachusetts | | Sardines (pilchard) | California | |
|---|---|---|---|---|---|
| | *Cases* | *Value* | | *Cases* | *Value* |
| In olive oil: Quarters, ¼-pound (100 cans) | 26,023 | $172,067 | ½-pound oval (48 cans) [1] | 38,514 | $114,442 |
| In cottonseed oil: Quarters, ¼-pound (100 cans) | 1,020,618 | 4,313,198 | 1-pound oval (48 cans): | | |
| In mustard: | | | In tomato sauce | 2,248,853 | 7,734,939 |
| | | | In mustard | 127,943 | 485,368 |
| | | | Soused | 14,650 | 54,829 |
| Quarters, ¼-pound (100 cans) | 76,691 | 359,059 | In other sauces | 10,650 | 38,293 |
| Three-quarters, ¾-pound (48 cans) | 93,114 | 379,482 | ¼-pound square (100 cans) [3] | 38,129 | 327,073 |
| In other sauces: Quarters, ¼-pound (100 cans) | [1] 4,707 | 25,224 | ½-pound square (100 cans) | [4] 117,057 | 513,840 |
| Total | 1,221,153 | 5,249,030 | Total | 2,595,796 | 9,268,784 |
| Total (standard cases) | 1,262,124 | | Total (standard cases) | 2,563,146 | |

[1] Largely in tomato sauce. Includes a few cases of savory sauce packed in 1-pound oval cans, 24 to the case, which have been converted to the equivalent of quarter-size cans, 100 to the case.
[2] Largely in tomato sauce.
[3] Largely in olive oil.
[4] Includes the pack of 6-ounce cans, 100 to the case, and also 8-ounce glass jars, 24 to the case, which have been converted to the equivalent of ½-pound cans, 100 to the case.

NOTE.—"Standard cases" represent the various sized cases converted to the uniform basis of one hundred ¼-pound cans to the case of sardines (herring) and forty-eight 1-pound cans to the case of sardines (pilchard).

*Pack of canned sardines, 1921 to 1927*

| Year | Maine and Massachusetts | | California | |
|---|---|---|---|---|
| | *Cases* [1] | *Value* | *Cases* [2] | *Value* |
| 1921 | 1,399,507 | $3,960,916 | 398,668 | $2,346,446 |
| 1922 | 1,869,719 | 5,750,109 | 715,364 | 3,361,480 |
| 1923 | 1,272,277 | 5,288,865 | 1,100,162 | 4,607,931 |
| 1924 | 1,899,925 | 7,191,026 | 1,367,139 | 5,445,573 |
| 1925 | 1,870,786 | 6,716,701 | 1,714,913 | 6,380,617 |
| 1926 | 1,717,537 | 6,727,388 | 2,093,278 | 7,807,404 |
| 1927 | 1,262,124 | 5,249,030 | 2,563,146 | 9,268,784 |

[1] Standard cases of one hundred ¼-pound cans. [2] Standard cases of forty-eight 1-pound cans.

*Tuna and tunalike fishes.*—These fishes were reported canned at 19 plants in California. The total production was 1,255,818 standard cases of forty-eight ½-pound cans, valued at $8,368,227. This is an increase of 48 per cent in quantity and 58 per cent in value as compared with the previous year, and the pack was larger than for any year during the period 1921 to 1926. Increases are noted mainly in bluefin, yellowfin, and striped tuna. While the pack of albacore also increased over that in 1926, it is still far below the average for previous years.

*Pack of canned tuna and tunalike fishes in California, 1927*

| Sizes | Albacore | | Yellowfin | | Bluefin | |
|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| ¼-pound round (48 cans) [1] | 8,705 | $47,984 | 56,783 | $282,134 | 16,634 | $84,739 |
| ½-pound round (48 cans) [2] | 111,688 | 957,318 | 299,017 | 2,041,695 | 27,639 | 184,323 |
| 1-pound round (48 cans) [3] | 5,839 | 94,942 | 45,160 | 570,185 | 4,692 | 56,468 |
| Flakes [4] | 3,439 | 18,741 | 22,372 | 91,132 | 923 | 3,421 |
| Total | 129,671 | 1,118,985 | 423,332 | 2,985,146 | 49,888 | 328,951 |
| Total (standard cases) | 131,157 | | 440,101 | | 46,263 | |

| Sizes | Tuna, bluefin, and yellowfin | | Tuna, striped | | "Tonno" | |
|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| ¼-pound round (48 cans) [1] | 1,734 | $7,997 | 56,378 | $205,858 | 185,611 | $790,810 |
| ½-pound round (48 cans) [2] | 22,448 | 154,976 | 307,204 | 1,751,762 | 21,823 | 178,465 |
| 1-pound round (48 cans) [3] | 3,594 | 48,003 | 36,447 | 384,141 | 853 | 10,585 |
| Flakes [4] | 16,824 | 69,122 | 6,027 | 20,826 | | |
| Total | 44,600 | 280,098 | 406,056 | 2,362,587 | 208,287 | 979,860 |
| Total (standard cases) | 47,327 | | 414,314 | | 116,335 | |

| Sizes | Bonito | | Yellowtail | | Total | |
|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| ¼-pound round (48 cans) [1] | 12,343 | $46,743 | 9,943 | $37,515 | 348,131 | $1,503,780 |
| ½-pound round (48 cans) [2] | 10,498 | 56,290 | 23,474 | 106,885 | 823,791 | 5,431,714 |
| 1-pound round (48 cans) [3] | 959 | 8,220 | 6,644 | 56,947 | 104,188 | 1,229,491 |
| Flakes [4] | | | | | 49,585 | 203,242 |
| Total | 23,800 | 111,253 | 40,061 | 201,347 | 1,325,695 | 8,368,227 |
| Total (standard cases) | 18,587 | | 41,734 | | 1,255,818 | |

[1] Includes the pack of ¼-pound round and square, 96 cans to the case, and ¼-pound round and square, 100 cans to the case, which have been converted to the equivalent of ¼-pound round, 48 cans to the case.
[2] Includes the pack of ½-pound square, 48 cans to the case and 50 cans to the case, which have been converted to the equivalent of ½-pound round, 48 cans to the case.
[3] Includes the pack of 4-pound round, 12 cans to the case, which have been converted to the equivalent of 1-pound round, 48 cans to the case.
[4] Flakes have been converted to standard cases.

NOTE.—"Standard cases" represent the various sized cases converted to the uniform basis of 48 half-pound cans to the case. Tuna and tunalike fishes were canned at 19 plants.

*Pack of canned tuna and tunalike fishes, 1921 to 1927*

| Year | Albacore | | Bluefin and yellowfin tuna | | Striped tuna | | "Tonno" | |
|---|---|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| 1921 | 456,152 | $2,657,266 | 64,816 | $306,486 | 27,972 | $109,929 | | |
| 1922 | 296,210 | 2,304,935 | 168,874 | 1,047,621 | 177,995 | 942,356 | 13,714 | $139,067 |
| 1923 | 310,037 | 3,106,329 | 261,773 | 1,959,812 | 96,452 | 578,254 | 124,416 | 1,136,814 |
| 1924 | 416,820 | 4,024,509 | 65,941 | 455,048 | 43,159 | 239,198 | 97,304 | 861,861 |
| 1925 | 518,079 | 4,412,655 | 261,482 | 1,745,338 | 168,177 | 997,697 | 131,159 | 1,212,024 |
| 1926 | 61,197 | 471,502 | 287,699 | 1,718,744 | 290,278 | 1,525,146 | 137,720 | 1,209,041 |
| 1927 | 131,157 | 1,118,985 | 533,691 | 3,594,195 | 414,314 | 2,362,587 | 116,335 | 979,860 |

| Year | Bonito | | Yellowtail | | Total | |
|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| 1921 | | | 210 | $945 | 549,150 | $3,074,626 |
| 1922 | 10,810 | $58,900 | 4,718 | 18,994 | 672,321 | 4,511,873 |
| 1923 | 15,089 | 77,906 | 10,059 | 55,645 | 817,836 | 6,914,760 |
| 1924 | 12,899 | 94,806 | 16,293 | 81,164 | 652,416 | 5,756,586 |
| 1925 | 10,090 | 61,207 | 13,484 | 70,159 | 1,102,471 | 8,499,080 |
| 1926 | 48,113 | 259,204 | 26,192 | 98,646 | 851,199 | 5,282,283 |
| 1927 | 18,587 | 111,253 | 41,734 | 201,347 | 1,255,818 | 8,368,227 |

NOTE.—Cases are on the standard basis of forty-eight ½-pound cans.

*Shrimp.*—In 1926, shrimp were canned in 1 plant in North Carolina, 2 in South Carolina, 10 in Georgia, 7 in Florida, 4 in Alabama, 19 in Mississippi, 26 in Louisiana, and 5 in Texas, a total of 74 plants, or 3 more than a year ago. The total pack amounted to 852,764 standard cases of 48 No. 1 cans (5-ounce cans dry pack and 5¾-ounce cans wet pack) valued at $5,321,652. This is an increase of 16 per cent in quantity and 29 per cent in value as compared with the previous year and is the largest pack of any year during the period 1921 to 1927.

*Pack of canned shrimp, 1927*

STANDARD CASES [1]

| States | Dry pack (in tins) | | Wet pack (in tins) | | Wet pack (in glass) | | Total | |
|---|---|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| North Carolina and South Carolina | 4,087 | $25,705 | 11,504 | $68,824 | | | 15,591 | $94,529 |
| Georgia | 30,871 | 196,201 | 78,191 | 471,356 | | | 109,062 | 667,557 |
| Florida | 4,508 | 26,983 | 34,447 | 203,657 | 31,327 | $337,152 | 70,282 | 567,792 |
| Alabama | 81,040 | 489,822 | 28,411 | 167,294 | | | 109,451 | 657,116 |
| Mississippi | 55,117 | 336,782 | 83,071 | 473,659 | 4,176 | 40,488 | 142,364 | 850,929 |
| Louisiana | 147,355 | 916,280 | 192,012 | 1,118,084 | | | 339,367 | 2,034,364 |
| Texas | 12,257 | 72,742 | 41,758 | 241,266 | | | 54,015 | 314,008 |
| Georgia, Louisiana, and Texas | | | | | 12,632 | 135,357 | 12,632 | 135,357 |
| Total | 335,235 | 2,064,515 | 469,394 | 2,744,140 | 48,135 | 512,997 | 852,764 | 5,321,652 |

ACTUAL CASES

| Sizes | Total | | Sizes | Total | |
|---|---|---|---|---|---|
| | *Cases* | *Value* | | *Cases* | *Value* |
| In tins, dry: | | | In glass, wet: | | |
| No. 1, 5-ounce (4 dozen) | 308,575 | $1,834,202 | 5¼-ounce (2 dozen) | 83,741 | $415,221 |
| No. 1½, 8¼-ounce (2 dozen) | 38,321 | 228,813 | 6¼-ounce (2 dozen) | 16,608 | 91,656 |
| In tins, wet: | | | Other sizes, in tins and glass, wet and dry (standard cases) | 1,258 | 7,892 |
| No. 1, 5¾-ounce (4 dozen) | 467,352 | 2,729,890 | | | |
| No. 1½, 9¾-ounce (2 dozen) | 2,353 | 13,978 | Total | | 5,321,652 |

[1] A "standard case" contains 4 dozen 5-ounce cans in the dry pack and 4 dozen 5¾-ounce cans in the wet pack.

NOTE.—Shrimp were canned at 1 plant in North Carolina, 2 in South Carolina, 10 in Georgia, 7 in Florida, 4 in Alabama, 19 in Mississippi, 26 in Louisiana, and 5 in Texas.

*Pack of canned shrimp, 1921 to 1927*

| Year | Cases | Value | Year | Cases | Value |
|---|---|---|---|---|---|
| 1921 | 655,364 | $3,804,781 | 1925 | 735,714 | $3,782,819 |
| 1922 | 579,797 | 3,064,087 | 1926 | 732,365 | 4,122,092 |
| 1923 | 700,429 | 4,381,534 | 1927 | 852,764 | 5,321,652 |
| 1924 | 718,517 | 4,608,950 | | | |

NOTE.—Cases have been reduced to the equivalent of 48 No. 1 cans.

*Clams.*—In 1927, razor-clam products were canned at 14 plants in Washington, 6 in Oregon, and 6 in Alaska; hard-clam products at 2 plants in Florida, 1 in Georgia, 1 in Rhode Island, 1 in New Jersey, and 3 in Washington; and soft-clam products at 15 plants in Maine and 2 in Massachusetts—a total of 51 plants, or one more than in the previous year. In standard cases of 48 No. 1 cans, the pack was as follows: Razor clams, 130,016 cases, valued at $1,046,797; hard clams, 37,693 cases, valued at $231,526; soft clams, 65,847 cases, valued at $270,747; and other clam products, such as chowders, soups, bouillon, and juices, 291,730 cases, valued at $1,195,884. The total pack amounted to 525,286 standard cases, valued at $2,744,954. This is an increase of 37 per cent in value compared with the previous year.

*Pack of canned clam products, 1927*

| Items and States | Cases | Value |
|---|---|---|
| Razor clams (Washington, Oregon, and Alaska): | | |
| Whole— | | |
| No. 1, 5-ounce (4 dozen) | 8,236 | $69,412 |
| 1-pound, 8-ounce (4 dozen) | 4,066 | 46,352 |
| No. 2, 10-ounce (2 dozen) | 647 | 5,435 |
| Minced— | | |
| ½-pound flat, 4-ounce (4 dozen) | 85,989 | 563,117 |
| No. 1, 5-ounce (4 dozen) | 42,224 | 334,183 |
| Other sizes (standard cases) | 3,612 | 28,298 |
| Total | 144,774 | 1,046,797 |
| Total (standard cases) | 130,016 | |
| Hard clams (Washington and Florida): | | |
| Whole— | | |
| 1-pound, 8-ounce (4 dozen) | 3,858 | 28,549 |
| No. 1, 5-ounce (4 dozen) | 8,123 | 67,508 |
| No. 2, 10-ounce (2 dozen) | 12,181 | 75,409 |
| No. 10, 52-ounce (½ dozen) | 4,774 | 25,064 |
| Minced— | | |
| No. 1, 5-ounce (4 dozen) | 1,534 | 11,629 |
| Other sizes (standard cases) | 3,476 | 23,367 |
| Total | 33,946 | 231,526 |
| Total (standard cases) | 37,693 | |
| Soft clams (Maine and Massachusetts): | | |
| Whole— | | |
| 5-ounce (4 dozen) | 37,510 | $161,061 |
| 8-ounce (4 dozen) | 8,103 | 52,335 |
| 10-ounce (2 dozen) | 5,180 | 20,459 |
| Other sizes (standard cases) | 10,000 | 36,892 |
| Total | 60,793 | 270,747 |
| Total (standard cases) | 65,847 | |
| Other hard, soft, and razor clam products (Maine, Massachusetts, Rhode Island, New Jersey, Georgia, Florida, Washington, and Oregon): | | |
| Chowder and soup— | | |
| No. 1, 10-ounce (4 dozen) | 139,558 | 557,817 |
| No. 3, 33-ounce (2 dozen) | 41,702 | 239,090 |
| No. 10, 102-ounce (½ dozen) | 2,602 | 9,907 |
| Other sizes (standard cases) | 53,954 | 269,186 |
| Bouillon and juice—Miscellaneous sizes in tins and glass (standard cases) | 26,092 | 119,884 |
| Total | 263,908 | 1,195,884 |
| Total (standard cases) | 291,730 | |
| Grand total (standard cases) | 525,286 | 2,744,954 |

NOTE.—"Standard cases" represent the various-sized cases converted to a uniform basis of No. 1 cans, 4 dozen to the case. "Cut out" or "drained" weights of can contents are shown for whole and minced clams and gross can contents for chowder, soup, bouillon, and juice.

*Value of canned clams and clam products, 1921 to 1927*

| Year | Razor clams | Hard clams | Soft clams | Clam chowders, juices, etc. | Total |
|---|---|---|---|---|---|
| 1921 | $506,591 | $138,699 | $338,775 | $182,442 | $1,166,507 |
| 1922 | 876,364 | 201,270 | 327,287 | 311,444 | 1,716,365 |
| 1923 | 883,535 | 194,937 | 308,560 | 323,584 | 1,710,616 |
| 1924 | 863,126 | 271,911 | 459,882 | 566,470 | 2,161,389 |
| 1925 | 860,002 | 218,601 | 287,073 | 484,702 | 1,850,378 |
| 1926 | 795,256 | 191,044 | 279,996 | 738,354 | 2,004,650 |
| 1927 | 1,046,797 | 231,526 | 270,747 | 1,195,884 | 2,744,954 |

*Oysters.*—In 1927, oysters were reported canned at 3 plants in Maryland, 4 in North Carolina, 14 in South Carolina, 3 in Georgia, 3 in Florida, 4 in Alabama, 17 in Mississippi, 6 in Louisiana, and 1 in Texas, a total of 55 plants, or the same number as a year ago. The total output of these plants amounted to 447,297 standard cases of forty-eight 5-ounce cans, valued at $2,367,949. This is an increase in quantity of 8 per cent and 17 per cent in value, as compared with the previous year.

*Pack of canned oysters, 1927*

STANDARD CASES [1]

| States | Cases | Value |
|---|---|---|
| Maryland | 20,472 | $126,972 |
| North Carolina | 15,618 | 81,715 |
| South Carolina | 111,923 | 588,070 |
| Georgia and Florida | 17,109 | 85,821 |
| Alabama | 23,032 | 119,051 |
| Mississippi | 229,801 | 1,217,538 |
| Louisiana and Texas | 29,342 | 148,782 |
| Total | 447,297 | 2,367,949 |

ACTUAL CASES

| Sizes | Cases | Value |
|---|---|---|
| 4-ounce (4 dozen) | 62,610 | $293,184 |
| 5-ounce (4 dozen) | 318,650 | 1,643,788 |
| 8-ounce (2 dozen) | 24,423 | 115,105 |
| 10-ounce (2 dozen) | 55,612 | 288,462 |
| Other sizes (standard cases) | 3,409 | 27,410 |
| Total | ............ | 2,367,949 |

[1] A "standard case" contains 4 dozen 5-ounce cans.

*Pack of canned oysters, 1921 to 1927*

| Year | Cases | Value | Year | Cases | Value |
|---|---|---|---|---|---|
| 1921 | 442,086 | $2,179,271 | 1925 | 654,755 | $3,721,159 |
| 1922 | 505,973 | 2,423,616 | 1926 | 413,834 | 2,026,569 |
| 1923 | 524,544 | 2,720,073 | 1927 | 447,297 | 2,367,949 |
| 1924 | 447,481 | 2,478,044 | | | |

NOTE.—Cases are on the standard basis of forty-eight 5-ounce cans.

*Miscellaneous canned fish products.*—In addition to the products shown in the foregoing, 298,644 standard cases of forty-eight 1-pound cans of various miscellaneous fishery products, valued at $2,334,776, were canned during 1927. Alewives and alewife roe were canned at 41 plants, shad and shad roe at 32 plants, crabs at 4 plants, miscellaneous shellfish at 5 plants, and miscellaneous fish, caviar, roe, and salmon eggs at 34 plants. Compared with a year ago, the pack of alewives and alewife roe, which amounted to 66,495 cases valued at $316,697, increased 24 per cent in quantity and 19 per cent in value; the pack of shad and shad roe, which amounted to 12,336 cases valued at $83,732, decreased 20 per cent in quantity and 19 per cent in value; the value of the crab pack amounted to $26,988 and increased 7 per cent.

*Pack of miscellaneous canned fishery products in the United States and Alaska, 1927* [1]

| Items | Cases | Value | Items | Cases | Value |
|---|---|---|---|---|---|
| Alewives | 21,327 | $64,577 | Salmon eggs (for bait) | 5,257 | $130,735 |
| Alewife roe | 45,168 | 252,120 | Crabs | 1,009 | 26,988 |
| Shad | 11,569 | 61,842 | Other shellfish | 3,470 | 64,485 |
| Shad roe | 767 | 21,890 | | | |
| Other fish | 203,683 | 1,639,469 | Total | 298,644 | 2,334,776 |
| Roe and caviar | 6,394 | 72,670 | | | |

[1] All packs under this heading have been converted to the equivalent of "standard cases" of forty-eight 1-pound cans.

*Pack of canned alewives and alewife roe, 1921 to 1927*

| Year | Alewives | | Alewife roe | | Total | |
|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| 1921 | 156 | $813 | 20,304 | $157,841 | 20,460 | $158,654 |
| 1922 | 489 | 1,994 | 18,099 | 137,514 | 18,588 | 139,508 |
| 1923 | 537 | 1,915 | 20,404 | 169,435 | 20,941 | 171,350 |
| 1924 | 1,550 | 5,118 | 41,642 | 332,245 | 43,192 | 337,363 |
| 1925 | 4,449 | 15,045 | 35,183 | 240,461 | 39,632 | 255,506 |
| 1926 | 19,920 | 65,405 | 33,886 | 201,278 | 53,806 | 266,683 |
| 1927 | 21,327 | 64,577 | 45,168 | 252,120 | 66,495 | 316,697 |

NOTE.—Cases have been converted to the equivalent of forty-eight 1-pound cans.

*Pack of canned shad and shad roe, 1921 to 1927*

| Year | Shad | | Shad roe | | Total | |
|---|---|---|---|---|---|---|
| | *Cases* | *Value* | *Cases* | *Value* | *Cases* | *Value* |
| 1921 | 641 | $2,455 | 38 | $142 | 679 | $2,597 |
| 1922 | 1,781 | 9,961 | 292 | 8,517 | 2,073 | 18,478 |
| 1923 | 2,162 | 37,165 | 536 | 16,288 | 2,698 | 53,453 |
| 1924 | 6,470 | 20,461 | 1,164 | 72,932 | 7,634 | 93,393 |
| 1925 | 12,569 | 53,875 | 2,430 | 100,571 | 14,999 | 154,446 |
| 1926 | 14,275 | 63,334 | 1,121 | 39,422 | 15,396 | 102,756 |
| 1927 | 11,569 | 61,842 | 767 | 21,890 | 12,336 | 83,732 |

NOTE.—*Cases have been reduced to the equivalent of forty-eight 1-pound cans.*

*Value of canned crabs, 1921 to 1927*

| Year | Value | Year | Value |
|---|---|---|---|
| 1921 | $115,800 | 1925 | $52,499 |
| 1922 | 104,171 | 1926 | 25,222 |
| 1923 | 47,023 | 1927 | 26,988 |
| 1924 | 35,944 | | |

## BY-PRODUCTS

The total value of by-products, including the products of the menhaden and whaling industries, amounted to $12,793,256 in 1927. These were made up of fish and whale oils; fish, whale, and shrimp scrap, meal, and bran; shell products; fish glue; and miscellaneous by-products. Their total value was 5 per cent more than in the previous year.

*Oils.*—The production of fish and marine-animal oils in 1927 amounted to 10,874,113 gallons valued at $4,905,021, which is slightly less in quantity and value than a year ago. Of the total production in 1927, 37 per cent consisted of menhaden oil; 23 per cent, sardine oil; 21 per cent, herring oil; 14 per cent, whale and sperm oil; and 5 per cent, oil from miscellaneous fish.

*Scrap and meal.*—The total value of fish scrap and meal of all kinds produced in 1927 was $4,321,082, which is an increase of 18 per cent over the value for the preceding year. Of the total value, that for dried scrap and meal accounted for 85 per cent; acidulated scrap, 13 per cent; shrimp bran and crude or green scrap, 2 per cent. The quantity of dried scrap and meal and shrimp bran produced was greater than in the previous year, while there was a decline in the production of acidulated scrap and crude or green scrap.

*Production of miscellaneous by-products, 1927*

| Products | Atlantic and Gulf coasts | | Pacific coast (including Alaska) | | Total | |
|---|---|---|---|---|---|---|
| | *Quantity* | *Value* | *Quantity* | *Value* | *Quantity* | *Value* |
| Fish and whale scrap and meal: | | | | | | |
| Dried ... tons | 10,071 | $532,019 | 32,007 | $1,761,900 | 42,078 | $2,293,919 |
| Crude or green ... do | 1,960 | 8,942 | | | 1,960 | 8,942 |
| Shrimp bran ... do | 1,427 | 44,716 | | | 1,427 | 41,716 |
| Oil: | | | | | | |
| Salmon ... gallons | | | 205,519 | 85,061 | 205,519 | 85,061 |
| Sardine ... do | | | 2,514,562 | 1,116,725 | 2,514,562 | 1,116,725 |
| Tuna ... do | | | 32,895 | 8,265 | 32,895 | 8,265 |
| Herring ... do | 257,020 | 96,416 | 2,034,667 | 863,834 | 2,291,687 | 960,250 |
| Whale ... do | | | 1,520,900 | 751,765 | 1,520,900 | 751,765 |
| Sperm ... do | | | 10,500 | 4,200 | 10,500 | 4,200 |
| Cod liver, crude ... do | 283,817 | 242,424 | | | 283,817 | 242,424 |
| Miscellaneous ... do | 14,025 | 7,250 | 43,140 | 12,607 | 57,165 | 19,857 |
| Liquid glue ... do | 512,136 | 860,396 | | | 512,136 | 860,396 |
| Miscellaneous by-products [1] ... pounds | 1,731,709 | 87,008 | 584,950 | 18,699 | 2,316,659 | 105,707 |
| Total | | 1,879,171 | | 4,623,056 | | 6,502,227 |

[1] Includes herring skins and scales, isinglass, fish flour, pickled whale meat, whalebone, and shark skins, fins, and meat.

NOTE.—The oils produced on the Pacific coast are reported in "trade" gallons (7½ pounds), and those produced on the Atlantic and Gulf coasts are reported in United States gallons (about 7.74 pounds).

*Production of fish and marine-animal oils, 1921 to 1927*

| Year | Menhaden | | Herring | | Sardine | |
|---|---|---|---|---|---|---|
| | *Gallons* | *Value* | *Gallons* | *Value* | *Gallons* | *Value* |
| 1921 | 6,260,478 | $1,719,892 | 112,838 | $26,735 | 170,977 | $35,760 |
| 1922 | 7,102,677 | 2,904,833 | 450,362 | 150,144 | 428,859 | 145,668 |
| 1923 | 7,461,365 | 3,316,277 | 945,424 | 384,053 | 966,247 | 424,103 |
| 1924 | 3,923,904 | 1,817,626 | 1,324,002 | 571,399 | 2,338,711 | 1,076,903 |
| 1925 | 6,023,108 | 3,001,106 | 2,442,527 | 1,034,071 | 3,120,048 | 1,568,753 |
| 1926 | 3,942,821 | 1,729,160 | 3,116,936 | 1,382,763 | 2,113,028 | 932,651 |
| 1927 | 3,957,068 | 1,716,474 | 2,291,687 | 960,250 | 2,514,562 | 1,116,725 |

| Year | Other fish oils | | Whale and sperm | | Total | |
|---|---|---|---|---|---|---|
| | *Gallons* | *Value* | *Gallons* | *Value* | *Gallons* | *Value* |
| 1921 | 378,887 | (1) | 523,101 | (1) | 7,446,281 | $2,078,670 |
| 1922 | 306,430 | $145,401 | 2,247,145 | $884,714 | 10,535,473 | 4,230,760 |
| 1923 | 443,935 | 187,877 | 1,556,830 | 791,884 | 11,373,801 | 5,104,194 |
| 1924 | 381,832 | 184,534 | 1,242,836 | 661,271 | 9,211,285 | 4,311,733 |
| 1925 | 480,195 | 211,250 | 1,221,198 | 685,011 | 13,287,076 | 6,500,191 |
| 1926 | 439,252 | 234,832 | 1,276,009 | 748,075 | 10,888,046 | 5,027,491 |
| 1927 | 579,396 | 355,607 | 1,531,400 | 755,965 | 10,874,113 | 4,905,021 |

1 Data not available.

*Production of fish, shellfish, and marine-animal meal and scrap, 1921 to 1927*

| Year | Dried scrap and meal | | Acidulated scrap | | Crude or green scrap | | Shrimp bran | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | *Tons* | *Value* | *Tons* | *Value* | *Tons* | *Value* | *Tons* | *Value* | *Value* |
| 1921 | 60,031 | $2,613,361 | 44,454 | $895,140 | 2,160 | $31,827 | 628 | $16,814 | $3,557,142 |
| 1922 | 89,459 | 3,755,787 | 25,712 | 555,973 | 433 | 9,519 | 562 | 15,398 | 4,336,677 |
| 1923 | 66,088 | 3,286,504 | 44,935 | 1,064,870 | 1,593 | 13,721 | 1,269 | 48,290 | 4,413,385 |
| 1924 | 51,855 | 2,370,237 | 24,963 | 504,639 | 3,543 | 6,262 | 936 | 31,580 | 2,912,718 |
| 1925 | 69,733 | 3,500,496 | 41,773 | 1,109,067 | 5,477 | 9,414 | 1,079 | 31,658 | 4,650,635 |
| 1926 | 61,929 | 3,056,406 | 23,852 | 551,405 | 6,157 | 9,491 | 1,036 | 33,775 | 3,651,077 |
| 1927 | 68,495 | 3,700,834 | 19,984 | 566,590 | 1,960 | 8,942 | 1,427 | 44,716 | 4,321,082 |

*Glue.*—In 1927, fish glue was manufactured at four plants in Massachusetts. The production amounted to 512,136 gallons, valued at $860,396, which is a decrease of 2 per cent in quantity and an increase of 18 per cent in value compared with the previous year.

*Production of fish glue, 1921 to 1927*

| Year | Gallons | Value | Year | Gallons | Value |
|---|---|---|---|---|---|
| 1921 | 347,048 | $364,415 | 1925 | 510,816 | $589,064 |
| 1922 | 323,003 | 278,424 | 1926 | 520,622 | 732,109 |
| 1923 | 465,814 | 680,054 | 1927 | 512,136 | 860,396 |
| 1924 | 502,940 | 550,391 | | | |

*Shell products.*—Shell products were manufactured at 47 plants in 1927. The production amounted to 310,519 tons of oyster-shell products, valued at $2,601,050. This is an increase in quantity and value as compared with the previous year. This does not include crushed shell produced as a by-product of the fresh-water pearl-button industry, statistics of which are not available. Of the total production, 80 per cent consisted of crushed oyster shell for poultry and 20 per cent was lime. The production in 1927 of crushed shell was slightly less and lime slightly more, compared with the production of these commodities in the previous year.

Louisiana ranks as the most important State in the production of oyster-shell products and accounted for 40 per cent of the total quantity produced and 42 per cent of the total value. Many of the shells used there were dead shells taken from marine-shell deposits.

*Production of oyster-shell products, 1927*

| States | Crushed oyster shell for poultry feed | | Oyster-shell lime | | Total | |
|---|---|---|---|---|---|---|
| | *Tons* | *Value* | *Tons* | *Value* | *Tons* | *Value* |
| Connecticut, Rhode Island, and Pennsylvania | 8,274 | $88,090 | 1,970 | $7,563 | 10,244 | $95,653 |
| New Jersey | 3,904 | 43,450 | 1,265 | 4,210 | 5,169 | 47,660 |
| Maryland | 50,734 | 501,216 | 25,662 | 68,544 | 76,396 | 569,760 |
| Virginia | 12,515 | 130,846 | 22,976 | 161,423 | 35,491 | 292,269 |
| North Carolina and South Carolina | 16,199 | 180,139 | 2,375 | 16,588 | 18,574 | 196,727 |
| Florida and Alabama | 8,438 | 70,730 | 2,150 | 2,088 | 10,588 | 72,818 |
| Mississippi and Texas | 26,712 | 235,469 | 2,095 | 3,394 | 28,807 | 238,863 |
| Louisiana | 123,183 | 1,082,125 | 2,067 | 5,175 | 125,250 | 1,087,300 |
| Total | 249,959 | 2,332,065 | 60,560 | 268,985 | 310,519 | 2,601,050 |

*Production of oyster-shell products, 1921 to 1927*

| Year | Crushed oyster shell for poultry feed | | Oyster-shell lime | | Total |
|---|---|---|---|---|---|
| | *Tons* | *Value* | *Tons* | *Value* | *Value* |
| 1921 | 185,474 | $1,759,120 | 73,764 | $502,634 | $2,261,754 |
| 1922 | 236,021 | 2,005,838 | 93,168 | 431,213 | 2,437,051 |
| 1923 | 224,983 | 1,986,249 | 83,808 | 372,286 | 2,358,535 |
| 1924 | 219,211 | 2,019,254 | 70,269 | 336,384 | 2,355,638 |
| 1925 | 226,971 | 2,075,057 | 67,818 | 303,261 | 2,378,318 |
| 1926 | 251,166 | 2,379,141 | 57,232 | 207,019 | 2,586,160 |
| 1927 | 249,959 | 2,332,065 | 60,560 | 268,985 | 2,601,050 |

*Menhaden industry.*—In 1927, 1 menhaden plant operated in Connecticut, 1 in New York, 2 in New Jersey, 3 in Delaware, 14 in Virginia, 15 in North Carolina, 1 in Georgia, and 2 in Florida. These 39 plants utilized 586,214,000 fish for the manufacture of 26,417 tons of scrap and meal, valued at $1,406,915; 19,984 tons of acidulated scrap, valued at $566,590; and 3,957,068 gallons of oil, valued at $1,716,474, making a total value of products of $3,689,979. This is an increase in value over that for the previous year of 7 per cent, indicating that this industry has recovered slightly from the poor season of 1926. However, the value is considerably less than in the years 1922 and 1923. Virginia ranks first in importance in the menhaden industry and in 1927 accounted for 42 per cent of the total value of all menhaden products.

*Fish utilized and products of the menhaden industry, 1927*

| States | Quantity of menhaden utilized | Products | | | | Total |
|---|---|---|---|---|---|---|
| | | Scrap and meal | | Oil | | |
| | *Number* | *Tons* | *Value* | *Gallons* | *Value* | *Value* |
| Connecticut, New York, New Jersey, and Delaware | 68, 997, 000 | 7, 147 | $219, 550 | 795, 226 | $384, 132 | $603, 682 |
| Virginia | 181, 013, 000 | [1] 13, 188 | 741, 271 | 1, 867, 279 | 798, 286 | 1, 539, 557 |
| North Carolina | 148, 886, 000 | [2] 14, 821 | 519, 449 | 782, 778 | 330, 685 | 850, 134 |
| Georgia and Florida | 187, 318, 000 | 11, 245 | 493, 235 | 511, 785 | 203, 371 | 696, 606 |
| Total | [3] 586, 214, 000 | [4] 46, 401 | 1, 973, 505 | 3, 957, 068 | 1, 716, 474 | 3, 689, 979 |

[1] Of this quantity, 9,869 tons, valued at $537,188, were reported as dry scrap and 3,319 tons, valued at $204,083, as fish meal.
[2] Of this quantity, 5,049, tons, valued at $233,549, were reported as dry scrap; 2,304 tons, valued at $124,110, as fish meal; and 7,468 tons, valued at $161,790, as green and acidulated scrap.
[3] 351,728,769 pounds
[4] Of this quantity, 19,430 tons, valued at $993,472, were reported as dry scrap; 6,987 tons, valued at $413,443, as fish meal; and 19,984 tons, valued at $566,590, as green and acidulated scrap.

NOTE.—Menhaden oil is reported in United States gallons (about 7.74 pounds).

*Products of the menhaden industry, 1921 to 1927*

| Year | Dried scrap and meal | | Acidulated scrap | | Oil | | Total |
|---|---|---|---|---|---|---|---|
| | *Tons* | *Value* | *Tons* | *Value* | *Gallons* | *Value* | *Value* |
| 1921 | 37, 858 | $1, 380, 455 | 44, 804 | $905, 640 | 6, 260, 478 | $1, 719, 892 | $4, 005, 987 |
| 1922 | 67, 821 | 2, 665, 441 | 25, 755 | 556, 317 | 7, 102, 677 | 2, 904, 833 | 6, 126, 591 |
| 1923 | 43, 452 | 2, 029, 406 | 44, 935 | 1, 064, 870 | 7, 461, 365 | 3, 316, 277 | 6, 410, 553 |
| 1924 | 21, 008 | 996, 866 | 24, 409 | 495, 684 | 3, 923, 904 | 1, 817, 626 | 3, 310, 176 |
| 1925 | 30, 167 | 1, 519, 458 | 41, 463 | 1, 102, 051 | 6, 023, 108 | 3, 001, 106 | 5, 622, 615 |
| 1926 | 24, 226 | 1, 164, 396 | 23, 553 | 548, 204 | 3, 942, 821 | 1, 729, 160 | 3, 441, 760 |
| 1927 | 26, 417 | 1, 406, 915 | 19, 984 | 566, 590 | 3, 957, 068 | 1, 716, 474 | 3, 689, 979 |

## FROZEN-FISH TRADE

During 1927, there were 150 freezers and cold-storage establishments devoted wholly or in part to the storage of frozen fish. This is a smaller number than was operated in the previous year, although the volume of fish handled was larger. That frozen fish is being used more generally is evidenced by the fact that average monthly holdings in the last three years have become greater, those in 1927 amounting to 48,957,000 pounds, or 7 per cent more than in 1926 and 18 per cent more than is normal or than the 5-year average. The quantity of fish frozen annually also has increased during the past few years. The holdings per month during the first 7 months of 1927 were 17 to 53 per cent greater than during the corresponding period in 1926, and during the last 5 months they were 6 to 11 per cent less than in the previous year and varied from 24,732,000 pounds in April to 66,791,000 pounds in November. Compared with the 5-year average for each month, the holdings per month in 1927 were 3 to 54 per cent greater, the largest gains being registered generally in the late spring months.

*Holdings of frozen fish for 1927 and 1926, and the 5-year average*

[Expressed in thousands of pounds; that is, 000 omitted]

| Month | 1927 | 1926 | 5-year average | Increase (+) or decrease (−) | |
|---|---|---|---|---|---|
| | | | | Compared with 1926 | Compared with 5-year average |
| | | | | *Per cent* | *Per cent* |
| January | 58, 655 | 48, 181 | 48, 894 | +22 | +20 |
| February | 48, 684 | 37, 378 | 37, 332 | +30 | +30 |
| March | 34, 889 | 24, 894 | 25, 304 | +40 | +38 |
| April | 24, 732 | 16, 154 | 17, 631 | +53 | +40 |
| May | 29, 781 | 21, 540 | 19, 304 | +38 | +54 |
| June | 36, 694 | 31, 345 | 25, 808 | +17 | +42 |
| July | 42, 116 | 33, 902 | 34, 988 | +24 | +20 |
| August | 54, 063 | 57, 627 | 45, 092 | −6 | +20 |
| September | 60, 328 | 64, 657 | 54, 216 | −7 | +11 |
| October | 65, 958 | 70, 310 | 62, 611 | −6 | +5 |
| November | 66, 791 | 75, 034 | 65, 052 | −11 | +3 |
| December | 64, 788 | 69, 854 | 61, 839 | −7 | +5 |
| Average for year | 48, 957 | 45, 906 | 41, 506 | +7 | +18 |

*Holdings of frozen fish in the United States in 1927, and a 5-year average, 1922 to 1926*

[Expressed in thousands of pounds; that is, 000 omitted]

| Species | Month ended— | | | | | |
|---|---|---|---|---|---|---|
| | Jan. 15 | Feb. 15 | Mar. 15 | Apr. 15 | May 15 | June 15 |
| Bluefish (all trade sizes) | 561 | 416 | 276 | 196 | 198 | 284 |
| Butterfish (all trade sizes) | 1, 153 | 903 | 581 | 428 | 386 | 311 |
| Catfish | 227 | 225 | 223 | 152 | 151 | 169 |
| Cisco (Lake Erie) | 514 | 314 | 202 | 116 | 75 | 58 |
| Cisco (lake herring), including bluefin, blackfin, and chub | 2, 850 | 1, 998 | 1, 116 | 655 | 551 | 477 |
| Cisco (tullibees, Canadian Lakes) | 1, 723 | 2, 170 | 1, 965 | 1, 499 | 1, 340 | 1, 204 |
| Cod, haddock, hake, pollock | 2, 196 | 1, 854 | 1, 379 | 743 | 1, 024 | 1, 100 |
| Croaker | 1, 252 | 981 | 225 | 55 | 824 | 1, 251 |
| Flounders | 726 | 623 | 424 | 330 | 398 | 670 |
| Halibut (all trade sizes) | 6, 265 | 4, 221 | 2, 905 | 3, 096 | 5, 109 | 7, 567 |
| Herring, sea (including alewives and bluebacks) | 2, 154 | 1, 951 | 2, 020 | 1, 593 | 2, 166 | 2, 718 |
| Lake trout | 1, 564 | 1, 245 | 896 | 556 | 641 | 554 |
| Mackerel (except Spanish) | 7, 047 | 5, 629 | 3, 817 | 1, 748 | 3, 010 | 3, 798 |
| Pike: | | | | | | |
| Blue and sauger | 647 | 512 | 257 | 121 | 657 | 512 |
| Yellow or wall-eyed | 313 | 452 | 382 | 274 | 218 | 196 |
| Pike (including pickerel, jacks, and yellow jack) | 1, 542 | 1, 542 | 1, 404 | 1, 121 | 1, 031 | 1, 036 |
| Sablefish (black cod) | 1, 359 | 968 | 572 | 398 | 356 | 368 |
| Salmon: | | | | | | |
| Chinook | 899 | 686 | 397 | 113 | 81 | 501 |
| Silver | 2, 712 | 1, 902 | 1, 489 | 1, 187 | 1, 048 | 998 |
| Fall and pink | 1, 084 | 757 | 442 | 208 | 176 | 141 |
| Steelhead trout | 377 | 315 | 141 | 124 | 36 | 66 |
| All other | 2, 450 | 2, 098 | 1, 657 | 1, 239 | 920 | 1, 054 |
| Scup (porgies) | 103 | 62 | 27 | 6 | 1 | 223 |
| Shad and shad roe | 331 | 305 | 135 | 108 | 377 | 595 |
| Shellfish | 1, 561 | 1, 558 | 1, 166 | 792 | 681 | 690 |
| Smelts, eulachon, etc | 669 | 1, 309 | 1, 383 | 745 | 653 | 509 |
| Squid | 1, 790 | 1, 502 | 1, 303 | 825 | 672 | 1, 010 |
| Sturgeon and spoonbill cat | 1, 161 | 1, 078 | 858 | 1, 009 | 1, 015 | 1, 095 |
| Suckers | 92 | 66 | 58 | 36 | 43 | 50 |
| Weakfish (including southern "sea trout") | 1, 096 | 771 | 269 | 77 | 314 | 653 |
| Whitefish | 1, 279 | 1, 493 | 1, 228 | 837 | 607 | 555 |
| Whiting | 5, 449 | 3, 452 | 1, 890 | 1, 429 | 1, 417 | 2, 221 |
| Miscellaneous frozen fish | 5, 509 | 5, 326 | 3, 801 | 2, 916 | 3, 605 | 4, 060 |
| Total frozen fish | 58, 655 | 48, 684 | 34, 889 | 24, 732 | 29, 781 | 36, 694 |
| 5-year average, 1922–1926 | 48, 894 | 37, 332 | 25, 304 | 17, 631 | 19, 304 | 25, 808 |

*Holdings of frozen fish in the United States in 1927, and a 5-year average, 1922 to 1926*—Continued

[Expressed in thousands of pounds; that is, 000 omitted]

| Species | Month ended— | | | | | |
|---|---|---|---|---|---|---|
| | July 15 | Aug. 15 | Sept. 15 | Oct. 15 | Nov. 15 | Dec. 15 |
| Bluefish (all trade sizes) | 316 | 275 | 343 | 358 | 337 | 304 |
| Butterfish (all trade sizes) | 280 | 433 | 522 | 703 | 591 | 437 |
| Catfish | 236 | 318 | 339 | 404 | 395 | 353 |
| Cisco (Lake Erie) | 188 | 279 | 448 | 865 | 654 | 751 |
| Cisco (lake herring), including bluefin, blackfin, and chub | 627 | 1,496 | 2,244 | 2,138 | 2,490 | 3,720 |
| Cisco (tullibees, Canadian Lakes) | 1,110 | 1,009 | 1,017 | 962 | 962 | 1,157 |
| Cod, haddock, hake, pollock | 1,207 | 1,348 | 1,950 | 2,695 | 2,303 | 1,800 |
| Croaker | 1,442 | 2,109 | 1,780 | 1,615 | 1,272 | 1,001 |
| Flounders | 667 | 707 | 669 | 800 | 778 | 678 |
| Halibut (all trade sizes) | 9,019 | 12,233 | 13,990 | 14,114 | 13,585 | 13,031 |
| Herring, sea (including alewives and bluebacks) | 2,627 | 2,769 | 3,082 | 3,982 | 4,106 | 4,124 |
| Lake trout | 606 | 818 | 977 | 1,292 | 2,079 | 1,975 |
| Mackerel (except Spanish) | 4,708 | 6,383 | 6,279 | 5,621 | 4,710 | 3,616 |
| Pike: | | | | | | |
| Blue and sauger | 511 | 297 | 222 | 199 | 575 | 652 |
| Yellow or wall-eyed | 200 | 177 | 194 | 177 | 205 | 292 |
| Pike (including pickerel, jacks, and yellow jack) | 1,027 | 975 | 863 | 1,050 | 1,239 | 922 |
| Sablefish (black cod) | 492 | 608 | 1,315 | 2,329 | 2,882 | 2,571 |
| Salmon: | | | | | | |
| Chinook | 1,193 | 1,645 | 1,788 | 2,049 | 1,722 | 1,358 |
| Silver | 1,110 | 1,678 | 2,314 | 3,542 | 3,428 | 3,241 |
| Fall and pink | 165 | 346 | 462 | 530 | 1,177 | 1,161 |
| Steelhead trout | 195 | 547 | 749 | 801 | 589 | 405 |
| All other | 1,692 | 1,562 | 1,721 | 2,029 | 2,004 | 2,024 |
| Scup (porgies) | 351 | 380 | 404 | 480 | 452 | 384 |
| Shad and shad roe | 569 | 607 | 580 | 564 | 540 | 534 |
| Shellfish | 632 | 772 | 981 | 1,296 | 1,666 | 2,110 |
| Smelts, eulachon, etc | 485 | 474 | 459 | 434 | 358 | 252 |
| Squid | 1,077 | 1,447 | 1,425 | 1,531 | 1,465 | 1,394 |
| Sturgeon and spoonbill cat | 1,109 | 1,069 | 1,248 | 1,239 | 1,241 | 1,420 |
| Suckers | 46 | 52 | 45 | 55 | 93 | 89 |
| Weakfish (including southern "sea trout") | 633 | 928 | 914 | 1,105 | 1,163 | 1,009 |
| Whitefish | 702 | 740 | 718 | 592 | 891 | 1,104 |
| Whiting | 2,620 | 4,445 | 4,713 | 4,461 | 4,620 | 3,980 |
| Miscellaneous frozen fish | 4,274 | 5,137 | 5,573 | 4,946 | 6,219 | 6,939 |
| Total frozen fish | 42,116 | 54,063 | 60,328 | 65,958 | 66,791 | 64,788 |
| 5-year average, 1922–1926 | 34,988 | 45,092 | 54,216 | 62,611 | 65,052 | 61,839 |

## FOREIGN FISHERY TRADE

The foreign trade in fishery products of the United States during 1927 amounted to $74,350,515, of which $55,633,612 represents the value of those imported for consumption and $18,716,903 the value of exports of domestic fishery products. Compared with the previous year, this is an increase of 6 per cent in total trade, an increase of 11 per cent in the value of fishery products imported for consumption, and a decrease of 8 per cent in the value of the exports of domestic fishery products.

Imports consisted of 311,857,599 pounds of edible products (including fresh, frozen, cured, and canned fish), valued at $34,854,246, and nonedible products (comprised mainly of fish and marine-animal oils, pearls, and imitation pearls), valued at $20,779,366. Compared with 1926, this is an increase of 1 per cent in the quantity and 7 per cent in the value of edible products imported and an increase of 18 per cent in the value of nonedible products imported. The increase in the quantity and value of the edible products imported was due chiefly to large imports of cured fish and canned shellfish. Other edible groups showed little change from a year ago. The increase in the value of nonedible products imported is due almost entirely to the greater value of the fish and marine-animal oil group and the value of pearls and imitation pearls. Fishery exports consisted of edible products, amounting to 158,427,507 pounds, valued at $18,340,624, and nonedible products valued at $376,279. Compared with the previous year, there is a decrease of 3 per cent in the quantity and 8 per cent in the value of the edible products exported and a decrease of 11 per cent in the value of the nonedible products exported.

The decline in edible export products is attributed chiefly to a decrease in both the amount and value of canned salmon. On the other hand, exports of canned sardines (the chief competitor of canned salmon in foreign markets) show a fair increase in both amount and value compared with a year ago and represent the largest individual export item. Exports of the other groups of edible fishery products show little change in 1927 compared with the previous year.

Considering only the amount of fishery products on which we usually have an unfavorable trade balance, the imports of fresh and frozen fish were about seventeen times as great as the exports in 1927, which is a somewhat lower ratio than in the year previous. In 1927, the imports of cured fish were about seven times as great as the exports, which is a slightly higher ratio than a year ago. Imports of fresh and canned shellfish were about two times as great as the exports in 1927, which is about the same ratio as for 1926. Imports of fish and marine-animal oils were about one hundred and ninety-two times the amount of the exports in 1927, compared with one hundred and fifteen times in 1926. While this unfavorable trade balance exists for fish and marine-animal oils, the fishery trade in the United States continues to discard large quantities of fish waste and offal that are suitable for manufacture into oil and meal.

Contrasting these products with those on which we usually have a favorable trade balance, the exports of canned fish (which is the most important export group) were almost four times as great as the imports in 1927, which is about the same ratio as in 1926. Exports of miscellaneous edible fishery products were over two and one-half times the quantity of imports in 1927, or about the same ratio as the previous year.

*Imports for consumption and domestic exports of fishery products, 1927, and ratio comparisons*

| Item | Imports | | Exports | | Ratio of imports to exports | |
|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Quantity* | *Value* |
| Edible fishery products: | | | | | | |
| Fish, fresh, frozen, or packed in ice | 135,048,461 | $10,384,575 | 8,079,455 | $911,420 | 167:10 | $114:10 |
| Fish, salted, dried, smoked, or pickled | 117,594,895 | 9,285,674 | 17,381,590 | 2,242,449 | 68:10 | 41:10 |
| Fish, canned or packed in oil | 32,177,681 | 6,525,266 | 119,702,162 | 13,157,388 | 10:37 | 10:20 |
| Shellfish, canned or fresh | 26,312,491 | 8,003,027 | 11,346,186 | 1,878,438 | 23:10 | 43:10 |
| Other fish products, roe, caviar, etc | 724,071 | 655,704 | 1,918,114 | 150,929 | 10:26 | 43:10 |
| Total | 311,857,599 | 34,854,246 | 158,427,507 | 18,340,624 | 20:10 | 19:10 |
| Nonedible fishery products: | | | | | | |
| Fish and marine-animal oil [1] | 133,430,378 | 8,582,976 | 692,128 | 80,051 | 1,927:10 | 1,072:10 |
| All other | | 12,196,390 | | 296,228 | | 412:10 |
| Total | | 20,779,366 | | 376,279 | | 552:10 |
| Grand total | | 55,633,612 | | 18,716,903 | | 30:10 |

[1] Gallon of fish or marine-animal oil calculated at 7.5 pounds.

*Exports of domestic fishery products, 1926 and 1927*

| Items | 1926 | | 1927 | |
|---|---|---|---|---|
| | *Quantity* | *Value* | *Quantity* | *Value* |
| Fish, fresh, frozen, or packed in ice: | | | | |
| Salmon........pounds.. | 3,062,307 | $487,542 | 3,079,251 | $471,764 |
| Other fresh fish........do.... | 3,766,406 | 382,468 | 5,000,204 | 439,656 |
| Total........do.... | 6,828,713 | 870,010 | 8,079,455 | 911,420 |
| Fish, salted, or dry-cured: | | | | |
| Cod........do.... | 3,954,342 | 423,937 | 3,820,178 | 374,347 |
| Haddock, hake, and pollock........do.... | 2,703,613 | 196,782 | 2,189,403 | 158,279 |
| Herring........do.... | 2,350,883 | 155,471 | 2,342,391 | 136,531 |
| Salmon........do.... | 2,169,595 | 455,270 | 2,356,291 | 510,406 |
| Other........do.... | 1,652,651 | 190,506 | 2,203,527 | 182,123 |
| Total........do.... | 12,831,084 | 1,421,966 | 12,911,790 | 1,361,686 |
| Fish, pickled: | | | | |
| Salmon........do.... | 3,356,200 | 803,051 | 2,947,400 | 787,371 |
| Other........do.... | 2,444,400 | 136,303 | 1,522,400 | 93,392 |
| Total........do.... | 5,800,600 | 939,354 | 4,469,800 | 880,763 |
| Fish, canned: | | | | |
| Salmon........do.... | 53,511,098 | 8,578,221 | 38,247,932 | 6,028,960 |
| Sardines........do.... | 71,285,456 | 6,126,476 | 79,439,503 | 6,817,662 |
| Other........do.... | 1,993,003 | 308,355 | 2,014,727 | 310,766 |
| Total........do.... | 126,789,557 | 15,013,052 | 119,702,162 | 13,157,388 |
| Shellfish: | | | | |
| Canned........do.... | 3,443,164 | 691,131 | 3,863,323 | 825,636 |
| Not canned........do.... | 6,320,012 | 829,516 | 7,482,863 | 1,052,802 |
| Total........do.... | 9,763,176 | 1,520,647 | 11,346,186 | 1,878,438 |
| Other fish products........do.... | 1,493,922 | 138,808 | 1,918,114 | 150,929 |
| Total edible products........do.... | 163,507,052 | 19,903,837 | 158,427,507 | 18,340,624 |
| Fish oils........do.... | 808,827 | 118,986 | 692,128 | 80,051 |
| Buttons, pearl or shell........gross.. | 350,886 | 141,379 | 395,605 | 128,400 |
| Sponges........pounds.. | 105,550 | 164,805 | 100,389 | 167,828 |
| Total........ | ........ | 306,184 | ........ | 296,228 |
| Total nonedible products........ | ........ | 425,170 | ........ | 376,279 |
| Grand total........ | ........ | 20,329,007 | ........ | 18,716,903 |

*Imports of fishery products entered for consumption, 1926 and 1927*

| Items | 1926 | | 1927 | |
|---|---|---|---|---|
| | *Quantity* | *Value* | *Quantity* | *Value* |
| Edible fishery products: | | | | |
| Fish, fresh, frozen, or packed in ice | | | | |
| Cod, haddock, hake, and pollock.pounds.. | 976,473 | $48,526 | 727,786 | $35,484 |
| Eels........do.... | 901,262 | 125,186 | 492,522 | 54,685 |
| Fresh-water fishes........do.... | 47,985,060 | 4,680,585 | 52,562,778 | 4,993,917 |
| Halibut........do.... | 5,719,206 | 747,310 | 4,014,279 | 478,685 |
| Herring (frozen)........do.... | 1,438,905 | 68,032 | 2,120,701 | 108,306 |
| Herring (fresh sea)........do.... | 46,252,918 | 429,052 | 16,959,583 | 132,786 |
| Mackerel........do.... | 2,858,612 | 160,212 | 2,187,412 | 155,925 |
| Salmon........do.... | 5,348,725 | 636,391 | 6,002,487 | 664,090 |
| Smelts........do.... | 9,099,087 | 1,185,948 | 6,716,378 | 930,845 |
| Swordfish........do.... | 1,175,014 | 170,844 | 713,987 | 106,422 |
| Tuna........do.... | 9,898,985 | 525,575 | 32,485,097 | 1,640,230 |
| Other dutiable........do.... | 7,195,187 | 993,155 | 10,065,451 | 1,083,200 |
| Total........do.... | 138,849,434 | 9,770,816 | 135,048,461 | 10,384,575 |
| Fish, salted, dried, smoked, or pickled— | | | | |
| Cod, dried........pounds.. | 33,196,832 | 2,541,117 | 28,989,347 | 2,018,798 |
| Finnan haddie........do.... | 1,637,197 | 141,912 | 1,144,817 | 102,202 |
| Hake and pollock, dried........do.... | 1,386,220 | 77,573 | 755,414 | 44,756 |
| Herring— | | | | |
| Dried........do.... | 994,859 | 57,920 | 1,210,687 | 75,525 |
| Pickled or salted........do.... | 31,524,616 | 1,951,628 | 39,291,828 | 2,741,124 |
| Smoked, skinned, or boned....do.... | 655,014 | 78,451 | 296,406 | 38,562 |

*Imports of fishery products entered for consumption, 1926 and 1927*—Continued

| Items | 1926 | | 1927 | |
|---|---|---|---|---|
| | *Quantity* | *Value* | *Quantity* | *Value* |
| Edible fishery products—Continued. | | | | |
| Fish, salted, dried, smoked, or pickled—Con. | | | | |
| Mackerel, pickled or salted.....pounds.. | 10,721,327 | $652,617 | 12,071,146 | $789,004 |
| Salmon, dried.....do.... | 130,568 | 13,330 | 226,037 | 26,287 |
| Salmon, kippered, smoked, salted, pickled or otherwise prepared.....pounds.. | 1,066,653 | 183,045 | 618,875 | 75,762 |
| Other kippered, smoked, salted, pickled, or otherwise prepared, not elsewhere specified.....pounds.. | 19,769,295 | 2,003,369 | 5,133,696 | 567,916 |
| Other dried fish.....do.... | 5,621,252 | 765,498 | 3,756,014 | 576,005 |
| Others, in bulk or packages.....do.... | 4,702,918 | 562,959 | 24,100,628 | 2,429,733 |
| Total.....do.... | 111,406,751 | 9,029,419 | 117,594,895 | 9,285,674 |
| Fish packed in oil or other substances— | | | | |
| Sardines.....pounds.. | 25,529,032 | $4,358,219 | 26,255,351 | $5,094,583 |
| All others.....do.... | 9,115,018 | 1,784,067 | 5,922,330 | 1,430,683 |
| Total.....do.... | 34,644,050 | 6,142,286 | 32,177,681 | 6,525,266 |
| Fish roe, frozen, prepared, or preserved— | | | | |
| Caviar.....do.... | 358,903 | 505,765 | 413,658 | 579,021 |
| Other fish roe, preserved.....do.... | 283,557 | 60,368 | 310,413 | 76,683 |
| *Total*.....do.... | 642,460 | 566,133 | 724,071 | 655,704 |
| Shellfish— | | | | |
| Crabs.....do.... | 102,644 | 8,609 | 56,708 | 4,568 |
| Crab meat packed in ice, frozen, or otherwise prepared or preserved.....pounds.. | 7,243,455 | 3,188,154 | 9,300,219 | 4,052,750 |
| Lobsters, canned.....do.... | 1,792,038 | 1,135,921 | 1,773,413 | 1,016,706 |
| Lobsters (other than canned), fresh, frozen, packed in ice, or prepared or preserved in any manner not specially provided for.....pounds.. | 6,537,088 | 1,555,875 | 6,369,392 | 1,680,356 |
| Turtles.....do.... | 465,009 | 25,746 | 745,030 | 40,503 |
| Other shellfish and shrimp.....do.... | 6,994,338 | 1,095,020 | 8,067,729 | 1,228,144 |
| Total.....do.... | 23,134,572 | 7,009,325 | 26,312,491 | 8,003,027 |
| Total edible fishery products.....do.... | 308,677,267 | 32,517,979 | 311,857,599 | 34,854,246 |
| *Nonedible fishery products:* | | | | |
| Fish and marine-animal oils— | | | | |
| Cod oil.....gallons.. | 2,425,599 | 1,250,836 | 2,114,264 | 1,064,228 |
| Cod-liver oil.....do.... | 1,921,422 | 1,615,967 | 2,375,297 | 2,231,032 |
| Herring, menhaden, and cod oil.....do.... | 1,942,846 | 755,316 | 5,228,789 | 1,733,782 |
| *Other fish oils*.....do.... | 108,263 | 41,565 | 93,097 | 28,643 |
| Seal oil.....do.... | 650,775 | 315,203 | 629,160 | 250,969 |
| Whale oil, sperm.....do.... | 137,309 | 51,272 | 265,983 | 95,597 |
| Whale oil, other.....do.... | 5,233,220 | 2,664,147 | 7,084,127 | 3,178,725 |
| Total.....do.... | 12,419,434 | 6,694,306 | 17,790,717 | 8,582,976 |
| Pearls and imitation pearl— | | | | |
| Pearls and parts, *not strung or set*..... | ............ | 5,322,140 | ............ | 6,043,162 |
| Imitation half pearls and hollow or filled pearls, without holes or with holes partly through.....number.. | 17,755,752 | 93,654 | 21,019,130 | 108,832 |
| Imitation solid pearls, wholly or partly pierced, *mounted or unmounted*.....number.. | 1,061,640 | 40,528 | 208,426 | 34,189 |
| Imitation-pearl beads..... | ............ | 1,180,070 | ............ | 2,012,727 |
| Total..... | ............ | 6,636,392 | ............ | 8,198,910 |
| Shells and buttons of pearl or shell— | | | | |
| Shells, not manufactured— | | | | |
| Green snail shell.....pounds.. | 182,509 | 24,409 | 169,830 | 24,909 |
| Mother-of-pearl.....do.... | 7,049,992 | 2,040,517 | 6,516,562 | 1,708,675 |
| All others.....do.... | 4,329,950 | 133,440 | 4,353,837 | 230,432 |
| Shells, manufactured..... | ............ | 100,112 | ............ | 101,581 |
| Shell pearl buttons— | | | | |
| Fresh-water.....*gross*.. | 7,864 | 2,600 | 1,419 | 963 |
| Ocean or trochus.....do.... | 103,900 | 41,735 | 106,946 | 35,282 |
| Button blanks, not turned, faced, or drilled.....gross.. | 638 | 735 | 48 | 20 |
| Buttons (from Philippine Islands).....*gross*.. | 992,169 | 455,619 | 715,913 | 350,770 |
| Total..... | ............ | 2,799,167 | ............ | 2,452,632 |

*Imports of fishery products entered for consumption, 1926 and 1927*—Continued

| Items | 1926 | | 1927 | |
|---|---|---|---|---|
| | *Quantity* | *Value* | *Quantity* | *Value* |
| Nonedible fishery products—Continued. | | | | |
| Sponges...pounds.. | 244,540 | $243,437 | 174,770 | $242,390 |
| From Cuba...do.. | 700,831 | 664,804 | 628,154 | 818,927 |
| From Philippine Islands...do.. | 1,130 | 3,514 | 3,170 | 7,580 |
| Manufactures of, not specially provided for...pounds.. | 704 | 645 | 3,014 | 3,303 |
| From Cuba...do.. | 2,631 | 3,904 | 2,348 | 3,198 |
| From Philippine Islands...do... | 53 | 138 | | |
| Total...do... | 949,889 | 916,442 | 811,456 | 1,075,398 |
| Agar-agar...do.. | 465,832 | 320,559 | 383,250 | 243,168 |
| Ambergris...do... | 134 | 14,551 | 491 | 95,412 |
| Cuttlefish bone...do... | 264,471 | 31,250 | 281,261 | 36,510 |
| Fish for purposes other than human consumption...pounds.. | 3,851,060 | 72,967 | 1,226,163 | 29,182 |
| Fishskins, raw or salted...do.. | 367,643 | 11,715 | 435,723 | 19,864 |
| Fish sounds, crude, dried, or salted for preservation only...pounds.. | 116,654 | 31,218 | 58,210 | 8,835 |
| Sea grass, eelgrass, and seaweed, dyed or manufactured... | | 43,891 | | 34,470 |
| Whalebone, unmanufactured...pounds.. | 5,148 | 3,878 | 3,441 | 1,761 |
| Whalebone, manufactures of...do.. | 173 | 471 | 231 | 248 |
| Total... | | 530,500 | | 469,450 |
| Total nonedible fishery products... | | 17,576,807 | | 20,779,366 |
| Grand total... | | 50,094,786 | | 55,633,612 |

## COD FISHERY ON THE EAST COAST OF NORTH AMERICA

The fishery for cod on the east coast of North America is probably our most international fishery, five nations participating in it. Named in order of the size of their catches, these are Newfoundland, France, Canada, the United States, and Portugal. During the last 30 years the total annual catch of cod by these nations averaged over 1,000,000,000 pounds. There have been fluctuations over this period, but on the whole the catch appears to have neither increased nor decreased.

The full report on this fishery, which was compiled by the bureau's representative on the North American Committee on Atlantic Fishery Investigations, is published as Bureau of Fisheries Document No. 1034. This may be purchased from the superintendent of Documents, Government Printing Office, Washington, D. C., for 5 cents.

## MACKEREL FISHERY ON THE EAST COAST OF THE UNITED STATES

The 1927 mackerel fishery was marked by unusually heavy runs in the south, a slack summer in the Gulf of Maine, and very little activity on Cape Shore. There were 211 vessels in the fishery at one time or another during the year though very few fished regularly throughout the season. The total catch [4] amounted to 41,634,000 pounds. Of this amount 39,821,000 pounds were caught by seiners, and 1,813,000 pounds by drift netters. The season opened in the south on April 18, when first catches were made by both netters and seiners. Then followed a very heavy run from south of the Delaware Capes, which glutted the New York market and caused mackerel to move at very low prices. So great was the glut that at certain times

[4] Figures on the miscellaneous shore fisheries are not included herein.

catches were limited to about 30,000 pounds by agreement among vessel captains. Though the effect of such limitations can not be estimated accurately, there was a definite restriction of the fishery during at least a 10-day period early in May. In June another heavy run took place in the offing of Block Island and east to Nantucket Shoals. This continued until July 5. Altogether during the period between April 18 and July 5, 20,623,000 pounds of mackerel were caught in the region south and west of Nantucket Shoals. Of this amount, 19,459,000 pounds were caught by seiners and 1,164,000 pounds by netters.

Mackerel appeared in the Gulf of Maine as early as June 1, when a number of small catches were made by netters sailing from Portland, Me.; but the season did not begin in earnest until July 3, when seine catches of some size were made off Chatham. The season for seiners lasted until November 2, but never at any time was marked by very good runs of fish. The netters continued to make small catches until December 22, when the season finally closed. Altogether, the seiners caught 20,228,000 pounds and the netters 649,000 pounds, a total of 20,877,000 pounds for the Gulf of Maine. As remarked above, there was little mackerel fishing on the Cape Shore. Only three vessels made trips to these waters, but their catches were good, on the average, totaling 134,000 pounds.

*Mackerel fishery, 1927*

| Items | Vessels | Net tonnage | Crew | Catch [1] |
|---|---|---|---|---|
| South and west of Cape Cod: | | | | |
| Seiners | 81 | 2,820 | 886 | 19,459 |
| Netters | 38 | 475 | 166 | 1,164 |
| Total | | | | 20,623 |
| Gulf of Maine: | | | | |
| Seiners | 105 | 3,439 | 1,089 | 20,228 |
| Netters | 72 | 1,060 | 308 | 649 |
| Total | | | | 20,877 |
| Cape Shore: Seiners | 3 | 167 | 40 | 134 |
| Grand total (exclusive of duplication) | 211 | 4,972 | 1,291 | 41,634 |

[1] In thousands of pounds.

## FISHERIES OF THE NEW ENGLAND STATES

The latest statistical canvass made by this division of the fisheries and fishery industries of New England (Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut) was for the calendar year 1924, and complete statistics were published in the report of the division of fishery industries for 1925 and in condensed form in Statistical Bulletin No. 703. During 1924 the fisheries and fishery industries of New England gave employment to 24,513 persons, of whom 15,983 were employed in fishing operations, 1,922 in the wholesale fishery trade, and 6,608 in the canning, salting, smoking, and by-products industries. The yield of the fisheries aggregated 406,822,165 pounds, valued at $18,818,132, while the output of the canning, salting, smoking, and by-products industries was valued at $14,253,831.

In addition to those above mentioned, statistics on the fisheries of Connecticut are available for the years 1925 and 1926. These were collected by a representative of the State of Connecticut and were published in detail in the report of the division of fishery industries for 1926.

Annual statistics are collected on the vessel fisheries that center at Boston and Gloucester, Mass., and Portland, Me. A discussion of those for the year 1927 follows.

### VESSEL FISHERIES AT PRINCIPAL NEW ENGLAND PORTS

Landings of fishery products by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me. (the principal New England ports), during 1927 amounted to 263,849,573 pounds, valued at $9,404,511, and exceeded the amount landed for any year for which statistics are available, while the value of the products was greater than for any year except 1918.

Continuing the steady increase since 1920, the landings at Boston in 1927 amounted to 194,940,789 pounds, or 74 per cent of the total, and were valued at $7,371,542. This is an increase over 1926 of 17 per cent in amount and 5 per cent in value. Landings at Gloucester amounted to 52,522,540 pounds, or 20 per cent of the total, and were valued at $1,493,935. Gloucester landings decreased 4 per cent in amount and increased slightly in value, compared to a year ago. Landings at Gloucester have become rather less during late years, due chiefly to fewer landings of salt fish. Landings at Portland amounted to 16,356,244 pounds, valued at $539,034, which was 6 per cent of the total landings for 1927 and is a slight increase in amount but a decrease in value compared with a year ago.

*Species landed.*—Among the fresh fish, haddock was by far the most important. The landings of this species amounted to 128,542,583 pounds, or 50 per cent of the total fresh fish, which is an increase over 1926 of 37 per cent. The larger landings of haddock are due in a large measure to the use of this species for filleting purposes. Of the total haddock landed, 74 per cent were taken from the South Channel and the remainder chiefly from Browns Bank, Georges Bank, and the shore grounds.

Cod, of next importance, formerly was the most important species landed, when they were used mainly in the salt-fish trade. The landings of fresh cod in 1927 amounted to 61,367,445 pounds, or 24 per cent of the total amount of fresh fish landed, and represent a decrease of 17 per cent from those for 1926. Cod were taken mainly on Georges Bank, South Channel, Browns Bank, Western Bank, and the shore grounds.

The landings of fresh mackerel at Boston, Gloucester, and Portland amounted to 31,354,236 pounds, or 12 per cent of the total fresh fish, a decrease of 11 per cent from 1926.

Flounders ranked fourth in importance among the fresh fish with landings of 8,359,131 pounds, an increase of 23 per cent over a year ago. Inclusion of flounders landed by vessels of under 5 net tons would increase this amount considerably. Formerly, flounders ranked as one of the unimportant species of fish landed at New England ports, and prior to 1913 statistics on the landings of this fish were not separated from the miscellaneous fish. In 1913, the landings amounted to 400,000 pounds, and since that year they have increased each year over the landings for the previous year, with but two exceptions. Flounders are taken largely by small vessels that operate a gear known as a flounder drag. This is merely a small otter trawl adapted to fit a vessel of small tonnage. Flounders are taken mainly on South Channel and shore grounds. They are becoming of increasing importance in the package-fish trade.

Pollock, with landings of 7,651,711 pounds, ranked fifth in importance and increased 14 per cent over a year ago. Quantities of these fish are filleted.

The landings of all other varieties of fresh fish at these ports were greater than a year ago, except those of swordfish and cusk, which were slightly smaller.

Among the salt fish, herring ranked first in importance with landings of 4,410,436 pounds, or about 14 times as much as for 1926. The landings of salt groundfish (cod, haddock, hake, cusk, pollock, and halibut) amounted to 2,105,048 pounds, or 56 per cent less than those for the previous year. Landings of salt mackerel amounted to 175,655 pounds, a decrease from a year ago of 84 per cent.

*Fishing grounds.*—Fishery products landed at Boston, Gloucester, and Portland by American fishing vessels are taken from the fishing grounds off the United States, Newfoundland, and the Canadian Maritime Provinces. The fishing banks off the United States include all those west of 66° west longitude. Those off Newfoundland on which fishing was prosecuted during 1927 include Green Bank, Grand Bank, St. Peters Bank, Straits of Belle Isle, and off Newfoundland. Those off the Canadian Maritime Provinces include all the fishing banks east of 66° west longitude not already listed in the group off Newfoundland.

During 1927, vessels that land at the principal New England ports obtained 240,083,000 pounds from fishing grounds off the United States, or 91 per cent of the total landings. This is an increase of 21 per cent over the amount obtained from these grounds in 1926 and shows a tendency on the part of fishermen to obtain fish nearer to port.

The more important banks in this group were South Channel, where 121,688,000 pounds were obtained; Georges Bank, where 38,154,000 pounds were obtained; shore grounds, where 32,022,000 pounds were obtained; and Browns Bank, where 12,091,000 pounds were taken. South Channel abounds with haddock, and, since it has a comparatively smooth bottom, it has become a desirable ground upon which to prosecute on otter-trawl fishery.

Landings from banks off the Canadian Maritime Provinces amounted to 17,378,000 pounds, or 7 per cent of the total landings. This represents a decrease under a year ago of 55 per cent. Virtually the entire amount was obtained from La Have Bank and Western Bank. All the fish caught by American fishing vessels off the coasts of the Canadian Maritime Provinces were from offshore fishing grounds.

Landings obtained from banks off Newfoundland accounted for only 2 per cent of the total and amounted to 6,388,000 pounds. This is an increase of 291 per cent over a year ago. Virtually the entire amount from these grounds consisted of salt herring, which was used chiefly for bait and was taken from the treaty coast of Newfoundland. The other species were obtained from fishing banks on the high seas.

*Fishing fleet, trips, and days' absence.*—During 1927, the fishing fleet at the three ports numbered 359 sail, steam, and gasoline vessels, including 26 steam otter-trawl vessels. This is an increase of 9 vessels over the previous year.

As indicative of the increasing popularity of fresh fish in preference to salted fish, there were but 4 vessels engaged in the salt-bank fishery in 1927, or 2 less than a year ago. In contrast with this, there were 166 vessels in the market fishery and 181 in the shore fishery, which is considerably more than a year ago. The mackerel fishery was prosecuted by 124 vessels, the swordfish fishery by 79 vessels, and the herring fishery by 10 vessels.

All vessels fishing made a total of 10,162 trips to the grounds, or 17 per cent more than in 1926. In making these trips, including the date of departure and date of arrival, these vessels were absent from port 47,258 days, or on the average about 4½ days per trip. The average length of trips made in March, 1927 (which was about 3½ days) was less than for any other month in the year. The longest trips were made during July and August, when the average trip consumed about 6 days. Generally, the number of days' absence per trip was 5 in the summer months and 4 in the winter months. This undoubtedly is due to the influence of mackerel and swordfish vessels, which generally make longer trips than vessels engaged in other fisheries.

*Fishery by months.*—Total landings of fish at these ports during the month of August, which amounted to 28,950,309 pounds, exceeded those for any other month during the year, although March, with 28,092,327 pounds, ranked a close second. Landings made during the other months ranged between about 16,000,000 and 24,000,000 pounds, those made during the summer months being generally greater.

*Otter-trawl fishery.*—In 1927, 26 otter-trawl vessels in 794 trips landed 77,577,439 pounds of fishery products at Boston, Gloucester, and Portland, valued at $2,208,602. This is a decrease of 4 in the number of vessels under 1926 and an increase of 19 per cent in the number of trips, 27 per cent in amount of products, and 10 per cent in value.

In making the trips (including the date of departure and date of arrival), these vessels were absent from port 5,954 days, making the average trip of about 7½ days' duration. This is 12 per cent longer than in 1926, when the trips averaged about 8 days. Of the total catch by otter trawls, 89 per cent consisted of haddock, 5 per cent of cod, and the remainder of hake, pollock, cusk, halibut, and various miscellaneous species. Almost the entire catch was taken from South Channel, but lesser quantities came from Nantucket Shoals and Georges Bank, which are near by, and an almost negligible quantity from Western Bank and off Chatham.

In 1927, March was the best individual month for fishing by these otter trawlers, and 11,503,841 pounds, or 15 per cent of their total catch, was taken in that month. Landings during the other months ranged between 4,000,000 and 8,000,000 pounds, those during the winter months being generally greater.

The following table gives the statistics obtained on the vessel fisheries centering at Boston, Gloucester, and Portland for 1927, for vessels of 5 net tons and upward, as measured by the United States Customs Service. The weights of fresh and salted fish given in these statistics represent the fish as landed from the vessels, and the values are those received by the fishermen. The grades, or sizes, given for certain species are those recognized in the trade.

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*

BY BANKS

| Fishing grounds | Number of trips | Cod | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Large (10 pounds and over) | | | | Market (under 10 and over 2½ pounds) | | | |
| | | Fresh | | Salted | | Fresh | | Salted | |
| | | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| LANDED AT BOSTON | | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | | |
| La Have Bank | 81 | 1,630,665 | $80,045 | | | 386,915 | $12,313 | | |
| Western Bank | 42 | 777,765 | 26,074 | | | 32,600 | 629 | | |
| Quereau Bank | 33 | 32,325 | 1,127 | | | 700 | 18 | | |
| Green Bank | 3 | 12,000 | 480 | | | 1,000 | 23 | | |
| Grand Bank | 19 | 7,700 | 539 | | | | | | |
| St. Peters Bank | 13 | 4,000 | 120 | | | | | | |
| Off Newfoundland | 2 | | | | | | | | |
| Cape Shore | 34 | 164,195 | 10,009 | | | 142,575 | 4,158 | | |
| St. Anns Bank | 1 | | | | | | | | |
| The Gully | 1 | | | | | | | | |
| Labrador Coast | 1 | | | | | | | | |
| Roseway Bank | 1 | | | | | | | | |
| West of 66° W. longitude: | | | | | | | | | |
| Browns Bank | 183 | 3,697,315 | 143,467 | | | 1,205,258 | 31,199 | | |
| Georges Bank | 786 | 15,661,564 | 550,866 | | | 2,872,237 | 68,911 | | |
| Cashes Bank | 8 | 55,705 | 4,433 | | | 19,720 | 716 | | |
| Tillies Bank | 10 | 270 | 27 | | | 130 | 8 | | |
| Middle Bank | 69 | 49,770 | 2,955 | | | 35,265 | 1,519 | | |
| Jeffreys Ledge | 99 | 68,451 | 4,171 | | | 63,105 | 2,184 | | |
| South Channel | 1,918 | 6,889,802 | 335,293 | | | 4,948,699 | 125,212 | | |
| Nantucket Shoals | 189 | 315,925 | 15,691 | | | 541,915 | 13,388 | | |
| Off Highland Light | 55 | 1,325 | 83 | | | 1,245 | 40 | | |
| Off Chatham | 229 | 53,438 | 2,270 | | | 46,527 | 1,476 | | |
| Seal Island | 2 | 26,440 | 2,012 | | | 25,825 | 824 | | |
| South | 300 | | | | | | | | |
| Shore, general | 605 | 229,583 | 10,042 | | | 166,404 | 4,695 | | |
| Total | 4,684 | 29,678,238 | 1,189,704 | | | 10,490,120 | 267,313 | | |
| LANDED AT GLOUCESTER | | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | | |
| La Have Bank | 36 | 1,576,340 | 31,365 | 4,490 | $168 | 506,515 | 8,719 | 13,045 | $359 |
| Western Bank | 49 | 4,088,470 | 76,795 | 452,550 | 17,639 | 617,727 | 8,940 | 61,375 | 1,680 |
| Quereau Bank | 24 | 105,185 | 2,318 | 189,712 | 7,575 | 16,195 | 259 | 21,249 | 600 |
| Green Bank | 2 | 4,200 | 105 | 8,655 | 365 | 1,040 | 23 | 145 | 6 |
| Grand Bank | 18 | 19,200 | 432 | 150,475 | 6,049 | 600 | 11 | 8,215 | 257 |
| St. Peters Bank | 7 | 27,915 | 547 | 25,610 | 1,012 | 3,395 | 57 | 2,520 | 76 |
| Off Newfoundland | 14 | | | 3,685 | 129 | | | 1,510 | 42 |
| Strait of Belle Isle | 1 | | | 3,960 | 149 | | | 3,540 | 97 |
| Roseway Bank | 1 | | | 2,700 | 108 | | | 1,760 | 53 |
| West of 66° W. longitude: | | | | | | | | | |
| Browns Bank | 37 | 1,008,785 | 19,427 | 73,100 | 2,917 | 287,190 | 4,433 | 12,344 | 382 |
| Georges Bank | 164 | 4,449,535 | 90,612 | 743,653 | 29,794 | 292,530 | 5,182 | 90,800 | 2,750 |
| Middle Bank | 5 | | | | | | | | |
| South Channel | 102 | 75,270 | 1,559 | | | 218,880 | 4,529 | | |
| Nantucket Shoals | 24 | | | | | | | | |
| South | 6 | | | | | | | | |
| Shore, general | 3,282 | 5,046,320 | 246,043 | | | 14,270 | 796 | | |
| Total | 3,772 | 16,401,220 | 469,203 | 1,658,590 | 65,905 | 1,958,342 | 32,949 | 216,503 | 6,302 |
| LANDED AT PORTLAND | | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | | |
| La Have Bank | 2 | | | 25,430 | 846 | | | | |
| Western Bank | 4 | | | | | | | | |
| Quereau Bank | 6 | 410 | 8 | 17,180 | 783 | | | 1,750 | 63 |
| Green Bank | 1 | | | 6,595 | 297 | | | 815 | 29 |
| Grand Bank | 3 | 270 | 3 | 18,925 | 860 | 160 | 8 | 3,650 | 129 |
| St. Peters Bank | 2 | 925 | 53 | 4,060 | 162 | | | 250 | 10 |
| Off Newfoundland | 1 | | | | | | | | |
| Cape Shore | 14 | | | | | | | | |
| Gulf of St. Lawrence | 2 | | | | | | | | |
| The Gully | 1 | 3,981 | 129 | | | | | | |
| Labrador Coast | 1 | | | 345 | 14 | | | 50 | 2 |
| West of 66° W. longitude: | | | | | | | | | |
| Browns Bank | 6 | 28,215 | 540 | 10,920 | 492 | | | 636 | 27 |
| Georges Bank | 13 | 135,255 | 3,726 | 425 | 10 | | | | |
| Cashes Bank | 55 | 142,205 | 3,952 | 14,700 | 661 | 40,969 | 1,273 | 670 | 24 |
| Fippenies Bank | 24 | 21,265 | 1,241 | | | 12,520 | 454 | | |
| Platts Bank | 123 | 113,410 | 6,376 | | | 53,575 | 1,927 | | |
| Jeffreys Ledge | 553 | 716,900 | 33,549 | 552 | 22 | 124,546 | 3,995 | 195 | 5 |
| South Channel | 16 | 31,670 | 609 | | | 54 | 2 | | |
| Nantucket Shoals | 3 | | | | | 60 | 1 | | |
| Shore, general | 876 | 1,043,234 | 45,785 | 120 | 6 | 130,275 | 3,981 | 890 | 39 |
| Total | 1,706 | 2,237,740 | 95,971 | 99,252 | 4,153 | 362,189 | 11,641 | 8,906 | 328 |
| Grand total | 10,162 | 48,317,198 | 1,754,878 | 1,757,842 | 70,058 | 12,810,651 | 311,903 | 225,409 | 6,630 |

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

BY BANKS—Continued

| Fishing grounds | Cod—Continued | | | | Haddock | | | |
|---|---|---|---|---|---|---|---|---|
| | Scrod (1 to 2½ pounds) | | | | Large (over 2½ pounds) | | | |
| | Fresh | | Salted | | Fresh | | Salted | |
| **LANDED AT BOSTON** | | | | | | | | |
| East of 66° W. longitude: | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| La Have Bank | 3,500 | $43 | | | 1,396,425 | $48,705 | | |
| Western Bank | | | | | 114,950 | 2,191 | | |
| Quereau Bank | | | | | 33,250 | 665 | | |
| Cape Shore | 2,000 | 20 | | | 115,285 | 4,572 | | |
| West of 66° W. longitude: | | | | | | | | |
| Browns Bank | 9,900 | 159 | | | 3,382,070 | 110,771 | | |
| Georges Bank | 23,915 | 245 | | | 7,321,675 | 206,809 | | |
| Cashes Bank | 680 | 7 | | | 85,125 | 3,904 | | |
| Tillies Bank | 100 | 3 | | | 6,000 | 480 | | |
| Middle Bank | 5,875 | 109 | | | 554,900 | 27,308 | | |
| Jeffreys Ledge | 8,990 | 182 | | | 885,185 | 43,779 | | |
| South Channel | 68,120 | 869 | | | 73,656,619 | 2,144,954 | | |
| Nantucket Shoals | 10,380 | 148 | | | 4,858,015 | 158,939 | | |
| Off Highland Light | 200 | 4 | | | 41,140 | 1,793 | | |
| Off Chatham | 4,905 | 79 | | | 1,614,100 | 56,302 | | |
| Seal Island | | | | | 34,640 | 1,495 | | |
| Shore, general | 2,750 | 45 | | | 2,019,195 | 65,669 | | |
| Total | 141,315 | 1,913 | | | 96,118,574 | 2,878,336 | | |
| **LANDED AT GLOUCESTER** | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | |
| La Have Bank | 861 | 9 | 1,090 | $22 | 776,226 | 8,193 | | |
| Western Bank | 200 | 2 | 2,003 | 39 | 563,040 | 5,690 | 710 | $14 |
| Green Bank | | | | | 200 | 2 | | |
| West of 66° W. longitude: | | | | | | | | |
| Browns Bank | 480 | 4 | | | 572,865 | 5,827 | | |
| Georges Bank | 3,015 | 30 | 740 | 15 | 941,085 | 10,186 | | |
| South Channel | 6,030 | 60 | | | 5,564,915 | 78,344 | | |
| Nantucket Shoals | | | | | 534,240 | 11,047 | | |
| Shore, general | | | | | 1,580,620 | 61,792 | 48,870 | 611 |
| Total | 10,586 | 105 | 3,833 | 76 | 10,533,191 | 181,081 | 49,580 | 625 |
| **LANDED AT PORTLAND** | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | |
| Western Bank | | | | | 704,700 | 10,981 | | |
| Quereau Bank | | | | | | | 100 | 2 |
| Grand Bank | | | | | | | 100 | 2 |
| The Gully | | | | | | | 320 | 6 |
| West of 66° W. longitude: | | | | | | | | |
| Browns Bank | | | | | 199,500 | 3,532 | | |
| Georges Bank | | | 200 | 4 | 13,465 | 277 | | |
| Cashes Bank | 9,525 | 124 | | | 164,308 | 7,358 | | |
| Fippenies Bank | 3,770 | 56 | | | 123,319 | 7,004 | | |
| Platts Bank | 20,530 | 244 | | | 573,658 | 30,499 | | |
| Jeffreys Ledge | 24,277 | 232 | | | 1,295,692 | 51,100 | | |
| South Channel | | | | | 2,927,025 | 44,909 | | |
| Nantucket Shoals | | | | | 212,240 | 3,184 | | |
| Shore, general | 29,593 | 280 | | | 1,059,804 | 34,185 | | |
| Total | 87,695 | 936 | 200 | 4 | 7,273,711 | 193,029 | 520 | 10 |
| Grand total | 239,596 | 2,954 | 4,033 | 80 | 113,925,476 | 3,252,446 | 50,100 | 635 |

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

BY BANKS—Continued

| Fishing grounds | Haddock—Continued | | Hake | | | |
|---|---|---|---|---|---|---|
| | Scrod (1 to 2½ pounds) | | Large (6 pounds and over) | | | |
| | Fresh | | Fresh | | Salted | |
| LANDED AT BOSTON | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| East of 66° W. longitude: | | | | | | |
| La Have Bank | 12,820 | $171 | 55,750 | $1,114 | | |
| Western Bank | | | 10,175 | 330 | | |
| Quereau Bank | 1,000 | 8 | 4,445 | 89 | | |
| Cape Shore | 7,600 | 107 | 6,370 | 235 | | |
| West of 66° W. longitude: | | | | | | |
| Browns Bank | 13,600 | 328 | 31,950 | 992 | | |
| Georges Bank | 519,645 | 12,308 | 83,840 | 2,218 | | |
| Cashes Bank | 8,800 | 88 | 15,040 | 760 | | |
| Tillies Bank | 220 | 11 | 2,800 | 168 | | |
| Middle Bank | 12,390 | 348 | 99,155 | 3,580 | | |
| Jeffreys Ledge | 20,580 | 609 | 189,410 | 6,951 | | |
| South Channel | 12,106,834 | 234,934 | 3,919,751 | 106,406 | | |
| Nantucket Shoals | 641,785 | 12,292 | 71,205 | 1,832 | | |
| Off Highland Light | 6,650 | 198 | 880 | 44 | | |
| Off Chatham | 205,080 | 4,959 | 39,940 | 1,601 | | |
| Seal Island | 800 | 16 | 1,200 | 12 | | |
| Shore, general | 183,975 | 4,356 | 193,005 | 4,254 | | |
| Total | 13,741,779 | 270,733 | 4,724,916 | 130,586 | | |
| LANDED AT GLOUCESTER | | | | | | |
| East of 66° W. longitude: | | | | | | |
| La Have Bank | | | 43,975 | 477 | | |
| Western Bank | | | 22,930 | 250 | 4,955 | $99 |
| Quereau Bank | | | 7,775 | 78 | 5,585 | 112 |
| Green Bank | | | 5,435 | 54 | | |
| Grand Bank | | | 3,520 | 39 | 2,230 | 45 |
| St. Peters Bank | | | 2,515 | 28 | | |
| West of 66° W. longitude: | | | | | | |
| Browns Bank | | | 16,300 | 178 | 1,200 | 24 |
| Georges Bank | 5,510 | 55 | 3,195 | 33 | 535 | 11 |
| South Channel | 723,230 | 6,190 | 25,980 | 263 | | |
| Nantucket Shoals | | | 1,340 | 13 | | |
| Shore, general | 1,260 | 38 | 80,050 | 1,564 | | |
| Total | 730,000 | 6,283 | 213,015 | 2,977 | 14,505 | 291 |
| LANDED AT PORTLAND | | | | | | |
| East of 66° W. longitude: | | | | | | |
| Green Bank | | | | | 280 | 7 |
| The Gully | | | 2,300 | 92 | | |
| West of 66° W. longitude: | | | | | | |
| Cashes Bank | 10,085 | 129 | 1,670 | 31 | | |
| Fippenies Bank | 6,360 | 82 | | | | |
| Platts Bank | 27,363 | 352 | 3,350 | 115 | | |
| Jeffreys Ledge | 59,493 | 710 | 5,585 | 128 | | |
| Shore, general | 42,027 | 343 | 2,560 | 81 | | |
| Total | 145,328 | 1,616 | 15,465 | 447 | 280 | 7 |
| Grand total | 14,617,107 | 278,632 | 4,953,396 | 134,010 | 14,785 | 298 |

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

BY BANKS—Continued

| Fishing grounds | Hake—Continued: Small (under 6 pounds): Fresh | | Salted | | Pollock: Fresh | | Salted | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| LANDED AT BOSTON | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | |
| La Have Bank | | | | | 58, 915 | $1, 502 | | |
| Western Bank | | | | | 6, 380 | 148 | | |
| Cape Shore | | | | | 9, 745 | 206 | | |
| West of 66° W. longitude: | | | | | | | | |
| Browns Bank | | | | | 153, 580 | 3, 213 | | |
| Georges Bank | | | | | 925, 100 | 21, 088 | | |
| Cashes Bank | | | | | 2, 860 | 111 | | |
| Tillies Bank | | | | | 135 | 5 | | |
| Middle Bank | | | | | 19, 930 | 597 | | |
| Jeffreys Ledge | 7, 100 | $77 | | | 51, 935 | 1, 057 | | |
| South Channel | 47, 425 | 622 | | | 1, 877, 547 | 56, 079 | | |
| Nantucket Shoals | | | | | 50, 885 | 1, 002 | | |
| Off Highland Light | | | | | 110 | 3 | | |
| Off Chatham | | | | | 12, 565 | 346 | | |
| Seal Island | | | | | 875 | 14 | | |
| Shore, general | | | | | 30, 963 | 741 | | |
| Total | 54, 525 | 699 | | | 3, 201, 525 | 86, 112 | | |
| LANDED AT GLOUCESTER | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | |
| La Have Bank | | | | | 26, 330 | 265 | 280 | $5 |
| Western Bank | | | | | 45, 770 | 459 | 2, 055 | 41 |
| Quereau Bank | | | | | 195 | 3 | 1, 445 | 28 |
| Grand Bank | | | 250 | $5 | | | 275 | 6 |
| St. Peters Bank | | | | | | | 40 | 1 |
| Roseway Bank | | | 510 | 10 | | | | |
| West of 66° W. longitude: | | | | | | | | |
| Browns Bank | | | | | 18, 475 | 186 | 1, 150 | 23 |
| Georges Bank | | | | | 53, 565 | 545 | 4, 345 | 87 |
| South Channel | | | | | 9, 830 | 99 | | |
| Shore, general | | | | | 3, 481, 835 | 70, 510 | | |
| Total | | | 760 | 15 | 3, 636, 000 | 72, 067 | 9, 570 | 191 |
| LANDED AT PORTLAND | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | |
| La Have Bank | 4, 330 | 43 | | | | | 130 | 3 |
| Western Bank | 5, 325 | 107 | | | | | | |
| Quereau Bank | 85 | 2 | 1, 170 | 23 | | | | |
| Grand Bank | | | 200 | 3 | | | | |
| St. Peters Bank | 770 | 17 | | | | | 880 | 35 |
| The Gully | | | | | 360 | 14 | | |
| West of 66° W. longitude: | | | | | | | | |
| Browns Bank | 930 | 9 | | | 2, 130 | 21 | | |
| Georges Bank | | | | | 1, 000 | 26 | | |
| Cashes Bank | 94, 153 | 3, 697 | | | 16, 305 | 280 | 70 | 1 |
| Fippenies Bank | 16, 154 | 564 | | | 11, 200 | 203 | | |
| Platts Bank | 207, 590 | 6, 181 | | | 87, 480 | 1, 382 | | |
| Jeffreys Ledge | 348, 342 | 7, 461 | | | 407, 791 | 7, 138 | | |
| South Channel | 520 | 5 | | | 1, 255 | 15 | | |
| Nantucket Shoals | 210 | 5 | | | | | | |
| Shore, general | 159, 071 | 3, 395 | 310 | 11 | 286, 665 | 4, 361 | | |
| Total | 837, 480 | 21, 486 | 1, 680 | 37 | 814, 186 | 13, 440 | 1, 080 | 39 |
| Grand total | 892, 005 | 22, 185 | 2, 440 | 52 | 7, 651, 711 | 171, 619 | 10, 650 | 230 |

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

BY BANKS—Continued

| Fishing grounds | Cusk | | | | Halibut | | | |
|---|---|---|---|---|---|---|---|---|
| | Fresh | | Salted | | Fresh | | Salted | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| LANDED AT BOSTON | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | |
| La Have Bank | 166,070 | $4,390 | | | 195,449 | $36,317 | | |
| Western Bank | 6,980 | 151 | | | 129,362 | 21,240 | | |
| Quereau Bank | 6,500 | 228 | | | 800,667 | 129,926 | | |
| Green Bank | 4,300 | 97 | | | 98,738 | 17,998 | | |
| Grand Bank | 800 | 20 | | | 675,200 | 116,421 | | |
| St. Peters Bank | 1,400 | 28 | | | 609,196 | 105,351 | | |
| Off Newfoundland | | | | | 105,024 | 11,176 | | |
| Cape Shore | 10,545 | 149 | | | 1,142 | 338 | | |
| St. Anns Bank | | | | | 32,958 | 4,817 | | |
| The Gully | | | | | 42,767 | 7,665 | | |
| Labrador Coast | | | | | 81,303 | 8,295 | | |
| Roseway Bank | | | | | 29,388 | 3,333 | | |
| West of 66° W. longitude: | | | | | | | | |
| Browns Bank | 567,635 | 11,786 | | | 155,155 | 32,958 | | |
| Georges Bank | 168,395 | 3,686 | | | 1,066,760 | 204,361 | | |
| Cashes Bank | 66,715 | 2,674 | | | 204 | 77 | | |
| Tillies Bank | 250 | 10 | | | | | | |
| Middle Bank | 34,220 | 1,234 | | | 1,204 | 442 | | |
| Jeffreys Ledge | 106,635 | 3,350 | | | 687 | 221 | | |
| South Channel | 459,515 | 14,621 | | | 267,095 | 58,336 | | |
| Nantucket Shoals | 1,150 | 40 | | | 14,634 | 2,022 | | |
| Off Highland Light | 750 | 23 | | | 35 | 18 | | |
| Off Chatham | 10,400 | 316 | | | 1,329 | 256 | | |
| Seal Island | 7,400 | 204 | | | 130 | 39 | | |
| Shore, general | 60,464 | 1,898 | | | 11,609 | 2,472 | | |
| Total | 1,680,124 | 44,905 | | | 4,320,036 | 764,079 | | |
| LANDED AT GLOUCESTER | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | |
| La Have Bank | 66,605 | 833 | | | | | | |
| Western Bank | 18,875 | 237 | 140 | $3 | | | 105 | $8 |
| Quereau Bank | 32,685 | 457 | 7,522 | 157 | 31,955 | 2,556 | 150 | 21 |
| Grand Bank | 570 | 9 | 2,110 | 56 | 5,130 | 381 | 5,542 | 526 |
| St. Peters Bank | 280 | 4 | | | | | | |
| West of 66° W. longitude: | | | | | | | | |
| Browns Bank | 86,810 | 1,045 | 13,265 | 332 | | | | |
| Georges Bank | 118,675 | 1,590 | 8,695 | 183 | | | | |
| Total | 324,500 | 4,175 | 31,732 | 731 | 37,085 | 2,937 | 5,797 | 555 |
| LANDED AT PORTLAND | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | |
| La Have Bank | 10,000 | 125 | 400 | 8 | 20,566 | 2,651 | | |
| Western Bank | 730 | 11 | | | 13,431 | 1,776 | | |
| Quereau Bank | 11,325 | 170 | 1,860 | 47 | 77,066 | 16,569 | | |
| Green Bank | | | | | 29,702 | 5,573 | | |
| Grand Bank | | | | | 47,882 | 8,164 | | |
| St. Peters Bank | 2,100 | 26 | | | 34,143 | 6,312 | | |
| Off Newfoundland | | | | | 12,629 | 1,879 | | |
| Gulf of St. Lawrence | | | | | 63,261 | 8,810 | | |
| The Gully | | | | | 19,198 | 4,899 | | |
| Labrador Coast | | | | | 19,569 | 2,294 | | |
| West of 66° W. longitude: | | | | | | | | |
| Browns Bank | 16,960 | 299 | | | 49,082 | 7,784 | | |
| Cashes Bank | 265,199 | 8,057 | | | 15,556 | 2,865 | | |
| Fippenies Bank | 14,870 | 687 | | | 2,461 | 527 | | |
| Platts Bank | 86,542 | 3,249 | | | 2,057 | 491 | | |
| Jeffreys Ledge | 124,930 | 3,841 | | | 3,960 | 684 | | |
| South Channel | | | | | 1,904 | 257 | | |
| Nantucket Shoals | | | | | 255 | 70 | | |
| Shore, general | 155,945 | 5,043 | | | 3,643 | 769 | | |
| Total | 688,601 | 21,508 | 2,260 | 55 | 416,365 | 72,374 | | |
| Grand total | 2,693,225 | 70,588 | 33,992 | 786 | 4,773,486 | 839,390 | 5,797 | 555 |

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

BY BANKS—Continued

| Fishing grounds | Mackerel | | | | Miscellaneous | | | |
|---|---|---|---|---|---|---|---|---|
| | Fresh | | Salted | | Fresh | | Salted | |
| LANDED AT BOSTON | | | | | | | | |
| East of 66° W. longitude: | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| La Have Bank | | | | | 72,909 | $8,272 | | |
| Western Bank | | | | | 5,048 | 290 | | |
| Quereau Bank | | | | | 12,307 | 781 | | |
| Grand Bank | | | | | 713 | 169 | | |
| St. Peters Bank | | | | | 178 | 45 | | |
| Cape Shore | 92,550 | $2,050 | | | 180,485 | 43,465 | | |
| West of 66° W. longitude: | | | | | | | | |
| Browns Bank | | | | | 457,228 | 77,245 | | |
| Georges Bank | 777,010 | 82,644 | 4,000 | $200 | 1,580,478 | 324,028 | | |
| Cashes Bank | | | | | 1,755 | 56 | | |
| Tillies Bank | 138,975 | 12,185 | | | 115 | 19 | | |
| Middle Bank | 785,228 | 29,741 | 3,400 | 151 | 14,965 | 988 | | |
| Jeffreys Ledge | 81,685 | 3,278 | | | 31,623 | 1,890 | | |
| South Channel | 4,045,390 | 175,176 | 32,000 | 1,580 | 3,776,643 | 216,173 | | |
| Nantucket Shoals | 57,850 | 1,831 | | | 1,042,468 | 69,255 | | |
| Off Highland Light | 757,707 | 76,984 | | | 2,755 | 287 | | |
| Off Chatham | 3,701,534 | 160,072 | 12,400 | 581 | 202,768 | 11,245 | | |
| South | 9,743,906 | 295,968 | 12,000 | 590 | 23,010 | 880 | | |
| Shore, general | 198,445 | 20,154 | | | 2,940,109 | 118,889 | | |
| Total | 20,380,280 | 860,083 | 63,800 | 3,102 | 10,345,557 | 873,977 | | |
| LANDED AT GLOUCESTER | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | |
| Off Newfoundland | | | | | | | 4,410,436 | $163,825 |
| West of 66° W. longitude: | | | | | | | | |
| Georges Bank | 105,210 | 12,021 | | | 34,420 | 9,534 | | |
| Middle Bank | 212,960 | 5,287 | | | 6,000 | 60 | | |
| South Channel | 1,070 | 21 | | | | | | |
| Nantucket Shoals | 92,740 | 3,366 | | | 12,240 | 2,570 | | |
| South | 183,970 | 4,109 | | | | | | |
| Shore, general | 9,863,055 | 387,009 | 95,390 | 5,157 | 1,700,240 | 54,508 | | |
| Total | 10,459,005 | 411,813 | 95,390 | 5,157 | 1,752,900 | 66,672 | 4,410,436 | 163,825 |
| LANDED AT PORTLAND | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | |
| Cape Shore | 104,850 | 2,331 | | | 74,092 | 14,859 | | |
| Labrador Coast | | | | | 19 | 3 | | |
| West of 66° W. longitude: | | | | | | | | |
| Browns Bank | | | | | 16,193 | 2,670 | | |
| Georges Bank | 46,000 | 1,150 | 2,200 | 99 | 94,114 | 20,517 | | |
| Cashes Bank | | | | | 9,836 | 291 | | |
| Fippenies Bank | | | | | 2,725 | 122 | | |
| Platts Bank | | | | | 76,788 | 1,396 | | |
| Jeffreys Ledge | 162,107 | 5,208 | | | 1,592,265 | 23,872 | | |
| South Channel | | | | | 5,620 | 241 | | |
| Nantucket Shoals | 17,880 | 358 | | | | | | |
| Shore, general | 184,114 | 5,887 | 14,265 | 359 | 960,238 | 22,590 | | |
| Total | 514,951 | 14,934 | 16,465 | 458 | 2,831,890 | 86,561 | | |
| Grand total | 31,354,236 | 1,286,830 | 175,655 | 8,717 | 14,930,347 | 1,027,210 | 4,410,436 | 163,825 |

| Fishing grounds | Total | | | | Grand total | |
|---|---|---|---|---|---|---|
| | Fresh | | Salted | | | |
| LANDED AT BOSTON | | | | | | |
| East of 66° W. longitude: | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| La Have Bank | 3,979,418 | $192,872 | | | 3,979,418 | $192,872 |
| Western Bank | 1,083,260 | 51,053 | | | 1,083,260 | 51,053 |
| Quereau Bank | 891,194 | 132,842 | | | 891,194 | 132,842 |
| Green Bank | 116,038 | 18,598 | | | 116,038 | 18,598 |
| Grand Bank | 684,413 | 117,149 | | | 684,413 | 117,149 |
| St. Peters Bank | 614,774 | 105,544 | | | 614,774 | 105,544 |
| Off Newfoundland | 105,024 | 11,176 | | | 105,024 | 11,176 |
| Cape Shore | 732,492 | 65,309 | | | 732,492 | 65,309 |
| St. Anns Bank | 32,958 | 4,817 | | | 32,958 | 4,817 |

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

BY BANKS—Continued

| Fishing grounds | Total | | | | Grand total | |
|---|---|---|---|---|---|---|
| | Fresh | | Salted | | | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| LANDED AT BOSTON—continued | | | | | | |
| East of 60° W. longitude—Continued. | | | | | | |
| The Gully | 42, 767 | $7, 665 | | | 42, 767 | $7, 665 |
| Labrador coast | 81, 303 | 8, 295 | | | 81, 303 | 8, 295 |
| Roseway Bank | 29, 388 | 3, 333 | | | 29, 388 | 3, 333 |
| West of 66° W. longitude: | | | | | | |
| Browns Bank | 9, 673, 691 | 412, 118 | | | 9, 673, 691 | 412, 118 |
| Georges Bank | 31, 000, 619 | 1, 477, 164 | 4, 000 | $200 | 31, 004, 619 | 1, 477, 364 |
| Cashes Bank | 256, 604 | 12, 826 | | | 256, 604 | 12, 826 |
| Tillies Bank | 148, 995 | 12, 916 | | | 148, 995 | 12, 916 |
| Middle Bank | 1, 612, 902 | 68, 821 | 3, 400 | 151 | 1, 616, 302 | 68, 972 |
| Jeffreys Ledge | 1, 515, 386 | 67, 749 | | | 1, 515, 386 | 67, 749 |
| South Channel | 112, 063, 440 | 3, 468, 675 | 32, 000 | 1, 580 | 112, 095, 440 | 3, 470, 255 |
| Nantucket Shoals | 7, 606, 212 | 276, 440 | | | 7, 606, 212 | 276, 440 |
| Off Highland Light | 812, 797 | 79, 477 | | | 812, 797 | 79, 477 |
| Off Chatham | 5, 892, 586 | 238, 922 | 12, 400 | 581 | 5, 904, 986 | 239, 503 |
| Seal Island | 97, 310 | 4, 616 | | | 97, 310 | 4, 616 |
| South | 9, 766, 916 | 296, 848 | 12, 000 | 590 | 9, 778, 916 | 297, 438 |
| Shore, general | 6, 036, 502 | 233, 215 | | | 6, 036, 502 | 233, 215 |
| Total | 194, 876, 989 | 7, 368, 440 | 63, 800 | 3, 102 | 194, 940, 789 | 7, 371, 542 |
| LANDED AT GLOUCESTER | | | | | | |
| East of 66° W. longitude: | | | | | | |
| La Have Bank | 2, 996, 852 | 49, 861 | 18, 885 | 554 | 3, 015, 737 | 50, 415 |
| Western Bank | 5, 357, 012 | 92, 373 | 523, 893 | 19, 523 | 5, 880, 905 | 111, 896 |
| Quereau Bank | 193, 990 | 5, 671 | 225, 663 | 8, 493 | 419, 653 | 14, 164 |
| Green Bank | 10, 875 | 184 | 8, 800 | 371 | 19, 675 | 555 |
| Grand Bank | 29, 020 | 872 | 169, 097 | 6, 944 | 198, 117 | 7, 816 |
| St. Peters Bank | 34, 105 | 636 | 28, 170 | 1, 089 | 62, 275 | 1, 725 |
| Off Newfoundland | | | 4, 415, 631 | 163, 996 | 4, 415, 631 | 163, 996 |
| Strait of Belle Isle | | | 7, 500 | 246 | 7, 500 | 246 |
| Roseway Bank | | | 4, 970 | 171 | 4, 970 | 171 |
| West of 66° W. longitude: | | | | | | |
| Browns Bank | 1, 990, 905 | 31, 100 | 101, 059 | 3, 678 | 2, 091, 964 | 34, 778 |
| Georges Bank | 6, 006, 740 | 129, 788 | 848, 768 | 32, 840 | 6, 855, 508 | 162, 628 |
| Middle Bank | 218, 960 | 5, 347 | | | 218, 960 | 5, 347 |
| South Channel | 6, 625, 205 | 91, 065 | | | 6, 625, 205 | 91, 065 |
| Nantucket Shoals | 640, 560 | 16, 996 | | | 640, 560 | 16, 996 |
| South | 183, 970 | 4, 109 | | | 183, 970 | 4, 109 |
| Shore, general | 21, 767, 650 | 822, 260 | 144, 260 | 5, 768 | 21, 911, 910 | 828, 028 |
| Total | 46, 055, 844 | 1, 250, 262 | 6, 496, 696 | 243, 673 | 52, 552, 540 | 1, 493, 935 |
| LANDED AT PORTLAND | | | | | | |
| East of 66° W. longitude: | | | | | | |
| La Have Bank | 34, 896 | 2, 819 | 25, 960 | 857 | 60, 856 | 3, 676 |
| Western Bank | 724, 186 | 12, 875 | | | 724, 186 | 12, 875 |
| Quereau Bank | 88, 886 | 16, 749 | 22, 060 | 918 | 110, 946 | 17, 667 |
| Green Bank | 29, 702 | 5, 573 | 7, 690 | 333 | 37, 392 | 5, 906 |
| Grand Bank | 48, 312 | 8, 175 | 22, 875 | 994 | 71, 187 | 9, 169 |
| St. Peters Bank | 37, 938 | 6, 408 | 5, 190 | 207 | 43, 128 | 6, 615 |
| Off Newfoundland | 12, 629 | 1, 879 | | | 12, 629 | 1, 879 |
| Cape Shore | 178, 942 | 17, 190 | | | 178, 942 | 17, 190 |
| Gulf of St. Lawrence | 63, 261 | 8, 810 | | | 63, 261 | 8, 810 |
| The Gully | 25, 839 | 5, 134 | 320 | 6 | 26, 159 | 5, 140 |
| Labrador coast | 19, 588 | 2, 297 | 395 | 16 | 19, 983 | 2, 313 |
| West of 66° W. longitude: | | | | | | |
| Browns Bank | 313, 010 | 14, 855 | 11, 556 | 519 | 324, 566 | 15, 374 |
| Georges Bank | 289, 834 | 25, 696 | 2, 825 | 113 | 292, 659 | 25, 809 |
| Cashes Bank | 769, 841 | 28, 057 | 15, 440 | 686 | 785, 281 | 28, 743 |
| Fippenies Bank | 214, 644 | 10, 940 | | | 214, 644 | 10, 940 |
| Platts Bank | 1, 252, 343 | 52, 212 | | | 1, 252, 343 | 52, 212 |
| Jeffreys Ledge | 4, 865, 888 | 137, 918 | 747 | 27 | 4, 866, 635 | 137, 945 |
| South Channel | 2, 968, 048 | 46, 038 | | | 2, 968, 048 | 46, 038 |
| Nantucket Shoals | 230, 645 | 3, 618 | | | 230, 645 | 3, 618 |
| Shore, general | 4, 057, 169 | 126, 700 | 15, 585 | 415 | 4, 072, 754 | 127, 115 |
| Total | 16, 225, 601 | 533, 943 | 130, 643 | 5, 091 | 16, 356, 244 | 539, 034 |
| Grand total | 257, 158, 434 | 9, 152, 645 | 6, 691, 139 | 251, 866 | 263, 849, 573 | 9, 404, 511 |

NOTE.—The items under "Miscellaneous" include bluebacks, 297,395 pounds, value $4,085; butterfish 28,359 pounds, value $4,460; eels, 298 pounds, value $32; flounders, 8,359,131 pounds, value $419,744; herring, fresh, 2,735,000 pounds, value $36,911; herring, salted, 4,410,436 pounds, value $163,825; rosefish, 66,266 pounds value $1,261; salmon, 19 pounds, value $3; shad, 76,542 pounds, value $2,734; sharks, 61,111 pounds, value $1,253; skates, 31,710 pounds, value $544; sturgeon, 834 pounds, value $179; swordfish, 2,245,493 pounds, value $513,582; whiting, 15,715 pounds, value $529; wolffish, 481,265 pounds, value $16,385; squid, 3,280 pounds, value $50; lobster, 151 pounds, value $49; scallops, 4,263 pounds, value $345; livers, 347,222 pounds, value $8,253; spawn, 128,921 pounds, value $12,092; tongues, 458 pounds, value $11; sounds, 460 pounds, value $10; and oil 46,454 pounds, value $4,698.

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

BY MONTHS

| Months | Number of trips | Cod | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Large (10 pounds and over) | | | | Market (under 10 and over 2½ pounds) | | | |
| | | Fresh | | Salted | | Fresh | | Salted | |
| | | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| LANDED AT BOSTON | | | | | | | | | |
| January | 330 | 3,403,855 | $131,618 | | | 577,815 | $19,623 | | |
| February | 300 | 4,458,916 | 136,039 | | | 245,923 | 8,116 | | |
| March | 343 | 4,436,666 | 124,404 | | | 274,815 | 9,202 | | |
| April | 296 | 2,243,850 | 72,677 | | | 612,217 | 15,090 | | |
| May | 389 | 1,961,805 | 55,561 | | | 640,597 | 11,125 | | |
| June | 482 | 1,892,630 | 86,442 | | | 748,885 | 17,713 | | |
| July | 452 | 1,938,768 | 76,303 | | | 1,050,335 | 21,938 | | |
| August | 507 | 2,565,103 | 107,626 | | | 1,698,290 | 31,948 | | |
| September | 449 | 2,293,490 | 100,669 | | | 1,663,283 | 35,538 | | |
| October | 406 | 2,009,683 | 113,469 | | | 1,485,254 | 40,003 | | |
| November | 387 | 1,287,873 | 80,733 | | | 803,808 | 24,850 | | |
| December | 343 | 1,185,599 | 104,163 | | | 688,898 | 32,167 | | |
| Total | 4,684 | 29,678,238 | 1,189,704 | | | 10,490,120 | 267,313 | | |
| LANDED AT GLOUCESTER | | | | | | | | | |
| January | 190 | 787,455 | 26,059 | | | 12,270 | 479 | | |
| February | 234 | 1,231,370 | 31,947 | 230 | $10 | 15,715 | 255 | 155 | $6 |
| March | 537 | 3,108,295 | 88,074 | 9,455 | 397 | 55,015 | 846 | 1,300 | 39 |
| April | 504 | 2,730,645 | 85,955 | 213,858 | 8,433 | 179,900 | 2,636 | 31,770 | 916 |
| May | 299 | 2,374,872 | 48,425 | 366,020 | 14,147 | 380,282 | 5,152 | 48,555 | 1,431 |
| June | 175 | 1,395,030 | 29,804 | 567,082 | 21,972 | 206,655 | 2,671 | 61,195 | 1,745 |
| July | 219 | 2,181,580 | 46,904 | 169,066 | 6,636 | 284,795 | 4,223 | 43,230 | 1,218 |
| August | 215 | 865,920 | 18,468 | 182,565 | 7,178 | 263,520 | 4,315 | 21,210 | 629 |
| September | 268 | 735,418 | 23,239 | 87,245 | 4,087 | 268,650 | 5,477 | 6,220 | 210 |
| October | 285 | 402,805 | 17,351 | 50,500 | 2,416 | 196,060 | 4,279 | 2,068 | 76 |
| November | 410 | 94,880 | 4,470 | 12,570 | 629 | 81,720 | 1,852 | 800 | 32 |
| December | 436 | 492,950 | 48,507 | | | 13,760 | 764 | | |
| Total | 3,772 | 16,401,220 | 469,203 | 1,658,590 | 65,905 | 1,958,342 | 32,949 | 216,503 | 6,302 |
| LANDED AT PORTLAND | | | | | | | | | |
| January | 114 | 71,541 | 4,229 | | | 31,873 | 1,447 | | |
| February | 68 | 165,748 | 5,142 | 425 | 10 | 19,822 | 864 | | |
| March | 123 | 93,144 | 3,780 | 2,515 | 80 | 57,845 | 2,121 | 115 | 3 |
| April | 163 | 279,989 | 8,998 | 7,640 | 323 | 59,412 | 1,523 | 370 | 15 |
| May | 150 | 265,549 | 7,349 | 17,995 | 775 | 24,076 | 470 | 550 | 19 |
| June | 196 | 381,235 | 15,446 | 120 | 6 | 20,195 | 477 | 890 | 39 |
| July | 156 | 234,405 | 10,695 | 12,362 | 539 | 7,410 | 197 | 3,630 | 126 |
| August | 187 | 285,261 | 14,614 | 21,075 | 683 | 10,338 | 263 | 286 | 11 |
| September | 164 | 189,645 | 9,085 | 21,110 | 951 | 15,625 | 389 | 2,055 | 76 |
| October | 123 | 86,126 | 4,224 | 13,645 | 668 | 43,567 | 1,189 | 870 | 33 |
| November | 130 | 97,891 | 5,169 | 2,365 | 118 | 42,999 | 1,268 | 140 | 6 |
| December | 132 | 87,206 | 7,240 | | | 29,027 | 1,433 | | |
| Total | 1,706 | 2,237,740 | 95,971 | 99,252 | 4,153 | 362,189 | 11,641 | 8,906 | 328 |
| Grand total | 10,162 | 48,317,198 | 1,754,878 | 1,757,842 | 70,058 | 12,810,651 | 311,903 | 225,409 | 6,630 |
| Grounds east of 66° west long. | 420 | 8,455,546 | 230,149 | 914,372 | 36,156 | 1,709,422 | 35,158 | 119,874 | 3,403 |
| Grounds west of 66° west long. | 9,742 | 39,861,652 | 1,524,729 | 843,470 | 33,902 | 11,101,229 | 276,745 | 105,535 | 3,227 |
| Landed at Boston in 1926 | 4,569 | 31,788,349 | 1,342,317 | 13,980 | 607 | 9,234,681 | 271,730 | 3,290 | 132 |
| Landed at Gloucester in 1926 | 2,665 | 25,600,942 | 650,378 | 3,778,912 | 174,222 | 2,823,000 | 49,850 | 644,892 | 22,776 |
| Landed at Portland in 1926 | 1,461 | 3,622,919 | 114,308 | 96,326 | 4,673 | 409,650 | 12,979 | 16,168 | 609 |

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

BY MONTHS—Continued

| Months | Cod—Continued | | | | Haddock | | | |
|---|---|---|---|---|---|---|---|---|
| | Scrod (1 to 2½ pounds) | | | | Large (over 2½ pounds) | | | |
| | Fresh | | Salted | | Fresh | | Salted | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| LANDED AT BOSTON | | | | | | | | |
| January | 22,060 | $359 | | | 8,761,791 | $309,382 | | |
| February | 6,700 | 124 | | | 9,396,575 | 287,335 | | |
| March | 4,965 | 88 | | | 11,774,064 | 352,502 | | |
| April | 13,915 | 130 | | | 6,488,415 | 218,108 | | |
| May | 8,630 | 88 | | | 6,081,205 | 137,220 | | |
| June | 11,700 | 104 | | | 6,950,460 | 115,665 | | |
| July | 5,800 | 57 | | | 5,234,260 | 96,658 | | |
| August | 5,230 | 59 | | | 6,833,507 | 160,149 | | |
| September | 20,800 | 183 | | | 9,202,357 | 161,844 | | |
| October | 14,080 | 188 | | | 10,400,201 | 295,524 | | |
| November | 8,940 | 107 | | | 8,188,084 | 299,299 | | |
| December | 18,495 | 426 | | | 6,807,655 | 444,650 | | |
| Total | 141,315 | 1,913 | | | 96,118,574 | 2,878,336 | | |
| LANDED AT GLOUCESTER | | | | | | | | |
| January | | | | | 48,020 | 547 | | |
| February | | | | | 222,400 | 4,487 | | |
| March | | | | | 3,016,870 | 42,323 | | |
| April | 935 | 8 | | | 1,786,315 | 46,616 | 48,870 | $611 |
| May | 1,240 | 12 | 80 | $2 | 512,945 | 8,169 | | |
| June | 400 | 4 | 603 | 14 | 1,043,620 | 10,502 | | |
| July | 200 | 2 | 1,580 | 29 | 1,290,086 | 14,456 | | |
| August | 1,060 | 11 | 1,570 | 31 | 469,025 | 5,635 | 710 | 14 |
| September | 3,700 | 37 | | | 954,440 | 11,513 | | |
| October | 2,575 | 26 | | | 589,605 | 13,566 | | |
| November | 476 | 5 | | | 390,625 | 10,151 | | |
| December | | | | | 209,240 | 13,116 | | |
| Total | 10,586 | 105 | 3,833 | 76 | 10,533,191 | 181,081 | 49,580 | 625 |
| LANDED AT PORTLAND | | | | | | | | |
| January | 12,408 | 236 | | | 255,638 | 14,918 | | |
| February | 4,265 | 85 | | | 113,817 | 7,415 | 320 | 6 |
| March | 14,180 | 203 | | | 780,410 | 21,458 | | |
| April | 7,010 | 71 | | | 1,099,466 | 21,877 | | |
| May | 4,075 | 28 | | | 1,965,155 | 31,297 | | |
| June | 5,845 | 39 | | | 832,363 | 14,221 | | |
| July | 1,915 | 15 | | | 131,035 | 4,385 | | |
| August | 2,200 | 18 | 200 | 4 | 466,525 | 10,027 | | |
| September | 6,250 | 36 | | | 277,746 | 7,465 | 100 | 2 |
| October | 12,442 | 72 | | | 475,584 | 16,615 | 100 | 2 |
| November | 9,405 | 62 | | | 492,993 | 17,901 | | |
| December | 7,700 | 71 | | | 382,979 | 25,450 | | |
| Total | 87,695 | 936 | 200 | 4 | 7,273,711 | 193,029 | 520 | 10 |
| Grand total | 239,596 | 2,954 | 4,033 | 80 | 113,925,476 | 3,252,446 | 50,100 | 635 |
| Grounds east of 66° west long | 6,561 | 74 | 3,093 | 61 | 3,704,076 | 80,999 | 1,230 | 24 |
| Grounds west of 66° west long | 233,035 | 2,880 | 940 | 19 | 110,221,400 | 3,171,447 | 48,870 | 611 |
| Landed at Boston in 1926 | 61,175 | 1,150 | | | 71,454,983 | 2,591,880 | | |
| Landed at Gloucester in 1926 | 7,035 | 71 | 8,055 | 221 | 5,436,790 | 77,253 | 2,395 | 52 |
| Landed at Portland in 1926 | 89,178 | 1,093 | 20,151 | 362 | 5,840,842 | 168,122 | 74,130 | 1,474 |

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

BY MONTHS—Continued

| Months | Haddock—Continued | | | | Hake | | | |
|---|---|---|---|---|---|---|---|---|
| | Scrod (1 to 2½ pounds) | | | | Large (6 pounds and over) | | | |
| | Fresh | | Salted | | Fresh | | Salted | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| LANDED AT BOSTON | | | | | | | | |
| January | 1,323,755 | $34,523 | | | 330,415 | $13,503 | | |
| February | 1,463,310 | 33,058 | | | 174,955 | 10,159 | | |
| March | 1,412,515 | 42,409 | | | 242,030 | 10,584 | | |
| April | 1,256,565 | 33,532 | | | 45,400 | 2,013 | | |
| May | 924,485 | 10,416 | | | 48,460 | 1,657 | | |
| June | 1,087,670 | 8,180 | | | 123,670 | 2,943 | | |
| July | 711,225 | 6,105 | | | 147,680 | 2,708 | | |
| August | 956,394 | 11,015 | | | 377,631 | 5,798 | | |
| September | 1,169,025 | 11,667 | | | 472,150 | 7,765 | | |
| October | 1,934,225 | 31,395 | | | 1,035,320 | 21,849 | | |
| November | 1,005,195 | 24,364 | | | 1,134,218 | 20,862 | | |
| December | 497,415 | 24,069 | | | 592,987 | 30,745 | | |
| Total | 13,741,779 | 270,733 | | | 4,724,916 | 130,586 | | |
| LANDED AT GLOUCESTER | | | | | | | | |
| February | 37,260 | 373 | | | | | | |
| March | 112,745 | 853 | | | 970 | 10 | | |
| April | 124,910 | 965 | | | 3,465 | 36 | 400 | $8 |
| May | 78,580 | 589 | | | 2,780 | 28 | | |
| June | 122,490 | 904 | | | 3,650 | 36 | 1,000 | 20 |
| July | 60,565 | 454 | | | 35,575 | 372 | 5,455 | 109 |
| August | 43,175 | 324 | | | 32,430 | 342 | 6,025 | 121 |
| September | 78,385 | 593 | | | 67,110 | 908 | 140 | 3 |
| October | 7,630 | 63 | | | 46,620 | 766 | 445 | 9 |
| November | 54,240 | 674 | | | 20,415 | 479 | 1,040 | 21 |
| December | 10,020 | 491 | | | | | | |
| Total | 730,000 | 6,283 | | | 213,015 | 2,977 | 14,505 | 291 |
| LANDED AT PORTLAND | | | | | | | | |
| January | 15,625 | 305 | | | 35 | 2 | | |
| February | 6,945 | 138 | | | 2,300 | 92 | | |
| March | 22,877 | 346 | | | 935 | 65 | | |
| April | 10,410 | 120 | | | 2,205 | 53 | | |
| May | 2,820 | 22 | | | 1,980 | 73 | | |
| June | 5,765 | 54 | | | 210 | 4 | | |
| July | 5,993 | 36 | | | 360 | 6 | | |
| August | 12,165 | 84 | | | | | | |
| September | 11,180 | 72 | | | | | 280 | 7 |
| October | 17,383 | 141 | | | 4,800 | 86 | | |
| November | 20,801 | 169 | | | 2,210 | 44 | | |
| December | 13,364 | 129 | | | 430 | 22 | | |
| Total | 145,328 | 1,616 | | | 15,465 | 447 | 280 | 7 |
| Grand total | 14,617,107 | 278,632 | | | 4,953,396 | 134,010 | 14,785 | 298 |
| Grounds east of 66° west longitude | 21,420 | 286 | | | 165,190 | 2,786 | 13,050 | 263 |
| Grounds west of 66° west longitude | 14,595,687 | 278,346 | | | 4,788,206 | 131,224 | 1,735 | 35 |
| Landed at Boston in 1926 | 10,407,893 | 236,409 | | | 4,256,347 | 102,444 | 3,420 | 71 |
| Landed at Gloucester in 1926 | 710,510 | 6,194 | | | 174,805 | 2,482 | 17,065 | 351 |
| Landed at Portland in 1926 | 132,391 | 1,524 | 800 | $16 | 14,895 | 442 | 1,500 | 45 |

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

BY MONTHS—Continued

| Months | Hake—Continued: Small (under 6 pounds) | | | | Pollock | | | |
|---|---|---|---|---|---|---|---|---|
| | Fresh | | Salted | | Fresh | | Salted | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| LANDED AT BOSTON | | | | | | | | |
| January | 2,875 | $86 | | | 453,775 | $11,644 | | |
| February | 600 | 24 | | | 143,880 | 6,412 | | |
| March | | | | | 127,365 | 6,293 | | |
| April | | | | | 132,965 | 5,219 | | |
| May | | | | | 89,588 | 2,027 | | |
| June | | | | | 149,360 | 3,580 | | |
| July | | | | | 161,050 | 3,764 | | |
| August | | | | | 418,962 | 8,085 | | |
| September | | | | | 353,135 | 7,095 | | |
| October | | | | | 436,285 | 7,895 | | |
| November | 51,050 | 589 | | | 355,375 | 6,050 | | |
| December | | | | | 379,785 | 18,048 | | |
| Total | 54,525 | 699 | | | 3,201,525 | 86,112 | | |
| LANDED AT GLOUCESTER | | | | | | | | |
| January | | | | | 399,270 | 9,683 | | |
| February | | | | | 13,420 | 134 | | |
| March | | | | | 15,205 | 152 | 40 | $1 |
| April | | | 760 | $15 | 13,990 | 144 | 1,185 | 23 |
| May | | | | | 15,900 | 175 | 865 | 17 |
| June | | | | | 20,315 | 405 | 1,420 | 29 |
| July | | | | | 31,440 | 478 | 2,640 | 52 |
| August | | | | | 24,965 | 254 | 2,595 | 52 |
| September | | | | | 29,995 | 529 | 630 | 13 |
| October | | | | | 477,860 | 10,402 | 195 | 4 |
| November | | | | | 2,143,330 | 32,691 | | |
| December | | | | | 450,310 | 17,020 | | |
| Total | | | 760 | 15 | 3,636,000 | 72,067 | 9,570 | 191 |
| LANDED AT PORTLAND | | | | | | | | |
| January | 39,815 | 1,659 | | | 36,511 | 773 | | |
| February | 31,250 | 1,553 | | | 8,660 | 270 | | |
| March | 42,851 | 1,643 | | | 33,218 | 1,148 | | |
| April | 10,060 | 323 | | | 28,225 | 1,089 | 880 | 35 |
| May | 30,907 | 1,064 | | | 25,530 | 417 | 70 | 1 |
| June | 11,015 | 231 | 310 | 11 | 87,920 | 1,421 | | |
| July | 18,869 | 330 | | | 111,903 | 1,243 | | |
| August | 50,162 | 802 | | | 86,093 | 1,108 | 130 | 3 |
| September | 218,525 | 3,004 | | | 142,290 | 1,708 | | |
| October | 178,604 | 4,280 | 1,370 | 26 | 118,266 | 1,605 | | |
| November | 134,605 | 3,012 | | | 86,890 | 1,072 | | |
| December | 70,817 | 3,585 | | | 48,680 | 1,586 | | |
| Total | 837,480 | 21,486 | 1,680 | 37 | 814,186 | 13,440 | 1,080 | 39 |
| Grand total | 892,005 | 22,185 | 2,440 | 52 | 7,651,711 | 171,619 | 10,650 | 230 |
| Grounds east of 66° west longitude | 10,510 | 169 | 2,130 | 41 | 147,695 | 2,597 | 5,085 | 119 |
| Grounds west of 66° west longitude | 881,495 | 22,016 | 310 | 11 | 7,504,016 | 169,022 | 5,565 | 111 |
| Landed at Boston in 1926 | 413,927 | 22,942 | | | 3,103,723 | 85,773 | | |
| Landed at Gloucester in 1926 | | | | | 2,835,415 | 53,810 | 23,635 | 483 |
| Landed at Portland in 1926 | 622,190 | 17,456 | 470 | 9 | 766,037 | 13,356 | 10,704 | 263 |

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

BY MONTHS—*Continued*

| Months | Cusk | | | | Halibut | | | |
|---|---|---|---|---|---|---|---|---|
| | Fresh | | Salted | | Fresh | | Salted | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| LANDED AT BOSTON | | | | | | | | |
| January | 103, 670 | $3, 291 | | | 16, 662 | $6, 486 | | |
| February | 145, 560 | 5, 321 | | | 122, 458 | 29, 972 | | |
| March | 211, 975 | 6, 475 | | | 554, 713 | 101, 729 | | |
| April | 197, 135 | 4, 365 | | | 601, 480 | 106, 118 | | |
| May | 106, 295 | 1, 520 | | | 624, 586 | 101, 369 | | |
| June | 25, 930 | 715 | | | 524, 087 | 97, 970 | | |
| July | 116, 315 | 1, 852 | | | 491, 328 | 76, 677 | | |
| August | 117, 495 | 2, 102 | | | 640, 855 | 93, 646 | | |
| September | 73, 645 | 1, 323 | | | 226, 018 | 50, 727 | | |
| October | 89, 985 | 1, 668 | | | 425, 075 | 73, 248 | | |
| November | 237, 435 | 6, 070 | | | 65, 797 | 15, 640 | | |
| December | 254, 684 | 10, 203 | | | 26, 977 | 10, 497 | | |
| Total | 1, 680, 124 | 44, 905 | | | 4, 320, 036 | 764, 079 | | |
| LANDED AT GLOUCESTER | | | | | | | | |
| January | 75 | 1 | | | | | | |
| March | 3, 080 | 46 | | | | | | |
| April | 60, 965 | 707 | 1, 165 | $23 | 5, 130 | 381 | | |
| May | 49, 805 | 598 | 1, 370 | 22 | 31, 955 | 2, 556 | 150 | $21 |
| June | 18, 925 | 238 | 4, 237 | 85 | | | 105 | 8 |
| July | 65, 625 | 876 | 1, 480 | 37 | | | | |
| August | 51, 335 | 706 | 20, 855 | 497 | | | 325 | 39 |
| September | 34, 410 | 452 | 2, 100 | 52 | | | 5, 217 | 487 |
| October | 30, 010 | 413 | 525 | 15 | | | | |
| November | 10, 270 | 138 | | | | | | |
| Total | 324, 500 | 4, 175 | 31, 732 | 731 | 37, 085 | 2, 937 | 5, 797 | 555 |
| LANDED AT PORTLAND | | | | | | | | |
| January | 105, 400 | 4, 418 | | | 1, 012 | 260 | | |
| February | 81, 293 | 3, 667 | | | 19, 464 | 4, 963 | | |
| March | 217, 968 | 5, 994 | | | 31, 293 | 6, 217 | | |
| April | 78, 827 | 1, 912 | | | 39, 074 | 7, 065 | | |
| May | 39, 225 | 1, 065 | | | 26, 395 | 3, 914 | | |
| June | 9, 050 | 221 | | | 19, 462 | 3, 336 | | |
| July | 1, 355 | 44 | | | 23, 491 | 2, 222 | | |
| August | 15, 109 | 225 | 400 | 8 | 107, 880 | 13, 997 | | |
| September | 41, 508 | 755 | 1, 860 | 47 | 91, 798 | 17, 371 | | |
| October | 35, 277 | 857 | | | 18, 286 | 4, 637 | | |
| November | 31, 116 | 666 | | | 35, 800 | 7, 807 | | |
| December | 32, 473 | 1, 684 | | | 2, 410 | 585 | | |
| Total | 688, 601 | 21, 508 | 2, 260 | 55 | 416, 365 | 72, 374 | | |
| Grand total | 2, 693, 225 | 70, 588 | 33, 992 | 786 | 4, 773, 486 | 839, 390 | 5, 797 | 555 |
| Grounds east of 66° west long | 339, 765 | 6, 935 | 12, 032 | 271 | 3, 175, 726 | 524, 741 | 5, 797 | 555 |
| Grounds west of 66° west long | 2, 353, 460 | 63, 653 | 21, 960 | 515 | 1, 597, 760 | 314, 649 | | |
| Landed at Boston in 1926 | 1, 432, 410 | 38, 657 | | | 2, 967, 402 | 584, 702 | | |
| Landed at Gloucester in 1926 | 432, 110 | 5, 584 | 34, 255 | 906 | 9, 860 | 2, 958 | 4, 730 | 580 |
| Landed at Portland in 1926 | 829, 002 | 24, 431 | 170 | 5 | 448, 965 | 82, 910 | | |

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

BY MONTHS—Continued

| Months | Mackerel | | | | Miscellaneous [1] | | | |
|---|---|---|---|---|---|---|---|---|
| | Fresh | | Salted | | Fresh | | Salted | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| LANDED AT BOSTON | | | | | | | | |
| January | | | | | 764, 258 | $50, 680 | | |
| February | | | | | 573, 485 | 33, 988 | | |
| March | | | | | 820, 071 | 37, 271 | | |
| April | | | | | 851, 521 | 32, 366 | | |
| May | 4, 176, 251 | $110, 701 | 8, 000 | $390 | 866, 214 | 17, 300 | | |
| June | 5, 535, 720 | 177, 944 | 4, 000 | 200 | 683, 190 | 69, 471 | | |
| July | 4, 373, 829 | 168, 040 | 32, 400 | 1, 456 | 945, 621 | 174, 395 | | |
| August | 4, 251, 690 | 187, 017 | 19, 400 | 1, 056 | 1, 332, 353 | 207, 938 | | |
| September | 1, 749, 880 | 168, 966 | | | 965, 536 | 91, 476 | | |
| October | 259, 875 | 41, 128 | | | 745, 390 | 46, 912 | | |
| November | 6, 775 | 1, 298 | | | 970, 067 | 51, 841 | | |
| December | 26, 260 | 4, 989 | | | 827, 851 | 60, 339 | | |
| Total | 20, 380, 280 | 860, 083 | 63, 800 | 3, 102 | 10, 345, 557 | 873, 977 | | |
| LANDED AT GLOUCESTER | | | | | | | | |
| January | | | | | 144, 450 | 5, 818 | 1, 696, 480 | $61, 420 |
| February | | | | | 235, 180 | 12, 186 | | |
| March | | | | | 235, 820 | 13, 625 | 330, 600 | 12, 325 |
| April | | | | | 16, 940 | 701 | | |
| May | 366, 040 | 7, 697 | | | 163, 680 | 2, 481 | | |
| June | 638, 940 | 14, 665 | | | 292, 910 | 4, 218 | | |
| July | 2, 509, 520 | 62, 590 | 16, 400 | 984 | 54, 470 | 10, 132 | | |
| August | 5, 778, 170 | 153, 620 | 77, 790 | 4, 101 | 141, 380 | 4, 213 | | |
| September | 481, 140 | 51, 364 | 1, 200 | 72 | 292, 290 | 3, 392 | | |
| October | 330, 005 | 55, 226 | | | 22, 970 | 988 | | |
| November | 75, 910 | 12, 545 | | | 47, 220 | 1, 812 | | |
| December | 279, 280 | 54, 106 | | | 105, 590 | 7, 106 | 2, 383, 356 | 90, 080 |
| Total | 10, 459, 005 | 411, 813 | 95, 390 | 5, 157 | 1, 752, 900 | 66, 672 | 4, 410, 436 | 163, 825 |
| LANDED AT PORTLAND | | | | | | | | |
| January | | | | | 52, 111 | 2, 560 | | |
| February | | | | | 30, 579 | 1, 270 | | |
| March | | | | | 46, 402 | 1, 392 | | |
| April | | | | | 47, 240 | 1, 485 | | |
| May | 43, 730 | 1, 325 | 350 | 11 | 123, 709 | 1, 496 | | |
| June | 153, 580 | 3, 873 | | | 329, 738 | 4, 535 | | |
| July | 45, 495 | 1, 362 | 13, 915 | 348 | 509, 847 | 20, 517 | | |
| August | 268, 770 | 7, 974 | 2, 200 | 99 | 419, 980 | 24, 597 | | |
| September | 2, 981 | 332 | | | 868, 761 | 18, 232 | | |
| October | | | | | 316, 968 | 5, 513 | | |
| November | 395 | 68 | | | 38, 292 | 1, 989 | | |
| December | | | | | 48, 263 | 2, 975 | | |
| Total | 514, 951 | 14, 934 | 16, 465 | 458 | 2, 831, 890 | 86, 561 | | |
| Grand total | 31, 354, 236 | 1, 286, 830 | 175, 655 | 8, 717 | 14, 930, 347 | 1, 027, 210 | 4, 410, 436 | 163, 825 |
| Grounds east of 66° west long | 197, 400 | 4, 381 | | | 345, 751 | 67, 884 | 4, 410, 436 | 163, 825 |
| Grounds west of 66° west long | 31, 156, 836 | 1, 282, 449 | 175, 655 | 8, 717 | 14, 584, 596 | 959, 326 | | |
| Landed at Boston in 1926 | 23, 252, 725 | 962, 604 | 236, 000 | 10, 501 | 8, 687, 521 | 750, 683 | | |
| Landed at Gloucester in 1926 | 9, 940, 778 | 329, 845 | 850, 060 | 44, 423 | 1, 250, 300 | 55, 662 | 315, 280 | 12, 110 |
| Landed at Portland in 1926 | 1, 929, 852 | 58, 382 | 23, 240 | 730 | 1, 257, 993 | 72, 570 | | |

[1] Includes herring from Newfoundland, 4,410,436 pounds salted, value $163,825.

*Fishery products landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

BY MONTHS—Continued

| Months | Total | | | | Grand total | |
|---|---|---|---|---|---|---|
| | Fresh | | Salted | | | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| LANDED AT BOSTON | | | | | | |
| January | 15, 760, 931 | $581, 195 | | | 15, 760, 931 | $581, 195 |
| February | 16, 732, 362 | 550, 548 | | | 16, 732, 362 | 550, 548 |
| March | 19, 859, 179 | 690, 957 | | | 19, 859, 179 | 690, 957 |
| April | 12, 443, 463 | 489, 618 | | | 12, 443, 463 | 489, 618 |
| May | 15, 528, 116 | 448, 984 | 8, 000 | $390 | 15, 536, 116 | 449, 374 |
| June | 17, 732, 302 | 580, 727 | 4, 000 | 200 | 17, 737, 302 | 580, 927 |
| July | 15, 176, 211 | 628, 497 | 32, 400 | 1, 456 | 15, 208, 611 | 629, 953 |
| August | 19, 197, 510 | 815, 383 | 19, 400 | 1, 056 | 19, 216, 910 | 816, 439 |
| September | 18, 189, 319 | 637, 253 | | | 18, 189, 319 | 637, 253 |
| October | 18, 835, 373 | 673, 279 | | | 18, 835, 373 | 673, 279 |
| November | 14, 114, 617 | 531, 703 | | | 14, 114, 617 | 531, 703 |
| December | 11, 306, 606 | 740, 296 | | | 11, 306, 606 | 740, 296 |
| Total | 194, 876, 989 | 7, 368, 440 | 63, 800 | 3, 102 | 194, 940, 789 | 7, 371, 542 |
| LANDED AT GLOUCESTER | | | | | | |
| January | 1, 391, 540 | 42, 587 | 1, 696, 480 | 61, 420 | 3, 088, 020 | 104, 007 |
| February | 1, 755, 345 | 49, 382 | 385 | 16 | 1, 755, 730 | 49, 398 |
| March | 6, 548, 000 | 145, 929 | 341, 395 | 12, 762 | 6, 889, 395 | 158, 691 |
| April | 4, 923, 195 | 138, 149 | 298, 008 | 10, 029 | 5, 221, 203 | 148, 178 |
| May | 3, 978, 079 | 75, 882 | 417, 040 | 15, 640 | 4, 395, 119 | 91, 522 |
| June | 3, 742, 935 | 63, 447 | 635, 642 | 23, 873 | 4, 378, 577 | 87, 320 |
| July | 6, 513, 856 | 140, 487 | 239, 850 | 9, 065 | 6, 753, 706 | 149, 552 |
| August | 7, 670, 980 | 187, 888 | 313, 645 | 12, 662 | 7, 984, 625 | 200, 550 |
| September | 2, 945, 538 | 97, 504 | 102, 752 | 4, 924 | 3, 048, 290 | 102, 428 |
| October | 2, 106, 140 | 103, 080 | 53, 733 | 2, 520 | 2, 159, 873 | 105, 600 |
| November | 2, 919, 086 | 64, 817 | 14, 410 | 682 | 2, 933, 496 | 65, 499 |
| December | 1, 561, 150 | 141, 110 | 2, 383, 356 | 90, 080 | 3, 944, 506 | 231, 190 |
| Total | 46, 055, 844 | 1, 250, 262 | 6, 496, 696 | 243, 673 | 52, 552, 540 | 1, 493, 935 |
| LANDED AT PORTLAND | | | | | | |
| January | 621, 969 | 30, 807 | | | 621, 969 | 30, 807 |
| February | 484, 143 | 25, 459 | 745 | 16 | 484, 888 | 25, 475 |
| March | 1, 341, 123 | 44, 367 | 2, 630 | 83 | 1, 343, 753 | 44, 450 |
| April | 1, 661, 918 | 44, 516 | 8, 890 | 373 | 1, 670, 808 | 44, 889 |
| May | 2, 553, 151 | 48, 520 | 18, 965 | 806 | 2, 572, 116 | 49, 326 |
| June | 1, 856, 378 | 43, 858 | 1, 320 | 56 | 1, 857, 698 | 43, 914 |
| July | 1, 092, 078 | 41, 052 | 29, 907 | 1, 013 | 1, 121, 985 | 42, 065 |
| August | 1, 724, 483 | 73, 709 | 24, 291 | 808 | 1, 748, 774 | 74, 517 |
| September | 1, 866, 309 | 58, 449 | 25, 405 | 1, 083 | 1, 891, 714 | 59, 532 |
| October | 1, 307, 303 | 39, 219 | 15, 985 | 729 | 1, 323, 288 | 39, 948 |
| November | 993, 397 | 39, 227 | 2, 505 | 124 | 995, 902 | 39, 351 |
| December | 723, 349 | 44, 760 | | | 723, 349 | 44, 760 |
| Total | 16, 225, 601 | 533, 943 | 130, 643 | 5, 091 | 16, 356, 244 | 539, 034 |
| Grand total | 257, 158, 434 | 9, 152, 645 | 6, 691, 139 | 251, 866 | 263, 849, 573 | 9, 404, 511 |
| Grounds east of 66° west longitude | 18, 279, 062 | 956, 159 | 5, 487, 099 | 204, 718 | 23, 766, 161 | 1, 160, 877 |
| Ground west of 66° west longitude | 238, 879, 372 | 8, 196, 486 | 1, 204, 040 | 47, 148 | 240, 083, 412 | 8, 243, 634 |
| Landed at Boston in 1926 | 167, 061, 136 | 6, 991, 291 | 256, 690 | 11, 311 | 167, 317, 826 | 7, 002, 602 |
| Landed at Gloucester in 1926 | 49, 221, 545 | 1, 234, 087 | 5, 679, 279 | 256, 124 | 54, 900, 824 | 1, 490, 211 |
| Landed at Portland in 1926 | 15, 963, 914 | 567, 574 | 243, 659 | 8, 186 | 16, 207, 573 | 575, 760 |

*Fishery products landed by American otter trawlers at Boston and Gloucester, Mass., and Portland, Me., 1927*

| Items | Trips | Days absent | Cod | | Haddock | |
|---|---|---|---|---|---|---|
| | | | Pounds | Value | Pounds | Value |
| BY FISHING GROUNDS | | | | | | |
| East of 66° W. longitude: | | | | | | |
| Western Bank | 1 | 9 | ---------- | ---------- | 272,800 | $3,410 |
| West of 66° W. longitude: | | | | | | |
| Georges Bank | 17 | 139 | 178,987 | $6,435 | 1,350,685 | 42,933 |
| South Channel | 736 | 5,504 | 3,709,688 | 144,123 | 63,593,777 | 1,651,498 |
| Nantucket Shoals | 39 | 296 | 88,230 | 3,275 | 3,908,690 | 119,757 |
| Off Chatham | 1 | 6 | 6,000 | 240 | 111,700 | 6,612 |
| Total | 794 | 5,954 | 3,982,905 | 154,073 | 69,237,652 | 1,824,210 |
| BY MONTHS | | | | | | |
| January | 77 | 618 | 469,166 | 22,166 | 6,382,881 | 211,044 |
| February | 74 | 589 | 401,209 | 14,063 | 7,747,420 | 221,307 |
| March | 98 | 711 | 433,720 | 13,840 | 10,777,599 | 278,537 |
| April | 70 | 550 | 600,034 | 20,417 | 4,946,070 | 147,848 |
| May | 50 | 388 | 218,999 | 4,913 | 5,030,545 | 85,992 |
| June | 50 | 350 | 134,730 | 5,512 | 5,643,225 | 77,869 |
| July | 38 | 271 | 84,510 | 2,191 | 3,844,225 | 55,847 |
| August | 39 | 259 | 159,030 | 1,662 | 4,107,593 | 79,288 |
| September | 53 | 372 | 355,458 | 9,356 | 5,531,677 | 83,929 |
| October | 75 | 539 | 427,035 | 15,132 | 6,765,208 | 177,294 |
| November | 86 | 657 | 353,830 | 18,028 | 4,790,489 | 166,310 |
| December | 84 | 650 | 345,184 | 26,793 | 3,670,720 | 238,945 |
| Total | 794 | 5,954 | 3,982,905 | 154,073 | 69,237,652 | 1,824,210 |

| Items | Hake | | Pollock | | Cusk | |
|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value |
| BY FISHING GROUNDS | | | | | | |
| East of 66° W. longitude: | | | | | | |
| Western Bank | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- |
| West of 66° W. longitude: | | | | | | |
| Georges Bank | 1,895 | $49 | 15,840 | $727 | ---------- | ---------- |
| South Channel | 947,110 | 27,543 | 1,077,545 | 38,987 | 11,440 | $440 |
| Nantucket Shoals | 45,225 | 1,045 | 14,100 | 443 | 175 | 6 |
| Off Chatham | 500 | 40 | 240 | 17 | ---------- | ---------- |
| Total | 994,730 | 28,677 | 1,107,725 | 40,174 | 11,615 | 446 |
| BY MONTHS | | | | | | |
| January | 115,465 | 4,604 | 340,675 | 9,252 | 5,080 | 207 |
| February | 37,455 | 2,180 | 73,210 | 4,199 | 2,620 | 109 |
| March | 29,185 | 1,261 | 69,985 | 4,091 | 165 | 5 |
| April | 33,845 | 1,510 | 52,450 | 2,592 | 325 | 10 |
| May | 31,840 | 1,178 | 13,725 | 381 | ---------- | ---------- |
| June | 70,935 | 1,780 | 6,275 | 174 | 50 | 1 |
| July | 62,400 | 1,031 | 2,820 | 74 | ---------- | ---------- |
| August | 78,445 | 981 | 2,130 | 49 | ---------- | ---------- |
| September | 71,035 | 840 | 46,300 | 1,056 | ---------- | ---------- |
| October | 128,530 | 2,255 | 86,375 | 1,824 | 70 | 1 |
| November | 189,450 | 3,089 | 138,975 | 2,672 | 1,085 | 22 |
| December | 146,145 | 7,968 | 274,805 | 13,810 | 2,220 | 91 |
| Total | 994,730 | 28,677 | 1,107,725 | 40,174 | 11,615 | 446 |

*Fishery products landed by American otter trawlers at Boston and Gloucester, Mass., and Portland, Me., 1927*—Continued

| Items | Halibut | | Miscellaneous | | Total | |
|---|---|---|---|---|---|---|
| BY FISHING GROUNDS | | | | | | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| East of 66° W. longitude: | | | | | | |
| Western Bank | | | | | 272, 800 | $3, 410 |
| West of 66° W. longitude: | | | | | | |
| Georges Bank | 2, 405 | $712 | 34, 720 | $2, 612 | 1, 584, 532 | 53, 468 |
| South Channel | 94, 796 | 23, 542 | 2, 000, 773 | 127, 196 | 71, 435, 129 | 2, 013, 329 |
| Nantucket Shoals | 1, 556 | 380 | 86, 982 | 5, 142 | 4, 144, 958 | 130, 048 |
| Off Chatham | 10 | 2 | 21, 570 | 1, 436 | 140, 020 | 8, 347 |
| Total | 98, 767 | 24, 636 | 2, 144, 045 | 136, 386 | 77, 577, 439 | 2, 208, 602 |
| BY MONTHS | | | | | | |
| January | 4, 437 | 1, 676 | 338, 548 | 25, 760 | 7, 656, 252 | 274, 709 |
| February | 13, 258 | 3, 807 | 249, 059 | 16, 784 | 8, 524, 231 | 262, 449 |
| March | 17, 754 | 4, 036 | 175, 433 | 10, 322 | 11, 503, 841 | 312, 092 |
| April | 17, 490 | 3, 223 | 298, 932 | 12, 040 | 5, 949, 146 | 187, 640 |
| May | 5, 453 | 809 | 129, 075 | 2, 216 | 5, 429, 637 | 95, 489 |
| June | 4, 817 | 898 | 124, 005 | 4, 231 | 5, 984, 037 | 90, 465 |
| July | 1, 873 | 350 | 63, 489 | 2, 927 | 4, 059, 317 | 62, 420 |
| August | 1, 778 | 340 | 80, 530 | 4, 848 | 4, 429, 506 | 87, 168 |
| September | 2, 808 | 562 | 85, 270 | 5, 504 | 6, 092, 548 | 101, 247 |
| October | 8, 794 | 1, 955 | 106, 455 | 10, 008 | 7, 522, 467 | 208, 469 |
| November | 12, 169 | 3, 900 | 242, 944 | 18, 070 | 5, 728, 942 | 212, 091 |
| December | 8, 136 | 3, 080 | 250, 305 | 23, 676 | 4, 697, 515 | 314, 363 |
| Total | 98, 767 | 24, 636 | 2, 144, 045 | 136, 386 | 77, 577, 439 | 2, 208, 602 |

NOTE.—All fish landed by these vessels were fresh.

*Cod, haddock, and hake landed at Boston and Gloucester, Mass., and Portland, Me., by otter trawlers in various years*

| Year | Trips | Cod | Haddock | Hake | Year | Trips | Cod | Haddock | Hake |
|---|---|---|---|---|---|---|---|---|---|
| | | *Pounds* | *Pounds* | *Pounds* | | | *Pounds* | *Pounds* | *Pounds* |
| 1908 | 44 | 209, 800 | 1, 542, 000 | 46, 600 | 1921 | 346 | 2, 482, 833 | 26, 734, 893 | 241, 650 |
| 1909 | 47 | 159, 800 | 1, 719, 000 | 74, 400 | 1922 | 578 | 11, 161, 947 | 35, 878, 524 | 576, 370 |
| 1910 | 59 | 125, 850 | 2, 775, 000 | 46, 600 | 1923 | 665 | 14, 961, 590 | 35, 527, 297 | 471, 600 |
| 1911 | 178 | 564, 500 | 7, 367, 100 | 151, 700 | 1924 | 543 | 8, 231, 430 | 35, 197, 940 | 616, 853 |
| 1912 | 295 | 1, 952, 950 | 12, 966, 700 | 105, 500 | 1925 | 607 | 7, 309, 930 | 44, 034, 281 | 711, 212 |
| 1913 | 326 | 1, 667, 806 | 12, 488, 992 | 209, 485 | 1926 | 667 | 5, 203, 911 | 52, 405, 653 | 894, 885 |
| 1914 | 387 | 1, 149, 595 | 15, 383, 550 | 259, 913 | 1927 | 794 | 3, 982, 905 | 69, 237, 652 | 994, 730 |
| 1920 | 646 | 6, 311, 389 | 51, 962, 457 | | | | | | |

*Fish landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 1927, from fishing grounds off the coasts specified*

| Species | United States | | Newfoundland | | Canadian Provinces | | Total | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Cod: | | | | | | | | |
| Fresh | 51, 195, 916 | $1, 804, 354 | 82, 405 | $2, 401 | 10, 089, 124 | $262, 980 | 61, 367, 445 | $2, 069, 735 |
| Salted | 949, 945 | 37, 148 | 242, 610 | 9, 669 | 794, 729 | 29, 951 | 1, 987, 284 | 76, 768 |
| Haddock: | | | | | | | | |
| Fresh | 124, 817, 087 | 3, 449, 793 | 200 | 2 | 3, 725, 296 | 81, 283 | 128, 542, 583 | 3, 531, 078 |
| Salted | 48, 870 | 611 | 100 | 2 | 1, 130 | 22 | 50, 100 | 635 |
| Hake: | | | | | | | | |
| Fresh | 5, 669, 701 | 153, 240 | 12, 240 | 138 | 163, 460 | 2, 817 | 5, 845, 401 | 156, 195 |
| Salted | 2, 045 | 46 | 2, 960 | 60 | 12, 220 | 244 | 17, 225 | 350 |
| Pollock: | | | | | | | | |
| Fresh | 7, 504, 016 | 169, 022 | | | 147, 695 | 2, 597 | 7, 651, 711 | 171, 619 |
| Salted | 5, 565 | 111 | 1, 195 | 42 | 3, 890 | 77 | 10, 650 | 230 |
| Cusk: | | | | | | | | |
| Fresh | 2, 353, 460 | 63, 653 | 9, 450 | 184 | 330, 315 | 6, 751 | 2, 693, 225 | 70, 588 |
| Salted | 21, 960 | 515 | 2, 110 | 56 | 9, 922 | 215 | 33, 992 | 786 |
| Halibut: | | | | | | | | |
| Fresh | 1, 597, 760 | 314, 649 | 1, 617, 644 | 273, 255 | 1, 558, 082 | 251, 486 | 4, 773, 486 | 839, 390 |
| Salted | | | 5, 542 | 526 | 255 | 29 | 5, 797 | 555 |
| Mackerel: | | | | | | | | |
| Fresh | 31, 156, 836 | 1, 282, 449 | | | 197, 400 | 4, 381 | 31, 354, 236 | 1, 286, 830 |
| Salted | 175, 655 | 8, 717 | | | | | 175, 655 | 8, 717 |
| Herring: | | | | | | | | |
| Fresh | 2, 735, 000 | 36, 911 | | | | | 2, 735, 000 | 36, 911 |
| Salted | | | 4, 410, 436 | 163, 825 | | | 4, 410, 436 | 163, 825 |
| Swordfish, fresh | 1, 947, 504 | 447, 497 | 891 | 214 | 297, 098 | 65, 871 | 2, 245, 493 | 513, 582 |
| Miscellaneous, fresh | 9, 902, 092 | 474, 918 | | | 47, 762 | 1, 799 | 9, 949, 854 | 476, 717 |
| Total | 240, 083, 412 | 8, 243, 634 | 6, 387, 783 | 450, 374 | 17, 378, 378 | 710, 503 | 263, 849, 573 | 9, 404, 511 |

*Days' absence from port of American fishing vessels landing fish at Boston and Gloucester, Mass., and Portland, Me., 1927*

| Fishing grounds | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BOSTON | | | | | | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | | | | | | |
| La Have Bank | 53 | | 25 | 125 | 101 | 59 | 72 | 133 | 41 | 129 | 104 | 143 | 985 |
| Western Bank | | | | 35 | 100 | 122 | 240 | 84 | 49 | | 16 | | 646 |
| Quereau Bank | | | 41 | 50 | 58 | 191 | 52 | 66 | 36 | 182 | 29 | | 705 |
| Green Bank | | | | | | | 29 | | | 21 | 8 | | 58 |
| Grand Bank | | | 29 | 67 | | 27 | 107 | 148 | 29 | 29 | | | 436 |
| St. Peters Bank | | 56 | 135 | 47 | 22 | | | | 29 | 18 | | | 307 |
| Off Newfoundland | | | | | | 26 | 28 | | | | | | 54 |
| Cape Shore | 46 | | | | | 26 | 7 | 102 | 439 | | 42 | 36 | 698 |
| St. Anns | | | | | | 15 | | | | | | | 15 |
| The Gully | | | 36 | | | | | | | | | | 36 |
| Labrador coast | | | | | | | | 29 | | | | | 29 |
| Roseway Bank | | | | 29 | | | | | | | | | 29 |
| West of 66° W. longitude: | | | | | | | | | | | | | |
| Browns Bank | 286 | 35 | 65 | 255 | 186 | 34 | 81 | 472 | 102 | 86 | 54 | 222 | 1,878 |
| Georges Bank | 485 | 835 | 480 | 466 | 595 | 858 | 1,585 | 994 | 555 | 426 | 165 | 150 | 7,594 |
| Cashes Bank | | | 6 | 5 | 8 | | | | | | 7 | 14 | 40 |
| Tillies Bank | | | | | | | | | 18 | | | 3 | 21 |
| Middle Bank | 33 | 42 | 23 | 10 | | | 40 | 3 | 22 | 3 | 10 | 39 | 225 |
| Jeffreys Ledge | 77 | 31 | 31 | 19 | | | 8 | 8 | 9 | 32 | 69 | 64 | 348 |
| South Channel | 762 | 772 | 988 | 862 | 691 | 763 | 655 | 1,090 | 1,099 | 1,207 | 1,320 | 1,153 | 11,452 |
| Nantucket Shoals | 52 | 28 | 32 | 50 | 80 | 27 | 134 | 216 | 131 | 128 | 230 | 121 | 1,229 |
| Off Highland Light | 24 | | | | | | 14 | 56 | 30 | 7 | | | 131 |
| Off Chatham | 143 | 151 | 41 | 57 | 27 | | 210 | 148 | 52 | 9 | 23 | 18 | 879 |
| Seal Island | | | | | | | | | | | 11 | 10 | 21 |
| South | | | | | 357 | 569 | 15 | | | | | | 941 |
| Shore, general | 201 | 236 | 242 | 115 | 228 | 156 | 97 | 96 | 195 | 171 | 255 | 169 | 2,161 |
| Total | 2,162 | 2,186 | 2,174 | 2,192 | 2,453 | 2,873 | 3,374 | 3,645 | 2,836 | 2,538 | 2,343 | 2,142 | 30,918 |
| GLOUCESTER | | | | | | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | | | | | | |
| La Have Bank | | | | 55 | 107 | 57 | 93 | 94 | 26 | 110 | 48 | | 590 |
| Western Bank | | | | 38 | 151 | 292 | 343 | 71 | 65 | | 17 | | 977 |
| Quereau Bank | | | | 37 | 50 | 176 | 53 | 50 | 55 | 197 | | | 618 |
| Green Bank | | | | | | | | 22 | | | 27 | | 49 |
| Grand Bank | | | | 73 | 24 | 52 | 58 | 156 | 68 | | 162 | | 593 |
| St. Peters Bank | | | 43 | 43 | 18 | | | | | 29 | | | 133 |
| Off Newfoundland | 341 | | 62 | | | 31 | | | | | | 324 | 758 |
| Strait of Belle Isle | | | | | | | 57 | | | | | | 57 |
| West of 66° W. longitude: | | | | | | | | | | | | | |
| Browns Bank | 14 | | 8 | 140 | 168 | 91 | | 128 | 45 | 29 | 16 | | 639 |
| Georges Bank | 131 | 245 | 269 | 327 | 376 | 212 | 223 | 163 | 160 | 6 | 32 | | 2,144 |
| Middle Bank | | | | | | | 12 | | | | | | 12 |
| South Channel | | 11 | 133 | 60 | 36 | 108 | 96 | 15 | 100 | 58 | 57 | 63 | 737 |
| Nantucket Shoals | | | | | 9 | 42 | 12 | 50 | 26 | 19 | | | 158 |
| South | | | | | 25 | | | | | | | | 25 |
| Shore, general | 221 | 355 | 599 | 506 | 266 | 184 | 412 | 705 | 509 | 389 | 537 | 613 | 5,296 |
| Total | 707 | 611 | 1,114 | 1,279 | 1,230 | 1,245 | 1,359 | 1,454 | 1,054 | 837 | 896 | 1,000 | 12,786 |
| PORTLAND | | | | | | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | | | | | | |
| La Have Bank | | | | | 17 | | | 22 | | | | | 39 |
| Western Bank | | | | | 22 | 8 | | 9 | | | | | 39 |
| Quereau Bank | | | | | | | 13 | | 52 | 25 | 34 | | 124 |
| Green Bank | | | | | | | | | 22 | | | | 22 |
| Grand Bank | | | 17 | | | | 35 | | | 25 | | | 77 |
| St. Peters Bank | | | | 53 | | | | | | | | | 53 |
| Off Newfoundland | | | | | | 24 | | | | | | | 24 |
| Cape Shore | | | | | | 29 | | 140 | 63 | | | | 232 |
| Gulf of St. Lawrence | | | | | | | | 29 | 22 | | | | 51 |
| The Gully | | 26 | | | | | | | | | | | 26 |
| Labrador coast | | | | | | | | 29 | | | | | 29 |
| West of 66° W. longitude: | | | | | | | | | | | | | |
| Browns Bank | | | | 9 | 17 | | | 36 | 18 | | | | 80 |
| Georges Bank | | 12 | | | | | 133 | 63 | | | | | 208 |
| Cashes Bank | 19 | 35 | 36 | 28 | 25 | 12 | | | 14 | 12 | 3 | | 184 |
| Fippenies Bank | 18 | 2 | 2 | | | | | | | 10 | 7 | 13 | 52 |
| Platts Bank | 41 | 12 | 17 | | | | 3 | | | 61 | 52 | 52 | 238 |
| Jeffreys Ledge | 28 | 20 | 101 | 76 | 49 | 20 | 49 | 80 | 124 | 71 | 113 | 57 | 788 |
| South Channel | | | 15 | 44 | 48 | 16 | | | | | | | 123 |
| Nantucket Shoals | | | | | 15 | 3 | | | | | | | 18 |
| Shore, general | 61 | 34 | 49 | 126 | 114 | 210 | 142 | 139 | 97 | 58 | 44 | 73 | 1,147 |
| Total | 167 | 141 | 237 | 336 | 307 | 322 | 375 | 547 | 412 | 262 | 253 | 195 | 3,554 |
| Grand total | 3,036 | 2,938 | 3,525 | 3,807 | 3,900 | 4,440 | 5,108 | 5,616 | 4,302 | 3,637 | 3,492 | 3,337 | 47,258 |

*Days' absence from port of American otter trawlers landing fish at Boston and Gloucester, Mass., and Portland, Me., 1927*

| Fishing grounds | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BOSTON | | | | | | | | | | | | | |
| West of 66° W. longitude: | | | | | | | | | | | | | |
| Georges Bank | 36 | 25 | 20 | | 9 | | | | 16 | 9 | 17 | 7 | 139 |
| South Channel | 543 | 534 | 557 | 436 | 253 | 246 | 149 | 235 | 317 | 523 | 586 | 608 | 4,987 |
| Nantucket Shoals | 39 | 22 | 9 | 11 | 23 | 21 | 50 | | | 7 | 47 | 35 | 264 |
| Off Chatham | | | | 6 | | | | | | | | | 6 |
| Total | 618 | 581 | 586 | 453 | 285 | 267 | 199 | 235 | 333 | 539 | 650 | 650 | 5,396 |
| GLOUCESTER | | | | | | | | | | | | | |
| West of 66° W. longitude: | | | | | | | | | | | | | |
| South Channel | | 8 | 110 | 60 | 31 | 59 | 72 | 15 | 39 | | 7 | | 401 |
| Nantucket Shoals | | | | | 9 | 8 | | | | | | | 17 |
| Total | | 8 | 110 | 60 | 40 | 67 | 72 | 15 | 39 | | 7 | | 418 |
| PORTLAND | | | | | | | | | | | | | |
| East of 66° W. longitude: | | | | | | | | | | | | | |
| Western Bank | | | | | | | | 9 | | | | | 9 |
| West of 66° W. longitude: | | | | | | | | | | | | | |
| South Channel | | | 15 | 37 | 48 | 16 | | | | | | | 116 |
| Nantucket Shoals | | | | | 15 | | | | | | | | 15 |
| Total | | | 15 | 37 | 63 | 16 | | 9 | | | | | 140 |
| Grand total | 618 | 589 | 711 | 550 | 388 | 350 | 271 | 259 | 372 | 539 | 657 | 650 | 5,954 |

Annual statistics on the landings of fish by vessels at Boston and Gloucester, Mass., are available for the years 1893 to 1927, and at Portland, Me., for the years 1916 to 1927. Analysis of the landings reveals an almost steady increase in the landings of fresh fish and a steady downward trend in the landings of salt fish. Beginning with landings of about 46,000,000 pounds in 1893, salt-fish landings in 1927 diminished to about 6,700,000 pounds, or only a fraction of the amount landed in former years. This decrease is attributed mainly to the fewer landings of salt cod. Whereas in 1893 the landings of salt cod amounted to over 34,000,000 pounds, or about 14,000,000 more pounds than the amount landed fresh, in 1927, they amounted to only about 2,000,000 pounds, or 59,000,000 less than the landings of fresh cod. In contrast to the total landings of all salt fish, the landings of all fresh fish at the principal New England ports in 1893 (which amounted to about 96,000,000 pounds, or a little over twice the landings of all salt fish) increased to 257,000,000 pounds in 1927, or about 38 times the landings of all salt fish for the same year.

The change in character of the landings at the New England ports is due to consumer preference for fresh and frozen fish, to improved boats and methods of catching fish, and to improved methods of handling fish aboard vessels. Formerly, because of the lack of refrigerants aboard vessels, it was necessary to preserve the fish with salt. At that time, also, many sailboats were in operation, and the common mode of fishing was with hand lines. Thus, with the slower means of catching and conveying to market and the fishing on banks farther from ports, sufficient ice to preserve the fish could not be carried, hence they were salted.

With the introduction of otter-trawl vessels in the early part of the century, which were adapted to fishing on grounds nearer the home port, more fish were landed fresh. In 1921, finding that the supply of fresh fish was increasing and realizing that the consumer's taste had changed from salt to fresh fish, producers and wholesalers

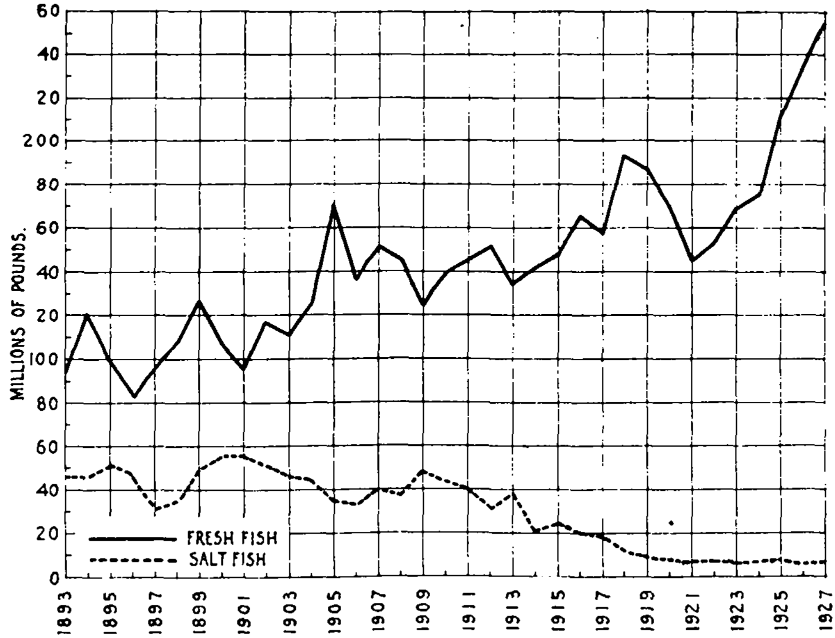


FIGURE 1.—Landings, by vessels, of all fresh and salt fish at the principal New England ports, 1893–1927

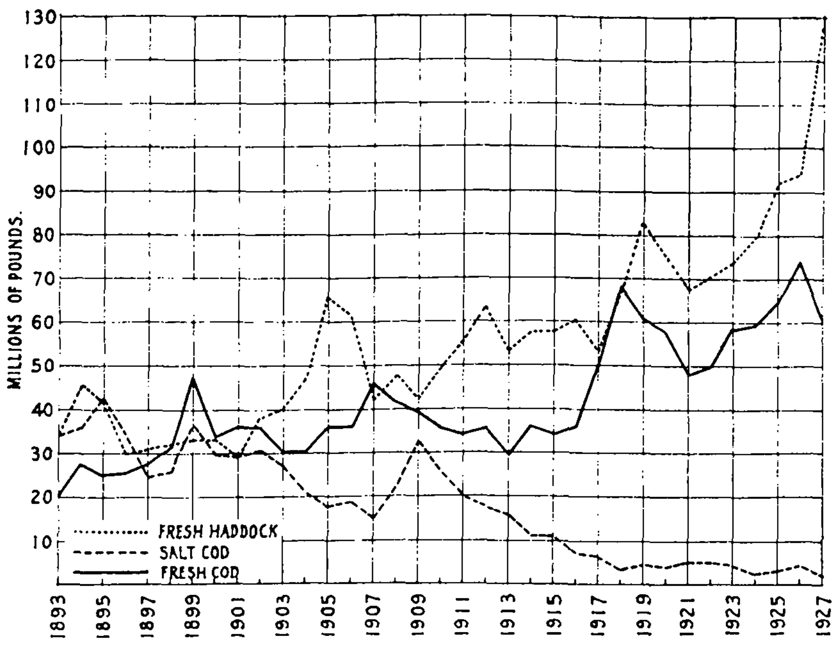


FIGURE 2.—Landings, by vessels, of cod and haddock at the principal New England ports, 1893–1927 (landings of salt haddock never reached over 650,000 pounds in any year and therefore have been omitted)

began merchandising fish in a new form, known as fillets, which are the edible portion only of the fish. Merchandising fillets has provided an incentive to fishermen to bring in fresh fish, so that of late years the landings of fresh fish at these ports have been unprecedented

In the preparation of fillets, fresh haddock are used mainly. The landings of this species fresh amounted to about 34,000,000 pounds in 1893, or about equal the amount of salt cod landed in that year; and though fluctuating, landings of fresh haddock have increased steadily until in 1927 they amounted to over 128,000,000 pounds. While landings of fresh cod have not increased as tremendously as fresh haddock, nevertheless they have grown from about 20,000,000 pounds in 1893 to over 61,000,000 pounds in 1927. Fresh cod are used to some extent for filleting purposes.

During the period 1893 to 1927, the landings of hake and cusk decreased considerably and those of pollock somewhat. The landings of halibut have fluctuated, being smallest in 1917, 1918, and 1919. The amount landed in 1927 was a little over half as great as in 1893. Landings of fresh and salt mackerel have fluctuated widely from year to year, the amounts landed in 1926 and 1927 being larger than in any previous year under discussion. Landings of fresh and salt herring have varied greatly, also, while landings of swordfish have remained fairly constant from year to year. A notable increase was recorded in the landings of fresh flounders. Statistics are available on this species only since 1913. In that year 400,000 pounds were landed, whereas in 1927 over 8,000,000 pounds were brought in.

Comparison between landings at various ports reveals that the greatest increase occurred at Boston. At this port, the landings of fresh fish increased, with little fluctuation, from about 66,000,000 pounds in 1893 to about 195,000,000 pounds in 1927, but those of salt fish have been almost negligible. At Gloucester it appears that while the landings of fresh fish have fluctuated somewhat in amount, those of salt fish have decreased tremendously. In 1893, fresh fish landed at Gloucester amounted to over 29,000,000 pounds, reached a peak of 68,000,000 pounds in 1905, and then settled back to a little over 46,000,000 pounds in 1927. On the other hand, landings of salt fish at this port, which in 1893 amounted to over 45,000,000 pounds, reached a peak of 52,000,000 pounds in 1901 and have since decreased to about 6,500,000 pounds in 1927. Statistics on the landings of fish at Portland are available from 1916 to 1927 and show that landings of fish during this period remained fairly constant, those of salt fish being inconsiderable. In 1916, the landings of fresh fish at this port were about 20,500,000 pounds and in 1927 they were a little over 16,000,000 pounds.

*Landings of fish by fishing vessels at Boston, Gloucester, and Portland, 1893 to 1927*

[Expressed in thousands of pounds; that is, 000 omitted]

BY SPECIES

| Year | Cod | | Haddock | | Hake | | Pollock | |
|---|---|---|---|---|---|---|---|---|
| | Fresh | Salted | Fresh | Salted | Fresh | Salted | Fresh | Salted |
| 1893 | 20, 254 | 34, 373 | 33, 865 | 44 | 19, 754 | 238 | 3, 453 | 161 |
| 1894 | 27, 762 | 35, 829 | 45, 608 | 4 | 23, 305 | 39 | 2, 175 | 6 |
| 1895 | 24, 071 | 43, 228 | 41, 578 | 28 | 15, 176 | 165 | 2, 356 | 122 |
| 1896 | 25, 448 | 34, 040 | 30, 167 | ........ | 10, 526 | 18 | 1, 908 | 255 |
| 1897 | 27, 238 | 24, 757 | 30, 978 | ........ | 14, 679 | 18 | 1, 891 | ........ |
| 1898 | 31, 674 | 26, 485 | 32, 482 | 37 | 17, 502 | 19 | 4, 464 | 20 |
| 1899 | 48, 294 | 36, 906 | 33, 291 | 15 | 16, 657 | 53 | 7, 343 | 144 |
| 1900 | 34, 051 | 29, 969 | 33, 043 | 6 | 11, 445 | 78 | 5, 278 | 41 |
| 1901 | 35, 972 | 29, 719 | 28, 930 | 46 | 11, 121 | 148 | 7, 345 | 98 |
| 1902 | 36, 373 | 30, 248 | 38, 395 | 2 | 14, 264 | 134 | 12, 580 | 16 |
| 1903 | 30, 557 | 27, 195 | 40, 339 | 4 | 14, 769 | 78 | 11, 290 | 154 |
| 1904 | 30, 636 | 21, 443 | 47, 509 | 532 | 21, 887 | 237 | 10, 521 | 637 |
| 1905 | 36, 137 | 17, 852 | 65, 897 | 423 | 22, 781 | 457 | 20, 409 | 1, 646 |
| 1906 | 36, 196 | 18, 323 | 61, 195 | 400 | 13, 027 | 260 | 8, 522 | 988 |
| 1907 | 45, 953 | 15, 368 | 41, 815 | 463 | 19, 580 | 214 | 20, 428 | 776 |
| 1908 | 41, 615 | 21, 832 | 47, 418 | 641 | 20, 434 | 122 | 12. 429 | 1, 090 |
| 1909 | 38, 590 | 32, 744 | 42, 401 | 425 | 13, 163 | 113 | 12, 502 | 1, 381 |
| 1910 | 35, 549 | 25, 790 | 49, 227 | 340 | 19, 759 | 189 | 18, 808 | 816 |
| 1911 | 33, 977 | 19, 729 | 55, 711 | 464 | 18, 097 | 355 | 14, 747 | 879 |
| 1912 | 35, 519 | 18, 186 | 63, 225 | 323 | 15, 289 | 270 | 14, 359 | 307 |
| 1913 | 29, 177 | 15, 688 | 53, 436 | 237 | 13, 740 | 345 | 15, 031 | 236 |
| 1914 | 36, 080 | 11, 450 | 57, 599 | 155 | 12, 531 | 222 | 12, 243 | 211 |
| 1915 | 34, 088 | 10, 968 | 57, 813 | 131 | 14, 589 | 301 | 12, 961 | 235 |
| 1916 | 35, 993 | 7, 629 | 60, 371 | 184 | 13, 029 | 143 | 15, 502 | 101 |
| 1917 | 49, 873 | 6, 574 | 53, 395 | 160 | 7, 839 | 75 | 14, 467 | 40 |
| 1918 | 68, 338 | 3, 487 | 66, 603 | 68 | 5, 246 | 35 | 26, 507 | 53 |
| 1919 | 60, 651 | 4, 723 | 82, 561 | 155 | 4, 300 | 40 | 18, 696 | 56 |
| 1920 | 58, 407 | 3, 858 | 75, 235 | 45 | 4, 666 | 55 | 8, 539 | 22 |
| 1921 | 48, 106 | 5, 409 | 67, 397 | 15 | 4, 494 | 42 | 6, 893 | 52 |
| 1922 | 50, 174 | 5, 006 | 70, 065 | 131 | 5, 341 | 33 | 5, 048 | 49 |
| 1923 | 58, 232 | 4, 443 | 73, 718 | 44 | 6, 315 | 22 | 4, 766 | 39 |
| 1924 | 58, 656 | 2, 793 | 79, 897 | 5 | 7, 263 | 22 | 5, 067 | 18 |
| 1925 | 64, 097 | 3, 153 | 91, 861 | 25 | 5, 789 | 17 | 5, 243 | 47 |
| 1926 | 73, 637 | 4, 582 | 93, 983 | 77 | 5, 482 | 23 | 6, 705 | 34 |
| 1927 | 61, 367 | 1, 987 | 128, 543 | 50 | 5, 845 | 17 | 7, 652 | 11 |

| Year | Cusk | | Halibut | | Mackerel | | Flounders |
|---|---|---|---|---|---|---|---|
| | Fresh | Salted | Fresh | Salted | Fresh | Salted | Fresh |
| 1893 | 9, 110 | 174 | 7, 964 | 1, 829 | 552 | 8, 744 | ........ |
| 1894 | 10, 454 | 191 | 9, 378 | 1, 527 | 936 | 7, 077 | ........ |
| 1895 | 5, 566 | 255 | 8, 660 | 1, 062 | 553 | 4, 033 | ........ |
| 1896 | 3, 322 | 305 | 9, 689 | 1, 207 | 1, 136 | 10, 484 | ........ |
| 1897 | 3, 049 | 144 | 8, 329 | 1, 572 | 1, 146 | 1, 784 | ........ |
| 1898 | 4, 918 | 107 | 8, 381 | 1, 997 | 874 | 2, 222 | ........ |
| 1899 | 3, 411 | 228 | 8, 236 | 789 | 1, 230 | 3, 862 | ........ |
| 1900 | 2, 018 | 131 | 7, 275 | 1, 569 | 8, 889 | 15, 966 | ........ |
| 1901 | 2, 029 | 52 | 5, 065 | 463 | 2, 783 | 12, 013 | ........ |
| 1902 | 1, 785 | 21 | 6, 326 | 753 | 2, 772 | 8, 139 | ........ |
| 1903 | 2, 881 | 78 | 3, 622 | 832 | 2, 040 | 8, 032 | ........ |
| 1904 | 5, 414 | 236 | 2, 437 | 853 | 2, 182 | 5, 184 | ........ |
| 1905 | 8, 797 | 231 | 2, 952 | 515 | 3, 499 | 5, 645 | ........ |
| 1906 | 5, 101 | 230 | 4, 019 | 636 | 1, 740 | 2, 100 | ........ |
| 1907 | 7, 027 | 72 | 3, 293 | 904 | 4, 091 | 6, 386 | ........ |
| 1908 | 5, 067 | 141 | 3, 179 | 947 | 5, 508 | 3, 467 | ........ |
| 1909 | 3, 148 | 185 | 3, 589 | 860 | 4, 121 | 3, 458 | ........ |
| 1910 | 4, 504 | 191 | 2, 988 | 1, 036 | 583 | 610 | ........ |
| 1911 | 6, 433 | 248 | 3, 091 | 411 | 3, 099 | 1, 439 | ........ |
| 1912 | 6, 317 | 163 | 3, 060 | 481 | 2, 660 | 1, 548 | ........ |
| 1913 | 5, 816 | 144 | 4, 756 | 532 | 4, 293 | 1, 383 | 400 |
| 1914 | 5, 747 | 112 | 3, 063 | 317 | 3, 980 | 2, 708 | 863 |
| 1915 | 6, 236 | 95 | 3, 584 | 286 | 7, 345 | 3, 574 | 652 |
| 1916 | 6, 017 | 52 | 3, 364 | 95 | 10, 832 | 5, 075 | 1, 298 |
| 1917 | 3, 525 | 24 | 1, 724 | 42 | 12, 032 | 5, 410 | 1, 280 |
| 1918 | 2, 644 | 14 | 1, 770 | 11 | 7, 583 | 2, 576 | 2, 270 |
| 1919 | 2, 025 | 38 | 2, 100 | 15 | 4, 315 | 1, 398 | 2, 452 |
| 1920 | 1, 849 | 6 | 3, 768 | 22 | 6, 284 | 1, 008 | 3, 638 |
| 1921 | 2, 060 | 38 | 5, 618 | 48 | 2, 735 | 650 | 2, 605 |
| 1922 | 2, 194 | 54 | 5, 608 | 16 | 4, 266 | 460 | 3, 281 |
| 1923 | 2, 911 | 87 | 4, 873 | 2 | 10, 684 | 881 | 3, 437 |
| 1924 | 3, 344 | 62 | 4, 422 | 1 | 8, 474 | 1, 283 | 4, 335 |
| 1925 | 3, 606 | 107 | 3, 553 | 8 | 24, 115 | 2, 095 | 6, 638 |
| 1926 | 2, 694 | 34 | 3, 426 | 5 | 35, 123 | 1, 109 | 6, 779 |
| 1927 | 2, 693 | 34 | 4, 773 | 6 | 31, 354 | 176 | 8, 359 |

NOTE.—Prior to 1916, Portland landings are lacking.

*Landings of fish by fishing vessels at Boston, Gloucester, and Portland, 1893 to 1927*—Continued

[Expressed in thousands of pounds; that is, 000 omitted]

BY SPECIES—Continued

| Year | Herring | | Swordfish | | Other | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Fresh | Salted | Fresh | Salted | Fresh | Salted | Fresh | Salted |
| 1893 | | | | | 1,045 | 837 | 95,996 | 46,400 |
| 1894 | 799 | 1,224 | 417 | | 285 | 99 | 121,119 | 45,996 |
| 1895 | | | | | 1,717 | 1,869 | 99,677 | 50,762 |
| 1896 | | | | | 1,549 | 620 | 83,745 | 46,929 |
| 1897 | | | | | 8,354 | 2,926 | 95,664 | 31,201 |
| 1898 | 6,138 | 4,244 | | | 1,448 | 392 | 107,881 | 35,523 |
| 1899 | 6,082 | 7,412 | | | 2,730 | 91 | 127,274 | 49,500 |
| 1900 | | | | | 5,184 | 7,276 | 107,183 | 55,036 |
| 1901 | 1,719 | 10,030 | | | 1,475 | 2,157 | 96,439 | 54,726 |
| 1902 | 2,637 | 10,023 | | | 2,091 | 1,395 | 117,223 | 50,731 |
| 1903 | 3,097 | 7,887 | | | 2,847 | 1,790 | 111,442 | 46,050 |
| 1904 | 2,917 | 16,270 | 2,151 | 3 | 117 | | 125,771 | 45,395 |
| 1905 | 6,882 | 8,569 | 2,009 | | 172 | 14 | 169,535 | 35,352 |
| 1906 | 5,273 | 10,935 | 928 | | 517 | 12 | 136,518 | 33,884 |
| 1907 | 5,452 | 15,614 | 2,044 | | 2,142 | | 151,775 | 39,797 |
| 1908 | 6,708 | 8,629 | 1,358 | | 880 | | 144,596 | 36,869 |
| 1909 | 4,421 | 9,278 | 1,637 | | 1,059 | 27 | 124,631 | 48,471 |
| 1910 | 4,994 | 14,720 | 1,039 | | 592 | | 138,043 | 43,692 |
| 1911 | 6,399 | 16,752 | 1,503 | | 1,807 | 11 | 144,864 | 40,288 |
| 1912 | 5,885 | 10,005 | 1,810 | | 3,297 | | 151,421 | 31,283 |
| 1913 | 2,070 | 9,677 | 2,376 | 5 | 2,875 | | 133,970 | 28,247 |
| 1914 | 4,910 | 5,839 | 1,500 | | 3,059 | | 141,575 | 21,014 |
| 1915 | 4,346 | 8,931 | 2,239 | | 3,222 | (1) | 147,075 | 24,521 |
| 1916 | 11,410 | 7,223 | 1,773 | | 5,732 | 1 | 165,321 | 20,503 |
| 1917 | 6,817 | 6,322 | 1,973 | | 3,858 | | 156,783 | 18,647 |
| 1918 | 8,764 | 6,233 | 1,034 | | 2,265 | | 193,024 | 12,477 |
| 1919 | 6,858 | 3,502 | 883 | | 1,702 | 11 | 186,543 | 9,938 |
| 1920 | 3,901 | 3,097 | 2,532 | | 1,348 | | 170,167 | 8,113 |
| 1921 | 2,262 | 351 | 1,598 | | 491 | 1 | 144,259 | 6,606 |
| 1922 | 752 | 1,892 | 3,282 | | 2,178 | 44 | 152,189 | 7,685 |
| 1923 | 264 | 1,219 | 2,455 | | 561 | 9 | 168,216 | 6,746 |
| 1924 | 1,467 | 2,943 | 2,023 | | 873 | | 175,821 | 7,127 |
| 1925 | 1,542 | 2,400 | 1,527 | | 1,046 | | 209,017 | 7,852 |
| 1926 | 1,266 | 315 | 2,442 | | 710 | | 232,247 | 6,179 |
| 1927 | 2,735 | 4,410 | 2,246 | | 1,591 | | 257,158 | 6,691 |

BY PORTS

| Year | Boston | | Gloucester | | Portland | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Fresh | Salted | Fresh | Salted | Fresh | Salted | Fresh | Salted |
| 1893 | 66,518 | 1,077 | 29,478 | 45,323 | | | 95,996 | 46,400 |
| 1894 | 86,129 | 1,335 | 34,990 | 44,661 | | | 121,119 | 45,996 |
| 1895 | 73,612 | 195 | 26,065 | 50,567 | | | 99,677 | 50,762 |
| 1896 | 61,820 | 1,256 | 21,925 | 45,673 | | | 83,745 | 46,929 |
| 1897 | 62,704 | 199 | 32,960 | 31,002 | | | 95,664 | 31,201 |
| 1898 | 53,494 | 1,186 | 54,387 | 34,337 | | | 107,881 | 35,523 |
| 1899 | 63,450 | 1,274 | 63,824 | 48,226 | | | 127,274 | 49,500 |
| 1900 | 63,648 | 3,173 | 43,535 | 51,863 | | | 107,183 | 55,036 |
| 1901 | 56,855 | 2,137 | 39,584 | 52,589 | | | 96,439 | 54,726 |
| 1902 | 77,608 | 1,365 | 39,615 | 49,366 | | | 117,223 | 50,731 |
| 1903 | 78,383 | 1,883 | 33,059 | 44,167 | | | 111,442 | 46,050 |
| 1904 | 81,183 | 911 | 44,588 | 44,484 | | | 125,771 | 45,395 |
| 1905 | 101,085 | 222 | 68,450 | 35,130 | | | 169,535 | 35,352 |
| 1906 | 89,610 | 83 | 46,908 | 33,801 | | | 136,518 | 33,884 |
| 1907 | 87,717 | 394 | 64,058 | 39,403 | | | 151,775 | 39,797 |
| 1908 | 94,713 | 947 | 49,883 | 35,922 | | | 144,596 | 36,869 |
| 1909 | 92,085 | 491 | 32,546 | 47,980 | | | 124,631 | 48,471 |
| 1910 | 102,059 | 31 | 35,984 | 43,661 | | | 138,043 | 43,692 |
| 1911 | 93,629 | 131 | 51,235 | 40,157 | | | 144,864 | 40,288 |
| 1912 | 100,157 | 143 | 51,264 | 31,140 | | | 151,421 | 31,283 |
| 1913 | 92,202 | 149 | 41,768 | 28,098 | | | 133,970 | 28,247 |
| 1914 | 92,231 | 113 | 49,344 | 20,901 | | | 141,575 | 21,014 |
| 1915 | 97,397 | 502 | 49,678 | 24,019 | | | 147,075 | 24,521 |
| 1916 | 98,255 | 76 | 46,515 | 20,165 | 20,551 | 262 | 165,321 | 20,503 |
| 1917 | 98,155 | 495 | 40,062 | 18,073 | 18,566 | 79 | 156,783 | 18,647 |
| 1918 | 109,227 | 249 | 62,002 | 12,173 | 21,795 | 55 | 193,024 | 12,477 |
| 1919 | 103,209 | 183 | 61,621 | 9,749 | 21,713 | 6 | 186,543 | 9,938 |
| 1920 | 118,302 | 257 | 39,113 | 7,627 | 12,752 | 229 | 170,167 | 8,113 |
| 1921 | 104,277 | 91 | 26,747 | 6,269 | 13,235 | 246 | 144,259 | 6,606 |
| 1922 | 106,032 | 158 | 30,395 | 7,355 | 15,762 | 172 | 152,189 | 7,685 |
| 1923 | 123,982 | 253 | 29,012 | 6,018 | 15,222 | 475 | 168,216 | 6,746 |
| 1924 | 130,631 | 335 | 29,263 | 6,583 | 15,927 | 209 | 175,821 | 7,127 |
| 1925 | 148,723 | 315 | 42,161 | 7,311 | 18,133 | 226 | 209,017 | 7,852 |
| 1926 | 167,061 | 257 | 49,222 | 5,679 | 15,964 | 243 | 232,247 | 6,179 |
| 1927 | 194,877 | 64 | 46,056 | 6,497 | 16,225 | 130 | 257,150 | 6,691 |

[1] Less than 500 pounds.

NOTE.—Prior to 1916, Portland landings are lacking.

## FISHERIES OF THE MIDDLE ATLANTIC STATES

The last previous statistical canvass of the fisheries of the Middle Atlantic States (New York, New Jersey, Pennsylvania, and Delaware) was for the calendar year 1926. The complete statistics for this canvass have already been published in condensed form and distributed as Statistical Bulletin No. 786, and the detailed statistics are published herewith. Statistics for the oyster product are for the season beginning in 1925, and the statistics for New York and Pennsylvania do not include any fisheries of the Great Lakes or other inland waters of these States. In addition to the above, there are published herewith statistics on the shad fishery of the Hudson River for 1927.

*Earlier publications.*—Some of the earlier publications relating to the fisheries of New York, New Jersey, Pennsylvania, and Delaware, published in Washington, D. C., follow:

1887. New York and its fisheries. By Fred. Mather. *In* The Fisheries and Fishery Industries of the United States, by George Brown Goode and associates, 1880 (1887), Sec. II, Pt. VI, pp. 341–377.

New Jersey and its fisheries. By R. Edward Earll. *Ibid.*, Pt. VII, pp. 379–400.

Pennsylvania and its fisheries. By R. Edward Earll. *Ibid.*, Pt. VIII, pp. 401–405.

Delaware and its fisheries. By Joseph W. Collins. *Ibid.*, Pt. IX, pp. 407–419.

1890. The sturgeons and sturgeon industries of the eastern coast of the United States, with an account of experiments bearing upon sturgeon culture. By John A. Ryder. Bulletin, U. S. Fish Commission, Vol. VIII, for 1888 (1890), pp. 231–328.

1892. IV. Fisheries of the Middle Atlantic States (1887 and 1888). *In* Statistical review of the coast fisheries of the United States, prepared under the direction of J. W. Collins. Report, U. S. Commission of Fish and Fisheries, 1888 (1892), pp. 323–351.

1894. Notes on the oyster industry of New Jersey. By Ansley Hall. Report of the Commissioner of Fish and Fisheries for 1892 (1894), pp. 463–528.

1895. A statistical report on the fisheries of the Middle Atlantic States (1889–1893). By Hugh M. Smith. Bulletin, U. S. Fish Commission, Vol. XIV, 1894 (1895), pp. 339–467.

1898. Shad and alewife fisheries (1896–1897). *In* Report of the Division of Statistics and Methods of the Fisheries. By Hugh M. Smith. Report of the Commissioner of Fish and Fisheries for 1897 (1898), pp. cxxv–cxxx.

1899. Statistics of certain fisheries of the New England and Middle Atlantic States and the Great Lakes (1897). *In* Report of the Division of Statistics and Methods of the Fisheries. By C. H. Townsend. Report of the Commissioner of Fish and Fisheries for 1898 (1899), pp. CLXVI–CLXXV.

Notes on the extent and condition of the alewife fisheries of the United States in 1896. By Hugh M. Smith. Appendix to the Report of the Commissioner of Fish and Fisheries for 1898 (1899), pp. 31–43.

1899. The shad fisheries of the Atlantic Coast of the United States. By Charles H. Stevenson. Appendix to the Report of the Commissioner of Fish and Fisheries for 1898 (1899), pp. 101–269.

1900. The sturgeon fishery of Delaware River and Bay (1890–1898). By John N. Cobb. Report of the Commissioner of Fish and Fisheries for 1899 (1900), pp. 369–380.

1901. Statistics of the fisheries of the Middle Atlantic States (1897). By C. H. Townsend. Appendix to the Report of the Commissioner of Fish and Fisheries for 1900 (1901), pp. 195–310.

1904. The lobster fishery (1900). *In* Report of the Division of Statistics and Methods of the Fisheries. By C. H. Townsend. Report of the Commissioner of Fish and Fisheries for 1902 (1904), pp. 156–158.

Statistics of the Fisheries of the Middle Atlantic States (1901). By Barton W. Evermann. Report of the Commissioner of Fish and Fisheries for 1902 (1904), pp. 433–540.

1905. Statistics of the Fisheries of the Middle Atlantic States for 1904. Report, U. S. Commissioner of Fisheries, 1905, 122 pp. Bureau of Fisheries Doc. No. 609.
1911. Shad and alewife fisheries (1909). Report, U. S. Commissioner of Fisheries, 1910 (1911), pp. 27-28.
1913. Shad fisheries (1910). Report, U. S. Commissioner of Fisheries, 1911 (1913), pp. 35-37.
1914. The oyster industry (1911). Report, U. S. Commissioner of Fisheries, 1912 (1914), pp. 7-23.
1915. The menhaden industry (1912). Report, U. S. Commissioner of Fisheries, 1914 (1915), pp. 18-22.
The sturgeon industry of Delaware River (1914). *Ibid.*, p. 23.
1917. The lobster fishery (1913). Report, U. S. Commissioner of Fisheries, 1915 (1917), pp. 37-43.
Coastal fisheries of New York and New Jersey (1915). Report, U. S. Commissioner of Fisheries, 1916 (1917), pp. 72-75.
Shad fishery of the Hudson River (1915-1916). *Ibid.*, pp. 76-77.
1920. Coastal fisheries of New York and New Jersey (1917). Report, U. S. Commissioner of Fisheries, 1918 (1920), pp. 66-70.
Shad fishery of the Hudson River (1917-1918). *Ibid.*, p. 72.
Statistics of the wholesale fish trade of New York City (1918). *Ibid.*, pp. 73-76.
1921. Shad fishery of the Hudson River (1919). *In* Fishery Industries of the United States. Report of the Division of Statistics and Methods of the Fisheries for 1919. By Lewis Radcliffe. Appendix X to the Report of the U. S. Commissioner of Fisheries for 1919 (1921), pp. 49-50. Bureau of Fisheries Doc. No. 892.
Shad fishery of the Hudson River (1920). *In* Fishery Industries of the United States. Report of the Division of Statistics and Methods of the Fisheries for 1920. By Lewis Radcliffe. Appendix V to the Report of the U. S. Commissioner of Fisheries for 1921 (1922), p. 51. Bureau of Fisheries Doc. No. 908.
1923. Fisheries of New York, New Jersey, Pennsylvania and Delaware in 1921. *In* Fishery Industries of the United States. Report of the Division of Fishery Industries for 1922. By Harden F. Taylor. Appendix V to the Report of the U. S. Commissioner of Fisheries for 1923 (1924), pp. 63-111. Bureau of Fisheries Doc. No. 954.
1923. Shad fishery of the Hudson River (1921-1922). *In* Fishery Industries of the United States. Report of the Division of Fishery Industries for 1922. By Harden F. Taylor. Appendix V to the Report of the U. S. Commissioner of Fisheries for 1923 (1924), pp. 69-70. Bureau of Fisheries Doc. No. 954.
1926. Wholesale trade in fresh and frozen fishery products and related marketing considerations in New York City. By R. H. Fiedler and J. H. Matthews. Appendix VI to the Report of the U. S. Commissioner of Fisheries for 1925 (1926), pp. 183-217. Bureau of Fisheries Doc. No. 996.
1926. Shad fishery of the Hudson River (1923-1924). *In* Fishery Industries of the United States. Report of the Division of Fishery Industries for 1925. By Oscar E. Sette. Appendix V to the Report of the U. S. Commissioner of Fisheries for 1926 (1927), pp. 261-262. Bureau of Fisheries Doc. No. 1010.
1928. Shad fishery of the Hudson River (1925-1926). *In* Fishery Industries of the United States. Report of the Division of Fishery Industries for 1926. By Oscar E. Sette. Appendix V to the Report of the U. S. Commissioner of Fisheries for 1927 (1928) pp. 395-396.

## GENERAL STATISTICS

The Middle Atlantic States, with a coast line of over 1,700 miles, rank as one of our important fishery sections for the production of oysters, squeteague, butterfish, bonito, sea bass, shad, and menhaden. In 1926, the fisheries of these States employed 9,953 fishermen, which is 3 per cent less than the number employed in 1921. The catch of these fishermen amounted to 168,012,495 pounds, valued at

$12,456,256. Of this catch, 128,121,258 pounds, valued at $12,292,932, were principally food fish and shellfish, and 39,891,237 pounds, valued at $162,324, were menhaden. Compared with the amount and value of the 1921 catch of food fish and menhaden, respectively, the food-fish group increased 22 per cent in amount and 19 per cent in value, while menhaden decreased 82 per cent in amount and 88 per cent in value.

Of the total products, those of fish account for 71 per cent of the amount and only 37 per cent of the value, while those of shellfish account for only 29 per cent of the amount and but 63 per cent of the value. This high value for shellfish products is due chiefly to that for oysters. On the basis of the computed value to the fishermen of the total fishery products taken, the annual earning power of persons engaged in catching fish in this section was about $1,250 during 1926. This must not be taken to represent the total average earning power of these fishermen, for in many cases fishing is a seasonal occupation with them, and when the fish are out of season they turn to other pursuits. Possibly $1,250 represents more nearly one-half to two-thirds of their annual earning power.

The industries related to the fisheries of these States in 1926 employed 4,382 persons, of whom 107 were engaged in transporting fishery products, 3,412 were in the wholesale trade, 510 in the prepared-fish and by-products industries, and 353 in menhaden reduction factories. Those employed in the related fishery industries (exclusive of the 107 persons employed in transporting and the 343 connected with the wholesale trade but not employed in these establishments) received $5,133,949 in wages during 1926. This constitued an average earning from this class of work of about $1,300. As with the fishermen, persons employed in the related fishery industries generally do not confine their entire time to the work, so that $1,300 can not be taken as representing the entire annual earnings of these persons. In all probability it constitutes between one-half and two-thirds of their annual income.

*Fisheries of the Middle Atlantic States, 1926*

OPERATING UNITS: BY STATES

| Items | New York | New Jersey | Pennsylvania | Delaware | Total |
|---|---|---|---|---|---|
| Fishermen: | | | | | |
| On vessels | 1,026 | 2,581 | 111 | 646 | 4,384 |
| In shore or boat fisheries | 2,087 | 2,553 | 87 | 862 | 5,589 |
| Total | 3,113 | 5,134 | 198 | 1,508 | 9,953 |
| Vessels: | | | | | |
| Steam | 13 | | | 11 | 24 |
| Tonnage | 1,519 | | | 1,519 | 3,038 |
| Motor | 202 | 255 | 12 | 23 | 492 |
| Tonnage | 2,464 | 3,160 | 220 | 477 | 6,321 |
| Sail | 3 | 93 | | 5 | 101 |
| Tonnage | 62 | 1,704 | | 55 | 1,821 |
| Motor boats | 737 | 1,195 | 5 | 160 | 2,097 |
| Sailboats | 15 | 6 | | | 21 |
| Rowboats, etc | 947 | 986 | 35 | 403 | 2,371 |
| Apparatus: | | | | | |
| Purse seines | 23 | 14 | 1 | 14 | 52 |
| Yards | 9,610 | 5,250 | 350 | 4,722 | 19,932 |
| Haul seines | 135 | 158 | 19 | 100 | 412 |
| Yards | 20,247 | 20,970 | 2,028 | 26,340 | 69,585 |

*Fisheries of the Middle Atlantic States, 1926*—Continued

OPERATING UNITS: BY STATES—Continued

| Items | New York | New Jersey | Pennsylvania | Delaware | Total |
|---|---|---|---|---|---|
| Apparatus—Continued. | | | | | |
| Gill nets | 487 | 3,495 | 107 | 259 | 4,348 |
| Yards | 80,932 | 346,569 | 9,400 | 71,419 | 508,320 |
| Pound nets, floating traps and weirs | 422 | 198 | | 30 | 650 |
| Stop nets | | 64 | 1 | 19 | 84 |
| Yards | | 22,085 | 200 | 6,290 | 28,575 |
| Fyke nets | 2,306 | 2,129 | 175 | 520 | 5,130 |
| Bag nets | | 36 | | | 36 |
| Dip nets and scap nets | 183 | | | | 183 |
| Otter trawls | 5 | | | | 5 |
| Scallop trawls | 26 | | | | 26 |
| Flounder drags | 115 | 50 | | | 165 |
| Eelpots | 3,696 | 3,189 | | 1,106 | 7,991 |
| Lobster pots | 13,432 | 15,168 | | 300 | 28,900 |
| Dredges | 1,464 | 534 | 16 | 50 | 2,064 |
| Tongs | 743 | 777 | | 94 | 1,614 |
| Rakes, hoes, and forks | 420 | 507 | | 12 | 939 |
| Other apparatus | 84 | 58 | | 207 | 349 |

NOTE.—In addition to the operating units listed, lines and harpoons were used, the number of which was not determined.

CATCH: BY STATES

| Products | New York | | New Jersey | | Pennsylvania | |
|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Albacore | 16,800 | $668 | 18,268 | $665 | | |
| Alewives | 1,564,415 | 25,594 | 379,550 | 12,584 | 5,300 | $165 |
| Bluefish | 261,740 | 60,381 | 628,241 | 148,147 | 21,400 | 4,850 |
| Bonito | 90,205 | 4,910 | 507,660 | 40,756 | 400 | 40 |
| Butterfish | 998,135 | 84,313 | 3,078,247 | 235,293 | 6,000 | 300 |
| Carp | 207,100 | 27,636 | 279,039 | 50,024 | 3,875 | 800 |
| Catfish and bullheads | 23,567 | 3,981 | 136,226 | 10,935 | 5,600 | 505 |
| Cod | 2,642,961 | 123,555 | 2,216,691 | 109,065 | 14,287 | 817 |
| Cod roe | 40 | 4 | | | | |
| Croaker | 4,000 | 120 | 2,455,867 | 104,827 | 1,000 | 40 |
| Drum: | | | | | | |
| Black | 200 | 2 | 31,100 | 909 | | |
| Red | 100 | 2 | 14,300 | 412 | | |
| Eels | 516,394 | 70,543 | 251,671 | 25,392 | 2,500 | 375 |
| Flounders | 7,532,138 | 396,707 | 2,921,714 | 209,314 | 400 | 26 |
| Grayfish | 2,115 | 69 | 4,640 | 278 | | |
| Haddock | 17,019,780 | 597,276 | 3,450 | 156 | | |
| Hake | 175,845 | 6,966 | 451,320 | 9,497 | | |
| Halibut | 10,381 | 3,489 | | | | |
| Herring | 2,407 | 40 | 235,665 | 7,030 | | |
| Hickory shad | 13,147 | 586 | 5,439 | 219 | | |
| King whiting or "kingfish" | 63,861 | 10,599 | 33,125 | 4,664 | | |
| Mackerel | 740,299 | 52,579 | 2,165,752 | 141,147 | 39,847 | 2,284 |
| Menhaden | 11,224,870 | 44,759 | 5,378,807 | 20,945 | 36,000 | 240 |
| Minnows | 8,033 | 4,598 | | | | |
| Mullet | 750 | 21 | 6,000 | 500 | | |
| Mummichog | 9,075 | 620 | | | | |
| Pike or pickerel | 327 | 98 | | | | |
| Pilotfish | 225 | 10 | 3,900 | 125 | | |
| Pollock | 102,463 | 5,057 | 23,310 | 1,244 | | |
| Pompano | 116 | 12 | 625 | 243 | | |
| Scup or porgy | 927,493 | 88,553 | 2,452,079 | 126,397 | 122,400 | 5,520 |
| Sea bass | 231,125 | 29,385 | 2,095,857 | 171,606 | 42,800 | 3,574 |
| Sea robin | 30,084 | 572 | 23,100 | 684 | | |
| Shad | 231,392 | 49,212 | 552,480 | 139,564 | 20,766 | 5,322 |
| Sharks | 15,763 | 408 | 48,710 | 1,365 | | |
| Silversides or spearing | 61,200 | 2,715 | 2,000 | 2,000 | | |
| Skates | 40,240 | 1,207 | 47,446 | 1,331 | | |
| Smelt | 180 | 44 | | | | |
| Spanish mackerel | 37 | 9 | 13,992 | 1,804 | | |
| Spot | 436,484 | 26,084 | 1,217,704 | 75,972 | | |
| Squeteagues or weakfish | 1,073,211 | 98,544 | 7,172,685 | 448,198 | 383,000 | 15,440 |
| Striped bass | 86,550 | 20,984 | 64,159 | 18,470 | | |
| Sturgeon | 8,946 | 1,682 | 7,400 | 2,248 | | |
| Sturgeon roe | 80 | 22 | 490 | 740 | | |
| Suckers | 72,493 | 9,505 | 92,675 | 14,975 | 26,000 | 2,858 |
| Swellfish | 12,900 | 390 | | | | |
| Swordfish | 60,809 | 11,391 | | | | |
| Tautog | 48,312 | 4,393 | 21,729 | 1,700 | 200 | 16 |

*Fisheries of the Middle Atlantic States, 1926*—Continued

CATCH: BY STATES—Continued

| Products | New York | | New Jersey | | Pennsylvania | |
|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Thimble-eyed mackerel | 16,890 | $1,166 | 105,038 | $3,498 | | |
| Tilefish | 1,801,750 | 111,500 | | | | |
| Tomcod or frostfish | 53,512 | 2,387 | 1,100 | 72 | | |
| Tomcod roe | 3,000 | 250 | | | | |
| Tuna or horse mackerel | 11,942 | 1,959 | 132,420 | 9,544 | | |
| Whitebait | 18,100 | 1,200 | | | | |
| White perch | 20,061 | 2,570 | 113,035 | 15,885 | | |
| Whiting | 583,054 | 13,600 | 6,935,124 | 142,243 | 2,500 | $15 |
| Yellow perch | 14,328 | 1,926 | 27,000 | 5,075 | | |
| Miscellaneous fish | 560,751 | 4,798 | 68,206 | 5,888 | | |
| Total | 49,652,176 | 2,011,651 | 42,425,036 | 2,323,630 | 734,275 | 43,187 |
| Crabs: | | | | | | |
| Hard | 2,000 | 100 | 61,566 | 5,825 | | |
| Soft | 979 | 535 | 6,400 | 4,100 | | |
| King | | | 2,248,000 | 10,856 | | |
| Lobsters | 455,218 | 130,716 | 643,286 | 193,649 | | |
| Shrimp | 6,400 | 2,400 | 36,276 | 1,758 | | |
| Squid | 539,563 | 35,310 | 1,036,264 | 64,627 | | |
| Clams, hard: | | | | | | |
| Public | 518,152 | 248,912 | 613,864 | 297,470 | | |
| Private | 68,888 | 42,484 | 23,384 | 12,000 | | |
| Clams, soft | 264,220 | 56,046 | 144,600 | 25,350 | | |
| Skimmers or surf clams | 59,112 | 15,436 | | | | |
| Mussels | 210,000 | 10,200 | 47,000 | 560 | | |
| Oysters, market: | | | | | | |
| Public | 5,950 | 1,025 | 67,424 | 12,563 | | |
| Private | 7,119,315 | 2,110,697 | 11,137,721 | 2,033,991 | | |
| Oysters, seed: | | | | | | |
| Public | 214,550 | 39,125 | 14,650,447 | 1,243,918 | | |
| Private | 224,000 | 49,600 | 93,100 | 6,740 | | |
| Scallops: | | | | | | |
| Bay | 299,892 | 92,253 | | | | |
| Sea | 1,067,964 | 267,938 | 47,436 | 15,688 | | |
| Turtles | 490 | 15 | 17,319 | 1,539 | 500 | 100 |
| Miscellaneous products (for bait) | 12,000 | 14,300 | | | | |
| Total | 11,068,693 | 3,117,092 | 30,874,087 | 3,930,634 | 500 | 100 |
| Grand total | 60,720,869 | 5,128,743 | 73,299,123 | 6,254,264 | 734,775 | 43,287 |

| Products | Delaware | | Total | |
|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* |
| Albacore | | | 35,068 | $1,333 |
| Alewives | 546,050 | $8,704 | 2,495,315 | 47,047 |
| Bluefish | 10,300 | 2,952 | 921,681 | 216,330 |
| Bonito | | | 598,265 | 45,706 |
| Butterfish | 6,320 | 344 | 4,088,702 | 320,250 |
| Carp | 109,548 | 15,168 | 599,562 | 93,628 |
| Catfish and bullheads | 55,617 | 3,525 | 221,010 | 18,946 |
| Cod | | | 4,873,939 | 233,437 |
| Cod roe | | | 40 | 4 |
| Croaker | 897,100 | 24,256 | 3,357,967 | 129,243 |
| Drum: | | | | |
| Black | 4,240 | 73 | 35,540 | 984 |
| Red | 3,310 | 60 | 17,710 | 474 |
| Eels | 52,040 | 8,043 | 822,605 | 104,353 |
| Flounders | 66,040 | 3,439 | 10,520,292 | 609,486 |
| Grayfish | | | 6,755 | 347 |
| Haddock | | | 17,023,230 | 597,432 |
| Hake | | | 627,165 | 16,463 |
| Halibut | | | 10,381 | 3,489 |
| Herring | | | 238,072 | 7,070 |
| Hickory shad | | | 18,586 | 805 |
| King whiting or "kingfish" | 4,250 | 406 | 101,236 | 15,669 |
| Mackerel | | | 2,945,898 | 196,010 |
| Menhaden | 23,251,560 | 96,380 | 39,891,237 | 162,324 |
| Minnows | | | 8,033 | 4,598 |
| Mullet | 22,250 | 972 | 29,000 | 1,493 |
| Mummichog | | | 9,075 | 620 |
| Pike or pickerel | 500 | 75 | 827 | 173 |
| Pilotfish | | | 4,125 | 135 |
| Pollock | | | 125,773 | 6,301 |
| Pompano | | | 741 | 255 |

*Fisheries of the Middle Atlantic States, 1926*—Continued

CATCH: BY STATES—Continued

| Products | Delaware | | Total | |
|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* |
| Scup or porgy | 2,000 | $160 | 3,503,972 | $220,630 |
| Sea bass | | | 2,369,782 | 204,565 |
| Sea robin | | | 53,184 | 1,256 |
| Shad | 147,095 | 39,621 | 951,733 | 233,719 |
| Sharks | | | 64,473 | 1,773 |
| Silversides or spearing | | | 63,200 | 4,715 |
| Skates | | | 87,686 | 2,538 |
| Smelt | | | 180 | 44 |
| Spanish mackerel | | | 14,029 | 1,813 |
| Spot | 103,900 | 6,439 | 1,758,088 | 108,495 |
| Squeteagues or weakfish | 771,880 | 38,812 | 9,400,776 | 600,994 |
| Striped bass | 46,347 | 8,916 | 197,056 | 48,370 |
| Sturgeon | 5,580 | 2,561 | 21,926 | 6,491 |
| Sturgeon roe | 891 | 922 | 1,461 | 1,684 |
| Suckers | 2,600 | 118 | 193,768 | 27,456 |
| Swellfish | | | 12,900 | 390 |
| Swordfish | | | 60,809 | 11,391 |
| Tautog | 12,000 | 600 | 82,241 | 6,709 |
| Thimble-eyed mackerel | | | 121,928 | 4,664 |
| Tilefish | | | 1,801,750 | 111,500 |
| Tomcod or frostfish | | | 54,612 | 2,459 |
| Tomcod roe | | | 3,000 | 250 |
| Tuna or horse mackerel | | | 144,362 | 11,503 |
| Whitebait | | | 18,100 | 1,200 |
| White perch | 64,944 | 5,313 | 198,040 | 23,768 |
| Whiting | | | 7,520,678 | 155,858 |
| Yellow perch | 23,106 | 2,111 | 64,434 | 9,112 |
| Miscellaneous fish | 156 | 10 | 629,113 | 10,696 |
| Total | 26,209,624 | 269,980 | 119,021,111 | 4,648,448 |
| Crabs: | | | | |
| Hard | 166,842 | 7,702 | 230,408 | 13,627 |
| Soft | 155,820 | 43,950 | 163,199 | 48,585 |
| King | 640,000 | 1,600 | 2,888,000 | 12,456 |
| Lobsters | 20,640 | 6,202 | 1,119,144 | 330,567 |
| Shrimp | | | [1] 42,676 | 4,158 |
| Squid | | | 1,575,827 | 99,937 |
| Clams, hard: | | | | |
| Public | 4,736 | 2,860 | 1,136,752 | 549,242 |
| Private | 48,256 | 21,864 | 140,528 | 76,348 |
| Clams, soft | | | 408,820 | 81,396 |
| Skimmers or surf clams | | | 59,112 | 15,436 |
| Mussels | | | 257,000 | 10,760 |
| Oysters, market: | | | | |
| Public | 826,560 | 41,010 | 899,934 | 54,598 |
| Private | 2,585,205 | 435,020 | 20,842,241 | 4,579,708 |
| Oysters, seed: | | | | |
| Public | 2,586,920 | 197,740 | 17,451,917 | 1,480,783 |
| Private | | | 317,100 | 56,340 |
| Scallops: | | | | |
| Bay | | | 299,892 | 92,253 |
| Sea | | | 1,115,400 | 283,626 |
| Frogs | 1,800 | 450 | 1,800 | 450 |
| Terrapin | 1,080 | 750 | 1,080 | 750 |
| Turtles | 10,245 | 834 | 28,554 | 2,488 |
| Miscellaneous products (for bait) | | | 12,000 | 14,300 |
| Total | 7,048,104 | 759,982 | 48,991,384 | 7,807,808 |
| Grand total | 33,257,728 | 1,029,962 | 168,012,495 | 12,456,256 |

[1] Taken mostly off the coast of Florida.

NOTE.—The above statistics do not include any fisheries of the Great Lakes or other inland waters.

*Fisheries of the Middle Atlantic States, 1926*—Continued

CATCH OF SHELLFISH: IN NUMBERS AND BUSHELS

| Products | New York | | New Jersey | | Delaware | | Total | |
|---|---|---|---|---|---|---|---|---|
| Crabs: | *Quantity* | *Value* | *Quantity* | *Value* | *Quantity* | *Value* | *Quantity* | *Value* |
| Hard.....number.. | 6,000 | $100 | 184,698 | $5,825 | 500,526 | $7,702 | 691,224 | $13,627 |
| Soft.....do.... | 2,937 | 535 | 19,200 | 4,100 | 467,460 | 43,950 | 489,597 | 48,585 |
| King.....do.... | | | 1,124,000 | 10,856 | 320,000 | 1,600 | 1,444,000 | 12,456 |
| Clams, hard: | | | | | | | | |
| Public.....bushels.. | 64,769 | 248,912 | 76,733 | 297,470 | 592 | 2,860 | 142,094 | 549,242 |
| Private.....do.... | 8,611 | 42,484 | 2,923 | 12,000 | 6,032 | 21,864 | 17,566 | 76,348 |
| Clams, soft.....do.... | 26,422 | 56,046 | 14,460 | 25,350 | | | 40,882 | 81,396 |
| Skimmers or surf clams.do.... | 7,389 | 15,436 | | | | | 7,389 | 15,436 |
| Mussels.....do.... | 21,000 | 10,200 | 4,700 | 560 | | | 25,700 | 10,760 |
| Oysters, market: | | | | | | | | |
| Public.....do.... | 850 | 1,025 | 9,632 | 12,563 | 118,080 | 41,010 | 128,562 | 54,598 |
| Private.....do.... | 1,017,045 | 2,110,697 | 1,591,103 | 2,033,991 | 369,315 | 435,020 | 2,977,463 | 4,579,708 |
| Oysters, seed: | | | | | | | | |
| Public.....do.... | 30,650 | 39,125 | 2,092,921 | 1,243,918 | 369,560 | 197,740 | 2,493,131 | 1,480,783 |
| Private.....do.... | 32,000 | 49,600 | 13,300 | 6,740 | | | 45,300 | 56,340 |
| Scallops: | | | | | | | | |
| Bay.....do.... | 49,982 | 92,253 | | | | | 49,982 | 92,253 |
| Sea.....do.... | 177,994 | 267,938 | 7,906 | 15,688 | | | 185,900 | 283,626 |

NOTE.—The statistics for New York include 105,500 bushels of market oysters from private grounds, valued at $158,250, taken by vessels owned and operated mainly in Connecticut. The statistics for New Jersey include 50,153 bushels of market oysters from private beds, valued at $63,904, and 97,000 bushels of seed oysters from public beds, valued at $58,200, taken by vessels owned in Pennsylvania. The statistics for Delaware include 214,400 bushels of market oysters from private grounds, valued at $268,000, 66,300 bushels of seed oysters from public beds, valued at $39,780, and 1,500 bushels of hard clams from private beds, valued at $6,000 taken by vessels owned in New Jersey, and 19,000 bushels of market oysters from private beds, valued at $23,750, by vessels owned in Pennsylvania.

## MENHADEN INDUSTRY

During 1926, one menhaden factory was operated in New York, two in New Jersey, and three in Delaware. These factories represented an investment of $1,058,994 and employed a cash or working capital of $235,000. There were 353 persons employed, who received $241,481 in wages. These factories utilized 64,644,000 menhaden, valued at $156,280. The products prepared included 7,031 tons of acidulated scrap, valued at $178,435, and 576,487 gallons of oil, valued at $252,420.

*Industries related to the fisheries of the Middle Atlantic States, 1926*

| Items | New York | New Jersey | Pennsylvania | Delaware | Total |
|---|---|---|---|---|---|
| *Transporting:* | | | | | |
| Persons engaged..... | 82 | 23 | 2 | | 107 |
| Boats, motor..... | 15 | | | | 15 |
| Vessels— | | | | | |
| Steam..... | 1 | | | | 1 |
| Tonnage..... | 36 | | | | 36 |
| Motor..... | 42 | 18 | 2 | | 62 |
| Tonnage..... | 738 | 171 | 15 | | 924 |
| Wholesale trade: | | | | | |
| Establishments..... | 156 | 52 | 41 | 12 | 261 |
| Persons engaged— | | | | | |
| In establishments..... | 1,886 | 602 | 336 | 245 | 3,069 |
| Others [1]..... | 295 | 38 | | 10 | 343 |
| Wages paid in establishments..... | $3,462,507 | $363,607 | $357,348 | $79,886 | $4,263,348 |
| Prepared products and by-products industries: | | | | | |
| Establishments..... | 21 | 9 | 8 | | 38 |
| Persons engaged..... | 235 | 164 | 111 | | 510 |
| Wages paid..... | $390,332 | $86,509 | $152,279 | | $629,120 |
| Products.....value.. | $2,288,997 | $744,086 | $947,285 | | $3,980,368 |

[1] Includes commission men, scallop shuckers, oyster shuckers, etc.

*Industries related to the fisheries of the Middle Atlantic States, 1926*—Continued

| Items | New York and New Jersey | Pennsylvania | Delaware | Total |
|---|---|---|---|---|
| Menhaden industry: | | | | |
| Factories | 3 | | 3 | 6 |
| Persons engaged | 195 | | 158 | 353 |
| Wages paid | $188,464 | | $53,017 | $241,481 |
| Menhaden utilized ... number | 25,187,000 | | 39,457,000 | [2] 64,644,000 |
| Products— | | | | |
| Acid scrap ... tons | 2,898 | | 4,133 | [3] 7,031 |
| Oil ... gallons | 185,800 | | 390,687 | [4] 576,487 |

[2] 38,714,200 pounds. [3] Value, $178,435. [4] Value, $252,420.

## NEW YORK

The fisheries and industries related to the fisheries of New York employed 5,767 persons in 1926, which is 19 per cent less than in 1921. Of these, 3,113 were employed in fishing, 82 were engaged on transporting boats and vessels, 2,181 were employed in the wholesale trade, and 391 were employed in the canning or prepared products trades and in menhaden-reduction plants.

The products of the fisheries amounted to 60,720,869 pounds, valued at $5,128,743. This represents a decrease of 71 per cent in amount and an increase of 3 per cent in value compared with the amount and value of the fisheries in 1921. The decrease in amount is due mainly to the smaller catch of menhaden.

Of the total value, oysters accounted for 43 per cent; haddock, 12 per cent; flounders, 8 per cent; clams, 7 per cent; scallops, 7 per cent; lobsters, 3 per cent; cod, 2 per cent; and tilefish, 2 per cent. Of the total production, haddock accounted for 28 per cent; oysters, 12 per cent; flounders, 12 per cent; cod, 4 per cent; tilefish, 3 per cent; scallops, 2 per cent; clams, 2 per cent; and lobsters, less than 1 per cent.

*Operating units.*—The catch of fishery products in New York during 1926 was taken by 1,699 motor, sail, and row boats, 13 steam vessels, 202 motor vessels, 3 sailing vessels, 20 types of apparatus, and by hand. The following table shows in detail the statistics of the boats and vessels and types of apparatus used during 1926:

*Fisheries of New York, 1926*

OPERATING UNITS: BY GEAR

| Items | Purse seines | Haul seines | Gill nets | Pound nets, floating trap nets, and weirs | Fyke nets | Otter trawls | Flounder drags | Lines | Scap nets and dip nets | Minor nets | Harpoons |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fishermen:** | | | | | | | | | | | |
| On boats or shore | | 289 | 360 | 248 | 157 | | 85 | 172 | 209 | 13 | 10 |
| On vessels | 305 | | 16 | 2 | 3 | 110 | 117 | 116 | 2 | | 13 |
| Total | 305 | 289 | 376 | 250 | 160 | 110 | 202 | 288 | 211 | 13 | 23 |
| **Fishing boats:** | | | | | | | | | | | |
| Motor | | 50 | 85 | 60 | 41 | | 54 | 87 | 19 | 5 | 5 |
| Other | | 121 | 146 | 157 | 98 | | | 23 | 179 | 7 | |
| **Fishing vessels:** | | | | | | | | | | | |
| Steam— | | | | | | | | | | | |
| 61 to 70 tons | 2 | | | | | | | | | | |
| 71 to 80 tons | 1 | | | | | | | | | | |
| 91 to 100 tons | 1 | | | | | | | | | | |
| 121 to 130 tons | | | | | | 2 | | | | | |
| 141 to 150 tons | 1 | | | | | | | | | | |
| 171 to 180 tons | | | | | | 2 | | | | | |
| 201 to 210 tons | 1 | | | | | 1 | | | | | |
| Total | 6 | | | | | 5 | | | | | |
| Net tonnage | 663 | | | | | 806 | | | | | |
| Motor: | | | | | | | | | | | |
| 5 to 10 tons | | | 6 | 1 | 2 | | 34 | 8 | 1 | | 5 |
| 11 to 20 tons | 2 | | | | | | 9 | | | | |
| 21 to 30 tons | 2 | | | | | | | 2 | | | |
| 41 to 50 tons | 2 | | | | | | 1 | 2 | | | 1 |
| 51 to 60 tons | | | | | | | | 1 | | | |
| 61 to 70 tons | 2 | | | | | | | 2 | | | |
| Total | 8 | | 6 | 1 | 2 | | 44 | 15 | 1 | | 6 |
| Net tonnage | 351 | | 46 | 5 | 11 | | 426 | 319 | 7 | | 86 |
| Grand total | 14 | | 6 | 1 | 2 | 5 | 44 | 15 | 1 | | 6 |
| Net tonnage | 1,014 | | 46 | 5 | 11 | 806 | 426 | 319 | 7 | | 86 |
| **Apparatus:** Number | 23 | 135 | 487 | 427 | 2,306 | 5 | 115 | (1) | 215 | 12 | (1) |
| Length, yards | 9,610 | 20,247 | 80,932 | | | | | | | | |

Number undetermined.

*Fisheries of New York, 1926*—Continued

OPERATING UNITS: BY GEAR—Continued

| Items | Spears | Eel-pots | Lobster pots | Scallop trawls | Mussel dredges | Oyster dredges | Scallop dredges | Tongs | Rakes, forks, and hoes | By hand | Total exclusive of duplication |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | | | |
| On boats or shore | 48 | 105 | 175 | 3 | | 14 | 207 | 422 | 405 | 120 | 2,087 |
| On vessels | | 2 | 6 | 94 | 7 | 225 | 108 | 97 | 4 | | 1,026 |
| Total | 48 | 107 | 181 | 97 | 7 | 239 | 315 | 519 | 409 | 120 | 3,113 |
| Fishing boats: | | | | | | | | | | | |
| Motor | 8 | 45 | 109 | 1 | | 5 | 125 | 187 | 48 | 8 | 737 |
| Other | 37 | 50 | 6 | | | | 27 | 220 | 120 | 91 | 962 |
| Fishing vessels: | | | | | | | | | | | |
| Steam— | | | | | | | | | | | |
| 11 to 20 tons | | | | | | 1 | | | | | 1 |
| 31 to 40 tons | | | | | | 1 | | | | | 1 |
| 61 to 70 tons | | | | | | | | | | | 2 |
| 71 to 80 tons | | | | | | | | | | | 1 |
| 91 to 100 tons | | | | | | | | | | | 1 |
| 121 to 130 tons | | | | | | | | | | | 2 |
| 141 to 150 tons | | | | | | | | | | | 1 |
| 171 to 180 tons | | | | | | | | | | | 2 |
| 201 to 210 tons | | | | | | | | | | | 2 |
| Total | | | | | | 2 | | | | | 13 |
| Net tonnage | | | | | | 50 | | | | | 1,519 |
| Motor— | | | | | | | | | | | |
| 5 to 10 tons | | 2 | 4 | 20 | | 13 | 30 | 42 | 3 | | 133 |
| 11 to 20 tons | | | | 4 | 3 | 26 | 9 | 1 | | | 47 |
| 21 to 30 tons | | | | | | 5 | 2 | | | | 10 |
| 31 to 40 tons | | | | | 1 | 2 | | | | | 3 |
| 41 to 50 tons | | | | | | 1 | | | | | 4 |
| 51 to 60 tons | | | | | | 1 | | | | | 2 |
| 61 to 70 tons | | | | | | | | | | | 2 |
| 71 to 80 tons | | | | | | | 1 | | | | 1 |
| Total | | 2 | 4 | 24 | 4 | 48 | 42 | 43 | 3 | | 202 |
| Net tonnage | | 10 | 27 | 211 | 77 | 786 | 453 | 276 | 17 | | 2,464 |
| Sail— | | | | | | | | | | | |
| 1 to 10 tons | | | | | | | 1 | 1 | | | 2 |
| 41 to 50 tons | | | | 1 | | | | | | | 1 |
| Total | | | | 1 | | | 1 | 1 | | | 3 |
| Net tonnage | | | | 50 | | | 6 | 6 | | | 62 |
| Grand total | | 2 | 4 | 25 | 4 | 50 | 43 | 44 | 3 | | 218 |
| Net tonnage | | 10 | 27 | 261 | 77 | 836 | 459 | 282 | 17 | | 4,045 |
| Apparatus: Number | 40 | 3,696 | 13,432 | 26 | 6 | 113 | 1,345 | 743 | 420 | | |

*Catch by gear.*—Four types of gear caught 85 per cent of the catch. Listed in order of importance, they were otter trawls and flounder drags, which accounted for 41 per cent of the catch; purse seines, 19 per cent; dredges, 14 per cent; and pound nets, trap nets, and weirs, 11 per cent.

The catch by otter trawls and flounder drags was made up largely of haddock and flounders; that of purse seines consisted chiefly of menhaden; that of dredges consisted entirely of oysters, scallops, and mussels; while that of pound nets, traps, and weirs consisted of virtually every species of fish represented in the catch. The following table shows the amounts and species of fishery products taken and their mode of capture:

*Fisheries of New York, 1926*

CATCH: BY GEAR

| Species | Purse seines | | Haul seines | | Gill nets | | Pound nets, trap nets, and weirs | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Albacore | | | | | | | 16,800 | $668 |
| Alewives | | | 1,256,950 | $18,958 | 23,720 | $1,155 | 259,756 | 4,014 |
| Bluefish | 9,250 | $2,661 | 1,005 | 250 | 42,345 | 8,541 | 39,820 | 7,317 |
| Bonito | | | | | | | 90,205 | 4,910 |
| Butterfish | 22 | 2 | | | 350 | 53 | 997,763 | 84,258 |
| Carp | | | 95,152 | 12,107 | 36,092 | 5,082 | | |
| Catfish and bullheads | | | 6,920 | 840 | | | | |
| Cod | | | | | | | 51,107 | 3,555 |
| Cod roe | | | | | | | 40 | 4 |
| Eels | | | 38,160 | 2,522 | | | 193,154 | 30,168 |
| Flounders | | | 64,700 | 2,290 | 6,000 | 400 | 689,033 | 47,132 |
| Grayfish | | | | | | | 2,115 | 69 |
| Hake | | | | | | | 1,715 | 86 |
| Herring | 107 | 5 | | | | | 2,300 | 35 |
| Hickory shad | | | | | | | 13,147 | 586 |
| King whiting or "kingfish" | | | 1,775 | 468 | 3,050 | 458 | 58,936 | 9,653 |
| Mackerel | 5,061 | 456 | | | 50,400 | 1,655 | 634,538 | 45,968 |
| Menhaden | 10,779,800 | 41,175 | 65,000 | 1,000 | | | 380,070 | 2,584 |
| Minnows | | | 6,073 | 2,562 | | | | |
| Mummichog | | | 8,875 | 575 | | | | |
| Pollock | | | | | | | 7,853 | 301 |
| Round herring | | | | | | | 5,600 | 325 |
| Scup or porgy | 485,482 | 56,283 | 1,600 | 107 | 2,775 | 425 | 385,421 | 25,103 |
| Sea bass | 7,023 | 1,513 | | | | | 162,767 | 17,737 |
| Sea robin | | | | | | | 30,084 | 572 |
| Shad | | | 18,672 | 3,911 | 202,661 | 43,560 | 10,059 | 1,741 |
| Sharks | | | | | | | 15,763 | 408 |
| Silversides or spearing | | | 58,700 | 2,615 | | | 2,500 | 100 |
| Skates | | | | | | | 40,240 | 1,207 |
| Spot | | | 2,020 | 94 | 56,075 | 3,687 | 378,389 | 22,303 |
| Squeteague or weakfish | 101,564 | 4,496 | 38,925 | 5,031 | 160,265 | 24,528 | 658,217 | 62,354 |
| Striped bass | | | 36,443 | 9,448 | 13,883 | 3,687 | 29,942 | 6,625 |
| Sturgeon | | | | | 7,274 | 1,404 | 1,672 | 278 |
| Sturgeon roe | | | | | | | 80 | 22 |
| Suckers | | | 17,242 | 1,962 | 1,238 | 201 | | |
| Sunfish | | | 20 | 2 | | | | |
| Swellfish | | | | | | | 12,900 | 390 |
| Tautog | | | 100 | 15 | 300 | 15 | 40,862 | 3,293 |
| Thimble-eyed mackerel | | | | | | | 16,890 | 1,166 |
| Tomcod or frostfish | | | | | | | 5,100 | 207 |
| Tuna or horse mackerel | | | | | | | 11,942 | 1,959 |
| Whitebait | | | 18,100 | 1,200 | | | | |
| White perch | | | 5,295 | 810 | 13,416 | 1,535 | 1,250 | 200 |
| Whiting | | | | | | | 581,764 | 13,510 |
| Yellow perch | | | 627 | 96 | 1,878 | 231 | 100 | 25 |
| Mixed and scrap fish | | | 1,055 | 68 | | | 539,281 | 3,906 |
| Lobsters | | | | | | | 10 | 5 |
| Squid | | | 100 | 15 | | | 539,463 | 35,296 |
| Turtles | | | | | | | 490 | 15 |
| Total | 11,388,309 | 106,591 | 1,743,509 | 66,936 | 721,722 | 96,617 | 6,909,138 | 440,054 |

*Fisheries of New York, 1926*—Continued

CATCH: BY GEAR—Continued

| Species | Fyke nets | | Otter trawls | | Flounder drags | | Lines | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Alewives | 2,715 | $104 | | | | | | |
| Bluefish | | | | | | | 169,320 | $41,612 |
| Carp | 20,903 | 2,810 | | | | | | |
| Catfish and bullheads | 14,482 | 2,813 | | | | | 449 | 94 |
| Cod | | | 598,660 | $34,041 | 829,670 | $24,194 | 1,163,524 | 61,765 |
| Croaker | | | | | 4,000 | 120 | | |
| Eels | 13,552 | 3,072 | | | | | 8,993 | 1,380 |
| Flounders | 741,620 | 13,640 | 122,051 | 9,555 | 5,871,380 | 320,630 | 37,354 | 3,060 |
| Haddock | | | 15,873,000 | 564,836 | 1,015,680 | 26,670 | 131,100 | 5,770 |
| Hake | | | 154,350 | 5,939 | 12,500 | 440 | 7,280 | 501 |
| Halibut | | | 7,651 | 2,639 | 2,730 | 850 | | |
| King whiting or "kingfish" | | | | | | | 100 | 20 |
| Mackerel | | | | | | | 50,300 | 4,500 |
| Mummichog | 100 | 25 | | | | | | |
| Pollock | | | 59,760 | 3,581 | 1,350 | 25 | 33,500 | 1,150 |
| Scup or porgy | | | | | | | 52,215 | 6,635 |
| Sea bass | | | | | | | 35,335 | 6,535 |
| Squeteague or weakfish | | | | | | | 14,240 | 2,135 |
| Striped bass | 52 | 16 | | | | | 6,230 | 1,208 |
| Suckers | 34,799 | 5,116 | | | | | | |
| Sunfish | 2,095 | 243 | | | | | | |
| Tautog | 1,100 | 105 | | | 100 | 10 | 5,850 | 955 |
| Tilefish | | | | | | | 1,801,750 | 111,500 |
| Tomcod or frostfish | 48,360 | 2,165 | | | | | | |
| Tomcod roe | 3,000 | 250 | | | | | | |
| White perch | 100 | 25 | | | | | | |
| Whiting | | | | | | | 1,290 | 90 |
| Yellow perch | 10,407 | 1,386 | | | | | | |
| Mixed and scrap fish | 13,502 | 306 | | | | | | |
| Lobsters | | | | | 100 | 25 | | |
| Crabs, hard | | | | | | | 2,000 | 100 |
| Scallops, sea | | | | | 16,914 | 4,310 | | |
| Total | 906,787 | 32,076 | 16,815,472 | 620,591 | 7,754,424 | 377,274 | 3,520,830 | 249,010 |

| Species | Scap, dip, and minor nets | | Harpoons and spears | | Eel pots | | Lobster pots | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Alewives | 21,274 | $1,363 | | | | | | |
| Carp | 54,953 | 7,637 | | | | | | |
| Catfish and bullheads | 1,716 | 234 | | | | | | |
| Eels | 55 | 12 | 33,720 | $5,210 | 228,760 | $28,179 | | |
| Minnows | 1,960 | 2,036 | | | | | | |
| Mummichog | | | | | 100 | 20 | | |
| Sea bass | | | | | | | 26,000 | $3,600 |
| Suckers | 19,214 | 2,226 | | | | | | |
| Sunfish | 983 | 126 | | | | | | |
| Swordfish | | | 60,809 | 11,391 | | | | |
| Tomcod or frostfish | 52 | 15 | | | | | | |
| Yellow perch | 1,316 | 188 | | | | | | |
| Mixed and scrap fish | 150 | 30 | | | | | | |
| Lobsters | | | | | | | 455,108 | 130,686 |
| Shrimp | 6,400 | 2,400 | | | | | | |
| Crabs, soft | 979 | 535 | | | | | | |
| Clams, soft | 33,400 | 5,555 | | | | | | |
| Scallops, bay | 4,404 | 1,810 | | | | | | |
| Total | 146,856 | 24,167 | 94,529 | 16,601 | 228,860 | 28,199 | 481,108 | 134,286 |

| Species | Scallop trawls | | Dredges | | Tongs | | Rakes, hoes, forks, and by hand | |
|---|---|---|---|---|---|---|---|---|
| Clams, hard: | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Public | | | | | 360,960 | $173,962 | 157,192 | $74,950 |
| Private | | | | | 68,888 | 42,484 | | |
| Clams, soft | | | | | | | 230,820 | 50,491 |
| Skimmers or surf clams | | | | | 59,112 | 15,436 | | |
| Mussels | | | 210,000 | $10,200 | | | | |
| Oysters, market: | | | | | | | | |
| Public | | | 700 | 175 | 1,750 | 350 | 3,500 | 500 |
| Private | | | 6,994,365 | 2,066,947 | 124,950 | 43,750 | | |
| Oysters, seed: | | | | | | | | |
| Public | | | | | 214,550 | 39,125 | | |
| Private | | | 224,000 | 49,600 | | | | |
| Scallops: | | | | | | | | |
| Bay | | | 295,488 | 90,443 | | | | |
| Sea | 494,472 | $126,367 | 556,578 | 137,261 | | | | |
| Miscellaneous products (for bait) | | | | | | | 12,000 | 14,300 |
| Total | 494,472 | 126,367 | 8,281,131 | 2,354,626 | 830,210 | 315,107 | 403,512 | 140,241 |

*Fisheries by counties.*—Fishing was prosecuted in the waters of 20 counties of New York State in 1926. In value, the fisheries of Suffolk County were most important and accounted for 58 per cent of the total catch and 66 per cent of the total value. New York County followed, accounting for 31 per cent of the total catch and 16 per cent of the total value. Nassau County ranked third, Kings County fourth, and Ulster County fifth in value of catch. The following table shows a summary of the fisheries of New York by counties:

*Fisheries of New York, 1926*

OPERATING UNITS AND CATCH: BY COUNTIES

| County | Fishermen | Vessels | | Motor boats | Other boats | Products | |
|---|---|---|---|---|---|---|---|
| | *Number* | *Number* | *Net tonnage* | *Number* | *Number* | *Pounds* | *Value* |
| Albany | 21 | | | | 13 | 17,095 | $1,985 |
| Bronx | 13 | | | 3 | 5 | 3,400 | 1,700 |
| Columbia | 41 | | | 1 | 21 | 46,919 | 4,688 |
| Dutchess | 83 | | | 15 | 32 | 129,969 | 22,220 |
| Greene | 36 | | | 2 | 29 | 30,205 | 3,507 |
| Kings | 295 | 29 | 379 | 84 | 41 | 3,460,692 | 329,471 |
| Montgomery | 4 | | | | 3 | 1,329 | 138 |
| Nassau | 331 | 21 | 284 | 62 | 178 | 1,900,871 | 421,754 |
| New York | 230 | 16 | 1,121 | 11 | 2 | 19,017,743 | 835,229 |
| Orange | 51 | | | 4 | 26 | 87,663 | 14,695 |
| Putnam | 3 | | | | 3 | 1,875 | 260 |
| Queens | 19 | 3 | 41 | 1 | 5 | 148,410 | 16,470 |
| Rensselaer | 31 | | | 1 | 16 | 27,092 | 3,581 |
| Richmond | 12 | 1 | 10 | 6 | 2 | 74,300 | 10,300 |
| Rockland | 48 | | | 5 | 23 | 32,299 | 6,319 |
| Saratoga | 10 | | | | 5 | 17,712 | 2,456 |
| Schenectady | 8 | | | | 6 | 11,629 | 1,902 |
| Suffolk | 1,643 | 148 | 2,210 | 524 | 404 | 35,451,433 | 3,408,478 |
| Ulster | 192 | | | 22 | 126 | 192,964 | 31,317 |
| Westchester | 60 | | | 11 | 22 | 67,269 | 12,273 |
| Total | 3,131 | 218 | 4,045 | 752 | 962 | 60,720,869 | 5,128,743 |

## INDUSTRIES RELATED TO THE FISHERIES

*Transporting.*—In 1926 there were 82 persons engaged primarily in transporting the catch of fishery products from the fishing grounds to market, of which 18 were employed on boats of less than 5 net tons and 64 on vessels of over 5 net tons. There were 15 motor boats in use, which were under 5 net tons in size, and 43 registered vessels with a total net tonnage of 774.

*Wholesale trade.*—In 1926 there were 138 wholesale establishments in New York City and 18 in localities outside the city engaged chiefly in handling primary fishery products. The total investment in these establishments amounted to $4,573,747 and the cash or working capital to $1,034,400. There were 1,886 persons employed, who received $3,462,507 in wages. In addition, there were 295 commission men, oyster shuckers, etc., employed. These were not connected directly with the wholesale trade, and therefore the amount of their wages was not obtained.

*Prepared-fish and by-products trades.*—In 1926 there were 21 establishments engaged in preparing smoked fish, miscellaneous canned fishery products, and scrap and oil from waste fish. All were located in New York City. The value of these establishments was $763,156, and the cash or working capital amounted to $176,867. There were 235 persons employed who received $390,332 in wages. The products prepared included 6,259,360 pounds of smoked fish, valued at $2,217,039, and miscellaneous products valued at $110,078.

Following are tables showing the statistics of the industries related to the fisheries of New York for 1926.

*Industries related to the fisheries of New York, 1926*

TRANSPORTING

| Items | Number | Items | Number |
|---|---|---|---|
| Persons engaged: | | Transporting vessels—Continued. | |
| On boats | 18 | Motor—Continued. | |
| On vessels | 64 | 21 to 30 tons | 8 |
| | | 31 to 40 tons | 3 |
| Total | 82 | 41 to 50 tons | 3 |
| | | 51 to 60 tons | 1 |
| Transporting boats (motor) | 15 | Total | 42 |
| Transporting vessels: | | | |
| Steam | 1 | Net tonnage | 738 |
| Net tonnage | 36 | | |
| | | Grand total | 43 |
| Motor— | | | |
| 5 to 10 tons | 22 | Net tonnage | 774 |
| 11 to 20 tons | 5 | | |

WHOLESALE FISHERY TRADE

| Items | Greater New York City | Outside of Greater New York City | Total |
|---|---|---|---|
| Establishments | 138 | 18 | 156 |
| Persons engaged: | | | |
| In establishments | 1,534 | 352 | 1,886 |
| Not directly connected with establishments | 23 | 272 | 295 |
| Wages paid in establishments | $3,205,845 | $256,662 | $3,462,507 |

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS TRADE

| Items | Number | |
|---|---|---|
| Establishments | 21 | |
| Persons engaged | 235 | |
| Wages paid | $390,332 | |
| Smoked fish: | *Pounds* | *Value* |
| Butterfish | 250,400 | $88,600 |
| Carp | 387,000 | 148,020 |
| Ciscoes | 1,088,500 | 383,035 |
| Eels | 40,700 | 16,280 |
| Finnan haddies (haddock) | 1,412,000 | 167,085 |
| Herring | 160,000 | 34,410 |
| Mackerel | 101,720 | 23,130 |
| Salmon | 2,256,540 | 820,622 |
| Spoonbill cat | 50,000 | 42,500 |
| Sturgeon | 511,900 | 493,167 |
| Other fish | 600 | 190 |
| Total | 6,259,360 | 2,217,039 |
| Miscellaneous products [1] | | 110,078 |

[1] Includes the following canned products: Whitefish caviar, sturgeon caviar, cisco caviar, cisco roe, salmon roe, smoked salmon, smoked eels, pickled eels, canned (pickled) mussels, turtle soup, turtle meat, terrapin stew, terrapin meat; and dry scrap from waste fish and oil from livers and waste fish.

## NEW JERSEY

The fisheries and industries related to the fisheries of New Jersey employed 6,000 persons in 1926, which is 4 per cent more than in 1921. Of the total, 5,134 were employed in fishing, 23 on transporting boats and vessels, 640 in the wholesale trade, and 203 in the canning or prepared-products trade and in menhaden-reduction plants.

The products of the fisheries amounted to 73,299,123 pounds, valued at $6,254,264. This represents a decrease of 24 per cent in amount and an increase of about 5 per cent in value, compared with the amount and value of the fisheries in 1921. The decrease in amount is due mainly to the smaller catches of menhaden and squeteagues or weakfish.

Of the total value, oysters accounted for 53 per cent; squeteagues or sea trout, 7 per cent; clams, 5 per cent; butterfish, 4 per cent; flounders, 3 per cent; lobsters, 3 per cent; sea bass, 3 per cent; and bluefish, 2 per cent. Of the total production, oysters accounted for 35 per cent; squeteagues or sea trout, 10 per cent; whiting, 10 per cent; butterfish, 4 per cent; flounders, 4 per cent; croakers, 3 per cent; scup or porgy, 3 per cent; and cod, 3 per cent.

*Operating units.*—The catch of fishery products in New Jersey during 1926 was taken by 2,187 motor, sail, and row boats, 255 motor vessels, 93 sail vessels, 16 types of apparatus, and by hand. The following table shows in detail the vessels, boats, and types of apparatus used in 1926.

*Fisheries of New Jersey, 1926*

OPERATING UNITS: BY GEAR

| Items | Purse seines | Haul seines | Gill nets | Pound nets and weirs | Fyke nets | Flounder drags | Lines | Bag nets | Stop nets | Dip nets | Cast nets |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | | | |
| On boats or shore | 13 | 329 | 621 | 163 | 156 | 50 | 559 | 24 | 128 | 13 | 3 |
| On vessels | 118 | | 37 | 334 | | 98 | 53 | | | | |
| Total | 131 | 329 | 658 | 497 | 156 | 148 | 612 | 24 | 128 | 13 | 3 |
| Fishing boats: | | | | | | | | | | | |
| Motor | 3 | 46 | 177 | 32 | 37 | | 825 | 10 | 29 | | |
| Other | | 156 | 113 | 43 | 82 | | 24 | 6 | 74 | 13 | |
| Fishing vessels: | | | | | | | | | | | |
| Motor— | | | | | | | | | | | |
| 5 to 10 tons | 1 | | 7 | 57 | | 13 | 8 | | | | |
| 11 to 20 tons | 4 | | 4 | | | 15 | 8 | | | | |
| 21 to 30 tons | 5 | | | | | 2 | | | | | |
| 31 to 40 tons | | | | | | | | | | | |
| 41 to 50 tons | 1 | | | | | | | | | | |
| Total | 11 | | 11 | 57 | | 30 | 16 | | | | |
| Net tonnage | 246 | | 113 | 356 | | 350 | 161 | | | | |
| Apparatus: Number | 14 | 158 | 3,495 | 198 | 2,129 | 45 | (1) | 36 | 64 | 13 | 3 |
| Length, yards | 5,250 | 20,970 | 346,569 | | | | | | 22,085 | | |

[1] Number undetermined.

*Fisheries of New Jersey, 1926*—Continued

OPERATING UNITS: BY GEAR—Continued

| Items | Spears and gaffs | Eel pots | Lobster pots | Crab dredges | Oyster dredges | Scallop dredges | Tongs | Rakes, hoes, and forks | By hand | Total exclusive of duplication |
|---|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | | |
| On boats or shore | 42 | 51 | 178 | | 46 | 2 | 841 | 455 | 7 | 2,553 |
| On vessels | | 2 | | 6 | 1,991 | 9 | | 20 | | 2,581 |
| Total | 42 | 53 | 178 | 6 | 2,037 | 11 | 841 | 475 | 7 | 5,134 |
| Fishing boats: | | | | | | | | | | |
| Motor | 4 | 35 | 111 | | 17 | 1 | 469 | 253 | | 1,195 |
| Other | 33 | 24 | 29 | | 5 | | 488 | 291 | | 992 |
| Fishing vessels: | | | | | | | | | | |
| Motor— | | | | | | | | | | |
| 5 to 10 tons | | 1 | | 1 | 58 | 2 | | 6 | | 122 |
| 11 to 20 tons | | | | 1 | 78 | 1 | | 2 | | 102 |
| 21 to 30 tons | | | | | 19 | | | | | 24 |
| 31 to 40 tons | | | | | 6 | | | | | 6 |
| 41 to 50 tons | | | | | | | | | | 1 |
| Total | | 1 | | 2 | 161 | 3 | | 8 | | 255 |
| Net tonnage | | 6 | | 27 | 2,101 | 31 | | 72 | | 3,160 |
| Sail— | | | | | | | | | | |
| 5 to 10 tons | | | | | 28 | | | | | 28 |
| 11 to 20 tons | | | | | 37 | | | | | 37 |
| 21 to 30 tons | | | | | 15 | | | | | 15 |
| 31 to 40 tons | | | | | 6 | | | | | 6 |
| 41 to 50 tons | | | | | 6 | | | | | 6 |
| 51 to 60 tons | | | | | 1 | | | | | 1 |
| Total | | | | | 93 | | | | | 93 |
| Net tonnage | | | | | 1,704 | | | | | 1,704 |
| Grand total | | 1 | | 2 | 253 | 3 | | 8 | | 348 |
| Net tonnage | | 6 | | 27 | 3,805 | 31 | | 72 | | 4,864 |
| Apparatus: Number | 42 | 3,189 | 15,168 | 12 | 512 | 10 | 777 | 507 | | |
| Length, yards | | | | | | | | | | |

*Catch by gear.*—Pound nets, weirs, and dredges were the most important types of apparatus used. The first two accounted for 40 per cent and the last for 34 per cent of the catch, or approximately three-fourths of the total catch made in New Jersey. The catch by pound nets and weirs consisted of virtually every species of fish represented in the fisheries, while that of dredges consisted almost entirely of oysters, with a few crabs, scallops, and clams. The following table shows the species of fishery products taken and their mode of capture:

*Fisheries of New Jersey, 1926*

CATCH: BY GEAR

| Species | Purse seines | | Haul seines | | Gill nets | | Pound nets and weirs | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Albacore | | | | | | | 18, 268 | $665 |
| Alewives | | | 251, 900 | $7, 230 | 89, 000 | $4, 182 | 38, 650 | 1, 172 |
| Bluefish | 158, 600 | $33, 120 | 2, 400 | 600 | 141, 010 | 35, 220 | 85, 201 | 16, 453 |
| Bonito | 17, 400 | 1, 400 | | | 20, 000 | 1, 640 | 171, 860 | 15, 709 |
| Butterfish | 77, 200 | 5, 490 | | | 40, 998 | 2, 746 | 2, 956, 049 | 226, 797 |
| Carp | | | 148, 195 | 24, 231 | 300 | 45 | | |
| Catfish | | | 26, 488 | 1, 981 | | | | |
| Cero or kingfish | | | | | [1] 2, 600 | 208 | [1] 100 | 8 |
| Cod | 64, 400 | 2, 945 | | | | | 385, 691 | 24, 674 |
| Crevalle | | | | | | | [2] 2, 000 | 90 |
| Croaker | 325, 000 | 12, 490 | 51, 250 | 2, 840 | 489, 597 | 14, 625 | 596, 774 | 34, 038 |
| Drum: | | | | | | | | |
| Black | | | | | | | 31, 100 | 909 |
| Red | | | | | | | 12, 700 | 380 |
| Eels | | | 7, 600 | 760 | | | 12, 031 | 1, 138 |
| Flounders | 18, 800 | 1, 424 | 44, 100 | 4, 300 | 1, 666 | 137 | 611, 371 | 50, 720 |
| Goosefish | | | | | | | 800 | 16 |
| Grayfish | | | | | | | 4, 640 | 278 |
| Hake | | | | | | | 444, 220 | 9, 298 |
| Herring | | | | | | | 235, 665 | 7, 030 |
| Hickory shad | | | | | | | 5, 439 | 219 |
| King whiting or "kingfish" | | | 4, 000 | 550 | 100 | 15 | 25, 894 | 3, 738 |
| Mackerel | 186, 000 | 11, 564 | | | 558, 100 | 31, 184 | 1, 421, 652 | 98, 399 |
| Menhaden | 239, 400 | 1, 794 | | | 92, 000 | 920 | 5, 047, 407 | 18, 231 |
| Mullet | | | 6, 000 | 500 | | | | |
| Pilotfish | | | | | | | 3, 900 | 125 |
| Pollock | | | | | | | 22, 860 | 1, 230 |
| Pompano | | | | | 400 | 160 | 225 | 83 |
| Scup or porgy | 1, 652, 400 | 81, 620 | | | 600 | 30 | 531, 343 | 32, 376 |
| Sea bass | 131, 800 | 10, 600 | 800 | 80 | 200 | 16 | 726, 298 | 72, 066 |
| Sea robin | | | | | | | 23, 100 | 684 |
| Shad | | | 27, 793 | 7, 949 | 460, 857 | 116, 943 | 63, 830 | 14, 672 |
| Sharks | | | | | | | 47, 110 | 1, 323 |
| Silversides or spearing | | | 2, 000 | 2, 000 | | | | |
| Skates | | | | | | | 45, 246 | 1, 293 |
| Spanish mackerel | | | | | [2] 10, 000 | 1, 000 | [2] 3, 492 | 754 |
| Spot | 6, 200 | 322 | 9, 100 | 410 | 110, 402 | 5, 975 | 1, 058, 326 | 66, 421 |
| Squeteagues | 2, 043, 200 | 99, 448 | 55, 000 | 4, 730 | 700, 330 | 52, 111 | 4, 254, 157 | 278, 929 |
| Striped bass | | | 22, 550 | 6, 077 | 17, 500 | 6, 050 | 2, 384 | 586 |
| Sturgeon | | | | | 2, 142 | 547 | 3, 309 | 921 |
| Sturgeon roe | | | | | 380 | 580 | 110 | 160 |
| Suckers | | | 89, 925 | 14, 575 | | | | |
| Tautog | 1, 500 | 96 | | | | | 13, 889 | 1, 089 |
| Thimble-eyed mackerel | | | | | | | 105, 038 | 3, 498 |
| Tuna or horse mackerel | | | | | | | 30, 450 | 2, 942 |
| White perch | | | 33, 350 | 4, 550 | 7, 500 | 1, 475 | 2, 885 | 215 |
| Whiting | | | | | 6, 000 | 180 | 6, 929, 124 | 142, 063 |
| Yellow perch | | | 10, 000 | 2, 000 | 10, 750 | 2, 150 | | |
| Crabs: | | | | | | | | |
| Hard | | | | | | | 1, 000 | 25 |
| Soft | | | 2, 000 | 1, 000 | | | | |
| King | | | | | | | 2, 248, 000 | 10, 856 |
| Squid | | | | | | | 1, 035, 264 | 64, 577 |
| Turtles | | | | | | | 4, 618 | 117 |
| Total | 4, 921, 900 | 262, 313 | 794, 451 | 86, 363 | 2, 762, 432 | 278, 139 | 29, 263, 470 | 1, 206, 967 |

[1] All taken in Florida waters. [2] Taken mostly in Florida waters.

*Fisheries of New Jersey, 1926*—Continued

CATCH: BY GEAR—Continued

| Species | Fyke nets and bag nets | | Flounder drags | | Lines | | Minor apparatus | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Barracuda | | | | | [3] 1,400 | $84 | | |
| Bluefish | | | | | 241,030 | 62,754 | | |
| Bonito | | | | | 298,400 | 22,007 | | |
| Butterfish | | | 4,000 | $260 | | | | |
| Carp | | | | | | | [4] 130,544 | $25,748 |
| Catfish | 108,138 | $8,844 | | | | | [5] 1,000 | 50 |
| Cero, or kingfish | | | | | [3] 49,856 | 4,788 | | |
| Cod | | | | | 1,766,600 | 81,446 | | |
| Crevalle | | | | | [6] 3,000 | 90 | | |
| Croaker | | | 744,046 | 27,302 | 249,200 | 13,532 | | |
| Drum, red | | | 1,600 | 32 | | | | |
| Eels | 24,160 | 3,049 | | | 600 | 30 | [7] 9,000 | 1,020 |
| Flounders | 141,170 | 10,010 | 2,022,007 | 136,105 | 82,600 | 6,618 | | |
| Groupers | | | | | [3] 2,600 | 120 | | |
| Haddock | | | | | 3,450 | 156 | | |
| Hake | | | | | 7,100 | 199 | | |
| King whiting, or "kingfish" | | | 2,261 | 230 | 870 | 131 | | |
| Pollock | | | | | 450 | 14 | | |
| Red snapper | | | | | [3] 5,850 | 484 | | |
| Scup or porgy | | | 23,311 | 1,153 | 244,425 | 11,218 | | |
| Sea bass | | | 126,559 | 11,767 | 1,104,850 | 76,542 | | |
| Sharks | | | | | 1,600 | 42 | | |
| Skates | | | | | 2,200 | 38 | | |
| Spanish mackerel | | | | | [6] 500 | 50 | | |
| Spot | | | 8,076 | 418 | 25,600 | 2,426 | | |
| Squeteagues | 1,300 | 100 | 2,418 | 146 | 116,280 | 12,734 | | |
| Striped bass | 13,825 | 3,757 | | | 7,900 | 2,000 | | |
| Sturgeon | | | 1,949 | 780 | | | | |
| Suckers | 1,000 | 50 | | | | | [8] 1,750 | 350 |
| Tautog | | | | | 6,340 | 515 | | |
| Tomcod or frostfish | 500 | 30 | | | | | | |
| Tuna or horse mackerel | | | | | 101,970 | 6,602 | | |
| White perch | 69,300 | 9,645 | | | | | | |
| Yellow perch | 6,250 | 925 | | | | | | |
| Lobsters | | | 13,481 | 3,175 | | | | |
| Shrimp | | | [9] 36,276 | 1,758 | | | | |
| Crabs: | | | | | | | | |
| Hard | | | | | 11,000 | 1,200 | [10] 12,000 | 1,500 |
| Soft | | | | | | | [10] 4,400 | 3,100 |
| Squid | | | 1,000 | 50 | | | | |
| Turtles | 7,951 | 844 | | | 1,200 | 149 | [11] 3,550 | 429 |
| Total | 373,594 | 37,254 | 2,986,984 | 183,176 | 4,336,871 | 305,969 | 162,244 | 32,197 |

| Species | Eel pots | | Lobster pots | | Dredges | | Tongs, rakes, hoes, forks, and by hand | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Catfish | 600 | $60 | | | | | | |
| Eels | 198,280 | 19,395 | | | | | | |
| Sea bass | | | 5,350 | $535 | | | | |
| Tomcod or frostfish | 600 | 42 | | | | | | |
| Lobsters | | | 629,805 | 190,474 | | | | |
| Crabs, hard | | | 6,666 | 600 | 30,900 | $2,500 | | |
| Clams, hard: | | | | | | | | |
| Public | | | | | 11,200 | 5,600 | 602,664 | $291,870 |
| Private | | | | | 9,144 | 5,000 | 14,240 | 7,000 |
| Clams, soft | | | | | | | 144,600 | 25,350 |
| Mussels | | | | | | | 47,000 | 560 |
| Oysters, market: | | | | | | | | |
| Public | | | | | | | 67,424 | 12,563 |
| Private | | | | | 10,686,032 | 1,926,460 | 451,689 | 107,531 |
| Oysters, seed: | | | | | | | | |
| Public | | | | | 13,827,947 | 1,188,470 | 822,500 | 55,448 |
| Private | | | | | | | 93,100 | 6,740 |
| Scallops, sea | | | | | 47,436 | 15,688 | | |
| Total | 199,480 | 19,497 | 641,821 | 191,609 | 24,612,659 | 3,143,718 | 2,243,217 | 507,062 |

[3] All taken off the coast of Florida.
[4] All taken by stop nets, except 4,800 pounds, valued at $972, which were taken by cast nets.
[5] All taken by cast nets.
[6] Taken mostly off the coast of Florida.
[7] All taken by spears.
[8] All taken by stop nets.
[9] All taken by a shrimp trawl off the coast of Florida.
[10] All taken by dip nets.
[11] All taken by gaffs.

*Fisheries by counties.*—Fishing was prosecuted in the waters of 14 counties in the State of New Jersey in 1926. The fisheries of Cumberland County were most important and accounted for 35 per cent of the total catch and 51 per cent of the total value. Ocean County followed in value of catch, accounting for 18 per cent of the total catch and 14 per cent of the total value. In value of catch, Cape May County ranked third, Monmouth County fourth, and Atlantic County fifth. The following table is a summary of the fisheries of New Jersey by counties.

*Fisheries of New Jersey, 1926*

OPERATING UNITS AND CATCH: BY COUNTIES

| County | Fishermen | Vessels | | Motor boats | Other boats | Products | |
|---|---|---|---|---|---|---|---|
| | *Number* | *Number* | *Net tonnage* | *Number* | *Number* | *Pounds* | *Value* |
| Atlantic | 432 | 10 | 134 | 145 | 252 | 4,454,143 | $443,946 |
| Bergen | 9 | | | 3 | 3 | 46,237 | 6,300 |
| Burlington | 152 | 1 | 11 | 74 | 85 | 458,619 | 101,719 |
| Camden | 8 | | | 1 | 2 | 25,690 | 1,760 |
| Cape May | 703 | 54 | 582 | 231 | 132 | 14,490,947 | 795,197 |
| Cumberland | 2,359 | 229 | 3,760 | 103 | 145 | 25,794,302 | 3,174,775 |
| Gloucester | 55 | | | 22 | 27 | 73,767 | 14,410 |
| Hudson | 1 | | | 1 | | 13,680 | 1,505 |
| Hunterdon | 18 | | | | 6 | 8,345 | 1,397 |
| Mercer | 34 | | | | 12 | 32,540 | 5,116 |
| Middlesex | 7 | 1 | 8 | 3 | 4 | 31,470 | 5,616 |
| Monmouth | 532 | 15 | 129 | 232 | 114 | 14,389,938 | 704,562 |
| Ocean | 590 | 38 | 240 | 311 | 121 | 12,942,745 | 884,194 |
| Salem | 234 | | | 69 | 89 | 536,700 | 113,767 |
| Total | 5,134 | 348 | 4,864 | 1,195 | 992 | 73,299,123 | 6,254,264 |

INDUSTRIES RELATED TO THE FISHERIES

*Transporting.*—In 1926, there were 23 persons engaged primarily in transporting the catch of fishery products from the fishing grounds to market. For the conduct of this trade 18 motor vessels were used, having an aggregate of 171 net tons.

*Wholesale trade.*—In 1926, there were 52 wholesale establishments in New Jersey engaged chiefly in handling primary fishery products. The total investment in these establishments amounted to $845,187 and the cash or working capital amounted to $316,000. There were 602 persons employed, who received $363,607 in wages. In addition, 38 commission men, oyster shuckers, etc., were employed. These were not connected directly with the wholesale trade, and therefore the amount of their wages was not obtained.

*Prepared and by-products trade.*—In 1926, there were 9 establishments engaged in preparing smoked fish and miscellaneous canned products and by-products. The value of these establishments was $236,066, and the cash or working capital amounted to $84,000. There were 164 persons employed who received $86,509 in wages. The products included 1,052,800 pounds of smoked fish, valued at $496,015, and miscellaneous products and by-products valued at $248,071.

Following are tables showing the statistics of the industries related to the fisheries of New Jersey for 1926.

*Industries related to the fisheries of New Jersey, 1929*

TRANSPORTING

| Items | Number |
|---|---|
| Men on transporting vessels | 23 |
| Transporting vessels (motor): | |
| 5 to 10 tons | 14 |
| 11 to 20 tons | 2 |
| 21 to 30 tons | 2 |
| Total | 18 |
| Net tonnage | 171 |

WHOLESALE FISHERY TRADE

| Items | Atlantic | Burlington and Cape May | Cumberland | Essex and Monmouth | Ocean | Total |
|---|---|---|---|---|---|---|
| Establishments | 6 | 5 | 25 | 3 | 13 | 52 |
| Persons engaged: | | | | | | |
| In establishments | 23 | 18 | 465 | 70 | 26 | 602 |
| Not directly connected with establishments | | | | 15 | 23 | 38 |
| Wages paid in establishments | $11,400 | $20,040 | $256,301 | $70,366 | $5,500 | $363,607 |

PREPARED PRODUCTS AND BY-PRODUCTS TRADE

| Items | Number | |
|---|---|---|
| Establishments | 9 | |
| Persons engaged | 164 | |
| Wages paid | $86,509 | |
| Smoked fish: | *Pounds* | *Value* |
| Butterfish | 62,500 | $25,000 |
| Carp | 47,000 | 21,500 |
| Ciscoes | 186,000 | 80,500 |
| Eels | 2,100 | 630 |
| Herring | 12,000 | 3,000 |
| Mackerel | 2,000 | 500 |
| Salmon | 545,000 | 239,010 |
| Shad | 500 | 180 |
| Sturgeon | 47,500 | 59,375 |
| Whitefish | 143,000 | 64,360 |
| Other fish | 5,200 | 1,880 |
| Total | 1,052,800 | 496,015 |
| Miscellaneous products: | *Tons* | |
| Poultry feed (from oyster shells) | 3,493 | 41,318 |
| Lime (from oyster shells) | 1,122 | 4,583 |
| Other products [1] | | 202,170 |
| Total | | 248,071 |

[1] Includes canned clam chowder and dry scrap from king crabs.

## PENNSYLVANIA

The fisheries and industries related to the fisheries of Pennsylvania employed 647 persons in 1926, which is 9 per cent greater than in 1921. Of the total, 198 persons were employed in fishing, 2 on transporting vessels, 336 in the wholesale trade, and 111 in the canning or prepared-products trade.

The products of the fisheries amounted to 734,775 pounds, valued at $43,287. This represents an increase of 24 per cent in amount and a decrease of 3 per cent in value compared with the amount and value of the fisheries in 1921. The increase in amount is due chiefly to the larger production of squeteagues.

Of the total value, squeteagues accounted for 36 per cent; scup or porgy, 13 per cent; shad, 12 per cent; bluefish, 11 per cent; and suckers about 7 per cent. Of the total production, squeteagues accounted for 52 per cent; scup or porgy, 17 per cent; suckers, 4 per cent; and shad and bluefish, each 3 per cent.

*Operating units.*—The catch of fishery products in Pennsylvania during 1926 was taken by 40 motor and row boats, 12 motor vessels, and 6 types of apparatus. The following table shows in detail the statistics of the boats, vessels, and types of apparatus used in the fisheries of Pennsylvania during 1926:

*Fisheries of Pennsylvania, 1926*

OPERATING UNITS: BY GEAR

| Items | Purse seines | Lines | Haul seines | Gill nets | Stop nets | Fyke nets | Oyster dredges [1] | Total, exclusive of duplication |
|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | |
| On boats or shore | | | 58 | 24 | 2 | 8 | | 87 |
| On vessels | 11 | 10 | | 10 | | | 90 | 111 |
| Total | 11 | 10 | 58 | 34 | 2 | 8 | 90 | 198 |
| Fishing boats: | | | | | | | | |
| Motor | | | | 4 | 1 | 1 | | 5 |
| Row | | | 21 | 12 | 1 | 4 | | 35 |
| Fishing vessels (motor): | | | | | | | | |
| 5 to 10 tons | | 2 | | 2 | | | | 2 |
| 11 to 20 tons | | 1 | | 1 | | | 4 | 5 |
| 21 to 30 tons | 1 | | | | | | 4 | 5 |
| Total | 1 | 3 | | 3 | | | 8 | 12 |
| Net tonnage | 28 | 31 | | 31 | | | 161 | 220 |
| Apparatus: Number | 1 | [2] | 19 | 107 | 1 | 175 | 16 | |
| Length, yards | 350 | | 2,028 | 9,400 | 200 | | | |

[1] Catch of these dredges included with catch of New Jersey and Delaware.
[2] Number undetermined.

*Catch by gear.*—Purse seines caught 79 per cent of the total production; lines, 8 per cent; gill nets, 6 per cent; and haul seines, 6 per cent, while the remainder was taken by fyke nets and stop nets. The catch by purse seines consisted of virtually every species of fish represented in the commercial catch, squeteagues and scup predominating. Lines caught chiefly sea bass; haul seines, suckers; and gill nets, mackerel and shad.

*Fisheries of Pennsylvania, 1926*

CATCH: BY GEAR

| Species | Purse seines | | Lines | | Haul seines | | Gill, fyke, and stop nets | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Alewives | | | | | 4,000 | $100 | [1] 1,300 | $65 |
| Bluefish | 10,000 | $2,000 | 11,400 | $2,850 | | | | |
| Bonito | 400 | 40 | | | | | | |
| Butterfish | 6,000 | 300 | | | | | | |
| Carp | | | | | 2,875 | 600 | [2] 1,000 | 200 |
| Catfish | | | | | 300 | 30 | [3] 5,300 | 475 |
| Cod | 10,287 | 617 | 4,000 | 200 | | | | |
| Croaker | 600 | 24 | 400 | 16 | | | | |
| Eels | | | | | | | [3] 2,500 | 375 |
| Flounders | 200 | 12 | 200 | 14 | | | | |
| Mackerel | 9,847 | 984 | | | | | [1] 30,000 | 1,300 |
| Menhaden | 36,000 | 240 | | | | | | |
| Scup or porgy | 120,000 | 5,400 | 2,400 | 120 | | | | |
| Sea bass | 200 | 16 | 42,600 | 3,558 | | | | |
| Shad | | | | | 7,489 | 2,301 | [1] 13,277 | 3,021 |
| Squeteagues | 380,000 | 15,200 | | | | | [1] 3,000 | 240 |
| Suckers | | | | | 26,000 | 2,858 | | |
| Tautog | 200 | 16 | | | | | | |
| Whiting | 2,500 | 15 | | | | | | |
| Turtles | | | | | | | [3] 500 | 100 |
| Total | 576,234 | 24,864 | 61,000 | 6,758 | 40,664 | 5,889 | 56,877 | 5,776 |

[1] Taken by gill nets. [2] Taken by stop nets. [3] Taken by fyke nets.

*Fisheries by counties.*—Marine fisheries were prosecuted in Bucks, Delaware, and Philadelphia Counties in Pennsylvania in 1926. Almost the entire catch was made in Philadelphia County, Bucks County ranking second and Delaware County following next. The following table is a summary of the fisheries of Pennsylvania by counties.

*Fisheries of Pennsylvania, 1926*

OPERATING UNITS AND CATCH: BY COUNTIES

| County | Fishermen | Vessels | | Motor boats | Other boats | Products | |
|---|---|---|---|---|---|---|---|
| | *Number* | *Number* | *Net tonnage* | *Number* | *Number* | *Pounds* | *Value* |
| Bucks | 67 | | | | 26 | 37,941 | $5,670 |
| Delaware | 12 | | | 5 | 6 | 16,000 | 3,020 |
| Philadelphia | 119 | 12 | 220 | | 3 | 680,834 | 34,597 |
| Total | 198 | 12 | 220 | 5 | 35 | 734,775 | 43,287 |

INDUSTRIES RELATED TO THE FISHERIES

*Transporting.*—In 1926, there were 2 men and 2 motor vessels, having an aggregate of 15 net tons, engaged primarily in transporting the catch of fishery products from the fishing grounds to market.

*Wholesale trade.*—In 1926, there were 41 wholesale establishments in Pennsylvania, all in Philadelphia, engaged chiefly in handling primary fishery products. The total investment in these establishments amounted to $908,300, and the cash or working capital amounted to $420,000. There were 336 persons engaged in this trade, who received $357,348 in wages.

*Prepared and by-products trade.*—In 1926, there were 8 establishments in Pennsylvania engaged in preparing smoked fish, salted herring, and miscellaneous fishery by-products. All were located in Philadelphia. The value of these establishments was $485,300, and their cash or working capital amounted to $130,000. There were 111 persons employed, who received $152,279 in wages. The products prepared included 2,719,073 pounds of smoked fish, largely salmon, herring, and ciscoes, valued at $860,890, and miscellaneous fishery products and by-products valued at $86,395.

*Industries related to the fisheries of Pennsylvania, 1926*

TRANSPORTING

| Items | Number |
|---|---|
| Men on transporting vessels | 2 |
| Transporting vessels (motor) | 2 |
| Net tonnage | 15 |

WHOLESALE FISHERY TRADE OF PHILADELPHIA

| Items | Number |
|---|---|
| Establishments | 41 |
| Persons engaged | 336 |
| Wages paid | $357,348 |

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS TRADE OF PHILADELPHIA

| Items | Number | |
|---|---|---|
| Establishments | 8 | |
| Persons engaged | 111 | |
| Wages paid | $152,279 | |
| Smoked fish: | *Pounds* | *Value* |
| Alewives | 1,000 | $120 |
| Butterfish | 25,500 | 8,823 |
| Carp | 23,400 | 9,300 |
| Ciscoes | 277,500 | 87,375 |
| Ciscoes ("tullibee") | 139,160 | 34,915 |
| Finnan haddie (haddock) | 97,500 | 17,700 |
| Herring, sea | 493,000 | 68,810 |
| Lake trout | 108,750 | 43,125 |
| Mackerel | 32,625 | 6,525 |
| Salmon | 992,063 | 416,574 |
| Salmon, kippered | 38,500 | 15,820 |
| Shad | 55,125 | 11,042 |
| Sturgeon | 13,550 | 16,563 |
| Miscellaneous fish | 421,400 | 124,198 |
| Total | 2,719,073 | 860,890 |
| Miscellaneous products [1] | | 86,395 |

[1] Includes salted herring and poultry feed and lime from oyster shells.

## DELAWARE

The fisheries and industries related to the fisheries of Delaware employed 1,921 persons in 1926, which is 97 per cent more than in 1921. Of the total, 1,508 were employed in fishing, 255 in the wholesale trade, and 158 in menhaden-reduction plants.

The product of the fisheries amounted to 33,257,728 pounds, valued at $1,029,962. This represents an increase of 33 per cent in amount and 58 per cent in value compared with the amount and value of the fisheries for 1921. The increase in amount is due chiefly to the large production of menhaden, while oysters, crabs, and croakers also contributed. Of the total value, oysters accounted for 65 per cent; menhaden, 9 per cent; hard and soft blue crabs, 5 per cent; and shad and squeteagues, each 4 per cent. Of the total production, menhaden accounted for 70 per cent; oysters, 18 per cent; squeteagues, 2 per cent; crabs, 1 per cent; and shad, less than 1 per cent.

*Operating units.*—The catch of fishery products in Delaware during 1926 was taken by 563 motor and row boats, 11 steam vessels, 23 motor vessels, 5 sail vessels, 15 types of apparatus and by hand. The following table shows in detail the statistics of the boats, vessels, and types of apparatus used during 1926.

*Fisheries of Delaware, 1926*

OPERATING UNITS: BY GEAR

| Items | Purse seines | Haul seines | Gill nets | Pound nets | Fyke nets | Lines | Stop nets | Dip nets | Cast nets |
|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | |
| On boat or shore |  | 374 | 233 | 17 | 103 | 47 | 27 | 190 | 17 |
| On vessels | 482 |  |  |  |  |  |  |  |  |
| Total | 482 | 374 | 233 | 17 | 103 | 47 | 27 | 190 | 17 |
| Fishing boats: | | | | | | | | | |
| Motor |  | 29 | 84 | 5 | 20 | 19 | 12 | 19 | 5 |
| Row |  | 114 | 45 | 8 | 51 | 2 | 13 | 128 | 9 |
| Fishing vessels: | | | | | | | | | |
| Steam— | | | | | | | | | |
| 81 to 90 tons | 1 |  |  |  |  |  |  |  |  |
| 91 to 100 tons | 1 |  |  |  |  |  |  |  |  |
| 101 to 110 tons | 1 |  |  |  |  |  |  |  |  |
| 111 to 120 tons | 2 |  |  |  |  |  |  |  |  |
| 121 to 130 tons | 1 |  |  |  |  |  |  |  |  |
| 161 to 170 tons | 2 |  |  |  |  |  |  |  |  |
| 171 to 180 tons | 2 |  |  |  |  |  |  |  |  |
| 181 to 190 tons | 1 |  |  |  |  |  |  |  |  |
| Total | 11 |  |  |  |  |  |  |  |  |
| Net tonnage | 1,519 |  |  |  |  |  |  |  |  |
| Motor— | | | | | | | | | |
| 61 to 70 tons | 1 |  |  |  |  |  |  |  |  |
| 71 to 80 tons | 2 |  |  |  |  |  |  |  |  |
| Total | 3 |  |  |  |  |  |  |  |  |
| Net tonnage | 220 |  |  |  |  |  |  |  |  |
| Grand total | 14 |  |  |  |  |  |  |  |  |
| Net tonnage | 1,739 |  |  |  |  |  |  |  |  |
| Apparatus: Number | 14 | 100 | 259 | 30 | 520 | (1) | 19 | 190 | 9 |
| Length, yards | 4,722 | 26,340 | 71,419 |  |  |  | 6,290 |  |  |

*Fisheries of Delaware, 1926*—Continued

OPERATING UNITS: BY GEAR—Continued

| Items | Wire baskets | Spears | Eel pots | Lobster pots | Oyster dredges | Tongs | Rakes | By hand | Total, exclusive of duplication |
|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | |
| On boat or shore | 1 | 3 | 56 | 14 | | 110 | 14 | 13 | 862 |
| On vessels | | | | | 164 | | | | 646 |
| Total | 1 | 3 | 56 | 14 | 164 | 110 | 14 | 13 | 1,508 |
| Fishing boats: | | | | | | | | | |
| Motor | 1 | | 20 | 5 | | 18 | 7 | | 160 |
| Row | | 3 | 22 | 6 | | 85 | 4 | 11 | 403 |
| Fishing vessels: | | | | | | | | | |
| Steam— | | | | | | | | | |
| 81 to 90 tons | | | | | | | | | 1 |
| 91 to 100 tons | | | | | | | | | 1 |
| 101 to 110 tons | | | | | | | | | 1 |
| 111 to 120 tons | | | | | | | | | 2 |
| 121 to 130 tons | | | | | | | | | 1 |
| 161 to 170 tons | | | | | | | | | 2 |
| 171 to 180 tons | | | | | | | | | 2 |
| 181 to 190 tons | | | | | | | | | 1 |
| Total | | | | | | | | | 11 |
| Net tonnage | | | | | | | | | 1,519 |
| Motor— | | | | | | | | | |
| 5 to 10 tons | | | | | 7 | | | | 7 |
| 11 to 20 tons | | | | | 11 | | | | 11 |
| 21 to 30 tons | | | | | 2 | | | | 2 |
| 61 to 70 tons | | | | | | | | | 1 |
| 71 to 80 tons | | | | | | | | | 2 |
| Total | | | | | 20 | | | | 23 |
| Net tonnage | | | | | 257 | | | | 477 |
| Sail— | | | | | | | | | |
| 5 to 10 tons | | | | | 4 | | | | 4 |
| 21 to 30 tons | | | | | 1 | | | | 1 |
| Total | | | | | 5 | | | | 5 |
| Net tonnage | | | | | 55 | | | | 55 |
| Grand total | | | | | 25 | | | | 39 |
| Net tonnage | | | | | 312 | | | | 2,051 |
| Apparatus: Number | 5 | 3 | 1,106 | 300 | 50 | 94 | 12 | | |

1 Number undetermined.

*Catch by gear.*—Two types of gear caught 86 per cent of the catch, of which purse seines took 70 per cent and dredges took 16 per cent. The catch of purse seines consisted entirely of menhaden and that of dredges mostly of oysters and a few clams. In addition, haul seines (which took 6 per cent of the catch) and gill nets (which took 2 per cent) accounted for quantities of virtually every species of fish represented in the catch. The following table shows the amount of the species of fishery products taken and their mode of capture:

## *Fisheries of Delaware, 1926*

CATCH: BY GEAR

| Species | Purse seines | | Haul seines | | Gill nets | | Pound nets | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Alewives | | | 361,000 | $5,773 | 16,850 | $299 | 34,500 | $557 |
| Bluefish | | | 5,800 | 1,602 | 4,100 | 1,230 | 400 | 120 |
| Butterfish | | | 920 | 44 | 4,400 | 220 | 1,000 | 80 |
| Carp | | | 64,183 | 6,929 | 1,000 | 150 | 1,800 | 230 |
| Catfish | | | 25,400 | 1,543 | 350 | 23 | 5,750 | 402 |
| Croaker | | | 439,800 | 10,044 | 422,900 | 13,180 | 22,800 | 684 |
| Drum: | | | | | | | | |
| Black | | | 4,240 | 73 | | | | |
| Red | | | 3,310 | 60 | | | | |
| Eels | | | 400 | 72 | | | 400 | 74 |
| Flounders | | | 33,300 | 1,560 | 2,240 | 131 | 200 | 20 |
| King whiting or "kingfish" | | | 3,900 | 371 | 350 | 35 | | |
| Menhaden | 23,251,560 | $96,380 | | | | | | |
| Mullet | | | 20,500 | 834 | 1,750 | 138 | | |
| Pike | | | 500 | 75 | | | | |
| Scup or porgy | | | | | | | 2,000 | 160 |
| Shad | | | 13,606 | 2,799 | 133,446 | 36,807 | 43 | 15 |
| Spot | | | 90,200 | 5,403 | 11,400 | 892 | 2,000 | 120 |
| Squeteagues | | | 750,880 | 37,029 | 14,300 | 1,193 | 4,000 | 320 |
| Striped bass | | | 37,540 | 6,976 | 6,007 | 1,280 | | |
| Sturgeon | | | | | 5,580 | 2,561 | | |
| Sturgeon roe | | | | | 891 | 922 | | |
| Suckers | | | 1,800 | 78 | | | 800 | 40 |
| White perch | | | 48,500 | 2,406 | 10,945 | 2,195 | 1,100 | 192 |
| Yellow perch | | | 10,300 | 928 | | | 6,400 | 572 |
| Crabs, king | | | | | | | 320,000 | 800 |
| Terrapin | | | 1,080 | 750 | | | | |
| Turtles | | | 750 | 60 | | | | |
| Total | 23,251,560 | 96,380 | 1,917,909 | 85,409 | 636,509 | 61,256 | 403,193 | 4,386 |

| Species | Fyke nets | | Lines | | Minor apparatus and by hand | | Eel pots and spears | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Alewives | 133,700 | $2,075 | | | | | | |
| Carp | 7,951 | 1,198 | | | 34,614 | $6,661 | | |
| Catfish | 23,117 | 1,457 | | | 1,000 | 100 | | |
| Croaker | | | 11,600 | $348 | | | | |
| Eels | 13,090 | 1,874 | | | | | [1] 38,150 | $6,023 |
| Flounders | 30,300 | 1,728 | | | | | | |
| Spot | 300 | 24 | | | | | | |
| Squeteagues | 300 | 30 | 2,400 | 240 | | | | |
| Striped bass | 2,800 | 660 | | | | | | |
| Sunfish | 156 | 10 | | | | | | |
| Tautog | | | 12,000 | 600 | | | | |
| White perch | 4,399 | 520 | | | | | | |
| Yellow perch | 6,406 | 611 | | | | | | |
| Crabs: | | | | | | | | |
| Hard | 1,536 | 97 | 159,933 | 6,945 | 573 | 60 | | |
| King | | | | | [2] 320,000 | 800 | | |
| Frogs | | | | | [2] 1,800 | 450 | | |
| Turtles | 6,995 | 549 | 2,500 | 225 | | | | |
| Total | 231,050 | 10,833 | 188,433 | 8,358 | 357,987 | 8,071 | 38,150 | 6,023 |

| Species | Lobster pots | | Dredges | | Tongs and rakes | | Dip nets | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Crabs: | | | | | | | | |
| Hard | 4,800 | $600 | | | | | | |
| Soft | | | | | | | 155,820 | $43,950 |
| Lobsters | 20,640 | 6,202 | | | | | | |
| Clams, hard: | | | | | | | | |
| Public | | | | | 4,736 | $2,860 | | |
| Private | | | 48,256 | $21,864 | | | | |
| Oysters, market: | | | | | | | | |
| Public | | | | | 826,560 | 41,010 | | |
| Private | | | 2,585,205 | 435,020 | | | | |
| Oysters, seed, public | | | 2,586,920 | 197,740 | | | | |
| Total | 25,440 | 6,802 | 5,220,381 | 654,624 | 831,296 | 43,870 | 155,820 | 43,950 |

[1] Of this amount, 600 pounds, valued at $90, were taken by spears.
[2] Taken by hand.

*Fisheries by counties.*—In 1926, fishing was prosecuted in the counties of Kent, New Castle, and Sussex in the State of Delaware. In value, the fisheries of Kent County ranked foremost and accounted for 19 per cent of the total production and 66 per cent of the total value. Sussex County followed, accounting for 80 per cent of the total catch and 30 per cent of the total value. New Castle County ranked third in importance and accounted for the remainder of the catch.

*Fisheries of Delaware, 1926*

OPERATING UNITS AND CATCH: BY COUNTIES

| County | Fishermen | Vessels | | Motor boats | Other boats | Products | |
|---|---|---|---|---|---|---|---|
| | *Number* | *Number* | *Net tonnage* | *Number* | *Number* | *Pounds* | *Value* |
| Kent | 344 | 21 | 276 | 36 | 72 | 6,430,714 | $682,768 |
| New Castle | 120 | 1 | 5 | 49 | 29 | 214,948 | 41,258 |
| Sussex | 1,044 | 17 | 1,770 | 75 | 302 | 26,612,066 | 305,936 |
| Total | 1,508 | 39 | 2,051 | 160 | 403 | 33,257,728 | 1,029,962 |

INDUSTRIES RELATED TO THE FISHERIES

During 1926, there were no vessels or boats in Delaware engaged in transporting fishery products from the fishing grounds to market. Three menhaden factories operated in 1926, the statistics for which are given on page 468.

*Wholesale trade.*—In 1926 there were 12 wholesale establishments engaged chiefly in handling primary fishery products. Eleven of these handled oysters and one handled fresh fish. The total investment in these establishments amounted to $57,200 and the cash or working capital to $22,400. There were 245 persons employed, who received $79,886 in wages. In addition, 10 commission men, oyster shuckers, etc., were employed. These were not connected directly with the wholesale trade, and therefore the amount of their wages was not obtained. The following table shows the statistics of the wholesale fish trade of Delaware for 1926.

*Industries related to the fisheries of Delaware, 1926*

WHOLESALE FISHERY TRADE

| Items | Kent | Sussex | Total |
|---|---|---|---|
| Establishments | 5 | 7 | 12 |
| Persons engaged: | | | |
| In establishments | 104 | 141 | 245 |
| Not directly connected with establishments | 10 | | 10 |
| Wages paid in establishments | $31,866 | $48,020 | $79,886 |

NOTE.—Of the above firms, 11 handled oysters and 1 fresh fish.

HISTORICAL REVIEW

The Bureau of Fisheries has made 12 statistical canvasses of the fisheries of New York, New Jersey, Pennsylvania, and Delaware during the 47 years from 1880 to 1926. While the frequency of these canvasses is not all that might be desired, nevertheless, it is believed they offer a fair statistical picture of the trend of our fisheries in this section. On the other hand, it may have been that during one of the years for which a canvass was not made the catch may have been greater or smaller than during any year for which statistics were taken. It must be remembered that a true picture can be obtained only by having annual statistics. In spite of the intervals between canvasses, sufficient data are available to afford comparisons, and the statistics of the more important species of fish and shellfish of these States have been assembled in comparable form and are published herewith. In the following discussion the phrase "year upon which statistics are available" has been omitted, as the reader is to understand that only 12 canvasses, in most cases, are under consideration.

*Total catch.*—Production of fishery products in the Middle Atlantic States has shown a decline from 1880. In that year, 408,202,000 pounds of fishery products were taken, which is the largest catch on record. Since then the annual production has fluctuated, that for 1926 (the last year for which statistics were collected) amounting to 168,013,000 pounds.

*Bluefish.*—The production of the highly-prized bluefish in 1926 was but a fraction of what it has been in former years. Beginning with a production of 6,711,000 pounds in 1880, the catch increased to the high point of 16,323,000 pounds in 1897. Since that time it has declined, at first slightly and then at an alarming rate, until in 1926 the catch amounted to only 922,000 pounds.

*Bonito.*—The production of bonito never attained very large proportions, and the catch for 1926, while only about one-third that for 1921 (the high point), nevertheless is about the average for the years 1880 to 1926.

*Butterfish.*—The catches of this well-liked pan fish have increased in size during late years. Statistics were not shown in the reports until 1889, when 602,000 pounds were produced. Since then the catch has fluctuated, although there was a steady upward trend until 1926, when the production was the greatest on record and amounted to 4,089,000 pounds.

*Cod.*—The amount of this staple fish caught has remained fairly constant over the period under discussion. In 1880, 5,247,000 pounds were taken. Slight fluctuations occurred through the years. The peak was reached in 1908, with 6,823,000 pounds, and the low year was 1920, with 1,355,000 pounds. In 1926 the production amounted to 4,874,000 pounds, which is nearly four times the amount taken in 1921.

*Croaker.*—This species of fish, which formerly was given little consideration, now is esteemed highly. Statistics for the catch of croakers for this section were not reported until 1897, when 578,000 pounds were taken. During late years the catch has increased, 4,237,000 pounds having been taken in 1921. The catch then decreased somewhat, and reports showed 3,358,000 pounds as the production for 1926.

*Scup or porgy.*—This species appears in the catch in 1889, when 360,000 pounds were taken. Since then there has been a general upward trend in catch until 1921, when 5,555,000 pounds were taken. The catch in 1926 was smaller (3,504,000 pounds), although this year ranks second in size of catch.

*Sea bass.*—The production of sea bass reached its highest level in 1891, when 5,358,000 pounds were taken. Since then the catch has fluctuated, that of 1926 amounting to 2,370,000 pounds.

*Shad.*—The production of this fish, which is considered by some to be the choice fish of the Atlantic seaboard, suffered the severest decline of any in this region. The peak catch was taken in 1901, when 21,814,000 pounds were caught. In 1904 the production dropped to 6,623,000 pounds, or slightly more than in 1880. A further decline was recorded for 1908, and in 1921 only 390,000 pounds were reported, or about 2 per cent of the amount taken in 1901. In 1926 there was a recovery and 952,000 pounds were produced.

*Squeteague or weakfish.*—The production of this fish during the period under discussion has varied between the low mark of 6,259,000 pounds in 1887 and the high one of 25,567,000 pounds in 1908. Since 1908 the catch has declined considerably, although that for 1926 amounted to 9,401,000 pounds, which greatly exceeded the production of any of the species of fish under discussion.

*Striped bass.*—During late years the production of this game and commercial fish has declined, the catch in 1926 amounting to 197,000 pounds and being only about one-fifth as large as the greatest catch recorded—in 1888.

*Lobsters.*—The production of lobsters, one of our most desirable crustaceans, has increased considerably in late years, the peak having been reached in 1921, when 1,446,000 pounds were taken. In 1926 there was a slight decline, the catch amounting to 1,119,000 pounds, which is still greatly in excess of the production prior to 1921, however.

*Crabs.*—The catch of this species of crustacean has shown an almost uninterrupted decline from 1880, the most productive year on record, to 1926, the poorest year. In 1880 there were 3,180,000 pounds of crabs taken in this locality and in 1926 only 394,000 pounds.

*Oysters.*—This sea food, our most important mollusk, has yielded almost uniform catches in these States from 1887 to date, which have varied between about 4,595,000 bushels and 6,179,000 bushels. The catch in 1926 was a little over 5,644,000 bushels.

*Hard clams.*—The production of hard clams reached its peak in 1891, when 1,000,000 bushels were taken. However, since that year the records indicate a constant decline, the catch for 1926 having amounted to only 160,000 bushels.

*Scallops.*—While the amount of this popular mollusk taken never has reached large proportions in this section, it has grown fairly steadily in late years, the catch for 1926 amounting to 236,000 bushels. This is the largest catch on record.

Considered in general terms, the catches of butterfish, croaker, scup or porgy, lobsters, and scallops have increased in size, while those of bonito, cod, sea bass, and oysters have remained fairly constant, and the bluefish, shad, squeteague, striped bass, crab, and clam catches have decreased. The following table shows the comparative statistics of the catches of fish and shellfish.

*Fisheries of the Middle Atlantic States, 1880 to 1926*

CATCH OF CERTAIN SPECIES: BY STATES

[Expressed in thousands of pounds; that is, 000 omitted]

| Year | Bluefish | | | | | Bonito | | |
|---|---|---|---|---|---|---|---|---|
| | New York | New Jersey | Pennsylvania | Delaware | Total | New York | New Jersey | Total |
| 1880 | 3,000 | 3,636 | 30 | 46 | 6,711 | | | |
| 1887 | 2,853 | 4,789 | 30 | (1) | 7,672 | 21 | (1) | 21 |
| 1888 | 3,454 | 4,661 | | (1) | 8,115 | | | |
| 1889 | 5,027 | 8,565 | (1) | (1) | 13,592 | 3 | 178 | 181 |
| 1890 | 5,740 | 9,291 | (1) | (1) | 15,031 | 2 | 145 | 147 |
| 1891 | 5,507 | 7,228 | (1) | (1) | 12,735 | 2 | 150 | 152 |
| 1897 | 11,146 | 5,164 | 13 | | 16,323 | 43 | 359 | 402 |
| 1901 | 9,351 | 6,110 | 1 | | 15,462 | 195 | 1,459 | 1,654 |
| 1904 | 11,414 | 2,723 | | | 14,137 | 310 | 598 | 908 |
| 1908 | 3,191 | 1,850 | 8 | | 5,049 | 102 | 578 | 680 |
| 1921 | 1,083 | 2,243 | 1 | 1 | 3,328 | 256 | 1,503 | 1,759 |
| 1926 | 262 | 628 | 22 | 10 | 922 | 90 | 508 | 598 |

| Year | Butterfish | | | | | Cod | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | New York | New Jersey | Pennsylvania | Delaware | Total | New York | New Jersey | Pennsylvania | Delaware | Total |
| 1880 | | | | | | 3,580 | 1,667 | (1) | | 5,247 |
| 1887 | | | | | | 3,455 | 788 | 30 | | 4,273 |
| 1888 | | | | | | 3,195 | 726 | 21 | (1) | 3,942 |
| 1889 | 365 | 237 | (1) | (1) | 602 | 1,880 | 982 | 148 | (1) | 3,010 |
| 1890 | 423 | 239 | (1) | (1) | 662 | 1,939 | 730 | 142 | (1) | 2,811 |
| 1891 | 837 | 231 | (1) | (1) | 1,068 | 2,277 | 841 | 133 | (1) | 3,251 |
| 1897 | 729 | 217 | | | 946 | 2,116 | 3,482 | | | 5,598 |
| 1901 | 591 | 3,008 | | | 3,599 | 1,172 | 2,301 | | 1 | 3,474 |
| 1904 | 579 | 1,357 | | | 1,936 | 1,170 | 1,262 | | 1 | 2,433 |
| 1908 | 1,229 | 2,054 | | | 3,283 | 2,999 | 3,767 | 50 | 7 | 6,823 |
| 1921 | 630 | 2,863 | | | 3,493 | 668 | 687 | | | 1,355 |
| 1926 | 998 | 3,078 | 6 | 7 | 4,089 | 2,643 | 2,217 | 14 | | 4,874 |

| Year | Croaker | | | | | Scup or porgy | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | New York | New Jersey | Pennsylvania | Delaware | Total | New York | New Jersey | Pennsylvania | Delaware | Total |
| 1889 | | | | | | 348 | 12 | (1) | (1) | 360 |
| 1890 | | | | | | 369 | 16 | (1) | (1) | 385 |
| 1891 | | | | | | 351 | 26 | (1) | (1) | 377 |
| 1897 | (1) | 281 | | 297 | 578 | 746 | 758 | 29 | | 1,533 |
| 1901 | | 226 | 6 | 29 | 261 | 804 | 607 | 23 | | 1,434 |
| 1904 | | 342 | | 25 | 367 | 1,494 | 1,055 | | | 2,549 |
| 1908 | 8 | 790 | 14 | 79 | 891 | 1,294 | 1,196 | 11 | | 2,501 |
| 1921 | (1) | 3,816 | 2 | 419 | 4,237 | 1,297 | 4,116 | 142 | | 5,555 |
| 1926 | 4 | 2,456 | 1 | 897 | 3,358 | 928 | 2,452 | 122 | 2 | 3,504 |

[1] Not specified.

*Fisheries of the Middle Atlantic States, 1880 to 1926*—Continued

CATCH OF CERTAIN SPECIES: BY STATES—Continued

[Expressed in thousands of pounds; that is, 000 omitted]

| Year | Sea bass | | | | | Shad | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | New York | New Jersey | Pennsylvania | Delaware | Total | New York | New Jersey | Pennsylvania | Delaware | Total |
| 1880 | | | | | | 2,734 | 750 | 559 | 1,050 | 5,093 |
| 1887 | 319 | 819 | 666 | 4 | 1,808 | 3,586 | 6,496 | 1,424 | 1,270 | 12,776 |
| 1888 | 309 | 816 | 738 | 2 | 1,865 | 3,446 | 6,523 | 1,387 | 1,389 | 12,745 |
| 1889 | 558 | 2,968 | 615 | (1) | 4,141 | 4,332 | 10,424 | 2,753 | 1,498 | 19,007 |
| 1890 | 751 | 3,560 | 803 | (1) | 5,114 | 3,777 | 10,623 | 2,898 | 1,797 | 19,095 |
| 1891 | 679 | 3,732 | 947 | (1) | 5,358 | 3,045 | 10,225 | 2,693 | 1,500 | 17,463 |
| 1897 | 354 | 2,132 | 900 | 2 | 3,388 | 1,884 | 13,001 | 2,007 | 1,621 | 18,513 |
| 1901 | 232 | 1,495 | 687 | 1 | 2,415 | 3,432 | 14,031 | 2,983 | 1,368 | 21,814 |
| 1904 | 320 | 2,572 | | 1 | 2,893 | 498 | 4,338 | 836 | 951 | 6,623 |
| 1908 | 723 | 3,161 | 860 | | 4,744 | 360 | 3,004 | 593 | 870 | 4,827 |
| 1921 | 149 | 1,378 | 135 | | 1,662 | 116 | 168 | 19 | 87 | 390 |
| 1926 | 231 | 2,096 | 43 | | 2,370 | 231 | 553 | 21 | 147 | 952 |

| Year | Squeteague or weakfish | | | | | Striped bass | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | New York | New Jersey | Pennsylvania | Delaware | Total | New York | New Jersey | Pennsylvania | Delaware | Total |
| 1880 | 4,000 | 4,430 | 15 | 2,619 | 11,064 | | | | | |
| 1887 | 1,505 | 2,377 | | 2,377 | 6,259 | 116 | 615 | 15 | 116 | 861 |
| 1888 | 1,435 | 2,845 | | 2,452 | 6,732 | 98 | 739 | 59 | 116 | 1,012 |
| 1889 | 2,802 | 4,716 | (1) | 3,212 | 10,730 | 212 | 306 | 24 | 110 | 652 |
| 1890 | | | | | | 208 | 328 | 23 | 107 | 666 |
| 1891 | | | | | | 205 | 298 | 25 | 95 | 623 |
| 1897 | 2,562 | 8,679 | | 1,441 | 12,682 | 116 | 287 | 10 | 129 | 542 |
| 1901 | 2,347 | 11,973 | 4 | 722 | 15,046 | 72 | 354 | 13 | 48 | 487 |
| 1904 | 6,340 | 10,699 | | 773 | 17,812 | 53 | 66 | 6 | 40 | 165 |
| 1908 | 11,151 | 11,814 | 12 | 2,590 | 25,567 | 45 | 53 | 7 | 53 | 158 |
| 1921 | 1,921 | 11,652 | 240 | 886 | 14,699 | 95 | 70 | | 5 | 170 |
| 1926 | 1,073 | 7,173 | 383 | 772 | 9,401 | 87 | 64 | | 46 | 197 |

| Year | Lobsters | | | | Crabs | | | |
|---|---|---|---|---|---|---|---|---|
| | New York | New Jersey | Delaware | Total | New York | New Jersey | Delaware | Total |
| 1880 | 135 | 157 | | 292 | 1,625 | 1,470 | 85 | 3,180 |
| 1887 | 114 | 102 | 39 | 255 | 983 | 1,489 | 205 | 2,677 |
| 1888 | 248 | 182 | 39 | 469 | 1,287 | 1,431 | 152 | 2,870 |
| 1889 | 124 | 188 | 10 | 322 | 531 | 354 | 124 | 1,009 |
| 1890 | 151 | 185 | 7 | 343 | 519 | 418 | 108 | 1,045 |
| 1891 | 165 | 166 | 8 | 339 | 529 | 520 | 86 | 1,135 |
| 1897 | 381 | 99 | 5 | 485 | 418 | 795 | 169 | 1,377 |
| 1901 | 183 | 66 | 3 | 252 | 832 | 1,138 | 151 | 2,121 |
| 1904 | 230 | 141 | 3 | 374 | 826 | 350 | 185 | 1,311 |
| 1908 | 423 | 115 | 6 | 544 | 602 | 345 | 199 | 1,146 |
| 1921 | 1,037 | 398 | 11 | 1,446 | 483 | 136 | 5 | 624 |
| 1926 | 455 | 643 | 21 | 1,119 | 3 | 68 | 323 | 394 |

1 Not specified.

*Fisheries of the Middle Atlantic States, 1880 to 1926*—Continued

CATCH OF CERTAIN SPECIES: BY STATES—Continued

[Expressed in thousands of bushels; that is, 000 omitted]

| Year | Oysters | | | | | Hard clams | | | | Scallops | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | New York | New Jersey | Pennsylvania | Delaware | Total | New York | New Jersey | Delaware | Total | New York | New Jersey | Total |
| 1880 | 1,043 | 1,975 | (1) | 300 | ...... | 349 | 392 | 1 | 742 | ...... | ...... | ...... |
| 1887 | 1,986 | 2,620 | 224 | 39 | 4,869 | ...... | ...... | ...... | ...... | 91 | ...... | 91 |
| 1888 | 1,901 | 2,525 | 227 | 42 | 4,695 | ...... | ...... | ...... | ...... | 57 | ...... | 57 |
| 1889 | 2,090 | 2,166 | 191 | 148 | 4,595 | 520 | 427 | 2 | 949 | 102 | ...... | 102 |
| 1890 | 2,351 | 2,259 | 178 | 169 | 4,957 | 525 | 425 | 3 | 953 | 132 | ...... | 132 |
| 1891 | 2,611 | 2,302 | 169 | 157 | 5,239 | 565 | 432 | 3 | 1,000 | 70 | ...... | 70 |
| 1897 | 2,127 | 3,005 | 266 | 164 | 5,562 | 184 | 591 | 1 | 776 | 148 | 12 | 160 |
| 1901 | 2,313 | 3,609 | 84 | 173 | 6,179 | 185 | 531 | 1 | 717 | 185 | 7 | 192 |
| 1904 | 3,329 | 2,135 | 118 | 242 | 5,824 | 167 | 271 | 1 | 439 | 149 | ...... | 149 |
| 1908 [2] | 2,463 | 2,586 | 277 | 348 | 5,674 | 101 | 273 | 1 | 375 | 108 | ...... | 108 |
| 1921 | 1,357 | 3,285 | (2) | 617 | 5,259 | 96 | 98 | 1 | 195 | 206 | ...... | 206 |
| 1926 | 1,080 | 3,707 | (2) | 857 | 5,644 | 73 | 80 | 7 | 160 | 228 | 8 | 236 |

[1] Not specified.

[2] From 1880 to 1908, inclusive, oysters taken from Delaware and New Jersey beds by vessels owned in Pennsylvania were credited to the latter State, but after 1908 they have been credited to the States in which the beds are located.

TOTAL CATCH: BY STATES

| Year | New York | | New Jersey | | Pennsylvania | | Delaware | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Quantity* | *Value* | *Quantity* | *Value* | *Quantity* | *Value* | *Quantity* | *Value* | *Quantity* | *Value* |
| 1880 | 329,453 | $4,226 | 65,151 | $3,176 | 1,680 | $277 | 11,918 | $998 | 408,202 | $8,677 |
| 1887 | 130,288 | 3,387 | 65,246 | 4,168 | 7,895 | 333 | 10,396 | 211 | 213,825 | 8,099 |
| 1888 | 192,513 | 3,466 | 61,115 | 4,199 | 12,901 | 344 | 10,226 | 209 | 276,755 | 8,218 |
| 1889 | 175,936 | 4,182 | 82,362 | 3,170 | 7,166 | 325 | 9,859 | 257 | 275,323 | 7,934 |
| 1890 | 192,471 | 4,602 | 88,730 | 3,447 | 7,849 | 328 | 10,054 | 267 | 299,104 | 8,644 |
| 1891 | 170,885 | 4,817 | 79,116 | 3,520 | 7,584 | 322 | 7,698 | 255 | 265,283 | 8,914 |
| 1892 | (3) | (3) | 73,267 | 3,646 | 6,324 | 284 | 7,195 | 251 | ...... | ...... |
| 1897 | 109,556 | 3,392 | 103,782 | 3,614 | 5,604 | 269 | 8,648 | 252 | 227,590 | 7,527 |
| 1898 | 210,497 | 3,545 | 90,297 | 3,564 | (3) | (3) | (3) | (3) | ...... | ...... |
| 1901 | 228,092 | 3,894 | 117,931 | 4,756 | 6,030 | 251 | 5,835 | 203 | 357,888 | 9,104 |
| 1904 | 277,650 | 6,231 | 90,108 | 3,385 | 2,046 | 167 | 5,608 | 260 | 375,412 | 10,043 |
| 1908 | 71,474 | 4,390 | 74,827 | 3,069 | 4,380 | 280 | 70,769 | 541 | 221,450 | 8,280 |
| 1921 | 210,377 | 4,987 | 96,937 | 5,983 | 595 | 45 | 25,023 | 652 | 332,932 | 11,667 |
| 1926 | 60,721 | 5,129 | 73,299 | 6,254 | 735 | 43 | 33,258 | 1,030 | 168,013 | 12,456 |

[3] Statistics not available.

## SHAD OF THE HUDSON RIVER

In 1927, the fishery for shad was carried on by 268 fishermen. It yielded 110,284 fish that weighed 358,055 pounds and were valued at $63,650. Of this number, 82 per cent were taken by New York fishermen and the remaining 18 per cent by New Jersey fishermen. Compared with the yield in 1926, there is an increase of 31 per cent in number, 35 per cent in weight, and 19 per cent in value. The yield in 1927 represents the largest catch in any year for which statistics are available, from 1910 to the present, but is less than half as large as the yield for that year. The most successful year of any for which statistics are available, from 1896 to the present, was 1901, when 973,927 were caught. While the catch of 1927 is considerably less than that for 1901, nevertheless it is gratifying to note that the yield has been increasing during late years.

*Shad fishery of the Hudson River in 1927*

| Items | New York | | | New Jersey | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Number* | *Pounds* | *Value* | *Number* | *Pounds* | *Value* | *Number* | *Pounds* | *Value* |
| Fishermen | 252 | | | 16 | | | 268 | | |
| Rowboats and scows | 100 | | $5,330 | 5 | | $1,200 | 105 | | $6,530 |
| Gasoline boats | 46 | | 8,975 | 4 | | 3,000 | 50 | | 11,975 |
| Gill nets | 123 | | 14,050 | 7 | | 700 | 130 | | 14,750 |
| Haul seines | 5 | | 535 | | | | 5 | | 535 |
| Shore and accessory property | | | 3,725 | | | 2,000 | | | 5,725 |
| Total | | | 32,615 | | | 6,900 | | | 39,515 |
| Shad caught: | | | | | | | | | |
| With gill nets | 85,174 | 283,041 | 53,977 | 20,300 | 58,362 | 6,700 | 105,474 | 341,403 | 60,677 |
| With seines | 4,337 | 15,023 | 2,586 | | | | 4,337 | 15,023 | 2,586 |
| With other apparatus incidentally | 473 | 1,629 | 387 | | | | 473 | 1,629 | 387 |
| Total | 89,984 | 299,693 | 56,950 | 20,300 | 58,362 | 6,700 | 110,284 | 358,055 | 63,650 |

*Catch of shad in the Hudson River, 1896 to 1927*

| Year | New York | | | New Jersey | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Number* | *Pounds* | *Value* | *Number* | *Pounds* | *Value* | *Number* | *Pounds* | *Value* |
| 1896 | 420,098 | 1,681,371 | $58,921 | 168,800 | 675,595 | $24,316 | 588,898 | 2,356,966 | $83,237 |
| 1897 | 404,877 | 1,506,142 | 49,353 | 115,200 | 529,920 | 17,934 | 520,077 | 2,036,062 | 67,287 |
| 1898 | 410,395 | 1,534,877 | 50,875 | 129,855 | 606,423 | 18,510 | 540,250 | 2,141,300 | 69,385 |
| 1901 | 829,612 | 3,202,302 | 100,762 | 144,315 | 577,260 | 21,647 | 973,927 | 3,779,562 | 122,409 |
| 1904 | 100,624 | 402,496 | 28,896 | 57,657 | 201,800 | 17,758 | 158,281 | 604,296 | 46,654 |
| 1910 [1] | 126,534 | 506,136 | 51,715 | 101,720 | 406,880 | 49,109 | 228,254 | 913,016 | 100,824 |
| 1915 | 11,606 | 48,564 | 5,969 | 4,249 | 20,104 | 2,674 | 15,855 | 68,668 | 8,643 |
| 1916 | 7,787 | 32,923 | 4,540 | 1,500 | 7,250 | 925 | 9,287 | 40,173 | 5,465 |
| 1917 | 10,615 | 38,344 | 5,810 | 1,400 | 5,040 | 720 | 12,015 | 43,384 | 6,530 |
| 1918 | 63,404 | 220,602 | 44,784 | 3,999 | 14,000 | 3,400 | 67,403 | 234,602 | 48,184 |
| 1919 | 76,501 | 301,306 | 60,690 | 13,800 | 73,668 | 23,034 | 90,301 | 374,974 | 83,724 |
| 1920 | 39,692 | 157,715 | 43,882 | 9,623 | 42,129 | 12,427 | 49,315 | 199,844 | 56,309 |
| 1921 | 28,948 | 104,883 | 24,329 | 6,500 | 25,920 | 6,294 | 35,448 | 130,803 | 30,623 |
| 1922 | 36,111 | 128,324 | 27,451 | 12,225 | 46,862 | 12,255 | 48,336 | 175,186 | 39,706 |
| 1923 | 28,636 | 97,863 | 22,644 | 6,450 | 23,865 | 6,000 | 35,086 | 121,728 | 28,644 |
| 1924 | 22,814 | 72,519 | 17,619 | 5,980 | 21,850 | 5,485 | 28,794 | 94,369 | 23,104 |
| 1925 | 34,568 | 110,359 | 24,030 | 4,300 | 13,975 | 2,400 | 38,868 | 124,334 | 26,430 |
| 1926 | 73,312 | 219,183 | 47,175 | 11,150 | 46,237 | 6,300 | 84,462 | 265,420 | 53,475 |
| 1927 | 89,984 | 299,693 | 56,950 | 20,300 | 58,362 | 6,700 | 110,284 | 358,055 | 63,650 |

[1] Includes catch in lower New York Bay and Raritan Bay and tributaries, but this was inconsiderable.

## FISHERIES OF THE CHESAPEAKE BAY STATES

The latest statistical canvass of the fisheries and fishery industries of the Chesapeake Bay States (Maryland and Virginia) was for the calendar year 1925. Complete statistics are published in the report of the division of fishery industries for 1926 and in condensed form in Statistical Bulletin No. 745.

During 1925, the fisheries and fishery industries of Maryland and Virginia gave employment to 39,091 persons, of whom 25,856 were engaged in fishing operations, 9,671 in the wholesale fishery trade, and 3,564 in the canning, salting, smoking, and by-products industries. The products of the fisheries of the two States amounted to 333,205,769 pounds, valued at $13,948,060. The products of the canning and other fishery industries had a value of $4,936,664.

In addition to the above general canvass, annual statistics are collected on the production of the shad and alewife fisheries of the Potomac River and on the fishery products received at the municipal fish wharf and market in Washington, D. C. Statistics for 1927 on these subjects are discussed on the following pages.

## SHAD AND ALEWIFE OF THE POTOMAC RIVER

In 1927, this fishery was prosecuted by 682 fishermen. It yielded 222,321 shad that weighed 686,581 pounds, valued at $113,825 to the fishermen. Compared with the yield for 1926, this is a decrease of 34 per cent in number, 34 per cent in weight, and 48 per cent in value. Of the total number, 86 per cent were taken by Virginia fishermen and the remaining 14 per cent by Maryland fishermen.

The catch of alewives amounted to 11,608,067 fish with a weight of 4,645,365 pounds, valued at $50,588 to the fishermen. This is a decrease of 16 per cent in number, 16 per cent in weight, and 9 per cent in value, compared with the yield in 1926. Of the total number, 89 per cent were taken by Virginia fishermen and the remaining 11 per cent by Maryland fishermen.

*Shad and alewife fisheries of the Potomac River, 1927*

| Items | Maryland | | | Virginia | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Number* | *Pounds* | *Value* | *Number* | *Pounds* | *Value* | *Number* | *Pounds* | *Value* |
| Fishermen | 218 | | | 464 | | | 682 | | |
| Rowboats | 81 | | $3,280 | 184 | | $6,325 | 265 | | $9,605 |
| Gasoline boats | 57 | | 16,265 | 183 | | 65,085 | 240 | | 81,350 |
| Pound nets | 99 | | 16,250 | 352 | | 120,375 | 451 | | 136,625 |
| Gill nets [1] | 72 | | 7,790 | 331 | | 8,013 | 403 | | 15,803 |
| Total | | | 43,585 | | | 199,798 | | | 243,383 |
| Shad caught: | | | | | | | | | |
| With pound nets | 7,219 | 21,523 | 3,690 | 165,703 | 489,367 | 79,704 | 172,922 | 510,890 | 83,394 |
| With gill nets [1] | 23,501 | 82,205 | 14,204 | 25,898 | 93,486 | 16,227 | 49,399 | 175,691 | 30,431 |
| Total | 30,720 | 103,728 | 17,894 | 191,601 | 582,853 | 95,931 | 222,321 | 686,581 | 113,825 |
| Alewives caught: | | | | | | | | | |
| With pound nets | 1,222,000 | 488,699 | 5,541 | 10,196,067 | 4,080,666 | 43,122 | 11,418,067 | 4,569,365 | 48,663 |
| With gill nets [1] | 50,000 | 20,000 | 200 | 140,000 | 56,000 | 1,725 | 190,000 | 76,000 | 1,925 |
| Total | 1,272,000 | 508,699 | 5,741 | 10,336,067 | 4,136,666 | 44,847 | 11,608,067 | 4,645,365 | 50,588 |

[1] Includes the statistics on one small haul seine in Maryland.

*Catch of shad in the Potomac River, 1896 to 1927*

| Year | Maryland | | | Virginia | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Number* | *Pounds* | *Value* | *Number* | *Pounds* | *Value* | *Number* | *Pounds* | *Value* |
| 1927 | 30,720 | 103,728 | $17,894 | 191,601 | 582,853 | $95,931 | 222,321 | 686,581 | $113,825 |
| 1926 | 51,601 | 162,861 | 34,808 | 285,061 | 871,345 | 182,653 | 336,662 | 1,034,206 | 217,461 |
| 1925 | 46,008 | 157,786 | 35,310 | 158,574 | 538,846 | 128,088 | 204,582 | 696,632 | 163,398 |
| 1924 | 37,505 | 127,285 | 20,469 | 134,805 | 450,925 | 67,981 | 172,310 | 578,210 | 88,450 |
| 1923 | 93,619 | 308,729 | 52,917 | 257,927 | 878,653 | 145,702 | 351,546 | 1,187,382 | 198,619 |
| 1922 | 203,682 | 706,501 | 95,140 | 680,494 | 2,409,070 | 324,882 | 884,176 | 3,115,571 | 420,022 |
| 1921 | 49,681 | 138,207 | 25,191 | 356,191 | 1,022,231 | 182,179 | 405,872 | 1,160,438 | 207,370 |
| 1920 | 80,944 | 302,237 | 55,963 | 448,414 | 1,677,543 | 278,501 | 529,358 | 1,979,780 | 334,464 |
| 1919 | 94,512 | 354,420 | 56,833 | 449,957 | 1,687,339 | 275,564 | 544,469 | 2,041,759 | 332,397 |
| 1915 | 17,196 | 64,485 | 6,827 | 165,206 | 619,523 | 65,300 | 182,402 | 684,008 | 72,127 |
| 1909 | 31,158 | 116,843 | 9,232 | 172,813 | 648,049 | 44,500 | 203,971 | 764,892 | 53,732 |
| 1904 | 83,147 | 311,801 | 16,343 | 289,500 | 1,085,625 | 51,709 | 372,647 | 1,397,426 | 68,052 |
| 1901 | 146,000 | 547,500 | 14,800 | 648,462 | 2,431,733 | 104,566 | 794,462 | 2,979,233 | 119,366 |
| 1896 | 233,238 | 874,643 | 20,524 | 450,825 | 1,690,594 | 43,084 | 684,063 | 2,565,237 | 63,608 |

*Catch of alewives in the Potomac River, 1909 to 1927*

| Year | Maryland | | | Virginia | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Number* | *Pounds* | *Value* | *Number* | *Pounds* | *Value* | *Number* | *Pounds* | *Value* |
| 1927 | 1, 272, 000 | 508, 699 | $5, 741 | 10, 336, 067 | 4, 136, 666 | $44, 847 | 11, 608, 067 | 4, 645, 365 | $50, 588 |
| 1926 | 1, 295, 020 | 518, 600 | 6, 518 | 12, 500, 828 | 5, 000, 330 | 48, 848 | 13, 795, 848 | 5, 518, 930 | 55, 366 |
| 1925 | 415, 000 | 166, 000 | 2, 070 | 7, 420, 380 | 2, 968, 152 | 35, 271 | 7, 835, 380 | 3, 134, 152 | 37, 341 |
| 1924 | 1, 834, 000 | 733, 600 | 6, 855 | 13, 299, 388 | 5, 319, 156 | 49, 667 | 15, 133, 388 | 6, 052, 756 | 56, 552 |
| 1923 | 2, 119, 787 | 847, 916 | 8, 764 | 9, 308, 782 | 3, 722, 912 | 40, 657 | 11, 428, 569 | 4, 570, 828 | 49, 421 |
| 1922 | 1, 292, 500 | 517, 000 | 3, 700 | 10, 074, 500 | 4, 029, 800 | 34, 642 | 11, 367, 000 | 4, 546, 800 | 38, 342 |
| 1921 | 1, 395, 000 | 558, 000 | 9, 010 | 8, 908, 510 | 3, 563, 404 | 35, 031 | 10, 303, 510 | 4, 121, 404 | 44, 041 |
| 1920 | 1, 077, 775 | 538, 888 | 13, 940 | 7, 681, 561 | 3, 813, 780 | 41, 197 | 8, 759, 336 | 4, 352, 668 | 55, 137 |
| 1919 | 1, 488, 583 | 772, 867 | 15, 508 | 7, 379, 319 | 2, 904, 054 | 45, 508 | 8, 867, 902 | 3, 676, 921 | 61, 016 |
| 1915 | 335, 000 | | 1, 420 | 7, 276, 428 | | 30, 741 | 7, 611, 428 | | 32, 161 |
| 1909 | 4, 883, 000 | | 10, 369 | 24, 601, 040 | | 42, 854 | 29, 484, 040 | | 53, 223 |

## PRODUCTS RECEIVED AT MUNICIPAL FISH WHARF AND MARKET, WASHINGTON, D. C.

Receipts of fresh and frozen fishery products at the municipal fish wharf and market, Washington, D. C., in 1927 amounted to 7,997,673 pounds, which is an increase of 6 per cent over the previous year and 15 per cent above the 5-year average. These products are taken chiefly in Chesapeake Bay, but quantities are taken at other points along the Atlantic Ocean, also, with lesser quantities originating in the Great Lakes and Pacific coast regions.

The great bulk of the Chesapeake Bay products is conveyed by boat and unloaded at the wharf of the market. Products originating at other points are transported by rail and are unloaded at the freight and express terminals in the city. Some products originating at points along the Chesapeake Bay not on a railroad and in close proximity to Washington are conveyed to the market by motor truck.

According to the amount of fishery products handled at this wharf and market, nine salt-water products are of commercial importance and constitute 75 per cent of the trade. Named in order of importance, these are squeteagues or "sea trout," croaker, river herring, oysters, haddock, shad, striped bass, butterfish, and mackerel (including Spanish mackerel). Except for the haddock and mackerels, the majority of the fish in this group are taken in local waters. Thirteen fishery products (10 salt-water and 3 fresh-water) are of moderate importance, constitute 20 per cent of the trade, and are taken chiefly in local or near-by waters.

In the group of slight importance are 32 products that constitute only 5 per cent of the trade. Some of these originate in distant sections of the country, and most of them are salt-water products.

It is estimated that 2,000,000 pounds of fresh and frozen fishery products are received by retail dealers, hotels, and restaurants direct from producers, which with the amount received at the municipal wharf would make a total of about 10,000,000 pounds of fresh and frozen fishery products that were handled in the District of Columbia during 1927. Virtually the entire amount was consumed in the District. According to the Bureau of the Census, the estimated population of the District of Columbia was 540,000 on July 1, 1927, making the per capita consumption of fresh and frozen fishery products during 1927 about 19 pounds.

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*Fishery products received at municipal fish wharf and market, Washington, D. C., 1927, in pounds*

| Species | January | February | March | April | May | June | July |
|---|---|---|---|---|---|---|---|
| Bass, black or sea | 3,800 | 4,600 | 300 | ---------- | 3,300 | 5,900 | 2,000 |
| Bluefish | 500 | ---------- | 200 | ---------- | 6,200 | 11,300 | 1,300 |
| Butterfish | 1,200 | 1,200 | 3,600 | 1,500 | 53,500 | 64,600 | 68,400 |
| Carp | 12,300 | 11,300 | 11,450 | 11,203 | 12,900 | 10,600 | 9,800 |
| Catfish | 4,600 | 19,500 | 26,070 | 16,600 | 9,300 | 16,000 | 17,200 |
| Cod | 2,500 | 4,300 | 7,900 | 6,300 | 2,500 | 3,300 | 2,900 |
| Crappie | 100 | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- |
| Croaker | 20,200 | 9,400 | 24,600 | 266,050 | 267,700 | 149,400 | 216,000 |
| Eels | 1,000 | ---------- | 1,445 | 1,095 | 200 | 770 | 200 |
| Flounders | 21,900 | 28,300 | 26,300 | 19,600 | 15,200 | 7,500 | 1,900 |
| Gizzard shad | 3,200 | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- |
| Haddock | 38,980 | 50,460 | 57,380 | 31,100 | 23,260 | 43,830 | 26,800 |
| Hake | 9,200 | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- |
| Halibut | 4,100 | 7,400 | 10,900 | 8,200 | 8,000 | 9,900 | 7,900 |
| Herring, river | 24,700 | 79,900 | 274,650 | 459,340 | 189,600 | 3,500 | ---------- |
| Hickory shad or "jacks" | 6,000 | 4,400 | 3,000 | 3,200 | 2,100 | ---------- | ---------- |
| Kingfish | 3,500 | 200 | 1,000 | 7,400 | 1,000 | 200 | ---------- |
| Mackerel (including Spanish) | 13,300 | 7,000 | 11,100 | 10,800 | 39,100 | 46,200 | 35,600 |
| Menhaden | ---------- | ---------- | 1,200 | ---------- | ---------- | ---------- | ---------- |
| Mullet | 100 | 600 | 2,200 | ---------- | ---------- | 100 | 400 |
| Perch | 11,400 | 23,400 | 47,000 | 27,160 | 9,650 | 3,800 | 4,000 |
| Pike or pickerel | 1,100 | 2,700 | 700 | ---------- | ---------- | ---------- | 100 |
| Pollock | 200 | 1,800 | ---------- | 400 | 600 | 600 | 2,200 |
| Pompano | ---------- | ---------- | ---------- | ---------- | ---------- | 100 | ---------- |
| Redfish or red drum | 400 | 200 | ---------- | ---------- | 550 | ---------- | ---------- |
| Red snapper | 200 | 700 | ---------- | 400 | 1,200 | 2,000 | 400 |
| Salmon | 2,800 | 2,100 | 2,700 | 100 | ---------- | 800 | 1,300 |
| Scup or porgy | ---------- | ---------- | ---------- | ---------- | 2,100 | 4,800 | 200 |
| Shad | 31,300 | 23,000 | 72,400 | 138,601 | 121,750 | 100 | ---------- |
| Sheepshead | 1,300 | 1,300 | ---------- | 400 | ---------- | ---------- | ---------- |
| Smelt | 1,800 | 1,060 | 700 | ---------- | ---------- | ---------- | ---------- |
| Spot | 4,800 | 1,200 | 200 | 2,200 | 14,800 | 15,100 | 24,200 |
| Squeteagues or "sea trout" | 19,400 | 16,600 | 27,500 | 15,400 | 240,100 | 158,000 | 148,200 |
| Squid | ---------- | ---------- | ---------- | ---------- | 600 | 2,000 | 200 |
| Striped bass | 17,900 | 18,100 | 57,900 | 92,275 | 17,925 | 9,700 | 18,050 |
| Sturgeon | ---------- | ---------- | ---------- | 200 | 650 | 525 | ---------- |
| Swordfish | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | 650 |
| Tilefish | 400 | 1,200 | 1,900 | 700 | 200 | 400 | 800 |
| Whitefish | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | 200 |
| Whiting | 14,300 | ---------- | 3,000 | ---------- | 800 | ---------- | ---------- |
| Clams, hard | 3,232 | 2,624 | 3,776 | 4,960 | 6,336 | 7,168 | 6,432 |
| Oysters: | | | | | | | |
| In the shell | 21,826 | 34,335 | 17,668 | 5,005 | 140 | 168 | ---------- |
| Opened | 58,262 | 30,995 | 25,930 | 5,833 | 165 | ---------- | ---------- |
| Scallops | 1,120 | ---------- | 480 | 480 | 1,120 | 640 | 480 |
| Crabs | ---------- | ---------- | 150 | 1,695 | 8,040 | 25,380 | 44,421 |
| Crab meat | 780 | 760 | 575 | 3,550 | 8,485 | 12,900 | 14,900 |
| Lobsters | ---------- | 50 | 250 | 250 | 450 | 550 | 250 |
| Shrimp | 1,050 | 4,400 | 2,400 | 4,400 | 9,600 | 7,000 | 3,200 |
| Turtles | 958 | 154 | 38 | 160 | 1,420 | 444 | 708 |
| Frogs | ---------- | ---------- | 6 | ---------- | 86 | 42 | ---------- |
| Total | 365,708 | 395,238 | 728,568 | 1,146,557 | 1,080,627 | 625,317 | 661,291 |

*Fishery products received at municipal fish wharf and market, Washington, D. C., 1927, in pounds*—Continued

| Species | August | September | October | November | December | Total |
|---|---|---|---|---|---|---|
| Angelfish |  |  | 200 |  |  | 200 |
| Bass, black or sea | 1,700 | 500 | 100 | 4,200 | 800 | 27,200 |
| Bluefish | 3,000 | 10,800 | 5,600 | 400 |  | 39,300 |
| Butterfish | 54,200 | 52,300 | 4,600 | 1,250 | 600 | 306,950 |
| Carp | 6,500 | 7,800 | 7,100 | 9,300 | 2,900 | 113,153 |
| Catfish | 4,775 | 16,700 | 25,500 | 25,600 | 10,420 | 192,265 |
| Cod | 3,000 | 1,900 | 1,400 | 7,700 | 600 | 44,300 |
| Crappie |  |  |  |  |  | 100 |
| Croaker | 229,600 | 88,000 | 36,000 | 68,600 | 44,500 | 1,420,050 |
| Eels | 200 | 600 | 3,380 | 1,800 | 300 | 10,990 |
| Flounders | 6,400 | 9,800 | 16,500 | 30,600 | 10,550 | 194,550 |
| Gizzard shad |  |  |  |  | 2,400 | 5,600 |
| Haddock | 22,500 | 47,240 | 43,300 | 33,550 | 24,820 | 443,220 |
| Hake |  | 600 | 9,200 | 66,600 | 37,200 | 122,800 |
| Halibut | 6,000 | 5,600 | 10,400 | 8,000 | 3,600 | 90,000 |
| Herring, river | 200 |  |  |  |  | 1,031,890 |
| Hickory shad or "jacks" |  |  |  |  |  | 18,700 |
| Kingfish | 800 | 100 | 9,200 | 7,100 | 6,350 | 36,850 |
| Mackerel (including Spanish) | 38,500 | 34,000 | 16,000 | 9,300 | 8,800 | 269,700 |
| Menhaden |  |  |  |  |  | 1,200 |
| Mullet | 1,200 | 9,200 | 4,900 | 4,900 | 300 | 23,900 |
| Perch | 2,325 | 3,300 | 9,300 | 20,400 | 9,000 | 170,735 |
| Pigfish |  |  |  | 400 |  | 400 |
| Pike or pickerel | 300 | 200 | 300 | 800 | 1,080 | 7,280 |
| Pollock | 2,000 | 4,400 | 3,200 | 5,400 | 2,200 | 23,000 |
| Pompano |  |  | 300 |  |  | 400 |
| Redfish or red drum |  | 400 | 800 | 400 |  | 2,750 |
| Red snapper |  | 800 |  | 800 | 400 | 6,900 |
| Salmon | 2,000 | 5,000 | 4,300 | 1,700 | 700 | 23,500 |
| Scup or porgy | 400 | 1,400 | 200 |  |  | 9,100 |
| Shad |  | 200 | 400 | 1,000 | 1,000 | 389,751 |
| Shark |  |  |  |  | 100 | 100 |
| Sheepshead |  |  | 400 |  |  | 3,400 |
| Skates |  |  |  |  | 400 | 400 |
| Smelt |  |  |  |  | 200 | 3,760 |
| Spot | 34,400 | 47,100 | 74,800 | 8,600 | 2,700 | 230,100 |
| Squeteagues or "sea trout" | 173,800 | 284,600 | 220,800 | 103,900 | 65,050 | 1,473,350 |
| Squid |  |  |  |  |  | 2,800 |
| Striped bass | 10,200 | 14,700 | 21,680 | 23,000 | 6,085 | 307,515 |
| Sturgeon |  |  | 500 | 100 | 100 | 2,075 |
| Swordfish | 100 |  |  |  |  | 750 |
| Tilefish | 800 | 1,800 | 600 | 1,100 | 400 | 10,300 |
| Whitefish | 400 |  |  |  |  | 600 |
| Whiting |  |  | 200 | 7,000 | 1,200 | 26,500 |
| Clams, hard | 6,304 | 7,232 | 4,448 | 3,584 | 1,216 | [1] 57,312 |
| Oysters: |  |  |  |  |  |  |
| In the shell | 56 | 6,069 | 32,655 | 52,704 | 12,397 | [2] 183,113 |
| Opened |  | 14,157 | 46,588 | 66,470 | 59,557 | [3] 307,966 |
| Scallops | 480 | 1,600 |  |  | 320 | 6,720 |
| Crabs | 57,603 | 52,650 | 10,725 | 75 |  | 200,739 |
| Crab meat | 14,860 | 13,895 | 9,545 | 4,350 | 1,355 | 85,955 |
| Lobsters |  | 162 | 50 | 50 | 150 | 2,212 |
| Lobster meat | 25 | 55 |  |  |  | 80 |
| Shrimp | 9,200 | 5,800 | 5,100 | 4,400 | 4,025 | 60,575 |
| Turtles | 170 | 290 | 72 | 22 | 32 | 4,408 |
| Frogs | 15 |  |  |  |  | 149 |
| Total | 694,013 | 750,950 | 640,343 | 585,264 | 323,807 | 7,997,673 |

[1] 7,164 bushels. [2] 26,159 bushels. [3] 37,329 gallons.

NOTE.—The clams have been reduced to pounds on the basis of 8 pounds of meat to a bushel; the oysters, on the basis of 7 pounds of meat to a bushel and 8¼ pounds to a gallon.

## FISHERIES OF THE SOUTH ATLANTIC STATES

The latest statistical canvass of the fisheries and fishery industries of the South Atlantic States (North Carolina, South Carolina, Georgia, and east coast of Florida) was made for the calendar year 1923. Complete statistics are published in the report of the division of fishery industries for 1924 and in condensed form in Statistical Bulletin No. 652.

During 1923, the fisheries and fishery industries of the South Atlantic States employed 16,298 persons, of whom 10,274 were employed in fishery operations and 6,024 in the wholesale fishery trade and the canning, salting, smoking, and by-products industries. The products of the fisheries of these States amounted to 228,747,930 pounds, valued at $5,087,340.

## FISHERIES OF THE GULF STATES

The latest statistical canvass of the fisheries and fishery industries of the Gulf States (west coast of Florida, Alabama, Mississippi, Louisiana, and Texas) was made for the calendar year 1923. Complete statistics are published in the report of the division of fishery industries for 1925 and in Statistical Bulletin No. 670.

During 1923, the fisheries and fishery industries of the Gulf States employed 17,793 persons, of whom 11,132 were engaged in fishing operations, 1,785 in the wholesale fishery trade, and 4,876 in the fish-canning and by-products industries. The yield of the fisheries aggregated 160,324,042 pounds, valued at $8,096,650. The products of the canning and by-products industries were valued at $6,264,913.

In addition to the above general canvass, annual statistics are collected on the quantity of sponges sold on the exchange at Tarpon Springs, Fla. The statistics for 1927 are discussed below.

### FLORIDA SPONGES

In 1927, the quantity of sponges sold on the sponge exchange, Tarpon Springs, Fla., was 414,417 pounds, valued at $865,510. Of this amount 252,463 pounds, valued at $752,435, were large wool; 35,413 pounds, valued at $61,973, were small wool; 65,429 pounds, valued at $32,714, were yellow; 50,495 pounds, valued at $14,139, were grass; and 10,617 pounds, valued at $4,249, were wire. It is estimated that sponges to the value of $50,000 were sold outside of the exchange at Tarpon Springs. Compared with the number of sponges sold on the exchange in 1926, the quantity sold in 1927 is 13 per cent greater, while the value was 30 per cent greater. The quantity of each grade of sponge handled in 1927 also increased over the previous year. Greater production was due, in a large measure, to the favorable weather conditions during the first six months of the year.

*Sponges sold at the exchange, Tarpon Springs, Fla., 1919 to 1927*

| Year | Total | | Large wool | Small wool | Yellow | Grass | Wire |
|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Pounds* | *Pounds* | *Pounds* | *Pounds* |
| 1927 | 414,417 | $865,510 | 252,463 | 35,413 | 65,429 | 50,495 | 10,617 |
| 1926 | 367,745 | 666,093 | 235,143 | 26,073 | 55,205 | 49,233 | 2,091 |
| 1925 | 434,672 | 715,097 | 242,020 | 29,968 | 120,748 | 28,622 | 13,314 |
| 1924 | 425,305 | 714,760 | 265,392 | 58,021 | 81,420 | 14,898 | 5,574 |
| 1923 | 490,200 | 734,391 | 243,230 | 54,292 | 87,878 | 88,772 | 16,028 |
| 1922 | 526,885 | 699,089 | 248,475 | 70,478 | 115,455 | 84,892 | 7,585 |
| 1921 | 386,390 | 540,093 | 173,723 | 63,786 | 70,218 | 65,745 | 12,918 |
| 1920 | 409,746 | 678,209 | 176,722 | 60,902 | 72,648 | 92,880 | 6,594 |
| 1919 | 424,075 | 707,964 | 205,462 | 76,309 | 73,051 | 62,547 | 6,706 |

## FISHERIES OF THE PACIFIC COAST STATES

The latest statistical canvass of the fisheries and fishery industries of the Pacific Coast States (Washington, Oregon, and California) was for the calendar year 1926. The complete statistics are published herewith. In addition to these, statistics also are collected monthly of the landings of fishery products at Seattle, Wash., and of the halibut landings at the principal Pacific ports. A summary of these for 1927 is published herein.

### GENERAL STATISTICS

The bureau's program of utilizing statistics collected by State agencies on the Pacific coast, in compiling the statistics in that region, has been continued.[5] In the statistics for 1926, for the first time under the present system of collecting statistics, the catch by each kind of fishing apparatus has been itemized separately in all of the State tables. This feature, continued in the future, should make possible a more accurate appraisal of trends in fishing effort and the resultant yield than has been possible heretofore. For purposes of comparison, the statistics for all available previous years are given in summarized form.

There were 18,597 fishermen engaged in the fisheries in 1926. These operated 703 vessels, 6,326 motor boats, and 803 other boats. This is a marked increase of fishermen, vessels, and boats over previous years. Virtually all of the vessels are motor driven, and it is this class that shows the greatest increase.

The total catch in 1926 was more than 521,000,000 pounds, with a value in first hands of nearly $19,000,000. The species used in the preparation of fishery products dominated in the Pacific coast fisheries. Their total weight was nearly 428,000,000 pounds, and they had a value of more than $11,000,000. This is 82 per cent of the total yield and 60 per cent of the total value. The species included in this category fall in five groups: The salmons, tuna and tunalike fishes, pilchard or sardine, Alaska cod, and whales. Of these, the salmons had the greatest value, being worth $7,000,000. Pilchards were most important from the standpoint of quantity, the catch amounting to nearly 287,000,000 pounds. The tuna group, which embraces albacore, bluefin and yellowfin tuna, skipjack, and bonito, provided raw material aggregating nearly 46,000,000 pounds and valued at more than $2,000,000, which placed the group third in quantity and second in value among the cannery fishes. The salt-cod fishery and the whaling industries accounted for the remainder, each having products valued at less than half a million dollars. Among the species used in the fresh and frozen fish trade, halibut dominated in Washington and Oregon, while sablefish, lingcod, shad, smelt, and minor species constituted the remainder. In California, the flounder group is important, as are also the rockfishes, barracuda, yellowtail, and white sea bass. Other fish are of minor importance, though their aggregate quantity is considerable.

[5] The method of collecting statistics in the various States and the items covered vary considerably. In compiling the data, it has been necessary for the bureau's Pacific coast agent, C. B. Tendick, to supplement those provided by the State by canvassing the industries for items omitted in State returns. In most cases the value of the catch was derived from dealers' records and estimates of prices. In Washington and Oregon the offshore fisheries were canvassed separately for units of operation, catch, and value of the catch. In almost all other respects the statistics are as collected by the States.

The shellfish yield was of considerable importance, aggregating 15,000,000 pounds and a value exceeding $1,500,000. Crabs accounted for nearly a third of this total. Clams and oysters also were outstanding, the former having provided raw material for a considerable canning industry. The sea crawfish, or spiny lobster, and the shrimp fisheries of California also made important contributions.

## WASHINGTON

In 1926, the fisheries of Washington employed more than 7,700 fishermen, who manned nearly 2,500 boats and 333 fishing vessels. Their catches aggregated nearly 90,000,000 pounds, valued at about $8,000,000. Salmon made up over half this catch, while halibut and cod were of importance. In the shellfish fisheries, oysters, clams, and crabs were the most valuable products, in the order named.

The statistics for the last five years show a constantly increasing number of fishermen, though there are not yet as many as were reported in 1915. The increase is more regular and pronounced in the shore or boat fisheries. The vessels are increasing in number, though the total tonnage appears to be declining. The principal losses to the vessel fleet in 1926 were three steamers in the whaling fleet and one sailing vessel of the Alaska cod fleet. The motor vessels increased.

The total catch declined 31 per cent as compared with 1925. Most of this loss was in humpback or pink salmon, 1926 being one of their biennial "off" years. Severe decreases occurred in the chinook and blueback, or sockeye, catches, also. The amount of carp, shad, and flounders caught seems to be increasing. The sturgeon yield, which had been increasing in recent years, though still far below the large catches of early years, suffered a sharp decline in 1926. The whaling station, which has operated with declining output for a number of years, ceased operations at the end of the 1925 season, hence whale products are absent from the 1926 report. Among the shellfishes, native oysters and razor clams have shown decidedly larger yields in recent years. The octopus fishery has grown in the last five years to be an item of some importance.

## OREGON

The fisheries of Oregon in 1926 employed over 4,900 fishermen, nearly 2,700 boats, and 8 fishing vessels. The total catch was about 33,000,000 pounds, valued at more than $3,000,000. The salmons accounted for more than three-fourths of this total, chinooks predominating. Of the remaining fishes, the shad and halibut yields were of the greatest value; among the shellfishes, crabs, fresh-water crawfish, and clams were most important.

The number of fishermen was virtually the same as in 1925 and considerably higher than in previous years. The number of motor boats also increased steadily throughout the period covered by the statistics. The catch in 1926 was smaller than that of 1925 by more than 17 per cent, due principally to the smaller amounts of chinook, chum, and silver salmon taken. The catch of blueback, or sockeye, more than doubled, and the shad catch was 60 per cent larger. In fact, the latter has been growing for a number of years.

## CALIFORNIA

In 1926, the fisheries of California employed nearly 6,000 fishermen, 2,000 boats, and 362 fishing vessels having a total net tonnage of 6,675. The catch amounted to nearly 400,000,000 pounds, valued at nearly $8,000,000. Pilchards, or sardines, were of greatest importance and accounted for nearly three-fourths of the weight and about one-fifth of the value. The tunas and tunalike fishes were next and together were of considerably greater value, though, of course, of smaller quantity than the sardine. Among the other fish taken, flounders, barracuda, yellowtail, rockfishes, and white sea bass were the most important. Of the shellfishes, crabs, spiny lobster, shrimp, clams, and abalone were important. The number of fishermen employed was the largest on record, as was also the number of motor boats. The number of vessels was the same as in 1925. The increase in number of vessels was rapid and continuous up to that year.

The total catch was about 10 per cent smaller than in 1925, due chiefly to the reduced catch of pilchards, or sardines. It should be remarked that, though the catch of sardines was smaller, the output of canned sardines increased, the decrease in catch being due mainly to restrictions imposed by the State on the use of sardines for reduction to fish meal and oil. The catch of albacore, choicest of the tunas, was only one-ninth as large as in 1925. The deficiency in this item was partially offset by the greater catch of skipjack or striped tuna. The catch of "California halibut" has been declining consistently for a number of years, and the catches of other flounders, which have been increasing, seem to have reached their maximum in 1925 and declined in 1926. The shad and salmon catches declined sharply in 1926. The catches of most of the shellfishes was about normal as compared with those of previous recent years.

*Fisheries of the Pacific Coast States, 1926*

OPERATING UNITS: BY STATES

| Items | Washington | Oregon | California | Total |
|---|---|---|---|---|
| Fishermen: | | | | |
| On boats and shore | 5,429 | 4,899 | 3,665 | 13,993 |
| On vessels | 2,288 | 37 | 2,279 | 4,604 |
| Total | 7,717 | 4,936 | 5,936 | 18,597 |
| Boats: | | | | |
| Motor | 2,120 | 2,487 | 1,719 | 6,326 |
| Other | 344 | 204 | 255 | 803 |
| Vessels: | | | | |
| Steam | 2 | | 5 | 7 |
| Net tonnage | 16 | | 196 | 212 |
| Motor | 326 | 8 | 351 | 685 |
| Net tonnage | 6,247 | 32 | 4,588 | 10,867 |
| Sail | 5 | | 6 | 11 |
| Net tonnage | 1,618 | | 1,891 | 3,509 |
| Total | 333 | 8 | 362 | 703 |
| Total net tonnage | 7,881 | 32 | 6,675 | 14,588 |

*Fisheries of the Pacific Coast States, 1926*—Continued

CATCH: BY STATES

| Species | Washington | | Oregon | | California | | Total | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Albacore | | | | | 2, 469, 385 | $232, 399 | 2, 469, 385 | $232, 399 |
| Anchovies | | | | | 60, 127 | 631 | 60, 127 | 631 |
| Barracuda | | | | | 5, 022, 494 | 449, 610 | 5, 022, 494 | 449, 610 |
| Bonito | | | | | 3, 078, 666 | 93, 256 | 3, 078, 666 | 93, 256 |
| Carp | 659, 288 | $19, 780 | | | 72, 178 | 2, 092 | 731, 466 | 21, 872 |
| Catfish | | | | | 257, 377 | 36, 130 | 257, 377 | 36, 130 |
| Cod, dry salted | 3. 976, 615 | 173, 035 | | | 3, 712, 070 | 235, 055 | 7, 688, 685 | 408, 090 |
| Cod tongues | 14, 000 | 1, 400 | | | | | 14, 000 | 1, 400 |
| Dolly Varden trout | 545 | 82 | | | | | 545 | 82 |
| Dolphins | | | | | 3, 145 | 94 | 3, 145 | 94 |
| Eels | | | | | 238 | 7 | 238 | 7 |
| Flounders: | | | | | | | | |
| "California halibut" | | | | | 1, 431, 000 | 209, 710 | 1, 431, 000 | 209, 710 |
| "Sole" | 205, 104 | 8, 157 | 1, 500 | $50 | 8, 649, 870 | 357, 405 | 8, 856, 474 | 365, 612 |
| Other | 140, 076 | 2, 843 | 3, 500 | 75 | 1, 813, 011 | 84, 366 | 1, 956, 587 | 87, 284 |
| Grayfish | 290, 395 | 1, 452 | | | 506, 723 | 3. 115 | 797, 118 | 4, 567 |
| Hake | | | | | 58, 335 | 1, 458 | 58, 335 | 1, 458 |
| Halibut | 17, 850, 452 | 2, 596, 753 | 362, 609 | 58, 132 | 256, 720 | 28, 413 | 18, 469, 781 | 2, 683. 298 |
| Hardhead | | | | | 43, 625 | 4, 409 | 43, 625 | 4, 409 |
| Herring | 2, 821, 692 | 28, 218 | | | 453, 607 | 9, 130 | 3, 275, 299 | 37, 348 |
| Horse mackerel | | | | | 239, 164 | 12, 604 | 239, 164 | 12, 604 |
| Kingfish | | | | | 484, 921 | 13, 573 | 484, 921 | 13, 573 |
| "Lingcod" | 823, 013 | 31, 916 | 16, 322 | 631 | 645, 000 | 22, 231 | 1, 484, 335 | 54, 778 |
| Mackerel | | | | | 3, 623, 290 | 96, 103 | 3, 623, 290 | 96, 103 |
| Mullet | | | | | 51, 753 | 7, 048 | 51, 753 | 7, 048 |
| Perch | 70, 468 | 3, 524 | | | 208, 910 | 11, 641 | 279, 378 | 15, 165 |
| Pike, Sacramento | | | | | 2, 990 | 139 | 2, 990 | 139 |
| Pilchard or sardine | | | | | 286, 741, 250 | 1, 527, 186 | 286, 741, 250 | 1, 527. 186 |
| Pompano | | | | | 8, 125 | 3, 908 | 8, 125 | 3, 908 |
| Rock bass | | | | | 636, 335 | 50, 104 | 636, 335 | 50, 104 |
| Rockfishes | 443, 222 | 19, 406 | 66, 711 | 2, 282 | 7, 538, 448 | 348, 069 | 8, 048, 381 | 369, 757 |
| Sablefish | 2, 211, 574 | 116, 973 | 386, 653 | 18, 762 | 183, 065 | 9, 802 | 2, 781, 292 | 145, 537 |
| Salmon | 51. 656, 389 | 3, 864, 520 | 26, 821, 843 | 2. 657, 708 | 6, 084, 079 | 610, 218 | 84, 562, 311 | 7, 132, 446 |
| Sculpin | | | | | 108, 068 | 9, 727 | 108, 068 | 9, 727 |
| Sea bass: | | | | | | | | |
| Black | | | | | 377, 934 | 12, 503 | 377, 934 | 12, 503 |
| White, or squeteague | | | | | 2, 216, 402 | 238, 590 | 2, 216, 402 | 238, 590 |
| Shad | 380, 458 | 7, 610 | 1, 654, 789 | 39, 650 | 902, 202 | 23, 800 | 2, 937, 449 | 71, 060 |
| Sheepshead | | | | | 138, 927 | 5, 083 | 138, 927 | 5, 083 |
| Skates | 4, 105 | 83 | | | 232, 993 | 4, 551 | 237, 098 | 4, 634 |
| Skipjack or striped tuna | | | | | 20, 994, 822 | 873, 932 | 20, 994, 822 | 873, 932 |
| Smelt: | | | | | | | | |
| Silver | 360, 790 | 43, 295 | | | 883, 123 | 79, 158 | 1, 243, 913 | 122, 453 |
| Eulachon | 466, 109 | 7, 372 | 72, 900 | 2, 187 | | | 539, 009 | 9, 559 |
| Splittail | | | | | 5, 322 | 206 | 5, 322 | 206 |
| Steelhead trout | 2, 561, 524 | 187, 556 | 2, 657, 470 | 196, 592 | | | 5, 218, 994 | 384, 148 |
| Striped bass | | | | | 750, 801 | 110, 118 | 750, 801 | 110, 118 |
| Sturgeon | 84, 600 | 6, 045 | 138, 416 | 9, 066 | | | 223, 016 | 15, 111 |
| Suckers | | | | | 1, 988 | 40 | 1, 988 | 40 |
| Swordfish | | | | | 45. 543 | 3, 763 | 45, 543 | 3, 763 |
| Tomcod | 1, 492 | 86 | 300 | 18 | 4, 325 | 130 | 6, 117 | 234 |
| Tuna: | | | | | | | | |
| Bluefin | | | | | 6, 526, 533 | 343, 412 | 6, 526, 533 | 343, 412 |
| Yellowfin | | | | | 12, 565, 085 | 590, 860 | 12, 565, 085 | 590, 860 |
| Mixed | | | | | 260, 756 | 18, 110 | 260, 756 | 18, 110 |
| Whitebait | | | | | 85, 557 | 7, 185 | 85, 557 | 7, 185 |
| Whitefish | | | | | 368, 064 | 28, 217 | 368, 064 | 28, 217 |
| Yellowtail | | | | | 5, 023, 114 | 266, 045 | 5, 023, 114 | 266, 045 |
| Other fish | 11, 445 | 467 | | | 230, 124 | 10, 578 | 241, 569 | 11, 045 |
| Total | 85, 033, 356 | 7, 120, 573 | 32, 183, 013 | 2, 985, 153 | 386, 057, 584 | 7, 085, 914 | 503, 273, 953 | 17, 191, 640 |
| SHELLFISH, ETC. | | | | | | | | |
| Crabs | 1, 937, 741 | 133, 506 | 532, 884 | 36, 333 | 3, 296, 280 | 241, 117 | 5, 766, 905 | 410, 956 |
| Crawfish | | | 105, 706 | 13, 214 | | | 105, 706 | 13, 214 |
| Sea crawfish or spiny lobster | | | | | 1, 175, 223 | 163, 182 | 1, 175, 223 | 163, 182 |
| Shrimp | 50, 624 | 7, 087 | | | 1, 431, 511 | 60, 755 | 1, 482, 135 | 67, 842 |
| Clams: | | | | | | | | |
| Cockle | | | | | 2, 377 | 2, 137 | 2, 377 | 2, 137 |
| Hard | 215, 279 | 40, 365 | 4, 837 | 2, 177 | | | 220, 116 | 42, 542 |
| Mixed | | | | | 5, 302 | 2, 585 | 5, 302 | 2, 585 |
| Pismo | | | | | 68, 579 | 27, 432 | 68, 579 | 27, 432 |
| Razor | 1, 288, 139 | 214, 690 | 154, 543 | 23, 611 | | | 1, 442, 682 | 238, 301 |
| Soft | | | 14, 519 | 5, 227 | 40, 993 | 21, 905 | 55, 512 | 27, 132 |
| Mussels | | | | | 1, 461 | 498 | 1, 461 | 498 |

*Fisheries of the Pacific Coast States*—Continued

CATCH: BY STATES—Continued

| Species | Washington | | Oregon | | California | | Total | |
|---|---|---|---|---|---|---|---|---|
| SHELLFISH, ETC.—con. | | | | | | | | |
| Oysters: | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Eastern, market | 20,280 | $21,181 | | | 61,042 | $26,161 | 81,322 | $47,342 |
| Native, market | 697,920 | 358,631 | 2,616 | $2,325 | 36 | 20 | 700,572 | 360,976 |
| Japanese, market | 60,000 | 30,000 | | | | | 60,000 | 30,000 |
| Scallops | 210,395 | 8,901 | | | | | 210,395 | 8,901 |
| Abalone | | | | | 412,154 | 84,827 | 412,154 | 84,827 |
| Octopus | 123,581 | 7,414 | | | 63,304 | 6,260 | 186,885 | 13,674 |
| Squid | | | | | 3,135,561 | 45,806 | 3,135,561 | 45,806 |
| Total | 4,603,959 | 821,775 | 815,105 | 82,887 | 9,693,823 | 682,685 | 15,112,887 | 1,587,347 |
| WHALE PRODUCTS | | | | | | | | |
| Sperm oil | | | | | 36,750 | 1,927 | 36,750 | 1,927 |
| Whale oil | | | | | 1,980,068 | 112,917 | 1,980,068 | 112,917 |
| Other whale products | | | | | 882,760 | 20,902 | 882,760 | 20,902 |
| Total | | | | | 2,899,578 | 135,746 | 2,899,578 | 135,746 |
| Grand total | 89,637,315 | 7,942,348 | 32,998,118 | 3,068,040 | 398,650,985 | 7,904,345 | 521,286,418 | 18,914,733 |

*Fisheries of the Pacific Coast States, 1888 to 1926*

OPERATING UNITS

| Items | 1888 | 1892 | 1895 | 1899 | 1904 | 1908 | 1915 | 1922 | 1923 | 1924 | 1925 | 1926 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | | | | |
| On boats or shore | 8,804 | 8,755 | 11,439 | 11,342 | 12,483 | 11,626 | 14,235 | 10,244 | 10,309 | 11,762 | 12,438 | 13,993 |
| On vessels | 1,663 | 2,216 | 1,927 | 1,561 | 1,205 | 1,754 | 4,229 | 3,162 | 3,932 | 3,597 | 4,418 | 4,604 |
| Total | 10,467 | 10,971 | 13,366 | 12,903 | 13,688 | 13,380 | 18,464 | 13,406 | 14,241 | 15,359 | 16,856 | 18,597 |
| Fishing boats: | | | | | | | | | | | | |
| Motor | (1) | (1) | (1) | (1) | 313 | 868 | 4,378 | 4,173 | 5,100 | 5,727 | 5,424 | 6,326 |
| Other | 4,101 | 4,575 | 6,110 | 5,751 | 7,066 | 6,363 | 5,024 | 1,041 | 657 | 676 | 1,019 | 548 |
| Fishing vessels: | | | | | | | | | | | | |
| Steam | (2) | (2) | (2) | (2) | (2) | [3] 107 | (2) | 10 | (2) | 10 | 12 | 7 |
| Net tonnage | (2) | (2) | (2) | (2) | (2) | [3] 4,582 | (2) | 514 | (2) | 382 | 220 | 212 |
| Motor | (2) | (2) | (2) | (2) | (2) | (3) | (2) | 510 | (2) | 534 | 643 | 677 |
| Net tonnage | (2) | (2) | (2) | (2) | (2) | (3) | (2) | 7,732 | (2) | 4,345 | 5,873 | 10,835 |
| Sail | (2) | (2) | (2) | (2) | (2) | 31 | (2) | 6 | (2) | 10 | 10 | 11 |
| Net tonnage | (2) | (2) | (2) | (2) | (2) | 3,889 | (2) | 2,019 | (2) | 1,448 | 1,838 | 3,509 |
| Total | 82 | 121 | 99 | 66 | 87 | 138 | 550 | 526 | 555 | 560 | 673 | 703 |
| Total net tonnage | 10,226 | 13,693 | 10,602 | 6,900 | 7,637 | 8,471 | 14,635 | 10,265 | 11,095 | 12,064 | 13,361 | 14,638 |

[1] Motor boats were not designated separately prior to 1904.
[2] Steam, motor, and sailing vessels not designated separately.
[3] Steam and motor vessels not designated separately.

*Fisheries of the Pacific Coast States, 1888 to 1926*—Continued

CATCH

[Expressed in thousands of pounds; that is, 000 omitted. Salt fish, except cod, have been converted to the equivalent of fresh fish]

| Species | 1888 | 1892 | 1895 | 1899 | 1904 | 1908 |
|---|---|---|---|---|---|---|
| FISH | | | | | | |
| Albacore | | | 299 | 179 | 210 | |
| Anchovies | | 150 | 460 | 7 | | 220 |
| Barracuda | | 436 | 1,245 | 1,425 | 2,375 | 3,205 |
| Bonito | | 421 | 301 | 189 | 212 | 329 |
| Carp | | 66 | 46 | 284 | 90 | 457 |
| Catfish | | | 376 | 626 | 923 | 1,270 |
| Cod: | | | | | | |
| Fresh | 239 | | 40 | | | |
| Dry salted | | 2,814 | 3,228 | 6,847 | 7,695 | 7,946 |
| Flounders: | | | | | | |
| "Sole" | | | | 32 | 3,883 | 190 |
| Other | | 4,465 | 3,415 | 4,747 | 4,560 | 6,988 |
| Hake | | | | | | 32 |
| Halibut | 1,520 | 1,429 | 1,849 | 6,878 | 12,091 | 30,088 |
| Hardhead | | | | 186 | 65 | |
| Herring | | 5,104 | 3,526 | 2,096 | 1,976 | 3,346 |
| Kingfish | | 40 | 148 | 127 | 174 | 682 |
| "Lingcod" | | 616 | 368 | 239 | 437 | 249 |
| Mackerel | | 350 | 95 | 168 | 135 | 197 |
| Mullet | | | | 22 | 13 | 4 |
| Pilchard or sardine | | 753 | 732 | 2,383 | 1,036 | 4,638 |
| Pompano | | | 11 | 13 | 34 | 89 |
| Rockfishes | | 2,088 | 1,614 | 1,260 | 1,924 | 2,456 |
| Sablefish | | 15 | 37 | 164 | 334 | 203 |
| Salmon: | | | | | | |
| Chinook | 40,935 | 29,251 | 38,488 | 31,779 | 50,150 | 39,358 |
| Silver | | 8,986 | 22,011 | 25,863 | 30,548 | 19,144 |
| Blueback | | 5,654 | 7,879 | 42,672 | 12,120 | 13,051 |
| Chum | | 3,310 | 7,597 | 7,357 | 14,651 | 13,960 |
| Humpback | | | 2,270 | 21,112 | | |
| Sculpin | | | | 3 | 3 | |
| Sea bass: | | | | | | |
| Black | | 263 | 37 | 96 | 63 | 161 |
| White, or squeteague | | | 640 | 952 | 983 | 1,337 |
| Shad | 10 | 738 | 372 | 1,255 | 489 | 1,700 |
| Skates | | | | | 198 | 124 |
| Smelt | 180 | 2,242 | 2,299 | 2,280 | 2,757 | 3,645 |
| Steelhead trout | | 5,316 | 8,652 | 2,725 | 3,018 | 4,884 |
| Striped bass | | 56 | 252 | 1,234 | 1,570 | 1,776 |
| Sturgeon | 1,157 | 3,775 | 3,140 | 296 | 138 | 309 |
| Surf fishes | | 400 | 436 | 165 | 272 | 885 |
| Swordfish | | | | | | 8 |
| Tomcod | | | 74 | 376 | 69 | 49 |
| Tuna: | | | | | | |
| Yellowfin | | | 32 | 24 | 15 | 12 |
| Whitefish | | | 203 | 58 | 270 | 466 |
| Yellowtail | | 546 | 316 | 334 | 358 | 571 |
| Other fish | 29,947 | 2,257 | 613 | 723 | 1,354 | 1,214 |
| Total | 73,988 | 81,541 | 113,161 | 167,176 | 157,193 | 165,243 |
| SHELLFISH | | | | | | |
| Crabs | 232 | 2,945 | 2,752 | 4,063 | 6,080 | 4,081 |
| Crawfish | 14 | 20 | 59 | 116 | 187 | 178 |
| Sea crawfish or spiny lobster | 231 | 303 | 558 | 607 | 1,078 | 573 |
| Shrimp | 4,907 | 5,315 | 5,461 | 6,515 | 3,006 | 505 |
| Clams: | | | | | | |
| Hard | | | | | 775 | 156 |
| Mixed | 2,771 | 3,231 | 3,269 | 6,281 | 96 | 132 |
| Razor | | | | | 164 | 234 |
| Soft | | | | | 140 | 498 |
| Mussels | | 2,880 | 512 | 383 | 28 | 68 |
| Oysters: | | | | | | |
| Eastern | | | 14,727 | 25,200 | 1,389 | 729 |
| Native | 5,251 | 25,141 | 6,573 | 9,560 | 1,377 | 1,328 |
| Scallops | | | | 4 | | |
| Abalone | 3,606 | 405 | 126 | 369 | 825 | 1,005 |
| Octopus | 244 | 375 | 2 | | | |
| Squid | | | 30 | 1,869 | 754 | 110 |
| Total | 17,256 | 40,615 | 34,069 | 54,967 | 15,899 | 9,597 |
| WHALE PRODUCTS | | | | | | |
| Sperm oil | | | | | | 169 |
| Whale oil | | 1,575 | 550 | 522 | 325 | 13 |
| Other whale products | | 197 | 99 | 207 | 95 | 32 |
| Total | | 1,772 | 649 | 729 | 420 | 214 |
| Grand total | 91,244 | 123,928 | 147,879 | 222,872 | 173,512 | 175,054 |

*Fisheries of the Pacific Coast States, 1888 to 1926*—Continued

CATCH—Continued

[Expressed in thousands of pounds; that is, 000 omitted. Salt fish, except cod, have been converted to the equivalent of fresh fish]

| Species | 1915 | 1922 | 1923 | 1924 | 1925 | 1926 |
|---|---|---|---|---|---|---|
| FISH | | | | | | |
| Albacore | 21,074 | 13,232 | 12,515 | 17,695 | 22,207 | 2,469 |
| Anchovies | 113 | 653 | 307 | 347 | 124 | 60 |
| Barracuda | 3,923 | 6,250 | 7,201 | 7,129 | 8,006 | 5,022 |
| Bonito | 448 | 929 | 1,115 | 1,038 | 867 | 3,079 |
| Carp | 601 | 442 | 533 | 455 | 444 | 731 |
| Catfish | 517 | 126 | 130 | 352 | 366 | 257 |
| Cod: | | | | | | |
| Fresh | 22 | | | | 1 | |
| Dry salted | 10,451 | 2,856 | 5,079 | 6,585 | 7,542 | 7,689 |
| Flounders: | | | | | | |
| "California halibut" | | [1] 3,403 | [1] 2,427 | 2,576 | 2,452 | 1,431 |
| "Sole" | 5,830 | 7,174 | 7,206 | 9,101 | 8,996 | 8,856 |
| Other | 6,962 | 1,797 | 2,075 | 2,269 | 2,812 | 1,957 |
| Hake | 269 | 75 | 79 | 61 | 22 | 58 |
| Halibut | 40,826 | 18,706 | 25,015 | 15,974 | 19,256 | 18,470 |
| Hardhead | 73 | 18 | 10 | 19 | 24 | 44 |
| Herring | 3,005 | 602 | 903 | 619 | 1,536 | 3,276 |
| Kingfish | 656 | 582 | 412 | 384 | 537 | 485 |
| "Lingcod" | 1,428 | 589 | 545 | 929 | 1,437 | 1,484 |
| Mackerel | 266 | 2,496 | 3,592 | 3,241 | 3,522 | 3,623 |
| Mullet | 3 | 31 | 74 | 62 | 37 | 62 |
| Pilchard or sardine | 4,390 | 93,400 | 159,197 | 242,686 | 315,295 | 286,741 |
| Pompano | 19 | 16 | 33 | 18 | 11 | 8 |
| Rock bass | 901 | 316 | 357 | 466 | 330 | 636 |
| Rockfishes | 4,465 | 4,626 | 5,592 | 5,051 | 5,928 | 8,048 |
| Sablefish | 657 | 1,348 | 3,014 | 2,989 | 3,512 | 2,782 |
| Salmon: | | | | | | |
| Chinook | 48,994 | 30,855 | 37,668 | 54,319 | 54,702 | 41,590 |
| Silver | 23,890 | 19,196 | 19,667 | 26,437 | 25,442 | 24,217 |
| Blueback | 5,380 | 6,040 | 5,729 | 5,489 | 10,565 | 4,531 |
| Chum | 19,176 | 6,448 | 9,927 | 15,217 | 13,831 | 14,096 |
| Humpback | 29,998 | 145 | 33,097 | 498 | 35,309 | 128 |
| Sculpin | 9 | 42 | 60 | 109 | 226 | 108 |
| Sea bass: | | | | | | |
| Black | 392 | 97 | 227 | 231 | 189 | 378 |
| White, or squeteague | 1,221 | 2,982 | 2,520 | 1,516 | 1,920 | 2,216 |
| Shad | 7,478 | 1,736 | 1,778 | 2,715 | 3,712 | 2,938 |
| Shark | 7,561 | 288 | 419 | 490 | 414 | 797 |
| Sheepshead | | 18 | 32 | 24 | 49 | 139 |
| Skates | 1,012 | 125 | 141 | 141 | 184 | 237 |
| Skipjack or striped tuna | | 11,862 | 11,463 | 3,781 | 14,235 | 20,995 |
| Smelt | 3,299 | 2,439 | 2,261 | 2,390 | 2,536 | 1,783 |
| Steelhead trout | 4,512 | 2,300 | 4,260 | 4,835 | 4,026 | 5,219 |
| Striped bass | 1,784 | 684 | 910 | 662 | 844 | 751 |
| Sturgeon | 160 | 485 | 208 | 262 | 281 | 223 |
| Surf fishes | 155 | 289 | 395 | 333 | 348 | 279 |
| Swordfish | | 23 | 12 | 32 | 27 | 46 |
| Tomcod | 64 | 32 | 48 | 43 | 15 | 6 |
| Tuna: | | | | | | |
| Bluefin | | 2,838 | 3,301 | 3,241 | 3,804 | 6,527 |
| Yellowfin | | 7,337 | 10,837 | 3,063 | 13,238 | 12,565 |
| Mixed | | 692 | 662 | 547 | 427 | 261 |
| Whitebait | 56 | 84 | 68 | 122 | 71 | 86 |
| Whitefish | | 30 | 40 | 273 | 222 | 368 |
| Yellowtail | 1,343 | 3,414 | 3,980 | 4,714 | 3,180 | 5,023 |
| Other fish | 689 | 287 | 237 | 377 | 253 | 509 |
| Total | 264,072 | 260,435 | 387,358 | 451,907 | 595,314 | 503,274 |
| SHELLFISH | | | | | | |
| Crabs | 3,563 | 2,763 | 2,589 | 3,086 | 4,708 | 5,767 |
| Crawfish | 184 | 69 | 142 | 12 | 128 | 106 |
| Sea crawfish or spiny lobster | 892 | 1,017 | 1,093 | 1,027 | 1,486 | 1,175 |
| Shrimp | 684 | 1,052 | 1,148 | 1,589 | 1,496 | 1,482 |
| Clams: | | | | | | |
| Cockle | | 4 | 5 | 1 | | 2 |
| Hard | 176 | 92 | 80 | 204 | 222 | 220 |
| Mixed | 66 | 5 | 4 | 7 | 9 | 5 |
| Pismo | | 49 | 59 | 73 | 81 | 69 |
| Razor | 450 | 1,008 | 430 | 557 | 982 | 1,443 |
| Soft | 90 | 71 | 52 | 56 | 64 | 56 |
| Mussels | 20 | 7 | 10 | 8 | 4 | 1 |

[1] Includes halibut caught in California.

*Fisheries of the Pacific Coast States, 1888 to 1926*—Continued

CATCH—Continued

[Expressed in thousands of pounds; that is, 000 omitted. Salt fish, except cod, have been converted to the equivalent of fresh fish]

| Species | 1915 | 1922 | 1923 | 1924 | 1925 | 1926 |
|---|---|---|---|---|---|---|
| SHELLFISH—Continued | | | | | | |
| Oysters: | | | | | | |
| Eastern | 641 | 119 | 114 | 89 | 67 | 81 |
| Native | 460 | 566 | 696 | 662 | 673 | 701 |
| Japanese | | 35 | 10 | 16 | 28 | 60 |
| Scallops | | | | 4 | 6 | 210 |
| Abalone | 731 | 312 | 318 | 449 | 471 | 412 |
| Octopus | 32 | 119 | 162 | 271 | 239 | 187 |
| Squid | 6,226 | 210 | 1,180 | 6,831 | 1,891 | 3,136 |
| Other shellfish | | 13 | 1 | | 4 | |
| Total | 14,215 | 7,511 | 8,093 | 14,942 | 12,559 | 15,113 |
| WHALE PRODUCTS | | | | | | |
| Sperm oil | | 299 | 363 | 68 | 136 | 37 |
| Whale oil | 2,635 | 8,626 | 6,020 | 4,404 | 1,668 | 1,980 |
| Other whale products | 1,298 | 4,266 | 3,114 | 2,374 | 1,319 | 883 |
| Total | 3,933 | 13,191 | 9,497 | 6,846 | 3,123 | 2,900 |
| Grand total | 282,220 | 281,137 | 404,948 | 473,695 | 610,996 | 521,287 |

*Fisheries of Washington, 1926*

OPERATING UNITS: BY DISTRICTS

| Items | Puget Sound | Washington coast | Columbia River | Total |
|---|---|---|---|---|
| Fishermen: | | | | |
| On boats and shore | 1,916 | 1,702 | 1,811 | 5,429 |
| On vessels | 2,280 | 8 | | 2,288 |
| Total | 4,196 | 1,710 | 1,811 | 7,717 |
| Boats: | | | | |
| Motor | 902 | 237 | 981 | 2,120 |
| Other | 183 | 131 | 30 | 344 |
| Vessels: | | | | |
| Steam | 2 | | | 2 |
| Net tonnage | 16 | | | 16 |
| Motor | 322 | 4 | | 326 |
| Net tonnage | 6,214 | 33 | | 6,247 |
| Sail | 5 | | | 5 |
| Net tonnage | 1,618 | | | 1,618 |
| Total | 329 | 4 | | 333 |
| Total net tonnage | 7,848 | 33 | | 7,881 |

OPERATING UNITS: BY GEAR

| Items | Purse seines | Haul seines | Gill nets, drift | Gill nets, set | Pound nets | Brush weirs | Beam trawls | Trawl lines | Troll lines |
|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | |
| On boats and shore | | 598 | 1,323 | 274 | 774 | 12 | 12 | | 730 |
| On vessels | 1,059 | 34 | 12 | 4 | | | 48 | 1,124 | 115 |
| Total | 1,059 | 632 | 1,335 | 278 | 774 | 12 | 60 | 1,124 | 845 |
| Boats: | | | | | | | | | |
| Motor | | 105 | 944 | 173 | 375 | 6 | 6 | | 428 |
| Other | | 46 | | 101 | 12 | | | | |
| Vessels: | | | | | | | | | |
| Steam | | | | | | | 2 | | |
| Net tonnage | | | | | | | 16 | | |
| Motor | 134 | 12 | 6 | 2 | | | 15 | 127 | 55 |
| Net tonnage | 2,901 | 155 | 42 | 41 | | | 203 | 2,893 | 428 |
| Sail | | | | | | | | 5 | |
| Net tonnage | | | | | | | | 1,618 | |
| Total | 134 | 12 | 6 | 2 | | | 17 | 132 | 55 |
| Total net tonnage | 2,901 | 155 | 42 | 41 | | | 219 | 4,511 | 428 |

*Fisheries of Washington, 1926*—Continued

OPERATING UNITS: BY GEAR—Continued

| Items | Set lines | Fish wheels | Drag bag nets | Dip bag nets | Reef nets | Crab traps | Oyster tongs | Clam forks | Total[1] |
|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | |
| On boats and shore | 42 | 28 | 102 | 146 | 8 | 147 | 109 | 1,511 | 5,429 |
| On vessels | | | 23 | | | 24 | | | 2,288 |
| Total | 42 | 28 | 125 | 146 | 8 | 171 | 109 | 1,511 | 7,717 |
| Boats: | | | | | | | | | |
| Motor | 35 | | 40 | 74 | 4 | 124 | 18 | | 2,120 |
| Other | 7 | | 11 | | | | 169 | | 344 |
| Vessels: | | | | | | | | | |
| Steam | | | | | | | | | 2 |
| Net tonnage | | | | | | | | | 16 |
| Motor | | | 8 | | | 12 | | | 326 |
| Net tonnage | | | 134 | | | 147 | | | 6,247 |
| Sail | | | | | | | | | 5 |
| Net tonnage | | | | | | | | | 1,618 |
| Total | | | 8 | | | 12 | | | 333 |
| Total net tonnage | | | 134 | | | 147 | | | 7,881 |

CATCH: BY DISTRICTS

| Species | Puget Sound District | | Coastal District | | Columbia River District | | Total | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Carp | 25 | $2 | | | 659,263 | $19,778 | 659,288 | $19,780 |
| Cod, dry salted | 3,976,615 | 173,035 | | | | | 3,976,615 | 173,035 |
| Cod, tongues | 14,000 | 1,400 | | | | | 14,000 | 1,400 |
| Dolly Varden trout | 499 | 75 | 46 | $7 | | | 545 | 82 |
| Flounders: | | | | | | | | |
| "Sole" | 205,104 | 8,157 | | | | | 205,104 | 8,157 |
| Other | 140,076 | 2,843 | | | | | 140,076 | 2,843 |
| Grayfish | 290,395 | 1,452 | | | | | 290,395 | 1,452 |
| Halibut | 17,850,452 | 2,596,753 | | | | | 17,850,452 | 2,596,753 |
| Herring | 2,821,692 | 28,218 | | | | | 2,821,692 | 28,218 |
| "Lingcod" | 823,013 | 31,916 | | | | | 823,013 | 31,916 |
| Perch | 68,991 | 3,450 | 1,477 | 74 | | | 70,468 | 3,524 |
| Rockfishes | 443,222 | 19,406 | | | | | 443,222 | 19,406 |
| Sablefish | 2,211,574 | 116,973 | | | | | 2,211,574 | 116,973 |
| Salmon: | | | | | | | | |
| Blueback or sockeye | 3,122,369 | 359,706 | 78,978 | 6,582 | 524,345 | 70,787 | 3,725,692 | 437,075 |
| Chinook | 9,731,368 | 1,029,399 | 1,103,402 | 49,826 | 8,273,677 | 857,610 | 19,108,447 | 1,936,835 |
| Chum | 10,636,950 | 372,293 | 2,085,312 | 24,946 | 561,222 | 5,612 | 13,283,484 | 402,851 |
| Humpback | 128,445 | 4,608 | | | | | 128,445 | 4,608 |
| Silver | 11,226,336 | 829,639 | 1,243,250 | 57,359 | 2,940,735 | 196,153 | 15,410,321 | 1,083,151 |
| Shad | | | | | 380,458 | 7,610 | 380,458 | 7,610 |
| Skates | 4,105 | 83 | | | | | 4,105 | 83 |
| Smelt: | | | | | | | | |
| Silver | 360,790 | 43,295 | | | | | 360,790 | 43,295 |
| Eulachon | | | | | 466,109 | 7,372 | 466,109 | 7,372 |
| Steelhead trout | 91,791 | 11,014 | 366,060 | 29,285 | 2,103,673 | 147,257 | 2,561,524 | 187,556 |
| Sturgeon | 1,120 | 168 | 6,600 | 880 | 76,880 | 4,997 | 84,600 | 6,045 |
| Tomcod | 1,492 | 86 | | | | | 1,492 | 86 |
| Other fish | 11,445 | 467 | | | | | 11,445 | 467 |
| Total | 64,161,869 | 5,634,438 | 4,885,125 | 168,959 | 15,986,362 | 1,317,176 | 85,033,356 | 7,120,573 |
| SHELLFISH, ETC. | | | | | | | | |
| Crabs | 650,359 | 36,952 | 1,287,382 | 96,554 | | | 1,937,741 | 133,506 |
| Shrimp | 50,624 | 7,087 | | | | | 50,624 | 7,087 |
| Clams: | | | | | | | | |
| Hard | 215,279 | 40,365 | | | | | 215,279 | 40,365 |
| Razor | | | 1,288,139 | 214,690 | | | 1,288,139 | 214,690 |
| Oysters: | | | | | | | | |
| Eastern, market | | | 20,280 | 21,181 | | | 20,280 | 21,181 |
| Native, market | 666,792 | 349,341 | 31,128 | 9,290 | | | 697,920 | 358,631 |
| Japanese, market | 60,000 | 30,000 | | | | | 60,000 | 30,000 |
| Scallops | 210,395 | 8,901 | | | | | 210,395 | 8,901 |
| Octopus | 123,581 | 7,414 | | | | | 123,581 | 7,414 |
| Total | 1,977,030 | 480,060 | 2,626,929 | 341,715 | | | 4,603,959 | 821,775 |
| Grand total | 66,138,899 | 6,114,498 | 7,512,054 | 510,674 | 15,986,362 | 1,317,176 | 89,637,315 | 7,942,348 |

[1] Exclusive of duplication.

*Fisheries of the Puget Sound district of Washington, 1926*

OPERATING UNITS: BY GEAR

| Items | Purse seines | Haul seines | Gill nets, drift | Gill nets, set | Pound nets | Brush weirs | Beam trawls | Trawl lines | Troll lines |
|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | |
| On boats and shore | | 162 | 508 | 3 | 152 | 12 | 12 | | 576 |
| On vessels | 1,059 | 34 | 12 | 4 | | | 48 | 1,124 | 115 |
| Total | 1,059 | 196 | 520 | 7 | 152 | 12 | 60 | 1,124 | 691 |
| Boats: | | | | | | | | | |
| Motor | | 65 | 322 | 3 | 76 | 6 | 6 | | 315 |
| Other | | 16 | | | | | | | |
| Vessels: | | | | | | | | | |
| Steam | | | | | | | 2 | | |
| Net tonnage | | | | | | | 16 | | |
| Motor | 134 | 12 | 6 | 2 | | | 15 | 127 | 55 |
| Net tonnage | 2,901 | 155 | 42 | 41 | | | 203 | 2,893 | 428 |
| Sail | | | | | | | | 5 | |
| Net tonnage | | | | | | | | 1,618 | |
| Total | 134 | 12 | 6 | 2 | | | 17 | 132 | 55 |
| Total net tonnage | 2,901 | 155 | 42 | 41 | | | 219 | 4,511 | 428 |

| Items | Set lines | Drag bag nets | Dip bag nets | Reef nets | Crab traps | Oyster tongs | Clam forks | Total [1] |
|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | |
| On boats and shore | 24 | 100 | 2 | 8 | 110 | 98 | 268 | 1,916 |
| On vessels | | 23 | | | 16 | | | 2,280 |
| Total | 24 | 123 | 2 | 8 | 126 | 98 | 268 | 4,196 |
| Boats: | | | | | | | | |
| Motor | 17 | 39 | 2 | 4 | 87 | 14 | | 902 |
| Other | 7 | 11 | | | | 151 | | 183 |
| Vessels: | | | | | | | | |
| Steam | | | | | | | | 2 |
| Net tonnage | | | | | | | | 16 |
| Motor | | 8 | | | 8 | | | 322 |
| Net tonnage | | 134 | | | 114 | | | 6,214 |
| Sail | | | | | | | | 5 |
| Net tonnage | | | | | | | | 1,618 |
| Total | | 8 | | | 8 | | | 329 |
| Total net tonnage | | 134 | | | 114 | | | 7,848 |

CATCH: BY GEAR

| Species | Lines | | Pound nets | | Purse seines | | Drift gill nets | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Carp | 13 | $1 | | | | | 12 | $1 |
| Cod, dry salted | 3,976,615 | 173,035 | | | | | | |
| Cod tongues | 14,000 | 1,400 | | | | | | |
| Dolly Varden trout | 230 | 35 | 269 | $40 | | | | |
| Flounders: | | | | | | | | |
| "Sole" | 3,150 | 79 | 5 | 1 | 160 | $6 | | |
| Other | 700 | 35 | 3,244 | 65 | | | | |
| Grayfish | 201,825 | 1,009 | 76,870 | 384 | | | 4,000 | 20 |
| Halibut | 17,850,079 | 2,596,697 | 373 | 56 | | | | |
| Herring | | | 173 | 2 | 173,900 | 1,739 | | |
| "Lingcod" | 809,456 | 31,534 | 1,923 | 77 | | | | |
| Perch | 1,699 | 85 | 100 | 5 | 1,075 | 54 | | |
| Rockfishes | 395,804 | 15,968 | 10,259 | 1,178 | 157 | 9 | | |
| Sablefish | 2,211,574 | 116,973 | | | | | | |
| Salmon: | | | | | | | | |
| Blueback or sockeye | 455 | 59 | 2,319,618 | 265,099 | 733,661 | 86,704 | 16,632 | 1,901 |
| Chinook | 4,109,626 | 412,058 | 4,452,052 | 489,726 | 225,318 | 23,735 | 899,602 | 98,956 |
| Chum | 850 | 30 | 1,251,640 | 43,807 | 8,383,710 | 293,430 | 987,340 | 34,557 |
| Humpback | 585 | 21 | 108,365 | 3,901 | 14,820 | 518 | 2,750 | 99 |
| Silver | 2,778,152 | 176,974 | 3,076,800 | 249,990 | 4,861,768 | 361,269 | 459,488 | 37,333 |
| Skates | 340 | 7 | 3,000 | 60 | | | | |
| Smelt | | | | | | | 324 | 39 |
| Steelhead trout | 1,584 | 190 | 57,411 | 6,889 | 1,845 | 221 | 30,897 | 3,708 |

[1] Exclusive of duplication.

*Fisheries of the Puget Sound district of Washington, 1926*—Continued

CATCH: BY GEAR—Continued

| Species | Lines | | Pound nets | | Purse seins | | Drift gill nets | |
|---|---|---|---|---|---|---|---|---|
| FISH—continued | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Sturgeon | | | 1,120 | $168 | | | | |
| Other fish | | | 3,646 | 73 | | | | |
| Total | 32,356,737 | $3,526,190 | 11,366,868 | 1,061,521 | 14,396,414 | $767,685 | 2,401,045 | $176,614 |
| SHELLFISH, ETC. | | | | | | | | |
| Octopus | 121,385 | 7,283 | 286 | 17 | 350 | 21 | | |
| Grand total | 32,478,122 | 3,533,473 | 11,367,154 | 1,061,538 | 14,396,764 | 767,706 | 2,401,045 | 176,614 |

| Species | Haul seines | | Beam trawls | | Drag bag nets | |
|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Flounders: | | | | | | |
| "Sole" | 5,980 | $239 | 195,659 | $7,826 | 150 | $6 |
| Other | 6,212 | 124 | 128,771 | 2,596 | 1,149 | 23 |
| Grayfish | 6,000 | 30 | | | | |
| Herring | 538,599 | 5,386 | | | 293,970 | 2,940 |
| "Lingcod" | 1,202 | 48 | 2,962 | 118 | 4,495 | 20 |
| Perch | 49,804 | 2,490 | 325 | 16 | 14,352 | 718 |
| Rockfishes | 9,492 | 570 | 12,535 | 753 | 13,770 | 826 |
| Salmon: | | | | | | |
| Blueback or sockeye | 46,858 | 5,355 | | | | |
| Chinook | 43,076 | 4,738 | | | | |
| Chum | 10,440 | 365 | | | 140 | 5 |
| Humpback | 1,895 | 68 | | | | |
| Silver | 22,704 | 1,845 | | | 64 | 5 |
| Skates | 280 | 6 | 485 | 10 | | |
| Smelt | 245,628 | 29,475 | | | 114,388 | 13,727 |
| Steelhead trout | 54 | 6 | | | | |
| Tomcod | 1,098 | 66 | 394 | 20 | | |
| Other fish | 1,077 | 30 | 4,922 | 246 | 1,800 | 118 |
| Total | 990,399 | 50,841 | 346,053 | 11,585 | 444,278 | 18,388 |
| SHELLFISH, ETC. | | | | | | |
| Shrimp | | | 50,624 | 7,087 | | |
| Scallops | | | 210,395 | 8,901 | | |
| Octopus | 70 | 4 | 40 | 2 | 1,450 | 87 |
| Total | 70 | 4 | 261,059 | 15,990 | 1,450 | 87 |
| Grand total | 990,469 | 50,845 | 607,112 | 27,575 | 445,728 | 18,475 |

| Species | Reef nets | | Set gill nets | | Brush weirs | | Dip bag nets | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Grayfish | | | 1,700 | $9 | | | | |
| Herring | | | | | 1,814,600 | $18,146 | 450 | $5 |
| "Lingcod" | | | 2,975 | 119 | | | | |
| Perch | | | 1,536 | 77 | 100 | 5 | | |
| Rockfishes | | | 1,205 | 102 | | | | |
| Salmon: | | | | | | | | |
| Blueback or sockeye | 5,146 | $588 | | | | | | |
| Chinook | 1,694 | 186 | | | | | | |
| Chum | 2,410 | 84 | 420 | 15 | | | | |
| Humpback | 30 | 1 | | | | | | |
| Silver | 23,656 | 1,922 | 3,704 | 301 | | | | |
| Smelt | | | | | | | 450 | 54 |
| Total | 32,935 | 2,781 | 11,540 | 623 | 1,814,700 | 18,151 | 900 | 59 |

| Species | Tongs | | Shovels and forks | | Crab traps | |
|---|---|---|---|---|---|---|
| SHELLFISH, ETC. | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Crabs | | | | | 650,359 | $36,952 |
| Clams, hard | | | 215,279 | $40,365 | | |
| Oysters: | | | | | | |
| Native, market | 666,792 | $349,341 | | | | |
| Japanese, market | 60,000 | 30,000 | | | | |
| Total | 726,792 | 379,341 | 215,279 | 40,365 | 650,359 | 36,952 |

*Fisheries of the coastal district of Washington, 1926*

OPERATING UNITS: BY GEAR

| Items | Gill nets, drift | Gill nets, set | Pound nets | Troll lines | Drag bag nets | Crab traps | Oyster tongs | Clam forks | Total [1] |
|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | |
| On boats and shore | 124 | 149 | 190 | 2 | 2 | 37 | 11 | 1,243 | 1,702 |
| On vessels | | | | | | 8 | | | 8 |
| Total | 124 | 149 | 190 | 2 | 2 | 45 | 11 | 1,243 | 1,710 |
| Boats: | | | | | | | | | |
| Motor | 87 | 48 | 83 | 1 | 1 | 37 | 4 | | 237 |
| Other | | 101 | 12 | | | | 18 | | 131 |
| Vessels: | | | | | | | | | |
| Motor | | | | | | 4 | | | 4 |
| Tonnage | | | | | | 33 | | | 33 |

CATCH: BY GEAR

| Fish | Pound nets | | Drift gill nets | | Set gill nets | | Drag bag nets | | Lines | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Dolly Varden trout | | | | | | | | | 46 | $7 |
| Perch | | | | | | | 1,342 | $67 | 135 | 7 |
| Salmon: | | | | | | | | | | |
| Blueback or sockeye | 43,998 | $3,667 | | | 34,980 | $2,915 | | | | |
| Chinook | 615,158 | 27,550 | 336,950 | $16,848 | 150,949 | 5,410 | 253 | 13 | 92 | 5 |
| Chum | 1,513,116 | 18,255 | 253,704 | 3,171 | 315,900 | 3,488 | 2,592 | 32 | | |
| Silver | 829,350 | 38,789 | 241,540 | 12,077 | 169,800 | 6,365 | 2,560 | 128 | | |
| Steelhead trout | 194,350 | 15,548 | 7,670 | 614 | 163,640 | 13,091 | 400 | 32 | | |
| Sturgeon | 300 | 40 | 6,270 | 834 | 30 | 4 | | | | |
| Total | 3,196,272 | 103,849 | 846,134 | 33,546 | 835,299 | 31,273 | 7,147 | 272 | 273 | 19 |

| Shellfish, etc. | Shovels and forks | | Traps | | Tongs | |
|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Clams, razor | 1,288,139 | $214,690 | | | | |
| Crabs | | | 1,287,382 | $96,554 | | |
| Oysters: | | | | | | |
| Eastern, market | | | | | 20,280 | $21,181 |
| Native, market | | | | | 31,128 | 9,290 |
| Total | 1,288,139 | 214,690 | 1,287,382 | 96,554 | 51,408 | 30,471 |

[1] Exclusive of duplication.

*Fisheries of the Columbia River district of Washington, 1926*

OPERATING UNITS: BY GEAR

| Items | Haul seines | Gill nets, drift | Gill nets, set | Pound nets | Troll lines | Set lines | Fish wheels | Dip bag nets | Total [1] |
|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | |
| On boats and shore | 436 | 691 | 122 | 432 | 152 | 18 | 28 | 144 | 1,811 |
| Boats: | | | | | | | | | |
| Motor | 40 | 535 | 122 | 216 | 112 | 18 | | 72 | 981 |
| Other | 30 | | | | | | | | 30 |

[1] Exclusive of duplication.

*Fisheries of the Columbia River district of Washington, 1926*—Continued

CATCH: BY GEAR

| Fish | Pound nets | | Drift gill nets | | Lines | |
|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Salmon: | | | | | | |
| Chinook | 3,519,782 | $366,057 | 3,344,936 | $347,873 | 393,969 | $38,121 |
| Chum | 236,547 | 2,365 | 315,522 | 3,155 | | |
| Silver | 1,207,760 | 73,190 | 233,510 | 14,151 | 1,482,345 | 107,774 |
| Sockeye | 111,740 | 15,085 | 250,070 | 33,759 | 15 | 2 |
| Steelhead trout | 1,149,210 | 80,445 | 366,280 | 25,640 | 183 | 13 |
| Smelt | | | 15,215 | 609 | | |
| Shad | 105,027 | 2,101 | 106,811 | 2,136 | | |
| Sturgeon | 10,760 | 699 | 38,920 | 2,530 | 14,040 | 913 |
| Total | 6,340,826 | 539,942 | 4,671,264 | 429,853 | 1,890,552 | 146,823 |

| Fish | Haul seines | | Set gill nets | | Wheels | | Dip nets | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Carp | 659,263 | $19,778 | | | | | | |
| Salmon: | | | | | | | | |
| Chinook | 879,175 | 91,434 | 89,539 | $9,312 | 46,276 | $4,813 | | |
| Chum | 2,088 | 21 | 7,065 | 71 | | | | |
| Silver | 8,180 | 496 | 3,360 | 507 | 580 | 35 | | |
| Sockeye | 68,575 | 9,258 | 80,510 | 10,869 | 13,435 | 1,814 | | |
| Steelhead trout | 342,130 | 23,949 | 224,820 | 15,737 | 21,050 | 1,473 | | |
| Smelt | | | | | | | 450,894 | $6,763 |
| Shad | 164,284 | 3,286 | 88 | 2 | 4,248 | 85 | | |
| Sturgeon | 1,560 | 101 | 8,440 | 549 | 3,160 | 205 | | |
| Total | 2,125,255 | 148,323 | 418,822 | 37,047 | 88,749 | 8,425 | 450,894 | 6,763 |

*Fisheries of Washington, 1888 to 1926*

OPERATING UNITS

| Items | 1888 | 1892 | 1895 | 1899 | 1904 | 1908 |
|---|---|---|---|---|---|---|
| Fishermen: | | | | | | |
| On boats or shore | 2,571 | 3,082 | 4,493 | 5,073 | 5,467 | 3,636 |
| On vessels | 267 | 331 | 457 | 544 | 367 | 1,109 |
| Total | 2,838 | 3,413 | 4,950 | 5,617 | 5,834 | 4,745 |
| Fishing boats: | | | | | | |
| Motor | (1) | (1) | (1) | (1) | 63 | 239 |
| Other | [1] 1,202 | [1] 1,690 | [1] 2,646 | [1] 2,566 | 3,448 | 2,559 |
| Fishing vessels: | | | | | | |
| Steam | (2) | (2) | (2) | (2) | (2) | [3] 85 |
| Net tonnage | (2) | (2) | (2) | (2) | (2) | [3] 2,329 |
| Motor | (2) | (2) | (2) | (2) | (2) | (3) |
| Net tonnage | (2) | (2) | (2) | (2) | (2) | (3) |
| Sail | (2) | (2) | (2) | (2) | (2) | 22 |
| Net tonnage | (2) | (2) | (2) | (2) | (2) | 1,662 |
| Total | 13 | 33 | 39 | 32 | 50 | 107 |
| Total net tonnage | 682 | 1,009 | 1,166 | 889 | 1,541 | 3,991 |

| Items | 1915 | 1922 | 1923 | 1924 | 1925 | 1926 |
|---|---|---|---|---|---|---|
| Fishermen: | | | | | | |
| On boats or shore | 5,481 | 3,109 | 3,454 | 4,551 | 5,055 | 5,429 |
| On vessels | 3,655 | 1,811 | 1,945 | 1,639 | 2,338 | 2,288 |
| Total | 9,136 | 4,920 | 5,399 | 6,190 | 7,393 | 7,717 |
| Fishing boats: | | | | | | |
| Motor | 1,567 | 1,158 | 1,751 | 2,036 | 1,945 | 2,120 |
| Other | 2,591 | 248 | 289 | 261 | 330 | 344 |
| Fishing vessels: | | | | | | |
| Steam | (2) | 3 | (2) | 4 | 6 | 2 |
| Net tonnage | (2) | 195 | (2) | 382 | 220 | 16 |
| Motor | (2) | 307 | (2) | 208 | 291 | 326 |
| Net tonnage | (2) | 5,159 | (2) | 4,345 | 5,873 | 6,247 |
| Sail | (2) | 3 | (2) | 5 | 6 | 5 |
| Net tonnage | (2) | 976 | (2) | 1,448 | 1,838 | 1,618 |
| Total | 472 | 313 | 267 | 217 | 303 | 333 |
| Total net tonnage | 11,363 | 6,330 | 6,980 | 6,175 | 7,931 | 7,881 |

[1] Motor boats were not designated separately prior to 1904.
[2] Steam, motor, and sailing vessels not designated separately.
[3] Steam and motor vessels not designated separately.

*Fisheries of Washington, 1888 to 1926*—Continued

CATCH

[Expressed in thousands of pounds; that is, 000 omitted. Salt fish, except cod, have been reduced to the equivalent of fresh fish]

| Species | 1888 | 1892 | 1895 | 1899 | 1904 | 1908 |
|---|---|---|---|---|---|---|
| FISH | | | | | | |
| Catfish | ---------- | ---------- | ---------- | 106 | 6 | ---------- |
| Cod: | | | | | | |
| Fresh | 239 | ---------- | 40 | ---------- | ---------- | ---------- |
| Dry salted | ---------- | 539 | 444 | 930 | 2,072 | 4,648 |
| Flounders: | | | | | | |
| "Sole" | ---------- | ---------- | ---------- | ---------- | 9 | 190 |
| Other | ---------- | 185 | 107 | 28 | 199 | 284 |
| Halibut | 1,520 | 1,410 | 1,844 | 6,861 | 12,066 | 30,072 |
| Herring | ---------- | 617 | 345 | 424 | 532 | 2,506 |
| "Lingcod" | ---------- | 359 | 223 | 91 | 144 | 62 |
| Rockfishes | ---------- | 163 | 38 | 72 | 83 | 132 |
| Sablefish | ---------- | 15 | 37 | 164 | 334 | 168 |
| Salmon: | | | | | | |
| Blueback or sockeye | | 2,514 | 7,313 | 42,071 | 11,507 | 12,501 |
| Chinook | | 9,844 | 12,937 | 10,938 | 15,212 | 12,336 |
| Chum | 16,454 | 3,310 | 5,472 | 6,567 | 13,652 | 13,055 |
| Humpback | | ---------- | 2,270 | 21,112 | ---------- | ---------- |
| Silver | | 3,597 | 12,384 | 20,649 | 26,021 | 14,080 |
| Shad | ---------- | 103 | ---------- | 85 | 125 | 100 |
| Smelt | ---------- | 322 | 528 | 937 | 1,370 | 2,897 |
| Steelhead trout | ---------- | 2,419 | 4,971 | 1,507 | 1,859 | 2,339 |
| Sturgeon | ---------- | 544 | 1,884 | 90 | 129 | 185 |
| Surf fishes | ---------- | 65 | 169 | 43 | 149 | 661 |
| Tomcod | ---------- | ---------- | 10 | ---------- | ---------- | ---------- |
| Other fish | 1,135 | 40 | 30 | 49 | 78 | ---------- |
| Total | 19,348 | 26,046 | 51,046 | 112,724 | 85,547 | 96,212 |
| SHELLFISH, ETC. | | | | | | |
| Crabs | 2 | 79 | 163 | 275 | 723 | 2,179 |
| Shrimp | 5 | 2 | 36 | 20 | 430 | 247 |
| Clams: | | | | | | |
| Hard | 300 | 684 | 1,405 | 3,131 | 775 | 155 |
| Razor | | | | | 133 | 234 |
| Oysters: | | | | | | |
| Eastern, market | | | | ---------- | 269 | ---------- |
| Native, market | 4,066 | 9,895 | 6,484 | 5,901 | 1,069 | 1,321 |
| Japanese, market | | | | ---------- | | |
| Mussels | ---------- | ---------- | 24 | 19 | ---------- | ---------- |
| Total | 4,373 | 10,660 | 8,112 | 9,346 | 3,399 | 4,136 |
| WHALE PRODUCTS | | | | | | |
| Whale oil | ---------- | ---------- | ---------- | 15 | ---------- | ---------- |
| Other whale products | ---------- | ---------- | ---------- | ---------- | 8 | ---------- |
| Total | ---------- | ---------- | ---------- | 15 | 8 | ---------- |
| Grand total | 23,721 | 36,706 | 59,158 | 122,085 | 88,954 | 100,352 |

*Fisheries of Washington, 1888 to 1926*—Continued

CATCH

[Expressed in thousands of pounds, that is, 000 omitted. Salt fish, except cod, have been reduced to the equivalent of fresh fish]

| Species | 1915 | 1922 | 1923 | 1924 | 1925 | 1926 |
|---|---|---|---|---|---|---|
| FISH | | | | | | |
| Carp | 200 | 375 | 384 | 379 | 286 | 659 |
| Catfish | | | 1 | | | |
| Cod: | | | | | | |
| Fresh | 22 | | | | 1 | |
| Dry salted | 5,498 | 1,176 | 3,081 | 3,701 | 4,126 | 3,977 |
| Flounders: | | | | | | |
| "Sole" | 68 | 131 | 120 | 266 | 231 | 205 |
| Other | 26 | 85 | 196 | 188 | 261 | 140 |
| Halibut | 40,591 | 18,467 | 24,151 | 15,330 | 18,516 | 17,850 |
| Herring | 2,129 | 260 | 425 | 183 | 670 | 2,822 |
| "Lingcod" | 837 | | | 477 | 695 | 823 |
| Rockfishes | 101 | [1] 361 | [1] 579 | 295 | 443 | 443 |
| Sablefish | 576 | 1,022 | 2,226 | 1,895 | 2,442 | 2,212 |
| Salmon: | | | | | | |
| Blueback or sockeye | 5,043 | 5,104 | 3,664 | 5,053 | 10,212 | 3,726 |
| Chinook | 18,188 | 10,970 | 13,217 | 24,698 | 23,756 | 19,108 |
| Chum | 17,156 | 6,320 | 8,791 | 12,219 | 11,493 | 13,284 |
| Humpback | 29,998 | 145 | 33,097 | 498 | 35,309 | 128 |
| Silver | 18,630 | 14,817 | 12,950 | 16,158 | 15,195 | 15,410 |
| Shad | 96 | 48 | 89 | 193 | 255 | 380 |
| Shark | 7,493 | 6 | 59 | 97 | 42 | 290 |
| Skates | 229 | 4 | 7 | 10 | 1 | 4 |
| Smelt | 2,158 | 1,392 | 1,178 | 1,441 | 1,475 | 827 |
| Steelhead trout | 2,114 | 476 | 1,401 | 1,443 | 1,719 | 2,562 |
| Sturgeon | 44 | 268 | 84 | 86 | 120 | 85 |
| Surf fishes | 15 | 51 | 54 | 44 | 80 | 70 |
| Tomcod | | | 1 | | | 1 |
| Other fish [2] | | 2 | | | | 26 |
| Total | 151,212 | 61,480 | 106,355 | 84,354 | 127,328 | 85,033 |
| SHELLFISH, ETC. | | | | | | |
| Crabs | 1,734 | 1,172 | 1,154 | 1,146 | 952 | 1,938 |
| Shrimp | 386 | 62 | 35 | 38 | 36 | 51 |
| Clams: | | | | | | |
| Hard | 176 | 92 | 80 | 203 | 222 | 215 |
| Razor | 373 | 949 | 381 | 524 | 893 | 1,288 |
| Soft | 1 | | | | | |
| Oysters: | | | | | | |
| Eastern, market | 265 | 45 | 45 | 36 | 10 | 20 |
| Native, market | 350 | 555 | 682 | 651 | 663 | 698 |
| Japanese, market | | 35 | 10 | 16 | 28 | 60 |
| Scallops | | | | 4 | 6 | 210 |
| Octopus | | 20 | 52 | 105 | 106 | 124 |
| Mussels | 1 | | | | | |
| Squid | 15 | | | | | |
| Other shellfish | | | | | 4 | |
| Total | 3,401 | 2,930 | 2,439 | 2,723 | 2,920 | 4,604 |
| WHALE PRODUCTS | | | | | | |
| Sperm oil | | 261 | 347 | 68 | 87 | |
| Whale oil | 2,635 | 1,763 | 1,376 | 1,472 | 142 | |
| Other whale products | 1,298 | 1,130 | 744 | 606 | 210 | |
| Total | 3,933 | 3,154 | 2,467 | 2,146 | 439 | |
| Grand total | 158,546 | 67,564 | 111,261 | 89,223 | 130,687 | 89,637 |

[1] Includes fresh cod and "lingcod."
[2] Includes cod tongues.

## *Fisheries of Oregon, 1926*

OPERATING UNITS: BY DISTRICTS

| Items | Columbia River | Coastal | Total |
|---|---|---|---|
| Fishermen: | | | |
| On boats or shore | 3,295 | 1,604 | 4,899 |
| On vessels | 37 | | 37 |
| Total | 3,332 | 1,604 | 4,936 |
| Boats: | | | |
| Motor | 1,494 | 993 | 2,487 |
| Other | 30 | 174 | 204 |
| Vessels: | | | |
| Motor | 8 | | 8 |
| Net tonnage | 82 | | 82 |

OPERATING UNITS: BY GEAR

| Items | Haul seines | Gill nets, drift | Gill nets, set | Pound nets | Trawl lines | Troll lines | Fish wheels | Dip bag nets | Crab traps | Craw-fish traps | Oys-ter tongs | Forks and shov-els | Total[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | | | | | |
| On boats or shore | 731 | 2,567 | 693 | 74 | 11 | 511 | 20 | 147 | 214 | 42 | 3 | 311 | 4,899 |
| On vessels | | | | | 37 | | | | | | | | 37 |
| Total | 731 | 2,567 | 693 | 74 | 48 | 511 | 20 | 147 | 214 | 42 | 3 | 311 | 4,936 |
| Boats: | | | | | | | | | | | | | |
| Motor | 54 | 1,632 | 522 | 37 | 11 | 317 | | | 214 | 42 | 1 | | 2,487 |
| Other | 30 | | 171 | | | | | | | | 3 | | 204 |
| Vessels: | | | | | | | | | | | | | |
| Motor | | | | | 8 | | | | | | | | 8 |
| Net tonnage | | | | | 82 | | | | | | | | 82 |

CATCH: BY DISTRICTS

| Species | Columbia River district | | Coastal district | | Total | |
|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Flounders: | | | | | | |
| "Sole" | 1,500 | $50 | | | 1,500 | $50 |
| Other | 3,500 | 75 | | | 3,500 | 75 |
| Halibut | 230,052 | 36,194 | 132,557 | $21,938 | 362,609 | 58,132 |
| "Lingcod" | 12,143 | 474 | 4,179 | 157 | 16,322 | 631 |
| Rockfishes | 51,686 | 1,770 | 15,025 | 512 | 66,711 | 2,282 |
| Sablefish | 246,651 | 12,029 | 140,002 | 6,733 | 386,653 | 18,762 |
| Salmon: | | | | | | |
| Blueback or sockeye | 805,334 | 108,720 | | | 805,334 | 108,720 |
| Chinook | 13,543,915 | 1,542,867 | 2,853,454 | 362,539 | 16,397,369 | 1,905,406 |
| Chum | 511,335 | 5,113 | 300,571 | 6,012 | 811,906 | 11,125 |
| Silver | 4,213,599 | 298,300 | 4,593,635 | 334,157 | 8,807,234 | 632,457 |
| Shad | 999,464 | 19,990 | 655,325 | 19,660 | 1,654,789 | 39,650 |
| Smelt, eulachon | 72,900 | 2,187 | | | 72,900 | 2,187 |
| Steelhead trout | 1,973,082 | 138,925 | 684,388 | 57,667 | 2,657,470 | 196,592 |
| Sturgeon | 132,262 | 8,864 | 6,154 | 202 | 138,416 | 9,066 |
| Tomcod | 300 | 18 | | | 300 | 18 |
| Total | 22,797,723 | 2,175,576 | 9,385,290 | 809,577 | 32,183,013 | 2,985,153 |
| SHELLFISH, ETC. | | | | | | |
| Crabs | 23,980 | 1,635 | 508,904 | 34,698 | 532,884 | 36,333 |
| Crawfish | 95,706 | 11,964 | 10,000 | 1,250 | 105,706 | 13,214 |
| Clams: | | | | | | |
| Hard | | | 4,837 | 2,177 | 4,837 | 2,177 |
| Razor | 154,543 | 23,611 | | | 154,543 | 23,611 |
| Soft | | | 14,519 | 5,227 | 14,519 | 5,227 |
| Oysters, native, market | | | 2,616 | 2,325 | 2,616 | 2,325 |
| Total | 274,229 | 37,210 | 540,876 | 45,677 | 815,105 | 82,887 |
| Grand total | 23,071,952 | 2,212,786 | 9,926,166 | 855,254 | 32,998,118 | 3,068,040 |

[1] Exclusive of duplication.

*Fisheries of the Columbia River district of Oregon, 1926*

OPERATING UNITS: BY GEAR

| Items | Haul seines | Gill nets, drift | Gill nets, set | Pound nets | Trawl lines | Troll lines | Fish wheels | Dip bag nets | Crab traps | Craw-fish traps | Forks and shov-els | Total [1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | | | | |
| On boats or shore | 731 | 1,565 | 137 | 74 | 11 | 370 | 20 | 147 | 35 | 40 | 242 | 3,295 |
| On vessels | | | | | 37 | | | | | | | 37 |
| Total | 731 | 1,565 | 137 | 74 | 48 | 370 | 20 | 147 | 35 | 40 | 242 | 3,332 |
| Boats: | | | | | | | | | | | | |
| Motor | 54 | 996 | 137 | 37 | 11 | 230 | | | 35 | 40 | | 1,494 |
| Other | 30 | | | | | | | | | | | 30 |
| Vessels: | | | | | | | | | | | | |
| Motor | | | | | 8 | | | | | | | 8 |
| Net tonnage | | | | | 82 | | | | | | | 82 |

CATCH: BY GEAR

| Species | Gill nets | | Haul seines | | Pound nets | | Wheels | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Salmon: | | | | | | | | |
| Chinook | 8,554,165 | $944,721 | 3,281,246 | $405,857 | 456,575 | $47,484 | 402,143 | $54,289 |
| Silver | 307,916 | 19,442 | 81,937 | 5,047 | 208,353 | 12,542 | 7,200 | 360 |
| Blueback | 462,421 | 62,427 | 242,319 | 32,713 | 18,707 | 2,526 | 48,577 | 6,558 |
| Chum | 356,218 | 3,562 | 114,778 | 1,148 | 40,339 | 403 | | |
| Shad | 308,539 | 6,171 | 538,143 | 10,763 | 141,478 | 2,830 | 9,647 | 193 |
| Steelhead trout | 634,684 | 48,335 | 781,641 | 54,871 | 269,940 | 17,902 | 161,857 | 10,019 |
| Sturgeon | 100,597 | 6,716 | 5,295 | 302 | 1,113 | 78 | 7,310 | 512 |
| Total | 10,724,540 | 1,091,374 | 5,045,359 | 510,701 | 1,136,505 | 83,764 | 636,734 | 71,931 |

| Species | Lines | | Dip bag nets | | Traps | | Shovels and forks | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Flounders: | | | | | | | | |
| "Sole" | 1,500 | $50 | | | | | | |
| Other | 3,500 | 75 | | | | | | |
| Halibut | 230,052 | 36,194 | | | | | | |
| "Lingcod" | 12,143 | 474 | | | | | | |
| Rockfishes | 51,686 | 1,770 | | | | | | |
| Sablefish | 246,651 | 12,029 | | | | | | |
| Salmon: | | | | | | | | |
| Chinook | 769,411 | 79,665 | 80,375 | $10,851 | | | | |
| Silver | 3,608,143 | 260,905 | 50 | 4 | | | | |
| Blueback | | | 33,310 | 4,497 | | | | |
| Shad | | | 1,657 | 33 | | | | |
| Smelt, eulachon | | | 72,900 | 2,187 | | | | |
| Steelhead trout | | | 124,960 | 7,798 | | | | |
| Sturgeon | 9,060 | 634 | 8,887 | 622 | | | | |
| Tomcod | 300 | 18 | | | | | | |
| Total | 4,932,446 | 391,814 | 322,139 | 25,992 | | | | |
| SHELLFISH, ETC. | | | | | | | | |
| Crabs | | | | | 23,980 | $1,635 | | |
| Crawfish | | | | | 95,706 | 11,964 | | |
| Clams, razor | | | | | | | 154,543 | $23,611 |
| Total | | | | | 119,686 | 13,599 | 154,543 | 23,611 |
| Grand total | 4,932,446 | 391,814 | 322,139 | 25,992 | 119,686 | 13,599 | 154,543 | 23,611 |

[1] Exclusive of duplication.

*Fisheries of the coastal district of Oregon, 1926*

OPERATING UNITS: BY GEAR

| Items | Gill nets, drift | Gill nets, set | Troll lines | Crab traps | Craw-fish traps | Oyster tongs | Forks and shovels | Total [1] |
|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | |
| On boats or shore | 1,002 | 556 | 141 | 179 | 2 | 3 | 69 | 1,604 |
| Boats: | | | | | | | | |
| Motor | 636 | 385 | 87 | 179 | 2 | 1 | | 993 |
| Other | | 171 | | | | 3 | | 174 |

CATCH: BY GEAR

| Fish | Gill nets | | Lines | |
|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* |
| Halibut | | | 132,557 | $21,938 |
| "Lingcod" | | | 4,179 | 157 |
| Rockfishes | | | 15,025 | 512 |
| Sablefish | | | 140,002 | 6,733 |
| Salmon: | | | | |
| Chinook | 2,726,677 | $348,469 | 126,777 | 14,070 |
| Silver | 3,232,509 | 227,569 | 1,361,126 | 106,588 |
| Chum | 300,571 | 6,012 | | |
| Shad | 655,325 | 19,660 | | |
| Steelhead trout | 680,808 | 57,399 | 3,580 | 268 |
| Sturgeon | 6,154 | 202 | | |
| Total | 7,602,044 | 659,311 | 1,783,246 | 150,266 |

| Shellfish, etc. | Traps | | Shovels | | Tongs | |
|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Crabs | 508,904 | $34,698 | | | | |
| Crawfish | 10,000 | 1,250 | | | | |
| Clams: | | | | | | |
| Hard | | | 4,837 | $2,177 | | |
| Soft | | | 14,519 | 5,227 | | |
| Oysters, native, market | | | | | 2,616 | $2,325 |
| Total | 518,904 | 35,948 | 19,356 | 7,404 | 2,616 | 2,325 |

[1] Exclusive of duplication.

*Fisheries of Oregon, 1888 to 1926*

OPERATING UNITS

| Items | 1888 | 1892 | 1895 | 1899 | 1904 | 1908 |
|---|---|---|---|---|---|---|
| Fishermen: | | | | | | |
| On boats or shore | 3,045 | 2,705 | 4,230 | 3,731 | 3,525 | 4,670 |
| On vessels | | 60 | 51 | 75 | | |
| Total | 3,045 | 2,765 | 4,281 | 3,806 | 3,525 | 4,670 |
| Fishing boats: | | | | | | |
| Motor | (1) | (1) | (1) | (1) | 19 | 216 |
| Other | 1,545 | 1,494 | 2,022 | 1,830 | 1,820 | 2,096 |
| Fishing vessels [2] | | 4 | 2 | 1 | | |
| Tonnage | | 248 | 221 | 59 | | |

| Items | 1915 | 1922 | 1923 | 1924 | 1925 | 1926 |
|---|---|---|---|---|---|---|
| Fishermen: | | | | | | |
| On boats or shore | 4,472 | 3,999 | 4,230 | 4,335 | 4,909 | 4,899 |
| On vessels | 23 | 20 | 15 | 25 | 36 | 37 |
| Total | 4,495 | 4,019 | 4,245 | 4,360 | 4,945 | 4,936 |
| Fishing boats: | | | | | | |
| Motor | 1,382 | 1,718 | 2,042 | 2,178 | 2,224 | 2,487 |
| Other | 1,264 | 501 | 233 | 283 | 539 | 204 |
| Fishing vessels [2] | 5 | 4 | 3 | 6 | 8 | 8 |
| Tonnage | 74 | 48 | 44 | 68 | 80 | 82 |

[1] Motor vessels not designated separately prior to 1904.
[2] Probably all were motor vessels in 1915 and subsequent years.

*Fisheries of Oregon, 1888 to 1926*—Continued

CATCH

[Expressed in thousands of pounds; that is, 000 omitted. Salt fish has been converted to the equivalent weight of fresh fish]

| Species | 1888 | 1892 | 1895 | 1899 | 1904 | 1906 |
|---|---|---|---|---|---|---|
| **FISH** | | | | | | |
| Carp | | | | | 20 | 30 |
| Catfish | | | 99 | 54 | 180 | 201 |
| Flounders: | | | | | | |
| "Sole" | | | | | | |
| Other | | 10 | | 4 | | 23 |
| Halibut | | 19 | 5 | 17 | 25 | 16 |
| Herring | | | | 19 | 18 | 15 |
| "Lingcod" | | 26 | 6 | | | 20 |
| Rockfishes | | 86 | 47 | | 21 | 5 |
| Salmon: | | | | | | |
| Blueback or sockeye | 24,481 | 3,140 | 566 | 579 | 334 | 403 |
| Chinook | | 15,686 | 21,101 | 13,750 | 20,022 | 18,176 |
| Chum | | | 2,125 | 790 | 999 | 905 |
| Silver | | 4,429 | 9,463 | 5,154 | 4,255 | 4,923 |
| Shad | 10 | 109 | 125 | 32 | 37 | 431 |
| Smelt | 180 | | 31 | 28 | 25 | 30 |
| Steelhead trout | | 2,587 | 3,220 | 1,104 | 1,104 | 2,469 |
| Sturgeon | 1,157 | 2,513 | 956 | | 9 | 114 |
| Surf fishes | | | | 6 | 4 | 26 |
| Other fish | 76 | | | | 10 | 13 |
| Total | 25,904 | 28,605 | 37,744 | 21,537 | 27,063 | 27,800 |
| **SHELLFISH** | | | | | | |
| Crabs | | 4 | 24 | 111 | 246 | 200 |
| Crawfish | 14 | 20 | 59 | 116 | 187 | 178 |
| Clams: | | | | | | |
| Razor | 75 | 50 | 281 | 979 | 31 | |
| Hard | | | | | | 1 |
| Soft | | | | | | 30 |
| Oysters, native, market | 275 | 147 | 89 | 59 | 7 | 7 |
| Total | 364 | 221 | 453 | 1,265 | 471 | 416 |
| Grand total | 26,268 | 28,826 | 38,197 | 22,802 | 27,534 | 28,216 |

| Species | 1915 | 1922 | 1923 | 1924 | 1925 | 1926 |
|---|---|---|---|---|---|---|
| **FISH** | | | | | | |
| Carp | 50 | | | | 63 | |
| Flounders: | | | | | | |
| "Sole" | | | | | 2 | 1 |
| Other | 2 | | 5 | | | 4 |
| Halibut | 235 | 239 | 864 | 511 | 578 | 363 |
| Herring | 12 | | 94 | | | |
| "Lingcod" | 13 | 21 | 78 | 52 | 59 | 16 |
| Rockfishes | 12 | 2 | 63 | 39 | 31 | 67 |
| Sablefish | 16 | 57 | 250 | 161 | 348 | 387 |
| Salmon: | | | | | | |
| Blueback or sockeye | 337 | 936 | 2,065 | 436 | 353 | 805 |
| Chinook | 23,482 | 12,650 | 17,361 | 19,606 | 21,420 | 16,398 |
| Chum | 1,982 | 128 | 1,136 | 2,998 | 2,338 | 812 |
| Silver | 4,845 | 4,379 | 8,717 | 10,279 | 10,247 | 8,807 |
| Shad | 489 | 578 | 404 | 983 | 1,017 | 1,655 |
| Smelt | 4 | 217 | 277 | 227 | 309 | 73 |
| Steelhead trout | 2,366 | 1,821 | 2,856 | 3,605 | 2,307 | 2,657 |
| Striped bass | | | | | 6 | |
| Sturgeon | 98 | 217 | 124 | 176 | 161 | 138 |
| Surf fishes | 12 | | 15 | | | |
| Tomcod | 22 | | 5 | | | |
| Other fish | 16 | 5 | | | | |
| Total | 33,993 | 21,250 | 32,314 | 39,073 | 39,239 | 32,183 |
| **SHELLFISH** | | | | | | |
| Crabs | 415 | 731 | 359 | 433 | 522 | 533 |
| Crawfish | 184 | 69 | 142 | 12 | 128 | 106 |
| Clams: | | | | | | |
| Razor | 77 | 59 | 49 | 33 | 89 | 154 |
| Hard | | | | 1 | | 5 |
| Soft | 22 | 14 | 5 | 15 | 20 | 14 |
| Oysters, native, market | 2 | 11 | 14 | 11 | 10 | 3 |
| Total | 700 | 884 | 569 | 505 | 769 | 815 |
| Grand total | 34,693 | 22,134 | 32,883 | 39,578 | 40,008 | 32,998 |

*Fisheries of California, 1926*

OPERATING UNITS: BY DISTRICTS

| Items | Northern | San Francisco | Monterey | Southern | Total |
|---|---|---|---|---|---|
| Fishermen: | | | | | |
| On boats or shore | 528 | 987 | 958 | 1,192 | 3,665 |
| On vessels | 23 | 311 | 72 | 1,873 | 2,279 |
| Total | 551 | 1,298 | 1,030 | 3,065 | 5,944 |
| Boats: | | | | | |
| Motor | 183 | 590 | 307 | 639 | 1,719 |
| Other | 205 | 50 | | | 255 |
| Vessels: | | | | | |
| Steam | | 5 | | | 5 |
| Tonnage | | 196 | | | 196 |
| Motor | 10 | 17 | 10 | 314 | 351 |
| Tonnage | 79 | 232 | 107 | 4,170 | 4,588 |
| Sail | | 6 | | | 6 |
| Tonnage | | 1,891 | | | 1,891 |
| Total | 10 | 28 | 10 | 314 | 362 |
| Total net tonnage | 79 | 2,319 | 107 | 4,170 | 6,675 |

OPERATING UNITS: BY GEAR

| Items | Purse seines | Haul seines | Gill nets | Trawl lines | Troll lines | Hand lines | Lampara nets | Paranzella nets | Trammel nets | Fyke nets |
|---|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | | |
| On boats or shore | | 45 | 1,062 | 776 | 1,737 | 143 | 849 | 10 | 106 | 73 |
| On vessels | 514 | | 97 | 421 | 1,059 | 77 | 951 | 65 | 61 | |
| Total | 514 | 45 | 1,159 | 1,197 | 2,796 | 220 | 1,800 | 75 | 167 | 73 |
| Boats: | | | | | | | | | | |
| Motor | | 20 | 456 | 579 | 1,249 | 103 | 97 | 4 | 41 | 32 |
| Other | | 19 | 157 | 47 | | | | | | 30 |
| Vessels: | | | | | | | | | | |
| Steam | | | | | | | | 2 | | |
| Tonnage | | | | | | | | 55 | | |
| Motor | 58 | | 32 | 47 | 258 | 22 | 132 | 14 | 19 | |
| Tonnage | 1,535 | | 220 | 642 | 2,794 | 221 | 1,579 | 211 | 134 | |
| Sail | | | | 6 | | | | | | |
| Tonnage | | | | 1,891 | | | | | | |
| Total | 58 | | 32 | 53 | 258 | 22 | 132 | 16 | 19 | |
| Total net tonnage | 1,535 | | 220 | 2,533 | 2,794 | 221 | 1,579 | 266 | 134 | |

| Items | Harpoons | Whaling apparatus | Octopus traps | Crab traps | Bag nets | Lobster pots | Abalone outfits | Oyster tongs | Shovels and rakes | Total [1] |
|---|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | | |
| On boats or shore | 5 | | 30 | 268 | 20 | 138 | 18 | 6 | 126 | 3,665 |
| On vessels | | 34 | | | 2 | 13 | 22 | | | 2,279 |
| Total | 5 | 34 | 30 | 268 | 22 | 151 | 40 | 6 | 126 | 5,944 |
| Boats: | | | | | | | | | | |
| Motor | 2 | | 27 | 265 | 12 | 96 | 4 | 2 | 1 | 1,719 |
| Other | | | | | | | | 6 | | 255 |
| Vessels: | | | | | | | | | | |
| Steam | | 3 | | | | | | | | 5 |
| Tonnage | | 141 | | | | | | | | 196 |
| Motor | | | | | 1 | 6 | 5 | | | 351 |
| Tonnage | | | | | 6 | 49 | 41 | | | 4,588 |
| Sail | | | | | | | | | | 6 |
| Tonnage | | | | | | | | | | 1,891 |
| Total | | 3 | | | 1 | 6 | 5 | | | 362 |
| Total net tonnage | | 141 | | | 6 | 49 | 41 | | | 6,675 |

[1] Exclusive of duplication.

*Fisheries of California, 1926*—Continued

CATCH: BY DISTRICTS

| Species | Northern district | | San Francisco district | | Monterey district | |
|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Albacore |  |  |  |  | 118,683 | $11,903 |
| Anchovies |  |  | 3,400 | $34 | 48,530 | 467 |
| Barracuda |  |  |  |  | 66,781 | 5,304 |
| Bonito |  |  |  |  | 58,053 | 1,566 |
| Carp | 13,815 | $404 | 45,506 | 1,302 |  |  |
| Catfish | 103,859 | 12,982 | 153,518 | 23,148 |  |  |
| Cod, dry, salted |  |  | 3,712,070 | 235,055 |  |  |
| Eels |  |  | 20 | 1 |  |  |
| Flounders: |  |  |  |  |  |  |
| "California halibut" |  |  | 91,218 | 10,125 | 13,480 | 1,621 |
| "Sole" | 195,530 | 6,817 | 6,078,453 | 243,315 | 2,270,750 | 102,035 |
| Other | 143,286 | 5,349 | 1,294,371 | 58,917 | 359,539 | 16,438 |
| Grayfish |  |  | 224,966 | 1,125 | 18,672 | 93 |
| Hake |  |  | 42,498 | 1,062 | 15,837 | 396 |
| Halibut | 254,779 | 28,123 | 1,941 | 290 |  |  |
| Hardhead |  |  | 43,625 | 4,409 |  |  |
| Herring | 6,801 | 126 | 432,817 | 8,656 |  |  |
| Horse mackerel |  |  |  |  | 56,517 | 3,105 |
| Kingfish |  |  | 41,597 | 1,664 | 95,671 | 4,220 |
| "Lingcod" | 48,556 | 1,479 | 449,514 | 13,486 | 145,682 | 7,179 |
| Mackerel | 378 | 36 | 899 | 54 | 1,119,620 | 34,114 |
| Perch | 31,634 | 1,863 | 99,557 | 6,074 | 13,323 | 560 |
| Pike, Sacramento |  |  | 2,990 | 139 |  |  |
| Pilchard, or sardine |  |  | 7,056,765 | 47,845 | 155,161,807 | 821,806 |
| Pompano |  |  |  |  | 81 | 40 |
| Rockfishes | 62,985 | 1,997 | 886,872 | 35,475 | 2,307,518 | 88,929 |
| Sablefish | 72,614 | 4,011 | 88,735 | 4,881 | 17,248 | 604 |
| Salmon | 3,808,135 | 393,797 | 2,224,189 | 210,923 | 51,755 | 5,498 |
| Sea bass, white, or squeteague | 125 | 15 | 108,794 | 13,056 | 311,251 | 24,680 |
| Shad |  |  | 902,202 | 23,800 |  |  |
| Skates | 1,950 | 39 | 156,338 | 3,127 | 43,109 | 862 |
| Skipjack, or striped tuna |  |  |  |  | 43,474 | 709 |
| Smelt, silver | 32,017 | 2,501 | 113,449 | 10,211 | 194,484 | 14,171 |
| Splittail |  |  | 5,322 | 206 |  |  |
| Striped bass | 17 | 1 | 750,714 | 110,100 | 70 | 17 |
| Suckers | 348 | 7 | 1,640 | 33 |  |  |
| Tomcod |  |  | 3,950 | 119 | 375 | 11 |
| Whitebait | 73,242 | 5,514 | 12,027 | 1,654 | 288 | 17 |
| Other fish | 20,064 | 608 | 13,135 | 514 | 38,351 | 869 |
| Total | 4,870,135 | 465,669 | 25,043,092 | 1,070,800 | 162,570,949 | 1,147,214 |
| SHELLFISH, ETC. |  |  |  |  |  |  |
| Crabs | 194,664 | 8,261 | 3,050,112 | 228,758 | 51,504 | 4,098 |
| Shrimp |  |  | 1,431,511 | 60,755 |  |  |
| Clams: |  |  |  |  |  |  |
| Cockle | 92 | 40 | 2,115 | 1,983 |  |  |
| Mixed | 2,066 | 815 | 2,689 | 1,512 |  |  |
| Soft | 269 | 103 | 40,724 | 21,802 |  |  |
| Abalone |  |  |  |  | 408,605 | 81,720 |
| Mussels |  |  | 1,140 | 456 | 248 | 31 |
| Oysters: Eastern, market |  |  | 61,042 | 26,161 |  |  |
| Octopus | 40 | 2 | 8,552 | 855 | 54,466 | 5,378 |
| Squid |  |  |  |  | 3,127,159 | 44,966 |
| Total | 197,131 | 9,221 | 4,597,885 | 342,282 | 3,641,982 | 136,193 |
| WHALE PRODUCTS |  |  |  |  |  |  |
| Sperm oil |  |  | 36,750 | 1,927 |  |  |
| Whale oil |  |  | 1,980,068 | 112,917 |  |  |
| Other whale products |  |  | 882,760 | 20,902 |  |  |
| Total |  |  | 2,899,578 | 135,746 |  |  |
| Grand total | 5,067,266 | 474,890 | 32,540,555 | 1,548,828 | 166,212,931 | 1,283,407 |

*Fisheries of California, 1926*—Continued

CATCH: BY DISTRICTS—Continued

| Species | Southern district | | | | Total | |
|---|---|---|---|---|---|---|
| | Off California coast | | Off Mexican coast | | | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| FISH | | | | | | |
| Albacore | 2,350,642 | $220,492 | 60 | $4 | 2,469,385 | $232,399 |
| Anchovies | 8,197 | 130 | | | 60,127 | 631 |
| Barracuda | 2,878,418 | 228,949 | 2,077,295 | 215,357 | 5,022,494 | 449,610 |
| Bonito | 2,841,915 | 85,800 | 178,698 | 5,890 | 3,078,666 | 93,256 |
| Carp | 12,857 | 386 | | | 72,178 | 2,092 |
| Catfish | | | | | 257,377 | 36,130 |
| Cod, dry, salted | | | | | 3,712,070 | 235,055 |
| Dolphin | | | 3,145 | 94 | 3,145 | 94 |
| Eels | 218 | 6 | | | 238 | 7 |
| Flounders: | | | | | | |
| "California halibut" | 893,965 | 134,121 | 432,337 | 63,843 | 1,431,000 | 209,710 |
| "Sole" | 105,137 | 5,238 | | | 8,649,870 | 357,405 |
| Other | 15,793 | 3,660 | 22 | 2 | 1,813,011 | 84,366 |
| Grayfish | 263,085 | 1,897 | | | 506,723 | 3,115 |
| Hake | | | | | 58,335 | 1,458 |
| Halibut | | | | | 256,720 | 28,413 |
| Hardhead | | | | | 43,625 | 4,409 |
| Herring | 13,989 | 348 | | | 453,607 | 9,130 |
| Horse mackerel | 178,634 | 9,291 | 4,013 | 208 | 239,164 | 12,604 |
| Kingfish | 347,508 | 7,682 | 145 | 7 | 484,921 | 13,573 |
| "Lingcod" | 1,248 | 87 | | | 645,000 | 22,231 |
| Mackerel | 2,489,201 | 61,557 | 13,192 | 342 | 3,623,290 | 96,103 |
| Mullet | 33,212 | 4,478 | 18,541 | 2,570 | 51,753 | 7,048 |
| Perch | 60,056 | 2,875 | 4,340 | 269 | 208,910 | 11,641 |
| Pike, Sacramento | | | | | 2,990 | 139 |
| Pilchard, or sardine | 124,522,678 | 657,535 | | | 286,741,250 | 1,527,186 |
| Pompano | 8,044 | 3,868 | | | 8,125 | 3,908 |
| Rock bass | 564,277 | 43,369 | 72,058 | 6,735 | 636,335 | 50,104 |
| Rockfishes | 4,267,051 | 221,157 | 14,022 | 511 | 7,538,448 | 348,069 |
| Sablefish | 4,468 | 306 | | | 183,065 | 9,802 |
| Salmon | | | | | 6,084,079 | 610,218 |
| Sculpin | 108,068 | 9,727 | | | 108,068 | 9,727 |
| Sea bass: | | | | | | |
| Black | 120,070 | 4,233 | 257,864 | 8,270 | 377,934 | 12,503 |
| White, or squeteague | 1,057,619 | 120,667 | 738,613 | 80,172 | 2,216,402 | 238,590 |
| Shad | | | | | 902,202 | 23,800 |
| Sheepshead | 136,067 | 4,977 | 2,860 | 106 | 138,927 | 5,083 |
| Skates | 31,596 | 523 | | | 232,993 | 4,551 |
| Skipjack, or striped tuna | 14,217,018 | 602,497 | 6,734,330 | 270,726 | 20,994,822 | 873,932 |
| Smelt, silver | 541,191 | 52,140 | 1,982 | 135 | 883,123 | 79,158 |
| Splittail | | | | | 5,322 | 206 |
| Striped bass | | | | | 750,801 | 110,118 |
| Suckers | | | | | 1,988 | 40 |
| Swordfish | 43,968 | 3,641 | 1,575 | 122 | 45,543 | 3,763 |
| Tomcod | | | | | 4,325 | 130 |
| Tuna: | | | | | | |
| Mixed | 260,756 | 18,110 | | | 260,756 | 18,110 |
| Bluefin | 6,526,533 | 343,412 | | | 6,526,533 | 343,412 |
| Yellowfin | 2,695,502 | 151,767 | 9,869,583 | 439,093 | 12,565,085 | 590,860 |
| Whitebait | | | | | 85,557 | 7,185 |
| Whitefish | 344,336 | 27,072 | 23,728 | 1,145 | 368,064 | 28,217 |
| Yellowtail | 3,173,424 | 156,954 | 1,849,690 | 109,091 | 5,023,114 | 266,045 |
| Other fish | 136,097 | 6,708 | 22,477 | 1,879 | 230,124 | 10,578 |
| Total | 171,252,838 | 3,195,660 | 22,320,570 | 1,206,571 | 386,057,584 | 7,085,914 |
| SHELLFISH, ETC. | | | | | | |
| Crabs | | | | | 3,296,280 | 241,117 |
| Sea crawfish, or spiny lobster | 442,198 | 70,276 | 733,025 | 92,906 | 1,175,223 | 163,182 |
| Shrimp | | | | | 1,431,511 | 60,755 |
| Clams: | | | | | | |
| Cockle | | | 170 | 114 | 2,377 | 2,137 |
| Mixed | 20 | 12 | 527 | 246 | 5,302 | 2,585 |
| Pismo | 68,579 | 27,432 | | | 68,579 | 27,432 |
| Soft | | | | | 40,993 | 21,905 |
| Abalone | 3,549 | 3,107 | | | 412,154 | 84,827 |
| Mussels | 73 | 11 | | | 1,461 | 498 |
| Oysters: | | | | | | |
| Eastern, market | | | | | 61,042 | 26,161 |
| Native, market | | | 36 | 20 | 36 | 20 |
| Octopus | 246 | 25 | | | 63,304 | 6,260 |
| Squid | 8,402 | 840 | | | 3,135,561 | 45,806 |
| Total | 523,067 | 101,703 | 733,758 | 93,286 | 9,693,823 | 682,685 |
| WHALE PRODUCTS | | | | | | |
| Sperm oil | | | | | 36,750 | 1,927 |
| Whale oil | | | | | 1,980,068 | 112,917 |
| Other whale products | | | | | 882,760 | 20,902 |
| Total | | | | | 2,899,578 | 135,746 |
| Grand total | 171,775,905 | 3,297,363 | 23,054,328 | 1,299,857 | 398,650,985 | 7,904,345 |

*Fisheries of the northern district of California, 1926*

OPERATING UNITS: BY GEAR

| Items | Haul seines | Gill nets | Trawl lines | Troll lines | Hand lines | Paranzella nets | Crab traps | Shovels and rakes | Total[1] |
|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | |
| On boats or shore | 23 | 245 | 62 | 209 | 1 | | 35 | 10 | 528 |
| On vessels | | | | 16 | | 7 | | | 23 |
| Total | 23 | 245 | 62 | 225 | 1 | 7 | 35 | 10 | 551 |
| Boats: | | | | | | | | | |
| Motor | 12 | | 12 | 169 | 1 | | 32 | | 183 |
| Other | 9 | 152 | 47 | | | | | | 205 |
| Vessels: | | | | | | | | | |
| Motor | | | | 8 | | 2 | | | 10 |
| Net tonnage | | | | 65 | | 14 | | | 79 |

CATCH: BY GEAR

| Species | Lines | | Gill nets | | Paranzella nets | |
|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Catfish | 103,859 | $12,982 | | | | |
| Flounders: | | | | | | |
| "Sole" | 1,760 | 35 | | | 193,770 | $6,782 |
| Other | | | | | 120,420 | 4,249 |
| Halibut | 254,779 | 28,123 | | | | |
| "Lingcod" | 35,107 | 1,075 | | | 13,449 | 404 |
| Mackerel | 378 | 36 | | | | |
| Perch | | | | | 405 | 24 |
| Rockfishes | 46,490 | 1,502 | | | 16,495 | 495 |
| Sablefish | 72,614 | 4,011 | | | | |
| Salmon | 3,040,245 | 334,427 | 767,890 | $59,370 | | |
| Sea bass, white, or squeteague | 125 | 15 | | | | |
| Skates | | | | | 1,950 | 39 |
| Other fish | | | | | 19,461 | 584 |
| Total | 3,555,357 | 382,206 | 767,890 | 59,370 | 365,950 | 12,577 |
| SHELLFISH, ETC. | | | | | | |
| Octopus | 40 | 2 | | | | |
| Grand total | 3,555,397 | 382,208 | 767,890 | 59,370 | 365,950 | 12,577 |

| Species | Haul seines | | Crab traps | | Clam shovels | |
|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Carp | 13,815 | $404 | | | | |
| Flounders: | | | | | | |
| "Sole" | | | | | | |
| Other | 22,866 | 1,100 | | | | |
| Herring | 6,801 | 126 | | | | |
| Perch | 31,229 | 1,839 | | | | |
| Smelt, silver | 32,017 | 2,501 | | | | |
| Striped bass | 17 | 1 | | | | |
| Suckers | 348 | 7 | | | | |
| Whitebait | 73,242 | 5,514 | | | | |
| Other fish | 603 | 24 | | | | |
| Total | 180,938 | 11,516 | | | | |
| SHELLFISH, ETC. | | | | | | |
| Crabs | | | 194,664 | $8,261 | | |
| Clams: | | | | | | |
| Cockle | | | | | 92 | $40 |
| Mixed | | | | | 2,066 | 815 |
| Soft | | | | | 269 | 103 |
| Total | | | 194,664 | 8,261 | 2,427 | 958 |
| Grand total | 180,938 | 11,516 | 194,664 | 8,261 | 2,427 | 958 |

[1] Exclusive of duplication.

*Fisheries of the San Francisco district of California, 1926*

OPERATING UNITS: BY GEAR

| Items | Haul seines | Gill nets | Trawl lines | Troll lines | Hand lines | Lampara nets | Paranzella nets | Fyke nets | Whaling apparatus | Crab traps | Bag nets | Oyster tongs | Shovels and rakes | Total[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | | | | | | |
| On boats or shore | 19 | 496 | 188 | 292 | 8 | 134 | | 73 | | 215 | 20 | 6 | 24 | 987 |
| On vessels | | | 209 | 8 | | | 58 | | 34 | | 2 | | | 311 |
| Total | 19 | 496 | 397 | 300 | 8 | 134 | 58 | 73 | 34 | 215 | 22 | 6 | 24 | 1, 298 |
| Boats: | | | | | | | | | | | | | | |
| Motor | 7 | 278 | 184 | 268 | 7 | 24 | | 32 | | 215 | 12 | 2 | | 590 |
| Other | 10 | 5 | | | | | | 30 | | | | 6 | | 50 |
| Vessels: | | | | | | | | | | | | | | |
| Steam | | | | | | | 2 | | 3 | | | | | 5 |
| Net tonnage | | | | | | | 55 | | 141 | | | | | 196 |
| Motor | | | | 4 | | | 12 | | | | 1 | | | 17 |
| Net tonnage | | | | 29 | | | 197 | | | | 6 | | | 232 |
| Sail | | | 6 | | | | | | | | | | | 6 |
| Net tonnage | | | 1, 891 | | | | | | | | | | | 1, 891 |
| Total | | | 6 | 4 | | | 14 | | 3 | | 1 | | | 28 |
| Total net tonnage | | | 1, 891 | 29 | | | 252 | | 141 | | 6 | | | 2, 319 |

CATCH: BY GEAR

| Species | Lines | | Paranzella nets | | Gill nets | | Lampara nets | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Anchovies | | | | | | | 3, 400 | $34 |
| Carp | | | | | 33, 893 | $990 | | |
| Cod, dry salted | 3, 712, 070 | $235, 055 | | | | | | |
| Eels | 20 | 1 | | | | | | |
| Flounders: | | | | | | | | |
| "California halibut" | | | 90, 879 | $10, 087 | | | 339 | 38 |
| "Sole" | 17, 673 | 884 | 6, 060, 780 | 242, 431 | | | | |
| Other | 148 | 6 | 1, 283, 128 | 58, 502 | 6, 396 | 222 | 3, 304 | 116 |
| Grayfish | 8, 070 | 40 | 216, 756 | 1, 084 | | | 140 | 1 |
| Hake | | | 42, 498 | 1, 062 | | | | |
| Halibut | 1, 941 | 290 | | | | | | |
| Herring | | | | | 50, 060 | 1, 001 | 372, 679 | 7, 453 |
| Kingfish | 21 | 1 | 39, 929 | 1, 597 | | | 1, 647 | 66 |
| "Lingcod" | 309, 151 | 9, 275 | 140, 363 | 4, 211 | | | | |
| Mackerel | | | | | | | 899 | 54 |
| Perch | | | 150 | 9 | 47, 315 | 2, 839 | 8, 182 | 491 |
| Pike, Sacramento | | | | | 1, 903 | 76 | | |
| Pilchard or sardine | | | 150 | 3 | | | 7, 056, 465 | 47, 839 |
| Rockfishes | 706, 452 | 28, 258 | 180, 420 | 7, 217 | | | | |
| Sablefish | 55, 995 | 3, 080 | 32, 740 | 1, 801 | | | | |
| Salmon | 957, 426 | 98, 998 | | | 1, 266, 763 | 111, 925 | | |
| Sea bass, white, or squeteague | | | 30 | 4 | 108, 654 | 13, 033 | 110 | 19 |
| Shad | | | | | 902, 202 | 23, 800 | | |
| Skates | | | 156, 338 | 3, 127 | | | | |
| Smelt, silver | | | | | 65, 806 | 5, 920 | 15, 252 | 1, 357 |
| Striped bass | | | | | 750, 714 | 110, 100 | | |
| Suckers | | | | | 1, 269 | 25 | | |
| Tomcod | | | 3, 900 | 117 | | | 50 | 2 |
| Whitebait | | | | | | | 7, 794 | 1, 072 |
| Other fish | 2, 877 | 115 | 9, 067 | 317 | 1, 163 | 81 | | |
| Total | 5, 771, 844 | 376, 003 | 8, 257, 128 | 331, 569 | 3, 236, 138 | 270, 012 | 7, 470, 261 | 58, 542 |
| SHELL FISH, ETC. | | | | | | | | |
| Octopus | 8, 427 | 843 | 125 | 12 | | | | |
| Grand total | 5, 780, 271 | 376, 846 | 8, 257, 253 | 331, 581 | 3, 236, 138 | 270, 012 | 7, 470, 261 | 58, 542 |

[1] Exclusive of duplication.

*Fisheries of the San Francisco district of California, 1926*—Continued

CATCH: BY GEAR—Continued

| Species | Fyke nets | | Haul seines | | Traps | | Shrimp bag nets | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Carp | 11,613 | $312 | | | | | | |
| Catfish | 153,518 | 23,148 | | | | | | |
| Flounders | | | 1,395 | $71 | | | | |
| Hardhead | 43,625 | 4,409 | | | | | | |
| Herring | | | 10,078 | 202 | | | | |
| Perch | | | 43,910 | 2,735 | | | | |
| Pike, Sacramento | 1,087 | 63 | | | | | | |
| Pilchard or sardine | | | 150 | 3 | | | | |
| Smelt | | | 32,391 | 2,934 | | | | |
| Splittail | 5,322 | 206 | | | | | | |
| Suckers | 371 | 8 | | | | | | |
| Whitebait | | | 4,233 | 582 | | | | |
| Other fish | | | 28 | 1 | | | | |
| Total | 215,536 | 28,146 | 92,185 | 6,528 | | | | |
| SHELLFISH, ETC. | | | | | | | | |
| Crabs | | | | | 3,050,112 | $228,758 | | |
| Shrimp | | | | | | | 1,431,511 | $60,755 |
| Total | | | | | 3,050,112 | 228,758 | 1,431,511 | 60,755 |
| Grand total | 215,536 | 28,146 | 92,185 | 6,528 | 3,050,112 | 228,758 | 1,431,511 | 60,755 |

| Species | Shovels and forks | | Rakes | | Tongs | | Whaling apparatus | |
|---|---|---|---|---|---|---|---|---|
| SHELLFISH, ETC. | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Clams: | | | | | | | | |
| Cockle | 2,116 | $1,983 | | | | | | |
| Mixed | 2,689 | 1,512 | | | | | | |
| Soft | 40,724 | 21,802 | | | | | | |
| Mussels | | | 1,140 | $456 | | | | |
| Oysters, eastern, market | | | | | 61,042 | $26,161 | | |
| Total | 45,528 | 25,297 | 1,140 | 456 | 61,042 | 26,161 | | |
| WHALE PRODUCTS | | | | | | | | |
| Sperm oil | | | | | | | 36,750 | $1,927 |
| Whale oil | | | | | | | 1,980,068 | 112,917 |
| Other whale products | | | | | | | 882,760 | 20,902 |
| Total | | | | | | | 2,899,578 | 135,746 |
| Grand total | 45,528 | 25,297 | 1,140 | 456 | 61,042 | 26,161 | 2,899,578 | 135,746 |

*Fisheries of the Monterey district of California, 1926*

OPERATING UNITS: BY GEAR

| Items | Purse seines | Gill nets | Trawl lines | Troll lines | Hand lines | Lampara nets | Octopus traps | Crab traps | Abalone outfits | Shovels and rakes | Total [1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | | | |
| On boats or shore | | 131 | 287 | 316 | 51 | 638 | 30 | 18 | 18 | 1 | 958 |
| On vessels | 18 | 2 | | 9 | | 32 | | | 22 | | 72 |
| Total | 18 | 133 | 287 | 325 | 51 | 670 | 30 | 18 | 40 | 1 | 1,030 |
| Boats: Motor | | 97 | 234 | 249 | 42 | 58 | 27 | 18 | 4 | 1 | 307 |
| Vessels: Motor | 2 | 1 | | 3 | | 3 | | | 5 | | 10 |
| Net tonnage | 44 | 6 | | 17 | | 22 | | | 41 | | 107 |

[1] Exclusive of duplication.

*Fisheries of the Monterey district of California, 1926*—Continued

CATCH: BY GEAR

| Species | Lines | | Paranzella nets | | Gill nets | | Lampara nets | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Albacore | 118,683 | $11,903 | | | | | | |
| Anchovies | | | | | | | 48,530 | $467 |
| Barracuda | | | | | 40,867 | $3,250 | 25,914 | 2,054 |
| Bonito | 21,414 | 589 | | | | | 36,639 | 977 |
| Flounders: | | | | | | | | |
| "California halibut" | 10,179 | 1,219 | 3,003 | $360 | | | 298 | 42 |
| "Sole" | 186,952 | 8,264 | 2,083,798 | 93,771 | | | | |
| Other | 9,249 | 342 | 350,290 | 16,096 | | | | |
| Grayfish | 11,442 | 57 | 7,230 | 36 | | | | |
| Hake | | | 15,837 | 396 | | | | |
| Horse mackerel | 5,767 | 382 | | | | | 50,750 | 2,723 |
| Kingfish | | | 17,040 | 682 | 50,327 | 2,060 | 28,304 | 1,478 |
| "Lingcod" | 98,383 | 5,760 | 47,265 | 1,418 | | | 34 | 1 |
| Mackerel | 1,017,962 | 31,281 | 450 | 14 | 4,716 | 160 | 96,492 | 2,659 |
| Perch | | | 8,685 | 348 | 4,317 | 200 | 321 | 12 |
| Pilchard or sardine | | | | | | | 151,831,507 | 803,497 |
| Pompano | | | | | | | 81 | 40 |
| Rockfishes | 2,271,466 | 87,541 | 36,052 | 1,388 | | | | |
| Sablefish | 14,273 | 515 | 2,975 | 89 | | | | |
| Salmon | 51,755 | 5,498 | | | | | | |
| Sea bass, white or squeteague | | | | | 194,033 | 15,509 | 117,218 | 9,081 |
| Skates | 50 | 1 | 43,059 | 861 | | | | |
| Skipjack or striped tuna | 42,952 | 688 | | | | | 522 | 21 |
| Smelt, silver | | | | | 130,651 | 9,691 | 63,833 | 4,480 |
| Striped bass | 70 | 17 | | | | | | |
| Tomcod | | | 375 | 11 | | | | |
| Whitebait | | | | | | | 288 | 17 |
| Other fish | 30,046 | 606 | 6,450 | 226 | | | 1,855 | 37 |
| Total | 3,890,643 | 154,663 | 2,622,509 | 115,696 | 424,911 | 30,960 | 152,302,586 | 827,586 |
| SHELLFISH, ETC. | | | | | | | | |
| Squid | | | | | | | 3,127,159 | 44,966 |
| Grand total | 3,890,643 | 154,663 | 2,622,509 | 115,696 | 424,911 | 30,960 | 155,429,745 | 872,552 |

| Species | Purse Seines | | Abalone outfits | | Traps | | Rakes | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Pilchard or sardine | 3,330,300 | $18,309 | | | | | | |
| SHELLFISH, ETC. | | | | | | | | |
| Abalone | | | 408,605 | $81,720 | | | | |
| Crabs | | | | | 51,504 | $4,098 | | |
| Mussels | | | | | | | 248 | $31 |
| Octopus | | | | | 54,466 | 5,378 | | |
| Total | | | 408,605 | 81,720 | 105,970 | 9,476 | 248 | 31 |
| Grand total | 3,330,300 | 18,309 | 408,605 | 81,720 | 105,970 | 9,476 | 248 | 31 |

*Fisheries of the southern district of California, 1926*

OPERATING UNITS: BY GEAR

| Items | Purse seines | Haul seines | Gill nets | Trawl lines | Troll lines | Hand lines | Lampara nets | Paranzella nets | Trammel nets | Harpoons | Lobster pots | Shovels and rakes | Total [1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishermen: | | | | | | | | | | | | | |
| On boats or shore | | 3 | 190 | 239 | 920 | 83 | 77 | 10 | 106 | 5 | 138 | 91 | 1,192 |
| On vessels | 496 | | 95 | 212 | 1,026 | 77 | 919 | | 61 | | 13 | | 1,873 |
| Total | 496 | 3 | 285 | 451 | 1,946 | 160 | 996 | 10 | 167 | 5 | 151 | 91 | 3,065 |
| Boats: Motor | | 1 | 81 | 149 | 563 | 53 | 15 | 4 | 41 | 2 | 96 | | 639 |
| Vessels: Motor | 56 | | 31 | 47 | 243 | 22 | 129 | | 19 | | 6 | | 314 |
| Net tonnage | 1,491 | | 214 | 642 | 2,683 | 221 | 1,557 | | 134 | | 49 | | 4,170 |

[1] Exclusive of duplication.

*Fisheries of the southern district of California, 1926*—Continued

CATCH OFF CALIFORNIA: BY GEAR

| Species | Lines | | Purse seines | | Lampara nets | | Gill nets | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Albacore | 2,342,123 | $219,475 | 8,519 | $1,017 | | | | |
| Anchovies | | | 580 | 9 | 7,617 | $121 | | |
| Barracuda | 1,322,759 | 81,496 | 118,625 | 11,854 | 162,774 | 13,461 | 1,274,260 | $122,138 |
| Bonito | 957,059 | 30,354 | 1,732,774 | 50,430 | 12,413 | 301 | 138,526 | 4,680 |
| Eels | 218 | 6 | | | | | | |
| Flounders: | | | | | | | | |
| "California halibut" | 31,476 | 4,514 | 251 | 33 | 2,934 | 524 | | |
| "Sole" | 4,381 | 318 | | | 188 | 11 | | |
| Other | 13,559 | 3,446 | | | | | | |
| Grayfish | 18,058 | 374 | 3,420 | 22 | 6,825 | 80 | 2,978 | 79 |
| Herring | | | | | | | 13,989 | 348 |
| Horse mackerel | 76,936 | 4,731 | 78,950 | 3,312 | 14,171 | 724 | 8,577 | 524 |
| Kingfish | 941 | 38 | 1,496 | 45 | 320,914 | 6,752 | 6,025 | 185 |
| Mackerel | 1,096,831 | 27,014 | 197,084 | 2,978 | 840,496 | 22,454 | 354,790 | 9,111 |
| Mullet | | | | | 33,212 | 4,478 | | |
| Perch | 2,201 | 186 | 1,744 | 125 | 43,767 | 1,882 | 12,344 | 682 |
| Pilchard or sardine | | | 54,323,415 | 288,789 | 70,199,263 | 368,746 | | |
| Pompano | | | | | 8,044 | 3,868 | | |
| Rock bass | 512,907 | 39,648 | 29,161 | 1,932 | 3,869 | 281 | 17,920 | 1,466 |
| Rockfishes | 4,265,076 | 221,052 | 445 | 27 | 1,530 | 78 | | |
| Sablefish | 4,468 | 306 | | | | | | |
| Sculpin | 97,081 | 8,689 | 170 | 16 | 3,673 | 359 | | |
| Sea bass: | | | | | | | | |
| Black | 103,945 | 3,674 | 3,312 | 118 | 2,638 | 82 | 7,822 | 274 |
| White, or squeteague | 94,340 | 10,690 | 40,411 | 4,562 | 61,054 | 6,958 | 847,695 | 96,836 |
| Sheepshead | 112,552 | 4,130 | 237 | 7 | 2,041 | 71 | 7,671 | 294 |
| Skates | 1,847 | 37 | | | | | | |
| Skipjack, or striped tuna | 14,071,075 | 595,769 | 145,943 | 6,728 | | | | |
| Smelt, silver | | | 2,909 | 189 | 354,910 | 34,670 | 183,372 | 17,281 |
| Swordfish | 10,798 | 324 | | | | | | |
| Tuna: | | | | | | | | |
| Mixed | 206,985 | 14,580 | 53,771 | 3,530 | | | | |
| Bluefin | 8,944 | 522 | 6,517,589 | 342,890 | | | | |
| Yellowfin | 2,567,152 | 146,585 | 128,350 | 5,182 | | | | |
| Whitefish | 342,095 | 26,940 | 720 | 47 | 1,205 | 60 | | |
| Yellowtail | 2,184,994 | 106,192 | 546,799 | 24,933 | 226,103 | 13,273 | 193,980 | 11,210 |
| Other fish | 79,611 | 3,624 | 1,273 | 81 | 18,065 | 1,219 | 25,660 | 1,156 |
| Total | 30,530,412 | 1,554,714 | 63,937,948 | 748,856 | 72,327,706 | 480,453 | 3,095,609 | 266,264 |
| SHELLFISH, ETC. | | | | | | | | |
| Octopus | 246 | 25 | | | | | | |
| Squid | | | | | 8,402 | 840 | | |
| Total | 246 | 25 | | | 8,402 | 840 | | |
| Grand total | 30,530,658 | 1,554,739 | 63,937,948 | 748,856 | 72,336,108 | 481,293 | 3,095,609 | 266,264 |

| Species | Trammel nets | | Paranzella nets | | Haul seines | | Harpoons | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Bonito | 1,143 | $35 | | | | | | |
| Carp | | | | | 12,857 | $386 | | |
| Flounders: | | | | | | | | |
| "California halibut" | 665,393 | 102,803 | 193,911 | $26,247 | | | | |
| "Sole" | 14,390 | 1,037 | 86,178 | 3,872 | | | | |
| Other | 2,234 | 214 | | | | | | |
| Grayfish | 231,804 | 1,342 | | | | | | |
| Kingfish | 18,132 | 662 | | | | | | |
| "Lingcod" | 1,248 | 87 | | | | | | |
| Rock bass | 420 | 42 | | | | | | |
| Sculpin | 7,144 | 663 | | | | | | |
| Sea bass: | | | | | | | | |
| Black | 2,353 | 85 | | | | | | |
| White, or squeteague | 14,119 | 1,621 | | | | | | |
| Sheepshead | 13,566 | 475 | | | | | | |
| Skates | 29,749 | 486 | | | | | | |
| Swordfish | | | | | | | 33,170 | $3,317 |
| Whitefish | 316 | 25 | | | | | | |
| Yellowtail | 21,548 | 1,346 | | | | | | |
| Other fish | 11,488 | 628 | | | | | | |
| Total | 1,035,047 | 111,551 | 280,089 | 30,119 | 12,857 | 386 | 33,170 | 3,317 |

*Fisheries of the southern district of California, 1926*—Continued

CATCH OFF CALIFORNIA: BY GEAR—Continued

| Species | Traps | | Abalone outfits | | Forks and shovels | | Rakes | |
|---|---|---|---|---|---|---|---|---|
| SHELLFISH, ETC. | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Sea crawfish, or spiny lobsters | 442,198 | $70,276 | | | | | | |
| Abalone | | | 3,549 | $3,107 | | | | |
| Clams: | | | | | | | | |
| Mixed | | | | | 20 | $12 | | |
| Pismo | | | | | 68,579 | 27,432 | | |
| Mussels | | | | | | | 73 | $11 |
| Total | 442,198 | 70,276 | 3,549 | 3,107 | 68,599 | 27,444 | 73 | 11 |

CATCH OFF MEXICO: BY GEAR

| Species | Lines | | Purse seines | | Gill nets | | Trammel nets | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Albacore | 60 | $4 | | | | | | |
| Barracuda | 315,197 | 18,943 | 1,697,640 | $192,879 | 64,458 | $3,535 | | |
| Bonito | 28,773 | 845 | 149,925 | 5,045 | | | | |
| Dolphin | 3,145 | 94 | | | | | | |
| Flounders: | | | | | | | | |
| "California halibut" | 1,464 | 164 | 230 | 41 | | | 430,643 | $63,638 |
| Other | | | | | | | 22 | 2 |
| Horse mackerel | | | 3,813 | 196 | 200 | 12 | | |
| Kingfish | | | | | 20 | 1 | 125 | 6 |
| Mackerel | 9,454 | 227 | 1,377 | 47 | 2,361 | 68 | | |
| Mullet | | | 2,025 | 283 | 16,516 | 2,287 | | |
| Perch | | | 3,218 | 225 | 1,122 | 44 | | |
| Rock bass | 66,300 | 6,218 | 5,758 | 517 | | | | |
| Rockfishes | 13,228 | 482 | 335 | 13 | | | 459 | 16 |
| Sea bass: | | | | | | | | |
| Black | 236,291 | 7,467 | 13,762 | 451 | 7,605 | 342 | 206 | 10 |
| White or squeteague | 349,404 | 35,264 | 321,439 | 35,518 | 67,770 | 9,390 | | |
| Sheepshead | 2,860 | 106 | | | | | | |
| Skipjack or striped tuna | 5,665,882 | 230,908 | 1,068,448 | 39,818 | | | | |
| Smelt, silver | | | 270 | 14 | 1,712 | 121 | | |
| Tuna, yellowfin | 7,631,741 | 353,655 | 2,237,842 | 85,438 | | | | |
| Whitefish | 23,166 | 1,123 | 562 | 22 | | | | |
| Yellowtail | 1,149,445 | 57,909 | 700,245 | 51,182 | | | | |
| Other fish | 710 | 38 | 21,504 | 1,830 | 263 | 11 | | |
| Total | 15,497,120 | 713,447 | 6,228,393 | 413,519 | 162,027 | 15,811 | 431,455 | 63,672 |

| Species | Harpoons | | Traps | | Forks | | Tongs | |
|---|---|---|---|---|---|---|---|---|
| FISH | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Swordfish | 1,575 | $122 | | | | | | |
| SHELLFISH, ETC. | | | | | | | | |
| Sea crawfish or spiny lobsters | | | 733,025 | $92,906 | | | | |
| Clams: | | | | | | | | |
| Cockle | | | | | 170 | $114 | | |
| Mixed | | | | | 527 | 246 | | |
| Oysters, native, market | | | | | | | 36 | $20 |
| Total | 1,575 | 122 | 733,025 | 92,906 | 697 | 360 | 36 | 20 |

*Fisheries of California, 1888 to 1926*

OPERATING UNITS

| Items | 1888 | 1892 | 1895 | 1899 | 1904 | 1908 |
|---|---|---|---|---|---|---|
| Fishermen: | | | | | | |
| On boats or shore | 3,188 | 2,968 | 2,716 | 2,538 | 3,491 | 3,320 |
| On vessels | 1,396 | 1,825 | 1,419 | 942 | 838 | 645 |
| Total | 4,584 | 4,793 | 4,135 | 3,480 | 4,329 | 3,965 |
| Fishing boats: | | | | | | |
| Motor | 1,354 | 1,391 | 1,442 | 1,355 | 231 | 413 |
| Other | | | | | 1,798 | 1,708 |
| Fishing vessels: | | | | | | |
| Steam | (1) | (1) | (1) | (1) | (1) | [2] 22 |
| Net tonnage | (1) | (1) | (1) | (1) | (1) | [2] 2,253 |
| Motor | (1) | (1) | (1) | (1) | (1) | (2) |
| Net tonnage | (1) | (1) | (1) | (1) | (1) | (2) |
| Sail | (1) | (1) | (1) | (1) | (1) | 9 |
| Net tonnage | (1) | (1) | (1) | (1) | (1) | 2,227 |
| Total | 69 | 84 | 58 | 33 | 37 | 31 |
| Total net tonnage | 9,544 | 12,436 | 9,215 | 5,952 | 6,096 | 4,480 |

| Items | 1915 | 1922 | 1923 | 1924 | 1925 | 1926 |
|---|---|---|---|---|---|---|
| Fishermen: | | | | | | |
| On boats or shore | 4,282 | 3,136 | 2,625 | 2,876 | 2,474 | 3,665 |
| On vessels | 551 | 1,331 | 1,972 | 1,933 | 2,044 | 2,279 |
| Total | 4,833 | 4,467 | 4,597 | 4,809 | 4,518 | 5,944 |
| Fishing boats: | | | | | | |
| Motor | 1,429 | 1,297 | 1,307 | 1,513 | 1,255 | 1,719 |
| Other | 1,169 | 292 | 135 | 132 | 150 | |
| Fishing vessels: | | | | | | |
| Steam | (1) | 7 | (1) | 6 | 6 | 5 |
| Net tonnage | (1) | 319 | (1) | (3) | (3) | 196 |
| Motor | (1) | 199 | (1) | 326 | 352 | 351 |
| Net tonnage | (1) | 2,525 | (1) | (3) | (3) | 4,588 |
| Sail | (1) | 3 | (1) | 5 | 4 | 6 |
| Net tonnage | (1) | 1,043 | (1) | (3) | (3) | 1,891 |
| Total | 73 | 209 | 285 | 337 | 362 | 362 |
| Total net tonnage | 3,198 | 3,887 | 4,071 | 5,821 | 5,350 | 6,675 |

CATCH

[Expressed in thousands of pounds; that is, 000 omitted. Salt fish, except cod, have been converted to the equivalent of fresh fish]

| Species | 1888 | 1892 | 1895 | 1899 | 1904 | 1908 | 1915 | 1918 |
|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | |
| Albacore | | | 299 | 179 | 210 | | 21,074 | 7,265 |
| Anchovies | | 150 | 460 | 7 | | 220 | 113 | 868 |
| Barracuda | | 436 | 1,245 | 1,425 | 2,375 | 3,205 | 3,923 | 4,838 |
| Bonito | | 421 | 301 | 189 | 212 | 329 | 448 | 2,441 |
| Carp | | 66 | 46 | 284 | 70 | 427 | 351 | 313 |
| Catfish | | | 277 | 466 | 737 | 1,069 | 517 | 205 |
| Cod, salted | | 2,275 | 2,784 | 5,917 | 5,623 | 3,298 | 4,953 | 4,713 |
| Flounders: | | | | | | | | |
| "California halibut" | | | | | | | | [4] 4,754 |
| "Sole" | | | | 32 | 3,874 | | 5,762 | 7,028 |
| Other | | 4,270 | 3,308 | 4,715 | 4,361 | [5] 6,681 | 6,934 | 2,574 |
| Hake | | | | | | 32 | 269 | 219 |
| Halibut | | | | | | | | |
| Hardhead | | | | 186 | 65 | | 73 | 28 |
| Herring | | 4,487 | 3,181 | 1,653 | 1,426 | 825 | 864 | 7,938 |

[1] Steam, motor, and sailing vessels not designated separately prior to 1922 and in 1923.
[2] Motor and steam vessels not designated separately prior to 1922.
[3] Steam, motor, and sailing vessel tonnages not designated separately in 1924 and 1925.
[4] Includes halibut.
[5] Includes "soles."

*Fisheries of California, 1888 to 1926*—Continued

CATCH—Continued

[Expressed in thousands of pounds; that is, 000 omitted. Salt fish, except cod, have been converted to the equivalent of fresh fish]

| Species | 1888 | 1892 | 1895 | 1899 | 1904 | 1908 | 1915 | 1918 |
|---|---|---|---|---|---|---|---|---|
| FISH—continued | | | | | | | | |
| Kingfish | | 40 | 148 | 127 | 174 | 682 | 656 | 975 |
| "Lingcod" | | 231 | 139 | 148 | 293 | 167 | 578 | 916 |
| Mackerel | | 350 | 95 | 168 | 135 | 197 | 266 | 4, 076 |
| Mullet | | | | 22 | 13 | 4 | 3 | 91 |
| Pilchard or sardine | | 753 | 732 | 2, 383 | 1, 036 | 4, 638 | 4, 390 | 157, 653 |
| Pompano | | | 11 | 13 | 34 | 89 | 19 | 24 |
| Rock bass | | | | | | | 901 | 784 |
| Rockfishes | | 1, 839 | 1, 529 | 1, 188 | 1, 820 | 2, 319 | 4, 352 | 7, 890 |
| Sablefish | | | | | | 35 | 65 | 409 |
| Salmon: | | | | | | | | |
| Chinook | | 3, 721 | 4, 450 | 7, 091 | 14, 916 | 8, 846 | 7, 324 | 13, 026 |
| Silver | | 960 | 164 | 60 | 272 | 141 | 415 | |
| Blueback | | | | 22 | 279 | 147 | | |
| Chum | | | | | | | 38 | |
| Sculpin | | | | 3 | 3 | | 9 | 28 |
| Sea bass: | | | | | | | | |
| Black | | 263 | 37 | 96 | 63 | 161 | 392 | 249 |
| White, squeteague | | | 640 | 952 | 983 | 1, 337 | 1, 221 | 1, 684 |
| Shad | | 526 | 247 | 1, 138 | 327 | 1, 169 | 6, 893 | 2, 384 |
| Sharks | | | | | | | 68 | 403 |
| Sheepshead | | | | | | | | 23 |
| Skates | | | | | 198 | 124 | 783 | 246 |
| Skipjack, or striped tuna | | | | | | | | 3, 024 |
| Smelt | | 1, 920 | 1, 740 | 1, 315 | 1, 362 | 718 | 1, 137 | 797 |
| Steelhead trout | | 310 | 461 | 114 | 55 | 76 | 32 | 22 |
| Striped bass | | 56 | 252 | 1, 234 | 1, 570 | 1, 776 | 1, 784 | 1, 408 |
| Sturgeon | | 718 | 300 | 206 | | 10 | 18 | |
| Surf fishes | | [6] 335 | [6] 267 | 116 | 119 | 198 | 128 | 198 |
| Swordfish | | | | | | 8 | | 18 |
| Tomcod | | | 64 | 376 | 69 | 49 | 42 | 49 |
| Tuna: | | | | | | | | |
| Yellowfin | | | 32 | 24 | 15 | 12 | | |
| Mixed | | | | | | | | 6, 241 |
| Whitebait | | | | | | | 56 | 136 |
| Whitefish | | | 263 | 58 | 270 | 466 | | |
| Yellowtail | | 546 | 316 | 334 | 358 | 571 | 1, 343 | 11, 798 |
| Other fish | 28, 736 | 2, 217 | 583 | 674 | 1, 266 | 1, 201 | 673 | 859 |
| Total | 28, 736 | 26, 890 | 24, 371 | 32, 915 | 44, 583 | 41, 227 | 78, 867 | 258, 685 |
| SHELLFISH, ETC. | | | | | | | | |
| Crabs | 230 | 2, 862 | 2, 565 | 3, 677 | 5, 111 | 1, 702 | 1, 414 | 1, 619 |
| Sea crawfish or spiny lobster | 231 | 303 | 558 | 607 | 1, 078 | 573 | 892 | 931 |
| Shrimp | 4, 902 | 5, 313 | 5, 425 | 6, 495 | 2, 576 | 258 | 298 | 722 |
| Clams: | | | | | | | | |
| Cockle | | | | | | | | 6 |
| Pismo | | | | | | | | 166 |
| Soft | | | | | 140 | 468 | 67 | 52 |
| Mixed | 2, 396 | 2, 497 | 1, 583 | 2, 171 | 96 | 132 | 66 | 19 |
| Mussels | | 2, 880 | 488 | 364 | 28 | 68 | 19 | 8 |
| Oysters: | | | | | | | | |
| Eastern, market | | | | 25, 200 | 1, 120 | 729 | 376 | 136 |
| Native, market | 910 | 15, 099 | 14, 727 | 3, 600 | 301 | | 8 | 6 |
| Abalone | [7] 3, 606 | [7] 405 | [8] 126 | 369 | [7] 825 | 1, 005 | 731 | 121 |
| Octopus | [9] 244 | [9] 375 | 2 | | | | 32 | 33 |
| Scallops | | | | 4 | | | | |
| Squid | | | 30 | 1, 869 | 754 | 110 | 6, 211 | 362 |
| Other shellfish | | | | | | | | 21 |
| Total | 12, 519 | 29, [illegible]4 | 25, 504 | 44, 356 | 12, 029 | 5, 045 | 10, 114 | 4, 202 |
| WHALE PRODUCTS | | | | | | | | |
| Sperm oil | | | | | | 169 | | |
| Whale oil | | 1, 575 | 550 | 507 | 325 | 13 | | 23 |
| Other whale products | | 197 | 99 | 207 | 87 | 32 | | |
| Total | | 1, 772 | 649 | 714 | 412 | 214 | | 23 |
| Grand total | 41, 255 | 58, 396 | 50, 524 | 77, 985 | 57, 024 | 46, 486 | 88, 981 | 262, 910 |

[6] Includes Sacramento perch.
[7] Includes shells.
[8] Dried.
[9] Includes squid.

*Fisheries of California, 1888 to 1926*—Continued

CATCH—Continued

[Expressed in thousands of pounds; that is, 000 omitted. Salt fish, except cod, have been converted to the equivalent of fresh fish]

| Species | 1919 | 1920 | 1921 | 1922 | 1923 | 1924 | 1925 | 1926 |
|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | |
| Albacore | 13,631 | 18,877 | 15,277 | 13,232 | 12,515 | 17,695 | 22,207 | 2,469 |
| Anchovies | 1,610 | 570 | 1,947 | 653 | 307 | 347 | 124 | 60 |
| Barracuda | 5,825 | 8,201 | 7,625 | 6,250 | 7,201 | 7,129 | 8,006 | 5,022 |
| Bonito | 3,504 | 873 | 321 | 929 | 1,115 | 1,038 | 867 | 3,079 |
| Carp | 261 | 134 | 102 | 67 | 149 | 76 | 95 | 72 |
| Catfish | 165 | 112 | 148 | 126 | 129 | 352 | 366 | 257 |
| Cod, salted | 2,086 | 2,474 | 805 | 1,680 | 1,398 | 2,884 | 3,416 | 3,712 |
| Flounders: | | | | | | | | |
| "California halibut" | [4] 4,859 | [4] 4,445 | [4] 3,796 | [4] 3,403 | [4] 2,427 | 2,576 | 2,452 | 1,431 |
| "Sole" | 5,529 | 3,822 | 4,871 | 7,043 | 7,086 | 8,835 | 8,763 | 8,650 |
| Other | 1,148 | 1,204 | 1,078 | 1,712 | 1,874 | 2,081 | 2,551 | 1,813 |
| Hake | 133 | 142 | 90 | 75 | 79 | 61 | 22 | 58 |
| Halibut | | | | | | 133 | 162 | 257 |
| Hardhead | 49 | 13 | 76 | 18 | 10 | 19 | 24 | 44 |
| Herring | 4,290 | 274 | 542 | 342 | 384 | 436 | 866 | 454 |
| Kingfish | 609 | 461 | 391 | 582 | 412 | 384 | 537 | 485 |
| "Lingcod" | 1,063 | 688 | 426 | 568 | 467 | 400 | 683 | 645 |
| Mackerel | 2,703 | 3,048 | 2,975 | 2,496 | 3,592 | 3,241 | 3,522 | 3,623 |
| Mullet | 9 | 18 | 29 | 31 | 74 | 62 | 37 | 52 |
| Pilchard or sardine | 153,877 | 118,521 | 59,323 | 93,400 | 159,197 | 242,686 | 315,295 | 286,741 |
| Pompano | 61 | 30 | 17 | 16 | 33 | 18 | 11 | 8 |
| Rock bass | 450 | 210 | 364 | 316 | 357 | 466 | 330 | 636 |
| Rockfishes | 5,333 | 5,601 | 4,688 | 4,263 | 4,950 | 4,717 | 5,454 | 7,538 |
| Sablefish | 335 | 781 | 1,023 | 269 | 538 | 933 | 722 | 183 |
| Salmon: | | | | | | | | |
| Chinook | 13,146 | 11,134 | 7,991 | 7,235 | 7,090 | 10,015 | 9,526 | 6,084 |
| Sculpin | 25 | 36 | 58 | 42 | 60 | 109 | 226 | 108 |
| Sea bass: | | | | | | | | |
| Black | 185 | 148 | 127 | 97 | 227 | 231 | 189 | 378 |
| White, squeteague | 2,520 | 2,661 | 2,643 | 2,982 | 2,520 | 1,516 | 1,920 | 2,216 |
| Shad | 1,574 | 1,410 | 863 | 1,110 | 1,285 | 1,539 | 2,440 | 903 |
| Sharks | 613 | 811 | 539 | 282 | 360 | 393 | 372 | 507 |
| Sheepshead | 18 | 15 | 24 | 18 | 32 | 24 | 49 | 139 |
| Skates | 253 | 89 | 60 | 121 | 134 | 131 | 183 | 233 |
| Skipjack, or striped tuna | 6,897 | 7,957 | 1,139 | 11,862 | 11,463 | 3,781 | 14,235 | 20,995 |
| Smelt | 757 | 744 | 765 | 830 | 806 | 722 | 752 | 883 |
| Steelhead trout | 17 | 7 | 4 | 3 | 3 | 87 | | |
| Striped bass | 762 | 672 | 602 | 684 | 910 | 662 | 838 | 751 |
| Sturgeon | | | | | | | | |
| Surf fishes | 191 | 181 | 243 | 238 | 326 | 289 | 268 | 209 |
| Swordfish | 18 | 13 | 15 | 23 | 12 | 32 | 27 | 46 |
| Tomcod | 31 | 37 | 42 | 32 | 42 | 43 | 15 | 4 |
| Tuna: | | | | | | | | |
| Bluefin | 14,991 | 10,530 | 2,032 | 2,838 | 3,301 | 3,241 | 3,804 | 6,527 |
| Yellowfin | 348 | 1,965 | 1,238 | 7,337 | 10,837 | 3,063 | 13,238 | 12,565 |
| Mixed | 2,461 | 5,483 | 1,553 | 692 | 662 | 547 | 427 | 261 |
| Whitebait | 6 | 1 | 5 | 84 | 68 | 122 | 71 | 86 |
| Whitefish | 27 | 14 | 29 | 30 | 40 | 273 | 222 | 368 |
| Yellowtail | 5,005 | 2,705 | 2,491 | 3,414 | 3,980 | 4,714 | 3,180 | 5,023 |
| Other fish | 655 | 681 | 1,359 | 280 | 237 | 377 | 253 | 482 |
| Total | 258,030 | 217,793 | 129,736 | 177,705 | 248,689 | 328,480 | 428,747 | 386,057 |
| SHELLFISH, ETC. | | | | | | | | |
| Crabs | 1,305 | 1,221 | 801 | 880 | 1,076 | 1,507 | 3,234 | 3,296 |
| Sea crawfish or spiny lobster | 1,089 | 1,190 | 1,278 | 1,017 | 1,093 | 1,027 | 1,486 | 1,175 |
| Shrimp | 813 | 818 | 910 | 990 | 1,113 | 1,551 | 1,460 | 1,432 |
| Clams: | | | | | | | | |
| Cockle | 3 | 2 | 2 | 4 | 5 | 1 | | 2 |
| Pismo | 104 | 75 | 55 | 49 | 59 | 73 | 81 | 69 |
| Soft | 50 | 39 | 36 | 57 | 47 | 41 | 44 | 41 |
| Mixed | 10 | 12 | 9 | 5 | 4 | 7 | 9 | 5 |
| Mussels | 6 | 6 | 2 | 7 | 10 | 8 | 4 | 1 |
| Oysters: | | | | | | | | |
| Eastern, market | 152 | 112 | 77 | 74 | 69 | 53 | 57 | 61 |
| Native, market | 14 | 9 | 1 | | | | | |
| Abalone | 152 | 180 | 298 | 312 | 318 | 449 | 471 | 412 |
| Octopus | 21 | 71 | 56 | 99 | 110 | 186 | 133 | 63 |
| Squid | 3,698 | 508 | 433 | 210 | 1,180 | 6,831 | 1,891 | 3,136 |
| Other shellfish | 270 | 97 | 4 | 13 | 1 | | | |
| Total | 7,687 | 4,340 | 3,962 | 3,697 | 5,085 | 11,714 | 8,870 | 9,693 |
| WHALE PRODUCTS | | | | | | | | |
| Sperm oil | | 13 | 9 | 38 | 16 | | 49 | 37 |
| Whale oil | 3,120 | 4,425 | 1,561 | 6,863 | 4,644 | 2,932 | 1,526 | 1,980 |
| Other whale products | 1,500 | 2,390 | 696 | 3,136 | 2,370 | 1,768 | 1,109 | 883 |
| Total | 4,620 | 6,828 | 2,266 | 10,037 | 7,030 | 4,700 | 2,684 | 2,900 |
| Grand total | 270,337 | 228,961 | 135,964 | 191,439 | 260,804 | 344,894 | 440,301 | 398,650 |

## VESSEL FISHERIES AT SEATTLE, WASH.

During 1927, fishing vessels of 5 net tons and over and collecting vessels landed 31,515,470 pounds of fishery products at Seattle, valued at $3,260,731. This is less than the previous year by 3 per cent in amount and 9 per cent in value.

The fishing vessels made 1,071 trips and landed 15,733,070 pounds of fish. This is an increase of 3 trips and 18 per cent in amount compared with a year ago. The increase is reflected mainly in the larger landings of halibut. During 1927, halibut was the most important species taken by these vessels and accounted for 75 per cent of the catch, while sablefish accounted for 15 per cent, and "lingcod," rockfish, and sturgeon accounted for 10 per cent.

The catch by fishing vessels was taken from fishing grounds along the coast from Oregon to Portlock Bank, Alaska. Hecate Strait ranked as the most important bank, 40 per cent of the catch being made there. Of second importance were the Flattery Banks, which provided 29 per cent of the catch; while Portlock Bank ranked third and furnished 18 per cent. The remainder of the catch was taken on the Oregon coast, Yakutat grounds, and Coronation Island grounds.

Due to the restriction on taking halibut from November 15 to February 15, the majority of the landings by fishing vessels were made at other times during the year.

Collecting vessels landed 15,782,400 pounds of fishery products at Seattle in 1927, all of which were taken in Puget Sound. This is 17 per cent less than the landings made here in the previous year, and was due mainly to the smaller quantity of salmon landed.

Of the total fishery products landed by collecting vessels, salmon accounted for 87 per cent, while sturgeon, herring, trout, smelt, perch, rockfish, "lingcod," flounders, sole, and crabs made up the rest. Collecting vessels landed their largest fares during the months from May to November, inclusive, those landed in July being the largest.

*Fishery products landed at Seattle, Wash., 1927*

BY AMERICAN VESSELS

| Fishing grounds | Number of trips | Halibut | | Sablefish | | "Lingcod" | |
|---|---|---|---|---|---|---|---|
| | | Fresh | | Fresh | | Fresh | |
| | | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Oregon Coast | 65 | 363,550 | $58,572 | 788,100 | $52,023 | 27,600 | $802 |
| Flattery Banks | 478 | 2,252,000 | 378,736 | 1,203,050 | 79,842 | 674,620 | 31,029 |
| Hecate Strait | 443 | 5,411,900 | 863,137 | 411,950 | 25,600 | 270,950 | 8,443 |
| Coronation Island | 1 | 57,000 | 8,550 | | | | |
| Yakutat Grounds | 22 | 778,000 | 92,725 | 12,800 | 1,024 | 500 | 20 |
| Portlock Bank | 61 | 2,845,700 | 375,525 | 10,000 | 720 | | |
| Unspecified | 1 | [1] 87,000 | 9,570 | | | | |
| Total | 1,071 | 11,795,150 | 1,786,815 | 2,425,900 | 159,209 | 973,670 | 40,294 |

| Fishing grounds | Rockfishes | | Sturgeon | | Total | |
|---|---|---|---|---|---|---|
| | Fresh | | Fresh | | Fresh | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Oregon Coast | 14,500 | $477 | | | 1,193,750 | $111,874 |
| Flattery Banks | 386,500 | 17,677 | | | 4,516,170 | 507,284 |
| Hecate Strait | 129,350 | 4,462 | 7,500 | $450 | 6,231,650 | 902,092 |
| Coronation Island | | | | | 57,000 | 8,550 |
| Yakutat Grounds | 500 | 20 | | | 791,800 | 93,789 |
| Portlock Bank | | | | | 2,855,700 | 376,245 |
| Unspecified | | | | | 87,000 | 9,570 |
| Total | 530,850 | 22,636 | 7,500 | 450 | 15,733,070 | 2,009,404 |

[1] Landed by the vessel Dorothy, chartered by the International Fisheries Commission.

*Fishery products landed at Seattle, Wash., 1927*—Continued

BY AMERICAN VESSELS—Continued

| Months | Number of trips | Halibut | | Sablefish | | "Lingcod" | |
|---|---|---|---|---|---|---|---|
| | | Fresh | | Fresh | | Fresh | |
| | | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| January | 9 | | | | | 68,000 | $5,520 |
| February | 13 | 19,200 | $5,415 | | | 36,400 | 2,383 |
| March | 107 | 475,550 | 88,727 | 35,350 | $2,842 | 91,300 | 5,849 |
| April | 139 | 1,063,300 | 191,598 | 94,400 | 7,130 | 143,150 | 4,949 |
| May | 159 | 1,790,450 | 278,529 | 85,250 | 7,173 | 107,820 | 3,385 |
| June | 135 | 1,774,750 | 264,243 | | | 153,800 | 3,238 |
| July | 90 | 1,262,150 | 196,490 | 155,250 | 10,963 | 58,000 | 1,165 |
| August | 112 | 1,449,700 | 209,414 | 512,600 | 31,962 | 68,500 | 1,394 |
| September | 116 | 1,307,550 | 203,549 | 667,350 | 37,566 | 51,850 | 1,127 |
| October | 95 | 989,450 | 139,766 | 538,700 | 37,156 | 59,000 | 2,626 |
| November | 82 | 1,576,050 | 199,514 | 334,800 | 24,244 | 46,450 | 2,865 |
| December | 14 | 87,000 | 9,570 | 2,200 | 173 | 89,400 | 5,793 |
| Total | 1,071 | 11,795,150 | 1,786,815 | 2,425,900 | 159,209 | 973,670 | 40,294 |

| Months | Rockfishes | | Sturgeon | | Total | |
|---|---|---|---|---|---|---|
| | Fresh | | Fresh | | Fresh | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| January | 29,500 | $2,345 | | | 97,500 | $7,865 |
| February | 20,500 | 1,370 | | | 76,100 | 9,168 |
| March | 43,300 | 2,325 | | | 645,500 | 99,743 |
| April | 86,450 | 3,039 | 7,500 | $450 | 1,394,800 | 207,166 |
| May | 50,000 | 1,583 | | | 2,033,520 | 290,670 |
| June | 53,400 | 1,144 | | | 1,981,950 | 268,625 |
| July | 23,500 | 470 | | | 1,498,900 | 209,088 |
| August | 74,600 | 3,278 | | | 2,105,400 | 246,048 |
| September | 45,700 | 1,362 | | | 2,072,450 | 243,604 |
| October | 37,300 | 1,597 | | | 1,624,450 | 181,145 |
| November | 20,800 | 1,181 | | | 1,978,100 | 227,804 |
| December | 45,800 | 2,942 | | | 224,400 | 18,478 |
| Total | 530,850 | 22,636 | 7,500 | 450 | 15,733,070 | 2,009,404 |

BY COLLECTING VESSELS: IN PUGET SOUND

| Species | January | | February | | March | | April | | May | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Sturgeon | | | 800 | $200 | | | | | | |
| Herring | 180,000 | $900 | 160,000 | 800 | 150,000 | $750 | 35,000 | $175 | 20,000 | $100 |
| Salmon: | | | | | | | | | | |
| King or spring | | | | | | | | | 940,000 | 94,000 |
| Coho or silver | | | | | | | | | 3,000 | 180 |
| Trout: Steelhead | | | 30,000 | 3,000 | | | | | 27,000 | 2,700 |
| Smelt | 8,000 | 720 | 6,000 | 660 | | | 4,500 | 600 | | |
| Perch | 6,500 | 455 | 4,500 | 270 | 12,000 | 600 | 27,000 | 1,620 | 3,000 | 200 |
| Rockfishes | 6,500 | 455 | 10,000 | 700 | 8,000 | 640 | 4,000 | 240 | 5,000 | 350 |
| "Lingcod" | | | | | 5,000 | 150 | 10,500 | 210 | | |
| Flounders | 7,000 | 150 | 6,500 | 130 | 4,000 | 80 | 6,000 | 120 | 6,000 | 120 |
| Sole | 35,500 | 1,420 | 56,000 | 2,240 | 6,000 | 240 | 32,000 | 1,280 | 50,000 | 2,000 |
| Crabs | 24,200 | 1,650 | 27,500 | 1,875 | 30,800 | 2,100 | 13,640 | 930 | 24,000 | 1,650 |
| Total | 267,700 | 5,750 | 301,300 | 9,875 | 215,800 | 4,560 | 132,640 | 5,175 | 1,078,000 | 101,300 |

*Fishery products landed at Seattle, Wash., 1927*—Continued

BY COLLECTING VESSELS: IN PUGET SOUND—Continued

| Species | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Sturgeon | | | 460 | $92 | 2,900 | $4,300 | 2,400 | $308 |
| Salmon: | | | | | | | | |
| Humpback or pink | | | 6,500 | 260 | 360,000 | 21,000 | 280,000 | 8,400 |
| Chum or keta | | | 16,000 | 640 | 80,000 | 4,000 | 55,000 | 2,200 |
| King or spring | 1,700,000 | $170,000 | 2,800,000 | 280,000 | 1,656,000 | 165,000 | 452,000 | 54,240 |
| Coho or silver | | | 146,000 | 7,300 | 334,000 | 20,040 | 650,000 | 60,000 |
| Sockeye or red | 18,000 | 1,800 | | | 48,000 | 4,800 | 28,000 | 2,800 |
| Trout: Steelhead | 9,000 | 450 | 16,000 | 1,600 | 12,800 | 1,280 | 22,000 | 2,200 |
| Smelt | | | | | 28,000 | 3,080 | 28,000 | 2,800 |
| Perch | | | | | 6,500 | 260 | 8,000 | 560 |
| Rockfishes | 2,000 | 140 | | | 20,000 | 1,400 | 6,000 | 480 |
| "Lingcod" | 4,200 | 84 | 18,000 | 720 | | | 4,000 | 160 |
| Flounders | 6,000 | 120 | 8,400 | 168 | 9,500 | 665 | 8,500 | 170 |
| Sole | 18,000 | 720 | 30,000 | 1,200 | 28,000 | 840 | 15,000 | 600 |
| Total | 1,757,200 | 173,314 | 3,041,360 | 291,980 | 2,585,700 | 226,665 | 1,558,900 | 134,918 |

| Species | October | | November | | December | | Total | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Sturgeon | 2,000 | $200 | | | | | 8,560 | $5,100 |
| Herring | | | 84,000 | $840 | 75,000 | $750 | 704,000 | 4,315 |
| Salmon: | | | | | | | | |
| Humpback or pink | | | | | | | 646,500 | 29,660 |
| Chum or keta | 1,600,000 | 64,000 | 610,000 | 30,500 | | | 2,361,000 | 101,340 |
| King or spring | 106,000 | 10,600 | 26,400 | 2,640 | | | 7,680,400 | 776,480 |
| Coho or silver | 1,660,000 | 132,800 | 216,000 | 21,600 | | | 3,009,000 | 241,920 |
| Sockeye or red | | | | | | | 94,000 | 9,400 |
| Trout: Steelhead | | | | | | | 116,800 | 11,230 |
| Smelt | 60,000 | 6,600 | 26,000 | 3,900 | 42,000 | 4,200 | 202,500 | 22,560 |
| Perch | | | 4,000 | 160 | 5,000 | 400 | 76,500 | 4,525 |
| Rockfishes | 7,000 | 420 | 11,000 | 660 | 12,000 | 720 | 91,500 | 6,205 |
| "Lingcod" | | | | | 8,000 | 320 | 49,700 | 1,644 |
| Flounders | 4,000 | 80 | 5,000 | 100 | | | 70,900 | 1,903 |
| Sole | 12,000 | 480 | 38,000 | 1,520 | 50,000 | 2,000 | 370,500 | 14,540 |
| Crabs | 66,000 | 4,500 | 70,400 | 4,800 | 44,000 | 3,000 | [1] 300,540 | 20,505 |
| Total | 3,517,000 | 219,680 | 1,090,800 | 66,720 | 236,000 | 11,390 | 15,782,400 | 1,251,327 |

[1] 13,670 dozen.

## HALIBUT FISHERY OF THE PACIFIC COAST [6]

The American halibut fleet on the Pacific coast in 1927 numbered 232 vessels that fish regularly for halibut; their total tonnage was 5,581, they were manned by 1,707 fishermen, and operated 10,490 skates of lines. In addition to the regular vessels, about 40 other vessels and 170 boats landed halibut at times. The total catch amounted to 45,100,000 pounds, valued at $5,233,000. In making this catch, a few other varieties of fish were caught incidentally and landed. They were as follows: Sablefish, 3,879,000 pounds, valued at $235,000; "lingcod," 989,000 pounds, valued at $38,000; and rockfish, 473,000 pounds, valued at $19,000; making the total value of the halibut fishery's 1927 output, $5,523,000.

[6] To preclude the possibility of unwarranted comparison of figures given in this section with others for previous years, it should be explained that the figures as herein compiled differ from those published in separate reports for the Alaska fisheries and the Pacific Coast States. The difference lies principally in the fleet classifications as between Washington and Alaska, though there is reason to believe that the figures on landings also are not comparable with those previously published, due to variable practice in the inclusion of American-caught halibut landed at foreign ports as well as the possible duplication of figures.

The present compilation is a complete résumé of the landings of the American fleet for the year 1927, without omission or duplication. The fleet classification has been applied arbitrarily by including in the "Washington fleet" all vessels that land more than half of their catch in that State. All others were included in the "Alaska fleet." It has been necessary, in some cases, to use "hailing fares"; the error therefrom is estimated to be less than 2 per cent.

Recent trends in the halibut fishery may be gained from the statistics published monthly by the bureau for the last three years [7] and reproduced below. It may be seen that the catches of both the American and Canadian vessels have increased, but landings in British Columbia have declined slightly, while the landings in the Pacific Coast States and Alaska have increased, most markedly in the latter.

*Halibut fishery of the Pacific coast, 1927*

OPERATING UNITS: BY FLEET CLASSIFICATION

| Items | Washington fleet | Alaska fleet | Total |
|---|---|---|---|
| Regular halibut vessels: | | | |
| Number | 81 | 151 | 232 |
| Net tonnage | 1,674 | 3,907 | 5,581 |
| Crew | 539 | 1,168 | 1,707 |
| Dories | 81 | 151 | 232 |
| Skates of lines | 3,745 | 6,745 | 10,490 |
| Vessels in other fisheries but landing one or more fares of halibut: | | | |
| Number | 20 | 24 | 44 |
| Net tonnage | 317 | 247 | 564 |
| Crew | 104 | 73 | 177 |
| Dories | 20 | 19 | 39 |
| Skates of lines | 800 | 710 | 1,510 |
| Regular halibut boats: | | | |
| Number | | 28 | 28 |
| Crew | | 84 | 84 |
| Skates of lines | | 420 | 420 |
| Boats in other fisheries but landing one or more fares of halibut: | | | |
| Number | 2 | 139 | 141 |
| Crew | 6 | 258 | 264 |
| Skates of lines | 60 | 1,505 | 1,565 |

CATCH: BY FLEET CLASSIFICATION AND LANDING POINTS

[Figures given in thousands of pounds and thousands of dollars; that is, 000 omitted]

| Fleet classification | Washington | | British Columbia | | Alaska | | Total | |
|---|---|---|---|---|---|---|---|---|
| Washington fleet: | *Quantity* | *Value* | *Quantity* | *Value* | *Quantity* | *Value* | *Quantity* | *Value* |
| Regular halibut vessels | 7,979 | $1,105 | 1,134 | $137 | 651 | $64 | 9,764 | $1,306 |
| Other vessels and boats | 811 | 117 | 32 | 4 | 1 | ([a]) | 844 | 121 |
| Total | 8,790 | 1,222 | 1,166 | 141 | 652 | 64 | 10,608 | 1,427 |
| Alaska fleet: | | | | | | | | |
| Regular halibut vessels | 3,000 | 374 | 16,993 | 1,950 | 12,106 | 1,227 | 32,099 | 3,551 |
| Other vessels and boats | | | 99 | 12 | 2,294 | 243 | 2,393 | 255 |
| Total | 3,000 | 374 | 17,092 | 1,962 | 14,400 | 1,470 | 34,492 | 3,806 |
| Both fleets: | | | | | | | | |
| Regular halibut vessels | 10,979 | 1,479 | 18,127 | 2,087 | 12,757 | 1,291 | 41,863 | 4,857 |
| Other vessels and boats | 811 | 117 | 131 | 16 | 2,295 | 243 | 3,237 | 376 |
| Grand total | 11,790 | 1,596 | 18,258 | 2,103 | 15,052 | 1,534 | 45,100 | 5,233 |

[a] *Less than $500.*

[7] These statistics are collected primarily for monthly trade-information purposes and are not as complete and accurate as might be desired, but probably are not significantly in error. The data on landings in British Columbia are from the American Consular Service. *The data for 1927 landings by the American fleet have been revised in accordance with the most recent returns.*

*Halibut fishery of the Pacific coast, 1927*—Continued

LANDINGS: BY NATIONALITY AND PORTS

[Figures in thousands of pounds; that is, 000 omitted]

| Year | Landed in— | | | | | Total | | |
|---|---|---|---|---|---|---|---|---|
| | Washington by American vessels | British Columbia | | | Alaska by American vessels | By American vessels | By Canadian vessels | Grand total |
| | | By American vessels | By Canadian vessels | Total | | | | |
| 1925 | 9,685 | 22,390 | 7,731 | 30,121 | 10,038 | 42,113 | 7,731 | 49,844 |
| 1926 | 10,050 | 20,331 | 9,277 | 29,608 | 14,122 | 44,503 | 9,277 | 53,780 |
| 1927 | 11,789 | 18,258 | 10,076 | 28,334 | 15,052 | 45,099 | 10,076 | 55,175 |

## LAKE FISHERIES

The latest complete statistical canvass made of the lake fisheries and fishery industries of the United States (Lakes Superior, Michigan, Huron, Erie, Ontario, and St. Clair, Lake of the Woods, Rainy Lake, and Lakes Kabetogama, Namakan, and Sand Point) was for the calendar year 1922. The complete statistics for this canvass are published in the report of the division of fishery industries for 1923 and in Statistical Bulletin No. 618.

In addition to the above general canvass, statistics of the lake fisheries [8] over a period of years have been secured by compiling data obtained through the various State agencies. Those for the years 1913 to 1924 were obtained in a tariff survey of the lake fisheries, while those for the years 1925 and 1926 were supplemented by the bureau in its surveys for those years. To complete these data for the various lakes, there have been included statistics of the Canadian lake fisheries, which have been secured from the Dominion official reports.

In the fall of 1927 a new system of obtaining fisheries statistics was initiated in Michigan with very satisfactory results. By this system, the commercial fisherman of the State are required to make monthly reports of catch together with a statement of the kind of gear used and the locality in which the catch was made. Because of the success of this system in Michigan, an effort was made to establish it in the other States bordering on the Great Lakes, and during the current year New York, Pennsylvania, and Illinois adopted a similar plan. Ohio, Wisconsin, and Minnesota approve of the plan, and it is believed that in the near future satisfactory statistics of monthly production for all the Great Lakes districts may be made available.

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[8] Includes the fisheries of Lakes Ontario, Erie, Huron, Michigan, Superior, Namakan Lake, Rainy Lake, and Lake of the Woods.

The statistics shown for the years 1913 to 1925 do not include the production in Illinois. Indiana, as well as Illinois, has not required reports of production from fishermen under its jurisdiction in the past; but the production in Indiana (the more important of the two) has been estimated for the various years. The disparity resulting from the noninclusion of the production in Illinois is negligible, the catch in 1922 and 1926 amounting to about one-third of 1 per cent of the total lakes' catch. In 1926, a canvass of production was made in these States, which permits the publication of complete catch data for all States in that year.

Statistics are for the calendar year in each State, except that those for Lake of the Woods, Rainy Lake, and Namakan Lake in Minnesota are for two seasons. For Lake of the Woods, the seasons are from June 1 to Nov. 1 and Dec. 1 to Apr. 1; those for Rainy and Namakan Lakes are from May 15 to Nov. 1 and Dec. 1 to Apr. 1. The two seasons, in the order named, have been combined to constitute a year, as shown in the accompanying statistics. The quantity of fish taken in these lakes between Jan. 1 and Apr. 1 amounted to less than 3 per cent of the total catch in 1927.

*Scientific and common names.*[9]—It has been thought to be desirable to clear up the confusion in local common names of the fishes of the lake fisheries by listing the species under their most common trade classification. It will be found that the cisco of Lake Erie, due to its economic importance in this lake, has been listed separately from the herring of the other lakes. In cases where species are taken in small quantities they are included with similar varieties or in the item "miscellaneous." Following is a list of the species discussed in this report with their scientific names:

| | |
|---|---|
| Lake trout | *Cristivomer namaycush.* |
| Whitefish | *Coregonus clupeaformis.* |
| Lake herring | *Leucichthys artedi* (Great Lakes, except Lake Erie). |
| Chubs | All leucichthys except *artedi* (in Great Lakes). |
| Cisco | *Leucichthys artedi* (Lake Erie only). |
| Sturgeon | *Acipenser rubicundus.* |
| Yellow pike | *Stizostedion vitreum.* |
| Blue pike [10] | *Stizostedion vitreum.* |
| Sauger | *Stizostedion canadense griseum.* |
| Sucker, "mullet" | Catostomidæ (species). |
| Sheepshead | *Aplodinotus grunniens.* |
| Yellow perch | *Perca flavescens.* |
| Pike (jacks) | *Esox lucius.* |
| Carp | *Cyprinus carpio.* |
| White bass | *Roccus chrysops.* |
| Catfish and bullheads | Ameiurus (species).<br>*Ictalurus punctatus* |
| Burbot | *Lota maculosa.* |

GENERAL STATISTICS

While, from the standpoint of production, our lake fisheries are of less importance than some of our other fisheries, the value of the products is unusually high in proportion. In 1926 the total catch of the lake fisheries of the United States and Canada amounted to 102,798,000 pounds. This represents an increase of 3 per cent, compared with the previous year, and a decrease of 15 per cent, compared with the 10-year average. Of the total catch, that taken in the United States amounted to 75,300,000 pounds, valued at $6,642,000. This is an increase of 9 per cent in amount, compared with the previous year's catch and a decrease of 11 per cent in amount compared with the 10-year average of the catch. The Canadian catch, which amounted to 27,498,000 pounds, showed a decline of 12 per cent as compared with the previous year, and 24 per cent as compared with the 10-year average.

*Catch by lakes.*—According to the production in the United States and Canada in 1926, Lake Erie ranks as the most important lake, with a catch of 33,809,000 pounds. This represents a decrease of 10 per cent, compared with the previous year, and 40 per cent compared with the 10-year average for this lake. This decline also is reflected in the proportion this lake has contributed to the total production of all the lakes. For the 10 years previous to 1926, the catch of fish in Lake Erie averaged about one-half of the total production of all the lakes. However, in 1926 the catch declined to a point where it was barely one-third of the total production of all the lakes. Lake Huron

[9] A table of common names used in each State is given in the discussion of the fisheries of the Great Lakes in Fishery Industries of the United States, 1926, Bureau of Fisheries Document No. 1025.
[10] Described by Doctor Hubbs as a distinct species, which he named *Stizostedion glaucum*.

ranks second in importance, the catch in 1926 amounting to 20,615,000 pounds, or about one-fifth of the total production of all the lakes. This is an increase of 44 per cent over the quantity taken in 1925 and 9 per cent when compared with the 10-year average for this lake. Lake Michigan ranked third in importance in 1926, although previously it usually ranked second. The catch in 1926 about approximated that for Lake Huron and amounted to 20,495,000 pounds. This is about one-fifth of the total production of all the lakes and shows a decrease of 6 per cent in amount, compared with the previous year, and 7 per cent when compared with the 10-year average for this lake. Lake Superior was fourth in importance in production in 1926 with a catch of 17,747,000 pounds. This catch represents about one-sixth of the production of all the lakes and is 12 per cent greater than that of the previous year and 28 per cent greater than the 10-year average for this lake. Lake Ontario was next, with a production of 5,015,000 pounds in 1926, which is about the same as for the previous year, the 10-year average, and the relative importance among the lakes. The catch in Lake of the Woods, Rainy Lake, and Namakan Lake, which totaled 5,117,000 pounds, showed a small loss, compared with the previous year's total, although there has been a general upward trend in the catch in these lakes since 1918.

*Catch by species.*—According to the production in the United States and Canada in 1926, lake herring ranked as the most important species of fish taken in the lake fisheries. The catch in 1926 amounted to 19,329,000 pounds. This is the largest since 1920, and is 19 per cent greater than the previous year's catch, and 3 per cent greater than the 10-year average for this species. During the past 4 years, the catch of lake herring has increased steadily, which is especially noticeable with regard to the catch in United States waters, where the major part of the catch is taken. Lake trout ranks second in importance with a catch of 17,992,000 pounds. This represents a very slight increase over the previous year and an increase of 9 per cent when compared with the 10-year average for this species. The annual catch of this species has remained fairly constant during the past 10 years. Virtually two-thirds of the catch is taken in waters of the United States and one-third in Canadian waters.

Blue pike is third in importance with a catch of 12,393,000 pounds in 1926. This is a slight decrease, compared with 1925, and an increase of 26 per cent, compared with the 10-year average for this species. This latter increase is attributed to the somewhat small production of the first 5 years of the 10-year period. During each of the last 5 years of the 10-year period the catch was greater than in 1926, with the exception of 1924, which it approximately equaled. During late years about three-fourths of the annual catch of blue pike have been taken in waters of the United States and about one-fourth in Canadian waters.

Whitefish was fourth in importance with a catch of 9,948,000 pounds. This is but a small gain over the production in 1925 and a decrease of 2 per cent compared with the 10-year average. The catch in waters of the United States during 1926 was greater than that for any year since 1918, while the Canadian catch in 1926 was somewhat less than that for any year since 1917 and was less than the United States' catch for the first time in eight years.

The catch of yellow perch, which amounted to 7,363,000 pounds in 1926, showed a substantial increase compared with the production of 1925 and an increase of 15 per cent compared with the 10-year average. The increase in 1926 is due to the unusually large catch made in waters of the United States, which was the largest since 1919 and was nearly three times as large as the Canadian catch. The catch of chubs, which are taken almost entirely in waters of the United States, amounted to 7,042,000 pounds in 1926. This is a small increase over the catch for the previous year and an increase of 54 per cent compared with the 10-year average. This species of fish, which formerly was considered of inferior quality, is now esteemed more highly and is finding a good market. The catch of yellow pike, considered by some authorities to be of the same species as the blue pike, amounted to 4,451,000 pounds in 1926. This is slightly less than the catch in 1925 and a decrease of 7 per cent when compared with the 10-year average for this species.

The catch of cisco in Lake Erie (the only lake in which this species is taken) amounted to 3,022,000 pounds in 1926. The amount of this species taken has declined at an alarming rate during late years, the catch in 1926 being 47 per cent less than the amount taken in 1925 and a decrease of 88 per cent compared with the 10-year average. During the period 1913 to 1925, the catch ranged between about 14,000,000 and 49,000,000 pounds annually. From this it can be seen readily that the 1926 catch is but a fraction of that of former years. During each of the years of the 10-year period prior to 1925, the catch in the waters of the United States was usually twice as large as that taken in Canadian waters. However, in 1925 and 1926 the Canadian catch exceeded that for the United States, although it also has fallen off unprecedentedly.

*Catch by States.*—According to production in waters of the United States in 1926, Michigan, with frontage on Lakes Erie, Huron, Michigan, and Superior, ranked of first importance in the lake fisheries. The catch in waters of this State amounted to 26,989,000 pounds, or 36 per cent of the total production in the United States of all the lakes. Ohio, with fisheries only in Lake Erie, ranked second in importance with a catch of 15,934,000 pounds, or 21 per cent of the total catch. Third in importance was Wisconsin, with a catch (taken in Lakes Michigan and Superior) of 12,388,000 pounds, or 16 per cent of the total catch. Minnesota ranked fourth with a catch of 10,552,000 pounds, or 14 per cent of the total catch. This catch was made in Minnesota waters of Lake Superior, Lake of the Woods, Rainy Lake, and Namakan Lake. The catch in Pennsylvania, which was taken entirely in Lake Erie, amounted to 5,001,000 pounds, or 7 per cent of the total. The catch in New York, which was taken from Lakes Ontario and Erie, amounted to 3,429,000 pounds, or 5 per cent of the total. The catch in Indiana amounted to 626,000 pounds and that in Illinois to 381,000 pounds. The catch in each of these States represents less than 1 per cent of the total production in the lake fisheries.

*Lake fisheries, 1926*

CATCH: BY STATES

| Species | New York | | Pennsylvania | | Ohio | |
|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Lake trout | 63,521 | $9,840 | 48 | $9 | | |
| Whitefish | 289,039 | 44,970 | 605,391 | 124,691 | 245,260 | $49,052 |
| Lake herring | 192,069 | 16,536 | | | | |
| Cisco (Lake Erie) | 215,717 | 20,048 | 1,126,321 | 122,237 | 107,267 | 12,872 |
| Sturgeon | 23,392 | 10,988 | 1,776 | 710 | | |
| Yellow pike | 23,507 | 4,840 | 10,209 | 1,445 | 1,179,061 | 176,859 |
| Blue pike | 2,192,029 | 116,210 | 2,935,674 | 211,016 | 4,234,034 | 241,340 |
| Sauger | | | | | 1,544,831 | 103,504 |
| Sucker, "mullet" | 122,451 | 7,208 | | | 899,497 | 39,578 |
| Sheepshead | | | | | 1,168,289 | 35,049 |
| Yellow perch | 102,732 | 9,696 | 76,394 | 6,449 | 2,414,371 | 159,348 |
| Carp | 20,372 | 1,745 | 50,297 | 3,162 | 3,001,043 | 153,053 |
| White bass | | | | | 157,732 | 12,776 |
| Catfish and bullheads | 33,690 | 5,837 | 1,994 | 361 | 680,712 | 527,276 |
| Burbot | 68,887 | 5,874 | | | 274,892 | 5,498 |
| Miscellaneous | 81,324 | 9,017 | 193,351 | 14,035 | 26,977 | 538 |
| Total | 3,428,730 | 262,809 | 5,001,455 | 484,115 | 15,933,966 | 1,516,743 |

| Species | Michigan | | Indiana | | Illinois | |
|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Lake trout | 7,543,998 | $957,409 | 250,285 | $50,057 | 165,420 | $31,430 |
| Whitefish | 3,444,987 | 589,050 | 12,094 | 3,024 | | |
| Lake herring | 5,950,465 | 197,532 | 79,648 | 7,965 | 34,060 | 3,406 |
| Chubs | 3,011,141 | 290,029 | 206,685 | 24,806 | 168,265 | 20,192 |
| Sturgeon | 10,881 | 4,533 | | | | |
| Yellow pike | 960,007 | 193,868 | | | | |
| Sauger | 34,224 | 4,025 | | | | |
| Sucker, "mullet" | 2,993,821 | 176,002 | 47 | 5 | | |
| Sheepshead | 156,302 | 6,995 | | | | |
| Yellow perch | 802,721 | 87,769 | 62,782 | 7,534 | 12,800 | 1,536 |
| Pike (jacks) | 29,995 | 3,425 | | | | |
| Carp | 1,571,410 | 76,125 | | | | |
| Catfish and bullheads | 150,204 | 19,787 | | | | |
| Burbot | 18,788 | 930 | 9,913 | 991 | | |
| Miscellaneous | 310,080 | 21,847 | 5,000 | 1,250 | | |
| Total | 26,989,024 | 2,629,326 | 626,454 | 95,632 | 380,545 | 56,564 |

| Species | Wisconsin | | Minnesota | | Total | |
|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Lake trout | 3,203,022 | $571,071 | 332,906 | $46,723 | 11,559,200 | $1,666,539 |
| Whitefish | 415,899 | 74,100 | 135,057 | 14,795 | 5,147,727 | 899,682 |
| Lake herring | 2,905,410 | 89,397 | 7,360,600 | 227,633 | 16,522,252 | 542,469 |
| Chubs | 2,001,381 | 205,441 | 621,970 | 35,548 | 6,069,442 | 576,016 |
| Cisco (Lake Erie) | | | | | 1,449,305 | 155,157 |
| Sturgeon | | | 2,289 | 907 | 38,338 | 17,138 |
| Yellow pike | 44,965 | 8,485 | 610,339 | 94,308 | 2,828,088 | 479,805 |
| Blue pike | | | | | 9,361,737 | 568,566 |
| Sauger | | | 54,719 | 3,713 | 1,633,774 | 111,242 |
| Sucker, "mullet" | | | 105,897 | 4,286 | 4,121,713 | 227,079 |
| Sheepshead | | | | | 1,324,591 | 42,044 |
| Yellow perch | 1,914,129 | 73,937 | 20,865 | 2,096 | 5,406,794 | 348,365 |
| Pike (jacks) | 29,529 | 3,607 | 242,469 | 12,203 | 301,993 | 19,235 |
| Carp | | | 6,133 | 44 | 4,649,255 | 234,129 |
| White bass | 300 | 24 | | | 158,032 | 12,800 |
| Catfish and bullheads | | | 43,755 | 4,862 | 910,355 | 558,123 |
| Tullibees | | | 990,447 | 54,183 | 990,447 | 54,183 |
| Burbot | | | | | 372,480 | 13,293 |
| Miscellaneous | 1,813,554 | 67,891 | 24,459 | 1,949 | 2,454,745 | 116,527 |
| Total | 12,388,189 | 1,093,953 | 10,551,905 | 503,250 | 75,300,268 | 6,642,392 |

*Lake fisheries, 1926*—Continued

CATCH: BY LAKES AND STATES

| Species | Lake Ontario | | Lake Erie | | | |
|---|---|---|---|---|---|---|
| | New York | | New York | | Pennsylvania | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Lake trout | 60,778 | $9,534 | 2,743 | $306 | 48 | $9 |
| Whitefish | 178,613 | 28,701 | 110,426 | 16,269 | 605,391 | 124,691 |
| Lake herring | 192,069 | 16,536 | | | | |
| Cisco | | | 215,717 | 20,048 | 1,126,321 | 122,237 |
| Sturgeon | 18,834 | 8,734 | 4,558 | 2,254 | 1,776 | 710 |
| Yellow pike | 21,997 | 4,530 | 1,510 | 310 | 10,209 | 1,445 |
| Blue pike | 22,041 | 2,922 | 2,169,988 | 113,288 | 2,935,674 | 211,016 |
| Sucker, "mullet" | 66,434 | 4,552 | 56,017 | 2,656 | | |
| Yellow perch | 34,343 | 3,268 | 68,389 | 6,428 | 76,394 | 6,449 |
| Carp | 17,942 | 1,325 | 2,430 | 420 | 50,297 | 3,162 |
| Catfish and bullheads | 33,600 | 5,828 | 90 | 9 | 1,994 | 361 |
| Burbot | 68,887 | 5,874 | | | | |
| Miscellaneous | 72,317 | 7,213 | 9,007 | 1,804 | 193,351 | 14,035 |
| Total | 787,855 | 99,017 | 2,640,875 | 163,792 | 5,001,455 | 484,115 |

| Species | Lake Erie | | | | | |
|---|---|---|---|---|---|---|
| | Ohio | | Michigan | | Total | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Lake trout | | | | | 2,791 | $315 |
| Whitefish | 245,260 | $49,052 | 80 | $$20 | 961,157 | 190,032 |
| Cisco | 107,267 | 12,872 | | | 1,449,305 | 155,157 |
| Sturgeon | | | | | 6,334 | 2,964 |
| Yellow pike | 1,179,061 | 176,859 | 81,817 | 11,619 | 1,272,597 | 190,233 |
| Blue pike | 4,234,034 | 241,340 | | | 9,339,696 | 565,644 |
| Sauger | 1,544,831 | 103,504 | 6,101 | 520 | 1,550,932 | 104,024 |
| Sucker, "mullet" | 899,497 | 39,578 | 89,166 | 4,098 | 1,044,680 | 46,332 |
| Sheepshead | 1,168,289 | 35,049 | 45,406 | 1,842 | 1,213,695 | 36,891 |
| Yellow perch | 2,414,371 | 159,348 | 62,721 | 5,472 | 2,621,875 | 177,697 |
| Pike (jacks) | | | 3,525 | 409 | 3,525 | 409 |
| Carp | 3,001,043 | 153,053 | 1,150,401 | 55,468 | 4,204,171 | 212,103 |
| White bass | 157,732 | 12,776 | | | 157,732 | 12,776 |
| Catfish and bullheads | 680,712 | 527,276 | 30,159 | 1,349 | 712,955 | 528,995 |
| Burbot | 274,892 | 5,498 | 6,819 | 521 | 281,711 | 6,019 |
| Miscellaneous | 26,977 | 538 | 4,712 | 475 | 234,047 | 16,852 |
| Total | 15,933,966 | 1,516,743 | 1,480,907 | 81,793 | 25,057,203 | 2,246,443 |

| Species | Lake Huron | | Lake Michigan | | | |
|---|---|---|---|---|---|---|
| | Michigan | | Michigan | | Indiana | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Lake trout | 1,685,067 | $248,123 | 3,352,439 | $438,801 | 250,285 | $50,057 |
| Whitefish | 1,722,441 | 327,676 | 1,537,709 | 233,412 | 12,094 | 3,024 |
| Lake herring | 4,311,277 | 131,540 | 970,471 | 36,259 | 79,648 | 7,965 |
| Chubs | 1,533,533 | 140,805 | 1,324,346 | 137,216 | 206,685 | 24,806 |
| Sturgeon | 4,040 | 1,438 | 6,368 | 2,931 | | |
| Yellow pike | 815,721 | 176,284 | 58,144 | 5,027 | | |
| Sauger | 28,123 | 3,506 | | | | |
| Sucker, "mullet" | 1,826,963 | 116,572 | 966,543 | 49,037 | 47 | 5 |
| Sheepshead | 91,171 | 4,159 | 19,725 | 994 | | |
| Yellow perch | 458,042 | 61,874 | 278,863 | 20,192 | 62,782 | 7,534 |
| Pike (jacks) | 15,974 | 1,768 | 8,153 | 922 | | |
| Carp | 414,356 | 20,398 | 6,653 | 259 | | |
| Catfish and bullheads | 119,650 | 18,346 | 395 | 92 | | |
| Burbot | 1,022 | 50 | 10,616 | 349 | 9,913 | 991 |
| Miscellaneous | 104,546 | 8,485 | 191,055 | 12,240 | 5,000 | 1,250 |
| Total | 13,131,926 | 1,261,023 | 8,731,480 | 937,731 | 626,454 | 95,632 |

*Lake fisheries, 1926*—Continued

CATCH: BY LAKES AND STATES—Continued

| Species | Lake Michigan | | | | | |
|---|---|---|---|---|---|---|
| | Illinois | | Wisconsin | | Total | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Lake trout | 165,420 | $31,430 | 2,762,105 | $513,954 | 6,530,249 | $1,034,242 |
| Whitefish | | | 325,420 | 59,273 | 1,875,223 | 295,709 |
| Lake herring | 34,060 | 3,406 | 2,199,905 | 72,280 | 3,284,084 | 119,910 |
| Chubs | 168,265 | 20,192 | 2,040,570 | 203,924 | 3,739,866 | 386,138 |
| Sturgeon | | | | | 6,368 | 2,931 |
| Yellow pike | | | 23,930 | 4,933 | 82,074 | 9,960 |
| Sucker, "mullet" | | | | | 966,590 | 49,042 |
| Sheepshead | | | | | 19,725 | 994 |
| Yellow perch | 12,800 | 1,536 | 1,911,758 | 73,667 | 2,266,203 | 102,929 |
| Pike (jacks) | | | 25,092 | 3,060 | 33,245 | 3,982 |
| Carp | | | | | 6,653 | 259 |
| White bass | | | 300 | 24 | 300 | 24 |
| Catfish and bullheads | | | | | 395 | 92 |
| Burbot | | | | | 20,529 | 1,340 |
| Miscellaneous | | | 1,466,958 | 56,589 | 1,663,013 | 70,079 |
| Total | 380,545 | 56,564 | 10,756,038 | 987,704 | 20,494,517 | 2,077,631 |

| Species | Lake Superior | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Michigan | | Wisconsin | | Minnesota | | Total | |
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Lake trout | 2,506,492 | $270,485 | 440,917 | $57,117 | 332,568 | $46,684 | 3,279,977 | $374,286 |
| Whitefish | 184,757 | 27,942 | 90,479 | 14,827 | 4,323 | 732 | 279,559 | 43,501 |
| Lake herring | 668,717 | 29,733 | 705,505 | 17,117 | 7,360,600 | 227,633 | 8,734,822 | 274,483 |
| Chubs | 153,262 | 12,008 | 20,811 | 1,517 | 440,053 | 28,872 | 614,126 | 42,397 |
| Sturgeon | 473 | 164 | | | | | 473 | 164 |
| Yellow pike | 4,325 | 938 | 21,035 | 3,552 | | | 25,360 | 4,490 |
| Sucker, "mullet" | 111,149 | 6,295 | | | 1,447 | 93 | 112,596 | 6,388 |
| Yellow perch | 3,095 | 231 | 2,371 | 270 | | | 5,466 | 501 |
| Pike (jacks) | 2,343 | 326 | 4,437 | 547 | | | 6,780 | 873 |
| Burbot | 331 | 10 | | | | | 331 | 10 |
| Miscellaneous | 9,767 | 647 | 346,596 | 11,302 | 20,489 | 1,470 | 376,852 | 13,419 |
| Total | 3,644,711 | 348,779 | 1,632,151 | 106,249 | 8,159,480 | 305,484 | 13,436,342 | 760,512 |

| Species | Lake of the Woods, Minn. | | Rainy Lake, Minn. | | Namakan Lake, Minn. | | Total, all lakes | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* | *Pounds* | *Value* |
| Lake trout | 338 | $39 | | | | | 11,559,200 | $1,666,539 |
| Whitefish | 31,393 | 3,282 | 88,898 | $9,585 | 10,443 | $1,196 | 5,147,727 | 899,682 |
| Lake herring | | | | | | | 16,522,252 | 542,469 |
| Chubs | 22,469 | 1,105 | 62,676 | 2,231 | 96,772 | 3,340 | 6,069,442 | 576,016 |
| Cisco | | | | | | | 1,449,305 | 155,157 |
| Sturgeon | 1,478 | 613 | 811 | 294 | | | 38,338 | 17,138 |
| Yellow pike | 508,925 | 82,842 | 79,157 | 9,018 | 22,257 | 2,448 | 2,828,088 | 479,805 |
| Blue pike | | | | | | | 9,361,737 | 568,566 |
| Sauger | 54,719 | 3,713 | | | | | 1,633,774 | 111,242 |
| Sucker, "mullet" | 98,870 | 4,081 | 696 | 12 | 4,884 | 100 | 4,121,713 | 227,079 |
| Sheepshead | | | | | | | 1,324,591 | 42,044 |
| Yellow perch | 17,118 | 1,679 | 2,909 | 319 | 838 | 98 | 5,406,794 | 348,365 |
| Pike (jacks) | 139,683 | 8,493 | 75,062 | 2,690 | 27,724 | 1,020 | 301,993 | 19,235 |
| Carp | 6,133 | 44 | | | | | 4,649,255 | 234,129 |
| White bass | | | | | | | 158,032 | 12,800 |
| Catfish and bullheads | 43,755 | 4,862 | | | | | 910,355 | 558,123 |
| Tullibees | 990,447 | 54,183 | | | | | 990,447 | 54,183 |
| Burbot | | | | | | | 372,480 | 13,293 |
| Miscellaneous | 3,970 | 479 | | | | | 2,454,745 | 116,527 |
| Total | 1,919,298 | 165,415 | 310,209 | 24,149 | 162,918 | 8,202 | 75,300,268 | 6,642,392 |

*Lake fisheries, 1926*—Continued

CATCH: BY LAKES (in pounds)

| Species | Lake Ontario | | | Lake Erie | | |
|---|---|---|---|---|---|---|
| | United States | Canada | Total | United States | Canada | Total |
| Lake trout | 60,778 | 784,300 | 845,078 | 2,791 | 400 | 3,191 |
| Whitefish | 178,613 | 1,822,400 | 2,001,013 | 961,157 | 868,100 | 1,829,257 |
| Lake herring | 192,069 | 638,200 | 830,269 | | | |
| Cisco | | | | 1,449,305 | 1,573,100 | 3,022,405 |
| Sturgeon | 18,834 | 7,020 | 25,854 | 6,334 | 51,417 | 57,751 |
| Yellow pike | 21,997 | 61,800 | 83,797 | 1,272,597 | 192,500 | 1,465,097 |
| Blue pike | 22,041 | 7,400 | 29,441 | 9,339,696 | 2,975,100 | 12,314,796 |
| Sauger | | | | 1,550,932 | | 1,550,932 |
| Sucker, "mullet" | 66,434 | | 66,434 | 1,044,680 | | 1,044,680 |
| Sheepshead | | | | 1,213,695 | | 1,213,695 |
| Yellow perch | 34,343 | 113,200 | 147,543 | 2,621,875 | 1,715,900 | 4,337,775 |
| Pike (jacks) | | 159,000 | 159,000 | 3,525 | 19,600 | 23,125 |
| Carp | 17,942 | 43,200 | 61,142 | 4,204,171 | 196,800 | 4,400,971 |
| White bass | | | | 157,732 | | 157,732 |
| Catfish and bullheads | 33,600 | 140,000 | 173,600 | 712,955 | 26,200 | 739,155 |
| Burbot | 68,887 | | 68,887 | 281,711 | | 281,711 |
| Miscellaneous | 72,317 | 450,300 | 522,617 | 234,047 | 1,132,700 | 1,366,747 |
| Total | 787,855 | 4,226,820 | 5,014,675 | 25,057,203 | 8,751,817 | 33,809,020 |

| Species | Lake Huron | | | Lake Michigan | Lake Superior | | |
|---|---|---|---|---|---|---|---|
| | United States | Canada | Total | United States | United States | Canada | Total |
| Lake trout | 1,685,067 | 3,667,400 | 5,352,467 | 6,530,249 | 3,279,977 | 1,966,000 | 5,245,977 |
| Whitefish | 1,722,441 | 1,520,500 | 3,242,941 | 1,875,223 | 279,559 | 317,000 | 596,559 |
| Lake herring | 4,311,277 | 350,800 | 4,662,077 | 3,284,084 | 8,734,822 | 1,818,500 | 10,553,322 |
| Chubs | 1,533,533 | 630,100 | 2,163,633 | 3,739,866 | 614,126 | | 614,126 |
| Sturgeon | 4,040 | 22,935 | 26,975 | 6,368 | 473 | 1,000 | 1,473 |
| Yellow pike | 815,721 | 303,900 | 1,119,621 | 82,074 | 25,360 | 95,700 | 121,060 |
| Blue pike | | 47,700 | 47,700 | | | 400 | 400 |
| Sauger | 28,123 | | 28,123 | | | | |
| Sucker "mullet" | 1,826,963 | | 1,826,963 | 966,590 | 112,596 | | 112,596 |
| Sheepshead | 91,171 | | 91,171 | 19,725 | | | |
| Yellow perch | 458,042 | 114,800 | 572,842 | 2,266,203 | 5,466 | 300 | 5,766 |
| Pike (jacks) | 15,974 | 156,700 | 172,674 | 33,245 | 6,780 | 5,800 | 12,580 |
| Carp | 414,356 | 47,400 | 461,756 | 6,653 | | | |
| White bass | | | | 300 | | | |
| Catfish and bullheads | 119,650 | 6,500 | 126,150 | 395 | | | |
| Burbot | 1,022 | | 1,022 | 20,529 | 331 | | 331 |
| Miscellaneous | 104,546 | 614,600 | 719,146 | 1,663,013 | 376,852 | 105,900 | 482,752 |
| Total | 13,131,926 | 7,483,335 | 20,615,261 | 20,494,517 | 13,436,342 | 4,310,600 | 17,746,942 |

| Species | Namakan Lake | | | Rainy Lake | | |
|---|---|---|---|---|---|---|
| | United States | Canada | Total | United States | Canada | Total |
| Lake trout | | | | | 88 | 88 |
| Whitefish | 10,443 | 9,644 | 20,087 | 88,898 | 64,331 | 153,229 |
| Chubs | 96,772 | 2,854 | 99,626 | 62,676 | 340,534 | 403,210 |
| Sturgeon | | 1,105 | 1,105 | 811 | 203 | 1,014 |
| Yellow pike | 22,257 | 7,558 | 29,815 | 79,157 | 318,170 | 397,327 |
| Sucker, "mullet" | 4,884 | | 4,884 | 696 | | 696 |
| Yellow perch | 838 | | 838 | 2,909 | 11,644 | 14,553 |
| Pike (jacks) | 27,724 | 8,797 | 36,521 | 75,062 | 148,259 | 223,321 |
| Miscellaneous | | 685 | 685 | | 15,169 | 15,169 |
| Total | 162,918 | 30,643 | 193,561 | 310,209 | 898,398 | 1,208,607 |

*Lake fisheries, 1926*—Continued

CATCH: BY LAKES (in pounds)

| Species | Lake of the Woods | | | Total all lakes | | |
|---|---|---|---|---|---|---|
| | United States | Canada | Total | United States | Canada | Total |
| Lake trout | 338 | 14,515 | 14,853 | 11,559,200 | 6,432,703 | 17,991,903 |
| Whitefish | 31,393 | 197,782 | 229,175 | 5,147,727 | 4,799,757 | 9,947,484 |
| Lake herring | | | | 16,522,252 | 2,807,500 | 19,329,752 |
| Chubs | 22,469 | | 22,469 | 6,069,442 | 973,488 | 7,042,930 |
| Cisco | | | | 1,449,305 | 1,573,100 | 3,022,405 |
| Sturgeon | 1,478 | 314 | 1,792 | 38,338 | 83,994 | 122,332 |
| Yellow pike | 508,925 | 643,207 | 1,152,132 | 2,828,088 | 1,622,835 | 4,450,923 |
| Blue pike | | | | 9,361,737 | 3,030,600 | 12,392,337 |
| Sauger | 54,719 | | 54,719 | 1,633,774 | | 1,633,774 |
| Sucker, "mullet" | 98,870 | | 98,870 | 4,121,713 | | 4,121,713 |
| Sheepshead | | | | 1,324,591 | | 1,324,591 |
| Yellow perch | 17,118 | 520 | 17,638 | 5,406,794 | 1,956,364 | 7,363,158 |
| Pike (jacks) | 139,683 | 454,406 | 594,089 | 301,993 | 952,562 | 1,254,555 |
| Carp | 6,133 | 4,408 | 10,541 | 4,649,255 | 291,808 | 4,941,063 |
| White bass | | | | 158,032 | | 158,032 |
| Catfish and bullheads | 43,755 | | 43,755 | 910,355 | 172,700 | 1,083,055 |
| Tullibees | 990,447 | 163,787 | 1,154,234 | 990,447 | 163,787 | 1,154,234 |
| Burbot | | | | 372,480 | | 372,480 |
| Miscellaneous | 3,970 | 317,338 | 321,308 | 2,454,745 | 2,636,692 | 5,091,437 |
| Total | 1,919,298 | 1,796,277 | 3,715,575 | 75,300,268 | 27,497,890 | 102,798,158 |

*Lake fisheries, 1913 to 1926*

CATCH: BY LAKES

[Expressed in thousands of pounds; that is, 000 omitted]

| Year | Lake Ontario | | | Lake Erie | | | Lake Huron | | | Lake Michigan |
|---|---|---|---|---|---|---|---|---|---|---|
| | United States [1] | Canada [2] | Total | United States | Canada | Total | United States | Canada | Total | United States |
| 1913 | 210 | 2,957 | 3,167 | 22,120 | 19,553 | 41,673 | 11,184 | 6,283 | 17,467 | 26,994 |
| 1914 | 277 | 3,525 | 3,802 | 53,571 | 19,982 | 73,553 | 8,248 | 6,616 | 14,864 | 28,195 |
| 1915 | 395 | 4,650 | 5,045 | 59,509 | 16,539 | 76,048 | 10,245 | 7,317 | 17,562 | 31,680 |
| 1916 | 317 | 4,927 | 5,244 | 41,223 | 12,623 | 53,846 | 17,145 | 7,289 | 24,434 | 23,023 |
| 1917 | 656 | 5,544 | 6,200 | 41,416 | 18,780 | 60,196 | 12,512 | 7,303 | 19,815 | 29,317 |
| 1918 | 524 | 5,033 | 5,557 | 51,479 | 19,493 | 70,972 | 14,966 | 6,497 | 21,463 | 26,675 |
| 1919 | 472 | 5,483 | 5,955 | 35,154 | 14,128 | 49,282 | 15,240 | 6,479 | 21,719 | 29,820 |
| 1920 | 314 | 4,979 | 5,293 | 32,192 | 16,791 | 48,983 | 11,250 | 6,229 | 17,479 | 23,053 |
| 1921 | 1,855 | 4,894 | 6,749 | 46,731 | 16,409 | 63,140 | 9,330 | 6,378 | 15,708 | 17,018 |
| 1922 | 889 | 4,526 | 5,415 | 40,912 | 17,684 | 58,596 | 13,481 | 7,162 | 20,643 | 16,605 |
| 1923 | 710 | 4,934 | 5,644 | 44,378 | 17,773 | 62,151 | 9,920 | 6,811 | 16,731 | 15,358 |
| 1924 | 1,049 | 5,184 | 6,233 | 40,264 | 18,977 | 59,241 | 9,074 | 7,260 | 16,334 | 17,694 |
| 1925 | 446 | 4,351 | 4,797 | 26,639 | 11,080 | 37,719 | 6,567 | 7,748 | 14,315 | 21,710 |
| 1926 | 788 | 4,227 | 5,015 | 25,057 | 8,752 | 33,809 | 13,132 | 7,483 | 20,615 | 20,495 |

| Year | Lake Superior | | | Lake of the Woods, Rainy Lake, and Namakan Lake | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | United States | Canada | Total | United States [3] | Canada [4] | Total | United States | Canada | Total |
| 1913 | 6,417 | 2,331 | 8,748 | 1,384 | 3,393 | 4,777 | 68,309 | 34,517 | 102,826 |
| 1914 | 7,088 | 2,934 | 10,022 | 1,246 | 3,420 | 4,666 | 98,625 | 36,477 | 135,102 |
| 1915 | 5,694 | 5,698 | 11,392 | 1,425 | 4,635 | 6,060 | 108,948 | 38,839 | 147,787 |
| 1916 | 5,437 | 5,464 | 10,901 | 1,287 | 2,443 | 3,730 | 88,432 | 32,746 | 121,178 |
| 1917 | 9,889 | 4,977 | 14,866 | 2,103 | 3,338 | 5,441 | 95,893 | 39,942 | 135,835 |
| 1918 | 11,546 | 8,754 | 20,300 | 1,489 | 3,067 | 4,556 | 106,679 | 42,844 | 149,523 |
| 1919 | 10,500 | 5,971 | 16,471 | 1,277 | 2,714 | 3,991 | 92,463 | 34,775 | 127,238 |
| 1920 | 9,267 | 4,632 | 13,899 | 1,299 | 2,028 | 3,327 | 77,375 | 34,659 | 112,034 |
| 1921 | 7,476 | 3,807 | 11,283 | 1,048 | 2,240 | 3,288 | 83,458 | 33,728 | 117,186 |
| 1922 | 6,569 | 3,985 | 10,554 | 978 | 2,513 | 3,491 | 79,434 | 35,870 | 115,304 |
| 1923 | 7,584 | 4,567 | 12,151 | 1,159 | 2,544 | 3,703 | 79,109 | 36,629 | 115,738 |
| 1924 | 8,944 | 3,216 | 12,160 | 1,256 | 3,356 | 4,612 | 78,281 | 37,993 | 116,274 |
| 1925 | 12,307 | 3,567 | 15,874 | 1,463 | 4,411 | 5,874 | 69,132 | 31,157 | 100,289 |
| 1926 | 13,436 | 4,311 | 17,747 | 2,392 | 2,725 | 5,117 | 75,300 | 27,498 | 102,798 |

[1] Includes the catch in Lake Ontario proper and Chaumont Bay in the years from 1913 to 1924, inclusive; Lake Ontario proper in 1925; and Lake Ontario proper, Niagara River below the Falls, St. Lawrence River and Chaumont, Black River, Port, Great Sodus Bay and Little Sodus Bay in 1926.
[2] Includes the catch in Niagara River below the Falls.
[3] Does not include the catch in Namakan and Rainy Lakes prior to 1926.
[4] Includes the catch in Lac Suel, Eagle Lake, etc., in the interior of Canada prior to 1926.

NOTE.—The catches in the Detroit River, St. Clair River, and Lake St. Clair are not included in these statistics.

*Lake fisheries, 1913 to 1926*—Continued

CATCH: By species

[Expressed in thousands of pounds; that is, 000 omitted]

| Year | Lake trout | | | Whitefish | | | Lake herring | | |
|---|---|---|---|---|---|---|---|---|---|
| | United States | Canada | Total | United States | Canada | Total | United States | Canada | Total |
| 1913 | 10,872 | 5,366 | 16,238 | 3,803 | 4,994 | 8,797 | 14,099 | 1,202 | 15,301 |
| 1914 | 9,899 | 5,212 | 15,111 | 5,451 | 5,036 | 10,487 | 14,412 | 1,984 | 16,396 |
| 1915 | 10,892 | 6,192 | 17,084 | 4,381 | 5,935 | 10,316 | 14,924 | 4,843 | 19,767 |
| 1916 | 9,934 | 5,658 | 15,592 | 4,952 | 4,607 | 9,559 | 16,981 | 5,028 | 22,005 |
| 1917 | 10,733 | 5,729 | 16,462 | 5,773 | 4,576 | 10,349 | 20,341 | 4,879 | 25,220 |
| 1918 | 9,784 | 6,619 | 16,403 | 5,695 | 5,710 | 11,405 | 20,727 | 5,809 | 26,536 |
| 1919 | 12,278 | 5,928 | 18,206 | 4,444 | 6,487 | 10,931 | 22,293 | 3,449 | 25,742 |
| 1920 | 10,066 | 4,785 | 14,851 | 3,634 | 6,375 | 10,009 | 16,803 | 2,821 | 19,624 |
| 1921 | 10,239 | 5,299 | 15,538 | 3,532 | 6,290 | 9,822 | 10,885 | 1,628 | 12,513 |
| 1922 | 11,101 | 6,451 | 17,552 | 4,325 | 6,025 | 10,350 | 11,731 | 1,189 | 12,920 |
| 1923 | 9,941 | 6,175 | 16,116 | 3,677 | 6,488 | 10,165 | 11,160 | 1,558 | 12,718 |
| 1924 | 10,144 | 6,527 | 16,671 | 3,794 | 5,728 | 9,522 | 12,815 | 1,568 | 14,383 |
| 1925 | 11,125 | 6,860 | 17,985 | 3,668 | 5,660 | 9,328 | 14,549 | 1,683 | 16,232 |
| 1926 | 11,559 | 6,433 | 17,992 | 5,148 | 4,800 | 9,948 | 16,522 | 2,807 | 19,329 |
| **Year** | **Chubs** | | | **Cisco** | | | **Sturgeon** | | |
| | United States | Canada | Total | United States | Canada | Total | United States | Canada | Total |
| 1913 | 5,162 | 330 | 5,492 | 12,513 | 11,608 | 24,121 | 67 | 192 | 259 |
| 1914 | 3,938 | 486 | 4,424 | 14,108 | 5,982 | 20,090 | 76 | 213 | 289 |
| 1915 | 3,865 | 374 | 4,239 | 15,978 | 5,574 | 21,552 | 109 | 206 | 315 |
| 1916 | 3,247 | 651 | 3,898 | 8,337 | 5,211 | 13,548 | 60 | 112 | 172 |
| 1917 | 5,099 | 819 | 5,918 | 19,453 | 14,158 | 33,611 | 49 | 107 | 156 |
| 1918 | 7,710 | 384 | 8,094 | 35,291 | 13,532 | 48,823 | 68 | 118 | 186 |
| 1919 | 6,350 | 251 | 6,601 | 17,846 | 7,426 | 25,272 | 96 | 105 | 201 |
| 1920 | 3,847 | 303 | 4,150 | 12,893 | 9,651 | 22,544 | 40 | 67 | 107 |
| 1921 | 2,438 | 254 | 2,692 | 14,964 | 5,225 | 20,189 | 25 | 54 | 79 |
| 1922 | 2,364 | 207 | 2,571 | 14,022 | 6,306 | 20,328 | 33 | 92 | 125 |
| 1923 | 1,955 | 204 | 2,159 | 20,930 | 9,241 | 30,171 | 20 | 110 | 130 |
| 1924 | 3,041 | 242 | 3,283 | 21,293 | 10,908 | 32,201 | 30 | 120 | 150 |
| 1925 | 6,016 | 429 | 6,445 | 2,817 | 2,840 | 5,657 | 24 | 90 | 114 |
| 1926 | 6,069 | 973 | 7,042 | 1,449 | 1,573 | 3,022 | 38 | 84 | 122 |
| **Year** | **Yellow pike** | | | **Blue pike** | | | **Sauger** | **Suckers or "mullet"** | **Sheepshead** |
| | United States | Canada | Total | United States | Canada | Total | United States | United States | United States |
| 1913 | 1,498 | 2,579 | 4,077 | 1,882 | 488 | 2,370 | 1,248 | 2,995 | 596 |
| 1914 | 2,926 | 3,869 | 6,795 | 11,435 | 2,968 | 14,403 | 4,569 | 6,185 | 2,282 |
| 1915 | 3,750 | 2,624 | 6,374 | 18,811 | 4,882 | 23,693 | 4,533 | 4,517 | 2,212 |
| 1916 | 3,494 | 1,909 | 5,403 | 9,403 | 2,539 | 11,942 | 6,187 | 4,801 | 2,384 |
| 1917 | 3,457 | 1,814 | 5,271 | 1,655 | 565 | 2,220 | 4,336 | 5,699 | 3,013 |
| 1918 | 3,263 | 1,525 | 4,788 | 1,330 | 800 | 2,130 | 2,101 | 3,549 | 2,982 |
| 1919 | 2,540 | 1,647 | 4,187 | 1,710 | 2,391 | 4,101 | 2,655 | 5,008 | 2,150 |
| 1920 | 2,257 | 1,420 | 3,677 | 3,983 | 3,365 | 7,348 | 2,932 | 4,078 | 1,984 |
| 1921 | 2,294 | 1,879 | 4,173 | 8,946 | 6,390 | 15,336 | 5,010 | 4,041 | 2,905 |
| 1922 | 2,907 | 2,273 | 5,180 | 10,361 | 6,342 | 16,703 | 4,623 | 3,788 | 1,415 |
| 1923 | 2,761 | 2,565 | 5,326 | 9,686 | 3,244 | 12,930 | 3,321 | 3,187 | 1,521 |
| 1924 | 2,562 | 2,718 | 5,279 | 8,970 | 3,036 | 12,006 | 1,847 | 2,728 | 2,834 |
| 1925 | 2,320 | 2,343 | 4,663 | 10,513 | 3,445 | 13,958 | 2,119 | 2,762 | 2,395 |
| 1926 | 2,828 | 1,623 | 4,451 | 9,362 | 3,031 | 12,393 | 1,634 | 4,122 | 1,325 |

*Lake fisheries, 1913 to 1926*—Continued

CATCH: BY SPECIES—Continued

[Expressed in thousands of pounds; that is, 000 omitted]

| Year | Yellow perch | | | Pike (Jacks) | | | Carp | | | White bass, United States |
|---|---|---|---|---|---|---|---|---|---|---|
| | United States | Canada | Total | United States | Canada | Total | United States | Canada | Total | |
| 1913 | 6,025 | 1,141 | 7,166 | 427 | 3,366 | 3,793 | 2,072 | 424 | 2,496 | 526 |
| 1914 | 5,771 | 1,651 | 7,422 | 494 | 4,338 | 4,832 | 12,039 | 1,615 | 13,654 | 478 |
| 1915 | 6,124 | 1,358 | 7,482 | 606 | 2,440 | 3,046 | 10,141 | 1,236 | 11,377 | 695 |
| 1916 | 5,708 | 1,114 | 6,822 | 323 | 1,378 | 1,701 | 5,861 | 1,097 | 6,958 | 343 |
| 1917 | 4,086 | 1,357 | 5,443 | 461 | 1,423 | 1,884 | 4,602 | 1,075 | 5,677 | 333 |
| 1918 | 3,978 | 2,249 | 6,227 | 417 | 1,234 | 1,651 | 4,820 | 880 | 5,700 | 129 |
| 1919 | 6,615 | 1,351 | 7,966 | 474 | 1,819 | 2,293 | 4,080 | 662 | 4,742 | 205 |
| 1920 | 4,591 | 1,533 | 6,124 | 606 | 1,008 | 1,614 | 5,828 | 583 | 6,411 | 514 |
| 1921 | 5,268 | 2,203 | 7,471 | 466 | 1,064 | 1,530 | 7,420 | 504 | 7,924 | 853 |
| 1922 | 3,555 | 2,346 | 5,901 | 402 | 1,129 | 1,531 | 5,094 | 435 | 5,529 | 831 |
| 1923 | 3,525 | 2,627 | 6,152 | 344 | 1,086 | 1,430 | 3,780 | 467 | 4,247 | 310 |
| 1924 | 3,345 | 2,390 | 5,735 | 400 | 1,145 | 1,545 | 1,780 | 433 | 2,213 | 192 |
| 1925 | 4,110 | 2,233 | 6,343 | 269 | 1,160 | 1,429 | 2,409 | 327 | 2,736 | 232 |
| 1926 | 5,407 | 1,956 | 7,363 | 302 | 952 | 1,254 | 4,649 | 292 | 4,941 | 158 |

| Year | Catfish | | | Tullibees | | | Burbot, United States | Miscellaneous fish | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | United States | Canada | Total | United States | Canada | Total | | United States | Canada | Total |
| 1913 | 196 | 332 | 528 | (5) | 177 | 177 | 42 | 4,286 | 2,318 | 6,604 |
| 1914 | 801 | 392 | 1,193 | (5) | 127 | 127 | 108 | 3,663 | 2,604 | 6,257 |
| 1915 | 596 | 435 | 1,031 | (5) | 262 | 262 | 45 | 6,769 | 2,478 | 9,247 |
| 1916 | 1,281 | 331 | 1,612 | (5) | 139 | 139 | 247 | 4,889 | 2,972 | 7,861 |
| 1917 | 2,296 | 278 | 2,574 | (5) | 174 | 174 | 69 | 4,438 | 2,988 | 7,426 |
| 1918 | 514 | 496 | 1,010 | (5) | 240 | 240 | 380 | 3,941 | 3,248 | 7,189 |
| 1919 | 1,164 | 365 | 1,529 | (5) | 241 | 241 | 542 | 2,013 | 2,653 | 4,666 |
| 1920 | 776 | 269 | 1,045 | (5) | 129 | 129 | 499 | 2,044 | 2,350 | 4,394 |
| 1921 | 1,502 | 299 | 1,801 | (5) | 117 | 117 | 490 | 2,180 | 2,522 | 4,702 |
| 1922 | 805 | 243 | 1,048 | (5) | 131 | 131 | 323 | 1,756 | 2,701 | 4,457 |
| 1923 | 716 | 247 | 963 | (5) | 112 | 112 | 310 | 1,965 | 2,525 | 4,490 |
| 1924 | 366 | 226 | 592 | (5) | 255 | 255 | 210 | 2,435 | 2,697 | 5,132 |
| 1925 | 835 | 233 | 1,068 | 301 | 461 | 762 | 269 | 2,399 | 3,393 | 5,792 |
| 1926 | 910 | 173 | 1,083 | 990 | 164 | 1,154 | 373 | 2,455 | 2,637 | 5,092 |

[5] Included with miscellaneous fish.

## FISHERIES OF THE MISSISSIPPI RIVER AND TRIBUTARIES

The latest statistical canvass made of the fisheries and fishery industries of the Mississippi River and tributaries was for the calendar year 1922. The complete statistics for the canvass were published in the report of the division of fishery industries for 1923 and in Statistical Bulletin No. 607.

During 1922 the fisheries and fishery industries of this region employed 19,122 persons, and the yield of the fisheries amounted to 105,733,734 pounds, valued at $4,503,521.

In addition to the above general canvass, periodic statistical canvasses are made of the fisheries of Lake Pepin and Lake Keokuk. A discussion of these for 1914, 1917, 1922, and 1927 follows.

### LAKE PEPIN AND LAKE KEOKUK

In June, 1913, a dam was put into operation on the Mississippi River between Keokuk, Iowa, and Hamilton, Ill., which caused the formation of an artificial lake, about 42 miles long and from ½ mile to 2½ miles or more wide, in the river behind the dam. This lake has been named Lake Keokuk. Farther up the river, about 400 miles from Lake Keokuk, the Mississippi River widens, and a natural body of water is formed, which is known as Lake Pepin. These two lakes have been subjected to extensive biological and ecological experiments and investigations during late years, and for this reason statistics of their fisheries are of more than ordinary interest. Presented herewith are detailed statistics for 1927 and comparative statistics for the years 1914, 1917, 1922, and 1927. For further data on the fisheries of Lakes Pepin and Keokuk, the reader is referred to a Bureau of Fisheries publication now in press, entitled "Keokuk Dam and the fisheries of the upper Mississippi River," by Robert E. Coker.

*Fisheries of Lake Keokuk, 1927*

OPERATING UNITS AND CATCH: BY GEAR

| Items | Seines | | Gill nets | | Lines | | Fish traps | | Fyke nets | | Total[1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishermen | 9 | | 2 | | 20 | | 44 | | 72 | | 102 | |
| Boats: | | | | | | | | | | | | |
| Motor | 6 | | | | 8 | | 38 | | 58 | | 70 | |
| Other | 8 | | 2 | | 18 | | 40 | | 57 | | 82 | |
| Fishing apparatus: | | | | | | | | | | | | |
| Number | 3 | | 26 | | | | 815 | | 1,594 | | | |
| Length, in yards | 600 | | 1,300 | | | | | | | | | |
| CATCH | *Lbs.* | *Value* | *Lbs.* | *Value* | *Lbs.* | *Value* | *Lbs.* | *Value* | *Lbs.* | *Value* | *Lbs.* | *Value* |
| Bowfin | 218 | $7 | | | 1,367 | $41 | | | 12,470 | $374 | 14,055 | $422 |
| Buffalo fish | 668 | 67 | 600 | $108 | | | | | 66,604 | 6,413 | 67,872 | 6,588 |
| Carp, German | 3,097 | 186 | 680 | 82 | 7,680 | 398 | | | 279,742 | 15,640 | 291,199 | 16,306 |
| Catfish | 760 | 114 | | | 9,020 | 1,180 | 96,707 | $11,821 | 33,856 | 4,241 | 140,343 | 17,356 |
| Drum | 468 | 33 | | | 813 | 50 | | | 26,257 | 1,726 | 27,538 | 1,809 |
| Paddlefish | 200 | 20 | 60 | 7 | 139 | 14 | | | 850 | 93 | 1,249 | 134 |
| Quillback | 480 | 14 | | | | | | | 9,400 | 319 | 9,880 | 333 |
| Sunfish | 174 | 10 | | | | | | | 13,389 | 793 | 13,563 | 803 |
| Turtles | 385 | 12 | | | | | | | | | 385 | 12 |
| Total | 6,450 | 463 | 1,340 | 197 | 19,019 | 1,683 | 96,707 | 11,821 | 442,568 | 29,599 | 566,084 | 43,763 |

[1] Exclusive of duplication.

*Fisheries of Lake Pepin, 1927*

OPERATING UNITS AND CATCH: BY GEAR

| Items | Seines | | Gill nets | | Lines | | Fyke nets | | Spears | | Total[1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishermen | 77 | | 22 | | 3 | | 56 | | 4 | | 139 | |
| Boats: | | | | | | | | | | | | |
| Motor | 23 | | 9 | | | | 17 | | | | 39 | |
| Other | 63 | | 14 | | 3 | | 37 | | 4 | | 105 | |
| Fishing apparatus: | | | | | | | | | | | | |
| Number | 23 | | 152 | | | | 280 | | 4 | | | |
| Length, in yards | 14,393 | | 7,716 | | | | | | | | | |
| CATCH | *Lbs.* | *Value* | *Lbs.* | *Value* | *Lbs.* | *Value* | *Lbs.* | *Value* | *Lbs.* | *Value* | *Lbs.* | *Value* |
| Bowfin | 717 | $20 | | | | | 2,617 | $89 | | | 3,334 | $109 |
| Buffalofish | 17,172 | 1,479 | 1,903 | $218 | | | 14,349 | 1,535 | 25 | $2 | 33,449 | 3,234 |
| Carp, German | 507,354 | 22,890 | 33,581 | 2,431 | 163 | $9 | 71,638 | 3,900 | 2,506 | 149 | 615,242 | 29,379 |
| Catfish | 7,253 | 1,656 | | | 228 | 46 | 45,595 | 10,794 | | | 53,076 | 12,396 |
| Drum | 43,193 | 3,209 | | | | | 70,600 | 5,487 | | | 113,793 | 8,696 |
| Eels | 24 | 3 | | | | | 294 | 51 | | | 318 | 54 |
| Mooneye | 5,500 | 105 | | | | | 3,476 | 81 | | | 8,976 | 186 |
| Paddlefish | 1,041 | 150 | 50 | 5 | | | 100 | 13 | | | 1,191 | 168 |
| Quillback | 3,265 | 125 | | | | | 1,570 | 47 | | | 4,835 | 172 |
| Suckers | 21,202 | 967 | | | | | 10,709 | 519 | | | 31,911 | 1,486 |
| Total | 606,721 | 30,504 | 35,534 | 2,654 | 391 | 55 | 220,948 | 22,516 | 2,531 | 151 | 866,125 | 55,880 |

[1] Exclusive of duplication.

*Fisheries of Lake Keokuk, 1914, 1917, 1922, and 1927*

OPERATING UNITS AND CATCH

| Items | 1914 | 1917 | 1922 | 1927 |
|---|---|---|---|---|
| OPERATING UNITS (number) | | | | |
| Fishermen | 105 | 118 | 122 | 102 |
| Boats: | | | | |
| Motor | 36 | 52 | 58 | 70 |
| Other | 94 | 80 | 111 | 82 |
| Fishing apparatus: [1] | | | | |
| Seines | | 1 | 2 | 3 |
| Anchored gill nets | | 12 | 235 | 26 |
| Trammel nets | 14 | 17 | 17 | |
| Fyke nets | 1,378 | 1,368 | 1,301 | 1,594 |
| Fish traps | | 81 | | 815 |
| Dip nets | | | 1 | |
| PRODUCTS (pounds) | | | | |
| Black bass | 15 | 4,163 | 6,200 | |
| Bowfin | | 26,000 | | 14,055 |
| Buffalo fish | 249,900 | 696,543 | 113,946 | 67,872 |
| Carp, German | 302,365 | 762,259 | 276,431 | 291,199 |
| Catfish and bullheads | 71,535 | 109,904 | 183,919 | 140,343 |
| Crappie | 70 | 17,560 | 13,770 | |
| Eels | 3,800 | 2,087 | | |
| Fresh-water drum, or sheepshead | 26,860 | 160,554 | 65,040 | 27,538 |
| Pike | | 20 | | |
| Pike perch, sauger | | | 2,280 | |
| Quillback, or American carp | | 5,936 | | 9,880 |
| Spoonbill cat, or paddlefish | | 927 | 27,405 | 1,249 |
| Sturgeon, sand [2] | 1,900 | 454 | | |
| Sturgeon, shovelnose | | | 600 | |
| Suckers | 4,640 | 700 | | |
| Sunfish | 50 | 13,879 | 11,590 | 13,563 |
| Turtles | | | | 385 |
| Total | 661,135 | 1,800,986 | 701,181 | 566,084 |

[1] Trot and hand lines are omitted from this statement because data on the quantity in use are not available.
[2] Reported as lake sturgeon in 1914.

*Fisheries of Lake Pepin, 1914, 1917, 1922, and 1927*

OPERATING UNITS AND CATCH

| Items | 1914 | 1917 | 1922 | 1927 |
|---|---|---|---|---|
| OPERATING UNITS (number) | | | | |
| Fishermen | 135 | 126 | 219 | 139 |
| Boats: | | | | |
| Motor | 28 | 35 | 109 | 39 |
| Other | 54 | 55 | 136 | 105 |
| Fishing apparatus: [1] | | | | |
| Seines | 14 | 17 | 33 | 23 |
| Anchored gill nets | 664 | 371 | 351 | 152 |
| Fyke nets | 295 | 262 | 95 | 280 |
| Fish traps | 8 | 14 | | |
| Spears | | | 7 | 4 |
| PRODUCTS (pounds) | | | | |
| Bowfin | 1,534 | 24,021 | 16,136 | 3,334 |
| Buffalo fish | 261,250 | 300,808 | 340,309 | 33,449 |
| Carp, German | 237,517 | 467,588 | 2,578,916 | 615,242 |
| Catfish and bullheads | 26,830 | 254,249 | 127,384 | 53,076 |
| Eels | | | 541 | 318 |
| Fresh-water drum, or sheepshead | 131,785 | 118,304 | 395,592 | 113,793 |
| Mooneye, fresh | 9,300 | 7,656 | | 8,976 |
| Mooneye, smoked | 1,465 | 7,250 | | |
| Pike | 50 | | | |
| Quillback, or American carp | 60,605 | 14,238 | 47,377 | 4,835 |
| Spoonbill cat, of paddlefish | 8,877 | 2,923 | 15,971 | 1,191 |
| Sturgeon, lake | 1,067 | 512 | 5,253 | |
| Sturgeon, shovelnose | | | 1,080 | |
| Suckers | 18,340 | 15,260 | 43,466 | 31,911 |
| Sunfish | 50 | | | |
| Turtles | | | 442 | |
| Total | 758,670 | 1,212,809 | 3,572,467 | 866,125 |

[1] Trot and hand lines are omitted from this statement because data on the quantity in use are not available.

## FISHERIES OF ALASKA

The latest statistical canvass made of the fisheries and fishery industries of Alaska was for the calendar year 1927. The complete statistics for the canvass were published in the report "Alaska fishery and fur-seal industries, 1927," and in Statistical Bulletin No. 790.

During 1927 the fisheries of Alaska employed 28,872 persons, of whom 11,030 were fishermen, 16,069 were employed in the wholesale and manufacturing industries, and 1,773 in transporting fishery products. The catch in the round weight, exclusive of whales, amounted to 458,546,100 pounds, valued at $13,812,218. The round weight of whales could not be determined, but their products amounted to 11,475,950 pounds, valued at $622,412. Of the total catch, exclusive of whales, 300,565,699 pounds, valued at $8,702,494, consisted of salmon; 156,233,673 pounds, valued at $5,021,066, consisted of other fish; and 1,746,728 pounds, valued at $88,658, consisted of shellfish.

During 1927 there were 282 establishments (exclusive of duplication) in Alaska engaged in the fisheries trade. Of this number, 139 canned fish, 122 cured fish, 34 manufactured by-products, and 34 handled fresh and frozen fishery products.

The output of these extablishments amounted to 289,149,363 pounds, valued at $40,163,300. The salmon industry was by far the most important and produced 186,978,797 pounds of products, valued at $32,361,767. In value, the halibut industry was next in importance and produced 34,491,283 pounds of products, valued at $3,805,088. The comparatively new herring industry ranked third in importance and produced 52,538,572 pounds of products, valued at $2,850,823. Of the remainder, whale, shrimp, and clam products were most important in value.

In considering the wholesale and manufacturing industries separately, the canning industry ranked foremost and produced 171,779,706 pounds of fishery products, valued at $30,163,083. In value, cured fish ranked second, producing 25,324,157 pounds of products, valued at $3,312,750. The fresh-fish industry was third with products amounting to 28,524,353 pounds, valued at $2,955,128; the by-products industry fourth with an output of 42,386,161 pounds, valued at $1,964,903; and the frozen-fish industry fifth, accounting for the remainder of the products, amounting to 21,134,986 pounds, valued at $1,767,436.