UNITED STATES COMMISSION OF FISH AND FISHERIES.

PART XIX.

REPORT

OF

THE COMMISSIONER

FOR

THE YEAR ENDING JUNE 30, 1893.

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REPORT

OF THE

UNITED STATES COMMISSIONER OF FISH AND FISHERIES

FOR THE

FISCAL YEAR ENDING JUNE 30, 1893.

The report herewith presented covers the operations of the Commission during the fiscal year beginning July 1, 1892, and ending June 30, 1893. The appropriations made by Congress were as follows:

For current expenses:	
Compensation of the Commissioner	$5,000
Propagation of food-fishes	152,500
Distribution of food-fishes	45,000
Maintenance of vessels	68,900
Inquiry respecting food-fishes	15,000
Statistical inquiry	15,000
Total	301,400
For completion of fish-cultural stations:	
Green Lake and Craig Brook, Me	8,000
St. Johnsbury, Vt	10,000
Leadville, Colo	15,000
Northville, Mich	3,000
For establishment of fish-cultural stations:	
Montana	10,000
Texas	10,000
For conducting examinations relative to the advisability of establishing fish-cultural stations:	
Washington	1,000
Tennessee	1,000
South Dakota, Iowa, and Nebraska	1,000
Wyoming	400

In accordance with law, a report showing details of expenditures from the foregoing appropriations was submitted to Congress December 4, 1893 (Senate Mis. Doc. No. 4, Fifty-third Congress, second session).

DIVISION OF ADMINISTRATION.

The work of this division has been under the general supervision of the chief clerk of the Commission, Mr. Herbert A. Gill. To it are assigned all matters connected with the general personnel of the Commission, appropriations, accounts, publications, library, office of architect and engineer, and other incidents of administration not specifically chargeable to any of the other divisions.

PUBLICATIONS.

In order that the information secured by the Commission may be placed in the hands of those interested at as early a date as possible, it has been the custom for some years to distribute, in advance of the completed reports and bulletins of the Commission, pamphlet copies of the different papers comprising these volumes. Under this system the following papers were issued during the year:

Report of distribution of fish and eggs from July 1, 1888, to June 30, 1889. (Report for 1888, pp. 379-394.)
Notes on Entozoa of marine fishes, with description of new species, Part III. (Report for 1888, pp. 523-542.)
The anatomy of *Thysanocephalum crispum* Linton, a parasite of the tiger shark. (Report for 1888, pp. 543-556.)
Report upon the participation of the United States Fish Commission in the Centennial Exposition held at Cincinnati, Ohio, in 1888, by J. W. Collins. (Report for 1888, pp. 869-885.)
Report of the Commissioner for 1888, by Marshall McDonald. (Report for 1888, pp. I-CXXVIII.)
Report on the fisheries of the New England States, by J. W. Collins and Hugh M. Smith. (Bulletin for 1890, pp. 73-176.)
Report on an investigation of the fisheries of Lake Ontario, by Hugh M. Smith. (Bulletin for 1890, pp. 177-215.)
A report upon the fishes of Iowa, based upon observations and collections made during 1889, 1890, and 1891, by S. E. Meek. (Bulletin for 1890, pp. 217-248.)
Report of an examination of the rivers of Kentucky, with lists of the fishes obtained, by Albert J. Woolman. (Bulletin for 1890, pp. 249-288.)
Notes on the streams and fishes of Clinton County, Ky., with a description of a new darter, by Philip H. Kirsch. (Bulletin for 1890, pp. 289-292.)
A report upon the rivers of central Florida tributary to the Gulf of Mexico, with lists of the fishes inhabiting them, by Albert J. Woolman. (Bulletin for 1890, pp. 293-302.)
An investigation of the coast waters of South Carolina with reference to oyster-culture, by John D. Battle. (Bulletin for 1890, pp. 303-330.)
Report on the salmon fisheries of Alaska, by Marshall McDonald. (Bulletin for 1892, pp. 1-50.)
Observations on the hatching of the yellow perch, by S. G. Worth. (Bulletin for 1890, pp. 331-334.)
The physical and biological characteristics of the natural oyster-grounds of South Carolina, by Bashford Dean. (Bulletin for 1890, pp. 335-361.)
The present methods of oyster-culture in France, by Bashford Dean. (Bulletin for 1890, pp. 363-388.)
A contribution to our knowledge of the morphology of lamellibranchiate mollusks, by James L. Kellogg. (Bulletin for 1890, pp. 389-436.)
Report on the establishment of fish-cultural stations in the Rocky Mountain region and Gulf States, consisting of (1) a reconnaissance of the streams and lakes of western Montana and northwestern Wyoming, and (2) a report upon investigations made in Texas in 1891, by B. W. Evermann. (Bulletin for 1891, pp. 1-90.)
A statistical report on the fisheries of the Gulf States, by J. W. Collins and Hugh M. Smith. (Bulletin for 1891, pp. 91-184.)
Description of a new sucker, *Pantosteus jordani*, from the Upper Missouri Basin, by Barton W. Evermann. (Bulletin for 1892, pp. 51-56.)
Report on a collection of fishes from the Albemarle region of North Carolina, by Hugh M. Smith. (Bulletin for 1891, pp. 185-200.)
Observations on the spawning habits of the shad, by S. G. Worth. (Bulletin for 1891, pp. 201-206.)
A preliminary report on the aquatic invertebrate fauna of the Yellowstone National Park, Wyoming, and of the Flathead region of Montana, by S. A. Forbes. (Bulletin for 1891, pp. 207-258.)
Notes on a collection of fishes from the southern tributaries of the Cumberland River in Kentucky and Tennessee, by P. H. Kirsch. (Bulletin for 1891, pp. 259-268.)
Report on the fisheries of the South Atlantic States, by Hugh M. Smith. (Bulletin for 1891, pp. 269-367.)

There was also issued the complete report of the Commissioner, covering the fiscal years 1889-90 and 1890-91. (Report for 1889-91, pages 1 to 204, and I to XI.)

The distribution of the publications of the Commission consisted of 2,700 bound volumes of the Reports and Bulletins, and about 11,000 copies of the various articles appearing therein. These were sent more especially to libraries, scientific institutions, and persons specially interested in the subjects respectively presented.

The following papers, published at the expense of the Museum of Comparative Zoology at Cambridge, Mass., and covering reports of the results of the investigations carried on during 1891 by the U. S. Fish Commission steamer *Albatross*, Lieut. Commander Z. L. Tanner, U. S. N., and under the charge of Prof. Alexander Agassiz, off the west coast of Central America and Mexico, were published during the year.

Vorläufiger Bericht über die erbeuteten Holothurien, by Hubert Ludwig. (Bulletin of the Museum of Comparative Zoology at Harvard College, vol. XXIV, No. 4.)

On a peculiar type of Arenaceous Foraminifer from the American tropical Pacific, *Neusina agassizi*, by A. Goës. (Bulletin of Museum of Comparative Zoology at Harvard College, vol. XXIII, No. 5.)

SPECIAL REPORTS.

On July 2, 1892, in response to a resolution of the United States Senate for information concerning the salmon fisheries of Alaska, a report was transmitted to the Senate (Mis. Doc. 192, Fifty-second Congress, first session) discussing the origin and development of the fisheries, statistics of the fisheries, present condition of the fisheries, methods and apparatus employed, the protective regulations of the fisheries, and recommendations as to further legislation in reference thereto. This report will also be found in the Bulletin of the United States Fish Commission for 1892.

LIBRARY.

The accessions to the library, which were mainly by donation and in exchange for the publications of the Commission, embraced 1,064 books, of which about one-fourth related directly to fish and fisheries, and the balance to zoology, natural history, and kindred subjects.

OFFICE OF ARCHITECT AND ENGINEER.

While under orders to make investigations of certain localities in Montana offering advantages for the location of a fish-cultural station, Mr. Charles E. Gorham, the architect and engineer of the Commission, died at Bozeman, Mont., November 13, 1892. For the purpose of securing a competent engineer to fill the position thus made vacant, the United States Civil Service Commission held a special examination for applicants, and upon their certification Mr. Hector von Bayer was appointed thereto on March 1, 1893.

The following is Mr. Von Bayer's report, showing the work of construction at the different stations of the Commission during the year:

Green Lake Station, Maine.—The two settling reservoirs were finished; a number of new rearing ponds were excavated; a branch box flume was laid, which taps the main supply flume, for feeding the new ponds, and a system of outdoor rearing-troughs and tubs; new drains from the ponds and troughs were laid; a number of buoys were placed in Green Lake for safer navigation; a new screen-gate was put at the foot of Green Lake to prevent the escape of fish; a portion of the road leading through the grounds was graded; a brick cistern was built in the superintendent's quarters and one in the foreman's quarters; minor repairs were made to the superintendent's cottage, such as strengthening the first floor by additional posts, strengthening the roof construction by additional collar-beams, and walling up the foundation of the earth closet; the siding and roof of the ice-house were repaired; the dam at Mountainey Pond was strengthened and leaks in the main supply flume were stopped.

Craig Brook Station, Maine.—Completion of stable and annex to superintendent's cottage; building of a small settling reservoir; deepening of ponds; repairing hatchery annex by laying a floor in the former woodshed and plastering the same for an office and food room; building a small smithy and annex to the farm house; repairing water conduits and flume; and some grading of the grounds.

Woods Hole Station, Massachusetts.—Repairs to doors, windows, and blinds of main building; grading along water front of same; repairing flooring of coal wharf; bottoms of boat-landing floats, woodwork around boat landings and small fish basin renewed; and the movable coal hoist repaired.

Fish Ponds, Washington, D. C.—Repairs to ponds and embankments, to supply and drain pipes, hydrants, grounds, etc. The north half of the first floor of the superintendent's cottage was strengthened for storing books thereon.

Bryan Point Station, Maryland.—Improvements on the grounds; the rebuilding of a landing; and minor repairs to buildings.

Wytheville Station, Virginia.—Repairs to ponds; laying additional supply pipes from spring to ponds, hatchery, and railroad; new spawning beds prepared; pond walls and embankments repaired; blind ditches opened; and a flagstaff erected.

Northville Station, Michigan.—The erection of a dam with fishway across the north branch of the Rouge River, 2,400 feet southwest of the hatchery grounds; the construction of a brick reservoir on the grounds, and the laying of an 18-inch water conduit of terra cotta from said dam to the reservoir on the grounds, capable of supplying 2,000 gallons of water per minute; repairs to the telephone line between the hatchery and the railroad depot; building of new ponds and repairs to old ones; laying new supply pipes from reservoirs to hatchery and ponds; and minor repairs to buildings and outfit.

Duluth Station, Minnesota.—Repairs to tanks, flume, crib well, hatchery flooring, and grounds.

Neosho Station, Missouri.—Building new ponds, new earth closet, and woodshed; minor repairs to buildings, ponds, walks in grounds, etc.

Leadville Station, Colorado.—Repairing the old hatchery, ponds, and a break in the embankment of Lower Evergreen Lake; building a number of new ponds and grading a portion of the grounds.

Baird Station, California.—Rebuilding a bridge with rack across the McCloud River; erecting a flagstaff; repairing stable, hatching and spawning houses, and current wheel, and other minor items of damage done by the past floods.

Fort Gaston Station, California.—A dam and trap were built at Mill Creek, a tributary of the Trinity River, about 4 miles distant from the station. The auxiliary hatching house on Redwood Creek, 11 miles southwest from Fort Gaston Station, was enlarged. Repairs were made to ponds, supply flume, and buildings.

Clackamas Station, Oregon.—A rack was built across the Clackamas River, as well as across the Sandy River, a tributary of the Columbia River, 17 miles northeast of the station, with a dam and flume at the latter; a flagstaff was erected, fish inclosures made, new conduits to hatchery laid, and grounds improved.

FISHWAY, POTOMAC RIVER.

Congress, by act approved August 5, 1892, made an additional appropriation of $15,000 to complete the erection of a fishway at Great Falls, in the Potomac River, sections 4, 5, and 6 having been completed during the previous year. Plans and specifications for sections 1, 2, and 3 were prepared, and proposals for the construction were invited by advertisement. But two bids were received, of which the lower—that of Isaac H. Hathaway, of Philadelphia—was accepted, and a contract entered into with him by the Chief of Engineers, U. S. A., on November 23, 1892. Sections 2 and 3 and a part of the permanent deflecting dam were completed during the year.

OFFICE OF MECHANICAL ENGINEER.

The following is the report of Passed Assistant Engineer I. S. K. Reeves, U. S. N., detailed by the Secretary of the Navy as the mechanical engineer of the Commission:

The steam, water, circulating, heating, electric, and gas plants, together with their attachments, pipe connections, etc., which are located at the different stations, have been, as opportunity offered, examined, overhauled, and repaired.

In the machine shop at Central Station a galvanized iron pipe coil refrigerator was built and introduced for the aquaria at Central Station for regulating the temperature of the salt-water supply. A water motor of the Tuerk patent was purchased, a hard-rubber pump fitted to the same, and introduced at Central Station, not only to save the expense of $25 per month for gas, but also to allow the necessary repairs to be made to the Rider hot-air pumping engine, which had been in use continually, night and day, for the past three years and needed extensive repairs. After the erection of the above-mentioned motor the pumping engine was put in thorough repair. A Bishop & Babcock air pump was purchased and connected to the different aquaria at Central Station in order to aërate the water. There was also purchased hard-rubber piping for new supply pipe for salt-water circulation for the aquaria.

Twenty-five defective tubes in the boiler for the pulsometers at the fish ponds were cut out and new ones put in.

The steam, water, and air circulating plants, transporting tanks, and their attachments on cars Nos. 2 and 3 were thoroughly overhauled and new piping substituted where required. A duplex pump of the New York Air Brake Company was placed in car No. 3, in order to supply air circulation to transporting tanks. The iron pipe coil-refrigerator in car No. 3 was removed, the system remodeled, and a new galvanized-iron coil put in. In the spring a baggage car was purchased and equipped with boiler, circulating pump, feed pump, air pump, tanks, and necessary attachments for circulating water and air during the transportation of fish to the World's Columbian Exposition. All boilers, pumps, steam-heating apparatus, etc., on the cars of the Commission were thoroughly overhauled and tested.

The engines, pumps, boilers, etc., of steamers *Plover*, *Canvasback*, *Blue Wing*, *Curlew*, *Cygnet*, *Shearwater*, and *Petrel* were overhauled, repaired, and tested; and small repairs were also made to the hulls of these steamers where required. The steamer *Petrel* was hauled out on the railway and hull coppered below water line. The steamer *Blue Wing* was also hauled out on the railway and a new sternpost put in. The lead sleeve in the deadwood was found so much worn that a new brass sleeve was put in. A new smokestack was also fitted to the boiler, and new holding-down bolts for engines were introduced. A new awning frame of galvanized-iron pipe was made for the steamer *Curlew*, and a new awning fitted. The steamer *Shearwater* was docked in Cleveland, Ohio, and hull and decks calked and painted; the jet condenser was removed, and a copper keel condenser connected. There were also a number of minor repairs made to the hull and machinery of this steamer. A pump in stock was transferred to this steamer, to circulate the water for transporting cans.

The gravity water supply at the Duluth Station having failed on several occasions from drought and freezing up, it could not be depended upon, and it became necessary to increase the pumping plant at that station; this was done by the transfer of a pump in stock at Battery Station. This was connected to the wells on the lake shore, which increased the water supply at the Duluth Station about 150 gallons per minute, giving a total supply from the two pumps of 400 gallons per minute.

The mechanical and machine work incident to the above-mentioned repairs, alterations, etc., was almost entirely performed by the machinists and firemen of the Commission, the machine work having been done in the different shops of the Commission, which are located at the different stations.

EXPOSITIONS.

The World's Columbian Exposition, Chicago.—Capt. J. W. Collins, assistant in charge of the Division of Fisheries, continued as representative of the Commission on the Board of Management and Control till the latter part of 1892, when he resigned from the Commission. On December 29 Dr. Tarleton H. Bean, assistant in charge of the Division of Fish-Culture, was appointed as his successor on the Board.

Columbian Historical Exposition, Madrid, 1892.—The participation of the Commission in this Exposition consisted in the transmission of a complete set of the publications of the Commission. In recognition of this exhibit, the Board of Directors of the Exposition conferred a a bronze commemorative medal, which has been deposited in the United States National Museum.

ADDITIONAL FISH-CULTURAL STATIONS.

Fish-hatchery at St. Johnsbury, Vt.—In the previous report reference was made to the selection of a site near St. Johnsbury for the fish-cultural station directed by law to be established in the State of Vermont. On July 21, 1892, the necessary plat of the site selected and the deeds conveying the different properties to the United States were forwarded to the United States Attorney-General. The following December that officer certified to the sufficiency of the deeds to vest in the United States valid titles; and in January, 1893, the purchase money was paid to the respective owners. These payments were, to E. and T. Fairbanks, $1,070; Asa S. Livingston, $300; John Morgan, $500; Calvin H. Cushman, $600; total, $2,470.

By the act approved July 5, 1892, a further appropriation of $10,000 was made by Congress for the completion of the station, to include the erection of buildings, the introduction of water supply, the construction of ponds, and other features in the development of the station. Owing, however, to the death of the engineer of the Commission and the delay incident to the selection and appointment of a successor, no actual construction work was undertaken during the year.

Fish-hatchery in New York.—Under the authority given by the act approved March 3, 1891, for the establishment of a fish-cultural station on or near the St. Lawrence River, New York, a preliminary investigation was made of certain localities in that State with a view to selecting a station furnishing the requirements as set forth in the report of the Commissioner for 1889–91, page 57. A site was examined at Theresa, but no conclusion in regard to the matter was reached at the time. Derogatory reports of the water supply of that place having been received, a further examination was made the following August, and the result demonstrated the unfitness of the site. In view of the ill success that attended investigations looking toward the selection of a suitable site (examinations having been made at Waddington, Redwood, Clayton, St. Lawrence, Richland, Pulaski, and Sand Bank, none of which nearly reached the standard required), and owing to the lateness of the season, it became necessary to postpone further investigations until another season.

Fish-hatchery at San Marcos, Tex.—In a previous report reference was made to an investigation with a view to establishing a fish-cultural station in the Gulf States, and to the fact that San Marcos, Tex., furnished a desirable site for a station for the propagation of fresh-water species of fishes. By act approved August 5, 1892, an appropriation of $10,000 was made for the establishment of such a station in Texas. Before final decision upon the selection of this site a further investigation of certain other localities was made.

In November, 1893, an offer was made by a committee of citizens of San Marcos to convey to the United States a tract of land in that town, near the head waters of the river and just below the dam of the San Marcos Water Company; to rebuild and raise the existing dam across the river, so as to provide a higher level and thus permit of the supply of water to the ponds by gravity; to obtain the right to enter upon the property of the San Marcos Water Company for the purpose of laying the necessary pipes and to take fishes from the lake for the purposes of propagation; and to secure the passage of certain city ordinances which would allow of the satisfactory conduct of the station. The consideration to be paid for the tract was $4,500, and for the water rights, dam, etc., $2,500. In view of all these circumstances, it was decided to select the San Marcos site, and the deed of Judge W. D. Wood covering the tract of ground was delivered on the 2d of May, 1893, and that of Mr. Ed. J. L. Green and the San Marcos Water Company for water rights, etc., on the 24th of April, 1893.

In accordance with the request of this office of the 14th of April, 1893, the United States attorney for the western district of Texas was directed to receive the papers and examine the titles to the property and rights thereby conveyed. Under date of May 25 the Attorney-General certified that the deed to the Wood tract was sufficient to vest in the United States a valid title to the same. In regard to the property of the San Marcos Water Company and Mr. Green, it was found that the title was affected by certain deeds of trust given by the company to secure certain issues of bonds, and it became necessary to arrange for releases, so far as the rights conveyed by the deed to the United States were concerned. Steps were therefore taken to secure from the trustees, with the consent of the holders of the bonds, the releases called for by the Attorney-General. This, however, it was impossible to have done before the close of the year, and the respective deeds were held in escrow until the final completion of all the requirements necessary to pass the property in fee simple to the United States.

Fish-hatchery at Bozeman, Mont.—In the last report of the Commissioner attention was called to the investigations which took place with a view of selecting suitable sites for the establishment of fish-cultural stations in the State of Montana and in one of the Gulf States. Of the sites examined in Montana, the most desirable for the proposed station was that embracing Davies Springs, near Bozeman. After a careful engineering survey an option for the sale of the property at $3,500 was obtained. The site embraces some 78 acres of land, on which are the Davies Springs, flowing between 1,200 and 1,500 gallons of water per minute. Certain rights connected with the water supply of Bridger Creek are also secured. The deed of William J. Davies and his wife transferring this property was dated May 20, 1893, and this document was duly transmitted to the United States Attorney-General for examination and certification as to the sufficiency of the same to vest a valid title in the United States. On June 26, 1893, the Attorney-General, in a communication to the Commissioner, stated that this deed was sufficient to pass a valid title to the United States.

Afognak forest and fish-culture reserve.—The act approved March 3, 1891, entitled "An act to repeal timber-culture laws, and for other purposes," affecting the acquisition of public lands, provides for the reservation in Alaska of such public lands as "shall be selected by the United States Commissioner of Fish and Fisheries on the islands of Kadiak and Afognak for the purpose of establishing fish-culture stations." Under this provision of the act the President, by proclamation of December 24, 1892, set aside "Afognak Bay, River, and Lake, with their tributary streams and the sources thereof, and the lands including the same on said Afognak Island, and within one mile from the shores thereof, as a reserve for the purpose of establishing fish-culture stations, and for the use of the United States Commission of Fish and Fisheries, the boundary lines of which include the head springs of the tributaries above mentioned, and the lands the drainage of which is into the same."

COURTESIES RECEIVED AND EXTENDED.

At the request of the Secretary of State, information on the fishery laws of various countries was furnished for use in the arbitration of the Bering Sea seal controversy between this country and Great Britain.

By direction of the President, the steamer *Albatross* was transferred to the Treasury Department, for duty in the investigation of the life-history of the fur seal and of the fur-seal fishery of Bering Sea.

The Treasury Department granted facilities to Mr. Charles H. Townsend, an assistant of the Commission, to study seal life upon the rookeries of the Pribilof Islands.

Information relative to the hydrographic soundings of the steamer *Albatross* was furnished the Coast and Geodetic Survey for the Coast Pilot of Alaska.

The steamer *Albatross* was transferred to the Navy Department, by direction of the President, for duty as a patrol in Bering Sea.

Capt. W. E. Dougherty, U. S. A., was, by request, detailed by the Secretary of War to superintend the fish-cultural work at Fort Gaston, Cal.

The Commission is again indebted to Gen. Albert Ordway, commanding the District of Columbia militia, for the loan of tents and equipment for use in the shad-hatching operations on the Potomac River.

The steam launches *Petrel* and *Canvasback* were loaned to the State of Virginia for use in investigating the oyster-grounds of that State.

The Standard Oil Company loaned seven tank cars for transporting 42,000 gallons of salt water for the United States Fish Commission aquaria at the World's Columbian Exposition, and the Chesapeake and Ohio Railroad Company and Cleveland, Cincinnati, Chicago, and St. Louis Railway Company transported the above free of charge from Beaufort, N. C., to Chicago.

STATE FISH COMMISSIONS.

During the year the policy of aiding, so far as possible, the work of the fish commissioners of the various States has been continued. The extent of this coöperation is shown by the following table:

Statement showing the kinds and number of fish and fish eggs furnished to State and Territorial fish commissions during the fiscal year 1892-93.

State or Territory.	Species.	Eggs.	Fish.
Arizona	Catfish		722
	Black bass		138
	Crappie		249
	Warmouth bass		628
California*	Quinnat salmon	3,530,000	
Connecticut	Atlantic salmon	108,000	
	Von Behr trout	20,000	
	Lake trout	105,000	
Delaware	Carp		1,400
	Tench		300
	Black bass		1,000
Georgia	Carp		2,000
	Rock bass		1,000
Illinois	Catfish		†475
	Yellow perch		†445
	White bass		†30
	Black bass		†3,216
	Crappie		†689
	Warmouth bass		†1,138
	Sunfish		†30
Iowa	Lake trout	100,000	
Maryland	Carp		1,030
	Rainbow trout	46,500	
	Von Behr trout	35,000	
Minnesota	Carp		1,500
	Loch Leven trout	20,000	
	Rainbow trout	20,000	
	Von Behr trout	20,000	
	Black-spotted trout		1,000
	Brook trout	20,000	
	Lake trout	100,000	
Missouri	Tench		5,000
	Rainbow trout	20,000	18
Nebraska	Rainbow trout	37,500	
	Von Behr trout	20,000	
	Lake trout	100,000	
New Hampshire	Loch Leven trout	15,000	
	Von Behr trout	25,000	
	Lake trout	100,000	
	Atlantic salmon	50,000	
New York	Atlantic salmon	75,000	
	Lake trout	100,000	
	Whitefish	5,000,000	
Ohio	Loch Leven trout		3,350
Oregon	Brook trout	20,000	
Vermont	Von Behr trout	20,000	2,500
	Rainbow trout	81,000	
	Brook trout	20,000	
	Lake trout	300,000	
West Virginia	Carp		1,000
Wisconsin	Carp		10,000
Wyoming	Black-spotted trout		3,600
	Black-spotted trout	25,000	
Total		10,133,000	42,458

* By request of the California Fish Commission, 91,000 muskellunge fry were received from the New York Fish Commission and transferred and deposited in California waters.

† Deposited by the United States Fish Commission in waters designated by the State commissioners.

RELATIONS WITH FOREIGN COUNTRIES.

Canada.—Carp were furnished the Game and Fish Commission of Ontario, and eggs of the Loch Leven trout and Von Behr trout were sent to Mr. W. P. Greenough, Portneuf, Quebec.

France.—Eggs of the rainbow trout were sent to C. Raveret-Wattel, Paris.

Switzerland.—At the request of the Government of Switzerland 30,000 eggs of the rainbow trout were sent to Mr. Emil Warner for that Government.

Japan.—To Prof. C. Sasaki, Tokyo, were sent eggs of the Loch Leven trout, Von Behr trout, and rainbow trout.

DIVISION OF INQUIRY RESPECTING FOOD-FISHES.

The work of this division during the year is set forth in the appended report of Mr. Richard Rathbun, assistant in charge. In addition to the regular inquiries of the Commission, the assistant in charge gave much time and labor, at the request of the Department of State, in preparing, for use before the Paris Tribunal of Arbitration, information concerning the condition and character of the more important fisheries of foreign countries and the legislation for their protection and improvement.

Owing to the detail of the *Albatross* for duty in Bering Sea, under the direction of the Secretary of the Treasury, and the necessity of repairs to the ship after the completion of her duties on this detail, the investigations on behalf of the Commission in the beginning of the year could only be incidentally performed. The opportunity was embraced, however, of making a careful study of the seal rookeries of the Pribilof Islands by the naturalists of the ship, who were temporarily detached from her. Upon the surrender of the *Albatross* to the Commission, on August 31, 1892, it was necessary to give her extensive repairs, which were not completed till the following April, when the President directed that she be placed under the orders of the Secretary of the Navy for duty in connection with the sealing patrol fleet in the North Pacific Ocean and Bering Sea. Owing to these details of the ship, the systematic prosecution of the inquiries of the Commission was not possible. It is hoped, however, that another season matters may be so arranged as to permit its performance.

On the Atlantic and Gulf coasts much attention was given to the study of the oyster beds and conditions affecting them. Among the grounds examined were those of Chesapeake Bay, embracing Tangier Sound, Mobjack Bay, and the rivers tributary thereto, and Galveston Bay, Gulf of Mexico. At Sea Isle City, N. J., experiments were conducted by Prof. John A. Ryder, of the University of Pennsylvania, formerly the embryologist of the Fish Commission, with the view of determining, if possible, a practical method for the collection of oyster spat, and the creation thereby of an industry distinct from, but as practical as, that of oyster-planting. Professor Ryder's observations on the subject will be found in the report of Mr. Rathbun.

Reference was made in my previous report to the visit of Dr. Bashford Dean to Europe for the purpose of studying the methods there followed in oyster-culture. The results of Dr. Dean's investigations were issued in December, 1892, and July, 1893, being published in the Bulletins of the Commission for the years 1890 and 1891, and will undoubtedly prove of great aid to those oystermen of this country who are seeking to improve the industry.

The subject of acclimatizing the eastern oyster on the Pacific coast has received attention, and investigations of the physical conditions of certain areas have been made. Favorable conditions appear to exist in Willapa Bay, Washington, and it is proposed to make plantings there from a number of localities on the Atlantic coast as soon as a favorable opportunity may arise.

Reference is made to the report of Mr. Rathbun for a résumé by Professor Libbey of the physical inquiries conducted by him during several preceding seasons off the southern New England and Middle States coast. These inquiries were discontinued during the season of 1892, and the schooner *Grampus* was used to make a search for the tilefish in those localities where it had previously been found. A few specimens only were received. The inquiry, however, establishes the fact of the continuity of the belt of warm waters on the Gulf Stream slope, so as to permit the northward summer migration of the species. We have therefore reason to expect that the tilefish will reoccupy its old grounds in undiminished numbers and that a valuable market fishery will be established should the fish be found acceptable to consumers.

At the laboratory of the Commission at Woods Hole studies of marine life were prosecuted as in previous years. The spawning and early habits of the common scallop or pecten were investigated by Dr. James L. Kellogg; Prof. Francis H. Herrick continued his observations on the development and life-history of the lobster; Prof. H. V. Wilson on the development of certain sponges; Dr. William Patten on the sense-organs in the horseshoe crab. The other inquiries conducted will be found noted in Mr. Rathbun's report.

Extensive investigations were made of the shores and inlets of Buzzards Bay and Vineyard Sound for the purpose of studying the habits and life-history, in the younger stages, of the common food-fishes of the locality, and much important information concerning the breeding and other habits of the menhaden was secured.

The interior waters examined during the year embraced the Columbia River and some of its tributaries, in Washington, Idaho, and Montana; the rivers and lakes of Minnesota, North and South Dakota, Iowa, Nebraska, Wyoming, Wisconsin, Arkansas, and California. These investigations were for the purpose of studying the physical characteristics of these waters and also to ascertain the various forms of animal and plant life inhabiting the same. Such inquiries are especially valuable as a guide in the work of the Commission of stocking our waters with suitable food-fishes.

The destructive methods followed in the capture of fish and shellfish in the territorial and contiguous waters of the United States and the British Possessions in North America, as also in the open seas outside of the territorial limits of either country, but which are resorted to for the purpose of fishing by their respective inhabitants, as well as the polluting and obstructing of such contiguous waters, to the detriment of their fisheries, have long been matters which have invited the attention of the respective Governments; and the necessity of uniform mutual laws regulating the prosecution of the fisheries, as also the adoption of methods for the replenishing of depleted waters, have equally been felt to be necessary if the fisheries were to be maintained. An agreement was reached by the two Governments on December 6, 1892, which provided for the appointment of a joint commission of two experts, one on behalf of each government, to consider and report upon the whole question. As representative on the part of Great Britain, Dr. William Wakeham, of the department of marine and fisheries of Canada, was appointed, and on the part of the United States Mr. Richard Rathbun, of the United States Commission of Fish and Fisheries. The two commissioners had their first meeting at Washington, on March 2, 1893. For the general scope of the inquiry to be prosecuted, reference is made to Mr. Rathbun's report.

During the spring and summer of 1893 investigations were conducted to learn what, if any, benefits had resulted from the series of close seasons in the spring mackerel fishery, provided by the act of Congress passed in 1886, the information also being needed by the Joint Fishery Commission. The schooner *Grampus* attended the fishing fleet on the southern fishing-grounds and thence to those off Nova Scotia. Many valuable observations were made, and much important information secured bearing upon the fishery. As the data of several seasons are necessary before any reasonable conclusions on the subject can be reached the consideration thereof is deferred. Other incidental investigations conducted by the division are shown in the report of Mr. Rathbun.

DIVISION OF STATISTICS AND METHODS OF THE FISHERIES.

During the year the administration of the affairs of this division devolved upon Dr. Hugh M. Smith, and reference is made to his appended report for a résumé of the work accomplished. Capt. J. W. Collins, the assistant in charge, retained the general direction of the work of the division up to September 26, 1892, and on December 27 of the same year he resigned from the Commission.

The work of the Division of Statistics and Methods of the Fisheries has continued of the same general character referred to in my previous reports. The scope of the operations is, however, becoming more extended and valuable year by year, and the practical usefulness of the division is annually becoming more evident.

The work of the division has consisted chiefly of field investigations of the commercial fisheries, and the preparation of general and special reports based on the data collected by the division. A large amount of correspondence embodying technical information has been sent out by the division; a number of special discussions on fishery topics have been prepared for the use of the Commissioner and others; and considerable statistical and other data have been supplied to State officials.

The field investigations carried on by this division were addressed to regions having very important fisheries. The previous practice of taking up for investigation each year definite sections or fisheries, depending largely on work already done covering the same subject, has been continued. In this way it is possible, with the present force, to canvass the fisheries of the coast and Great Lakes States about once in three or four years. The inquiries of the division in 1893 were mainly directed to the methods and statistics of the fisheries of the Middle Atlantic States, the New England States, the Pacific States, and of the mackerel fishery. Several minor subjects were also considered, and the regular agencies at Gloucester and Boston, Mass., were continued.

The inquiries in the Middle Atlantic States were in continuation of those of the previous year, referred to in the last report; the Chesapeake basin and the adjoining ocean shores of Maryland and Virginia were then canvassed, leaving for consideration during the fiscal year 1893 the fisheries of New York and New Jersey and those parts of Pennsylvania and Delaware not tributary to the Chesapeake. The field investigations in this region covered the calendar years 1889, 1890, 1891, and 1892, except in New York, in which the time of the inquiries prevented the agents from obtaining complete statistics for the last-named year. In the appended report of the assistant full references to the scope and results of the canvass of the Middle States are given, including statistics and comparative data.

The recent serious decline in the mackerel fishery, and the great attention which the scarcity of mackerel had received, made it desirable to have full statistical and other information upon these subjects. Accordingly, in connection with the other field inquiries, elsewhere alluded to, a canvass of the mackerel fishery was undertaken in the spring of 1893, and arrangements were made for securing more detailed data than had previously been obtained. This work was in progress at the close of the fiscal year. Reference to the accompanying report of the assistant in charge will show the scope and character of the investigation.

A study of the important fisheries of the New England States was made in conjunction with the investigation of the mackerel fishery of that region. No general fieldwork had been carried on in this section since 1889, and in the meantime some noticeable changes had occurred in the condition of the industry which made another canvass in 1893 timely. Special attention was directed to the lobster fishery, whose successful continuance has been seriously imperiled by overfishing. At the close of the year this investigation was well under way.

Early in the fiscal year an investigation of the fishing industry of the Pacific States was begun by Mr. W. A. Wilcox, who had made a similar canvass in 1889. Personal visits were made to all fishing centers on the coast and the coast streams, and very valuable data were secured for each of the years intervening since the last canvass. Especially useful statistics regarding the salmon industry were obtained. Although Alaska was not visited, complete statistical information covering the fisheries of that territory were obtained from the firms engaged, all of whom have headquarters in San Francisco or other cities of that coast. In San Francisco and vicinity Mr. Wilcox was assisted by Mr. A. B. Alexander, fishery expert on the *Albatross*, who was temporarily detached from the vessel for that purpose. The inquiry closed in May, 1893. An account of this work and its results is given in the report of the assistant, and Mr. Wilcox's full report will be found among the appendices to this report.

In connection with the work of the International Fisheries Commission, Dr. Smith, at the request of the United States commissioner, Mr. Rathbun, during June, 1893, accompanied the commission to Boston, Woods Hole, Provincetown, and other New England fishing centers.

The report for this division contains a brief synopsis of the papers, based on the division's field inquiries, issued during the year. These included statistical and descriptive articles on the fisheries of the New England States, the South Atlantic States, the Gulf States, and of Lake Ontario. The report concludes with notes on some of the more important fisheries, and on certain branches possessing special interest.

DIVISION OF FISH-CULTURE.

The continued growth of the Commission rendered it necessary that the Commissioner should relieve himself of the direct supervision of the details of this division, the charge of which he had assumed upon his appointment as Commissioner. On July 6, 1892, he therefore appointed as the assistant in charge Dr. Tarleton H. Bean, the ichthyologist of the Commission. Dr. Bean assumed charge of the division and retained its immediate direction till the beginning of the following January, when his appointment as representative of the Commission on the Government Board of Management and Control of the World's Columbian Exposition, Chicago, necessitated his being relieved of other duty. Mr. S. G. Worth, the superintendent of Central Station, was then detailed as acting assistant in charge of the division, the duties of which position he performed with fidelity and skill for the remainder of the year covered by this report.

The following tables exhibit the results of work at the different stations, and the summary, by species, of the fish distributed:

Summary of eggs and fish furnished for distribution by stations in the fiscal year 1892–93.

Source of supply.	Species.	Eggs.	Fry.	Adults and yearlings.
Schoodic, Me	Landlocked salmon			48,000
Craig Brook, Me	Atlantic salmon	233,000		1,448
	Landlocked salmon			17,031
	Brook trout			34,234
Green Lake, Me	Landlocked salmon			500
Gloucester, Mass	Cod	1,195,000	20,142,000	
Woods Hole, Mass	Sea bass		1,189,000	
	Cod		850,500	
	Flatfish		288,000	
	Mackerel		434,500	
	Lobster		8,818,000	
Battery Island, Md	Shad	3,248,000	31,145,000	
Bryan Point, Md	Shad	7,874,000		
Central Station, Washington, D. C.	Shad		5,614,000	
	Rainbow trout		30,000	
Fish Ponds, Washington, D. C.	Catfish			1,270
	Carp			74,518
	Tench			336
	Golden ide			398
	Goldfish			9,424
	Shad			600,000
	Black bass			34,379
	Golden tench			20
Wytheville, Va	Carp			5,108
	Goldfish			5,990
	Rainbow trout	125,000		79,547
	Black bass			1,433
	Rock bass			13,650
Put-in Bay, Ohio	Rainbow trout		65,000	
	Lake trout		81,500	
	Whitefish	5,000,000	22,570,000	
	Lake herring		6,505,000	
	Pike perch		20,200,000	
Northville, Mich	Loch Leven trout	100,000		3,400
	Von Behr trout	175,000		150
	Brook trout	90,000		19,900
	Lake trout	905,000	250,000	23,600
Alpena, Mich	Whitefish		16,640,000	
Duluth, Minn	Loch Leven trout			1,550
	Rainbow trout		83,000	
	Lake trout		2,355,000	
	Whitefish		10,482,000	
	Pike perch	500,000	5,500,000	
Quincy, Ill	Yellow (or ring) perch			4,454
	Catfish			7,811
	Pike perch			845
	White bass			1,877
	Black bass			33,987
	Crappie			10,754
	Warmouth bass			5,670
	Sunfish			1,756
	Pickerel			133
Neosho, Mo	Carp			634
	Tench			14,855
	Goldfish			937
	Shad			200,000
	Rainbow trout	140,000		38,684
	Brook trout			1,000
	Black bass			1,968
	Rock bass			9,000
	Golden ide			10
Leadville, Colo	Loch Leven trout			2,600
	Rainbow trout			1,550
	Von Behr trout			30,050
	Brook trout			98,200
	Black-spotted trout	60,000		46,500
Baird, Cal	Quinnat salmon	3,530,000	533,100	
	Rainbow trout	10,000		
Fort Gaston, Cal	Rainbow trout		35,000	
	Von Behr trout			10,950
	Brook trout			6,193
Clackamas, Oregon	Quinnat salmon		657,000	
Steamer Fish Hawk	Quinnat salmon		4,100,000	
	Shad		6,922,000	

Summary of distribution, 1892–93.

Species.	Eggs.	Fry.	Adults and yearlings.	Total.
Catfish			8, 486	8, 486
Carp			72, 481	72, 481
Tench			15, 155	15, 155
Golden ide			120	120
Goldfish			12, 588	12, 588
Shad		44, 530, 000	800, 000	45, 330, 000
Quinnat salmon	3, 530, 000	5, 290, 300		8, 820, 300
Atlantic salmon	233, 000		1, 448	234, 448
Landlocked salmon			65, 531	65, 531
Loch Leven trout	100, 000		7, 500	107, 500
Rainbow trout	275, 000	222, 000	111, 357	608, 357
Von Behr trout	175, 000		50, 821	225, 821
Black-spotted trout	60, 000		46, 025	106, 025
Brook trout	90, 000		158, 290	248, 290
Lake trout	905, 000	2, 674, 500	23, 001	3, 602, 501
Whitefish	5, 000, 000	49, 692, 000		54, 692, 000
Lake herring		6, 505, 000		6, 505, 000
Yellow perch			4, 328	4, 328
Pike perch	500, 000	24, 600, 000	845	25, 100, 845
Sea bass		1, 189, 000		1, 189, 000
White bass			1, 710	1, 710
Black bass			68, 269	68, 269
Crappie			9, 940	9, 940
Warmouth bass			4, 999	4, 999
Rock bass			21, 560	21, 560
Sunfish			1, 562	1, 562
Pickerel			101	101
Cod	1, 195, 000	20, 992, 500		22, 187, 500
Mackerel		434, 500		434, 500
Flatfish		288, 000		288, 000
Lobster		8, 818, 000		8, 818, 000
Total	12, 063, 000	165, 235, 800	1, 486, 117	178, 784, 917

In addition to the foregoing there were furnished for distribution, but lost in transit, during the year, 3,857,000 *shad fry*, 12,000 *lake-trout fry*, 1,100,000 *pike-perch fry*, and the *following adults and yearling* fish: 280 catfish, 5,662 carp, 1,915 goldfish, 50 Loch Leven trout, 8,390 rainbow trout, 329 Von Behr trout, 475 black-spotted trout, 1,237 brook trout, 599 lake trout, 126 yellow perch, 167 white bass, 4,417 black bass, 814 crappie, 671 warmouth bass, 1,090 rock bass, 194 sunfish, 32 pickerel.

For information as to the details of work at the stations, and of the distribution of their product, reference is made to the appended report of Mr. Worth.

MARSHALL McDONALD,
Commissioner.

REPORT UPON THE INQUIRY RESPECTING FOOD-FISHES AND THE FISHING-GROUNDS.

By RICHARD RATHBUN, *Assistant in charge.*

FUR-SEAL INVESTIGATIONS.

In the last annual report a brief account was given of the services rendered to the State Department by the Fish Commission in connection with the controversy respecting the sealing question in the North Pacific Ocean and Bering Sea. During the summer of 1891, the steamer *Albatross* was used to convey the Bering Sea commissioners on the part of the United States to and from the Pribilof Islands. On March 15, 1892, she was detailed to take an active part in the sealing investigations, under the orders of the Secretary of the Treasury, in conjunction with the revenue steamers *Corwin* and *Bear*, which service had not been completed at the close of that fiscal year.

During the summer of 1892, and again the following year, a very careful examination was made of the seal rookeries on St. Paul and St. George islands, by Mr. J. Stanley-Brown, then acting as a special Treasury agent. His work included the preparation of a set of base maps of both islands, on which the outlines of the rookeries were delineated, and also the taking of a series of photographs illustrating the distribution and abundance of seals on prominent parts of each of the rookeries. It was considered that the duplication of these graphic records during a term of years would serve to demonstrate any changes that might take place in the conditions and dimensions of the rookeries and, consequently, in the size of the seal herd. The summer of 1893 was the last preceding the meeting of the Paris Tribunal of Arbitration, for whose consideration Mr. Stanley-Brown's results were especially intended; but, appreciating the importance of further observations in the same line, the Secretary of the Treasury recommended to Congress that the work be continued under the direction of the Commissioner of Fisheries. Favorable action on this subject was taken in connection with the sundry civil appropriation bill, approved March 3, 1893, which also provided for investigations by the Fish Commission relative to the pelagic habits and distribution of the fur seal.

The assistant in charge of this division continued to be occupied during the first two or three months of the current year in preparing material for the Bering Sea case, respecting the character and condition of the more important fisheries in foreign countries and the methods there pursued for their protection and improvement.

OPERATIONS OF THE STEAMER ALBATROSS IN THE NORTH PACIFIC OCEAN AND BERING SEA.

At the beginning of the year the steamer *Albatross*, Commander Z. L. Tanner, U. S. N., commanding, was still on duty under direction of the Secretary of the Treasury, being at Port Townsend, Wash., where she had recently arrived after coaling at Departure Bay, British Columbia. She left the former place on July 1 for Unalaska, but unfortunately (owing to continuous sea service for a long period, much of the time under trying circumstances as regards sea and weather) her boilers were in bad condition, and in several other respects the ship needed a thorough overhauling. Ten days were consumed in making the passage to Unalaska, where it was found imperative to order a board of survey, which found the boilers unsafe for further use. Temporary repairs were begun at once, to permit of the ship's returning to San Francisco, but several weeks were required for their completion.

The unfinished work which the *Albatross* had been expected to carry on was assigned to the revenue steamers *Corwin* and *Rush*, to which Mr. C. H. Townsend and Mr. A. B. Alexander were transferred to serve as naturalists, and also two seal-hunters and the necessary appliances for conducting the investigations. Taking advantage of the delay, Prof. B. W. Evermann, then acting as chief naturalist of the *Albatross*, and Mr. N. B. Miller, laboratory assistant, were dispatched to the Pribilof Islands, where they made a careful inspection of the seal rookeries and obtained an interesting series of photographs bearing upon the same.

On August 3 the *Albatross* left Unalaska, having in tow a British schooner which had been captured while engaged in pelagic sealing in Bering Sea, in contravention of the provisions of the *modus vivendi* then in operation. After delivering this prize at Sitka, she proceeded to Port Townsend and thence to San Francisco, which was reached on September 3. By direction of the Secretary of the Treasury the control of the ship reverted to the Fish Commissioner at the close of August 31, while still upon her passage, having up to that date been in the service of the Treasury Department for a period of 5½ months, during which she visited 26 ports and steamed a distance of 14,848 miles, mostly in northern waters. In order to put the ship in suitable condition for further service it became necessary to provide new boilers and to make many alterations and repairs, which were not fully completed until the following April. Beginning on the 25th of that month, a successful trial trip was made, lasting three days, in the course of which investigations of the sea bottom were carried on off Monterey Bay.

On May 13 the President directed that the *Albatross* be placed under the orders of the Secretary of the Navy, for assignment to duty in connection with the sealing patrol fleet in the North Pacific Ocean and Bering Sea, composed otherwise of certain naval and revenue-marine vessels. It was arranged, however, that her commanding officer should receive his customary instructions relative to fishery and fur-seal investigations, which were to be carried out so far as the special duties devolving upon the ship would permit. The patrol fleet rendezvoused at Port Townsend, Wash., where the *Albatross* arrived May 24. She finished coaling at Comox, British Columbia, May 31, and proceeded northward by the passage inside of Vancouver Island to the open waters of the Pacific Ocean, where her patrol work began. The vessels of the fleet were so disposed as to cover the track of the seal herd and sealing vessels bound north, but the *Albatross* was given the western or off-shore route, which placed her outside of the usual course taken by the seals, and none were observed between Vancouver Island and Kadiak.

The first sealing vessel was encountered off the southern edge of Portlock Bank, and St. Paul, on Kadiak Island, was reached June 7. From this point, on the following day, the *Albatross* began working to the westward, boarding such pelagic sealers as were met with and warning them, in accordance with the temporary agreement between Great Britain and the United States, to refrain from carrying on their operations in Bering Sea. On arriving at Sand Point, Shumagin Islands, where the sealing vessels often congregate, it was found that none had yet reached that place. Continuing to the westward as far as Amukta Pass, and there entering Bering Sea, the ship proceeded to Unalaska for coal and thence returned to Sand Point, boarding several vessels on the way, one of which proved to be a cod-fishing schooner bound for Slime Bank, off the north side of Unimak Island.

Some time was spent among the Shumagin Islands, and the principal harbors were visited. Mist Harbor, on the east side of Nagai Island, a secure and convenient anchorage, was surveyed for the first time, and advantage was taken by the naturalists at each stop to obtain as much information as possible respecting the fishes and other marine animals of the region. Leaving Sand Point on June 26, the ship proceeded to Unalaska, and thence along the Bering Sea side of the Aleutian Islands, entering the Pacific Ocean through Amukta Pass, near which she was at midnight of June 30, the close of the fiscal year.

Owing to the long delay in port, in consequence of the extensive repairs made necessary by previous service, the *Albatross* was only 75 days at sea during the year, but the distance steamed amounted to 9,610 miles. Prof. B. W. Evermann, who acted as chief naturalist during the first cruise made on behalf of the Treasury Department, left the ship after his return from Alaska in August, 1892. The permanent civilian staff consisted of Charles H. Townsend, naturalist; A. B. Alexander, fishery expert; and N. B. Miller, laboratory assistant. The two former were attached to revenue vessels during the summer of 1892, but were with the *Albatross* during the remainder of the year.

No trawling or hydrographic work was carried on except during the short trial trip off Monterey, in April, 1893. Meteorological and density observations were continued, however, during the entire year, and a record was kept of all surface animal life and drift material observed at sea. Full details of the operations of the ship are given in the report of Commander Tanner, forming an appendix to this volume.

INVESTIGATION OF FISHERIES IN WATERS CONTIGUOUS TO CANADA AND THE UNITED STATES.

By an exchange of notes between the Government of Great Britain and that of the United States, an agreement was reached on December 6, 1892, which provided for the appointment of a joint commission of two experts, one on behalf of each government, to consider and report to their respective governments, jointly or severally, concerning the regulations, practices, and restrictions proper to be adopted in concert, on the following subjects:

1. The limitation or prevention of exhaustive or destructive methods of taking fish and shellfish in the territorial and contiguous waters of the United States and Her Majesty's possessions in North America, respectively, and also in the waters of the open seas outside of the territorial limits of either country to which the inhabitants of the respective countries may habitually resort for the purpose of such fishing.
2. The prevention of the polluting or obstructing of such contiguous waters to the detriment of the fisheries or of navigation.
3. The close seasons to be enforced and observed in such contiguous waters by the inhabitants of both countries, as respects the taking of the several kinds of fish and shellfish.
4. The adoption of practical methods of restocking and replenishing such contiguous and territorial waters with fish and shellfish, and the means by which such fish life may be therein preserved and increased.

It was furthermore provided that—

The commissioners to be so appointed shall meet at the city of Washington within three months from the date of this present agreement, and shall complete their investigation and submit their final reports thereof to the two governments, as herein provided, within two years from the date of their first meeting.

The contracting governments agree to place at the service of the said commissioners all information and material pertinent to the subject of their investigation which may be of record respectively in the offices of the United States Commission of Fish and Fisheries and in the Department of Marine and Fisheries of the Dominion of Canada; and, further, to place at the disposal of said commissioners, acting jointly, any vessel or vessels of either of the said fish commissions of the United States and Canada as may be convenient and proper to aid in the prosecution of their investigation in the contiguous and adjacent waters aforesaid. * * *

The two governments agree that so soon as the reports of the commissioners shall be laid before them as aforesaid, they shall consider the same and exchange views thereon, to the end of reaching, if expedient and practicable, such conventional or other understanding as may suffice to carry out the recommendations of the commissioners, by treaty, or concurrent legislation on the part of the respective governments, or the legislation of the several States and Provinces, or both, as may be found most advisable; but nothing herein contained shall be deemed to commit either government to the results of the investigation hereby instituted.

The two representatives appointed in accordance with the foregoing agreement were, on the part of Great Britain, Dr. William Wakeham, of the Department of Marine and Fisheries of Canada, and, on the part of the United States, Mr. Richard Rathbun, of the United States Fish Commission. Their first meeting was held at Washington, on March 2, 1893, at which Dr. Wakeham was accompanied by Mr. R. Venning, of the same department as himself, Dr. Hugh M. Smith, of the United States Fish Commission, acting with Mr. Rathbun. At this conference, which continued several days, the scope of the inquiry contemplated by the agreement and the plans for carrying on the necessary investigations were discussed in full, and arrangements were also made for beginning upon the field work as soon as the season was sufficiently advanced.

The waters covered by this agreement are not only very extensive and diversified, but they afford some of the most important fisheries of the world, in the preservation of which both Canada and the United States have a mutual interest. With respect to the open waters of the Atlantic coast it was decided that the mackerel fishery, which is carried on continuously from off Cape Hatteras, North Carolina, to the mouth of the River St. Lawrence, was the only one demanding immediate attention in this connection. At the mouth of the Bay of Fundy, about Eastport, Me., and the neighboring islands, are several marine fisheries which overlap the boundary line. Next come the rivers St. John and St. Croix, flowing in part between the Province of New Brunswick and the State of Maine. Following in succession are Lake Memphremagog, Lake Champlain, the upper part of the St. Lawrence River, and the entire chain of the Great Lakes, except Lake Michigan, which is entirely included within the territory of the United States. A short distance to the westward of Lake Superior are Rainy Lake and the Lake of the Woods, both situated on the northern border of Minnesota and finding an outlet northward into Lake Winnipeg and thence into Hudson Bay. Farther to the west there are no important waters until we reach the Columbia River, where it crosses the boundary into Washington. Finally, on the Pacific side, are the extensive sounds and straits between British Columbia and the State of Washington, still only slightly developed except as regards the catch of salmon.

As it was evident that the members of the joint commission would not have the opportunity of inspecting personally in detail all the fisheries on which they were expected to report, it was arranged on the part of the United States Fish Commission to send out several field parties to make special studies respecting some of the more difficult problems presented. The schooner *Grampus* was detailed to investigate the offshore or purse-seine mackerel fishery from the time of its commencement at the extreme south, as had been done in former years, but in accordance with a more comprehensive plan of operations; an assistant was stationed at Fulton Market, New York, to inspect all mackerel brought there both by the purse-seiners and from the nets along the coast, the owners of many of the latter being also supplied with blanks on which to record their catch of this species; and the assistants at the Woods Hole station of the Commission were charged with the study of the breeding and other habits of the mackerel in the neighboring region, which is especially well adapted for observations of that kind. A party was also established at Eastport, Me., and another on Lake Erie, while the steamer *Albatross* was directed to investigate the boundary waters on the western coast at such times as her regular duties would permit.

The members of the Commission, together with Mr. Venning and Dr. Smith, met at New York on June 2, where they began their inquiries respecting the mackerel fishery. From there they proceeded to Woods Hole, Mass., and thence visited all the more important fishing ports on Cape Cod. Subsequently a few days were spent in Boston and Gloucester, Mass., and Portland, Me. At all of these places interviews were held with the fishermen, the shore apparatus of capture was visited and many mackerel were examined. At the close of the fiscal year the party was at Eastport, Me., from which place it was planned to go to the Gulf of St. Lawrence.

OYSTER INVESTIGATIONS AND EXPERIMENTS.

CHESAPEAKE BAY.

The oyster survey of Mobjack Bay, begun in May, 1892, was continued during most of the following summer, being completed about August 20. The delineation of the oyster beds and of the areas of scattered oysters in the open waters of the bay, by means of the launch *Petrel*, was finished early in July. The dredging work was then immediately taken up by the steamer *Fish Hawk*, Lieut. Robert Platt, U. S. N., commanding, having for its object to determine the actual condition of the oyster beds, including the number of oysters of different sizes to each square yard of bottom. Subsequently the steamer *Fish Hawk* proceeded to Tangier Sound, on the east side of Chesapeake Bay, where extensive investigations had been carried on the previous year, and repeated its lines of dredgings over the principal beds, in order to ascertain what, if any, changes had taken place in their condition during the intervening twelve months. While the dredging work was in progress the launch *Petrel* continued the oyster survey up the four rivers tributary to Mobjack Bay, the East, North, Ware, and Severn. Signal stations had first to be established, followed by a triangulation of the streams as far as was considered necessary, after which the location and extent of the natural oyster beds were determined.

The assistants of the Fish Commission who were engaged upon this inquiry were Mr. John D. Battle, in charge, Mr. W. F. Hill, and Mr. B. L. Hardin. As soon as this party returned to Washington the construction of the charts to illustrate the results of the investigation, as well as the compilation of the data relating thereto, were pushed rapidly to completion, and copies of the same, together with the corresponding charts of Tangier and Pocomoke sounds, based upon the surveys of 1891, were supplied, at an early date, to the government of Virginia, to serve as a basis for establishing the outlines of the public oyster-grounds in those parts of the State waters to which they related, after the manner described in the last annual report. A steam launch was also provided for the use of the State party engaged upon this work. That the assistance rendered by the United States Fish Commission in this connection was of great value to the State authorities of Virginia and was duly appreciated by them may be judged from the following extracts from two letters received during the year from the engineer in charge:

> The steam launch furnished by the United States Fish Commission and the copies of the records of that Commission have alone enabled me to finish the work in Tangier and Pocomoke sounds in a short time.
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> * * * * * * *
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> The charts showing the legal boundaries of the natural oyster beds of about half of the Virginia waters have been published. I should never have been able to accomplish this without the assistance rendered by you.

The inquiries respecting the food of oysters and the relations of oysters to their environment, by Dr. John P. Lotsy, of Johns Hopkins University, the plans for which were referred to in the last report, were commenced early in July, 1892, and completed the latter part of September. These researches were carried on in the vicinity of Hampton, Va.

GALVESTON BAY, TEXAS.

In the early part of the summer of 1892 word was received of a sudden and extensive mortality among planted oysters in Galveston Bay, Texas, and an inquiry into the causes thereof was requested. One company alone had made plantings on 480 acres of bottom of empty oyster shells and seed oysters a year or so old, the latter growing rapidly and the beds being in a prosperous condition as late as the close of April, 1892. During May, however, the oysters began to die without apparent cause, and a month later scarcely anything but empty shells were left upon the ground where a yield of over 300,000 bushels had been expected the following winter. The mortality was not confined to this particular planting, but was said to have extended also to the wild oysters in other parts of the bay. In August Mr. John D. Battle was detailed to investigate this matter, and at the same time to make a general examination with respect to the oyster resources of the region, to serve as a basis for possible future inquiries on a more extensive scale. Only a short time was spent upon this work, but considerable information was obtained.

With regard to the question of mortality, the subject was studied from several standpoints. Too great an influx of fresh water has been considered a frequent cause of such destruction. However, the only sources, except seepage and local rainfall, from which a supply of fresh water can reach Galveston Bay are the San Jacinto and Trinity rivers, both of which are relatively small as compared with the main body of the bay. The Trinity drains quite an extensive territory, while the San Jacinto does not, but the fresh waters coming from both of these rivers meet and merge into each other and flow over Redfish Bar into the lower part of Galveston Bay. General inquiries made to ascertain if there had been an unusual rainfall and freshet in these rivers at or just before the period when the mortality on the planted grounds was first noticed afforded negative results. According to the records in the office of the Weather Bureau in Galveston, however, there had been an average rainfall during April and May, and in March only an inch more than the average. During the same period there had also been some strong northwest and southwest winds.

Although Mr. Battle's visit was made during the dry period of the year, he undertook to ascertain by density observations the point nearest to the planted grounds where fresh water could then be found, both at the surface and the bottom. A line of such observations was, therefore, run up the bay in a general northwesterly direction, from off the foot of Tremont street, Galveston, and over the planted grounds to the mouth of the San Jacinto River, a distance of 25 miles. At the foot of Tremont street the specific gravity was 1.017 at high water, and 1 mile farther, 1.0166. On section 1 of the planted beds it was the same as the last, and on section 8, three-fourths of a mile away, it amounted to 1.0164. Beyond the area of the planted grounds the observations succeeded one another as follows: About 1 mile WNW. of the west end of Pelican Island, 1.0147; about 1 mile SE. of Half-Moon lighthouse, high tide 1.015, ebb tide 1.0142; about 200 yards from Half-Moon light-ship, 1.0144; about 1 mile NNE. of Dollar Point, ebb tide 1.0132; about 2 miles south of Redfish light-house, ebb tide 1.007; Redfish Beacon, 1.0036; about 400 yards SE. of Northwest Beacon, 1.002. Five subsequent stations were made, the last about 1 mile NW. of Red Bluff Buoy, where the water was practically fresh both at the surface and bottom.

Information was furnished to the effect that the water in the bay is never fresher than at the time of year when this examination was conducted, but Mr. Battle is inclined to doubt the correctness of this view as not being based upon scientific observations, and, moreover, the occurrence of any particular freshet having its origin from 25 to 30 miles away might easily escape detection by those living along the sea. Such a freshet would undoubtedly bring the fresh-water point much nearer to the Gulf and might radically affect both planted and natural oyster beds. Even if the salinity of the water is as great at all seasons as it was in August, Mr. Battle thinks his observations clearly demonstrate that it would be the height of folly to plant oysters north of Redfish Bar. Empty shells are much more numerous than living oysters on this bar, and he has no doubt that fresh water was the main factor in their destruction. An oysterman of long experience in this region recalls that oysters have twice been destroyed in Galveston Bay within the past twenty-five years, once by fresh water and again during the great southeast storm of 1875, which lasted several days and swept everything before it.

Mr. Battle next made a critical investigation of the planted beds and of the natural beds nearest to them, with the object of determining their relative condition as to mortality and the character of the bottom. Samples were obtained by tonging from all of the eight sections of the planted ground. The total amount of material brought up was $1\frac{1}{2}$ bushels, which contained 46 adult oysters and 992 spat. The oysters were generally in groups or clusters, seldom single. The living adults seemed to be in as good condition as those examined on the natural beds, and the spat was still attaching and thrifty. Drawbridge Reef, about $2\frac{1}{4}$ miles southwest of the planted beds, which was next examined, is one of the best grounds as regards quality of oysters, but it has been overfished. It showed no signs of any special destruction which could be attributed to a late cause. It occupies a stable shelly bottom where the observations were made. On Blind Shoal Reef, another shelly bottom, about a mile northwest of the planted grounds, dead shells were more numerous, which may indicate a greater mortality, and the oysters were not so finely shaped as those on Drawbridge Reef. This bed is nearer the fresh-water point, but the density determinations were as high as 1.0126 and 1.013. The oysters on Half-Moon Reef, judging from the shells, show some deaths which may have been of late date, but not enough to assign any other cause for mortality than that of old age and the usual casualties.

Finally, the character of the bottom on the planted beds was tested by means of a sounding pole, which showed it to be generally soft, and in some places very soft. The pole would usually go down very easily a distance of 10 to 12 inches through the mud before it reached a harder substratum. Several times shells were felt at a depth of 10 or 12 inches, apparently resting on this substratum. Judging from the softness of the bottom and the mud-stained condition of the shells, Mr. Battle is led to believe that mud has been a factor which will account in part for the destruction of the planted oysters. The general trend of the currents over these beds is southeast and northwest. One may readily conceive that strong northwest winds, which have a sweep down the bay from the mouth of San Jacinto River, would affect objects lying on the bottom in shallow water. It would naturally impart a motion to them and cause them gradually to sink. It is reasonable to suppose also that this disturbance would make the water very thick with suspended mud, especially that part of it near the bottom and immediately surrounding the oysters, and if continued for any length of time would result in great injury to the beds. Southwest winds would have a similar but less effect, for the reason that they do not have the same sweep.

Comparing the general character of the bottom of the natural beds with that of the planted grounds, it will be found that the former are much more stable, owing to the yearly accretion of shells on which the living oysters grow. The plantings already made on the artificial beds, amounting to 400 bushels to the acre, may possibly furnish a foundation which will render the bottom more stable and result in the formation of a continuous oyster bed in the course of time, and the chances of success in that direction would be greatly heightened by the addition of more shells.

Within $1\frac{1}{2}$ miles of the planted area are located mills for the manufacture of creosote. It had been conjectured that the refuse from these mills might have been responsible for at least a part of the mortality above referred to. An examination of the piles of neighboring wharves, however, showed the presence of adult oysters and spat in a flourishing condition, as well as an abundance of other forms of life which are generally found in such situations. The pungent odor of creosote was very strong under the nearest wharf, but it did not seem to affect the welfare of the oysters there, although they appeared to Mr. Battle to leave an astringent taste in the mouth. A sample of the water and specimens of oysters from the wharves were afterwards subjected to chemical examination in Washington, without discovering the presence of creosote or of any other poisonous matter.

Besides the inquiries above referred to, Mr. Battle also located approximately all of the natural oyster beds in Galveston Bay. There are none in the deeper parts of the bay, probably owing to the soft character of the bottom, but they are situated on shoals, from which, in some instances, they have encroached on the adjacent soft bottom by yearly accretion. Except for the preponderance of this soft bottom the conditions seem favorable for oyster-culture south of Redfish Bar, in case the water is never fresher than in August for any length of time. The only enemies known are the drill, conch, and drumfish, no harmful starfishes, it is asserted, finding their way to the oyster beds.

SEA ISLE CITY, N. J.

In the last annual report reference was made to experiments by Prof. John A. Ryder, of the University of Pennsylvania, respecting the collecting of oyster spat in accordance with an entirely new method, which promised excellent practical results. Formerly, while a member of the scientific staff of the Fish Commission, Professor Ryder's energies were directed chiefly toward the solution of this important and perplexing problem, which involves the prosperity of a large proportion of our coastwise population. His work was then carried on mainly at St. Jerome Creek, Maryland, and at the Woods Hole station of the Fish Commission, and, although fair success was met with, it fell short, for some reason, of the practical benefits which had been anticipated.

During the season of 1891, taking advantage of the facilities afforded by the marine station of the University of Pennsylvania at Sea Isle City, N. J., Professor Ryder started upon a new series of experiments differing radically from any he had tried before. The incidental expenses of the work that year were met by the university. During the next summer, 1892, coöperation with the Fish Commission was accepted to the extent of paying for the appliances and supplies necessary to conduct the work upon a larger scale.

The following extracts from letters written by Professor Ryder in May and June, 1892, will serve to explain his plans:

I propose this summer to conduct a series of experiments on a wholly new line. I think most of us have been mistaken in our way of looking at the question. I want, this year, to produce from 30 to 60 bushels of seed oysters to the square rod. I have already experimented far enough at Sea Isle to show that such an estimate is not extravagant. * * * I firmly believe that the culture of oyster spat or seed is as practicable as bee-culture, and that it may be profitable also. I believe that the production of spat or seed oysters can be carried on in concentrated or condensed form, and that it may and will become a distinct industry from that of oyster planting. It will inevitably come to this, and will be as scientific and precise in its knowledge of conditions as bee-culture.

I have just returned from a visit to Sea Isle City to inspect my last year's experiments in oyster-culture. I find, to my surprise, that spatting is already in progress there, and I inclose with this a young oyster which I should judge was already three weeks old. These results, together with my Chesapeake Bay observations made in 1880, prove that the spatting period extends over four or five months. My method of working there has resulted in the development of what I believe must eventually be the method of rearing spat on a large scale for commercial purposes on an apparatus that will cost 30 cents per square yard. The yield from the very small plant already in use promises the first year from 1 to 3 bushels of seed oysters per square yard, ranging from 2 to 2½ inches in length. The method is, in fact, applicable where the bottom consists of ooze and is unfit for planting, and will enable the oystermen of New Jersey to reclaim thousands of unused acres of riparian territory. My plan is essentially the creation of an artificial bottom or bed which shall be at all times accessible for cleaning, sorting, spawning, and growing oysters to marketable dimensions. It also makes it possible to use the whole spawning season, four or five months, with clean shells for the whole time. Moreover, there is no loss of shells in the mud, so that shells once brought to the bed can be used until they have caught spat. This does away with the wasteful results of sowing shells on the bottom.

Since I have returned I have visited Sea Isle and met one of the oystermen there, who is very much interested. He told me that if he could do on a more extensive scale what I succeeded in doing there last year on a small scale, he would not hereafter need to import seed from the Chesapeake. He will supplement my work with experiments of his own. This, from a practical man who has been in the business for many years, is, it seems to me, a pretty strong indorsement.

The framework for holding the cultch and breeding oysters was constructed in the early part of July, 1892. It consisted of six squares of No. 16 galvanized-iron wire netting, each 1 rod square and having a 2-inch mesh. These squares or frames were supported on cedar piles driven into the soft mud and jointed with stringers of light pine. The entire outfit was very cheap, costing only a little over $60, inclusive of the oyster shells planted upon it, and will last for two or three years without repairs. This apparatus was arranged in the wide tide-water ditches which had been cut to drain the land about the laboratory at Sea Isle City. The wire screens were placed about 6 to 8 inches below high-water level, so that when covered with 30 to 50 bushels of clam and oyster shells as cultch, together with a few adult oysters to furnish the spawn, the top of the bed was nearly uncovered at low tide. The idea was to have the cultch as near the surface as possible, in order that the fry might have a proper chance to set.

The experiments of the first year, 1891, afforded very encouraging results, as at the end of eleven months some of the spat had attained a length of 3 inches and would have made cullings or good plants. In that year they obtained as many as 30 to 40 bushels of seed to the square rod, including the old shells to which they were attached. At this rate the possibility of growing seed from cultch thus treated may be considered as having been successfully proved, and at the end of the first half of 1893 the original square bed had been transformed into an almost solid oyster bank. In 1892 the six new frames were not in place until later in the season and the results were consequently not so good, but the experiment attracted much attention among the oyster-growers of the neighborhood.

The satisfactory outcome of Professor Ryder's experiments induced the legislature of New Jersey to appropriate $5,000 annually for three years to supplement his work upon a practical scale. In discussing the manner in which this sum could best be expended Professor Ryder has expressed himself as follows respecting the method which he would prefer to see tried:

If any action is to be taken in the matter, sites should be selected, under intelligent direction, at different points in the State at once, and work begun to carry out the experiments on a large, practical scale. If successful, this investment by the State of $5,000 per year will be an absolutely insignificant sum in comparison with the resulting development of an industry worth millions of dollars per annum to her citizens.

My plan, based partly upon the experimental results of the past obtained by myself and others, is something like the following: First of all, having obtained a suitable place where oyster spatting is known to occur naturally and abundantly, and where the salinity of the water is about right, or somewhere between 1.014 and 1.022, according to a standard hydrometer, a site is to be selected for the establishment of the plant, which should be in complete working condition not later than the 25th day of June next. This site should be of such a character as will enable the construction of an inclosure or pond on a pretty large scale, say half an acre at least. It might even be that a pond would have to be excavated near the shore; but in any event the plant should be so arranged that, under the given conditions, the most economical plans of construction could be followed. This pond should be completely shut off from all direct tidal connection with the sea while in use, and lie, if possible, in a perfectly accessible position from all sides, somewhat higher than sea level, though it should be possible to fill the pond from the sea if necessary.

The pond, which we will designate A, should represent an area, say, of from one-half to 1 acre, with a platform resting upon piles, quite near the surface of the water. This platform is formed of galvanized netting, 2-inch mesh, costing 3 cents per square yard, and supported on piles and stringers. It will hold a layer of oyster shells 3 or 4 inches thick, or 40 bushels to the square rod, or from 800 to 1,600 bushels of oyster shells, according as the size of such a pond and platform equals one-half or 1 acre. This is our nursery for clean oyster shells, clam shells, potsherds, tiles, or anything that young swimming oyster "fry" will cling to in order to grow into the condition of the young oyster, or "spat," as it is called.

There should be another platform, B, of an area of one-fourth acre, covered thickly, say, with 100 to 200 bushels of adult spawning oysters, and the whole immersed, say, 6 inches or 1 foot below extreme low water. This area should also have a ledge of heavy planking constructed all round it, so as to prevent the "fry" of the oyster during its floating stage from being wafted away by the tides and lost. Where a natural oyster reef exists the platform would not be needed, since such a reef near by would amply supply the millions of fry that would be required for our experiments.

Next there must be a wind engine and tank for pumping the sea water through pipes from all parts of the area B, and from near the surface, where the floating or swimming "fry" is very abundant. This sea water, charged with its oyster "fry," is then carried to the far side of the pond A. The water then flows from outlet pipes toward escape pipes and back to the sea. In this way, with only slight provisions for filtration, and perhaps a tank under the wind engine for allowing the coarsest sediment to subside, billions of oyster "fry" can be pumped from the area B through the mass of shells covering the platform A.

The best possible conditions could be maintained and the shells could be kept clean in the pond A by overhauling them by hand from time to time, giving each one a shaking in the water, so as to always present clean surfaces for spatting during the six to eight weeks within which that occurs. With such a plant, costing about $1,000 to $2,000 for its first installation, I would expect that something of permanent value might come, and that such establishments would become the basis for more extensive enterprises controlled by private capital.

The device here described provides many things in the best and cheapest form, though it is not assumed that the plan may not be greatly improved and perhaps modified as a result of practical experience. The aims to be sought are: (1) A vast amount of surface in the form of clean shells supported upon a platform, placed in position about the 1st day of July, when (2) the wind engine may be started to pump the water charged with "fry" from the bed of adult spawning oysters. (3) The "fry" should be pumped from the surface, where it swims for a time. This, I think, is an important point. Past experience shows that the passage of the "fry" through a pump does not injure it. With such a plant, and in the light of past experiences at Sea Isle, especially the season of 1891, for every bushel of shells put into the nursery I should expect a bushel of seed. Past experience shows that this seed will, in the space of twelve months, reach a size of 2½ inches. This estimate I believe to be a fair one, and since the installation or plant is practically a permanent fixture, the possibility of conducting such establishments as permanent nurseries for the production of seed oysters for planting is seen to be a practical matter awaiting a practical test. Oysters are like potatoes; they will stay just where you plant them. The only one of their stages that is locomotive is the "fry" or swimming stage. With such a device as the above we get the maximum possible spatting capacity from an abundant source of fry production. That source should be at least 200 bushels of adult spawners—better still if it were 2,000 bushels. This last number of spawners should yield at least 600,000,000,000 of fry. This vast multitude of young oysters pumped through 800 to 5,000 bushels of shells should yield an abundant supply of spat capable of growing into "plants" or seed oysters, fit for restocking exhausted beds.

The time may come, as it already has in parts of the country, where oyster and clam shells can not be obtained in sufficient quantity to serve as the "cultch" or nidus upon which the "fry" is to attach itself. When this happens it will be an easy matter to produce a cheap kind of tile or earthenware by machinery, in curved flakes somewhat like the oyster shell itself in shape, that can be "burned" or "kilned" somewhat after the manner of bricks. This material could be produced in vast quantity and very cheaply for the purpose of furnishing the foundations for the "spat" or seed oysters in these oyster nurseries of the future. The experiments conducted under my direction at Sea Isle for the past two years, on behalf of the United States Fish Commission, have served to show what the probabilities of artificial oyster-seed culture may some day become when pursued with sufficient capital and energy.

PACIFIC COAST.

While it has been impossible during the past year to undertake any extensive investigations or experiments respecting the subject of increasing the oyster supply on the Pacific coast, observations upon the temperature and density of the water in places supposed to be favorable to oyster growth have been made whenever the opportunity permitted. Such inquiries, continued from year to year, as they have been in the past, will ultimately yield information of great value to those desirous of attempting the establishment of new oyster plants from one source or another. There are several bays along that coast which seem to be suitable for the introduction of Atlantic stock, and it is now proposed by the Fish Commission, as soon as the necessary arrangements can be perfected, to make a small planting of the eastern species, probably at Willapa Bay, Washington, where the character of the bottom and salinity of the water appear to favor the success of such an experiment. Great interest is now manifested along the entire extent of the Pacific coast in respect to the oyster question in general, and letters requesting advice as to where the best seed can be obtained or as to the conditions necessary to insure the growth and welfare of this mollusk are constantly received.

EUROPEAN METHODS OF OYSTER-CULTURE.

The last annual report contains a reference to important studies respecting oyster-culture in France, made for the benefit of the Fish Commission during the summer and fall of 1891 by Dr. Bashford Dean, of Columbia College, New York.[1] Before the close of that year Dr. Dean extended his inquiries on the same subject to Spain and Portugal, and during the one just past he has visited Italy, Germany, Holland, Belgium, and England on a similar mission. A report upon the results of his observations in those several countries, accompanied by many instructive illustrations based upon photographs made by himself, has recently been received and published.[2] It will prove of great interest to all the practical oystermen of this country who are desirous of improving the condition of their industry. Dr. Dean's field inquiries were conducted with great care, strict attention being paid to all important matters of detail; and in the preparation of his report he has taken exceeding pains to present in a concise form the different subjects of which it treats, without omitting, however, anything essential to their complete understanding.

The reasons for extending these researches to other countries than France are explained by Dr. Dean as follows, in the introduction to his last paper:

> The methods in use along the ocean coast of France are, in general, similar to those of the neighboring countries. It has, however, seemed important to understand the cultural modifications rendered necessary by changes in climate, shore characters, and saltness of water. Local conditions may not unnaturally have favored one particular locality to such a degree that methods of culture there in use might prove of little value in other and even neighboring regions. By general comparison a more distinct idea may be obtained of the actual character and extent of artificial culture. Thus may be seen by what manner and means one country of Europe has taken advantage of the practical successes of a neighboring one, has modified processes to suit local conditions, found by experiment to what limits imported methods may be carried, and succeeded or failed in securing the most judicious governmental aid in obtaining concession of cultural lands and in preserving the natural supplies of spawning oysters.

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[1] Report on the Present Methods of Oyster-Culture in France, by Bashford Dean. Bull. U. S. Fish Comm. for 1890, pp. 363–388, plates 68–78.

[2] Report on the European Methods of Oyster-Culture, by Bashford Dean. Bull. U. S. Fish Comm. for 1891, pp. 357–406, plates 75–88.

The industry is discussed by Dr. Dean separately for each country, comprising in each case an account of the distribution and characteristics of the natural beds, of the methods employed in cultivation, in the production of seed and the rearing to adult size, and of all other matters bearing upon the subject of oyster production and preservation. The importance of the suggestions contained in this report, as well as in the preceding one, can not be overestimated, and it is sincerely to be hoped that the oyster interests of this country will be materially advanced thereby. Some of the more significant of Dr. Dean's conclusions are quoted herewith:

It would appear, for example, that the degree of density of the water is one of the most important factors influencing the spawning and fattening of the oyster. * * * The density of the water recorded in the best spawning-grounds of the French coast is practically that of the spawning-grounds of Italy and of northern Europe. * * * The specific gravity of the water in regions of maximum production throughout Europe appears to be uniform at about 1.023 in the case of the "flat" oyster (*Ostrea edulis*), and at about 1.021 in the case of the Portuguese species (*Ostrea angulata*). The influence of warmth is not to be underestimated in regard to the time and degree of spawning.

The amount of spat occurring annually in a region appears to be directly in proportion to the number of spawning oysters in that region. This is by no means a novel suggestion; it is one, however, that has been repeatedly impressed upon the writer. The older idea, it will be remembered, is that banks can never be exhausted, on the ground that the few oysters left by the dredgers will, by the annual spawning of several millions of young, cause a very rapid regeneration. That the banks regenerate is true, but the process is shown to be slow and beset with many difficulties. * * * It should be noted that only in those places in Europe where the natural bulk of spawning oysters is actually maintained does a great quantity of spat occur regularly; also that where the number of spawning oysters is equal, the percentage of spat will be notably greater if the spawning oysters are little disturbed.

The amount of oyster food appears to be notably characteristic of a locality whose normal food value is represented by conditions of warmth, density, and richness in the organic and inorganic salts, which serve to rapidly generate the oyster-food organisms. Should this natural food value of a locality be a high one, culture has demonstrated empirically that the number of oysters that may be reared is exceedingly great. It would appear that the number of oysters to be fattened is directly proportioned to the food normal of the locality and to the volume of water which passes over the bed. The actual size of a natural oyster bed is limited by other reasons than that of a failure of the food supply in the neighborhood. * * *

The system of stated oyster reserve has been the key to the success achieved by the French and Dutch industries, and has alone rendered it possible for these two countries to supply the entire seed market of Europe. To obtain seed oysters by collectors is shown to be possible only when a regular yearly fall of spat is thus assured. Proximity to a large stock of spawning oysters is one of the imperative conditions of artificial production, a condition that has been too often lost sight of in experiments made along the Atlantic coast of the United States. Collectors in Europe are placed on no river bank or sunk in no stream save where the culturist is fairly sure of a set that will be at least profitable. If experiments in artificial production are to be made in the United States, the suggestion given by European oyster-culture is to secure for the purpose a particular part of beach, near the line of low water, where spat has been found to regularly occur. If a trial demonstrates that the locality is favorable, the European culturist would then gradually and carefully expend his money in the purchase or preparation of a more extended area for collecting and would study to provide the most suitable form of collector. * * *

There can be no doubt that artificial production would succeed in American waters. The question is the practical one, whether it would, on an extended scale, be less costly than the price of natural seed. This can only be determined by experiments in a favorable locality. * * * The phase of European oyster-culture that has as yet no equivalent with us at home is that of the extreme value of land at particular points. * * * The general need in the United States for area in which to extend oyster-culture can hardly be regarded as immediate. At points, however, where local cultural conditions are exceedingly favorable to rapid growth or fattening, it would seem a practical measure to bring into cultivation extended shore strips near the zone of low-water mark by use of tidal parks of the least costly type.

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In those countries alone where government has absolutely preserved supplies of spawning oysters does seed-culture flourish. The permanent closure of a small natural oyster-bearing area has apparently done what has not been done by a close season of the "R"-less months. * * * That the absolute reservation of oyster-bearing land will have an immediate and important influence upon the production of seed in neighboring areas is a proposition which European experience seems to demonstrate; and the writer would suggest, as in his former report, that the matter of reservation seems far more pertinent to the needs of the American industry than any attempts at artificial production. * * * Reservation is clearly a governmental duty, whether State or local. The matter is not a new one, and the condensed experience of Europe merely emphasizes what, with various modifications as to tenure, time, and degree, the authorities on this subject in the United States have already advised.

PHYSICAL INQUIRIES.

OFF COAST OF SOUTHERN NEW ENGLAND AND THE MIDDLE STATES.

As it was found impossible to continue during the summer of 1892 the elaborate series of observations carried on during the previous three years respecting the temperature and other physical observations off the southern coast of New England, it was decided to have the schooner *Grampus* make a thorough search for the tilefish in the localities where it had abounded before the astonishing mortality in 1882, which seemed to have effected its extermination. Predicting its return upon the results of the physical inquiries recently conducted, it was confidently expected that at least a few specimens would be captured, and such proved to be the case. During the several trips made between the region off Marthas Vineyard and the latitude of the Delaware capes, 8 specimens were secured by means of cod trawls, some of them of very fair size. The investigations of 1892, as well as those of the previous three years, were in charge of Prof. William Libbey, jr., of Princeton College, the Commissioner of Fisheries also taking an active part in the work and accompanying the *Grampus* in its earlier trips.

The following notice of the results accomplished during the past three years has been prepared by Professor Libbey:

During the summers of 1890 and 1891 work was continued in the same area of water off the southern New England coast as in 1889, the same limitations, east and west, and north and south, being observed, except that in 1890 the lines run by the Coast Survey steamer *Blake* extended 20 miles farther out to sea than usual, or a total distance of 150 miles.

As the steamer *Blake* could not be spared for this purpose in 1891, the parties upon the schooner *Grampus* and the Nantucket New South Shoal light-ship were the only ones in the field. As it was considered inadvisable to make a regular series of observations over the entire area this year, such lines were chosen as would serve to bring out the essential character of conditions supposed to exist. Each line run, however, was equivalent to one that had been utilized in previous years, but the distance between the lines was greater. The schooner *Grampus* occupied 148 stations along 13 such lines, making a total of about 1,500 serial temperature observations of the water and over 300 determinations of its specific gravity. In the same connection over 11,000 hourly meteorological observations were recorded. The light-ship party was on duty from July 3 to August 17, during which time it made 500 serial temperature and 250 specific-gravity observations of the water, besides a special series of over 1,000 hourly determinations of specific gravity. The hourly observations respecting meteorological conditions by this party amounted to 17,000. The total number of observations made in 1891 was, therefore, 32,000, as compared with 39,000 the previous year, when three parties were at work.

The relations of the Gulf Stream to the Labrador current, as brought out by this study, are especially interesting because of their bearing upon the migrations of schools of fishes. The region off the southern coast of New England was chosen for this inquiry because it was supposed that the contrasts between the currents would be more distinctly shown there from the fact of their being forced closer together by the projection of the mainland to the southeastward from its general curve. This expectation was realized in the course of our investigations.

The 50° curve of temperature obtained by plotting the observations made at the different stations has been an interesting one from the beginning. It has been the means of demonstrating the fact that there are two sets of conditions under which these two distinct bodies of water come into contact. It will be convenient to speak of these two portions of the main current of the Gulf Stream separately under two headings, namely, the upper portion and the lower portion.

Upper portion.—The boundary between the cold and warm waters at the surface is very seldom a straight line, perpendicular to the surface of the water. It marks the position of the resultant of all the forces at work. Of course the general position of the boundary will be determined by the velocities of the two bodies of water and their direction when they come in contact. If we leave out of consideration, for the present, the wind as an effective agent in the production and directing of the ocean currents, we find that in addition it becomes a most potent factor in the causation of the changes which are produced in the position of the boundary line at the surface. The winds certainly sway the surface waters of these currents one way or another; it may be for miles in one direction or the other; just as they may retard or reenforce them in their general direction.

The winds which blow over this portion of the North Atlantic may, for convenience, be divided into two classes. One may be said to blow in a southeasterly direction and the other in a northwesterly direction. The general tendency of the first group or summer set will be to drive the warmer waters at the surface toward the coast, thus forcing them above the colder waters of the Labrador current. The other or winter set may be considered to have the opposite effect upon these waters, and the final position reached after a cycle is completed will depend on the relative velocities of the winds. It is not denied that there are other factors which enter into this result, or that this position is not affected by the physical characters of the waters, viz, their relative temperatures, densities, etc., but it is claimed that, after due allowance is made for these other factors, the winds are the most active causes of the daily and seasonal variations which take place in the position of this boundary.

While these motions may equalize one another and the resultant position remain the same from year to year, it is supposable that there may be an excess in one or the other of these directions for a series of years, with the result that the boundary will be carried far from its normal position in one direction or the other, and thus mask the true position of the main body of one or the other of these currents to a very considerable extent.

Lower portion.—It might be expected that in this position only the general causes which produce and modify the currents in the oceans could bring about any change in either their velocity or their direction. But there is no doubt that the cumulative effect of long-continued impulses, as described above, resulting in each case in a gain in one or the other of these directions, will ultimately be felt, and the result will be seen in a change of position of the main mass of the current. When these changes are brought about, they are of such a character as to evade detection, unless the averages of many observations are carefully studied, when the change in the position of the resultant becomes manifest. The contrast between these two portions of the current are seen in the apparently more flexible character of the upper portion as compared with the lower, the former being characterized by rather rapid changes in position, the latter by much slower motions.

The 50° line indicates very clearly the changes which take place in the relations of these currents. During the time when we were engaged upon this study its predominant shape was that of an inverted letter S, the lower part of the inverted letter representing the main body or lower portion of the Gulf Stream. Neither the 40° line nor the 60° line shows any great deflections under any circumstances, thus apparently indicating that they are well within the boundaries of each of the main bodies of their respective currents.

A study of the temperature profiles obtained in 1891 showed that the general relations of the currents had remained the same, but it was noticed that during the greater part of the time the curved bend of the lower part of the 50° line touched the edge of the continental platform, covering it completely from the depth of 70 fathoms to that of 120 fathoms in different places. This had occurred once or twice in 1890, but it was then believed to be rather an accidental feature than otherwise.

A comparison of the profiles of the three years revealed the fact that there had been a progressive motion during that period toward the shore. In 1889 the lower portion of the curve did not touch the edge of the continental platform at any point within the area we were studying. In 1890 this portion of the curve touched the continental edge both at Block Island and off Nantucket Island in the latter part of the season, and in 1891, as has been said, it touched along the whole edge of this portion of the platform during the greater part of the summer. The change which was thus produced in the temperature at the bottom along this edge of the continental platform was in the neighborhood of 10°, an item of considerable importance.

The effect produced by this change in temperature and its relations to the work of the Fish Commission can be seen to best advantage by reference to a very interesting problem in biology with which it has a direct connection. At a conference held in Washington with the Commissioner of Fisheries the results obtained were carefully discussed. We saw very plainly that if the same rate of motion held good during this year the whole of the continental edge, or at least that portion of it with which we were most directly concerned, would be covered with this warmer water. The idea was then suggested that if such were the case the conditions for the reappearance of the tilefish would be established if environment meant anything in the problem. In the years 1880 and 1881 this recently discovered fish had been found in considerable numbers upon the area we were studying, and had attracted so much attention among fishermen that preparations were made to take it upon a commercial scale for the New York and Boston markets during the ensuing season. Unfortunately, however, in the spring of 1882 the water from Cape May to Nantucket became covered with countless millions of this fish in a dead or dying condition. From that time the tilefish (*Lopholatilus chamæleonticeps*) disappeared from this area entirely, and all attempts to find it since then have been unsuccessful. The cause of its disappearance became a sort of biological puzzle.

The fish had previously been caught in a depth of water varying from 60 to 130 fathoms. Its feeding-ground being at the bottom would therefore occur just at the edge of the continental platform. It is probably a tropical deep-sea species, judging from its relationships, which had migrated northward through favorable inducements offered by an enlarged feeding-ground opened up in that direction. It is noteworthy that the temperature at which it was caught (50° to 58°) could only be established on the New England coast and at the edge of the continental platform by just such an invasion of warm water as has been described above. It is only necessary to conceive the whole of the continental edge from Florida to Nantucket thus overflowed by this warm band of water to see how the regular feeding-ground of a tropical species could be extended so that the fish could follow it throughout the whole of this largely increased area.

It was agreed to test these theoretical conclusions during the summer of 1892. In July the Commissioner and myself went out in the schooner *Grampus*, south of Marthas Vineyard, to the area which seemed to promise a reward for our labors. We found the temperature conditions right, set the cod trawls and caught the tilefish. During the remaining portion of the summer I spent considerable time tracing out the limits of the area over which the temperature of 50° and above could be found, using the trawl lines at the same time to ascertain if the fish were there. We found them all the way to the Delaware capes, and were satisfied that though they were not numerous they had taken advantage of the changed conditions to reoccupy this area.

WATER-TEMPERATURE STATIONS.

The Light-House Board and the Southern Pacific Company have continued during the year the taking of daily water-temperature observations for the benefit of the Fish Commission at the following places:

Temperature stations on the Atlantic coast.

Stations of the Light-House Board:

- Coast of Maine: Petit Manan Island, Mount Desert Rock, Matinicus Rock, Seguin Island, Boon Island.
- Coast of Massachusetts: Race Point, Pollock Rip light-ship, Great Round Shoal light-ship, Nantucket New South Shoal light-ship, Cross Rip light-ship, Vineyard Sound light-ship.
- Coast of Rhode Island: Brenton Reef light-ship, Block Island southeast light.
- Long Island Sound: Bartlett Reef light-ship, Stratford Shoal light-ship.
- Coast of New Jersey: Absecon Inlet, Five-Fathom Bank light-ship.
- Delaware Bay: Fourteen-Foot Bank light-ship.
- Coast of Virginia: Winter Quarter Shoal light-ship.
- Chesapeake Bay: Windmill Point, Stingray Point, Wolf Trap Bar, York Spit.
- Coast of North Carolina; Cape Lookout, Frying Pan Shoal light-ship.
- Coast of South Carolina: Rattlesnake Shoal light-ship, Martins Industry Shoal light-ship.
- Coast of Florida: Fowey Rocks, Carysfort Reef, Dry Tortugas.

Temperature stations on the Pacific Slope.

Stations of the Southern Pacific Company:

- Sacramento River at Tehama and Yolo bridges and King's Landing, California.
- Feather River at Feather River Bridge, California.
- American River at American River Bridge, California.
- Mokelumne River at Lodi, Cal.
- Tuolumne River at Modesto, Cal.
- San Joaquin River at the upper and lower railroad crossings.
- King River at Kingsburg, Cal.
- Colorado River at Yuma, Ariz.

WOODS HOLE LABORATORY.

The Woods Hole laboratory was opened as usual for biological researches on July 1, 1892, but several of the workers arrived and were given the necessary facilities for carrying on their studies during June. The laboratory was in charge of Dr. James L. Kellogg, of Johns Hopkins University, and the Commissioner was also present during most of the season, giving personal direction to such parts of the investigations as were undertaken for the Fish Commission. The total number of investigators in attendance, not including the regular employés of the Commission, was fourteen; of these, two were engaged in the study of special subjects for the benefit of the Commission. The work carried on by each may be summarized as follows:

Dr. James L. Kellogg was occupied mainly with the study of the spawning and early habits of the common scallop or pecten (*Pecten irradians*), the younger stages of which were found attached in great abundance to ulva in the Acushnet River, near New Bedford, Mass. The breeding season of this species occurs during May and June in this region, and is probably of shorter duration than in the case of many other important food mollusks. During June the young were observed to present very slight variation as to size, and during the two succeeding months the growth was not rapid. The attachment to ulva was by means of a well-developed byssus, the occurrence of which in the first stages of growth has been recognized for some time. The byssus-forming gland, which was carefully studied, was found to remain functional until the latter part of August, when it became atrophied, and in the adults all traces of it have disappeared. Late in August the shell in many instances reaches a diameter of two-thirds of an inch, but considerable differences then exist with respect to size. The method of byssus attachment was determined in both the young pecten and the black mussel, and it was made out that in each of those species the byssus could be thrown off at will, the animal crawling about by means of its foot and reattaching. A vestigial organ, probably a non-functional byssus organ, was discovered in the young of Yoldia, another form of Lamellibranch.

The practical bearing of the results of Dr. Kellogg's observations relate to the artificial propagation or transplanting of the scallop, which, during its attached stage, could be transported conveniently in immense numbers with slight danger of loss. Moreover, if reared in confinement, a suitable collector could readily be provided for the attachment of the young, thereby obviating the difficulties attending the handling of large quantities of fry in a free condition. Studies were also conducted by Dr. Kellogg relative to the morphology and physiology of several bivalve mollusks.

Prof. Francis H. Herrick, of Adelbert College, Cleveland, Ohio, continued his observations, begun in 1890, on the development and the life-history of the lobster. As previously announced, Professor Herrick is preparing for the Fish Commission a comprehensive report upon the natural history of this important marine invertebrate, which will be based chiefly upon his own studies now in progress, and is designed especially to present that class of facts regarded as essential in perfecting the methods of its propagation and providing for its better protection by means of legislation.

Prof. H. V. Wilson, of the University of North Carolina, nearly completed during the summer his inquiries relative to the development of certain sponges, which he had previously carried on at Woods Hole and at the Bahama Islands. These studies were partly undertaken with the view of using them as the basis for experimental operations in Florida respecting the cultivation of the commercial sponges, but this work has been deferred for the present owing to Professor Wilson's resignation from the service of the Commission. The report upon his observations, received during the year, has been published in the Journal of Morphology.[1]

Dr. William Patten, of the University of North Dakota, was engaged upon the study of the sense organs in the horseshoe crab (*Limulus*), supplementing his observations on structure by many interesting physiological experiments to determine their functions. These related in part to the sensibility of this animal to changes in temperature, a subject of great importance in respect to fishes, which it is hoped will soon be taken up. Certain points concerning the annelid worms were studied by Dr. E. A. Andrews, of Johns Hopkins University; the development of the group of mollusks known as chitons was observed by Mr. Maynard M. Metcalf, of the same university; and Dr. James I. Peck, of Williams College, was occupied in preparing a systematic paper on the pteropods and heteropods collected during recent explorations of the steamer *Albatross*.

The following persons were also present at the station: Mr. H. McE. Knower and Mr. Lefevre, post-graduate students of Johns Hopkins University, collecting and studying the surface life of the region; Mr. J. Y. Graham and Mr. Farr, of Princeton College, engaged in the study of the anatomy of several local fishes and invertebrates; Prof. E. R. Boyer, of the public schools, Chicago, collecting fishes and marine invertebrates for instructional purposes; Mr. W. McM. Woodworth and Mr. C. B. Davenport, of Harvard University, the latter investigating several forms of hydroids, in continuation of observations begun the previous season.

The schooner *Grampus*, which was employed during the summer months in conducting investigations along the outer margin of the continental platform south of New England and New York, made its headquarters at Woods Hole, and Professor Libbey, in direct charge of that inquiry, occupied quarters in the laboratory during the intervals between the different trips. The steamer *Fish Hawk* was also at work in Buzzards Bay and Vineyard Sound during a part of the summer.

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[1] Observations on the Gemmule and Egg Development of Marine Sponges, by Henry V. Wilson. Journal of Morphology, IX, No. 3, pp. 277–406, plates 14–25, 1894.

Mr. Vinal N. Edwards, the permanent collector at this station, whose work has been referred to in previous reports, was actively employed during the entire year in making collections of fishes and in recording the daily catch of the fishermen at all points in this vicinity. In the spring of 1893 special attention was paid to the spawning habits of the menhaden and mackerel, both of which species breed to some extent in this neighborhood. During several weeks of the summer of 1892 the writer was at Woods Hole, carrying on, in conjunction with Mr. Edwards, a thorough investigation of the shores and inlets of Buzzards Bay and Vineyard Sound with respect to the habits and life-history of the younger stages of the common food-fishes which resort to that region. Extensive collections and observations were made, the more interesting relating to the menhaden, the young of which occur in myriads in most of the brackish waters thereabouts, especially in the Acushnet River at New Bedford and in the Wareham River at the head of Buzzards Bay. At different times during the year visits were made by Mr. Edwards to more distant localities, such as Narragansett Bay and Cape Cod Bay, in search of further information respecting the breeding and other habits of the menhaden.

INVESTIGATION OF INTERIOR WATERS.

COLUMBIA RIVER.

During the early part of the fall of 1892 inquiries were conducted along a part of the Columbia River and several of its tributaries, with the object of determining: (1) The character and extent of the obstructions to the ascent of salmon in the Clarke Fork; (2) the advisability of establishing a hatching station for salmon in the eastern part of the State of Washington. The first of these inquiries originated in a joint resolution introduced in the United States Senate on February 19, 1891, and again on February 9, 1892, calling for an appropriation "to be expended under the direction of the Secretary of War in the removal of such obstructions in the Clarke Fork of the Columbia River as prevent the ascent of salmon and other fish up said river and its tributaries to the Flathead Lake and other waters in that vicinity." More definite information respecting these obstructions and the utility of their removal being desired before final action was taken in the matter, the United States Fish Commissioner was directed, by an item in the sundry civil appropriation bill, approved August 5, 1892, to make the necessary examinations; and the same bill also authorized the investigations relative to the hatchery site in Washington.

These inquiries were placed in charge of Dr. C. E. Gorham, engineer of the Fish Commission, who was assisted in the natural-history work by Mr. Barton A. Bean, of the United States National Museum, and Mr. A. J. Woolman, an ichthyologist of South Bend, Ind. This party reached the upper waters of Clarke Fork, in Montana, the middle of September, and continued in the field about a month. It was found impossible, however, to cover the ground during that period as thoroughly as was deemed advisable, and arrangements have been made to continue the work during the summer of 1893. The principal features of interest brought out by Mr. Gorham's party in respect to the Clarke Fork may be noted as follows:

The upper part of the river was first examined between Flathead Lake and Lake Pend d'Oreille, but within that part of its course no obstructions were discovered which could, to any extent, impede the passage of salmon in case they had free access to Lake Pend d'Oreille. The lower Flathead River drains the lake of the same name and, after flowing first southerly and then westerly a distance of about 70 miles, unites with the Missoula River to form the Clarke Fork. Just below the lake Flathead River is occupied for several miles by a succession of rapids, with still water here and there, its width averaging about 300 feet, and its depth probably from 6 to 10 feet. Even less active species than the salmon would have no difficulty in passing this point.

The next place of interest in going downstream is Thompson Falls, situated in the Clarke Fork some sixty-odd miles above Lake Pend d'Oreille. At this point the stream is very much contracted, and rushes through a rocky gorge a distance of several hundred feet. There is also here a fall of about 6 or 8 feet, over which a large volume of water pours, sufficient, it is supposed, to permit of the movements of salmon without difficulty. Immediately below the falls are large eddies and the river there appears as an ideal home for both salmon and trout. The water is clear and pure, and on September 19 had a temperature of 61° to 62° F. The course of the river from Thompson Falls to Lake Pend d'Oreille is clear of all obstructions, and the same is also true with respect to this lake itself, which has a length of about 20 miles between the mouth of the Clarke Fork and the beginning of the Pend d'Oreille River, being, in fact, practically only a general widening out of the river.

Below the lake the river is known as the Pend d'Oreille River. From Sand Point it flows almost directly west to the Washington line; thence northwesterly and northerly until within British America, where it makes a sharp turn to the WSW., and empties into the Columbia River within sight of the pole marking the international boundary line. The length of the river within the territory of the United States is slightly over 100 miles, and in British Columbia about 22 miles.

Between Lake Pend d'Oreille and the Idaho-Washington boundary line it presents only a single, rapid descent called Albany Falls, which are located about 1½ miles above the town of Newport, Idaho. An island divides the river here, and the Great Northern Railroad crosses it at the same place, making use of the island as the base of one of the bridge piers. The falls are therefore double, being situated on each side of the island. They have a rapid but not vertical descent of between 8 and 10 feet. They are much broken, and at the time they were visited had a good volume of water passing over them; but at periods of low water their descent would become somewhat more abrupt. Trout pass freely up the falls, and they would therefore present no obstacle to salmon.

The river is navigable above these falls to Lake Pend d'Oreille, and below them as far as Box Canyon, a distance of about 60 miles, being generally wide and comparatively quiet, though with a strong current. At Box Canyon the river is confined between vertical walls from 30 to 150 feet high and not more than 70 feet apart in places. Being reduced to such a narrow gorge, the stream becomes very deep and, although comparatively smooth, is very swift and dangerous for boats, but offers no obstacles to the passage of fish. Rowboats pass through the canyon, and a small steamer was taken through at one time. This part of the river could be greatly improved for navigation by the removal of a few obstructions at slight expense.

About 7 or 8 miles below the canyon and about 35 miles above the mouth of the Pend d'Oreille River are the Metaline Falls, the most serious of all the obstructions in the entire river. Their total descent is somewhere between 25 and 30 feet, more or less broken, and forming rather a series of rapids. On one side are perpendicular bluffs, 30 to 80 feet high, and on the other four large rock masses have fallen into the stream from the mountain which rises abruptly on that side. The possible effect of this obstruction upon the movements of salmon was not determined satisfactorily, although Dr. Gorham inclined to the opinion that it would be insurmountable in its present state, and he suggested that the conditions could be much improved by blasting out the head of the falls and by breaking up the large rock masses which cause the second or lower rush of waters.

Below the Metaline Falls the river is wide and deep. About 10 miles below, and 2½ miles in a direct line south of the Canadian boundary line, is Big Eddy Canyon, between 2 and 3 miles long, which has been reported to contain several falls. It is very difficult of inspection, and at only a few points, where the walls were somewhat broken, was it possible to get close enough to see inside. The walls are from 80 to 300 feet high, and at one place contract the river to a width of only about 20 feet. The current attains great velocity, but so far as could be determined there are no actual falls in the canyon, and this was also said to be the case by Mr. John Everett, a prospector, who has lived thirty-three years in this region.

From here on to the mouth of the Pend d'Oreille there are several rapids or slight falls, but none of great importance. These are all in British Columbia territory, partly above and partly below the Salmon River, which enters the Pend d'Oreille a short distance above the international boundary line. Just above the mouth of the Salmon, all contained within a distance of a few hundred feet, are five rapids or low falls, with a total descent of about 30 feet. The upper one, located at a point where the river is confined in a narrow gorge, scarcely 50 feet wide, has a height of about 5 feet. The second has about the same height; the third is about 6 feet high, and the fourth 4 feet high, while the lower one, quite near the mouth of Salmon River, has a total descent of about 10 feet. In Dr. Gorham's opinion none of these rapids, unless it might be the lower one, would serve to obstruct the ascent of salmon even during low water, while at times of high water it is quite certain that all difficulties in that respect would disappear.

Below the mouth of the Salmon River the Pend d'Oreille flows through a narrow gorge and forms a succession of rapids, after which it widens out and continues less turbulent for some distance; but the last 5 miles of its course are confined within another canyon. At its mouth it is from 150 to 200 feet wide, and before emptying into the Columbia it passes over a fall from 4 to 10 feet high, depending upon the stage of water in the Columbia River. Ordinarily salmon would have no trouble in passing over this obstruction.

Kettle Falls, the only important obstruction in the Upper Columbia River, located about 9 miles from Colville, Wash., and 40 or more miles south of the mouth of the Pend d'Oreille, were not visited by the party, but from information obtained from others it is evident that they do not constitute a serious impediment to the ascent of salmon, which formerly were said to have passed over them in greater or less numbers, although they do not at present.

No positive information was obtained respecting the occurrence of the true salmon (*Oncorhynchus chouicha*) in the Pend d'Oreille River, and it is said that none go farther upstream than the falls at the mouth of Salmon River. The evidence secured points to the fact that the salmon (so called) of both those rivers is the steelhead (*Salmo gairdneri*), and specimens of this species were observed. There was not, however, sufficient opportunity to study this question satisfactorily, and a prolonged series of observations may be necessary to determine the range and relative abundance of these two species in the upper waters of the Columbia River. Until conclusive evidence is obtained that the true salmon is prevented from ascending to the upper part of this river system because of the presence of natural barriers and not from other causes, it should not be considered advisable or judicious to expend money in the removal of any supposed obstructions to their passage. There are many conditions which require careful study and consideration before any definite steps are taken in that direction, and it is intended next year to begin upon a careful and detailed investigation of the subject throughout the entire course of the Columbia River and its tributaries.

Inquiries relative to a site for the establishment of a salmon-hatching station in eastern Washington were confined chiefly to Little Spokane River and Colville River. No success was met with, however, as no locality was found convenient of access and at the same time affording the means for securing an abundance of breeding fish. This subject will also be covered by the proposed general survey above referred to.

MINNESOTA, NORTH AND SOUTH DAKOTA.

During July and August, 1892, investigations were carried on in the contiguous parts of these three States by Mr. A. J. Woolman, of South Bend, Ind., assisted during a portion of the time by Prof. U. O. Cox, of the State Normal School, Mankato, Minn. The waters examined were Lake Traverse, Big Stone Lake, and the Minnesota River as far down as Montevideo, Minn.; the Red River of the North as far as the international line, including many of its tributaries; Devils Lake and the James River in North Dakota, the latter being a tributary of the Missouri River. The work was executed in a thorough manner, and was comprehensive in its scope, being directed toward determining the physical characteristics of the different bodies of water visited, as well as their fishes and other aquatic inhabitants, both animals and plants. No extensive ichthyological studies had previously been made in this region, and the report of Mr. Woolman upon the results obtained contains many observations of scientific and practical interest.

After discussing the geological history of the region examined, which points to the former existence of a very extensive lake, reaching northward to and including Lake Winnipeg, and drained by a broad waterway leading southward through the trough now occupied by Lake Traverse, Big Stone Lake, and the Minnesota River, Mr. Woolman proceeds to describe and account for the present conditions and relations of the principal water areas which he visited. Red River of the North is not the outlet of Lake Traverse, as is often represented on maps, nor has it been in modern times. Lake Traverse and Big Stone Lake, both lying in the valley of "River Warren" of geologists, are only about 5 miles apart, being separated by sediment piled a few feet above the surface of the former lake. The similarity of the species of fishes living in the two lake basins indicates that at one time they were connected, and yet the number of comparatively unimportant or minor differences, quite noticeable and constant, and reaching in some cases almost varietal significance, shows the landlocked condition of the fauna of Lake Traverse and points to the fact that these two lakes could not have been united in recent years.

Lake Traverse, lying between Minnesota and the northeastern corner of South Dakota, is about 14 miles long by 1 to 1½ miles wide, and has a maximum depth of about 30 feet, the average being possibly half that or less. The temperature of the water was high, having been 77° F. when the lake was visited in July. It must change rapidly with the seasons, and in winter the lake freezes to the bottom over much of its extent. There are only two small inlets, and the volume of water in the lake is gradually diminishing. The lake supports a rich and varied growth of plant life, and teems with crustaceans, mollusks, and insects. Nothwithstanding this fact, however, it contains few kinds of fishes, none of which can be regarded as abundant. About the only species utilized as food is the pickerel (*Lucius lucius*), although a few catfish (*Ameiurus nebulosus*) and strawberry bass (*Pomoxis*) are taken for this purpose. No small fishes were observed in the lake proper, and the total number of species obtained from the lake and its tributaries was only 7.

Big Stone Lake is 35 to 38 miles long and 1½ to 2 miles wide, with a maximum depth of 35 feet. The average depth is greater than in Lake Traverse, the water is clearer and purer, and it contains but little vegetation. Invertebrates are also less plentiful, although occurring in sufficient quantities to constitute an ample food supply, and there are many small fishes, such as minnows and darters. In the variety and abundance of its fishes this lake presents a marked contrast with Lake Traverse, 25 species having been secured. Food varieties are common, the most important being the pickerel, wall-eyed pike, black bass, rock bass, and crappies. From the Minnesota River and its tributaries, between Big Stone Lake and Montevideo, a total of 35 species of fishes was obtained, and from the James River, in North Dakota, 20 species.

The Red River of the North presents many features of special interest. It is the only large stream within the boundaries of the United States which finds an outlet toward the far north, suggesting marked differences in its faunal characteristics as compared with other water areas even within the adjacent region, conditions which were not found to exist, however, emphasizing the former connection of this river with the Minnesota and Mississippi. The course of the Red River of the North is northward down a long, gentle slope from a low watershed, which separates its basin from that of the Mississippi on the south, east, and west. Many of its tributaries take an opposite course, in keeping with the streams of the Mississippi system, trending southward until within the immediate valley or flood plain of the main river, when they bend abruptly. The narrow valley now occupied by this river is the product of erosion, and is cut down from 50 to 75 feet below the surrounding level country. Examinations were made at intervals along the main river and also on twelve of its tributaries, the most important of which were the Otter Tail River, Red Lake River, Sheyenne River, as far up as Valley City, N. Dak., and Pembina River, as far up as Minot, N. Dak. Thirty-eight species of fishes were obtained in this basin.

IOWA, NEBRASKA, SOUTH DAKOTA, AND WYOMING.

The sundry civil appropriation bill approved August 5, 1892, provided for investigations in these several States for the purpose of determining their requirements from a fish-cultural standpoint and of ascertaining the most suitable locations for the establishment of such hatching stations as the circumstances may warrant. It was found impossible to begin upon this inquiry until early in October, and operations for the season were suspended during the first part of November on account of inclement weather, which prevented the carrying on of many of the more essential observations, especially those relating to temperature and other physical conditions of the water. The investigations were resumed in the middle of June, 1893, and were completed in the middle of August following. The work was in charge of Prof. Barton W. Evermann, assisted in the fall of 1892 by Mr. Lewis M. McCormick, of the United States National Museum, and in 1893 by Prof. U. O. Cox, of the State Normal School, Mankato, Minn.; Mr. Cloud. Rutter, of Long Pine, Nebr., and Prof. R. G. Gillum. of the State Normal School, Terre Haute, Ind.

An account of the results of this inquiry must be deferred until the next annual report, to which it properly belongs, only a brief mention being made in this connection of the work accomplished during the fiscal year 1892-93. During October, 1892, many of the streams and springs among the Black Hills and in their vicinity were examined, some of the places visited being Belle Fourche, Spearfish, Rapid City, and Hot Springs, S. Dak., and Newcastle, Wyo. As the cold weather came on the party started eastward through Nebraska, making observations at Ravenna, Lincoln, Crete, and South Bend, in that State, and subsequently at Ames, Cedar Rapids, and Spirit Lake, in Iowa. During June, 1893, the investigations were confined to the southern part of South Dakota and northeastern Nebraska, streams being visited in the vicinity of Mitchell, Chamberlain, Scotland, and Springfield in the former State, and of Niobrara, Verdigris, and Creighton in the latter.

As is customary in inquiries of this kind, very complete and detailed observations were made, relating not only to the character and richness of the aquatic fauna, but also to the fitness or requirements of the waters with respect to stocking, their physical and other conditions, and to the relative advantages afforded by different localities for the carrying on of fish-cultural operations, the latter involving the consideration of several important factors, such as the water supply, transportation facilities, and to a certain extent the proximity of natural breeding-grounds, etc. Large collections of fishes and of other aquatic animals were made, a study of which will add greatly to our knowledge of the natural history of the regions examined.

WISCONSIN.

During the season of 1892 the physical and biological features of lakes Geneva, Delavan, and Winnebago, in Wisconsin, were investigated by Prof. S. A. Forbes, assisted by several of his students in the State University of Illinois. The main part of the work on lakes Geneva and Delavan was accomplished during May, but visits were also paid to the same lakes in July, August, and September following. Lake Winnebago was studied during the middle part of June. The contour of the bottom of these lakes was determined by means of soundings; temperature observations were made at the surface and at different depths, and sketch maps were prepared to illustrate their physical characteristics. The biological work consisted in dredging, the constant use of the surface tow net, and in collecting along the shores, the inquiries being extended into the creeks, ponds, sloughs, and other waters adjacent to the lakes.

ARKANSAS.

Beginning in the summer of 1891, Prof. S. E. Meek, of the Arkansas Industrial University, has carried on, from time to time, in the interests of the United States Fish Commission, important observations relating to the fishes of Arkansas. In his report upon these inquiries[1], Professor Meek has described the principal characteristics of the several rivers and of the more conspicuous springs for which some parts of the State are noted, and has given complete annotated lists of the fishes which are now known to occur in four of the principal river basins, the White River having a total of 84 species, the Little Red River 58 species, the Arkansas River 61 species, and the Illinois River 31 species.

The following remarks are extracted from Professor Meek's report:

From an ichthyological standpoint Arkansas is well favored. The State is bordered on the east by the Mississippi, and has four large navigable rivers flowing through it. Two of these rivers, with most of their tributaries, rise in the Ozark Mountains within the boundaries of the State. These streams are fed by many large and beautiful springs, whose waters are cool enough for the mountain trout, their suitability being well demonstrated by the success which has attended trout-culture at the several hatcheries already mentioned. In fact, it has been proven not only that trout will thrive in the Ozark Mountain region, but that their growth there is much more rapid than in some other places farther north, where their artificial cultivation is being carried on. The important question for the consideration of the practical fish-culturist is, how many pounds of fish he can secure from a certain number of eggs within a given period and with the least expenditure of artificial food. The records of the Neosho hatchery clearly indicate that fish-culture can be conducted successfully in this direction. While the mountain streams bid fair to contain an abundance of trout in the near future, the larger and more sluggish waters are well suited to the coarser food-fishes native to the State, the most important among them being the black bass, wall-eyed pike, eastern pickerel (*Lucius reticulatus*), buffalo-fishes, etc. All of the important rivers mentioned supply many fishes to the markets every year, and they may continue to do so if assistance shall be given toward restoring, so far as possible, the balance of life in favor of those species which man has done so much to destroy.

There is no doubt that Arkansas possesses piscatorial features of a high grade, which warrant more attention in the future than they have received in the past. The angler may find amusement along the picturesque streams of the Ozark Mountains, while the fish-culturist will come to recognize in this region one of his richest fields in North America. Arkansas is as yet only thinly settled, and a thorough exploration of the streams of the State before their faunæ have been much changed by cultivation would be of great economic and scientific interest. The increase and protection of her food-fishes, both the native and introduced species, can not be successfully accomplished without a more complete knowledge of the physical and natural-history features of the streams, and it is to be hoped that the means for making such a survey will not long be delayed.

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[1] Report of investigations respecting the fishes of Arkansas, conducted during 1891, 1892, and 1893, with a synopsis of previous explorations in the same State. By Seth Eugene Meek. Bull. U. S. Fish Comm. for 1894, pp. 67-94.

CALIFORNIA.

From 1891 to the close of the fiscal year just past the fresh-water fishes of California have been made the subject of investigation for the Fish Commission by Prof. Charles H. Gilbert, of Leland Stanford Junior University, during such times as his college duties would permit. A report upon these researches has been deferred until further observations can be made, but the field work so far accomplished may be summarized as follows:

During the fiscal year 1891–92, the inquiries related to the streams which, draining the eastern slope of the Santa Cruz Mountains and the western slope of the Mount Hamilton Range, enter the southern arm of San Francisco Bay, and those which drain the western slope of the Santa Cruz Mountains and enter the sea between San Francisco and Santa Cruz. These two sets of streams were found to have very different faunæ, the former containing, in addition to the fishes of general distribution in California, many of the peculiar forms of the Sacramento Basin, such as *Hysterocarpus traski*, *Archoplites interruptus*, *Orthodon microlepidotus*, *Lavinia exilicauda*, and *Pogonichthys macrolepidotus*, which are wholly excluded from the streams draining the western slope of the Santa Cruz Mountains. The latter have only species of general distribution, like the sucker (*Catostomus occidentalis*), trout (*Salmo gairdneri*), sticklebacks (*Gasterosteus microcephalus*), sculpins (*Cottus asper*), and occasionally a minnow.

Within the past year further examinations were made in the same region, and, in addition, the Pajaro River was studied from its mouth, in Monterey Bay, to the source of its principal tributary, the San Benito River. Los Gatos Creek, Fresno County, was also visited, but was found to be without fishes. This will probably prove true of all other streams entering the San Joaquin Valley from the west, as they are likely to be without running water during part of the hot, dry summer.

MISCELLANEOUS INQUIRIES.

MACKEREL INVESTIGATIONS.

The act of Congress passed in 1886, which virtually prohibited the spring mackerel vessel fishery prior to June 1 of each year during a term of five years, ceased to be operative after 1892. In order to determine, so far as possible, if any immediate benefits had resulted from this series of close seasons, and also to obtain information for the use of the Joint Fishery Commission between Great Britain and the United States, the schooner *Grampus*, Capt. A. C. Adams in command, was detailed to follow the progress of that fishery throughout its entire course in the spring of 1893. Sailing from Woods Holo at an early date, Captain Adams was directed to conduct a detailed series of physical observations on the way south until the body of mackerel had been discovered, after which he was to keep track of the movements, habits, and abundance of the latter, and to study the conditions of their environment as far north as Nova Scotia. The presence of a large fleet of purse-seiners on the grounds afforded excellent opportunities for learning of the distribution of the fish at all times, and through their means it was expected that specimens for examination would be obtainable. The *Grampus* also made use of the fishing apparatus she had on board, and an hourly record of physical determinations was maintained day and night, besides which the surface tow nets were frequently employed to discover the presence of mackerel food. The natural-history observations were conducted by Mr. W. C. Kendall. Mr. B. L. Hardin was stationed at Fulton Market, New York City, to inspect all arrivals of mackerel there from the purse-seine fleet, as well as from the shore apparatus tributary to that market.

The *Grampus* sailed from Woods Hole on April 10 and reported at Lewes, Del., April 21, having experienced heavy weather up to that date. Very few fish had been observed, and the fishing fleet had accomplished comparatively nothing. The latter also sought shelter at the same place. Poor success, both in the catch of fish and in the opportunities to make observations upon them continued thence to the close of the season, and by the middle of May nearly all the purse-seiners had left the southern grounds for the coast of Nova Scotia. The small catch made this season was partly due to stormy weather, but, even when all the conditions seemed favorable, mackerel were either scarce or difficult to capture. More light will probably be thrown upon this question when the elaborate series of notes obtained have been worked up, but the fishermen have failed thus far to recognize any beneficial results from the restrictions placed upon their spring fishery during the previous five years.

On May 23, the southern fishery having ended several days before that time, the *Grampus* left Woods Hole, where she had put in for supplies, and proceeded to Nova Scotia, to continue the inquiries on the same plan as at the south. The entire fleet had assembled there, but no fish were taken on this coast, except in trap nets on the shore, until after June 1. By June 5 some of the fleet had done fairly well, the others poorly. After their first appearance on this coast the mackerel moved rapidly eastward, the purse-seiners and the *Grampus* following them as far as Cape North on Cape Breton Island, the former as a whole making a good catch to the eastward of Halifax, as compared with former seasons. There were 75 seiners on the Nova Scotia shore, and their average fare was about 160 barrels each. The *Grampus* returned to Woods Hole the latter part of June, bringing a large quantity of specimens bearing upon the breeding habits, food, size, etc., of the mackerel, together with very complete records of the daily observations.

Mr. B. L. Hardin remained at New York from April 12 to June 3, and examined every fare of mackerel landed from the southern fishery, as well as the smaller catches made in the pound nets along the shores. Notes were kept upon the abundance, sizes, and spawning conditions of the fish, and interviews were held with the masters of the different schooners relative to the more important incidents connected with their several cruises.

INVESTIGATIONS IN CHESAPEAKE BAY AND ADJACENT WATERS.

The fishery investigations begun in June, 1892, in the lower part of Chesapeake Bay and the adjacent waters of the open ocean by the schooner *Grampus* were continued until about July 20, when that vessel proceeded to Woods Hole to take up the physical inquiries along the continental platform, as described above. A few trips were made out to sea during this period, but the examinations were principally confined to the waters of the bay, in which the beam trawl, seines, etc., were employed with good results.

FISHES OF CASCO BAY, MAINE.

During August, 1892, Mr. W. C. Kendall was engaged in collecting and observing the habits of fishes in the more inclosed waters of Casco Bay, Maine, including the lower parts of some of its tributary streams. The special object of his inquiries was to ascertain if the menhaden spawn in that region, and if the young occur in the brackish waters there during the summer months, as is the case south of Cape Cod. No specimens of young menhaden were secured, however, and no evidence was obtained to show that this species has been in the habit of spawning in this bay during recent years at least.

EMBRYOLOGY OF THE STURGEON.

Arrangements were made, in the spring of 1893, for the study, by Dr. Bashford Dean, of Columbia College, New York, of the embryology of the sturgeon (*Acipenser sturio oxyrhynchus* Mitchill), on board the steamer *Fish Hawk*, while stationed in the Delaware River off Gloucester City, N. J., during the shad-hatching season, the object of this inquiry being to supplement the investigations respecting the same species carried on for the Fish Commission several years before by Prof. John A. Ryder. As the necessary material could not be obtained conveniently in the locality named, however, Dr. Dean proceeded to Delaware City, Del., where he made his headquarters, and where he was fortunate in securing an abundance of ripe sturgeon of both sexes. His experiments and observations were carried on with entire success in all particulars. No difficulties were encountered in fertilizing the eggs and in holding them in good condition until they hatched. They were kept in improvised floating boxes, which were moored in several places in the river and canal, those placed in the mid-current affording the best results. Very few eggs were lost in any of the boxes, and with proper facilities Dr. Dean is confident that he could have produced enough fry to have made his work exceedingly profitable from a practical standpoint. He considers the vicinity of Delaware City especially well adapted to the propagation of the sturgeon, and thinks there would be no trouble in securing a sufficient number of spawning fish at the proper season. He was there from May 14 to 23. Observations were also made respecting the breeding and other habits of the sturgeon, and Dr. Dean has now in course of preparation a comprehensive account of the results of his investigations.

MORTALITY AMONG ALEWIVES, LAKE ONTARIO.

Reference has frequently been made in the Fish Commission publications to the extraordinary mortality which occurs among the alewives in Lake Ontario during every spring and summer, and which also, to some extent, affects other common fishes in the same waters. The cause of this annual epidemic has never been determined; it has a widespread distribution, and the number of dead and dying fishes which are often cast upon the shores in some places is so great as to occasion much inconvenience to residents and summer visitors from the unpleasant odors arising from the decaying bodies. Mr. C. H. Strowger, of Nine-Mile Point, near Webster, N. Y., has paid a great deal of attention to this phenomenon, and the Fish Commission is indebted to him for much information respecting it, as well as for specimens of the diseased fish. In order to reach a more complete understanding of the subject, Dr. R. R. Gurley was dispatched to Lake Ontario in the early part of June, 1893, and remained there about a month, visiting Nine-Mile Point, Wilson, Charlotte, and Cape Vincent. He spent the most of this time at the place first mentioned, where laboratory accommodations were supplied by Mr. Strowger, who also assisted Dr. Gurley personally in his investigations.

From the statements of persons living along the shores of Lake Ontario, the epidemic appears to begin in April, occasionally as early as the latter part of March, reaches its maximum in May, and decreases through June, although in some cases it may be found as late as August. The May and June maximum of the epidemic coincides with the period when the alewives are most abundant inshore. The diseased fish have a patch of saprolegnia, usually from three-fourths of an inch to an inch in diameter, on some parts of the body, but no other parasites were found on any of the dead alewives examined. None of the vital organs were affected by the fungus, the gills in particular always appearing clear, and otherwise also the fish seemed to be in good condition. An inflamed area was almost always noticed on the general surface of the body under the patch of saprolegnia, and very generally a sore or ulcer, the scales in such places being loosened or detached. In some cases the fungus appeared to have effected a lodgment in places where the surface of the body had been injured; in others the fungus seemed to be primary and the sore or ulceration secondary, but it was impossible to tell whether the fungus was causative or not. Numerous specimens were preserved for future examination.

PROPOSED INQUIRIES BY SPECIAL TREASURY AGENT TO ALASKA.

In April, 1893, Mr. John K. Luttrell was appointed a special agent of the Treasury Department, in accordance with the act of Congress providing for the supervision of certain fishery interests in Alaska. Although his services in this respect were not connected with the work of the Fish Commission, Mr. Luttrell kindly offered to make collections of fishes at the different places visited, and to conduct investigations relative to the distribution and habits of the more important species. He was accordingly supplied with a proper outfit for preserving specimens and was given full instructions respecting those matters on which information was especially desired. He left for the north during the latter part of the fiscal year.

COLLECTIONS, PREPARATION OF REPORTS, ETC.

No changes have been made since the last report in the laboratory and other quarters occupied by this division in the Central Station at Washington. Very large collections have been received from the vessels and field parties during the year, but undue crowding of the same has been obviated by an arrangement with the United States National Museum, whereby many of the specimens have been furnished temporary storage-room at the latter place.

The study of certain parts of the collections, especially the fresh-water fishes, by Prof. B. W. Evermann, has progressed rapidly, and some collections have also been placed in the hands of specialists outside of the Fish Commission staff for working up. The mollusks from all sources have been turned over to Mr. William H. Dall, curator in the National Museum, as fast as they were received. Arrangements have also been made with Dr. Alex. Goes, of Kisa, Sweden, to report upon the foraminifera from the dredgings of the steamer *Albatross* on both the Atlantic and Pacific coasts, and likewise with Prof. F. E. Schulze, of Berlin, Germany, with respect to the siliceous sponges from the same source. Prof. William E. Ritter, of the University of California, has offered to study the collections of ascidians made by the steamer *Albatross* in the North Pacific Ocean, and they will soon be sent to him.

There has been transferred to the custody of the National Museum a very large quantity of specimens, representing both the reserve series and duplicates of collections examined during the year. These consist chiefly of fishes and marine invertebrates, but include also representatives of many other groups, conspicuous among which are the skins and bones of several species of Pinnipedia. Duplicate specimens of marine invertebrates from the collections of the Fish Commission have been supplied by the National Museum to the following institutions: State Normal School, Oshkosh, Wis.; Clark University, Atlanta, Ga.; Columbia College, Van Allstyne, Tex.; Grammar School, Salem, Mass.

Preparations were made during the year for illustrating the objects and methods of work of this division, and the results so far accomplished by it, at the World's Columbian Exposition in Chicago. The exhibits were completed and transmitted in time for installation before the opening day. As this subject will be reported upon in full by Dr. Tarleton H. Bean, the representative of the Fish Commission at Chicago, an account of the material displayed need not be given in this connection.

The following reports from persons not in the employ of the Fish Commission, but based partly upon materials from its collections, were completed and submitted for publication during the year:

A review of the Sparoid Fishes of America and Europe. By David Starr Jordan and Bert Fesler. Report U. S. Fish Comm. for 1889-91, pp. 421-544, plates 28-62.

On the Viviparous Fishes of the Pacific coast of North America. By Carl H. Eigenmann. Bull. U. S. Fish Comm. for 1892, pp. 381-478, plates 93-118.

The Genus Salpa, a Monograph, with fifty-seven plates. By William K. Brooks, with a supplementary paper by Maynard M. Metcalf. Memoirs from the Biological Laboratory of the Johns Hopkins University, II, Baltimore, 1893. Two volumes, quarto, text and plates.

Report on the Actinæ collected by the U. S. Fish Commission steamer *Albatross* during the winter of 1887-1888. By J. Playfair McMurrich. Proc. U. S. Nat. Mus., XVI, pp. 119-216, plates 19-35, 1893.

Report on the Pteropods and Heteropods collected by the U. S. Fish Commission steamer *Albatross* during the voyage from Norfolk, Va., to San Francisco, Cal., 1887-1888. By James I. Peck. Proc. U. S. Nat. Mus., XVI, pp. 451-466, plates 53-55, 1893.

List of Diatomaceæ from a deep-sea dredging in the Atlantic Ocean off Delaware Bay by the U. S. Fish Commission steamer *Albatross*. By Albert Mann. Proc. U. S. Nat. Mus., XVI, pp. 303-312, 1893.

REPORT OF THE DIVISION OF STATISTICS AND METHODS OF THE FISHERIES.

By HUGH M. SMITH, *Acting Assistant in Charge.*

The report of the work of this division from July 1, 1892, to June 30, 1893, is respectfully submitted. Up to September 26, 1892, the division was in charge of Capt. J. W. Collins; on that date, however, he was relieved from duty, and I was designated as the acting assistant in charge, and held that position at the close of the fiscal year.

On July 31, 1892, the work of the division was seriously affected by the indefinite furlough of one field agent, two local agents, and two clerks, owing to the reduction of 25 per cent in the appropriations for this branch of the Commission. Under the provisions of the act making appropriations for this Commission, permitting the transfer of 10 per cent of the allotment for general expenses, the Commissioner, by November 1, was able to reinstate all the furloughed employés except one clerk. The most important drawback occasioned by this temporary reduction in the force was the interruption in the work of the local agents at Gloucester and Boston, and the lapse of several months in the otherwise continuous records running back for a number of years, showing the daily receipts of fish at those important fishing ports. The regular field inquiries and the office work were also retarded.

As in previous years, the force of the division was supplemented and the work considerably aided by the temporary detail of persons from other divisions. In June, 1893, Mr. E. F. Locke, custodian of the Gloucester hatching station, was assigned to field duty in Gloucester and vicinity in connection with the investigation of the New England fisheries elsewhere alluded to. Mr. A. B. Alexander, fishery expert on the *Albatross*, was detached from the vessel at San Francisco, Cal., in February, and entered on shore work for this division in that city and vicinity.

INVESTIGATIONS OF THE COMMERCIAL FISHERIES.

The field inquiries conducted by the division during this year covered an extensive territory maintaining fisheries of great prominence. Some features of the work were more important and detailed than had previously been provided for. Major inquiries were carried on in the Middle Atlantic, New England, and Pacific States, and the local agencies at Gloucester and Boston were continued.

THE MIDDLE ATLANTIC STATES.

The canvass of the statistics and methods of the fisheries of this important coast section was begun in the previous year. By reference to the report of the work of this division for 1891–92, it will be seen that the entire Chesapeake Basin and the adjoining ocean shores of Maryland and Virginia were then covered, leaving for future inquiry the States of New York, New Jersey, and those parts of Pennsylvania and Delaware not drained by the tributaries of the Chesapeake. The field work in this region began in August, 1892, and was the first undertaken in the fiscal year. The regular canvass was completed by April, but some special inquiries in the region were made as late as June, 1893.

The investigation of the fisheries of the entire State of New York was conducted by Mr. E. E. Race, with the exceptions to be noted later. The inquiry began at the eastern end of Long Island, included both shores of the island, was extended to Manhattan Island, Staten Island, and that part of the State on the north side of Long Island Sound, and embraced the Hudson River as far up as Stillwater, in Saratoga County, about 17 miles above Troy. In the vicinity of Greenport, at the eastern end of Long Island, the writer coöperated with Mr. Race for a short time in August. The collection of data showing the extent of the wholesale fish and oyster trades of New York City was undertaken by Mr. W. A. Wilcox, who also made a supplementary visit to a part of Westchester County. An important feature of the canvass of this State was the thorough investigation of the Hudson River to the limits of commercial fishing. The fisheries of this river had never before been completely covered in the statistical inquiries of the Commission. Extensive shad, striped bass, perch, and other fisheries were found to exist in the upper river, and valuable notes concerning the occurrence of the Atlantic salmon were obtained.

The coast and river fisheries of New Jersey were studied by Mr. Ansley Hall, Mr. E. E. Race, and the writer. The parts of the State visited by Mr. Hall included the New Jersey side of the Hudson River, the northern coast within Sandy Hook, the eastern coast betweeen Shark River and Cape May, and the shores of Delaware Bay. Mr. Race canvassed the New Jersey shores of Delaware River from its mouth to Shawnee, in Monroe County, Pa., about 6 miles above Delaware Water Gap. The coast of Monmouth County, between Atlantic Highlands and Shark River, was visited by the writer, who, in addition to a regular canvass of the fishing industry, made a special study of the important pound-net fishery of that section.

That part of Pennsylvania above Philadelphia bordering on the Delaware River was visited by Mr. Race, in conjunction with the canvass of the New Jersey side of the river. The remainder of the river front of the State was covered by Mr. C. H. Stevenson.

The fisheries of Delaware prosecuted on the ocean side of the State and on Delaware River and Bay were investigated by Mr. Stevenson.

The inquiry in this region placed the Commission in possession of statistical data, for the years 1889 to 1891 and in part for 1892, showing in detail the extent of the valuable fishery interests of the States and regions named. The two most prominent shad rivers in the country were thoroughly canvassed. The oyster industry here is second in extent and value only to that of the Chesapeake. Other branches of special interest or prominence are the bluefish, sea-bass, sturgeon, weakfish, and striped-bass fisheries, and the menhaden industry.

The inquiry disclosed the fact that the number of persons engaged in the fishing industry of the section in 1891 was 26,313, of whom 5,022 were vessel fishermen, 18,308 were shore or boat fishermen, and 2,983 were shore hands.

The capital invested in the business was $8,839,250. Over 1,300 vessels, with a tonnage of 20,142, valued with their outfits at $1,909,783, were employed in various capacities in these fisheries. The small boats used in the shore fisheries numbered 13,321 and had a value of $839,301. The apparatus of capture consisted of 989 seines, 451 pound nets, 12,048 gill nets, 10,936 fyke nets, and 22,468 pots, which, with other minor apparatus, were valued at $861,631. Shore property and cash capital representing an investment of $5,228,535 were devoted to the industry.

The yield of the fisheries amounted to 264,814,936 pounds, having a first value of $8,890,163. The quantity mentioned includes only the net weights of oysters, clams, and other mollusks. Two objects of fisheries in this section are together worth over $5,000,000, namely, the oyster, worth $4,582,711, and the quahog, or hard clam, worth $1,024,648, these values representing 5,238,963 bushels and 1,000,058 bushels, respectively. The next important product is the shad, of which 17,204,849 pounds, valued at $781,014, were taken. The catch of bluefish was 12,734,501 pounds, for which $501,173 was received. Menhaden rank next to bluefish in value, although far exceeding all other fish combined in quantity; over 125,000,000 pounds were secured, valued at $352,999. The next important fishes and the value of the catch in 1891 were as follows: Squeteague, $330,340; sea bass, $217,413; eels, $146,976; cod, $115,922; flounders, $79,019; striped bass, $78,556; and alewives, $63,152. The soft clam comes next to sea bass in value, the catch being worth $153,591.

The following tables show for each State detailed statistics of the fisheries. As elsewhere explained, the figures do not relate to those parts of Pennsylvania and Delaware tributary to Chesapeake Bay, which were covered by the statistics in the previous report of the division:

Persons employed.

Designation.	New York.	New Jersey.	Pennsylvania.	Delaware.	Total.
In vessel fisheries	2,346	2,218	353	105	5,022
In shore fisheries	7,858	7,889	994	1,567	18,308
On shore, in factories, etc	2,042	532	289	120	2,983
Total	12,246	10,639	1,636	1,792	26,313

Vessels, boats, apparatus, and capital employed.

Designation.	New York.		New Jersey.		Pennsylvania.		Delaware.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels	659	$991,640	607	$785,358	49	$107,295	26	$25,490	1,341	$1,909,783
Tonnage	9,292	....	9,320	....	1,220	....	310	....	20,142	....
Boats	6,227	373,670	5,742	412,373	454	24,685	898	28,573	13,321	839,301
Apparatus:										
Seines	327	75,640	372	38,022	93	16,080	197	9,813	989	139,555
Pound nets, trap nets, and weirs	263	71,340	185	55,370	......	....	3	150	451	126,860
Gill nets	6,402	88,450	3,983	129,832	209	21,450	1,454	33,251	12,048	272,983
Fyke nets	6,246	55,465	1,692	18,881	2,476	4,914	522	1,109	10,936	80,369
Lines	......	11,745	......	5,178	......	451	......	20	......	17,394
Pots	15,898	17,391	4,755	5,339	......	....	1,815	884	22,468	23,614
Spears	3,489	3,728	216	404	......	....	170	85	3,875	4,217
Dredges, rakes, and tongs	13,719	119,912	6,690	68,210	164	5,035	353	2,632	20,926	195,789
Minor apparatus	......	250	......	487	......	....	......	113	......	850
Shore and accessory property	......	1,794,969	......	409,561	......	448,205	......	28,300	......	2,681,035
Cash capital	......	1,679,000	......	538,850	......	303,750	......	25,900	......	2,547,500
Total	......	5,283,200	......	2,467,865	......	931,865	......	156,320	......	8,839,250

Products.

Species.	New York.		New Jersey.		Pennsylvania.		Delaware.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives	2,194,560	$23,526	2,066,820	$14,260	2,331,775	$13,449	776,660	$11,917
Black bass	....	....	9,250	1,166	6,385	718	....	....
Bluefish	5,506,575	237,010	7,227,926	264,163	....	....	....	....
Butter-fish	837,246	12,988	230,802	6,582	....	....	....	....
Carp	....	....	2,000	160	300	24	....	....
Catfish	117,180	5,144	133,824	8,265	127,968	5,999	67,260	3,778
Codfish	2,277,458	89,921	841,011	26,001	....	....	....	....
Drum	....	....	124,240	980	....	....	30,000	380
Eels	1,616,213	97,993	623,280	38,594	27,225	1,416	223,500	8,967
Flounders	1,561,696	45,231	987,895	33,620	....	....	5,000	168
Haddock	147,730	3,890	17,940	675	....	....	....	....
Kingfish	157,541	10,792	33,697	2,208	....	....	960	48
Mackerel	....	....	25,117	2,316	....	....	....	....
Menhaden	104,860,114	295,605	20,670,542	56,974	....	....	67,000	420
Mullet	160,060	7,878	88,350	4,902	....	....	38,900	1,125
Perch	88,125	6,329	693,962	40,758	10,845	625	235,070	15,211
Pike	8,215	740	19,485	1,904	975	97	23,400	1,455
Scup	350,858	7,016	25,682	855	....	....	....	....
Sea bass	670,180	35,350	3,731,538	147,693	947,500	33,805	....	....
Shad	3,044,956	161,209	10,225,455	443,438	2,491,775	114,854	1,442,663	61,513
Sheepshead	19,523	3,500	26,290	4,013	....	....	....	....
Skate	101,897	2,022	7,050	353	....	....	....	....
Spanish mackerel	74,836	7,255	78,391	12,620	....	....	....	....
Spots and croakers	17,501	700	106,680	4,521	....	....	42,460	2,280
Squeteague	2,852,653	111,301	6,002,563	201,515	....	....	1,164,730	17,524
Striped bass	205,449	21,389	298,164	43,296	10,415	1,128	94,760	12,743
Sturgeon	80,261	929	452,630	10,619	52,700	640	1,304,800	30,448
Suckers	25,378	1,545	56,680	4,008	35,850	1,948	11,050	501
Tautog	171,172	7,618	99,437	3,894	....	....	8,000	320
Tomcod	278,400	10,468	1,400	42	....	....	....	....
Other fish	238,741	8,178	317,953	13,541	64,430	3,324	2,080	44
Refuse fish	1,118,913	2,733	....	....	....	....	....	....
Crabs, hard	435,566	7,589	230,111	9,499	....	....	....	....
Crabs, soft	93,500	3,450	289,500	35,380	....	....	86,250	4,713
Crabs, king	....	....	2,798,980	7,534	....	....	740,000	647
Shrimp	....	....	1,200	600	....	....	....	....
Lobsters	165,093	15,655	165,664	12,463	....	....	8,200	410
Mussels	21,000	900	6,000	200	....	....	....	....
Oysters	18,277,434	2,748,509	16,114,567	1,639,648	1,183,700	124,420	1,097,040	70,134
Clams	1,505,500	105,891	827,000	47,700	....	....	....	....
Quahogs	4,524,520	650,621	3,454,024	371,033	....	....	21,920	2,094
Scallops	313,042	48,340	....	....	....	....	....	....
Squid	40,836	1,633	....	....	....	....	....	....
Shells	16,766,100	15,950	....	....	....	....	....	....
Terrapins	....	....	3,280	1,074	....	....	11,988	2,190
Turtles	....	....	....	....	....	....	18,000	1,260
Total	170,885,022	4,817,369	79,116,380	3,520,057	7,291,843	302,447	7,521,691	250,290

Products—Summary.

Species.	Pounds.	Value.	Species.	Pounds.	Value.
Alewives	7,369,815	$63,152	Squeteague	10,019,946	$330,340
Black bass	15,635	1,884	Striped bass	608,788	78,556
Bluefish	12,734,501	501,173	Sturgeon	1,840,391	42,636
Butter-fish	1,068,048	19,570	Suckers	128,958	8,002
Carp	2,300	184	Tautog	278,609	11,832
Catfish	446,232	23,180	Tomcod	279,800	10,510
Cod	3,118,469	115,922	Other fish	623,204	25,087
Drum	154,240	1,360	Refuse fish	1,118,913	2,733
Eels	2,490,218	146,976	Crabs, hard	665,677	17,088
Flounders	2,554,591	79,019	Crabs, soft	469,250	43,543
Haddock	165,670	4,565	Crabs, king	3,538,980	8,181
Kingfish	192,198	13,138	Shrimp	1,200	600
Mackerel	25,117	2,316	Lobsters	338,957	28,528
Menhaden	125,597,656	352,999	Mussels	27,000	1,100
Mullet	287,310	13,905	Oysters	36,672,741	4,582,711
Perch	1,028,002	62,923	Clams	2,332,500	153,591
Pike	52,075	4,190	Quahogs	8,000,464	1,024,648
Scup	376,540	7,871	Scallops	313,042	48,340
Sea bass	5,358,218	217,413	Squid	40,836	1,633
Shad	17,204,849	781,014	Shells	16,766,100	15,950
Sheepshead	45,813	7,513	Terrapins	15,268	3,264
Skate	108,947	2,375	Turtles	18,000	1,260
Spanish mackerel	153,227	19,875			
Spots and croakers	166,641	7,501	Total	264,814,936	8,890,163

In the following table the quantities of certain products shown in pounds in the foregoing table are reduced to the units by which they are usually designated in commerce:

Items.		New York.	New Jersey.	Pennsylvania.	Delaware.	Total.
Crabs, hard	number	1,306,698	690,333			1,997,031
Crabs, soft	do	280,500	868,500		258,750	1,407,750
Crabs, king	do		1,399,490		370,000	1,769,490
Mussels	bushels	2,100	600			2,700
Oysters	do	2,611,062	2,302,081	169,100	156,720	5,238,963
Clams	do	150,550	82,700			233,250
Quahogs	do	565,565	431,753		2,740	1,000,058
Scallops	do	69,565				69,565
Shells	do	372,580				372,580

Some interesting comparisons with 1880 may be made with the recently collected data. The large increase in the population of these States has naturally resulted in an increase in the fishing industry. No accurate comparison can be instituted in the case of Pennsylvania and Delaware, owing to the absence of separate figures for the two drainage systems of those States, but with New York and New Jersey a very satisfactory comparison is possible.

The fishing population of these two States has increased 10,321, of which number New York has 5,902 and New Jersey 4,419. Considered in the aggregate, the investment in fishing properties has nearly doubled. In New York the number of vessels and boats has increased 3,076, with a value of $311,425; in New Jersey, 1,694, worth $427,868. Among the more prominent changes in the fishing apparatus, it may be noticed that pound nets have come into much more general use and now constitute one of the most conspicuous features of the fisheries, while in 1880 they were of little importance; the increase in the number operated has been 373, or 500 per cent, the advance being marked in both States.

This appears to have been largely at the expense of seines, the number of which was reduced by over 1,200, mostly of small size and chiefly in New York. Many more gill nets were found to be employed, the increase amounting to 6,701, valued at $139,952, the expansion of this fishery being due to the development of the shad and sturgeon fisheries in the Hudson and Delaware rivers.

The outcome of the fishing industry presents a very gratifying increase, which is participated in by many important products. The aggregate augmentation in the value of the yield was $935,142, of which $591,674 is to be credited to New York and $343,468 to New Jersey. The catch of the following products among others has increased: Alewives, bluefish, butter-fish, catfish, eels, flounders, mullet, sea bass, shad, squeteague, sturgeon, tomcod, lobsters, quahogs, and oysters. The following are taken in smaller quantities than formerly, namely: Cod, mackerel, menhaden, scup, sheepshead, Spanish mackerel, striped bass, soft clams, crabs, and terrapin.

THE MACKEREL FISHERY.

In May and June, 1893, the field force was placed in the New England States for the special purpose of making a detailed investigation of the commercial aspects of the mackerel fishery. This inquiry was in progress at the close of the fiscal year.

Owing to the great attention the mackerel has recently been receiving on account of the unprecedentedly long period of scarcity, it was important for the purposes of the Commission, in order to afford the best basis for determining the cause and extent of the scarcity, to have accurate and detailed information relating to the various topics which could be legitimately considered by this division. To facilitate the collection of uniform data, provision was made for having the agents obtain the statistics on two printed forms relating, respectively, to the fisheries carried on with vessels and to those carried on from boats and the shore.

For the vessel fishery the following information was obtained for each vessel: Name of vessel, hailing port, rig, net tonnage, present value, value of outfit, number and value of each kind of fishing apparatus used, the number of crew specified by nativity and nationality, the kinds, quantities, and value of bait caught by the vessel or purchased in America or British provincial ports, the number of entries of foreign ports and the expenditures therein for each purpose, the lay of the crew, the quantity and value of each grade of mackerel taken in each region with each kind of apparatus, the fishing season in each region, the number of trips from each region and to each port, and the kinds, quantities, and value of other fish taken with mackerel.

In the case of the shore and boat fisheries the information secured for each proprietor-fisherman included the number and value of each form of apparatus employed, the number and value of boats, the fishing season, the number, nativity, and nationality of the fishermen, the wages received, the kind, quantity, and value of bait utilized, and the quantity and value of each grade of mackerel taken with each appliance.

A special feature of the inquiry was the provision to obtain complete figures showing, for fresh mackerel, the quantity and value of each standard size of fish taken, and for salt fish the quality and grade of the mackerel packed. While satisfactory figures relating to the different grades of salt mackerel inspected in Massachusetts are available, no attempts to obtain complete data for the grades of salt mackerel packed in other States or for the various sizes of fish sold in a fresh condition were ever before made.

Owing to the importance of having statistical data for the mackerel fishery covering each year of the "close-time" law, which took effect in 1888 and terminated in 1892, the inquiry was addressed to the years 1890, 1891, and 1892, information for the two earlier years having been previously obtained.

Some supplementary inquiries regarding mackerel were also instituted by the division, by securing the coöperation of fishermen on various parts of the coast in recording observations concerning the mackerel during the fishing season of 1893. For this purpose blank books of convenient size were prepared and distributed. They provided for a daily record of the number of extra large, large, medium, small, and tinker mackerel taken each day, a statement as to the nature of the weather, direction of the wind, etc.

In the first week in April, 1893, the writer visited New Jersey for the purpose of engaging for this inquiry the services of the pound-net fishermen on the northern part of the coast of that State. This section is the most southern part of the United States coast on which mackerel are regularly taken in considerable numbers with fixed apparatus. The fishermen who during the previous season had operated pound nets were personally visited and the object of the inquiry explained to them. They entered very heartily into the matter and agreed to record the daily catch as requested.

Record books of a similar character were placed among the pound-net and trap-net fishermen of the Massachusetts coast. The distribution was accomplished through Mr. F. F. Dimick, local agent at Boston, Mass. Fishermen at a number of points on the Maine and Virginia coasts were also communicated with by mail and asked to record their mackerel catch.

While it is not probable that all the fishermen receiving the blanks will keep the records requested, there seems no reason to doubt that some valuable information will thus be obtained.

In conjunction with his other duties, Mr. E. F. Locke carried on an examination of the spawning condition of the mackerel taken in the vicinity of Gloucester. His work on this subject continued until the temporary withdrawal of the mackerel from that part of the coast and the ending of the spawning season brought the work to a close.

THE NEW ENGLAND STATES.

Advantage was taken of the presence in the field of the agents engaging in the canvass of the mackerel fishery, and investigations of a number of other important fisheries of the New England States were undertaken. The time and force were not sufficient, however, to permit a canvass of all the commercial fisheries of the region. The study of these fisheries, like that of the mackerel fishery, was in progress at the close of the fiscal year.

The special branches of the industry which were made the subjects of inquiry and report were the whale, menhaden, herring, alewife, shad, salmon, smelt, lobster, oyster, clam, and scallop fisheries, sardine and lobster canning, and the manufacture of oil and fertilizer from menhaden. The statistics covering these fisheries were obtained in such form as to exhibit the extent of each, regardless of duplications of men and boats occasioned by their employment in more than one fishery. Descriptive notes for all these branches were required wherever changes in methods or conditions had occurred since the last inquiries, and especially detailed notes were called for on the lobster and a few other fisheries.

Perhaps the most important of the fisheries the canvass of which was undertaken is the lobster fishery. In my previous report attention was drawn to the great economic value of the lobster, to the very serious reduction in its abundance in recent years, and to the general interest taken in this fishery, whose condition affects a numerous population. As complete a study of the subject was planned as could properly be carried on by this division, and the collection of a very valuable mass of information is anticipated by the time the inquiry is completed. In addition to securing the usual statistical data for persons, boats, apparatus, catch, etc., the attention of the field agents was directed to the following topics for investigation and report:

1. The changes in the methods of the lobster fishery since 1880 and in more recent years.

2. The fishing season as compared with other years; the reasons for an extension or shortening of the season; the extent and origin of the fishery during the winter months.

3. The extent of the fishery during the molting season; the catch and destruction of soft, unmarketable lobsters during that period.

4. The depth of water and the distance from the land at which lobsters are now taken as compared with earlier years.

5. Comparison of the present and past average size of lobsters; the present limits of size of marketable lobsters; the proportion of short lobsters to the total catch.

6. Marked changes in abundance of lobsters in a given locality in recent years and the apparent reasons therefor.

7. The relation of the catch to the quantity and character of the apparatus used and to the methods employed.

8. A study of the laws in force and their apparent effect on the size and abundance of lobsters in a given locality; the efficiency of their enforcement and the extent of their observance.

9. Consideration of the bait used in the lobster fishery—its source, nature, quantity, and value, and the relative effectiveness of different kinds.

10. The sentiment and experience of the fishermen on the questions of (*a*) close season, (*b*) taking of small lobsters, (*c*) taking of molting lobsters, (*d*) effects of canneries on abundance, (*e*) results of protection, etc.

11. The extent of the practice of impounding short, molting, or other lobsters; the mortality among the impounded lobsters; the size and location of the pounds; the object and results of the procedure.

12. The extent, methods, etc., of the lobster-canning industry.

The inquiry regarding the clam fishery included a consideration of the extent of the bait business, one of the most important branches of the fisheries on certain parts of the New England coast.

The oyster industry, which has great importance in Rhode Island and Connecticut and in places on the southern coast of Massachusetts, was studied in detail, the inquiries being addressed to the extent of the planting industry, the methods followed in the cultivation of oysters, the sources and quantities of the seed oysters utilized, the areas of bottom occupied for planting purposes, and other questions having practical relation to the industry.

Provision was made for canvassing in their entirety the fisheries of that part of the coast of eastern Maine adjoining the Canadian province of New Brunswick, in view of the pending consideration by the International Fisheries Commission of the fisheries of the contiguous waters of the United States and Canada. The branches here prosecuted are the herring, lobster, salmon, alewife, and pollock fisheries, and sardine and lobster canning.

THE PACIFIC STATES.

Coincident with the inauguration of the field canvass in the Middle Atlantic States, the investigation of the fishing industry of the Pacific States was undertaken. Mr. W. A. Wilcox, the agent who in 1888 and 1889 had conducted an inquiry regarding the fisheries of this section, was again detailed for this work because of his extended acquaintance with the fishing population and his wide experience with the fisheries of the entire west coast. A report based on the previous inquiry was printed as an appendix to the report of the Commissioner for 1888.

Mr. Wilcox left Washington August 10, 1892, and proceeded to Portland, Oreg., with instructions to first canvass the Columbia River and then visit such parts of the coast as circumstances or expediency might require. It was important that the extensive salmon fishery of the Columbia, which was suspended by law on the 10th of August, should receive attention before the fishermen had scattered and the canneries had finally closed, and while the memory of the principal phases of the season's work was fresh in the minds of the canners and fishermen. After the completion of the work on the Columbia River, Portland was made headquarters while canvassing the fisheries of the remaining parts of Oregon and Washington. The inquiry in those States was completed about the middle of December, and the agent then proceeded to San Francisco, Cal., where the investigation of that State was inaugurated about December 20. The inquiry was completed on May 11, and Mr. Wilcox returned to Washington.

As in the previous canvass of this region, the work of Mr. Wilcox was efficiently aided by Mr. A. B. Alexander, fishery expert on the *Albatross*, who was detached from the ship at the beginning of February, 1893, and assisted in the investigations in California. He obtained statistics of the market fisheries of San Francisco, conducted the canvass of Sonoma County and part of Santa Cruz County, and cooperated with Mr. Wilcox in the examination of the records of the customs house and the transportation companies.

The work of Mr. Wilcox and Mr. Alexander on this coast covered all phases of the fishing industry. Complete statistical and descriptive data were collected for the years 1889 to 1892, inclusive. In the case of certain fisheries in some localities which were visited before the close of the fishing season, arrangement was made for having the information necessary to complete the account of the year's work forwarded by mail.

The details of the condition of the fisheries at the time of the investigation and comparisons with earlier years will be shown in the report of Mr. Wilcox, from which the following condensed preliminary statistics relating to the year 1892 are drawn:

Persons employed.

Designation.	California.	Oregon.	Washington.	Total.
Vessel fishermen	1,825	117	376	2,318
Shore and boat fishermen	2,968	2,705	3,082	8,755
Shoresmen	610	1,510	852	2,972
Total	5,403	4,332	4,310	14,045

Vessels, boats, apparatus, shore property, and cash capital employed.

Items.	California.		Oregon.		Washington.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels	83	$1,284,450	24	$110,695	51	$148,260	158	$1,543,405
Tonnage	12,436.30		802.83		1,185.12		14,424.25	
Boats	1,391	183,520	1,494	154,425	1,690	132,330	4,575	470,275
Apparatus:								
Seines	193	20,985	32	12,600	163	46,725	388	80,310
Gill nets	2,506	113,121	1,396	212,260	886	112,600	4,788	437,981
Pound and trap nets			247	173,400	157	124,700	404	298,100
Paranzella nets	20	3,800					20	3,800
Reef nets					10	500	10	500
Lines		15,954		10,520		5,830		32,304
Bag nets	1 279	40,160					1,279	40,160
Fyke nets	48	980					48	980
Dip nets	38	105	50	250			88	355
Trammel nets	440	7,426					440	7,426
Wheels			40	132,852	17	49,000	57	181,852
Pots	203	283					203	283
Tongs, hoes, and rakes		689		149		3,505		4,343
Other apparatus		12,953		2,050		6,317		21,320
Shore property		596,320		660,150		417,800		1,674,270
Cash capital		246,000		803,000		546,000		1,595,000
Total		2,526,746		2,272,351		1,593,567		6,392,664

Products.

Species.	California.		Oregon.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Anchovies	150,175	$1,502					150,175	$1,502
Barracuda	326,804	12,530					326,804	12,530
Bonito	249,332	9,400					249,332	9,400
Carp	65,662	2,191					65,662	2,191
Cod	2,274,565	56,864			539,000	$21,560	2,813,565	78,424
Cultus-cod	230,670	7,070	26,304	$1,315	359,000	6,875	615,974	15,260
Flounders	4,225,885	94,180	10,000	400	184,560	3,191	4,420.445	97,771
Halibut			18,870	1,787	1,410,500	29,140	1,429,370	30,927
Herring	4,486,887	55,796			617,112	6,817	5,103,999	62,613
Mackerel	350,399	14,159					350,399	14,159
Perch	335,117	10,927			65,140	1,303	400,257	12,230
Rockfish	1,829,657	51,765	86,115	4,255	163,000	4,515	2,078,772	60,535
Salmon	4,862,408	179,031	25,536,701	781,000	21,684,211	551,546	52,083.320	1,511,577
Sardines	752,994	15,237					752,994	15,237
Sea bass	257,712	9,795					257,712	9,795
Shad	526,494	14,372	109,000	3,270	103,350	3,183	738,844	20,825
Smelt	1,919,894	53,469			321,726	6,158	2,241,620	59,627
Striped bass	56,209	6,488					56,209	6,488
Sturgeon	718,017	21,854	2,513,490	28,001	543,623	5,757	3,775,130	55,612
Yellow-tail	354,434	13,682					354,434	13,682
Other fish	2,257,410	47,360			55,000	4,650	2,312,410	52,010
Abalone meats and shells	404,547	9,351					404,547	9,351
Octopus and squid	374,622	29,039					374,622	29,039
Clams	2,496,700	26,882	49,500	825	684,000	5,700	3,230,200	33,407
Oysters	15,098,700	698,257	147,000	3,062	9,895,440	147,995	25.141,140	849,314
Mussels	2,880,000	12,000					2,880,000	12,000
Crabs	2,862,320	102,900	4,125	495	79,000	3,550	2,945,445	106,945
Crawfish			20,000	3,000			20,000	3,000
Shrimp and prawn	5,313,345	241,817			2,000	500	5,315,345	242,317
Spiny lobster	303,275	8,486					303,275	8,486
Terrapins and frogs	45,625	8,050			13,125	5,250	58,750	13,300
Hair-seal and sea-lion pelts		2,267						2,267
Fur-seal pelts		167,526		43,266		121,528		332,320
Sea-otter pelts		36,150		1,729				37,879
Whale oil	1,574,843	62,123					1,574,843	62,123
Whalebone	197,339	937,371					197,339	937,371
Algæ	28,325	1,133					28,325	1,133
All other products	28,100	1,967			37,500	2,350	65,600	4,317
Total	57,838,466	3,022,991	28,521,105	872,405	36,757,287	931,568	123,116,858	4,826,964

The oysters, clams, crabs, oil, etc., which have been reduced to the common unit of a pound in the preceding table, and the seal, otter, and other pelts, of which no number is given, are shown separately in the following table:

Items.		California.	Oregon.	Washington.	Total.
Clams	bushels	40,470	825	11,400	52,695
Oysters	do	178,645	2,450	164,924	346,019
Mussels	do	48,000			48,000
Crabs	number	954,107	1,375	26,333	981.815
Hair-seal and sea-lion pelts	do	(a) 535			535
Fur-seal pelts	do	14,710	2,945	9,143	26,798
Sea-otter pelts	do	235	13		248
Whale oil	gallons	209,979			209,979

a Includes 17 live sea lions, which sold for $850.

Mr. Wilcox was able to obtain complete statistics of the salmon industry of Alaska, through the courtesy of packers whom he visited in San Francisco and other places. This information, with that relating to the cod, whale, and fur-seal fisheries of that Territory, which are tributary to San Francisco, will permit the presentation of figures representing the entire fishery industry of the Pacific Coast of the United States.

INQUIRIES AT GLOUCESTER AND BOSTON, MASS.

The services of the local agents at these important fishing ports have been continued. At Gloucester, the most prominent fishing port in the United States, Capt. S. J. Martin has, as heretofore, rendered eminently satisfactory service, notwithstanding the arduous duties and long hours of work necessitated by the character of the fisheries and the nature of the information obtained. The local agent at Boston, Mr. Frederick F. Dimick, is better qualified than anyone else, by virtue of long experience in the work, to represent the office at Boston, and his connection with the Boston Fish Bureau enables the Commission to obtain his services at a salary not more than one-fourth that which would have to be paid under other circumstances. Reference has elsewhere been made to the furlough of these agents during August, September, and October, on account of a deficient appropriation. The loss of data for those months, while serious, has in part been made up through the voluntary efforts of the agents.

In the previous report of the division an outline of the character of its work at Gloucester and Boston was given and its practical value was shown. It need only be stated that the inquiries have continued along the same general lines, and that the information gathered is the most complete, accurate, and valuable ever obtained regarding the resources and productiveness of the various fishing-grounds resorted to by New England vessels.

MINOR FIELD INQUIRIES.

In August Mr. Edward E. Race, who was then in Maine on leave of absence, was ordered to make an investigation of the menhaden industry of that State. He visited all the factories in the eastern part of the State engaged in making oil and fertilizer from the menhaden and obtained detailed statistical information for the years 1890 and 1891. Few fisheries have attracted more attention in Maine than the menhaden fishery; and the recent return of the fish to the waters of the State has caused a revival of the discussion which was suspended during the period of ten years when menhaden were practically absent from that coast.

In 1890 menhaden were very abundant on the Maine coast, and four 3 factories, located at Round Pond, Linnekin, and Boothbay Harbor, in Lincoln County, were operated. These were valued at $21,000. The number of shore employees was 306, to whom $38,640 was paid in wages during the fishing season, extending from June to September. The cash capital required to carry on the business was $95,000. The fish were caught and supplied to factories by 9 fishing steamers carrying about 200 men. The menhaden taken and utilized at the factories amounted to 302,700 barrels, equivalent to about 89,550,700 fish. From these the following products were made: 1,059,000 gallons of oil, with a market value of $264,750, and 10,930 tons of wet scrap, or "chum," valued at

$131,160. The fish were remarkably large and fat, 1,000 yielding about 12 gallons of oil, on an average, and 8,200 making a ton of wet scrap. The average catch of menhaden to a vessel in 1890 was about 33,633 barrels. Four steamers fishing for one factory averaged 43,750 barrels each.

The following year menhaden were less abundant than in 1890, and the catch fell off over 50 per cent. Five factories, located at Boothbay, Linnekin, and Round Pond, were in operation. These were supplied with raw material caught by a fleet of eight fishing steamers temporarily withdrawn from Rhode Island. The number of persons employed in the factories was 208, to whom $27,350 was paid in wages during the season. The value of the works and their equipments was $53,000, and $83,000 additional capital was required to conduct the business. The number of menhaden utilized at the factories was 40,850,000, equivalent to 123,750 barrels; these had a value of $122,550, or about $1 per barrel. From these the following manufactured products were prepared: 299,300 gallons of oil, with a market value of $74,825; 1,800 tons of dry scrap, worth $36,000, and 4,230 tons of wet scrap, valued at $50,760, the total value of the oil and scrap being $161,585. It appears from these figures that the fish contained much less fat than in 1890 and yielded less than 8 gallons of oil per 1,000 fish.

Mr. W. A. Wilcox made a short visit to Baltimore, in August, 1892, for the purpose of securing certain information on oyster packing to complete the report of his work in the Chesapeake basin during the previous year.

In December, 1892, Mr. W. H. Abbott devoted about two weeks' time to an examination of the fisheries of the eastern end of Lake Erie, supplementing the work done in that section during the previous year.

In April, 1893, a visit was made to Baltimore and Annapolis by Mr. C. H. Stevenson, for the purpose of securing from official and private records some special data on the oyster industry of Maryland.

THE INTERNATIONAL FISHERIES COMMISSION.

During the last month of the fiscal year the writer was absent from Washington on duty connected with the work of the International Fisheries Commission. The following orders from the Commissioner, dated June 1, 1893, indicate in a general way the purpose of the Commission and the writer's connection therewith:

Mr. Richard Rathbun, assistant in charge of the Division of Scientific Inquiry, having been appointed by the President as the representative of this Government in the matter of conducting certain investigations in the waters contiguous to Canada and the United States, as called for by the agreement of December 6, 1892, between the United States and Great Britain, this work to be carried on conjointly by the United States Fish Commission and the Department of Fisheries of Canada, you are hereby detailed, at the request of Mr. Rathbun, to cooperate with and assist him in the prosecution of these inquiries. The plans for the work will be duly prepared by Mr. Rathbun, and you will follow out such parts of them as he may desire. You are hereby authorized to make such trips as may be necessary in connection with this detail, but will at the same time maintain a close supervision over the office of your division, returning to Washington from time to time, as occasion may require.

Pursuant to these instructions, on June 1 the writer accompanied Mr. Rathbun to New York, where Dr. William Wakeham, the Canadian commissioner, and Mr. R. N. Venning, his assistant, were met. The party then proceeded to Boston, Woods Hole, Provincetown, North Truro, Wellfleet, and Gloucester, interviewing the fishermen and making observations on the fisheries, especially the mackerel fishery. On June 23 the writer returned to Washington and remained there until the close of the fiscal year.

Reference is elsewhere made to the inquiries of the field force of this division addressed to some of the subjects covered by the investigations of the International Fisheries Commission.

REPORTS ON THE FISHERIES.

During the year the reports on the statistics and methods of the fisheries issued by this Commission and emanating from this division covered three coast sections having important fishery interests. One of the Great Lakes, whose fisheries had recently received much attention, was made the subject of a special paper, and a report dealing chiefly with ichthyological matters, but containing many references to the commercial fisheries of an important region in one of the South Atlantic States, was presented. Following are the full titles of the papers and brief synopses of their contents:

Report on the Fisheries of the New England States. (Bulletin, 1890.)

This is one of a series of papers emanating from this division, largely statistical in their nature, in which the commercial fisheries of the different geographical divisions of the coast and lake States are considered. The paper is based entirely on original field work of the division alluded to in a previous report. In the scope and detail of the statistical matter this article is more comprehensive than any paper hitherto issued on the fisheries of the region.

This opportunity will be improved to call attention to an error of some importance which appears in the printed report, but which was discovered too late to secure its correction. In the tables for Massachusetts the following figures are given for the number of fishermen of different nationalities on the fishing vessels of the State: United States, 7,911; British Provinces, 1,157; other countries, 1,692; total, 10,760. In Essex County, which includes the important city of Gloucester, the vessel fishermen shown in the tables number 5,729, of whom 5,133 are given as citizens of the United States, 298 of the British Provinces, and 298 of other countries. Through a clerical error a relatively small number of foreign fishermen was thus accredited to Essex County, the correct figures for which were 3,679 Americans, 1,368 British Provincials, and 682 other foreigners. The amended figures for the entire State are: 6,457 Americans, 2,227 British Provincials, and 2,076 other foreigners. The attention which the subject of the personnel of the United States fishing marine has from time to time received makes it advisable to give prominence to this error and correction.

Report on an Investigation of the Fisheries of Lake Ontario. (Bulletin, 1890.)

This paper is based on an inquiry conducted by the writer in August and September, 1891, into the fisheries of Lake Ontario, and is preliminary to an account of the fishing industry of this lake which will appear in a general report on the entire Great Lakes basin. Owing to the interest which attaches to the subject of the preservation, protection, and propagation of the fishes of the lake, it was thought proper to expedite the publication of the results of the investigation.

A Statistical Report on the Fisheries of the Gulf States. (Bulletin, 1890.)

Of all the coastal regions of the United States none has been less known as regards its fishery interests than the States bordering on the Gulf of Mexico. No complete account of the fishing industry had been printed for more than a decade, and the actual condition and needs of the various branches of the fisheries, many of which are peculiar to this section, were entirely unknown. This paper, based on investigations made in 1890-91, mentioned in the previous report of the division, contains complete statistics of the fisheries of each State, together with descriptive text and comparisons with 1880.

Report on the Fisheries of the South Atlantic States. (Bulletin, 1891.)

This paper contains a detailed statistical account of the important coast and river fisheries of North Carolina, South Carolina, Georgia, and eastern Florida, together with explanatory and descriptive text. In a special chapter the fisheries are considered by river basins, and full statistical data are presented for each important stream. The value of the paper is enhanced by the addition of 82 plates representing all the important and most of the rarer food-fishes of this region. The basis for this report is an original field investigation carried on by this division in 1890 and 1891.

Report on a Collection of Fishes from the Albemarle Region of North Carolina. (Bulletin, 1891.)

This paper is based on an inquiry made during the last fiscal year and outlined in my previous report on the division. The physical features of the waters in which collections were made are described, the fish found in the different localities are listed, and notes are given on their habits, abundance, etc. While primarily a contribution to a knowledge of the fish fauna of the region, much information regarding the commercial fishes is presented.

As in previous years, a considerable amount of statistical and descriptive matter has been specially prepared for State authorities and other persons. In October a statistical and descriptive report on the fisheries of North Carolina, based on the field work of the division, was prepared for the board of World's Fair managers of that State. In January tables showing the extent of the fisheries of Maryland and Virginia were, by request, forwarded to Mr. S. G. Brock, chief of the Bureau of Statistics of the Treasury Department. For Mr. J. B. Baylor, of the United States Coast and Geodetic Survey, a statement was prepared in December showing the output of the oyster fishery of Maryland, Virginia, North Carolina, South Carolina, Georgia, and eastern Florida. In November a series of very detailed tables covering the oyster industry of Maryland was forwarded to Mr. B. Howard Haman, who had requested this information in behalf of the Baltimore Board of Trade and the State bureau of labor statistics. Statistics of the fisheries of Ohio were furnished to Hon. Daniel J. Ryan, of the Ohio board of managers of the World's Fair, in July. Numerous other requests for data were also received, and complied with when the interests of the office would permit.

NOTES ON COMMERCIAL FISH AND FISHERIES.

Continuing the practice which has been followed in previous reports of the division, attention will be here drawn to some features of the commercial fisheries which seem of sufficient interest and importance to warrant mention. These notes have been furnished to the Commission by its agents and correspondents or are suggested by the discussions in the public prints. Among the branches referred to are the mackerel fishery, the whale fishery, and snapper fishing on the Bank of Campeche, the last named possessing great interest. Other fisheries that attracted more or less attention during the year and are fully discussed in the regular reports of the Commission are the salmon fishery, the fur-seal fishery, and the Pacific cod fishery.

POMPANO AND SPANISH MACKEREL IN CHESAPEAKE BAY.

The pompano (*Trachinotus carolinus*) is of constant occurrence in the lower Chesapeake, but rarely appears in great abundance. The bay represents the northern limit of commercial fishing for this fish. In 1891 there was a remarkably numerous run of pompanoes in that part of the bay adjacent to its mouth. According to Mr. J. E. N. Sterling, of Cape Charles City, Va., the catch with pound nets and seines on the shores of Northampton County alone was between 20,000 and 25,000 pounds. The inquiries of the agents of the office disclosed a yield of 93,700 pounds in the Chesapeake, with a value to the fishermen of $9,520. In the following year the catch was much less, the Northampton County fishermen taking less than 5,000 pounds, according to Mr. Sterling, although there was said to be a large quantity in the bay which kept offshore out of reach of the nets.

The lower Chesapeake is now the most important fishing-ground for Spanish mackerel, although its productiveness is much less than formerly, owing, it is supposed, to the capture of large quantities of fish prior to or during the spawning season. The principal part of the catch is taken with pound nets set on the two sides of the bay near its mouth. According to the statements of Mr. Sterling, the yield in 1892 was but little more than half that of the previous season. The fish were probably twice as large, however, as in 1891. As was the case with the pompano, there appeared to be large schools of mackerel out in the bay, but they did not come within reach of the nets. Mr. Sterling states that nearly all the fish taken in the first part of the season, or up to July 4 or 5, were fully ripe; and sometimes several hundred would be brought in during a single day, all of which would contain ripe spawn.

SNAPPER FISHING ON CAMPECHE BANK.

In the division report for 1892 mention was made of the preliminary steps in the establishment of a fishery for red snappers and other fish on Campeche Bank, lying about 600 miles off Galveston, in the Gulf of Mexico. The Galveston Fish Company, organized to prosecute the fishery under the liberal regulations provided by the Mexican Government, has furnished a history of the fishing operations, from which the following account has been prepared:

During the year 1892 some experimental fishing was done with a view to ascertain the probable yield of the fishing-grounds on Campeche Bank. The success of the trials led to the establishment of a regular fishery. Early in January, 1893, three welled-smacks were placed on the bank, with headquarters at Alacran Reef; these were the schooners *Estella*, of 36.64 tons, *Caro Piper*, of 28.32 tons, and *Storm King*, of 41.20 tons. These were manned by crews of 8 to 12 fishermen. A steam vessel, carrying 11 men, was employed to transfer the catch from the smacks to the distributing point.

The principal fishes taken were the red snapper (*Lutjanus blackfordi*), the red grouper (*Epinephelus morio*), the warsaw or black grouper (*E. nigritus*), sometimes called jewfish, and the jewfish (*Promicrops guasa*), also known as the warsaw and called junefish by the Galveston Fishing Company. The red snappers greatly predominated in abundance, constituting more than three-fourths of the catch. They weighed from 3 to 20 pounds, large fish being very numerous. The red groupers ranked next to the snappers in abundance. They weighed on an average above 8 pounds. Warsaws and jewfish constantly figured in the catch, but were of little commercial value. They are large fish, and specimens of the latter were taken weighing 300 pounds.

The fishing-grounds frequented by the vessels lay between Alacran Reef and Arenas Cays. Fishing was done in water 40 to 60 fathoms deep. The fish were taken with hand lines, baited with fresh red snapper or grouper caught on the grounds. At times they would bite at almost anything, following the hook to the surface of the water, but on other occasions they became more wary and would take only fresh bait, Spanish mackerel being the most effective.

Owing to the great depth from which the fish came, it was found impossible to keep them alive in the shallow wells pending the arrival of the steamer. Consequently, as soon as caught, they were packed in ice whole and sent to Galveston in that condition. At Galveston they were sold whole or dressed, as the customers desired. From that place shipments were made in ice to Chicago, New York, and Denver. The fish, delivered on board the cars or boats, brought 4 to 7 cents a pound, varying with the condition in which sold.

Fish were very abundant at all times, and easily caught with the proper bait. As many as 20,000 pounds were taken in one day by the three smacks. Between January 21 and May 6 ten trips were made to Galveston by the steamer, and 367,808 pounds of fish were landed from the fishing-grounds, of which 321,056 pounds were red snappers, 41,412 pounds groupers, and 5,340 pounds other fish. The largest fare was brought in April 1, consisting of 51,452 pounds, of which 46,418 pounds were red snappers.

The dates and detailed figures for each trip are given in the following table:

Table showing the quantities of fish caught on Campeche Bank, Gulf of Mexico, and landed at Galveston, Tex., in 1893.

Date of trip.	Red snappers.	Groupers.	Warsaws.	Jewfish.	Total.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
January 21	26,996	2,700	200	100	29,996
February 4	40,401	2,950	200	150	43,701
February 18	45,079	3,100	150	250	48,579
March 4	28,806	8,119	100	320	37,345
March 18	27,587	4,200	123	500	32,410
March 25	26,281	4,500	200	280	31,261
April 1	46,418	4,634	150	250	51,452
April 8	32,946	5,583	300	a 815	39,644
April 22	33,243	3,626	400	543	37,812
May 6	13,299	2,000	200	109	15,608
Total	321,056	41,412	2,023	3,317	367,808

a Includes 415 pounds of "rock perch."

As the season wore on the weather became so warm that it was impossible to keep ice for the preservation of the fish, and the fishery was discontinued. The following comments on the success of this venture and additional notes on the fishery have been supplied by Mr. F. A. Walthew, the president of the company:

No doubt our plan for bringing these fish to this market in large quantities would be interesting, and I take pleasure in giving a short history of the venture, which has, unfortunately, not proven a success financially.

We adopted, as we thought, one of the best plans for bringing large quantities of fish here. We stationed at the Cay of Alacran three fishing smacks manned by 12 men each. These smacks were supplied with sufficient ice to store the fish caught during the steamer's run from that point to Galveston and return. We thought in this way that we could every week bring to this port not less than 40,000 pounds of fish. Doubtless we would have been successful in this had not circumstances been against us and misfortunes overtaken us. The intense heat in that latitude and the delay of the steamer in arriving there caused us to lose thousands of pounds of fish, and necessarily detained the steamer until a sufficient quantity could be caught to complete the cargo.

You will notice in our report that the steamer made only one trip in January, two in February, three in March, and three in April. This was the best we were able to do, and, although the fish are there in abundant quantities, the difficulty in catching and bringing them to this market with the attending expenses made it impossible for us to continue the business without a heavy loss. I do not know whether the plan would have been a success under more favorable circumstances or not, but I hardly think it would, as we found it a very difficult matter to obtain the services of men who would remain there and fish.

The island of Alacran is situated about 500 miles due southeast from Galveston. A concession to this island was granted us by the Mexican Government for five years, for the purpose of storing fish and ice, transferring fish, etc., in fact, for any purpose appertaining to the catching and handling of fish.

I beg to inform you that fish are there in an abundant supply, and are no trouble to catch. I believe the Campeche Bank is the home and breeding-ground of the deep-sea fish of the Gulf of Mexico, and there is no time of the year when fish can not be caught there, even when they have left all other banks on the coast of Texas and Florida.

No doubt there is a vast unexplored field there, and enough fish could be caught in one year to supply the entire United States. The fish were so numerous that they frequently would come to the surface of the water and the sea be fairly alive with red snappers and groupers. At such times they will snap at anything, but in certain seasons they appear to become dainty and will only bite at fresh bait, Spanish mackerel being their favorite.

TERRAPIN CULTURE.

The office is in receipt of numerous inquiries concerning the feasibility and methods of terrapin culture. The increasing scarcity of the diamond-back terrapin (*Malaclemmys palustris*) in most of the States of the Atlantic seaboard has resulted in attracting more attention to this valuable product than was ever before given, and the necessity for preserving the animal from extinction and of putting it on the market at a price which, while remunerative, will, nevertheless, be reasonable, has suggested to many people the desirability of attempting to resort to artificial means for maintaining the supply. The almost fabulous price now received for large terrapin is also a strong incentive, not only to fishermen, but also to people of means, to engage in the industry. Sixty dollars a dozen for "count" terrapins is not an unusual price in the past few years, and it is thought by dealers and others that in a short time, under present conditions of supply and demand, the price will advance to a much higher figure. The substitution of inferior kinds of terrapin has occurred, as might naturally be expected; the principal substitute is a fresh-water species known as the red-bellied terrapin or slider (*Pseudemys rugosa*).

The Fish Commission has made no direct attempts to propagate terrapin, but has, through its field agents, kept well informed concerning the experiments of private individuals, and has watched with interest the results of their efforts. A number of correspondents in the Middle and South Atlantic States have established terrapin farms, but sufficient time has not yet elapsed to fully demonstrate the feasibility of rearing terrapins for market from the egg.

The principal drawbacks in the artificial rearing of terrapin are the extremely slow rate of growth of the animals and their failure to engage in the reproductive process in captivity unless the conditions of water, marsh, shore, and food are suitable. The eggs, once laid, are extremely hardy and require no attention from the hands of the culturist, provided they are deposited in the proper place.

THE WHALE FISHERY.

Comparing the results of the whale fishery in 1892 with those in recent years, it appears that the season was fairly successful. This was due in a large measure to the high prices commanded by the whale products, the average value of whale and sperm oil being 42½ and 67½ cents per gallon, respectively, and that of bone $5.35 per pound.

The whaling fleet consisted of 95 vessels, of which 48 had headquarters at San Francisco, 33 at New Bedford, 7 at Provincetown, 1 at Edgartown, 1 at Boston, and 1 at New London.

The catch in the Atlantic Ocean was about the same as in 1891, and the season was considered satisfactory. The product consisted of 6,910 barrels of sperm oil, 1,775 barrels of whale oil, and 6,935 pounds of bone, the whole having a value of $201,895. One vessel, the bark *A. R. Tucker*, of New Bedford, fished in Hudson Bay, taking 276 barrels of oil and 4,000 pounds of bone.

The success of the vessels fishing out of San Francisco was marked, and was chiefly due to the abundance of whales in the Arctic Ocean about 300 miles east of Point Barrow, where only small catches had been made for nearly twenty years. About the middle of August, the fleet reached Point Barrow, thence 2 sailing and 9 steam vessels cruised to the eastward, joining the steamer *Mary D. Hume*, which had spent the winter at Herschel Island, in the mouth of the Mackenzie River. Within about a month these vessels took 116 bowhead whales in this region, and then sailed westward to join the remainder of the Arctic fleet in the vicinity of Herald Island, where 90 additional whales were obtained. Twenty-two vessels that cruised on the grounds off Kadiak and Okhotsk Sea took 27 bowhead whales. The total number of whales secured by the San Francisco fleet was 242. The oil and bone extracted from these consisted of 11,610 barrels of whale oil, valued at $155,429; 1,845 barrels of sperm oil, valued at $39,230; and 362,950 pounds of bone, valued at $1,941,783; the total stock of the west coast fleet being $2,136,442.

The most prominent feature of the whale fishery prosecuted on the Pacific coast was the conclusion of the voyage of the steamer *Mary D. Hume* in 1892, after the most successful whaling trip on record. The vessel sailed April 19, 1890, passed the winters of 1890–91 and 1891–92 in the ice at Herschel Island, and returned to San Francisco September 29, 1892. The vessel killed 12 whales in 1891 and 26 in 1892, which had a value of about $400,000. The captain is reported to have shared between $30,000 and $40,000, and each of the crew $1,800 or $2,000.

SOME RESULTS OF ACCLIMATIZATION.

The supply of shad on the Pacific Coast, to which attention has been drawn in several reports of the Commission, continues to increase, and the augmentation in the catch has been attended with such a marked reduction in the price to the consumer that the fish has been placed within the reach of every one, the retail value being much less than on the Atlantic Coast. Within a few years the shad has thus not only been acclimatized along the entire coast south of Alaska, but has become one of the cheapest fish of the region. The inquiries of the Commission disclosed a catch of over 700,000 pounds in 1892, having a value to the fishermen of over $20,000.

Over 50,000,000 shad fry have been planted in the streams of the Mississippi Valley without producing any marked results. The waters of this region are not so well adapted to shad as those of the Atlantic and Pacific coasts; the rivers are usually extremely muddy and subject to heavy freshets; the headwaters of the main streams are too remote from salt water to permit the shad to make the annual migration which occurs in the coast rivers; and except in the shorter rivers of the Gulf Coast, the shad would have to remain permanently in the streams. Instances of the capture of full-grown shad in some rivers of the Gulf Coast have from time to time been recorded. Two additional references may be mentioned: Under date of March 2, 1893, Mr. B. F. Sutter, of Montgomery, Ala., wrote that he had a shad, taken in the Alabama River, weighing $4\frac{3}{16}$ pounds; that the shad were planted in the river about six years before and are growing very fast; and that they are finely flavored fish. Mr. S. D. Ingram, of Pass Christian, Miss., stated in a letter dated June 3, 1893, that some shad had been taken near that place in the spring of that year.

The increase in striped bass in California is relatively as great as that in shad. The fish is now one of the most highly esteemed products of the west coast fisheries, and the high prices which prevailed a few years ago have been so reduced by the larger catches that the fish is generally available for food, although still ranging much above salmon in value. The distribution of the striped bass is still restricted to California. The yield in 1892 was about 50,000 pounds, valued at over $6,000.

The following brief account of the history and results of the introduction of shad and striped bass to the Pacific Coast was prepared by the present writer, with the Commissioner's approval, and printed in the issue of Science for August 18, 1893. The catch shown, embodying the preliminary returns, differs somewhat from the actual figures given elsewhere:

FISH ACCLIMATIZATION ON THE PACIFIC COAST.

Few experiments in fish-culture have been economically more important and successful than those which have been conducted by the United States Fish Commission with reference to the Pacific Coast. Coincident with the propagation of native fishes, the introduction of non-indigenous species has been undertaken, with results that have been extremely gratifying to fish-culturists, and perhaps more striking than any previously obtained in this or any other country.

Among the fishes inhabiting the rivers and coast waters of the Atlantic Slope, none is better known, more important, and more highly esteemed than the shad (*Clupea sapidissima*) and the striped bass or rockfish (*Roccus lineatus*), the former being a food-fish, pure and simple, the latter combining a gamey disposition with excellent food qualities. These fish are anadromous, entering the fresh water for the purpose of spawning and passing a large part of the year at sea or in the salt water. Attention will be called to the experimental introduction of these fishes to the west coast, although several other important food-fish, among them the black bass (*Micropterus salmoides*) and catfish (*Ameiurus nebulosus*) might also be mentioned in this connection.

The introduction of shad fry to the west coast was first undertaken as long ago as 1871, when 12,000 young fish were deposited in the Sacramento River, under the auspices of the California Fish Commission. After that the experiment was taken up by the United States Fish Commission and carried on until 1886, during which time 609,000 young shad were placed in the Sacramento River, 600,000 in the Willamette River, 300,000 in the Columbia River, and 10,000 in the Snake River.

Two or three years after the first fish were planted a few more or less mature examples were obtained in the Sacramento River; as additional deposits were made, the number of marketable fish began to increase, and the fish gradually distributed themselves along the entire coast of the United States north of Monterey Bay, until finally they have come to rank next to salmon in abundance among the river fishes of the west coast.

The United States Commissioner of Fish and Fisheries, in his annual report for 1887, speaking of the small plants of shad fry made in the Sacramento River at Tehama, says:

> From these slender colonies, aggregating less than 1 per cent of the number now annually planted in our Atlantic Slope rivers, the shad have multiplied and distributed themselves along 2,000 miles of coast, from the Golden Gate of California to Vancouver Island in British Columbia. They are abundant in some of the rivers, common in most of them, and occasional ones may be found everywhere in the estuaries and bays of this long coast line.
>
> Prior to our experiments on the west coast it was a dictum of fish-culture that fish planted in a river would return to it when mature for the purpose of spawning. The result of these experiments has been to demonstrate that this instinct of nativity, should it really exist, is in this case dominated by other influences, which have dispersed the shad planted in the Sacramento widely beyond the limits which we had assigned to them, and in the most unexpected direction.
>
> The cause is probably to be sought in the genial influences of the Japan current, which brings the warmth of equatorial Asia to temper the extremes of Arctic climate on the southern shore of the Alaskan Peninsula, and, thence sweeping to the south, carries tropical heats to the latitude of San Francisco. Repelled on the one hand by the low temperature of the great rivers and fringe of coast waters, and solicited on the other by the equable and higher temperature of the Japan current, the shad have become true nomads, and have broken the bounds of the hydrographic area to which we had supposed they would be restricted. Following the track of the Asiatic current, and finding more congenial temperatures as they progress, it is not unreasonable to expect that some colonies will eventually reach the coast of Asia and establish themselves in its great rivers.

Shad are now found in greatest numbers in the Sacramento and Columbia Rivers, where they are of considerable economic value. Owing to the fact that very little apparatus specially adapted to their capture is employed, no correct idea of their actual abundance in a given stream can be formed. Nearly all the shad thus far taken have been obtained in nets operated for salmon or other fish, shad being only an incidental element in the catch. The price received by the fishermen is a good criterion of the abundance of the fish. When first taken, shad brought as much as $1.20 a pound; in 1892 the value in many places was only 2 cents a pound, and in the Columbia River at one period the catch was so large and the price so low that the fishermen did not go to the trouble of marketing the fish caught. The average price on the coast has declined in the past four years from 10 cents per pound in 1889 to 4 cents in 1892.

An inquiry conducted by the United States Fish Commission in 1892 placed that bureau in possession of information showing the extent of the shad fishery in every river of the Pacific States. It was ascertained that in the year named 660,000 pounds of shad were marketed, the value of the same to the fishermen being about $27,000. Reports received during the present year indicate a catch of perhaps a million pounds, and it seems reasonable to anticipate a steady increase in the production with the improved facilities for shipment and the growing demand for fresh fish in the rising towns adjacent to the coast rivers. A careful estimate places the total value of the shad catch on the Pacific Coast to date at $145,000, representing over 3,000,000 pounds, while the aggregate outlay for all purposes connected with the introduction of the fry was less than $4,000. This is certainly a satisfactory investment of the people's money.

The absence of a special scientific inquiry precludes the possibility of chronicling the changes which have probably been wrought in the habits of the shad as a result of the changed physical surroundings, thermic conditions, enemies and food supply. It may be noted, however, that the characteristic habit on the east coast of periodically ascending the rivers for the purpose of spawning, and of returning, after the completion of that process, to the open sea, where the principal part of the life of the fish is spent, appears to be considerably modified, in California, at least, where in certain bays and estuaries the shad is found in greater or less abundance during every month in the year. The evidence at hand indicates a condition prevailing in the littoral and fluvial waters of the Pacific Coast that is very favorable to the growth of the shad. It is not unusual to take examples considerably larger than any ever seen in the eastern rivers. The average weight of the shad caught on the Atlantic Coast is under 4 pounds, and the capture of fish weighing 7, 8, or 9 pounds is extremely rare. In California, however, it is not uncommon to secure shad weighing 8 or 10 pounds, and reports have been made that 15-pound individuals have occasionally been obtained in salmon nets.

Of scarcely less consequence than the actual results of shad introduction on the west coast is the important bearing which the success of the experiment must have in determining the outcome of artificial propagation in regions in which it is not possible to distinguish with satisfactory accuracy the natural from the artificial conditions. If these far-reaching, and no doubt permanent, results attend the planting, on few occasions, of small numbers of fry in waters to which the fish are not indigenous, is it not permissible to assume that much more striking consequences must follow the planting of enormous quantities of fry, year after year, in native waters? There is no reasonable doubt that the perpetuation of the extensive shad fisheries in most of the rivers of the Atlantic Coast has been accomplished entirely by artificial propagation. On no other supposition can the maintenance and increase of the supply be accounted for.

The introduction of the striped bass was accomplished in 1879, when about 150 fish, a few inches long, taken in Shrewsbury River, New Jersey, were successfully carried across the continent and deposited at the mouth of the Sacramento River by an agent of the United States Fish Commission, cooperating with the California commission. Six or seven months later an example 8 inches in length was reported from Monterey Bay, 100 miles south of the locality where planted, and in eleven months another specimen 12½ inches long, and weighing 1 pound, was caught in San Francisco Harbor. This very rapid growth indicated the special adaptability of the waters of the region to this fish. In 1882 another plant, consisting of 300 fish, was made in the same region by the California authorities. As a result of these two small deposits, the species soon became distributed along the entire coast of California; its occurrence, however, in the other States of the region has not yet been determined.

The history of the striped bass is similar to that of the shad. It has attained considerable commercial importance, has increased steadily and rapidly, and is generally regarded as one of the best food-fishes of the coast. It has not yet attained anything like the abundance of the shad, nor was this to have been expected from the meager plants, but there seems to be no reason to doubt that it is only a question of time when it will become one of the most prominent economic fishery products of the region, as well as a favorite object of capture by sportsmen.

The largest quantities of striped bass are taken for market in San Francisco Bay with seines and gill nets. The fish are found in greatest numbers between October 1 and February 15, but occur in some abundance at all seasons. Their average weight is 8 or 10 pounds, but fish weighing 40 pounds are not scarce. The estimation in which they are held may be judged from the market value. In 1888 the ruling price in San Francisco was $1 a pound; in 1892, owing to an increased production, it had dropped to 12½ cents. The catch in the latter year was about 43,000 pounds, for which the fishermen received $5,350. The aggregate yield to date may be estimated at nearly 100,000 pounds, with a value at first hands of about $18,000. The transportation of striped bass to the Pacific being undertaken conjointly with that of a number of other fishes, it is probable that the proportional cost of introduction was not more than a few hundred dollars.

THE MACKEREL FISHERY.

The chief interest centering in this fishery during the year 1892–93 depended on the great activity which at times characterized the operations of the fleet on the New England shore in 1892 and on the renewal of the southern fishery in the spring of 1893.

The fishing season which terminated in the fall of 1892 was, on the 5
whole, the most successful since 1888. The number of vessels constituting the fleet was about 200. The catch of salt mackerel was reported to be about 47,000 barrels, against 38,000 barrels the previous year. The quantity of fresh mackerel taken was about 40,000 barrels. The total value of the catch was about $1,000,000. Early in the season a 6
large body of fish was found on the Nova Scotia shore, and some profitable fares were landed from that region. Later, fish were found in comparative abundance on the Maine coast, where the largest part of the season's catch was obtained. In August the fish disappeared from that section and were absent during the whole of the following month. Some good-sized fares were afterwards landed from Block Island. A small fleet entered the Gulf of St. Lawrence; 15 vessels are reported to have taken about 2,200 barrels of salt mackerel in that body of water.

After a lapse of five years the southern spring mackerel fishery was resumed in 1893 and constituted one of the most interesting features of the New England fishing industry during that year. The law which 7
prevented the prosecution of this fishery between 1888 and 1892, inclusive, was one of the very few legislative measures affecting the fisheries which had been enacted by the United States Congress, and as such it attracted much attention. The full text of the so-called close-time mackerel law was as follows:

An act relating to the importing and landing of mackerel caught during the spawning season.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the period of five years from and after the first day of March, eighteen hundred and eighty-eight, no mackerel, other than what is known as Spanish mackerel, caught between the first day of March and the first day of June, inclusive, of each year, shall be imported into the United States or landed upon its shores: *Provided, however,* That nothing in this act shall be held to apply to mackerel caught with hook and line from boats, and landed in said boats, or in traps and weirs connected with the shore.

SEC. 2. That section forty-three hundred and twenty-one of the Revised Statutes is amended, for the period of five years aforesaid, so as to read before the last sentence as follows: "This license does not grant the right to fish for mackerel, other than for what is known as Spanish mackerel, between the first day of March and the first day of June, inclusive, of this year." Or in lieu of the foregoing there shall be inserted so much of said period of time as may remain unexpired under this act.

SEC. 3. That the penalty for the violation or attemped violation of this act shall be forfeiture of license on the part of the vessel engaged in said violation, if a vessel of this country, and the forfeiture to the United States, according to law, of the mackerel imported or landed, or sought to be imported or landed.

SEC. 4. That all laws in conflict with this law are hereby repealed.

Approved, February 28, 1887.

On the approach of the usual time for starting on the southern cruise for mackerel, a large fleet of vessels from Gloucester, Portland, and other New England ports sailed for the grounds off the Virginia and Delaware coasts, where fish were sighted in due time. Large schools were reported from time to time, but they consisted mostly of small individuals which were turned loose when caught. A few vessels made satisfactory fares which realized good prices and encouraged others to continue the search for fish. The season closed, and the fishery passed into history generally regarded as a failure. A few thousand barrels of fresh mackerel were landed and a few hundred barrels of salt fish were saved, but many of the vessels failed to secure any fish whatever, and only a few paid expenses. The season was remarkable for the extremes of sizes represented by the fish landed. Some of the fares consisted of fish that averaged considerably larger than had been taken south during any recent years, while a cargo of 25 barrels of mackerel brought into New York was made up of smaller fish than were ever before sold in that market, 2,500 to 3,000 being required to fill a barrel.

THE NEW ENGLAND GROUND-FISH FISHERIES.

The important bank fisheries for cod, haddock, hake, cusk, and halibut were followed with the usual vigor during the year, and the catch, on the whole, was fully up to the average in recent years, while the price and demand were regarded as all that could be expected.

For several years the Grand Banks had shown a marked decrease in the abundance of cod, resulting in many broken voyages and considerable pecuniary loss to fishermen and owners. A much smaller fleet than usual was consequently sent out in 1892, and only about a dozen vessels from Provincetown, Mass., and Bucksport, Me., in addition to the comparatively large fleet from Gloucester, Mass., have represented the United States on these banks. Contrary to the general expectation, in 1892 cod were again found in great abundance on the Grand Banks. Nearly all of the Gloucester fleet made two trips, returning each time with full fares, and the aggregate catch was larger than during any year since 1887. Halibut were found in about their usual numbers. While during the past three years there was a slight tendency toward an increase in numbers, the fish are much scarcer than they were eight or ten years ago.

Georges Bank, the most celebrated fishing-ground off the coast of New England, continues to be the chief resort for the large fleets hailing from Gloucester, Boston, Provincetown, and other ports, especially those vessels engaged in supplying the increasing demand for fresh salt-water fish. During the spring the catch of cod was light, but in the fall the fish were more abundant. Haddock were more numerous than for many years. Many vessels, returning after a few days' fishing, brought from 80,000 to 100,000 pounds of fresh fish, chiefly haddock. The market was often overstocked with haddock, and the surplus had to be cured.

A somewhat interesting phenomenon attended the operations of the vessels frequenting Georges Bank. During the great abundance of haddock on Georges Bank cod were very scarce on the same grounds. This, in the opinion of many fishermen, was owing to the habit of throwing the offal overboard, thus covering the feeding-grounds and driving the cod away, although why the haddock were not also affected by the offal is not clear. During the scarcity of cod on Georges they were unusually plentiful on Cashes Bank and Jeffreys Ledge, adjoining grounds.

REPORT ON THE PROPAGATION AND DISTRIBUTION OF FOOD-FISHES.

By S. G. Worth, *Acting Assistant in Charge.*

INTRODUCTION.

In the Report proper of the Commissioner, pp. 6 and 14, reference may be found concerning the appointment of Dr. Tarleton H. Bean as assistant in charge of the Division of Fish-Culture, and also Dr. Bean's subsequent appointment as United States Fish Commission representative at the World's Columbian Exposition, Chicago, Ill. The performance of duties incident to the Exposition caused Dr. Bean to be absent from the Washington office after January 15.

Duties devolving upon the acting assistant, additional to those of the office of the Division of Fish-Culture, consisted in the installation of shad-hatching operations at Battery Island Station, the supervision of Central and Bryan Point stations, the preparation of artificial fish eggs for illustrating the hatching of eggs of a semi-buoyant and floating nature at the World's Fair, Chicago, the adaptation of a baggage car for transporting fishes in water oxygenized on a new plan, namely, with air circulation, and assisting the Commissioner in preparing for and conducting his experiments for solving in advance the value of salt water wholly artificial in character as the medium for exhibiting marine animals and plants in a live state at Chicago. There was also large expenditure of time and individual labor as a member of the civil service board of examiners of the Fish Commission.

STATION OPERATIONS.

The stations operated during the year were:

Schoodic Station, Maine.
Craig Brook Station, Maine.
Green Lake Station, Maine.
Gloucester Station, Massachusetts.
Woods Hole Station, Massachusetts.
Delaware River Station (steamer *Fish Hawk*).
Battery Island Station, Maryland.
Bryan Point Station, Maryland.
Central Station, Washington, D. C.
Fish Ponds, Washington, D. C.
Wytheville Station, Virginia.
Put-in Bay Station, Ohio.
Northville Station, Michigan.
Alpena Station, Michigan.
Duluth Station, Minnesota.
Quincy Station, Illinois.
Neosho Station, Missouri.
Leadville Station, Colorado.
Baird Station, California.
Fort Gaston Station, California.
Clackamas Station, Oregon.

SCHOODIC STATION, MAINE (CHARLES G. ATKINS, SUPERINTENDENT).

The fiscal year opened with 50,000 landlocked salmon in the rearing-troughs, the hatching of the April preceding. The losses amounted in July to 106 and in August to 1,346. Late in August about 48,000 were liberated in Grand Lake and its outlet. In September all property was stored, the services of employees discontinued, and subsequently such part of the apparatus as was deemed of value transferred to the Craig Brook Station, work being permanently stopped, and further operations with the landlocked salmon conducted at Green Lake Station.

CRAIG BROOK STATION, MAINE (CHARLES G. ATKINS, SUPERINTENDENT).

Some minor but important constructions during the year made this station almost perfect for the hatching and rearing of salmonidæ.

Atlantic salmon.—The most important departure in fish-cultural methods was in the disposition, widely apart on the lawn, of stands of rearing-troughs fed by water of different origin, the object being to prevent the recurrence of a wholesale spread of disease like that of the preceding year, and, in the event of the reappearance of unfavorable symptoms, to determine, if practicable, the underlying cause and the measures favorable to its eradication. No unfavorable developments occurring, the seat of former attacks remained undiscovered.

The collection of eggs was again effected, in cooperation with the authorities of the State of Maine. There had been purchased in June, 1892, and confined in the inclosure at Dead Brook, 222 adult fish, of which number 170 were available in October and November, 108 being females. The result in eggs was 1,108,500, of which 1,025,000 were alive in February when division was made, the portion of the Maine commissioners being 565,000 and that of the United States 460,000; of these latter, there were shipped as follows:

Date	To whom shipped.	No. of eggs.
Jan. 25, 1893	E. B. Hodge, fish commissioner, Plymouth, N. H.	50,000
Jan. 25, 1893	F. Mather, superintendent, Cold Spring Harbor, N. Y.	75,000
Feb. 16, 1893	R. E. Follett, superintendent, Lime Rock, Conn.	108,000
Feb. 19, 1893	United States Fish Commission Station, Green Lake, Me.	10,000

The remainder, 217,000, were applied to hatching and rearing. The Maine commissioners being desirous of devoting a portion of their quota of eggs to further stocking the Penobscot River, arrangements were effected for developing and hatching at the station as many of their stock as 200,000, they providing the additional labor and supplies requisite to meet the increased demands. These authorities subsequently donated 84,000 fry to the United States.

Forty-three salmon, resulting from eggs taken November, 1887, yielded in November, 1891, about 12,000 eggs, and in November, 1892, produced about 23,000 eggs. As the parent fish from the fry stage had been continuously held in fresh-water ponds of the station, thereby becoming acclimated and successfully reproducing their kind, the experiment is not without interest. A portion of the 23,000 eggs perished and 10,000 were shipped to the Green Lake Station, those remaining being applied to hatching. The resulting fry, estimated at 5,000, were represented by 2,000 survivors June 30, 1893. Of the total of 2,010 surviving Atlantic salmon on hand as fingerlings June 30, 1892, from the hatching of 305,000 eggs in April of that year, 1,100 were from eggs of the acclimated parents, and of the 1,448 subsequently liberated in November, 696 were of this kind. At the date of the liberation referred to, as many as 500 were remaining as a reserve, but these were reduced to 156 by the following June.

Landlocked salmon.—From fish reared 9,800 eggs were taken in November, and from wild fish captured from Toddy Pond 4,200 were secured. It is believed that the spawning fish in Toddy Pond were the large ones liberated from the Craig Brook Station in the spring of 1892. Egg losses were rather large.

Brook trout.—Fourteen thousand eggs were taken from fish reared in station ponds. The hatching is shown in tabular statement.

Rainbow trout.—The thirty adult fish held in ponds were reared at the station, having been hatched in 1889 from eggs received from the Northville Station, Michigan. In the spring of this year they, for the first time, evinced a tendency to spawn, eggs being taken March 15 and 16 to the number of 10,000. The eggs were inferior, and during the year there were seventeen deaths among the brood stock.

The statement below, based on close estimates, represents eggs of various species employed in hatching, and shows the results up to a period when all except the rainbow trout were taking food:

Kind.	Number of eggs.	Results in fry.		
		Hatched.	May 31.	June 30.
Atlantic salmon	227,300	226,800	a 290,000	257,500
Atlantic salmon acclimatized	13,400	6,800	5,000	2,000
Landlocked salmon	14,000	11,900	11,000	7,000
Brook trout	13,600	13,300	10,000	9,000
Rainbow trout	10,100	2,000	1,900	1,000
Total	278,400	260,800	317,900	276,500

a Increase effected by presentation, about June 1, of 84,000 by the Maine authorities.

In July the growing of fly larvæ was resumed, these with chopped meats comprising the food of the fish. Later in the summer experimental trials were made in the capture of grasshoppers, to determine their relative cost and food value, natural food having so far been found most desirable.

Losses sustained in the preceding year, from the causes mentioned, among fishes to be subjected to rearing, were so great that the numbers remaining on hand at commencement of the year, July 1, 1892, were comparatively small, as follows: Atlantic salmon, 2,010; landlocked salmon, 19,538; brook trout, 39,531; whitefish, 442; total, 61,521. From these, distribution of 52,713 was made, as follows:

Kind.	Date.	Number.	Place.
Atlantic salmon	November, 1892	1,448	Alamoosook Lake.
Landlocked salmon	July, 1892	999	Commodore Club, Hartland, Me.
Do	October, 1892	8,256	Toddy Pond, Orland, Me.
Do	June, 1893	7,776	Do.
Brook trout	July, 1892	1,970	Commodore Club, Hartland, Me.
Do	October and November, 1892	27,564	Alamoosook Lake.
Do	January, 1893	3,000	Otter Creek, Proctor, Vt.
Do	February, 1893	500	John McDonald, Amherst, Me.
Do	March, 1893	1,200	Beaver Pond, Proctor, Vt.

Of older fishes of various kinds brought over, there were 433, in addition to 199 adult sea salmon purchased jointly with the Maine commissioners from the Penobscot River catch, the latter having been confined in the inclosure at Dead Brook to await maturing of their eggs in November of this fiscal year, when they were manipulated and returned to open waters. Besides 276,500 fish in process of rearing, shown in a preceding table, there were on hand at the end of the year 242 wild Atlantic salmon, purchased in June as prospective spawners, and also those species enumerated in the subjoined statement:

Kind.	Year when hatched.					
	1892.	1891.	1890.	1889.	1888.	1888 and 1889.
Atlantic salmon	156		34		33	
Landlocked salmon			29			26
Brook trout	14			28		
Rainbow trout				13		
Loch Leven trout			49			
Swiss lake trout			29			
Scotch sea trout		63				
Von Behr trout		47				
Saibling			1			
Whitefish	1					
Total	171	110	142	41	33	26

Meteorological data of the year is presented in condensed form below. The water used at the hatching-house flows through a conduit having connection with the brook at a point above the sources of the springs. Pond B, referred to in table, being situated below the hatchery, receives a mixture of brook and spring water. It is a small pond, which, till May, 1893, accommodated the Atlantic salmon previously referred to as having been acclimated. The north stand of rearing-troughs, outdoor situation, is fed from above the hatchery, receiving commingled waters of brook and springs. Alamoosook Lake, a body of fresh water about 5 miles long, on the bank of which the station is located, became closed by ice formation December 12, and was not again open until May 1. On February 10 the ice measured 28½ inches, and was crossed by teams December 25 and April 8. Early in December exposed water conduits were protected by a covering of hay, boards, and evergreen brush, and toward the end of the month the two ice-houses were filled from the lake. The observations on which the table is based were made daily, at 7 a. m. and 2 p. m., omissions in June being incident to shutting off water for repairs:

Month.	Temperature, Fahrenheit.												Precipitation in inches.	
	Air.			Water.										
				Hatchery.			Outlet of Pond B.			Supply of north stand troughs				
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Rain.	Snow.
July	91	53	70.8	74	58	67.4	72	55	63.5	67	54	59.8	1.6	......
August	89	52	68.8	75	64	69.6	73	59	65.2	68	56	62.2	4.5	......
September	73	42	60.2	68	58	64.3	67	54	62	65	54	61.3	4.8	......
October	68	26	45.5	60	47	53.5	59	46	52.2	59	47	52.3	1.1	......
November	61	18	37.2	48	38	43.8	52	39	44.5	52	40	45.2	4.2	......
December	43	— 6	20.6	40	32.5	35	43	32.5	36.6	44	36	39	1.3	3.5
January	42	—12	13.1	36	32.5	33.2	39	32.5	34.7	40	35	36.4	2.6	7.5
February	42	— 8	17.4	35	32.5	33.1	38	32.5	34	40	34	36	1.5	32.6
March	48	— 4	27.6	37	32.5	34.4	42	32.5	36	42	34	37	1.2	2
April	59	18	38.6	46	35	38.7	49	34	40	50	34	40	.9	8
May	81	39	54.7	59	39	45.7	57	39	46	56	39	47.7	2.8	......
June	84	52	65.6	......	......	......	......	......	......	64	50	58	2.6	......

GREEN LAKE STATION, MAINE (H. H. BUCK AND SEYMOUR BOWER, SUPERINTENDENTS).

This station being new and incomplete, the year opened with improvements in progress. Mr. H. H. Buck was in charge until August 31, his resignation having been tendered in April, but remaining unacted upon owing to delay attending the selection of an efficient successor. He was followed by Seymour Bower, who was appointed from the foremanship of the Put-in-Bay Station, Ohio, and arrived for duty September 12. Mr. Bower's services, however, being solicited by the commissioners of Michigan, he tendered his resignation May 8, in order to accept the superintendency of the fish-cultural operations of that State. Owing to the inconvenience of providing a competent successor, Mr. Bower's services were retained until June 30. On his departure affairs were temporarily put under direction of the foreman, W. H. Munson.

Fry resulting from the April hatching and on hand at beginning of the fiscal year, by estimate, were as follows: Landlocked salmon, 60,000; Loch Leven trout, 16,000; Von Behr trout, 10,000; total, 86,000.

During July they underwent but little loss, but in August many deaths occurred. In September active measures were instituted with a view to checking the mortality. The changes were in the nature of increasing the depth of water in the rearing-troughs from 2½ to 4 inches, daily cleaning with scrub brushes and salt, increasing the flow of water through troughs, and more systematic and careful feeding. The numbers, by count, in December were but 4,903 landlocked salmon, 1,805 Loch Leven trout, and 1,252 Von Behr trout. Subsequent losses were trifling, there being but 14 dead removed in the four months following. The maximum water temperature in July was 82° F., in August 70°, and in September 68°. During the four months' period just referred to there were no deaths among the 3,800 landlocked salmon hatched in April, 1891, held in the reservoirs. On May 5 the fish of April, 1892, were again counted and transferred from rearing-ponds to new earth ponds, the numbers being, landlocked salmon, 4,656; Loch Leven trout, 1,688; Von Behr trout, 1,042; total, 7,386.

In April there were shipped alive to the World's Fair by Car No. 3 100 of each kind of trout and 300 of the salmon; also, 200 of the salmon of 1891. Other specimens sent consisted of 9 wild adult brook trout, 4 wild adult salmon, and a small collection of smelt from Green Lake. The only fish liberated, and these by accident, consisted of 500 of the younger salmon, which escaped into Green Lake November 16 through the misplacement of a screen. On December 14 there were 19 small German carp sent to the station by Dr. W. M. Haines, of Ellsworth, and liberated in Great Brook, tributary to Green Lake.

Landlocked salmon.—The salmon of Green Lake, averaging 6 pounds in weight, ordinarily spawn in the inflowing streams, but some pass through the outlet and lay their eggs below in the waters of Reed Branch, as was this year definitely proved. When the spawning period arrives during the seasons of drought, the affluents being low, the fish will not pass up, but remain in the lake. To induce them to ascend Great Brook at such times it is necessary to resort to artificial flushing, and there being facilities on the headwaters for accomplishing this, success has been attained. Mountainy, the uppermost pond, 5 miles distant, is used as the flushing reservoir, the system pursued consisting in opening gates about 2 p. m., creating a large flow throughout the night. The rainfall in September and October having been slight, there was by November 1 barely sufficient water for this purpose and the station proper. Great Brook was the only affluent affording adult fish, though in October many were seen jumping near the mouths of other inlets.

Egg collections being wholly dependent on wild fish, arrangements for capture were effected in September, at which time the slat traps in Great Brook were repaired, another obstruction being put in position at the discharge of Mann Brook. Two others were located at the lower end of the lake, one just inside, for the capture of outward-moving fish, and the other in Reed Brook, about a mile below, for the capture of fish ascending. Wire screens were, in November, placed in the gateways at the discharge of the lake to prevent fish escaping. Before the screens were inserted as many as 100 young salmon from 6 to 10 inches long were at one time seen below the dam.

The aggregate catch was 152, Great Brook furnishing 83 and the lake outlet trap 69. Of the captures at Great Brook trap, 53 were females; of those from the outlet of the lake, the females numbered 26. One salmon bearing "No. 2" tag, attached in 1890, was taken. The first capture, on September 27, consisted of two males and three females. On October 31 the first eggs of the season, 12,000 in number, were obtained. The largest success at the outlet of the lake was November 4, when 14 fish were taken, 8 of the 9 females affording 22,000 eggs of good quality. The most successful day was November 9, when 31,500 eggs were taken from fish held in the Great Brook traps. The last eggs were taken November 23, and the next day all parent fish were set free in the lake, the total of eggs for the season being 213,300. An inspection of the stream feeding Mountainy Pond was made in October, and also that connecting Mountainy and Rocky ponds in November, to determine the presence of available spawners, but no indications were found.

The eggs acquired were of superior quality, only 9,000 having been discarded by December 31, when the outlines of the embryos were clearly visible. It was anticipated that more than 200,000 would hatch, but on January 15 an unexpected death rate was encountered and its continuance for a month materially reduced the stock. A minute white spot on the egg resulted, in the course of two days, in a growth of fungus. The source of fatality is charged to careless handling in the process of picking, when the eggs were exposed to the higher air temperature of the room for unnecessarily long periods. On April 5 all were carefully washed, picked, and spread evenly on 81 trays, and the contents of several trays being ascertained by counting, the whole number was found to be 166,000. Hatching was observed as early as April 8, and at the end of the month no eggs remained. A subsequent table indicates the success attending the stock in the fry stage.

Brook trout.—Egg collections were from wild fish taken from Winkempaugh Brook, a tributary of Branch Pond, 10 miles distant. On October 19 two employees, provided with equipment for establishing a trap to arrest the progress of ascending fish, were dispatched to the scene. The trap was at once put in place, and eleven days after 1 male and 10 females were taken, from 5 of which, then ripe, 10,000 eggs were secured, these being delivered at the station the same day. The weight of one of these fish was about 5 pounds. During one night, about the middle of November, 34 female trout were taken. The ineffective arrangement of the trap permitted nearly all male fish to escape, and this, together with injuries sustained from the cutting of minks and muskrats, and a sudden freshet, led to the unobstructed passage of probably two-thirds of all fish ascending. There were 72 females captured, a portion of which escaped before their eggs were stripped. The Winkempaugh trout are the genuine *Salvelinus fontinalis*, ranging in weight from 2 to 5 pounds, and exhibiting brilliant markings. The collection of eggs amounted to 109,400, of which 8,500 were treated with milt of landlocked salmon without result. Besides the above, a few unproductive eggs were acquired from fish captured in the Great Brook traps. The eggs in development turned out poorly, as a result of defective fertilization, the greater portion being discarded by December, many of those remaining showing up as "ringers."

Other trout eggs.—Eggs additional to those already mentioned were in the nature of express consignments, represented below:

Date.	Kind.	Number.	Whence derived.
Jan. 18..	Atlantic salmon	10,000	Craig Brook Station, Maine.
23..	Von Behr trout	50,000	Northville Station, Michigan.
28..	Lake trout	50,000	Do.
28..	Loch Leven trout	30,000	Do.

On arrival there were dead, of the first three kinds named, 8, 13, and 16, respectively. A consignment of rainbow trout eggs arrived February 6 from Neosho Station, all having perished en route from delay consequent upon a railroad accident.

Fry.—All eggs were hatched in April and the fry were in good condition, except Atlantic salmon, and the parentage of this lot is mentioned under the heading of Green Lake Station. In order to accommodate and successfully care for the young fish in process of rearing, it was necessary to erect, in advance of more permanent constructions, a temporary outdoor stand containing 46 troughs. These, with 38 half hogsheads, arranged at the same point, and the interior troughs of the hatchery, afforded 126 receptacles. The supply conduit, 7,050 feet long, was ventilated by the removal of boards at more than 300 points, and for still more complete aëration 25 breakwaters were inserted. The flow was increased to permit the employment of 15 to 25 gallons of water per minute to each trough and tub. Four temporary ponds, to receive the waste of outdoor receptacles, were among the preparations.

Supplies of food, consisting principally of liver, were obtained at Bangor instead of Ellsworth at a reduced rate of cost. The older fry began feeding May 12, all others following before the end of the month. The approximate stock of fry May 31, with losses, is given below:

Kind.	On hand May 31.	Discarded.	Percentage of loss.
Landlocked salmon	164,000	5,937	3.4
Brook trout	6,000	555	8.4
Von Behr trout	49,000	1,412	2.8
Lake trout	46,000	2,521	5.1
Loch Leven trout	29,000	786	2.7
Atlantic salmon	8,000	4,389	35

The only material loss during June was through the instrumentality of a parasite which attacked and destroyed the greater portion of the lake trout and a relatively smaller number of salmon. A report on this subject, by S. G. Worth, contained the following:

The lake-trout fry in rearing-troughs, both outdoors and under shelter, were undergoing a higher rate of mortality than any other species, their bodies being dotted with white spots. It had been found that the treatment with salt, termed "salting," had lowered the death rate, practically ending it, but no solution of the malady was given. My examination showed that the spots on an average were the size of a common fly speck, scattered irregularly over the bodies of the fish, on the foreheads, sides, tail, and fin bases, and even on the extremities of these appendages. The spots were white with a tinge of blue, the blue being due, perhaps, to sky reflection. They were easily removed by a knife blade and came off immediately on contact with cheesecloth hand-net.

The fish had been feeding poorly and at first I thought the spots were pimples resulting from intestinal inflammation—in other words, an eruption. This surmise was strengthened by the limp consistency of the pimples, some of which were pointed at their apexes, the general appearance being that of mucus. Upon detaching specimens they had the appearance of clabber (sour milk), and under a pocket glass of low power I found irregular watery markings, occupying, in some specimens, 25 per cent of the area. Upon examining them patiently I discovered a movement in one and later in another, and finally seven specimens on the pane of glass, as if recovering from the shock incident to detachment, were all in motion, circling around at the rate of one-eighth to one-fourth inch per second. Hence I inferred that the spots were animals, parasites, perhaps the larvæ of some insect.

It should be stated that, in the report just referred to, the statement is made that in June Mr. Davis, fish-culturist at the Green Lake Station, witnessed the killing of four landlocked salmon by a horse-leech in one of the interior hatching-troughs, the deaths occurring within a few minutes' time. The fish of all kinds on hand June 30, the end of the fiscal year, are represented in the statement below:

Kind.	Hatched in the year—		
	1893.	1892.	1891.
Landlocked salmon	164,000	4,656	3,700
Brook trout	6,000	....	....
Von Behr trout	49,000	1,042	....
Loch Leven trout	29,000	1,688	....
Lake trout	30,000	....	....
Atlantic salmon	8,000	....	....
Total	286,000	7,386	3,700

The station being about 4 miles from the railroad point, and the traps at opposite ends of the lake being several miles apart, connection was established by renting a small steam launch belonging to the Reed Pond Land and Navigation Company. On the breaking of the launch's shaft, November 5, the station horse and small boats were used instead.

In December the air temperature on three or four mornings dropped below zero, the water in the hatchery descending as low as 34° F., the maximum for the month being 38°. An increased flow of water through the supply conduit, as a general protection against freezing, caused overflowings and the formation of heavy icicles upon trestlings where the ravines are spanned, requiring at times much labor in cutting away the accumulations. The first snow permitting sleighing fell January 10. Connection with the post-office was effected daily by sleigh over the ice on Green Lake after January 5, continuing until late in April, the ice being melted May 12, when steam-launch service was resumed. The air temperature in January was as low as −14°, the water in the hatchery ranging from 34° minimum to 36.5° maximum. In February one snow-fall of 27 inches occurred. In that month a temporary structure was stored with 25 tons of ice of 24-inch thickness. The April water temperature was 37.5° minimum and 46° maximum. When the ice broke up in the lake, May 6, the water rose above the station wharf, but by the end of the month it had fallen over 2 feet. The minimum hatchery temperature for May was 44°, maximum 64°, average 54.5°. Toward the end of the year negotiations were pending for renting a larger boat for service on Green Lake.

Gloucester Station, Massachusetts (A. C. Adams, Master of the Schooner Grampus, in charge).

General overhauling of the station in preparation for the winter's operations commenced December 13, cold weather delaying this work considerably, the supply pump not being in readiness until January 10. The United States Fish Commission schooner *Grampus*, her crew acting as spawn-takers, was employed in making egg collections. Fish being scarce off Gloucester, the schooner was stationed the greater portion of the time at Kittery Point, Maine, where regular supplies of eggs of fair quality were obtained from January 13 to March 13. As usual, a small run of codfish, available for spawn-taking purposes, appeared off Gloucester in November, but fish were generally scarce here throughout the season, the few eggs obtained being from the schooner *Odd Fellow*. Early in January the upper harbor became filled with ice and the weather was so intensely cold that the steam condenser, the waste from which is employed to increase the water temperature, became inoperative on account of ice formation in the pipes.

The collections from Kittery Point were obtained from vessels fishing in Ipswich Bay, the price paid for good eggs being $5 per 1,000,000. The collections were transferred to the station by messenger over the railroad, the greater part arriving in good condition.

There were no eggs obtained except of the codfish, and the first of these were secured January 14. On that date the harbor temperature was 31°, the warm water overflow from the steam condenser, available at that time, increasing the temperature in the hatching-boxes by 3°. The shipments from Kittery Point in January were 12,202,000, February 18,408,000, and March 29,200,000. The total number received was 51,584,000, of which 49,831,000 were good. The fry produced amounted to 20,142,000, these being liberated in the waters adjacent, within a few days after hatching. Operations by months are indicated below:

Months.	Eggs received.	Fry produced.
January	11,045,000	5,150,000
February	15,019,000	7,328,000
March	23,767,000	7,664,000
Total	49,831,000	20,142,000

On April 13 there were also received 1,753,000 eggs, of which 1,195,000 remained on hand unhatched when the station was closed, these being placed overboard.

This was a clear-water season until February 10, when a violent storm occurred, filling the water with sediment. There was less uniformity in the hatching of eggs and the fry were weaker than in the best seasons. The poorer quality of hatching was attributed to the low water temperature, which could not be controlled for the reason mentioned, but the larger portion of the fry were active, and the poorer lots—those which failed to straighten—were not included in the record of those distributed. One lot of eggs, February 16, consisting of 2,000,000, produced 76 per cent of fry.

Alcoholic collections of eggs and embryo fishes were prepared and transferred to the general office for use at the World's Fair. On April 17 the station was closed, Mr. E. F. Locke, fish-culturist, being left in charge of property.

WOODS HOLE STATION, MASSACHUSETTS (JOHN MAXWELL, SUPERINTENDENT).

Operations were on the usual basis, fish-cultural work consuming about eight months of the year. A large amount of interesting and valuable material, consisting of marine fishes, crustaceans, plants, etc., was collected April 1 to June 30 for transfer to the aquarial exhibit at Chicago. About 9,000 living animal forms were transferred, these representing 40 species. The lobsters were crated in seaweed. Large alcoholic collections were also made.

Codfish.—This was a poor season for hatching codfish. On October 27 the *Grampus* was detailed to make collections of adult fish, but between the date named and December 28 the total amounted to but 41. In order that success might be secured, Mr. Vinal N. Edwards, the collector at the Woods Hole Station, was sent out as pilot, but the great draft of the *Grampus* prevented successful handling in shoal water, where cod were most abundant. Numerous trips were made to Block Island, Nantucket Shoals, and Browns Ledge, but fish were too scarce to afford success. Eventually a contract was entered into with private parties engaged in fishing, and by purchase 275 additional fish were obtained, a total for the season of 316. On January 1 the *Grampus* sailed for Gloucester, operating there the remainder of the winter.

The total of eggs obtained was 2,883,000, taken December 13 to January 5 from 20 fish. The fry produced amounted to 850,500, a fraction over 29 per cent. It will be noted that this winter was one of unusual severity, and on January 6 a sudden change in temperature reduced the harbor water from 31° to 29°, causing the death of all adult codfish held in the inclosures awaiting the ripening of their eggs. The fish thus killed amounted to 204, and operations were abruptly terminated. Many of the fish in the harbor were killed, among them cunners, tautog, and eels. The statement below represents the work with codfish somewhat in detail:

Date.	No. of eggs taken.	No. of fish produced.	Per cent of fish produced.
December 1	370,900	175,000	47
2	278,200	Died Jan. 16	....
3	208,400	Died Jan. 20	....
4	510,000	225,000	44
5	1,066,300	400,000	37
6	273,900	50,000	18
7	50,000	Died Feb. 1	....
January 8	50,000	Died Jan. 28	....
9	75,000	Died Jan. 28	....

The eggs hatched in periods of 552 to 904 hours, in a temperature varying from 31.25° to 33.75°.

Flatfish.—Parent fish of this species not being obtainable in large numbers, the amount of work done was limited. Only 17 spawning fish were obtained, March 20 and 22, the eggs amounting to 461,000 and the fry to 288,000. The period of hatching ranged from 552 to 576 hours, in temperature of 37.5°.

Lobster.—This was the most successful season of production, the operations extending from April 15 to June 22, affording 702 egg-lobsters, from which were obtained 10,037,000 eggs. The former practice of obtaining lobsters by the agency of the station employees was continued only in part, 86 lobsters being secured in this way, the remaining 616 by purchase. The buying of egg-lobsters out of season was made possible by the regular appointment of the superintendent of the station as a deputy for the enforcement of the fishery protective laws of the State of Massachusetts. This appointment came through Hon. E. A. Brackett, chairman of the board of commissioners of fish and game, and authorized purchase by the United States Fish Commission, the conditions being that all egg-lobsters should be returned alive to the water after removal of eggs and while being held for manipulation they should be kept in live cars bearing the names of the United States Fish Commission and the fish commission of the State of Massachusetts. The 86 lobsters captured by employees produced 895,000 eggs, the others 9,142,000. The young, liberated at the age of 24 to 48 hours, amounted to 8,818,000. In addition to the above there were liberated in July, 1892, 1,100,000, hatched from eggs collected in June of the preceding fiscal year.

The lobsters obtained by purchase were principally from the vicinity of Gay Head, weights running from 4 to 9½ pounds each, the price paid to fishermen being 5, 8, and 10 cents per lobster. A statement of operations by months, on a basis of 6,090 eggs to the fluid ounce, is given below:

Month.	No. of lobsters stripped.	No. of eggs obtained.	Egg yield per individual.		
			Greatest.	Smallest.	Average.
April	55	596,000	18,200	3,045	10,840
May	207	2,691,000	39,500	3,045	12,990
June	440	6,750,000	85,200	3,045	15,340

The time required for hatching under varying water temperatures is indicated below:

Month.	No. of hours hatching.	Temperature.
April	46 to 56 hours	51° to 53°
May	15 to 43 hours	53° to 59°
June	14 to 27 hours	59° to 66°

Mackerel.—Only three spawning fish were obtained, these by station employees, June 14. The yield of eggs was 434,500, which produced 368,000 fry. In a temperature of 62° the eggs hatched in 77 hours.

Sea bass.—Only nine spawning fish were obtained, these being captured by station employees on June 21. The eggs, numbering 1,332,000, hatched in 76 hours in a temperature of 63°, producing 1,189,000 fry.

In May and June investigations were made for the purpose of acquiring a more complete knowledge of spawning habits of the menhaden.

The plantings of young fish of all species during the year were made in neighboring waters, principally in Vineyard Sound.

The average temperature of water and its density were as follows:

Month.	Mean temperature.	Mean density.
December, 1892	37.9	1.0256
January, 1893	29.5	1.0256
February, 1893	29.4	1.0258
March, 1893	32.7	1.0256
April, 1893	41	1.0255
May, 1893	51.2	1.0255
June, 1893	61.2	1.0255

COLD SPRING HARBOR STATION, NEW YORK (FRED MATHER, SUPERINTENDENT).

The operations of this station had been jointly conducted by this Commission and that of New York, of which latter it was the property. The reduction made by Congress in the appropriations for the work necessitated a curtailment of expenses, and the association of the two commissions was discontinued with the close of July, 1892.

DELAWARE RIVER STATION (LIEUT. ROBERT PLATT, U. S. N., IN CHARGE).

In pursuance of the usual practice, the United States Fish Commission steamer *Fish Hawk* was employed in the propagation of shad on the Delaware River. This steamer during the greater portion of the year was occupied with special investigations concerning the oyster, etc., but on May 12 arrived at Gloucester City, N. J., to take up shad hatching. As in former years, the egg-collecting and the manipulation necessary to development and hatching were conducted by the crew of this steamer. The period of operations, May 15 to June 2, was rather more brief than usual, and the number of eggs collected was relatively small, as was the case also on the Susquehanna and Potomac rivers. The aggregate obtained and the numbers from separate fisheries were: Howell's Cove fishery, 4,540,000; Faunce's fishery, 3,751,000; Bennett's fishery, 2,117,000; Gloucester Point, 45,000; total, 10,453,000.

To obtain these, 233 shad were stripped, the average number of eggs per fish reaching nearly 45,000. Between May 23 and June 7 the fry were liberated, 1,573,000 being transferred to the Hudson River and 5,349,000 to the Delaware.

With the exception of May 23 to 26, the water was muddy. Temperature for May, maximum 68°, minimum 59°, mean 63.83°; for June, maximum 71°, minimum 67°, mean 68.20°.

On May 26 the eggs of a scale carp, obtained from the river, were taken and placed in a universal hatching jar, the fry therefrom appearing in 85 hours. The commercial fishermen at that time took quantities of carp which sold readily on the shores at 8 cents per pound.

In March and April, just prior to taking up shad-hatching, the *Fish Hawk* was engaged in the lower part of the Chesapeake Bay, capturing, with beam-trawl and otherwise, marine specimens, animal and vegetable, for the Fish Commission aquarium, World's Fair, Chicago.

BATTERY ISLAND STATION, MARYLAND (W. DE C. RAVENEL, SUPERINTENDENT).

The superintendent having been assigned to temporary duty in connection with the Columbian Exposition, the services of Mr. E. M. Robinson, a former employee, were engaged for conducting shad operations during April, May, and June. On April 25 spawn-takers entered the field, but the extremely cold winter preceding caused the season to be a backward one, and the water remained cool throughout the period of operations. In addition to the low temperatures, freshets filled the water with driftwood, fishermen being unable to operate much of the time. The worst visitation by muddy water occurred May 6, which was in the middle of the period when eggs are most abundant. As a result of unfavorable conditions, collections were very light between April 30 and May 10. Results are shown, by months, below:

Month.	Eggs collected.	Eggs transferred.	Retained for hatching.	Lost in station.	Fry produced.	Per cent hatched.
April	7,707,000	553,000	7,154,000	3,615,000	3,539,000	49.4
May	43,341,000	2,695,000	40,646,000	15,678,000	24,968,000	61.4
June	3,779,000	....	3,779,000	1,141,000	2,638,000	69.8
Total for season	54,827,000	3,248,000	51,579,000	20,434,000	31,145,000	60.3

Of eggs shipped, 553,000 were transferred to Central Station by messenger April 28, to be used in making up a shipment for the illustration of hatching methods at the World's Fair. There were shipped by car No. 3, 1,708,000 for the waters of the Congaree River, South Carolina, the eggs being hatched en route. An additional consignment of 987,000 was made by car No. 3 to Dighton, Mass., for streams there, the fry being hatched on the car. Low temperature of water prevented eggs from developing in the time usually required, many remaining unhatched for ten or twelve days, and the fry from such, being too weak for distant transportation, were liberated in waters adjacent. Those so liberated amounted to 10,874,000.

The water temperatures from April 25 to June 6, compiled from observations morning, noon, and night, are set forth below:

Month.	Max.	Min.	Mean.
April	54	42	49.7
May	70	51	60.1
June	75	64	69.5

It was noted that carp were very abundant in the waters, and several reports of large numbers captured were brought in. On May 31 there was a capture of 2,700 pounds reported in a single haul of a seine.

On June 9 the temporary employees were dispensed with, operations ceasing, and on June 26, property having been inventoried and stored, the station was turned over to R. A. Davis, custodian.

BRYAN POINT STATION, MARYLAND (S. G. WORTH, SUPERINTENDENT).

Preparations for the opening were made by Mr. L. G. Harron, superintendent of aquaria, but his services being required in connection with the maintenance of aquaria at Chicago, he was ordered away early in the season. From that time the immediate supervision of the station was under W. T. Lindsey, custodian, the superintendent being detained at the general office in Washington by temporary assignment.

The cold of the winter preceding was almost unprecedented, and a poor fishing season followed. The running of ice in the Potomac seriously damaged the temporary wharf, and it was necessary to rebuild in the month of March. The river shore was not clear of ice until February 9. Employees were again quartered in tents, furnished by the courtesy of Gen. Albert Ordway, commanding the District of Columbia militia. The tents were ready for occupation April 9. The adoption of tent quarters became necessary on account of lack of buildings, but their use during three consecutive seasons has demonstrated that they are more desirable than one large building. Each tent accommodates two sleeping berths, and as the spawn-takers are usually paired off, and come in from their work at all hours of the night, it is found that by having sleeping quarters subdivided those who arrive early are less disturbed in sleep; moreover, from a sanitary standpoint it is found that tents are greatly to be preferred. As the weather is sometimes quite harsh during the shad-hatching season, even so late as in May, the tents were provided with heating stoves made of sheet iron, which, with the necessary piping and chimney pots, cost less than $2 each. By using shavings and finely split wood the tents could be warmed and made comfortable within two or three minutes' time.

On May 6 occurred the most severe freshet since 1889. Prior to this day the fishermen had a favorable outlook, the first gill fishermen having commenced operations as early as March 27, catching at that time 12 fish at a drift, and on March 31 some capturing as many as 22 at a drift. The results, however, were poorer than in some years. The seine operated by the Fish Commission was put overboard April 14, but, like all other fisheries, it was rather unproductive of eggs. The total results for the season were only 8,870,000. The eggs from all sources between April 17 and May 22, are shown in the statement below:

Bryan Point seine	939,000
Chapman seine	958,000
Tulip Hill seine	683,000
Stony Point seine	512,000
Gill fishermen	5,778,000
Total	8,870,000

Following the practice inaugurated more than ten years ago, eggs collected were transferred to Central Station, Washington, D. C., for hatching, consignments being made in crates by the Mount Vernon and Marshall Hall Steamboat Company's line, the April shipments amounting to 3,023,000, and those of May to 5,847,000.

In consequence of the poor success met with by commercial fishermen, operations were greatly reduced early in May, thereby bringing the season to an early close, and there being no productive work for the spawn-takers, two of the best-trained ones were transferred to Battery Island Station, that collections there might be increased if possible.

Water temperatures during the collecting season were as follows:

Period.	Maximum.	Minimum.	Mean.
	Degrees.	*Degrees.*	*Degrees.*
April 17-30	59	48	50.2
May 1-22	66	52	59

CENTRAL STATION, WASHINGTON, D. C. (S. G. WORTH, SUPERINTENDENT).

Following the assignment of the assistant in charge of the Division of Fish-Culture as the representative of the Fish Commission at the World's Columbian Exposition, the superintendent of Central Station, in addition to other duties, was temporarily placed in charge of the office of the Division of Fish-Culture. The history of operations with eggs handled is shown in the statement which follows:

Date	Kind.	Whence received.	Number of eggs. Consigned.	Number of eggs. Received alive.	Number of eggs. Transferred.	No. of fry furnished for distribution.
Jan. 19	Rainbow trout	Wytheville Station	15,000	15,000	15,000	
24	do	do	10,000	9,697		8,662
24	do	do	15,000	15,000	15,000	
23	do	Neosho Station	15,000	14,686		12,411
25	do	do	17,500	17,500	17,500	
30	do	do	20,000	19,960		17,927
Feb. 2	do	do	29,000	29,000	29,000	
6	do	do	23,000	23,000	23,000	
Apr. 28	Shad	Battery Island Station	553,000	430,000	430,000	
Apr. 21 to May 26.	do	Bryan Point Station	8,870,000	7,874,000	1,027,000	5,614,000
			9,567,500	8,447,843	1,556,500	5,653,000

The rainbow-trout eggs transferred were consigned as follows:

Date.	Consignee.	Number.
Jan. 19, 1893	Emil Warner, consul of Switzerland, Havre, France	15,000
26, 1893	do	15,000
26, 1893	R. T. Browning, fish commissioner, Oakland, Md	17,500
Feb. 2, 1893	Lloyd W. Delawder, fish commissioner, Baltimore, Md	29,000
6, 1893	U. S. Fish Commission Station, Wytheville, Va	23,000

The shad eggs from Bryan Point Station, situated on the Potomac River, opposite Mount Vernon, were conveyed to Washington daily, by special messenger, who received them on the Mount Vernon steamer at Marshall Hall wharf, where they were delivered by the steam launch engaged in collecting. The first consignment, April 29, from Central Station, consisted of 1,223,000, by car No. 2, for hatching in the fish-cultural exhibit at Chicago, the shipment being made up in part from 553,000 eggs taken at the Battery Island Station. The second consignment of 234,000, by car No. 3, May 14, was for South Carolina streams at Columbia. May 1 to 9, there were transferred 1,444,000 fry, the first of the season, to the fish ponds, Washington, D. C., the object being, as in former years, to have them reared to fingerling size before liberation.

The product of the United States fish ponds located in Washington, D. C., reaches public streams and applicants through Central Station, fish being consigned from the ponds as required, stored in tanks, and subsequently counted and placed in vessels suitable for transportation. Many are counted out in carload lots, sometimes placed in the tanks in bulk, at other times in pails containing 25 to 150 fish each. Numbers are also sent by express shipment to States nearest Washington. To obviate complaints, indicating that fish were removed while in transit, a system of sealing the pails was introduced. The method consisted in passing a string through the handle supports and two small rings soldered on the edges at points equally distant between the handles, when the free ends were slipped through the openings in the lead seal. The sealing was then effected by means of a hand press, in all essentials the same as those used for sealing doors of railway cars. This method was so favorably received that the order was made for presses for each of three special cars and the Neosho and Wytheville stations.

A summary of operations with fingerling and larger fish is represented in the statement below:

Kind.	Whence derived.	Number received.	Number shipped.
Leather carp	United States fish ponds, Washington, D. C	33,029	
Blue carp	do	2,122	
Scale carp	do	38,741	72,341
Mirror carp	do	26	
Spotted catfish	do	1,270	1,235
Tench	do	336	336
Golden tench	do	20	20
Golden ide	do	398	271
Goldfish	do	9,424	....
Do	Wytheville Station	3,815	11,926
Black bass	do	463	
Do	Quincy Station	25	34,867
Do	United States fish ponds, Washington, D. C	34,379	
Rock bass	Wytheville Station	950	787
Warmouth bass	Quincy Station	227	227
Crappie	do	165	165
Rainbow trout	Wytheville Station	9,784	9,111
Total		135,774	131,286

Among the improvements at the station was the introduction of an American watchman's time detector, with 12 stations distributed throughout the general offices, aquaria, etc.

The superintendent was instructed, in 1889, to develop a scheme for the production of artificial eggs, and more or less study was given the subject from that time. The question was satisfactorily determined, and in the early part of the fiscal year covered by this report supplies of eggs were prepared and shipped to the World's Fair. The method of producing them consists in passing resin through heated tubes of metal, the falling drops being received below in water. It was found that eggs, representative of the shad and whitefish, could be closely imitated in roundness, size, and transparency. Those intended to represent smaller eggs, as of the Spanish mackerel and codfish, were produced by pouring melted resin through sieves from an elevation, the falling particles being caught in water. The latter class had to be screened to separate the different sizes, those made by means of tubes being practically uniform. During some months attention was paid almost wholly to the selection of substances which could be united to produce a composition of required specific gravity for eggs semi-buoyant and floating. Meantime the point of obtaining eggs of perfect roundness was solved, and while yet looking to the regulation of the specific gravity it was accidentally found that eggs of resin could be made to represent any desired specific gravity by subjecting them to solutions of salt water of relative densities. When this was ascertained it was readily seen that both kinds were possible from the same material, the brine for the semi-buoyant ones requiring to be weaker and for the floating ones stronger.

Another duty devolving upon the superintendent was that of assisting the Commissioner in preparing for and carrying out experiments for determining the relative value of artificial salt water as the basis of maintaining an exhibit of marine animals and plants at the Columbian Exposition. As it was impracticable to devise satisfactory means for circulating the small quantity of water with which he was experimenting, it was necessary to adopt the alternative of oxygenizing the water by means of air circulation. As long ago as October, 1888, while the Ohio Valley Exposition at Cincinnati was occupying attention, instructions were received from the Commissioner to establish a small number of aquaria in the west end of the building and provide therefor an air circulation. Attempts were then made to liberate air through rubber tubing gashed with a knife or perforated with pin holes, but without good results. Following this, tests were made with sections of grapevine and other twigs selected from the mass of driftwood found on the shores of the Potomac at the shad-egg station. Grapevine gave tolerably fair results, but in time it was discarded, and Mr. W. P. Seal, then in charge of the aquaria, adopted sponge, a crude alternative, which, being cut into small pieces, was thrust into holes punched into half-inch rubber tubing.

All former efforts to diffuse volumes of air through water in currents sufficiently minute to effect ideal aëration having failed, and the solution of the problem being dependent upon the application of air circulation, active steps were taken to discover a material of the desired porosity. Plugs were made in cross-section from various kinds of wood, with the hope of finding one of suitable porosity. Mr. L. G. Harron removed a dead branch from an American linden tree on the public Mall, and it was just what was desired. From that day the question of successful liberation of air in water, for our purposes, has been solved.

Supplies of dead limbs from the linden tree are obtained from Massachusetts avenue and also on B street, SW., after heavy storms. Subsequent trials with sycamore boughs were rather encouraging. The newly acquired knowledge led to the adoption of air liberators in all of the aquaria at Central Station, and formed the basis of the circulating process adopted a few weeks later in the fourth special car added to the distribution service. It also resulted in effecting the permanent introduction of an air compressor, with small iron piping as a conduit, in Central Station. Prior to this the aquaria had been supplied with air by a crude method, described on pages 2 and 3, United States Fish Commission Bulletin, 1890.

FISH PONDS, WASHINGTON, D. C. (RUDOLPH HESSEL, SUPERINTENDENT).

The product of this station consists of fingerling fish, there being annually stored and reared in one or more of the ponds, additional to the regular work, an average of 2,000,000 young shad, which are released in the fall months when they have attained a length of 3 to 4 inches. One of the difficulties met with here is in keeping down the growth of vegetation in the ponds. Since the flood of May, 1889, its removal has required the expenditure of a large amount of labor from May to November. Men go overboard with mowing scythes and cut the plants near the bottom, afterwards gathering with small boats and wooden rakes for transfer to the shore. The great weight of this material makes its removal laborious, even after placed on the banks; wheelbarrows are employed in transferring it to portions of the grounds where it can be put out of sight. In July probably 400 cart-loads were removed. It is necessary each October to thoroughly remove the vegetation to afford free passage of fish from all parts of the ponds to the receivers, otherwise the fish will not collect at the points desired, but scatter over the areas and be lost under the growth.

The drawing off of ponds commenced November 21, when the sorting and counting of fish was begun and continued for a period. The pond containing black bass was drawn December 1, and the sorting and counting occupied almost a week. Almost as quickly as ponds were freed from the year's production, it became necessary to take up their cleaning and preparation for another year's work, banks having been injured and the trenches in the bottoms leading to the collectors being filled with mud.

Carp.—The new pond, 5 acres area, being partitioned off, leather carp were produced on one side and scale carp on the other. Two small ponds, 40 by 60 feet each, were devoted to the blue-leather and blue-scale varieties.

Spotted catfish.—No definite observations could be made concerning the spawning habits of this fish, as it was in hiding during the spawning season. There were 8 spawning fish in the ponds, producing 1,300 young.

Golden ide.—No results were obtained from this species, in consequence of cold weather in the first half of April, whereby the eggs were destroyed.

Black bass.—From 15 black bass 34,500 young were obtained, 500 of which were 5 to 7 inches long, the remainder 2 to 3 inches. The larger and smaller ones were raised in the same pond, and it is inferred that difference in size was due to cannibalism. Much labor was required to supply food, the daily ration being about 15 pounds of fish and every other day 30 pounds, that quantity of live fish being obtained during the summer and fall in the vicinity of Observatory Hill. Small river fishes of no table value were secured by seines and small boats operated by regular employees. On September 8, the number of bass having been observed to be decreasing, and the small fish available as food for them having been greatly reduced, purchases were made of offal fish in the markets, 10 to 20 pounds being obtained daily.

Shad.—Shad fry amounting to 1,989,000 received from Central Station in the preceding fiscal year, May 5 to 10, were placed in a rearing-pond of about 5 acres and held for liberation in the Potomac, effected by the lifting of gates December 2. The number released was about 600,000.

The production of other species was: Leather carp, 35,000; scale carp, 46,700; blue-leather carp, 1,700; blue-scale carp, 2,400; spotted catfish, 1,300; tench, 356; golden ide, 398; goldfish, 9,500; black bass, 34,500.

In December preparations were made for the next season's spawning of black bass by the introduction of quantities of clean gravel into their spawning pond. The method of handling black bass at this station is to place a limited number of spawning fish in a small pond a few rods square in which the water is shallow, the bottom being covered with clean gravel, the small pond being connected with another, ten or twenty times as large, by means of wire screen of proper size mesh to permit the young to pass out. After the young have left the nest and obtained access to this larger and more fruitful feeding-ground they are safe from being eaten by their parents. In January, the Potomac River being filled with ice from Washington to its upper source, it was anticipated that a gorge would occur, resulting in the flooding of this station, and to avoid the loss of brood fish the ice was removed from 14 ponds, its amount being about 500 cart loads, and the fish stored in the brick vats and covered with netting. No freshet occurred; but so much damage from frost was sustained by water-pipes and valves, the cross-partitions in ponds, the banks of ponds, etc., that a great portion of the next four weeks was occupied in repairs.

During the later months of the year spawning by the pond fishes was accomplished, the results, however, only to be definitely determined in the fall months of the succeeding fiscal year. In furtherance of the practice adopted a few seasons ago, the first shad hatched at Central Station were delivered here for rearing in ponds, the number received this year, May 1 to 9, being 1,444,000.

WYTHEVILLE STATION, VIRGINIA (GEORGE A. SEAGLE, SUPERINTENDENT).

This station is the property of the State of Virginia, but is operated by the United States Fish Commission. During the year improvements were made, chiefly in the nature of repairs, funds applied thereto being furnished by Dr. J. T. Wilkins, commissioner of Virginia, and labor by regular employees. The repairs were applied mainly to the rearing-ponds, broken embankments being overhauled and new piling introduced where necessary, and bottoms tamped with clay or cemented. Eight ponds were thus repaired. Water connection was established between the spring and the nursery building, the piping being extended to the railroad siding, where Fish Commission cars receive the product of the station for distribution.

The fish brought over from the preceding year in process of rearing consisted of rainbow trout in troughs; black bass, rock bass, carp, and goldfish in ponds, where they had been hatched by natural methods. In September the rainbow trout were culled, the various sizes being placed in separate apartments. These were counted in October in advance of distribution. In September nearly 12,000 were suffocated in the nursery building by accident, the supply gate having been temporarily shut off and forgotten. The distribution of this species was taken up November 16, and continued until February 14. Applicants in Virginia, North Carolina, Tennessee, Kentucky, Georgia, Pennsylvania, and Maryland were supplied. The number delivered to cars was 79,547. On account of depreciation in the quality of brood stock, 4,000 were retained to be reared for spawn-taking purposes.

Black bass distribution occurred between November 16 and March 10, 1,433 being furnished to applicants in Virginia, North Carolina, and Alabama. Of this species, 400 were received from car No. 3; but, being attacked by fungus, only 135 were available for distribution. A few were retained in order to increase brood stock.

The distribution of other species was effected on lists furnished from Washington, consignments being chiefly to adjoining States already referred to, transportation being made in tin pails. The movement of these fish took place between November 15 and March 10, the principal deliveries of all kinds taking place before the end of December.

The number furnished for distribution was larger than ever before, being as follows: Rainbow trout, 79,547; black bass, 1,433; rock bass, 13,650; carp, 5,168; goldfish, 5,990.

Contributions were made for the World's Fair exhibit, consisting of alcoholic specimens of eggs and embryos of the various species, and also specimens of destructive insects and larvæ.

Rainbow trout.—In the absence of new brood fish to make up deficiencies in old stock, the egg collections were somewhat inferior, and losses were heavy on account of the large percentage of hard or glassy eggs. The presence of eggs of this character having been previously observed, efforts were made this season to determine the cause, and accordingly Dr. R. R. Gurley, of the Division of Scientific

Inquiry, was sent to this station in December. Examinations with the microscope led him to express the opinion, in a preliminary report, dated January 17, 1892, that eggs of this character are the production of individuals, not existing among all and hence not epidemic; that the disorder was nonparasitic, but resulted from inflamed ovaries.

The trout began spawning November 18, continuing for 117 days; 18,000 were taken in November, 145,000 in December, 137,000 in January, and 70,000 in February. Eggs were taken from 310 fish, the average being 1,221 per fish, and the total 378,500. In addition, 81,500 eggs were received from Neosho Station, where the production was greatly in excess of the rearing capacity.

Eggs were transferred as follows:

Date.	Consignee.	Number.
Jan. 13, 1893	John W. Titcomb, fish commissioner, Roxbury, Vt	20,000
14, 1893	John H. Gordon, South Bend, Wyo	10,000
14, 1893	C. Raveret-Wattel, Fecamp, France	10,000
17, 1893	Central Station, Washington, D. C	15,000
18, 1893	G. W. Thayer, Provo City, Utah	10,000
20, 1893	J. G. Bluhm, Rio Negro, United States of Colombia	10,000
23, 1893	Central Station, Washington, D. C	15,000
28, 1893	John W. Titcomb, fish commissioner, Rutland, Vt	25,000
Feb. 7, 1893	S. S. Watkins, superintendent, St. Paul, Minn	20,000
	Total	135,000

The consignment to Utah was unsuccessful, owing to use of sphagnum moss which had not been sufficiently soaked in water, the expansion taking place in the egg crate and increasing bulk to an extent to crush the eggs. This was by oversight, it being the custom to give the moss a water bath for two or three days in advance of the shipment.

Although rainbow-trout eggs are handled in February and March, it is not practicable to make up shipments after January, as it is difficult to bring together enough of the same age.

Eggs lost at the station were 142,000, the fry hatched being 183,000. From those hatched 95,000 fry appeared in February. The fry commenced taking food in March, and in May all were sorted and counted.

Black-spotted trout.—The brood fish on hand, 31 months old, spawned in March, the first eggs being taken early in the month. These eggs were not sufficiently fertilized and were without effect. The females were four to six weeks later than the males in maturing. An attempt was made to increase the brood stock, and in July, 1892, fish of that year were forwarded from Leadville Station, Colorado. The number sent was 15,000, but only about 1,500 reached their destination alive, on account of sickness of the messenger in charge. Food supplied the young fish consisted of beef livers, from cold storage at Roanoke, Va., and from Washington, D. C. The older fish are fed on mush composed of common flour or shorts and liver, the proportion of the latter being about one-fourth of the whole.

Other species.—Black bass and other pond species were transferred in April to summer ponds, spawning-beds being constructed for them. The results were apparently satisfactory in all cases, it not being known, however, at the end of the year whether the black bass had produced numerously or not, the young at that time being still in the spawning-beds. The rock bass and goldfish spawned in May, many of both species hatching during that month. The numbers of fish of all kinds on hand, counted or estimated, at the end of fiscal year, June 30, 1893, are represented in the table which follows:

Kind.	Year hatched.			
	1893.	1892.	1891.	1890 or earlier.
Rainbow trout	112,000	4,000		2,000
Black-spotted trout		300	200	
Black bass		50	10	
Rock bass	20,000			200
Carp	8,000			50
Goldfish	8,000			100

PUT-IN BAY STATION, OHIO (J. J. STRANAHAN, SUPERINTENDENT).

Production was greatly curtailed by hard weather, there occurring in the eleven days after October 28 three gales of unusual severity, many of the fishermen's nets being injured so badly that they were pulled out for the season. There were also severe gales in the spring months, interfering with the collection of pike-perch eggs. All eggs taken, however, proved to be of fair quality.

Whitefish.—The collection of whitefish eggs was not commenced, owing to storms, until November 11, the season terminating November 23, with an aggregate of 50,080,000, derived from sources below:

North Bass Island, Lake Erie	22,690,000
Middle Bass Island, Lake Erie	5,600,000
South Bass Island, Lake Erie	14,310,000
Kelley Island, Lake Erie	5,590,000
Catawba Island, Lake Erie	1,400,000
Toledo, Lake Erie	280,000
Unrecorded	210,000

As many as two-fifths were from gill nets, and all were obtained through spawn-takers attached to the station, and paid for at the rate of 40 cents per liquid quart. Only eggs of good quality, were purchased, determinations being made by microscope immediately after segmentation.

On February 13 a shipment of 5,000,000 eggs was made to the New York Fish Commission, addressed to the hatchery at Clayton, M. B. Hill, superintendent. These, by error, were shipped by freight, and were on the road twenty days, and on arrival were found to be frozen. They were successfully thawed out, however, and Mr. Hill, in a letter dated April 10, gave the gratifying information that all were hatched and liberated with a loss of but 10 per cent. On February 27 a shipment of 5,000,000 eggs was sent to Duluth Station. Eggs retained produced 22,570,000 fry, which were liberated on reefs off the islands in the vicinity of Put-in Bay Station. In development it was discovered that those eggs which occupied the upper tier were of poorest quality. The reason for this was not definitely ascertained, but was supposed to be due to the fact that the water to the upper tier was delivered through closed pipes, while that used in the lower tiers was from open troughs in which the water had been partially aërated.

With regard to measuring whitefish and other eggs, the following is from a letter from Superintendent Stranahan:

Our plan for computing the number of fish eggs is to carefully measure out a fluid quart in water, draining until fairly dry, or to an extent that they will no longer drip. The eggs are then divided into two pans, which are part of the weighing scales, until they balance. One panful is then divided on the scales in the same manner until finally one-eighth of a quart is obtained, these being counted. The scales, prepared at the station, under my supervision, are so sensitive that the weight of one herring egg is indicated. Duplicate counts of one-eighth quart show variations of five to twelve eggs. To compute the number of eggs in the hatchery we take ten jars, introducing a quart of water into each, marking the level on the gauge, and taking the mean of the ten marks for the 1-quart mark. The second quart is then added to each jar, and so on until 5 quarts have been introduced. Lines are established on the gauge stick between quart marks to indicate pints and half pints. Cisco or lake-herring eggs are found to number 78,848 per quart, whitefish 40,000, and pike-perch 171,000.

The gauge employed is of wood, in the shape of a carpenter's square, the short arm resting across the top of jar, the longer one following the outside to the base.

Cisco or lake herring.—Active interest being exhibited by commercial fishermen in behalf of the propagation of this species, the collecting and hatching of their eggs was this year taken up, Messrs. Stone & Gilbert, Daniel Vrooman, and Frank Miller granting the eggs free of cost and affording facilities to spawn-takers. The collecting-grounds were on the shoals around Put-in Bay, operations being confined to November, aggregate collections for the month being 11,756,000. The fry resulting amounted to 6,500,000, and these, escaping simultaneously with the whitefish, were drawn into the same collectors and distributed together, shipping cans containing both species.

The opinion prevailing among local fishermen that a hybrid between the whitefish and cisco existed in those waters, an attempt was made to produce such a fish, the eggs used being those of the cisco. The number successfully fertilized was 588,000, of which 200,000 were shipped to Smethers & Thompson, Warren, Ind., for experimental purposes. The hatching was successful and the fry were liberated in one of their private ponds. A letter received June 9 represented that thousands of these fish, 2 inches long, were in sight around the inlet. The water in the pond was from an artesian well. Eggs retained at the station produced 200,000 healthy fry, which were liberated in Lake Erie at points in the vicinity of the station.

Lake trout.—When it was too late in the season a spawn-taker was dispatched to Dunkirk, N. Y., egg collections of lake trout numbering 400,000 being secured. A loss of more than 100,000 was sustained almost immediately, while the eggs were held in cans of running water. Those reaching the station amounted to 225,000, of which 25 per cent died inside of ten days, and only 81,500 fry were produced, which were liberated on May 10 in Lake Erie. Lake trout have been but rarely observed in the vicinity of the station during the past twenty years, none having been seen in five or six years by persons familiar with the locality. On November 7, however, Mr. E. J. Dodge took from one of his trap nets a specimen weighing nearly a pound, and on November 19 he captured another, both being forwarded to the general office for identification. It is believed that the fish were of the 190,000 liberated from this station in the spring of 1890.

Rainbow trout.—On February 14 and 18 consignments of rainbow-trout eggs, aggregating 75,000, were received from Neosho Station, Missouri. They were in excellent condition on arrival, but underwent considerable loss both in the egg stage and as fry, the young available for distribution numbering 65,000. The fry, on arriving at the feeding stage, were liberated in the vicinity, in Lake Erie. Owing to lack of vitality it is feared that only a portion survived.

Pike perch.—Collections of pike-perch eggs aggregated 30,750,000, of which 25,564,500 were obtained from the shoals of Put-in Bay and the remainder from East Sister Island, Lake Erie, the season terminating April 19. The fry resulting numbered 20,200,000, of which 16,600,000 were delivered by the steam launch *Shearwater* at Sandusky, car No. 1 receiving 10,500,000, and car No. 2, 6,100,000. The remaining 3,600,000 were put in Lake Erie. The cost of pike-perch eggs, all items included, is found to be about $1 per million.

The distribution, exclusive of whitefish eggs, was as follows: Rainbow trout, 65,000; lake trout, 81,500; cisco, 6,505,000; whitefish, 22,570,000; pike perch, 20,200,000.

Important aid was rendered in World's Fair collections, the work being taken up March 29, terminating June 3. During that period four car loads containing 1,000 specimens, representing over forty species, were delivered for transportation to Chicago. Among these were 44 adult brook trout from the Castalia Trout Club, presented by Hon. John C. Zollinger, president of the club, and delivered to our cars at Sandusky. Mr. Zollinger also presented 2,000 trout eggs from the hatchery of the club, but these, owing to defective packing, perished en route.

An interesting development emanating from this station in connection with the World's Fair was the preserving of discarded fish eggs in brine for use in Chicago as representatives of good eggs in process of hatching. In 1890 Mr. Stranahan conceived the idea of illustrating hatching methods during summer, when active operations were suspended. Having succeeded fairly with his first trial, he concluded that something of the same character might be done at Chicago, and after experimenting he found that eggs could be successfully preserved in a brine sufficiently weak to permit their sinking slowly. The result of his observation and experiment proved highly gratifying in the fish-culture exhibit.

NORTHVILLE STATION, MICHIGAN (FRANK N. CLARK, SUPERINTENDENT).

The operations consisted largely in handling eggs derived from brood fish held in ponds. The Alpena Station, however, being operated under the same superintendency, a certain amount of the work consisted in handling eggs of lake trout and whitefish. Improvements consisted chiefly in procuring an additional water supply from a creek and the construction of a new series of forty rearing-ponds, ten of the latter being completed before the year closed. There was a slight increase in the take of eggs and their quality was excellent. Attempted transfers of trout eggs to the Government of Japan were unsuccessful.

At the beginning of the year young fish on hand, in process of rearing, consisted of the following: Lake trout, 75,000; brook trout, 59,000; Loch Leven trout, 70,000; Von Behr trout, 64,000; total, 268,000.

The fish remaining on hand October 24, by actual count, were as follows: Lake trout, 38,644; brook trout, 34,986; Von Behr trout, 14,265; Loch Leven trout, 9,926; total, 97,821.

In consequence of intensely cold weather, subsequent losses reduced the numbers, those distributed being 23,600 lake trout, 19,900 brook trout, 3,400 Loch Leven trout, and 150 Von Behr trout. Some were retained for brood stock. In November a portion of the yearling fish were transferred from rearing-troughs to the new rearing-ponds. The cold weather in January so injured these ponds that it was necessary to make repairs after the disappearance of ice. The distribution occurred between January 24 and March 20.

Contributions to the World's Fair exhibit, Chicago, occupied quite a portion of the time of the superintendent, live specimens of the various trout mentioned, and of the black-spotted and rainbow varieties, of all sizes and ages from fry to four years old, being furnished. In addition, 64 glass jars of eggs and young of the various species, from earliest stages to 12 months' age, were furnished. Pike-perch eggs were also collected and forwarded.

In September, in advance of the egg-collecting period, hatching-troughs, trays, and other equipment were overhauled and asphalted, 150 new trays being provided.

Lake trout.—Between November 11 and 26 there were received from the Alpena Station, in four consignments, 2,051,000 eggs of lake trout. Their condition was only fair. Of these eggs, 955,000 were forwarded by express shipment, as follows:

Date.	Consignee.	Number.
Jan. 21, 1893	M. E. O'Brien, superintendent, South Bend, Nebr	100,000
21, 1893	M. A. Green, superintendent, Caledonia, N. Y	100,000
23, 1893	T. J. Griggs, fish commissioner, Spirit Lake, Iowa	100,000
23, 1893	S. S. Watkins, superintendent, St. Paul, Minn	100,000
24, 1893	C. C. Warren, fish commissioner, Roxbury, Vt	100,000
25, 1893	O. H. Daniels, Laconia, N. H	100,000
25, 1893	Green Lake Station, Hancock County, Me	50,000
Feb. 2, 1893	R. E. Follett, superintendent, Lime Rock, Conn	105,000
3, 1893	C. C. Warren, fish commissioner, Roxbury, Vt	200,000

There were retained at the station, for rearing, 250,000; these were highly successful in hatching, producing an equal number of fish, which were liberated in the inland lakes of Michigan and Indiana May 3 to 13.

Brook trout.—Through the courtesy of the officers of the Flint and Pere Marquette Fishing Club, arrangements were effected for obtaining adult brook trout from Kenne Creek, a stream controlled by them. The fish were readily secured in October by two employees of the Northville Station and Mr. George Brown, associated with the club. In four days 415 were secured with hook and line and transferred to the station without loss. Kenne Creek was first stocked in 1880, and in the first season of fishing, 1892, more than 5,000 fish were captured, none measuring less than 6 inches.

From original brood fish in ponds, 244,500 eggs were obtained from 285 fish between October 26 and January 12, and from the new stock of trout, practically between the same dates, 41,600 eggs were taken from 144 fish. There were retained for hatching 120,000, and transferred as exchanges, donations, or to other stations, 90,000, as represented below:

Date.	Consignee.	Number.
Dec. 26, 1892	Flint and Pere Marquette Club, Wingleton, Mich	25,000
Jan. 17, 1893	Troutdale Fish Farm Company, Mammoth Spring, Ark	5,000
26, 1893	S. S. Watkins, superintendent, St. Paul, Minn	20,000
Feb. 1, 1893	C. C. Warren, fish commissioner, Roxbury, Vt	20,000
6, 1893	U. S. Fish Commission Station, Clackamas, Oreg	20,000

Loch Leven trout.—Among brood stock there was a reduction to the extent of about 400, chiefly on account of deaths, but partly from the transfer of the parent fish to the World's Fair and to the aquarium at Washington, D. C. Between October 26 and January 16, 444,500 eggs were obtained from 764 spawning fish. There were retained for hatching 118,000, consignments to other hatcheries being as follows:

Date.	Consignee.	Number.
Dec. 26, 1892	Flint and Pere Marquette Club, Wingleton, Mich	25,000
Jan. 14, 1893	S. Chinda, Japanese consul, San Francisco, Cal	10,000
16, 1893	S. S. Watkins, superintendent, St. Paul, Minn	20,000
19, 1893	E. B. Hodge, fish commissioner, Plymouth, N. H	15,000
19, 1893	W. P. Greenough, La Chévrotière, Quebec, Canada	10,000
25, 1893	U. S. Fish Commission Station, Green Lake, Me	30,000
Feb. 1, 1893	Samuel Farbush, Hartland, Me	20,000
10, 1893	U. S. Fish Commission Station, Leadville, Colo	75,000
	Total	205,000

Von Behr trout.—There having been no addition to the stock of brood fish, a decline in eggs was perceptible. The spawning commenced October 26, when 6,750 eggs were obtained, and terminated January 7, the number taken on the last date being 1,750; the total product of 590 fishes was 375,800. The number retained for hatching was 112,000, and the transfers, aggregating 225,000, were consigned as follows:

Date.	Consignee.	Number.
Jan. 14, 1893	S. Chinda, Japanese consul, San Francisco, Cal	10,000
16, 1893	S. S. Watkins, superintendent, St. Paul, Minn	20,000
17, 1893	Otto Gramm, State treasurer, Laramie, Wyo	15,000
19, 1893	E. B. Hodge, fish commissioner, Plymouth, N. H	25,000
19, 1893	W. P. Greenough, La Chévrotière, Quebec, Canada	10,000
20, 1893	U. S. Fish Commission Station, Green Lake, Me	50,000
24, 1893	M. E. O'Brien, superintendent, South Bend, Nebr	20,000
Feb. 1, 1893	C. C. Warren, fish commissioner, Roxbury, Vt	20,000
2, 1893	R. T. Browning, fish commissioner, Baltimore, Md	35,000
2, 1893	R. E. Follett, superintendent, Lime Rock, Conn	20,000

Black-spotted trout.—In addition to the 940 already on hand, from the hatching of 1891, there were received in February, from Leadville Station, 2,287 fish of the hatching of 1892. The shipment consisted of 5,000, but owing to delays en route the greater part was lost.

Whitefish.—There were received from the Alpena Station, and forwarded February 20, by express, to the Fish Commission establishment at Duluth, Minn., 6,000,000 eggs of this species.

Pike perch.—For the purpose of illustrating fish-cultural methods in the exhibit of the Fish Commission in the Government Building at the World's Fair, Chicago, collections of eggs of this species, to the number of 16,550,000, were made on Saginaw Bay and Detroit River in April, Mr. Herschel Whitaker, commissioner of Michigan, cooperating in their obtainment. In addition, 154,000 eggs of the common sucker were secured and forwarded.

During March preparations were made for the care of the young fish derived from eggs held at the station, when the rearing-troughs were thoroughly cleaned and asphalted. The first were placed in rearing-troughs March 1. The mortality in May and June was somewhat unusual, and was charged to an insufficient supply of water and limited tank and pond areas. The number remaining on hand at the end of the fiscal year, June 30, 1893, together with other fish in ponds, is given in the table which follows:

Kind.	Hatched in the year—			
	1893.	1892.	1891.	1890 or previously.
Lake trout	75,000			
Brook trout	60,000	4,000	3,000	575
Loch Leven trout	58,000			1,700
Von Behr trout	44,000	2,300		900
Black-spotted trout		1,500	940	
Total	237,000	7,800	3,940	3,175

Alpena Station, Michigan (Frank N. Clark, Superintendent).

Operations consisted in collecting eggs of whitefish and lake trout, the former being hatched at this station to a large extent and the latter transferred to the Northville Station. Mr. S. P. Wires, as foreman, executed the fieldwork. In April, 1893, his services being required at the Duluth Station, he was relieved, E. A. Tulian succeeding him. In

September field preparations were made for anticipated collections of eggs from the commercial fishing-grounds on Lakes Huron and Michigan. These preparations were continued until late in October, in the meantime repairs being made to hatching-troughs, tanks, egg-trays, and spawn-taking outfit. In November a night watchman, second assistant, and others to comprise the spawn-taking force, were temporarily employed. Severe storms prevented the collection of the usual number of eggs.

Whitefish.—The first eggs were received November 8, consisting of 256,000, the total by November 30 amounting to 25,040,000. The losses while hatching were: November, 320,000; December, 1,180,000; January, 660,000; February, 240,000; March, none.

On the 22d of February 6,000,000 eggs were transferred by express freight to Northville Station for reshipment to the Duluth establishment. The eggs retained, 16,640,000, commenced to hatch April 17, continuing slowly until April 20, when, the water turning cold, very few additional ones hatched until the 23d, there being about 7,000,000 out by the end of the month. The last to leave the eggs came out May 8. The fry proved to be of excellent quality, and between April 27 and May 23 there were liberated 16,640,000.

Lake trout.—Eggs of this species were collected during November to the amount of 2,350,000, all being transferred to the Northville Station prior to November 30, in express freight consignments, as follows: 323,000 on November 11; 678,000 on November 17; 870,000 on November 22; 180,000 on November 26; total, 2,051,000. The shortage represents the loss. The majority were taken near Thompson, Lake Michigan, but 250,000 obtained from Lake Huron by means of tugs operating from Alpena were best in quality.

The water temperature November 1 was 42° F., and on November 30 it had fallen to 33°. From this date until April 13 it ranged from 32.5° to 33°. On April 19 it was 41°, on the 22d 38°, advancing after that date gradually to 41° on the 27th. From this date a gradual rise was experienced until May 27, when it was 56°. By the first of June the equipment was stored to await operations of the next fall.

DULUTH STATION, MINNESOTA (R. O. SWEENY, SR., AND S. P. WIRES, SUPERINTENDENTS).

R. O. Sweeny, sr., resigned the superintendency April 15, 1893, and S. P. Wires, foreman of Alpena Station, was appointed acting superintendent. On June 10 Mr. Wires was made superintendent.

In July the high temperature and generally unfavorable condition of the gravity water supply from Lester River rendered it impracticable to hold the young lake trout brought over from the preceding year, numbering 843,000. The surface of the water on the streams and lake was covered with a yellow powder, which on the lake was seen in areas 100 yards wide, 2 miles long, and 2 inches thick, consisting of the pollen of the flowerless plants of the family *Lycopodiaceæ*. On July 12 losses occurred amounting to 139,000, and as a result distribution was commenced, 340,000 being liberated in that month. The mortality continued, and during August 100,000 additional fish were liberated, completing the distribution.

Lake trout.—On October 1 preparations were commenced looking to the collection of lake-trout eggs at Isle Royale. This island, in the northwestern portion of Lake Superior, is an uninhabited wilderness of jagged rocks and tangled thickets, containing neither trails, paths, nor roads, and visited by one steamer only, whose service is irregular. At Grand Portage a few eggs were obtained from fish caught in pound nets, all others being from gill-net captures. The weather was exceedingly stormy, and the quality of eggs poor. The first eggs were received at the station October 4, packed in boxes. Other shipments followed throughout this month and in November, the spawn-takers returning November 19. Low air temperature destroyed a number of eggs in shipment and the shrinkage was great. Measured on December 13, the total number was found to be 1,527,000. The first hatching occurred 21st December, 10,000 having come out from the eggs by the end of the month, the last hatching occurring May 16. Fry were liberated in sixteen lots, March 8 to April 10, aggregating 850,000, there being left on hand April 15, 400,000 eggs and 695,000 fry. Losses in May amounted to 5,000, and in June to 15,000. There being a mortality of 6,000 on June 19, gravity water was discontinued, the pumps supplying water from the lake. Distribution during the month amounted to 1,075,000, deposited near the shores of Michigan and Minnesota, the total liberation during the year being 2,365,000.

Whitefish.—There were collected by station employees in the fall 750,000 eggs of whitefish, the number on hand December 13 being estimated at 500,000. This number being insufficient for stocking waters of that region, eggs were assigned from Alpena and Put-in Bay stations, 6,000,000 being received from the former, with a transportation loss of 18,000, February 24, and 5,000,000 from the latter station, with a loss of 300,000, March 1. Between April 1 and 10 four lots of fry liberated in the vicinity amounted to 145,000, leaving 10,382,000 eggs and 100,000 fry on hand April 15. During April 300,000 fry were liberated, and in May 10,182,000, of which 2,982,000 were put out in the vicinity of the station, 6,000,000 near the shores of Wisconsin, 1,500,000 near the shores of Michigan, the last eggs hatching May 24. In December, 1892, young whitefish appearing in the vicinity of the station (an unusual occurrence), specimens were sent to Washington for identification.

Rainbow trout.—The Neosho Station being overrun with rainbow-trout eggs, two consignments were made to the Duluth Station, 75,000 being received February 11 and 25,000 February 15. The losses from date of receipt to April 15 amounted to 5,000, leaving on hand 20,000 eggs and 70,000 young. There were lost subsequently, 750 in April, 6,000 in May, and 250 in June, the last hatching occurring May 21. The distribution of 83,000 occurred in June, 43,000 being placed in the St.

Croix and White rivers, Wisconsin, and 40,000 in Sandy and Partridge rivers, Minnesota.

Pike perch.—In March preliminary arrangements were made for obtaining pike-perch eggs from Pike River, and on April 30 a personal reconnaissance of the locality was made by the superintendent. The collecting period was brief, extending from May 1 to 15, and owing to the slow disappearance of ice fully half of the fish had spawned before they ascended the river to the egg-collecting point where a seine could be used. The total of eggs amounted to 14,000,000. Of this number 500,000 were deposited in the stream where obtained, the remainder being conveyed to the station. The losses following transfer were 5,860,000 in May and 2,140,000 in June, hatching occurring June 1 to 5. The distribution aggregated 5,500,000, these being placed, before absorption of the sac, near the shores of Michigan, Wisconsin, and Minnesota.

Late in November there was a considerable fall of snow, and on December 10 ice above the dam from which gravity water is obtained formed to a sufficient thickness to cut off the supply to hatchery, enforcing the use of steam pumps in obtaining lake water from crib wells. In January the mean temperature was 5.66° below zero, and in February snow was more than 3 feet deep on a level, the ice at end of March above gravity dam being 4 feet thick. On April 30 the water temperature was 35°, and on May 10 the ice was still obstructing the passage of water to the hatchery from the gravity dam. By May 31 the average temperature of the water was found to be 39°, and in June it had reached the point of 70°. The distribution for the year was: Rainbow trout, 83,000; lake trout, 2,355,000; whitefish. 10,482,000; pike perch, 5,500,000; pike-perch eggs, 500,000.

QUINCY STATION, ILLINOIS (S. P. BARTLETT, SUPERINTENDENT).

The collection and distribution of native food-fishes from the overflow river basins was continued on the same basis as in former seasons. While this work does not aggregate large numbers of fish distributed, their larger size more than compensates for absence of numbers.

On July 15 the water in the Illinois and Meredosia rivers was found to be receding, the banks at that time just beginning to appear above the surface. On July 23 the water was still high, but falling, affording an opportunity for the commencement of operations in August, when both rivers and the overflowed lands were worked. All collections are secured with seines, the fish being transferred by small boats and a special steamer to the railway tracks, where the cars are in attendance. The difficulties in prosecuting this class of work are great, one of the worst being the high temperatures prevailing in air and water. A large proportion of the fish captured were taken from water only 4 to 8 inches deep, with an underlying deposit of soft mud 10 inches or more in thickness, and in hauling the nets it is impossible to avoid drawing ashore quantities of this substance, thereby suffocating the fish unless quickly removed. Another difficulty is in securing at the right time a sufficient number of fishes of prescribed kinds to make up a carload consignment. Were it possible to make up carloads of any and all kinds a large amount of time would be saved, but large numbers are taken that can not be utilized in making up a particular shipment, and the fish must be separated and some transferred to storage for filling subsequent orders.

It is found that there is a wide variation in the abundance of the different species in different seasons. There may be one year a very plentiful supply of a given kind, and another year the same species may be conspicuously scarce. There is a similar variation in the abundance of species in the different localities. A particular pond may, one year, produce a large number of black bass, but another season will perhaps contain practically none. When large quantities of fish are secured the surplus is placed in storage ponds, as the fish can not be successfully held in live cars. The common practice is to return all of the more common varieties to the waters immediately around.

On Meredosia Island quite a large storage pond, not altogether safe from freshets, was provided for the holding of the surplus or reserve catch. When operations began some fish were in these ponds from June of the fiscal year preceding. Another pond for breeding purposes, situated near Naples, was secured. It is near the Illinois River and above high-water mark, and a number of large black bass were this season introduced in it with the object of securing young bass the next season. A noticeable feature in the operations this year was the presence of great numbers of carp, quantities being taken with haul seines, they being as numerous, relatively, as any native species. In that particular locality they were consumed as food in greater proportion than any other kind. Young carp hatched in the spring of 1892 were so abundant that they were caught with hook and line at every point on the two rivers, their length being 6 to 10 inches. Operations were very much benefited by rains which fell about September 10, cooling air and water.

The periods during which the cars were engaged in the movement of fishes are as follows: Car No. 1, September 24 to December 2; Car No. 2, August 11 to October 30, and Car No. 3, August 7 to November 5. The facilities for the transportation of the cars afforded by the railroad companies were the best yet secured, the officials being not only courteous, but furnishing a greatly increased amount of free transportation. The assistance furnished was of such importance that to this source is to be attributed in large part the accomplishment of the best season of work at this place. The number of fish sent out was not larger than in any previous year, but they were larger in size, many black bass weighing 2 to 3 pounds, but those averaging about a pound being the more numerous. When liberated the fish were counted, and with very few exceptions they were counted when loaded on cars.

A large area of territory was covered in the distribution, comprising Arizona, Colorado, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Missouri, New Mexico, Ohio, Oregon, South Dakota, Tennessee, Virginia, Washington, and Wisconsin, some fish also being transferred for distribution in the New England States and to the District of Columbia. The mileage of the several cars is shown below:

Car.	Free.	Paid.	Total.
No. 1	6,612	1,567	8,179
No. 2	15,127	2,663	17,790
No. 3	15,010	2,921	17,931
Total	36,749	7,151	43,900

That the distribution was highly satisfactory may be seen from the statement below, indicating the successful liberation of 64,633 fish out of 67,187 delivered to the cars:

Kind.	Furnished for distribution.	Lost in transit.
Catfish	7,811	80
Yellow (or ring) perch	4,454	126
Pike perch	845	....
White bass	1,877	167
Black bass	33,987	470
Warmouth bass	5,670	671
Crappie	10,754	814
Sunfish	1,756	194
Pickerel	133	32

A consignment of fish, representing the different species, forwarded to the aquaria at Central Station is not included in the statement above. Cold weather early in January terminated the regular season, and the work subsequently consisted in making collections in May and June and forwarding to the aquaria at the World's Columbian exhibit.

NEOSHO STATION, MISSOURI (WILLIAM F. PAGE, SUPERINTENDENT).

The superintendent was specially detailed to assist in examining the site of the proposed station at San Marcos, Tex.; he also accompanied Car No. 2 during the distribution of the rainbow-trout yearlings in order to inquire into the cause of mortality among them in transportation. Examinations were also made with the view of obtaining pike-perch eggs from the vicinity of Baxter Springs, Kans., and of the overflow district of northeastern Arkansas, along the line of the Kansas City, Fort Scott and Memphis Railway, for determining the possibility of collecting and distributing native food-fishes from river swamps. An addition to the station was made in the nature of a trout pool 6 by 60 feet, planked with 1½-inch oak, with the expectation of its holding during the rearing stage 25,000 rainbow trout.

A satisfactory number of trout were brought over from the last fiscal year for rearing and liberation in the fall months, but the production of black bass was below the normal, and the carp were few in number and of too large size for successful pail shipments. On hand October 24, 1892, as determined by actual count, there were as follows: Rainbow trout, 40,266; brook trout, 1,200; tench, 19,000; black bass, 2,174; rock bass, 9,548; goldfish, 1,490; carp, 670; total, 74,348.

Owing to the quantity of work in the distribution service these fish could not be liberated with sufficient promptness, and the following losses occurred: Brook trout, 100; tench, 3,872; black bass, 204; rock bass, 548; goldfish, 553; carp, 36; total, 5,313. The losses among rainbow yearlings were very small, they being held in rearing-ponds under normal conditions up to the time of delivery to car messengers.

The 3,500 brook-trout fry brought over were diseased and continued to die until the last of September, when the survivors suddenly commenced growing rapidly, and those remaining for distribution were in fine condition.

The distribution of rainbow trout occurred between December 23 and March 31, the deposits being made chiefly in Missouri, Arkansas, Texas, Kansas, Illinois, and Iowa. The tench were shipped between December 3 and March 20, being placed chiefly in the waters of Missouri and Texas. Black bass and rock bass were liberated between January 19 and March 15, these being sent chiefly to Kansas and Missouri.

The distribution was as follows: Rainbow trout, 38,684; brook trout, 1,000; tench, 14,855; rock bass, 9,000; black bass, 1,968; carp, 634; goldfish, 937; golden ide, 10; total, 67,088.

In addition, 200,000 fingerling shad were liberated in waters tributary to the Gulf of Mexico. Their number could not be ascertained except by estimate, owing to the fact that these fish can not be successfully handled. They were the product of 700,000 fry sent from Washington in the preceding June. In preparing for their release the hatchery branch was in October cleared of shoals, drifts, and aquatic plants for three-quarters of a mile to a point where it empties into Hickory Creek. Early in November, when the branch was swollen by rain water, the 6-months-old fish were allowed to pass through open gates. They were some hours in escaping, a continuous silvery mass. These were the first fingerling shad planted in waters tributary to the Gulf of Mexico.

The pond which contained the shad was infested with crawfish, 1,750 pounds being removed and destroyed between August 3 and October 31. These were estimated to be 70,000 in number. By some unaccountable means black bass of the large-mouthed variety were also present. In preparing for receipt of the shad the pond had been drawn in November, 1891, and the bottom exposed for three weeks, and in the following April the process was repeated, all water connections with black-bass ponds having been broken and an independent supply being established. On August 3, the intruding fish being observed, a hook and line were brought into use, and on the first day 5, averaging 1½ pounds each, were caught, and by October 31 the catch had reached a total of 152. It is believed that they burrowed in the mud, surviving the absence of water during the two periods mentioned. It is not definitely known that the black-bass lived imbedded in the mud during these periods, but the indications point to the correctness of this supposition.

A large amount of material was furnished for exhibition at the

World's Fair, and to the World's Fair commissioners of the State of Missouri. Specimens of fish and other natural-history collections were furnished to Prof. S. E. Meek, curator of the museum of the Arkansas Industrial University.

Of the rainbow trout brought over from the preceding year, 1,500 were set aside for brood fish. These were weighed and measured in February and fed for sixty-three days on a diet consisting of 2.85 pounds of beef liver and 15.5 pounds of mush made of mill shorts. During the succeeding twenty-seven days they were fed on 4.44 pounds of liver compounded with 22.94 pounds of mush. On the dates April 26, May 20, and June 19 they had progressed from the aggregate weight of 140.5 pounds to 390, 480 and 522.2 pounds, respectively. The cost of each pound at the end of the first period was 3.6 cents, at the end of the second 1.16, and at the end of the third 6.5, the price of liver being 4.5 cents per pound.

Dried blood in conjunction with mush was tried without good results, owing to the fact that the substance could not be reduced to its original state so as to freely mingle with the farinaceous matter. Experimental tests were made with cotton-seed meal. A trial with purely farinaceous diet was made with rainbow-trout fry with satisfactory results.

Examinations for *Gammarus* in the surrounding streams having demonstrated that none was present, 1,000 were obtained in December from the Mammoth Spring, Arkansas. Introduced into the black-bass ponds, all apparently were destroyed, but in the others they multiplied. An attempt to convert into fish food the crawfish destroyed was unsuccessful, as the time consumed in handling was not economically invested.

Rainbow trout.—This species has attained unprecedented growth in the ponds of this station, where it has been demonstrated that they will spawn the second year. All reports concerning the growth of fish liberated in the waters of the Ozark region have been encouraging.

On December 14 the 3-year-old brood fish commenced to spawn, and by December 30, only 23,000 eggs having been taken, it became evident that the parent fish would not enter the spawning race. Thereupon a haul seine was applied to their capture every day until the close of the season, March 7. The quality of the eggs being superior to those taken last year, the conclusion was reached that the hard and glassy kind heretofore puzzling the minds of all concerned were the result of overretention. In the preceding year, when the spawning race was depended upon, 60 per cent of all eggs taken were of the kind named, while this year none were of that character. Hence, it is inferred that the hard and glassy eggs may be avoided by seining, and taking eggs from fish as soon as mature. The total from 730 females was 672,526, of which, 84½ per cent, or 542,868, were fertilized, the average number of eggs per fish being 935. Of the fish stripped, only 79 voluntarily entered the spawning race, all others being forcibly captured.

As this station was equipped and designed to hatch only about 60,000 eggs, it was impracticable to care for the number obtained, and 21 lots of eggs, aggregating 463,500, were shipped to other points, as shown by the following statement:

Date.	Consignee.	Number.
Jan. 17	H. M. Garlichs, Missouri fish commissioner	20,000
20	Central Station, U. S. F. C., Washington, D. C	15,000
21	.....do	17,500
25	.....do	20,000
25	Wytheville Station, Wytheville, Va	15,000
27	.....do	15,000
28	.....do	33,000
30	Central Station, U. S. F. C., Washington, D. C	29,000
Feb. 1	.....do	23,000
2	C. C. Warren, Vermont commissioner	36,000
6	Green Lake Station, U. S. F. C., Green Lake, Me	30,000
6	Duluth Station, U. S. F. C., Duluth, Minn	14,000
7	.....do	45,000
8	.....do	16,000
10	.....do	22,000
10	Put-in Bay Station, U. S. F. C., Put-in Bay, Ohio	21,000
13	.....do	27,000
14	.....do	20,000
15	.....do	7,500
24	M. E. O'Brien, superintendent Nebraska Fish Commission	21,000
Mar. 3	.....do	16,500
	Total	463,500

With the exception of one package lost in a railroad accident while en route to Green Lake Station, the eggs were received in good condition and were pronounced to be of high grade. No sphagnum moss being available for the unexpected shipments, fine shavings of common grades of sponge were used for packing the eggs on the canton-flannel trays. It was found that a much larger amount of labor was required to prepare it than sphagnum moss, but, its expansibility being more uniform, the pack could be much more evenly effected and with greater safety. Moreover, this material can be reused upon being subjected to boiling. One pound is sufficient to pack 15,000 eggs, it not being used in the outside packing employed to exclude atmospheric heat.

The eggs retained for hatching and rearing were 74,700, which by April 17 afforded 60,000 fry, then placed in pools for rearing. The eggs being of different ages, the hatching was prolonged until March 26. Losses in fry during the hatching process were 7,838, of which 6,051 were killed by the choking of an inlet pipe by a small fish.

In May an epidemic occurred in one of the pools, about 8,000 fry dying, but the mortality was soon arrested by applying salt and earth.

Pond species.—In February preparations were commenced in anticipation of the spring spawning of pond fishes, the water areas being drawn and cleaned and all necessary materials brought together in proper condition. In the four weeks succeeding April 10, constituting the height of the spawning and hatching season, there was a rainfall of 8.8 inches, accompanied by five severe hail-storms and three windstorms, the latter carrying bunches of moss and willow roots laden with glutinous eggs out of the ponds, thousands of additional eggs and young being destroyed by hailstones and raindrops. Owing to the flooded condition of the large streams there was an influx of aquatic birds, many of which attacked the pond stock, capturing some of the spawning fish from off their nests of eggs. For nineteen days it was necessary to have the station patrolled by one of the employees, during which time eight fish-hawks were killed. This station is not only infested with crawfish, but by many wild animals, and constant vigilance on the part of employees is necessary. The records show the following as having been caught during the fiscal year: Kingfishers, 9; wild duck, 52; gull, 1; grebe, 9; water-hens, 11; fish-hawks, 9; bittern, 15; heron, 3; egret, 1; owl, 1; turtles, 43; snakes, 98; frogs, 794; muskrats, 7; raccoon, 1; mink, 1; water rats, 15; crawfish, 267,460.

The black bass began to prepare nests toward the end of April, and by May 15 as many as 15,000 young were transferred from the nests to unoccupied ponds. A larger number could have been transferred had the pond area been available. The tench, which spawn at this station at two years of age, deposited their eggs by May 15. The golden ide spawned profusely April 7, but without effect. An attempt was made to artificially handle a portion of the eggs, but without success, all being found covered with fungus at the expiration of ten days. The eggs flowed freely and were apparently in good condition. In color they were dark brick-red. In August, 1892, the rock bass were found to be spawning for the second time in that calendar year. The channel catfish again, for the third season, failed to deposit eggs, for reasons unknown, every care having been bestowed upon them.

The rainfall for the year was 37.3 inches, the fall of snow being 10.75. The maximum air temperatures in July and August were 105° and 102°, respectively, the lowest temperatures being reached in December and January, the thermometer registering 8° below zero in the latter month. The extremes of temperature in trout ponds were 80° maximum and 32° minimum; in black-bass ponds, 88° and 36°. Ice gathered from the ponds and stored in December was 6 inches thick, and comprised about 60 tons. The fish remaining on hand June 30, 1893, of all kinds, are represented in the statement which follows:

Kind.	Hatched in—			
	1893.	1892.	1891.	1890 or earlier.
Rainbow trout	52,000	1,000		1,000
Black bass	3,000			25
Rock bass	10,000			115
Carp	8,000		6	30
Catfish				20
Tench	20,000			25
Golden ide			4	16
Goldfish	2,000			29

LEADVILLE STATION, COLORADO (H. D. DEAN, SUPERINTENDENT).

Work was confined to the salmonidæ, the fish liberated being of yearling size, and the output larger than in any previous year, amounting to 178,900 fish and 60,000 eggs.

In addition to repairs to the old hatching-house, 14 new rearing-ponds were prepared, the smallest being 5 feet wide and 15 feet long, and the largest 15 by 40. These were constructed with plank sides, the smaller ones being also planked on the bottoms.

As the result of the breaking of the bank of the lower lake, May 27, the water supply for a month was obtained from the De Mary irrigating ditch. As the temperature of the lake water rose to 70° F. in the warmer portion of the day, half of the station supply was obtained during summer from the ditch. In September the establishment was threatened with forest fires, requiring some labor to save the building. A snow-fall of 5 inches, October 31, removed the danger.

Egg collections were made at two periods, the first from November to January, inclusive, and the second in May and June. There were brought over from the preceding year eggs and fish represented in the table which follows:

Kind.	Eggs.	Fry.	Yearling.	Two years old.	Brood stock.
Black-spotted trout	144,983	91,168	321	733	938
Yellow-finned trout	....	1,755	1,314	....	....
Rainbow trout	3,145	1,900	....	30	3
Brook trout	....	169,492	1,907	1,480	93
Von Behr trout	....	56,190	....	....	....
Loch Leven trout	....	12,013	....	105	....

Of the eggs of the black-spotted trout there were shipped in July the following: H. M. Orahood, Denver, Colo., 30,000; G. Schmitger, Laramie, Wyo., 25,000; Otto Gramm, Laramie, Wyo., 5,000; total, 60,000. All the other eggs were hatched, 15,000 black-spotted fry being transferred to the Wytheville Station in July.

Losses among the younger trout, undergoing rearing, may be inferred from the following statement of numbers on hand September 30, by count: Black-spotted, 77,100; yellow-finned, 250; rainbow, 1,800; brook, 105,300; Von Behr, 34,000; Loch Leven, 4,900; total, 223,350.

Distribution was effected between November 12 and December 24, the fish being sent for the most part to Colorado, Montana, North Dakota, Nebraska, and New Mexico. Those furnished for distribution are as follows: Loch Leven, 2,600; rainbow, 1,550; Von Behr, 30,050; brook, 98,200; black-spotted, 46,500.

In November 5,000 black-spotted yearlings were transferred to Northville Station. There were also distributed 23,000 hybrid trout, 300 of which were forwarded to the Central Station, Washington, D. C. As a result of attempting to hold over a considerable number of yearling Von Behr trout during the winter, 17,000 were lost, it being impracticable to induce them to take food in the low water-temperature prevailing.

Materials collected and forwarded to the World's Fair, Chicago, consisted of black-spotted and yellow-finned trout, showing development up to six years. Adults, 375 in number, reached destination without loss. In addition to the live fish, alcoholic specimens of ovaries, eggs, and embryos were furnished.

Brook trout.—Observations at this station point to the superiority of the brook trout over all others for Colorado waters, native varieties not being excepted. In October, when the adults were placed in the spawning-ponds, it was found extensive losses had been sustained and, to compensate, 900 fish, weighing on an average about 0.3 pound, were purchased. It was believed that missing fish had been stolen, or possibly destroyed through cannibalism.

Eggs were obtained from three sources, the ponds of the station, Uneva Lake, and the private ponds of Dr. John Law. The collections were satisfactory in number, but inferior in quality. The first were taken October 28, the total collections from the station ponds being 268,800, of which 205,000 were obtained during November. Nine trips were made to Lake Uneva, where 70 adult trout, weighing nearly 3 pounds each, and 153,600 eggs were collected in November. The owners of the fish, Messrs. Searl and Lazenby, by way of return, received 25 per cent of the fry in the summer following. After Dr. Law's hatchery had been filled with eggs, he allowed the remainder to be taken by the United States Fish Commission, and in December 50,000 were secured.

Both those eggs from Uneva Lake and Dr. Law's establishment proved to be of poor quality, 50,000 from the former place having been discarded by December 31, and 40,000 from the latter by February 28. The losses were attributed to defective fertilization. It is, moreover, believed that the prolonged period of incubation, on account of low temperature of the water, is of great disadvantage, eggs not being hatched till the end of five months. The temperature throughout this period remained at 34° F. On January 31 the eggs in Dr. Law's hatchery, in a temperature of 43° to 44°, were nearly all hatched, they having been taken in the month of November.

Black-spotted trout.—The results with this species in small breeding-ponds have not been satisfactory. Out of about 4,000 adults captured and confined at the station during the four preceding years, but 800 were this year surviving, and it is believed that the only source of dependence for eggs will be on wild fish in open streams and lakes of this region, the most inviting field being Twin Lakes. Eggs collected amounted to 118,600, all at the station except 18,000 from Sweetwater Lake. Attempted collections at the latter place were in conjunction with the State fish commissioners of Colorado. The first eggs of the season were taken May 25, collections for that month amounting to nearly 35,000, and in June about 83,000. A shipment of 20,000 was made to the World's Fair, Chicago.

Rainbow trout.—In June there were taken from fish confined in the ponds 6,200 eggs, of which 5,665 remained on hand June 30, 1893.

Loch Leven trout.—Eggs to the number of 75,000 were received from the Northville Station by express freight February 14. On unpacking they appeared to be in good condition, but on the succeeding day as many as 10,000 hatched prematurely. The hatching of the remainder was normal, but before the feeding stage was reached about 65 per cent perished.

In February the mean air temperature was 15°, with a snow-fall of 5½ feet. This remained on the ground to such an extent that in the month of April it was necessary to shovel out a mile of the road to Leadville several times in order to obtain supplies. In the latter month outdoor operations were resumed to a slight extent, and in May the ponds were cleaned and those injured by heaving of ice were repaired. At this season black-spotted and rainbow brood trout were transferred to spawning-ponds. The full stock of eggs and fish on hand at end of fiscal year, June 30, 1893, follows:

Kind.	Eggs.	Fry.	Yearling and two years old.	Brood fish.
Black-spotted trout	57,589			977
Yellow-finned trout			1,060	
Rainbow trout	5,665			28
Brook trout		74,032	6,338	1,414
Von Behr trout			1,450	
Loch Leven trout		22,368	1,970	27
Total	63,254	96,300	10,818	2,446

BAIRD STATION, CALIFORNIA (LIVINGSTON STONE, SUPERINTENDENT).

The production of this station, consisting almost exclusively of quinnat salmon eggs, is largely transferred to the commissioners of the State of California. At their hatchery at Sisson the eggs are hatched and fry liberated under direction of those authorities.

Mr. G. B. Williams resigned the superintendency and turned over the property of the station July 29. He was succeeded by Mr. Livingston Stone, who had charge of these operations at their installation, he reporting August 10.

The first salmon yielding eggs was caught August 13, the fish, however, at that time being too scarce to warrant regular hauling of seine. On August 24, regular work being started, 44,000 eggs were taken. The California State law, permitting proprietors of canneries to operate seines until September 1, enabled those operators to catch nearly all the summer run of fish in the lower part of the Sacramento River, and the take of eggs from the summer run amounted to but 834,000. Egg operations lasted only nineteen days, during which time 220 spawning fish were handled. All eggs taken, with the exception of about 500,000, were forwarded to the State hatchery at Sisson.

Egg collections from the fall run of fish commenced October 20, the number obtained being 2,273,000. At this time funds having been exhausted, operations would have ceased but that the California commissioners came to the rescue and paid expenses during a period of about one week, there being obtained through their efforts 423,000 additional eggs. The whole number of salmon spawned during the fall run amounted to 620, the eggs produced being 2,696,000, and the aggregate for the year being 3,530,000. Work was abruptly stopped November 26 by a violent snow-storm. The eggs taken from the last run were forwarded to Sisson.

Storms were frequent and of severe character. In October 250,000 eggs were destroyed by high water, and in December the McCloud River was swollen to a height of 17½ feet, no mails being received during a period of ten days. The current wheel, supplying the hatchery with water, escaped damage, and at the end of the season was taken to pieces and stored.

In the statement which follows it will be seen that 533,100 young salmon were liberated at the station, these having been placed in the McCloud River in December. Egg transfers to the California commission are shown by dates.

Date.	Run, etc.	Number.
Oct. 9	Summer run	300,900
Nov. 30	Fall run	477,000
Dec. 5	...do	513,600
17	...do	541,000
29	...do	248,000
2	Fry liberated	533,100
	Losses, including 250,000 resulting from storm	916,400
	Total	3,530,000

Rainbow trout.—In January preparations were made for the collection of rainbow-trout eggs to be forwarded to Japan, and for that purpose 10,000 were secured. These were transferred in five consignments during March and April to Professor Sasaki, agricultural and commerce department, Tokyo, four shipments arriving in satisfactory condition. In January a new seine boat was built for future use in capturing adult salmon. In April a survey was made looking to a gravity supply of water from a neighboring stream, and after its completion the scheme was considered practicable. In June work was commenced on the rack across the McCloud River in preparation for next year's supply of adult fish, no salmon being permitted to ascend after June 30.

A collection of salmon eggs and fry, together with their natural enemies and food, was prepared in alcohol and sent forward, to be included in the exhibit at Chicago. The 7 a.m. air and water temperatures for the year are shown below:

Month.	Air.			Water.		
	Max.	Min.	Mean.	Max.	Min.	Mean.
1892.	°	°	°	°	°	°
July	68	42	57.80	60	52	54.35
August	66	40	55.58	56	52	52.61
September	64	44	51.6	53	50	51.76
October	50	33	42.77	50	43	45.87
November	51	25	39.63	43	39	41.76
December	58	23	38.25	45	38	42.03
1893.						
January	46	25	33.61	45	41	42.70
February	45	22	37.32	46	39	42.64
March	52	26	40.51	48	43	45.12
April	58	32	43	47	41	45.73
May	65	40	51.35	51	46	48.74
June	66	47	55.06	57	48	52.6

FORT GASTON STATION, CALIFORNIA (LIVINGSTON STONE AND W. E. DOUGHERTY, CAPTAIN U. S. A., IN CHARGE).

This establishment was the first experiment in occupying a Government reservation on the west coast. Privileges granted by the Interior Department were continued, and the outlook for further good results is favorable. The water supply is unlimited and of finest quality. The building occupied combines hatchery and quarters for employees. Five ponds are employed in holding brood fish and as nurseries.

On the abandonment of the reservation for military purposes, July 1, 1892, supervision passed from Capt. Frank H. Edmunds, U. S. A., to Livingston Stone, superintendent of the Baird establishment, McCloud River, Mr. Stone remaining in charge until January, 1893. The Secretary of War was requested in December to permit Capt. William E. Dougherty, U. S. A., to resume supervision, and the request being granted, operations for the remaining half year were under his direction.

Fish brought over from the preceding fiscal year consisted of the following: Rainbow trout (brood fish), 300; rainbow trout (fry), 18,450; Von Behr trout (fry), 24,856; brook trout (fry), 9,854.

In July 15,000 rainbow-trout fry were liberated in local streams. On April 30, there were remaining on hand of Von Behr trout 12,000, and of brook trout 7,000. These were liberated in May, with the exception of 500 of the former and 400 of the latter, retained for brood stock. Those liberated were placed in the Supply, Mill, and Tishtang creeks, the number of Von Behr being 10,950, and the brook trout 6,193.

Quinnat salmon.—In August plans were inaugurated for the capture of adult salmon from the tributaries of Trinity River and from Redwood Creek, a dam and trap being constructed near the mouth of Mill Creek, a tributary of Trinity River, about 4 miles from the station. Traps were also constructed at Redwood and in Supply Creek, the latter being near the station. The limited amount of fishing on Redwood Creek, as a result of the absence of canneries on that stream, rendered it the most profitable source. Another trap in the vicinity, constructed by Indians, also furnished adult fish.

Salmon in this region ascend the streams for laying eggs twice a year, the first run occurring early in winter and the second late in spring. Eggs taken in the fall run amounted, by December 31, to 180,000, producing 117,000 fry for liberation in local waters February 23. Captures of adult fish were made to a limited extent in January and February, small numbers of eggs being taken.

In March and April 375,000 eggs were transferred from the auxiliary hatchery at Redwood to the station. Other consignments followed, which, together with those from traps on tributaries of Trinity River, furnished 540,000 fry for liberation in local streams in May and June.

Lieut. Commander J. J. Brice, U. S. N., in a report regarding the establishment of additional stations at Government reservations on the west coast, makes the following reference to the spawning habits of salmon:

The conjunction of natural causes assisting salmon in all movements and in depositing eggs is as interesting as beautiful. In the operation of spawning, from my own observation, the salmon, on arriving at the place selected, remain quiet until recovered from the effects of the long journey from the sea, and for this purpose they select a pool where there is protection or concealment, under driftwood or overhanging bank. In pairs, male and female, they build nests, generally in the swift water on the ripple above or below the pool, the male guarding it with great jealousy, fighting away all intruders. The pool serves as a place of concealment during the day, the salmon spawning and making the nest at night or early in the morning, continuing during the day if the sky is overcast. The act of spawning may go on at intervals for a week before all the eggs are deposited. The construction of the nest is commenced by digging an elongated hole up and down stream, the fish using the snout and fins in making the excavation, throwing out sand and gravel in volumes. The stones and gravel are carried by the current below the excavation, forming a nest covering a space sometimes more than 6 feet in diameter, the small particles of sand and dirt being carried farther downstream. It seems strange that a collection of stone and pebbles should form a fish nest, yet nature has made it very simple, and secured results in a matter-of-fact way. The eggs are deposited in the hole by the female and impregnated by the male, the eggs clinging together in a mass and to the bottom, thirty to fifty minutes, at the end of which time they commence to separate. The gentle current sweeping through the trough-like hole carries each egg out of the excavation as it becomes detached from the mass and on to the nest of stones below, where it tumbles from one to another until it drops into one of the crevices, eventually finding its way to the bottom of the pile or nest, and there, lying securely hidden away, well protected from predatory fish, it finally hatches. It takes from forty to sixty days for the eggs to hatch, the time depending upon the temperature of water. After hatching the fish remain in the nest about twenty days, until the umbilical sac is exhausted, having during this time but one instinct, to hide and burrow deeper in the nest.

Steelhead salmon.—At the first haul of the seine in October a steelhead was caught, and subsequently 16 more were obtained from the Indian dam in the vicinity. These were placed in a small pond and held for the purpose of obtaining their eggs, but none was secured.

Rainbow trout.—In addition to the brood fish already on hand, 14 large specimens were obtained in October from a pond at the Indian agency. The eggs from these in March and April were sufficient to produce 100,000 fry, 20,000 of which were liberated in local waters in May, the remainder being carried over into the next fiscal year.

The mean temperature of the air in March was 43° F. and of the water 44°, in April 44.5° and 44.1°. The snow-fall was so great that on April 22 the snow was over 5 feet deep, hard packed, on the road where it crosses the mountains. The fishes remaining on hand at end of the fiscal year, June 30, 1893, are stated below:

Kind.	1893.	1892.	Brood fish.
Brook trout		400	
Von Behr trout		500	
Rainbow trout	80,000		250
Steelheads			20

CLACKAMAS STATION, OREGON (WALDO F. HUBBARD, SUPERINTENDENT).

Quinnat salmon eggs were obtained from the Clackamas and Sandy rivers, the latter stream being a new field. Alcoholic collections of eggs and fry were made and transmitted for the World's Fair.

At the opening of the fiscal year the building of a rack across the Clackamas for arresting the ascent of spawning salmon was well under way, the structure being completed July 7. The former barrier used consisted of two racks built on either side of an island, but this season the stream was closed on one side, the trap being located opposite. In the latter part of June and throughout July a growth of green moss, never before observed, was found on the bottom of the river, large quantities floating down during a period of five or six weeks, banking against the rack. Its removal required a great deal of labor. During the late summer boats were repaired and minor improvements made. In September the trap which formed a part of the rack was put in position, suitable inclosures built for holding the parent fish, and egg-collecting and hatching apparatus overhauled.

No salmon having appeared late in August, and it having been learned that they could not pass the sawmill dam at Gladstone, a tour was made to this point in company with Governor Pennoyer, the executive of the State of Oregon, the examination proving that there were no means of ascent. A fishway on this dam, owing to poor construction, was wholly ineffective. In compliance with Governor Pennoyer's request, the superintendent of the mill promised to erect a better fishway, but his promise was not fulfilled, and no fish would have passed the dam but for freshets, two of which occurred in October.

The first eggs from the Clackamas trap were taken September 20, collections being made each day thereafter until November 11, the number obtained amounting to 3,265,000. The greatest number taken in a single day was 132,000 on October 21; the smallest, 4,000 on November 11. Adult fish yielding eggs numbered 623. Male fish predominated, the exact number not being recorded. About 80 per cent of the eggs were obtained in October; 248,000 in September, 2,590,000 in October, and 427,000 in November.

Early in September two trips were made to the Sandy River, distant about 15 miles, a suitable location for a field station being found, both for an obstructing rack and water supply for developing eggs. Preparations were made for receiving and holding eggs, hatching-troughs being transported overland from the station. Water was obtained from a spring brook by means of a small dam and a wooden flume 150 feet long. Across the river a rack 175 feet long, with a trap below, was constructed. Employees were quartered in tents, all preparations being completed by September 20. The taking of eggs was commenced October 6, continuing thirty days, collections amounting to 1,179,000 from 253 fish. As soon as the eggs had developed sufficiently for eye-spots to be distinctly seen they were transferred to the station by wagon, in four loads, between November 17 and December 3, the losses sustained incident to transfer being small. About 20 per cent of eggs obtained here were unimpregnated, but the relative loss in the season's hatching was small. Could the rack have been placed earlier on the Sandy River it is believed that larger collections could have been made, the migration of fish having been in progress two months before completing the rack.

The liberation of fry was commenced December 29, continuing almost daily, as they developed, until April 20, deposits being made in the Clackamas River and in Clear Creek, a tributary. The young were scattered over an area of about 5 miles. In January the water temperature was very low, and as a result of ice formation in the troughs the flow was almost cut off. In the cold water the development of fry was retarded, and but few were released during the month. Those released in February amounted to about 1,000,000, in March to 1,500,000, and in April to about 1,000,000, the total reaching 4,100,000.

After the termination of the egg-collecting season the racks and inclosures on the Clackamas were removed and stored above the freshet line. From the commencement the pump was required to supply the hatchery, it being employed throughout November with the exception of three days. It was also used occasionally in December, but after December 21 there was, as a result of rainfall, sufficient brook water. On February 1 and 2 snow falling in the brook compelled constant attention to keep the water flowing. Once during February and again early in April Clear Creek was very high, floating one end of the bridge.

On February 7 there were received from Northville Station 20,000 eggs of brook trout. These arrived in good condition and hatched with slight loss, but the young began dying just before the sac was absorbed, all soon perishing. After March 31 the station force was reduced.

AQUARIA, CENTRAL STATION, WASHINGTON, D. C. (L. G. HARRON, IN CHARGE).

Both fresh-water and marine species were successfully maintained for purposes of study. Before the expiration of the fiscal year the superintendent was temporarily transferred to Chicago, where he was in immediate charge of the salt-water section of the aquaria maintained by the United States Fish Commission. The salt-water section at Chicago having proved relatively more successful than the fresh-water section, it is apparent that studies carried on at the aquaria in Washington brought about the result, the water in Chicago being circulated and aërated after the processes developed here.

In July, 1892, an experiment was made looking to the reduction of temperature in the aquaria by applying ice to the pipes in which salt water was circulated, but the consumption ran up to about 2,000 pounds per day, making the cost too great. No attempt has been made to reduce temperature by application of compressed air. The salt water being in circulation and subject to surrounding air temperature, reaches a high point in the warm months, attaining 88° in August. In winter it is also subject to low temperatures, which, however, are not so extreme, the surrounding air being tempered by means of artificial heat from stoves. In December the temperature was 43°, and in January as low as 38° several days, in consequence of which the sheepshead, croakers, and spots were greatly affected, all of the first two kinds dying. Other species were unfavorably affected, but revived when the temperature rose to 50° and 60°.

In August the aquaria were repaired and put in condition for restocking on the advent of fall. Collections were obtained from Woods Hole, Quincy, Wytheville, and the Washington Fish Ponds, the steamer *Fish Hawk* contributing specimens of marine animals and plants and 800 gallons of sea water from the Chesapeake Bay. Salt-water collections were made at Fortress Monroe, Va.—water, animals, and plants. At that point an agent was employed periodically to make collections and hold in live-cars, when a messenger was sent to receive them. From Morehead City, N. C., February 22 to 28, there were obtained 22 spotted sea trout, 14 red drum, and a number of shellfish and plants, but the extremely cold winter had driven all other species beyond the reach of fishermen. The Potomac River, Accokeek Creek, Occoquan, and other local waters were drawn upon for fresh-water fishes. A trip to Fortress Monroe in July was unsuccessful owing to high temperature.

A fair degree of success was this year attained in holding the filefish, thorn-toads, and hermit-crabs, and by experiment it was found that sea-anemones could be successfully maintained in water oxygenized by the introduction of air jets. During the winter assistance was rendered the Commissioner in making his experimental tests of artificial and natural sea water in preparation for Chicago.

INVESTIGATIONS.

The appearance of a destructive parasite on young lake trout and landlocked salmon in June, 1893, is referred to under the Green Lake heading.

An inquiry, somewhat disappointing, but based on interesting statements, was made into the striped-bass fishery in the upper end of Albemarle Sound, with a view of ascertaining regular spawning-grounds. The New York fish commissioners have recently evinced a lively interest in the subject, the office being twice visited by Hon. L. D. Huntington, chairman, who expressed himself as anxious to take up the work, but scarcely able, on account of inadequate funds. In 1892 Mr. J. K. Rea, of Edenton, N. C., a fisherman of repute, operating the Williams fishery, a mile above Mackey Creek, caught in sturgeon nets of 11-inch mesh large numbers of striped bass, and while on a visit to Washington he informed a Fish Commission employee that over 100 of these fish were in spawning condition, the eggs freely running when the fish were taken into boats. The fish weighed from 50 to 75 pounds each, and being captured at a point favorable for railroad and other communication, the matter was deemed worthy of an investigation.

So far as known the only point where eggs can be obtained with anything like uniformity from season to season is on the upper waters of the Roanoke, at Weldon, N. C., where supplies are limited. The Williams fishery being situated immediately below and in the influence of this river, where it enters Albemarle Sound, caused reasonable hope that something of value might be learned. Accordingly a visit was made to the scene, two days being spent there, April 29 and 30. Inquiry developed the fact that 60 per cent of the sales by J. K. Rea, operating there, were striped bass, and he was this year fishing 15 pound nets, 4 sturgeon gill nets, and 1,500 yards of shad gill nets. Provisional arrangements were effected for obtaining the spare room in Mr. Rea's buildings, his nets, boats, and his personal cooperation for the nominal sum of $1 per day, all fish stripped in obtaining eggs to be paid for at the rate of $1 each, to cover damage sustained. Recommendations being approved, on May 8 Mr. J. L. Leary, a former citizen of Edenton, who had operated nets in that region and was acquainted with the people and surroundings, was engaged to examine the fish taken. From Washington he took 50 jars, the necessary piping, and a hand pump, in order to subject a part of all lots secured to the hatching test. Within two days after arrival an annex to the fish-house, 9 by 29 feet, containing hatching equipment, was completed. Three stands intended for salting fish were connected with piping, forming a tank of 300 gallons capacity, and it was found that one person could in 20 minutes easily pump up a supply more than ample to run the 50 jars for an hour.

Within two days the fishermen were confronted with a disastrous freshet from the Roanoke, the worst seen in ten years, the sound water being thick for miles, and covered with saw logs, railroad ties, and trees. As a result all fishing operations in that area were suspended for a week, shad and herring disappearing by May 20, none having been caught throughout the entire week in ten pound nets. The weather became so cold that frost was barely escaped. From May 13, however, and every day after, the nets were examined, sometimes twice a day. The total number of bass caught consisted of 182 males and 10 females, none of the latter being in spawning condition. The weight of fish was from 2 to 8 pounds, males and females, with the exception of one female weighing 50 pounds. Of those caught, 75 were taken between May 28 and 31. Not only were Mr. Rea's nets constantly looked after, but communication was kept up with a number of other fishermen, and inquiry developed the fact that but few bass were anywhere taken in the sound after the muddy water arrived. The sturgeon fishery, which in 1892 was inaugurated on April 8, was not commenced this year until April 20. A trustworthy report was received that Captain Hettrick, the introducer of the pound net in the Albemarle region, fishing some miles below, took on April 15 a large striped bass which was spawning.

Reference to Mr. J. K. Rea's book established the fact that it was between April 10 and 18, 1892, that the bulk of large spawning fish referred to were taken. On June 20 two ovaries in dry salt were forwarded from Edenton, one from a 72-pound fish and the other from a 60-pound fish. The roe of the larger weighed 21¾ pounds. These were obtained from Mr. W. D. Rea, of Edenton, who had captured the fish between April 15 and 20.

On June 9, fishing operations being concluded, the equipment was returned. The Commission is indebted to Messrs. J. K. Rea & Bros. for courtesies. As these parties are on the lookout for a recurrence of schools of spawning fish it is believed that data may yet be obtained as a result of the inquiry.

DISTRIBUTION.

In addition to the regular work of distribution, the special cars were more or less engaged in transferring live material, marine and fresh-water, to the World's Fair, Chicago, Ill., for fish-cultural and aquarial exhibits made by the United States Fish Commission. In obtaining this material the several stations of the Commission and the steamer *Fish Hawk* were drawn upon, salt-water specimens being secured on the Atlantic, Gulf, and Pacific coasts. The special cars, each having a crew of 5 men, were as follows: Car No. 1, T. C. Pearce in charge; No. 2, G. H. Lambson in charge; No. 3, R. S. Johnson in charge; No. 4, F. P. Hagen and F. C. James in charge.

During the year the car service was enlarged in efficiency by the purchase of a new baggage car, afterwards equipped with a special view to the character of work to be performed. The demand for this increase arose from the fact that there had been a large growth in the number of hatching-stations, while transportation facilities had remained the same. Car No. 4 was purchased from the Harlan & Hollingsworth Company, Wilmington, Del., March 1, 1893; its length is 55 feet 7 inches, its width 9 feet 9 inches. Its entire cost with the special equipment was about $4,500. It was fitted with new approved couplers, conforming to regulations of the railway service. The special equipment for moving fishes consisted of four cedar tanks, each 4 feet in diameter, and two others of the same material 8 feet in diameter, all being about 2 feet in depth. These tanks were bolted to the bottom of the car, and provided, at first, with canvas covers to prevent the wasting of water and undue agitation from which fish would receive injuries. Subsequently the canvas was removed and in place of it gratings of wood provided. The gratings were made with narrow openings about one-fourth inch wide, and were held in position by wedges supported on cleats. When the tanks were filled the surface water was just even with upper surface of gratings. By means of this appliance the water was not only restrained from wasting and from violent agitation, but was also aërated. After the tanks had been placed in position they were sterilized by means of steam.

The steam plant consisted of an upright boiler and duplex air pump, the latter from the New York Air Brake Company. The aëration of water in the tanks was effected by air circulation, the first application to the transportation service, derived from the air pump and introduced into tanks by means of rubber tubing attached to iron piping. The separation of the air current into minute bubbles was effected by forcing through wooden plugs of the American linden tree, inserted a few inches apart in rubber tubing. In addition to appliances already mentioned, sleeping berths of a temporary character were provided for the crew, cooking arrangements also being made.

The fish commissioners of New York having presented 100,000 muskellunge to the commissioners of California, and the latter authorities not being able to provide for the transportation, they sought the assistance of the United States Fish Commission, and on May 25 the fry were taken on board car No. 2, at Bemus Point, N. Y. The trip was highly successful, the loss in transit being estimated at only 9,000. Those which survived were deposited in Lake Merced and Lake Pilarcitos, California, 60,000 in the former and 31,000 in the latter, May 31. The first named were liberated at Ocean View, San Mateo County, Cal., the latter at Millbræ, in the same county.

The scope of the distribution service for the year and the details of the distribution of fishes are shown in the following tables:

Summary showing names of railroads and total number of miles of free transportation furnished the United States Fish Commission cars and messengers during the fiscal year ending June 30, 1893.

Name of railroad.	Cars.	Messengers.	Total.
Atchison, Topeka and Santa Fe	5,727	1,104	6,831
Baltimore and Ohio	513	632	1,145
Baltimore and Ohio Southwestern	90	....	90
Burlington, Cedar Rapids and Northern	2,923	78	3,001
Chesapeake and Ohio	8,136	220	8,356
Chicago, Burlington and Quincy	7,614	644	8,258
Chicago and Northwestern	882	....	882
Chicago, St. Paul, Minneapolis and Omaha	64	....	64
Cleveland, Cincinnati, Chicago and St. Louis	6,806	....	6,806
Colorado Midland	540	125	665
Delaware and Hudson	234	202	436
Denver and Rio Grande	....	2,259	2,259
Duluth and Iron Range	....	374	374
Duluth, South Shore and Atlantic	266	....	266
Flint and Pere Marquette	1,452	29	1,481
Fremont, Elkhorn and Missouri Valley	824	272	1,096
Grand Rapids and Indiana	935	....	935
Great Northern	342	....	342
International and Great Northern	26	....	26
Jacksonville Southeastern	545	....	545
Kansas City, Fort Scott and Memphis	1,010	46	1,056
Kansas City, Fort Smith and Southern	38	380	418
Kentucky Central	192	....	192
Louisville and Nashville	546	9	555
Michigan Central	12,021	279	12,300
Minneapolis, St. Paul and Sault Ste. Marie	213	....	213
Missouri, Kansas and Texas	406	....	406
Missouri Pacific	1,347	....	1,347
Mobile and Ohio	466	....	466
Montana Union	....	32	32
Nashville, Chattanooga and St. Louis	98	....	98
New York, Lake Erie and Western	296	....	296
Northern Pacific	4,112	1,370	5,482
Pennsylvania Railroad	54	....	54
Southern Pacific	2,074	....	2,074
Spokane Falls and Northern	80	....	80
St. Louis and San Francisco	1,786	752	2,538
St. Louis Southwestern	212	....	212
Terre Haute and Indianapolis	634	....	634
Texas Pacific	1,465	....	1,465
Union Pacific	13,249	4,253	17,502
Wabash	4,072	112	4,184
West Virginia and Pittsburg	....	206	206
Wilmington and Northern	....	15	15
Wisconsin Central	1,626	....	1,626
Zanesville and Ohio	52	....	52
	83,968	13,393	97,361

Statement of mileage by cars, detached messengers, and species.

Kind of fish, etc.	Transferred by—	Number of miles traveled.		
		Paid.	Free.	Total.
Native food-fishes	Car 1	1,567	6,446	48,250
	Car 2	2,641	15,108	
	Car 3	3,771	15,338	
	Detached messenger	2,444	935	
Trout	Car 1	361		56,191
	Car 2	2,287	10,212	
	Car 3	7,619	4,492	
	Detached messenger	20,980	10,240	
Carp	Car 1	5,188	4,917	12,117
	Detached messenger	1,902	110	
Pike perch	Car 1	1,052	398	2,935
	Car 2	666	540	
	Detached messenger	279		
Shad	Car 3	2,542		12,513
	Detached messenger	9,971		
World's Fair	Car 1	3,134	5,943	44,842
	Car 2	3,994	5,896	
	Car 3	3,362	4,818	
	Car 4	4,812	9,860	
	Detached messenger	2,872	151	
Miscellaneous	Car 1	222		12,610
	Car 2	222		
	Car 3	410		
	Car 4	222		
	Detached messenger	9,577	1,957	
Total		92,097	97,361	189,458

Details of distribution.

Disposition.	Eggs.	Fry.	Adults and yearling.
Spotted catfish (*Ictalurus punctatus*):			
Arizona Fish Commission			722
Applicants in District of Columbia			5
Illinois			383
Chicago, Burlington and Quincy Company's ponds, near Galesburg, Ill			325
Lake Bartlett, near Waterloo, Ill			150
Applicants in Indiana			100
Lake Wawassee, near Cedar Beach, Ind			125
Pine Lake, near Laporte, Ind			230
Upper Iowa River, near Decorah, Iowa			200
Turkey River, near Cresco, Iowa			90
Wapsipinicon River, near Independence, Iowa			50
Cedar River, near Cedar Rapids, Iowa			500
Waterloo, Iowa			500
Spirit Lake, near Spirit Lake, Iowa			258
Reservoir near Creston, Iowa			147
Applicants in Kansas			360
Kentucky			120
Lake Mingo, near Nicholasville, Ky			100
Nolan and Valley creeks, near Glendale, Ky			50
Streams near Hagerstown, Md			300
Little Clam Lake, near Cadillac, Mich			300
Big Clam Lake, near Cadillac, Mich			307
Applicants in Missouri			1,050
New Mexico			225
Ohio			25
Bass Lake, near Chardon, Ohio			75
Mahoning River, near Leavittsburg, Ohio			60
Applicants in Pennsylvania			50
French Creek, near Rapid City, S. Dak			200
White Clay and Porcupine creeks, on Pine Ridge Indian Agency, S. Dak			445
Beaver Creek, near Huntingdon, Tenn			150
Applicants in Virginia			400
Jackson River, near Cedar River, Virginia			94
Craig Creek, near New Castle, Va			75
Applicants in Washington			125
Clear Lake, near Clear Lake, Wash			75
Deer Lake, near Loon Lake, Wash			50
Chain of Lakes near Waupaca, Wis			65
Carp (*Cyprinus carpio*):			
Applicants in Alabama			1,340
Arizona			1,301
Arkansas			1,080
Colorado			136
Connecticut			131

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Carp (*Cyprinus carpio*)—Continued.			
Applicants in Delaware			30
Delaware Fish Commission			1,400
Applicants in District of Columbia			300
Florida			1,018
Georgia			1,545
Georgia Fish Commission			2,000
Appalachee River, near Farmington, Ga			1,000
Oconee River, near Mount Vernon, Ga			500
Watkinsville, Ga			500
Savannah River, near Augusta, Ga			1,000
Yellow River, near Covington, Ga			1,000
Applicants in Idaho			493
Illinois			372
Indiana			218
Indian Territory			103
Iowa			453
Kansas			767
Kentucky			130
Cumberland River, near Pineville, Ky			2,000
Applicants in Louisiana			105
Maine			150
Maryland			387
Maryland Fish Commission			1,030
Applicants in Massachusetts			200
Michigan			102
Minnesota			118
Minnesota Fish Commission			1,500
Applicants in Mississippi			136
Missouri			628
Montana			321
New Hampshire			30
New Jersey			120
New Mexico			360
New York			2,530
North Carolina			1,844
Neuse River, near Goldsboro, N. C			3,936
Newbern, N. C			1,502
Roanoke River, near Weldon, N. C			3,936
Trent River, near Newbern, N. C			2,344
Applicants in North Dakota			900
Ohio			545
Oklahoma			373
Oregon			6
Pennsylvania			1,108
Rhode Island			30
South Carolina			558
South Dakota			608
Streams on Pine Ridge Indian Reservation, S. Dak			4,900
Applicants in Tennessee			344
Texas			939
Utah			3,130
Virginia			2,744
James River, near Richmond, Va			3,936
Applicants in Washington			225
West Virginia			200
West Virginia Fish Commission			1,000
Applicants in Wisconsin			410
Wisconsin Fish Commission			10,000
Applicants in Wyoming			30
Ontario Fish Commission, Canada			300
Tench (*Tinca tinca*):			
Applicants in Arkansas			300
Delaware Fish Commission			300
Applicants in Missouri			25
Missouri Fish Commission			5,000
Meramec River at crossing of St. L. and S. F. Rwy., Mo			6,430
Applicants in Mississippi			100
Colorado River, near Austin, Tex			1,500
San Marcos River, near San Marcos, Tex			1,500
Golden ide (*Idus melanotus*):			
Applicants in Missouri			10
New York			100
North Carolina			10
Goldfish (*Carassius auratus*):			
Applicants in Alabama			76
Arkansas			171
Colorado			43
Connecticut			37
Delaware			76
District of Columbia			2,146
Florida			100
Georgia			202
Idaho			4

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Goldfish (*Carassius auratus*)—Continued.			
Applicants in Illinois			742
Indiana			133
Indian Territory			40
Iowa			159
Kansas			456
Kentucky			121
Louisiana			148
Maine			8
Massachusetts			139
Michigan			113
Minnesota			52
Mississippi			68
Missouri			1,723
Nebraska			24
New Hampshire			14
New Jersey			183
New York			523
North Carolina			272
Ohio			598
Oklahoma			4
Pennsylvania			1,114
Rhode Island			8
South Carolina			95
South Dakota			28
Tennessee			350
Texas			60
Utah			90
Virginia			2,280
Washington			4
West Virginia			154
Wisconsin			30
Shad (*Clupea sapidissima*).			
United States Fish Commission ponds, Washington, D. C.		a(1,444,000)	
Brandywine Creek, Wilmington, Del.		2,237,000	
Nanticoke River, Seaford, Del.		870,000	
Patapsco River, Relay station, Md.		215,000	
Patuxent River, Laurel, Md.		405,000	
Bush River, Bush River station, Md.		1,800,000	
North East River, North East, Md.		1,770,000	
Back River, Back River station, Md.		1,350,000	
Tuckahoe Creek, Queen Anne, Md.		900,000	
Elk River, Elkton, Md.		2,220,000	
Chester River, Chestertown, Md.		450,000	
Gunpowder River, Gunpowder station, Md.		1,800,000	
Wicomico River, Salisbury, Md.		840,000	
Grand Pond, near Norfolk, Mass.		350,000	
Taunton River, near Taunton, Mass.		988,000	
Hearrels Branch, tributary to Shoal Creek, tributary to Spring River, tributary to Neosho River, Missouri			b 200,000
Delaware River, Port Jervis, N. Y.		900,000	
Callicoon, N. Y.		450,000	
Delaware Water Gap, Pa.		1,729,000	
Lackawaxen, Pa.		750,000	
Timber Creek, near Gloucester, N. J.		744,000	
Dividing Creek, Dividing Creek, N. J.		776,000	
Neuse River, Goldsboro, N. C.		252,500	
Branch of Cape Fear River, near Wallace, N. C.		252,000	
Lumber River, near Lumberton, N. C.		336,000	
Susquehanna River, near Battery Island, Md.		7,224,000	
Port Deposit, Md.		3,650,000	
Columbia, Pa.		1,761,000	
Fites Eddy, Pa.		1,770,000	
Peach Bottom, Pa.		1,800,000	
Hudson River, near Athens, N. Y.		1,573,000	
Congaree River, near Columbia, S. C.		1,660,500	
Chappawansic Creek, Quantico, Va.		317,000	
Neabsco Creek, Freestone, Va.		97,000	
Mattapony River, near Milford, Va.		335,000	
Stony Creek, Stony Creek station, Va.		338,000	
Rapidan River, Rapidan, Va.		400,000	
Otter River, Evington, Va.		292,000	
Rappahannock River, Fredericksburg, Va.		500,000	
Cedar River, Catlett, Va.		428,000	
Potomac River, Washington, D. C.			c 600,000

a Deposited for rearing and distribution in fall of 1893.
b Estimated product of 700,000 fry deposited in rearing-ponds at United States Fish Commission Station, Neosho, Mo.
c Estimated product of 1,980,000 fry deposited in rearing-ponds of the United States Fish Commission at Washington, D. C.

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Quinnat salmon (*Oncorhynchus chouicha*):			
California Fish Commission	3,530,000		
McCloud River, near Baird, Cal		533,100	
Redwood Creek, near Baird Ranch, Cal		170,000	
Trinity River, Fort Gaston, Cal		487,200	
Clackamas River, near Clackamas, Oreg		4,100,000	
Atlantic salmon (*Salmo salar*):			
Connecticut Fish Commission	108,000		
New York Fish Commission	75,000		
New Hampshire Fish Commission	50,000		
Alamoosook Lake, near Craig Brook, Me			1,448
Landlocked salmon (*Salmo salar* var. *sebago*):			
Commodore Club, Hartland, Me			999
Green Lake, in Hancock County, Me			500
Toddy Pond, near Orland, Me			16,032
Grand Lake and Grand Lake Stream, in Washington County, Me			48,000
Loch Leven trout (*Salmo levenensis*):			
E. A. Adams, Boston, Mass	20,000		
Geo. M. Brown, for F. and P. M. Rwy. Co., Saginaw, Mich	25,000		
Minnesota Fish Commission	20,000		
New Hampshire Fish Commission	15,000		
Prof. C. Sasaki, Tokyo, Japan	10,000		
W. P. Greenough, La Chévrotière, Quebec, Canada	10,000		
Lester River, near Duluth, Minn			1,550
Ohio Fish Commission			3,350
Applicants in Wyoming			2,600
Rainbow trout (*Salmo irideus*):			
Maryland Fish Commission	46,500		
Minnesota Fish Commission	20,000		
Missouri Fish Commission	20,000		
Nebraska Fish Commission	37,500		
G. W. Thayer, Provo City, Utah	10,000		
Vermont Fish Commission	81,000		
John H. Gordon, South Bend, Wyo	10,000		
C. Raveret-Wattel, Fécamp, Seine Inférieure, France	10,000		
Prof. C. Sasaki, Tokyo, Japan	10,000		
Emil Warner, Swiss consul, Havre, France, for the Government of Switzerland	30,000		
Trinity River, near Fort Gaston, Cal		35,000	
Applicants in District of Columbia		2,000	
Maryland		2,000	
Walker Run, near Hagerstown, Md		16,500	
Lake Erie, near Put-in Bay, Ohio		65,000	
Warner Mill Creek, near Chanceford, Pa		16,500	
Applicants in Virginia		2,000	
Sandy River, near McGregor, Minn		20,000	
Partridge River, near Okwanim, Minn		20,000	
St. Croix River, near Gordon, Wis		23,000	
White River, near Mason, Wis		20,000	
Applicants in Alabama			650
Arkansas			100
Crystal Lake, near Eureka Springs, Ark			1,000
Mine Creek, near Nashville, Ark			800
Black Fish Lake, in St. Francis County, Ark			500
Silver Springs, near Rogers, Ark			500
Lower Evergreen Lake, in Lake County, Colo			1,550
Applicants in District of Columbia			500
Georgia			3,100
Illinois			375
Bloody Run, near McGregor, Iowa			150
Des Moines River, near Ottumwa, Iowa			600
Des Moines, Iowa			100
Mississippi River, near Dubuque, Iowa			175
Applicants in Kansas			475
Strangers Creek, near Atchison, Kans			350
Deer Creek, near Atchison, Kans			150
Crane Creek, near London, Ky			500
Applicants in Louisiana			225
Maryland			1,883
Bennett Creek, near Frederick, Md			500
Ballenger Creek, near Frederick, Md			240
First and Second Mine runs, near Towson, Md			1,000
Walker Run, near Hagerstown, Md			500
Shoemaker and Silver runs, near Brooklandville, Md			1,200
Seven Brooks, near Glyndon, Md			1,000
Applicants in Missouri			3,550
Current River, near Chilton, Mo			9,891
Shoal Creek, near Neosho, Mo			2,316
Exeter, Mo			400
Granby, Mo			600
Barbee Lake, near Ritchey, Mo			1,100
Indian Creek, near Eagle Mills, Mo			600

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Rainbow trout (*Salmo irideus*)—Continued.			
Indian Creek, near Lanagan, Mo			1,945
South Fork of Buffalo River, near Pratts Place, Mo			600
Baynham Branch, near Neosho, Mo			500
Hickory Creek, near Neosho, Mo			500
Big Lost Creek, near Racine, Mo			600
Elk River, near Pineville, Mo			600
Rutledge, Mo			600
South Fork of Elkhorn River, near Indian Springs, Mo			600
Crane Creek, near Crane, Mo			600
Missouri Fish Commission			18
Applicants in New Jersey			1,300
Stony Creek, near Delaware, N. J			1,000
Raritan River, near Trenton, N. J			1,000
Applicants in New York			600
Wiscoy Creek, near Bliss, N. Y			800
Applicants in North Carolina			350
Flat Creek, near Black Mountain, N. C			1,500
Broad River, near Black Mountain, N. C			1,000
Honing Creek, near Asheville, N. C			986
Toms Creek, near Marion, N. C			985
Public streams near Linville, N. C			1,000
Applicants in Pennsylvania			7,175
Hawkes Pond, near Scranton, Pa			600
Mountain Branch, near Houtzdale, Pa			1,000
Cabin Branch, near York, Pa			400
Cold Spring Brook, near Susquehanna, Pa			200
Streams near Jermyn, Pa			500
Falling Springs, near Chambersburg, Pa			2,200
Big Springs, near Florin, Pa			1,000
Dennis Run, near Coatesville, Pa			100
Steen Run, near Coatesville, Pa			100
Alder Run, near Kylertown, Pa			1,000
Morgan Run, near Clearfield, Pa			1,100
Youngs Run, near Coatesville, Pa			100
Cook Run, near Coatesville, Pa			100
Powell Run, near Coatesville, Pa			100
Long Run, near Gaines, Pa			436
Elk Creek, near Toughkenamon, Pa			500
Starrucca Creek, near Susquehanna, Pa			600
Brandt, Pa			400
Black Lick Creek, near Conemaugh, Pa			800
Lackawanna Creek, near Burnwood, Pa			200
Beaner Creek, near East Hickory, Pa			500
Canawaste Creek, near Susquehanna, Pa			200
White Deer Creek, near Milton, Pa			800
Hemlock Creek, near Brandt, Pa			200
Wild Cat Creek, near Brandt, Pa			200
Tunkhannock Creek, near Susquehanna, Pa			600
Pickering Creek, near Phœnixville, Pa			200
Lamb Creek, near Mansfield, Pa			700
Big Roaring Creek, near Shamokin, Pa			1,000
Ridley Creek, near Chester, Pa			300
Nanon Creek, near Du Bois, Pa			300
Mill Creek, near Tioga, Pa			700
Haller Creek, near Richland, Pa			300
Harvey Creek, near Nanticoke, Pa			600
West Branch of Susquehanna, near Lock Haven, Pa			500
Susquehanna River, near Driftwood, Pa			600
Allegheny River, near Coudersport, Pa			600
Black Lick River, near Ebensburg, Pa			1,000
Applicants in South Carolina			200
Long Cane Creek, near Abbeville, S. C			1,000
Cullasoga River, near Walhalla, S. C			600
Applicants in Tennessee			400
Piney River, near Spring City, Tenn			200
Doe River, near Roan Station, Tenn			750
Public streams, near Johnson City, Tenn			800
Applicants in Texas			256
Cypress Bayou, near Jefferson, Tex			400
Otter Creek, near Rutland, Vt			1,401
Mill Creek, near Middleway, W. Va			1,000
Cheat River, near Cheat Bridge, W. Va			1,560
Little and Big Plow rivers, near Stevens Point, Wis			2,100
Applicants in Virginia			4,050
Algoma Lake, near Howardsville, Va			400
Bold Brook, near Louisa, Va			400
South Fork and Roaring Branch, near Big Stone Gap, Va			1,000
Pinkley Branch, near Wytheville, Va			200
Bens Run, near Boyce, Va			300
Laurel Run, near Lexington, Va			600
Cameron and Four Mile runs, near Four Mile Run, Va			275
Mountain streams near Greenwood Depot, Va			600

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Rainbow trout (*Salmo irideus*)—Continued.			
Mountain streams near Cleveland, Va			800
Stony Creek, near Liberty Furnace, Va			600
Calhoun Creek, near Big Stone Gap, Va			1,000
Hawksbill Creek, near Luray, Va			400
Goose and Cococton creeks, near Clark Gap, Va			500
Barbour Creek, near Craig City, Va			1,000
Mill Creek, near Craig City, Va			1,000
Healing Creek, near Hot Springs, Va			500
Falling Spring Creek, near Hot Springs, Va			970
Jackson River, near Hot Springs, Va			960
Piney River, near Culpeper, Va			1,000
New River, near Point Pleasant, Va			200
Cow Pasture River, near Millboro, Va			1,500
Catawba River, near Fincastle, Va			800
Von Behr trout (*Salmo fario*):			
Connecticut Fish Commission	20,000		
Maryland Fish Commission	35,000		
Minnesota Fish Commission	20,000		
Nebraska Fish Commission	20,000		
New Hampshire Fish Commission	25,000		
Vermont Fish Commission	20,000		
Otto Gramm, Laramie, Wyo	15,000		
Prof. C. Sasaki, Tokyo, Japan	10,000		
W. P. Greenough, La Chévrotière, Quebec, Canada	10,000		
Redwood Creek, in Humboldt County, Cal			178
Three creeks, in Humboldt County, Cal			50
Supply Mill and Fish Tang creeks, near Hoopa Valley, Cal			10,700
Uneva Lake, in Summit County, Colo			2,500
Wellington Lake, near Buffalo, Colo			2,000
Twin Lakes, near Twin Lakes, Colo			2,000
St. Vrain River, near Lyons, Colo			1,000
Deer Creek, near Baily, Park County, Colo			3,950
Boulder Creek, near Boulder, Colo			4,000
Rock Creek, in Lake County, Colo			2,500
Fryingpan Creek, in Pitkin County, Colo			2,000
Arkansas River, near Salida, Colo			2,000
Lake Park, in Lake County, Colo			1,500
Applicants in Idaho			300
Maine			500
Massachusetts			300
Michigan			150
Nebraska Fish Commission			6,000
South Branch, near Trenton, N. J			993
Demorest Creek, near Congers, N. Y			1,000
Analomink Creek, near Delaware Water Gap, Pa			1,000
Applicants in Texas			200
Applicants in Vermont			1,000
Otter Creek, near Proctor, Vt			2,500
Vermont Fish Commission			2,500
Black-spotted trout (*Salmo mykiss*):			
Wyoming Fish Commission	25,000		
Otto Gramm, Laramie, Wyo	5,000		
H. M. Orahood, Buffalo Creek, Colo	30,000		
Applicants in Colorado			1,000
Wellington Lake, near Buffalo, Colo			2,000
Twin Lakes, near Snowden, Colo			7,000
Mammoth Creek and Lake, near Central City, Colo			7,000
Michigan Creek, near Jefferson, Colo			1,000
Grizzly Creek, near Glenwood, Colo			1,000
Deer Creek, near Baily, Colo			2,000
Arkansas River, near Salida, Colo			2,000
Lower Evergreen Lakes, in Lake County, Colo			500
Minnesota Fish Commission			1,000
Sun River, near Great Falls, Mont			5,000
Belt Creek, near Goodman, Mont			1,000
Little Sheep Creek, near Lima, Mont			2,000
Humboldt River, near Elko, Nev			4,925
Wisconsin Fish Commission			3,600
Applicants in Wyoming			5,000
Brook trout (*Salvelinus fontinalis*):			
Troutdale Fish Farm Co., Mammoth Springs, Ark	5,000		
Flint and Pere Marquette R. R. Co., per G. M. Brown, Saginaw, Mich	25,000		
Minnesota Fish Commission	20,000		
Oregon Fish Commission	20,000		
Vermont Fish Commission	20,000		
Applicants in Colorado			2,500
Uneva Lake, in Summit County, Colo			2,500
Wellington Lake, near Buffalo, Colo			2,000
Lake Edith, near Idaho Springs, Colo			5,500

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Brook trout (*Salvelinus fontinalis*)—Continued.			
Twin Lakes, near Snowden, Colo			5,000
Mammoth Creek and Lake, near Central City, Colo			6,000
Lake Lenore, near Ouray, Colo			1,000
Texas Creek, near Cotopaxie, Colo			300
Grizzly Creek, near Glenwood, Colo			1,000
Clear Creek, near Georgetown, Colo			2,000
Boulder Creek, near Boulder, Colo			1,000
Greenhorn Creek, near Graneros, Colo			1,000
Fryingpan Creek, near Norrie, Colo			2,000
St. Vrain River, near Lyons, Colo			1,000
Arkansas River, near Salida, Colo			1,000
North Fork of South Platte River, in Jefferson Co., Colo			10,800
North Fork of North Platte River, near Walden, Colo			1,000
Park Lake, in Lake County, Colo			1,500
Rock Creek, in Lake County, Colo			2,500
South Platte River, in Park and Jefferson counties, Colo			5,000
Redwood Creek, in Humboldt County, Cal			215
Three Creeks, in Humboldt County, Cal			50
Supply Mill and Fish Tang creeks, near Hoopa Valley, Cal			5,900
Applicants in Indiana			800
Maine			500
Alamoosook Lake, near Orland, Me			27,564
Moose Pond, near Hartland, Me			1,970
Mill Brook, near North Amherst, Mass			500
Whately Brook, near Whately, Mass			200
Broad Brook, near Holyoke, Mass			300
Rush Creek, near Jenison, Mich			1,000
Clark Creek, near Grand Rapids, Mich			500
Indian Mill Creek, near Grand Rapids, Mich			500
Grand River, near Norvell, Mich			500
Brevoort Lake, near Moran, Mich			978
Silver Lake, near Quoto, Mich			300
Hickory Creek, in Newton County, Mo			900
Applicants in Missouri			100
Lake Leslie, near Elkhorn, Mont			2,000
Upper Elkhorn Creek, near Elkhorn, Mont			5,000
Goodman Creek, near Goodman, Mont			3,000
Lost Creek, near Anaconda, Mont			2,000
Little Sheep Creek, near Lima, Mont			4,000
Applicants in Nebraska			900
Otter Creek, near Ogallala, Nebr			5,000
Middle Loup River, near Halsey, Nebr			5,000
Nebraska Fish Commission			6,000
Applicants in New Hampshire			500
Small Brook, near Nashua, N. H			400
Santa Fe River, near Santa Fe, N. Mex			4,850
Musconetong Creek, near Trenton, N. J			1,285
Lake View, near Bismarck, N. Dak			4,970
Deer Creek, near London, Ohio			800
Applicants in Pennsylvania			100
Meadow Brook, near Scranton, Pa			500
Rose Brook, near Honesdale, Pa			500
Tributaries of Dyberry Creek, near Honesdale, Pa			1,560
Little Dyberry Creek, near Honesdale, Pa			500
Lackawanna Creek, near Uniondale, Pa			973
Tobyhanna River, near Tobyhanna, Pa			800
Black Lick River, near Ebensburg, Pa			500
White River, near Hartford, Vt			1,000
Otter Creek, near Proctor, Vt			3,000
Beaver Creek near Proctor, Vt			1,200
Beechwood Lake, near Marinette, Wis			500
Miller and Barker creeks, near Barron, Wis			950
Hay Creek, near Marinette, Wis			500
Pokegama Creek, near Rice Lake, Wis			1,000
Menominee River, near Marinette, Wis			900
Green River, near Werley, Wis			725
Lake trout (*Salvelinus namaycush*):			
Connecticut Fish Commission	105,000		
Iowa Fish Commission	100,000		
Minnesota Fish Commission	100,000		
Nebraska Fish Commission	100,000		
New Hampshire Fish Commissioner	100,000		
New York Fish Commission	100,000		
Vermont Fish Commission	300,000		
Burt Lake, near Indian River, Mich		50,000	
Muskrat Lake, near Lake City, Mich		30,000	
Mullett Lake, near Topinabee, Mich		50,000	
Lake Erie, near North Bass Island reef, Ohio		81,500	
James Lake, near Angola, Ind		30,000	
Lake Kosciusko, near Syracuse, Ind		58,000	
Sylvan Lake, near Pontiac, Mich		20,000	
Lake Superior, near Lester Park, Minn		1,305,000	

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Lake trout (*Salvelinus namaycush*)—Continued.			
Lake Superior, near Grand Portage, Minn		100,000	
Fish Island, Minn		75,000	
Chicago Bay, Minn		50,000	
Two Harbor, Minn		50,000	
Beaver Bay, Minn		50,000	
Grand Marais, Minn		50,000	
Fisherman's Home, Mich		100,000	
Washington Harbor, Mich		100,000	
Wright Island, Mich		75,000	
Trout Lake, near Tower, Minn		100,000	
Eagle Nest Lake, near Ely, Minn		100,000	
Big McDonald Lake, near Perham, Minn		40,000	
Lake Sally, near Detroit, Minn		40,000	
Minnewaska Lake, near Glenwood, Minn		40,000	
Detroit Lake, near Detroit, Minn		40,000	
Battle Lake, near Battle Lake, Minn		40,000	
Clear Lake, near South Bend, Ind			1,000
Sawyer Lake, near Iron Mountain, Mich			1,000
Whitmore Lake, near Whitmore Lake, Mich			1,000
Mill Lake, near Wingleton, Mich			4,966
Trout Lake, near Trout Lake, Mich			3,955
Applicants in Pennsylvania			500
Glass Factory Pond, near Honesdale, Pa			1,480
Dun Pond, near Ararat, Pa			500
Elk Lake, near Honesdale, Pa			1,800
Harveys and Elk lakes, near Scranton, Pa			1,000
Fiddle Lake, near Ararat, Pa			500
Five-Mile Lake, near Poyntelle, Pa			500
Poyntelle Lake, near Poyntelle, Pa			400
Lake St. Croix, near Hudson, Wis			2,300
Rice Lake, near Rice Lake, Wis			1,950
Whitefish (*Coregonus clupeiformis*):			
New York State Fish Commission	5,000,000		
Lake Erie, near North Bass Island, Ohio		4,000,000	
Middle Bass Island, Ohio		4,400,000	
Ballast Island, Ohio		4,880,000	
Rattlesnake Island, Ohio		2,720,000	
Peach Point reefs, Ohio		3,000,000	
Kelley Island, Ohio		3,570,000	
Lake Michigan, near Manistique and Scott Point		1,000,000	
Epaufette and Warehouse Point		1,000,000	
Lake Huron, near Thunder Bay, Partridge Point, Mich		3,140,000	
Sturgeon Point		1,500,000	
East Tawas		1,500,000	
Miller Point		3,000,000	
Detour Passage, near Hay Point		2,000,000	
Whitefish Lake, near Corinne, Mich		2,000,000	
Straits of Mackinac, near Bois Blanc, Mich		1,500,000	
Lake Superior, near Duluth, Minn		2,982,000	
Wisconsin shore		6,000,000	
Tobin Bay, Mich		1,000,000	
Washington Harbor, Mich		500,000	
Lake herring (*Coregonus artedi*):			
Lake Erie, on the reefs of North Bass, Middle Bass, Ballast, Rattlesnake, and Kelley islands		6,505,000	
Yellow perch (*Perca flavescens*):			
Applicants in Illinois			325
Chicago, Burlington, and Quincy Company's pond, near Galesburg, Ill			110
North Fork Creek, near Danville, Ill			150
Sugar Creek, near Paris, Ill			185
Lake Maxinkuckee, near Marmont, Ind			385
Lake Wawassee, near Cedar Beach, Ind			257
Pine Lake, near Laporte, Ind			144
Applicants in Indiana			100
Upper Iowa River, near Decorah, Iowa			150
Wapsipinicon River, near Independence, Iowa			150
Cedar River, near Cedar Rapids, Iowa			900
Spirit Lake, near Spirit Lake, Iowa			200
Applicants in Kansas			50
Kentucky			150
Lake Mingo, near Nicholasville, Ky			50
Nolan and Valley creeks, near Glendale, Ky			186
Applicants in Missouri			50
New Mexico			25
Mohican Creek, near Lexington, Ohio			70
Mahoning River, near Leavittsville, Ohio			400
Long Lake, near Akron, Ohio			25
Mud Lake, near Hudson, Ohio			25
Tawawa Lake, near Sidney, Ohio			50
White, Clay, and Porcupine creeks, near Pine Ridge Indian Agency, S. Dak			41
Beaver Creek, near Huntingdon, Tenn			150

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Pike perch (*Stizostedion vitreum*):			
Pike River, in Minnesota	500,000		
Applicants in Illinois			166
Chain Lake, in St. Joseph County, Ind		200,000	
Chamberlain Lake, in St. Joseph County, Ind		200,000	
Riddle Lake, in St. Joseph County, Ind		200,000	
Clear Lake, in St. Joseph County, Ind		200,000	
Notre Dame Lake, in St. Joseph County, Ind		200,000	
Hudson Lake, in Laporte County, Ind		2,000,000	
Bear Lake, near Albion, Ind		200,000	
Private Lake, near Albion, Ind		300,000	
Lake Wawassee, near Cedar Beach, Ind			148
Pine Lake, near Laporte, Ind			31
Cedar River, near Waterloo, Iowa			300
Small lakes near Iron Mountain, Mich		500,000	
Poplar River, in Lake County, Minn		500,000	
Sandusky River and tributaries, near Upper Sandusky, Ohio		500,000	
Lake Erie, near Rattlesnake Island, Ohio		3,600,000	
Punderson Pond, near Burton, Ohio		500,000	
West Branch of Susquehanna River, in Clinton County, Pa		4,400,000	
West Branch of Susquehanna River, in Lycoming County, Pa		1,000,000	
Sinnemahoning Branch, in Cameron County, Pa		200,000	
Mouth of Bald Eagle Creek, in Clinton County, Pa		400,000	
Tennessee River, near Knoxville, Tenn		500,000	
Loudon, Tenn		400,000	
Clinch River and other streams, near Luttrell, Tenn		400,000	
Tennessee, Clinch, and Emory rivers, in Roane County, Tenn		500,000	
French Broad, Holston, and other streams, in Jefferson County, Tenn		500,000	
Little River, Little Tennessee River, and other streams, in Blount County, Tenn		500,000	
Powell River and other streams, in Campbell County, Tenn		500,000	
Clinch River and other streams, in Anderson County, Tenn		500,000	
Emory, Obeds, and other streams, in Morgan County, Tenn		300,000	
French Broad and Pigeon rivers, in Sevier County, Tenn		500,000	
New River and tributaries, in Scott County, Tenn		400,000	
Beaver Creek, near Huntingdon, Tenn			200
Lakes of the Wausaukee Club, near Amberg, Wis		500,000	
Lake Superior, near Superior Entry, Wis		4,000,000	
Sea bass (*Serranus atrarius*):			
Vineyard Sound, off Massachusetts coast		1,189,000	
White bass (*Roccus chrysops*):			
Applicants in Illinois			41
Chicago, Burlington and Quincy Company's pond, near Galesburg, Ill			30
Lake Wawassee, near Cedar Beach, Ind			250
Pine Lake, near Laporte, Ind			90
Upper Iowa River, near Decorah, Iowa			100
Maquoketa River, near Strawberry Point, Iowa			195
Turkey River, near Cresco, Iowa			200
Cedar River, near Waterloo, Iowa			500
Spirit Lake, near Spirit Lake, Iowa			75
Applicants in Kentucky			39
White Clay and Porcupine creeks, on Pine Ridge Indian Agency, S. Dak			40
Beaver Creek, near Huntingdon, Tenn			150
Black bass (*Micropterus dolomieu* and *M. salmoides*):			
Cook Creek, near Florence, Ala			200
Blackfish Lake, in St. Francis County, Ark			200
Arizona Fish Commission			138
Applicants in Arkansas			295
Colorado			600
Lake Saltonstall, near East Haven, Conn			200
Delaware Fish Commission			1,000
Brandywine Creek, near Wilmington, Del			480
Applicants in District of Columbia			850
Georgia			281
Boise River, near Boise, Idaho			1,597
Applicants in Illinois			845
Chicago, Burlington and Quincy Railroad Company's pond, near Galesburg, Ill			360
Grays Lake, near De Nicos Lake, Ill			100
Deep Lake, near Lake Villa, Ill			100
Sni River, near East Hannibal, Ill			1,300
Island Lake, near Waterloo, Ill			616
Lake Bartlett, near Waterloo, Ill			325

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Black bass (*Micropterus dolomieu* and *M. salmoides*)—Cont'd.			
Schorr Lake, near Waterloo, Ill			325
North Fork Creek, near Danville, Ill			90
Applicants in Indiana			200
Lake Maxinkuckee, near Marmont, Ind			1,190
Lake Wawassee, near Cedar Beach, Ind			582
Pine Lake, near Laporte, Ind			100
Upper Iowa River, near Decorah, Iowa			200
Maquoketa River, near Strawberry Point, Iowa			385
Turkey River, near Cresco, Iowa			200
Wapsipinicon River, near Independence, Iowa			300
Cedar River, near Cedar Rapids, Iowa			1,400
Waterloo, Iowa			1,500
Spirit Lake, near Spirit Lake, Iowa			685
Reservoir near Cresco, Iowa			150
Applicants in Kansas			1,450
Walnut River, near Eldorado, Kans			200
Applicants in Kentucky			855
Lake Mingo, near Nicholasville, Ky			200
Nolan and Valley Creeks, near Glendale, Ky			177
Applicants in Louisiana			300
Maryland			1,088
Plank Ridge Run, near Leonardtown, Md			1,000
Potomac River above Great Falls, Md			400
below Great Falls, Md			500
Principio Creek, near Principio, Md			150
Patuxent River, near Laurel, Md			1,000
Piscataway Creek, near Stony Point, Md			1,000
Nine Mile Pond, near Springfield, Mass			640
Lake Brevoort, near Moran, Mich			300
Railroad Lake, near Wingleton, Mich			225
Mill Lake, near Wingleton, Mich			145
Little Clam Lake, near Cadillac, Mich			300
Big Clam Lake, near Cadillac, Mich			300
Applicants in Mississippi			275
Missouri			600
Indian Creek, near Neosho, Mo			118
Applicants in New Jersey			475
Overpeck Creek, near Leonia, N. J			120
Upper Millstone River, near Princeton, N. J			150
Applicants in New Mexico			1,980
New York			350
Honing Creek, near Asheville, N. C			65
Applicants in Ohio			550
Mahoning River, near Warren, Ohio			150
Muskingum River, near McConnellsville, Ohio			290
Mohican Creek, near Lexington, Ohio			250
Rocky Fork, near Hillsboro, Ohio			50
Bass Lake, near Chardon, Ohio			350
Punderson Lake, near Burton, Ohio			225
Long Lake, near Akron, Ohio			100
Mud Lake, near Hudson, Ohio			250
Tawawa Lake, near Sidney, Ohio			250
Willamette River, near Salem, Oregon			500
Applicants in Pennsylvania			1,425
Mauryp Dam, near Shenandoah, Pa			150
Loyalhanna Creek, near Latrobe, Pa			400
Kriders Dam, near Annville, Pa			300
Biedwell Pond, near Scranton, Pa			350
Brandywine Creek, near Chadds Ford, Pa			100
Branch of Brandywine Creek, near Honeybrook, Pa			400
Brandywine Creek, near Reading, Pa			480
Tioga River, near Tioga, Pa			150
Keeley Run, near Shenandoah, Va			400
Allegheny River, near Kittanning, Pa			200
West Branch of Susquehanna River, near Lock Haven, Pa			600
Susquehanna River, near Harrisburg, Pa			1,185
French Creek, near Rapid City, S. Dak			165
White, Clay, and Porcupine creeks, on Pine Ridge Indian Agency, S. Dak			400
Beaver Creek, near Huntingdon, Tenn			500
Private ponds in Texas			2,275
Cisco Water Company's Lake, near Cisco, Tex			110
Como Lake, near Fort Worth, Tex			100
Railroad reservoir, near Coal Mine Junction, Tex			100
Mill Pond, near Mineola, Tex			100
Cypress Bayou, near Jefferson, Tex			400
Applicants in Virginia			780
Broad Run, in Loudoun County, Va			1,000
Five-acre Lake, near Manassas, Va			300
Mountain streams, near Cleveland, Va			200
Powhick Creek, near Lorton Valley, Va			100
Aquia Creek, near Stafford Court-House, Va			200

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Black bass (*Micropterus dolomieu* and *M. salmoides*)—Cont'd.			
Walker Little Creek, near Pulaski City, Va			200
Goose Creek, in Loudoun County, Va			2,000
Occoquan River, near Woodbridge, Va			1,100
Appomattox River, near Blackstone, Va			100
Anna River, near Ashland, Va			100
North River, near Lexington, Va			400
South Fork of Holston River, near Marion, Va			500
Jackson River, near Cedar Creek, Va			1,200
Cow Pasture River, near Long Dale, Va			840
North River, near Goshen, Va			1,100
Craig Creek, near New Castle, Va			750
Occotink Creek, near Occotink, Va			1 000
Neapsico Creek, near Freestone, Va			1,000
Quantico Creek, near Quantico, Va			1,000
Reed Creek, near Wytheville, Va			968
Applicants in Washington			100
Gravelly Lake, near Lake View, Wash			550
Liberty Lake, near Spokane Falls, Wash			300
American Lake, near Tacoma, Wash			500
Clear Lake, near Clear Lake, Wash			300
Clear Lake, near Medical Lake, Wash			397
McDonald Lake, near Cedar Mountain, Wash			300
Deer Lake, near Loon Lake, Wash			700
Loon Lake, near Loon Lake, Wash			400
Applicants in West Virginia			400
Gauley River, near Camden, W. Va			1,992
Lake Geneva, near Lake Geneva, Wis			1,695
Chain of Lakes, near Waupaca, Wis			1,285
Lake Beulah, near Lake Beulah, Wis			100
Crappie (*Pomoxis annularis* and *P. sparoides*):			
Arizona Fish Commission			249
Applicants in Colorado			100
Boise River, near Boise, Idaho			388
Applicants in Illinois			145
Chicago, Burlington and Quincy Company's ponds, near Galesburg, Ill			161
Sni River, near East Hannibal, Ill			500
North Fork Creek, near Danville, Ill			28
Lake Maxinkuckee, near Marmont, Ind			50
Lake Wawassee, near Cedar Beach, Ind			188
Pine Lake, near Laporte, Ind			150
Maquoketa River, near Strawberry Point, Iowa			9
Cedar River, near Waterloo, Iowa			300
Spirit Lake, near Spirit Lake, Iowa			106
Reservoir near Creston, Iowa			200
Applicants in Kentucky			296
Lake Brevoort, near Moran, Mich			2,400
Little Clam Lake, near Cadillac, Mich			1,510
Big Clam Lake, near Cadillac, Mich			1,500
Applicants in Missouri			30
Applicants in Ohio			50
Muskingum River, near McConnellsville, Ohio			400
Rocky Fork, near Hillsboro, Ohio			50
White, Clay, and Porcupine creeks, on Pine Ridge Indian Agency, S. Dak			80
Beaver Creek, near Huntingdon, Tenn			75
Jackson Creek, near Cedar Creek, Va			200
Cow Pasture River, near Long Dale, Va			230
North River, near Goshen, Va			305
Craig Creek, near New Castle, Va			100
Deer Lake, near Loon Lake, Wash			25
Chain of Lakes, near Waupaca, Wis			115
Warmouth bass (*Chænobryttus gulosus*):			
Arizona Fish Commission			628
Applicants in Idaho			300
Boise River, near Boise, Idaho			201
Applicants in Illinois			205
North Fork Creek, near Danville, Ill			300
Sugar Creek, near Paris, Ill			278
Sni River, near East Hannibal, Ill			500
Chicago, Burlington and Quincy Company's ponds, near Galesburg, Ill			60
Lake Wawassee, near Cedar Beach, Ind			10
Lake Maxinkuckee, near Marmont, Ind			400
Pine Lake, near Laporte, Ind			75
Applicants in Indiana			100
Cedar River, near Waterloo, Iowa			200
Reservoir near Creston, Iowa			100
Spirit Lake, near Spirit Lake, Iowa			247
Applicants in Kentucky			215
Lake Reba, near Richmond, Ky			50
Applicants in Missouri			60

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Warmouth bass (*Chænobryttus gulosus*)—Continued.			
Muskingum River, near McConnellsville, Ohio			222
White, Clay, and Porcupine creeks, on Pine Ridge Indian Agency, S. Dak			65
Beaver Creek, near Huntingdon, Tenn			150
Shenandoah River, near Riverton, Va			202
Jackson River, near Cedar Creek, Va			100
Craig Creek, near New Castle, Va			107
Loon Lake, near Loon Lake, Wash			29
Chain of Lakes, near Waupaca, Wis			105
Rock bass (*Ambloplites rupestris*):			
Applicants in Alabama			1,400
District of Columbia			150
Georgia			50
Georgia Fish Commission			1,000
Applicants in Kansas			1,000
Lake Evelyn, near Bonner Springs, Kans			1,000
Mill Creek, near Alma, Kans			500
Lyons Creek, near Junction City, Kans			500
Winnescah Creek, near Pratt, Kans			500
Wild Cat Creek, near Manhattan, Kans			500
Cottonwood River, near Marion, Kans			500
Applicants in Kentucky			500
Maryland			300
Mississippi			50
Missouri			2,700
Osage River, near Schell, Mo			1,600
Applicants in New Jersey			500
North Carolina			1,100
Pennsylvania			1,700
Susquehanna River, near Milton, Pa			300
Applicants in Tennessee			1,150
Texas			260
Virginia			2,550
Local streams near Gladys, Va			300
South Mayo River, near Ridgeway, Va			350
Reed Creek, near Wytheville, Va			1,100
Sunfish (*Lepomis*, sp):			
Applicants in Illinois			556
Chicago, Burlington and Quincy Railroad Company's pond, near Galesburg, Ill			30
Pine Lake, near Laporte, Ind			200
Upper Iowa River, near Decorah, Iowa			32
Spirit Lake, near Spirit Lake, Iowa			190
Turkey River, near Cresco, Iowa			25
Applicants in Kansas			45
Kentucky			89
Missouri			100
Mohican Creek, near Lexington, Ohio			80
Tawawa Lake, near Sidney, Ohio			100
White, Clay, and Porcupine creeks, on Pine Ridge Indian Agency, S. Dak			31
Beaver Creek, near Huntingdon, Tenn			75
Deer Lake, near Loon Lake, Wash			9
Pickerel (*Lucius lucius*):			
Boise River, near Boise, Idaho			76
Beaver Creek, near Huntingdon, Tenn			25
Cod (*Gadus morrhua*):			
Massachusetts Bay, off Cape Ann, Mass	1,195,000	20,142,000	
Vineyard Sound, off Massachusetts coast		850,500	
Mackerel (*Scomber scombrus*):			
Vineyard Sound, off Massachusetts coast		434,500	
Flatfish (*Pseudopleuronectes americanus*):			
Vineyard Sound, off Massachusetts coast		288,000	
Lobster (*Homarus americanus*):			
Vineyard Sound, off Massachusetts coast		8,818,000	
Total	12,063,000	165,235,800	1,486,117

NOTE.—By request of the California Fish Commission, 100,000 muskellunge fry were received from the New York Fish Commission and transferred as follows: Lake Merced, near Ocean View, Cal., 60,000; Lake Pilarcitos, near Millbrae, Cal., 31,000.

SALMON GILL-NET BOATS WAITING FOR CHANGE OF TIDE, MOUTH OF COLUMBIA RIVER. (See page 242.)

1.—THE FISHERIES OF THE PACIFIC COAST.

INTRODUCTORY.

Within the past five years the fisheries of the west coast of the United States have attracted more attention from the general public than those of any other region, and some of the questions which have arisen in connection therewith have been of great national and international importance. The principal branches which have been considered are the salmon industry and the fur-seal fishery. The vast interests depending on the preservation of the salmon supply have drawn to that subject the attention of Congress, as well as of the State legislatures; and the necessity for the protection of the fur seal on the high seas and at the rookeries has resulted in Congressional action and protracted diplomatic negotiations.

When, in 1889, the United States Commission of Fish and Fisheries completed a canvass of the fishing industry of the Pacific States, it acquired a full knowledge of the extent and importance of these fisheries for the first time in about ten years—that is, since the investigations for the Tenth Census. It was found that the advance in the industry since that time had been phenomenal in almost every branch, while a number of new features had in the meantime developed. The canvass of the fisheries of this extensive coast section was intrusted to Mr. W. A. Wilcox, who entered into the work with great zeal and brought a deep practical knowledge of the commercial fisheries to bear on the inquiry. The report based on Mr. Wilcox's investigations was printed as an appendix to the Report of the Commissioner of Fish and Fisheries for 1888. The paper was extensively distributed among the fishing interests of the west coast and was received with marked favor. Taking into consideration the rapid growth of this industry between 1879 and 1889, another investigation appeared opportune in 1892. Mr. Wilcox was again detailed for the work and has performed it in a manner satisfactory to the Commission and creditable to himself. The following report, prepared by him, represents the results of his inquiries.

The previous inquiry conducted by Mr. Wilcox covered all features of the industry, including full descriptions of methods, apparatus, fishing-grounds, etc., as well as comprehensive statistics. In the recent investigation special attention was devoted to the collection of detailed statistical data, and only such descriptive matter was obtained as was necessary to elucidate the statistics or record changes in the methods or conditions since the last canvass. Statistics for the years 1889 to 1892, inclusive, covering all phases of the fisheries and related shore industries, were procured by the personal efforts of the agent. The commercial fisheries of the high seas, coasts, bays, and rivers prosecuted by fishermen of California, Oregon, and Washington were systematically and completely considered; and, in most cases, the statistics given represent actual records. As the firms prosecuting fishing in Alaska have their main offices in San Francisco or other cities of the Pacific States, Mr. Wilcox was able to obtain from them very satisfactory and approximately complete information for all the fisheries of Alaska in which white men are engaged. These data add greatly to the interest of the report and permit the presentation of statistics embracing the economic fisheries of the entire west coast of the United States.

In the vicinity of San Francisco, Mr. A. B. Alexander, fishery expert on the Fish Commission steamer *Albatross*, aided in the canvass. The statistics given for the year 1893 are the results of inquiries carried on by Mr. Alexander during the fall and winter of that year.

The years which have elapsed since the completion of the canvass of the west coast fisheries in 1889 have been characterized by great literary activity as regards the fishing industry. The following papers relating to fish and fisheries, issued by this Commission between 1889 and 1894, inclusive, which represent only a small part of the printed matter pertaining to this region which has appeared in Government reports, magazines, the public press, and State documents, are sufficient to show the interest taken in the subject by the national Fish Commission:

List of papers relative to the fish and fisheries of the Pacific Coast of the United States, published by the United States Fish Commission, from 1889 to 1894, inclusive.

Explorations of the fishing-grounds of Alaska, Washington Territory, and Oregon during 1888 by the United States Fish Commission steamer *Albatross*.
The transplanting of lobsters to the Pacific Coast of the United States.
Report upon the pearl fishery of the Gulf of California.
Report upon certain investigations relating to the planting of oysters in southern California.
Report on the salmon and salmon rivers of Alaska, with notes on the conditions, methods, and needs of the salmon fisheries.
The fishing-grounds of Bristol Bay, Alaska; a preliminary report upon the investigations of the United States Fish Commission steamer *Albatross* during the summer of 1890.
Report on the fisheries of the Pacific Coast of the United States.
Report on the investigations of the United States Fish Commission steamer *Albatross* for the year ending June 30, 1889.
The fishing vessels and boats of the Pacific Coast.
Report of the Commissioner of Fish and Fisheries relative to the salmon and salmon industries of Alaska.
Report upon the investigations of the United States Fish Commission steamer *Albatross* from July 1, 1889, to June 30, 1891.
Report of observations respecting the oyster resources and oyster fishery of the Pacific Coast of the United States.
Summary of fishery investigations conducted in North Pacific Ocean and Bering Sea from July 1, 1888, to July 1, 1892.
On the viviparous fishes of the Pacific Coast of North America.
Past and future of the fur seal.
Notes on the fisheries and fishery industries of Puget Sound.
Report upon the investigations of the United States Fish Commission steamer *Albatross* for the year ending June 30, 1892.
The salmon fisheries of the Columbia River basin, together with a report upon physical and natural-history investigations in the region.

The fishing industry is one of the most important enterprises of the west coast, and in some sections is more prominent than all other branches of business. Compared with the other coastal sections of the United States, the States of the Pacific Coast, including Alaska, now maintain fisheries that rank next to those of the New England and Middle Atlantic States in extent and importance. The value of the fishery products is greater than in the South Atlantic, Gulf, and Great Lakes States combined.

The inquiries of the Commission disclosed the fact that in 1892 the number of persons engaged in the fisheries of the Pacific States was 16,929, of whom 5,403 were in California, 4,332 in Oregon, 4,310 in Washington, and 2,884 in Alaska. The aggregate capital invested was found to be $9,002,314. The shares of the different States were $2,526,746 for California, $2,272,351 for Oregon, $1,593,567 for Washington, and $2,609,650 for Alaska. The value of the catch was $6,245,192, a sum representing the products as landed by the fishermen. Of this amount California is credited with $3,022,991, Oregon with $872,405, Washington with $931,568, and Alaska with $1,418,228.

The chief objects constituting the products of the west coast fisheries are salmon, cod, herring, flounders, rockfish, smelts, whales, fur seals, crabs, shrimps, and oysters. The salmon are nearly as valuable as all of the other products combined. Next to these in point of value are whalebone, oysters, fur-seal pelts, shrimp, cod, flounders, crabs, herring, whale oil, rockfish, and smelt.

Chief among the fishery industries of the Pacific States is the canning of salmon, which is prosecuted on a large scale in California, Oregon, Washington, and Alaska. In 1892, 56 canneries were in operation. These utilized 81,487,993 pounds of salmon, having a value of $2,376,037, from which 1,118,098 cases of canned fish, each holding 48 one-pound cans or the equivalent, were prepared, the market value of the canned goods being $5,294,032.

HUGH M. SMITH,
Assistant in charge Division of Statistics and Methods of the Fisheries.

THE FISHERIES OF THE PACIFIC COAST.

By William A. Wilcox,

Statistical Agent, United States Commission of Fish and Fisheries.

GENERAL REMARKS.

In the years 1888 and 1889 the writer conducted a personal canvass of the fisheries of the Pacific Coast of the United States. Detailed statistics of the fishing industry were obtained, and descriptive notes on the history, apparatus, and methods of the fisheries, the abundance of the economic products, the fishing-grounds, etc., were secured. A report[1] embodying the results of that inquiry was published in the Report of the United States Fish Commissioner for 1888 and extensively distributed among the persons engaged in the fishing industry of that region.

In 1892 the rapidly growing importance of the various fisheries of the Pacific States, as determined by the investigations in 1888 and 1889, appeared to warrant further attention, and, accordingly, in August of that year, the writer was again detailed for duty on that coast for the purpose of making another investigation of the commercial aspects of the fishing industry. The inquiries began on the Columbia River and were extended over the entire coasts of Washington, Oregon, and California, the canvass being completed in May, 1893. The accompanying report is based on the observations made and information gathered during that time. The detailed references to products, apparatus, methods, fishing-grounds, etc., in the previous report make unnecessary at this time any similar discussion. The text in the present paper is, therefore, intentionally brief, and is either explanatory of the statistics or is addressed to changes that have occurred in the industry since the last investigation.

The years intervening between the two investigations will be recalled as those of more or less depression in nearly all kinds of business. A period of great commercial activity was followed by a marked decline in most branches, and many of the young cities of the west coast that had been giving employment to thousands of laborers and mechanics found their growth for the time checked. A general depression in other lines of trade has often had a beneficial effect on the fisheries. For lack

[1] Report on the Fisheries of the Pacific Coast of the United States. 269 pages; 49 plates of fishes, apparatus, boats, vessels, fishing-grounds, etc.

of other regular employment, men of small means have turned to the fisheries and thus have not only found work, but have assisted in furnishing the masses with cheap and wholesome food at a time when this was specially needed. This was the case at a number of places in the Pacific States during the later years covered by this report.

The previous report on the fisheries of this region contained a number of suggestions for the improvement of the fisheries. Among these were the much-needed use of ice, the adoption of cold storage, and the better care of fish by fishermen and dealers. In most cases the desired reforms were as conspicuous for their absence in 1892 as in 1889. Fresh fish continue to be sent to the city markets as they come from the water, seldom being eviscerated; and only a small amount of ice, if any, is used on them during transportation. When the market fishermen adopt the custom, which is almost universal in the East, of dressing and icing their catch before shipment, an increased demand and better prices may be expected, to say nothing of the advantage which will come to the consumer through having more wholesome food.

As during the previous investigations, the inquiries of the Commission were much facilitated by the courtesy of railroad, steamboat, and express companies in permitting access to their records. The fishing and canning firms of the coast took great interest in the agent's inquiries, and often extended much assistance, in addition to allowing the examination of records. The thanks of the Commission are due to the fishing interests of the west coast and also to the members of the State fish commissions for courtesies extended.

The field work on the Sacramento, San Joaquin, and Eel rivers and Monterey and San Francisco bays was ably assisted by Mr. A. B. Alexander, of the United States Fish Commission steamer *Albatross*.

CONDENSED STATISTICS OF THE INDUSTRY.

The extent of the fisheries of the Pacific Coast in 1892 is shown in the following tables, the figures for California, Oregon, Washington, and Alaska being separately given.

In the matter of persons engaged in the industry, California leads in the item of vessel fishermen, Washington in shore or boat fishermen, and Oregon in shore employees, such as factory hands, although Alaska leads in the number of shoresmen when all its canneries are in operation.

The aggregate investment in the fisheries of Alaska is greater than elsewhere, owing to the relatively expensive canneries there located and the large amount of working capital required to operate them. California takes first rank in the number, value, and tonnage of vessels employed, and also in the number of seines and gill nets used, but the seines in Washington and the gill nets in Oregon have a greater value. Oregon follows California in the amount of the general investment, and has important pound-net and wheel interests which are lacking elsewhere except in Washington.

Nearly half the value of the products of the fisheries of the coast represents the outcome of the fisheries of California. That State takes precedence in the catch of numerous market fishes, as well as cod, oysters, crabs, shrimp, fur seals, and whales. The salmon fishery is most valuable in Alaska, the yield of whose fisheries is second to those of California in value. Washington leads Oregon in the general importance of the fisheries, owing to the relatively important oyster fishery, which is insignificant in Oregon.

Persons employed in the fishing industry of the Pacific Coast of the United States in 1892.

How employed.	Alaska.	California.	Oregon.	Washington.	Total.
In vessel fisheries	331	1,825	117	376	2,649
In shore fisheries	1,020	2,968	2,705	3,082	9,775
On shore	1,533	610	1,510	852	4,505
Total	2,884	5,403	4,332	4,310	16,929

Vessels, boats, apparatus, shore property, and cash capital employed in the fisheries of the Pacific Coast of the United States in 1892.

Items.	Alaska.		California.		Oregon.		Washington.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels	40	$461,000	84	$890,450	24	$90,400	51	$114,630
Tonnage	8,623		12,436.30		802.83		1,185.12	
Outfit		33,400		394,000		20,295		33,630
Boats	421	63,575	1,391	183,520	1,494	154,425	1,690	132,330
Apparatus:								
Seines	69	27,025	193	20,985	32	12,600	163	46,725
Gill nets and trammel nets	243	28,750	2,946	120,547	1,396	212,260	886	112,600
Pound nets and trap nets	16	13,200			247	173,400	157	124,700
Bag nets and paranzella nets			1,299	43,960				
Fyke nets and minor nets			49	980	50	250	30	600
Lines		4,050		15,951		10,520		5,830
Wheels					40	132,852	17	49,000
Tongs, hoes, etc				689		149		3,505
Other apparatus		500		13,341		2,050		6,217
Shore property		720,650		596,320		660,150		417,800
Cash capital		1,257,500		246,000		803,000		546,000
Total		2,609,650		2,526,746		2,272,351		1,593,567

SUMMARY.

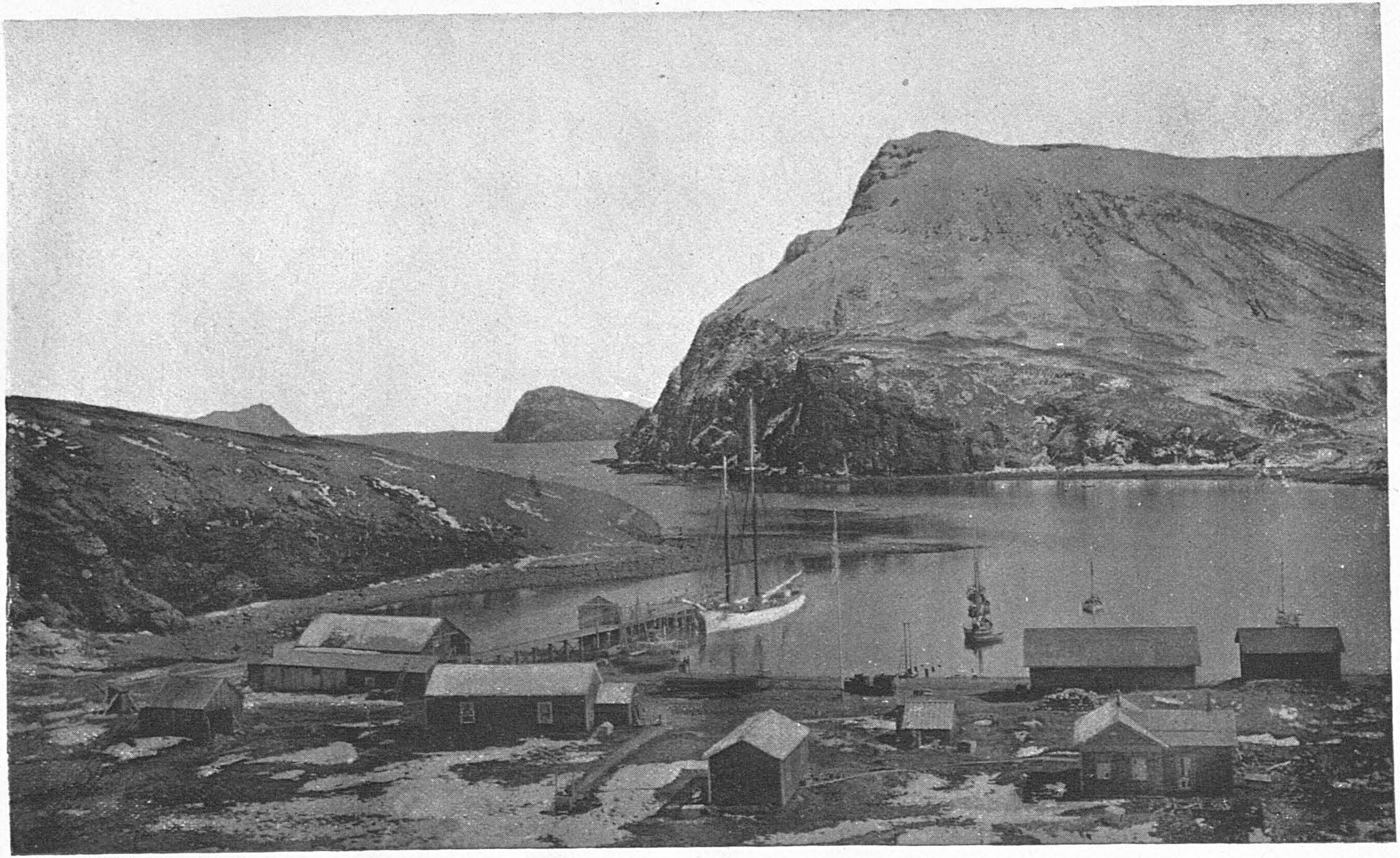
Items.	No.	Value.	Items.	No.	Value.
Vessels	199	$1,556,480	Apparatus—continued.		
Tonnage	14,510.48		Fyke nets and minor nets	129	$1,830
Outfit		481,325	Lines		36,354
Boats	4,996	533,850	Wheels	57	181,852
Apparatus:			Tongs, hoes, etc		4,343
Seines	457	107,335	Other apparatus		22,108
Gill nets and trammel nets	5,471	474,157	Shore property		2,394,920
Pound nets and trap nets	420	311,300	Cash capital		2,852,500
Bag nets and paranzella nets	1,299	43,960	Total		9,002,314

Products of the fisheries of the Pacific Coast of the United States in 1892.

Species.	Alaska.		California.		Oregon.		Washington.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Anchovies			150,175	$1,502				
Barracuda			326,804	12,530				
Bonito			249,332	9,400				
Carp			65,662	2,191				
Cod	2,219,835	$55,562	2,274,565	56,804			539,000	$21,560
Cultus-cod			230,670	7,070	26,304	$1,315	359,000	6,875
Flounders			4,225,885	94,180	10,000	400	184,560	3,191
Halibut					18,870	1,787	1,410,500	29,140
Herring	18,700,000	32,900	4,486,887	55,796			617,112	6,817
Mackerel			350,399	14,159				
Perch			335,117	10,927			65,140	1,303
Rockfish			1,829,657	51,765	86,115	4,255	163,000	4,515
Salmon	42,231,500	1,219,973	4,862,408	179,031	25,536,701	781,000	21,684,211	551,546
Sardines			752,994	15,237				
Sea bass			257,712	9,795				
Shad			526,494	14,372	109,000	3,270	103,350	3,183
Smelt			1,919,894	53,469			321,726	6,158
Striped bass			56,209	6,488				
Sturgeon			718,017	21,854	2,513,490	28,001	543,623	5,757
Yellow-tail			354,434	13,682				
Other fish			2,257,410	47,360			55,000	4,650
Abalone meats and shells			404,547	9,351				
Octopus and squid			374,622	29,039				
Clams, hard			479,500	6,449				
Clams, soft			2,017,200	20,433	49,500	825	684,000	5,700
Oysters			15,098,700	698,257	147,000	3,062	9,895,440	147,995
Mussels			2,880,000	12,000				
Crabs			2,862,320	102,900	4,125	495	79,000	3,550
Crawfish					20,000	3,000		
Shrimp and prawn			5,313,345	241,817			2,000	500
Spiny lobster			303,275	8,486				
Terrapin and frogs			45,625	8,050			13,125	5,250
Hair-seal and sea-lion pelts				2,267				
Fur-seal pelts		107,573		167,526		43,266		121,528
Sea-otter pelts		2,220		36,150		1,729		
Whale oil			1,574,843	62,123				
Whalebone			197,339	937,371				
Algæ			28,325	1,133				
All other products			28,100	1,967			37,500	2,350
Total	63,151,335	1,418,228	57,838,466	3,022,991	28,521,105	872,405	36,757,287	931,568

SUMMARY.

Species.	Pounds.	Value.	Species.	Pounds.	Value.
Anchovies	150,175	$1,502	Abalone meats and shells	404,547	$9,351
Barracuda	326,804	12,530	Octopus and squid	374,622	29,039
Bonito	249,332	9,400	Clams, hard	479,500	6,449
Carp	65,662	2,191	Clams, soft	2,750,700	26,958
Cod	5,033,400	133,986	Oysters	25,141,140	849,314
Cultus-cod	615,974	15,260	Mussels	2,880,000	12,000
Flounders	4,420,445	97,771	Crabs	2,945,445	106,945
Halibut	1,429,370	30,927	Crawfish	20,000	3,000
Herring	23,803,999	95,513	Shrimp and prawn	5,315,345	242,317
Mackerel	350,399	14,159	Spiny lobster	303,275	8,486
Perch	400,257	12,230	Terrapins and frogs	58,750	13,300
Rockfish	2,078,772	60,535	Hair-seal and sea-lion pelts		2,267
Salmon	94,314,820	2,731,550	Fur-seal pelts		439,893
Sardines	752,994	15,237	Sea-otter pelts		40,099
Sea bass	257,712	9,795	Whale oil	1,574,843	62,123
Shad	738,844	20,825	Whalebone	197,339	937,371
Smelt	2,241,620	59,627	Algæ	28,325	1,133
Striped bass	56,209	6,488	All other products	65,600	4,317
Sturgeon	3,775,130	55,612			
Yellow-tail	354,434	13,682			
Other fish	2,312,410	52,010	Total	186,268,193	6,245,192



COD FISHING STATION, PIRATE COVE, SHUMAGIN ISLANDS, ALASKA.

Summary of the salmon-canning industry of the Pacific Coast of the United States in 1892.

States.	Persons employed.	No. of canneries.	Value.	Cash capital.	Total investment.	Salmon utilized.		Salmon canned.	
						Pounds.	Value.	Cases.	Value.
California	222	6	$95,000	$40,000	$135,000	1,071,612	$32,568	15,884	$75,696
Oregon	1,510	22	598,000	835,000	1,433,000	26,432,711	703,238	394,486	2,085,072
Washington	851	13	369,750	520,000	889,750	16,449,570	424,208	238,758	1,163,590
Alaska	1,399	15	493,400	1,067,500	1,560,900	37,534,100	1,126,023	468,970	1,969,674
Total	3,982	56	1,556,150	2,462,500	4,018,650	81,487,993	2,376,037	1,118,098	5,294,032

CALIFORNIA.

GENERAL IMPORTANCE AND EXTENT OF THE INDUSTRY.

The fisheries of California are more important and varied than those of any other west coast State, as determined by the products taken. Considering the entire country, the rank of California as a fishing State is sixth; in the value of its products it is surpassed only by Massachusetts, Maryland, New York, Virginia, and New Jersey. The growth of the industry of late years has been marked, and the near future will doubtless witness an advance in the relative position of California at the expense of several of the east coast States named. The possibilities for the development of the inshore and offshore market fisheries and of other branches are believed to be great.

The special products which give to California the important rank it now occupies are oysters, shrimp, crabs, whales, fur seals, and the general food-fishes of the coast; in the yield of all these it surpasses the other States of this region. The salmon catch, while large as compared with the other products of the State, is insignificant when the remainder of the region is considered. The State owes much of its prominence in this connection to the extensive offshore vessel fisheries carried on for whales, cod, fur seals, etc., a branch of the industry which is of very small extent elsewhere on this coast.

The extent of the fisheries of this State in 1889, 1890, 1891, and 1892 is shown in the following tables, which relate, respectively, to persons employed, capital invested, and products taken:

Persons employed in the fisheries of California.

How engaged.	1889.	1890.	1891.	1892.
Vessel fisheries	1,147	1,412	1,569	1,825
Shore and boat fisheries	2,940	2,922	2,964	2,968
Canning industry and wholesale trade	597	547	576	610
Total	4,684	4,881	5,109	5,403

Vessels, boats, apparatus, shore property, etc., employed in the fisheries of California.

Items.	1889.		1890.		1891.		1892.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels	53	$628,900	63	$715,300	74	$784,900	84	$890,450
Tonnage	8,608.85	....	10,261.80	....	10,582.15	....	12,436.30	....
Outfit	....	271,382	....	328,907	....	338,959	....	394,000
Boats	1,351	179,336	1,364	180,500	1,397	184,123	1,391	183,520
Apparatus:								
Seines	187	21,520	188	21,195	192	21,140	193	20,985
Gill and trammel nets	2,680	117,845	2,675	114,700	2,791	117,427	2,946	120,547
Bag nets and paranzella nets	1,254	38,755	1,251	38,640	1,289	42,395	1,299	43,960
Fyke nets	49	980	49	980	49	980	49	980
Lines	....	11,936	....	13,238	....	14,230	....	15,954
Pots	183	256	196	273	200	278	203	283
Hoes, rakes, and tongs	....	681	....	679	....	683	....	689
Other apparatus	....	6,053	....	7,716	....	11,803	....	13,058
Shore property	....	459,806	....	490,027	....	537,528	....	596,320
Cash capital	....	344,500	....	303,000	....	248,000	....	246,000
Total	....	2,081,950	....	2,215,155	....	2,302,446	....	2,526,746

Products of the fisheries of California.

Species.	1889.		1890.		1891.		1892.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Anchovies, fresh	122,510	$2,447	135,000	$2,700	145,000	$2,114	150,175	$1,502
Atka mackerel, salted	....	....	....	....	64,800	4,860	....	....
Barracuda, fresh	383,088	16,381	395,238	16,645	575,751	21,717	217,190	8,693
Barracuda, salted	117,626	4,427	115,840	4,054	119,042	4,249	109,614	3,837
Bonito, fresh	80,619	3,456	93,383	4,237	106,410	4,626	77,110	3,280
Bonito, salted	153,934	5,421	187,417	6,658	174,484	6,179	172,222	6,120
Carp, fresh	51,214	1,734	58,113	1,974	59,618	2,016	65,662	2,191
Cod, salted	1,463,424	36,587	1,782,679	44,567	2,047,911	51,393	2,274,565	56,864
Cultus-cod, fresh	131,044	4,736	167,758	6,283	213,618	7,639	230,670	7,070
Flounders, fresh	3,657,990	87,331	3,531,158	85,237	3,071,989	77,280	4,182,048	92,426
Flounders, salted	67,880	2,715	43,649	1,747	41,071	1,644	43,837	1,754
Herring, fresh	2,572,811	66,101	3,398,824	54,996	3,757,075	48,571	4,486,887	55,796
Kingfish, fresh	8,460	254	10,208	306	24,080	963	40,000	1,201
Mackerel, fresh	315,253	13,249	311,564	12,698	518,883	20,863	350,399	14,159
Perch, fresh	353,849	15,908	400,429	18,273	325,455	10,906	335,117	10,927
Rockfish, fresh	2,065,678	63,119	2,253,308	67,822	1,893,072	59,325	1,819,987	51,282
Rockfish, salted	42,553	1,866	30,716	1,354	29,219	1,258	9,670	483
Salmon, chinook, fresh	6,765,430	271,092	3,380,116	134,492	2,341,045	91,639	3,541,204	141,155
Salmon, chinook, salted	....	....	....	....	....	....	90,000	3,600
Salmon, silver, fresh	1,365,720	40,826	1,184,952	35,381	1,073,446	34,516	881,762	27,632
Salmon, silver, salted	435,600	17,324	167,000	6,680	116,200	4,448	39,000	1,500
Salmon, steelhead, fresh	440,921	10,506	363,399	7,007	315,731	6,220	310,442	6,084
Sardines, fresh	1,097,397	22,429	1,314,800	20,591	937,568	18,988	752,994	15,237
Sea bass, fresh	452,847	17,957	319,081	12,560	372,258	12,414	253,212	9,610
Sea bass, salted	2,500	125	6,581	291	21,301	1,022	4,500	185
Shad, fresh	263,788	10,833	318,140	11,891	445,006	15,856	526,494	14,372
Smelt, fresh	1,915,478	57,492	2,073,509	61,306	2,126,084	64,623	1,919,894	53,469
Striped bass, fresh	16,296	4,073	20,119	4,021	30,674	4,602	56,209	6,488
Sturgeon, fresh	693,650	21,250	612,585	18,869	727,551	22,213	718,017	21,854
Yellow-tail, fresh	188,272	7,336	112,583	4,817	160,981	6,591	163,027	6,871
Yellow-tail, salted	58,243	2,116	172,268	6,109	178,751	6,334	191,407	6,811
Other fish	1,717,851	33,277	1,895,101	36,022	1,902,992	37,971	2,217,410	46,150
Abalone meats and shells	310,079	8,089	203,783	5,553	302,781	7,572	404,547	9,351
Octopus and squid	484,100	38,212	267,809	20,816	314,910	24,323	374,622	29,039
Clams, hard	570,710	6,232	511,980	5,975	450,800	5,660	479,500	6,449
Clams, soft	1,118,700	11,897	1,261,980	13,421	1,515,360	15,877	2,017,200	20,433
Oysters	12,369,000	571,525	12,829,500	592,137	13,387,800	618,455	15,098,700	698,257
Mussels	2,100,000	8,750	2,700,000	11,250	2,998,080	12,500	2,880,000	12,000
Crabs	2,030,400	79,045	2,090,000	83,125	2,348,100	93,406	2,862,320	102,900
Shrimp and prawn	5,535,322	253,617	5,822,693	266,593	4,892,940	223,601	5,313,34[illegible]	241,817
Spiny lobster	266,458	7,327	278,310	7,747	272,245	7,668	303,275	8,486
Terrapin and frogs	41,250	5,400	47,563	7,550	49,762	7,770	45,625	8,050
Hair-seal and sea-lion pelts	....	2,198	....	1,770	....	3,206	....	2,267
Fur-seal pelts	....	15,219	....	69,816	....	134,220	....	167,526
Sea-otter pelts	....	30,700	....	29,300	....	31,700	....	36,150
Whale oil	1,510,080	61,952	2,235,915	105,052	1,763,985	71,190	1,574,843	62,123
Whalebone	119,650	520,478	170,118	680,472	223,771	1,118,855	197,339	937,371
Seal oil	14,610	619	11,790	521	9,990	423	....	....
Cod sounds	....	....	....	....	....	....	600	42
Cod oil	....	....	....	....	975	65	....	....
Cod tongues	12,600	882	13,800	966	16,200	1,134	27,500	1,925
Algæ	20,170	807	29,345	1,174	10,141	765	28,325	1,133
Total	53,505,055	2,465,317	53,830,194	2,592,826	52,483,906	3,031,430	57,838,466	3,022,991

In the foregoing figures, the products have, wherever practicable, been reduced to the common unit of a pound. In the following table such products as crabs, clams, oysters, etc., that are commonly sold on a different basis, and the pelts of marine mammals of which only the value is given in the above table, are shown by number, bushels, etc., as the case may be.

Species.	1889.	1890.	1891.	1892.
Crabs .... number..	676, 800	696, 667	782, 700	954, 107
Clams, hard .... bushels..	8, 153	7, 314	6, 440	6, 850
Clams, soft .... do....	18, 645	21, 033	25, 256	33, 620
Mussels .... do....	35, 000	45, 000	49, 968	48, 000
Oysters .... do....	140, 150	151, 325	158, 130	178, 645
Hair-seal and sea-lion pelts .... number..	814	639	573	535
Fur-seal pelts .... do....	1. 691	5, 818	8, 948	14, 710
Sea-otter pelts .... do....	307	293	163	235
Whale oil .... gallons..	201, 344	298, 122	235, 198	209, 979

SHAD AND STRIPED BASS.

Among the most interesting and important information that may be presented regarding the fisheries of California is that concerning the remarkable success attending the introduction of shad and striped bass in the waters of the State. While much has already been said and written on this subject, the following data, representing the personal inquiries of the writer, are thought to contain some points of interest not before generally known.

Soon after the shad first began to be caught in the gill nets of the salmon fishermen of San Francisco Bay and Sacramento River, the fish were protected by State law, and the few examples occasionally smuggled into the San Francisco market sometimes brought the fishermen $5 apiece. The rapid increase of the fish, however, soon made it apparent that further protection was unnecessary, and, accordingly, in 1889 the restrictions on capture were removed. In the year named the fish were so abundant that at times they sold for 10 cents per pound. In 1892 the catch had become so large that the price at which the fish were retailed in San Francisco was only 2 or 3 cents per pound, two fish often being sold for 25 cents. At times the San Francisco Bay fishermen were able to sell their catch at only 1 cent a pound. In other parts of the State, where only a small number of shad are taken incidentally during the salmon fishery, much higher prices are received in the local market.

The catch of shad in California waters is made chiefly in San Francisco Bay and Sacramento River. Monterey Bay continues to be the southern limit on the coast at which shad are found. More fish are taken on the north side of the bay by the Santa Cruz fishermen than elsewhere in that region. The mountain streams which enter the bay at Santa Cruz may be responsible for the presence of the shad only on that side of the bay. The fish is also taken in small numbers in all the coast rivers north of San Francisco. In the vicinity of San Francisco the principal part of the shad yield is obtained between February and May, but the market fishermen of San Francisco take larger or smaller quantities during every month. San Francisco is the only city in the United States in the markets of which fresh shad just from the water may be found at any time in the year.

All of the shad taken in California are obtained with gill nets and haul seines used in other branches of the fisheries, no special apparatus being used and no special attention being given to their capture.

The following table is of interest as showing the rapid increase of shad during the comparatively few years which have elapsed since its introduction on the Pacific Coast. The fish have not only increased in numbers, but also show a gain in average weight and size which has been quite marked. While a few years ago the average weight was only 2½ or 3 pounds, it is now somewhat over 4 pounds, and large numbers of specimens weighing 8 pounds or more are taken.

Counties.	1889.		1890.		1891.		1892.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Contra Costa	96,722	$3,869	102,216	$4,089	108,111	$4,320	139,364	$4,181
Humboldt	300	30	250	25	160	16	100	10
Sacramento	13,224	703	15,960	958	17,516	1,051	21,579	1,295
San Francisco	61,072	2,443	116,942	3,508	230,460	6,914	242,749	4,855
Santa Cruz	20,264	810	24,880	995	30,120	1,205	35,000	1,400
Solano	72,206	2,888	57,892	2,316	58,739	2,350	87,702	2,631
Total	263,788	10,833	318,140	11,891	445,006	15,856	526,494	14,372

The striped bass of the Atlantic is justly classed as one of the best of the food-fishes of that coast. This fish was unknown on the Pacific up to its introduction a few years since through the agency of the United States Fish Commission. During the past four years it has steadily and largely increased in abundance and size, apparently thriving as well in its new home on the Pacific Coast as on the Atlantic seaboard. The principal catch is from about the first of October up to the middle of February, but a few are taken in all of the other months. Most of the fish are obtained from the salmon gill nets fished in San Francisco Bay and its several arms, and near the mouth of the Sacramento River.

The only apparatus used exclusively for striped bass are a few small purse seines. The seines are from 40 to 50 fathoms long, 3 fathoms deep, and cost $125 each. Each seine is operated by four fishermen and two boats. The salmon gill nets, in which many bass are found, are 200 to 250 fathoms long, 4½ fathoms deep, with a 6 to 6½ inch mesh, and a value of $150 to $225 each. Most of the bass are taken in and near the mouth of the San Joaquin River.

The spawning-grounds of the fish are located in Middle River and Old River, both arms of the San Joaquin, and only a few miles above its mouth. These rivers have sandy and gravelly beds that are favorite grounds for the striped bass during the spawning season. Many fish are taken from this section, but few, if any, are found further up the San Joaquin River.

The striped bass seems to make its home between the entrance to the Golden Gate and the short distance mentioned up the San Joaquin, a distance of some 100 to 125 miles. It does not go up the Sacramento River much, if any, above its mouth, none being caught by Sacramento fishermen near that city.

The striped bass vary in weight from 3 to 25 pounds, in some cases reaching 35 to 40 pounds; the average is 8 to 12 pounds. With the increase of the abundance of the fish and the augmented catch, both the consumer and the fisherman have reaped benefits; the marked decrease in price that favored the one was more than made up to the fisherman in his larger sales. The average price received by the fishermen was 40 cents a pound in 1889, 25 cents in 1890, 20 cents in 1891, and 12½ cents in 1892.

During the season of 1892, when fish were most abundant, the fishermen received only 8 cents a pound, and again, in times of scarcity, as high as 20 cents a pound. During 1888 the few bass caught brought a dollar a pound in city markets; in 1892 the retail price was 20 to 30 cents a pound. The yearly catch has been as follows:

Years.	Pounds.	Value.
1889	2,440	$976
1890	9,760	2,440
1891	21,350	4,270
1892	42,700	5,337

DETAILED STATISTICAL DATA.

In the following tables detailed statistics of the fisheries of California are given for the years 1889 to 1892 inclusive. The fishery interests of each county are separately indicated. The tables presented are: (1) The number of persons engaged in different capacities in the fishing industry; (2) the same designated by nativity and nationality; (3) the vessels, boats, apparatus, shore property, and cash capital devoted to the fisheries; (4) the quantity and value of products taken; (5) the same specified by the apparatus with which obtained. The statistical information is thus more complete than any heretofore offered for this State.

Table showing by counties the number of persons employed in the fisheries of California in 1889, 1890, 1891, and 1892.

Counties.	1889. On vessels fishing.	1889. On vessels transporting.	1889. In shore fisheries.	1889. On shore, in canneries, etc.	1889. Total.	1890. On vessels fishing.	1890. On vessels transporting.	1890. In shore fisheries.	1890. On shore, in canneries, etc.	1890. Total.
Contra Costa			337	62	399			333	62	395
Del Norte			45	67	112			46	72	118
Humboldt			352	31	383			316	6	322
Los Angeles			165		165			175		175
Marin			236	89	325			233	87	320
Monterey			122		122			123		123
Orange			8		8			10		10
Sacramento			46	11	57			46	11	57
San Diego	33		72		105	30		72		102
San Francisco	1,090	24	797	263	2,174	1,355	24	799	270	2,448
San Luis Obispo			35		35			38		38
San Mateo			195		195			197		197
Santa Barbara			35		35		3	36		39
Santa Cruz			60		60			63		63
Shasta			9		9			9		9
Solano			380	74	454			378	39	417
Sonoma			18		18			19		19
Tehama			24		24			25		25
Ventura			4		4			4		4
Total	1,123	24	2,940	597	4,681	1,385	27	2,922	547	4,881

Counties.	1891. On vessels fishing.	1891. On vessels transporting.	1891. In shore fisheries.	1891. On shore, in canneries, etc.	1891. Total.	1892. On vessels fishing.	1892. On vessels transporting.	1892. In shore fisheries.	1892. On shore, in canneries, etc.	1892. Total.
Contra Costa			320	62	382			320	62	382
Del Norte			47	45	92			48	70	118
Humboldt			314	6	320			320	6	326
Los Angeles	3		191	25	219	10		199	25	234
Marin			238	88	326			239	90	329
Monterey			121		121			121		121
Orange			12		12			12		12
Sacramento			45	11	56			44	11	55
San Diego	27		82		109	30		62		92
San Francisco	1,502	34	812	281	2,629	1,758	24	824	286	2,892
San Luis Obispo			38		38			38		38
San Mateo			204		204			200		200
Santa Barbara		3	37		40		3	37		40
Santa Cruz			62		62			60		60
Shasta			11		11			11		11
Solano			381	58	439			384	60	444
Sonoma			19		19			19		19
Tehama			26		26			26		26
Ventura			4		4			4		4
Total	1,532	37	2,964	576	5,109	1,798	27	2,968	610	5,403

Table showing by counties the nativity and nationality of the vessel fishermen of California in 1892.

Countries.	Los Angeles.		San Diego.		San Francisco.		Santa Barbara.	
	Nativity.	Nationality.	Nativity.	Nationality.	Nativity.	Nationality.	Nativity.	Nationality.
Africa					1			
Australia					16			
Austria					6	1		
Belgium					7	5		
Canada					28			
China			6	6	3	3		
Denmark					44	29		
East Indies					2			
England					132	212		
France					24	19		
Germany					131	86		
Greece					4			
Holland					12	5		
Ireland					37			
Italy					11			
Japan					45	45		
Mexico					4	4		
New Brunswick					7			
Newfoundland					1			
New Zealand					3			
Norway					125	72		
Nova Scotia					20			
Portugal	3	2	18	12	120	88		
Russia					34	22		
St. Helena					6			
Sandwich Islands					31	28		
Scotland					43			
South America					14	8		
Spain					65	55		
Sweden					129	71		
Switzerland					6	4		
United States	7	8	6	12	612	1,014	3	3
United States Indians					9	9		
United States of Colombia					2	2		
West Indies					18			
Total	10	10	30	30	1,782	1,782	3	3

NOTE.—In this table the various provinces of the British Empire are shown separately as regards the nativity of the fishermen, but in the matter of nationality all are given under the general head of England.

Table showing the nativity of the shore or boat fishermen of California in 1892.

Counties.	United States.	China.	Norway.	Austria.	Germany.	Spain.	Greece.	Italy.	American Indian.	Russia.	Sweden	Portugal.	Sandwich Islands.	Mexico.	Great Britain.	France.	Total.
Contra Costa	1	150	2	6	6	2	16	137									320
Del Norte	18								30								48
Humboldt	110		22					69	26	28	30	35					320
Los Angeles	53		3		1		16	54		2	28	42					199
Marin	9	•200		13				15	2								239
Monterey		80	3			1		7				30					121
Orange	6							6									12
Sacramento		20			4			2					18				44
San Diego	50											12					62
San Francisco	6	300		111		61	72	218				56					824
San Luis Obispo	5		2									30		1			38
San Mateo		200															200
Santa Barbara	12	18		5				2									37
Santa Cruz	18	7	2		4			28			1						60
Shasta	11																11
Solano	11		14		20		101	170		4	14	28			12	10	384
Sonoma	10							1	8								19
Tehama	26																26
Ventura								4									4
Total	346	975	48	135	35	64	205	713	66	34	73	233	18	1	12	10	2,968

Table showing the nationality of the shore or boat fishermen of California in 1892.

Counties.	Countries.																
	United States.	China.	Norway.	Austria.	Germany.	Spain.	Greece.	Italy.	American Indian.	Russia.	Sweden.	Portugal.	Sandwich Islands.	Mexico.	Great Britain.	France.	Total.
Contra Costa	67	150	....	2	....	2	1	98	....	....	....	....	....	....	....	....	320
Del Norte	18	....	....	....	....	....	....	....	30	....	....	....	....	....	....	....	48
Humboldt	232	....	5	....	....	....	....	35	26	9	6	7	....	....	....	....	320
Los Angeles	100	....	2	....	....	....	12	42	....	2	11	30	....	....	....	....	199
Marin	11	200	....	11	....	....	....	15	2	....	....	....	....	....	....	....	239
Monterey	37	80	2	....	....	....	....	2	....	....	....	....	....	....	....	....	121
Orange	8	....	....	....	....	....	....	4	....	....	....	....	....	....	....	....	12
Sacramento	4	20	....	....	....	....	....	2	....	....	....	....	18	....	....	....	44
San Diego	54	....	....	....	....	....	....	....	....	....	....	8	....	....	....	....	62
San Francisco	220	300	....	82	....	30	41	113	....	....	....	38	....	....	....	....	824
San Luis Obispo	25	....	1	....	....	....	....	....	....	....	....	11	....	1	....	....	38
San Mateo	....	200	....	....	....	....	....	....	....	....	....	....	....	....	....	....	200
Santa Barbara	14	18	....	5	....	....	....	....	....	....	....	....	....	....	....	....	37
Santa Cruz	33	7	....	....	....	....	....	20	....	....	....	....	....	....	....	....	60
Shasta	11	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	11
Solano	138	....	....	....	....	....	71	145	....	....	....	12	....	....	12	6	384
Sonoma	10	....	....	....	....	....	....	1	8	....	....	....	....	....	....	....	19
Tehama	26	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	26
Ventura	2	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	4
Total	1,010	975	10	100	....	32	125	479	66	11	17	106	18	1	12	6	2,968

Table showing the nativity and nationality of shoresmen and factory hands employed in the fishing industry of California in 1892.

Counties.	Nativity.							Nationality.						
	United States.	United States Indians.	China.	Sweden.	Norway.	Great Britain.	Total.	United States.	United States Indians.	China.	Sweden.	Norway.	Great Britain.	Total.
Contra Costa	12	......	50	....	....	....	62	12	......	50	....	....	....	62
Del Norte	15	55	......	....	....	....	70	15	55	......	....	....	....	70
Humboldt	6	......	......	....	....	....	6	6	......	......	....	....	....	6
Los Angeles	25	......	......	....	....	....	25	25	......	......	....	....	....	25
Marin	16	......	......	35	26	13	90	56	......	......	15	13	6	90
Sacramento	6	......	5	....	....	....	11	6	......	5	....	....	....	11
San Francisco	286	......	......	....	....	....	286	286	......	......	....	....	....	286
Solano	13	......	47	....	....	....	60	13	......	47	....	....	....	60
Total	379	55	102	35	26	13	610	419	55	102	15	13	6	610

Table showing by counties the apparatus and capital employed in the fisheries of California in 1889, 1890, 1891, and 1892.

Items.	Contra Costa.		Del Norte.		Humboldt.		Los Angeles.		Marin.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
1889.										
Boats	160	$23,110	31	$910	146	$3,020	99	$17,925	58	$4,040
Apparatus—shore fisheries:										
Seines			3	800	17	5,100	4	400	7	550
Gill nets	75	16,500	31	950	120	6,000	108	4,770	128	2,280
Bag nets	193	4,875					23	2,250	250	6,280
Fyke nets	24	480								
Trammel nets									12	180
Hoop nets					18	45				
Lines		480				50		730		
Pots							98	128		
Hoes and rakes						12				24
Minor apparatus										3
Shore property		24,365		22,000		20,000		405		66,100
Cash capital		60,000		12,500		30,000				25,000
Total		129,810		37,160		64,827		26,608		104,457
1890.										
Boats	164	22,970	30	887	142	2,940	105	18,573	58	4,025
Apparatus—shore fisheries:										
Seines			3	800	15	4,500	4	400	7	550
Gill nets	72	15,960	30	918	115	6,325	113	5,020	126	2,245
Bag nets	100	4,800					23	2,250	245	6,125
Fyke nets	24	480								
Trammel nets									12	180
Hoop nets					18	45				
Lines		498				50		745		
Pots							105	135		
Hoes and rakes						12				22
Minor apparatus										3
Shore property		24,365		22,000		5,000		415		66,000
Cash capital		60,000		17,000		5,000				25,000
Total		129,073		41,605		23,872		27,538		104,150
1891.										
Vessels fishing							1	500		
Tonnage							14.41			
Outfit								400		
Boats	160	22,943	30	885	141	2,920	115	19,360	58	4,010
Apparatus—vessel fisheries:										
Lines								50		
Apparatus—shore fisheries:										
Seines			3	825	15	4,500	4	400	7	550
Gill nets	70	15,715	30	900	112	6,160	130	5,450	126	2,245
Bag nets	188	4,760					29	2,700	252	6,300
Fyke nets	24	480								
Trammel nets									12	180
Hoop nets					18	45				
Lines		525				60		910		
Pots							105	135		
Hoes and rakes						14				22
Minor apparatus										3
Shore property		24,380		14,000		5,000		5,675		66,075
Cash capital		10,000		12,000		5,000		10,000		25,000
Total		78,753		28,610		23,699		45,580		104,385
1892.										
Vessels fishing							3	7,000		
Tonnage							64.21			
Outfit								1,000		
Boats	164	22,910	30	885	144	3,520	121	20,341	58	4,080
Apparatus—vessel fisheries:										
Lines								150		
Apparatus—shore fisheries:										
Seines			3	850	14	4,200	4	400	7	550
Gill nets	70	15,625	30	900	119	6,545	140	5,950	125	2,226
Bag nets	188	4,760					28	2,625	250	6,250
Fyke nets	24	480								
Trammel nets									12	180
Hoop nets					18	45				
Lines		570				80		960		
Pots							105	135		
Hoes and rakes						17				25
Minor apparatus										3
Shore property		24,330		22,000		5,000		5,690		66,000
Cash capital		20,000		8,000		5,000		5,000		25,000
Total		88,075		32,635		24,407		49,251		104,314

Apparatus and capital employed in the fisheries of California, etc.—Continued.

Items.	Monterey.		Orange.		Sacramento.		San Diego.		San Luis Obispo.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
1889.										
Vessels fishing							11	$5,900		
Tonnage							127.81			
Outfit								4,425		
Boats	86	$5,940	4	$90	23	$375	88	15,916	14	$1,925
Apparatus—vessel fisheries:										
Lines								510		
Apparatus—shore fisheries:										
Seines	25	2,500	1	150	8	410	10	2,000		
Gill nets	354	8,690			13	975	12	1,200	40	2,000
Bag nets	5	200	1	75			2	1,000	2	300
Fyke nets					25	500				
Hoop nets					18	55				
Lines		1,245		40				467		100
Pots							25	38		
Hoes and rakes								20		
Minor apparatus								45		645
Shore property		2,165				1,565		5,700		370
Cash capital						6,000				
Total		20,140		355		9,880		37,221		5,340
1890.										
Vessels fishing							10	5,000		
Tonnage							105.22			
Outfit								3,825		
Boats	87	5,995	5	120	22	355	90	16,275	16	1,075
Apparatus—vessel fisheries:										
Lines								480		
Apparatus—shore fisheries:										
Seines	25	2,500	1	150	8	410	10	2,000		
Gill nets	357	8,227			12	900	12	1,200	28	1,910
Bag nets	5	200	1	75			2	1,000	2	300
Fyke nets					25	500				
Hoop nets					17	53				
Lines		1,287		65				490		110
Pots							25	38		
Hoes and rakes								20		
Minor apparatus								45		400
Shore property		2,230				1,578		5,700		500
Cash capital						6,000				
Total		20,439		410		9,796		36,073		5,195
1891.										
Vessels fishing							9	4,600		
Tonnage							89.10			
Outfit								3,500		
Boats	86	5,932	6	150	21	340	100	17,988	16	1,975
Apparatus—vessel fisheries:										
Lines								430		
Apparatus—shore fisheries:										
Seines	25	2,500	2	300	8	400	6	1,200		
Gill nets	353	8,075			10	750	10	1,000	38	1,910
Bag nets	5	200	2	150			3	1,500	2	300
Fyke nets					25	500				
Hoop nets					19	58				
Lines		1,360		75				536		126
Pots							25	38		
Hoes and rakes								22		
Minor apparatus								60		400
Shore property		2,450				1,550		5,700		700
Cash capital						6,000				
Total		20,517		675		9,598		36,574		5,411
1892.										
Vessels fishing							10	5,150		
Tonnage							95.91			
Outfit								3,900		
Boats	84	5,800	6	150	21	340	77	13,844	16	1,975
Apparatus—vessel fisheries:										
Lines								480		
Apparatus—shore fisheries:										
Seines	25	2,500	2	300	8	400	3	600		
Gill nets	350	8,000			10	750	6	600	40	2,000
Bag nets	5	200	2	150			4	2,000	2	300
Fyke nets					25	500				
Hoop nets					20	60				
Lines		1,395		75				580		140
Pots							25	38		
Hoes and rakes								22		
Minor apparatus								75		400
Shore property		2,500				1,550		5,700		800
Cash capital						6,000				
Total		20,395		675		9,600		32,989		5,615

Apparatus and capital employed in the fisheries of California, etc.—Continued.

Items.	San Mateo.		Santa Barbara.		Santa Cruz.		Shasta.		Solano.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
1889.										
Boats	48	$2,415	22	$2,775	43	$5,040	3	$60	259	$33,765
Apparatus—shore fisheries:										
Seines			3	600	1	75	3	300		
Gill nets			17	1,690	113	2,120			186	36,090
Bag nets	328	8,200			8	1,100				
Trammel nets					80	1,625				
Lines				70		190				2,016
Pots			60	90						
Minor apparatus				300						
Shore property		7,800		410		826		50		20,000
Cash capital										43,000
Total		18,415		5,935		10,976		410		134,871
1890.										
Vessels transporting			1	5,000						
Tonnage			14.80							
Outfit				300						
Boats	47	2,400	23	2,880	48	4,900	3	60	259	33,765
Apparatus—shore fisheries:										
Seines			3	600	1	75	3	300		
Gill nets			19	1,900	90	1,945			186	36,090
Bag nets	325	8,140			8	1,025				
Trammel nets					74	1,410				
Lines				70		190				2,140
Pots			66	100						
Minor apparatus				300						
Shore property		7,900		465		774		50		20,000
Cash capital										15,000
Total		18,440		11,615		10,319		410		106,995
1891.										
Vessels transporting			1	4,300						
Tonnage			11.92							
Outfit				440						
Boats	48	2,440	25	3,150	54	4,590	4	75	262	34,250
Apparatus—shore fisheries:										
Seines			3	600	1	75	4	400		
Gill nets			20	1,000	104	1,920			192	37,050
Bag nets	330	8,260			9	1,325				
Trammel nets					75	1,425				
Lines				68		207				2,200
Pots			70	105						
Minor apparatus				300						
Shore property		7,900		480		808		50		50,000
Cash capital										8,000
Total		18,600		10,443		10,410		525		131,500
1892.										
Vessels transporting			1	4,300						
Tonnage			11.92							
Outfit				300						
Boats	50	2,500	25	3,150	53	4,465	4	70	263	34,425
Apparatus—shore fisheries:										
Seines			3	600	1	75	4	400		
Gill nets			20	1,000	100	1,805			192	37,050
Bag nets	335	8,375			9	1,300				
Trammel nets					71	1,356				
Lines				75		220				2,376
Pots			73	110						
Minor apparatus				300						
Shore property		8,000		500		950		50		50,000
Cash capital										8,000
Total		18,875		10,335		10,171		520		131,851

Apparatus and capital employed in the fisheries of California, etc.—Continued.

Items.	San Francisco.		Sonoma.		Tehama.		Ventura.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value
1889.										
Vessels fishing	36	$598,000							47	$603,900
Tonnage	8,270.55								8,398.36	
Outfit		266,357								269,782
Vessels transporting	6	25,000							6	25,000
Tonnage	338.49								338.49	
Outfit		1,600								1,600
Boats	239	60,650	8	$500	10	$180	4	$700	1,351	179,336
Apparatus—vessel fisheries:										
Paranzella nets	5	950							5	950
Lines		288								798
Other apparatus		3,250								3,250
Apparatus—shore fisheries:										
Seines	90	7,200	2	150	13	1,285			187	21,520
Gill nets	1,170	27,000	6	600					2,273	110,865
Bag nets	435	13,375					2	150	1,249	37,805
Fyke nets									49	980
Trammel nets	315	5,175							407	6,980
Hoop nets									36	100
Lines		5,700		40				10		11,138
Pots									183	256
Tongs	50	500							50	500
Hoes and rakes		125								161
Minor apparatus		1,710								2,703
Shore property		287,800				250				459,806
Cash capital		168,000								344,500
Total		1,471,680		1,290		1,715		860		2,081,950
1890.										
Vessels fishing	46	680,300							56	685,300
Tonnage	9,803.35								9,908.57	
Outfit		322,482								326,307
Vessels transporting	6	25,000							7	30,000
Tonnage	338.43								353.23	
Outfit		2,300								2,600
Boats	243	60,960	8	540	10	180	4	700	1,364	180,500
Apparatus—vessel fisheries:										
Paranzella nets	5	950							5	950
Lines		382								862
Other apparatus		5,250								5,250
Apparatus—shore fisheries:										
Seines	92	7,360	2	150	14	1,400			188	21,195
Gill nets	-,123	24,920	6	600					2,289	108,160
Bag nets	443	13,625					2	150	1,246	37,690
Fyke nets									49	980
Trammel nets	300	4,050							386	6,540
Hoop nets									35	98
Lines		6,679		42				10		12,376
Pots									196	273
Tongs	50	500							50	500
Hoes and rakes		125								179
Minor apparatus		1,620								2,368
Shore property		332,800				250				490,027
Cash capital		175,000								303,000
Total		1,665,203		1,332		1,830		860		2,215,155

Apparatus and capital employed in the fisheries of California, etc.—Continued.

Items.	San Francisco.		Sonoma.		Tehama.		Ventura.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
1891.										
Vessels fishing	55	$739,500							65	$744,600
Tonnage	9,942.46								10,045.97	
Outfit		331,519								335,419
Vessels transporting	8	36,000							9	40,300
Tonnage	524.26								536.18	
Outfit		3,100								3,540
Boats	248	61,650	8	$550	11	$195	4	$720	1,307	184,123
Apparatus—vessel fisheries:										
Paranzella nets	15	2,850							15	2,850
Lines		419								899
Other apparatus		9,250								9,250
Apparatus—shore fisheries:										
Seines	98	7,840	2	150	14	1,400			192	21,140
Gill nets	1,185	27,800	6	600					2,386	110,575
Bag nets	452	13,900					2	150	1,274	39,545
Fyke nets									49	980
Trammel nets	318	5,247							405	6,852
Hoop nets									37	103
Lines		7,202		50				12		13,331
Pots									200	278
Tongs	50	500							50	500
Hoes and rakes		125								183
Minor apparatus		1,687								2,450
Shore property		352,500				250				537,528
Cash capital		172,000								248,000
Total		1,773,089		1,350		1,845		882		2,302,446
1892.										
Vessels fishing	63	834,500							76	846,050
Tonnage	11,792.65								11,952.77	
Output		386,600								391,500
Vessels transporting	6	39,500							7	43,800
Tonnage	471.61								483.53	
Output		2,200								2,500
Boats	252	63,000	8	550	11	195	4	720	1,391	183,520
Apparatus—vessel fisheries:										
Paranzella nets	20	3,800							20	3,800
Seines	1	400							1	400
Lines		494								1,124
Other apparatus		10,450								10,450
Apparatus—shore fisheries:										
Seines	102	8,160	2	150	14	1,400			192	20,585
Gill nets	1,298	30,070	6	600					2,506	113,121
Bag nets	454	14,050					2	150	1,279	40,160
Fyke nets									49	980
Trammel nets	357	5,890							440	7,426
Hoop nets									38	105
Lines		8,294		50				15		14,830
Pots									203	283
Tongs	50	500							50	500
Hoes and rakes		125								189
Minor apparatus		1,725								2,503
Shore property		403,000				250				596,320
Cash capital		169,000								246,000
Total		1,982,358		1,350		1,845		885		2,526,746

Table showing by counties and species the yield of the fisheries of California in 1889.

Species.	Contra Costa.		Del Norte.		Humboldt.		Los Angeles.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh							88,891	$3,454
Carp, fresh	11,914	$357						
Cultus-cod, fresh					21,040	$735		
Flounders, fresh	256,692	3,850			132,440	3,139	177,822	7,112
Herring fresh	192,519	2,888			10,000	200	61,000	2,440
Mackerel, fresh							117,423	4,697
Perch, fresh					20,150	504	17,200	688
Rockfish, fresh					26,115	755	45,054	1,838
Salmon, chinook, fresh	3,195,747	127,830	218,875	$6,078				
Salmon, silver, fresh			189,205	3,543	1,176,515	37,283		
Salmon, silver, salted					435,600	17,324		
Salmon, steelhead, fresh			48,750	728	392,171	9,778		
Sardines, fresh							18,397	669
Sea bass, fresh							11,109	444
Shad, fresh	96,722	3,869			300	30		
Smelt, fresh	130,012	2,070			29,500	738	145,301	5,812
Striped bass, fresh	13,776	3,443						
Sturgeon, fresh	350,410	10,513						
Yellow-tail, fresh							30,650	1,226
Other fish, fresh and salted	206,264	3,221					61,774	2,470
Abalone meats and shells							19,810	452
Clams, hard					43,750	937		
Clams, soft					10,800	270		
Crabs					86,400	3,000		
Shrimp and prawn	919,221	41,769						
Spiny lobster							108,000	2,815
Hair-seal and sea-lion pelts								580
Seal oil							7,200	288
Total	5,373,277	199,810	456,830	10,349	2,384,781	74,693	910,531	34,985

Species.	Marin.		Monterey.		Orange.		Sacramento.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh			28,056	$1,680	2,000	$80		
Carp, fresh							39,300	$1,377
Flounders, fresh	407,653	$7,840	278,490	5,565	5,481	195		
Flounders, salted			67,880	2,715				
Herring, fresh	337,442	7,080			4,645	170		
Mackerel, fresh			75,040	3,753	3,000	120		
Perch, fresh	89,997	3,600			2,320	92	4,282	255
Rockfish, fresh			1,112,753	22,267	6,000	240		
Rockfish, salted			30,750	1,230				
Salmon, chinook, fresh	25,000	1,000	10,098	606			151,510	10,607
Sardines, fresh					2,000	80		
Sea bass, fresh	33,142	1,320			3,000	120		
Shad, fresh							13,224	793
Smelt, fresh	269,150	6,340	83,258	3,330	17,805	710		
Sturgeon, fresh	30,240	1,200					4,880	293
Yellow-tail, fresh					5,000	200		
Other fish, fresh and salted	248,687	3,572	19,280	690	2,000	80	200,726	4,821
Abalone meats and shells			3,850	73				
Octopus and squid			468,000	37,440				
Clams, hard	32,060	690						
Clams, soft	11,100	109						
Shrimp and prawn	1,225,628	55,693						
Terrapin and frogs	11,250	3,000						
Algæ			5,800	232				
Total	2,721,349	91,444	2,183,255	79,581	53,251	2,087	413,958	18,146

Species.	Santa Cruz.		Shasta.		Solano.		Sonoma.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh	5,000	$240						
Flounders, fresh	69,674	2,737					5,500	$220
Mackerel, fresh	9,845	488						
Rockfish, fresh	126,528	4,045					3,375	135
Rockfish, salted	3,215	211						
Salmon, chinook, fresh	13,552	610	28,760	$720	1,973,400	$78,936	26,810	1,610
Shad, fresh	20,264	810			72,206	2,888		
Smelt, fresh	18,600	745						
Striped bass, fresh					960	240		
Sturgeon, fresh					232,794	6,984		
Total	266,678	10,786	28,760	720	2,279,360	89,048	35,685	1,965

Yield of the fisheries of California in 1889—Continued.

Species.	San Diego.		San Luis Obispo.		San Mateo.		Santa Barbara.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh	157,793	$6,312	25,116	$875			65,370	$3,250
Barracuda, salted	97,106	3,399	1,000	50			19,520	978
Bonito, fresh	45,030	1,802	1,500	75			23,509	1,174
Bonito, salted	151,319	5,296					2,615	125
Flounders, fresh	7,050	282	16,360	716	748,883	$11,403	7,775	385
Herring, fresh	24,980	998						
Mackerel, fresh	10,030	401	95,070	3,550			4,845	240
Perch, fresh	22,775	913						
Rockfish, fresh	35,000	1,400	79,000	3,065				
Rockfish, salted			4,000	200			4,588	225
Sardines, fresh	7,000	280						
Sea bass, fresh	11,748	470	52,180	1,820			11,908	595
Sea bass, salted			2,500	125				
Smelt, fresh	12,110	485	28,060	980	218,910	3,485	6,100	310
Yellow-tail, fresh	122,864	4,480					25,396	1,265
Yellow-tail, salted	53,081	1,858					5,162	258
Other fish, fresh and salted	63,309	2,529			315,665	4,564	19,387	948
Abalone meats and shells	27,540	1,087					228,879	5,877
Clams, hard	420,000	3,000						
Shrimp and prawn					1,532,034	69,616		
Spiny lobster	48,158	1,203					110,300	3,309
Hair-seal and sea-lion pelts		1,000		195				423
Sea-otter pelts								3,000
Whale oil			30,000	1,000				
Seal oil			3,210	107			4,200	224
Algæ							14,370	575
Total	1,316,893	37,195	337,996	12,758	2,815,492	89,068	554,014	23,161

Species.	San Francisco.		Tehama.		Ventura.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Anchovies, fresh	122,510	$2,447					122,510	$2,447
Barracuda, fresh					10,862	$490	383,088	16,381
Barracuda, salted							117,626	4,427
Bonito, fresh					10,580	405	80,619	3,456
Bonito, salted							153,934	5,421
Carp, fresh							51,214	1,734
Cod, salted	1,463,424	36,587					1,463,424	36,587
Cultus-cod, fresh	110,004	4,001					131,044	4,736
Flounders, fresh	1,542,040	43,800			2,130	87	3,657,900	87,331
Flounders, salted							67,880	2,715
Herring, fresh	1,942,225	52,325					2,572,811	66,101
Kingfish, fresh	8,460	254					8,460	254
Mackerel, fresh							315,253	13,249
Perch, fresh	197,125	9,856					353,849	15,908
Rockfish, fresh	620,742	28,066			10,211	408	2,065,678	63,119
Rockfish, salted							42,553	1,866
Salmon, chinook, fresh	1,003,503	40,140	118,145	$2,955			6,765,430	271,092
Salmon, silver, fresh							1,365,720	40,826
Salmon, silver, salted							435,600	17,324
Salmon, steelhead, fresh							440,921	10,506
Sardines, fresh	1,070,000	21,400					1,097,397	22,429
Sea bass, fresh	325,000	13,000			4,760	188	452,847	17,957
Sea bass, salted							2,500	125
Shad, fresh	61,072	2,443					263,788	10,833
Smelt, fresh	956,582	32,487					1,915,478	57,492
Striped bass, fresh	1,560	390					16,296	4,073
Sturgeon, fresh	75,320	2,260					693,650	21,250
Yellow-tail, fresh					4,362	165	188,272	7,336
Yellow-tail, salted							58,243	2,116
Other fish, fresh and salted	574,026	10,120			6,733	262	1,717,851	33,277
Abalone meats and shells	30,000	600					310,079	8,089
Octopus and squid	16,100	772					484,100	38,212
Clams, hard	74,900	1,605					570,710	6,232
Clams, soft	1,096,800	11,518					1,118,700	11,897
Oysters	12,369,000	571,525					12,369,000	571,525
Mussels	2,100,000	8,750					2,100,000	8,750
Crabs	1,944,000	76,045					2,030,400	79,045
Shrimp and prawn	1,858,439	86,539					5,535,322	253,617
Spiny lobster							266,458	7,327
Terrapin and frogs	30,000	2,400					41,250	5,400
Hair-seal and sea-lion pelts								2,198
Fur-seal pelts		15,219						15,219
Sea-otter pelts		27,700						30,700
Whale oil	1,480,080	60,952					1,510,080	61,952
Whalebone	119,650	520,478					119,650	520,478
Cod tongues	12,600	882					12,600	882
Seal oil							14,610	619
Algæ							20,170	807
Total	31,205,162	1,684,561	118,145	2,955	49,638	2,005	53,505,055	2,465,317

Table showing by counties and species the yield of the fisheries of California in 1890.

Species.	Contra Costa.		Del Norte.		Humboldt.		Los Angeles.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh							142,414	$5,697
Carp, fresh	12,209	$306						
Cultus-cod, fresh					20,280	$710		
Flounders, fresh	285,550	4,283			164,112	3,807	187,583	7,503
Herring, fresh	214,129	3,212			11,150	223	48,000	1,920
Mackerel, fresh							160,174	6,407
Perch, fresh					21,610	539	19,990	800
Rockfish, fresh					24,968	748	57,740	2,310
Salmon, chinook, fresh	1,423,880	56,955	345,250	$10,357				
Salmon, silver, fresh			250,375	4,227	934,577	31,154		
Salmon, silver, salted					167,000	6,680		
Salmon, steelhead, fresh			51,875	777	311,524	6,230		
Sardines, fresh							24,765	991
Sea bass, fresh							14,344	574
Sea bass, salted							3,781	151
Shad, fresh	102,216	4,089			250	25		
Smelt, fresh	148,760	2,231			28,160	704	182,260	7,286
Striped bass, fresh	15,715	3,143						
Sturgeon, fresh	235,522	7,066						
Yellow-tail, fresh							38,260	1,530
Other fish, fresh and salted	221,159	3,456					107,677	4,308
Abalone meats and shells							860	34
Clams, hard					42,000	900		
Clams, soft					12,000	300		
Crabs					90,000	3,125		
Shrimp and prawn	967,947	43,983						
Spiny lobster							107,000	2,810
Hair-seal and sea-lion pelts								225
Seal oil							4,800	192
Total	3,627,087	128,784	647,500	15,361	1,827,631	55,145	1,099,648	42,738

Species.	Marin.		Monterey.		Orange.		Sacramento.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh			18,658	$1,120	3,000	$120		
Carp, fresh							45,904	$1,608
Cultus-cod, fresh					8,998	350		
Flounders, fresh	629,303	$12,068	123,082	2,462				
Flounders, salted			43,649	1,747				
Herring, fresh	368,951	7,654	3,920	196	8,445	332		
Mackerel, fresh			41,312	2,066	6,000	240		
Perch, fresh	81,997	3,280			5,089	190	5,605	338
Rockfish, fresh			1,245,678	24,902	15,000	600		
Rockfish, salted			18,200	728				
Salmon, chinook, fresh	22,110	880	8,770	526			145,540	10,188
Sardines, fresh					5,035	200		
Sea bass, fresh	30,365	1,200			5,000	200		
Shad, fresh							15,960	958
Smelt, fresh	278,690	6,250	107,184	4,287	20,715	828		
Striped bass, fresh							54	8
Sturgeon, fresh	38,170	1,520					3,860	232
Yellow-tail, fresh					10,000	400		
Other fish, fresh and salted	278,100	4,078	24,496	881	2,000	80	212,629	5,123
Abalone meats and shells			4,400	83				
Clams, hard	30,450	655						
Clams, soft	10,080	101						
Shrimp and prawn	1,290,600	58,643						
Terrapin and frogs	12,563	3,350						
Algæ			6,500	260				
Total	3,071,379	99,679	1,645,849	39,258	89,282	3,540	429,552	18,455

Species.	Santa Cruz.		Shasta.		Solano.		Sonoma.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh	3,731	$182						
Flounders, fresh	77,770	3,110					6,190	$248
Mackerel, fresh	10,495	478						
Rockfish, fresh	174,805	6,956					4,515	180
Rockfish, salted	3,000	150						
Salmon, chinook, fresh	12,500	550	25,825	$646	1,030,580	$41,223	21,375	1,283
Shad, fresh	24,880	995			57,892	2,316		
Smelt, fresh	21,437	860						
Striped bass, fresh					1,218	244		
Sturgeon, fresh					269,923	8,098		
Total	328,618	13,281	25,825	646	1,359,613	51,881	32,080	1,711

Yield of the fisheries of California in 1890—Continued.

Species.	San Diego.		San Luis Obispo.		San Mateo.		Santa Barbara.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh	133,200	$5,326	22,705	$720			60,115	$3,000
Barracuda, salted	115,840	4,054						
Bonito, fresh	35,040	1,401					52,617	2,618
Bonito, salted	180,645	6,323	2,200	110			4,572	225
Flounders, fresh	6,078	243	15,040	632	473,085	$7,195	6,298	311
Herring, fresh	20,000	800			354,814	5,120		
Mackerel, fresh	8,190	327	82,310	3,030			3,083	150
Perch, fresh	18,030	721						
Rockfish, fresh	30,000	1,200	75,106	3,010				
Rockfish, salted			5,000	250			4,516	226
Sardines, fresh	5,000	200						
Sea bass, fresh	10,965	440	50,315	1,750			8,585	418
Sea bass, salted			2,800	140				
Smelt, fresh	10,086	403	25,115	875	243,802	3,855	4,787	240
Yellow-tail, fresh	24,000	960					30,343	1,532
Yellow-tail, salted	166,875	5,841					5,393	268
Other fish, fresh and salted	51,210	2,049			347,554	5,142	14,730	675
Abalone meats and shells	55,590	934					114,933	3,942
Octopus and squid	256,000	20,480						
Clams, hard	350,000	2,500						
Shrimp and prawn					1,613,246	73,303		
Spiny lobster	40,370	1,009					130,940	3,928
Hair-seal and sea-lion pelts		875		143				527
Sea-otter pelts								2,000
Whale oil			38,250	1,270				
Seal oil			2,100	73			4,800	256
Algæ							22,845	914
Total	1,517,119	56,086	321,031	12,003	3,032,501	94,615	468,557	21,230

Species.	San Francisco.		Tehama.		Ventura.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Anchovies, fresh	135,000	$2,700					135,000	$2,700
Barracuda, fresh					11,415	$480	395,238	16,645
Barracuda, salted							115,840	4,054
Bonito, fresh					5,726	218	93,383	4,237
Bonito, salted							187,417	6,658
Carp, fresh							58,113	1,974
Codfish, salted	1,782,679	44,567					1,782,679	44,567
Cultus-cod, fresh	147,478	5,573					167,758	6,283
Flounders, fresh	1,545,096	42,009			2,973	116	3,531,158	85,237
Flounders, salted							43,040	1,747
Herring, fresh	2,369,415	35,539					3,308,824	54,996
Kingfish, fresh	10,208	306					10,208	306
Mackerel, fresh							311,564	12,698
Perch, fresh	248,108	12,405					400,429	18,273
Rockfish, fresh	610,430	27,316			15,066	600	2,253,308	67,822
Rockfish, salted							30,716	1,354
Salmon, chinook, fresh	218,426	8,737	125,860	$3,147			3,380,116	134,492
Salmon, silver, fresh							1,184,052	35,381
Salmon, silver, salted							167,000	6,680
Salmon, steelhead, fresh							363,399	7,007
Sardines, fresh	1,280,000	19,200					1,314,800	20,591
Sea bass, fresh	195,000	7,800			4,507	178	319,081	12,560
Sea bass, salted							6,581	201
Shad, fresh	116,942	3,508					318,140	11,891
Smelt, fresh	1,002,003	33,487					2,073,599	61,306
Striped bass, fresh	3,132	626					20,119	4,021
Sturgeon, fresh	65,110	1,953					612,585	18,869
Yellow-tail, fresh					9,980	395	112,583	4,817
Yellow-tail, salted							172,268	6,109
Other fish, fresh and salted	633,200	10,153			2,346	77	1,895,101	36,022
Abalone meats and shells	28,000	560					203,783	5,553
Octopus and squid	11,809	336					267,809	20,816
Clams, hard	89,530	1,920					511,980	5,975
Clams, soft	1,239,900	13,020					1,261,980	13,421
Oysters	12,829,500	592,137					12,829,500	592,137
Mussels	2,700,000	11,250					2,700,000	11,250
Crabs	2,000,060	80,000					2,090,000	83,125
Shrimp and prawn	1,950,900	90,664					5,822,693	206,593
Spiny lobster							278,310	7,747
Terrapin and frogs	35,000	4,200					47,563	7,550
Hair-seal and sea-lion pelts								1,770
Fur-seal pelts		69,816						69,816
Sea-otter pelts		27,300						29,300
Whale oil	2,197,665	103,782					2,235,915	105,052
Whalebone	170,118	680,472					170,118	680,472
Cod tongues	13,800	966					13,800	966
Seal oil							11,790	521
Algæ							29,345	1,174
Total	33,629,049	1,933,202	125,860	3,147	52,013	2,064	53,330,194	2,592,826

Table showing by counties and species the yield of the fisheries of California in 1891.

Species.	Contra Costa.		Del Norte.		Humboldt.		Los Angeles.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh							210,001	$6,430
Carp, fresh	14,188	$426						
Cultus-cod, fresh					24,118	$840		
Flounders, fresh					151,018	3,617	157,810	6,312
Herring, fresh	203,130	3,145			12,000	240	68,000	2,720
Mackerel, fresh							326,409	13,058
Perch, fresh					23,650	690	25,691	988
Rockfish, fresh					34,472	1,034	81,192	3,248
Salmon, chinook, fresh	594,006	23,760	308,750	$9,262				
Salmon, silver, fresh			182,500	4,818	890,946	29,698		
Salmon, silver, salted					116,200	4,448		
Salmon, steelhead, fresh			18,750	280	296,981	5,940		
Sardines, fresh							66,007	1,326
Sea bass, fresh							18,206	728
Sea bass, salted							4,301	172
Shad, fresh	108,011	4,320			160	16		
Smelt, fresh	141,420	2,167			32,000	800	175,965	7,039
Striped bass, fresh	23,932	3,590						
Sturgeon, fresh	269,725	8,092						
Yellow-tail, fresh							67,690	2,708
Other fish, fresh and salted	213,810	3,422					118,950	5,026
Abalone meats and shells							5,135	86
Clams, hard					47,250	1,012		
Clams, soft					15,000	375		
Crabs					98,100	3,406		
Shrimp and prawn	813,806	36,967						
Spiny lobster							102,125	2,688
Total	2,382,028	85,889	510,000	14,360	1,741,895	52,116	1,427,542	52,529

Species.	Marin.		Monterey.		Orange.		Sacramento.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh			13,235	$785	2,000	$80		
Carp, fresh							45,430	$1,590
Flounders, fresh	401,395	$7,017	190,510	3,810	6,710	257		
Flounders, salted			41,071	1,644				
Herring, fresh	320,541	6,050			6,498	255		
Mackerel, fresh			32,734	1,637	3,000	120		
Perch, fresh	55,008	2,200			3,365	120	4,553	274
Rockfish, fresh			758,578	15,172	7,000	280		
Rockfish, salted			19,472	760				
Salmon, chinook, fresh	15,035	600	7,990	480			76,112	5,328
Sardines, fresh	.3,561	142						
Sea bass, fresh	15,482	610			3,000	120		
Shad, fresh							17,516	1,051
Smelt, fresh	242,090	5,048	76,985	3,080	18,115	724		
Striped bass, fresh							157	24
Sturgeon, fresh	15,946	630					3,250	195
Yellow-tail, fresh					5,000	200		
Other fish, fresh and salted	264,840	3,924	16,920	610	2,000	80	228,445	5,566
Abalone meats and shells			3,700	66				
Octopus and squid			300,760	23,960				
Clams, hard	28,700	615						
Clams, soft	10,380	106						
Shrimp and prawn	1,085,175	49,280						
Terrapin and frogs	12,262	3,270						
Algæ			7,780	310				
Total	2,470,415	79,501	1,469,735	52,314	56,688	2,236	375,463	14,028

Species.	Santa Cruz.		Shasta.		Solano.		Sonoma.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh	4,350	$212						
Flounders, fresh	71,151	2,846					4,900	$196
Mackerel, fresh	12,855	592						
Rockfish, fresh	183,084	7,265					4,264	171
Rockfish, salted	5,130	257						
Salmon, chinook, fresh	15,260	690	29,110	$730	694,181	$27,767	36,656	2,199
Shad, fresh	30,120	1,205			58,739	2,350		
Smelt, fresh	25,661	1,226						
Striped bass, fresh					2,265	340		
Sturgeon, fresh					366,380	10,991		
Total	347,611	14,293	29,110	730	121,565	41,448	45,820	2,566

Yield of the fisheries of California in 1891—Continued.

Species.	San Diego.		San Luis Obiepo.		San Mateo.		Santa Barbara.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh	229,755	$9,188	49,800	$1,750			58,000	$2,900
Barracuda, salted	113,542	3,974	5,500	275				
Bonito, fresh	59,900	2,386					40,192	2,000
Bonito, salted	169,783	5,949	1,000	50			3,701	180
Flounders, fresh	5,059	203	21,340	955	451,400	$6,871	7,010	348
Herring, fresh	35,230	1,410			338,550	4,977		
Mackerel, fresh	14,960	599	122,890	4,560			5,975	297
Rockfish, fresh	23,768	951						
Rockfish, salted	62,000	2,480	129,720	4,970				
Salmon, chinook, fresh			1,500	75			3,117	166
Sea bass, fresh	8,000	320						
Sea bass, salted	12,360	495	88,970	3,110			9,015	451
Shad, *fresh*			17,000	850				
Smelt, fresh	15,735	630	19,930	687	234,700	3,720	7,790	388
Yellow-tail, fresh	59,000	2,360					20,015	1,000
Yellow-tail, salted	63,461	2,230					4,632	231
Other fish, fresh and salted	84,630	3,380			329,120	4,745	17,084	842
Abalone meats and shells	52,120	1,172					241,826	6,248
Clams, hard	280,000	2,000						
Shrimp and prawn					1,356,345	61,610		
Spiny lobster	25,000	625					145,120	4,355
Hair-seal and sea-lion pelts		750		350				2,097
Sea-otter pelts								1,500
Whale oil			36,450	1,220				
Seal oil			5,490	183			4,500	240
Algæ							11,361	455
Total	1,314,303	41,102	499,596	19,044	2,710,115	81,923	579,338	23,608

Species.	San Francisco.		Tehama.		Ventura.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Anchovies, fresh	145,000	$2,114					145,000	$2,114
Atka mackerel, salted	64,800	4,860					64,800	4,860
Barracuda, fresh					8,610	$372	575,751	21,717
Barracuda, salted							119,042	4,249
Bonito, fresh					6,318	240	106,410	4,626
Bonito, salted							174,484	6,179
Carp, fresh							59,618	2,016
Codfish, salted	2,047,911	51,393					2,047,911	51,393
Cultus-cod, fresh	189,500	6,799					213,618	7,639
Flounders, fresh	1,599,784	44,693			3,896	155	3,071,989	77,280
Flounders, salted							41,071	1,644
Herring, fresh	2,773,126	29,774					3,757,075	48,571
Kingfish, fresh	21,080	963					24,080	963
Mackerel, fresh							518,883	20,863
Perch, fresh	189,420	5,683					325,455	10,906
Rockfish, fresh	619,502	24,179			13,260	526	1,893,072	59,325
Rockfish, salted							29,219	1,258
Salmon, chinook, fresh	448,322	17,933	115,623	$2,890			2,341,045	91,639
Salmon, silver, fresh							1,073,446	34,516
Salmon, silver, salted							116,200	4,448
Salmon, steelhead, fresh							315,731	6,220
Sardines, fresh	860,000	17,200					937,568	18,988
Sea bass, fresh	220,410	6,710			4,815	190	372,258	12,414
Sea bass, salted							21,301	1,022
Shad, fresh	230,460	6,914					445,006	15,856
Smelt, fresh	1,135,693	39,114					2,126,084	64,629
Striped bass, fresh	4,320	648					30,674	4,602
Sturgeon, fresh	72,250	2,305					727,551	22,213
Yellow-tail, fresh					9,276	323	160,981	6,591
Yellow-tail, salted	110,658	3,873					178,751	6,334
Other fish, fresh and salted	624,463	10,268			2,730	108	1,902,992	37,971
Abalone meats and shells							302,781	7,572
Octopus and squid	14,150	363					314,910	24,323
Clams, hard	94,850	2,033					450,800	5,660
Clams, soft	1,489,980	15,396					1,515,360	15,877
Oysters	13,387,800	618,455					13,387,800	618,455
Mussels	2,998,080	12,500					2,998,080	12,500
Crabs	2,250,000	90,000					2,348,100	93,406
Shrimp and prawn	1,637,614	75,735					4,892,940	223,601
Spiny lobster							272,245	7,668
Terrapin and frogs	37,500	4,500					49,762	7,770
Hair-seal and sea-lion pelts								3,206
Fur-seal pelts		134,220						134,220
Sea-otter pelts		30,200						31,700
Whale oil	1,727,535	69,970					1,763,985	71,190
Whalebone	223,771	1,118,855					223,771	1,118,885
Cod oil	975	65					975	65
Seal oil							9,990	423
Cod tongues	16,200	1,134					16,200	1,134
Algæ							19,141	765
Total	35,238,514	2,448,849	115,623	2,890	48,905	1,914	52,483 900	3,031,430

Table showing by counties and species the yield of the fisheries of California in 1892.

Species.	Contra Costa.		Del Norte.		Humboldt.		Los Angeles.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh							6,430	$257
Carp, fresh	21,342	$640						
Cultus-cod, fresh					30,000	$1,050		
Flounders, fresh	303,350	4,550			160,873	4,267	156,548	6,262
Herring, fresh	227,515	3,412			13,000	260	41,000	1,640
Mackerel, fresh							313,837	12,552
Perch, fresh					28,500	560	24,841	994
Rockfish, fresh					50,000	1,500	57,755	2,310
Salmon, chinook, fresh	1,037,331	41,493	133,563	$3,587				
Salmon, silver, fresh			99,124	1,534	782,638	26,098		
Salmon, silver, salted					39,000	1,560		
Salmon, steelhead, fresh			49,563	867	260,879	5,217		
Sardines, fresh							41,864	854
Sea bass, fresh							19,212	768
Shad, fresh	139,364	4,181			100	10		
Smelt, fresh	151,675	2,275			42,250	1,056	187,430	7,497
Striped bass, fresh	38,947	4,674						
Sturgeon, fresh	323,855	9,715						
Yellow-tail, fresh							66,347	2,654
Other fish, fresh and salted	255,470	4,272					111,479	4,576
Abalone meats and shells					7,775	162		
Clams, hard					52,500	1,125		
Clams, soft					17,400	435		
Crabs					112,320	3,900		
Shrimp and prawn	885,010	40,195						
Spiny lobster							128,425	3,340
Hair-seal and sea-lion pelts								330
Total	3,383,859	115,407	282,250	5,988	1,597,235	46,200	1,155,168	44,034

Species.	Marin.		Monterey.		Orange.		Sacramento.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Carp, fresh							44,320	$1,551
Flounders, fresh	442,468	$7,587	189,820	$3,796	11,122	$440		
Flounders, salted			43,837	1,754				
Herring, fresh	338,760	5,967			6,000	240		
Mackerel, fresh			6,209	286				
Perch, fresh	50,000	2,000			5,000	200	5,668	340
Rockfish, fresh			725,380	14,506	4,320	173		
Salmon, chinook, fresh	12,000	480	6,915	415			81,112	5,678
Sardines, fresh					5,000	200		
Sea bass, fresh	13,000	520						
Shad, fresh							21,579	1,295
Smelt, fresh	252,065	5,035	74,868	2,995	25,621	1,025		
Striped bass, fresh							199	30
Sturgeon, fresh	20,000	800					3,820	229
Yellow-tail, fresh					3,680	147		
Other fish, fresh and salted	303,519	4,650	14,058	507			243,497	5,802
Abalone meats and shells			4,189	85				
Octopus and squid			357,622	28,610				
Clams, hard	33,110	720						
Clams, soft	11,040	110						
Shrimp and prawn	1,180,020	53,590						
Terrapin and frogs	13,125	3,500						
Algæ			14,835	593				
Total	2,669,113	84,959	1,437,733	53,547	60,743	2,425	400,195	14,925

Species.	Santa Cruz.		Shasta.		Solano.		Sonoma.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Flounders, fresh	71,315	$2,853					5,187	$210
Mackerel, fresh	8,783	399						
Rockfish, fresh	172,220	6,890					3,700	148
Rockfish, salted	2,620	131						
Salmon, chinook, fresh	14,175	640	31,445	$785	944,507	$38,220	28,839	1,730
Shad, fresh	35,000	1,400			87,702	2,631		
Smelt, fresh	52,322	2,090						
Striped bass, fresh					3,910	469		
Sturgeon, fresh	72,545	2,176			217,637	6,529		
Total	428,980	16,579	31,445	785	1,253,756	47,849	37,726	2,088

Yield of the fisheries of California in 1892—Continued.

Species.	San Diego.		San Luis Obispo.		San Mateo.		Santa Barbara.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Barracuda, fresh	199,760	$7,996						
Barracuda, salted	109,614	3,837						
Bonito, fresh	50,000	2,000					20,000	$1,000
Bonito, salted	171,222	6,070					1,000	50
Flounders, fresh	2,960	117	11,110	$525	505,585	$7,585	6,500	325
Herring, fresh	50,000	2,000			379,190	5,688		
Mackerel, fresh	4,770	191	11,300	456			5,500	275
Perch, fresh	20,000	800						
Rockfish, fresh	50,000	2,000	98,240	3,865				
Rockfish, salted			6,500	325			550	27
Sardines, fresh	3,000	120						
Sea bass, fresh	10,000	400	61,650	1,808			14,000	700
Sea bass, salted			590	25				
Smelt, fresh	18,000	720	5,300	186	252,795	3,792	8,000	400
Yellow-tail, fresh	50,000	2,000					35,000	1,750
Yellow-tail, salted	189,607	6,721					1,800	90
Other fish, fresh and salted	158,925	6,360			379,185	5,686	19,450	973
Abalone meats and shells	124,120	3,234					238,463	5,280
Clams, hard	252,000	1,800						
Shrimp and prawn					1,475,020	66,989		
Spiny lobster	20,000	500					154,850	4,646
Hair-seal and sea-lion pelts		660		256				1,021
Sea-otter pelts								1,200
Whale oil			32,100	1,070				
Algæ							13,490	540
Total	1,483,978	47,526	226,700	8,516	2,991,775	89,740	518,603	18,277

Species.	San Francisco.		Tehama.		Ventura.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Anchovies, fresh	150,175	$1,502					150,175	$1,502
Barracuda, fresh					11,000	$440	217,190	8,693
Barracuda, salted							109,614	3,837
Bonito, fresh					7,110	280	77,110	3,280
Bonito, salted							172,222	6,120
Carp, fresh							65,662	2,191
Cod, salted	2,274,565	56,864					2,274,565	56,864
Cultus-cod, fresh	200,670	6,020					230,670	7,070
Flounders, fresh	2,312,210	53,789			3,000	120	4,182,048	92,426
Flounders, salted							43,837	1,754
Herring, fresh	3,431,416	36,589					4,486,867	55,796
Kingfish, fresh	40,000	1,201					40,000	1,201
Mackerel, fresh							350,399	14,159
Perch, fresh	201,108	6,033					335,117	10,927
Rockfish, fresh	644,372	19,330			14,000	560	1,819,987	51,282
Rockfish, salted							9,670	483
Salmon, chinook, fresh	1,122,928	44,917	128,389	$3,210			3,541,204	141,155
Salmon, chinook, salted	90,000	3,600					90,000	3,600
Salmon, silver, fresh							881,762	27,632
Salmon, silver, salted							39,000	1,560
Salmon, steelhead, fresh							310,442	6,084
Sardines, fresh	703,130	14,063					752,994	15,237
Sea bass, fresh	135,350	5,414					253,212	9,610
Sea bass, salted					4,000	160	4,500	185
Shad, fresh	242,740	4,855					520,494	14,372
Smelt, fresh	849,568	26,398					1,919,894	53,469
Striped bass, fresh	13,153	1,315					56,209	6,488
Sturgeon, fresh	80,160	2,405					718,017	21,854
Yellow-tail, fresh					8,000	320	163,027	6,871
Yellow-tail, salted							191,407	6,811
Other fish, fresh and salted	729,827	13,253			2,000	80	2,217,410	46,159
Abalone meats and shells	30,000	590					404,547	9,351
Octopus and squid	17,000	429					374,622	29,039
Clams, hard	141,890	2,804					479,500	6,449
Clams, soft	1,988,760	19,883					2,017,200	20,433
Oysters	15,098,700	698,257					15,098,700	698,257
Mussels	2,880,000	12,000					2,880,000	12,000
Crabs	2,750,000	99,000					2,862,320	102,900
Shrimp and prawn	1,773,295	81,043					5,313,345	241,817
Spiny lobster							303,275	8,486
Terrapin and frogs	32,500	4,550					45,625	8,050
Hair-seal and sea-lion pelts								2,267
Fur-seal pelts		167,526						167,526
Sea-otter pelts		34,950						36,150
Whale oil	1,542,743	61,053					1,574,843	62,123
Whalebone	197,339	937,371					197,339	937,371
Cod sounds	600	42					600	42
Cod tongues	27,500	1,925					27,500	1,925
Algæ							28,325	1,133
Total	30,701,708	2,418,976	128,389	3,210	49,110	1,960	57,838,466	3,022,991

Statement by counties, apparatus, and species of the yield of the vessel fisheries of California in 1889, 1890, 1891, and 1892.

Apparatus and species.	Los Angeles.		San Diego.		San Francisco.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1889.								
Lines:								
Barracuda, salted			60, 683	$2, 124			60, 683	$2, 124
Bonito, salted			95, 184	3, 331			95, 184	3, 331
Cod, salted					1, 463, 424	$36, 587	1, 463, 424	36, 587
Yellow-tail, salted			86, 864	3, 040			86, 864	3, 040
Total			242, 731	8, 495	1, 463, 424	36, 587	1, 706, 155	45, 082
Paranzella nets:								
Flounders, fresh					352, 320	8, 808	352, 320	8, 808
Kingfish, fresh					8, 460	254	8, 460	254
Rockfish, fresh					33, 312	999	33, 312	999
Other fish, fresh					14, 760	443	14, 760	443
Prawn, fresh					13, 218	1, 980	13, 218	1, 980
Octopus					1, 100	22	1, 100	22
Total					423, 170	12, 506	423, 170	12, 506
Miscellaneous:								
Abalone meat and shells			27, 540	1, 087			27, 540	1, 087
Hair-seal pelts				1, 000				1, 000
Fur-seal pelts						15, 219		15, 219
Sea-otter pelts						27, 700		27, 700
Whale oil					1, 480, 080	60, 952	1, 480, 080	60, 952
Whalebone					119, 650	520, 478	119, 650	520, 478
Cod tongues					12, 600	882	12, 600	882
Total			27, 540	2, 087	1, 612, 330	625, 231	1, 639, 870	627, 318
Grand total			270, 271	10, 582	3, 498, 924	674, 324	3, 769, 195	684, 906
1890.								
Lines:								
Barracuda, salted			72, 400	2, 534			72, 400	2, 534
Bonito, salted			112, 860	3, 950			112, 860	3, 950
Cod, salted					1, 782, 679	44, 567	1, 782, 679	44, 567
Yellow-tail, salted			104, 340	3, 652			104, 340	3, 652
Total			289, 600	10, 136	1, 782, 679	44, 567	2, 072, 279	54, 703
Paranzella nets:								
Flounders, fresh					347, 112	8, 678	347, 112	8, 678
Kingfish, fresh					10, 208	306	10, 208	306
Rockfish, fresh					35, 320	1, 060	35, 320	1, 060
Other fish, fresh					13, 530	406	13, 530	406
Prawn fresh					9, 845	1, 770	9, 845	1, 770
Octopus					1, 809	36	1, 809	36
Total					417, 824	12, 256	417, 824	12, 256
Miscellaneous:								
Abalone meat and shells			55, 590	934			55, 590	934
Hair-seal pelts				875				875
Fur-seal pelts						69, 816		69, 816
Sea-otter pelts						27, 300		27, 300
Whale oil					2, 197, 665	103, 782	2, 197, 665	103, 782
Whalebone					170, 118	680, 472	170, 118	680, 472
Cod tongues					13, 800	966	13, 800	966
Total			55, 590	1, 809	2, 381, 583	882, 336	2, 437, 173	884, 145
Grand total			345, 190	11, 945	4, 582, 086	939, 159	4, 927, 276	951, 104
1891.								
Lines:								
Atka mackerel, salted					64, 800	4, 860	64, 800	4, 860
Barracuda, fresh	2, 100	$84					2, 100	84
Barracuda, salted			70, 964	2, 484			70, 964	2, 484
Bonito, salted			102, 234	3, 578			102, 234	3, 578
Cod, salted					2, 047, 911	51, 393	2, 047, 911	51, 393
Mackerel, fresh	12, 150	486					12, 150	486
Yellow-tail, fresh	2, 500	100					2, 500	100
Yellow-tail, salted					110, 658	3, 873	110, 658	3, 873
Total	16, 750	670	173, 198	6, 062	2, 223, 369	60, 126	2, 413, 317	66, 858

Statement by counties, apparatus, and species of the yield of the vessel fisheries of California in 1889, 1890, 1891, and 1892—Continued.

Apparatus and species.	Los Angeles.		San Diego.		San Francisco.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1891.								
Paranzella nets:								
Flounders, fresh					621, 845	$18, 656	621, 845	$18, 656
Kingfish, fresh					24, 080	963	24, 080	963
Rockfish, fresh					62, 260	2, 490	62, 260	2, 490
Other fish, salted					46, 690	1, 401	46, 690	1, 401
Prawn, fresh					6, 382	1, 150	6, 382	1, 150
Octopus					6, 150	123	6, 150	123
Total					767, 407	24, 783	767, 407	24, 783
Miscellaneous:								
Abalone meat and shells			52, 120	$1, 172			52, 120	1, 172
Hair-seal pelts				750				750
Fur-seal pelts						134, 220		134, 220
Sea-otter pelts						30, 200		30, 200
Whale oil					1, 727, 535	69, 970	1, 727, 535	69, 970
Whalebone					223, 771	1, 118, 855	223, 771	1, 118, 855
Cod oil					975	65	975	65
Cod tongues					16, 200	1, 134	16, 200	1, 134
Total			52, 120	1, 922	1, 968, 481	1, 354, 444	2, 020, 601	1, 356, 366
Grand total	16, 750	$670	225, 318	7, 984	4, 959, 257	1, 439, 353	5, 201, 325	1, 448, 007
1892.								
Seines:								
Salmon, salted					90, 000	3, 600	90, 000	3, 600
Lines:								
Barracuda, fresh	6, 430	257					6, 430	257
Barracuda, salted			68, 510	2, 397			68, 510	2, 397
Bonito, salted			96, 558	3, 380			96, 558	3, 380
Cod, salted					2, 274, 565	56, 864	2, 274, 565	56, 864
Mackerel, fresh	36, 435	1, 456					36, 435	1, 456
Yellow-tail, fresh	7, 040	282					7, 040	282
Yellow-tail, salted			108, 975	3, 814			108, 975	3, 814
Total	49, 905	1, 995	274, 043	9, 591	2, 274, 565	56, 864	2, 598, 513	68, 450
Paranzella nets:								
Flounders, fresh					1, 409, 192	35, 220	1, 409, 192	35, 229
Kingfish, fresh					40, 000	1, 201	40, 000	1, 201
Rockfish, fresh					116, 952	3, 508	116, 952	3, 508
Other fish, fresh					74, 240	2, 228	74, 240	2, 228
Prawn, fresh					3, 270	654	3, 270	654
Octopus					8, 000	159	8, 000	159
Total					1, 651, 654	42, 979	1, 651, 654	42, 979
Miscellaneous:								
Abalone meat and shells			124, 210	3, 234			124, 210	3, 234
Hair-seal pelts				660				660
Fur-seal pelts						167, 526		167, 526
Sea-otter pelts						34, 950		34, 950
Whale oil					1, 542, 743	61, 053	1, 542, 743	61, 053
Whalebone					197, 339	937, 371	197, 339	937, 371
Cod sounds					600	42	600	42
Cod tongues					27, 500	1, 925	27, 500	1, 925
Total			124, 210	3, 894	1, 768, 182	1, 202, 867	1, 892, 392	1,206,761
Grand total	49, 905	1, 995	398, 253	13, 485	5, 784, 401	1, 306, 310	6, 232, 559	1,321,790

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1889.

Counties and apparatus of capture.	Anchovies, fresh.		Barracuda, fresh.		Barracuda, salted.		Bonito, fresh.		Bonito, salted.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
San Francisco	30,140	$600								
Gill nets and trammel nets:										
Monterey			28,056	$1,680						
San Diego			36,793	1,472			10,680	$427		
San Francisco	92,370	1,847								
Santa Barbara							20,675	1,033	2,615	$125
Total	92,370	1,847	64,849	3,152			31,355	1,460	2,615	125
Lines:										
Los Angeles			88,891	3,454						
Orange			2,000	80						
San Diego			121,000	4,840	36,423	$1,275	34,350	1,375	56,135	1,965
San Luis Obispo			25,116	875	1,000	50	1,500	75		
Santa Barbara			65,370	3,250	19,520	978	2,834	141		
Santa Cruz			5,000	240						
Ventura			10,862	490			10,580	405		
Total			318,239	13,229	56,943	2,303	49,264	1,996	56,135	1,965
Grand total	122,510	2,447	383,088	16,381	56,943	2,303	80,619	3,456	58,750	2,090

Counties and apparatus of capture.	Carp, fresh.		Cultus-cod, fresh.		Flounders, fresh.		Flounders, salted.		Herring, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Humboldt					125,450	$2,509			10,000	$200
Los Angeles					3,090	123			41,000	1,640
Marin					65,395	2,690			26,915	1,077
Orange					1,415	50			2,280	90
Sacramento	10,064	$353								
San Diego					5,050	202			18,150	725
San Francisco					224,106	8,964			386,541	11,596
Santa Barbara					3,540	172				
Sonoma					5,500	220				
Total	10,064	353			433,546	14,840			484,886	15,328
Gill nets and trammel nets:										
Los Angeles									4,000	160
Marin									53,835	2,153
Monterey					163,208	3,260				
San Diego									6,830	273
San Francisco			16,670	$667	449,499	18,053			1,159,624	34,789
Santa Cruz					22,650	906				
Total			16,670	667	635,357	22,219			1,224,289	37,375
Bag nets and paranzella nets:										
Contra Costa					256,692	3,850			192,519	2,888
Los Angeles					61,502	2,460			16,000	640
Marin					342,258	5,240			256,692	3,850
Monterey					61,710	1,235	47,500	$1,900		
Orange					2,874	100			2,365	80
San Diego					2,000	80				
San Francisco			15,100	604	513,400	7,700			306,060	5,940
San Luis Obispo					10,360	506				
San Mateo					748,883	11,403				
Santa Cruz					33,100	1,324				
Ventura					2,130	87				
Total			15,100	604	2,034,909	33,985	47,500	1,900	863,636	13,398
Fyke nets and minor nets:										
Contra Costa	11,914	357								
Sacramento	29,236	1,024								
Total	41,150	1,381								

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1889—Continued.

Counties and apparatus of capture.	Carp, fresh.		Cultus-cod, fresh.		Flounders, fresh.		Flounders, salted.		Herring, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Lines:										
Humboldt			21,040	$735	6,990	$630				
Los Angeles					113,230	4,529				
Monterey					53,572	1,070	20,380	$815		
Orange					1,192	45				
San Francisco			78,234	2,730	2,715	275				
San Luis Obispo					6,000	210				
Santa Barbara					4,235	213				
Santa Cruz					13,924	597				
Total			99,274	3,465	201,858	7,470	20,380	815		
Grand total	51,214	$1,734	131,044	4,736	3,305,670	78,523	67,880	2,715	2,572,811	$66,101

Counties and apparatus of capture.	Mackerel, fresh.		Perch, fresh.		Rockfish, fresh.		Rockfish, salted.		Sardines, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Humboldt			20,150	$504						
Los Angeles			10,200	408					15,756	$563
Marin			53,410	2,133						
Orange			1,000	40					2,000	80
Sacramento			972	59						
San Diego			16,193	648					7,000	280
San Francisco			197,125	9,856					1,070,000	21,400
Santa Barbara							1,200	$60		
Santa Cruz							3,215	211		
Total			299,050	13,648			4,415	271	1,094,756	22,323
Gill nets and trammel nets:										
Los Angeles	25,105	$1,004								
Marin			36,587	1,467						
Monterey	5,500	275			538,325	$10,767				
San Diego	3,000	120								
San Francisco					95,405	4,770				
Santa Barbara	2,583	125								
Santa Cruz	2,762	130			28,000	1,120				
Total	38,950	1,654	36,587	1,467	661,730	16,657				
Bag nets and paranzella nets:										
Los Angeles			7,000	280	13,988	559			2,641	106
Orange			1,320	52						
San Diego			6,582	265						
San Francisco					100,405	40,016				
Santa Cruz					35,250	1,410				
Ventura					5,380	216				
Total			14,902	597	155,023	6,201			2,641	106
Fyke nets and minor nets:										
Sacramento			3,310	196						
Lines:										
Humboldt					26,115	755				
Los Angeles	92,318	3,693			31,966	1,279				
Monterey	69,540	3,478			574,428	11,500	30,750	1,230		
Orange	3,000	120			6,000	240				
San Diego	7,030	281			35,000	1,400				
San Francisco					391,620	18,281				
San Luis Obispo	95,070	3,550			79,000	3,065	4,000	200		
Santa Barbara	2,262	115					3,388	165		
Santa Cruz	7,083	358			63,278	2,415				
Sonoma					3,375	135				
Ventura					4,831	192				
Total	276,303	11,595			1,215,613	39,262	38,138	1,595		
Grand total	315,253	13,249	353,849	15,908	2,032,366	62,120	42,553	1,866	1,097,397	22,429

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1889—Continued.

Counties and apparatus of capture.	Salmon, fresh.						Salmon, salted.	
	Chinook.		Silver.		Steelhead.		Silver.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Seines:								
Del Norte	105,458	$2,676	189,205	$3,543	48,750	$728	....	....
Humboldt	....	....	580,441	17,414	193,480	5,804	225,400	$8,916
Shasta	28,760	720	....	....	....	....	....	....
Tehama	118,145	2,955	....	....	....	....	....	....
Total	252,363	6,351	769,646	20,957	242,230	6,532	225,400	8,916
Gill nets and trammel nets:								
Contra Costa	3,195,747	127,830	....	....	....	....	....	....
Del Norte	113,417	3,402	....	....	....	....	....	....
Humboldt	....	....	596,074	19,869	198,691	3,974	210,200	8,408
Marin	25,000	1,000	....	....	....	....	....	....
Sacramento	151,540	10,607	....	....	....	....	....	....
San Francisco	1,003,503	40,140	....	....	....	....	....	....
Solano	1,973,400	78,936	....	....	....	....	....	....
Sonoma	26,810	1,610	....	....	....	....	....	....
Total	6,489,417	263,525	596,074	19,869	198,691	3,974	210,200	8,408
Lines:								
Monterey	10,098	606	....	....	....	....	....	....
Santa Cruz	13,552	610	....	....	....	....	....	....
Total	23,650	1,216	....	....	....	....	....	....
Grand total	6,765,430	271,092	1,365,720	40,826	440,921	10,506	435,600	17,324

Counties and apparatus of capture.	Sea bass, fresh.		Sea bass, salted.		Shad, fresh.		Smelt, fresh.		Striped bass, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Humboldt	....	....	....	....	300	$30	29,560	$738	....	....
Los Angeles	....	....	....	....	....	....	90,976	3,639	....	....
Marin	....	....	....	....	....	....	46,520	1,860	....	....
Orange	....	....	....	....	....	....	9,385	375	....	....
San Diego	....	....	....	....	....	....	9,000	360	....	....
San Francisco	....	....	....	....	....	....	139,978	5,599	....	....
Santa Barbara	....	....	....	....	....	....	3,380	168	....	....
Total	....	....	....	....	300	30	328,739	12,739	....	....
Gill nets and trammel nets:										
Contra Costa	....	....	....	....	96,722	3,869	....	....	13,776	$3,443
Los Angeles	2,777	$111	....	....	....	....	35,325	1,413	....	....
Marin	33,142	1,320	....	....	....	....	43,500	1,740	....	....
Monterey	....	....	....	....	....	....	83,258	3,330	....	....
Sacramento	....	....	....	....	13,224	793	....	....	....	....
San Diego	3,000	120	....	....	....	....	3,110	125	....	....
San Francisco	325,000	13,000	....	....	61,072	2,443	559,914	22,396	1,560	890
San Luis Obispo	52,180	1,820	2,500	$125	....	....	28,060	980	....	....
Santa Barbara	5,418	275	....	....	....	....	2,810	142	....	....
Santa Cruz	....	....	....	....	20,264	810	18,600	745	....	....
Solano	....	....	....	....	72,206	2,888	....	....	960	240
Total	421,517	16,646	2,500	125	263,488	10,803	774,577	30,871	16,296	4,073
Bag nets and paranzella nets:										
Contra Costa	....	....	....	....	....	....	130,012	2,070	....	....
Los Angeles	....	....	....	....	....	....	19,000	760	....	....
Marin	....	....	....	....	....	....	179,130	2,740	....	....
Orange	....	....	....	....	....	....	8,420	335	....	....
San Francisco	....	....	....	....	....	....	256,690	4,492	....	....
San Mateo	....	....	....	....	....	....	218,910	3,485	....	....
Total	....	....	....	....	....	....	812,162	13,882	....	....
Lines:										
Los Angeles	8,332	333	....	....	....	....	....	....	....	....
Orange	3,000	120	....	....	....	....	....	....	....	....
San Diego	8,748	350	....	....	....	....	....	....	....	....
Santa Barbara	6,490	320	....	....	....	....	....	....	....	....
Ventura	4,760	188	....	....	....	....	....	....	....	....
Total	31,330	1,311	....	....	....	....	....	....	....	....
Grand total	452,847	17,957	2,500	125	263,788	10,833	1,915,478	57,492	16,296	4,073

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1889—Continued.

Counties and apparatus of capture.	Sturgeon, fresh.		Yellow-tail, fresh.		Yellow-tail, salted.		Other fish, fresh and salted.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Del Norte									343, 413	$6, 947
Humboldt									1, 184, 721	36, 115
Los Angeles							16, 362	$654	177, 384	7, 027
Marin									192, 240	7, 670
Orange									16, 080	635
Sacramento							51, 087	1, 257	62, 123	1, 669
San Diego							17, 900	716	73, 293	2, 931
San Francisco							7, 075	406	2, 054, 965	58, 421
Santa Barbara			13, 280	$660	2, 750	$138	15, 432	750	39, 582	1, 948
Santa Cruz									3, 215	211
Shasta									28, 760	720
Sonoma									5, 500	220
Tehama									118, 145	2, 955
Total			13, 280	660	2. 750	138	107, 856	3, 783	4, 299, 421	127, 469
Gill nets and trammel nets:										
Contra Costa	262, 919	$7, 888					1, 620	65	3, 570, 784	143, 095
Del Norte									113, 417	3, 402
Humboldt									1, 004, 965	32, 251
Los Angeles									67, 207	2, 688
Marin	30, 240	1, 200							222, 304	8, 880
Monterey							12, 060	470	830, 407	19, 782
Sacramento	4, 886	293							169, 650	11, 693
San Diego							17, 409	693	80, 822	3, 230
San Francisco	18, 830	565					29, 921	935	3, 813, 368	139, 995
San Luis Obispo									82, 740	2, 925
Santa Barbara									34, 101	1, 700
Santa Cruz									92, 276	3, 711
Solano	174, 596	5, 238							2, 221, 162	87, 302
Sonoma									26, 810	1, 610
Total	491, 471	15, 184					61, 010	2, 163	12,330,013	462, 264
Bag nets and paranzella nets:										
Contra Costa							192, 622	2, 795	771, 845	11, 603
Los Angeles							33, 212	1, 328	153, 343	6, 133
Marin							248, 687	3, 572	1, 026, 767	15, 402
Monterey							7, 220	220	116, 430	3, 355
Orange									14, 979	567
San Diego									8, 582	345
San Francisco							441, 970	6, 679	1, 723, 625	20, 431
San Luis Obispo									10, 360	506
San Mateo							315, 665	4, 564	1, 283, 458	19, 452
Santa Cruz									68, 350	2, 734
Ventura							6, 733	262	14, 243	565
Total							1,246.109	19, 420	5, 191, 982	90, 093
Fyke nets and minor nets:										
Contra Costa							12, 022	361	23, 936	718
Sacramento							149, 639	3, 564	182, 185	4, 784
Total							161, 661	3, 925	206, 121	5, 502
Lines:										
Contra Costa	87, 401	2, 625							87, 491	2, 625
Humboldt									54, 145	2, 120
Los Angeles			30, 650	1, 226			12, 200	488	377, 587	15, 002
Monterey									758, 768	18, 690
Orange			5, 000	200			2, 000	80	22, 192	885
San Diego			36, 000	1, 440	53, 081	1, 858	28, 000	1, 120	415, 767	15, 904
San Francisco	56, 490	1, 695					80, 300	1, 657	609, 359	24, 638
San Luis Obispo									211, 686	8, 025
Santa Barbara			12, 116	605	2, 412	120	3, 955	198	122, 582	6, 105
Santa Cruz									102, 837	4, 130
Solano	58, 198	1, 746							58, 198	1, 746
Sonoma									3, 375	135
Ventura			4, 362	165					35, 395	1, 440
Total	202, 179	6, 066	88, 128	3, 036	55, 493	1, 978	126, 455	3, 543	2, 859, 382	101, 454
Grand total	693, 650	21, 250	101, 408	4, 296	58, 243	2. 116	1,703,091	32, 834	24,886,919	786, 782

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1890.

Counties and apparatus of capture.	Anchovies, fresh.		Barracuda, fresh.		Barracuda, salted.		Bonito, fresh.		Bonito, salted.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
San Francisco	33,750	$675								
Gill nets and trammel nets:										
Monterey			18,658	$1,120						
San Diego			31,020	1,241			7,260	$318		
San Francisco	101,250	2,025								
Santa Barbara							26,945	1,340	2,425	$115
Total	101,250	2,025	49,678	2,361			34,905	1,658	2,425	115
Lines:										
Los Angeles			142,414	5,697						
Orange			3,000	120						
San Diego			102,180	4,085	43,440	$1,520	27,080	1,083	67,785	2,373
San Luis Obispo			22,705	720					2,200	110
Santa Barbara			60,115	3,000			25,672	1,278	2,147	110
Santa Cruz			3,731	182						
Ventura			11,415	480			5,726	218		
Total			345,560	14,284	43,440	1,520	58,478	2,579	72,132	2,593
Grand total	135,000	2,700	395,238	16,645	43,440	1,520	93,383	4,237	74,557	2,708

Counties and apparatus of capture.	Carp, fresh.		Cultus-cod, fresh.		Flounders, fresh		Flounders, salted.		Herring, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Humboldt					156,509	$3,132			11,150	$223
Los Angeles					2,637	105			28,000	1,120
Marin					62,180	2,480			28,279	1,131
Orange					2,687	100			4,325	172
Sacramento	11,590	$406								
San Diego					4,263	170			14,000	560
San Francisco					208,370	8,335			485,860	7,288
Santa Barbara					2,813	141				
Sonoma					6,190	248				
Total	11,590	406			445,739	14,711			571,614	10,494
Gill nets and trammel nets:										
Los Angeles									2,500	100
Marin									56,572	2,262
Monterey					188,323	3,806			3,920	196
San Diego									6,000	240
San Francisco			27,538	$1,105	418,572	16,850			1,457,580	21,863
Santa Cruz					26,950	1,078				
Total			27,538	1,105	633,845	21,734			1,526,572	24,661
Bag nets and paranzella nets:										
Contra Costa					285,550	4,283			214,129	3,212
Los Angeles					129,929	5,197			17,500	700
Marin					378,800	5,782			284,100	4,261
Monterey					65,450	1,310	30,534	$1,222		
Orange					4,586	180			4,120	160
San Diego					1,815	73				
San Francisco			22,460	895	567,702	8,716			425,975	6,388
San Luis Obispo					7,040	352				
San Mateo					473,085	7,195			354,814	5,120
Santa Cruz					35,250	1,410				
Ventura					2,973	116				
Total			22,460	895	1,952,180	34,614	30,534	1,222	1,300,638	19,841
Fyke nets and minor nets:										
Contra Costa	12,209	366								
Sacramento	34,314	1,202								
Total	46,523	1,568								

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1890—Continued.

Counties and apparatus of capture.	Carp, fresh.		Cultus-cod, fresh.		Flounders, fresh.		Flounders, salted.		Herring, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Lines:										
Humboldt			20,280	$710	7,513	$675				
Los Angeles					55,017	2,201				
Monterey					57,632	1,152	13,115	$525		
Orange					1,725	70				
San Francisco			97,480	3,573	3,340	330				
San Luis Obispo					8,000	280				
Santa Barbara					3,485	170				
Santa Cruz					15,570	622				
Total			117,760	4,283	152,282	5,500	13,115	525		
Grand total	58,113	$1,974	167,758	6,283	3,184,046	76,559	43,649	1,747	3,398,824	$54,996

Counties and apparatus of capture.	Mackerel, fresh.		Perch, fresh.		Rockfish, fresh.		Rockfish, salted.		Sardines, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Humboldt			21,610	$539						
Los Angeles			7,200	288					19,765	$791
Marin			47,915	1,920						
Orange			2,172	80					5,035	200
Sacramento			1,373	83						
San Diego			12,320	493					5,000	200
San Francisco			248,108	12,405					1,280,000	19,200
Santa Barbara							1,087	$54		
Santa Cruz							3,000	150		
Total			340,698	15,808			4,087	204	1,309,800	20,391
Gill nets and trammel nets:										
Los Angeles	35,792	$1,431								
Marin			34,082	1,360						
Monterey					587,340	$11,747				
San Diego	2,680	107								
San Francisco					92,651	4,633				
Santa Barbara	1,463	70								
Santa Cruz	2,945	148			40,575	1,623				
Total	42,880	1,756	34,082	1,360	720,566	18,003				
Bag nets and paranzella nets:										
Los Angeles			12,790	512	17,434	697			5,000	200
Orange			2,917	110						
San Diego			5,710	228						
San Francisco					99,055	3,953				
Santa Cruz					46,825	1,873				
Ventura					7,750	310				
Total			21,417	850	171,064	6,833			5,000	200
Fyke nets and minor nets:										
Sacramento			4,232	255						
Lines:										
Humboldt					24,968	748				
Los Angeles	124,382	4,976			40,306	1,613				
Monterey	41,312	2,066			658,338	13,155	18,200	728		
Orange	6,000	240			15,000	600				
San Diego	5,510	220			30,000	1,200				
San Francisco					383,404	17,670				
San Luis Obispo	82,310	3,030			75,106	3,010	5,000	250		
Santa Barbara	1,620	80					3,429	172		
Santa Cruz	7,550	330			87,405	3,460				
Sonoma					4,515	180				
Ventura					7,316	290				
Total	268,684	10,942			1,326,358	41,926	26,629	1,150		
Grand total	311,564	12,698	400,429	18,273	2,217,988	66,762	30,716	1,354	1,314,800	20,591

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1890—Continued.

Counties and apparatus of capture.	Salmon, fresh.						Salmon, salted.	
	Chinook.		Silver.		Steelhead.		Silver.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Seines:								
Del Norte	149,666	$4,490	250,375	$4,227	51,875	$777		
Humboldt			460,272	15,343	153,423	3,068	91,342	$3,654
Shasta	25,825	646						
Tehama	125,860	3,147						
Total	301,351	8,283	710,647	19,570	205,298	3,845	91,342	3,654
Gill nets and trammel nets:								
Contra Costa	1,423,880	56,955						
Del Norte	195,584	5,867						
Humboldt			474,305	15,811	158,101	3,162	75,658	3,026
Marin	22,110	880						
Sacramento	145,540	10,188						
San Francisco	218,426	8,737						
Solano	1,030,580	41,223						
Sonoma	21,375	1,283						
Total	3,057,495	125,133	474,305	15,811	158,101	3,162	75,658	3,026
Lines:								
Montérey	8,770	526						
Santa Cruz	12,500	550						
Total	21,270	1,076						
Grand total	3,380,116	134,492	1,184,952	35,381	363,399	7,007	167,000	6,680

Counties and apparatus of capture.	Sea bass, fresh.		Sea bass, salted.		Shad, fresh.		Smelt, fresh.		Striped bass, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Humboldt					250	$25	28,160	$704		
Los Angeles							90,120	3,605		
Marin							42,060	1,680		
Orange							10,890	435		
San Diego							7,800	312		
San Francisco							141,730	5,669		
Santa Barbara							2,287	115		
Total					250	25	323,047	12,520		
Gill nets and trammel nets:										
Contra Costa					102,216	4,089			15,715	$3,143
Los Angeles			3,781	$151			42,640	1,701		
Marin	30,365	$1,200					41,230	1,640		
Monterey							107,184	4,287		
Sacramento					15,960	958			54	8
San Diego	2,915	119					2,286	91		
San Francisco	195,000	7,800			116,942	3,508	566,922	22,676	3,132	626
San Luis Obispo	50,315	1,750	2,800	140			25,115	875		
Santa Barbara	3,875	192					2,500	125		
Santa Cruz					24,880	995	21,437	860		
Solano					57,892	2,316			1,218	244
Total	282,470	11,061	6,581	291	317,890	11,866	809,314	32,255	20,119	4,021
Bag nets and paranzella nets:										
Contra Costa							148,760	2,231		
Los Angeles							49,500	1,980		
Marin							195,400	2,930		
Orange							9,825	393		
San Francisco							293,951	5,142		
San Mateo							243,802	3,855		
Total							941,238	16,531		
Lines:										
Los Angeles	14,344	574								
Orange	5,000	200								
San Diego	8,050	321								
Santa Barbara	4,710	226								
Ventura	4,507	178								
Total	36,611	1,499								
Grand total	319,081	12,560	6,581	291	318,140	11,891	2,073,599	61,306	20,119	4,021

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1890—Continued.

Counties and apparatus of capture.	Sturgeon, fresh.		Yellow-tail, fresh.		Yellow-tail, salted.		Other fish, fresh and salted.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Del Norte									451,916	$9,494
Humboldt									922,806	26,688
Los Angeles							19,155	$767	166,877	6,676
Marin									180,434	7,211
Orange									25,109	987
Sacramento							53,542	1,310	66,505	1,799
San Diego							15,595	624	58,978	2,359
San Francisco							6,860	363	2,404,678	53,935
Santa Barbara			15,778	$790	2,800	$140	11,060	500	35,825	1,740
Santa Cruz									3,000	150
Shasta									25,825	646
Sonoma									6,190	248
Tehama									125,860	3,147
Total			15,778	790	2,800	140	106,212	3,564	4,474,003	115,080
Gill nets and trammel nets:										
Contra Costa	195,695	$5,871					280	11	1,737,780	70,069
Del Norte									195,584	5,867
Humboldt									708,064	21,999
Los Angeles									84,713	3,383
Marin	38,170	1,520							222,529	8,862
Monterey							16,121	623	921,546	21,779
Sacramento	3,860	232							165,414	11,386
San Diego							15,615	625	68,476	2,741
San Francisco	16,277	488					48,572	1,140	3,262,862	91,451
San Luis Obispo									78,230	2,765
Santa Barbara									37,208	1,842
Santa Cruz									116,787	4,704
Solano	202,443	6,074							1,292,133	49,857
Sonoma									21,375	1,283
Total	456,445	14,185					80,588	2,399	8,912,707	297,988
Bag nets and paranzella nets:										
Contra Costa							208,196	3,065	856,635	12,791
Los Angeles							69,322	2,773	301,475	12,059
Marin							278,100	4,078	1,136,400	17,051
Monterey							8,375	258	104,359	2,790
Orange									21,448	843
San Diego									7,525	301
San Francisco							470,638	6,834	1,879,781	31,928
San Luis Obispo									7,040	352
San Mateo							347,554	5,142	1,419,255	21,312
Santa Cruz									82,075	3,283
Ventura			4,700	185			2,346	77	17,769	688
Total			4,700	185			1,384,531	22,227	5,833,762	103,398
Fyke nets and minor nets:										
Contra Costa							12,683	380	24,892	746
Sacramento							159,087	3,813	197,633	5,270
Total							171,770	4,193	222,525	6,016
Lines:										
Contra Costa	39,827	1,195							39,827	1,195
Humboldt									52,761	2,133
Los Angeles			38,260	1,530			19,200	768	433,923	17,359
Monterey									797,367	18,152
Orange			10,000	400			2,000	80	42,725	1,710
San Diego			24,000	960	62,535	2,189	20,000	800	390,580	14,751
San Francisco	48,833	1,465					93,600	1,416	626,657	24,448
San Luis Obispo									195,321	7,400
Santa Barbara			14,565	742	2,593	128	3,670	175	122,006	6,081
Santa Cruz									126,756	5,144
Solano	67,480	2,024							67,480	2,024
Sonoma									4,515	180
Ventura			5,280	210					34,244	1,376
Total	156,140	4,684	92,105	3,842	65,128	2,317	138,470	3,233	2,934,162	101,953
Grand total	612,585	18,869	112,583	4,817	67,928	2,457	1,881,571	35,616	22,377,159	624,435

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1891.

Counties and apparatus of capture.	Anchovies, fresh.		Barracuda, fresh.		Barracuda, salted.		Bonito, fresh.		Bonito, salted.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
San Francisco	36,250	$483								
Gill nets and trammel nets:										
Monterey			13,235	$785						
San Diego			53,820	2,153			13,950	$548		
San Francisco	108,750	1,631								
Santa Barbara							20,032	1,000	1,685	$80
Total	108,750	1,631	67,055	2,938			33,982	1,548	1,685	80
Lines:										
Los Angeles			207,901	6,346						
Orange			2,000	80						
San Diego			175,935	7,035	42,578	$1,490	45,950	1,838	67,549	2,371
San Luis Obispo			49,800	1,750	5,500	275			1,000	50
Santa Barbara			58,000	2,900			20,160	1,000	2,016	100
Santa Cruz			4,350	212						
Ventura			8,010	372			6,318	240		
Total			506,596	18,695	48,078	1,765	72,428	3,078	70,565	2,521
Grand total	145,000	2,114	573,651	21,633	48,078	1,765	106,410	4,626	72,250	2,601

Counties and apparatus of capture.	Carp, fresh.		Cultus-cod, fresh.		Flounders, fresh.		Flounders, salted.		Herring, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Humboldt					142,373	$2,847			12,000	$240
Los Angeles					4,326	173			45,000	1,800
Marin					40,275	1,600			16,567	663
Orange					1,815	70			3,062	120
Sacramento	11,267	$394								
San Diego					3,522	142			25,640	1,026
San Francisco					143,420	5,737			591,716	5,920
Santa Barbara					3,110	153				
Sonoma					4,900	196				
Total	11,267	394			343,741	10,918			693,985	9,769
Gill nets and trammel nets:										
Los Angeles									3,500	140
Marin									33,134	1,325
Monterey					138,172	2,763				
San Diego									9,590	384
San Francisco			32,870	$1,315	288,840	11,674			1,775,150	17,760
Santa Cruz					21,900	876				
Total			32,870	1,315	448,912	15,313			1,821,374	19,609
Bag nets and paranzella nets:										
Contra Costa					270,840	4,063			203,130	3,145
Los Angeles					73,231	2,929			19,500	780
Marin					361,120	5,417			270,840	4,062
Monterey					30,185	605	28,579	$1,144		
Orange					3,530	132			3,430	135
San Diego					1,537	61				
San Francisco			30,740	1,230	541,679	8,226			406,260	6,094
San Luis Obispo					11,216	595				
San Mateo					451,400	6,871			338,550	4,977
Santa Cruz					34,625	1,385				
Ventura					3,896	155				
Total			30,740	1,230	1,783,259	30,439	28,579	1,144	1,241,716	19,193
Fyke and minor nets:										
Contra Costa	14,188	426								
Sacramento	34,163	1,196								
Total	48,351	1,622								

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1891—Continued.

Counties and apparatus of capture.	Carp, fresh.		Cultus-cod, fresh.		Flounders, fresh.		Flounders, salted.		Herring, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Lines:										
Humboldt	......	......	24,118	$840	8,645	$770	......	......	......	......
Los Angeles	......	......	......	......	80,253	3,210	......	......	......	......
Monterey	......	......	......	......	22,153	442	12,492	$500	......	......
Orange	......	......	......	......	1,365	55	......	......	......	......
San Francisco	......	......	125,890	4,254	4,000	400	......	......	......	......
San Luis Obispo	......	......	......	......	10,130	360	......	......	......	......
Santa Barbara	......	......	......	......	3,900	195	......	......	......	......
Santa Cruz	......	......	......	......	14,626	585	......	......	......	......
Total	......	......	150,008	5,094	145,072	6,017	12,492	500	......	......
Grand total	59,618	$2,016	213,618	7,639	2,720,984	62,687	41,071	1,644	3,757,075	$48,571

Counties and apparatus of capture.	Mackerel, fresh.		Perch, fresh.		Rockfish, fresh.		Rockfish, salted.		Sardines, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Humboldt	......	......	23,625	$690	......	......	......	......	......	......
Los Angeles	......	......	7,915	317	......	......	......	......	62,007	$1,166
Marin	......	......	30,118	1,200	......	......	......	......	......	......
Orange	......	......	1,500	60	......	......	......	......	3,561	142
Sacramento	......	......	1,076	65	......	......	......	......	......	......
San Diego	......	......	17,518	70[illegible]	......	......	......	......	8,000	320
San Francisco	......	......	189,420	5,683	......	......	......	......	860,000	17,200
Santa Barbara	......	......	......	......	......	......	779	$49	......	......
Santa Cruz	......	......	......	......	......	......	5,130	257	......	......
Total	......	......	271,172	8,716	......	......	5,909	306	933,568	18,828
Gill nets and trammel nets:										
Los Angeles	78,117	$3,124	......	......	......	......	......	......	......	......
Marin	......	......	24,890	1,000	......	......	......	......	......	......
Monterey	2,800	140	......	......	362,716	$7,255	......	......	......	......
San Diego	3,970	159	......	......	......	......	......	......	......	......
San Francisco	......	......	......	......	88,873	3,555	......	......	......	......
Santa Barbara	3,225	162	......	......	......	......	......	......	......	......
Santa Cruz	3,590	175	......	......	41,750	1,670	......	......	......	......
Total	91,702	3,760	24,890	1,000	493,339	12,480	......	......	......	......
Bag nets and paranzella nets:										
Los Angeles	......	......	17,770	671	22,547	902	......	......	4,000	160
Orange	......	......	1,865	60	......	......	......	......	......	......
San Diego	......	......	6,250	250	......	......	......	......	......	......
San Francisco	......	......	......	......	97,873	3,915	......	......	......	......
Santa Cruz	......	......	......	......	49,830	1,990	......	......	......	......
Ventura	......	......	......	......	6,835	270	......	......	......	......
Total	......	......	25,891	981	177,085	7,077	......	......	4,000	160
Fyke and minor nets:										
Sacramento	......	......	3,477	209	......	......	......	......	......	......
Lines:										
Humboldt	......	......	......	......	34,472	1,034	......	......	......	......
Los Angeles	248,352	9,934	......	......	58,645	2,346	......	......	......	......
Monterey	29,934	1,497	......	......	395,862	7,917	19,472	760	......	......
Orange	3,000	120	......	......	7,000	280	......	......	......	......
San Diego	10,990	440	......	......	62,000	2,480	......	......	......	......
San Francisco	......	......	......	......	370,496	14,219	......	......	......	......
San Luis Obispo	122,890	4,560	......	......	129,720	4,970	1,500	75	......	......
Santa Barbara	2,750	135	......	......	......	......	2,338	117	......	......
Santa Cruz	9,265	417	......	......	91,504	3,605	......	......	......	......
Sonoma	......	......	......	......	4,264	171	......	......	......	......
Ventura	......	......	......	......	6,425	256	......	......	......	......
Total	427,181	17,103	......	......	1,160,388	37,278	23,310	952	......	......
Grand total	518,883	20,863	325,430	10,906	1,830,812	56,835	29,219	1,258	937,568	18,988

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1891—Continued.

Counties and apparatus of capture.	Salmon, fresh.						Salmon, salted.	
	Chinook.		Silver.		Steelhead.		Silver.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Seines:								
Del Norte	114,890	$3,446	182,500	$4,818	18,750	$280		
Humboldt			442,166	14,739	147,388	2,948	66,384	$2,465
Shasta	29,110	730						
Tehama	115,623	2,890						
Total	259,623	7,066	624,666	19,557	166,138	3,228	66,384	2,465
Gill nets and trammel nets:								
Contra Costa	594,006	23,760						
Del Norte	193,860	5,816						
Humboldt			448,780	14,959	149,593	2,992	49,816	1,983
Marin	15,035	600						
Sacramento	76,112	5,328						
San Francisco	448,322	17,933						
Solano	694,181	27,767						
Sonoma	36,656	2,199						
Total	2,058,172	83,403	448,780	14,959	149,593	2,992	49,816	1,983
Lines:								
Monterey	7,990	480						
Santa Cruz	15,260	690						
Total	23,250	1,170						
Grand total	2,341,045	91,639	1,073,446	34,516	315,731	6,220	116,200	4,448

Counties and apparatus of capture.	Sea bass, fresh.		Sea bass, salted.		Shad, fresh.		Smelt, fresh.		Striped bass, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Humboldt					160	$16	32,000	$800		
Los Angeles							68,974	2,760		
Marin							28,310	1,120		
Orange							9,470	378		
San Diego							12,000	480		
San Francisco							170,971	6,839		
Santa Barbara							3,790	188		
Total					160	16	325,515	12,565		
Gill nets and trammel nets:										
Contra Costa					108,011	4,320			23,932	$3,590
Los Angeles			4,301	$172			45,491	1,819		
Marin	15,482	$610					27,220	1,080		
Monterey							76,985	3,080		
Sacramento					17,516	1,051			157	24
San Diego	3,360	135					3,735	150		
San Francisco	220,410	6,710			230,460	6,014	683,884	27,355	4,320	648
San Luis Obispo	88,970	3,110	17,000	850			19,930	687		
Santa Barbara	4,880	245					4,000	200		
Santa Cruz					30,120	1,205	25,661	1,226		
Solano					58,739	2,350			2,265	340
Total	333,102	10,810	21,301	1,022	444,846	15,840	886,906	35,597	30,674	4,602
Bag nets and paranzella nets:										
Contra Costa							141,420	2,167		
Los Angeles							61,500	2,460		
Marin							186,560	2,848		
Orange							8,645	346		
San Francisco							280,838	4,920		
San Mateo							234,700	3,720		
Total							913,663	16,461		
Lines:										
Los Angeles	18,206	728								
Orange	3,000	120								
San Diego	9,000	360								
Santa Barbara	4,135	206								
Ventura	4,815	190								
Total	39,156	1,604								
Grand total	372,258	12,414	21,301	1,022	445,006	15,856	2,126,084	64,623	30,674	4,602

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1891—Continued.

Counties and apparatus of capture.	Sturgeon, fresh.		Yellow-tail, fresh.		Yellow-tail, salted.		Other fish, fresh and salted.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Del Norte									316, 140	$8, 544
Humboldt									866. 096	24, 745
Los Angeles							20, 323	$1, 081	208, 545	7, 297
Marin									115, 270	4, 583
Orange									19, 408	770
Sacramento							57, 587	1, 415	69, 930	1, 874
San Diego							21, 587	862	88, 267	3, 531
San Francisco							9, 280	464	2, 001, 057	42, 326
Santa Barbara			10, 805	$540	2, 500	$125	12, 220	600	33, 204	1, 655
Santa Cruz									5, 130	257
Shasta									29, 110	730
Sonoma									4, 900	196
Tehama									115, 623	2, 890
Total			10, 805	540	2, 500	125	120, 997	4, 422	3, 872, 680	99, 398
Gill nets and trammel nets:										
Contra Costa	213. 625	$6, 409					915	37	940, 489	38, 116
Del Norte									193. 860	5, 816
Humboldt									648, 189	19, 934
Los Angeles									131, 409	5, 255
Marin	15, 946	630							131, 707	5, 245
Monterey							11, 810	455	605, 718	14, 478
Sacramento	3, 250	195							97, 035	6, 598
San Diego							21, 228	845	109, 653	4, 374
San Francisco	18, 137	545					43, 970	1, 062	3, 943, 986	97, 102
San Luis Obispo									125, 900	4, 647
Santa Barbara									33, 822	1, 687
Santa Cruz									123, 021	5, 152
Solano	274, 785	8, 243							1, 029, 970	38, 700
Sonoma									36, 656	2, 199
Total	525, 743	16, 022					77, 923	2, 399	8, 151, 415	249, 303
Bag nets and paranzella nets:										
Contra Costa							197, 882	2, 935	813, 272	12, 310
Los Angeles							76, 325	3, 053	274, 879	10, 955
Marin							264. 840	3, 924	1, 083, 360	16, 251
Monterey							5, 110	155	63, 874	1, 904
Orange									17, 476	673
San Diego									7, 787	311
San Francisco							440, 031	6, 201	1, 797, 421	30, 586
San Luis Obispo									11, 216	595
San Mateo							329, 120	4, 745	1, 353, 770	20, 313
Santa Cruz									84. 455	3, 375
Ventura			4, 256	150			2. 730	108	17, 717	683
Total			4, 256	150			1,316,038	21, 121	5, 525, 227	97, 956
Fyke and minor nets:										
Contra Costa							15, 013	450	29, 201	876
Sacramento							170, 858	4, 151	208, 498	5, 556
Total							185. 871	4, 601	237, 699	6, 432
Lines:										
Contra Costa	56, 100	1, 683							56, 100	1, 683
Humboldt									67, 235	2, 644
Los Angeles			65, 190	2, 608			22. 302	892	700, 849	26, 064
Monterey									487, 903	11, 596
Orange			5, 000	200			2, 000	80	23, 365	935
San Diego			59, 000	2, 360	63, 461	2, 230	41, 815	1, 673	578, 278	22, 277
San Francisco	54, 113	1, 760					84, 492	1. 140	638, 991	21, 773
San Luis Obispo									320, 540	12, 040
Santa Barbara			9, 210	460	2. 132	106	4, 864	242	109, 805	5, 461
Santa Cruz									135, 005	5, 509
Solano	91, 595	2, 748							91, 595	2, 748
Sonoma									4, 264	171
Ventura			5, 020	173					31, 188	1, 231
Total	201, 808	6, 191	143, 420	5. 801	65. 593	2, 336	155, 473	4, 027	3, 244, 818	114, 132
Grand total	727, 551	22, 213	158, 481	6, 491	68, 093	2, 461	1,856,302	36, 570	21,031,839	567, 221

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1892.

Counties and apparatus of capture.	Anchovies, fresh.		Barracuda, fresh.		Barracuda, salted.		Bonito, fresh		Bonito, salted.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
San Francisco	39,053	$390								
Gill nets and trammel nets:										
San Diego			47,190	$1,886			13,525	$540		
San Francisco	111,122	1,112								
Santa Barbara							9,200	460	440	$22
Total	111,122	1,112	47,190	1,886			22,725	1,000	440	22
Lines:										
Los Angeles			254,433	5,345						
San Diego			152,570	6,110	41,104	$1,440	38,475	1,460	74,664	2,690
San Luis Obispo			7,500	263						
Santa Barbara			72,000	3,600			10,800	540	560	28
Ventura			11,000	440			7,110	280		
Total			497,503	15,758	41,104	1,440	54,385	2,280	75,224	2,718
Grand total	150,175	1,502	544,693	17,644	41,104	1,440	77,110	3,280	75,664	2,740

Counties and apparatus of capture.	Carp, fresh.		Cultus-cod, fresh.		Flounders, fresh.		Flounders, salted.		Herring, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Humboldt					145,873	$2,917			13,000	$260
Los Angeles					2,529	101			25,000	1,000
Marin					38,000	1,520			9,946	398
Orange					2,380	95			3,745	150
Sacramento	9,915	$347								
San Diego					2,070	82			36,940	1,478
San Francisco					98,105	2,943			719,209	7,192
Santa Barbara					2,510	125				
Sonoma					5,187	210				
Total	9,915	347			296,654	7,993			807,840	10,478
Gill nets and trammel nets:										
Los Angeles									2,000	80
Marin									25,470	1,019
Monterey					123,360	2,468				
San Diego									13,060	522
San Francisco			34,000	$1,020	192,695	5,956			2,257,180	22,572
Santa Cruz					17,845	714				
Total			34,000	1,020	333,900	9,138			2,297,710	24,193
Bag nets and paranzella nets:										
Contra Costa					303,350	4,550			227,515	3,412
Los Angeles					99,804	3,903			14,000	560
Marin					404,468	6,067			303,350	4,550
Monterey					34,990	700	30,167	$1,207		
Orange					5,782	230			2,255	90
San Diego					890	35				
San Francisco			36,170	1,085	606,703	9,110			455,027	6,825
San Luis Obispo					9,000	450				
San Mateo					505,585	7,585			379,190	5,688
Santa Cruz					33,520	1,341				
Ventura					3,000	120				
Total			36,170	1,085	2,007,092	34,181	30,167	1,207	1,381,337	21,125
Fyke nets and minor nets:										
Contra Costa	21,342	$640								
Sacramento	34,405	1,204								
Total	55,747	1,844								

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1892—Continued.

Counties and apparatus of capture.	Carp, fresh.		Cultus-cod, fresh.		Flounders, fresh.		Flounders, salted.		Herring, fresh.	
	Lbs	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Lines:										
Humboldt			30,000	$1,050	15,000	$1,350				
Los Angeles					54,215	2,168				
Monterey					31,470	628	13,670	$547		
Orange					2,960	115				
San Francisco			130,500	3,915	5,515	551				
San Luis Obispo					2,110	75				
Santa Barbara					3,090	200				
Santa Cruz					19,950	798				
Total			160,500	4,965	135,210	5,885	13,670	547		
Grand total	65,662	$2,191	230,670	7,070	2,772,856	57,197	43,837	1,754	4,486,887	$55,796

Counties and apparatus of capture.	Mackerel, fresh.		Perch, fresh.		Rockfish, fresh.		Rockfish, salted.		Sardines, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Humboldt			28,500	$560						
Los Angeles			7,114	285					36,864	$654
Marin			28,525	1,141						
Orange			4,000	160					5,000	200
Sacramento			1,114	67						
San Diego			14,725	589					3,000	120
San Francisco			201,108	6,033					703,130	14,063
Santa Barbara							275	$14		
Santa Cruz							2,620	131		
Total			285,086	8,835			2,895	145	747,994	15,037
Gill nets and trammel nets:										
Los Angeles	67,350	$2,693								
Marin			21,475	859						
Monterey	125	6			356,860	$7,137				
San Diego	1,020	41								
San Francisco					84,703	2,541				
Santa Barbara	3,080	154								
Santa Cruz	2,483	125			43,055	1,723				
Total	74,058	3,019	21,475	859	484,618	11,401				
Bag nets and paranzella nets:										
Los Angeles			17,727	709	11,938	477			5,000	200
Orange			1,000	40						
San Diego			5,275	211						
San Francisco					91,103	2,733				
Santa Cruz					45,270	1,811				
Ventura					7,780	311				
Total			24,002	960	156,091	5,332			5,000	200
Fyke nets and minor nets:										
Sacramento			4,554	273						
Lines:										
Humboldt					50,000	1,500				
Los Angeles	210,052	8,403			45,817	1,833				
Monterey	6,084	280			368,520	7,369	18,580	743		
Orange					4,320	173				
San Diego	3,750	150			50,000	2,000				
San Francisco					351,614	10,548				
San Luis Obispo	11,300	456			98,240	3,865	6,500	325		
Santa Barbara	2,420	121					275	13		
Santa Cruz	6,300	274			83,895	3,350				
Sonoma					3,700	148				
Ventura					6,220	249				
Total	239,906	9,684			1,062,326	31,041	25,355	1,081		
Grand total	313,964	12,703	335,117	10,927	1,703,035	47,774	28,250	1,226	752,994	15,237

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1892—Continued.

Counties and apparatus of capture.	Salmon, fresh.						Salmon, salted.	
	Chinook.		Silver.		Steelhead.		Silver.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Seines:								
Del Norte	49,563	$1,067	99,124	$1,534	49,563	$867		
Humboldt			388,050	12,935	129,350	2,587	21,630	$865
Shasta	31,445	785						
Tehama	128,389	3,210						
Total	209,397	5,062	487,174	14,469	178,913	3,454	21,630	865
Gill nets and trammel nets:								
Contra Costa	1,037,331	41,493						
Del Norte	84,000	2,520						
Humboldt			394,588	13,163	131,529	2,630	17,370	695
Marin	12,000	480						
Sacramento	81,112	5,678						
San Francisco	1,122,928	44,917						
Solano	944,507	38,220						
Sonoma	28,839	1,730						
Total	3,310,717	135,038	394,588	13,163	131,529	2,630	17,370	695
Lines:								
Monterey	6,915	415						
Santa Cruz	14,175	640						
Total	21,090	1,055						
Grand total	3,541,204	141,155	881,762	27,632	310,442	6,084	39,000	1,569

Counties and apparatus of capture.	Sea bass, fresh.		Sea bass, salted.		Shad, fresh.		Smelt, fresh.		Striped bass, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Humboldt					100	$10	42,250	$1,056		
Los Angeles							75,323	3,013		
Marin							24,500	980		
Orange							11,921	477		
San Diego							13,645	546		
San Francisco							112,470	4,500		
Santa Barbara							4,260	213		
Total					100	10	284,869	10,785		
Gill nets and trammel nets:										
Contra Costa					139,364	4,181			38,947	$4,674
Los Angeles	2,553	$102					51,107	2,044		
Marin	13,000	520					25,500	1,020		
Monterey							74,868	2,995		
Sacramento					21,579	1,295			199	30
San Diego	2,375	95					4,355	174		
San Francisco	135,350	5,414			242,749	4,855	433,747	17,348	13,153	1,315
San Luis Obispo	61,650	1,808	500	$25			5,300	186		
Santa Barbara	7,640	372					3,740	187		
Santa Cruz					35,000	1,400	52,322	2,090		
Solano					87,702	2,631			3,910	469
Total	222,568	8,311	500	25	526,394	14,362	650,930	26,044	56,209	6,488
Bag nets and paranzella nets:										
Contra Costa							151,675	2,275		
Los Angeles							61,000	2,440		
Marin							202,065	3,035		
Orange							13,700	548		
San Francisco							303,351	4,550		
San Mateo							252,795	3,792		
Total							984,586	16,640		
Lines:										
Los Angeles	16,659	666								
San Diego	7,625	305								
Santa Barbara	6,360	328								
Ventura			4,000	160						
Total	30,644	1,299	4,000	160						
Grand total	253,212	9,610	4,500	185	526,494	14,372	1,919,894	53,469	56,209	6,488

Table showing by counties and apparatus of capture the yield of food-fishes in the shore or boat fisheries of California in 1892—Continued.

Counties and appatraus of capture.	Sturgeon, fresh.		Yellow-tail, fresh.		Yellow-tail, salted.		Other fish, fresh and salted.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Del Norte	......	......	......	......	......	......	......	......	198, 250	$3, 468
Humboldt	......	......	......	......	......	......	......	......	768, 753	21, 190
Los Angeles	......	......	......	......	......	......	14, 174	$684	161, 004	6, 737
Marin	......	......	......	......	......	......	......	......	100, 971	4, 039
Orange	......	......	......	......	......	......	......	......	27, 046	1, 082
Sacramento	......	......	......	......	......	......	63, 168	1, 447	74, 197	1, 861
San Diego	......	......	......	......	......	......	18, 150	725	88, 530	3, 540
San Francisco	......	......	......	......	......	......	15, 550	547	1, 887, 625	35, 668
Santa Barbara	......	......	18, 620	$931	800	$40	16, 000	800	42, 465	2, 123
Santa Cruz	......	......	......	......	......	......	......	......	2, 620	131
Shasta	......	......	......	......	......	......	......	......	31, 445	785
Sonoma	......	......	......	......	......	......	......	......	5, 187	210
Tehama	......	......	......	......	......	......	......	......	128, 389	3, 210
Total	......	......	18, 620	931	800	40	126, 042	4, 203	3, 516, 482	83, 044
Gill nets and trammel nets:										
Contra Costa	274, 575	$8, 237	......	......	......	......	1, 080	43	1, 491, 297	58, 628
Del Norte	......	......	......	......	......	......	......	......	84, 000	2, 520
Humboldt	......	......	......	......	......	......	......	......	543, 487	16, 488
Los Angeles	......	......	......	......	......	......	......	......	123, 010	4, 919
Marin	20, 000	800	......	......	......	......	......	......	117, 445	4, 698
Monterey	......	......	......	......	......	......	9, 638	382	564, 851	12, 988
Sacramento	3, 820	229	......	......	......	......	......	......	106, 710	7, 232
San Diego	......	......	......	......	......	......	14, 850	595	96, 375	3, 853
San Francisco	18, 840	565	......	......	......	......	39, 665	1, 012	4, 686, 132	108, 627
San Luis Obispo	......	......	......	......	......	......	......	......	67, 450	2, 019
Santa Barbara	......	......	......	......	......	......	......	......	24, 100	1, 195
Santa Cruz	......	......	......	......	......	......	......	......	150, 705	6, 052
Solano	217, 637	6, 529	......	......	......	......	......	......	1, 253, 756	47, 849
Sonoma	......	......	......	......	......	......	......	......	28, 839	1, 730
Total	534, 872	16, 360	......	......	......	......	65, 233	2, 032	9, 338, 157	278, 798
Bag nets and paranzella nets:										
Contra Costa	......	......	......	......	......	......	228, 185	3, 443	910, 725	13, 680
Los Angeles	......	......	......	......	......	......	73, 815	2, 954	283, 314	11, 333
Marin	......	......	......	......	......	......	303, 519	4, 650	1, 213, 402	18, 302
Monterey	......	......	......	......	......	......	4, 420	125	69, 577	2, 032
Orange	......	......	......	......	......	......	......	......	22, 737	908
San Diego	......	......	......	......	......	......	......	......	26, 165	246
San Francisco	......	......	......	......	......	......	508, 657	8, 123	2, 001, 011	32, 426
San Luis Obispo	......	......	......	......	......	......	......	......	9, 000	450
San Mateo	......	......	......	......	......	......	379, 185	5, 686	1, 516, 755	22, 751
Santa Cruz	......	......	......	......	......	......	......	......	78, 790	3, 152
Ventura	......	......	3, 170	127	......	......	2, 000	80	15, 950	638
Total	......	......	3, 170	127	......	......	1, 499, 811	25, 061	6, 127, 426	105, 918
Fyke nets and minor nets:										
Contra Costa	......	......	......	......	......	......	26, 205	786	47, 547	1, 426
Sacramento	......	......	......	......	......	......	180, 329	4, 355	219, 288	5, 832
Total	......	......	......	......	......	......	206, 534	5, 141	266, 835	7, 258
Lines:										
Contra Costa	49, 280	1, 478	......	......	......	......	......	......	49, 280	1, 478
Humboldt	......	......	......	......	......	......	......	......	95, 000	3, 900
Los Angeles	......	......	59, 307	2, 372	......	......	23, 460	938	663, 943	21, 725
Monterey	......	......	......	......	......	......	......	......	445, 289	9, 982
Orange	......	......	3, 680	147	......	......	......	......	10, 960	435
San Diego	......	......	50, 000	2, 000	80, 632	2, 907	125, 925	5, 040	622, 745	24, 102
San Francisco	61, 320	1, 840	......	......	......	......	92, 715	1, 343	641, 664	18, 197
San Luis Obispo	......	......	......	......	......	......	......	......	125, 650	4, 984
Santa Barbara	......	......	16, 380	819	1, 000	50	3, 450	173	117, 235	5, 872
Santa Cruz	......	......	......	......	......	......	......	......	124, 320	5, 068
Solano	72, 545	2, 176	......	......	......	......	......	......	72, 545	2, 176
Sonoma	......	......	......	......	......	......	......	......	3, 700	148
Ventura	......	......	4, 830	193	......	......	......	......	33, 160	1, 322
Total	183, 145	5, 494	134, 197	5, 531	81, 632	2, 957	245, 550	7, 494	3, 005, 441	99, 389
Grand total	718, 017	21, 854	155, 987	6, 589	82, 432	2, 997	2,143,170	43, 931	22,254,341	574, 407

Table showing by counties the yield of crustaceans, mollusks, and reptiles, etc., in the shore or boat fisheries of California in 1889, 1890, 1891, and 1892.

Years and counties.	Crabs.		Shrimp and prawn.		Spiny lobsters.		Abalone meat and shells.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1889.								
Bag nets:								
Contra Costa			919,221	$41,769				
Marin			1,225,628	55,693				
San Francisco			1,845,221	84,559				
San Mateo			1,532,034	69,616				
Total			5,522,104	251,637				
Other apparatus:								
Humboldt	86,400	$3,000						
Los Angeles					108,000	$2,815	19,810	$452
Monterey							3,850	73
San Diego					48,158	1,203		
San Francisco	1,944,000	76,045					30,000	600
Santa Barbara					110,300	3,309	228,879	5,877
Total	2,030,400	79,045			266,458	7,327	282,539	7,002
1890.								
Bag nets:								
Contra Costa			967,947	43,983				
Marin			1,290,600	58,643				
San Francisco			1,941,055	88,894				
San Mateo			1,613,246	73,303				
Total			5,812,848	264,823				
Other apparatus:								
Humboldt	90,000	3,125						
Los Angeles					107,000	2,810	860	34
Monterey							4,400	83
San Diego					40,370	1,000		
San Francisco	2,000,000	80,000					28,000	560
Santa Barbara					130,940	3,928	114,933	3,942
Total	2,090,000	83,125			278,310	7,747	148,193	4,619
1891.								
Bag nets:								
Contra Costa			813,806	36,967				
Marin			1,085,175	49,289				
San Francisco			1,631,232	74,585				
San Mateo			1,356,345	61,610				
Total			4,886,558	222,451				
Other apparatus:								
Humboldt	98,100	3,406						
Los Angeles					102,125	2,688	5,135	86
Monterey							3,700	66
San Diego					25,000	625		
San Francisco	2,250,000	90,000					24,000	480
Santa Barbara					145,120	4,355	241,826	6,248
Total	2,348,100	93,406			272,245	7,668	274,661	6,880
1892.								
Bag nets:								
Contra Costa			885,010	40,105				
Marin			1,180,020	53,590				
San Francisco			1,770,025	80,389				
San Mateo			1,475,020	66,989				
Total			5,310,075	241,163				
Other apparatus:								
Humboldt	112,320	3,900						
Los Angeles					128,425	3,340	7,775	162
Monterey							4,180	85
San Diego					20,000	500		
San Francisco	2,750,000	99,000					30,000	590
Santa Barbara					154,850	4,646	238,463	5,280
Total	2,862,320	102,900			303,275	8,486	280,427	6,117

Table showing by counties the yield of crustaceans, mollusks, and reptiles, etc., in the shore or boat fisheries of California—Continued.

Years and counties.	Clams, hard.		Clams, soft.		Mussels.		Oysters.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1889.								
Humboldt	43,750	$937	10,800	$270				
Marin	32,060	690	11,100	109				
San Diego	420,000	3,000						
San Francisco	74,900	1,605	1,096,800	11,518	2,100,000	$8,750	12,369,000	$571,525
Total	570,710	6,232	1,118,700	11,897	2,100,000	8,750	12,369,000	571,525
1890.								
Humboldt	42,000	900	12,000	300				
Marin	30,450	655	10,080	101				
San Diego	350,000	2,500						
San Francisco	89,530	1,920	1,239,900	13,020	2,700,000	11,250	12,829,500	592,137
Total	511,980	5,975	1,261,980	13,421	2,700,000	11,250	12,829,500	592,137
1891.								
Humboldt	47,250	1,012	15,000	375				
Marin	28,700	615	10,380	106				
San Diego	280,000	2,000						
San Francisco	94,850	2,033	1,489,980	15,396	2,998,080	12,500	13,387,800	618,455
Total	450,800	5,660	1,515,360	15,877	2,998,080	12,500	13,387,800	618,455
1892.								
Humboldt	52,500	1,125	17,400	435				
Marin	33,110	720	11,040	110				
San Diego	252,000	1,800						
San Francisco	141,890	2,804	1,988,760	19,888	2,880,000	12,000	15,098,700	698,257
Total	479,500	6,449	2,017,200	20,433	2,880,000	12,000	15,098,700	698,257

Years and counties.	Octopus and squid.		Terrapin and frogs.		Hair-seal, sea-lion, and sea-otter pelts.		Whale and seal oil.		Algæ.	
	Lbs.	Value.	Lbs.	Value.	No.	Value.	Lbs.	Value.	Lbs.	Value.
1889.										
Los Angeles					215	$580	7,200	$288		
Marin			11,250	$3,000						
Monterey	468,000	$37,440							5,800	$232
San Francisco	15,000	750	30,000	2,400						
San Luis Obispo					78	195	33,210	1,107		
Santa Barbara					181	3,423	4,200	224	14,370	575
Total	483,000	38,190	41,250	5,400	474	4,198	44,610	1,619	20,170	807
1890.										
Los Angeles					83	225	4,800	192		
Marin			12,563	3,350						
Monterey	256,000	20,480							6,500	260
San Francisco	10,000	300	35,000	4,200						
San Luis Obispo					53	143	40,440	1,343		
Santa Barbara					199	2,527	4,800	256	22,845	914
Total	266,000	20,780	47,563	7,550	335	2,895	50,040	1,791	29,345	1,174
1891.										
Marin			12,262	3,270						
Monterey	300,760	23,960							7,780	310
San Francisco	8,000	240	37,500	4,500						
San Luis Obispo					133	359	41,940	1,403		
Santa Barbara					182	3,597	4,500	240	11,361	455
Total	308,760	24,200	49,762	7,770	315	3,956	46,440	1,643	19,141	765
1892.										
Los Angeles					121	330				
Marin			13,125	3,500						
Monterey	357,622	28,610							14,835	593
San Francisco	9,000	270	32,500	4,550						
San Luis Obispo					95	256	36,015	1,200		
Santa Barbara					85	2,221	2,150	112	13,490	540
Total	366,622	28,880	45,625	8,050	301	2,807	38,165	1,312	28,325	1,133

SAN DIEGO COUNTY.

As compared with the last investigation, the fisheries of the most southern county in California show considerable fluctuation. The decrease in the general building trade had called to other sections of the State a large number of men and their families, thus reducing the home demand for food-fish, and consequently curtailing the extent of the fisheries. Some attempts have recently been made to increase the domestic and foreign trade in fish, but these efforts were scarcely sufficient to retain the few fishermen employed. During 1892 a limited quantity of fresh fish was shipped as far east as Denver, Colo., and one carload, made up of crawfish (i. e., spiny lobsters), fresh fish, and salted fish, was sent to Chicago and Philadelphia in a refrigerator car. It was probably the first attempt to dispose of the abundant crawfish of the west coast in the markets east of the Rocky Mountains. At the time of this experiment the true lobsters were very scarce and of high price in the East, and the crawfish was regarded as a fair substitute and met with a ready sale at good prices.

The yield of the fisheries of this county is nearly equally divided between fish consumed in a fresh condition and those cured. The aggregate amount of fish proper taken in 1892 was somewhat less than in 1889, as may be seen from the following comparison:

Fish.	1889.	1892.
	Pounds.	*Pounds.*
Fresh	630,400	522,000
Cured	530,220	566,365
Total	1,160,620	1,088,365

Both the dry and pickle cured fish are largely exported to the Sandwich Islands. Five-eighths of the catch is taken by means of small vessels ranging in size from 7 to 15 tons. These vessels in most cases frequent grounds south of San Diego. Sometimes, if fish are not found nearer, they resort to grounds 100 miles from the home port. The crew usually consists of three men, who employ hand and troll lines. About three-eighths of the catch is obtained by small boats fishing nearer the shore. The shore fishermen go out in the morning and return the same evening, fishing along the coast some 10 to 15 miles south of San Diego, and about the same distance north from Point Loma, at the entrance to the harbor of San Diego.

Chinese junks were formerly much used by the Chinese fishermen of San Diego County. In 1888 thirteen of various sizes were engaged in fishing. Year by year the Chinese have been withdrawing from the business, deeming it too hazardous on account of the danger from seizure by the Mexican Government for illegal fishing, and the possibility of not being permitted to reenter the United States. The junk fishermen, sailing under no flag, have been obliged to pay alien port charges, which materially reduced the profits of the business. In a few cases the junks have been sold to American fishermen, the numbers by which they were known to the customs officials being supplanted by names. The junks used in San Diego County have declined from 13 used in 1888, 6 in 1889 and 1890, to 1 in 1893.

The shore fisheries of this county are carried on from small cat, sloop, or schooner rigged boats, carrying a crew of two men, who reside in San Diego and market their catch in that city. A small camp of Portuguese fishermen is found at La Playa, on the side of the bay opposite San Diego. These fishermen man their boats singly, and cure all of their catch, most of which is pickled for the Sandwich Islands trade. Of the quantity pickled, about three-fourths are albacore, one-eighth bonito, and one-eighth yellow-tail. The entire catch is taken by trolling. When fishing each boat uses four 15-fathom lines, each provided with a single hook. Just above the hook a decoy bait is fastened consisting of a piece of bone sometimes cut to resemble a small fish, but in most cases simply a narrow fragment without definite shape.

In the vessel fishery the same kinds of lines are employed, although eight instead of four are used by each craft. The lines are fished from the sides of the vessels, being rigged on poles in a manner similar to that employed in the mackerel fishery of the Atlantic coast many years ago.

In hand-lining the men use what may be designated a reverse trawl, not noticed elsewhere in the United States. The line is from 100 to 150 fathoms long and is provided with 25 to 50 hooks attached to gangings, which in turn are fastened to the main line at intervals of a foot apart, beginning at the bottom. The hooks are baited with either fresh or salted fish. Such lines are used from the sides of the vessels in from 15 to 100 fathoms of water. The fishermen seem pleased with this rig, and comment on its superiority over other forms of lines. Having dropped the line over the side of the vessel to the bottom, they have a string of baited hooks suspended that attract the fish much more effectively than would be the case with a single hook or a series of hooks arranged on the ordinary trawl. As soon as the line reaches the bottom the fishermen begin to draw it in and the fish follow it toward the surface. Often as many as half the hooks are found to have fish on them.

The fishermen report no scarcity of fish on the grounds adjacent to the Bay of San Diego, but few fish are now caught inside of the bay, where fine fishing was formerly enjoyed. The city sewage and the dumping of city refuse and garbage just outside of the harbor have, in the opinion of the fishermen, prevented the fish from entering the bay.

In September, 1891, an experimental shipment of 3,660 pounds of pickled fish was made to the Sandwich Islands. The fish met with such favor that the business rapidly increased, until in 1892 the fish so shipped amounted to 34,300 pounds. The largest part of the pickled fish consists of albacore, which are taken in abundance at all seasons of the year, and range in size from 30 to 70 pounds. The principal part of the catch is taken by trolling on the grounds some 10 miles southwest from Point Loma. The fish intended for the Sandwich

Islands trade are prepared as follows: After the removal of the head and viscera, the fish, without being split, are cut transversely into slices 1 to 1½ inches thick, which are thrown into vats of strong pickle, and after being throughly cured are packed into barrels and half-barrels for shipment.

Among the invertebrate products of the fisheries of this county the crawfish, or the spiny lobster, is most important. This crustacean occurs in great abundance and is taken in pots and drop nets of various kinds. The pots used by one firm of fishermen are unique in being made of iron, to better withstand the heavy swell and rough sea. Their general style is similar to the traps used by the lobster fishermen of Massachusetts. The frame is constructed of ⅜-inch gas-pipe, the body of galvanized-iron wire, twine being used at the ends in the construction of the funnels. These pots are 20 inches square and 4 feet long. It is claimed that they will emerge in good shape from usage that would totally destroy the ordinary lobster pots. They were first used during the winter of 1893.

The business of taking abalones continues of some importance. These mollusks appear to have increased to some extent during the past few years, owing to the discontinuance of the Chinese fisheries, the low prices received for shells and meat affording no inducement to white fishermen to undertake the business.

ORANGE COUNTY.

This is a county recently formed from parts of Los Angeles and other adjacent counties. The principal center is Newport, which was formerly included in Los Angeles County. The fisheries consist in the operations of a few fishermen located at Newport. The catch in 1892 amounted to about 75,000 pounds, which was hauled in teams to Santa Ana, and sent thence by express to Los Angeles.

LOS ANGELES COUNTY.

The fisheries of this county present few changes in methods compared with the conditions found in the previous investigation. There has, however, been quite an increase in the extent of the industry, and it is probable that the next few years will witness a still further augmentation. New and competing lines of railroad have been opened up, freight rates have been reduced, and new fishing stations have been established. The centers in this county from which commercial fishing is now prosecuted are Redondo Beach, Ballona, Santa Monica, Long Beach, San Pedro, and Wilmington.

Redondo Beach, located 22 miles from Los Angeles, was first reached by railroad in November, 1889. Previous to the construction of this road the few fishermen at this point sent their catch by teams to Los Angeles. A marked increase in the important fisheries has ensued since the establishment of rail communication with Los Angeles, the catch being 51,700 pounds in 1889, and 181,905 pounds in 1892. Fishing is here done by means of bag nets, gill nets, and hand lines, which are operated along the beach from small boats. There being no harbor of shelter, in stormy weather the boats and fishing gear are hauled high up on the beach. Fish are generally abundant and in large variety, and the fishermen have no difficulty in speedily filling their dories.

At Ballona, located 8 miles north of Redondo Beach, four American fishermen plied their vocation in 1889, 1890, and 1891, but abandoned the business the following year. The catch averaged about 30,000 pounds annually. Two other small fishing-camps are located 2½ and 6 miles, respectively, to the south of Redondo Beach.

The fishing business of Santa Monica is limited, the annual shipments and local consumption aggregating only 75,000 to 100,000 pounds.

From Long Beach 30,000 to 35,000 pounds of fresh fish are annually sent by express to Los Angeles by fishermen living at San Pedro and Wilmington, but taking their fish off Long Beach. San Pedro, with its safe harbor and good rail and steamboat facilities, as well as its nearness to the fishing-grounds, continues to be the chief fishing center in Los Angeles County. The fisheries have shown a steady increase, largely on account of reduced rates for railroad transportation.

Large shipments of fresh, pickled, and dry fish are sent from this point to San Francisco, Los Angeles, and other points. The total quantities of fishery products sent from this place during the four years ending 1892 were as follows:

Years.	Pounds.	Value.
1889	480,370	$17,938
1890	547,550	20,702
1891	505,385	19,276
1892	650,253	24,444

Wilmington, by virtue of its shipping advantages, is the second point of fishing importance in Los Angeles County. The quantities of fresh and salt products distributed from this point during the years named were as follows:

Years.	By express.	By freight.	By team.	Total.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1889	131,383	34,645	102,125	268,153
1890	129,100	18,548	110,415	258,083
1891	182,879	352,263	35,260	570,402
1892	69,451	223,045	20,350	312,846

The shipments by express and team consisted of fresh fish sent to Los Angeles. The shipments by freight were salt fish, abalones, and sea-lion pelts. In March, 1891, a firm located at this place began the extensive curing of fish. The business consisted chiefly in pickling mackerel and barracuda and in packing sardines in kegs and small packages. In March, 1892, the curing establishment was burned and not rebuilt, this fact accounting for the diminution in the catch of this county in 1892 as compared with 1891.

The quantities of cured fish shipped from Wilmington in the years 1889 to 1892, inclusive, were as follows:

Species.	1889.	1890.	1891.	1892.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Mackerel	9,023	9,059	175,229	109,457
Sardines	2,256	2,265	43,807	27,364
Barracuda	6,766	6,794	131,421	82,094
Total	18,045	18,118	350,458	218,915

Additional shipments of prepared products were as follows:

Products.	1889.	1890.	1891.	1892.
Abalone meat ... pounds..	3,170	430	435	
Abalone shells ... do...	12,400		1,375	
Sea-lion pelts ... do...	11,000			4,130
Sea-lion oil ... gallons..	960	640		

Los Angeles, the principal community in the county, has no fisheries, but is the chief distributing-point for fishery products caught in the waters of the county and consumed in many of the interior towns of southern California. Nearly all the fresh fish shipped from the different fishing stations of the county is sent by rail or team to the wholesale and retail dealers of Los Angeles. A somewhat unusual feature of the business is the contracting by the dealers for all the fish caught by the fishermen at a uniform price per pound, usually 4 cents, regardless of the different species. Dealers in Los Angeles are experimenting in the smoking, pickling, and canning of several of the desirable food-fishes found on the coast of the county. The barracuda have been smoked and pronounced by experts equal to finnan haddies, of which considerable quantities were previously imported from the East. The bull's-eye mackerel has been pickled to some extent; this is a very good food-fish in a fresh condition, but owing to the deficiency of fat in its flesh it does not make a satisfactory pickled fish.

Some sardines of excellent quality have been packed in oil, mustard, and other ways common to the trade. In the vicinity of San Pedro and Santa Catalina Island, sardines are, in their season, found in large quantities. During February, March, and April of each year small sardines are usually abundant and in fine condition for canning. In May and June the larger sardines arrive and appear to crowd out the fish of smaller size. In July and August the large fish withdraw and the small fish again become plentiful. Up to August the fish are generally in fine condition, but after that date at times the small fish are usually of poor quality for canning. The larger sardines found in this part of the State are somewhat smaller in size than those occurring in San Francisco Bay, being of the size most suitable for packing in half-pound cans in mustard and spices. There appears to be a bright future for the sardine industry in this county, and the expansion of the business may be confidently expected during the next few years.

VENTURA COUNTY.

Less than half a dozen fishermen, with headquarters at Ventura, represent the fishing industry of this county. Fish are abundant, and the fishing business could no doubt be largely increased with profit to the producer and benefit to the people of the interior, but at the present time the entire catch is used locally. A branch of the Southern Pacific Railroad connects Ventura with Los Angeles. Within comparatively few years this section of the State has rapidly developed and the valleys have been settled by farmers and fruit-growers.

SANTA BARBARA COUNTY.

The fisheries of this county are prosecuted from Santa Barbara and the adjacent islands, and present few new features as compared with 1888. The branches of the fishing industry here followed are the taking of the shore food-fishes, the hunting of sea otters and sea lions, and the utilization of abalones and algæ.

Fish are abundant at all seasons and the weather is mild and favorable for fishing throughout the year. The extent of the fisheries is, however, quite limited and does not to any extent represent the resources of the county. The few fishermen here, mainly Austrians and Chinese, make a good living with little exertion, carrying on their business only when the weather is perfect and they are so disposed. Most of the catch is consumed locally, the demand being considerable during the winter months, when thousands of visitors and tourists are found in this section. In summer but small quantities of fish are taken.

Three camps of fishermen and sea-lion hunters are located on the islands of Santa Cruz and Santa Rosa, the fishermen being Americans and Chinese. The former give attention to sea lions and sea otters, while the Chinese take most of the algæ and abalones, and prepare the dry fish which are exported.

Sea lions are taken at San Miguel and Flea Islands and on Richardson's Rock. They are hunted for their oil, which brings about 40 cents per gallon, and their hides, which are worth about 4 cents per pound. The skins are tanned and make serviceable leather. Many of the sea lions are of large size. Of late years there has been quite a demand for live specimens to be placed in public parks and gardens in some of the eastern cities, and a considerable number have also been shipped alive to Europe. In 1891, 34 sea lions, weighing 9,580 pounds, were shipped east from this county, and in the following year 17, weighing 6,470 pounds, were so disposed of. The sea lions sought for their oil and hides are killed by means of guns, while those captured alive are taken by throwing a lasso over their heads.

Six American fishermen in three boats hunt the sea otters around the islands of San Miguel, Santa Rosa, and San Nicholas. The number killed is quite small and the animals are growing scarcer each year. Thirty were taken in 1889, 20 in 1890, 12 in 1891, and 8 in 1892, the pelts having an average value to the hunters of $150.

Of late years abalones have been more abundant. The low price of shells which had for some time prevailed offered small inducement for even the frugal Chinese to take these mollusks, which consequently had an opportunity to increase. The Chinese gather from the rocks large quantities of algæ, which they dry, pack in bales, and export to China, where it is used in making soups. During 1892 13,490 pounds of dried algæ were shipped from Santa Barbara.

SAN LUIS OBISPO COUNTY.

Compared with the extent of the fisheries shown in the previous report the fishing industry of this county has undergone a slight increase, as gauged by the quantity and value of the products taken. Port Harford, with the steamboat and railroad connections, is the most important of the several fishing stations of the county, the others being located at Morro and Cazucos, 15 and 21 miles, respectively, north of Port Harford, and at San Simeon, a shore whaling station some 20 miles farther north.

The catch of food-fish in 1892 was unusually light, owing to scarcity of mackerel and barracuda; the catch of the former at Port Harford was 105,000 pounds in 1891 and only 7,300 pounds in 1892, the catch of barracuda falling off from 50,000 pounds to 750 pounds.

In close proximity to Port Harford are Pecho Rock and Lion Rock, which are favorite resorts for a large number of sea lions, which are hunted for their pelts and oil. The extent of this branch of the fisheries in the years 1890, 1891, and 1892 was as follows:

Years.	Sea lions killed.	Pelts.		Oil.	
		Pounds.	Value.	Gallons.	Value.
1890	53	3,577	$143	292	$73
1891	133	8,978	359	732	183
1892	95	6,412	256	522	130

The shore whale fishery, which was at one time carried on with considerable activity from a number of stations along the California coast, is now restricted to the limited operations of a few fishermen at San Simeon, at the northern end of this county. The results of the business during the past four years were as follows:

Years.	Whales killed.	Oil made.	
		Gallons.	Value.
1889	5	4,000	$1,000
1890	7	5,000	2,000
1891	7	5,000	2,000
1892	5	4,000	1,000

MONTEREY COUNTY.

The fisheries of this county have a peculiar interest in that Monterey Bay, the principal fishing-ground, represents the limit of migration of many fishes; shad and salmon, for instance, are here found in some numbers, but do not occur south of Monterey Bay, while a large variety of fish annually migrate northward as far as this section which are seldom found in any abundance in higher latitudes. Among the latter are the mackerel, bonito, albacore, and barracuda. The fishermen of this county usually find a great abundance of fish and have the choice of a larger number of species than is found elsewhere on the west coast. The other economic water products of this county consist chiefly of squid and algæ. With few exceptions the fishermen are Portuguese or Chinese, the latter comprising two-thirds of the fishing population. Most of the Portuguese are naturalized citizens.

Nearly all of the catch of both whites and Chinese is sent by steamer or rail to San Francisco. The squid and dry fish shipped by the Chinese are in large part reshipped to the Sandwich Islands or China. The quantities of fresh fish sent to market by the white and Chinese fishermen of this county were somewhat less in 1892 than during the three previous years, as shown in the following table. The species shipped are specified in the detailed tables elsewhere presented.

Statement of fresh fish shipped to San Francisco by fishermen of Monterey County.

Fishermen.	1889.	1890.	1891.	1892.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
White	979,507	1,130,962	825,338	672,129
Chinese	345,849	369,250	157,015	199,380
Total	1,325,356	1,500,212	982,353	871,509

The following shipments were also made by the Chinese fishermen, consisting of dry fish, squid, and abalones and abalone shells, and algæ:

Products.	1889.	1890.	1891.	1892.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Dry fish	102,000	64,000	61,240	63,830
Dry squid	468,000	256,000	300,760	357,622
Dry abalones	1,150	1,300	900	1,235
Abalone shells	2,700	3,100	2,800	2,954
Algæ	5,800	6,500	6,500	14,835
Total	579,650	330,900	372,200	440,476

SANTA CRUZ COUNTY.

The fisheries of Santa Cruz County present no new features as compared with the conditions recorded in the last report. The quantity of fish taken shows a small increase each year, but the industry may be regarded as only imperfectly developed. Shad are found along the coast of this county, but do not appear to be undergoing the marked increase in numbers which is witnessed in the more northern counties of the State. In 1889 20,000 pounds were taken, and in 1892 the catch was 35,000 pounds. Salmon are also caught in limited quantities each year. The few fresh-water streams entering the ocean on this part of the coast probably accounts for the small increase in shad and salmon. The bulk of the catch consists of flounders, rockfish, smelt, and sturgeon, and nearly the entire yield is sent fresh to San Francisco. The shipments of fresh fish during each of the four years ending 1892 were as follows:

Years.	Pounds.	Value.
1889	249,960	$9,998
1890	310,776	12,431
1891	330,694	13,226
1892	354,213	14,169

SAN FRANCISCO COUNTY AND VICINITY.

By far the most extensive fisheries of California are located at San Francisco, which has the distinction of being the most important fishing center on the Pacific Coast of North America. Besides maintaining valuable fisheries, the city is the principal market for the product of nearly every county in the State and is in very close relation with the adjacent counties of Contra Costa, Solano, Sonoma, and Marin.

The branches which give prominence to this region are the general market fisheries of San Francisco Bay and tributaries and of the adjacent ocean, the cod fishery, the whale fishery, the fur-seal and sea-otter fishery, the oyster industry, and the Chinese fisheries. These have been so fully described in the previous report that it is only necessary at this time to record their extent and the few changes which have ensued.

PHYSICAL FEATURES OF SAN FRANCISCO BAY AND TRIBUTARIES.

A large part of the salt-water and fresh-water fish received in San Francisco is taken in San Francisco Bay and its tributary bays and streams. This inland water area is of large extent and well adapted to the support of a large amount and variety of animal life. The quantity of fishery products annually withdrawn from these waters is enormous, but it is doubtful if the full resources are utilized or appreciated.

In a general way the dimensions of San Francisco Bay and the smaller bays connected therewith may be stated as follows: From the southern end of San Francisco Bay, bordering on Santa Clara County, to San Francisco is a distance of 25 miles, the width of the bay being from 2 to 10 miles. Between San Francisco and the entrance of San Pablo Bay the distance is 11 miles; San Pablo Bay is 10 miles long and from 8 to 10 miles wide. Karquines Strait, which connects San Pablo Bay with Suisun Bay, is 8 miles long and ½ to 1 mile wide. Suisun Bay is 16 miles long and from ½ to 6 miles wide. The total length of these connected waters is about 70 miles.

At the northern end of Suisun Bay, in Solano County, the two largest rivers in the State have their outlets. A peculiar feature of these rivers, probably not found elsewhere in the United States, is the relation existing between their respective sources and outlets. The San

Joaquin takes it rise in the semitropical section of the southern part of the State, and flows northward hundreds of miles through a warm region. The Sacramento, with its head waters among the perpetually snow-covered Sierra Nevada Mountains, flows south many hundred miles, and, through numerous passages, mingles with the San Joaquin and is lost in the tide waters of the bay. These two streams constantly carry with them a large amount of minute animal and vegetable life, much of which must find a congenial home in San Francisco Bay and furnish a large and varied quantity of food for the fish life of the fresh, brackish, and salt waters.

Another interesting feature of the bay is the almost uniform temperature of the water, there being only a few degrees variation at any season of the year. That the conditions are extremely favorable to the support of aquatic life is demonstrated in the rapid increase and permanent residence of the several fine food-fishes introduced from the Atlantic Coast by the Government. Some of the fishes thus acclimatized are naturally anadromous, but in San Francisco Bay, contrary to their usually migratory habits, they do not appear to have any desire to spend much if any of their existence in the ocean.

Another feature which has its influence upon the quantity of animal life present in San Francisco Bay is the absence of fishing banks or submerged chains of mountains off the coast of California adjacent to the Golden Gate. Fishing-grounds such as are found off the coast of the Atlantic States do not occur within many hundred miles of the California coast. It may therefore be assumed that during very stormy weather numbers of the near-shore marine fishes would seek food and shelter inside the Golden Gate, where, finding favorable conditions, many remain.

THE MARKET FISHERIES.

The fresh-fish business of San Francisco presents few changes or improvements. Fish are handled in the same primitive manner often described and always noticed by everyone that takes any interest in visiting the fish markets. The fish are seldom dressed and but a small amount of ice is used. Several of the dealers united as one company during 1892 and have made quite an improvement in having larger and more inviting quarters in which to transact their business. Six days in the week, every week in the year, with the exception of a few stormy days, the little lateen-rigged fishing boats sail out in the morning for the same fishing-grounds, with the same kind of fishing gear, nets, or trawls; with little trouble they catch the same varieties of fish, and the evening finds them back in their fishing dock.

The use of steamers, recommended in a previous report, in place of sail vessels is slowly taking place. The first steamer to engage in the market fisheries began work in or about 1885. This vessel was a tug that combined towing part of the time with fishing, when not otherwise engaged. During 1891 several of the wholesale firms united and added two steamers to the business, and in 1892 one more was added, making four steam vessels then in the market fishery. Some of these steamers are continually engaged in the fishing business, and at most times all four of them are. They leave the fishing dock early every morning, except Saturday, which is their day of rest, made so from the next day being Sunday, in which they could not dispose of their catch, as they return in the evening of the same day they leave. The steamers leave the fishing dock and soon pass out through the Golden Gate; turning north, a run of a few hours brings them to their usual fishing-grounds in Drake Bay, where the paranzella or drag net is soon in the water, and the steamer slowly drags it along the bottom until it is thought best to reel it in, empty the catch, and repeat the operation.

The steamer's crew consists of captain, engineer, fireman, and four to six fishermen, who are hired by the month.

The catch consists mostly of flounders and the numerous varieties of flatfish, with a small amount of many other kinds of bottom fish, some of which are saved and others thrown overboard quite likely to be recaught the following day, as nearly the same fishing-ground is gone over day after day, and generally the catch is equally good.

One good result of the use of steamers is that the catch can always be landed fresh and only a few hours at most from the time the fish were freely swimming in the ocean.

The many varieties of salt-water fish caught by the market fishermen outside of the Golden Gate have as a general thing been of an average abundance and ample for the needs of the market. Of the anadromous fishes, shad and striped bass have wonderfully increased in the market. The price of the latter has fallen from 75 cents or $1 a pound, which was freely paid in 1889, to 10 to 15 cents a pound in 1892. Shad, which a few years after their introduction brought $5 each, have year by year largely increased in numbers, and the price has fallen in the market as low as 25 cents for two fish, or about 3 cents a pound, the fishermen often receiving as little as a cent a pound. Salmon have in few instances been very plentiful, but the season's catches on the whole have not been satisfactory. The tables by counties will show the catch of these and all other species for the past four years.

A conspicuous part of the fresh-fish supply of San Francisco is taken in San Francisco Bay and the adjoining bays to the north. Between San Francisco and the southern end of the bay the principal fisheries carried on are for oysters, shrimp, herring, and smelt. At the extreme end, and for a few miles above on each side, are the only cultivated oyster beds in the State. These embrace several hundred acres. At many places in San Francisco Bay may be found the remains of native oyster beds in the shape of very small shells. Where native oysters are found alive their size is too small to render them of any commercial value. Investigations made by the United States Fish Commission disclosed the existence of a number of these native oyster beds that were not previously known, most of which were south of San Francisco, although a few were in the vicinity of San Pablo Bay. On some

COD CURING STATION, PESCADA LANDING, CALIFORNIA.

of these old beds were found numbers of medium-sized eastern oysters in good condition. These were probably the outcome of spat that had drifted with the tide from the cultivated beds of eastern oysters.

Next in importance to the oyster industry is the shrimp fishery carried on by the Chinese. At several points on the west side of the southern part of the bay are located extensive camps of the Chinese fishermen, while in close proximity to their camps along the borders of the bay and as far out as the main channel may be seen hundreds of their shrimp nets fastened to stakes.

From the middle of January to the middle of June smelt are more or less abundant and taken with nets along the west shore and along the border of the channel. From November to February herring and smelt are netted on the east side of the bay. From San Francisco to a distance 5 miles south smelt are caught during July and August, and a short distance south on the east side of the bay smelt and herring are found in December and January.

The foregoing comprise all of the principal fishing done within that part of the bay south of San Francisco. Just inside the Golden Gate primitive traps to the number of several hundred are fished for crabs. The first of the winter catch of herring is taken in Richardson Bay north of the Golden Gate, in which is located one of the large stations for the receiving and curing of cod. Another important station connected with the cod fishery is found a few miles distant on the main bay, these comprising all the firms that are engaged in the cod fishery of California. From the harbor of San Francisco to the upper extremity of Suisun Bay salmon, shad, and striped bass are netted from April to the middle of September, the principal part of the run of fish being taken in or near the channel. On each side of the entrance to San Pablo Bay the Chinese fishermen, whose operations were fully noticed in the previous report, continue to have their camps and follow their important fisheries for shrimp and the smaller species of bottom fish. On the west side of San Pablo Bay sturgeon and flounders are taken between February and May.

The fisheries of Suisun Bay are limited to the taking of salmon, shad, and striped bass.

THE PACIFIC COD FISHERY.

This branch of the Pacific fisheries is making history, although in many respects differing from the much older one of the Atlantic. Since the landing of the first cargo in 1864, up to 1893, the few firms engaged in the catching and curing of codfish have seen many fluctuations and changes in the business. The increase which the industry has undergone has only been reached by seeking the widely separated and distant markets of the Atlantic Coast, the Sandwich Islands, and Australia. Changes have taken place in the mode of preparing the fish for market. A small amount is yet called for in the old style, hard dried with skin on and tied up in bundles of 75 to 100 pounds; but most of the fish after curing are stripped of their skins, cut up, and packed as boneless fish. This modern way of placing cod on the market has been most favorably received in Australia, where the American boneless cod has nearly driven the hard-cured "stock fish" of northern Europe from the market.

Changes are taking place in the grounds resorted to by fishermen. The distant Okhotsk Sea and far eastern waters, where attention was first called to the cod of the Pacific, have nearly been abandoned by American fishermen for the nearer home fishing-grounds of Bering Sea, and the vessel fisheries of the latter are giving way to the establishment of permanent fishing stations on the islands bordering Bering Sea. Both American and native fishermen remain at these stations and fish on the adjacent banks, which are quickly and easily reached by small boats. The fares are soon taken, and on returning to the station the fish are dressed, salted, and packed away until vessels from San Francisco arrive. These bring salt for curing and supplies for the men, and return with loads of kench-cured fish to be unloaded at the home station, and there prepared as boneless cod.

Firms at San Francisco engaged in the cod fishery have branch stations at the following points on the Shumagin Islands: Sand Point, Red Cove, Company Harbor, Squaw Harbor, Ikaluk, Chichagof Bay, Henderson Island, Unga Island, Nelson Island, Pirate Cove, Sanborn, Rasatska, Johnson's Harbor, and Port Stanley.

The San Francisco cod fleet in Okhotsk Sea in 1889 and 1890 consisted of two brigs of 618 tons, whose aggregate catch was 1,168,484 pounds and 1,123,941 pounds, respectively. During 1891 no American cod vessels visited that region. In 1892 a three-masted schooner of 369 tons took 516,000 pounds of cod.

The extent of the Bering Sea cod fishery carried on by San Francisco vessels during the four years beginning 1889 was as follows, two small schooners being employed in transporting the catch:

Years.	No. of vessels.		Tonnage.	Catch.	
	Brigs.	Schooners.		Pounds.	Value.
1889	1	2	208	294,940	$7,374
1890	2	2	376	655,138	16,378
1891	4	3	1,120	2,114,711	52,868
1892	4	2	994	1,742,155	43,554

The aggregate receipts of salt cod by San Francisco firms, specified by fishing-grounds, are shown for four years in the following table:

Grounds.	1889.	1890.	1891.	1892.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Okhotsk Sea	1,168,484	1,123,941	....	516,000
Bering Sea	294,940	655,138	2,114,711	1,742,155
Islands of Alaska	1,134,775	1,659,602	1,637,000	2,208,035
Total	2,598,199	3,438,681	3,751,711	4,466,190

Vessels going to Okhotsk Sea on cod-fishing trips usually leave San Francisco about May 1 and return home by the latter part of September. The start for Bering Sea is made early in April and the home port is reached toward the end of August. There is considerable difference in the size and value of the codfish found in different parts of Bering Sea. As time passes and more knowledge of the extensive fishing banks is gained, fish of larger size, with thicker flesh and of better quality, are taken. A decided improvement in the quality of the catch is noticed compared with a few years back.

On entering Bering Sea vessels first anchor and begin fishing on Slime Bank, at the entrance to Bristol Bay. Cod are not always plentiful in this locality and, if scarce, a move is made to grounds off Port Möller, which is the region resorted to during June and July. It is fished over for some 10 miles northwest and southeast of Port Möller. Occasionally two trips are made, or a vessel will start later than the date mentioned; if so, the catch during August and September is obtained farther north, off Cape Pierce and Hagemeister Island.

THE PELAGIC FUR-SEAL AND SEA-OTTER FISHERY.

The high price commanded by seal pelts in recent years and the almost fabulous sums received for the sea-otter skins, incidentally obtained in the same fishery, have resulted in a marked increase in this branch of the San Francisco fisheries. The size of the fleet increased from six vessels in 1889 to eighteen in 1892, with a corresponding advance in the yield of fur seals, although the number of otters killed was in almost inverse ratio to the size of the fleet.

In addition to the home fleet, vessels from Oregon and Washington come to San Francisco for outfits and crews. Early in January the vessels are busy making ready, and by the middle of February all have sailed. On leaving San Francisco on a sealing trip vessels usually go but a short distance, some 50 miles west or southwest, before the hunting begins. Sometimes the day after leaving port seals are fallen in with, quite a catch is made, and the vessels will be back in port, having been away less than forty-eight hours. The first to sail in 1892 left December 28, and returned January 20, 1893, with 207 skins. Again, not meeting with the moving herds, a vessel will cruise along the southern coast or to the southwest for a few hundred miles, and then, heading to the north, will work up the coast. The business is at the best quite uncertain. Some vessels at the close of the season have a fine balance, others little, if anything, and may show quite a loss.

The sealing crews as a rule ship on a lay or share, which varies somewhat with the different vessels. The captain usually has a private agreement at so much a month, with or without a share or percentage. The first mate receives one-fifteenth of the stock or $65 a month, or $10 a month and 40 cents for each seal taken by the boat he is in. The second mate, if by the month, gets $30 to $45. The cook and steward, combined in one, is paid $45 to $50 a month. The cabin boy receives

$15 to $20 a month. The seamen, if on a lay, are entitled to one-hundredth of the stock, but most of them receive 50 cents for each seal taken by the boat in which they are. Hunters, so known, are the men who shoot the seals; they usually receive $2 for each seal and $6 to $7 for each otter that they may kill and secure. The owners of the vessels furnish all food, guns, ammunition, and other needed supplies, and in case seals are not found they are the ones to suffer the loss, the crew being out their time only.

The extent of this fishery from 1889 to 1892, inclusive, is shown in condensed form in the following table:

The pelagic fur-seal and sea-otter fleet of San Francisco.

Years.	Vessels.		Seal skins taken.		Sea-otter skins taken.	
	No.	Tonnage.	No.	Value.	No.	Value.
1889	6	377.09	1,691	$15,219	277	$27,700
1890	9	633.37	5,818	69,816	273	27,300
1891	16	1,153.58	8,948	134,220	151	30,200
1892	18	1,308.36	14,710	167,526	227	34,950

The average number of seals and sea otters taken by each vessel varied greatly during the four years named, and shows the uncertainty attending the prosecution of this fishery. Some vessels returned home without having taken a single pelt, while others obtained as many as 2,600 skins. The following brief statement of averages, based on the foregoing table, shows some interesting points:

Years.	Seal skins.		Sea-otter skins.	
	Average number to a vessel.	Average stock to a vessel.	Average number to a vessel.	Average stock to a vessel.
1889	282	$2,536	46	$4,617
1890	646	7,757	30	3,033
1891	559	8,389	10	1,887
1892	817	10,470	12	1,942

THE WHALE FISHERY.

Probably no other business on the Pacific Coast with anything like the capital invested is followed with the uncertainty of the Arctic whale fishery. One year may witness a remunerative fishery, to be followed the next season with heavy loss of life, money, and property. The fishery continues to center at San Francisco, which, in addition to having a large local fleet, is the permanent headquarters of numbers of vessels belonging in New Bedford, Mass.

With the low prices received for oil, the whale fishery would soon come to an end were it not for the more valuable whalebone. Often during recent years only the bone has been saved if other whales are in sight, the remainder of the carcass being cast adrift. The market price of whalebone has ruled high, with wide fluctuations from time to time. During 1891 the price varied from \$4 to \$5 a pound for Arctic bone; in April, 1891, it had advanced to \$6.50, and in October had dropped to \$5, closing in December at \$5.75. The opening price in 1892 was \$5.62, with sales up to \$6; as the season wore on it declined to \$5, and later in the year to \$4. During the early fall, news of the success or failure of the Arctic fishery is anxiously looked for, and the market is governed by the same. The prices given are eastern quotations, and do not make much difference to the seamen engaged in the taking of the whales; although they ship on a lay, or share, the price of whalebone and oil is usually agreed on in advance.

The extent of the whaling business carried on by vessels owned at San Francisco is shown in condensed form in the following table:

Summary of the San Francisco whale fleet and its operations, 1890 to 1892.

Years.	Number of fishermen.	Vessels.				Advances to crews.
		Number.	Net tonnage.	Value.	Value of outfit.	
1890	1,090	32	8,174.61	\$572,000	\$276,297	\$112,135
1891	1,059	31	7,626.10	570,000	263,756	108,628
1892	1,240	36	8,983.16	648,500	302,060	126,026

Years.	Whalebone.		Sperm oil.		Whale oil.		Total value of catch.
	Pounds.	Value.	Gallons.	Value.	Gallons.	Value.	
1890	168,303	\$710,239	6,121	\$3,979	286,901	\$120,498	\$834,716
1891	218,781	1,177,042	3,472	2,396	226,866	106,627	1,286,065
1892	192,950	1,032,282	12,804	8,579	192,895	81,016	1,121,877

There is no fishery in the United States in which a more heterogeneous personnel is found than in the Pacific whale fishery. Nearly every State and every nation is represented, as will appear from the following tables based on the official shipping lists:

Table showing the nativity and nationality of the persons employed on the San Francisco whaling fleet in 1892.

Countries.	Nativity.	Nationality.	Countries.	Nativity.	Nationality.
United States	438	639	New Zealand	3	....
Austria	6	1	Nova Scotia	11	....
Australia	11	....	Norway	50	38
Belgium	5	5	Portugal	110	79
China	3	3	Russia	19	16
Canada	13	....	South America	14	8
Denmark	27	21	Spain	58	55
East Indies	2	....	Scotland	35	....
England *	115	181	Sandwich Islands	31	28
France	22	18	Switzerland	6	4
Germany	108	76	Sweden	69	49
Holland	11	5	St. Helena	6	....
Italy	1	....	United States of Colombia	2	2
Ireland	32	....	West Indies	18	....
Japan	8	8			
Mexico	4	4	Total	1,240	1,240
New Brunswick	2	....			

* The nationality of the fishermen of the various British provinces is shown in the aggregate under the general head of England.

Of the native-born citizens on the whaling vessels, the following States were represented to the extent shown:

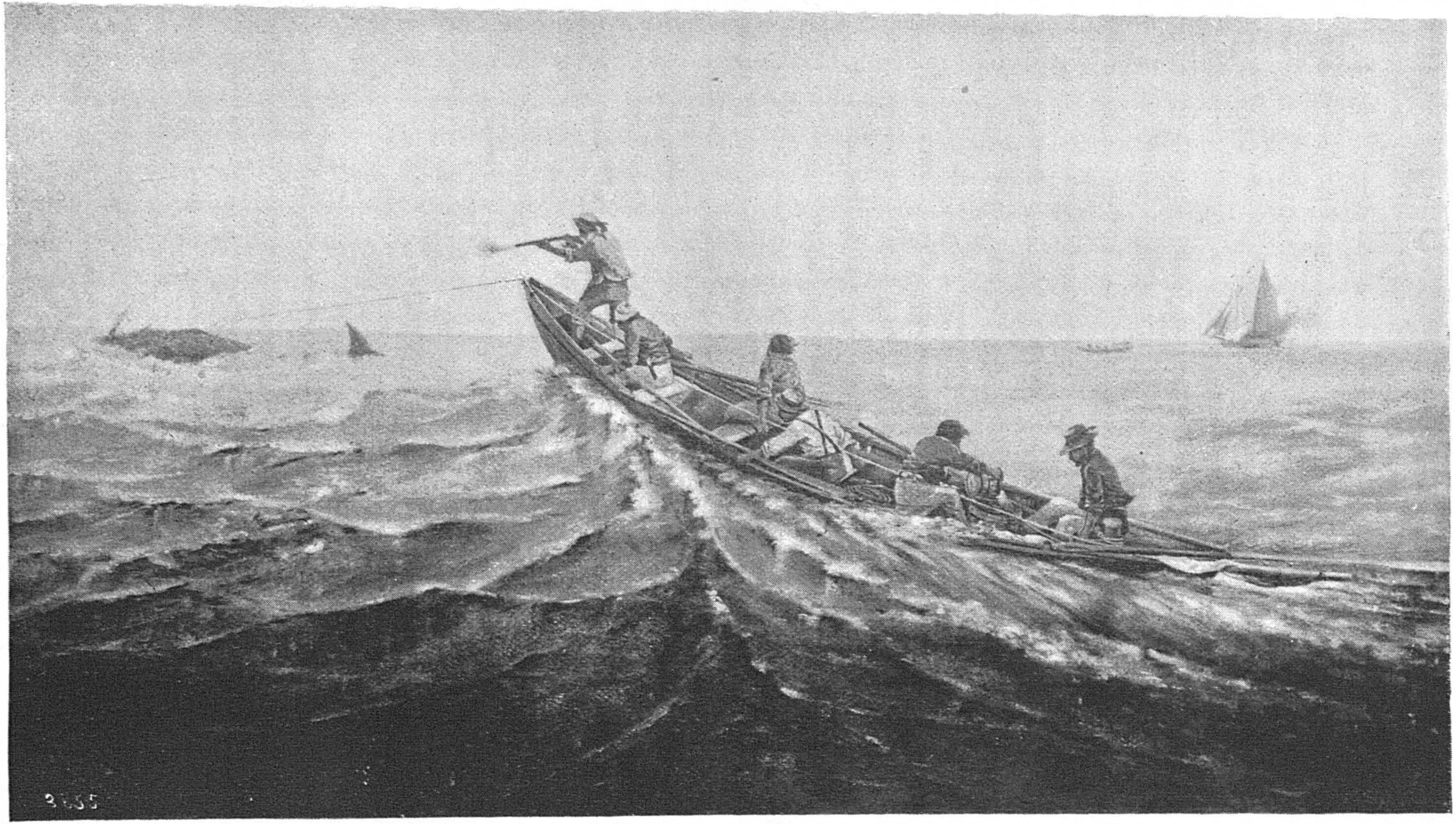
States and Territories.	1892.	States and Territories.	1892.
Alabama	1	Minnesota	3
California	77	Missouri	9
Colorado	3	Montana	1
Connecticut	7	Nebraska	2
Delaware	2	Nevada	3
District of Columbia	5	North Carolina	2
Dakota	1	New York	77
Florida	3	New Jersey	2
Georgia	1	Ohio	10
Illinois	15	Oregon	4
Indiana	2	Pennsylvania	21
Iowa	6	Rhode Island	5
Kansas	2	Vermont	2
Maine	28	Virginia	3
Maryland	9	Wisconsin	3
Massachusetts	122		
Mississippi	1	Total	438
Michigan	6		

The names, rigs, and tonnage of the vessels constituting the fleet were as shown in the following table:

Name.	Rig.	Net tonnage.	Years engaged.		
			1890.	1891.	1892.
Alton	Sch	84.30	×	×	×
Alexander	Brig	128.88	×	×	× *a*
Bounding Billow	Bark	228.83	×	×	×
Beluga	Str	409.48	×	×	×
Balæna	Str	389.67	×	×	×
Bonanza	Sch	128.70	×	×	×
Blakely	Sch	133.64			×
Eliza	Bark	281.71	× *b*		
E. F. Harriman	Bark	366.10	×	×	×
Grampus	Str	250.26	×	×	×
Helen Mar	Bark	308.13	×	×	× *c*
Hunter	Bark	337.38	×	×	×
Hidalgo	Bark	165.96	×	×	×
Jane Gray	Sch	107.07	×	×	×
John & Winthrop	Bark	321.38	×	×	×
John P. West	Bark	335.64	×	×	× *a*
James Allen	Bark	330.98	×	×	×
J. H. Freeman	Str	359.80	×	×	×
Karluk	Str	220.93			×
Lydia	Bark	312.28	×	×	×
Mars	Bark	243.44	×	×	×
Mary H. Thomas	Sch	93.08	×	×	×
Mary D. Hume	Str	108.01	×	×	×
Nicotine	Sch	65.50	×	×	×
Narwhal	Str	389.67	×	×	×
Northern Light	Bark	365.42	×	×	×
Orca	Str	462.30	×	×	×
Rosario	Sch	141.25	×	×	×
Percy Edward	Brig	189.18			×
Stamboul	Bark	247.42	×	×	×
Sea Breeze	Bark	307.24	×	×	×
Silver Wave	Sch	26.90	× *d*	×	×
Thrasher	Str	343.01	×	×	×
Tamerlane	Bark	353.87			× *e*
W. H. Myer	Brig	256.50	×	×	×
Wanderer	Bark	288.13	×	×	×

a Lost; crew saved.
b Lost on St. Lawrence Island; crew saved.
c Lost in Arctic ice; of the crew of 40 only 2 were saved.
d Tender to the fleet.
e Lost by going ashore at Sandwich Islands; 19 of the crew lost.

The whaling business carried on by New Bedford vessels making their headquarters at San Francisco is about half as extensive as that of the home fleet. The following condensed figures, applying to the years 1890, 1891, and 1892, show the prominent features of the fishery:



SHOOTING A BOMB LANCE INTO A WHALE.

Summary of the New Bedford whale fleet and its operations, 1890 to 1892.

Years.	Number of fishermen.	Vessels.				Advances to crews.
		Number.	Net tonnage.	Value.	Value of outfit.	
1890	652	17	5,081.98	$197,900	$188,900	$61,500
1891	630	16	4,787.95	203,500	182,100	62,800
1892	645	17	4,880.33	217,500	194,000	63,400

Years.	Whalebone.		Sperm oil.		Whale oil.		Total value of catch.
	Pounds.	Value.	Gallons.	Value.	Gallons.	Value.	
1890	114,350	$400,225	11,535	$7,497	172,187	$72,318	$480,040
1891	91,700	412,650	9,700	6,693	139,137	65,395	484,738
1892	122,500	551,250	55,293	37,044	161,384	67,778	656,072

The nationality and nativity of the persons constituting the crews of the New Bedford whaling fleet operating in the North Pacific Ocean are exhibited in the following table:

Table showing the nativity and nationality of the persons employed on the New Bedford whaling fleet in 1892.

Countries.	Nativity.	Nationality.	Countries.	Nativity.	Nationality.
United States	220	292	Mexico	7	7
Austria	1	1	Norway	14	14
Australia	7	....	Nova Scotia	3	....
Africa	2	....	New Brunswick	3	....
Brazil	2	2	Portugal	93	93
Belgium	1	1	Peru	4	3
Canada	6	....	Poland	1	....
Chile	8	8	Russia	5	6
Denmark	3	2	Spain	73	69
England*	32	73	Sweden	9	6
East Indies	7	....	Scotland	11	....
France	3	13	Sandwich Islands	29	20
Fiji Islands	1	....	St. Helena	6	....
Germany	50	21	Switzerland	3	3
Holland	6	6	United States of Colombia	2	2
Italy	1	1	West Indies	15	....
Ireland	14	....			
Japan	3	3	Total	645	645

* The nationality of the fishermen of the various British provinces is shown in the aggregate under the general head of England

The States and Territories in which the native-born citizens belong are given in the following statement:

States and Territories.	1892.	States and Territories.	1892.
Alaska	2	New Hampshire	1
California	18	Nevada	1
Connecticut	3	North Carolina	1
District of Columbia	1	New Jersey	6
Florida	1	New Mexico	1
Illinois	8	Ohio	4
Indiana	2	Oregon	3
Iowa	2	Pennsylvania	20
Kansas	4	Rhode Island	7
Kentucky	2	Vermont	2
Maine	4	Virginia	3
Maryland	5	Wisconsin	2
Massachusetts	70	Washington	2
Michigan	2		
Missouri	4	Total	220
New York	30		

The names, rig, and tonnage of the New Bedford whaling fleet are shown for the years 1890, 1891, and 1892 in the following table:

Name.	Rig.	Net tonnage.	Years engaged. 1890.	1891.	1892.
Alaska	Bark	323.00	×	×	×
Andrew Hicks	Bark	287.96	×	×	×
Alice Knowles	Bark	287.64	×	×	×
Andrew Barker	Bark	361.14	×	×	×
Belvedere	Str	339.37	×	×	×
Chas. W. *Morgan*	Bark	298.06	×	×	×
California	Bark	348.25	......	......	×
Cape Horn Pigeon	Bark	201.42	×	×	×
Frances A. Barstow	Brig	121.19	×	×	×
Horatio	Bark	321.58	......	......	×
Josephine	Bark	384.54	×	×	×
Lagoda	Bark	352.29	×*a*	......	......
Mermaid	Bark	259.65	......	......	×
Navarro	Str	171.39	......	......	×
Ocean	Bark	274.32	×*b*	......	......
Reindeer	Bark	319.62	×	×	×
Sea Ranger	Bark	259.46	×	×	×
Tamerlane	Bark	353.87	×	×	......
Triton	Bark	251.60	×	×	×
William Baylis	Bark	308.83	×	×	×
William Lewis	Str	332.04	×	×*a*	......

a Lost. *b* Condemned.

Data are at hand for a very interesting presentation of the number of each kind of whale taken during the years 1890, 1891, and 1892 by the vessels belonging in San Francisco and New Bedford, respectively. The variations in the comparative abundance of the different whales, as shown by the numbers killed, are suggestive and instructive:

Number and kind of whales taken in 1890, 1891, and 1892 by the American whaling fleet making headquarters at San Francisco.

Kinds of whales.	Vessels belonging at San Francisco. 1890.	1891.	1892.	Vessels belonging at New Bedford. 1890.	1891.	1892.	Total. 1890.	1891.	1892.
Right	42	59	14	19	33	16	61	93	30
Bowhead	69	106	107	46	30	52	115	136	159
Sperm	4	3	3	2	14	20	6	17	23
Humpback	1	......	......	......	......	......	1	......	......
Total	116	168	124	67	77	88	183	146	212

THE OYSTER INDUSTRY.

The oyster industry centering at San Francisco is one of the most important branches of the fishing industry of California. San Francisco firms, with extensive beds of native and eastern oysters in San Francisco Bay, are the only planters of oysters in California. Each fall and spring seed oysters in car-load lots are brought from the Atlantic Coast and planted in the bay. Some years as many as 100 car-loads, averaging 90 barrels of seed oysters each, are transplanted. A limited amount of the small-sized native oysters are also brought from beds in Washington. The latter are planted solely to keep them fresh and near at hand when desired. If it were not for the constant planting of seed oysters the beds would soon be exhausted, the natural propagation not keeping up with the demand.

Seed oysters brought from the Atlantic remain on the beds from three to four years, during which time they grow to the average size of the oyster of like age on the Atlantic. The original flavor is retained, although planted on the same beds with the natives of Washington, which are widely known for their small size and peculiar strong copper flavor, which they retain when brought and planted in California.

Ten small sailing vessels are engaged in transporting the oysters, as needed, from the beds to San Francisco. On arriving at the city, the bulk of the oysters grown from Atlantic seed are opened, canned, and packed in ice, and are known to the trade as eastern oysters. They are distributed all over the west coast, meeting those from the Atlantic at Denver, Colo.

In addition to the opening and canning of eastern oysters, considerable business is done in supplying the large city demand for oysters in the shell. Both the eastern and native oysters show an improvement during the past few years; they have larger shell, plumper meat, and a better flavor. The only noteworthy feature since the more detailed report of 1889 is a slow but steady growth in the business.

There is room for an increase in the business, but to accomplish this the industry, as at present carried on, will require large capital, and several years would elapse before the seed would grow and returns be expected. The freight on the seed from the Atlantic is a large item in the expense of the business. Firms now engaged are reported as holding several thousand acres of ground adaptable for oyster-culture, but not so used.

The extent of the oyster industry of San Francisco during the years 1889 to 1892, inclusive, is shown in the following tables. The persons employed at the beds (105 in number) and on shore and the capital devoted to the business were the same each year.

Property and capital.

Items.	Value.
Vessels	$15, 100
Shore property	100, 000
Oyster beds	100, 000
Cash capital	75, 000
Total	290, 100

Products.

Years.	Eastern oysters.		Native oysters.		Total.	
	Bushels.	Value.	Bushels.	Value.	Bushels.	Value.
1889	120, 000	$480, 000	26, 150	$91, 525	146, 150	$571, 525
1890	125, 000	500, 000	26, 325	92, 137	151, 325	592, 137
1891	130, 000	520, 000	28, 130	98, 455	158, 130	618, 455
1892	146, 000	584, 000	32, 645	114, 257	178, 645	698, 257

SARDINE CANNING.

This branch of the fishing industry is yet in its infancy on the Pacific Coast. The Golden Gate Packing Company, of San Francisco, established in 1890, had up to 1892 the only sardine cannery on the coast. Sardines and anchovies are utilized. Those of small size were packed in oil in the usual quarter-pound cans; the larger fish were put up in round cans holding 1 and 2 pounds. The goods were of fine quality and met with a ready sale, but the quantity prepared was small. A number of causes, chief of which was the failure of sardines to enter San Francisco Bay in sufficient quantities, limited the pack and caused a suspension of the business in 1893, when the cannery was sold and removed to Los Angeles County, where sardines were reported to be in greater abundance. Of late years sardines have been very erratic in their appearance in San Francisco Bay. One year the fish for weeks at a time would be extremely plentiful, while during the next season they would scarcely be found at all. The quantities of fish packed during the three years 1890, 1891, and 1892 were as follows, 100 of the quarter-pound cans, 48 of the 1-pound cans, and 24 of the 2-pound cans being contained in each case:

Grades.	1890.	1891.	1892.
	Cases.	*Cases.*	*Cases.*
Quarter oils	3,000	7,000	10,000
One pound	5,000	2,000	....
Two-pound	5,000	2,000	....
Total	13,000	11,000	10,000

THE FISH TRADE OF SAN FRANCISCO.

The fresh-fish markets of San Francisco are interesting and in some respects unique. In them one may buy a single pound of fish or a car load, both wholesale and retail business being carried on at the same stand. About 12,000,000 pounds of fresh fish are handled annually, exclusive of those in the Chinese markets. Large quantities of oysters, clams, mussels, shrimp, and crabs are also sold.

The fish are received daily from the adjacent fishing-grounds visited by the home fishermen, and from the interior waters and coast towns by rail and steamship lines. The fresh and salt waters of the State are rich in quantity and variety of animal life, and fishery products from all over the State find their way to this market. It is said that over 275 species of fish are found in the waters of the State, although many of these are not used as food, except by the frugal Chinese, who rarely permit anything to go to waste.

The following table represents approximately the quantity and value of all of the important fish and other water products entering into the fresh-fish trade of San Francisco. Most of the products named may be found in the market at all seasons, selling at prices that are within the reach of all classes. Attention may be specially drawn to the figures for shad, striped bass, catfish, and carp, fishes which have been introduced from the east.

Table showing the extent of the fresh-fish trade of San Francisco in 1890, 1891, and 1892.

Species.	1890.		1891.		1892.	
	Quantity.	Retail value.	Quantity.	Retail value.	Quantity.	Retail value.
Fish:						
Anchovies .....pounds..	135,000	$5,400	145,000	$4,350	150,215	$3,755
Barracuda.........do....	120,000	10,800	150,000	12,000	75,000	6,750
Bonito ....do....	95,000	5,700	110,000	6,600	95,000	10,450
Carp ....do....	75,000	3,000	90,000	2,700	75,000	1,875
Catfish ....do....	10,000	900	20,000	1,400	25,000	1,500
Cultus-cod ....do....	150,000	10,500	190,000	11,400	200,000	10,000
Flatfish and flounders, pounds	1,415,959	113,176	1,341,038	80,462	1,657,268	66,288
Herring ....pounds..	2,000,000	60,000	2,400,000	48,000	3,000,000	30,000
Hake..............do....	100,000	1,000	90,000	900	85,000	850
Horse-mackerel ...do....	75,000	6,000	40,000	3,600	15,000	1,200
Kingfish ....do....	40,000	2,400	25,000	2,450	40,000	2,000
Mackerel..........do....	20,000	2,600	15,000	2,100	10,000	1,500
Pike...............do....	25,000	1,500	22,000	1,320	20,000	1,200
Perch, fresh-water .do....	160,000	15,000	100,000	7,000	40,000	3,200
Perch, salt-water ..do....	250,000	20,000	200,000	10,000	200,000	8,000
Rockfish ....do....	1,797,482	143,798	1,024,619	71,723	1,421,489	71,074
Salmon............do....	2,125,000	136,500	2,065,000	129,750	2,919,848	143,061
Sardines ....do....	500,000	10,000	200,000	6,000	103,130	4,125
Sea bass...........do....	275,000	19,250	325,000	16,250	100,000	7,000
Striped bass.......do....	5,000	1,000	25,000	3,750	50,000	6,250
Shad ....do....	300,000	12,000	600,000	18,000	500,000	12,500
Skates ....do....	50,000	2,500	30,000	1,200	40,000	800
Smelt ....do....	900,000	63,000	1,000,000	70,000	700,000	42,000
Sturgeon ....do....	587,625	29,381	715,795	35,789	765,297	34,438
Suckers ....do....	175,000	5,250	160,000	4,800	140,000	4,200
Tomcod .... do....	8,000	800	15,000	1,200	25,000	1,500
Trout ....do....	25,000	5,000	20,000	4,000	18,000	3,600
Miscellaneous.....do....	31,160	6,230	35,100	5,905	52,930	9,102
Total	11,440,221	692,685	11,153,552	562,649	12,523,117	488,218
Mollusks, crustaceans, etc.:						
Oysters ....bushels..	151,325	592,137	158,130	618,455	178,645	698,287
Clams, hard......sacks..	1,000	3,000	1,100	3,300	1,200	3,600
Clams, soft.......boxes..	25,000	25,000	30,000	30,000	40,000	40,000
Mussels .... buckets..	45,000	22,500	50,000	25,000	48,000	24,000
Spiny lobsters..pounds .	25,000	1,500	20,000	1,200	18,000	1,080
Crabs...........dozens..	80,000	80,000	90,000	90,000	110,000	99,000
Shrimps........pounds..	200,000	12,000	500,000	25,000	775,000	38,750
Prawns ....do....	15,000	3,750	10,000	2,500	5,000	1,250
Squid and octopus .do....	10,000	500	8,000	400	10,000	500
Terrapin ....dozen..	1,400	5,600	1,500	6,000	1,400	7,000
Abalones..........do....	1,400	1,050	1,200	900	1,500	1,125
Turtles.........pounds..	30,000	1,500	25,000	1,250	18,000	900
Frogs ....dozen..	6,000	21,000	6,000	21,000	8,000	28,000
Total	....	769,537	....	825,005	....	943,492
Grand total...........	....	1,462,222	....	1,387,654	....	1,431,710

EXPORT TRADE OF SAN FRANCISCO.

San Francisco maintains a large export trade in fishery products. Canned salmon constitutes the great bulk of the shipments, but cured codfish, salt salmon, oysters, shrimp, and other products are of considerable importance. The following table, based on the custom-house records, shows in detail the extent of the exportations in the years 1890, 1891, and 1892. The items for which it is possible to present separate figures are cured codfish, other cured fish, canned salmon, pickled salmon, other canned fish, oysters, and other shellfish. The "other cured fish" consist chiefly of dried squid, shipped by the Chinese to Hongkong and the Sandwich Islands. The "other shellfish" are chiefly dried shrimp, with a few dried abalone, shipped by the Chinese to Hongkong, the Sandwich Islands, and other ports.

Table showing exports of fishery products from San Francisco in 1890, 1891, and 1892.

Destination.	Codfish, cured.		Other cured fish.	
	Pounds.	Value.	Pounds.	Value.
1890.				
Australia	473, 270	$32, 635		
British Columbia	17, 060	1, 260	2, 100	$124
China	13, 940	973		
Costa Rica	16, 010	1, 226		
East India	1, 900	119		
Guatemala	15, 640	1, 112		
Hongkong	45, 700	3, 080	304, 850	18, 391
Japan	3, 400	229		
Mexico	8, 065	576		
Nicaragua	680	56		
San Salvador	5, 660	388		
Sandwich Islands	278, 608	16, 557	404, 650	24, 218
Other places	11, 490	809		
Total	892, 313	59, 020	711, 600	42, 733
1891.				
Australia	248, 320	15, 155		
British Columbia	7, 800	570		
China	12, 750	872		
United States of Colombia	900	63		
Chile	800	61		
Costa Rica	28, 580	2, 160		
East India	4, 500	294		
Guatemala	20, 960	1, 546		
Hongkong	35, 410	2, 201	429, 900	26, 745
Japan	7, 420	515		
Mexico	6, 840	457		
Nicaragua	950	65		
Oceanica	4, 020	243		
San Salvador	5, 620	305		
Sandwich Islands	267, 220	13, 767	324, 900	18, 946
Other places	4, 640	306		
Total	656, 730	38, 670	754, 800	45, 691
1892.				
Australia	90, 720	5, 136	40, 300	2, 410
British Columbia	9, 170	641		
China	17, 580	1, 148		
Costa Rica	21, 810	1, 409		
Guatemala	24, 600	1, 631		
Hongkong	19, 640	1, 077	294, 100	17, 470
Japan	1, 810	98		
Mexico	7, 185	435		
Nicaragua	1, 160	73		
Oceanica	9, 080	539		
San Salvador	9, 050	576		
Sandwich Islands	270, 590	13, 042	291, 500	16, 960
Other places	900	68		
Total	483, 205	25, 873	625, 900	36, 846

Exports of fishery products from San Francisco in 1890, 1891, and 1892—Continued.

Destination.	Canned salmon.		Value of pickled salmon.	Value of canned fish other than salmon.	Value of oysters.	Value of other shellfish.	Total value.
	Pounds.	Value.					
1890.							
Australia	2,099,338	$217,951	$20,167	$4,222	$55	$1,677	$276,707
British Columbia	6,840	720	722	748	10,023	1,468	15,005
China	5,010	552		119		75	1,719
U. S. of Colombia				14		268	282
Chile	60,096	5,238		46		7,359	12,643
Costa Rica	29,490	3,187		427	788	74	5,702
England	13,409,486	1,211,458					1,211,458
East India	39,220	4,143	20			174	4,456
Ecuador	110,400	2,944					2,944
France	144,070	16,008					16,008
Germany	9,600	1,100					1,100
Guatemala	4,880	541		684	327	84	2,748
Hongkong	204,040	21,419		567	191	213,885	257,533
Japan	12,680	1,356	195	516	56	117	2,400
Mexico	24,030	2,586	66	978	1,447	512	6,165
Nicaragua	3,055	364		190	370	38	1,018
Peru	1,440	150					150
San Salvador	1,500	164		149	149	60	910
Sandwich Islands	229,250	24,082	37,359	7,669	10,583	32,622	153,690
Other places	93,765	9,346	2,322	1,497	445	496	14,915
Total	16,497,190	1,523,909	60,851	17,856	24,434	258,909	1,987,712
1891.							
Australia	1,368,650	131,868	40,323	1,533	282	2,233	191,394
British Columbia	7,200	750		1,354	8,651	2,024	18,349
China	6,520	672		133		261	1,938
U. S. of Colombia	1,850	194		184	482	639	1,562
Chile	19,460	2,025		175		8,149	10,410
Costa Rica	82,906	8,520		138	364		11,182
England	13,601,195	1,221,142		75			1,221,217
East India	12,840	1,295		88		515	2,192
Guatemala	5,046	537		361	897	501	3,842
Hongkong	89,100	8,747	37	669	24	192,173	230,596
Japan	7,680	804		193		1,725	3,237
Mexico	32,290	3,433		1,062	1,302	426	6,680
Nicaragua	2,360	255		160	188	106	774
Oceanica	37,918	3,989	739	502	69	66	5,608
San Salvador	2,860	306		60	466	302	1,520
Sandwich Islands	194,820	20,353	37,651	8,443	9,630	32,279	141,069
Other places	35,420	3,723	1,995	894	345	248	7,511
Total	15,508,115	1,408,613	80,745	16,024	22,700	241,647	1,854,090
1892.							
Australia	1,597,240	160,773	11,470	275	15	829	180,914
British Columbia	4,580	478		527	1,634	1,919	5,109
China	6,956	735		95	15	298	2,291
U. S. of Colombia						280	280
Chile	61,100	5,947				4,605	10,552
Costa Rica	4,760	489			18		1,916
England	17,377,838	1,701,715					1,701,715
East India	18,700	1,943		32	90	541	2,606
Ecuador	2,400	250		225			475
Germany	2,400	225					225
Guatemala	13,700	1,409		933	244	56	4,273
Hongkong	65,790	6,674		509	31	195,504	221,265
Japan	4,510	470		241			809
Mexico	23,886	2,480		1,511	1,600	172	6,207
Nicaragua	700	74		37		157	341
Oceanica	62,465	6,297	1,654	341	128	201	9,160
Peru	12,000	1,000					1,000
San Salvador	9,840	1,079		285	529	154	2,623
Sandwich Islands	154,160	15,856	33,670	5,191	5,109	19,257	109,085
Other places	27,220	2,634	182	48		40	2,972
Total	19,450,335	1,910,537	46,976	10,250	9,413	224,013	2,263,908

TEHAMA COUNTY.

This county is near the head waters of the Sacramento River, which flows through it. Late in the fall some attention is given to taking salmon; gill nets and haul seines are used, and the catch is shipped fresh to San Francisco. The fish taken are usually of a poor quality and bring but a small price. They are probably the fish that, having escaped the many nets of the lower river, finally reached the spawning-grounds and later fell into the nets of the fishermen of the upper river. The amount and value of the catch of late years have been as follows:

Years.	Pounds.	Value.
1889	118,145	$2,955
1890	125,860	3,147
1891	115,623	2,890
1892	128,389	3,210

HUMBOLDT COUNTY.

Of the four years covered by this report the fisheries of Humboldt County were most important in 1889, in the matter of products and capital invested, owing to the fact that in that year a salmon cannery was operated which was idle during the three following years. This is one of the most important fishing counties in California. Over 300 fishermen are regularly employed during the fishing season and the value of the catch is from $45,000 to $80,000 annually. The most prominent product is the salmon. The catch of salt-water fish and of clams and crabs is also important. The principal fishing center is Eureka, situated near Eel River, in which most of the salmon are taken. The salt-water fish are obtained at the mouth of the river, off Trinidad, located a few miles to the north, and in Humboldt Bay. The local demand for fish in Eureka and vicinity takes a large part of the catch, the surplus fish being sent to San Francisco by steamer. The yield of salmon during the four years named was over 1,000,000 pounds annually, and that of other fish aggregated several hundred thousand pounds. About 1,000 bushels of clams and 2,400 to 3,000 dozen of crabs were taken and sold each year. The number of cases of canned salmon prepared at the cannery during 1889 was 11,652.

DEL NORTE COUNTY.

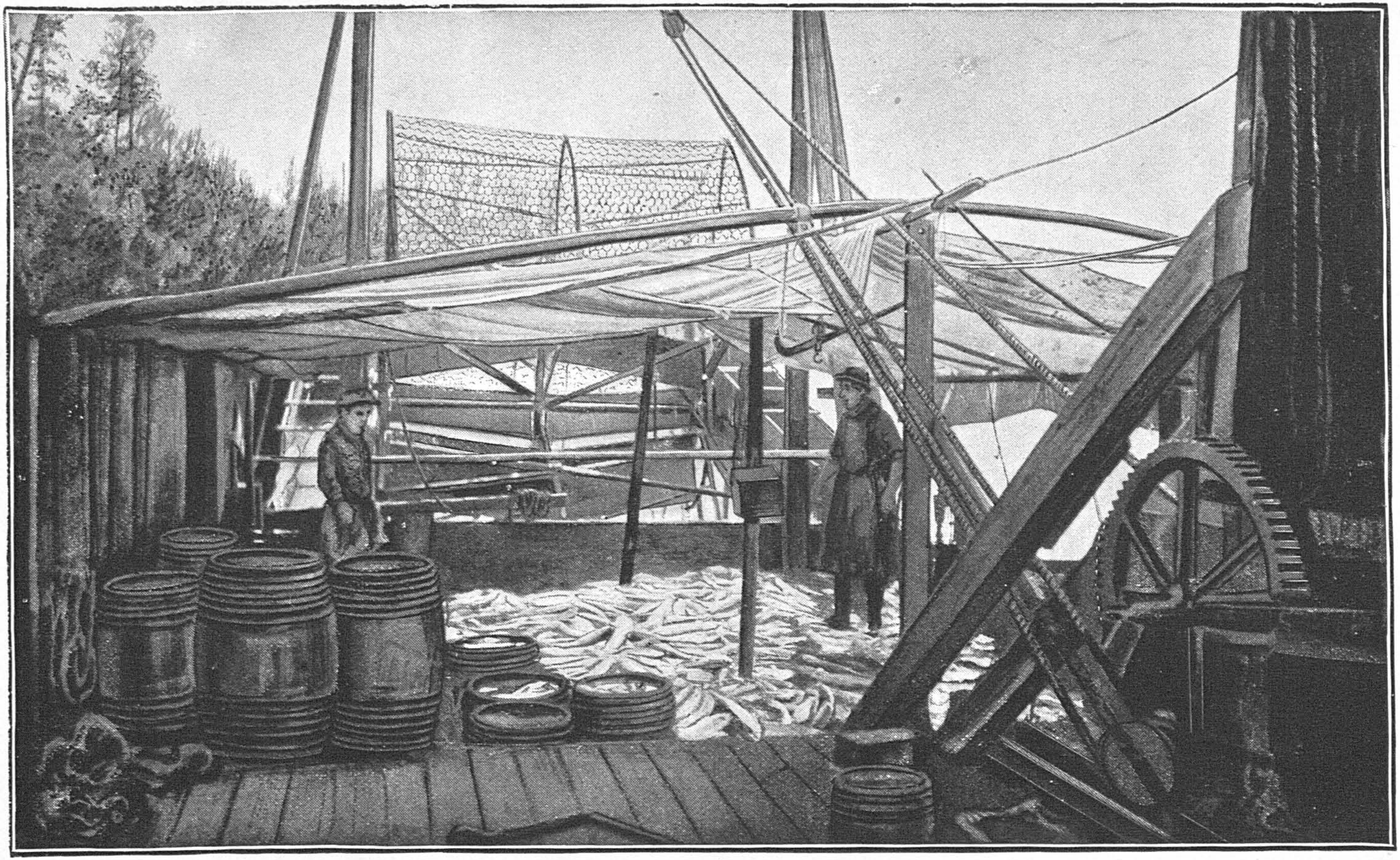
Up to the present time the fisheries of this county have been limited to the taking of salmon at and near the mouths of Smith and Klamath rivers. A small salmon cannery on each river consumes the bulk of the catch, a part of which is also used for local consumption, and a part salted and shipped to San Francisco.

Nearly all the persons employed in the fishing industry of these two rivers are Indians, native to the section, there being a strong objection to the employment of Chinese laborers in this county.

The following is a statement of the quantities of salmon packed in this county in the years 1889 to 1892, inclusive. The fish utilized in canning consist of chinooks and silversides in about equal proportions.

Year.	Klamath River.	Smith River.	Total.
	Cases.	*Cases.*	*Cases.*
1889	2,669	3,000	5,669
1890	5,000	2,500	7,500
1891	4,500	....	4,500
1892	1,200	3,050	4,250

PLATE 5.



SCOW FISH WHEEL, COLUMBIA RIVER.

OREGON.

GENERAL EXTENT AND FEATURES OF THE FISHERIES.

From the first settlement of the State the fisheries of Oregon have yearly been of increasing interest. The abundance of salmon first attracted the fishermen, and their capture has continued the leading branch of the business. While natural causes, often unaccountable, largely govern the migrations of fish and are chiefly responsible for the uncertain character of their movements and the fluctuations in the catch, there is no room for doubt that the preservation of the supply in the rivers is largely dependent on man. During recent years a large increase is annually shown in the various appliances of capture in the salmon fisheries of the Columbia River, which yields the bulk of the salmon caught in the State. From an increase in fishing appliances a gain in the catch might be expected, but such is generally not the case. In the years of largest production a much less amount of fishing gear was used than at present. As the fish were depleted, the fishermen, eager to keep up the amount of their catch, increased the number of their gill nets, pound nets, wheels, etc., often only to find a yet smaller catch, which would again be followed by more fishing appliances.

Artificial propagation, which has been carried on so far as means would permit, has in a measure made good the losses from increased fishing gear. The naturally favorable conditions of the Columbia and most of the other rivers of the State for abundance of desirable food-fish continue nearly, if not quite, as favorable as in the early days of the fisheries, when the only fish caught were those taken by the native Indians for their own use. The waters remain unpolluted by the sewage of large cities and the refuse of manufactories, and from the topography of the country through which the rivers flow they may be expected to remain unimpaired for many years.

The salmon fishery and the dependent canning business are vastly more important than all other branches of the fisheries of this State, the only other fishery of any prominence being that for sturgeon. Only very limited quantities of other food-fish are taken, and the general fisheries are much less developed than in California or Washington. Oysters and fur seals contribute to the income of the fishermen.

The following tables show the extent of the fisheries of this State. In the last year covered by the statistics, 4,332 persons were engaged in the industry, \$2,272,351 was invested, and 28,521,105 pounds of products were taken, having a value of \$872,405.

Persons employed in the fisheries of Oregon.

How engaged.	1889.	1890.	1891.	1892.
On vessels fishing	11	25	55	60
On vessels transporting	40	40	38	57
In shore fisheries	2,234	2,112	2,452	2,705
On shore, in canneries, etc	1,334	1,282	1,342	1,510
Total	3,619	3,459	3,887	4,332

Vessels, boats, apparatus, shore property, and cash capital used in fisheries of Oregon.

Items.	1889.		1890.		1891.		1892.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	1	$18,000	1	$10,000	3	$15,000	4	$17,300
Tonnage	71.17		148.97		231.90		247.63	
Outfit		4,600		3,150		7,450		8,350
Vessels transporting	10	42,900	10	42,900	10	53,740	20	73,100
Tonnage	443.94		443.94		458.31		555.20	
Outfit		9,530		9,530		9,010		11,945
Boats	1,164	125,885	1,113	125,040	1,252	142,585	1,494	154,425
Apparatus:								
Gill nets	1,404	181,955	1,234	178,320	1,302	201,625	1,396	212,260
Pound nets	101	74,700	108	76,500	142	100,500	247	173,400
Seines	23	7,425	18	4,825	32	14,350	32	12,600
Wheels	31	120,052	29	107,552	30	108,152	40	132,852
Dip nets	95	475	85	425	60	300	50	250
Lines		4,487		6,530		7,446		10,520
Tongs and hoes		145		150		153		149
Other apparatus				850		2,050		2,050
Shore property		618,245		596,445		582,950		660,150
Cash capital		620,900		707,000		640,000		803,000
Total		1,859,299		1,869,217		1,885,311		2,272,351

Products of the fisheries of Oregon.

Species.	1889.		1890.		1891.		1892.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Black-cod	25,000	$1,250			1,000	$8		
Blueback salmon	1,147,090	34,961	3,543,943	$97,961	871,392	24,127	3,140,397	$83,370
Chinook salmon, fresh	12,478,087	536,120	16,596,301	535,484	17,168,968	643,710	15,577,282	579,007
Chinook salmon, salted	70,900	2,186	87,100	2,338	97,450	2,860	54,700	1,407
Cultus-cod	101,112	3,555	27,120	1,356	28,415	1,389	26,304	1,315
Flounders							10,000	400
Halibut	487,250	11,125	16,450	1,045	43,930	2,093	18,870	1,787
Rockfish	84,010	4,200	82,200	4,113	83,220	4,161	86,115	4,255
Shad	29,990	2,999	50,100	4,008	70,500	4,230	109,000	3,270
Silver salmon, fresh	4,125,540	91,563	2,168,399	33,573	1,175,620	18,040	3,925,451	64,180
Silver salmon, salted	359,100	11,048	313,100	5,524	299,550	5,638	252,100	4,484
Steelhead salmon	844,080	18,837	1,802,989	29,573	1,122,340	16,956	2,586,771	48,552
Sturgeon	741,730	8,821	1,441,446	16,279	1,456,619	17,311	2,513,490	28,001
Crabs	6,628	265	4,200	168	3,521	141	4,125	495
Crawfish	20,000	3,000	25,000	3,750	30,000	4,800	20,000	3,000
Oysters	150,000	3,125	132,360	2,758	146,040	3,043	147,000	3,062
Clams	48,720	812	46,500	775	45,600	760	49,500	825
Fur seals				15,000		26,480		43,266
Sea otter								1,729
Total	20,719,237	733,867	26,337,268	754,305	22,644,165	777,247	28,521,105	872,405

In the following supplementary table the quantities of certain products are designated by the unit by which they are usually sold:

Products.		1889.	1890.	1891.	1892.
Crabs	number	2,209	1,400	1,173	1,375
Oysters	bushels	1,666	1,470	1,622	1,633
Clams	do	696	664	651	700
Fur seals	number		1,250	1,730	2,945
Sea otters	do				13

BEAM-TRAWL FISHING.

Several attempts have been made on the Atlantic coast to introduce the beam trawl, a form of apparatus that is so largely and successfully used by the fishermen of England; but on account of the rough, rocky bottom on which most of the trials were made, the results have been unfavorable and its further use has been discontinued. An account of a similar experiment on the Pacific coast has been furnished by Captain Exon, now a pilot on the Columbia River, whose father was lost while engaged in beam-trawling. During 1884 Capt. John Exon, of East Portland, Oreg., was in the employ of a fishing firm known as the Portland Deep-Sea Fishing Company, with headquarters at Portland. Captain Exon at the time was master of the schooner *Carrie B. Lake*, of about 36 tons burden, engaged in line fishing just outside the mouth of the Columbia River. The numerous varieties of bottom fish were very abundant, and the ground fished over had an even and smooth sandy bottom. Captain Exon had formerly been engaged in the beam-trawl fishery from Grimsby, England, and sent there for two beam-trawls, which were brought out by his brother in 1884 and at once put to use.

The trawls were operated near the mouth of the Columbia and off Grays Harbor with equally good success, the catch comprising large hauls of sole, flounders, orange and red rockfish, and many other varieties of bottom fish. This fishery was successfully carried on during 1885. Unfortunately for the enterprising promoter of this fishery and his well-laid plans, on January 3, 1886, while on a fishing trip, the vessel and its master, mate, and cook were lost. The firm soon after gave up the fishing business, and no later attempts at beam-trawl fishing on the Pacific coast have been reported. With the growth of the fish business of the Pacific States, some enterprising firms may yet take advantage of the experiments of the pioneer in this mode of fishing, the success of which he demonstrated. The United States Fish Commission steamer *Albatross* has also made frequent use of the beam-trawl in extensive investigations along the Pacific coast.

DETAILED STATISTICAL DATA.

The following tables, relating to each of the years 1889 to 1892, inclusive, show the extent of the fishing industry in each county of Oregon. The scope of the tables is such that but little explanation is necessary, and they are to be consulted in conjunction with the descriptive notes on each county which follow.

Table showing by counties the number of persons employed in the fisheries of Oregon in 1889, 1890, 1891, and 1892.

Counties.	1889.					1890.				
	On vessels fishing.	On vessels transporting.	In shore fisheries.	On shore, in canneries, etc.	Total.	On vessels fishing.	On vessels transporting.	In shore fisheries.	On shore, in canneries, etc.	Total.
Benton			112	34	146			48		48
Clackamas			38		38			38		38
Clatsop		13	1,361	688	2,062		13	1,472	768	2,253
Columbia			35	4	39			40	4	44
Coos			131	85	216			68	6	74
Curry		27	74	105	206		27	70	78	175
Douglas			78	49	127			4		4
Lane			52	50	102			48	32	80
Multnomah	11		183	169	363	25		159	207	391
Tillamook			50	56	106			50	59	109
Wasco			120	94	214			115	128	243
Total	11	40	2,234	1,334	3,619	25	40	2,112	1,282	3,459

Table showing by counties the number of persons employed in the fisheries of Oregon in 1889, 1890, 1891, and 1892—Continued.

Counties.	1891.					1892.				
	On vessels fishing.	On vessels transporting.	In shore fisheries.	On shore, in canneries, etc.	Total.	On vessels fishing.	On vessels transporting.	In shore fisheries.	On shore, in canneries, etc.	Total.
Benton			85	22	107			83	22	105
Clackamas			40		40			40		40
Clatsop	32	11	1,764	841	2,648	35	21	1,821	792	2,669
Columbia			43	6	49			40	12	52
Coos			88	37	125			143	35	178
Curry		27	83	72	182		27	76	63	166
Douglas			4		4			56	51	107
Lane			42	36	78			103	91	194
Multnomah	23		133	176	332	25	9	157	252	443
Tillamook			50	45	95			62	63	125
Wasco			120	107	227			124	129	253
Total	55	38	2,452	1,342	3,887	60	57	2,705	1,510	4,332

Table showing by counties the nativity of persons employed in the fisheries of Oregon in 1892.

Counties.	Countries.																
	United States.	Sweden.	Norway.	Russia.	Great Britain.	Italy.	Austria.	Greece.	Germany.	France.	China.	Denmark.	United States Indians.	Japan.	Portugal.	Others.	Total.
On vessels fishing:																	
Clatsop	11	6	6		8											4	35
Multnomah	12	2	1		9									1			25
Total	23	8	7		17									1		4	60
On vessels transporting:																	
Clatsop	21																21
Curry	27																27
Multnomah	9																9
Total	57																57
In shore or boat fisheries:																	
Benton	59	12	10	2													83
Clackamas	40																40
Clatsop	207	330	180	684	86	68	184	48	15			6			4		1,821
Columbia	40																40
Coos	53	30	25	30						4					1		143
Curry	55	1			2				4				14				76
Douglas	32	5	1	1	3	1	1		1				5		6		56
Lane	32	20	20	15									16				103
Multnomah	70	34	16	33					4								157
Tillamook	36	7					19										62
Wasco	30	6							3			3	82				124
Total	654	445	261	765	91	69	204	48	27	4		9	117		11		2,705
On shore, in canneries, etc.:																	
Benton	4										18						22
Clatsop	143	20	7	20	6				2		592	2					792
Columbia	12																12
Coos	10										25						35
Curry	27										36						63
Douglas	9										42						51
Lane	24										53		14				91
Multnomah	46	6	2	6	4						188						252
Tillamook	6										57						63
Wasco	17										95		17				129
Total	208	26	9	26	10				2		1,106	2	31				1,510

Table showing by counties the nationality of persons employed in the fisheries of Oregon in 1892.

Counties.	United States.	Sweden.	Norway.	Russia.	Great Britian.	Italy.	Austria.	Greece.	Germany.	France.	China.	Denmark.	United States Indians.	Japan.	Portugal.	Others.	Total.
On vessels fishing:																	
Clatsop	22	2	4		3											4	35
Multnomah	17	1	1		5									1			25
Total	39	3	5		8									1		4	60
On vessels transporting:																	
Clatsop	21																21
Curry	27																27
Multnomah	9																9
Total	57																57
In shore or boat fisheries:																	
Benton	75	4	4														83
Clackamas	40																40
Clatsop	1,621	28	23	99	11	4	35										1,821
Columbia	40																40
Coos	108	9	11	11						3					1		143
Curry	62												14				76
Douglas	51												5				56
Lane	75	5	4	3									16				103
Multnomah	157																157
Tillamook	62																62
Wasco	37	2							1			2	82				124
Total	2,328	48	42	113	11	4	35		1	3		2	117		1		2,705
On shore, in canneries, etc.:																	
Benton	4										18						22
Clatsop	178	8	2	10							592	2					792
Columbia	12																12
Coos	10										25						35
Curry	27										36						63
Douglas	9										42						51
Lane	24										53		14				91
Multnomah	59	2		3							188						252
Tillamook	6										57						63
Wasco	17										95		17				129
Total	346	10	2	13							1,106	2	31				1,510

Table showing by counties the vessels, boats, apparatus, and property employed in the fisheries of Oregon in 1889, 1890, 1891, and 1892.

Years and counties.	Vessels fishing.				Vessels transporting.				Boats.	
	No.	Tonnage.	Value.	Value of outfit.	No.	Tonnage.	Value.	Value of outfit.	No.	Value.
1889.										
Benton									67	$1,710
Clackamas									29	700
Clatsop					5	85.23	$12,900	$3,090	702	97,675
Columbia									35	2,625
Coos									76	3,925
Curry					5	358.71	30,000	6,440	41	3,250
Douglas									38	3,275
Lane									26	650
Multnomah									125	9,575
Tillamook	1	71.17	$18,000	$4,600					25	2,500
Total	1	71.17	18,000	4,600	10	443.94	42,900	9,530	1,164	125,885

Table showing by counties the vessels, boats, apparatus, and property employed in the fisheries of Oregon in 1889, 1890, 1891, and 1892—Continued.

Years and counties.	Vessels fishing.				Vessels transporting.				Boats.	
	No.	Tonnage.	Value.	Value of outfit.	No.	Tonnage.	Value.	Value of outfit.	No.	Value.
1890.										
Benton									30	$630
Clackamas									29	710
Clatsop					5	85.23	$12,900	$3,075	739	102,925
Columbia									52	2,800
Coos									31	1,475
Curry					5	358.71	30,000	6,455	41	3,250
Douglas									2	150
Lane									24	600
Multnomah	1	148.97	$10,000	$3,150					140	10,000
Tillamook									25	2,500
Total	1	148.97	10,000	3,150	10	443.94	42,900	9,530	1,113	125,040
1891.										
Benton									45	1,150
Clackamas									30	730
Clatsop	2	82.93	5,000	3,450	5	99.60	24,365	2,880	853	119,325
Columbia									60	3,000
Coos									38	1,675
Curry					5	358.71	29,375	6,130	43	3,550
Douglas									2	150
Lane									21	525
Multnomah	1	148.97	10,000	4,000					132	9,865
Tillamook									26	2,575
Wasco									2	40
Total	3	231.90	15,000	7,450	10	458.31	53,740	9,010	1,252	142,585
1892.										
Benton									50	1,350
Clackamas									30	750
Clatsop	3	98.66	7,300	4,350	12	154.06	30,900	3,725	966	127,975
Columbia									98	3,950
Coos									60	2,325
Curry					5	358.71	29,200	5,820	40	3,475
Douglas									28	2,100
Lane									58	1,900
Multnomah	1	148.97	10,000	4,000	3	42.43	13,000	2,400	157	10,450
Wasco									7	150
Total	4	247.63	17,300	8,350	20	555.20	73,100	11,945	1,494	154,425

Years and counties.	Apparatus of capture.												
	Gill nets.		Pound nets.		Seines.		Wheels.		Dip nets.		Value of lines.	Value of tongs and hoes.	Value of guns, etc.
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.			
1889.													
Benton	55	$3,300										$120	
Clackamas	117	2,930											
Clatsop	568	144,925	99	$73,900	8	$4,875							
Columbia	41	5,590									$1,750		
Coos	140	4,700			5	750					87	25	
Curry	168	3,560			10	1,800							
Douglas	45	6,190	2	800									
Lane	26	1,560											
Multnomah	194	5,450					15	$44,552			2,650		
Tillamook	50	3,750											
Wasco							16	75,500	95	$475			
Total	1,404	181,955	101	74,700	23	7,425	31	120,052	95	475	4,487	145	
1890.													
Benton	18	1,080										125	
Clackamas	118	2,945											
Clatsop	601	152,825	108	76,500	7	2,775							
Columbia	43	5,620									2,240		
Coos	56	2,050			1	250					90	25	
Curry	168	3,560			10	1,800							
Douglas	2	150											
Lane	24	1,440											
Multnomah	154	4,900					13	37,052			4,200		$850
Tillamook	50	3,750											
Wasco							16	70,500	85	425			
Total	1,234	178,320	108	76,500	18	4,825	29	107,552	85	425	6,530	150	850

Table showing by counties the vessels, boats, apparatus, and property employed in the fisheries of Oregon in 1889, 1890, 1891, and 1892—Continued.

Years and counties.	Apparatus of capture.												
	Gill nets.		Pound nets.		Seines.		Wheels.		Dip nets.		Value of lines.	Value of tongs and hoes.	Value of guns, etc.
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.			
1891.													
Benton	40	$2,400	....	....	1	$300	....	....	....	....	....	$128	......
Clackamas	118	2,950	....	....	....	....	....	....	....	....	....	......	......
Clatsop	667	175,100	142	$100,500	18	10,750	....	....	....	....	....	......	$1,000
Columbia	45	5,650	....	....	....	....	....	....	....	....	$2,800	......	......
Coos	70	2,470	....	....	2	500	....	....	....	....	96	25	......
Curry	164	3,480	....	....	9	2,100	....	....	....	....	....	......	200
Douglas	2	150	....	....	....	....	....	....	....	....	....	......	......
Lane	21	1,260	....	....	....	....	....	....	....	....	....	......	......
Multnomah	125	4,415	....	....	....	....	12	$31,052	....	....	4,550	......	850
Tillamook	50	3,750	....	....	1	300	....	....	....	....	....	......	......
Wasco	......	....	....	....	1	400	18	77,100	60	$300	....	......	......
Total	1,302	201,625	142	100,500	32	14,350	30	108,152	60	300	7,446	153	2,050
1892.													
Benton	37	2,220	....	....	1	300	....	....	....	....	....	124	......
Clackamas	120	3,000	....	....	....	....	....	....	....	....	....	......	......
Clatsop	677	181,800	245	172,400	13	7,550	....	....	....	....	....	......	1,000
Columbia	45	5,650	....	....	....	....	....	....	....	....	4,080	......	......
Coos	107	4,000	....	....	6	1,500	....	....	....	....	100	25	......
Curry	160	3,400	....	....	8	2,000	....	....	....	....	....	......	200
Douglas	28	3,710	....	....	....	....	....	....	....	....	....	......	......
Lane	58	3,480	....	....	1	150	....	....	....	....	....	......	......
Multnomah	164	5,000	....	....	....	....	19	40,752	....	....	5,740	......	850
Wasco	......	....	2	1,000	3	1,100	21	92,100	50	250	....	......	......
Total	1,306	212,260	247	173,400	32	12,600	40	132,852	50	250	10,520	149	2,050

Years and counties.	Value of shore and accessory property.	Cash capital.	Total value of investment.
1889.			
Benton	$14,000	$25,000	$44,130
Clackamas	290	....	3,920
Clatsop	428,900	358,000	1,124,265
Columbia	2,500	3,000	15,465
Coos	16,000	40,000	65,487
Curry	33,300	55,000	133,350
Douglas	15,000	30,000	55,265
Lane	13,000	30,000	45,210
Multnomah	53,755	31,900	147,882
Tillamook	21,000	20,000	69,850
Wasco	50,500	28,000	154,475
Total	648,245	620,900	1,859,299
1890.			
Benton	4,000	....	5,835
Clackamas	290	....	3,945
Clatsop	402,300	400,000	1,153,300
Columbia	2,500	4,000	17,160
Coos	1,600	4,000	9,490
Curry	31,200	52,000	128,265
Douglas	....	....	300
Lane	13,000	10,000	25,040
Multnomah	60,055	140,000	270,207
Tillamook	21,000	27,000	54,250
Wasco	60,500	70,000	201,425
Total	596,445	707,000	1,869,217
1891.			
Benton	$14,000	$11,000	$28,978
Clackamas	300	....	3,980
Clatsop	393,700	469,000	1,305,070
Columbia	2,500	6,000	19,950
Coos	10,700	10,000	25,466
Curry	31,100	52,000	127,935
Douglas	....	....	300
Lane	13,000	7,000	21,785
Multnomah	61,000	55,000	180,732
Tillamook	21,000	10,000	37,625
Wasco	35,650	20,000	133,490
Total	582,950	640,000	1,885,311
1892.			
Benton	14,000	10,000	27,994
Clackamas	300	....	4,050
Clatsop	413,600	449,000	1,399,600
Columbia	2,500	14,000	30,780
Coos	11,100	20,000	39,050
Curry	30,900	35,000	109,995
Douglas	15,000	20,000	40,810
Lane	24,000	35,000	64,530
Multnomah	88,100	170,000	350,292
Wasco	60,650	50,000	205,250
Total	660,150	803,000	2,272,351

Table showing by counties and species the yield of the fisheries of Oregon in 1889, 1890, 1891, and 1892.

Counties and species.	1889.		1890.		1891.		1892.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Benton:								
Chinook salmon	428, 428	$5, 968	71. 160	$1, 343	260, 359	$3, 117	284, 290	$3, 396
Silver salmon	444, 709	7, 269	85, 400	1, 668	135, 383	2, 018	88, 710	1, 584
Crabs	6, 628	265	4, 200	168	3, 521	141	4, 125	495
Oysters	150, 000	3, 125	132, 360	2, 758	146, 040	3, 043	147, 000	3, 062
Total	1, 029, 765	16, 627	293, 120	5, 937	545, 303	8, 319	524, 125	8, 537
Clackamas:								
Blueback salmon	15, 220	609	22, 340	894	21, 140	846	27. 225	1, 089
Chinook salmon	90, 114	3, 605	124, 114	4, 964	88. 750	3, 550	114, 112	4, 564
Steelhead salmon	20, 670	413	30, 206	604	18, 112	362	24, 214	630
Total	126. 004	4, 627	176, 660	6, 462	128, 002	4, 758	165, 551	6,283
Clatsop:								
Black-cod					1, 000	8		
Blueback salmon	185, 015	3, 775	263, 715	5, 275	126, 940	3, 191	626. 495	15, 980
Chinook salmon	9, 121, 935	449, 548	12, 047, 880	405, 528	14, 216, 680	565, 354	12, 107, 750	484, 316
Cultus-cod					800	8		
Flounders							10, 000	400
Halibut					28, 000	1, 400	2, 000	100
Rockfish							5, 000	200
Shad	29, 990	2, 999	50, 100	4, 008	70, 500	4, 230	109, 000	3. 270
Silver salmon	407, 990	9, 619	441, 890	5, 479	132, 580	1, 325		
Steelhead salmon	654, 740	13, 513	766, 550	7. 664	699, 380	7, 392	1, 316, 120	13, 975
Fur-seal pelts						8, 480		18, 788
Total	10, 399, 670	479, 454	13, 570, 135	427, 954	15, 275, 880	591, 388	14, 176, 365	537, 029
Columbia:								
Blueback salmon	17, 000	510	25, 000	750	15, 000	550	20, 000	700
Chinook salmon	116. 000	4, 640	187, 000	7, 480	115, 000	4, 600.	150, 000	6, 000
Steelhead salmon	21, 050	528	38, 000	1, 140	22, 000	560	30, 000	750
Sturgeon	314, 730	3, 395	358, 620	3, 996	471. 987	5, 170	960, 795	10, 280
Total	468, 730	9, 073	608, 620	13, 366	623. 987	10, 880	1, 160, 795	17, 730
Coos:								
Chinook salmon, fresh	138, 841	3, 286	17, 500	188	29, 110	320	52, 500	836
Chinook salmon, salted	47. 500	1, 250	40, 000	454	36, 250	412	32, 500	517
Cultus-cod	26, 112	1, 305	27, 120	1, 356	27, 615	1, 381	26, 304	1. 315
Halibut	17, 250	1, 725	16, 450	1, 045	15, 930	1, 593	16, 870	1, 687
Rockfish	84, 010	4, 200	82, 260	4, 113	83, 220	4, 161	81, 115	4, 055
Silver salmon, fresh	987, 009	25, 051	126, 000	1, 890	203, 770	3, 056	262, 500	4, 037
Silver salmon, salted	332, 500	9, 984	280, 000	4, 200	253, 750	3, 806	227, 500	3, 500
Clams	48, 720	812	46, 500	775	45, 600	760	49, 500	825
Total	1, 681, 942	47, 613	635, 830	14, 021	695, 245	15, 489	748, 789	16, 772
Curry:								
Chinook salmon, fresh	912, 382	26, 974	1, 100, 252	32, 353	1, 162, 313	34, 870	685, 897	19, 911
Chinook salmon, salted	23, 400	936	47, 100	1, 884	61, 200	2. 448	22, 200	890
Silver salmon, fresh	554, 358	10, 965	238, 808	4, 662	135, 087	2, 702	200, 353	3, 874
Silver salmon, salted	26, 600	1, 064	33, 100	1, 324	45, 800	1, 832	24, 600	984
Sea-otter pelts								1, 729
Total	1, 516, 740	39, 939	1, 419, 260	40, 223	1, 404, 400	41, 852	933, 050	27, 388
Douglas:								
Chinook salmon	271, 345	5, 426	7, 000	350	8, 000	400	105, 000	1, 312
Silver salmon	536, 655	10, 733	13, 000	650	14, 000	700	754, 600	11, 314
Total	808. 000	16, 159	20, 000	1, 000	22, 000	1, 100	859, 600	12, 626
Lane:								
Chinook salmon	168. 420	3, 368	114, 969	862	110. 000	825	141, 100	1, 763
Silver salmon	842. 210	21, 054	291, 621	4. 375	223, 270	3. 350	1, 198, 300	17, 794
Total	1, 010, 630	24, 422	406, 590	5, 237	333, 270	4, 175	1, 339, 400	19, 557
Multnomah:								
Black-cod	25. 000	1, 250						
Blueback salmon	330. 240	12. 549	1, 643, 978	45, 837	267, 610	8, 497	1, 234, 405	33. 059
Chinook salmon	387, 789	16, 012	1, 485, 339	46, 981	491, 654	16, 728	824, 548	28, 465
Cultus-cod	75, 000	2, 250						
Halibut	470, 000	9, 400						
Steelhead salmon	99, 080	3, 156	326. 823	7, 470	126, 208	3, 482	437, 093	11, 360
Sturgeon	427, 000	5, 426	1, 082, 826	12, 283	984, 632	12, 141	1, 552, 695	17, 721
Fur-seal pelts				15, 000		18, 000		24, 478
Crawfish	20, 000	3, 000	25. 000	3, 750	30, 000	4, 800	20, 000	3, 000
Total	1, 834, 109	53, 043	4, 563, 966	131, 321	1, 900, 104	63, 648	4, 068, 741	118, 083

Table showing by counties and species the yield of the fisheries of Oregon in 1889, 1890, 1891, and 1892—Continued.

Counties and species.	1889.		1890.		1891.		1892.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Tillamook:								
Chinook salmon	490,000	$7,840	297,500	$2,975	309,458	$3,705	280,000	$3,360
Silver salmon	285,115	5,702	868,800	13,032	218,500	3,277	1,049,500	15,742
Total	775,115	13,542	1,166,300	16,007	527,958	6,982	1,329,500	19,102
Wasco:								
Blueback salmon	599,615	17,518	1,588,910	45,205	440,702	11,043	1,232,272	32,542
Chinook salmon	322,833	9,453	1,143,587	32,460	377,644	10,241	832,085	25,084
Silver salmon	67,494	1,170	102,880	1,817	113,030	2,212	371,488	9,835
Steelhead salmon	48,590	1,227	641,410	12,695	256,640	5,160	779,344	21,837
Total	1,038,532	29,368	3,476,787	92,177	1,188,016	28,656	3,215,189	89,298
All counties:								
Black-cod	25,000	1,250	....	....	1,000	8	....	....
Blueback salmon	1,147,090	34,961	3,543,943	97,961	871,392	24,127	3,140,397	83,370
Chinook salmon, fresh	12,478,087	536,120	16,596,301	535,484	17,168,968	643,710	15,577,282	579,007
Chinook salmon, salted	70,900	2,186	87,100	2,338	97,450	2,860	54,700	1,407
Cultus-cod	101,112	3,555	27,120	1,356	28,415	1,389	26,304	1,315
Flounders	....	....	....	....	....	....	10,000	400
Halibut	487,250	11,125	16,450	1,645	43,960	2,993	18,870	1,787
Rockfish	84,010	4,200	82,260	4,113	83,220	4,161	86,115	4,255
Shad	29,990	2,909	50,100	4,008	70,500	4,230	109,000	3,270
Silver salmon, fresh	4,125,540	91,563	2,168,399	33,573	1,175,620	18,640	3,925,451	64,180
Silver salmon, salted	359,100	11,048	313,100	5,524	290,550	5,638	252,100	4,484
Steelhead salmon	814,080	18,837	1,802,989	29,573	1,122,340	16,956	2,586,771	48,552
Sturgeon	741,730	8,821	1,441,446	16,279	1,456,619	17,311	2,513,490	28,001
Fur-seal pelts	....	....	....	15,000	....	26,480	....	43,266
Sea-otter pelts	....	....	....	....	....	....	....	1,729
Crawfish	20,000	3,000	25,000	3,750	30,000	4,800	20,000	3,000
Crabs	6,628	265	4,200	168	3,521	141	4,125	495
Clams	48,720	812	46,500	775	45,600	760	49,500	825
Oysters	150,000	3,125	132,360	2,758	146,040	3,043	147,000	3,062
Grand total	20,719,237	733,867	26,337,268	754,305	22,644,165	777,247	28,521,105	872,405

Table showing by counties, species, and apparatus of capture the yield of the fisheries of Oregon in 1889.

Counties and species.	Gill nets.		Pound nets and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Benton:								
Chinook salmon	428,428	$5,068	....	....	....	....	....	....
Silver salmon	444,709	7,269	....	....	....	....	....	....
Crabs	6,628	265	....	....	....	....	....	....
Total	879,765	13,502	....	....	....	....	....	....
Clackamas:								
Blueback salmon	15,220	609	....	....	....	....	....	....
Chinook salmon	90,114	3,605	....	....	....	....	....	....
Steelhead salmon	20,670	413	....	....	....	....	....	....
Total	126,004	4,627	....	....	....	....	....	....
Clatsop:								
Blueback salmon	655	13	166,860	$3,281	17,500	$481	....	....
Chinook salmon	6,315,960	309,811	2,187,175	108,994	618,800	30,743	....	....
Shad	....	....	29,800	2,980	190	19	....	....
Silver salmon	330,577	8,071	....	....	77,413	1,548	....	....
Steelhead salmon	103,560	2,071	383,980	7,724	167,200	3,718	....	....
Total	6,750,752	319,966	2,767,815	122,979	881,103	36,509	....	....
Columbia:								
Blueback salmon	17,000	510	....	....	....	....	....	....
Chinook salmon	116,000	4,640	....	....	....	....	....	....
Steelhead salmon	21,000	528	....	....	....	....	....	....
Sturgeon	78,682	848	....	....	....	....	236,048	$2,547
Total	232,682	6,526	....	....	....	....	236,048	2,547

Table showing by counties, species, and apparatus of capture the yield of the fisheries of Oregon in 1889—Continued.

Counties and species.	Gill nets.		Pound nets and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Coos:								
Chinook salmon, fresh	103,394	$2,353			35,447	$933		
Chinook salmon, salted	47,500	1,250						
Cultus-cod							26,112	$1,305
Halibut							17,250	1,725
Rockfish							84,010	4,200
Silver salmon, fresh	800,773	19,734			177,236	5,317		
Silver salmon, salted	332,500	9,984						
Total	1,293,167	33,321			212,683	6,250	127,372	7,230
Curry:								
Chinook salmon, fresh	689,280	20,391			253,102	6,583		
Chinook salmon, salted	4,000	160			19,400	776		
Silver salmon, fresh	7,500	150			546,858	10,815		
Silver salmon, salted	9,000	360			17,600	704		
Total	709,780	21,061			836,960	18,878		
Douglas:								
Chinook salmon	238,345	4,766	33,000	$660				
Silver salmon	506,655	10,133	30,000	600				
Total	745,000	14,899	63,000	1,260				
Lane:								
Chinook salmon	168,420	3,368						
Silver salmon	842,210	21,054						
Total	1,010,630	24,422						
Multnomah:								
Black-cod							25,000	1,250
Blueback salmon	144,905	5,136						
Chinook salmon	273,789	11,452						
Cultus-cod							75,000	2,250
Halibut							470,000	9,400
Steelhead salmon	72,930	2,111						
Sturgeon							427,000	5,426
Total	491,624	18,699					997,000	18,326
Tillamook:								
Chinook salmon	490,000	7,840						
Silver salmon	285,115	5,702						
Total	775,115	13,542						
All counties:								
Black-cod								
Blueback salmon	177,780	6,268	166,680	3,281	17,500	481	25,000	4,200
Chinook salmon, fresh	8,913,730	374,194	2,220,175	109,654	907,349	38,259		
Chinook salmon, salted	51,500	1,410			19,400	776		
Cultus-cod							101,112	3,555
Halibut							487,250	11,125
Rockfish							84,010	4,200
Shad			29,800	2,980	190	19		
Silver salmon, fresh	3,226,539	72,113	30,000	600	801,507	17,680		
Silver salmon, salted	341,500	10,344			17,600	704		
Steelhead salmon	218,160	5,123	383,080	7,724	167,200	3,718		
Sturgeon	78,682	848					663,048	7,973
Crabs	6,628	265						
Grand total	13,014,519	470,565	2,830,815	124,239	1,930,746	61,637	1,360,420	28,103

Table showing by counties, species, and apparatus of capture the yield of the fisheries of Oregon in 1889—Continued.

Counties and species.	Wheels.		Minor nets.		Tongs and hoes.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Benton:						
Oysters					150,000	$3,125
Coos:						
Clams					48,720	812
Multnomah:						
Blueback salmon	185,325	$7,413				
Chinook salmon	114,000	4,560				
Steelhead salmon	26,150	1,045				
Crawfish			20,000	$3,000		
Total	325,485	13,018	20,000	3,000		
Wasco:						
Blueback salmon	515,115	15,677	84,500	1,841		
Chinook salmon	265,550	8,307	57,283	1,146		
Silver salmon	31,500	630	35,994	540		
Steelhead salmon	37,140	998	11,450	229		
Total	849,305	25,612	189,227	3,756		
All counties:						
Blueback salmon	700,450	23,090	84,500	1,841		
Chinook salmon	379,550	12,867	57,283	1,146		
Silver salmon	31,500	630	35,994	540		
Steelhead salmon	63,290	2,043	11,450	229		
Crawfish			20,000	3,000		
Clams					48,720	812
Oysters					150,000	3,125
Grand total	1,174,790	38,630	209,227	6,756	198,720	3,937

Table showing by counties, species, and apparatus of capture the yield of the fisheries of Oregon in 1890.

Counties and species.	Gill nets.		Pound nets and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Benton:								
Chinook salmon	71,160	$1,343						
Silver salmon	85,400	1,668						
Crabs	4,200	168						
Total	160,760	3,179						
Clackamas:								
Blueback salmon	22,340	894						
Chinook salmon	124,114	4,964						
Steelhead salmon	30,206	604						
Total	176,660	6,462						
Clatsop:								
Blueback salmon			252,465	$5,050	11,250	$225		
Chinook salmon	9,176,655	303,143	2,602,475	93,385	268,750	9,000		
Shad			49,570	3,965	530	43		
Silver salmon	364,556	3,932			77,334	1,547		
Steelhead salmon	160,420	1,604	516,000	5,159	90,130	901		
Total	9,701,631	308,679	3,420,510	107,559	417,994	11,716		
Columbia:								
Blueback salmon	25,000	750						
Chinook salmon	187,000	7,480						
Steelhead salmon	38,000	1,140						
Sturgeon	89,659	998					268,961	$2,998
Total	339,659	10,368					268,961	2,998
Coos:								
Chinook salmon, fresh	14,000	148			3,500	40		
Chinook salmon, salted	40,000	454						
Cultus-cod							27,120	1,356
Halibut							16,450	1,645
Rockfish							82,260	4,113
Silver salmon, fresh	101,000	1,515			25,000	375		
Silver salmon, salted	280,000	4,200						
Total	435,000	6,317			28,500	415	125,830	7,114

Table showing by counties, species, and apparatus of capture the yield of the fisheries of Oregon in 1890—Continued.

Counties and species.	Gill nets.		Pound nets and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Curry:								
Chinook salmon, fresh	983,450	$20,504			116,802	$2,849		
Chinook salmon, salted	11,400	456			35,700	1,428		
Silver salmon, fresh					238,808	4,662		
Silver salmon, salted	6,000	240			27,100	1,084		
Total	1,000,850	30,200			418,410	10,023		
Douglas:								
Chinook salmon	7,000	350						
Silver salmon	13,000	650						
Total	20,000	1,000						
Lane:								
Chinook salmon	114,969	862						
Silver salmon	291,621	4,375						
Total	406,590	5,237						
Multnomah:								
Blueback salmon	420,993	9,148						
Chinook salmon	423,339	15,122						
Steelhead salmon	145,843	2,041						
Sturgeon							1,082,826	$12,283
Total	990,175	26,311					1,082,826	12,283
Tillamook:								
Chinook salmon	297,500	2,975						
Silver salmon	868,800	13,032						
Total	1,166,300	16,007						
All counties:								
Blueback salmon	468,333	10,792	252,465	$5,050	11,250	225		
Chinook salmon, fresh	11,399,187	365,891	2,602,475	93,385	389,052	11,889		
Chinook salmon, salted	51,400	910			35,700	1,428		
Cultus-cod							27,120	1,356
Halibut							16,450	1,645
Rockfish							82,260	4,113
Shad			49,570	3,965	530	43		
Silver salmon, fresh	1,724,377	25,172			341,142	6,584		
Silver salmon, salted	286,000	4,440			27,100	1,084		
Steelhead salmon	374,469	5,389	516,000	5,159	90,130	901		
Sturgeon	89,659	998					1,351,787	15,281
Crabs	4,200	168						
Grand total	14,397,625	413,760	3,420,510	107,559	894,004	22,154	1,477,617	22,395

Counties and species.	Wheels.		Minor nets.		Tongs and hoes.		Spears, guns, etc.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Benton:								
Oysters					132,360	$2,758		
Coos:								
Clams					46,500	775		
Multnomah:								
Blueback salmon	1,222,985	$36,689						
Chinook salmon	1,062,000	31,859						
Steelhead salmon	180,980	5,429						
Fur-seal pelts								$15,000
Crawfish			25,000	$3,750				
Total	2,465,965	73,977	25,000	3,750				15,000
Wasco:								
Blueback salmon	1,425,170	42,755	163,740	2,450				
Chinook salmon	1,018,053	30,502	125,534	1,958				
Silver salmon	31,620	749	71,260	1,068				
Steelhead salmon	531,410	11,045	110,000	1,650				
Total	3,006,253	85,051	470,534	7,126				
All counties:								
Blueback salmon	2,648,155	79,444	163,740	2,450				
Chinook salmon	2,080,053	62,361	125,534	1,958				
Silver salmon	31,620	749	71,260	1,068				
Steelhead salmon	712,390	16,474	110,000	1,650				
Fur-seal pelts								15,000
Crawfish			25,000	3,750				
Clams					46,500	775		
Oysters					132,360	2,758		
Grand total	5,472,218	159,028	495,534	10,876	178,860	3,533		15,000

Table showing by counties, species, and apparatus of capture the yield of the fisheries of Oregon in 1891.

Counties and species.	Gill nets.		Pound nets and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Benton:								
Chinook salmon	182,359	$2,337			78,000	$780		
Silver salmon	72,383	1,388			63,000	630		
Crabs	3,521	141						
Total	258,263	3,866			141,000	1,410		
Clackamas:								
Blueback salmon	21,140	846						
Chinook salmon	88,750	3,550						
Steelhead salmon	18,112	362						
Total	128,002	4,758						
Clatsop:								
Black-cod							1,000	$8
Blueback salmon			115,080	$2,896	11,260	295		
Chinook salmon	11,064,180	439,252	2,740,325	109,613	412,175	16,489		
Cultus-cod							800	8
Halibut							28,000	1,400
Shad			62,000	3,720	8,500	510		
Silver salmon	132,580	1,325						
Steelhead salmon	102,800	971	548,660	5,563	47,920	858		
Total	11,299,560	441,548	3,466,065	121,792	479,855	18,152	29,800	1,416
Columbia:								
Blueback salmon	15,000	550						
Chinook salmon	115,000	4,600						
Steelhead salmon	22,000	560						
Sturgeon	118,001	1,292					353,986	3,878
Total	270,001	7,002					353,986	3,878
Coos:								
Chinook salmon, fresh	14,000	148			15,110	172		
Chinook salmon, salted	36,250	412						
Cultus-cod							27,615	1,381
Halibut							15,930	1,593
Rockfish							83,220	4,161
Silver salmon, fresh	101,000	1,515			102,770	1,541		
Silver salmon, salted	253,750	3,806						
Total	405,000	5,881			117,880	1,713	126,765	7,135
Curry:								
Chinook salmon, fresh	1,117,285	33,519			45,028	1,351		
Chinook salmon, salted	12,500	500			48,700	1,948		
Silver salmon, fresh					135,087	2,702		
Silver salmon, salted	2,500	100			43,300	1,732		
Total	1,132,285	34,119			272,115	7,733		
Douglas:								
Chinook salmon	8,000	400						
Silver salmon	14,000	700						
Total	22,000	1,100						
Lane:								
Chinook salmon	110,000	825						
Silver salmon	223,270	3,350						
Total	333,270	4,175						
Multnomah:								
Blueback salmon	151,215	4,945						
Chinook salmon	325,754	11,561						
Steelhead salmon	78,268	2,044						
Sturgeon							984,632	12,141
Total	555,237	18,550					984,632	12,141
Tillamook:								
Chinook salmon	259,598	3,115			49,860	590		
Silver salmon	178,500	2,677			40,000	600		
Total	438,098	5,792			89,860	1,190		

Table showing by counties, species, and apparatus of capture the yield of the fisheries of Oregon in 1891—Continued.

Counties and species.	Gill nets.		Pound nets and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Wasco:								
Silver salmon					6,000	$190		
Steelhead salmon					3,000	90		
Total					9,000	280		
All counties:								
Black-cod							1,000	$8
Blueback salmon	187,355	$6,341	115,680	$2,896	11,260	295		
Chinook salmon, fresh	13,284,926	499,307	2,740,325	109,613	600,173	19,382		
Chinook salmon, salted	48,750	912			48,700	1,948		
Cultus-cod							28,415	1,389
Halibut							43,930	2,993
Rockfish							83,220	4,161
Shad			62,000	3,720	8,500	510		
Silver salmon, fresh	721,733	10,955			346,857	5,663		
Silver salmon, salted	256,250	3,906			43,300	1,732		
Steelhead salmon	221,180	3,937	548,660	5,563	50,920	948		
Sturgeon	118,001	1,292					1,338,618	16,019
Crabs	3,521	141						
Grand total	14,841,716	526,791	3,466,665	121,792	1,109,710	30,478	1,495,183	24,570

Counties and species.	Wheels.		Minor nets.		Tongs and hoes.		Spears, guns, etc.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Benton:								
Oysters					146,040	$3,043		
Clatsop:								
Fur-seal pelts								$8,480
Coos:								
Clams					45,600	760		
Multnomah:								
Blueback salmon	116,395	$3,552						
Chinook salmon	165,900	5,167						
Steelhead salmon	47,940	1,438						
Fur-seal pelts								18,000
Crawfish			30,000	$4,800				
Total	330,235	10,157	30,000	4,800				18,000
Wasco:								
Blueback salmon	288,520	8,655	152,182	2,388				
Chinook salmon	304,053	9,122	73,591	1,119				
Silver salmon	34,440	933	72,590	1,089				
Steelhead salmon	179,040	3,930	74,600	1,140				
Total	806,053	22,640	372,963	5,736				
All counties:								
Blueback salmon	404,915	12,207	152,182	2,388				
Chinook salmon	469,953	14,289	73,591	1,119				
Silver salmon	34,440	933	72,590	1,089				
Steelhead salmon	226,980	5,368	74,600	1,140				
Fur-seal pelts								26,480
Crawfish			30,000	4,800				
Clams					45,600	760		
Oysters					146,040	3,043		
Grand total	1,136,288	32,797	402,963	10,536	191,640	3,803		26,480

Table showing by counties, species, and apparatus of capture the yield of the fisheries of Oregon in 1892.

Counties and species.	Gill nets.		Pound nets and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Benton:								
Chinook salmon	246, 790	$3, 021			37, 500	$375		
Silver salmon	76, 710	1, 464			12, 000	120		
Crabs	4, 125	495						
Total	327, 625	4, 980			49, 500	495		
Clackamas:								
Blueback salmon	27, 225	1, 089						
Chinook salmon	114, 112	4, 564						
Steelhead salmon	24, 214	630						
Total	165, 551	6, 283						
Clatsop:								
Blueback salmon			494, 210	$12, 360	132, 285	3, 620		
Chinook salmon	8, 314, 650	332, 622	3, 153, 925	126, 127	639, 175	25, 567		
Flounders							10, 000	$400
Halibut							2, 000	100
Rockfish							5, 000	200
Shad			94, 000	2, 820	15, 000	450		
Steelhead salmon	46, 480	499	1, 132, 400	11, 411	137, 240	2, 065		
Total	8, 361, 130	333, 121	4, 874, 535	152, 718	923, 700	31, 702	17, 000	700
Columbia:								
Blueback salmon	20, 000	700						
Chinook salmon	150, 000	6, 000						
Steelhead salmon	30, 000	750						
Sturgeon	120, 283	1, 287					840, 512	8, 993
Total	320, 283	8, 737					840, 512	8, 993
Coos:								
Chinook salmon, fresh	25, 000	398			27, 500	438		
Chinook salmon, salted	32, 500	517						
Cultus cod							26, 304	1, 315
Halibut							16, 870	1, 687
Rockfish							81, 115	4, 055
Silver salmon, fresh	137, 500	2, 114			125, 000	1, 923		
Silver salmon, salted	227, 500	3, 500						
Total	422, 500	6, 529			152, 500	2, 361	124, 289	7, 057
Curry:								
Chinook salmon, fresh	583, 570	17, 507			102, 327	2, 404		
Chinook salmon, salted	2, 000	80			20, 200	810		
Silver salmon, fresh					200, 353	3, 874		
Silver salmon, salted	3, 000	120			21, 600	864		
Total	588, 570	17, 707			344, 480	7, 952		
Douglas:								
Chinook salmon	105, 000	1, 312						
Silver salmon	754, 600	11, 314						
Total	859, 600	12, 626						
Lane:								
Chinook salmon	136, 950	1, 711			4, 150	52		
Silver salmon	1, 186, 140	17, 612			12, 160	182		
Total	1, 323, 090	19, 323			16, 310	234		
Multnomah:								
Blueback salmon	488, 195	10, 673						
Chinook salmon	372, 898	14, 915						
Steelhead salmon	140, 983	2, 477						
Sturgeon							1, 552, 695	17, 721
Total	1, 002, 076	28, 065					1, 552, 695	17, 721
Tillamook:								
Chinook salmon	280, 000	3, 360						
Silver salmon	1, 049, 500	15, 742						
Total	1, 329, 500	19, 102						

Table showing by counties, species, and apparatus of capture the yield of the fisheries of Oregon in 1892—Continued.

Counties and species.	Gill nets.		Pound nets and trap nets.		Seines		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Wasco:								
Blueback salmon			5,000	$150	105,450	$3,164		
Chinook salmon			51,180	2,140	49,540	1,511		
Silver salmon					10,000	300		
Steelhead salmon			3,000	45	48,112	962		
Total			59,180	2,335	213,102	5,937		
All counties:								
Blueback salmon	535,420	$12,462	499,210	12,510	237,735	6,784		
Chinook salmon, fresh	10,328,970	385,410	3,205,105	128,267	860,192	30,347		
Chinook salmon, salted	34,500	597			20,200	810		
Cultus-cod							26,304	$1,315
Flounders							10,000	400
Halibut							18,870	1,787
Rockfish							86,115	4,255
Shad			94,000	2,820	15,000	450		
Silver salmon, fresh	3,204,450	48,246			359,513	6,399		
Silver salmon, salted	230,500	3,620			21,600	864		
Steelhead salmon	241,677	4,356	1,135,400	11,456	185,352	3,027		
Sturgeon	120,283	1,287					2,393,207	26,714
Crabs	4,125	495						
Grand total	14,699,925	456,473	4,933,715	155,053	1,699,592	48,681	2,534,496	34,471

Counties and species.	Wheels.		Minor nets.		Tongs and hoes.		Spears, guns, etc.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Benton:								
Oysters					147,000	$3,062		
Clatsop:								
Fur seals								$18,788
Coos:								
Clams					49,500	825		
Curry:								
Sea-otter pelts								1,729
Multnomah:								
Blueback salmon	746,210	$22,386						
Chinook salmon	451,650	13,550						
Steelhead salmon	296,110	8,883						
Fur-seal pelts								24,478
Crawfish			20,000	$3,000				
Total	1,493,970	44,819	20,000	3,000				24,478
Wasco:								
Blueback salmon	826,713	24,801	295,109	4,427				
Chinook salmon	697,465	20,924	33,900	509				
Silver salmon	274,785	8,234	86,703	1,301				
Steelhead salmon	660,430	19,813	67,802	1,017				
Total	2,459,393	73,772	483,514	7,254				
All counties:								
Blueback salmon	1,572,923	47,187	295,109	4,427				
Chinook salmon	1,149,115	34,474	33,900	509				
Silver salmon	274,785	8,234	86,703	1,301				
Steelhead salmon	956,540	28,696	67,802	1,017				
Fur-seal pelts								43,266
Sea-otter pelts								1,729
Crawfish			20,000	3,000				
Clams					49,500	825		
Oysters					147,000	3,062		
Grand total	3,953,363	118,591	503,514	10,254	196,500	3,887		44,995

Table showing by counties the extent of the salmon-canning industry of Oregon in 1889, 1890, 1891, and 1892.

Counties and years.	No. of employees.	Canneries. No.	Canneries. Value.	Canneries. Cash capital.	Counties and years.	No. of employees.	Canneries. No.	Canneries. Value.	Canneries. Cash capital.
Benton:					Lane—cont'd.				
1889	34	1	$10,000	$25,000	1891	32	1	$13,000	$7,000
1891	22	1	10,000	11,000	1892	91	2	24,000	35,000
1892	22	1	10,000	10,000	Multnomah:				
Clatsop:					1889	157	2	46,000	29,000
1889	684	11	370,500	354,500	1890	191	2	46,000	133,000
1890	737	10	347,500	396,500	1891	158	2	46,000	46,000
1891	830	10	385,000	464,900	1892	225	3	71,000	150,000
1892	838	10	365,000	465,000	Tillamook:				
Coos:					1889	56	1	21,000	20,000
1889	87	2	14,500	40,000	1890	59	1	21,000	27,000
1891	37	1	9,000	10,000	1891	45	1	21,000	10,000
1892	35	1	9,000	20,000	1892	63	1	21,000	30,000
Curry:					Wasco:				
1889	105	2	32,300	55,000	1889	69	1	30,000	28,000
1890	78	1	30,000	52,000	1890	89	2	55,000	70,000
1891	72	1	30,000	52,000	1891	69	1	30,000	20,000
1892	63	1	30,000	35,000	1892	122	2	55,000	70,000
Douglas:					Total:				
1889	49	1	15,000	30,000	1889	1,281	22	552,300	611,500
1892	51	1	13,000	20,000	1890	1,190	17	512,500	688,500
Lane:					1891	1,265	18	544,000	620,000
1889	40	1	13,000	30,000	1892	1,510	22	598,000	835,000
1890	36	1	13,000	10,000					

Counties and years.	Salmon utilized in canning. Chinook. Pounds.	Chinook. Value.	Blueback. Pounds.	Blueback. Value.	Steelhead. Pounds.	Steelhead. Value.	Silver. Pounds.	Silver. Value.	Total. Pounds.	Total. Value.
Benton:										
1889	320,740	$3,849	......	......	......	......	309,260	$4,639	630,000	$8,488
1891	193,000	1,930	......	......	......	......	55,800	558	248,800	2,488
1892	224,000	2,600	......	......	......	......	14,000	180	238,000	2,780
Clatsop:										
1889	8,866,085	430,614	213,378	$10,669	681,846	$20,455	331,940	8,097	10,093,249	469,835
1890	11,298,416	342,237	242,352	4,847	869,088	8,691	372,890	5,659	12,782,746	361,434
1891	13,974,042	555,874	145,860	2,917	802,164	10,428	141,680	1,417	15,063,746	570 636
1892	12,328,418	483,635	629,244	14,169	1,383,954	22,143	574,000	5,740	14,915,616	525,687
Coos:										
1889	32,500	487	......	......	......	......	455.000	9,100	487,500	9,587
1891	29,100	320	......	......	......	......	158,770	2,381	187,870	2,701
1892	52,500	836	......	......	......	......	262,500	4,037	315,000	4,873
Curry:										
1889	871,757	25,687	......	......	......	......	509,483	10,190	1,381,240	35,877
1890	1,048,027	31,441	......	......	......	......	193,533	3,871	1,241,560	35,312
1891	1,162,113	34,870	......	......	......	......	135,087	2,702	1,297,200	37,572
1892	632,637	17,507	......	......	......	......	147,323	2,946	779,960	20,453
Douglas:										
1889	270,900	5,418	......	......	......	......	534,100	10,682	805,000	16,100
1892	105,000	1,312	......	......	......	......	754,600	11,314	859,600	12,626
Lane:										
1889	168,420	3,368	......	......	......	......	614,810	16,370	783,230	19,738
1890	107,100	803	......	......	......	......	178,221	2,675	285,321	3,478
1891	49,700	373	......	......	......	......	98,770	1,482	148,470	1,855
1892	130,900	1,636	......	......	......	......	1,149.400	17,140	1,280,300	18,776
Multnomah:										
1889	322,475	12,809	359,860	14,395	62,240	2,490	......	......	744,575	29,703
1890	1,393,815	41,814	2,084,645	62,499	345,350	10,360	......	......	3,823,810	114,673
1891	677,234	20,316	331,855	9,955	216,060	6,482	......	......	1,225,149	36,753
1892	1,313,300	39,400	2,079,855	60,639	960,370	28,911	......	......	4,353,525	128,950
Tillamook:										
1889	490,000	7,840	......	......	......	......	252,000	5,040	742,000	12,880
1890	297,500	2,975	......	......	......	......	840,000	12,600	1,137,500	15,575
1891	309,610	3,715	......	......	......	......	147,000	2,205	456,610	5,920
1892	280,000	3,360	......	......	......	......	1,015,000	15,225	1,295,000	18,585
Wasco:										
1889	261,732	8,179	488,032	14,641	31,500	631	......	......	781.264	23,451
1890	670,871	20,126	1,391,880	41,756	490,000	9,318	......	......	2,552,751	71,200
1891	226,060	6,800	253,820	7,615	192,220	4,324	......	......	672,700	18,739
1892	549,120	16,443	768,210	23,045	704,195	13,536	374,185	7,484	2,395.710	60,508
Total:										
1889	11,604,609	498,341	1,061,270	39,705	775,586	23,585	3,006,593	64,118	16,448,058	625,749
1890	14,815,729	439,396	3,718,877	109,102	1,704,438	28,369	1,584,644	24,805	21,823,688	601,672
1891	16,621,459	624,198	731,535	20,487	1,210,444	21,234	737,107	10,745	19,300,545	676,664
1892	15,615,875	566,729	3,477,309	97,853	3,048,519	64,590	4,291,008	64,066	26,432,711	793,238

Extent of salmon-canning industry of Oregon in 1889, 1890, 1891, and 1892—Continued.

Counties and years.	Cases of salmon packed.									
	Chinook.		Blueback.		Steelhead.		Silver.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Benton:										
1889	4,582	$25,201					4,418	$19,881	9,000	$45,082
1891	2,800	14,700					800	3,600	3,600	18,300
1892	3,200	16,800					200	900	3,400	17,700
Clatsop:										
1889	136,129	811,174	3,238	$18,467	10,331	$43,906	4,742	19,468	154,440	893,015
1890	170,938	985,041	3,672	20,196	13,168	52,672	5,330	19,655	193,108	1,077,564
1891	211,621	1,211,105	2,210	12,154	9,750	39,000	2,024	7,084	225,605	1,269,343
1892	186,673	1,079,103	9,534	62,437	20,969	83,876	8,200	28,700	225,376	1,254,116
Coos:										
1889	500	2,750					6,500	29,250	7,000	32,000
1891	413	2,271					2,268	11,149	2,681	13,420
1892	750	3,750					3,750	15,937	4,500	19,687
Curry:										
1889	13,360	80,160					7,836	34,862	21,196	115,022
1890	16,125	90,289					2,981	12,669	19,106	102,958
1891	17,882	100,139					2,078	9,641	19,960	109,780
1892	9,733	54,505					2,267	9,634	12,000	64,139
Douglas:										
1889	3,870	20,317					7,630	34,335	11,500	54,652
1892	1,500	7,500					10,780	43,120	12,280	50,620
Lane:										
1889	2,406	13,954					8,783	44,788	11,189	58,742
1890	1,530	8,032					2,547	12,353	4,077	20,385
1891	710	3,727					1,411	6,878	2,121	10,605
1892	1,870	9,817					16,420	73,433	18,290	83,250
Multnomah:										
1889	4,613	27,678	5,412	30,020	911	3,943			10,936	61,641
1890	19,912	115,489	29,795	163,872	6,440	25,760			56,147	305,121
1891	9,868	57,234	5,023	27,626	3,088	12,352			17,979	97,212
1892	21,292	123,493	29,169	160,429	13,913	55,652			64,374	339,574
Tillamook:										
1889	7,000	31,500					3,600	14,400	10,600	45,000
1890	4,250	21,250					12,000	48,000	16,250	69,250
1891	4,423	22,115					2,100	8,400	6,523	30,515
1892	4,000	20,000					14,500	58,000	18,500	78,000
Wasco:										
1889	3,739	22,434	7,329	42,141	450	2,050			11,518	66,625
1890	9,691	55,797	19,884	84,036	7,000	28,000			36,575	167,833
1891	3,238	17,809	3,626	19,036	2,746	10,884			9,610	47,729
1892	8,666	49,904	12,403	65,118	10,521	42,084	4,176	20,880	35,766	177,980
Total:										
1889	176,199	1,035,168	15,979	90,628	11,692	49,899	43,509	196,984	247,379	1,372,679
1890	222,446	1,275,898	53,351	268,104	26,608	106,432	22,858	92,677	325,263	1,743,111
1891	250,955	1,429,100	10,859	58,816	15,584	62,236	10,681	46,752	288,079	1,596,904
1892	237,684	1,364,872	51,106	287,984	45,403	181,612	60,293	250,604	394,486	2,085,072

Counties and years.	Quantity of salmon salted.						Barrels salted.					
	Chinook.		Silver.		Total.		Chinook.		Silver.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	No.	Value.	No.	Value.	No.	Value.
Benton:												
1889			15,000	$225	15,000	$225			50	$400	50	$400
1891			13,200	132	13,200	132			44	352	44	352
1892			15,000	175	15,000	175			50	400	50	400
Clatsop:												
1889			30,000	600	30,000	600			100	800	100	800
1890	240,000	$6,600	31,500	315	271,500	6,915	800	$7,200	105	840	905	8,040
1891			28,500	285	28,500	285			95	760	95	760
1892			30,600	306	30,600	306			102	816	102	816
Curry:												
1889	12,000	340	4,500	90	16,500	430	40	360	15	120	55	480
1891			16,500	330	16,500	330			55	440	55	440
Lane:												
1889			227,400	4,684	227,400	4,684			758	6,064	758	6,064
1890	7,869	59	113,400	1,700	121,269	1,759	26	208	378	3,000	404	3,208
1891	60,300	452	124,500	1,868	184,800	2,320	201	1,608	415	3,320	616	4,928
1892	10,200	127	48,900	654	59,100	781	34	272	163	1,304	197	1,576
Tillamook:												
1889			33,600	660	33,600	660			112	896	112	896
1890			27,900	418	27,900	418			93	745	93	745
1891			31,500	472	31,500	472			105	840	105	840
1892			34,500	517	34,500	517			115	920	115	920
Total:												
1889	12,000	340	310,500	6,259	322,500	6,599	40	360	1,035	8,280	1,075	8,640
1890	247,869	6,659	172,800	2,433	420,669	9,092	826	7,408	576	4,585	1,402	11,993
1891	60,300	452	214,200	3,087	274,500	3,539	201	1,608	714	5,712	915	7,320
1892	10,200	127	129,000	1,652	139,200	1,779	34	272	430	3,440	464	3,712

Extent of salmon-canning industry of Oregon in 1889, 1890, 1891, and 1892—Continued.

Counties and years.	Total quantity of fresh salmon utilized.									
	Chinook.		Blueback.		Steelhead.		Silver.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Benton:										
1889	320,740	$3,849					324,260	$4,864	645,000	$8,713
1891	193,000	1,930					69,000	690	262,000	2,620
1892	224,000	2,600					29,000	355	253,000	2,955
Clatsop:										
1889	8,866,085	430,614	213,378	$10,669	681,846	$20,455	361,940	8,697	10,123,249	470,435
1890	11,538,416	348,837	242,352	4,847	809,088	8,691	404,390	5,974	13,054,246	368,349
1891	13,974,042	555,874	145,860	2,917	802,164	10,428	170,180	1,702	15,092,246	570,921
1892	12,328,418	483,635	629,244	14,169	1,383,954	22,143	604,600	6,046	14,946,216	525,993
Coos:										
1889	32,500	487					455,000	9,100	487,500	9,587
1891	29,100	320					158,770	2,381	187,870	2,701
1892	52,500	836					262,500	4,037	315,000	4,873
Curry:										
1889	883,757	26,027					513,983	10,280	1,397,740	36,307
1890	1,048,027	31,441					193,533	3,871	1,241,560	35,312
1891	1,162,113	34,870					151,587	3,032	1,313,700	37,902
1892	632,637	17,507					147,323	2,946	779,960	20,453
Douglas:										
1889	270,900	5,418					534,100	10,682	805,000	16,100
1892	105,000	1,312					754,600	11,314	859,600	12,626
Lane:										
1889	168,420	3,368					842,210	21,054	1,010,630	24,422
1890	114,969	862					291,621	4,375	406,590	5,237
1891	110,000	825					223,270	3,350	333,270	4,175
1892	141,100	1,763					1,198,300	17,794	1,339,400	19,557
Multnomah:										
1889	322,475	12,899	359,860	14,395	62,240	2,499			744,575	29,793
1890	1,393,815	41,814	2,084,645	62,499	345,350	10,360			3,823,810	114,673
1891	677,234	20,316	331,855	9,955	216,060	6,482			1,225,149	36,753
1892	1,313,300	39,400	2,079,855	60,639	960,370	28,911			4,353,525	128,950
Tillamook:										
1889	490,000	7,840					285,600	5,700	775,600	13,540
1890	297,500	2,975					867,900	13,018	1,165,400	15,993
1891	309,610	3,715					178,500	2,677	488,110	6,392
1892	280,000	3,360					1,049,500	15,742	1,329,500	19,102
Wasco:										
1889	261,732	8,179	488,032	14,641	31,500	631			781,264	23,451
1890	670,871	20,126	1,391,880	41,756	490,000	9,318			2,552,751	71,200
1891	226,660	6,800	253,820	7,615	192,220	4,324			672,700	18,739
1892	549,120	16,443	768,210	23,045	704,195	13,536	374,185	7,484	2,395,710	60,508
Total:										
1889	11,616,609	498,681	1,061,270	39,705	775,586	23,585	3,317,093	70,377	16,770,558	632,348
1890	15,063,598	446,055	3,718,877	109,102	1,704,438	28,369	1,757,444	27,238	22,244,357	610,764
1891	16,681,759	624,650	731,535	20,487	1,210,444	21,234	951,307	13,832	19,575,045	680,203
1892	15,626,075	566,856	3,477,309	97,853	3,048,519	64,590	4,420,008	65,718	26,571,911	795,017

CURRY COUNTY.

The fisheries of this, the most southern county of the State, continue to be confined to the taking of salmon, although other anadromous species are, in their season, found entering some of the rivers, while numerous other fish are found in the ocean just outside the mouths of the streams. The five rivers of the county in which commercial fishing is prosecuted (Rogue, Windchuck, Chetco, Sikhs, and Elk) have been described in a former report. The Sikhs and Elk are of little importance as fishing streams except to the ranchers living near them.

Rogue River.—This, next to the Columbia, is the largest and longest coast river in Oregon. It has spring and fall runs of chinook salmon, and its fisheries continue of great importance. The catch of salmon shows considerable fluctuation, which is, in a measure, dependent on the amount of artificial propagation carried on at the private hatchery on the river. The marked decrease in the yield in 1892 was thought to be due to some unknown natural causes. The catch represents about the productive capacity of the river and, as it is all used for canning, a statement of the salmon pack will show the abundance of the fish. The number of canned salmon prepared on the river in each of the ten years ending in 1892 was as follows:

Years.	Cases.	Years.	Cases.
1883	16,156	1888	21,062
1884	12,576	1889	20,296
1885	9,310	1890	19,104
1886	12,147	1891	19,960
1887	17,216	1892	12,000

Salmon fishing on the Rogue River is limited by State law; the open season is from April 1 to November 15. By far the largest part of the catch is made during what is known as the spring run, between April 1 and June 30. The summer catch is taken between July 1 and August 30, and the fall catch represents the remainder of the open season.

Windchuck River.—A few salmon run up this small stream in spring, but the supply is too limited to warrant special operations, and the only fishing is done in September and October, when the regular run is in progress. Two haul seines are here used, and the catch is salted or sold fresh. The catch in the four years ending 1892 was as follows:

Years.	Salted.	Fresh.	Total.
	Pounds.	*Pounds.*	*Pounds.*
1889	16,000	....	16,000
1890	10,000	85,000	95,000
1891	10,000	75,000	85,000
1892	30,000	....	30,000

The fish sold fresh were sent to a salmon cannery on Smith River, California. In 1889 and 1892, when that cannery was idle, the catch was much reduced and had to be salted owing to lack of a market and absence of facilities for shipping. The few fishermen living on this small but beautiful stream take much interest in the fisheries, and in their primitive way have made some attempts at propagating salmon.

Chetko River.—This small stream has its mouth near the State line of California and Oregon. Twelve fishermen, using two haul seines, represent the full extent of the fisheries. In September chinook salmon are taken, and in October the run consists mostly of silver salmon. When the cannery on Smith River is open, most of the catch finds a market there, otherwise it must be salted. The quantity of the catch in 1889 to 1892, inclusive, was as follows:

Years.	Salted.	Fresh.	Total.
	Pounds.	*Pounds.*	*Pounds.*
1889	73,000	33,000	103,000
1890	10,000	108,000	118,000
1891	30,000	93,000	123,000
1892	56,000	....	56,000

Sikhs River.—This river is of some importance to the ranchers living near by, who depend on it for their supply of fish food, and some years a small quantity of fish is salted for market. In 1888, 20,000 pounds of fresh salmon were sold to a cannery on Coquille River, and in 1889 60,000 pounds to a cannery on Elk River. In 1891–92 no fish were taken except those consumed locally by ranchers. The output of this stream in recent years has been as follows:

Years.	Salted.	Fresh.	Total.
	Pounds.	*Pounds.*	*Pounds.*
1887	45,000	....	45,000
1888	12,000	20,000	32,000
1889	20,000	60,000	80,000
1890	30,000	....	30,000

Elk River.—For a short time each year this stream is fished by a few ranchers living near its mouth. The river has only a small run of salmon, and is so inconveniently situated that its fisheries will probably never have very much importance. In recent years the catch of the ranchers has amounted to only about 50 barrels of salt fish. In 1889 a cannery was established in connection with a steam sawmill at the mouth of the river. Some 900 cases of salmon were canned, but the business proved unsatisfactory and was not resumed. The output of the Elk River since 1887 has been as follows:

Years.	Salted.	Fresh.	Canned.	Total.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1887	45,000	....	....	45,000
1888	12,000	20,000	....	32,000
1889	15,000	20,000	58,500	93,000
1890	15,000	....	....	15,000
1891	15,000	....	....	15,000

Sea-otter hunting.—In 1891 the high price of sea-otter pelts led to the formation of two bands of hunters in Curry County. Twelve men, armed with rifles and using two sail and three row boats, skirted the coast from Cape Blanco to Rogue River, weather permitting, during March and April and August and September. At night the men camp at some desirable point. Some of their camping stations are located near high bluffs that have a fringe of timber along the ridge overlooking the sea. Such a spot near the feeding-grounds of the otter is a favorite place for a camp, for in the branches of some tall pine the hunter has his lookout station. A few boughs are chopped off and made into a comfortable resting-place up among the branches, and here one of the hunters will lie for hours, concealed by the thick foliage from view of shore or sea animal. His lofty location gives him an uninterrupted sea view for miles. His boat is close at hand. In case an otter shows up within range of a rifle, it is shot, and the hunter or one of his companions in hiding is quickly in the boat and going for the game. While some of the men are thus engaged, others may be miles away sailing along the coast with a sharp lookout for otters.

The number of otters killed is small, but they are of large size and have very fine fur, the pelts bringing from $150 to $200 each, and in some cases much more. During 1891, 20 otters were secured, and in one week in September, 1892, when the writer visited one of these unique tree-top stations, 8 otters were killed, the total catch for the year being 13, valued at $133 each. In 1893 the number taken was 17, having an average value of $157.

COOS COUNTY.

When contrasted with the last investigation, the fisheries of this county present few new features. Coquille River and Coos River and Bay are the fishing-grounds. The only catch of the rivers is salmon. A little more attention is given to the bay fisheries near Bandon and Empire City, where some halibut, perch, and cultus-cod are taken; these fish, with flounders and other varieties of salt-water fish, are found abundantly, but the demand is limited to local use and only small quantities are taken.

Coquille River.—Owing to a number of causes the fisheries of the Coquille have not been up to the average during the past few years. Only one cannery was packing during 1889, 1891, and 1892, and none during 1890. The run of fish was good in 1889, and the single cannery in operation packed 9,115 cases, of which one-sixth were chinook and five-sixths silver salmon; 50 barrels were also salted. The fishermen received 50 cents each for chinook and 30 cents each for silver salmon. Prices of canned salmon were low during the fall and winter, and gave little encouragement to canners; in consequence, during 1890, for the first season in a number of years, no salmon were canned on the river. A light catch was made and 200 barrels were salted. In 1891 the one cannery once more packed, but the run was light and only 2,684 cases were canned and 150 barrels salted, the fishermen receiving 25 cents each for chinook and 15 cents for silver salmon. In 1892 salmon were very abundant, more so than for a number of years. The run of the previous year having been so light, a large run was not expected and preparations had only been made for a small pack. The result of the year's work was 4,500 cases. On account of a scarcity of cans the surplus catch was salted, and 650 barrels were thus prepared. The fishermen received 35 cents each for chinook and 20 cents for silver salmon, the catch consisting of one-eighth chinook and seven-eighths silver salmon. A few fishermen of Bandon, near the mouth of the river, fished outside with hook and line, their catch in 1892 being 10,250 pounds of halibut, 9,112 pounds of cultus-cod, and 36,010 pounds of rockfish.

Coos River and Bay.—The one salmon cannery at Empire City being idle in 1890, 1891, and 1892, the fisheries were not given so much attention as in past years. The salmon catch had to be salted, and amounted to 900, 800, and 1,400 barrels, respectively, in the years named. A few fishermen fished outside the bay for salt-water fish that they disposed of locally, their catch being 17,000 pounds of cultus-cod, 7,000 pounds of halibut, and 48,000 pounds of rockfish, all taken with hand lines. In addition to the above, the fisheries of Coos Bay and River produced 50,000 pounds of salmon that were sold fresh for local use or shipped to San Francisco.

DOUGLAS COUNTY (UMPQUAH RIVER).

The fishing business of Douglas County is confined to the Umpquah River, and the catch consists only of salmon. Numerous other fish, however, come in from the ocean, among which are herring, sardines, smelt, and just outside the mouth of the river are halibut, cultus-cod, flounders, and rockfish. The section is remote from railroad or steamboat lines, and no attention is given to any fish except salmon, the catch of which is utilized at a cannery at Gardner. In 1889 a good run of salmon entered the Umpquah River. The fishermen disposed of their entire catch at the cannery at Gardner, near the mouth of the river, receiving 45 cents each for chinook salmon and 25 cents each for silver salmon. The cannery packed 11,500 cases. From some unknown cause very few salmon entered the river in 1890 or 1891, during which years the cannery remained closed. Only enough fish to supply the local demand were taken, the catch being 20,000 pounds in 1890 and 22,000 pounds in 1891. During 1892 salmon entered the river in great abundance, and the run in September was very heavy. The pack was only limited by the number of cans on hand and could have been doubled with proper facilities. As it was, 12,280 cases were packed. The fishermen received 25 cents each for chinook and 15 cents each for silver salmon, the latter constituting the bulk of the catch. No salmon was salted during the years mentioned.

LANE COUNTY (SIUSLAW RIVER).

The fisheries of Lane County are confined to the Siuslaw River and the catch consists only of salmon for canning purposes. This river is the dividing line between Lane and Douglas counties. One cannery, located at Florence, near the mouth of the river, was in operation in 1889, 1890, 1891, and 1892; one other cannery, 2 miles above, was idle during the first three years mentioned, but was run in 1892. The salmon pack during these years was 11,189 cases in 1889; 4,077 cases in 1890; 2,121 cases in 1891, and 18,290 cases in 1892.

It will be noticed by the amount packed that the run of fish is uncertain. In common with the other rivers of this State, salmon were very abundant during the fall of 1889, but only a few entered the stream in 1890 and 1891. In the fall of 1892 the run was again heavy and the fish were of good size and quality. The catch in 1892 amounted to 6,018 chinook salmon and 103,410 silver salmon, the average gross weight of the former being 20 pounds, and of the latter 10¾ pounds. In addition to the quantity canned in 1892, 34 barrels of chinook and 163 barrels of silver salmon were salted. The salmon are mostly caught with gill nets, only one haul seine being used. The fishermen comprise various nationalities, one-third of them being native-born, one-half Europeans, and twelve Indians. The cannery employees are Chinese, with the exception of a few Indian women.

This stream has no spring run of salmon. The first fish to enter the river are the chinooks, which arrive about the middle of July; most of the run of this species is in the river by the middle of September, a few also being found up to October 1. Silver salmon first enter the river about the time the run of the chinooks is dropping off, or from the first to the middle of September. In 1892 the first silver salmon were taken September 16. A good run at that time was followed the first week in October by a very large body of fish. When the river was visited by the writer on October 5 silver salmon were very abundant.

Large and small sardines are very abundant between June and September, and other varieties of good food-fish are found in the river at certain seasons, and at all times just outside of the river. From its isolated location, with indirect transportation facilities, no attention is paid to any branch of the fisheries except the salmon.

BENTON COUNTY.

This comparatively small county has two rivers whose fisheries are of considerable prominence, namely, the Alseya and the Yaquina. Each of these near its mouth expands into a long, narrow bay, which takes the name of its respective river. Outside the rivers the fisheries are of no importance, although there is an abundance of salt-water fish on the outlying banks in the near vicinity.

Alseya River.—The run of salmon on this stream was quite large in 1889, and 9,000 cases and 50 barrels were packed at the only cannery in operation. Prices of canned salmon ruled low, and on that account and the poor prospects for satisfactory results the cannery was idle during the following year. Fish were scarce in 1890; the cannery was closed, and besides a few salmon taken for local use only 50 barrels were salted and 6,000 pounds shipped fresh to Portland. In 1891 the fish were not abundant, and only 3,500 cases were canned, 50 barrels salted, and 16,000 pounds shipped away fresh. In 1892 a very large run of salmon entered the river for the first time in three years. The canners, not looking for the great increase, were prepared for only a light catch, and were obliged to close down early in the season as soon as all the cans had been filled. At the time the river was visited by the writer, on October 8, 1892, it was full of salmon, but no fishing was carried on. With only a limited number of cans to fill and a large run of fish to draw from, the fish packed consisted almost entirely of chinooks, although, as in the other coast rivers, silver salmon comprised fully three-fourths of the run.

Yaquina River.—Since the closing of the small canneries located on this stream in 1889 the fishing business has greatly decreased. A few barrels of salmon are annually packed for their own use by the ranchers living near by, and about 100,000 pounds are shipped fresh to Portland, Salem, and Albany. In the fall of 1892 one man from Oakland, Cal., was engaged in salting salmon. At the time the river was visited by the writer a few hundred barrels had been salted. The fish are mostly silver salmon, averaging 12 pounds each. The fishermen receive only 8 cents apiece for them.

The shipments of fresh salmon from the Yaquina River to Portland and other places in Oregon are quite large, and during the years 1889–1892 were as follows:

Years.	Pounds.	Value.
1889	208,137	$4,163
1890	118,060	2,361
1891	102,742	2,055
1892	125,000	2,500

The Yaquina is noticeable as being the only river on the Pacific Coast in which any considerable quantities of oysters are found. The oysters are natives, having the small size and peculiar flavor of those taken in Willapa Bay and Puget Sound. The quantity of oysters marketed, prices received, and persons employed in the business, etc., show few changes since the last inquiry, although the oystermen report that at present they can not tong and cull more than 2 or 3 bushels a day as against 5 or 6 bushels in past years. By State law the native oyster beds are apportioned out to citizens desiring to work them. No one is permitted to have over 2 acres. The aggregate acreage is small and the available land is all taken up. Oysters are tonged in water 12 to 15 feet deep at low tide. The tongs have handles 15 to 18 feet long, some being 26 feet long.

The price commanded by the oysters remains about the same from year to year, $2.50 a sack when shipped away, or $3 a sack for local use being the ruling prices. A sack weighs 105 pounds, and is known as 2 bushels, but is somewhat short of that amount.

The oyster output of the Yaquina River from 1889 to 1892, inclusive, was as follows:

Years.	Sacks.	Value.
1889	1,250	$3,125
1890	1,103	2,758
1891	1,217	3,043
1892	1,225	3,062

Crabs enter the river in considerable quantities. They are picked from the salmon nets and are gathered by the oystermen. The catch, which is small, is mostly shipped to Albany, Salem, and Portland.

The yearly shipments have been as follows:

Years.	Pounds.	Value.
1889	6,628	$265
1890	4,200	168
1891	3,521	141
1892	4,125	165

TILLAMOOK COUNTY.

This county has a frontage of over 50 miles on the Pacific Ocean and is traversed by a number of rivers, chief among which are the Siletz, Nestuggah, Tillamook, and Nehalem, the latter forming the boundary between Tillamook and Clatsop counties. The Nestuggah and Tillamook rivers empty into bays of the same name. The fisheries of the county are restricted to the capture of salmon, which enter the rivers in large quantities during the fall months. The relative abundance of chinook salmon in the streams of this county is greater than farther south. Some seasons the catch of chinooks will be fully equal in weight to that of silver salmon; at other times, as in the year 1892, the catch is often three-fourths silver salmon. Both fish run in greatest abundance about the same time, although the chinooks are the first to arrive, during August, while the silver salmon come in September. The movement of both species is over in November, when the fishing operations cease. A few fish continue to enter the river in the winter, in company with very large numbers of steelheads, but no attention is paid to them.

The entire salmon catch of Tillamook River is utilized at a cannery located near the mouth of that stream. The number of cases packed during each of the four years 1889 to 1892 were as follows:

Species.	1889.	1890.	1891.	1892.
	Cases.	*Cases.*	*Cases.*	*Cases.*
Chinook salmon	7,000	4,250	4,423	4,000
Silver salmon	3,600	12,000	2,100	14,500
Total	10,600	16,250	6,523	18,500

The Siletz River flows through an Indian reservation and the entire catch is obtained by Indians, who cure the fish for winter use. The annual quantity of salmon thus prepared is about 60,000 pounds.

CLATSOP COUNTY (NEHALEM RIVER).

The fisheries of the ocean side of this county are carried on only in the Nehalem River. Those in the Columbia River will be included in the general remarks on that river which follow. The Nehalem is a small stream rising in the Coast Range, in Clatsop County, and flowing southwesterly to the Pacific, which it enters at the southern end of the county, whose boundary it forms. Its fisheries, which are of some importance, are carried on in the fall, when there is a run of chinook and silver salmon in the river. With the exception of a few salmon salted, the entire catch is utilized at the cannery located on the river. Fishing is done by 44 Indian, Russian, and Austrian fishermen, using gill nets. The chinooks taken average about 20 pounds in weight, being somewhat lighter than those of the Columbia; the silver salmon average 10 pounds. The abundance of salmon varies a great deal from year to year; in 1891 the fish were very scarce, while in 1892 the run of silver salmon was phenomenally large; chinooks were less numerous in 1891 and 1892 than during the two preceding years. The catch of each kind of salmon during the four years named was as follows, the figures representing the number of fish taken:

Years.	Chinook salmon.	Silver salmon.	Total.
1889	13,093	29,194	42,287
1890	14,445	33,439	47,884
1891	6,174	17,168	23,342
1892	7,000	57,400	64,400

The quantity and value of the salmon packed and salted in the same years are given in the following table:

Years.	Salmon canned.						Salmon salted.		Total value.
	Chinook.		Silver.		Total.				
	Cases.	Value.	Cases.	Value.	Cases.	Value.	Barrels.	Value.	
1889	3,740	$16,830	3,742	$14,968	7,482	$31,798	100	$800	$32,598
1890	4,127	17,539	4,327	15,144	8,454	32,683	105	840	33,523
1891	1,764	7,056	2,024	7,084	3,788	14,140	100	800	14,940
1892	2,000	9,000	8,200	32,800	10,200	41,800	102	816	42,616

THE COLUMBIA RIVER.

The fisheries of this river are more extensive than those of any other stream in the United States, and the canning industry dependent thereon is more important than any other similar business connected with the fisheries. The annual output of fish in the Columbia River is greater than from any other river in the country, and no other stream has in the aggregate yielded such large quantities of fish.

The importance of the fishing industry of this river and the increased attention now being given to its condition warrant and make desirable the consideration of the stream as a unit, regardless of the separate interests of the two States whose boundary it forms and whose fisheries are given in detail, by counties, in the tables elsewhere presented.

Reference is seldom made to the fisheries of Washington and Oregon in which the Columbia is not mentioned, although the fishing industry comprises but one of the many branches of commerce connected with this important stream. In the previous report of this Commission on the fisheries of the west coast, the history and methods of the fisheries of the Columbia were discussed at considerable length. It only remains at this time to record such changes as have taken place in the industry during the past three or four years. In the investigation on which this report is based it was feasible to visit only that part of the Columbia basin within the States of Washington and Oregon. For hundreds of miles east and northeast of that section, however, salmon and other fish in more or less abundance are found, the catch being mostly utilized by ranchers and Indians living near the stream.

The following counties of Washington and Oregon, bordering on the Columbia River and its tributaries, maintain commercial fisheries, the full extent of which is exhibited in the tables elsewhere presented:

Oregon: Clatsop, Columbia, Multnomah, and Wasco counties.

Washington: Pacific, Wahkiakum, Cowlitz, Clarke, Skamania, and Klickitat counties.

Clatsop and Pacific counties, which are at the mouth of Columbia River, have fishing interests on their ocean sides as well as in the river.

Through the courtesy of the numerous firms engaged in the fishing business of the river, the agent was able to obtain from their well-kept records detailed statistics showing the results of the fishery and canning industry of the river in a more comprehensive, useful, and reliable form than have heretofore been obtained.

THE SALMON INDUSTRY.

This branch of the fisheries completely overshadows all others, and is the only one entitled to mention with the exception of the sturgeon fishery, which is of recent development.

In the early years of the salmon-packing business on the Columbia chinook salmon were extremely abundant, comprising the bulk of the run and all of the pack; other varieties were unutilized. With the beginning of a decrease in the abundance of chinook salmon the small blueback salmon was brought more into notice. When the run of chinooks began to fail some of the packers made cautious experimental packs of small quantities of bluebacks to help out their annual pack, although few were willing to concede the advisability of utilizing any fish except chinooks. The bright red color and fine flavor of the bluebacks at once gave the fish a firm hold on the trade and resulted in an active demand, which has continued to the present time. Singular as it may seem, the utilization of the bluebacks and the increasing quantities consumed annually have been attended by an apparent increase in the abundance of the fish.

The accompanying figures will show that while the blueback is found in the Columbia River every year it has of late had its years of abundance and scarcity, thus resembling in its migrations the humpback salmon of Puget Sound. For the past six or eight seasons the even years have witnessed the larger run of bluebacks. Up to a comparatively recent date the steelhead, which has always occurred abundantly in the Columbia, was considered wholly unsuitable for packing. The same cause, however, which brought the blueback into use has led to the utilization of the steelhead. Recently the demand for canned almon in certain sections of the country has called for a cheaper grade of fish, which has brought the neglected steelhead into prominence. The silver salmon, which does not enter the river until most of the anneries are closed, has also been canned in some quantities, and oth it and the steelhead have met with a ready sale that has yearly hown tendencies to greatly increase.

Fishermen, prices, etc.—Under the laws of Oregon and Washington ll fishermen must be naturalized citizens of the United States. Reference to the previous report on the fisheries of this river will show hat in 1888 a very large proportion of the fishermen, especially those mployed in the gill-net fishery, were aliens. The law is said to be ery fully complied with, and the men now profess to be citizens and oters. They represent many nationalities.

The gill-net fishermen belong chiefly to the Latin races. They are nited under the name of the Columbia River Fishermen's Protective Jnion, with headquarters at Astoria, Oreg. The pound-net fishermen re mostly native-born Americans or Scandinavians. These have ombined for mutual protection under the name of the Washington Fishermen's Association, with headquarters at Ilwaco, Pacific County, Wash., near which place most of the pound nets employed in the Columbia River are located. These two associations are to some extent ntagonistic. Each legislature usually finds representatives from both ssociations advocating their claims and portraying their supposed rievances. The object of the association of pound-net fishermen is aid to be:

> To promote and foster the fishing industry of the State of Washington; to assist n building and maintaining fish-hatcheries; to induce legislation, by petition or ther lawful means, to protect the industry and those engaged in it; to extend to ts members aid and assistance, pecuniary or otherwise, when necessary.

By an agreement between the canners and fishermen, the price to be aid for the catch during the ensuing year is usually agreed upon efore the beginning of fishing operations. The failure to agree on a rice in 1890 resulted in a strike that was disastrous to the fishermen. For several years prior to 1890 the men had been receiving $1 each or chinook salmon, which comprised nearly all of the gill-net catch. The men demanded $1.25 each for their fish, which, being refused, a eneral strike was begun which lasted throughout the month of April. After losing one month of the short salmon season, the men agreed to he price first offered, but refused to contract at that price for the entire eason. One dollar per fish was paid up to June 1, after which the anners would give only 75 cents for chinooks. The most serious outome of the strike was the attempt of the association fishermen to estroy the nets of a few non-union men. A large body of fishermen elonging to the gill-net association embarked in their boats at Astoria nd proceeded several miles up the river, where the nets of the nonnion men were set. On beginning their work of destruction, they vere met with a volley of rifle balls from the fishermen on the shore, and the attacking party hastily withdrew to Astoria, leaving several of their number killed and wounded. No further attempt was made to interfere with the non-union fishermen.

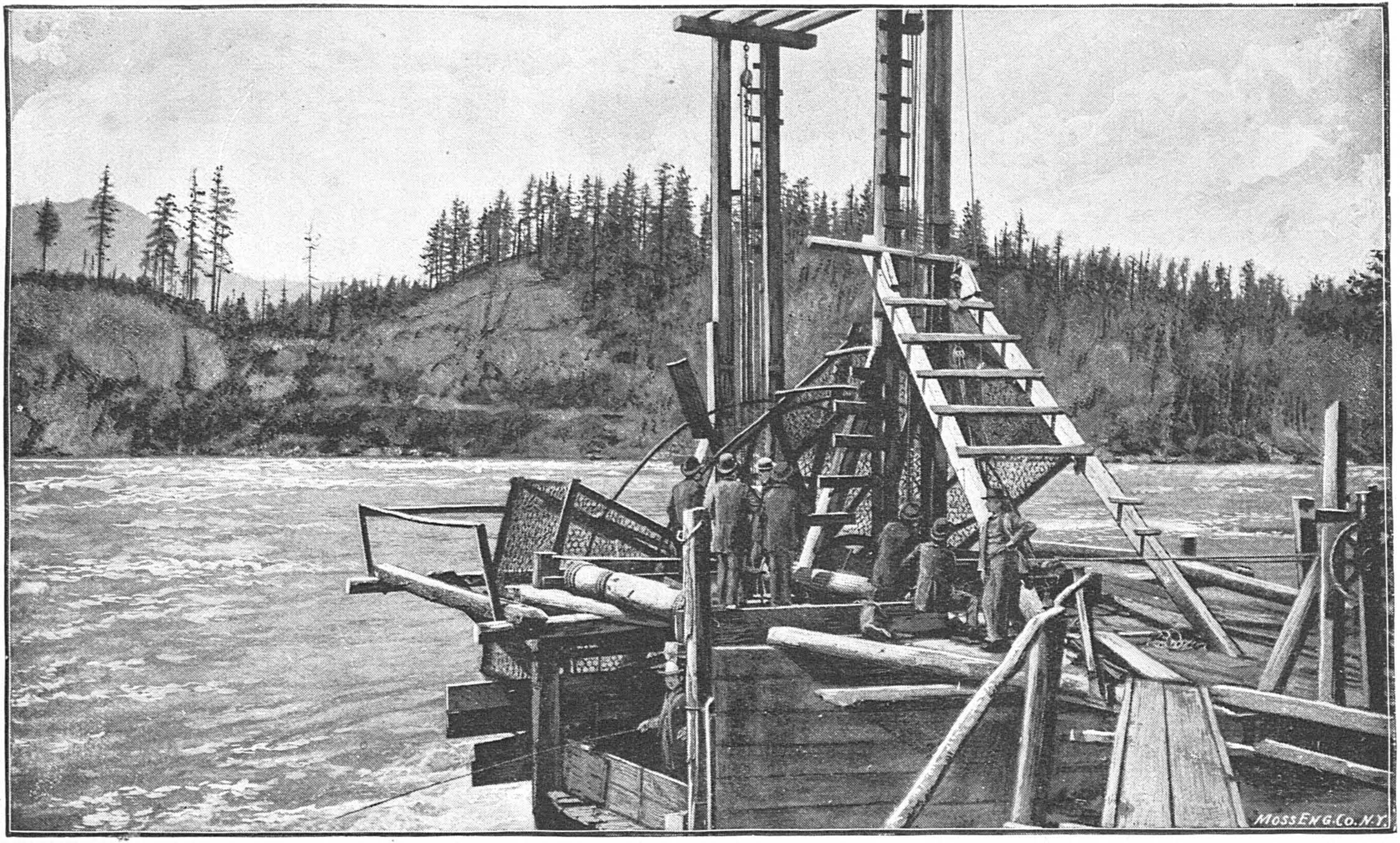
The fishing apparatus and methods.—The various appliances employed in the Columbia River for the catching of fish and the manner of operating the same present few changes as compared with the previous investigation. No new method of capture has been devised, although there has been a very marked increase in the number of traps, wheels, nets, etc., operated.

Gill-net fishing is by far the most important branch of the salmon fishery of the Columbia River. More money is invested in the fishery than in any other, and larger quantities of fish are thus taken than by any other means. The number of men interested also outnumbers those employed in all other branches of the salmon fishery. The fishing-grounds covered by the fleet of gill-net boats are mostly near Astoria, extending about 10 miles above that place, and the same distance below. Several hundred boats cruise upstream and as many more descend the river.

The boats are mostly owned by the salmon-packers, but the nets are made and owned by the fishermen. Before the opening of the fishing season the men contract with the canners, who have supplied their boats, for the entire catch during the year. Fishing is done more or less during the entire twenty-four hours. The best hauls, however, are usually made at night, at which time the fish are less able to see and avoid the drifting net.

The boats drift up and down stream with the tide. If the morning finds a fisherman near the cannery at which he has contracted to deliver his catch, he lands his fish there; if he has drifted to the mouth of the river, his fish are delivered on board a receiving scow of the cannery with which he is connected, an agent on board receipting for the fish, which later in the day are collected by a steam tug and taken to the cannery. The work of the night being over and the fish delivered, the fisherman prepares his breakfast and rests during the time intervening between the tides. His boat is sailed to a quiet spot out of the channel, the anchor is dropped, the sail taken in, and his simple meal cooked over a small oil stove. The rudder is then unshipped and stood up on deck at the stern, the mast is taken down, the sail removed, and the mast is placed lengthwise the boat, one end resting in the bow, the other end on the top of the unshipped rudder, forming a ridgepole for the extemporized tent formed by the sail. Often several hundred boats may be found within a small area, each containing the sleeping fisherman and his assistant.

While chinook salmon constitute the great bulk of the gill-net catch, the quantity of other fish thus taken is considerable and is increasing yearly. With the demand for cheaper grades of salmon the size of the mesh of the gill nets has been reduced.



STATIONARY FISH WHEEL, COLUMBIA RIVER.

PLATE 6.

Seines are used at Sand Island, near the mouth of the river, and on the sand bars to a distance of 15 to 30 miles above the ocean. These bars as a rule are dry at low tide, at which time the seines are hauled. Up to a comparatively recent time the bars in the Columbia River were owned by the State and their fishing privileges were free. As they became valuable for seine fishing, and had no other use, private parties had them surveyed and bought them from the State at a low price. A title deed having been secured, the value of these bars at once increased from a few dollars to many thousands. The desirable seining-grounds are limited and have fallen into the hands of a few persons, which fact accounts for the relatively small number of seines used, and this form of apparatus is the only one which does not show an increase in recent years.

Fish-wheels are the most interesting form of apparatus used in the Columbia River. Their origin is comparatively recent, and the construction and method of operation are entirely different from any other appliances used for the capture of fish. Owing to their supposed very destructive powers they have been the subject of much antagonism on the part of the general public and the fishermen using other forms of apparatus. Since the first introduction of fish-wheels their number and use have steadily grown, and in 1892 more were employed than at any previous time. As compared with the number of gill nets and pound nets used the number of wheels is very small and has probably nearly reached its limit, as their use is confined to a few desirable places bordering the rapids of the Columbia River at the Cascades and The Dalles, and the favorable sites have passed into the hands of a few persons.

Pound nets are extensively employed in the lower Columbia, the largest number being set in Baker Bay near the mouth of the river. The nets are usually owned by the canners. Between 1889 and 1892 the increase in the number of these nets on the Columbia was 133 per cent. The pound net has almost completely superseded the old wooden trap that dates back to the early days of the salmon business, and has now almost passed out of existence.

The other minor forms of apparatus employed on the river, namely, dip nets, squaw nets, etc., which are mostly used by Indians, present no marked changes in numbers or in methods of use. The Indians continue to take large quantities of fish in this way for their own use and for sale.

Complete tables are elsewhere given showing the number and value of each different kind of apparatus employed in each county on this river and also showing the quantity and value of each kind of fish taken therein. Some general tables follow showing for the Columbia basin as a whole the quantities of apparatus used and the catch in each. The following table has been prepared to show the increase in the number of pound nets, haul seines, fish-wheels, and gill nets owned or used on the Washington and Oregon sides of the river respectively in 1889 to 1892, inclusive.

Apparatus employed on the Columbia River in 1889, 1890, 1891, and 1892.

Apparatus.	Years.	Oregon.	Washington.	Total.	Apparatus.	Years.	Oregon.	Washington.	Total.
		No.	*No.*	*No.*			*No.*	*No.*	*No.*
Pound nets	1889	102	62	164	Fish-wheels	1889	31	9	40
	1890	98	70	168		1890	29	12	41
	1891	140	98	238		1891	30	14	44
	1892	247	131	378		1892	40	17	57
Haul seines	1889	7	33	40	Gill nets	1889	757	436	1,193
	1890	6	29	35		1890	760	432	1,192
	1891	19	30	49		1891	790	472	1,262
	1892	12	26	38		1892	861	453	1,314

General statistics of the industry.—In the following tables the extent of the salmon fishery and salmon-canning industry of the Columbia basin for the years 1889 to 1892, inclusive, are given:

Number of persons engaged in the salmon industry of Columbia River from 1889 to 1892.

How engaged	Oregon.				Washington.				Total.			
	1889.	1890.	1891.	1892.	1889.	1890.	1891.	1892.	1889.	1890.	1891.	1892.
Fishermen	1,606	1,648	1,929	2,064	1,535	1,510	1,575	1,677	3,141	3,194	3,504	3,741
Shoresmen and cannery employees	870	1,028	1,057	1,100	594	602	654	704	1,464	1,630	1,711	1,804
Total	2,476	2,712	2,986	3,164	2,129	2,112	2,229	2,381	4,605	4,824	5,215	5,545

Number and value of boats and apparatus and the value of shore property and cash capital employed in the salmon industry of the Columbia River in 1889, 1890, 1891, and 1892.

Apparatus and capital.	1889.		1890.		1891.		1892.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Oregon:								
Boats	751	$99,850	776	$104,400	876	$120,815	998	$131,550
Pile-drivers and scows	21	5,900	23	6,300	30	8,300	29	7,400
Pound nets	102	72,300	98	76,500	140	98,900	247	173,400
Trap nets	2	1,600	......	......	2	1,600	2	1,600
Seines	7	4,800	6	2,700	19	11,150	12	5,650
Gill nets	757	152,000	760	159,450	790	181,265	861	190,100
Wheels	31	120,052	29	107,552	30	108,152	40	132,852
Dip nets and squaw nets	95	475	85	425	60	300	50	250
Shore property	......	502,955	......	486,355	......	455,205	......	507,805
Cash capital	......	395,000	......	581,000	......	520,000	......	614,000
Total	......	1,354,932	......	1,524,682	......	1,505,687	......	1,764,607
Washington:								
Boats	475	60,340	468	59,780	534	67,280	538	64,895
Pile-drivers and scows	39	9,050	37	9,950	42	10,750	45	13,550
Pound nets	62	48,200	70	55,200	98	77,000	131	103,400
Trap nets	2	1,400	2	1,400	2	1,400	1	700
Seines	33	18,700	29	16,400	30	16,900	26	10,000
Gill nets	436	88,775	432	89,480	472	101,780	453	98,130
Wheels	9	25,000	12	48,500	14	45,000	17	49,100
Dip nets and squaw nets	15	75	18	90	23	115	25	125
Shore property	......	245,950	......	247,280	......	321,050	......	282,800
Cash capital	......	304,000	......	331,000	......	332,000	......	330,000
Total	......	801,490	......	859,080	......	973,275	......	952,700
Total for river:								
Boats	1,226	160,190	1,244	164,180	1,410	188,095	1,536	196,445
Pile-drivers and scows	60	14,950	60	16,250	72	19,050	74	20,950
Pound nets	164	120,500	168	131,700	238	175,900	378	276,800
Trap nets	4	3,000	2	1,400	4	3,000	3	2,300
Seines	40	23,500	35	19,100	49	28,050	38	15,650
Gill nets	1,193	240,775	1,192	248,930	1,262	283,045	1,314	288,230
Wheels	40	145,052	41	156,052	44	153,152	57	181,952
Dip nets and squaw nets	110	550	103	515	83	415	75	375
Shore property	......	748,905	......	733,635	......	776,255	......	790,605
Cash capital	......	699,000	......	912,000	......	852,000	......	944,000
Total	......	2,156,422	......	2,383,762	......	2,478,962	......	2,717,307

Table showing by apparatus the number, weight, and value of each species of salmon taken in the Columbia River in 1889, 1890, 1891, and 1892.

Apparatus and species.	Oregon.			Washington.			Total.		
	No.	Lbs.	Value.	No.	Lbs.	Value.	No.	Lbs.	Value.
1889.									
Pound nets:									
Chinook......	86, 777	2, 169, 425	$108, 469	40, 323	1, 008, 075	$50, 353	127, 100	3, 177, 500	$158, 822
Blueback.....	33, 372	166, 860	8, 342	24, 199	120, 995	5, 904	57, 571	287, 855	14, 246
Steelhead	37, 958	379, 545	11, 386	22, 460	224, 600	6, 737	60, 418	604, 145	18, 123
Total.....	158, 107	2, 715, 830	128, 197	86, 982	1, 353, 670	62, 994	245, 089	4, 069, 500	191, 191
Trap nets:									
Chinook......	710	17, 750	887	2, 275	56, 875	2, 844	2, 985	74, 625	3, 731
Steelhead	440	4, 400	132	803	8, 030	241	1, 243	12, 430	373
Total.....	1, 150	22, 150	1, 019	3, 078	64, 905	3, 085	4, 228	87, 055	4, 104
Seines:									
Chinook......	24, 752	618, 800	30, 940	63, 782	1, 594, 550	79, 727	88, 534	2, 213, 350	110, 667
Blueback.....	3. 500	17, 500	875	2, 444	12, 225	611	5, 944	29, 725	1, 486
Steelhead	16, 720	167, 200	4, 816	43, 978	439, 780	13, 193	60, 698	606, 980	18, 009
Total.....	44, 972	803, 500	36, 631	110, 204	2, 046, 555	93, 531	155, 176	2, 850, 055	130, 162
Gill nets:									
Chinook......	252, 044	6, 301, 325	312, 563	226, 053	5, 759, 050	281, 470	478, 097	12,060,375	594, 033
Blueback.....	27, 623	139, 115	4, 751	17, 218	86, 090	3, 044	44, 841	225, 205	7, 795
Steelhead	16, 472	164, 720	5, 090	15, 970	159, 700	4, 785	32, 442	324, 420	9, 875
Total.....	296, 139	6, 605, 160	322, 404	259, 241	6, 004, 840	289, 299	555, 380	12,610,000	611, 703
Wheels:									
Chinook......	15, 182	379, 550	12. 867	6, 876	171, 900	6, 978	22, 058	551, 450	19, 845
Blueback.....	140, 090	700, 450	23, 090	51, 064	230, 322	9, 260	191, 154	930, 772	32, 350
Steelhead	6, 329	63, 290	2. 043	1, 480	14, 800	484	7, 809	78, 090	2, 527
Silver	4, 500	31, 500	630	2, 540	16, 780	503	7, 040	48, 280	1, 133
Total.....	166, 101	1, 174, 790	38, 630	61, 960	433. 802	17. 225	228, 061	1, 608. 592	55, 855
Dip nets and squaw nets:									
Chinook......	2, 291	57, 283	1, 146	1, 360	34, 000	510	3, 651	91, 283	1, 656
Blueback.....	16, 910	84, 550	1, 841	8. 112	40, 560	608	25, 022	125, 110	2, 449
Steelhead	1, 145	11, 450	229	509	5, 090	77	1, 654	16, 540	306
Silver	5, 142	35, 994	540	3, 175	22, 225	333	8, 317	58. 219	873
Total.....	25, 488	189, 277	3, 756	13, 156	101, 875	1, 528	38, 644	291, 152	5, 284
All apparatus:									
Chinook......	381, 756	9, 544, 133	466, 872	340, 669	8, 624, 450	421, 882	722, 425	18,168,583	888. 754
Blueback.....	221, 495	1, 108, 475	38, 899	103, 037	490, 192	19, 427	324, 532	1,598,667	58, 326
Steelhead	79, 064	790, 605	23, 696	85, 200	852, 000	25, 517	164, 264	1,642,605	49, 213
Silver	9, 642	67, 494	1, 170	5. 715	39, 005	836	15, 357	106, 499	2, 006
Total.....	691, 957	11,510,707	530, 637	534, 621	10,005,647	467, 662	1,226,578	21,516,354	998, 299
1890.									
Pound nets:									
Chinook......	104, 099	2, 602, 475	78, 491	71, 346	1, 783, 659	53, 510	175, 445	4. 386, 125	132, 001
Blueback.....	50, 493	252, 465	5, 048	42, 097	210, 485	4, 209	92, 590	462, 950	9, 257
Steelhead	51, 600	516, 000	5, 160	41, 412	414, 120	4, 140	93, 012	930, 120	9, 300
Total.....	206, 192	3, 370, 940	88, 699	154, 855	2, 408, 255	61, 859	361, 047	5, 779, 195	150, 558
Trap nets:									
Chinook......	....	....	....	3, 629	90, 725	2, 721	3, 629	90, 725	2, 721
Blueback.....	....	....	....	303	1, 515	30	303	1, 515	30
Steelhead	....	....	....	2, 979	29, 790	298	2, 979	29, 790	298
Total.....	....	....	....	6, 911	122, 030	3, 049	6, 911	122, 030	3, 049
Seines:									
Chinook......	10, 750	268, 750	8, 063	53, 752	1, 343, 800	41, 402	64, 502	1, 612, 550	49, 465
Blueback.....	2, 250	11, 250	225	14, 292	71, 460	1, 425	16, 542	82. 710	1, 650
Steelhead	9, 013	90, 130	901	36, 701	367, 010	3. 669	45, 714	457, 140	4, 570
Total.....	22, 013	370, 130	9, 189	104, 743	1, 782, 270	46, 496	126, 758	2, 152, 400	55, 685
Gill nets:									
Chinook......	369, 196	9, 229. 700	288, 730	211, 675	5. 366, 675	166, 167	580, 871	14,596,375	454, 897
Blueback.....	81, 909	409, 545	8, 440	25, 718	138, 590	2, 884	107, 627	548, 135	11, 324
Steelhead	29, 593	295, 935	3, 819	18, 635	186, 350	2, 467	48, 228	482, 285	6, 286
Total.....	480, 698	9, 935. 180	300, 980	256, 028	5, 691, 615	171, 518	736, 726	15,626,795	472, 507

Table showing by apparatus the number, weight, and value of each species of salmon taken in the Columbia River in 1889, 1890, 1891, and 1892—Continued.

Apparatus and species.	Oregon.			Washington.			Total.		
	No.	Lbs.	Value.	No.	Lbs.	Value.	No.	Lbs.	Value.
1890.									
Wheels:									
Chinook	83,202	2,080,053	$62,401	27,972	699,317	$20,979	111,174	2,779,370	$83,380
Blueback	529,646	2,648,155	79,444	207,298	1,036,465	30,431	736,944	3,684,620	109,875
Steelhead	71,239	712,390	16,474	13,801	138,010	2,322	85,040	850,400	18,796
Silver	4,660	31,612	749	1,500	10,500	210	6,160	42,112	959
Total	688,747	5,472,210	159,068	250,571	1,884,292	53,942	939,318	7,356,502	213,010
Dip nets and squaw nets:									
Chinook	5,021	125,534	1,958	2,242	56,068	841	7,263	181,602	2,799
Blueback	32,748	163,740	2,450	7,717	38,585	579	40,465	202,325	3,029
Steelhead	11,000	110,000	1,650	1,402	14,025	210	12,402	124,025	1,860
Silver	10,180	71,260	1,068	4,500	31,500	472	14,680	102,760	1,540
Total	58,949	470,534	7,126	15,861	140,178	2,102	74,810	610,712	9,228
All apparatus:									
Chinook	572,268	14,306,512	439,643	370,616	9,340,235	285,620	942,884	23,646,747	725,263
Blueback	697,046	3,485,155	95,607	297,425	1,497,100	39,558	994,471	4,982,255	135,165
Steelhead	172,445	1,724,455	28,004	114,930	1,149,305	13,106	287,375	2,873,760	41,110
Silver	14,840	102,872	1,817	6,000	42,000	682	20,840	144,872	2,499
Total	1,456,599	19,618,994	565,071	788,071	12,028,640	338,966	2,245,570	31,647,634	904,037
1891.									
Pound nets:									
Chinook	108,983	2,724,575	108,983	94,624	2,365,600	94,594	203,607	5,090,175	203,577
Blueback	22,988	114,940	2,298	52,164	260,840	5,336	75,152	375,780	7,634
Steelhead	54,080	540,800	7,029	44,448	444,464	6,308	98,528	985,264	13,337
Total	186,051	3,380,315	118,310	191,236	3,070,904	106,238	377,287	6,451,219	224,548
Trap nets:									
Chinook	630	15,750	630	712	17,800	712	1,342	33,550	1,342
Blueback	148	740	15	....	....	....	148	740	15
Steelhead	786	7,860	118	501	5,010	75	1,287	12,870	193
Total	1,564	24,350	763	1,213	22,810	787	2,777	47,160	1,550
Seines:									
Chinook	16,489	412,225	16,489	48,596	1,214,900	36,884	65,085	1,627,125	53,373
Blueback	2,252	11,260	225	8,325	41,625	1,221	10,577	52,885	1,446
Steelhead	5,092	50,920	919	27,469	274,690	5,467	32,561	325,610	6,386
Silver	857	5,999	190	....	....	....	857	5,999	190
Total	24,690	480,404	17,823	84,390	1,531,215	43,572	109,080	2,011,619	61,395
Gill nets:									
Chinook	448,500	11,212,500	447,031	208,633	5,341,525	208,593	657,133	16,554,025	655,624
Blueback	25,679	131,395	4,102	15,268	76,340	2,589	40,947	207,735	6,691
Steelhead	17,274	172,740	3,541	20,581	205,815	3,468	37,855	378,555	7,009
Silver	285	1,995	60	694	4,858	145	979	6,853	205
Total	491,738	11,518,630	454,734	245,176	5,628,538	214,795	736,914	17,147,168	669,529
Wheels:									
Chinook	23,645	591,153	17,735	9,621	240,540	7,216	33,266	831,693	24,951
Blueback	80,004	400,020	12,000	36,675	183,375	5,502	116,679	583,395	17,502
Steelhead	27,053	270,530	6,675	11,536	115,360	3,460	38,589	385,890	10,135
Silver	4,920	34,440	933	2,730	19,110	573	7,650	53,550	1,506
Total	135,622	1,296,143	37,343	60,562	558,385	16,751	196,184	1,854,528	54,094
Dip nets and squaw nets:									
Chinook	2,943	73,591	1,119	403	10,083	151	3,346	83,674	1,270
Blueback	30,436	152,182	2,388	13,887	60,918	914	44,323	213,100	3,302
Steelhead	7,459	74,590	1,149	2,016	20,164	302	9,475	94,754	1,451
Silver	10,370	72,591	1,089	4,260	29,820	447	14,630	102,411	1,536
Total	51,208	372,954	5,745	20,566	120,985	1,814	71,774	493,939	7,559
All apparatus:									
Chinook	601,190	15,029,794	591,987	362,589	9,190,448	348,150	963,779	24,220,242	940,137
Blueback	161,507	810,537	21,028	126,319	623,098	15,562	287,826	1,433,635	36,590
Steelhead	111,744	1,117,440	19,431	106,551	1,065,503	19,080	218,295	2,182,943	38,511
Silver	16,432	115,025	2,272	7,684	53,788	1,165	24,116	168,813	3,437
Total	890,873	17,072,796	634,718	603,143	10,932,837	383,957	1,494,016	28,005,633	1,018,675

Table showing by apparatus the number, weight, and value of each species of salmon taken in the Columbia River in 1889, 1890, 1891, and 1892—Continued.

Apparatus and species.	Oregon.			Washington.			Total.		
	No.	Lbs.	Value.	No.	Lbs.	Value.	No.	Lbs.	Value.
1892.									
Pound nets:									
Chinook......	127,627	3,191,675	$127,627	89,852	2,246,300	$89,852	217,479	5,537,975	$217,479
Blueback	99,602	498,010	10,010	191,222	950,110	19,122	290,824	1,454,120	29,132
Steelhead	112,661	1,126,610	16,899	76,998	769,980	11,549	189,659	1,896,590	28,448
Total.....	339,890	4,816,295	154,536	358,072	3,972,390	120,523	697,962	8,788,685	275,059
Trap nets:									
Chinook......	530	13,250	530	20	500	20	550	13,750	550
Blueback	240	1,200	24	....	....	....	240	1,200	24
Steelhead	879	8,790	132	150	1,500	150	1,029	10,290	282
Total.....	1,649	23,240	686	170	2,000	170	1,819	25,240	856
Seines:									
Chinook......	27,707	689,535	20,686	27,582	689,550	20,687	55,289	1,379,085	41,373
Blueback	48,347	237,735	7,132	75,031	375,185	11,256	123,378	612,920	18,388
Steelhead	18,544	185,352	3,707	34,843	348,430	6,969	53,387	533,782	10,076
Silver	1,428	10,000	300	....	....	....	1,428	10,000	300
Total.....	96,026	1,122,622	31,825	137,456	1,413,165	38,912	233,482	2,535,787	70,737
Gill nets:									
Chinook......	355,715	8,892,870	355,715	223,197	5,715,675	223,167	578,912	14,608,545	578,882
Blueback	94,141	407,705	9,714	21,021	110,105	3,303	115,162	580,810	13,017
Steelhead	37,043	370,430	5,866	33,428	334,280	5,090	70,471	704,710	10,956
Silver	....	....	....	714	5,000	150	714	5,000	150
Total.....	486,899	9,734,005	371,295	278,360	6,165,060	231,710	765,259	15,899,065	603,005
Wheels:									
Chinook......	45,964	1,149,115	34,474	16,705	417,630	12,529	62,669	1,566,745	47,003
Blueback	314,585	1,572,923	47,187	145,766	728,832	21,865	460,351	2,301,755	69,052
Steelhead	95,654	956,540	28,696	45,056	450,560	13,517	140,710	1,407,100	42,213
Silver	39,255	274,785	8,234	4,872	34,104	1,023	44,127	308,889	9,257
Total.....	495,458	3,953,363	118,591	212,399	1,631,126	48,934	707,857	5,584,489	167,525
Dip nets and squaw nets:									
Chinook......	1,356	33,900	509	578	14,450	217	1,934	48,350	726
Blueback	59,023	295,109	4,427	15,380	76,900	1,154	74,403	372,009	5,581
Steelhead	6,780	67,802	1,017	2,890	28,900	434	9,670	96,702	1,451
Silver	12,386	86,703	1,301	4,850	33,950	510	17,236	120,653	1,811
Total.....	79,545	483,514	7,254	23,698	154,200	2,315	103,243	637,714	9,569
All apparatus:									
Chinook......	558,899	13,970,345	539,541	357,934	9,084,105	346,472	916,833	23,054,450	886,013
Blueback	615,938	3,075,682	78,494	448,420	2,247,132	56,700	1,064,358	5,322,814	135,194
Steelhead	271,561	2,715,524	56,317	193,365	1,933,650	37,709	464,926	4,649,174	94,026
Silver	53,069	371,488	9,835	10,436	73,054	1,683	63,505	444,542	11,518
Total.....	1,499,467	20,133,039	684,187	1,010,155	13,337,941	442,564	2,509,622	33,470,980	1,126,751

Number and location of the salmon canneries operated on the Columbia River, 1889-92.

Location.	1889.	1890.	1891.	1892.	Location.	1889.	1890.	1891.	1892.
Oregon:					Washington:				
Astoria	8	8	8	8	Ilwaco	1	1	1	1
Clifton	1	......	1	1	Knappton	......	......	1	1
Maple Dell	1	1	1	1	Chinook	1	1	1	1
Warrendale	1	1	1	1	Pillar Rock	1	1	1	1
Dalles	1	1	1	1	Brookfield	1	1	1	1
Celilo	......	1	......	1	Waterford	1	1	1	1
Portland *a*	......	......	......	1	Eureka	1	1	1	1
					Cathlamet	1	1	1	1
Total	12	12	12	14	Bay View	1	1	1	1
					Eagle Cliff	1	1	1	1
					Total	9	9	10	10
					Grand total	21	21	22	24

a This cannery, on the Willamette River, received its fish from the Columbia River.

Table showing by species the salmon pack of the Columbia River from 1889 to 1892.

States and species.	1889.		1890.		1891.		1892.	
	Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
Oregon:								
Chinook	140, 741	$844, 446	196, 414	$1, 138, 787	222, 963	$1, 279, 092	214, 631	$1, 244, 500
Blueback	15, 979	90, 628	53, 351	268, 104	10, 850	58, 816	51, 106	287, 984
Steelhead	11, 692	49, 899	26, 608	106, 432	15, 584	62, 236	45, 403	181, 612
Silver	....	....	....	....	....	....	4, 176	20, 880
Total	168, 412	984, 973	276, 373	1, 513, 323	249, 406	1, 400, 144	315, 316	1, 734, 976
Washington:								
Chinook	125, 956	755, 736	139, 190	807, 300	130, 944	759, 474	129, 636	751, 888
Blueback	1, 818	10, 423	3, 994	21, 965	4, 623	25, 426	15, 441	84, 925
Steelhead	13, 699	58, 688	16, 217	64, 868	13, 980	55, 920	26, 945	107, 280
Silver	....	....	....	....	....	....	....	....
Total	141, 473	824, 847	159, 401	894, 133	149, 547	840, 820	172, 022	944, 093
Total for river:								
Chinook	266, 697	1, 600, 182	335, 604	1, 946, 087	353, 907	2, 038, 566	344, 267	1, 996, 388
Blueback	17, 797	101, 051	57, 345	290, 069	15, 482	84, 242	66, 547	372, 909
Steelhead	25, 391	108, 587	42, 825	171, 300	29, 564	118, 156	72, 348	288, 892
Silver	....	....	....	....	....	....	4, 176	20, 880
Total	309, 885	1, 809, 820	435, 774	2, 407, 456	398, 953	2, 240, 964	487, 338	2, 679, 069

In 1893 the pack of chinook salmon amounted to 290,000 cases.

Table showing by months the number and weight of each species of salmon utilized for canning purposes on the Columbia River in 1889, 1890, 1891, and 1892.

Years and months.	Chinook.		Blueback.		Steelhead.		Silver.		Total.	
	No. of fish.	Gross weight.	No. of fish.	Gross weight.	No. of fish.	Gross weight.	No. of fish.	Gross weight.	No. of fish.	Gross weight.
1889.		*Pounds.*		*Pounds.*		*Pounds.*		*Pounds.*		*Pounds.*
April	89,266	2,231,650	36,676	183,380	9,408	94,080	......	....	135,350	2,509,110
May	156,117	3,902,925	76,517	382,585	14,709	147,090	......	....	247,343	4,432,600
June	108,959	4,223,975	82,453	412,265	62,695	626,950	......	....	314,107	5,263,100
July	301,254	7,535,350	36,717	183,585	76,166	761,660	......	....	414,137	8,480,595
Total	715,596	17,893,900	232,363	1,161,815	162,978	1,629,780	......	....	1,110,937	20,685,495
1890.										
April	32,727	818,175	63,180	315,900	11,005	110,050	......	....	106,912	1,244,125
May	236,776	5,919,400	202,580	1,012,900	22,983	229,830	......	....	462,339	7,162,130
June	252,754	6,318,850	297,234	1,486,170	87,567	875,670	......	....	637,555	8,680,690
July	357,183	8,932,575	150,299	751,495	139,596	1,395,960	......	....	647,078	11,080,030
August	13,941	318,525	22,107	110,535	15,535	155,350	......	....	51,583	614,410
Total	893,381	22,337,525	735,400	3,677,000	276,686	2,766,860	......	....	1,905,467	28,781,385
1891.										
April	82,413	2,060,325	17,437	87,185	5,178	51,780	......	....	105,028	2,199,290
May	184,090	4,502,250	55,229	276,145	13,314	133,140	......	....	252,633	4,911,535
June	223,964	5,599,100	83,743	418,715	52,676	526,760	......	....	360,383	6,544,575
July	398,247	9,956,175	32,389	161,945	97,900	979,000	......	....	528,536	11,097,120
August	58,670	1,466,750	3,701	18,505	21,286	212,860	......	....	83,657	1,698,115
Total	947,384	23,584,600	192,499	962,495	190,354	1,903,540	......	....	1,330,237	26,450,635
1892.										
April	55,021	1,375,525	86,449	432,245	10,503	105,030	......	....	151,973	1,912,800
May	187,492	4,687,300	308,946	1,544,730	32,795	327,950	......	....	529,233	6,559,980
June	239,498	5,987,450	330,558	1,652,790	141,194	1,411,940	......	....	711,250	9,052,180
July	343,421	8,585,525	128,043	640,215	199,333	1,993,330	......	....	670,797	11,219,070
August	84,124	2,103,100	19,110	95,550	52,991	529,910	......	....	156,225	2,728,560
September	....	....	....	....	11,293	112,930	19,489	136,423	30,782	249,353
October	....	....	....	....	22,629	226,290	33,966	237,762	56,595	464,052
Total	909,556	22,738,900	873,106	4,365,530	470,738	4,707,380	53,455	374,185	2,306,855	32,185,905

Scarcely any attention is given to the refuse at the salmon canneries. On the Columbia River this waste yearly averages over 7,000,000 pounds, or 3,500 tons, nearly all of which is emptied into the river. The only efforts to save and utilize this valuable waste product are at Astoria, and there but a small part of the refuse is collected, as will be seen by the following statement of the oil and fertilizer prepared from salmon waste at a small factory:

Years.	Oil.		Scrap.	
	Gallons.	Value.	Tons.	Value.
1889	15, 000	$3, 600		
1890	12, 000	2, 880	25	$500
1891	26, 000	6, 240	35	700
1892	30, 000	6, 750	40	800

Summary of the salmon industry.—From 1866, the year in which salmon canning began on the Columbia River, to 1893, inclusive, the gross weight of the salmon utilized for canning was over 658,000,000 pounds, and the value of the pack was over $59,000,000. The annual results of this industry are shown in the following table:

Summary of salmon-canning industry of the Columbia River from 1866 to 1893.

Year.	Gross weight of salmon utilized.	No. of cases packed.	Value.	Average value per case.	Year.	Gross weight of salmon utilized.	No. of cases packed.	Value.	Average value per case.
	Pounds.					*Pounds.*			
1866	260, 000	4, 000	$64, 000	$16. 00	1881	35, 750, 000	550, 000	$2, 475, 000	$1. 50
1867	1, 170, 000	18, 000	288, 000	16. 00	1882	35, 184, 500	541, 300	2, 600, 000	4. 80
1868	1, 820, 000	28, 000	392, 000	14. 00	1883	40, 911, 000	629, 400	3, 147, 000	5. 00
1869	6, 500, 000	100, 000	1, 350, 000	13. 50	1884	40, 300, 000	620, 000	2, 915, 000	4. 70
1870	9, 750, 000	150, 000	1, 800, 000	12. 00	1885	35, 997, 000	553, 800	2, 500, 000	4. 51
1871	13, 000, 000	200, 000	2, 100, 000	10. 50	1886	29, 152, 000	448, 500	2, 135, 000	4. 76
1872	16, 250, 000	250, 000	2, 325, 000	9. 30	1887	23, 140, 000	356, 000	2, 124, 000	5. 97
1873	16, 250, 000	250, 000	2, 250, 000	9. 00	1888	24, 211, 005	372, 477	2, 327, 981	6. 25
1874	22, 750, 000	350, 000	2, 625, 000	7. 50	1889	20, 685, 495	309, 885	1, 809, 820	5. 84
1875	24, 375, 000	375, 000	2, 250, 000	6. 00	1890	28, 781, 385	435, 774	2, 407, 456	5. 52
1876	29, 250, 000	450, 000	2, 475, 000	5. 50	1891	26, 450, 635	398, 953	2, 240, 964	5. 62
1877	24, 700, 000	380, 000	2, 052, 000	5. 40	1892	32, 185, 995	487, 338	2, 679, 069	5. 50
1878	29, 900, 000	460, 000	2, 300, 000	5. 00	1893	24, 050, 000	370, 000	2, 107, 500	5. 70
1879	31, 200, 000	480, 000	2, 040, 000	5. 50					
1880	34, 450, 000	530, 000	2, 650, 000	5. 00	Total	658, 424, 515	10, 098, 427	59, 029, 790	5. 85

In addition to the salmon used for canning, very large quantities have been salted, consumed fresh locally, or shipped fresh to other parts of the country. The fish thus utilized have aggregated about 192,000,000 pounds, giving 850,000,000 pounds as the total salmon output of the Columbia River since 1866, the value of which, as sold fresh, canned, or salted, was $66,000,000. As a matter of interest, it may be stated that if the total salmon catch of the Columbia River could be loaded into railroad cars, 42,500 ordinary freight cars would be required to contain the fish, which would make a solid train over 280 miles long.

Exportations of canned salmon from Astoria.—Queries are often made as to where the enormous quantities of salmon prepared in the lower Columbia River and elsewhere on the Pacific Coast are sold. In the early days of the canning industry, and for several years after, nearly the entire product was sold in foreign countries, and there is still a large export trade with England, Australia, and other countries. Reference is made to the table of exports from San Francisco for a statement of the destination of the canned salmon sent from that port. Much the largest part of the canned salmon exported from Astoria is consigned to England. The shipments are made exclusively in sailing vessels, which clear from Astoria deeply laden with no other merchandise than canned salmon.

The following is a statement of the shipment by months from 1887 to September, 1892, inclusive:

Year and month.	Destination.	Cases.	Net weight of fish.	Value.
			Pounds.	
1887—July	England	41,582	1,995,936	$218,285
August	do	78,750	3,780,000	466,631
1888—August	do	61,226	2,938,848	436,824
September	do	12,869	617,712	90,856
1889—May	do	8,650	415,200	59,785
July	do	23,475	1,126,800	161,125
August	do	74,011	3,553,488	501,838
September	do	20,334	976,032	124,824
November	do	8,124	389,952	44,864
1890—March	do	7,000	336,000	35,000
November	do	20,701	993,642	102,285
1891—May	do	700	33,600	4,200
June	do	1,200	57,600	7,450
July	do	47,015	2,256,720	217,997
August	do	35,263	1,692,624	183,724
1892—February	Chile	3,000	144,000	1,140
March	do	500	24,000	2,200
June	England	300	16,800	2,450
August	do	27,107	1,320,336	160,651
September	do	46,972	2,254,656	264,518

THE STURGEON FISHERY.

For many years the fishermen of the Columbia River gave scarcely any attention to any fish caught in their nets except salmon. Sturgeon were very plentiful and were caught incidentally in the salmon nets in considerable quantities. A few were saved and sent to the Portland market, and during the winter months some were also shipped by steamer in a round or undressed state to San Francisco, but as a rule the sturgeon was looked upon as a nuisance and in most cases was knocked in the head and set adrift in the river. This practice prevailed up to a comparatively recent date.

In 1888 an eastern firm established experimental fishing-camps at several points on the river with a view to determine the abundance and location of the sturgeon, and, by shipping a few carloads of frozen sturgeon, to demonstrate the feasibility of creating a market in the East. The undertaking proved a success from the outset, and the industry soon attracted other firms from the East, so that in 1892 there were four firms interested in the business. The catch increased from 960,705 pounds in 1889 to 3,006,757 pounds in 1892. The fishery has been of great importance to the fishermen in that it does not interfere in any way with their regular salmon operations, but is prosecuted after the close of the salmon season, and in 1892 added over $41,000 to their income.

The sturgeon fishery begins immediately at the close of the salmon fishery; that is, about the middle of August or the first of September, and is followed to the opening of the salmon season in the following April. Sturgeon are found in the river throughout the year, but are most abundant during the run of sardines, in July and August, and the run of smelt in January and February, the sturgeon feeding to a considerable extent on these fish. The spawning season appears to be in November and later, thus contrasting strongly with the sturgeon of the Atlantic Coast. Mature roe, suitable for the preparation of caviar, is not found in quantities before November. With the exception of the sturgeon taken incidentally in the salmon nets, which are sold for local use, the fish is neglected during the summer months.

The average gross weight of the sturgeon caught is 150 pounds, the market fish ranging from 40 to 500 pounds. Some fish of relatively small size are caught, and occasionally very large ones are taken. In 1891 a sturgeon taken near Kalama weighed 848 pounds, and one taken off Oak Point in 1892 weighed 800 pounds.

Fishing is prosecuted from the mouth of the river as far up as the Cascades, a few fish being taken above the latter point; but the bulk of the catch is obtained between Astoria and Kalama, a distance of 60 miles. During the early part of the season fishing is done nearer the mouth of the river. The fishermen meet the fish as they come into the stream and move along with them.

With the exception of a few gill nets employed in the lower river the fishing is carried on exclusively with set lines. Each line is provided with 200 to 400 hooks, the hooks being 1 foot apart, and 5 to 8 lines constituting the complement of each fishing boat. When the fishing was first inaugurated lampreys were used for bait, but in the following year the Chinese method of using baitless hooks was found successful and has since been universally practiced. The hooks differ from those used by the Chinese, however, in being barbed, but resemble them in being ground to a needle-like point. The lines, as a rule, are anchored across the bed of the river, in some cases diagonally, and also in the bays formed by the expansion of the river. At intervals of 7 feet a junk bottle or block of wood is fastened to the line to buoy it up and maintain it in position about 4 inches from the bottom. The fishermen closely study the movements and habits of the sturgeon and set their lines on the grounds most frequented. The fish swimming along the bottom of the stream in search of food, as is their habit, must necessarily cross the set lines, and are almost certain to be snagged by one or more of the sharp-pointed hooks. In attempting to free themselves more hooks are apt to be caught in their body and they are held fast. Occasionally fish are taken showing healed-up scars, evidence of previous capture and escape. The lines are tended on the slack tide and are usually visited only once in twenty-four hours.

In 1892 the business of buying, packing, and shipping sturgeon was carried on by two firms located at Portland, Oreg., one at Kalama, Wash., and one at Ranier, Oreg. There were also numerous receiving stations located near the fishing-grounds. If, after tending his lines, the fisherman is near the head station or packing house, he delivers his catch there; but if some distance away he takes it to the nearest receiving station of the firm with which he has contracted to furnish his catch. The prices received by the fishermen are 1 cent per pound as the fish come from the water, or 1½ cents per pound if the viscera have been removed. When the fish contain roe suitable for the manufacture of caviar, the fishermen remove it and receive 4 cents per pound for the same. As soon as the fish are landed at the packing-house a gang of employees dress them for market. In some cases the skin is removed, in others it is left intact. After dressing, the fish are cut into sizes to fit the freezing-pans, which are then placed in bins, covered with ice and salt, and frozen into solid cakes. After freezing, the blocks of sturgeon are removed from the pans and placed in boxes holding from 200 to 250 pounds, which are loaded into refrigerator cars and shipped to market. Most of the catch has been sent to Sandusky, Ohio, Chicago, Ill., and New York City, where it is smoked and finds a ready sale at good prices. The number of car loads of fresh sturgeon sent east was 25 in 1889, 77 in 1890, 102 in 1891, and 115 in 1892.

One product of the sturgeon is used entirely by the Chinese, namely, the spinal marrow. As soon as the fish are landed at the packing establishment a Chinaman, armed with a hook, pulls out enough of the marrow to furnish a good hold, then seizing it, draws the remainder of it out hand over hand. In the average-sized sturgeon the spinal cord is 4 or 5 feet long and consists of long, white connecting links resembling sausages. These are cut open and the jelly-like substance contained within is scraped off and thrown away. This marrow is known by the Chinese and the trade under the name of "bone." It is thoroughly dried, and if not sold to the Chinese in this country it is exported to China, where it is much prized for making soups. The Chinamen pay 4 cents a pound for this "bone" and remove it from the fish themselves.

Valuable as the sturgeon is, there seems to be a large waste that might be utilized for fertilizing purposes. Nearly half the gross weight of the fish is at present thrown away, the head, viscera, and skin being discarded. This refuse contains more or less oil and valuable fertilizing properties, and could, no doubt, be utilized to great advantage.

The sturgeon fishery of this river was investigated for the United States Fish Commission by the writer in 1889 and again in 1892, the various fishing camps and grounds and packing stations being visited each year, and the firms engaged in the business courteously furnished the desired statistical and general information. Up to the date of the last visit sturgeon had been found in ample abundance for the demands of the firms, but the fishermen were beginning to complain of a growing scarcity. As is usual in such cases, more apparatus was required, and this had to be moved from point to point more frequently in order to keep up the catch. Advices received from this river in 1893 reported a great scarcity of sturgeon, which was followed in 1894 by a still more marked decrease in the abundance of the fish, so that the persons interested were obliged to discontinue the business, and some moved their plants to Grays Harbor, Wash., and Fraser River, British Columbia. The absence of any protective laws or a close season during the spawning period, together with the avidity with which the fishing was prosecuted, have doubtless led to this destruction of a once valuable fishery. The failure of the States to take proper action for the preservation of the sturgeon has no doubt been due to the recent date at which the fishery was established and to the absence of accurate knowledge as to its destructive tendency. The extreme brevity of the existence of this fishery is very suggestive, although in keeping with other rivers of the Eastern States in which the sturgeon fishery has been entirely abandoned.

The extent of the sturgeon fishery of the Columbia River during the four years, 1889 to 1892, is shown in the following tables, relating to persons employed, apparatus, boats, etc., used, and quantity and value of products.

Persons employed in the sturgeon fishery of the Columbia River.

Years.	Fishermen.	Shore employees.	Total.
1889	135	20	155
1890	183	29	212
1891	202	35	237
1892	287	53	340

Boats, apparatus, and other property employed in the sturgeon fishery of the Columbia River.

Items.	1889.		1890.		1891.		1892.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Boats	90	$2,250	122	$3,050	135	$3,375	200	$8,690
Set lines	630	6,300	854	8,540	945	9,450	1,322	13,220
Gill nets	15	1,500	15	1,500	15	1,500	15	1,500
Shore property	......	17,200	......	23,500	......	24,500	......	27,000
Cash capital	......	8,900	......	14,000	......	21,000	......	40,000
Total	......	36,150	......	50,590	......	59,825	......	90,410

Products of the sturgeon fishery of the Columbia River.

Products.	1889.		1890.		1891.		1892.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Flesh	921,945	$10,094	1,627,434	$17,275	1,868,902	$20,447	2,915,428	$30,904
Roe	21,275	851	36,650	1,346	47,680	1,907	47,260	1,890
Marrow	15,500	1,395	33,300	2,331	39,400	1,970	56,020	2,241
Sounds	1,195	2,902	2,325	3,487	3,117	4,676	4,405	6,758
Total	960,705	15,242	1,696,709	24,439	1,959,099	29,000	3,006,757	41,743

THE FISH TRADE OF PORTLAND, OREGON.

The fish business of Portland is of considerable extent and is one of the most important branches of trade. In the wholesale trade, fresh, pickled, and canned salmon, and fresh sturgeon are handled in large quantities, the fresh fish being shipped in refrigerator cars to points east of the Missouri River. One salmon cannery is located within the city limits, and several others on the Columbia River and in other places are owned by persons having their business headquarters at Portland.

A good variety of fresh-water and salt-water fish may be found in the markets of the city at almost any time in the year. German carp, shad, and catfish, which were only recently introduced into that part of the country, have wonderfully increased and are found constantly in the markets. Their abundance is such that at times it is difficult to sell them at any price. Salmon is the favorite fish and is usually sold at a very reasonable price. Any recent decrease in the quantities of carp, shad, and catfish consumed in Portland may be attributed to the increased use of salmon. Carp and catfish are plentiful around the city docks and are also very abundant in the several streams adjacent to Portland.

The salt-water fish entering into the fresh-fish trade of Portland come largely from Puget Sound. Native oysters are brought from Willapa Bay and the Yaquina River in sacks holding about 100 pounds each. Crawfish are common and come from the sloughs of the Willamette River, a few miles from the city. The crabs and clams which are consumed locally are received from Willapa Bay and the mouth of the Columbia River.

In the following table the extent of the fresh-fish trade of Portland in the years 1889 to 1892 is shown. The values given represent the prices paid by the dealers to the fishermen.

Fresh-fish trade of Portland, Oregon.

Species.	1889.		1890.		1891.		1892.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Cultus-cod	20,109	$1,005	22,320	$1,116	28,200	$1,413	30,119	$1,506
Flounders	60,117	1,804	65,220	1,957	70,300	2,111	75,108	2,253
Halibut	55,000	2,750	61,108	3,055	75,320	3,766	122,500	6,125
Herring	55,214	1,656	60,512	1,815	64,670	1,940	71,870	2,156
Perch	90,212	2,706	95,317	2,860	98,230	2,947	110,160	3,305
Salmon	830,105	32,050	920,222	36,800	960,115	38,400	1,004,320	30,130
Shad	10,145	507	20,360	1,018	31,125	1,556	45,840	2,292
Smelt	198,400	4,962	101,115	2,528	149,870	3,746	300,422	7,510
Trout	13,319	1,998	14,270	2,140	16,180	2,427	19,430	2,914
Other fish	8,328	833	29,958	2,387	63,694	2,634	103,470	4,522
Clams	50,115	1,250	60,340	1,500	70,530	1,763	80,240	2,006
Oysters	200,000	5,000	210,000	5,250	260,000	6,500	316,000	7,400
Crabs	7,200	250	13,350	467	18,000	630	21,600	756
Crawfish	20,000	3,000	25,000	3,750	30,000	4,800	20,000	3,000
Total	1,618,324	59,771	1,699,092	66,643	1,936,354	74,633	2,321,079	75,875

WASHINGTON.

GENERAL IMPORTANCE OF THE FISHERIES.

The fisheries of this State are more valuable than those of Oregon, owing to a greater development of the oyster industry, the pelagic fur-seal fishery, and the general fisheries for salt-water fish, although the extent of the salmon fishery is considerably less than in Oregon.

The fishing industry of the State has witnessed a gratifying increase yearly. In the face of the depressed condition of trade during part of the time covered by this report the fisheries underwent a noteworthy development, and the continued increase in the State's population will no doubt lead to a still more important fishing business.

As at present prosecuted the fisheries of Washington of special prominence are the salmon and sturgeon fisheries of the Columbia River, Grays Harbor, and Whatcom County, the oyster industry of Willapa Bay, the general food-fish and fur-seal fisheries of Puget Sound and Strait of Fuca, and the cod fishery of Skagit County.

The fishing industry of Washington in 1892 gave employment to 4,310 persons; the capital invested was $1,593,567; the value of the products was $931,568. Statistics showing the aggregate of the business in 1892 and in the three preceding years are given in the following tables:

Persons employed in the fisheries of Washington.

How engaged.	1889.	1890.	1891.	1892.
On fishing vessels	103	95	217	331
On transporting vessels	28	27	40	45
In shore fisheries	2,528	2,470	2,818	3,082
On shore, in canneries, etc	704	652	778	852
Total	3,363	3,253	3,853	4,310

Vessels, boats, apparatus, shore property, and cash capital of the fisheries of Washington.

Items.	1889.		1890.		1891.		1892.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	8	$30,850	9	$24,550	19	$45,850	33	$85,730
Tonnage	319.10		254.57		588.83		1,009.17	
Outfit		10,245		8,775		10,305		27,880
Vessels transporting	12	16,050	12	11,900	15	31,300	18	28,900
Tonnage	109.38		107.18		166.11		175.95	
Outfit		7,820		1,500		3,700		5,750
Boats	1,277	108,414	1,280	106,175	1,474	123,610	1,690	132,330
Apparatus—vessel fisheries:								
Seines	1	75	1	75	3	525	1	75
Gill nets							1	50
Lines		700		400		955		1,765
Guns and spears		1,400		1,400		3,153		4,517
Apparatus—shore fisheries:								
Gill nets	638	98,987	743	97,830	871	112,137	885	112,550
Pound and trap nets	137	92,300	74	58,200	118	117,200	157	124,700
Seines	120	38,950	126	36,750	151	45,775	162	46,650
Reef nets					20	1,000	10	500
Minor nets	15	75	18	90	23	115	20	100
Wheels	9	26,000	12	48,500	14	45,000	17	49,000
Lines		3,320		3,630		3,071		4,005
Tongs, rakes, and hoes		302		3,492		4,195		3,505
Guns, spears, harpoons, etc.		1,050		1,050		1,222		1,700
Shore property		363,450		308,280		442,550		417,800
Cash capital		461,000		405,000		495,060		546,000
Total		1,261,078		1,117,687		1,486,563		1,593,567

Products of the fisheries of Washington.

Species.	1889.		1890.		1891.		1892.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Black-cod			4,700	$141	13,500	$405	15,000	$450
Blueback salmon	490,192	$19,427	1,487,100	39,558	1,145,858	26,764	2,513,932	62,431
Chinook salmon	10,207,756	455,913	9,547,343	291,333	9,723,673	358,123	9,843,627	363,363
Cod, salted	80,000	2,800			85,000	3,400	539,000	21,560
Cultus-cod	267,000	5,360	276,000	5,620	283,000	6,835	359,000	6,875
Dog salmon	413,327	4,189	918,773	8,328	1,021,051	9,066	3,310,115	22,190
Flounders	105,000	1,700	134,000	2,255	193,150	3,288	184,560	3,191
Halibut	685,000	15,640	740,000	16,750	994,500	23,620	1,410,500	29,140
Herring	215,000	2,475	407,000	4,590	508,000	5,750	617,112	6,817
Humpback salmon	322,392	5,615			752,941	11,957		
Perch	23,000	460	44,000	880	60,000	1,500	65,140	1,303
Rockfish	102,000	2,910	110,000	3,075	150,000	4,275	163,000	4,515
Shad	21,010	2,055	44,167	3,519	59,900	3,590	103,350	3,183
Silver salmon	4,020,815	86,944	1,419,172	30,621	2,193,320	39,552	3,597,345	60,143
Smelt	203,000	3,750	236,000	4,500	272,000	5,160	321,726	6,158
Steelhead salmon	962,805	27,884	1,362,615	17,372	1,325,423	24,279	2,419,192	43,419
Sturgeon	218,985	2,300	255,263	2,871	503,327	5,468	543,623	5,757
Trout, black-spotted	12,000	1,800	15,000	2,700	16,000	2,880	20,000	3,600
Trout, salmon	13,000	390	15,000	450	18,000	540	20,000	600
Crabs	22,400	840	48,400	1,900	69,600	2,760	79,000	3,550
Shrimp	1,500	300	1,475	295	1,800	450	2,000	500
Clams	438,000	3,650	624,000	5,200	736,800	6,140	684,000	5,700
Oysters	7,547,400	128,604	8,889,000	147,930	9,985,680	154,961	9,895,440	147,995
Whales		800		600		2,400		600
Fur seals		30,190		58,906		70,179		121,528
Frogs	7,500	3,000	10,813	4,325	8,413	3,365	13,125	5,250
Dogfish oil	28,500	1,330	30,000	1,400	33,750	1,575	37,500	1,750
Total	26,407,582	810,326	26,619,821	655,119	30,154,686	777,282	36,757,287	931,568

The crabs, clams, oysters, frogs, oil, etc., specified by pounds in the foregoing table are, in the following supplementary table, reduced to the basis on which they are sold in the markets, and the number of whales and fur seals are shown:

Products.		1889.	1890.	1891.	1892.
Crabs	number	7,466	16,133	23,200	26,333
Clams	bushels	6,257	8,914	10,525	9,771
Oysters	do	125,790	148,150	166,428	164,924
Whales	number	4	3	12	3
Fur seals	do	2,875	4,620	4,267	9,143
Frogs	do	36,060	51,900	40,380	63,000
Dogfish oil	gallons	3,800	4,000	4,500	5,000

DETAILED STATISTICS.

The following series of tables relates to the fisheries of Washington in the years 1889 to 1892, inclusive. Figures for each county are shown in detail.

Table showing by counties the number of persons employed in the fisheries of Washington in 1889, 1890, 1891, and 1892.

Counties.	1889.					1890.				
	On vessels fishing.	On vessels transporting.	In shore fisheries.	On shore, in canneries, etc.	Total.	On vessels fishing.	On vessels transporting.	In shore fisheries.	On shore, in canneries, etc.	Total.
Chehalis			66	8	74			45	6	51
Clallam			315		315			322		322
Clarke			20		20			20		20
Cowlitz			30	2	32			42	5	47
Jefferson	12		17		29	12		17		29
King	91		235	142	468	76		287	89	452
Klickitat			50		50			55		55
Mason			64	6	70			64	6	70
Pacific		23	576	184	783		22	483	189	694
Pierce			118	3	121	7		127	3	137
San Juan								6	5	11
Skamania			20		20			22		22
Thurston			12		12			12		12
Wahkiakum		5	1,005	359	1,369		5	977	349	1,331
Total	103	28	2.528	704	3,363	95	27	2,479	652	3,253

Counties.	1891.					1892.				
	On vessels fishing.	On vessels transporting.	In shore fisheries.	On shore, in canneries, etc.	Total.	On vessels fishing.	On vessels transporting.	In shore fisheries.	On shore, in canneries, etc.	Total.
Chehalis			45	4	49			68	10	78
Clallam	66		356		422	92		387		479
Clarke			20		20			20		20
Cowlitz			32	7	39			38	11	49
Jefferson	20		17		37	26		17		43
King	96	5	323	82	506	155	4	363	83	605
Klickitat			68		68			63		63
Mason			64	6	70			64	6	70
Pacific		26	651	262	939		32	726	299	1,057
Pierce	7		130	5	151	20		150	7	177
San Juan			6	5	11			6	5	11
Skagit	32			3	35	35			3	38
Skamania			22		22			28		28
Thurston			14		14			14		14
Wahkiakum		5	857	332	1,194		5	953	346	1,304
Whatcom		4	204	72	280	3	4	185	82	274
Total	221	40	2,818	778	3,857	331	45	3,082	852	4,310

Table showing by counties the nativity of persons employed in the fisheries of Washington in 1892.

Counties.	Countries.															
	United States.	Russia.	Sweden.	Norway.	Austria.	Greece.	Italy.	Germany.	France.	Great Britain.	Holland.	China.	Portugal.	Japan.	American Indians.	Total.
On vessels fishing:																
Clallam	7														85	92
Jefferson	16														10	26
King	106		16	6					2	9					16	155
Pierce	20															20
Skagit	24		3	3									2		3	35
Whatcom	3															3
Total	176		19	9					2	9			2		114	331
On vessels transporting:																
King	4															4
Pacific	32															32
Wahkiakum	5															5
Whatcom	3									1						4
Total	44									1						45
In shore or boat fisheries:																
Chehalis	40	14	8	6												68
Clallam	16		11												360	387
Clarke	20															20
Cowlitz	38															38
Jefferson	8			4											5	17
King	58		59	49	102	55	40									303
Klickitat	23														40	63
Mason	45											8			11	64
Pacific	295	77	83	48	18		2	9	1	10					183	726
Pierce	25		50	41			5		2				7		20	150
San Juan	6															6
Skamania	6	19	3													28
Thurston															14	14
Wahkiakum	237	119	274	115	60	63	8	14	2	39	2				20	953
Whatcom	50		20	15											100	185
Total	867	229	508	278	180	118	55	23	5	49	2	8	7		753	3,082
On shore, in canneries, etc.:																
Chehalis	10															10
Cowlitz	10											1				11
King	20											46		17		83
Mason	6															6
Pacific	63	4	1					1		1		229				299
Pierce	7															7
San Juan	5															5
Skagit	3															3
Wahkiakum	39		1					1				305				346
Whatcom	17											50			15	82
Total	180	4	2					2		1		631		17	15	852

Table showing by counties the nationality of persons employed in the fisheries of Washington in 1892.

Counties.	Countries.															
	United States.	Russia.	Sweden.	Norway.	Austria.	Greece.	Italy.	Germany.	France.	Great Britain.	Holland.	China.	Portugal.	Japan.	American Indian.	Total.
On vessels fishing:																
Clallam	5		2												85	92
Jefferson	16														10	26
King	91		23	13					2	10					16	155
Pierce	20															20
Skagit	22		5	3									2		3	35
Whatcom	3															3
Total	157		30	16					2	10			2		114	331
On vessels transporting:																
King	4															4
Pacific	32															32
Wahkiakum	5															5
Whatcom	2									2						4
Total	43									2						45
In shore or boat fisheries:																
Chehalis	68															68
Clallam	27														360	387
Clarke	20															20
Cowlitz	38															38
Jefferson	12														5	17
King	363															363
Klickitat	23														40	63
Mason	45											8			11	64
Pacific	543														183	726
Pierce	130														20	150
San Juan	6															6
Skamania	28															28
Thurston															14	14
Wahkiakum	953															953
Whatcom	85														100	185
Total	2,341											8			733	3,082
On shore, in canneries, etc.:																
Chehalis	10															10
Cowlitz	10											1				11
King	20											46		17		83
Mason	6															6
Pacific	66	4										229				299
Pierce	7															7
San Juan	5															5
Skagit	3															3
Wahkiakum	41											305				346
Whatcom	17											50			15	82
Total	185	4										631		17	15	852

Table showing by counties the apparatus and capital employed in the fisheries of Washington in 1889, 1890, 1891, and 1892.

Years and counties.	Vessels fishing.				Vessels transporting.				Boats.	
	No.	Tonnage.	Value.	Value of outfit.	No.	Tonnage.	Value.	Value of outfit.	No.	Value.
1889.										
Chehalis									15	$1,500
Clallam									174	10,125
Clarke									10	750
Cowlitz									45	2,250
Jefferson	2	11.60	$950	$215					8	1,360
King	6	307.50	29,900	10,030					97	7,885
Klickitat									9	140
Mason									118	3,560
Pacific					11	72.37	$9,050	$920	295	20,494
Pierce									92	3,430
Skamania									6	120
Thurston									30	1,000
Wahkiakum					1	37.01	7,000	6,900	378	55,800
Total	8	319.10	30,850	10,245	12	109.38	16,050	7,820	1,277	108,414
1890.										
Chehalis									25	1,750
Clallam									177	10,250
Clarke									14	1,050
Cowlitz									55	2,950
Jefferson	2	11.60	950	220					8	1,330
King	5	223.05	21,900	7,705					81	6,980
Klickitat									9	140
Mason									118	3,560
Pacific					11	70.17	4,900		281	18,850
Pierce	2	19.92	1,700	850					97	3.745
San Juan									4	250
Skamania									6	120
Thurston									30	1,000
Wahkiakum					1	37.01	7,000	1,500	355	54,200
Total	9	254.57	24,550	8,775	12	107.18	11,900	1,500	1,260	106,175
1891.										
Chehalis									25	1,750
Clallam	3	98.40	3,100	2,205					205	11,900
Clarke									11	825
Cowlitz									54	2,550
Jefferson	4	22.66	1,650	720					8	1,330
King	7	261.06	24,400	3,255	1	33.66	10,000	1,000	98	8,730
Klickitat									10	160
Mason									118	3,560
Pacific					12	83.55	10,800	300	385	31,047
Pierce	3	28.08	2,700	1,325					102	4,070
San Juan									4	250
Skagit	2	178.63	14,000	2,800						
Skamania									6	120
Thurston									31	1,018
Wahkiakum					1	37.01	7,000	1,500	357	52,600
Whatcom					1	11.89	3,500	900	60	3,000
Total	19	588.83	45,850	10,305	15	166.11	31,300	3,700	1,474	123,510
1892.										
Chehalis									49	3,025
Clallam	7	178.29	6,700	3,205					210	12,250
Clarke									13	975
Cowlitz									58	2,800
Jefferson	8	76.90	4,250	1,810					8	965
King	15	448.83	40,600	15,675	1	10.82	3,500	750	107	11,005
Klickitat									11	170
Mason									118	3,560
Pacific					15	113.94	12,400	2,100	508	40,195
Pierce	5	103.79	18,180	4,010					130	5,075
San Juan									4	250
Skagit	2	178.63	14,000	3,100						
Skamania									6	120
Thurston									31	1,015
Wahkiakum					1	37.01	7,000	1,500	397	48,175
Whatcom	1	22.73	2,000	80	1	14.18	6,000	1,400	40	2,750
Total	33	1,009.17	85,730	27,880	18	175.95	28,900	5,750	1,690	132,330

Table showing by counties the apparatus and capital employed in the fisheries of Washington in 1889, 1890, 1891, and 1892—Continued.

Years and counties.	Apparatus—vessel fisheries.				Apparatus—shore fisheries.							
	Seines and gill nets.		Value of lines.	Value of guns and spears.	Gill nets.		Pound and trap nets.		Seines.		Reef nets.	
	No.	Value.			No.	Value.	No.	Value.	No.	Value.	No.	Value.
1889.												
Chehalis					59	$3,250	28	$19,400				
Clarke					39	925						
Cowlitz					20	3,075						
Jefferson	1	$75	$70						2	$150		
King			630	$1,400	103	2,312	9	5,500	20	11,300		
Klickitat					25	375	2	800				
Pacific					60	11,650	91	61,800	2	1,000		
Pierce							2	1,600	65	8,800		
Skamania					20	300						
Wahkiakum					312	77,100	5	3,200	31	17,700		
Total	1	75	700	1,400	638	98,987	137	92,300	120	38,950		
1890.												
Chehalis					70	2,600						
Clarke					50	1,250						
Cowlitz					30	4,500						
Jefferson	1	75	70						2	150		
King			270	1,400	210	4,000			22	10,200		
Klickitat					25	375	2	800				
Pacific					22	7,500	68	54,400	2	1,000		
Pierce			150				2	1,600	71	9,550		
San Juan									2	450		
Skamania					20	300						
Wahkiakum					306	77,305	2	1,400	27	15,400		
Total	1	75	490	1,400	743	97,830	74	58,200	126	36,750		
1891.												
Chehalis					70	2,600						
Clallam				853					2	200		
Clarke					43	1,025						
Cowlitz					22	3,375						
Jefferson	1	75	150						2	150		
King			275	1,700	285	4,937			30	15,625		
Klickitat					28	395	2	800				
Pacific					79	21,100	107	108,600	2	1,000		
Pierce			230				2	1,600	81	10,800		
San Juan									2	450		
Skagit			300	600								
Skamania					20	300						
Wahkiakum					304	76,905	5	3,200	28	15,900		
Whatcom					20	1,500	2	3,000	6	2,100	20	$1,000
Total	1	75	955	3,153	871	112,137	118	117,200	153	46,225	20	1,000
1892.												
Chehalis					66	3,900						
Clallam	*a* 1	50	25	1,117					5	500		
Clarke					49	1,000						
Cowlitz					24	3,675						
Jefferson	1	75	345						2	150		
King			595	2,800	310	5,250	3	1,500	36	20,000		
Klickitat					32	410	2	800				
Pacific					103	30,400	141	109,800	4	2,600		
Pierce			450				2	1,600	91	12,050		
San Juan									2	450		
Skagit			300	600								
Skamania					20	300						
Wahkiakum					261	66,055	4	2,500	12	7,400		
Whatcom			50		20	1,500	5	8,500	10	3,500	10	500
Total	2	125	1,765	4,517	885	112,550	157	124,700	162	46,650	10	500

a Gill net.

Table showing by counties the apparatus and capital employed in the fisheries of Washington in 1889, 1890, 1891, and 1892—Continued.

Years and counties.	Minor nets.		Wheels.		Value of lines.	Value of tongs, rakes, and hoes.	Value of guns, spears, harpoons, etc.	Value of shore property.	Cash capital.	Total investment.
	No.	Value.	No.	Value.						
1889.										
Chehalis								$34,000	$30,000	$88,150
Clallam					$825		$1,050			12,000
Clarke			2	$4,000				2,000		7,675
Cowlitz					2,100			7,000	3,000	17,425
Jefferson					305			2,000		5,125
King						$50		41,500	45,000	155,507
Klickitat	15	$75	3	11,500						12,890
Mason						172		1,000	5,000	9,732
Pacific								80,400	134,000	319,314
Pierce					90	130		5,000	5,000	24,050
Skamania			4	10,500						10,920
Thurston						40				1,040
Wahkiakum								190,550	239,000	597,250
Total	15	75	9	26,000	3,320	392	1,050	363,450	461,000	1,261,078
1890.										
Chehalis								1,000		5,350
Clallam					850		1,050			12,150
Clarke			2	4,000				2,000		8,300
Cowlitz					2,380			7,000	3,000	19,830
Jefferson					305			2,000		5,100
King						50		44,000	28,000	124,505
Klickitat	18	90	3	11,500						12,905
Mason						172		1,000	5,000	9,732
Pacific						3,100		55,400	114,000	259,150
Pierce					95	130		5,000	5,000	27,820
San Juan								1,000		1,700
Skamania			7	33,000						33,420
Thurston						40				1,040
Wahkiakum								189,880	250,000	596,685
Total	18	90	12	48,500	3,630	3,492	1,050	308,280	405,000	1,117,687
1891.										
Chehalis								1,000		5,350
Clallam						875	1,050			20,183
Clarke			2	4,000				2,000		7,850
Cowlitz					2,660			7,000	6,000	21,585
Jefferson					265			2,000		6,340
King					50			42,000	45,000	156,972
Klickitat	23	115	5	21,500						22,970
Mason						43	172	1,000	5,000	9,775
Pacific						3,100		140,650	177,000	494,197
Pierce					96	135		25,000	20,000	65,950
San Juan								1,000		1,700
Skagit								5,500	5,000	28,200
Skamania			7	19,500						19,920
Thurston						42				1,060
Wahkiakum								190,400	207,000	554,505
Whatcom								25,000	30,000	70,000
Total	23	115	14	45,000	3,071	4,195	1,222	442,550	495,000	1,486,563
1892.										
Chehalis								8,000	30,000	44,985
Clallam					900		1,700			26,447
Clarke			3	5,000				3,000		9,975
Cowlitz					2,800			7,500	6,000	22,775
Jefferson					265			2,000		9,860
King						50		45,000	50,000	196,725
Klickitat	20	100	6	23,000						24,480
Mason						172		1,000	5,000	9,732
Pacific						3,100		142,300	213,000	555,895
Pierce					100	143		25,000	25,000	91,608
San Juan								1,000		1,700
Skagit								5,500	5,000	28,500
Skamania			8	21,000						21,420
Thurston						40				1,055
Wahkiakum								147,500	172,000	452,130
Whatcom								30,000	40,000	96,280
Total	20	100	17	40,000	4,065	3,505	1,700	417,800	546,000	1,593,567

Table showing, by counties and species the yield of the fisheries of Washington in 1889.

Species.	Chehalis.		Clallam.		Clarke.		Cowlitz.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Blueback salmon					51,750	$1,737	13,000	$390
Chinook salmon	1,085,075	$21,701			30,200	1,310	81,000	3,240
Cultus-cod			130,000	$2,500				
Dog salmon			47,210	965				
Halibut			300,000	4,500				
Humpback salmon			39,350	810				
Rockfish			60,000	1,650				
Silver salmon	1,282,200	32,044	86,440	2,695			26,675	667
Steelhead salmon					8,920	263	42,325	1,143
Sturgeon							218,985	2,300
Whales				800				
Total	2,367,275	53,745	663,000	13,920	90,870	3,310	381,985	7,740

Species.	Jefferson.		King.		Klickitat.		Mason.		Pacific.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Blueback salmon					172,817	$5,898			111,850	$5,586
Chinook salmon			80,248	$1,828	112,925	3,667			1,632,953	71,569
Cod, salted			80,000	2,800						
Cultus-cod	24,000	$600	8,000	160						
Dog salmon	4,000	80	289,247	2,415						
Flounders			25,000	500						
Halibut	61,000	1,420	320,000	9,600						
Herring	15,000	300	35,000	525						
Humpback salmon			184,427	2,764						
Perch			23,000	460						
Shad									14,125	1,412
Silver salmon	14,000	580	1,086,960	13,922	39,005	836			1,198,000	29,950
Smelt	25,000	750	33,000	825						
Steelhead salmon			90,570	1,811	10,870	326,			251,520	7,544
Crabs			14,400	600						
Clams			108,000	900						
Oysters							1,500,000	$37,500	5,609,400	81,804
Fur seals				30,190						
Frogs			7,500	3,000						
Total	143,000	3,730	2,385,352	72,300	335,617	10,727	1,500,000	37,500	8,817,848	197,865

Species.	Pierce.		Skamania.		Thurston.		Wahkiakum.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Blueback salmon			133,315	$5,443			7,460	$373	490,192	$19,427
Chinook salmon	15,980	$480	99,275	4,001			7,070,100	348,117	10,207,756	455,913
Cod, salted									80,000	2,800
Cultus-cod	105,000	2,100							267,000	5,360
Dog salmon	72,870	729							413,327	4,189
Flounders	80,000	1,200							105,000	1,700
Halibut	4,000	120							685,000	15,640
Herring	165,000	1,650							215,000	2,475
Humpback salmon	98,615	2,041							322,392	5,615
Perch									23,000	460
Rockfish	42,000	1,260							102,000	2,910
Shad	1,000	55					5,885	588	21,010	2,055
Silver salmon	287,535	6,250							4,020,815	86,974
Smelt	145,000	2,175							203,000	3,750
Steelhead salmon			5,010	190			553,590	16,607	962,805	27,884
Sturgeon									218,985	2,300
Trout, black-spotted	12,000	1,800							12,000	1,800
Trout, salmon	13,000	390							13,000	390
Crabs	8,000	240							22,400	840
Shrimp	1,500	300							1,500	300
Clams	330,000	2,750							438,000	3,650
Oysters	360,000	7,500			78,000	$1,800			7,547,400	128,604
Whales										800
Fur seals										30,190
Frogs									7,500	3,000
Dogfish oil	28,500	1,330							28,500	1,330
Total	1,770,000	32,370	237,600	9,634	78,000	1,800	7,637,035	365,685	26,407,582	810,326

Table showing by counties and species the yield of the fisheries of Washington in 1890.

Species.	Chehalis.		Clallam.		Clarke.		Cowlitz.		Jefferson.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Blueback salmon					152,170	$3,055	20,000	$700		
Chinook salmon	75,000	$1,875			75,300	2,259	137,000	5,480		
Cultus-cod			120,000	$2,350					28,000	$710
Dog salmon			63,800	1,275					6,000	120
Halibut			280,000	4,200					80,000	1,900
Herring									17,000	340
Rockfish			65,000	1,725						
Silver salmon	150,000	3,750	96,200	3,000			37,150	743	16,000	680
Smelt									20,000	600
Steelhead salmon					24,680	247	70,850	1,717		
Sturgeon							255,263	2,871		
Whales				600						
Total	225,000	5,625	625,000	13,150	252,150	5,561	520,263	11,511	167,000	4,350

Species.	King.		Klickitat.		Mason.		Pacific.		Pierce.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Black-cod			357,535	$9,913			213,515	$4,270	4,700	$141
Blueback salmon			212,410	5,531			2,119,975	63,602		
Chinook salmon	93,793	$2,686							38,390	1,152
Cultus-cod	11,000	220							117,000	2,340
Dog salmon	745,485	5,899							103,488	1,034
Flounders	49,000	980							85,000	1,275
Halibut	177,000	5,310							203,000	5,340
Herring	70,000	1,050							170,000	1,700
Perch	44,000	880								
Rockfish									45,000	1,350
Shad							26,125	2,090	9,237	724
Silver salmon	719,700	13,952	42,000	682					358,122	7,814
Smelt	66,000	1,650							150,000	2,250
Steelhead salmon	172,460	3,449	117,875	1,733			412,430	4,123		
Trout, black-spotted									15,000	2,700
Trout, salmon									15,000	450
Crabs	38,400	1,600							10,000	300
Shrimp									1,475	295
Clams	204,000	1,700							420,000	3,500
Oysters					1,524,000	$38,100	6,898,200	100,598	390,000	7,312
Fur seals		58,906								
Frogs	10,813	4,325								
Dogfish oil									30,000	1,400
Total	2,401,651	102,607	729,820	17,859	1,524,000	38,100	9,670,245	174,683	2,165,412	41,077

Species.	San Juan.		Skamania.		Thurston.		Wahkiakum.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Black-cod									4,700	$141
Blueback salmon			684,745	$20,442			59,135	$1,178	1,487,100	39,558
Chinook salmon			518,675	15,560			6,276,800	193,188	9,547,343	291,333
Cultus-cod									276,000	5,620
Dog salmon									918,773	8,328
Flounders									134,000	2,255
Halibut									740,000	16,750
Herring	150,000	$1,500							407,000	4,590
Perch									44,000	880
Rockfish									110,000	3,075
Shad							8,805	705	44,167	3,519
Silver salmon									1,419,172	30,621
Smelt									236,000	4,500
Steelhead salmon			29,080	752			535,240	5,351	1,362,615	17,372
Sturgeon									255,263	2,871
Trout, black-spotted									15,000	2,700
Trout, salmon									15,000	450
Crabs									48,400	1,900
Shrimp									1,475	295
Clams									624,000	5,200
Oysters					76,800	$1,920			8,889,000	147,930
Whales										600
Fur seals										58,906
Frogs									10,813	4,325
Dogfish oil									30,000	1,400
Total	150,000	1,500	1,232,500	36,754	76,800	1,920	6,879,980	200,422	26,619,821	655,119

Table showing by counties and species the yield of the fisheries of Washington in 1891.

Species.	Chehalis.		Clallam.		Clarke.		Cowlitz.		Jefferson.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Blueback salmon					53,830	$1,855	12,000	$420		
Chinook salmon	60,000	$1,500			35,500	1,275	82,500	3,300		
Cultus-cod			115,000	$2,275					24,000	$620
Dog salmon			55,140	1,060					13,000	260
Flounders			8,150	163						
Halibut			315,000	5,350					120,000	2,950
Herring			15,000	150					16,000	320
Humpback salmon			37,880	757						
Rockfish			100,000	2,775						
Silver salmon	130,000	3,150	103,980	3,163			53,400	1,068	23,500	965
Smelt									22,000	660
Steelhead salmon					9,300	254	68,600	1,537		
Sturgeon							503,327	5,468		
Whales				2,400						
Fur seals				14,947						
Total	190,000	4,650	750,150	33,040	98,630	3,384	719,827	11,793	218,500	5,775

Species.	King.		Klickitat.		Mason.		Pacific.	
	Pounds.	Value	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Blueback salmon			147,773	$3,520			251,750	$5,034
Chinook salmon	146,063	$3,530	73,848	2,061			3,603,300	136,559
Cultus-cod	12,000	300						
Dog salmon	861,472	6,832						
Flounders	70,000	1,400						
Halibut	207,000	6,480						
Herring	102,000	1,530						
Humpback salmon	610,416	9,288						
Perch	60,000	1,500						
Shad							42,180	2,531
Silver salmon	931,081	17,220	48,930	1,020			443,000	4,730
Smelt	75,000	1,875						
Steelhead salmon	209,320	4,187	78,314	2,046			464,709	6,537
Crabs	57,600	2,400						
Clams	270,000	2,250						
Oysters					1,560,000	$39,000	7,890,480	105,206
Fur seals		45,632						
Frogs	8,413	3,365						
Total	3,629,365	107,789	348,865	8,647	1,560,000	39,000	12,695,419	260,597

Species.	Pierce.		San Juan.		Skagit.		Skamania.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Black-cod	13,500	$405						
Blueback salmon							118,925	$3,568
Chinook salmon	56,612	1,698					171,875	5,181
Cod, salted					85,000	$3,400		
Cultus-cod	132,000	2,640						
Dog salmon	91,439	914						
Flounders	115,000	1,725						
Halibut	352,500	8,840						
Herring	175,000	1,750	200,000	$2,000				
Humpback salmon	95,645	1,912						
Rockfish	50,000	1,500						
Shad	1,012	57						
Silver salmon	356,304	7,136						
Smelt	175,000	2,625						
Steelhead salmon							67,010	1,950
Trout, black-spotted	16,000	2,880						
Trout, salmon	18,000	540						
Crabs	12,000	360						
Shrimp	1,800	450						
Clams	466,800	3,890						
Oysters	420,000	7,875						
Fur seals						9,600		
Dogfish oil	33,750	1,575						
Total	2,582,362	48,772	200,000	2,000	85,000	13,000	357,810	10,699

Table showing by counties and species the yield of the fisheries of Washington in 1891—Continued.

Species.	Thurston.		Wahkiakum.		Whatcom.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Black-cod							13,500	$405
Blueback salmon			38,820	$1,165	522,760	$11,202	1,145,858	26,764
Chinook salmon			5,493,975	203,019			9,723,673	358,123
Cod, salted							85,000	3,400
Cultus-cod							283,000	5,835
Dog salmon							1,021,051	9,066
Flounders							193,150	3,288
Halibut							994,500	23,620
Herring							508,000	5,750
Humpback salmon							752,941	11,957
Perch							60,000	1,500
Rockfish							150,000	4,275
Shad			16,708	1,002			59,900	3,590
Silver salmon					103,125	1,100	2,193,320	39,552
Smelt							272,000	5,160
Steelhead salmon			428,170	7,768			1,325,423	24,279
Sturgeon							503,327	5,468
Trout, black-spotted							16,000	2,880
Trout, salmon							18,000	540
Crabs							69,600	2,760
Shrimp							1,800	450
Clams							736,800	6,140
Oysters	115,200	$2,880					9,985,680	154,961
Whales								2,400
Fur seals								70,179
Frogs							8,413	3,365
Dogfish oil							33,750	1,575
Total	115,200	2,880	5,977,673	212,954	625,885	12,302	30,154,686	777,282

Table showing by counties and species the yield of the fisheries of Washington in 1892.

Species.	Chehalis.		Clallam.		Clarke.		Cowlitz.		Jefferson.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Blueback salmon					162,500	$4,875	15,000	$450		
Chinook salmon	398,738	$7,043			65,825	2,245	110,000	4,400		
Cultus-cod			119,000	$2,345					96,000	$1,590
Dog salmon	322,000	1,610	93,690	1,805					4,000	80
Flounders			12,400	248						
Halibut			359,000	6,135					355,000	6,950
Herring			25,000	250					12,000	240
Rockfish			123,000	3,315						
Silver salmon	751,477	13,397	152,310	4,215			27,600	552	11,000	470
Smelt									23,000	690
Steelhead salmon					35,400	972	49,400	863		
Sturgeon	38,000	190					505,623	5,567		
Whales				600						
Fur seals				19,237						
Total	1,510,215	22,240	884,400	38,150	263,725	8,092	707,623	11,832	501,000	10,020

Species.	King.		Klickitat.		Mason.		Pacific.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Blueback salmon			319,952	$8,306			943,975	$18,970
Chinook salmon	145,384	$4,136	144,855	4,149			3,456,775	136,118
Cod, salted	175,000	7,000						
Cultus-cod	16,000	380						
Dog salmon	1,916,220	12,562					203,000	1,015
Flounders	72,160	1,443						
Halibut	348,000	10,150						
Herring	105,112	1,577						
Perch	65,140	1,303						
Shad							62,400	1,872
Silver salmon	1,268,614	22,651	73,054	1,683			756,000	7,560
Smelt	98,726	2,468						
Steelhead salmon	261,142	5,222	280,870	4,933			790,130	11,924
Crabs	60,000	2,500					9,000	750
Oysters					1,576,800	$32,850	7,588,440	101,179
Clams	300,000	2,500						
Fur seals		98,511						
Frogs	13,125	5,250						
Total	4,844,623	177,653	818,731	19,071	1,567,800	32,850	13,809,720	279,388

Table showing by counties and species the yield of Washington fisheries in 1892—Cont'd.

Species.	Pierce.		San Juan.		Skagit.		Skamania.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Black-cod	15,000	$450						
Blueback salmon							432,280	$12,968
Chinook salmon	140,400	4,212					257,400	7,762
Cod, salted					364,000	$14,560		
Cultus-cod	128,000	2,560						
Dog salmon	165,880	1,659						
Flounders	100,000	1,500						
Halibut	348,000	5,890						
Herring	225,000	2,250	250,000	$2,500				
Rockfish	40,000	1,200						
Shad	1,100	55						
Silver salmon	393,340	7,866						
Smelt	200,000	3,000						
Steelhead salmon							383,190	8,421
Trout, black-spotted	20,000	3,600						
Trout, salmon	20,000	600						
Crabs	10,000	300						
Shrimp	2,000	500						
Oysters	598,200	11,216						
Clams	384,000	3,200						
Fur seals						3,780		
Dogfish oil	37,500	1,750						
Total	2,828,420	51,808	250,000	2,500	364,000	18,340	1,072,870	29,151

Species.	Thurston.		Wahkiakum.		Whatcom.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Black-cod							15,000	$450
Blueback salmon			366,000	$10,986	274,225	$5,876	2,513,932	62,431
Chinook salmon			5,124,250	193,298			9,843,627	363,363
Cod, salted							539,000	21,560
Cultus-cod							359,000	6,875
Dog salmon					605,325	3,459	3,310,115	22,190
Flounders							184,560	3,191
Halibut					500	15	1,410,500	29,140
Herring							617,112	6,817
Perch							65,140	1,303
Rockfish							163,000	4,515
Shad			39,850	1,256			103,350	3,183
Silver salmon					163,950	1,749	3,597,345	60,143
Smelt							321,726	6,158
Steelhead salmon			619,060	11,084			2,419,192	43,419
Sturgeon							543,623	5,757
Trout, black-spotted							20,000	3,600
Trout, salmon							20,000	600
Crabs							79,000	3,550
Shrimp							2,000	500
Oysters	132,000	$2,750					9,895,440	147,995
Clams							684,000	5,700
Whales								600
Fur seals								121,528
Frogs							13,125	5,250
Dogfish oil							37,500	1,750
Total	132,000	2,750	6,149,160	216,624	1,044,000	11,099	36,757,287	931,568

Table showing by counties, species, and apparatus of capture the yield of vessel fisheries of Washington in 1889, 1890, 1891, and 1892.

Year.	Counties.	Species.	Lines.		Seines and gill nets.		Guns and spears.		Total.	
			Lbs.	Value.	Lbs.	Value.	No.	Value.	Lbs.	Value.
1889	Jefferson	Cultus-cod	5,000	$100					5,000	$100
		Dog salmon			4,000	$80			4,000	80
		Halibut	20,000	600					20,000	600
		Silver salmon			8,000	280			8,000	280
		Total	25,000	700	12,000	360			37,000	1,060
1889	King	Cod, salted	80,000	2,800					80,000	2,800
		Cultus-cod	8,000	160					8,000	160
		Halibut	320,000	9,600					320,000	9,600
		Fur seals					2,875	$30,190		30,190
		Total	408,000	12,560			2,875	30,190	408,000	42,750
		Grand total	433,000	13,260	12,000	360	2,875	30,190	445,000	43,810

Table showing by counties, species, and apparatus of capture the yield of vessel fisheries of Washington in 1889, 1890, 1891, and 1892—Continued.

Year.	Counties.	Species.	Lines.		Seines and gill nets.		Guns and spears.		Total.	
			Lbs.	Value.	Lbs.	Value.	No.	Value.	Lbs.	Value.
1890	Jefferson	Cultus-cod	7,000	$140					7,000	$140
		Dog salmon			6,000	$120			6,000	120
		Halibut	30,000	900					30,000	900
		Silver salmon			9,000	330			9,000	330
		Total	37,000	1,040	15,000	450			52,000	1,490
1890	King	Cultus-cod	11,000	220					11,000	220
		Halibut	177,000	5,310					177,000	5,310
		Fur seals					4,620	$58,906		58,906
		Total	188,000	5,530			4,620	58,906	188,000	64,436
1890	Pierce	Black cod	4,700	141					4,700	141
		Cultus-cod	2,000	40					2,000	40
		Halibut	200,000	5,250					200,000	5,250
		Total	206,700	5,431					206,700	5,431
		Grand total	431,700	12,001	15,000	450	4,620	58,906	446,700	71,357
1891	Clallam	Fur seals					815	14,947		14,947
1891	Jefferson	Cultus-cod	10,000	200					10,000	200
		Dog salmon			13,000	260			13,000	260
		Halibut	60,000	1,750					60,000	1,750
		Silver salmon			17,000	640			17,000	640
		Total	70,000	1,950	30,000	900			100,000	2,850
1891	King	Cultus-cod	12,000	300					12,000	300
		Halibut	207,000	6,480					207,000	6,480
		Fur seals					2,852	45,632		45,632
		Total	219,000	6,780			2,852	45,632	219,000	52,412
1891	Pierce	Black-cod	13,500	405					13,500	405
		Cultus-cod	2,000	40					2,000	40
		Halibut	349,000	8,735					349,000	8,735
		Total	364,500	9,180					364,500	9,180
1891	Skagit	Cod, salted	85,000	3,400					85,000	3,400
		Fur seals					600	9,600		9,600
		Total	85,000	3,400			600	9,600	85,000	13,000
		Grand total	738,500	21,310	30,000	900	4,267	70,179	768,500	92,389
1892	Clallam	Cultus-cod	2,000	40					2,000	40
		Dog salmon			*2,000	40			2,000	40
		Halibut	5,000	100					5,000	100
		Silver salmon			*3,000	110			3,000	110
		Fur seals					1,743	16,537		16,537
		Total	7,000	140	5,000	150	1,743	16,537	12,000	16,827
1892	Jefferson	Cultus-cod	59,000	730					59,000	730
		Dog salmon			4,000	80			4,000	80
		Halibut	265,000	5,150					265,000	5,150
		Silver salmon			6,000	220			6,000	220
		Total	324,000	5,880	10,000	300			334,000	6,180
1892	King	Cod, salted	175,000	7,000					175,000	7,000
		Cultus-cod	16,000	380					16,000	380
		Halibut	348,000	10,150					348,000	10,150
		Fur seals					6,830	98,511		98,511
		Total	539,000	17,530			6,830	98,511	539,000	116,041
1892	Pierce	Black-cod	15,000	450					15,000	450
		Cultus-cod	3,000	60					3,000	60
		Halibut	345,000	5,800					345,000	5,800
		Total	363,000	6,310					363,000	6,310
1892	Skagit	Cod, salted	364,000	14,560					364,000	14,560
		Fur seals					270	3,780		3,780
		Total	364,000	14,560			270	3,780	364,000	18,340
1892	Whatcom	Halibut	500	15					500	15
		Grand total	1,597,500	44,435	15,000	450	8,843	118,828	1,612,500	163,713

* Caught with gill net.

Tables showing by counties, species, and apparatus of capture the yield of the shore fisheries of Washington in 1889.

Counties and species.	Gill nets.		Pound nets and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Chehalis:								
Chinook salmon	1,085,075	$21,701						
Silver salmon	662,750	16,558	619,450	$15,486				
Total	1,747,825	38,259	619,450	15,486				
Clallam:								
Cultus-cod							130,000	$2,500
Dog salmon							47,210	965
Halibut							300,000	4,500
Humpback salmon							39,350	810
Rockfish							60,000	1,650
Silver salmon							86,440	2,695
Total							663,000	13,120
Clarke:								
Blueback salmon	47,000	1,500						
Chinook salmon	20,000	800						
Steelhead salmon	6,000	175						
Total	73,000	2,475						
Cowlitz:								
Blueback salmon	13,000	390						
Chinook salmon	81,000	3,240						
Silver salmon	26,675	667						
Steelhead salmon	42,325	1,143						
Sturgeon							218,985	2,300
Total	163,000	5,440					218,985	2,300
Jefferson:								
Cultus-cod							19,000	500
Halibut							41,000	820
Herring					15,000	$300		
Silver salmon							6,000	300
Smelt					25,000	750		
Total					40,000	1,050	66,000	1,620
King:								
Chinook salmon	35,861	984	17,273	327	27,114	517		
Dog salmon	155,347	1,483	12,115	61	121,785	871		
Flounders					25,000	500		
Herring	26,250	394			8,750	131		
Humpback salmon	29,255	439	17,212	257	137,960	2,068		
Perch					23,000	460		
Silver salmon	208,583	4,249	375,830	4,021	502,547	5,652		
Smelt					33,000	825		
Steelhead salmon	57,600	1,152	11,520	230	21,450	429		
Crabs					14,400	600		
Total	512,896	8,701	433,950	4,896	915,006	12,053		
Klickitat:								
Blueback salmon	15,000	600	14,000	560				
Chinook salmon	8,500	340	5,000	200				
Steelhead salmon	2,000	60	1,000	30				
Total	25,500	1,000	20,000	790				
Pacific:								
Blueback salmon	90	4	106,995	5,344	4,765	238		
Chinook salmon	608,200	20,332	990,575	49,528	34,178	1,709		
Shad			14,125	1,412				
Silver salmon	399,330	9,983	798,670	19,967				
Steelhead salmon	1,120	33	221,160	6,634	29,240	877		
Total	1,008,740	30,352	2,131,525	82,885	68,183	2,824		
Pierce:								
Chinook salmon			3,500	105	12,480	375		
Cultus-cod							105,000	2,100
Dog salmon			21,405	214	51,465	515		
Flounders					80,000	1,200		
Halibut							4,000	120
Herring					165,000	1,650		
Humpback salmon			22,125	443	76,490	1,598		
Rockfish							42,000	1,260
Shad			500	30	500	25		
Silver salmon			71,320	1,558	216,215	4,692		
Smelt					145,000	2,175		
Trout, black-spotted							12,000	1,800
Trout, salmon					13,000	390		
Crabs					8,000	240		
Shrimp					1,500	300		
Total			118,850	2,350	769,650	13,160	163,000	5,280

Tables showing by counties, species, and apparatus of capture the yield of the shore fisheries of Washington in 1889—Continued.

Counties and species.	Gill nets.		Pound nets and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Skamania:								
Blueback salmon	11,000	$550						
Chinook salmon	3,000	150						
Steelhead salmon	1,000	30						
Total	15,000	730						
Wahkiakum:								
Blueback salmon					7,460	$373		
Chinook salmon	5,440,350	266,630	69,375	$3,469	1,560,375	78,018		
Shad			5,875	587	10	1		
Steelhead salmon	132,580	3,977	10,470	314	410,540	12,316		
Total	5,572,930	270,607	85,720	4,370	1,978,385	90,708		
All counties:								
Blueback salmon	86,090	3,044	120,995	5,904	12,225	611		
Chinook salmon	7,281,986	314,177	1,085,723	53,629	1,634,147	80,619		
Cultus-cod							254,000	$5,100
Dog salmon	155,347	1,483	33,520	275	173,250	1,386	47,210	965
Flounders					105,000	1,700		
Halibut							345,000	5,440
Herring	26,250	394			188,750	2,081		
Humpback salmon	29,255	439	39,337	700	214,450	3,666	39,350	810
Perch					23,000	460		
Rockfish							102,000	2,910
Shad			20,500	2,029	510	26		
Silver salmon	1,297,338	31,457	1,865,270	41,032	718,762	10,344	92,440	2,995
Smelt					203,000	3,750		
Steelhead salmon	242,625	6,570	244,150	7,208	461,230	13,622		
Sturgeon							218,985	2,300
Trout, black-spotted							12,000	1,800
Trout, salmon					13,000	390		
Crabs					22,400	840		
Shrimp					1,500	300		
Grand total	9,118,891	357,564	3,409,495	110,777	3,771,224	119,795	1,110,985	22,320

Counties and species.	Wheels.		Minor nets.		Tongs and hoes.		Spears, guns, etc.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Clallam:								
Whales								$800
Clarke:								
Blueback salmon	4,750	$237						
Chinook salmon	10,200	510						
Steelhead salmon	2,920	88						
Total	17,870	835						
King:								
Frogs			7,500	$3,000				
Clams					108,000	$900		
Total			7,500	3,000	108,000	900		
Klickitat:								
Blueback salmon	103,257	4,130	40,560	608				
Chinook salmon	65,425	2,617	34,000	510				
Silver salmon	16,780	503	22,225	333				
Steelhead salmon	7,870	236						
Total	193,332	7,486	96,785	1,451				
Mason:								
Oysters					1,500,000	37,500		
Pacific:								
Oysters					5,609,400	81,804		
Pierce:								
Clams					330,000	2,750		
Oysters					360,000	7,500		
Dogfish oil							28,500	1,330
Total					690,000	10,250	28,500	1,330

Tables showing by counties, species, and apparatus of capture the yield of the shore fisheries of Washington in 1889—Continued.

Counties and species.	Wheels.		Minor nets.		Tongs and hoes.		Spears, guns, etc.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Skamania:								
Blueback salmon	122,315	$4,893						
Chinook salmon	96,275	3,851						
Steelhead salmon	4,010	160						
Total	222,600	8,904						
Thurston:								
Oysters					78,000	$1,800		
All counties:								
Blueback salmon	230,322	9,260	40,500	$608				
Chinook salmon	171,900	6,978	34,000	510				
Silver salmon	16,780	503	22,225	333				
Steelhead salmon	14,800	484						
Frogs			7,500	3,000				
Clams					438,000	3,650		
Oysters					7,547,400	128,604		
Dogfish oil							28,500	$1,330
Whales								800
Grand total	433,802	17,225	104,285	4,451	7,985,400	132,254	28,500	2,130

Table showing by counties, species, and apparatus of capture the yield of the shore fisheries of Washington in 1890.

Counties and species.	Gill nets.		Pound and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Chehalis:								
Chinook salmon	75,000	$1,875						
Silver salmon	150,000	3,750						
Total	225,000	5,625						
Clallam:								
Cultus-cod							120,000	$2,350
Halibut							280,000	4,200
Rockfish							65,000	1,725
Dog salmon							63,800	1,275
Silver salmon							96,200	3,000
Total							625,000	12,550
Clarke:								
Blueback salmon	85,920	1,730						
Chinook salmon	34,000	1,020						
Steelhead salmon	6,000	60						
Total	125,920	2,810						
Cowlitz:								
Blueback salmon	20,000	700						
Chinook salmon	137,000	5,480						
Silver salmon	37,150	743						
Steelhead salmon	70,850	1,717						
Sturgeon							255,263	2,871
Total	265,000	8,640					255,263	2,871
Jefferson:								
Cultus-cod							21,000	570
Halibut							50,000	1,000
Herring					17,000	$340		
Silver salmon							7,000	350
Smelt					20,000	600		
Total					37,000	940	78,000	1,920
King:								
Chinook salmon	56,270	1,656			37,523	1,030		
Dog salmon	350,481	3,158			395,004	2,741		
Flounders					49,000	980		
Herring	52,500	788			17,500	262		
Perch					44,000	880		
Silver salmon	311,214	7,426			408,486	6,526		
Smelt					66,000	1,650		
Steelhead salmon	107,787	2,156			64,673	1,293		
Crabs					38,400	1,600		
Total	878,252	15,184			1,120,586	16,962		

Table showing by counties, species, and apparatus of capture the yield of the shore fisheries of Washington in 1890—Continued.

Counties and species.	Gill nets.		Pound and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Klickitat:								
Blueback salmon	11,480	$230	12,000	$240				
Chinook salmon	8,000	240	5,000	150				
Steelhead salmon	4,600	50	3,000	30				
Total	24,080	520	20,000	420				
Pacific:								
Blueback salmon	85	2	198,485	3,960	14,945	$299		
Chinook salmon	266,825	8,005	1,778,650	53,360	74,500	2,237		
Shad			26,1[illegible]5	2,090				
Steelhead salmon	1,310	13	411,120	4,110				
Total	268,220	8,020	2,414,380	63,529	89,445	2,536		
Pierce:								
Chinook salmon			7,500	225	30,890	927		
Cultus-cod							115,000	$2,300
Dog salmon			27,761	277	75,727	757		
Flounders					85,000	1,275		
Halibut							3,000	90
Herring					170,000	1,700		
Rockfish							45,000	1,350
Shad			8,725	698	512	26		
Silver salmon			97,400	2,168	260,722	5,646		
Smelt					150,000	2,250		
Trout, black-spotted							15,000	2,700
Trout, salmon					15,000	450		
Crabs					10,000	300		
Shrimp					1,475	295		
Total			141,386	3,368	799,326	13,626	178,000	6,440
San Juan:								
Herring					150,000	1,500		
Skamania:								
Blueback salmon	10,000	200						
Chinook salmon	4,000	120						
Steelhead salmon	6,000	60						
Total	20,000	380						
Wahkiakum:								
Blueback salmon	1,105	22	1,515	30	56,515	1,126		
Chinook salmon	4,916,850	151,302	90,725	2,721	1,269,225	39,165		
Shad			8,725	698	80	7		
Steelhead salmon	138,440	1,384	29,790	298	367,010	3,669		
Total	5,056,395	152,708	130,755	3,747	1,692,830	43,967		
All counties:								
Blueback salmon	128,590	2,884	212,000	4,239	71,460	1,425		
Chinook salmon	5,497,945	169,698	1,881,875	56,456	1,412,138	43,359		
Cultus-cod							256,000	5,220
Dog salmon	350,481	3,158	27,761	277	470,731	3,498	63,800	1,275
Flounders					134,000	2,255		
Halibut							333,000	5,290
Herring	52,500	788			354,500	3,802		
Perch					44,000	880		
Rockfish							110,000	3,075
Shad			43,575	3,486	592	33		
Silver salmon	498,364	11,919	97,400	2,168	669,208	12,172	103,200	3,350
Smelt					236,000	4,500		
Steelhead salmon	334,987	5,440	443,910	4,438	431,683	4,962		
Sturgeon							255,263	2,871
Trout, black-spotted							15,000	2.700
Trout, salmon					15,000	450		
Crabs					48,400	1,900		
Shrimp					1,475	295		
Grand total	6,862,867	193,887	2,706,521	71,064	3,889,187	79,531	1,136,263	23,781

Table showing by counties, species, and apparatus of capture the yield of the shore fisheries of Washington in 1890—Continued.

Counties and species.	Wheels.		Minor nets.		Tongs and hoes.		Spears, guns, etc.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Clallam:								
Whales								$600
Clarke:								
Blueback salmon	66,250	$1,325						
Chinook salmon	41,300	1,239						
Steelhead salmon	18,680	187						
Total	126,230	2,751						
King:								
Frogs			10,813	$4,325				
Clams					204,000	$1,700		
Total			10,813	4,325	204,000	1,700		
Klickitat:								
Blueback salmon	295,470	8,864	38,585	579				
Chinook salmon	143,342	4,300	56,068	841				
Silver salmon	10,500	210	31,500	472				
Steelhead salmon	96,250	1,443	14,025	210				
Total	545,562	14,817	140,178	2,102				
Mason:								
Oysters					1,524,000	38,100		
Pacific:								
Oysters					6,898,200	100,598		
Pierce:								
Clams					420,000	3,500		
Oysters					390,000	7,312		
Dogfish oil							30,000	1,400
Total					810,000	10,812	30,000	1,400
Skamania:								
Blueback salmon	674,745	20,242						
Chinook salmon	514,675	15,440						
Steelhead salmon	23,080	692						
Total	1,212,500	36 374						
Thurston:								
Oysters					76,800	1,920		
All counties:								
Blueback salmon	1,036,465	30,431	38,585	579				
Chinook salmon	699,317	20,979	56,068	841				
Silver salmon	10,500	210	31,500	472				
Steelhead salmon	138,010	2,322	14,025	210				
Frogs			10,813	4,325				
Clams					624,000	5,200		
Oysters					8,889,000	147,930		
Dogfish oil							30,000	1,400
Whales								600
Grand total	1,884,292	53,942	150,991	6,427	9,513,000	153,130	30,000	2,000

Table showing by counties, species, and apparatus of capture the yield of the shore fisheries of Washington in 1891.

Counties and species.	Gill nets.		Pound and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Chehalis:								
Chinook salmon	60,000	$1,500						
Silver salmon	130,000	3,150						
Total	190,000	4,650						
Clallam:								
Cultus-cod							115,000	$2,275
Flounders					8,150	$163		
Halibut							315,000	5,350
Herring					15,000	150		
Dog salmon					8,370	125	46,770	935
Humpback salmon							37,880	757
Rockfish							100,000	2,775
Silver salmon					21,630	475	82,350	2,088
Total					53,150	913	697,000	14,780
Clarke:								
Blueback salmon	48,000	1,680						
Chinook salmon	21,000	840						
Steelhead salmon	5,000	125						
Total	74,000	2,645						
Cowlitz:								
Blueback salmon	12,000	420						
Chinook salmon	82,500	3,300						
Silver salmon	53,400	1,068						
Steelhead salmon	68,600	1,537						
Sturgeon							503,327	5,468
Total	216,500	6,325					503,327	5,468
Jefferson:								
Cultus-cod							14,000	420
Halibut							60,000	1,200
Herring	16,000	320						
Silver salmon							6,500	325
Smelt	22,000	660						
Total	38,000	980					80,500	1,945
King:								
Chinook salmon	75,580	2,055			70,483	1,475		
Dog salmon	411,199	3,667			450,273	3,165		
Flounders					70,000	1,400		
Herring	76,500	1,148			25,500	382		
Humpback salmon	154,854	2,322			464,562	6,966		
Perch					60,000	1,500		
Silver salmon	387,511	8,948			543,570	8,272		
Smelt					75,000	1,875		
Steelhead salmon	130,825	2,617			78,495	1,570		
Crabs					57,600	2,400		
Total	1,236,469	20,757			1,895,483	29,005		
Klickitat:								
Blueback salmon	11,400	342	12,000	$360				
Chinook salmon	4,000	120	3,000	90				
Steelhead salmon	5,100	153	5,000	150				
Total	20,500	615	20,000	600				
Pacific:								
Blueback salmon	105	2	248,840	4,976	2,805	56		
Chinook salmon	1,222,075	41,310	2,337,600	93,504	43,625	1,745		
Shad			42,180	2,531				
Silver salmon	137,660	1,377	305,340	3,353				
Steelhead salmon	27,075	406	432,304	6,051	5,330	80		
Total	1,386,915	43,095	3,366,264	110,415	51,760	1,881		

Table showing by counties, species, and apparatus of capture the yield of the shore fisheries of Washington in 1891—Continued.

Counties and species.	Gill nets.		Pound and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Pierce:								
Chinook salmon			19,012	$570	37,600	$1,128		
Cultus-cod							130,000	$2,600
Dog salmon			26,500	265	64,939	649		
Flounders					115,000	1,725		
Halibut							3,500	105
Herring					175,000	1,750		
Humpback salmon			25,416	508	70,229	1,404		
Rockfish							50,000	1,500
Shad			612	37	400	20		
Silver salmon			95,300	1,916	261,004	5,220		
Smelt					175,000	2,625		
Trout, black-spotted							16,000	2,880
Trout, salmon					18,000	540		
Crabs					12,000	360		
Shrimp					1,800	450		
Total			166,840	3,296	930,972	15,871	199,500	7,085
San Juan:								
Herring					200,000	2,000		
Skamania:								
Blueback salmon	4,835	$145						
Chinook salmon	2,500	100						
Steelhead salmon	4,000	60						
Total	11,335	305						
Wahkiakum:								
Blueback salmon					38,820	1,165		
Chinook salmon	4,279,900	166,168	42,800	1,712	1,171,275	35,139		
Shad			12,208	732	4,500	270		
Steelhead salmon	146,640	2,199	12,170	182	269,360	5,387		
Total	4,426,540	168,367	67,178	2,626	1,483,955	41,961		
Whatcom:								
Blueback salmon			512,260	10,977				
Silver salmon	14,625	156			72,750	776		
Total	14,625	156	512,260	10,977	72,750	776		
All counties:								
Blueback salmon	76,340	2,589	773,100	16,313	41,625	1,221		
Chinook salmon	5,747,555	215,393	2,402,412	95,876	1,322,983	39,487		
Cultus-cod							259,000	5,295
Dog salmon	411,199	3,667	26,500	265	523,582	3,939	46,770	935
Flounders					193,150	3,288		
Halibut							378,500	6,655
Herring	92,500	1,468			415,500	4,282		
Humpback salmon	154,854	2,322	25,416	508	534,791	8,370	37,880	757
Perch					60,000	1,500		
Rockfish							150,000	4,275
Shad			55,000	3,300	4,900	290		
Silver salmon	723,196	14,699	400,640	5,269	898,954	14,743	88,850	3,013
Smelt	22,000	660			250,000	4,500		
Steelhead salmon	387,240	7,097	449,474	6,383	353,185	7,037		
Sturgeon							503,327	5,468
Trout, black-spotted							16,000	2,880
Trout, salmon					18,000	540		
Crabs					69,600	2,760		
Shrimp					1,800	450		
Grand total	7,614,884	247,895	4,132,542	127,914	4,688,070	92,407	1,480,327	29,278

Table showing by counties, species, and apparatus of capture the yield of the shore fisheries of Washington in 1891—Continued.

Counties and species.	Wheels.		Minor nets.		Tongs and hoes.		Spears, guns, etc.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Clallam:								
Whales								$2,400
Clarke:								
Blueback salmon	5,830	$175						
Chinook salmon	14,500	435						
Steelhead salmon	4,300	129						
Total	24,630	739						
King:								
Frogs			8,413	$3,365				
Clams					270,000	$2,250		
Total			8,413	3,365	270,000	2,250		
Klickitat:								
Blueback salmon	63,455	1,904	60,918	914				
Chinook salmon	56,665	1,700	10,183	151				
Silver salmon	19,110	573	29,820	447				
Steelhead salmon	48,050	1,441	20,164	302				
Total	187,280	5,618	121,085	1,814				
Mason:								
Oysters					1,560,000	39,000		
Pacific:								
Oysters					7,890,480	105,206		
Pierce:								
Clams					466,800	3,890		
Oysters					420,000	7,875		
Dogfish oil							33,750	1,575
Total					886,800	11,765	33,750	1,575
Skamania:								
Blueback salmon	114,090	3,423						
Chinook salmon	169,375	5,081						
Steelhead salmon	63,010	1,890						
Total	346,475	10,394						
Thurston:								
Oysters					115,200	2,880		
Whatcom:								
Blueback salmon			10,500	225				
Silver salmon			15,750	168				
Total			26,250	393				
All counties:								
Blueback salmon	183,375	5,502	71,418	1,139				
Chinook salmon	240,540	7,216	10,183	151				
Silver salmon	19,110	573	45,570	615				
Steelhead salmon	115,360	3,460	20,164	302				
Frogs			8,413	3,365				
Clams					736,800	6,140		
Oysters					0,985,680	154,961		
Dogfish oil							33,750	1,575
Whales								2,400
Grand total	558,385	16,751	155,748	5,572	10,722,480	161,101	33,750	3,975

Table showing by counties, species, and apparatus of capture the yield of the shore fisheries of Washington in 1892.

Counties and species.	Gill nets.		Pound nets and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Chehalis:								
Chinook salmon	299,054	$5,283	99,684	$1,760				
Dog salmon	219,860	1,099	102,140	511				
Silver salmon	563,608	10,048	187,869	3,349				
Sturgeon			38,000	190				
Total	1,082,522	16,430	427,693	5,810				
Clallam:								
Cultus-cod							117,000	$2,305
Flounders					12,400	$248		
Halibut							354,000	6,035
Herring					25,000	250		
Dog salmon					17,690	325	74,000	1,440
Rockfish							123,000	3,315
Silver salmon					38,310	895	111,000	3,210
Total					93,400	1,718	779,000	16,305
Clarke:								
Blueback salmon	68,000	2,040						
Chinook salmon	27,000	1,080						
Steelhead salmon	6,000	90						
Total	101,000	3,210						
Cowlitz:								
Blueback salmon	15,000	450						
Chinook salmon	110,000	4,400						
Silver salmon	27,600	552						
Steelhead salmon	49,400	863						
Sturgeon							505,623	5,567
Total	202,000	6,265					505,623	5,567
Jefferson:								
Cultus-cod							37,000	860
Halibut							90,000	1,800
Herring					12,000	240		
Silver salmon							5,000	250
Smelt					23,000	690		
Total					35,000	930	132,000	2,910
King:								
Chinook salmon	69,917	2,040	32,018	962	43,449	1,134		
Dog salmon	643,110	4,780	164,790	1,640	1,108,320	6,142		
Flounders					72,160	1,443		
Herring	78,834	1,183			26,278	394		
Perch					65,140	1,303		
Silver salmon	447,932	9,585	128,230	3,847	692,452	9,219		
Smelt					98,726	2,468		
Steelhead salmon	130,570	2,611	62,322	1,246	68,250	1,365		
Crabs					60,000	2,500		
Total	1,370,363	20,199	387,360	7,695	2,234,775	25,968		
Klickitat:								
Blueback salmon	12,000	360	14,000	280				
Chinook salmon	3,000	90	2,000	80				
Silver salmon	5,000	150						
Steelhead salmon	5,000	150	4,000	60				
Total	25,000	750	20,000	420				
Pacific:								
Blueback salmon	105	3	934,885	18,697	8,985	270		
Chinook salmon	1,097,175	43,387	2,294,300	90,772	65,300	1,959		
Dog salmon	67,666	338	135,334	677				
Shad			62,400	1,872				
Silver salmon	252,000	2,520	504,000	5,040				
Steelhead salmon	9,710	146	765,980	11,489	14,440	289		
Crabs	9,000	750						
Total	1,435,656	47,144	4,696,899	128,547	88,725	2,518		

Table showing by counties, species, and apparatus of capture the yield of the shore fisheries of Washington in 1892—Continued.

Counties and species.	Gill nets.		Pound nets and trap nets.		Seines.		Lines.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Pierce:								
Chinook salmon			48,600	$1,458	91,800	$2,754		
Cultus-cod							125,000	$2,500
Dog salmon			55,280	553	110,600	1,106		
Flounders					100,000	1,500		
Halibut							3,000	90
Herring					225,000	2,250		
Rockfish							40,000	1,200
Shad			500	25	600	30		
Silver salmon			165,560	3,311	227,780	4,555		
Smelt					200,000	3,000		
Trout, black-spotted							20,000	3,600
Trout, salmon					20,000	600		
Crabs					10,000	300		
Shrimp					2,000	500		
Total			269,940	5,347	987,780	16,595	188,000	7,390
San Juan:								
Herring					250,000	2,500		
Skamania:								
Blueback salmon	15,000	$450						
Chinook salmon	4,000	160						
Steelhead salmon	5,000	75						
Total	24,000	685						
Wahkiakum:								
Blueback salmon					366,000	10,986		
Chinook salmon	4,499,500	174,550	500	20	624,250	18,728		
Shad			17,850	536	22,000	720		
Steelhead salmon	283,570	4,254	1,500	150	333,990	6,680		
Total	4,783,070	178,804	19,850	706	1,346,240	37,114		
Whatcom:								
Blueback salmon			260,225	5,576				
Dog salmon	83,475	477			500,850	2,862		
Silver salmon	21,000	224			127,950	1,365		
Total	104,475	701	260,225	5,576	628,800	4,227		
All counties:								
Blueback salmon	110,105	3,303	1,209,110	24,553	374,985	11,256		
Chinook salmon	6,109,646	230,990	2,477,102	95,052	824,799	24,575		
Cultus-cod							279,000	5,665
Dog salmon	1,014,111	6,694	457,544	3,381	1,737,460	10,435	74,000	1,440
Flounders					184,560	3,191		
Herring	78,834	1,183			538,278	5,634		
Halibut							447,000	7,925
Perch					65,140	1,303		
Rockfish							163,000	4,515
Shad			80,750	2,433	22,600	750		
Silver salmon	1,317,140	23,079	985,659	15,547	1,086,492	16,034	116,000	3,460
Smelt					321,726	6,158		
Steelhead salmon	489,250	8,189	833,802	12,945	416,680	8,334		
Sturgeon			38,000	190			505,623	5,567
Trout, black-spotted							20,000	3,600
Trout, salmon					20,000	600		
Crabs	9,000	750			70,000	2,800		
Shrimp					2,000	500		
Grand total	9,128,086	273,188	6,081,967	154,101	5,664,720	91,570	1,604,623	32,172

Table showing by counties, species, and apparatus of capture the yield of the shore fisheries of Washington in 1892—Continued.

Counties and species.	Wheels.		Minor nets.		Tongs and hoes.		Spears, guns, etc.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Clallam:								
Whales								$600
Fur-seal pelts								2,700
Total								3,300
Clarke:								
Blueback salmon	94,500	$2,835						
Chinook salmon	38,825	1,165						
Steelhead salmon	29,400	882						
Total	162,725	4,882						
King:								
Clams					300,000	$2,500		
Frogs			13,125	$5,250				
Total			13,125	5,250	300,000	2,500		
Klickitat:								
Blueback salmon	217,052	6,512	76,900	1,154				
Chinook salmon	125,405	3,762	14,450	217				
Silver salmon	34,104	1,023	33,950	510				
Steelhead salmon	242,970	4,289	28,900	434				
Total	619,531	15,586	154,200	2,315				
Mason:								
Oysters					1,576,800	32,850		
Pacific:								
Oysters					7,588,440	101,179		
Pierce:								
Clams					384,000	3,200		
Oysters					598,200	11,216		
Dogfish oil							37,500	1,750
Total					982,200	14,416	37,500	1,750
Skamania:								
Blueback salmon	417,280	12,518						
Chinook salmon	253,400	7,602						
Steelhead salmon	378,190	8,346						
Total	1,048,870	28,466						
Thurston:								
Oysters					132,000	2,750		
Whatcom:								
Blueback salmon			14,000	300				
Dog salmon			21,000	120				
Silver salmon			15,000	160				
Total			50,000	580				
All counties:								
Blueback salmon	728,832	21,865	90,900	1,454				
Chinook salmon	417,630	12,529	14,450	217				
Dog salmon			21,000	120				
Silver salmon	34,104	1,023	48,950	670				
Steelhead salmon	650,560	13,517	28,900	434				
Frogs			13,125	5,250				
Clams					684,000	5,700		
Oysters					9,895,440	147,995		
Dogfish oil							37,500	1,750
Whales								600
Fur-seal pelts								2,700
Grand total	1,831,126	48,934	217,325	8,145	10,579,440	153,695	37,500	5,050

Table showing by counties and species the yield of the shore fisheries of Washington—Continued.

SUMMARY.

Counties and species.	1889. Pounds.	1889. Value.	1890. Pounds.	1890. Value.	1891. Pounds.	1891. Value.	1892. Pounds.	1892. Value.
Chehalis:								
Chinook salmon	1,085,075	$21,701	75,000	$1,875	60,000	$1,500	398,738	$7,043
Dog salmon							322,000	1,610
Silver salmon	1,282,200	32,044	150,000	3,750	130,000	3,150	751,477	13,397
Sturgeon							38,000	190
Total	2,367,275	53,745	225,000	5,625	190,000	4,650	1,510,215	22,240
Clallam:								
Cultus-cod	130,000	2,500	120,000	2,350	115,000	2,275	117,000	2,305
Flounders					8,150	163	12,400	248
Halibut	300,000	4,500	280,000	4,200	315,000	5,350	354,000	6,035
Herring					15,000	150	25,000	250
Dog salmon	47,210	965	63,800	1,275	55,140	1,060	91,690	1,765
Humpback salmon	39,350	810			37,880	757		
Rockfish	60,000	1,650	65,000	1,725	100,000	2,775	123,000	3,315
Silver salmon	86,440	2,695	96,200	3,000	103,980	3,163	149,310	4,105
Whales		800		600		2,400		600
Fur-seal pelts								2,700
Total	663,000	13,920	625,000	13,150	750,150	18,093	872,400	21,323
Clarke:								
Blueback salmon	51,750	1,737	152,170	3,055	53,830	1,855	162,500	4,875
Chinook salmon	30,200	1,310	75,300	2,259	35,500	2,275	65,825	2,245
Steelhead salmon	8,920	263	24,680	247	9,300	254	35,400	972
Total	90,870	3,310	252,150	5,561	98,630	3,384	263,725	8,092
Cowlitz:								
Blueback salmon	13,000	390	20,000	700	12,000	420	15,000	450
Chinook salmon	81,000	3,240	137,000	5,480	82,500	3,300	110,000	4,400
Silver salmon	26,675	667	37,150	743	53,400	1,068	27,600	552
Steelhead salmon	42,325	1,143	70,850	1,717	68,600	1,537	49,400	863
Sturgeon	218,985	2,300	255,263	2,871	503,327	5,468	505,623	5,567
Total	381,985	7,740	520,263	11,511	719,827	11,793	707,623	11,832
Jefferson:								
Cultus-cod	19,000	500	21,000	570	14,000	420	37,000	860
Halibut	41,000	820	50,000	1,000	60,000	1,200	90,000	1,800
Herring	15,000	300	17,000	340	16,000	320	12,000	240
Silver salmon	6,000	300	7,000	350	6,500	325	5,000	250
Smelt	25,000	750	20,000	600	22,000	660	23,000	690
Total	106,000	2,670	115,000	2,860	118,500	2,925	167,000	3,840
King:								
Chinook salmon	80,248	1,828	93,793	2,686	146,063	3,530	145,384	4,136
Dog salmon	289,247	2,415	745,485	5,899	861,472	6,832	1,916,220	12,562
Flounders	25,000	500	49,000	980	70,000	1,400	72,160	1,443
Herring	35,000	525	70,000	1,050	102,000	1,530	105,112	1,577
Humpback salmon	184,427	2,764			619,416	9,288		
Perch	23,000	460	44,000	880	60,000	1,500	65,140	1,303
Silver salmon	1,086,960	13,922	719,700	13,952	931,081	17,220	1,268,614	22,651
Smelt	33,000	825	66,000	1,650	75,000	1,875	98,726	2,468
Steelhead salmon	90,570	1,811	172,460	3,449	209,320	4,187	261,142	5,222
Crabs	14,400	600	38,400	1,600	57,600	2,400	60,000	2,500
Frogs	7,500	3,000	10,813	4,325	8,413	3,365	13,125	5,250
Clams	108,000	900	204,000	1,700	270,000	2,250	300,000	2,500
Total	1,977,352	29,550	2,213,651	38,171	3,410,365	55,377	4,305,623	61,612
Klickitat:								
Blueback salmon	172,817	5,898	357,535	9,913	147,773	3,520	319,952	8,300
Chinook salmon	112,925	3,667	212,410	5,531	73,848	2,061	144,855	4,149
Silver salmon	39,005	836	42,000	682	48,930	1,020	73,054	1,683
Steelhead salmon	10,870	326	117,875	1,733	78,314	2,046	280,870	4,933
Total	335,617	10,727	729,820	17,859	348,865	8,647	818,731	19,071
Mason:								
Oysters	1,500,000	37,500	1,524,000	38,100	1,560,000	39,000	1,576,800	32,850
Pacific:								
Blueback salmon	111,850	5,586	213,515	4,270	251,750	5,034	943,975	18,970
Chinook salmon	1,632,953	71,560	2,119,975	63,602	3,603,300	136,559	3,456,775	136,118
Dog salmon							203,000	1,015
Shad	14,125	1,412	26,125	2,090	42,180	2,531	62,400	1,872
Silver salmon	1,198,000	29,950			443,000	4,730	756,000	7,560
Steelhead salmon	251,520	7,544	412,430	4,123	464,709	6,537	790,130	11,924
Crabs							9,000	750
Oysters	5,609,400	81,804	6,898,200	100,598	7,890,480	105,206	7,588,440	101,179
Total	8,817,848	197,865	9,670,245	174,683	12,695,419	260,597	13,809,720	279,388

Table showing by counties and species the yield of the shore fisheries of Washington—Continued.

SUMMARY—Continued.

Counties and species.	1889.		1890.		1891.		1892.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Pierce:								
Chinook salmon	15,980	$480	38,390	$1,152	56,612	$1,698	140,400	$4,212
Cultus-cod	105,000	2,100	115,000	2,300	130,000	2,600	125,000	2,500
Dog salmon	72,870	729	103,488	1,034	91,439	914	165,880	1,659
Flounders	80,000	1,200	85,000	1,275	115,000	1,725	100,000	1,500
Halibut	4,000	120	3,000	90	3,500	105	3,000	90
Herring	165,000	1,650	170,000	1,700	175,000	1,750	225,000	2,250
Humpback salmon	98,615	2,041	....	....	95,645	1,912	....	....
Rockfish	42,000	1,260	45,000	1,350	50,000	1,500	40,000	1,200
Shad	1,000	55	9,237	724	1,012	57	1,100	55
Silver salmon	287,535	6,250	358,122	7,814	356,304	7,136	393,340	7,866
Smelt	145,000	2,175	150,000	2,250	175,000	2,625	200,000	3,000
Trout, black-spotted	12,000	1,800	15,000	2,700	16,000	2,880	20,000	3,600
Trout, salmon	13,000	390	15,000	450	18,000	540	20,000	600
Crabs	8,000	240	10,000	300	12,000	360	10,000	300
Shrimp	1,500	300	1,475	295	1,800	450	2,000	500
Clams	330,000	2,750	420,000	3,500	466,800	3,890	384,000	3,200
Oysters	360,000	7,500	390,000	7,312	420,000	7,875	598,200	11,216
Dogfish oil	28,500	1,330	30,000	1,400	33,750	1,575	37,500	1,750
Total	1,770,000	32,370	1,958,712	35,646	2,217,862	39,592	2,465,420	45,498
San Juan:								
Herring	....	....	150,000	1,500	200,000	2,000	250,000	2,500
Skamania:								
Blueback salmon	133,315	5,443	684,745	20,442	118,925	3,568	432,280	12,968
Chinook salmon	99,275	4,001	518,675	15,560	171,875	5,181	257,400	7,762
Steelhead salmon	5,010	190	29,080	752	67,010	1,950	383,190	8,421
Total	237,600	9,634	1,232,500	36,754	357,810	10,699	1,072,870	29,151
Thurston:								
Oysters	78,000	1,800	76,800	1,920	115,200	2,880	132,000	2,750
Wahkiakum:								
Blueback salmon	7,460	373	59,135	1,178	38,820	1,165	366,000	10,986
Chinook salmon	7,070,100	348,117	6,276,800	193,188	5,493,975	203,019	5,124,250	193,298
Shad	5,885	588	8,805	705	16,708	1,002	39,850	1,256
Steelhead salmon	553,590	16,607	535,240	5,351	428,170	7,768	619,060	11,084
Total	7,637,035	365,685	6,879,980	200,422	5,977,673	212,954	6,149,160	216,624
Whatcom:								
Blueback salmon	....	....	....	....	522,760	11,202	274,225	5,876
Dog salmon	....	....	....	....	....	....	605,325	3,459
Silver salmon	....	....	....	....	103,125	1,100	163,950	1,749
Total	....	....	....	....	625,885	12,302	1,043,500	11,084
All counties:								
Blueback salmon	490,192	19,427	1,487,100	39,558	1,145,858	26,764	2,513,932	62,431
Chinook salmon	10,207,756	455,913	9,547,343	291,333	9,723,673	358,123	9,843,627	363,363
Cultus-cod	254,000	5,100	256,000	5,220	259,000	5,295	270,000	5,665
Dog salmon	409,327	4,109	912,773	8,208	1,008,051	8,806	3,304,115	22,070
Flounders	105,000	1,700	134,000	2,255	193,150	3,288	184,560	3,191
Halibut	345,000	5,440	333,000	5,290	378,500	6,655	447,000	7,925
Herring	215,000	2,475	407,000	4,590	508,000	5,750	617,112	6,817
Humpback salmon	322,392	5,615	....	....	752,041	11,957	....	....
Perch	23,000	460	44,000	880	60,000	1,500	65,140	1,303
Rockfish	102,000	2,910	110,000	3,075	150,000	4,275	163,000	4,515
Shad	21,010	2,055	44,167	3,519	59,900	3,590	103,350	3,183
Silver salmon	4,012,815	86,664	1,410,172	30,291	2,176,320	38,912	3,588,345	59,813
Smelt	203,000	3,750	236,000	4,500	272,000	5,160	321,726	6,168
Steelhead salmon	962,805	27,884	1,362,615	17,372	1,325,423	24,279	2,419,192	43,419
Sturgeon	218,985	2,300	255,263	2,871	503,327	5,468	543,623	5,757
Trout, black-spotted	12,000	1,800	15,000	2,700	16,000	2,880	20,000	3,600
Trout, salmon	13,000	390	15,000	450	18,000	540	20,000	600
Fur-seal pelts	....	....	....	....	....	....	....	2,700
Frogs	7,500	3,000	10,813	4,325	8,413	3,365	13,125	5,250
Clams	438,000	3,650	624,000	5,200	736,800	6,140	684,000	5,700
Crabs	22,400	840	48,400	1,000	69,600	2,760	79,000	3,550
Shrimp	1,500	300	1,475	295	1,800	450	2,000	500
Oysters	7,547,400	128,604	8,889,000	147,930	9,985,680	154,961	9,895,440	147,995
Whales	....	800	....	600	....	2,400	....	600
Dogfish oil	28,500	1,330	30,000	1,400	33,750	1,575	37,500	1,750
Grand total	25,962,582	706,516	26,173,121	583,762	29,386,186	684,803	35,144,787	707,855

Table showing by counties the extent of the salmon-canning industry of Washington in 1889, 1890, 1891, and 1892.

Counties and years.	No. of employees. (a)	Canneries.			Salmon utilized in canning.													
		No.	Value.	Cash capital.	Chinook.		Blueback.		Steelhead.		Silver.		Dog.		Humpback.		Total.	
					Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds	Value.	Pounds.	Value.
Chehalis:																		
1889	180	3	$34,000	$45,000	860,600	$19,560					1,282,200	$32,044					2,142,800	$51,604
1892	56	1	8,000	30,000	292,500	4,387					539,000	8,085	322,200	$1,610			1,153,500	14,082
King:																		
1889	138	2	22,500	40,000	28,728	274					904,344	8,542	129,531	623	272,194	$4,081	1,334,797	13,520
1890	85	1	15,000	20,000	6,268	60					369,600	3,450	307,860	1,466			683,728	4,976
1891	77	1	7,000	35,000	41,895	399					518,437	4,839	339,261	1,613	619,416	9,291	1,519,009	16,142
1892	73	1	7,000	35,000	11,098	106					745,500	6,958	1,260,000	6,000			2,016,598	13,064
Pacific:																		
1889	278	4	80,000	104,000	1,486,725	63,026	111,215	$2,224	395,220	$9,880	1,066,000	26,650					3,059,160	101,780
1890	183	2	55,000	81,000	2,090,075	75,242	204,620	4,092	517,980	5,179							2,812,675	84,513
1891	296	4	140,250	141,000	3,243,875	123,567	264,415	5,290	464,620	6,969	383,500	5,752					4,356,410	141,578
1892	298	4	141,500	183,000	3,296,700	131,868	460,135	9,203	1,018,290	15,273	756,000	7,560	203,000	1,015			5,734,125	164,919
Wahkiakum:																		
1889	356	7	184,500	239,000	7,114,649	350,241	7,460	373	553,590	12,383							7,675,699	362,997
1890	344	7	182,050	250,000	6,912,288	266,839	59,135	1,178	577,240	5,773							7,548,663	273,790
1891	328	7	177,500	207,000	5,586,143	216,335	38,820	776	478,170	7,171							6,103,133	224,282
1892	342	7	183,250	232,000	5,194,252	201,700	518,065	11,464	789,530	7,895							6,501,847	221,059
Whatcom:																		
1891	72	1	25,000	30,000			522,760	11,202			103,125	1,100					625,885	12,302
1892	82	1	30,000	40,000			274,225	5,876			163,950	1,749	605,325	3,459			1,043,500	11,084
Total:																		
1889	952	16	321,000	428,000	9,490,702	433,101	118,675	2,597	948,810	22,263	3,252,544	67,236	129,531	623	272,194	4,081	14,212,456	529,901
1890	612	10	252,050	351,000	9,008,631	342,141	263,755	5,270	1,095,220	10,952	369,600	3,450	307,860	1,466			11,045,066	363,279
1891	773	12	289,750	413,000	8,871,913	340,301	825,995	17,268	942,790	14,140	1,005,062	11,691	339,261	1,613	619,416	9,291	12,604,437	394,304
1892	851	13	369,750	520,000	8,794,550	338,061	1,252,425	26,543	1,807,820	23,168	2,201,450	24,352	2,390,325	12,084			16,449,570	424,208

a Included in the figures for Pacific County are 100 persons in 1889, 40 in 1891, and 45 in 1892 who were employed in salmon canning at Shoalwater (Willapa) Bay after the close of the season on the Columbia River. They have been credited to the Columbia River in the regular statistics of persons employed.

Table showing by counties the extent of the salmon-canning industry of Washington in 1889, 1890, 1891, and 1892—Continued.

Counties and years.	Cases of salmon packed.													
	Chinook.		Blueback.		Steelhead.		Silver.		Dog.		Humpback.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Chehalis:														
1889	13,240	$66,590					18,310	$72,055					31,550	$138,645
1892	4,500	20,250					7,700	30,800	4,600	$16,100			16,800	67,150
King:														
1889	326	1,385					10,129	38,111	1,551	5,623	3,804	$14,396	15,810	59,515
1890	83	332					4,978	16,697	4,169	12,507			9,230	29,536
1891	517	2,068					6,448	21,093	4,188	12,564	7,647	24,435	18,800	60,160
1892	117	526					7,858	27,503	13,261	42,261			21,236	70,290
Pacific:														
1889	22,873	105,228	1,711	$6,844	5,646	$21,173	16,400	64,000					46,630	197,245
1890	32,155	147,522	3,148	13,728	7,969	29,883							43,272	191,133
1891	49,906	270,382	4,069	21,361	7,148	28,592	5,900	20,650					67,023	340,985
1892	49,950	274,725	7,079	36,589	15,666	62,664	10,800	43,200	2,900	8,700			86,395	425,878
Wahkiakum:														
1889	108,883	621,740	107	585	8,053	33,060							117,043	655,385
1890	107,035	616,641	846	4,482	8,248	32,992							116,129	654,115
1891	84,398	485,955	554	2,946	6,832	26,328							91,784	515,229
1892	79,686	458,818	8,362	42,533	11,279	44,976							99,327	546,327
Whatcom:														
1891			7,500	30,000			1,500	5,625					9,000	35,625
1892			4,000	16,000			2,350	9,400	8,650	28,545			15,000	53,945
Total:														
1889	145,322	794,943	1,818	7,429	13,699	54,233	44,839	174,166	1,551	5,623	3,804	14,396	211,033	1,050,790
1890	139,273	764,495	3,994	18,210	16,217	62,875	4,978	16,697	4,169	12,507			168,631	874,784
1891	134,821	758,405	12,123	54,307	13,980	54,920	13,848	47,368	4,188	12,564	7,647	24,435	186,607	951,999
1892	134,253	754,319	19,441	95,122	26,945	107,640	28,708	110,903	29,411	95,606			238,758	1,163,590

PACIFIC COUNTY.

This county is favorably located in respect to its fishing resources. One-half of its southern border is at the mouth of the Columbia River. Here are located over 300 pound nets used in the salmon fishery, many of which are owned in the county. Here, also, a large part of the salmon catch of the river is taken and distributed among the salmon canneries on both sides of the river. Here, at certain seasons, sardines, herring, shad, and other varieties not now utilized hold out inducements for the extension of the fisheries.

Just outside of the mouth of the Columbia, and off the shores of Pacific County, are good fishing-grounds on which may be found in more or less abundance, at all seasons of the year, rockfish, flounders, perch, halibut, and numerous other varieties of good food-fish, to all of which only slight attention is given.

At the northern end of the county Willapa Harbor is a good haven for shelter, and leading from it is Willapa Bay, formerly known as Shoalwater Bay, which is noted for its extensive beds of native oysters, as well as the abundance of salmon occurring during the fall.

The fisheries of Willapa Bay are confined to the salmon and oyster business, in addition to which a small quantity of crabs taken in the salmon nets are utilized.

The run of salmon was fair in 1889, light in 1890 and 1891, and the largest in many years in 1892. The fish in 1892 were also of larger size and better quality than the average of past years. Three canneries are located on the bay, but only one of them was packing during 1892. The low price of canned salmon and the light run in 1890 and 1891 were so discouraging to the canners that two of the canneries did not resume in 1892, and the only one packing was ill prepared for the large run, and was obliged to shut down in the height of the season, owing to lack of cans in which to pack. The first salmon to enter this bay are the chinooks, locally known as black salmon; they run from the last of July to the last of August, with some stragglers later. Silver salmon appear about the middle of August and drop off in September, to be followed by dog salmon and another run of silver salmon during the last of September or early in October. A few steelheads are found in November, but only a light run of them occurs before December, after which they are to be found more or less abundantly all winter.

The salmon catch is chiefly by pound nets, of which twelve were located on North River and three on Willapa River, near their entrance to the bay. As showing the abundance of salmon in 1892, the catch of 1,700 salmon, of which 1,460 were silver salmon, at one lift of a single pound net may be recorded. Pound nets are put down in August, previous to which time the fishing in Willapa Bay is of small extent and for local use.

The prices paid the salmon fishermen during 1892 were 10 cents each for silver salmon, 25 cents each for chinook salmon, and 5 cents each for dog salmon. During 1892 no arrangements had been made for salting the catch of salmon, and preparations for canning were based on the expectation of only a light run, as in the two previous years. At the date of closing, thousands of salmon were taken from the pound nets only to be refused at the cannery and then thrown away from want of salt and barrels in which to cure or tins in which to pack them; the fishing was consequently discontinued.

During December, 1892, the railroad reached Willapa Bay, its terminal being at South Bend on the Willapa River. The first house in South Bend is reported to have been built in 1889; in 1892 the town had a population of 2,000. With the advent of the railroad a cold-storage company was organized to engage extensively in the fresh-fish trade. Should the plans of the company be realized it would be of great advantage to the fishermen and would provide an outlet for any such abundance of salmon as was witnessed in 1892.

The growth of the salmon fishery of Willapa Bay from 1890 to 1892 was phenomenal. In 1890 the only salmon taken were for local use. In 1891 30,000 pounds of silver salmon were shipped fresh, in addition to the local consumption. In 1892 10,800 cases of silver salmon and 2,900 cases of dog salmon were canned, and 75,000 pounds of fresh chinook salmon were sent to market, the total catch of the 45 salmon fishermen being 1,034,000 pounds, valued at $10,075.

The oyster industry of Willapa Bay has its principal headquarters at Bay Center, though the business is important at Oysterville. In 1892 365 persons were employed, including 143 Indians; $47,735 was invested, and the value of the output was $101,179. Next to San Francisco Bay, the oyster industry of Willapa Bay is more important than elsewhere on the Pacific Coast.

Since the oyster beds in Willapa Bay were visited by the writer in 1889 they had suffered severe loss from numerous storms; at times the shoal waters of the bay would sweep the oysters from the beds, leaving them in rows, buried in the mud and grass of the bottom. Thousands of bushels of oysters were thus killed. With the increased care of the beds, the replanting of the small oysters and of shells, the great losses by storms have been overcome, and the quantity of oysters taken for market has been kept up to the average of late years. For years the business was carried on with little or no regard to the future interest of the beds, the chief and only aim of the fishermen seemingly being to take all the oysters possible during the time permitted, without cultivating or caring for the beds in any way. The decline in the native beds called attention to the necessity for preserving them from complete depletion, and measures were taken by the State with that end in view.

During the open season before cold weather the native oysters are gathered by hand at low tide, the beds being entirely exposed, and only the market oysters being taken. With the return of the tide the oystermen work from boats with tongs, and the catch under such circumstances is culled, all small oysters and old shells being returned to the water. During the prevalence of cold weather rakes and shovels take the place of hand-picking at low tide, and the oysters are culled, as is done with those taken by means of tongs.

The oysters gathered at Bay Center are mostly marketed at San Francisco; those taken at Oysterville go to Portland, Oreg.

The quantity and value of the oyster output of the bay in 1889, 1890, 1891, and 1892 were as follows:

Location.	1889.		1890.		1891.		1892.	
	Bushels.	Value.	Bushels.	Value.	Bushels.	Value.	Bushels.	Value.
Bay Center	80,490	$70,429	100,720	$88,130	118,268	$94,614	114,250	$91,400
Oysterville	13,000	11,375	14,250	12,468	13,240	10,592	12,224	9,779
Total	93,490	81,804	114,970	100,598	131,508	105,206	126,474	101,179

CHEHALIS COUNTY.

The fisheries of this county are located on the Chehalis River, mostly near its mouth, and in Grays Harbor. In addition to the commercial fishing which is there carried on, considerable quantities of fish are also taken by Indians belonging on the Quinaiult Reservation, who fish in the river of the same name for local consumption. Fishing in the Chehalis River is done by means of gill nets and pound nets, the only fish utilized being salmon and sturgeon. Ocean food-fish in great abundance and variety are found just outside the harbor. These, together with the salmon, sturgeon, trout, and other fish found in the river and bay, will doubtless lead to a marked development of the fisheries of this county within a short time.

During 1889 three canneries were located on the Chehalis River whose aggregate pack was 31,550 cases. The very large output of canned salmon in that year on the west coast resulted in such low prices that many canneries were kept idle during the next two years, among which were the three canneries on this river. The only fishing carried on during 1890 and 1891 was a limited amount of gill-net salmon fishing in the Chehalis, and the Indian fishing already alluded to.

In December, 1891, a branch of the Pacific Railroad was opened to Ocosta, near the entrance to Grays Harbor. The facilities for shipment thus furnished and the opening of a cannery the following year revived the business that for two years had been almost abandoned. A cold-storage company was organized which contemplated entering largely into the fresh-fish business and shipping to Atlantic cities by means of refrigerator cars. During the fall of 1892 the run of the several varieties of salmon was very good. Chinooks, locally known as black salmon, entered the river in limited numbers as early as August 10, and by the 15th they were quite abundant; their average weight was 24 pounds. Silver salmon were found from the last of September to the first of November, averaging 12 pounds in weight. There was a short run of dog salmon from October 10 to November 1, these fish having an average weight of 12 pounds. There was also a small run of dog salmon in the river after November 1. Steelheads are found from November to the following March, but the closing of the canneries before the run begins had, prior to building the railroad, prevented their utilization. The prices received by the salmon fishermen in 1892 were 30 cents each for chinooks, 15 cents each for silver salmon, and 5 cents each for dog salmon. In 1892 there were 102 fishermen employed in the salmon fishery of the Chehalis River, 34 of whom came from the Columbia River after the close of the season on that stream. Of the capital employed, amounting to $52,285, $7,300 represented nets, boats, etc., brought from the Columbia. Fifty-eight Chinamen were employed as cannery hands. The aggregate catch of salmon on the Chehalis in 1892 was 1,472,215 pounds, with a value to the fishermen of $22,050. This quantity included salmon canned, used locally, and shipped fresh by express. During the years 1889 and 1892, when salmon canning was done on this river, the following quantities of the different kinds of salmon were packed:

Species.	1889.	1892.
	Cases.	*Cases.*
Chinooks	13,240	4,500
Silver	18,310	7,700
Dog	....	4,600
Total	31,550	16,800

Sturgeon have always been more or less abundant in the Chehalis River, but up to a recent date no value was attached to them, and those found in the pound nets were knocked in the head and thrown away. Direct rail communication soon brought buyers from Puget Sound, and no more sturgeon were discarded. In 1892 38,000 pounds of sturgeon incidentally taken in the pound nets were disposed of; the price received by the fishermen being one-half cent a pound gross weight.

A few fine shad are taken in the pound nets of Chehalis River, but no special fishing for shad is done at any time. No nets of any kind are used until the fall run of salmon begins, by which time the run of shad is probably nearly over. The few shad taken are eaten by the fishermen. Salmon trout are found plentifully in the Chehalis River, but are fished for only by sportsmen.

JEFFERSON COUNTY.

The fishing business of this county centers at Port Townsend. The many advantages which this point possesses for the carrying on of an extensive fishing industry have often been mentioned. The city has one of the best harbors on the Pacific coast. Many varieties of desirable food-fish are to be found almost at the city's docks. The halibut, cod, and other fish, which are found in abundance just within and outside the Strait of San Juan de Fuca, are much nearer to Port Townsend than to any other city or important shipping point. The fisheries have not reached that stage of development which was anticipated a few years ago, chiefly for the reason that the attempts to utilize the fine resources of the region have not been sufficiently extensive and enough capital has not been put into the business to demonstrate the success of the industry. The great depression in all kinds of business during the past few years had its effects here as elsewhere and prevented the introduction of new enterprises or the enlargement of those already in existence. There is little reason to doubt that in the near future the fishing business of this county will be of great importance. A number of small-sized sailboats using hand lines for cultus-cod and halibut furnish the city with an abundance of food-fish, the surplus catch being sent to the various ports on Puget Sound. This, at present, constitutes the extent of the fishing industry of the county, with the exception of a small amount of seine fishing for herring and smelt. The western end of this county, which borders on the Pacific Ocean, is mountainous and unsettled, and maintains no fisheries.

CLALLAM COUNTY.

On the west this county abuts on the Pacific Ocean, while its northern border extends the entire length of the Strait of Fuca. It is therefore conveniently located with reference to the fishing-grounds, and it maintains fisheries of great and growing importance. The chief fishing centers are Neah Bay, Port Angeles, and Dungeness.

The fishery resources of this county are varied and valuable. The western section is mountainous and sparsely settled, and the fishing is confined to the taking of salmon by the Indians living along the banks of the Quillaiute River, which flows through their reservation. Small quantities of halibut and cod, with an occasional whale, are also taken by these Indians, who depend chiefly on these products for their winter supply of food. During the early spring months, for several weeks, the fur seal is found resting and feeding off the shores of this county before proceeding on its migration to Bering Sea. In the fall immense numbers of salmon come in from the ocean on their way up the strait and sound. Herring, anchovies, and smelt are also found in large bodies. The fishing banks and shoals in the immediate vicinity of the northwestern end of the county abound with fish, of which halibut, cultus-cod, rockfish, and black-cod are most sought after, while flounders, perch, dogfish, sharks, sculpins, and many other species are also abundant. The value of the fishery resources of this section has long been known, but up to the past few years the attempts made to utilize the resources have been limited.

In 1889 these fisheries were investigated for the United States Fish Commission by the writer, who again visited the region in 1892. In the interim the attention of the fishermen had been especially directed to this section by the printed reports distributed by the Commission, and as a result the fishermen largely extended their operations in that vicinity, marketing their catch at the various cities on the strait and sound, whence the surplus was shipped to the interior.

Neah Bay.—The most important of the fishing communities of this county is Neah Bay, located on a reservation of the Makah Indians. Its nearness to the fishing-grounds makes it important as a harbor of refuge for fishermen of this entire region. In 1892 the Indians of Neah Bay numbered 442. They are industrious, self-supporting, quiet, and peaceable. The only work performed by them is connected with the fisheries, with the exception that during the hop-picking season men, women, and children are engaged in the hopyards of the white settlers of distant counties on or near Puget Sound. As reported in 1889, these Indians continue to procure the larger part of their food supply from the fishing-grounds of the Strait of Fuca and the adjacent ocean. No records are kept of their catch, and the amounts credited in the tables are based on careful estimates made at the agency.

Halibut are the favorite food-fish of the Indians. It is estimated at the agency that 280,000 pounds of this fish are used annually as food, in addition to the quantities sold. During 1892 a fishing firm located at Tacoma had a steamer employed in visiting the grounds near Cape Flattery and buying the catch from the Indians and the small sailing vessels of white men. It is the practice of the Indians to go into camp near Cape Flattery, where the fish are dressed and disposed of, those not sold fresh being taken home and smoked for future use. The home market thus created induced a largely increased catch.

The average daily catch of a halibut canoe is about 40 fish, having an average weight of 30 pounds, many of the fish taken being much heavier. The fishing season is from the middle of May to the middle of August, after which time three-fourths of the Indians leave for the hop vineyards. The halibut continue to be taken by the Indians with large, cumbersome wooden hooks made by them, which they prefer to the regular trade hooks used by white men. Halibut have been found in their usual abundance on the several fishing-grounds inside and outside the Strait of Fuca, although the larger catch is taken in the ocean. In rough and stormy weather fishing can be successfully carried on inside the mouth of the strait.

In 1892 new grounds were resorted to with excellent results. These were located from 25 to 40 miles southwest from Cape Flattery, and fishing was done in a depth of 75 fathoms. The Indians of this county pay but little attention to salmon. Their catch is only made by trolling a bone or spoon hook in the American waters of the Strait of Fuca. The principal portion of the salmon run, which occurs in the fall, is said to be on the British side of the strait, on reaching the inner extremity of which the fish turn into their customary routes, one body going into Puget Sound and one going northward into the Strait of Georgia destined for the Fraser River.

The pursuit of the fur seal is an important branch of the fisheries carried on by the Indians of Neah Bay. Small sailing vessels making their headquarters at that point are employed, several of which are owned by the Indians. In addition to the five sailing vessels used, in

1892 two others were bought and one was built in Seattle, too late for use during that year, all of which were to be put into this fishery in the following season.

Whales are pursued in large canoes that often go 15 or 20 miles from the shore. Only harpoons and lances are employed by the Indians in the whale fishery. After being killed, the whale is buoyed with large air bags made from the skins of sea lions and towed to the shore, where it is soon cut up and divided among the tribe. The blubber is cut into long, narrow strips and smoked for later use as one of their favorite articles of food.

The Indian, almost from infancy, is familiar with the canoe and its management. Very young children are often noticed dexterously manipulating the paddle in miniature canoes, and during youth the greater part of the life of the Indians is spent in their canoes. Strange to say, however, they do not feel safe on the deck of a vessel and seldom become good sailors. Even in the fur-seal fishery in which the Indians are the owners of the vessels employed, they never go any distance from land without having a white man aboard as navigator.

On returning from a fishing trip, the work of the Indian fisherman ceases until he again enters his canoe. The women meet the boats as soon as they land and attend to all the details connected with the care and preservation of the catch.

The canoes used by the Indians are all made of red cedar, each from a single log. Canoes of different sizes are employed in the different fisheries, the standards being about as follows:

Dimensions and crews of Indian canoes, Neah Bay.

Fisheries in which employed.	Length.	Beam.	Crew.
	Feet.	*Feet.*	
Salmon	10	2½ to 3	1 to 2
Halibut	30 to 33	5	4 to 6
Whale	35 to 40	6 to 7	8
Fur seal	22	2½	2

The quantities and values of the products taken by the Indians of Neah Bay when fishing in their canoes were as follows, the figures applying to each of the years 1889 to 1892, inclusive. In addition to the products shown, the Indians of the same tribe and county living on the Quillaiute River took 300 fur seals, valued at $2,700, and a large amount of fish for local consumption of which no estimate can be given.

Species.	1889.		1890.		1891.		1892.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Halibut	300,000	$4,500	280,000	$4,200	290,000	$4,350	325,000	$4,875
Salmon	48,000	720	35,000	525	42,000	630	60,000	900
Cod (cultus and black)	100,000	1,500	90,000	1,350	85,000	1,275	87,000	1,305
Rockfish	10,000	150	15,000	225	15,000	225	25,000	375
Whales ....number	(4)	8C0	(3)	600	(12)	2,400	(3)	600
Total	458,000	7,650	420,000	6,900	432,000	8,880	497,000	8,055

During 1889 and 1890 the sealing vessels of Neah Bay were seized for illegal sealing. In 1891 they took 815 seals, which were sold for $14,947, and in the following year 1,743 seals were killed, which brought $16,537. Three vessels were used in 1891 and five in 1892.

Port Angeles.—Prior to 1891 the fisheries of this port were confined to the operations of the Indians who live in the vicinity, but with the growth of the place during the years covered by this report more attention was given to developing the fishing business. A fishing and canning company under the name of the Port Angeles Packing Company was organized in 1892, a small cannery was built, and $10,000 was invested in the plant. The business was started too late in the season to do more than prepare for the ensuing year.

Two small vessels and several boats were engaged in the line and gill-net fisheries of this place, the catch, consisting of cultus-cod, halibut, and salmon, being marketed at Port Townsend or Seattle, when not sold locally. Fish of numerous varieties are fairly abundant at most seasons of the year, and the port has one of the best harbors in this region. It would therefore appear that with the further growth of the country the fisheries will receive more attention. In 1891 and 1892 the following quantities of fish were taken by the fishermen of Port Angeles and the immediate vicinity, including some Indian fishermen of Elwha Creek, located 6 miles west of Port Angeles:

Species.	1891.		1892.	
	Pounds.	Value.	Pounds.	Value.
Salmon	30,000	$600	46,000	$870
Halibut	25,000	1,000	34,000	1,180
Rockfish	35,000	1,050	50,000	1,480
Total	90,000	2,650	130,000	3,530

Dungeness.—Dungeness is a settlement composed for the most part of Indians, with only a few white families. The section is rough and mountainous, the harbor is shallow, and the conditions do not appear favorable for a great increase in the fisheries. Some little fishing is carried on from canoes, with hooks and lines, by Clallam Indian men and women. Any surplus catch, which is seldom made, finds a market at Seattle. The quantity taken varies but little from year to year, and in 1892 was about as follows:

Species.	Pounds.	Value.
Salmon	125,000	$3,750
Cultus cod and black-cod	30,000	1,000
Rockfish	50,000	1,500
Total	205,000	6,250

PIERCE COUNTY.

This county occupies the head of Puget Sound and has as its fishing center Tacoma, where most of the fishermen of the county reside and nearly all of the catch is marketed. With the recent growth of the city, the construction of a large cold-storage warehouse, and the investment of more capital in the industry, the outlook for the fisheries is very encouraging to the fishermen, and the results of the business present a considerable increase since the last report.

The principal fisheries are for salmon, carried on with pound nets; for cultus-cod, halibut, and rockfish, with lines; for flounders, herring, salmon, smelt, etc., with seines; and for oysters and clams, with tongs. The most important single products are oysters and silver salmon.

During 1892 a firm largely interested in the fisheries placed the steamer *Francis Cutting* in the business. This steamer was chiefly used as a transporter, making frequent trips from Tacoma to the several fishing banks of the sound and strait. The fishing season extended from May 1 to November 2, during which time about 500,000 pounds of halibut, 50,000 pounds of black-cod, and 75,000 pounds of cultus-cod were bought from the fishermen on the fishing-grounds, in addition to which the crew of the steamer caught about 20,000 pounds of halibut. On securing a fare the steamer returned to Tacoma, where the catch was placed in cold storage until needed. Fishing for halibut and the other fish is done by a small fleet of sailing vessels using hand lines.

Besides the halibut, black-cod, and cultus-cod brought in by the steamer, this firm handled considerable quantities of salmon, smelt, and sturgeon. After supplying the local demand, the surplus catch was packed in refrigerator cars and shipped to points east of the Rocky Mountains. The sturgeon handled came by rail from Grays Harbor the other fish were caught locally. This was probably the first year in which smelt were sent from the Pacific Coast to the East. The business of freezing and shipping fresh fish to eastern points promises a large increase in the near future. In 1891 one car, with 20,000 pounds of fresh fish, was sent east. In 1892, up to the middle of December, eleven cars, containing 297,369 pounds of fresh frozen fish, had been sent, while half a dozen car loads still remained in storage, to be forwarded later.

KING COUNTY.

The most important fishing center of this county is Seattle. The rapid growth in the population of Seattle, the building of a cold-storage warehouse, and the establishment of new fishing firms have led to a threefold increase in the fisheries of this county as compared with 1888.

The salmon canning business of Seattle and vicinity has fluctuated considerably in recent years. In 1889 three canneries were operated. During that season one was destroyed by fire, and the following year another shared the same fate, and the third was closed. The cannery destroyed in 1890 was burned during the packing season, but the business was continued in a hastily provided temporary building, the packing for the season being necessarily much reduced, owing to the interruption. A large new cannery to replace the loss by fire was constructed, and was the only one in operation during the years 1891 and 1892. The most abundant salmon taken in this county is the dog salmon, which constitutes about five-twelfths of the catch. Silver salmon is next in abundance, representing one-third the catch, while steelhead and chinook salmon, respectively, comprise one-sixth and one-twelfth of the yield. In 1889 about three-eighths of the salmon catch of this county was obtained by means of pound nets, but in the later years the use of purse seines has been increasing and pound nets have been given up, so that in 1892 three-fourths of the catch was made with purse seines and one-fourth with gill nets.

A fleet of small-sized schooners, built for the fisheries during the years 1891 and 1892, at once inaugurated the halibut fishery, and their catch met with a ready sale at Seattle.

The business of shipping fish fresh in refrigerator cars is growing in importance. Shipments are as yet confined to fresh salmon and halibut consigned mostly to points east of the Missouri River. Each car carries from 12 to 18 tons of fish. In 1890 six carloads, comprising 195,250 pounds of fresh fish, were sent east from Seattle; the following year, nineteen carloads, aggregating 690,210 pounds, were sent east. Up to December 1, 1892, five carloads, equivalent to 121,550 pounds, had been sent, and it is probable that the shipments during the remainder of the year would make the aggregate for the season fully equal to that of 1891.

The Puget Sound and Alaska Commercial Company, of Seattle, was the pioneer of the cod-fishing business of that city. The firm began operations in February, 1892, and on March 5 of that year sent the schooner *Moonlight*, of 68 tons, with a crew of 17 men, on the first cod-fishing trip from Seattle. The vessel fished in Bering Sea and returned to Seattle on August 20 with 175,000 pounds of salt cod. Soon after being landed the fish were prepared in the usual manner as boneless cod and placed on the market. The success attending this first trip and the favorable reception accorded the prepared catch indicate that the future may see this business largely increased.

The pelagic fur-seal fishery has for many years received considerable attention in Seattle. Of late more vessels and larger craft have been engaged in this branch of the fisheries. During 1892 the vessels were very successful in taking seals and in receiving good prices in the London market, to which the entire catch was sent. At the close of 1892 vessels were being overhauled and made ready for an early start in January, 1893, for the distant sealing-grounds off the coast of Japan.

SKAGIT COUNTY.

This county is favorably located with reference to the fishing-grounds of the Strait of Fuca and Strait of Georgia, and will no doubt come into prominence with the further settlement of the section, but at the present time it maintains no local fisheries, and the only feature which entitles it to mention is the offshore cod fishery carried on from Anacortes, in this county. During 1892 direct rail communication was established between Seattle and this county, with the water terminal at Anacortes. This town was one of many communities that the opening of the railroad brought into existence. Up to the date of the visit of the agent of the Fish Commission no attention had been given to the fisheries, with the exception of the cod fishery noted.

In 1891 Capt. J. A. Matteson, of Provincetown, Mass., brought to Anacortes the schooner *Lizzie Colby*, which had for a number of years been engaged in the Grand Banks cod fishery out of Provincetown. On the arrival of the vessel she was at once sent to the fishing banks in Bering Sea. Although the season was late when fishing began and the operations were continued only twenty days, 85,000 pounds of codfish were taken and brought to Anacortes. On March 17, 1892, this pioneer vessel in the cod fishery of Washington sailed from Anacortes on her second trip to Bristol Bay, Alaska, returning August 30 with 364,000 pounds of codfish, which were caught in three months' fishing. On the return of the vessel the cargo was stored under pickle in tanks until needed. As occasion requires, the fish are dried on outdoor flakes, and prepared for market as boneless codfish. The fish are sold in Seattle, Portland, and other cities of the west coast, and one car load was sent to Boston, Mass.

WHATCOM COUNTY.

This is the most northern county of the Pacific Coast of the United States. It lies at the southern entrance to the Gulf of Georgia and just northeast of the Strait of Fuca, and is of considerable importance in connection with the fisheries. Salmon on their way to the Fraser River pass the shores of this county, off which they are usually found about a month earlier than they are in the Fraser. The fisheries are centered at Point Roberts, a military reservation. Numerous varieties of fish are here found, but only salmon at the present time have any commercial importance. Previous to the establishment of a salmon cannery at Point Roberts in 1891, all the fishing of the county was confined to the period of the early run of salmon on their way to the Fraser. At that time the catch, of which no reliable report could be procured, was used locally, and sold to the canneries over the boundary line, on the Fraser River, and was much less than in 1891 and 1892.

During 1892 over three-fourths of the catch was taken by the 85 white men using purse seines and pound nets, and less than one-fourth by 100 Indian fishermen employing reef nets and gill nets. The reef net, of which a diagram and description were given in the previous report on the fisheries of this coast, is gradually going out of use, only 10 being used in 1892, against 20 in 1891. The proportional quantities of salmon taken with the different kinds of apparatus are as follows: Pound nets, two-tenths; purse seines, six-tenths; gill nets, one-tenth; reef nets, one-tenth. Silver salmon and skowitz or dog salmon are taken by purse seines and gill nets; sockeye or blueback salmon are caught by pound nets, while all species are taken in small quantities in reef nets. The average gross weights of the different species of salmon taken at Point Roberts in 1892 were as follows: Blueback salmon, 7 pounds; silver salmon, 7½ pounds; dog salmon, 10½ pounds. The prices paid to the fishermen for these fish were 15 cents, 8 cents, and 6 cents, respectively.

The total quantity of salmon taken in 1891 was 625,885 pounds, and in 1892 1,043,500 pounds, all of which were caught and used in canning at Point Roberts.

SAN JUAN COUNTY.

This county consists of numerous islands lying midway between the island of Vancouver on the west and Skagit County on the east, in the direct line of migration of the large bodies of salmon on their way from the ocean to the Fraser River and other streams of the northwest coast. While the opportunities for commercial fishing for salmon and other fishes are regarded as extremely good, the fishing industry is insignificant. On Waldron Island some attention was given to the taking and smoking of herring during the years 1891 and 1892, several hundred thousand pounds of raw material being utilized annually. After being smoked the fish are packed in small boxes holding 5 or 6 pounds, and find a ready market in the cities of the Pacific Coast.

THE OYSTER BUSINESS OF PUGET SOUND.

Native oyster beds are abundant in Mason and Thurston counties, the beds in Mason County being in Oakland Bay, Case Inlet, Totten Inlet or Oyster Bay, and Hood Canal, and those of Thurston County in Mud Bay near Olympia; all of these bodies of water are tributary to Puget Sound. During the past few years more attention has been given to the native beds of this region. The small seed oysters obtained from the cull have been planted, and starfish found on the beds have been destroyed. In all cases in which some care has been bestowed on the beds a gain in the output has resulted, while localities where the beds have received no attention have generally shown a decrease, some beds worked as late as 1889 now being abandoned. In past years starfish have been very destructive to the native beds of Puget Sound; of late the efforts to rid the beds of this injurious animal have been increased, and depredations have been almost entirely prevented. The beds are exposed at low tide, at which time the starfish are gathered by hand and with forks, and used on the land for fertilizer.

In taking oysters in the Puget Sound region tongs are but little used—in some instances not at all, the oysters being picked by hand at low tide, and carried to floats, where they are culled, small seed oysters and shells being returned to the beds.

Market oysters are sent to Olympia, Tacoma, Seattle, and other points, in sacks containing 115 pounds, equivalent to 2 bushels. Prices in 1889 were $3 per sack, and in 1891 and 1892 $2.50 per sack. The oyster season is from September 1 to May 1. Two sacks per day are considered a fair quantity to be taken by one man.

Considerable interest is being taken in the question as to whether eastern oysters will propagate or thrive in the waters of Puget Sound. It is reported that the experiment will soon be given a trial by planting a consignment of oysters from the East.

The extent of the oyster industry of Puget Sound in the years 1889 to 1892, inclusive, is shown in the following tables. The number of men engaged and the capital invested in this industry show little change from year to year, although there has been a slight increase in the quantity of products, with a reduction in their value. In addition to the persons shown in the table, there were perhaps as many more employed at odd times in connection with the industry, but their operations were too brief to entitle them to mention in the tables. In addition to the quantities of oysters given for Mason and Thurston counties, about 10,000 bushels are taken annually from these counties by fishermen living at Tacoma, to which place their catch is credited.

In 1892 small beds of a bivalve mollusk (*Placunanomia macroschisma*) of no economic value were found between Tacoma and Seattle. Considerable attention was given to this discovery, because of the extensive notices in the press. By the newspapers the shellfish were almost invariably designated as valuable beds of eastern oysters. Their shells were about the size of a medium eastern oyster. The soft part of most of them was of a bright red color, resembling fresh meat rather than shellfish. The Indians of the sound have long been familiar with these mollusks, and report them as good for food at certain seasons and as poisonous at other times. No experiments as to their value for food were made by the whites, and the beds remain undisturbed.

Persons employed in the oyster industry of Puget Sound.

Counties and countries.	Nativity.	Nationality.
Mason:		
United States	40	45
United States (Indians)	11	11
China	8	8
France	5	....
Total	64	64
Thurston:		
United States (Indians)	12	12
Grand total	76	76

Boats, apparatus, shore property, and cash capital employed in the oyster industry of Puget Sound.

Items.	Mason.		Thurston.		Total.	
	No.	Value.	No.	Value.	No.	Value.
Boats	a78	$1,560	b25	$750	103	$2,310
Tongs	43	172	10	40	53	212
Floats	40	2,000	5	250	45	2,250
Shore property	......	1,000	......	....	......	1,000
Cash capital	......	5,000	......	....	......	5,000
Total	161	9,732	40	1,040	201	10,772

a Rowboats. b Canoes.

Product of the oyster industry of Puget Sound.

Years.	Mason.		Thurston.		Total.	
	Bushels.	Value.	Bushels.	Value.	Bushels.	Value.
1889	25,000	$37,500	1,200	$1,800	26,200	$39,300
1890	25,400	38,100	1,280	1,920	26,680	40,020
1891	26,000	39,000	1,920	2,880	27,920	41,880
1892	26,280	32,850	2,200	2,750	28,480	35,600

ALASKA.

GROWTH OF THE FISHING INDUSTRY.

Until a few years ago the wonderful fishery resources of Alaska were little known except to the natives of the country. Attention was called to this distant portion of the United States by Dr. Tarleton H. Bean, of the United States Fish Commission, in the report of the Commission for 1880. This report was extensively copied and was read with great interest, and its accounts of the wonderful abundance of salmon and other fish were by many received with doubts similar to those entertained two hundred and fifty years before regarding the reports carried to Europe as to the abundance of fish off the New England coast. Time has proved that the statements of Dr. Bean were quite moderate and fully reliable. Notwithstanding the great abundance of fish in Alaskan waters, the total value of the fish utilized in 1880 by others than natives was shown to have been insignificant.

Soon after attention had been called to Alaska and its resources by the United States Fish Commission, many persons engaged in the salmon business on the Columbia and other coast rivers gave the subject of Alaskan fisheries careful consideration. Although the fish were very abundant, the great distance of the grounds and the expense necessary to establish a plant there were considered to involve too great a risk to warrant the inauguration of fisheries. The first experiment having proven a financial success, the doubtful watchers, slowly at first and later with more eagerness, followed, until at the present time it will be seen that over half of the aggregate pack of salmon in the United States and nearly half of the pack of the entire world comes from Alaska.

The large area, and the wide distances between inhabited stations of this vast domain, render the gathering of complete general and statistical information a matter of much time, difficulty, and expense. Fortunately, so far as the fisheries are concerned, the various fishing firms in Alaska have their home stations and headquarters at San Francisco, or in Washington and Oregon, and can be reached with comparative ease. The instructions to the writer on his last investigation of the fisheries of the Pacific Coast in 1892 called for such statistical information regarding the Alaskan fisheries as could be procured without visiting that Territory. Each of the headquarter offices, as previously mentioned, was visited, and through the courtesy of the proprietors and officers complete and accurate information was obtained directly from the books of every salmon cannery in Alaska, without one dollar of extra expense to the Government.

With the exception of the considerable quantities of fish caught and consumed in Alaska by the natives, the accompanying tables represent the entire food-fish fisheries of Alaska. The waters of that region, however, abound in many varieties of fine food-fish to which scarcely any attention has been given. San Francisco firms engaged in the cod fishery procure their catch on the extensive fishing banks just off the shores of Alaska, on which they have several stations. Their catch will be found in the statistical tables of California, and the two vessels in the same business from Washington will be credited to that State.

STATISTICS OF THE INDUSTRY.

The following tables show, for the years 1889 to 1892, inclusive, the extent of the fisheries of Alaska. The figures relate to persons employed; vessels, boats, apparatus, etc., used; and the quantity and value of the catch:

Persons employed in the fisheries of Alaska.

How employed.	1889.	1890.	1891.	1892.
In vessel fisheries	283	310	321	331
In shore fisheries	1,442	1,678	1,820	1,020
On shore, in canneries, etc.	2,497	2,668	2,806	1,533
Total	4,222	4,656	4,947	2,884

Vessels, boats, apparatus, shore property, and cash capital employed in Alaska fisheries.

Designation.	1889		1890.		1891.		1892.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels	33	$433,000	36	$504,500	39	$532,500	40	$461,000
Tonnage	6,710		6,860		6,923		8,623	
Outfit		26,400		29,900		32,950		33,400
Boats	722	131,175	793	138,200	809	148,175	421	63,575
Apparatus:								
Seines	105	45,225	124	55,425	127	55,000	69	27,025
Gill nets	478	51,650	510	55,650	590	60,850	243	28,750
Pound nets	20	17,200	24	20,200	25	21,000	16	13,200
Lines		3,350		5,650		5,350		4,050
Guns								500
Shore property		1,124,900		1,214,400		1,268,500		720,650
Cash capital		1,723,000		1,788,750		2,061,500		1,257,500
Total		3,555,900		3,812,675		4,185,825		2,609,650

Products of the fisheries of Alaska.

Species.	1889.		1890.		1891.		1892.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Cod	1,135,975	$28,453	1,166,002	$41,682	1,637,000	$40,925	2,219,835	$55,562
Herring	13,860,800	24,395	15,604,800	27,464	15,437,000	27,169	18,700,000	32,900
Salmon	50,917,220	1,500,496	55,444,820	1,630,281	69,071,040	2,031,552	42,231,500	1,219,973
Fur-seal pelts		a 1,077,478		b 267,750		c 217,408		d 107,573
Sea-otter pelts								e 2,220
Total	65,913,995	2,630,822	72,215,622	1,967,177	86,145,040	2,317,054	63,151,335	1,418,228

a Represents 102,617 skins.
b Represents 21,000 skins.
c Represents 13,588 skins.
d Represents 7,175 skins.
e Represents 18 skins.

THE SALMON INDUSTRY.

Brief notice has been made of the first canning of salmon in Alaska, of its success, and of the rush to this new region of those previously engaged in the business in other sections. The number of canneries in the Territory increased up to 1891, when the business reached high-water mark; the number of canneries in operation was 33 and the pack was 808,908 cases. This large amount of canned salmon, added to the customary yearly pack of the Columbia and other rivers, could have but one result, that of an overstocked market that at once necessitated a curtailing of operations. Salmon continued in great abundance in Alaskan waters, and it was apparent that the running of the 33 canneries to their full capacity would result in great pecuniary loss. Twenty-seven of the canning firms consequently decided to largely diminish expenses and reduce the amount of the pack in 1892, and in future years, so far as possible, to limit the production to the probable demand of the trade. This was accomplished by the firms mentioned pooling their business and closing 18 canneries that had run in 1891; the others, with those not entering the combine, made the number of factories operated in 1892 only 15. The pack in 1892 was 468,970 cases.

The principal salmon used in the canning business in Alaska are the small red-meated fish, locally known as red salmon, which has an average weight of 7 pounds, and the larger king or chinook salmon, which averages 30 pounds. In packing a case of 48 one-pound cans, the average number of red salmon required is 12, and of king salmon 2¾. This is a much larger average than obtains at the canneries in the Pacific States, where the fish are less abundant and more valuable. The great abundance of these fish in Alaska results in the use of only the choicest parts and in the loss or waste of large quantities of products which otherwise would be utilized.

The extent of the salmon fishery of Alaska and of the canning and salting industry dependent thereon is given in the following tables. It appears that in 1892 2,601 persons were engaged in the industry, that $2,184,303 was invested, that 37,534,100 pounds of salmon were utilized at the canneries in the preparation of 468,970 cases of canned fish and 55 barrels of salt salmon, the manufactured products having a value of $1,970,110. For reasons already given, the business was much less extensive in 1892 than in any of the other years under consideration. The canneries not operated in the years shown represent a very large investment which does not appear in the statistics. Only the property actively employed is noticed.

The business of salting salmon, as a branch of the fishing industry independent of the salting done at the canneries, is quite important and is yearly increasing in extent. About a dozen firms, located in various parts of Alaska, engaged in salting salmon in 1892, utilizing 4,697,400 pounds of fresh fish and preparing 15,658 barrels of salt salmon, having a value of $125,264. In the following year 5,871,600 pounds of raw material were consumed in the production of 19,572 barrels of salt fish worth $156,576. The persons employed in this branch of the salmon industry and the capital invested therein are included in the figures given in the preceding paragraph and in the tables which follow.

Persons employed in the salmon industry of Alaska.

Years.	On vessels.	In shore fisheries.	On shore.	Total.
1889	252	1,324	2,397	3,973
1890	279	1,533	2,568	4,380
1891	290	1,557	2,706	4,553
1892	288	880	1,433	2,601

Vessels, boats, apparatus, shore property, and cash capital employed in the salmon industry of Alaska.

Items.	1889.		1890.		1891.		1892.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Establishments	36	$914,903	39	$998,903	42	$1,050,403	25	$503,403
Cash capital		1,538,000		1,603,750		1,891,500		1,117,500
Vessels	28	*a*413,000	31	*a*488,000	34	*a*518,500	34	*a*441,500
Tonnage	6,552.42		6,701.80		6,765.24		8,421.48	
Boats	680	127,075	732	132,275	748	142,250	365	58,025
Seines	96	40,125	113	49,325	118	49,900	60	21,925
Gill nets	478	51,650	510	55,650	590	60,850	243	28,750
Trap nets	20	17,200	24	20,200	25	21,000	16	13,200
Total		3,101,953		3,348,103		3,734,403		2,184,303

a With outfit.

The vessels shown in the foregoing table are employed about the stations or are engaged in transporting supplies to the canneries and the prepared products to the markets. Many are of large size, and are among the finest vessels employed in the United States in connection with the fisheries. They are mostly steamers, but there are also ships, barks, and schooners. The largest sailing vessel is a ship of 1,158.30 tons, and the largest steamer has a tonnage of 449.64. These two vessels carry crews of 30 and 14 men, respectively. The aggregate tonnage of this fleet in 1892 was 8,421.48, the value of the vessels was $441,000, and the crews numbered 288. The following table relates to the vessels employed in this capacity from 1889 to 1892, inclusive. A number of steam launches of less than 5 tons burden, used at the canneries, are classed as boats and do not appear in the table.

Vessels engaged in the salmon industry of Alaska.

Years and rigs.	No.	Net tonnage.	Value. (*a*)	No. of crew.	Years and rigs.	No.	Net tonnage.	Value. (*a*)	No of crew.
1889—Steam	18	1,041.91	$268,500	106	1891—Steam	25	1,290.95	$378,000	148
Sail	10	5,510.51	144,500	146	Sail	9	5,474.29	140,500	142
Total	28	6,552.42	413,000	252	Total	34	6,765.24	518,500	290
1890—Steam	22	1,227.51	347,500	137	1892—Steam	23	1,062.63	315,500	129
Sail	9	5,474.29	140,500	142	Sail	11	7,358.85	126,000	159
Total	31	6,701.80	488,000	279	Total	34	8,421.48	441,500	288

a Includes outfit.

Products of the salmon industry of Alaska.

Years.	Salmon canneries.						Salmon salteries.			
	Salmon utilized.		Salmon canned.		Salmon salted.		Salmon utilized.		Salmon salted.	
	Pounds.	Value.	Cases.	Value.	Bbls.	Value.	Pounds.	Value.	Bbls.	Value.
1889....	48,213,120	$1,446,394	599,394	$2,996,970	872	$6,976	2,705,100	$54,102	9,017	$72,136
1890....	52,138,520	1,564,156	641,449	2,629,491	2,742	21,936	3,306,300	66,125	11,021	88,168
1891....	65,013,240	1,950,397	808,908	3,235,632	1,002	8,016	4,057,800	81,155	13,526	108,208
1892....	37,534,100	1,126,023	468,970	1,969,674	55	440	4,697,400	93,950	15,658	125,264
1893....	51,725,060	1,551,752	636,427	2,863,921	2,703	21,624	5,871,600	117,432	19,572	156,576

The names of the salmon-canning firms in Alaska and the location of the canneries are shown for four years in the following list, the cross-marks indicating the years in which the canneries were operated:

List of Alaskan salmon canneries operated in 1889, 1890, 1891, and 1892.

Name of cannery.	Location.	1889.	1890.	1891.	1892.
Astoria Packing Company	Kuiu Island	......	×	×	......
Alaska Packing Company	Nushagak River	×	×	×	×
Arctic Packing Company	Uyak	×	×	×	......
Do	Bristol Bay	......	......	×	......
Do	Alitak	×	×	×	×
Do	Cook Inlet	×	......	×	......
Aleutian Island Fishing and Mining Company	Karluk	×	×	×	......
Alaska Salmon Packing and Fur Company	Loring	×	×	×	×
Alaska Improvement Company	Kadiak	×	×	×	×
Aberdeen Packing Company	Wrangel	×	×	×	......
Boston Fish and Trading Company	Yes Bay	×	×	×	×
Behring Sea Packing Company	Ugashik	......	......	×	......
Bristol Bay Canning Company	Bristol Bay	×	×	×	×
Baranoff Packing Company	Baranof Island	×	×	×	×
Central Alaska Company	Thin Point	×	×	×	......
Chilkat Packing Company	Chilkat River	×	×	×	......
Chilkat Canning Company	....do	×	×	×	×
Chignig Bay Packing Company	Chignig Bay	×	×	×	×
G. W. Hume	Cook Inlet	......	×	×	×
Hume Packing Company	Karluk	×	×	×	×
Karluk Packing Company	....do	×	×	×	×
Kadiak Packing Company	....do	×	×	×	......
Do	Alitak	......	×	×	......
Metlakahtla Mission	Clarence Strait	......	......	×	×
North Pacific Trading and Packing Company	Klawak	×	×	×	×
Northern Packing Company	Cook Inlet	×	×	×	......
Nushagak Canning Company	*Bristol Bay*	×	×	×	......
Pacific Packing Company	Copper River	×	×	×	......
Pacific Steam Whaling Company	....do	×	×	×	......
Peninsular Trading and Fishing Company	....do	×	×	×	......
Pyramid Harbor Packing Company	Pyramid Harbor	×	×	×	×
Royal Packing Company	Afognak	×	×	......	......
Russian-American Packing Company	....do	×	×	×	......
Thin Point Packing Company	Thin Point	×	×	×	......
Total		28	30	33	15

Mr. A. B. Alexander, fishery expert on the United States Fish Commission steamer *Albatross*, makes the following remarks on the business of salting salmon in Alaska:

The demand for salt salmon is yearly increasing. A few years ago there was but little call for it, probably owing to the fact that little effort was made on the part of those engaged in the business to introduce it in the East. Seeing the absolute necessity of taking steps to place their products on the eastern market in order to increase the demand and establish a trade for salt-cured salmon, efforts have been pushed in that direction, and the encouragement met with has induced many who had not the means or desire to enter into the expensive business of canning salmon to establish salmon salteries in various parts of Alaska.

The amount of capital required to start on a small scale in this business is not large. One or two boats fitted with drag seines, a cabin on shore for living quarters, a rough shed or fish house in which to dress and salt the fish and for performing such general work as may be required in a limited business of this kind, will suffice for all purposes. Many of the well-established salteries were first started in this manner and have since grown to be of considerable importance. Two or three men with only a small amount of capital, if they are fortunate in selecting a good locality where the run of salmon can be relied upon—for the success of the entire business depends upon the location—can, if they display the required amount of energy, build up a paying business. They of course must appreciate the fact that at least for seven months out of the year they must content themselves with being cut off and isolated from civilization, but the class of men who seek a livelihood in this remote part of the world care little for social life, or, if so, the prospect which looms up before them for making money is fully equivalent to any hardships of this nature they may undergo.

Several small vessels manned by men of small means have, during the past few years, made annual voyages to Alaska, spent the fishing season there, and in the fall brought back the summer's catch. At first they temporarily located themselves by way of an experiment where it was thought to be a good position for carrying on the business. If the experiment proved a success, the next year greater preparations were made, and in this way from a small beginning quite a number of valuable plants have been established.

The greater part of the salmon put up at the salteries are caught in drag seines, although a few are taken in gill nets and traps, but at most places where salteries are situated the drag seine has been found to be the most profitable apparatus of capture, owing to the great number of smooth beaches where the fish can be easily taken. There are, however, numerous bays, channels, and straits in Alaska where the purse seine could be used to advantage. The reason why this style of net has not been adopted in places where it can be used is because the fishermen of the coast are not experienced in handling it. In 1893 a mackerel purse seine was for the first time used at Tongas Narrows, in southeastern Alaska. Previous to the introduction of this seine the drag seine had always been used. Mr. Clarke, one of the owners of the saltery established here, says that after a season's trial he has come to the conclusion that the purse seine is superior to the drag seine, and during the next season he intends to employ several of them. The secret of Mr. Clarke's success in fishing for salmon with a purse seine is in his knowledge of using it, which was gained by nearly twenty years' experience in the mackerel and other fisheries in New England. Seeing no reason why salmon could not be caught in the same manner as mackerel in places where the bottom and general surroundings were favorable, he sent East for enough twine to make a seine 150 fathoms long, 17 fathoms deep in the bunt, and 14 fathoms on the wings, the size of the twine being 9 and 12 thread. It will be observed that this seine is considerably deeper in proportion to its length than the ordinary mackerel seine. The reason for this extra depth is that salmon, when they find themselves surrounded by twine, will, like mackerel, dive, but, as a rule, they will only go down from 12 to 14 fathoms. By having the seine several fathoms deeper than they generally dive, a school, when once surrounded, is pretty sure of being caught. Mr. Clarke says he did not lose a single school during the summer.

The attempt to catch the salmon in this manner being only an experiment, everything connected with the new method, except the seine, was crude. A seine boat had to be built and the crew to man it drilled. The boat was manufactured on the spot by men connected with the fishing station.

Mr. Clarke finds this method a much more economical way of fishing than with drag seines. The bottom about Tongas Narrows is very rocky and drag seines are frequently torn to pieces. This involves a great deal of labor in keeping them in repair, and besides the expense amounts to considerable during the season. There being plenty of water here where the fishing is carried on, the purse seine never comes in contact with the bottom, and the hardest usage it gets is the natural wear and tear from handling.

Two purse seines have been used for several years at Yes Bay. One is 300 fathoms long and 17 fathoms deep in the bunt, and the other is about 100 fathoms long. The larger one is used more frequently and is set from a small steamer. The superintendent of the saltery at that point says it works all right when he can get men who know how to handle it. Purse seines have also been in use for two seasons at Metlakahtla, and with very good success.

Employes at the salteries have, heretofore, been paid by the month, but a few salters during the past season gave their men a lay. Sixty dollars a month for white fishermen and $1 a day for native help have been the established wages. It is fast becoming the custom to pay so much per barrel to white fishermen for all salmon caught. At all places where this system has been tried it has given satisfaction to both fishermen and owners. Ten cents a barrel is the lay received. In all fishing communities where fishing is performed on a lay much better results follow than where stipulated wages are given. The constant expectation of good catches stimulates the men with energy which wages have not the power to bring out. The fishermen know that what benefits the proprietors likewise helps them.

All barrels used for putting up salmon in southeastern Alaska are manufactured at the salteries. Suitable wood being abundant, they can be made at a reasonable price. During the winter months enough barrels are made to meet the demand for the coming season. A cooper is an indispensable person about a salmon saltery, for, besides performing his regular duties as a cooper, he is often called upon to assist in various mechanical jobs, and is paid by the piece, or so much per barrel—85 cents for making a whole barrel and 65 cents for a half barrel. At this price he can earn good wages, for he is under no expense for board.

It being the object of every man owning a saltery to enlarge on the plant and increase his business as rapidly as possible, several weeks of each year, before and after the fishing season, are spent in building wharves if needed, erecting buildings, and making such improvements as are required to keep a place of this kind in good order.

Many salmon salters have gained a firmer foothold in Alaska than the mere business of salting salmon would give them. They have branched out into general trade, and have stores well stocked with goods of all kinds. In this way they have drawn around them the neighboring tribes of Indians who are ever ready to buy and trade for such commodities as they require. The result of barter and trade with the Indians has been to annually fill the stores with large collections of furs. Bear, fox, and deer skins are chiefly dealt in, the most of which are shipped direct to San Francisco.

MANUFACTURE OF HERRING OIL AND GUANO.

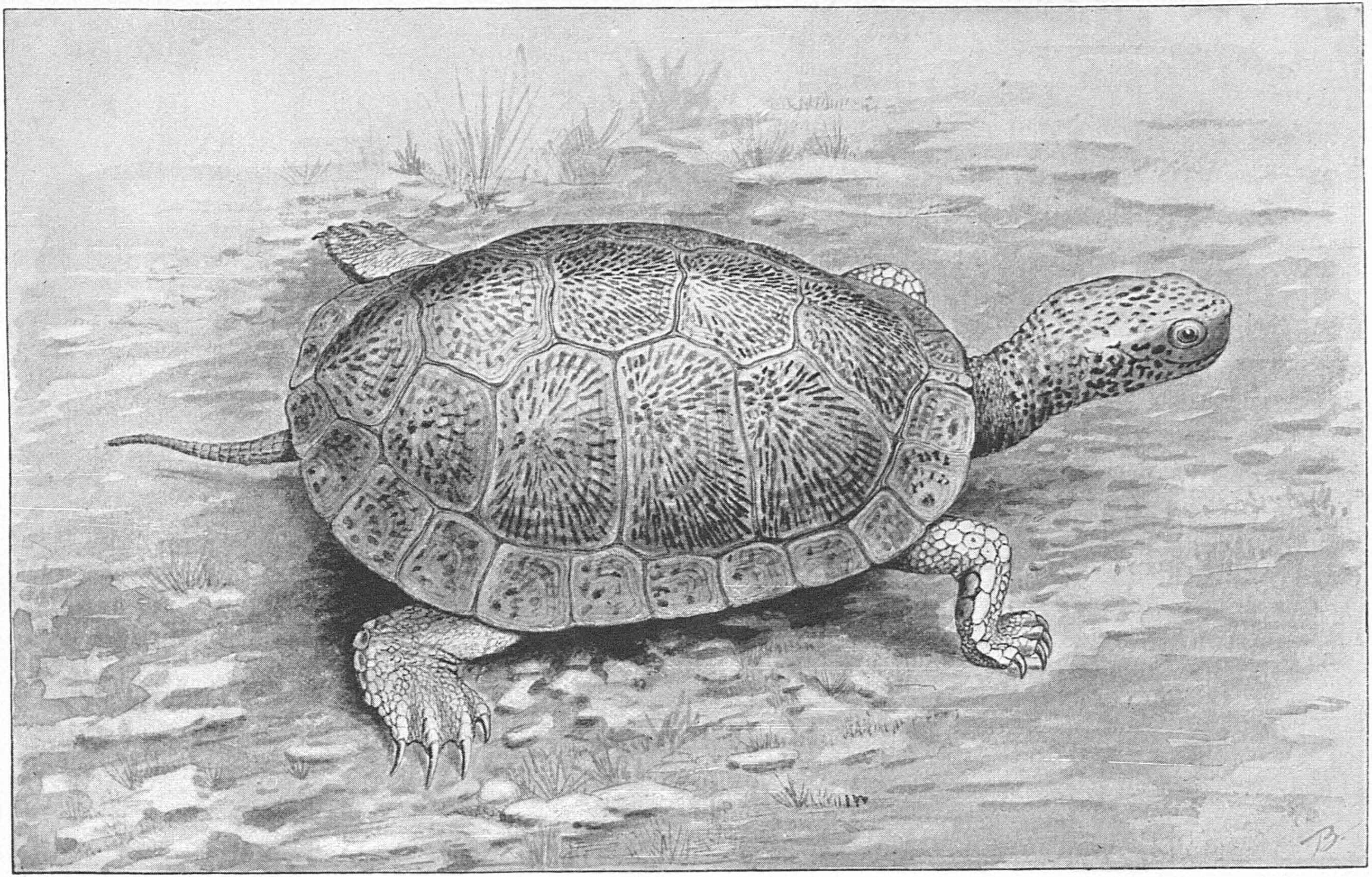
According to the report of Mr. Paul S. Luttrell, special agent of the Treasury Department for the protection of the salmon fisheries of Alaska, a herring fishery of some magnitude was carried on in 1892 at Killisnoo, Alaska, by the Alaska Oil and Guano Company. While a considerable quantity of herring was preserved by salting, the chief feature of the business was the manufacture of oil and fertilizer. One hundred and twenty-two persons were employed in various capacities, of whom 93 were in the oil works and 29 on steamers engaged in fishing. Of the factory employes 47 were whites, 4 were Chinese, and 42 were natives. Four steamers, of 60, 42, 23, and 4 tons, respectively, were used. The value of the property and improvements was $100,000.

During the year 93,000 barrels of herring were taken, from which the following were prepared: 500 half barrels of salt herring, 1,000 barrels of salt herring, 316,000 gallons of oil, 700 tons of guano. The oil, the price of which at the trade centers was 25 to 35 cents a gallon, had an aggregate value of $85,000. The value of fertilizer was $21,000, or $30 a ton.

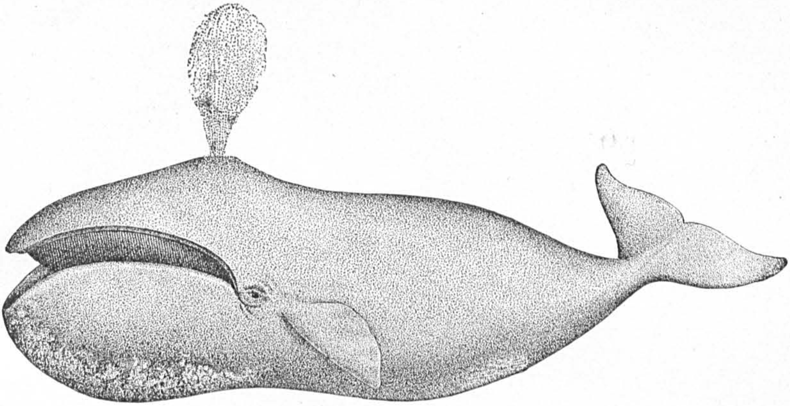
THE ATKA MACKEREL.

The few persons who are familiar with this fish pronounce it one of the best of the numerous food-fishes found in the waters of Alaska. Its name is misleading in that the fish has no relation to the mackerel family and does not resemble it in looks or flavor. While found at numerous places in Alaskan waters, it has so far been observed most plentifully around the far-distant island of Attu. This island is the outer one in the Aleutian chain, and is the most western land belonging to the United States. It is so far west that it might, with almost equal propriety, be called east, being nearer the Asiatic shore than to any other mainland. San Francisco vessels engaged in trading or seal hunting have from time to time brought back larger or smaller quantities of salted Atka mackerel, usually taken in the vicinity of Attu. One of these vessels, the schooner *Rosa Sparks*, of 42.11 tons, with a crew of 20 men, which was engaged during the season of 1891 in fishing and sealing, returned with 148 seal skins and 324 barrels of Atka mackerel. The latter found a ready sale at $15 a barrel. The captain of the vessel, Mr. S. L. Weatherbee, reports that his catch was made at Attu Island, and furnishes the following statements on the subject:

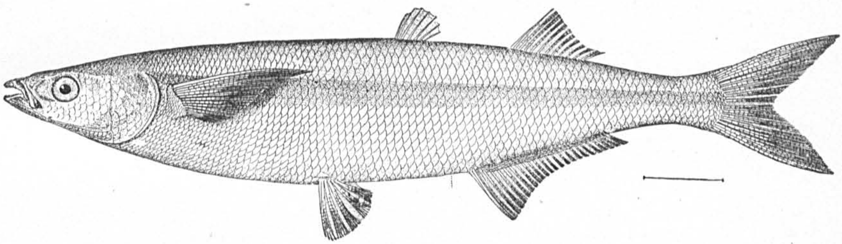
Atka mackerel are reported by the natives as remaining in the vicinity of Atka all winter, but do not reach Attu before April 10, from which date up to September they are found among the kelp in great abundance. Up to July they are very fat and in their best condition. The spawning season is in July, at which time they grow thin and poor. The fish are taken in 25 fathoms of water by jigging, no bait being required. Three or four hooks are fastened together and placed in a mold, into which lead, pewter, or some similar composition is run, welding the hooks together and leaving a shank that is polished up brightly to attract the fish; this also serves as a sinker. These lines and hooks are put down through the kelp, amidst which the fish are feeding. Being attracted by the bright metal, to which the hooks are attached, they swim around it in such numbers that their capture is easy by simply drawing the hooks up through them, and repeating the act so long as a catch is desired. From 8 to 10 barrels a day have been taken by two men in a single dory. Cod follow the Atka mackerel to this place to feed on them. The few Atka mackerel that have occasionally reached San Francisco are always eagerly sought after, and some fish have been sold at $20 a barrel. Seines or nets of any kind could not be used to advantage, owing to the abundance of the large kelp among which the fish are always found.



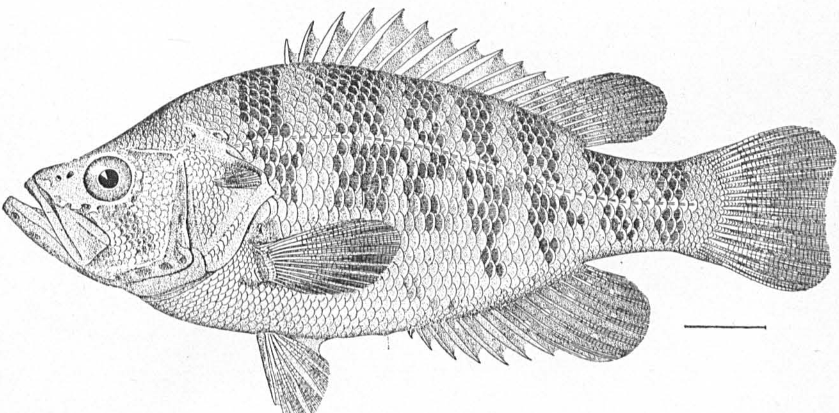
FRESH-WATER TERRAPIN (*Chelopus marmoratus*).



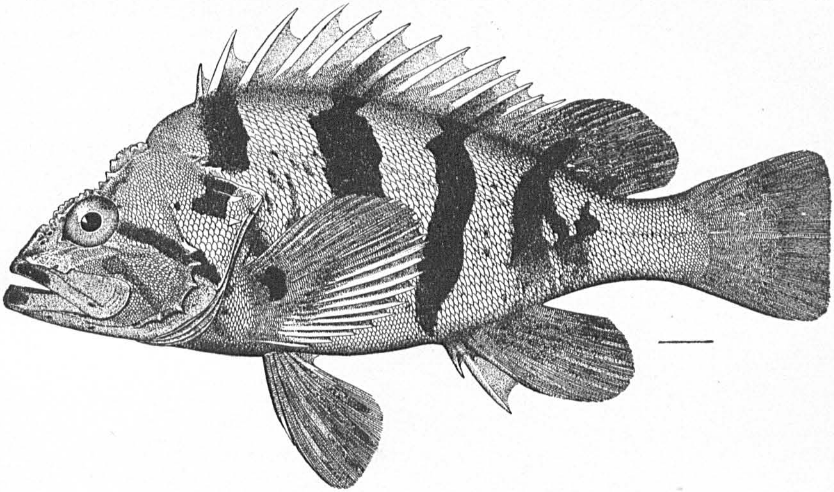
BOWHEAD OR ARCTIC WHALE (*Balœna mysticetus*).



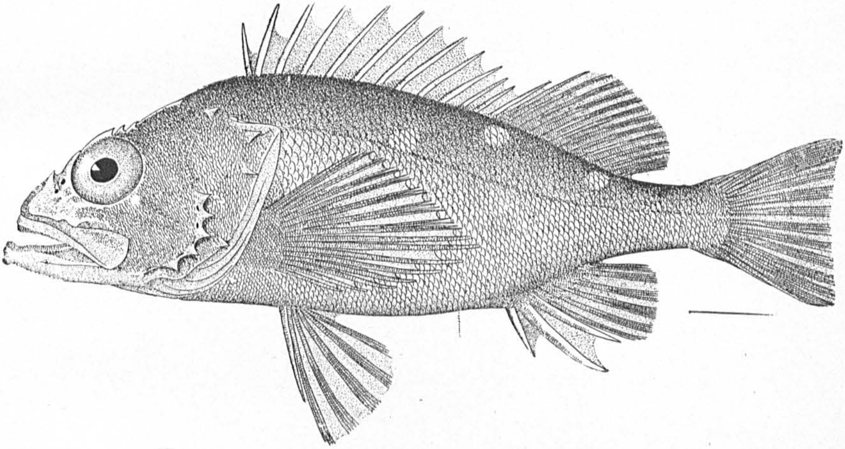
CALIFORNIA SMELT (*Atherinopsis californiensis*).



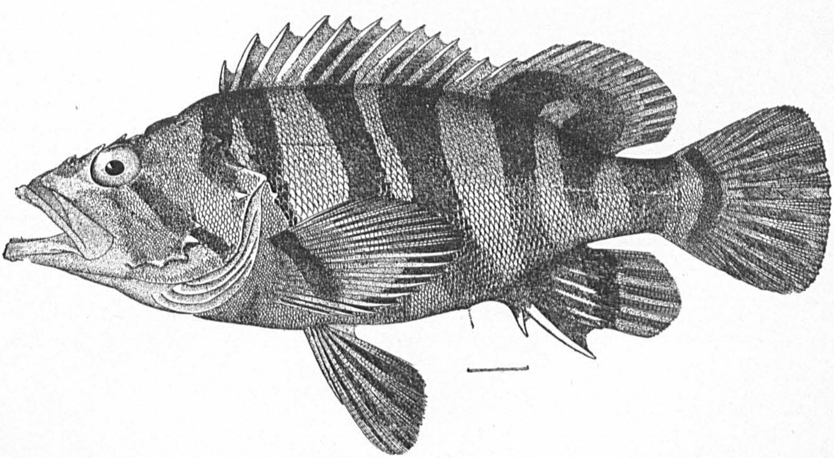
SACRAMENTO PERCH (*Archoplitus interruptus*).



BLACK-BANDED ROCKFISH (*Sebastichthys nigrocinctus*).

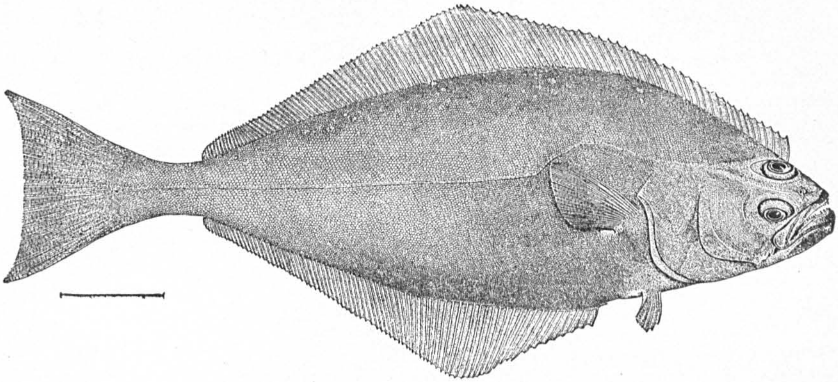


CORSAIR (*Sebastichthys rosaceus*).

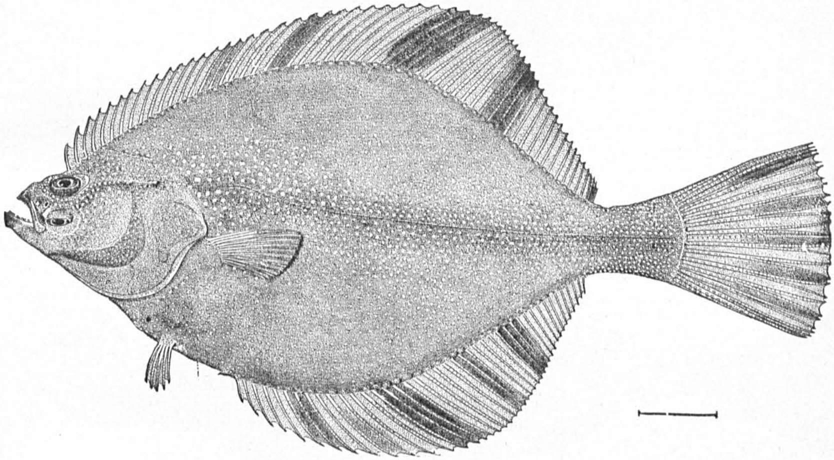


TREEFISH (*Sebastichthys serriceps*).

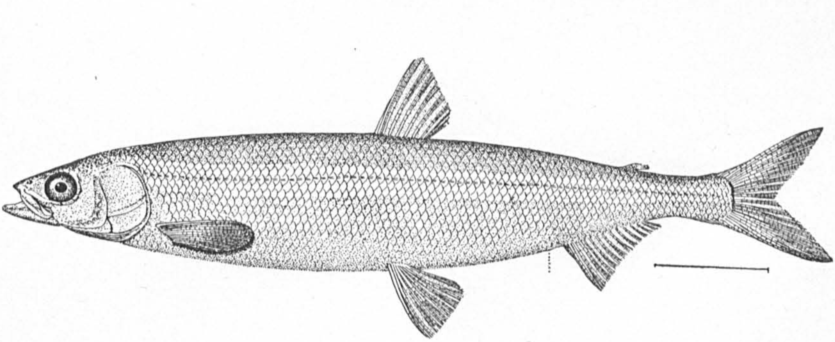
 PLATE 10.



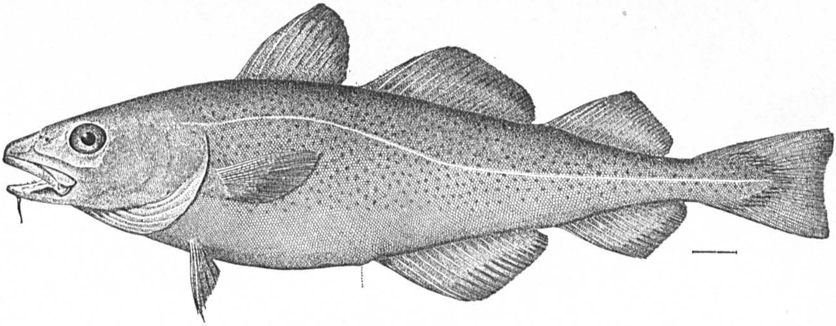
HALIBUT (*Hippoglossus hippoglossus*).



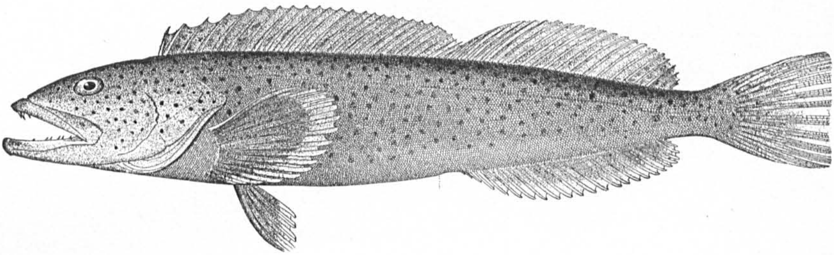
CALIFORNIA FLOUNDER (*Paralichthys stellatus*).



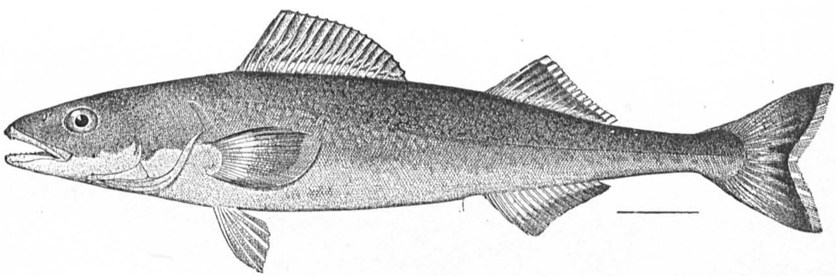
SURF SMELT (*Hypomesus pretiosus*).



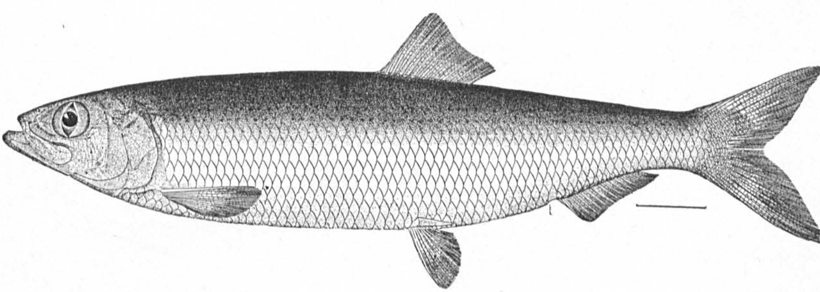
COD (*Gadus morrhua*).



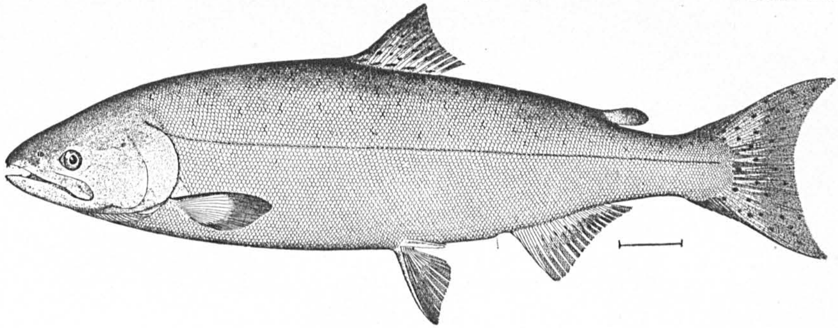
CULTUS-COD (*Ophiodon elongatus*).



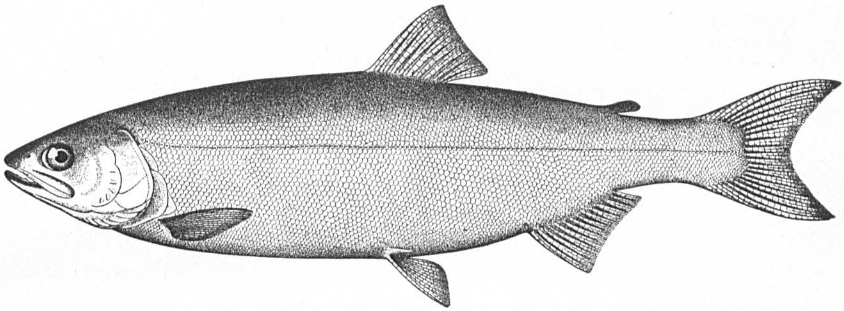
BLACK COD, OR BESHOWE (*Anoplopoma fimbria*).



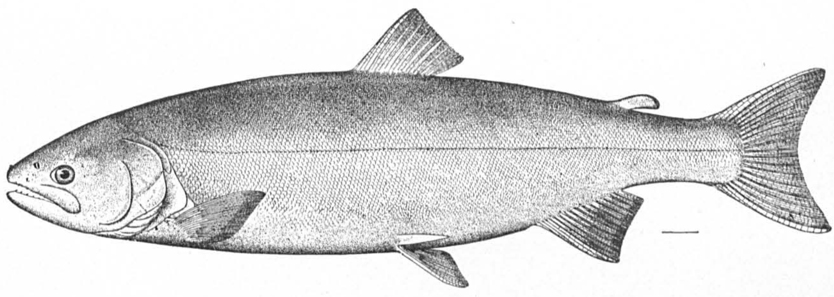
CALIFORNIA HERRING (*Clupea pallasi*).



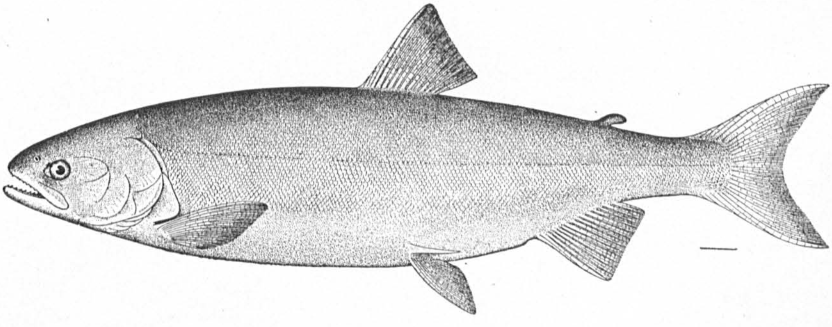
CHINOOK, KING, OR QUINNAT SALMON (*Oncorhynchus chouicha*).



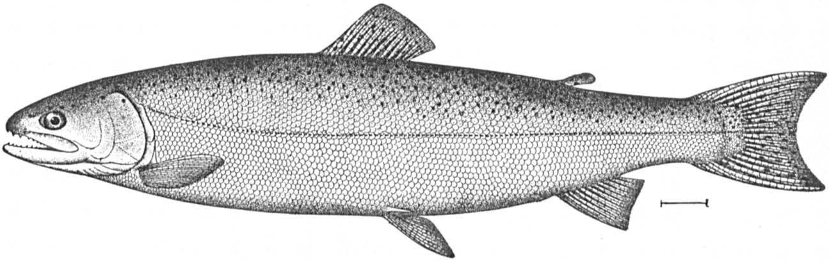
BLUEBACK OR RED SALMON (*Oncorhynchus nerka*).



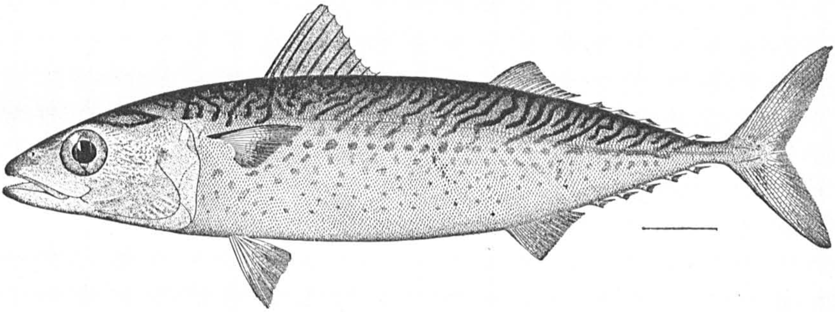
SILVER SALMON (*Oncorhynchus kisutch*).



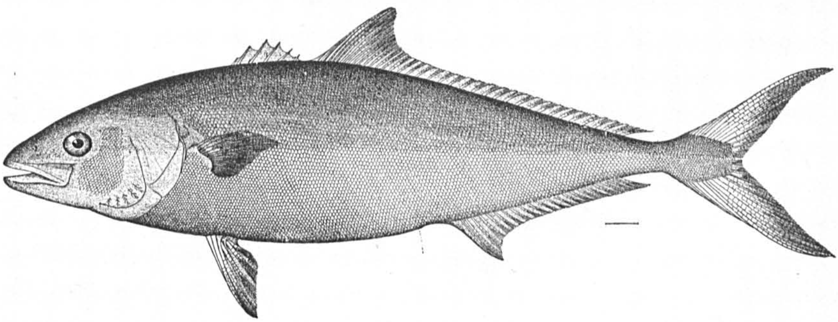
DOG SALMON (*Oncorhynchus keta*).



STEELHEAD (*Salmo gairdneri*).

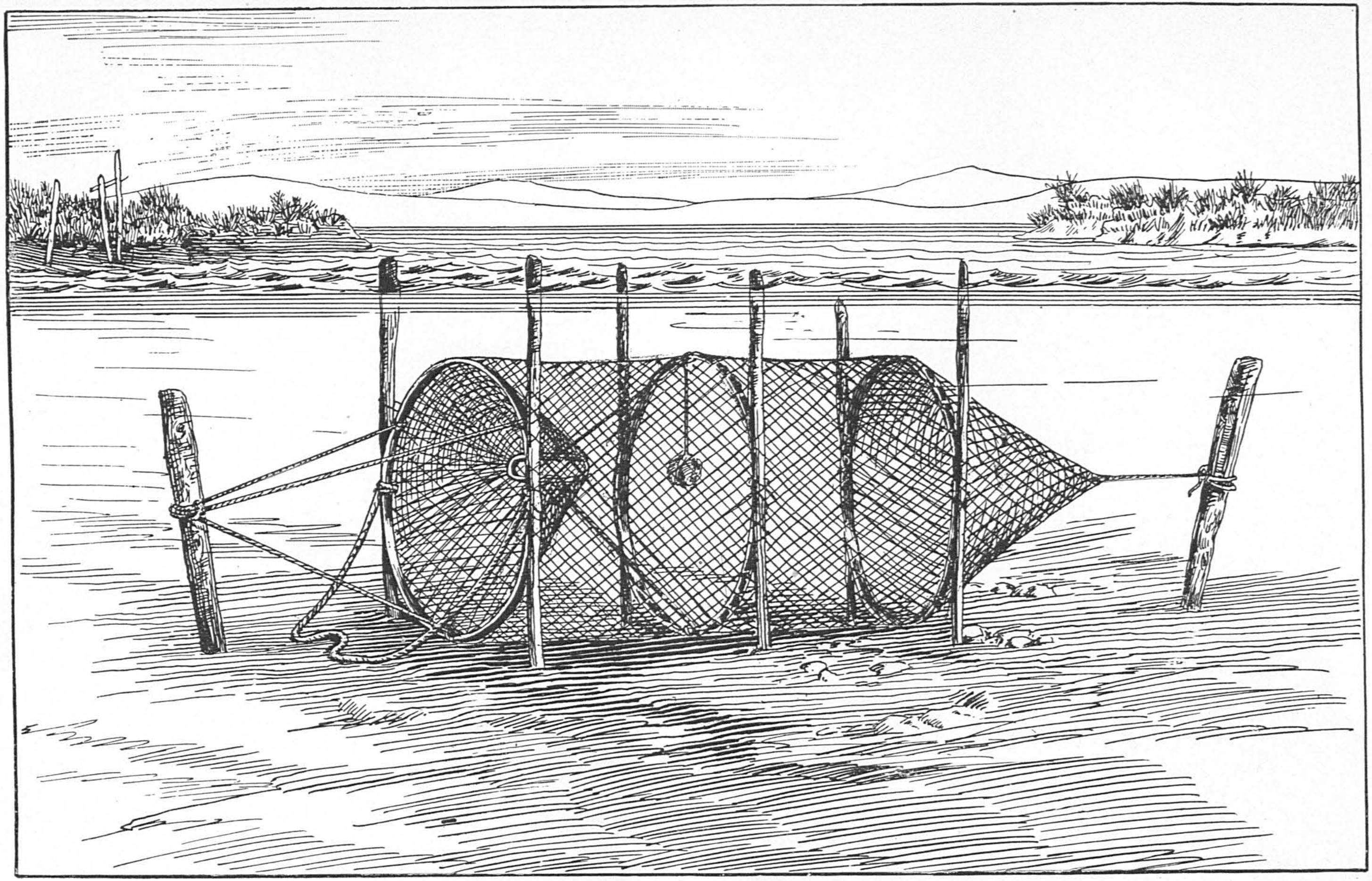


BULL'S-EYE, OR CHUB MACKEREL (*Scomber colias*).



YELLOW TAIL, OR AMBER FISH (*Seriola dorsalis*).

Report U. S. F. C. 1893. Pacific Coast Fisheries. (To face page 304.)



TERRAPIN NET, SACRAMENTO RIVER.

2.—REPORT ON THE WORK OF THE FISH COMMISSION STEAMER ALBATROSS, FOR THE YEAR ENDING JUNE 30, 1893.

By Commander Z. L. TANNER, U. S. Navy, commanding.

The *Albatross* was lying in the harbor of Port Townsend, Wash., at the close of the fiscal year ending June 30, 1892, ready for sea, and sailed at 12.55 a. m. July 1 for Unalaska.

Taking an approximate great-circle course from Cape Flattery to the Fox Islands Passes, light to moderate winds were encountered until the 5th, boisterous weather and heavy seas during the 7th, and smooth, pleasant weather thence to port. The usual lookout was kept for seal life, and a single individual was seen between the Sannaks and Unimak Pass. Whales and the usual varieties of sea birds were frequently noticed; floating kelp and driftwood were observed nearly every day, and, on the 8th, about 350 miles from Unalaska, the trunk of a tree was seen with roots attached, but without branches or bark. The high land of Ugamok Island was sighted at 7.30 p. m. July 9, and at 6.40 a. m. on the 10th we anchored in Unalaska.

The boiler in use, the only one available, was leaking badly, and was so much salted up that it was difficult to maintain a speed of 6 knots. The condition of the boilers had been rapidly growing worse during the cruise, and it was now obvious that they had nearly reached their limit of usefulness; indeed, their condition was so serious that the chief engineer requested a survey. The request was promptly complied with, and the report of survey condemned the boilers as unsafe without extensive repairs, which could not be made on the station.

The only course open was to make temporary repairs and return to San Francisco; so, with our own crew and the assistance of a boiler-maker from the *Yorktown*, we made such repairs as were practicable.

The unexecuted portion of our orders was turned over to Captain Evans, who detailed the revenue steamers *Corwin* and *Rush* to carry them out as far as possible. A seal-hunter and a naturalist were sent to each vessel to assist in the work, and they took with them everything requisite for the capture and preservation of specimens.

Two bidarkas with complete hunting outfits were received from the Alaska Commercial Company for the World's Columbian Exposition, the outfits including hunting and fishing implements, clothing, etc. The boats were built under the personal supervision of Mr. Gray, and the outfit was collected by Mr. Rudolph Neumann at St. Michaels. These gentlemen gave their services freely, and without their cooperation it would have been impossible to collect so complete an exhibit. The articles obtained in St. Michaels were transported to Unalaska on the steamer *St. Paul* without charge.

When it became evident that the *Albatross* would be unable to continue her work, arrangements were made for Professor Evermann and Mr. Miller to visit the Seal Islands. The North American Commercial Company's steamer *Bertha* was about to sail on her regular annual supply trip, and, through the courtesy of Mr. Tingle, the superintendent of the company, they were furnished transportation on that vessel, sailing July 17 and returning August 1, having made headquarters on board during the whole trip. Professor Evermann reported that they had made a careful inspection of the rookeries and had taken an extensive and valuable series of photographs, illustrating various phases of seal life. Mr. Tingle declined to accept compensation for the transportation and subsistence of the party.

An order was received from Commander R. D. Evans, commanding the United States naval force in Bering Sea, dated August 1, directing me to take charge of the British schooner *Winifred* and deliver her to the collector of customs at Sitka, Alaska. This small sealer, of 11 tons register, was captured July 29 in Bering Sea. She leaked badly about the decks and rudder, and was hardly seaworthy. Ensign E. A. Anderson was ordered as prize-master when the schooner was turned over to us, and soon had her in fairly good condition for the trip.

Steam was raised on the after boiler August 1, with reduced pressure of 40 pounds, and as it stood the test fairly well we decided to start, although the forward one was not quite ready for service. Accordingly, at 7.10 a. m. August 3, we took the prize in tow and proceeded to sea, entering the Pacific via the Akutan Pass. Our speed was necessarily slow under one boiler and reduced pressure, but we were obliged to reduce it still more to accommodate the diminutive craft in tow, although the sea was smooth.

The volcano of Akutan presented an interesting display during the early part of the afternoon. Dense volumes of smoke were intermittently ejected from the crater high into air, rising like ever-growing plumes, until finally all shape was lost in cloudlike drift. The puffs were accompanied by detonations which were distinctly heard on board. Shishaldin, Pavlof, and Aghileen volcanoes were in sight the following day, but none of them gave evidence of activity.

Nothing occurred worthy of note until the morning of the 6th, when a fresh southeast wind, with short, irregular sea, compelled the schooner to cast off and heave to under storm sail. She made some headway as the wind veered, and we finally took her in tow again the next morning.

The working boiler began leaking seriously on the 8th, and became so badly salted that we were obliged to let the fires die down on the 10th and get steam on the other one, which by that time was ready for use. The remainder of the trip was uneventful, and with pleasant weather and smooth seas we made good progress, arriving in Sitka at 7.40 a. m. August 11. The *Winifred*, together with her papers, personnel, and equipment, was delivered to the collector of customs. The papers of the whaling bark *Lydia* were turned over also, that vessel having been seized for infraction of the revenue laws.

A small quantity of coal was taken on board and preparations made for the run to Departure Bay. We were nearly ready for sea, when, on the morning of the 17th, a boat came alongside from the whaling bark *Lydia* with a message from Lieutenant Dodge, U. S. Revenue Marine, in charge, saying the vessel had been drifting helplessly off the coast, becalmed for four days, and asking assistance. We had steam on one boiler, fortunately, and went out and brought her into a safe anchorage.

Our preparations having been completed, we left Sitka at 4 p. m. August 18, and, after a smooth and uneventful run, entered Goletas Channel at 2 p. m. on the 21st, arriving at Departure Bay on the morning of the 23d, when the bunkers were filled with coal. At 9 a. m. on the 24th we left for Port Townsend, arriving at 10 p. m. the same day. The boilers had again become badly salted, the back connections being filled in places with solid masses, which had to be cut out with hammer and cold chisel.

A telegram from the Secretary of the Treasury was received on the 24th, as follows:

Telegraph Department extent of repairs necessary to fit *Albatross* for two months' cruise, estimating time and cost of expeditious work.

To which I replied, August 25:

Temporary repairs can not be made. Time to fit vessel for two months' cruise, four months. Expense, $15,000.

This estimate was based on the renewal of tube sheets and other repairs on the old boilers, including necessary work on the engines which would be largely of a temporary nature. The following telegram was received from the Secretary of the Treasury, dated August 27:

Steamer *Albatross* will be returned to Fish Commission on 31st instant. Submit without delay vouchers for all bills payable by Revenue-Cutter Service to that date inclusive.

At 8.50 a. m. August 30, we got underway and proceeded to sea, en-route for San Francisco. We were off the coast of Oregon at midnight on the 31st, when, by the telegram of the Secretary of the Treasury, the *Albatross* reverted to the control of the Fish Commission. Her service under the Treasury Department extended over a period of 5½ months, during which time she visited 26 ports and steamed 14,848 miles, mostly in northern waters.

The trip down the coast was uneventful; fair winds and pleasant weather were the rule, sail being carried most of the time. We reached the navy-yard, Mare Island, at 10.05 a. m. September 3, with machinery and boilers, particularly the latter, in wretched condition, and we congratulated ourselves upon reaching our destination without serious disaster, which was liable to occur at any moment while the vessel was under steam.

I was called to Washington by the Commissioner on business connected with repairing and refitting the *Albatross*, and, leaving San Francisco September 17, I arrived at the capital ten days later. Formal application was made by the Commissioner to the Secretary of the Navy for the transfer of two boilers originally constructed for the *Monadnock*, but which, owing to change in type of engines from compound to triple expansion, were no longer available for use on that vessel. The requisite legal formalities having been completed, the boilers were transferred on payment of $2,500.

Instructions were wired to the *Albatross* to make preparations for removing the old boilers and for general repairs to the machinery, the work to be done with the crew as far as practicable. I returned to the vessel October 27, and found preparations well advanced in the engineer's department for the removal of the old boilers. The machinery was generally overhauled during the winter. New propellers of bronze were made, new boilers put in, a Baird evaporator added to the engineer's department, and the electric plant of the vessel rewired. A new spar deck was laid, and minor repairs made to the hull and rigging.

Passed Assistant Surgeon T. A. Berryhill reported for duty January 5, 1893, and Passed Assistant Surgeon F. W. F. Wieber was detached on the 6th. Lieut. A. F. Fechteler reported January 7, and Lieut. C. G. Calkins was detached the same day. Ensign W. G. Miller was detached January 25.

The vessel was docked January 13 to change propellers, line shafts, renew stern bushings, overhaul outboard bearings, clean and paint bottom, etc. The work of tearing up and relaying the spar deck commenced January 31 and was completed March 3. The vessel's bottom was scaled and painted, and on March 4 she was hauled out of dock and moored at the wharf.

Passed Assistant Paymaster J. S. Carpenter was stricken with snow-blindness during the northern cruise, and after suffering for months without apparent improvement was examined on March 10 by a medical board, which recommended that he be given six months' sick leave. Assistant Paymaster Eugene D. Ryan reported for duty April 11, relieving Passed Assistant Paymaster Carpenter, who was detached the following day, April 12.

Seventy-three tons of Comox coal were taken on board on the 17th and 18th (April), and on the 20th we had a dock trial of the engines, which was considered satisfactory. Changes and repairs had been so extensive that it was deemed advisable to have a sea trial before sailing for northern waters, where we would be entirely dependent upon our own resources, and with this object in view we left the navy-yard at 9.55 a. m., April 25, with light fires under both boilers. No attempt at high speed was made, but we ran from 8 to 10 knots an hour with everything working satisfactorily, until 8.10 p. m., when we anchored off Santa Cruz for the night.

Got under way at 6.40 a. m. on the 26th and swung ship under steam, observing azimuths of the sun on every point for compass errors, then stood to the cable trough off Salinas, and tested the sounding and dredging apparatus, also the maneuvering qualities of the vessel with her new propellers. The trial was satisfactory as far as it went.

The new form of Tanner intermediate tow-net, tested for the first time, performed all that was expected of it after the weights for operating the drawstring had been increased to 30 pounds each; they were first tried at 15 pounds, and closed the net properly when both were brought into action, but one alone failed to close it securely under conditions of actual service. The engines worked very satisfactorily, and the new bronze propellers of modern type reduced vibration to the minimum.

We anchored off Monterey for several hours to readjust valves, finally getting underway at 8.15 p. m. for the return trip. At daylight the following morning the deep-sea apparatus was again tested in from 200 to 300 fathoms, and, having satisfied ourselves that the vessel and her appliances were in good working order, we returned to the navy-yard, Mare Island, mooring to the wharf at 5.30 p. m. April 27. A crack in the shell of the main condenser was discovered during the trip and repaired at small cost after our return.

The following telegram was received from the Commissioner of Fish and Fisheries May 13:

In obedience to instructions from the President you are directed to report by telegraph to the Honorable Secretary of the Navy for such duty as he may assign you.

Having reported as directed, the following message was received from the Secretary of the Navy, dated May 15:

Proceed with the vessel under your command to Port Townsend, Washington, and report to Commander Nicoll Ludlow, U. S. N., for duty in connection with the United States naval forces in Bering Sea.

On the 16th instructions were received at the navy-yard, Mare Island, to furnish the *Albatross* with coal and such other supplies as were necessary to perform duty with the Bering Sea fleet.

Final preparations were promptly made, and on May 20 the *Albatross* sailed for Port Townsend, arriving on the 24th, when I reported to Commander Ludlow in obedience to the order of the Secretary of the Navy. We carried up a draft of men and a quantity of stores for the U. S. S. *Mohican*, which were delivered on our arrival.

The vessels of the fleet rendezvoused at Port Townsend, where general instructions were issued by the senior officer commanding the United States Bering Sea force, and the vessels were then dispatched singly as occasion required. The orders of the *Albatross* contemplated the performance of patrol duty until the middle of July, or such time as her services could be dispensed with, the remainder of the season to be devoted to scientific work under direction of the Commissioner of Fish and Fisheries. Patrol duty was in reality performed throughout the season, but during the progress of scientific work it was limited to the boarding of vessels encountered within our field of operations.

We left Port Townsend May 28, reached Vancouver, British Columbia, the same evening, and crossed to Comox the following day; coaled ship, and at 10.15 a. m. May 31 we sailed for the north, taking the inland passages to the northern end of Vancouver Island.

The Comox mine has been opened recently, and consequently little is known concerning it or its product. The wharf is in Union Bay, west side of Baynes Sound, 12 miles from its southern entrance. It is easy of approach, the chutes are adjustable, and the delivery of coal is under perfect control. The mines are about 13 miles from the shipping-point, the output being transported by rail through a wild and densely wooded country. Union, the nearest settlement, is 11 miles from the wharf; the company's offices are located there. A telegraph line has recently been opened to Victoria, and they are in telephonic communication with the mine and wharf.

The weather was fair and pleasant after our departure from Comox, and the trip up the Strait of Georgia was without incident. Passed through Seymour Narrows at 6.15 p. m., and anchored for the night two hours later in a snug cove on the east side of Pender Island, where we were out of the strength of the current. Getting under way at 4.15 next morning, June 1, we resumed our course through Johnstone Strait to Alert Bay, where we left a mail; thence through Queen Charlotte Sound and Goletas Channel, and at 3 p. m. took our departure from Mexicana Point and laid a course for Cape St. James.

Patrol duty commenced upon our reaching the open waters of the Pacific; masthead lookouts were stationed with instructions to report vessels, seals, whales, driftwood, kelp, etc. The general course was designated by the officer commanding the Bering Sea force, the vessels of the fleet being so disposed as to cover the usual track of the northward-bound seal herd and the sealing vessels following it.

Strong westerly winds were encountered on the 2d, making progress under one boiler rather slow, but it moderated next morning and the speed increased accordingly.

The *Albatross* had a western or offshore route, which carried her outside the usual track of seals; in fact, we saw none between Vancouver Island and Kadiak, and the first sealing schooner was boarded on the morning of June 6 in latitude 57° 48′ N., longitude 148°, W., not far from the 100-fathom line on the southern edge of Portlock Bank.

A detention of two hours occurred on the 5th by the breaking of the piston springs in the port H. P. cylinder, which, leaving the rings without proper support, also gave way. No further damage resulted, and after wedging the latter in place we steamed ahead again.

The sealing schooner *Annie E. Paint* was boarded on the afternoon of the 6th, when the master reported seeing much wreckage in the region assigned to Pamplona Rocks; also that from among it a whaleboat had been picked up a few days before with a dead man lying under the thwarts, all of which he considered good evidence of the existence of those dangers. It was subsequently ascertained that the whaling bark *Sea Ranger* had been wrecked off Cape St. Elias, thus accounting for boat and wreckage.

At 5.10 a. m. June 7 arrived in St. Paul, Kadiak. The only vessel in port was a small sloop used as a tender at one of the trading stations. Copies of the proclamation of the President of the United States, and instructions of the Secretary of the Navy to the senior officer commanding the United States naval force in Bering Sea, were delivered to the deputy collector of customs and agents of trading companies with the request that they be posted in public places. We took on board 73 tons of coal, and at 11 a. m. June 8 cast off from the wharf and proceeded to sea. Cruising to the westward in the track of sealers, we continued to board and warn them against sealing in Bering Sea, until our arrival at Sand Point, Popof Island, Shumagins, on the afternoon of June 10. No sealing vessels had yet reached that point; the fleet was expected during the latter part of the month.

Our first fur seal was seen near Kadiak Island on the afternoon of June 8, only one being observed that day; but the following morning several were sighted off Chirikof Island. The sealers reported very poor success since leaving the vicinity of Middleton Island.

In U. S. Hydographic Notice to Mariners, No. 46, of November 12, 1892, paragraph 925, is the following:

> Captain Applegate, of the American schooner *Matthew Hale*, reports a shoal or bank, with 7 fathoms of water on it, extending 20 to 35 miles southeastward from Simeonof Island, Shumagin group. Cod fishermen anchored on the bank last year.

The position of this reported bank, remote from land and outside of the 100-fathom line as established by the soundings of this vessel, occasioned no little surprise to the officers engaged in the work; hence, we took the earliest opportunity to investigate the matter. Fortunately, Captain Gaffney was in Sand Point at the time of our arrival, and as he had spent many years in the cod fisheries of the Shumagins he was able to give us reliable information. He was shown the notice quoted, and in reply said that the only bank he knew of in that vicinity lies 15 miles ENE. (mag.) from the highest point of Simeonof, and has 27 fathoms, rough, rocky bottom, on which he has been in the habit of fishing. It is of small extent and difficult to find except by bearings and ranges; a depth of 23 fathoms has been reported 1½ miles east of the 27-fathom patch, but he had never been able to find it. He had no knowledge of the bank reported by Captain Applegate, but knew positively that fishermen did not go so far from land in that region.

In a subsequent interview with Captain Applegate he said that the report to him was vague, and he was not confident as to bearing, distance, or depth of water, but he gave the report as he remembered it. In view of these facts I think we may safely conclude that there is no bank in the position indicated in Hydrographic Notice No. 46, 1892.

At 9.25 a. m. June 11, we left Sand Point for a cruise to the westward, following the general track of sealers, but saw none between the Shumagins and Amukta (or 172d meridian) Pass, through which we entered Bering Sea on the morning of the 13th; neither were any met with between there and Unalaska. We made Bogoslof Volcano at

12.35 the next morning, and reached Dutch Harbor at 6.40 the same evening, going at once to the coal wharf. June 15 we took on board 81 tons of coal, and at 6.10 p. m. proceeded to sea, entering the Pacific via Unalga Pass. Several vessels were boarded between there and the Shumagins, among them the American fishing schooner *Moonlight*, of Seattle, bound for Slime Bank, Bering Sea.

We arrived at Sand Point at 12.10 a. m. June 16, and found several of the sealing fleet at anchor, and others arrived from day to day. A constant lookout was kept for seals during the cruise to the westward, but none was seen except off Unimak Pass, and then but one or two at a time. We boarded and warned all vessels found in port, and those which arrived up to meridian of the 18th, when we left for a cruise among the islands of the Shumagin group. Communicated with the U. S. S. *Ranger* off Mountain Cape, and having received a mail, we proceeded on our course; the *Ranger* was bound for Sand Point. Having made a complete circuit of the southern islands and visited the principal harbors, we returned to Sand Point on the evening of the 20th, when we met the *Ranger* and received orders from the senior officer.

Getting under way again at 4 a. m. on the 22d, an examination was made of the southern portion of the group and anchorage was found for the night in Mist Harbor, east side of Nagai Island. It is protected on the sea face by two gravel spits, the ends of which slightly overlap, a narrow but deep entrance lying between their extremities. There is little known concerning this snug harbor, and, as we had no chart of it, a hurried reconnaissance was made next morning. Near the head of Mist Harbor, and separated from it by a narrow neck of land, is a large bay making in from the northward from 3 to 4 miles deep and about 2 miles wide at the entrance. It is not shown on the Coast Survey charts.

The examination of coasts and harbors of the group was continued on the 23d, and we returned to Sand Point in the evening. The sealing fleet were now leaving for the Japan coast, several being met during the day outward bound. We were away again at 2.45 a. m. June 24, and came to in Sanborn Harbor three hours later, where we remained until the following morning and then returned to Sand Point.

The naturalists availed themselves of the opportunity to examine the region about Sanborn Harbor during the day. The scarcity of land birds was soon remarked, and eventually traced to the presence of large numbers of foxes. Salmon had not yet commenced to run, and the beaches were almost barren of other species of fish. Better success followed the hauling of the seine in the lakes, where many trout and flounders were taken, besides other species, one, at least, new to science. Although trout were plentiful, the persistent efforts of anglers with rod and fly were ineffectual; nothing but salmon roe would tempt them. No directions are necessary for entering Sanborn Harbor, except to take a mid channel course and keep the lead going when approaching the anchorage, as the water shoals rather suddenly. The *Albatross* anchored in 10 fathoms with ample swinging room.

The mail steamer *Crescent City* was found at Sand Point on our return, but brought no additional orders. The U. S. S. *Mohican*, flagship of the Bering Sea fleet, arrived about noon June 25, followed a few hours later by H. B. M. S. *Garnet* and U. S. revenue cutter *Rush*, the latter short of coal. We gave her 40 tons from our bunkers.

At 5.30 p. m. June 26 we left for a second cruise to the westward. Although it was clear in the harbor there were unmistakable evidences of thick weather outside, and arriving off Delarof Harbor we ran into a dense fog which was carried with short intervals to Unalaska, where we arrived at 8.45 p. m. June 27. Seals were plentiful from the Sannaks to Unimak Pass. Coaled ship on the 28th, taking 167 tons. Dressed ship with the British flag at the main in honor of coronation day, having been invited to join in its celebration by Captain Huntingford, of H. B. M. S. *Nymphe*, which was lying at anchor in the harbor.

We were under way again at 7 p. m., and finding the passes blocked with fog took the Bering Sea side of the Aleutian Islands to Amukta Pass, through which we entered the Pacific. Fog met us off Cape Makushin, and with momentary intervals continued until we arrived in the Bay of Waterfalls, at 7.30 p. m. July 1. This beautiful bay takes its name from numerous streams which fall into it from the surrounding heights. A plentiful supply of pure fresh water from the snow-capped mountains, an ample store of driftwood—with which the beaches are lined—and its isolated situation, remote from the usual cruising grounds of the Bering Sea patrol fleet, made it the most desirable point west of the Shumagins for the sealing fleet to rendezvous. We found no vessels in the bay, but the remains of recent driftwood fires on the beach gave sufficient evidence of late visitors.

Three schooners were boarded off the bay a few days later, when the fog lifted, all bound in for water, and as they were among the last of the fleet destined for the Japan coast, it is more than probable that it had earlier been a port of call for vessels that did not rendezvous at Sand Point or touch at some other place farther to the eastward.

The *Albatross* was in latitude 51° 39′ N., longitude 172° 22′ W., at midnight June 30 (at which time this report properly closes), cruising on patrol duty under orders of the senior officer commanding the United States naval force in Bering Sea, the vessel having been temporarily transferred to the Navy Department May 13 for that purpose.

The first two months of the fiscal year were employed in seal investigations under the general direction of the Treasury Department, and the following eight months were spent at the navy-yard, Mare Island, putting in new boilers and making general repairs to hull and machinery. In this connection I wish to acknowledge the admirable facilities accorded us by the commandant and heads of departments, which enabled us to effect thorough and extensive repairs at moderate cost.

The scientific apparatus is in good working order, the mechanical appliances having been thoroughly overhauled while general repairs were in progress. The Tanner intermediate tow-net and improved dredging quadrant were the only additions of importance.

The improved dredging quadrant is a refinement of the instrument described on page 94, Report on the Construction and Outfit of the U. S. Fish Commission steamer *Albatross*. In its present form the frame A A consists of two pieces of black walnut 2 feet in length, half an inch thick, and 2 inches wide, screwed together with brass screws, forming a water-tight joint. One of the pieces has a semicircular extension at its center, which supports the scale C C.

Fig. 1 represents the quadrant ready for use. Figs. 2 and 3 show it with the two parts of the frame separated, bringing into view the method of construction. Fig. 4 is an end view at D, and Fig. 5 is a sectional view of rod D and spring E.

Nomenclature: A A, frame, of black walnut; B, pendulum, of brass; C C, scale, of brass; D, rod, brass, controlling elliptical spring; E, spring catch, of brass.

The pendulum, B, 4 inches in length, moves freely on a friction bearing, and has on its upper extremity a disk with milled surface. The rod, D, is attached to and controls an elliptical spring which, when in action, grips the milled surface of the disk on the pendulum and holds the latter in position while the reading is taken. The spring catch, E, holds the rod, D, in place when it is pressed in for the purpose of distending the elliptical spring to allow free movement of the pendulum. It engages a slot cut in the rod D, for the purpose. The scale, C C, is graduated on each side of the semicircle from a vertical to a horizontal position, the latter reaching 90°. The instrument is intended to measure the angle of dredge rope when operating in deep water, where a change too small to be noticed by the eye might carry the trawl many fathoms off the bottom.

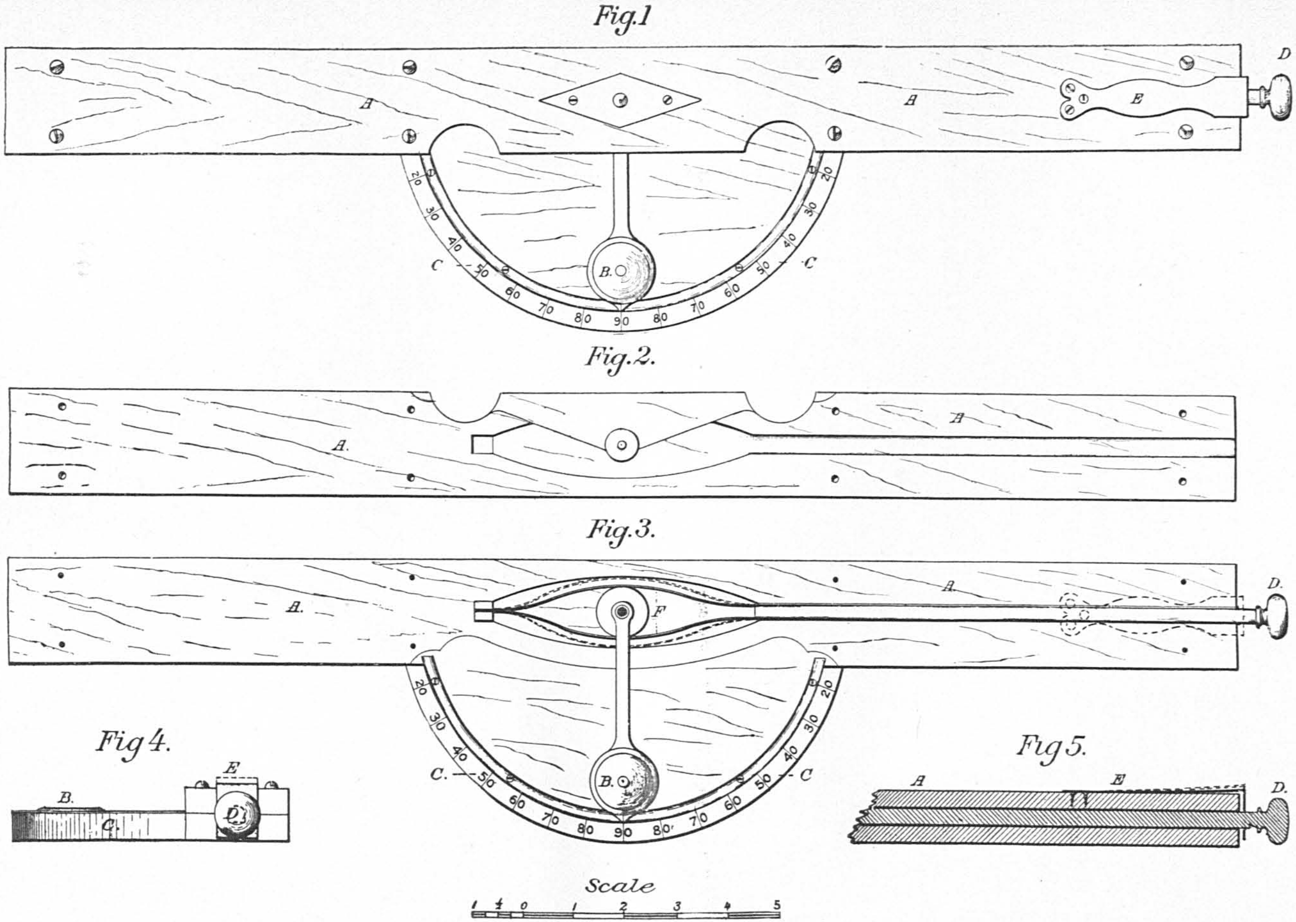
To use the quadrant, take it in both hands, press the rod D with the right hand until the spring catch E engages the slot on D; take a favorable position and incline the instrument until its upper edge is in line with the dredge rope, then press spring catch E with the thumb of the right hand, disengaging the rod D, and thus locking the pendulum B, when the angle from the vertical can be read on the scale.

We have now the perpendicular (depth) and hypothenuse of a right-angled triangle (amount of dredge rope out and its angle). With these elements enter table 2 in Bowditch and obtain the third element necessary to complete the triangle, when it will be seen whether the trawl is on the bottom or not, due allowance having been made for catenary curve of the rope.

There have been several changes in the personnel during the year. Ensign C. M. Fahs, U. S. Navy, reported for duty September 5, 1892; Ensign W. B. Fletcher, U. S. Navy, was detached September 14, 1892; Passed Assistant Surgeon T. A. Berryhill, U. S. Navy, reported January 5, relieving Passed Assistant Surgeon F. W. F. Wieber, U. S. Navy, who was detached January 6, 1893; Lieut. C. G. Calkins, U. S. Navy, was detached January 7, being relieved by Lieut. A. F. Fechteler, U. S. Navy, who reported the same day; Ensign W. G. Miller, U. S. Navy, was detached January 25; Passed Assistant Paymaster J. S. Carpenter,

PLATE 15.

Report U. S. F. C. 1893. Albatross Explorations. (To face page 314.)



THE TANNER IMPROVED DREDGING QUADRANT.

U. S. Navy, was detached April 11, Assistant Paymaster Eugene D. Ryan, U. S. Navy, reporting as his relief the same day; Ensign C. F. Hughes, U. S. Navy, reported May 5.

The following officers were attached to the *Albatross* June 30, 1893: Commander Z. L. Tanner, U. S. Navy, commanding; Lieut. A. F. Fechteler, U. S. Navy, executive officer and navigator; Ensign H. B. Wilson, U. S. Navy; Ensign E. A. Anderson, U. S. Navy; Ensign C. M. Fahs, U. S. Navy; Ensign C. F. Hughes, U. S. Navy; Passed Assistant Surgeon T. A. Berryhill, U. S. Navy; Assistant Paymaster Eugene D. Ryan, U. S. Navy; Passed Assistant Engineer A. M. Hunt, U. S. Navy.

The civilian staff consisted of C. H. Townsend, resident naturalist; A. B. Alexander, fishery expert; N. B. Miller, assistant in scientific department; Harry Clifford Fassett, captain's clerk.

The present crew-list of fifty-three enlisted men is totally inadequate for the performance of the ordinary duties of the vessel while engaged in the work of deep-sea exploration, and the practice of shipping a temporary force of civilians on the eve of sailing is still followed. The original number of enlisted men, sixty-eight, was based on the manual force required to carry on the work of the vessel, watch and watch, which is absolutely necessary when operations are continued night and day, as has been the custom on board this vessel.

The general health of officers and crew has been excellent, and the hygienic condition of the vessel continues most satisfactory.

The *Albatross* has been seventy-five days at sea and has steamed 9,610 miles during the year.

REPORT BY A. B. ALEXANDER ON FISHERY INQUIRIES.

The *Albatross* left Mare Island navy-yard on the morning of May 20, 1893. The first fishing was at Comox, Vancouver Island, on May 30. The beaches here are very poor for seine hauls; in most places they are rocky and generally unsuited for collecting with nets. No economic species were taken in the seine. Clams were fairly abundant.

These mollusks constitute one of the principal articles of food of the small Indian tribe which lives here during the summer months. This tribe, numbering about one hundred persons, camps here annually for the purpose of laying in a supply of salmon for the winter. All fish taken intended for future use are either dried or smoked. Fish to be smoked are hung on lines or poles near the roofs of the huts or houses, where the smoke freely circulates among them; those to be dried are thrown upon the rocks or sand and left until they are sufficiently cured to admit of being packed away and shipped to the winter settlement, which is near the town of Union, 13 miles from the coast.

I saw no seines or nets of any kind at the fishing settlement, and presume, from what information I could gain, that all salmon are taken by trolling. Salmon are sufficiently plentiful to supply the wants of both the white and Indian populations, but not numerous enough to induce capital to build canneries.

Our next stopping-place was at Pender Island, British Columbia, 77 miles north of Comox, where we anchored for the night. There being a fine working beach not far from our anchorage, a party landed upon it and made several hauls with a 135-foot drag seine. Nothing was taken. The current sweeps by the island with considerable velocity, which may account for there being no fish here. A day's trial might have resulted differently.

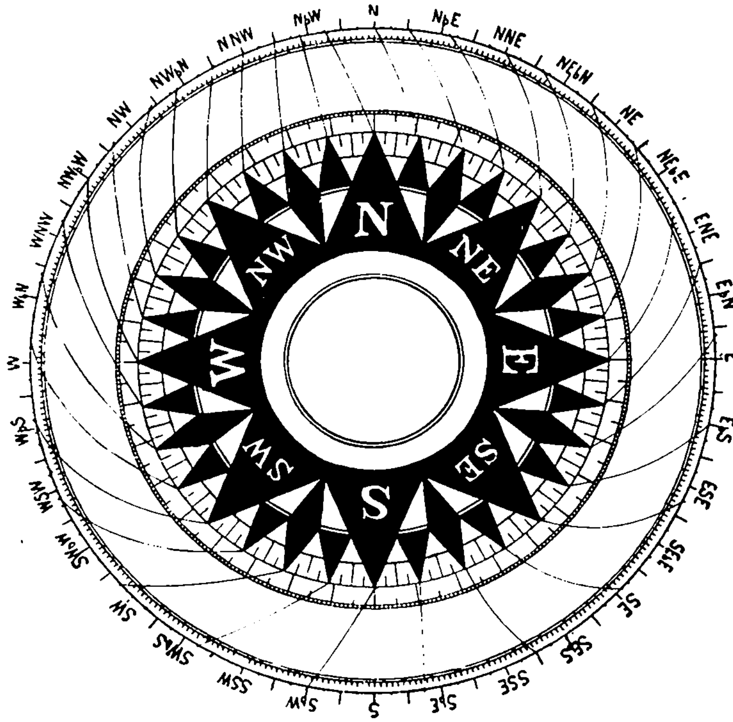
St. Paul, Kadiak.—Arrived here on the morning of June 7. Shortly after coming to anchor a fishing party landed upon a beach about 1½ miles east of the town. A considerable number of flounders, sculpins, and salmon trout were caught in the drag seine. The following morning a second visit was made to the same place, thinking to lay in a supply of trout, but only one specimen was taken. A few cod were captured in the seine; they were very small and sickly looking. Several taken on hand lines by the crew, from the ship, were much more thrifty in appearance. Several native women and boys were noticed fishing with hand lines from the beach; the cod which they caught were small and emaciated. The white population of St. Paul always fish for cod and other bottom fish a mile or two from the islands, where plump and healthy fish are to be found.

Humboldt Harbor, Popof Island.—One hundred and fifty flounders and a few salmon (small fry) were caught in a drag seine at the mouth of a small creek. Two small halibut, weighing 5 pounds each, were taken on a hand line from the ship, the result of a day's fishing. Repeated hauls were made with the drag seine at Humboldt Harbor, but all species of fish except flounders were as scarce as they had been a week previous. A few cod and halibut were caught over the side of the ship; they were of fine quality, but too small for market.

Other islands of the Shumagin group.—Fishing was next carried on at Northeast Harbor, Sandy Cove, and Yukon Harbor. The first two places are situated on Little Koniushi Island, the last on Big Koniushi. At Sandy Cove cod were plentiful, 50 being caught in a short time; average weight, 7½ pounds; the largest 16½ and the smallest 4 pounds. At Northeast Harbor and Yukon Harbor only a few flounders were caught. The beaches being composed of large stones, it was difficult to find a place where the seine could be hauled.

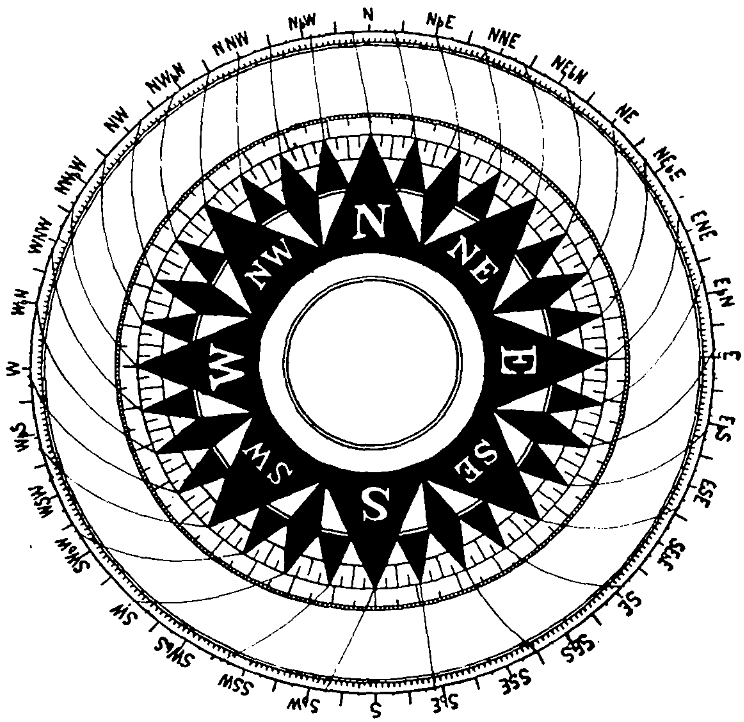
Mist Harbor, Nagai Island.—This is one of the finest harbors for a cod-fishing station in the Shumagin group. It is perfectly landlocked, and large enough to hold a large fleet of fishing vessels. The water is quite deep in all parts, with twenty odd fathoms within an eighth of a mile from the shore at the entrance. While cod are scarce in its near vicinity, it would nevertheless be a suitable place to establish fish-houses, wharfs, etc., for the curing of fish.

The drag seine was hauled in all parts of the harbor, but collecting was found to be poor. One salmon was seen to jump near the mouth of a small mountain stream, but repeated hauls failed to catch a specimen. It is very probable, however, that later in the season salmon strike here



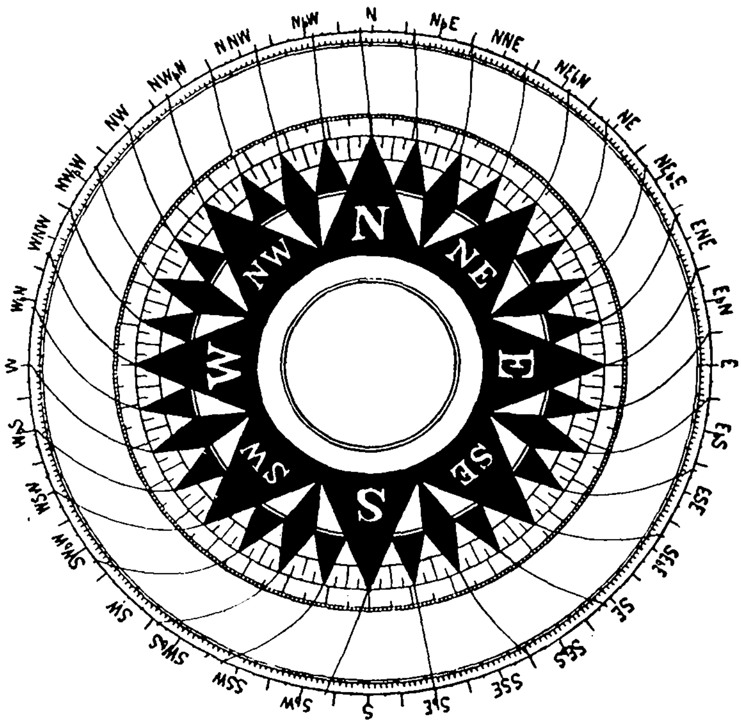
DEVIATION CARD. EAST OF ST. PAUL, KADIAK ISLAND.

Latitude 58° 00' N.; Longitude 152° 00' W. June 6, 1893.



DEVIATION CARD. OFF PORT TOWNSEND, WASHINGTON.

Latitude 48° 06' N.; Longitude 122° 45' W. May 27, 1893.



DEVIATION CARD. OFF SANTA CRUZ, CALIFORNIA.

Latitude 36° 57′ N.; Longitude 122° 01′ W. April 29, 1893.

in considerable numbers. The beaches near the water's edge are almost entirely destitute of animal life; it is only in depths of from 2 to 3 fathoms that life is found. The water is very clear, and the bottom can be distinctly seen at a considerable depth.

Finding it useless to haul the drag seine, I took the collecting boat and a couple of hand lines and anchored off a rocky point not far from the ship, where a number of bottom fish had been seen during the afternoon. I was rewarded by two cod weighing 3 pounds each. It was rapidly growing dark, and fishing was given up for the day. The two specimens taken answered every purpose, however, as they were sufficient to establish the occurrence of the species here. I see no reaşon why cod should not be plentiful about this harbor; it is possible that they may be in their season, for they may have times for visiting this locality.

The following morning we took a small drag seine in the dory, and rowed outside the entrance of the harbor about a mile to a beach across which the dory was dragged and launched into a small lake which had been observed from the ship the previous evening. Five hauls resulted in over twenty small trout and half a bucket of sticklebacks.

Sanborn Harbor, Nagai Island.—This harbor is situated on the west side of the island. It is well sheltered, and a good locality for establishing a fishing station. Hauls with the drag seine were made in every available place. Large numbers of flounders (two species), 6 salmon, 8 salmon trout, about a dozen sculpins, and a bucketful of young salmon were taken; the salmon were about 2 inches in length.

Several hundred small trout, a few tomcod, and a large number of starry flounders were caught in a small lake. The water from the lake had at one time emptied into the sea, but a dam composed of rocks and wood, built by fishermen, now prevents the sea from flowing in or the fresh water from flowing out, except what escapes under it. The water was perfectly fresh, but it did not seem to affect the salt-water species in the least, as those on board who sampled the flounders pronounced them equally as good as any previously taken in those waters.

No further fishing or collecting was carried on among the islands of this group.

Unalaska.—During the afternoon of June 28 the drag seine was hauled several times along the beach, or spit, which forms Dutch Harbor. Two flounders and four sea trout were the result of half a day's work. This has never proved to be a prolific beach for collecting. In 1888 several attempts were made to collect here, but each time we met with poor results. The beach in most places makes off very abruptly, and the bottom is nearly devoid of such life as attracts flounders and other food-fish. Clams are fairly abundant, and at low tide it is a common occurrence to see the crews of whalers, men-of-war, and other vessels on the beach with buckets and spades.

Record of hydrographic soundings, fiscal year 1893.

Date.	Serial No.	Time of day.	Position. Lat. N.	Position. Long. W.	Depth.	Character of bottom.	Temperatures. Air. Dry bulb.	Temperatures. Water. Surface.	Temperatures. Water. Bottom.	Machine and weight of sinker used.
1893.			° ′ ″	° ′ ″	Fms.					
Apr. 26	3240	10.00 a. m.	36 48 15	121 59 05	266	(No specimen)	58	54	....	Sigsbee, 35 pounds.
27	3241	8.33 a. m.	37 29 00	123 01 20	301	Stf. gy. M	54	53	....	Do.

Record of dredging and trawling stations.

Serial No.	Date.	Time.	Position. Lat. N.	Position. Long. W.	Temperature. Air.	Temperature. Surface.	Temperature. Bottom.	Depth.	Character of bottom.	Wind. Direction.	Wind. Force.	Instruments used.	Remarks.
	1893.		° ′ ″	° ′ ″	°	°	°	Fms.					
3477	Apr. 26	9.20 a. m.	36 50 00	121 59 45	54	51	46.5	80	Rky	North	1	L. B. T.	
3478	...do ...	11.24 a. m.	36 44 45	121 57 00	56	53	....	68	gy. S. M	SW	2	L. B. T.	Surface tow net.
3479	Apr. 27	6.55 a. m.	37 28 00	123 00 00	52	50	....	276	gn. M. fin. S	WNW	3	L. B. T.	

Record of intermediate towing net.

Serial No.	Date.	Time.	Position. Lat. N.	Position. Long. W.	Temperature. Air.	Temperature. Surface.	Temperature. Bottom.	Depth in fathoms.	Condition of sea.	Wind. Direction.	Wind. Force.	Appearance of sky.	Remarks.
	1893.		° ′ ″	° ′ ″	°	°	°						
*31	Apr. 26	10.11 a.m.	36 48 15	121 59 05	58	54	.....	5 fathoms to surface	Smooth	North	1	Clear	Entire net open.
32	Apr. 27	8.30 a.m.	37 29 00	123 01 20	54	53	41.7	100 fathoms to surface	....do	WNW	2	Clear	All specimens from upper net. Lower net closed, but empty.

* Serial Nos. 1–30, cable survey.

Meteorological and cruising record.

Date.	Meridian position. Lat. N.	Meridian position. Long. W.	Distance run per log.	Barometer. Max.	Barometer. Min.	Temperature. Air. Dry bulb. Max.	Temperature. Air. Dry bulb. Min.	Temperature. Air. Wet bulb. Max.	Temperature. Air. Wet bulb. Min.	Temperature. Water at surface. Max.	Temperature. Water at surface. Min.	State of the weather.	Force and direction of winds.	Rainfall (approx.).	State of sea.	Currents.	Strength in knots per hour.	Number of hours sealing weather.	Number of seals seen.
1892.	° ′ ″	° ′ ″	*Knots*																
July 1	48 37 00	125 01 00	97.3	30.40	30.26	59	53	58	53	59	52	Overcast and misty to clearing.	Variable, 2; W'ly, 2	Misty	Smooth	No account taken.	....	8	0
2	50 13 30	129 41 00	211.9	30.38	30.35	57	51	56	49	56	51	Overcast and misty	SE., veering to W., 2 to 4	Misty	Smooth	East	0.3	14	0
3	51 23 00	134 17 00	192.9	30.35	30.14	51	48	50	47	54	51	Cloudy, misty, and foggy.	WSW., 4 to SSW., 5-6	Misty	Moderate sea and swell.	South	0.4	0	0
4	52 18 00	138 26 00	172.1	30.23	30.00	50	48	50	47	50	48	Overcast and misty to fair.	S'd, 7, veering to W. and NNW.	Misty	Moderate	N. 46° E	0.6	0	0
5	52 53 10	143 04 00	172.4	30.25	30.10	48	45	47	44	48	47	Overcast and foggy; drizzling at times.	SW., 4-5, hauling to S. and S. by W.	Light	Moderate	S. 12° W	0.2	0	0
6	53 35 20	147 19 20	166.8	30.20	30.00	49	48	49	47	49	47	Foggy and misty; rain squalls in a.m.	S'd, 4-5	Light	Moderate chop.	N. 57° E	0.5	0	0
7	53 55 00	151 50 10	164.8	30.50	30.17	49	47	48	46	49	48	Thick and misty; clear interval middle of day.	SW. by S., 4; S. by W., 3	Misty	Moderating.	S. 42° E	0.2	0	0
8	53 57 00	156 56 00	188.4	30.50	30.22	51	48	50	47	50	48	Fair to misty; drizzling at times in p.m.	SSE., 2, to SE., 4; SE., 3	Light	Smooth; light swell.	N. 59° E	0.4	16	0
9	53 50 00	162 24 20	179.0	30.20	29.90	50	45	50	45	50	44	Overcast, cloudy, and misty.	S. by E., 3, to SSE., 5	Misty	S'easterly swell.	N. 80° W	0.6	0	1
10	Iliuliuk Harbor, Unalaska Island.		162.0	30.27	29.90	51	45	48	44	48	43	Fair and pleasant	S'd, 5-4; squally, 6	None	Gentle	No account taken.	....	0	0
11	....do	....do	....	30.36	30.27	50	46	49	45	50	44	Generally pleasant; partly clear.	S., 3, shifting to NE., 2; calm.	None	....	....	....	....	....
12	....do	....do	....	30.34	29.82	54	46	53	46	51	47	Fair weather; cloudy at times.	Calm; S'd and E'd, 3 to 5; squally.	None	....	....	....	....	....
13	Dutch Harbor, Unalaska Island.		2.8	29.80	29.74	55	46	53	45	51	45	Fair and pleasant generally.	SE. and S., 3 to 5; squally	None	....	....	....	....	....
14	....do	....do	....	29.80	29.57	55	46	51	45	49	45	Cloudy to misty and rainy in p.m.	Calm; S'd, 2-3	Light	....	....	....	....	....
15	....do	....do	....	30.10	29.76	54	46	51	45	49	45	Fair and pleasant	S., 4-5; squalls, 6-7	None	....	....	....	....	....
16	....do	....do	....	30.40	30.12	64	46	57	45	50	45	Clear and pleasant	S., 5 to 3; squally in a.m	None	....	....	....	....	....
17	....do	....do	....	30.44	30.28	57	46	57	45	51	47	Fair and pleasant; rain 10 to 12 p.m.	Calm generally; E'ly, 1	Light	....	....	....	....	....

Meteorological and cruising record—Continued.

Date.	Meridian position. Lat. N.	Meridian position. Long. W.	Distance run per log.	Barometer. Max.	Barometer. Min.	Temperature. Air. Dry bulb. Max.	Temperature. Air. Dry bulb. Min.	Temperature. Air. Wet bulb. Max.	Temperature. Air. Wet bulb. Min.	Temperature. Water at surface. Max.	Temperature. Water at surface. Min.	State of the weather.	Force and direction of winds.	Rainfall (approx.).	State of sea.	Currents.	Strength in knots per hour.	Number of hours sealing weather.	Number of seals seen.
1892.	° ′ ″	° ′ ″	*Knots*																
July 18	Dutch Harbor, Unalaska Island.		......	30.26	30.14	56	50	56	49	51	49	Overcast, misty, and foggy.	Variable, 1	Misty					
19	....do	....do	......	30.32	30.18	57	46	54	45	53	46	Overcast and foggy to fair and pleasant.	Calm; NE., 2 (1 to 7 p.m.); calm.	None					
20	....do	....do	......	30.43	30.32	56	43	53	42	54	46	Fair and pleasant	E'ly, 1; occasional calms	None					
21	....do	....do	......	30.46	30.38	59	45	55	44	54	50	Fair and pleasant generally; foggy to begin.	Calm; ENE., 3 (10 a.m., 2 p.m.); calm.	None					
22	....do	....do	......	30.40	30.29	58	48	57	47	55	51	Clear and pleasant	Calm; E., 1 (9 a.m., 7 p.m.); calm.	None					
23	....do	....do	......	30.29	30.14	66	49	63	48	57	50	Fair and pleasant generally; foggy at times.	Calm; ENE., 3 (1 to 6 p.m.); calm.	None					
24	....do	....do	......	30.15	29.86	58	50	56	49	57	49	Generally pleasant; high fog.	Calm; S'd and E'd, 2 (11 a.m., 6 p.m.); calm.	None					
25	....do	....do	......	29.95	29.85	58	51	54	50	59	50	Fair and pleasant	S., 3	None					
26	....do	....do	......	29.93	29.76	58	51	56	51	59	53	....do	S'd, 2–3	None					
27	....do	....do	......	29.89	29.75	60	51	58	50	56	51	Fair to overcast and misty.	E'd, 1; SSE., 2	Misty					
28	....do	....do	......	30.10	29.86	56	48	54	47	53	50	Fair and pleasant	NE., 3–2; calm	None					
29	....do	....do	......	30.20	30.10	54	46	52	45	53	50	Fair and pleasant to overcast.	Calm; NE., 3	None					
30	....do	....do	......	30.32	30.20	62	49	61	49	56	51	Misty and rainy to clearing.	E'd, 1 and 2	Light					
*31	....do	....do	......	30.39	30.32	71	56	67	56	59	53	Fair and pleasant	S., 3 to 2; calm	None					
Aug. 1	....do	....do	......	30.42	30.33	63	55	61	54	59	53	Overcast and cloudy	NE., 2; calm	None					
2	....do	....do	......	30.35	30.20	59	52	57	50	58	50	Overcast, foggy, and misty.	E., 1	Misty					
3	54 01 30	165 58 30	30.6	30.19	29.85	57	51	55	50	55	46	Overcast and misty to fair and pleasant.	Calm; NW'd, 2; SW., 2	Misty	Smooth	No account taken.	....	16	0
4	54 00 12	161 18 00	169.4	29.82	29.70	59	52	57	51	55	52	Clear and pleasant	NW. by W. and NW., 3	None	Smooth	S. 36° W	0.1	16	0
5	54 22 00	157 27 00	167.7	29.81	29.74	56	54	55	54	57	55	Overcast and misty	S'd, 2 to 4	Misty	Smooth	S. 65° W	1.3	16	0
6	54 50 00	153 52 00	141.1	29.80	29.33	55	53	54	53	55	55	Overcast, misty, and rainy.	SSE., 4 to 7 to 4	Moderate.	Increasing to rough.	S. 78° W	0.5	0	0

7	55 27 00	152 15 30	69.0	29.69	29.38	56	53	55	53	56	54	Overcast, foggy, and misty.	SW., 4; SSE., 3; variable, 2	Misty	Choppy swell.	N. 15° E	0.7	8	0
8	55 53 00	147 42 00	174.0	29.72	29.67	55	53	54	53	56	53	Overcast and misty	SW. to WSW., 4	Misty	Moderate	West	0.8	0	0
9	56 16 00	142 50 30	176.7	29.72	29.61	59	55	58	54	57	55	Cloudy to overcast and rainy.	W'd, 1-2 to 4 from 4 p. m	Heavy	Moderate	S. 69° W	0.5	12	0
10	56 46 00	138 05 00	168.5	29.73	29.60	63	55	60	54	60	56	Rainy to clear and pleasant.	W., 4; SSW., 3; WSW., 1	Light	W'ly swell	S. 58° W	0.4	16	0
11	Sitka, SE. Alaska		107.3	29.84	29.70	57	54	56	53	58	55	Overcast and rainy	E. and ESE., 1	Heavy	Smooth	No account taken.		4	0
12	do	do		30.04	29.87	61	53	59	52	60	55	Misty to fair and pleasant.	Variable, 1; occasional calms	Misty					
13	do	do		30.05	29.86	63	54	61	53	62	57	Clear and pleasant	Calm; WSW., 3 (3 to 7 p. m.); calm.	None					
14	do	do		30.10	29.93	69	52	64	51	61	56	Fair and pleasant	Calm; SSE., 1	None					
15	do	do		30.31	30.11	63	56	61	56	62	58	Clear and pleasant	Calm; SE'ly, 1 (8 a. m., 1 p. m.); calm.	None					
16	do	do		30.40	30.30	63	55	61	54	62	58	Cloudy to clear and pleasant.	Calm; W., 1 (8 a. m., 12 m.); calm.	None					
17	56 59 00	135 28 30	18.0	30.47	30.40	64	54	62	53	64	57	Clear and pleasant	Calm; S'ly, 1 (9 a. m., 6 p. m.); calm.	None					
18	Sitka, SE. Alaska		8.0	30.50	30.36	64	51	62	50	63	57	do	S., 1; SSW., 2	None					
19	55 07 00	134 20 00	153.0	30.36	30.20	63	56	61	56	62	58	do	E. veering to SE., 3 and 2	None	Smooth	N. 17° W	1.0	16	0
20	52 39 00	132 14 00	180.8	30.29	30.20	68	57	63	56	61	56	Misty to clear and pleasant.	SE. to W., 3; WNW., 4	Misty	Smooth	N. 13° W	0.5	16	0
21	51 04 00	128 16 00	195.0	30.24	30.14	72	55	60	54	60	50	Clear and pleasant	NW., 3; calm	None	Smooth	N. 66° W	0.7	12	0
22	50 24 00	125 38 00	139.6	30.14	29.88	80	53	69	53	70	50	Misty to clear and pleasant.	Variable, 1; occasional calms	Misty	Smooth	No account taken.			
23	Departure Bay, B.C		105.5	30.10	29.93	66	60	64	58	66	61	Clear and pleasant	ENE., 3; variable, 1	None	Smooth				
24	48 59 00	123 25 00	28.0	30.24	30.10	66	55	65	54	66	52	do	W'd, 2 to 4; calm	None	Smooth				
25	Port Townsend, Wash.		79.7	30.26	30.16	62	51	59	51	52	50	Foggy to clear and pleasant.	Calm; WSW., 2 to 4	None					
26	do	do		30.28	30.20	64	53	60	53	53	50	Clear to fair and pleasant.	Calm; WSW., 3-4	None					
27	do	do		30.37	30.25	66	53	63	52	52	50	Clear and pleasant	Calm; WNW., 3-2	None					
28	do	do		30.31	30.05	69	53	66	52	53	49	do	Calm; NW'd, 2; calm	None					
29	do	do		30.08	29.93	68	55	65	54	53	50	do	Calm; W'd, 1; WSW., 4	None					
30	48 11 00	123 11 00	23.0	30.19	30.05	57	54	55	53	51	50	Fair and pleasant	S'd and W'd, 2 to 4	None	Smooth	No account taken.			
†31	46 33 00	125 02 00	193.2	30.25	30.15	70	54	64	53	60	50	Clear and pleasant	W'd, 2; WNW., 4	None	Smooth	North	0.6	14	0
Sept. 1	43 04 00	124 46 00	207.1	30.15	30.09	62	51	59	50	53	46	Clear and pleasant to foggy.	N'd, 4; NNW., 2	None	Moderating.	S	0.1	0	0
2	39 52 00	124 11 00	206.3	30.20	30.12	65	52	61	52	55	49	Fair and pleasant	N'd and W'd, 3-5	None	Moderate	N. 13° E	0.5	0	0
3	Navy-yard, Mare Island, Cal.		186.5	30.15	30.05	66	54	63	54	64	50	Thick and hazy to fair and pleasant.	NW., 4; variable, 2; SW., 3	None	Smooth	No account taken.		0	0
4	do	do		30.18	30.04	69	55	65	54	66	60	Clear and pleasant	SSW., 2; WSW., 4	None					
5	do	do		30.17	30.04	73	54	70	54	66	61	do	SSW., 3-2	None					
6	do	do		30.15	29.93	85	63	77	62	69	61	Clear and pleasant; cloudless.	SSW., 1	None					
7	do	do		30.06	29.88	87	58	77	58	66	64	do	SSW., 1-3	None					

*Total distance steamed in July, 1,710.4 knots; total days under way at sea, 11.
†Total distance steamed in August, 2,328.1 knots; total days under way, 20.

Meteorological and cruising record—Continued.

Date.	Meridian position.		Distance run per log.	Barometer.		Temperature.						State of the weather.	Force and direction of winds.	Rainfall (approx.).	State of sea.	Currents.	Strength in knots per hour.	Number of hours sealing weather.	Number of seals seen.
						Air.				Water at surface.									
						Dry bulb.		Wet bulb.											
	Lat. N.	Long. W.		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.								
1892.			*Knots.*																
Sept. 8	Navy-yard, Mare Island, Cal.			30.06	29.93	65	56	64	56	66	63	Overcast to clear and pleasant.	SSW., 4	None					
9	do	do		30.14	30.01	67	57	65	57	66	61	do	SSW., 2-3	None					
10	do	do		30.14	29.98	69	56	67	56	65	62	Clear and pleasant	W., 2; SSW., 3; WSW., 4	None					
11	do	do		30.08	29.92	67	56	65	55	65	60	do	SSW., 3	None					
12	do	do		30.00	29.88	66	55	65	55	65	62	Cloudy to clear and pleasant.	SSW., 2; WSW., 3	None					
13	do	do		30.00	29.89	68	58	66	57	65	60	do	SW., 2-3	None					
14	do	do		30.12	30.00	70	58	67	56	65	59	Clear and pleasant	WSW. and SSW., 2	None					
15	do	do		30.18	30.06	71	60	69	59	65	60	Fair and pleasant	S'd and W'd, 1	None					
16	do	do		30.18	30.09	67	58	65	57	64	60	Fair to clear and pleasant.	SW., 2-4	None					
17	do	do		30.22	30.10	68	58	66	57	65	60	Fair and pleasant	SW'ly, 1; SSW., 2	None					
18	do	do		30.18	30.10	71	57	70	57	67	59	Clear and pleasant	SSW., 2-3	None					
19	do	do		30.18	30.02	77	60	75	60	65	61	do	WSW., 2	None					
20	do	do		30.06	29.89	68	60	67	59	65	61	Fair to clear and pleasant.	SSW., 2	None					
21	do	do		29.96	29.87	65	57	63	56	64	62	Cloudy and unsettled to fair.	S'd, 1 to 3	None					
22	do	do		30.04	29.95	69	56	65	55	65	51	Clear and pleasant	SW., 1; S. to WSW., 2	None					
23	do	do		30.14	30.00	78	57	70	56	64	62	do	SSW., 2	None					
24	do	do		30.17	29.98	79	60	73	59	67	62	do	SSW., 2; SW., 1	None					
25	do	do		30.10	29.88	79	61	74	60	65	62	Fair and pleasant	S'd and W'd, 1	None					
26	do	do		30.02	29.89	76	63	74	62	67	63	Clear and pleasant	do	None					
27	do	do		29.96	29.86	73	60	71	58	65	63	do	S'd and W'd, 1; S., 4; S'd and W'd, 1.	None					
28	do	do		29.95	29.84	66	59	65	59	64	62	Clear and pleasant to cloudy.	WNW., 1; SSW., 2-4	None					
29	do	do		29.97	29.85	70	61	68	60	66	64	Cloudy, but pleasant	S'd and W'd, 1	None					
*30	do	do		30.16	29.93	68	59	66	58	67	62	Fair and pleasant	SSW. and W., 1 and 2	None					
Oct. 1	do	do		30.19	29.98	75	56	70	56	65	63	Clear and pleasant	Calm; S'd and W'd, 1 and 2	None					
2	do	do		30.09	29.92	80	60	72	59	66	62	do	Calm; SW., 1	None					
3	do	do		30.06	29.93	76	58	71	57	70	61	do	Calm; SSW., 1	None					
4	do	do		30.08	29.94	73	62	70	61	78	63	Fair to clear and pleasant.	SSW., 1-2	None					

	5	....do	........do	......	29.99	29.90	73	60	70	58	67	63	Fair and pleasant	Calm; SSW., 2-3	None
	6	....do	........do	......	30.04	29.94	65	59	63	58	66	62	Overcast and cloudy, occasional showers.	S'd and W'd, 1 to 3 in squalls	Light
	7	....do	........do	......	30.08	29.96	65	59	63	58	65	62	Clear and pleasant	SW. and SSW., 1	None
	8	....do	........do	......	30.09	29.98	67	58	65	57	65	61	Cloudy to overcast and rainy.	SSW., 2; to S'd and E'd, 4-5	Light
	9	....do	........do	......	30.22	30.06	70	59	68	57	65	60	Cloudy and drizzling to clearing.	S'd and W'd, 2	Light
	10	....do	........do	......	30.20	30.04	73	55	67	54	64	61	Fair and pleasant	SSW. and WSW., 2-3	None
	11	....do	........do	......	30.16	30.03	70	54	67	53	63	57	....do	N'd and W'd, 2 to 4	None
	12	....do	........do	......	30.09	29.97	76	60	69	57	67	58	Clear and pleasant	N'd, 4-3; variable, 1	None
	13	....do	........do	......	30.06	29.90	78	53	67	52	63	58	....do	Calm; SSW., 2	None
	14	....do	........do	......	30.00	29.88	62	48	60	47	62	58	....do	S'd and W'd, 1-3	None
	15	....do	........do	......	30.00	29.93	59	48	56	47	60	54	Cloudy; rain and mist middle of day.	W., 1; SSW., 1-2	Light
	16	....do	........do	......	30.23	30.00	60	52	59	51	60	54	Cloudy; occasional showers.	S'd and W'd, 1	Light
	17	....do	........do	......	30.35	30.22	61	49	59	48	60	53	Fair and pleasant	Calm; SSW., 1	None
	18	....do	........do	......	30.20	29.99	65	50	64	49	60	55	Clear and pleasant	Calm; SSW., 1; calm	None
	19	....do	........do	......	30.06	29.90	69	51	67	50	60	55	....do	Calm; SSW., 1 (9 a.m., 6 p.m.); calm.	None
	20	....do	........do	......	30.04	29.90	70	54	65	52	60	56	....do	SSW., 1	None
	21	....do	........do	......	30.18	30.02	62	50	61	50	59	54	Fair and pleasant; misty early morning.	SSW., 1-2	Misty
	22	....do	........do	......	30.12	29.98	60	50	58	50	60	55	Clear and pleasant	S'd and W'd, 1 and 2	None
	23	....do	........do	......	30.16	30.03	60	49	59	48	58	53	Fair and pleasant	W'ly, 1	None
	24	....do	........do	......	30.22	30.10	61	51	60	51	58	54	Foggy to fair and pleasant.	Calm; SSW., 1 (8 a.m., 4 p.m.); calm.	None
	25	....do	........do	......	30.19	30.00	67	52	65	52	60	55	Fair and pleasant	Calm; SW., 1 (12 m., 4 p.m.); calm.	None
	26	....do	........do	......	30.10	29.88	70	53	67	53	62	55	Clear and pleasant	Calm; SSW., 4	None
	27	....do	........do	......	30.10	30.00	63	54	61	53	59	56	....do	Variable, 1; SSW., 2 to 4	None
	28	....do	........do	......	30.14	30.06	63	55	61	54	59	56	Overcast to fair and pleasant.	W., 1; SSW. and SW., 2	None
	29	....do	........do	......	30.17	30.08	62	53	60	52	60	56	Fair to cloudy, but pleasant.	WNW., 1; SSW., 2	None
	30	....do	........do	......	30.22	30.13	58	54	58	54	59	57	Overcast and rainy	N'd and E'd, 1 and 2	Moderate.
	31	....do	........do	......	30.29	30.16	64	55	63	54	59	57	Overcast and misty to clearing.	Calm; NW., 2; S'd and W'd, 1.	Misty
Nov.	1	....do	........do	......	30.24	30.10	66	52	66	51	60	57	Clear and pleasant	SSW., 2; calm	None
	2	....do	........do	......	30.23	30.10	68	52	65	52	59	57	....do	E'ly, 2; SW., 1; calm	None
	3	....do	........do	......	30.22	30.06	69	55	66	55	61	57	Fair to clear and pleasant.	N'd and E'd, 2; calm	None
	4	....do	........do	......	30.20	30.06	68	54	64	53	59	56	Fair and pleasant	Calm; SW., 2	None
	5	....do	........do	......	30.26	30.12	63	53	62	52	58	56	Foggy to fair and pleasant.	Calm; SW., 2; calm	None
	6	....do	........do	......	30.18	30.07	60	52	59	52	58	56	....do	Calm; SSW., 2 (10 a.m., 5 p.m.); calm.	None

* Total distance steamed in September, 599.9 knots; total days under way, 3.

Meteorological and cruising record—Continued.

Date.	Meridian position. Lat. N.	Meridian position. Long. W.	Distance run per log.	Barometer. Max.	Barometer. Min.	Temperature. Air. Dry bulb. Max.	Temperature. Air. Dry bulb. Min.	Temperature. Air. Wet bulb. Max.	Temperature. Air. Wet bulb. Min.	Temperature. Water at surface. Max.	Temperature. Water at surface. Min.	State of the weather.	Force and direction of winds.	Rainfall (approx.).	State of sea.	Currents.	Strength in knots per hour.	Number of hours sealing weather.	Number of seals seen.
1892.			*Knots*																
Nov. 7	Navy-yard, Mare Island, Cal.		.	30.17	30.02	68	49	66	49	60	55	Foggy to fair and pleasant.	Calm; SSW., 1 (11 a. m., 4 p. m.); calm.	None					
8	do	do		30.18	30.07	69	55	65	53	60	55	Clear and pleasant	E., 2-1; calm	None					
9	do	do		30.30	30.17	70	57	65	56	60	55	Fair and pleasant	Calm; E, 2 (9 a. m., 4 p. m.); calm.	None					
10	do	do		30.31	30.13	68	54	66	54	60	56	Clear and pleasant	Calm; SW., 1 (1 to 5 p. m.); calm.	None					
11	do	do		30.25	30.09	69	53	64	53	60	56	do	Calm; SSW., 1	None					
12	do	do		30.30	30.16	64	55	63	54	58	56	do	Calm; SW'ly, 1 (5 a. m., 4 p. m.); calm.	None					
13	do	do		30.30	30.15	64	49	60	49	60	54	do	SSW., 1	None					
14	do	do		30.23	30.09	61	49	59	48	58	55	do	SW. and SSW., 2; calm	None					
15	do	do		30.20	30.12	59	45	57	44	57	51	Clear to fair and pleasant.	W'ly, 1-3	None					
16	do	do		30.36	30.21	59	44	55	43	57	51	Clear and pleasant	W., 1; SW., 2; calm	None					
17	do	do		30.43	30.30	58	42	55	41	55	50	do	Calm; E., 2 (9 a. m., 3 p. m.); calm.	None					
18	do	do		30.36	30.15	65	46	63	44	57	51	do	E. and ENE., 2; calm	None					
19	do	do		30.23	30.07	60	48	59	47	57	51	do	S'ly and E'ly, 1	None					
20	do	do		30.20	30.06	60	48	59	48	55	53	Foggy and misty to fair and pleasant.	SSW., 1-2	Misty					
21	do	do		30.26	30.12	63	46	60	46	58	51	Foggy to fair and pleasant.	Calm	None					
22	do	do		30.20	30.10	59	52	58	51	56	51	Fair and pleasant to overcast.	Calm; variable, 1; calm	None					
23	do	do		30.07	29.92	58	44	57	43	55	51	Overcast and rainy to clearing.	SW., 3; squalls, 4-5, frequent	Moderate.					
24	do	do		30.24	30.08	50	40	48	40	52	49	Clear and pleasant	SW'ly, 1	None					
25	do	do		30.15	29.98	49	42	48	41	52	49	Fair to rainy to clearing.	Variable, 1	Moderate.					
26	do	do		30.10	29.92	53	45	51	45	53	49	Fair and pleasant	E. and SE., 1	None					
27	do	do		29.88	29.64	58	52	57	50	52	50	Overcast, rainy, and stormy.	S'd and E'd, 4; squalls, 6-7, frequent.	Heavy					
28	do	do		29.85	29.60	58	54	57	53	53	50	Cloudy, rainy, and stormy.	S'd and E'd, 7	Heavy					

	29	....do	........do	......	29.92	29.72	60	57	59	56	54	51	Cloudy and stormy; rain squalls.	SSE., 7, to SSW., 6	Moderate.
	30	....do	........do	......	30.00	29.60	60	48	59	47	52	51	Stormy and rainy to moderating.	S'd and W'd, 10, moderating to 3.	Heavy.
Dec.	1	....do	........do	......	30.14	30.02	55	48	54	47	53	49	Clear and pleasant	E., 1	None.
	2	....do	........do	......	30.01	29.84	59	53	58	52	52	51	Overcast and rainy	S'd, 1	Moderate.
	3	....do	........do	......	30.12	29.90	55	49	54	48	52	50	Cloudy and drizzly to clearing.	SSW., 1-2	Light.
	4	....do	........do	......	30.22	30.09	51	44	50	44	52	50	Fair and pleasant	W'ly, 1-2	None.
	5	....do	........do	......	30.32	30.16	52	41	51	40	50	48	Clear and pleasant	Calm; variable airs occasionally.	None.
	6	....do	........do	......	30.38	30.27	50	41	49	40	50	44	Fair and pleasant	NE., 2; E., 3	None.
	7	....do	........do	......	30.34	30.17	51	41	50	40	48	43	Clear and pleasant	Calm; E., 1-2; calm	None.
	8	....do	........do	......	30.33	30.24	50	40	48	40	48	43	....do	Calm; E., 2 (7 a. m., 6 p. m.); calm.	None.
	9	....do	........do	......	30.39	30.27	44	39	43	39	46	42	Foggy and misty to fair and pleasant.	E. and ENE., 2-3	Misty.
	10	....do	........do	......	30.27	30.11	55	41	50	40	47	44	Overcast to clear and pleasant.	NE., 1; NW., 4	None.
	11	....do	........do	......	30.22	30.07	58	45	53	42	48	45	Clear and pleasant	NW., 1; NNE., 3	None.
	12	....do	........do	......	30.25	30.24	48	39	47	38	46	44	Clear and pleasant; cold.	E., 2	None.
	13	....do	........do	......	30.41	30.30	51	38	50	37	46	43	....do	Calm; S., 1, veering to NNW., 3.	None.
	14	....do	........do	......	30.51	30.40	55	43	52	41	46	44	Clear and pleasant	N'd, 4; E., 2; ENE., 3	None.
	15	....do	........do	......	30.49	30.30	52	40	50	39	46	42	....do	Calm; ENE., 2 (9 a. m., 4 p. m.); calm.	None.
	16	....do	........do	......	30.28	30.13	57	41	55	40	47	43	....do	E'd, 3-2; variable, 1	None.
	17	....do	........do	......	30.32	30.18	55	42	53	40	46	44	....do	N'ly, 2; calm; NNW., 2; calm.	None.
	18	....do	........do	......	30.29	30.16	49	39	47	38	45	41	....do	Calm; variable airs occasionally.	None.
	19	....do	........do	......	30.28	30.20	48	42	47	40	44	42	Overcast and cloudy; misty 1 to 4 p. m.	Calm; E., 2; variable, 1	Misty.
	20	....do	........do	......	30.23	30.09	52	40	51	39	45	42	Overcast to fair and pleasant.	SSW., 1; calm; variable, 1 and 2.	None.
	21	....do	........do	......	30.13	30.02	49	36	48	35	45	42	Cold and foggy to overcast and rainy.	S'd and E'd, 2-4	Light.
	22	....do	........do	......	30.12	30.01	58	51	56	50	47	44	Overcast and rainy	SE., 4, to ESE., 3	Moderate.
	23	....do	........do	......	30.00	29.68	60	53	59	52	47	43	Overcast, rainy, and stormy.	ESE., 2-3; SE., 4, with squalls, 6.	Heavy.
	24	....do	........do	......	30.24	29.63	63	54	61	53	51	46	Overcast and rainy to clearing.	S'd and E'd, 3-5; SW., 2; calm.	Moderate.
	25	....do	........do	......	30.32	30.22	60	53	60	53	52	48	Overcast and rainy	E'd, 1-2; calm	Moderate.
	26	....do	........do	......	30.43	30.32	62	58	61	57	53	49	Overcast and unsettled; showery in a. m.	S'd and W'd, 1-2	Light.
	27	....do	........do	......	30.36	30.23	60	56	59	55	53	44	Overcast, misty, and foggy.	Calm; SW., 1	Misty.

Meteorological and cruising record—Continued.

Date.	Meridian position. Lat. N.	Long. W.	Distance run per log.	Barometer. Max.	Min.	Temperature. Air. Dry bulb. Max.	Min.	Wet bulb. Max.	Min.	Water at surface. Max.	Min.	State of the weather.	Force and direction of winds.	Rain-fall (approx.).	State of sea.	Currents.	Strength in knots per hour.	Number of hours sealing weather.	Number of seals seen.
1892.			*Knots*																
Dec. 28	Navy-yard, Mare Island, Cal.			30.34	30.24	58	50	57	49	54	47	Clear and pleasant	W., 2; SW., 2	None					
29	do	do		30.36	30.27	60	49	58	48	51	48	do	W., 2	None					
30	do	do		30.43	30.34	56	48	53	44	50	46	do	E. and NE., 2	None					
31	do	do		30.50	30.36	55	44	51	43	49	45	do	NE., 2	None					
1893.																			
Jan. 1	do	do		30.43	30.30	48	43	47	42	50	44	Clear to cloudy and foggy.	Calm; NE., 2	None					
2	do	do		30.38	30.29	46	41	45	41	48	45	Foggy to clear and pleasant.	NE., 2–3	None					
3	do	do		30.43	30.31	45	42	44	41	46	43	Foggy to fair and pleasant.	ENE., 2–3	None					
4	do	do		30.38	30.28	44	40	43	40	46	44	do	ENE., 3–4	None					
5	do	do		30.33	30.22	42	40	42	39	45	43	Heavy fog to fair a. m.	ENE. and E., 2–3	None					
6	do	do		30.25	30.16	43	39	42	38	45	42	Overcast, cloudy, and foggy.	ENE., 3; E., 2–4	None					
7	do	do		30.35	30.24	43	38	42	37	45	41	Cold and foggy to fair and pleasant.	E., 3	None					
8	do	do		30.44	30.32	43	37	43	37	45	41	Overcast and foggy; disagreeable.	E. 3; ENE., 4	None					
9	do	do		30.37	30.25	41	36	40	36	45	41	Cold, cloudy, and foggy; very disagreeable.	ENE. and E., 3	None					
10	do	do		30.30	30.21	43	36	43	36	45	44	Foggy to cloudy, to fair and pleasant.	ENE., 2	None					
11	do	do		30.31	30.20	45	38	44	37	46	42	Clear, but cold and disagreeable.	ENE. and E., 2–3; squalls 4, 1 a. m. to 4 a. m.	None					
12	do	do		30.32	30.22	44	39	43	38	46	43	Overcast and cloudy	E., 4; ENE., 3	None					
13	do	do		30.24	30.12	53	42	53	41	Dry dock.		Clear to fair and pleasant.	Calm; ENE., 1; calm	None					
14	do	do		30.23	30.16	55	47	54	46	do		Fair to overcast and drizzling.	Calm; E. and ESE., 1	Light					
15	do	do		30.26	30.16	55	50	54	49	do		Overcast and rainy	ESE., 1	Heavy					
16	do	do		30.25	30.15	56	46	54	45	do		Fair to clear and pleasant.	Calm; W'ly., 1–2 (8 a. m., 5 p. m.); calm.	None					

	17	do	do		30.31	30.17	56	44	55	43	do	Clear and pleasant	Calm; WSW., 1 (11 a. m., 5 p. m.); calm.	None						
	18	do	do		30.30	30.15	55	41	54	40	do	Foggy to clear and pleasant.	Calm; E., 2 (8 a. m., 6 p. m.); calm.	None						
	19	do	do		30.25	30.12	56	38	54	37	do	Clear and pleasant	Calm; E'ly., 2 (10 a. m., 6 p. m.); calm.	None						
	20	do	do		30.29	30.19	52	38	51	38	do	do	Calm; E., 2 (7 a. m., 8 p. m.); calm.	None						
	21	do	do		30.42	30.30	48	38	47	38	do	Foggy; partly clear, 10 a. m. to 5 p. m.	E., 2	None						
	22	do	do		30.53	30.42	46	39	45	39	do	Fair and pleasant	E., 2–3	None						
	23	do	do		30.50	30.32	49	37	48	37	do	Foggy to fair and pleasant.	E., 2	None						
	24	do	do		30.32	30.06	45	38	44	38	do	do	ENE., 3	None						
	25	do	do		30.08	29.99	44	38	43	38	do	Overcast and cloudy	E., 3–2	None						
	26	do	do		29.94	29.60	56	42	55	42	do	Overcast and rainy	E., 3; SE., 5; S., 4	Heavy						
	27	do	do		30.12	29.69	53	45	52	45	do	Overcast and rainy to clearing.	S., 4; squally, 6; WSW., 2	Heavy						
	28	do	do		30.26	30.12	54	43	53	42	do	Fair and pleasant; light drizzle.	E., 1; S., 2	Light						
	29	do	do		30.28	30.04	56	42	55	42	do	Fair and pleasant to drizzling.	E., 1 and calms; E., 2–3	Light						
	30	do	do		30.09	29.75	49	41	48	40	do	Overcast and rainy to clearing.	N., 7 to ENE., 4; to SE., 2	Moderate.						
	31	do	do		30.14	30.02	50	35	49	35	do	Clear and pleasant	Calm; variable, 1 (9 a. m., 6 p. m.); calm.	None						
Feb.	1	do	do		30.27	30.08	50	34	48	33	do	Clear and cold to cloudy and rainy.	S'd and W'd, 1–2	Light						
	2	do	do		30.37	30.25	54	39	53	38	do	Clear and pleasant	S'd and E'd, 1	None						
	3	do	do		30.27	30.06	53	40	52	39	do	Overcast and showery.	E. 2; SE., 3–4; and squalls, 5–6.	Light						
	4	do	do		30.05	29.85	53	47	52	46	do	Stormy and rainy to fair.	SE., 4–6, and squalls, 7; WSW., 3–2.	Moderate.						
	5	do	do		30.42	30.06	50	43	50	42	do	Rainy to fair and pleasant.	SW. and WSW., 2	Light						
	6	do	do		30.48	30.33	51	36	49	35	do	Clear and cold	Variable, 1; E., 1	None						
	7	do	do		30.32	30.00	48	38	47	37	do	Fair and pleasant to overcast and rainy.	E., 2–3	Light						
	8	do	do		30.20	39.93	53	46	52	45	do	Overcast and rainy	SE., 2; SW., 2; SE., 2	Moderate.						
	9	do	do		30.26	29.98	53	46	52	45	do	Overcast and rainy to fair and pleasant.	E., 2–3	Moderate.						
	10	do	do		30.49	30.30	55	45	54	44	do	Cloudy and misty to fair and pleasant.	Calm; S., 1 (1 p. m., 8 p. m.); calm.	None						
	11	do	do		30.51	30.32	53	47	52	47	do	Foggy, misty, and cloudy.	Calm; ESE., 1–3	None						
	12	do	do		30.30	30.18	54	42	52	41	do	Overcast and rainy to fair.	SSE., 3; WSW., 3; W., 4	Light						
	13	do	do		30.32	30.18	52	38	49	38	do	Clear and pleasant	W. and WSW., 2	None						
	14	do	do		30.42	30.25	57	42	50	41	do	do	N'd and W'd, 3	None						
	15	do	do		30.46	30.32	59	37	55	36	do	Clear to fair and pleasant.	Calm; E'ly, 2 (2 p. m., 5 p. m.); calm.	None						

Meteorological and cruising record—Continued.

Date.	Meridian position. Lat. N.	Meridian position. Long. W.	Distance run per log.	Barometer. Max.	Barometer. Min.	Temperature. Air. Dry bulb. Max.	Temperature. Air. Dry bulb. Min.	Temperature. Air. Wet bulb. Max.	Temperature. Air. Wet bulb. Min.	Temperature. Water at surface. Max.	Temperature. Water at surface. Min.	State of the weather.	Force and direction of winds.	Rainfall (approx.).	State of sea.	Currents.	Strength in knots per hour.	Number of hours sealing weather.	Number of seals seen.
1893.			*Knots*																
Feb. 16	Navy-yard, Mare Island, Cal.		......	30.44	30.33	58	40	57	39	Dry dock.		Fair and pleasant.....	Calm; E'ly, 1 (6 a. m., 6 p. m.); calm.	None..	....	....	.....	.....	.....
17	...do	...do	......	30.39	30.27	62	45	58	44	...do...		...do	Calm; ENE., 1 (8 a. m., 4 p. m.); calm.	None..	....	....	.....	.....	.....
18	...do	...do	......	30.40	30.29	61	42	58	41	...do...		...do	Calm; S'd and W'd, 1	None..	....	....	.....	.....	.....
19	...do	...do	......	30.47	30.30	64	46	62	45	...do...		Clear and pleasant....	Calm	None..	....	....	.....	.....	.....
20	...do	...do	......	30.35	30.20	68	44	63	43	...do...		...do	Calm; E'ly, 1 (3 p. m., 7 p. m.); calm.	None..	....	....	.....	.....	.....
21	...do	...do	......	30.36	30.23	63	43	59	42	...do...		...do	Calm; S'd and W'd, 1	None..	....	....	.....	.....	.....
22	...do	...do	......	30.39	30.20	71	44	60	43	...do...		...do	N'd and W'd, 1	None..	....	....	.....	.....	.....
23	...do	...do	......	30.39	30.18	70	45	62	43	...do...		...do	Calm; W'd, 1 (in forenoon); calm.	None..	....	....	.....	.....	.....
24	...do	...do	......	30.28	30.09	71	49	68	47	...do...		...do	Calm; variable, 1; calm	None..	....	....	.....	.....	.....
25	...do	...do	......	30.17	29.95	65	46	62	44	...do...		...do	Calm; S'd and W'd, 2 to 7....	None..	....	....	.....	.....	.....
26	...do	...do	......	30.09	29.96	60	43	56	41	...do...		...do	WNW., 4; W., 2-1	None..	....	....	.....	.....	.....
27	...do	...do	......	30.18	30.06	61	40	58	39	...do...		...do	Calm; W'ly, 1 (4 a. m., 8 p. m.); calm.	None..	....	....	.....	.....	.....
28	...do	...do	......	30.18	30.02	56	42	54	41	...do...		Fair and pleasant; cloudy.	Calm; SW'ly, 1 (9 a. m., 7 p. m.); calm.	None..	....	....	.....	.....	.....
Mar. 1	...do	...do	......	30.04	29.92	62	44	59	43	...do...		Clear and pleasant....	Calm; S'd and E'd, 1 (8 a. m., 6 p. m.); calm.	None..	....	....	.....	.....	.....
2	...do	...do	......	30.06	29.90	65	43	61	42	...do...		...do	Calm	None..	....	....	.....	.....	.....
3	...do	...do	......	30.09	29.88	62	53	59	52	...do...		Overcast and cloudy...	Calm; ESE., 2-3	None..	....	....	.....	.....	.....
4	...do	...do	......	29.87	29.70	57	48	55	47	...do...		Overcast and rainy....	S'd and E'd, 3-2	Moderate.	....	....	.....	.....	.....
5	...do	...do	......	30.00	29.89	56	47	54	46	51	48	Overcast and drizzly to clearing and fair.	East, 2, hauling via S'd, to W.	Light	....	....	.....	.....	.....
6	...do	...do	......	30.08	29.97	60	45	58	44	52	47	Clear and pleasant	Calm; S'd and W'd, 1	None	....	....	.....	.....	.....
7	...do	...do	......	30.09	29.77	58	49	56	48	52	50	Overcast and cloudy to rainy.	SSW., 2; SSE, 2	Light	....	....	.....	.....	.....
8	...do	...do	......	29.90	29.78	54	44	51	42	51	47	Overcast and cloudy to fair.	SW., 2-3	None..	....	....	.....	.....	.....
9	...do	...do	......	30.18	29.90	54	38	53	37	50	48	Fair and pleasant.....	W., 2-3	None..	....	....	.....	.....	.....
10	...do	...do	......	30.24	30.03	56	45	54	44	51	48	Fair to overcast and threatening.	Calm; S'd and E'd, 2-3	None..	....	....	.....	.....	.....

11	....do	........do....	......	30.37	29.88	53	44	52	42	51	47	Stormy and rainy to clearing.	SE., 3; W'd, 5–9–3	Heavy
12	....do	........do....	......	30.57	30.39	56	39	54	38	52	45	Clear and pleasant....	W'd, 1-2	None..
13	....do	........do....	......	30.52	30.02	55	41	54	40	52	47	.....do	Calm; ENE., 3	None..
14	....do	........do....	......	30.01	29.71	49	48	48	47	50	47	Overcast to rainy to cloudy.	ENE., 4–2; calm	Light.
15	....do	........do....	......	30.31	29.86	56	47	55	46	52	47	Cloudy; frequent passing showers.	S'd and W'd, 1-2	Light.
16	....do	........do....	......	30.42	30.32	59	48	57	47	52	49	Cloudy and showery to fair.	Variable, 1; SSW., 2; calm	Light.
17	....do	........do....	......	30.39	30.27	62	52	60	50	57	50	Fair and pleasant.....	Calm; SW., 1-2 (7 a. m., 9 p. m.); calm.	None..
18	....do	........do....	......	30.29	30.09	60	52	59	51	53	50	Fair to drizzly and rainy.	S., 1; SSW., 2	Light.
19	....do	........do....	......	30.09	29.94	62	54	60	53	53	50	Overcast, drizzly, and misty.	SSW. to S., 2	Light.
20	....do	........do....	......	29.91	29.68	62	52	60	50	55	51	Overcast, drizzly, and rainy.	S'd, 2-3	Moderate.
21	....do	........do....	......	29.94	29.71	62	47	61	46	56	50	Cloudy and rainy to clearing.	WSW., 2; W., 3	Light.
22	....do	........do....	......	30.15	29.94	57	44	55	43	53	48	Fair and pleasant.....	W., 2	None..
23	....do	........do....	......	30.25	30.14	56	47	55	46	52	50	Fair to misty and rainy	W., 1; SE. and E., 2	Light.
24	....do	........do....	......	30.29	30.20	63	50	61	49	55	51	Overcast and cloudy to fair.	Calm; W'ly, 1 (12 m., 8 p. m.); calm.	None..
25	....do	........do....	......	30.33	30.23	64	50	62	49	56	50	Cloudy, but pleasant..	Calm; W'd, 1	None..
26	....do	........do....	......	30.35	30.21	65	54	63	53	57	53	Overcast and cloudy to fair.	S., 1; SW., 2; calm	None..
27	....do	........do....	......	30.26	30.06	70	50	69	49	59	53	Fair and pleasant.....	Calm; E., 2 (10 a. m., 8 p. m.); calm.	None..
28	....do	........do....	......	30.12	29.95	74	55	72	53	61	54	.....do	Calm; E., 2 (6 a. m., 5 p. m.); calm.	None..
29	....do	........do....	......	30.22	30.03	68	55	65	54	61	55	Fair and pleasant to overcast.	SW., 2-4; SSW., 3	None..
30	....do	........do....	......	30.33	30.22	61	51	60	50	60	56	Overcast to fair and pleasant.	SSW., 2-3	None..
31	....do	........do....	......	30.39	30.22	65	46	62	45	62	53	Clear and pleasant....	SW., 2; SSW., 2-1	None..
Apr. 1	....do	........do....	......	30.27	30.06	72	46	70	45	60	55	.....do	S'd and W'd, 1-3	None..
2	....do	........do....	......	30.28	30.09	63	48	60	46	59	55	Fair to overcast and drizzly.	W., 3; SW., 4; squally at times.	Light.
3	....do	........do....	......	30.32	30.26	68	54	64	52	59	54	Fair and pleasant.....	S., 2; SSW., 2	None..
4	....do	........do....	......	30.29	30.10	67	56	65	55	61	57	Fair to cloudy to overcast.	Calm; S., 1-2	None..
5	....do	........do....	......	30.10	29.71	63	50	60	48	59	53	Overcast, rainy, and stormy.	SSE., 3; S'd, 3, and squalls, 7.	Moderate.
6	....do	........do....	......	30.30	29.79	58	46	55	44	56	53	Boisterous and rainy to clearing.	S'd and W'd, 3, and squalls, 7; W., 3.	Moderate.
7	....do	........do....	......	30.35	30.28	58	45	55	43	56	52	Cloudy and rainy......	Calm; S., 1-2	Moderate.
8	....do	........do....	......	30.40	30.32	64	50	61	48	56	54	Overcast and cloudy to fair.	E., 1; calm; S. to W., 2	None..
9	....do	........do....	......	30.38	30.13	62	45	60	44	57	53	Fair to overcast and drizzly.	Calm; S., 1; SSW., 2-3	Light.

Meteorological and cruising record—Continued.

Date.	Meridian position. Lat. N.	Meridian position. Long. W.	Distance run per log.	Barometer. Max.	Barometer. Min.	Temperature. Air. Dry bulb. Max.	Temperature. Air. Dry bulb. Min.	Temperature. Air. Wet bulb. Max.	Temperature. Air. Wet bulb. Min.	Temperature. Water at surface. Max.	Temperature. Water at surface. Min.	State of the weather.	Force and direction of winds.	Rainfall (approx.).	State of sea.	Currents.	Strength in knots per hour.	Number of hours sealing weather.	Number of seals seen.
1893.	° ′ ″	° ′ ″	*Knots*																
Apr. 10	Navy-yard, Mare Island, Cal.		......	30.28	30.13	58	43	55	42	59	52	Fair and pleasant	W., 4-6	None					
11	...do	...do	......	30.27	30.18	63	48	61	47	57	52	Cloudy but pleasant	W., 3; SW., 2; W., 3	None					
12	...do	...do	......	30.42	30.28	65	43	63	42	56	51	Clear and pleasant	S'd and W'd, 3; calm	None					
13	...do	...do	......	30.43	30.30	64	46	61	43	57	52	...do	NW., 4; W., 3; S., 1	None					
14	...do	...do	......	30.35	30.16	73	49	69	47	60	53	...do	Calm; W., 1 (12 m..7 p.m.); calm.	None					
15	...do	...do	......	30.22	30.06	69	49	65	47	60	54	...do	Calm; SW., 1	None					
16	...do	...do	......	30.30	30.16	65	48	62	46	59	53	...do	S'd and W'd, 1-2	None					
17	...do	...do	......	30.38	30.28	63	49	59	47	58	53	...do	WSW., 2-3	None					
18	...do	...do	......	30.42	30.30	65	47	62	45	59	50	...do	WSW., 1-2	None					
19	...do	...do	......	30.36	30.20	68	49	65	47	60	54	...do	Calm; S'd, 1-2	None					
20	...do	...do	......	30.25	30.07	70	56	67	53	61	54	...do	S'd and W'd, 1-2	None					
21	...do	...do	......	30.11	29.94	72	57	70	54	61	55	Fair to overcast and drizzling.	...do	Light					
22	...do	...do	......	30.10	29.94	66	53	64	50	61	55	Overcast and rainy to clearing.	S'd and W'd, 2-3	Moderate.					
23	...do	...do	......	30.20	30.12	76	48	74	47	60	53	Clear and pleasant	S'd and W'd, 3	None					
24	...do	...do	......	30.22	30.12	67	45	65	44	61	50	...do	S'd and W'd, 2	None					
25	37 52 00	122 28 40	21.0	30.29	30.20	74	51	72	50	62	49	Fair and pleasant generally.	SW'ly, 2; E., 2	None	Smooth	No account			
26	36 46 00	121 57 00	87.0	30.24	30.14	59	50	57	48	56	49	Cloudy but pleasant	Variable, 1; SW., 2	None	Smooth	No account			
27	37 43 00	122 43 40	108.5	30.23	30.08	60	50	58	48	59	50	...do	WNW., 4; W., 3	None	Smooth	No account			
28	Navy-yard, Mare Island, Cal.		41.5	30.14	30.06	65	46	63	42	59	50	Fair and pleasant	W'd, 3	None					
29	...do	...do	......	30.19	30.08	77	50	76	49	62	53	Clear and pleasant	W., 2; SW., 3	None					
*30	...do	...do	......	30.20	30.10	73	50	72	48	63	53	...do	S'd and W'd, 1	None					
May 1	...do	...do	......	30.22	30.12	71	52	68	51	61	53	...do	...do	None					
2	...do	...do	......	30.24	30.15	71	55	66	53	61	53	...do	S'd and W'd, 2	None					
3	...do	...do	......	30.19	29.99	73	50	69	50	61	53	...do	S'd and W'd, 1-2	None					
4	...do	...do	......	30.03	29.96	71	52	68	51	61	54	Cloudy and showery	SSW., 2; SSW., 4, and squalls, 6.	Light					
5	...do	...do	......	30.08	29.97	73	52	72	51	62	54	Clear and pleasant	SSW., 2; WSW., 1	None					
6	...do	...do	......	30.05	29.91	88	57	84	55	64	58	...do	W'd, 1	None					

7	do	do		30.06	29.92	80	58	76	56	64	59	do	SW., 1; SW., 3, and squalls, 5; SW., 2.	None					
8	do	do		30.00	29.89	68	57	65	55	63	60	Cloudy and threatening to fair.	S'd and W'd, 1-2	Light					
9	do	do		30.03	29.91	75	54	73	53	64	59	Fair and pleasant	S'd and W'd, 1	None					
10	do	do		30.09	29.90	82	58	77	56	65	59	Clear and pleasant	Calm; S'd and W'd, 1	None					
11	do	do		30.07	29.95	80	60	74	58	67	60	do	SW., 2	None					
12	do	do		30.01	29.78	83	53	78	52	66	55	Clear and pleasant to cloudy.	S'd and W'd, 2-3, and squalls, 5.	None					
13	do	do		30.06	29.87	71	53	68	51	65	54	Clear and pleasant	S'd and W'd, 3	None					
14	do	do		30.07	29.96	73	55	69	54	66	58	do	W., veering to SSW., 3	None					
15	do	do		30.09	30.01	72	57	67	56	67	61	Cloudy and drizzling to clearing.	S'd and W'd, 1-3	Light					
16	do	do		30.12	30.02	69	58	67	52	65	59	Cloudy, with passing showers.	S'd and W'd. 2	Light					
17	do	do		30.18	30.06	64	52	62	50	65	59	Cloudy and unsettled; showery.	S'd and W'd, 2-3	Light					
18	do	do		30.26	30.13	68	50	64	49	65	57	Clear and pleasant	WNW., 1; WSW., 2	None					
19	do	do		30.18	30.10	71	53	68	51	63	57	do	W., 2; SW., 3-1	None					
20	38 03 00	122 19 00	6.0	30.42	30.19	78	52	72	51	65	52	Fair to showery to clearing.	SW., 2; W., 3; SW. to WNW., 4.	Light	Smooth to moderate.	No account			
21	39 48 30	123 59 00	180.4	30.50	30.42	57	52	54	50	54	50	Clear and pleasant	N'd and W'd, 4-3; S., 4	None	Moderate	No account			
22	42 25 00	124 39 00	186.1	30.50	30.46	55	49	53	48	53	50	Clear to drizzling to clearing.	N'd and W'd, 3-4	Light	Moderating.	No account			
23	45 58 00	124 19 00	232.6	30.46	30.34	52	49	49	46	53	50	Cloudy and showery to fair.	N'd and W'd, 4	Light	Moderate	No account			
24	48 10 00	123 00 00	248.8	30.40	30.19	60	49	56	48	54	47	Fair to clear and pleasant.	NW. and W., 2; E'd, 2	None	Smooth	No account			
25	Port Townsend, Wash.		10.1	30.24	30.10	62	48	58	47	51	46	Fair generally; some fog.	Calm generally; NW., 2	None	Smooth				
26	do	do		30.24	30.12	61	49	57	49	52	48	Foggy to clear and pleasant.	do	None					
27	do	do		30.18	30.02	59	50	57	49	51	48	Foggy to fair and pleasant.	Calm; W., 2, to SW., 4	None					
28	48 32 00	123 11 00	32.7	30.14	30.00	55	50	53	49	54	47	Misty, foggy, and drizzly.	S'd and W'd, 2; NE., 2; calm	Light	Smooth				
29	Vancouver, B. C.		56.5	30.22	30.03	60	50	58	49	58	50	Cloudy, but pleasant	E'd, 2-3	None	Smooth				
30	Union Bay, Baynes Sound, B. C.		76.0	30.16	30.05	57	53	55	51	56	52	Cloudy and drizzly; disagreeable.	E., 2; calm	Light	Smooth				
†31	49 30 00	124 43 00	14.0	30.15	30.06	57	53	56	51	56	47	Cloudy, but pleasant	ESE. to N'd and W'd, 1; calm	None	Smooth				
June 1	50 44 00	127 21 00	140.8	30.28	30.13	54	49	53	48	49	47	Overcast and drizzly; disagreeable.	S'd and W'd, 2-5	Light	Smooth to moderate	No account		0	0
2	51 28 00	130 55 00	152.1	30.52	30.28	49	48	48	46	49	47	Fair and pleasant	S'd and W'd, to W., 5-4	None	Moderate to rough.	S. 12° E	0.5	16	0
3	53 04 00	134 46 00	177.0	30.55	30.40	50	47	48	45	49	46	Clear to cloudy; pleasant.	W. to SW., 3; S. by E., 3	None	Moderating.	N. 70° E	0.2	14	0
4	55 06 00	139 17 00	219.0	30.42	30.37	48	45	46	44	46	45	Drizzly to fair	S. by E., 3; to S'd and W'd, 3.	Light	Smooth	N. 72° E	1.0	18	0
5	57 37 00	143 11 00	212.0	30.36	30.20	48	45	46	43	47	45	Overcast and cloudy	S'd and W'd, 3-2	None	Smooth	N. 74° E	0.9	18	0
6	57 51 00	148 34 00	193.0	30.18	29.95	47	43	45	42	46	44	Cloudy to clear and pleasant.	SSW. to S. by E., 3	None	Smooth	N. 74° E	0.6	0	0

* Total distance steamed in April, 258 knots; total days under way, 4.

† Total distance steamed in May, 1,043.2 knots; total days under way, 10.

Meteorological and cruising record—Continued.

Date.	Meridian position. Lat. N.	Meridian position. Long. W.	Distance run per log.	Barometer. Max.	Barometer. Min.	Temperature. Air. Dry bulb. Max.	Temperature. Air. Dry bulb. Min.	Temperature. Air. Wet bulb. Max.	Temperature. Air. Wet bulb. Min.	Temperature. Water at surface. Max.	Temperature. Water at surface. Min.	State of the weather.	Force and direction of winds.	Rainfall (approx.).	State of sea.	Currents.	Strength in knots per hour.	Number of hours sealing weather.	Number of seals seen.
1893.	° ′ ″	° ′ ″	*Knots*																
June 7	St. Paul, Kadiak Island, Alaska.		145.0	29.96	29.83	50	44	48	43	50	43	Cloudy, but pleasant	SE. to E., 3	None	Smooth	N. 15° W.	0.3	9	0
8	57 44 00	152 19 00	5.5	29.84	29.64	50	45	48	44	49	44	Cloudy to drizzly and rainy.	N. 2; NE. and ENE., 3-4	Light	Smooth	No account	....	13	1
9	55 41 00	155 19 00	179.0	29.86	29.62	47	43	45	42	45	42	Rainy and drizzly to fair.	NW'd to W. and SW., 4	Light	Smooth	West	0.7	0	2
10	55 19 00	159 41 00	191.0	29.98	29.88	46	43	45	42	44	42	Clear and pleasant generally.	SW., 6-5; W., 5-4	None	Moderate	S. 58° E.	1.0	8	0
11	55 02 00	160 33 00	68.0	29.98	29.79	50	43	48	41	43	42	Fair and pleasant; cloudy.	W. to WSW., 3-4	None	Smooth	S. 45° W.	*1.0	14	0
12	53 07 00	166 15 00	240.0	30.10	29.93	44	43	43	42	44	42	Fair, to overcast and misty.	WSW. and SW., 2-3	Light	Swell from south'd; smooth.	S. 83° E.	0.3	4	3
13	52 48 00	170 58 00	241.8	30.37	30.11	44	43	43	41	42	41	Overcast and cloudy; misty at times.	WSW. to NW. to WNW., 3.	Light	Swell, S'd and W'd; smooth.	S. 71° W.	1.3	3	0
14	Dutch Harbor, Unalaska Island, Alaska.		185.0	30.46	30.36	57	43	55	42	49	42	Overcast and misty; clear at intervals.	N., 2; S., 2	Light	Smooth	N. 65° E.	0.1	15	1
15	54 19 00	162 10 00	194.2	30.50	30.42	48	44	47	43	45	42	Cloudy to clear and pleasant.	N'd and W'd, 4	None	Swell from westw'd; smooth.	S. 87° W.	1.0	0	1
16	Sand Point, Popof Island, Alaska.		116.0	30.50	30.44	53	44	51	43	45	41	Clear and pleasant	NW., 4-2; calm	None	Smooth	S. 45° W.	0.9	0	0
17	....do	........do	......	30.43	30.31	58	47	56	46	47	43	Fair to rainy and drizzly.	Calm; W. to NW., 1-2	Moderate.	....	....	....	....	....
18	55 18 30	160 32 45	1.8	30.34	30.30	51	46	50	45	44	42	Drizzly and foggy; disagreeable.	S. to SSW. to S. by W., 6-5	Light	Moderate	No account	....	0	0
19	Sandy Cove, Little Koniushi Island, Alaska.		166.2	30.31	30.23	46	45	45	44	43	42	Overcast, misty, and drizzly; thick.	S'd., 4, and squalls, 6	Light	Rough to moderate	No account	....	0	0
20	54 38 00	159 37 00	94.0	30.38	30.29	47	45	45	44	44	42	Drizzly and foggy to clear and pleasant.	S'd, 4, to SW., 5, and squalls, 6.	Light	Moderate	No account	....	0	0
21	Sand Point, Popof Island, Alaska.		67.0	30.39	30.31	59	46	56	44	46	43	Clear and pleasant	SSE., 2; WSW., 2-4, and squalls, 6.	None	....	....	....	....	....

22	54 54 00	159 50 00	70.0	30.36	30.24	62	49	59	47	50	44	....do	S'd and W'd, 2–3	None..	Smooth ...	No account	....	14	0
23	54 51 00	160 06 00	68.7	30.36	30.27	54	47	52	43	48	44	....do	W'ly., 3; NW., 3–2	None..	Smooth ...	No account	....	8	0
24	Sanborn Harbor, Nagai Island, Alaska.		62.0	30.33	30.10	59	50	57	48	52	44	Fair to drizzly and rainy.	SW., 2, and squalls, 4	Light.	....	....	....	....	....
25	Sand Point, Popof Island, Alaska.		26.2	30.21	30.08	58	48	56	46	48	44	Drizzly and foggy, to fair.	WSW., 2; N., 3	Light.	h ...	No account	....	0	0
*26	....do........do....		......	30.24	30.20	54	48	52	47	47	44	Overcast to thick and foggy.	Calm; W. to SSE., 2	None..	Smooth ...	No account	....	2	0
*27	54 06 00	164 31 00	196.5	30.22	30.09	51	46	50	45	52	44	Overcast and foggy; thick.	S. by E. and SSE., 1	None..	Smooth...	N. 34° E...	0.5	17	58
28	Dutch Harbor, Unalaska Island, Alaska.		92.7	30.08	29.92	56	51	55	50	50	48	Overcast and rainy....	SSE. to SE., 3, and squalls, 4.	Light.	....	....	....	....	....
29	....do........do....		......	29.96	29.92	59	53	57	51	50	46	Overcast and cloudy..	SE., 3, and frequent squalls, 4–5.	None..	Smooth ...	No account	....	0	0
†30	53 01 00	170 37 00	166.0	30.10	29.96	47	42	46	41	45	40	Overcast and foggy; thick.	S'd and W'd to SE., 2	None..	Smooth ...	N. 31° E...	0.3	16	0

* Day.

† Total distance steamed in June, 3,670.5 knots; total days under way, 27.

Record of animal life, driftwood, kelp, etc.,

Date.	Meridian position. Latitude north.	Meridian position. Longitude west.	Mean temperature. Air. Dry bulb.	Mean temperature. Water. Surface.	Fur seals.	Whales.	Auks.	Cormorants.	Ducks.
									FROM PORT TOWNSEND, WASH.,
1892.	° ′ ″	° ′ ″	°	°					
July 1	48 37 00	125 01 00	56	55					
2	50 13 30	129 41 00	54	53					
3	51 23 00	134 17 00	49	52		One			
4	52 18 00	138 26 00	49	49		One			
5	52 53 10	143 04 00	46	47					
6	53 35 20	147 19 20	48	48		Two			
7	53 55 00	151 50 10	48	48		Two			
8	53 57 00	156 56 00	49	49		Four			
9	53 50 00	162 24 20	48	47	One	Two	Few		
10	Iliuliuk Harbor, Unalaska Island.								
									FROM UNALASKA, ALASKA,
Aug. 3	54 01 30	165 58 30	54	50		One	Few		
4	54 00 12	161 18 00	56	54		Three	Several		
5	54 22 00	157 27 00	55	56		Two	Several		
6	54 50 00	153 50 00	54	55					
7	55 27 00	152 15 30	55	55					
8	55 53 00	147 42 00	54	55		One (dead)			
9	56 16 00	142 50 30	57	56		Two			
10	56 46 00	138 05 00	59	58					
11	Sitka Harbor, Alaska.								
									FROM SITKA, ALASKA, TO PORT TOWNSEND,
Aug. 18	Sitka Harbor, Alaska.		58	60		Several		Few	Few
19	55 07 00	134 20 00	60	60		Many		Few	Few
20	52 39 00	132 14 00	63	59		Several			
21	51 04 00	128 16 00	64	55		Several		Many	Several
22	50 24 00	125 38 00	66	60				Several	Few
23	Departure Bay, B. C.		63	64					Few
24	48 59 00	123 25 00	61	59					
25	Port Townsend, Wash.								
									FROM PORT TOWNSEND, WASH.,
Aug. 30	48 11 00	123 11 00	56	51					
31	46 33 00	125 02 00	62	55					
Sept. 1	43 04 00	124 46 00	57	50		Four			
2	39 52 00	124 11 00	59	52		Two			
3	Navy-yard, Mare Island, Cal.								
									SEA TRIAL: NAVY-YARD, MARE ISLAND,
1893.									
Apr. 25	37 52 00	122 28 40	63	56					
26	36 46 00	121 57 00	55	53					
27	37 43 00	122 43 40	55	54					
28	Navy-yard, Mare Island, Cal.								

observed from deck of Albatross at sea.

TO UNALASKA, ALASKA.

Gulls.	Goneys.	Guillemots.	Petrels.	Puffins.	Terns.	Drift-wood.	Kelp.	Remarks.
Many	Many	Few	Several			Several logs.	Much	
Few	Many		Several			Much	Much	
	Several		Several					
	Several		Several				Little	
	Several		Several			1 log		
One	Several		Many	Several		Little	Much	
	Many		Many	Few			1 piece	
Many	Few	Few	Many	Many		1 tree		Trunk of large tree; roots attached.
Many	Few	Many	Several	Many	Few		Much	

TO SITKA, ALASKA.

Gulls.	Goneys.	Guillemots.	Petrels.	Puffins.	Terns.	Drift-wood.	Kelp.	Remarks.
Several		Many	Many	Many	Several		Little	
Few		Many	Many	Many			Much	
Several	Few	Many	Many	Many	Few		Much	
Few	Few	Several	Several	Few				
Few	Few	Few	Few	Several		2 logs		
Few	Few		Many			1 log		
Few	Few		Several	Few		Little	Little	
Few	Few		Several	Few	Few	Little	Much	Several jagers; 1 coot.

WASH., VIA DEPARTURE BAY, B. C.

Gulls.	Goneys.	Guillemots.	Petrels.	Puffins.	Terns.	Drift-wood.	Kelp.	Remarks.
	Several				Few	Little	Much	School of porpoises.
Several	Several		Many	Several		Much	Much	Several phalaropes and divers.
Few			Several	Several		1 log		Several phalaropes.
Several	Few	Few	Few	Few	Several	Much	Much	
Several			Few		Few	Much	Much	
Several					Few	Little	Little	
Few					Few	Much	Little	

TO NAVY-YARD, MARE ISLAND, CAL.

Gulls.	Goneys.	Guillemots.	Petrels.	Puffins.	Terns.	Drift-wood.	Kelp.	Remarks.
Few	Few		Few			Little	Little	
Several	Several		Several				Much	
Several	Several		Several				Much	School of porpoises.
Many	Several		Few					Do.

TO MONTEREY, CAL., AND RETURN.

Gulls.	Goneys.	Guillemots.	Petrels.	Puffins.	Terns.	Drift-wood.	Kelp.	Remarks.
Many	Several	Many	Few					
Many	Few	Many	Several					
Many		Few	Few					

Record of animal life, driftwood, kelp, etc., observed

Date.	Meridian position. Latitude north.	Meridian position. Longitude west.	Mean temperature. Air. Dry bulb.	Mean temperature. Water. Surface.	Fur seals.	Whales.	Auks.	Cormorants.	Ducks.
	° ′ ″	° ′ ″	°	°					
FROM NAVY-YARD, MARE ISLAND,									
1893. May 20	38 03 00	122 19 00	65	50	....	....	....	....	....
21	39 48 30	123 59 00	55	52	....	Several ...	....	....	....
22	42 25 00	124 39 00	52	52	....	Several ...	....	....	....
23	45 58 00	124 19 00	51	52	....	....	....	Few	....
24	48 10 00	123 00 00	55	51	....	....	....	Few	....
25	Port Townsend, Wash.								
FROM PORT TOWNSEND, WASH., TO ST. PAULS HARBOR,									
May 28	48 32 00	123 11 00	53	50	....	....	....	....	Few ......
29	Vancouver Harbor, British Columbia.		55	54	....	....	....	....	....
30	Union Bay, Baynes Sound, British Columbia.		55	54	....	....	....	....	Few ......
31	49 30 00	124 43 00	55	51	....	....	....	Few	....
June 1	50 44 00	127 21 00	51	48	....	Several ...	....	Many	....
2	51 28 00	130 55 00	48	48	....	....	....	....	....
3	53 04 00	134 46 00	49	47	....	One	....	....	....
4	55 06 00	139 17 00	47	45	....	....	....	....	One ......
5	57 37 00	143 11 00	47	46	....	Two	....	....	....
6	57 51 00	148 34 00	45	45	....	Nine	....	....	Two ......
7	St. Paul Harbor, Kadiak Island, Alaska		47	46	....	....			
FROM ST. PAUL HARBOR, KADIAK ISLAND,									
June 8	57 44 00	152 19 00	47	46	One	Several ...	....	Many	....
9	55 41 00	155 19 00	45	43	Two	Two	....	Many	....
10	55 19 00	159 41 00	45	43	....	Three	Many	....	Several ...
FROM SAND POINT, POPOF ISLAND, TO									
June 11	55 02 00	160 33 00	46	42	....	Several ...	Few	....	
12	53 07 00	166 15 00	43	43	Three ..	One	....	....	....
13	52 48 00	170 58 00	43	41	....	Many	....	One	....
14	Dutch Harbor, Unalaska Island, Alaska.		50	45	One ...	One	....	....	....
FROM DUTCH HARBOR, UNALASKA ISLAND, TO SAND POINT, POPOF ISLAND,									
June 15	54 19 00	162 10 00	46	43	One	One	....	....	....
16	Sand Point, Popof Island, Alaska.		49	43	....	....	....	....	....
17	....do....		53	45	....	....	....	....	....
18	55 18 30	160 32 45	49	43	....	Few	Myriads ..	....	....
19	Sandy Cove, Little Koniushi Island, Alaska.		45	42	....	....	Myriads ..	....	....

from deck of Albatross at sea—Continued.

CAL., TO PORT TOWNSEND, WASH.

Gulls.	Goneys.	Guillemots.	Petrels.	Puffins.	Terns.	Driftwood.	Kelp.	Remarks.
Several	Few	Many	Few					
Several	Many	Few	Several				Little	Large patches of velella.
Several	Several	Several	Few					Do.
Many	Several	Few	Several			Much		
Many	Few		Few			Little	Little	

KADIAK ISLAND, ALASKA, VIA BRITISH COLUMBIA PORTS.

Few						Much		
Many					Few	Little		
Few								
							Little	Several porpoises.
	Several		Few				Little	
	Many							Several phalaropes.
			Few					
Several	Several		Several	One		1 large log.		
Several	Several		Many	Several	Many		Much	2 white goneys.
Many								

TO SAND POINT, POPOF ISLAND, ALASKA.

Many	Many	Many	Many	Many	Many			
Many	One	Many	Many	Many			Much	
Many		Many	Several	Many	Many			

UNALASKA, ALASKA, VIA AMUTKA PASS.

Few	Several	Many	Several	Many				Observed many sea lions on and about Unga Seal Rocks.
Few	Many	Several	Few	Several		1 large log.	Much	Several white goneys.
	One	Many	Few	Many			Much	Many killer whales.
	One	Many						1 white goney.

CRUISING ABOUT SHUMAGIN ISLANDS, AND RETURN TO DUTCH HARBOR.

Few	Few	Many	Many	Many				
Several		Many	Several	Many	Several		Little	1 white goney.
Many	Many	Many	Many	Many				Several white goneys.

Record of animal life, driftwood, kelp, etc., observed

FROM DUTCH HARBOR, UNALASKA ISLAND, TO SAND POINT, POPOF ISLAND,

Date.	Meridian position. Latitude north.	Meridian position. Longitude west.	Mean temperature. Air. Dry bulb.	Mean temperature. Water. Surface.	Fur seals.	Whales.	Auks.	Cormorants.	Ducks.
1893.	° ′ ″	° ′ ″	°	°					
June 20	54 38 00	159 37 00	46	43	....	Four......	Myriads ..	....	....
21	Sand Point, Popof Island, Alaska.		52	44	....	....	....	....	....
22	54 54 00	159 50 00	55	47	....	Several ...	Many.....	Few	Several ...
23	54 51 00	160 06 00	50	46	....	Two	Few	....	Several ...
24	Sanborn Harbor, Nagai Island, Alaska.		54	48	....	....	Few	....	Several ...
25	Sand Point, Popof Island, Alaska.		53	46	....	....	....	....	....
26	.....do		51	45	....	....	....	....	....
27	54 06 00	164 31 00	48	48	Sixty-eight.	Many.....	....	....	....
28	Dutch Harbor, Unalaska Island, Alaska.		53	49	....	....	....	....	....

FROM DUTCH HARBOR, UNALASKA ISLAND, TO

Date.	Latitude north.	Longitude west.	Air.	Water.	Fur seals.	Whales.	Auks.	Cormorants.	Ducks.
June 29	Dutch Harbor, Unalaska Island, Alaska.		56	48	....	....	....	....	....
30	53 01 00	170 37 00	44	42	Six	Six	....	....	....

from deck of Albatross at sea—Continued.

CRUISING ABOUT SHUMAGIN ISLANDS, AND RETURN, ETC.—Continued.

Gulls.	Goneys.	Guillemots.	Petrels.	Puffins.	Terns.	Drift-wood.	Kelp.	Remarks.
Many	Many	Many	Many	Many			Little	
Several	Few	Many		Several	Few		Little	
Many	Few	Many		Many			Little	3 oyster catchers in Mist Harbor.
Few	Few	Many					Little	1 oyster catcher in Sanborn Harbor.
		Several		Few				1 goose.
Many	Several	Many	Many	Many	Many			Many phalaropes.

BAY OF WATERFALLS, ADAK ISLAND, ALASKA.

Gulls.	Goneys.	Guillemots.	Petrels.	Puffins.	Terns.	Drift-wood.	Kelp.	Remarks.
Few							Much	
Many		Great many.	Many	Several			Much	Several white goneys.

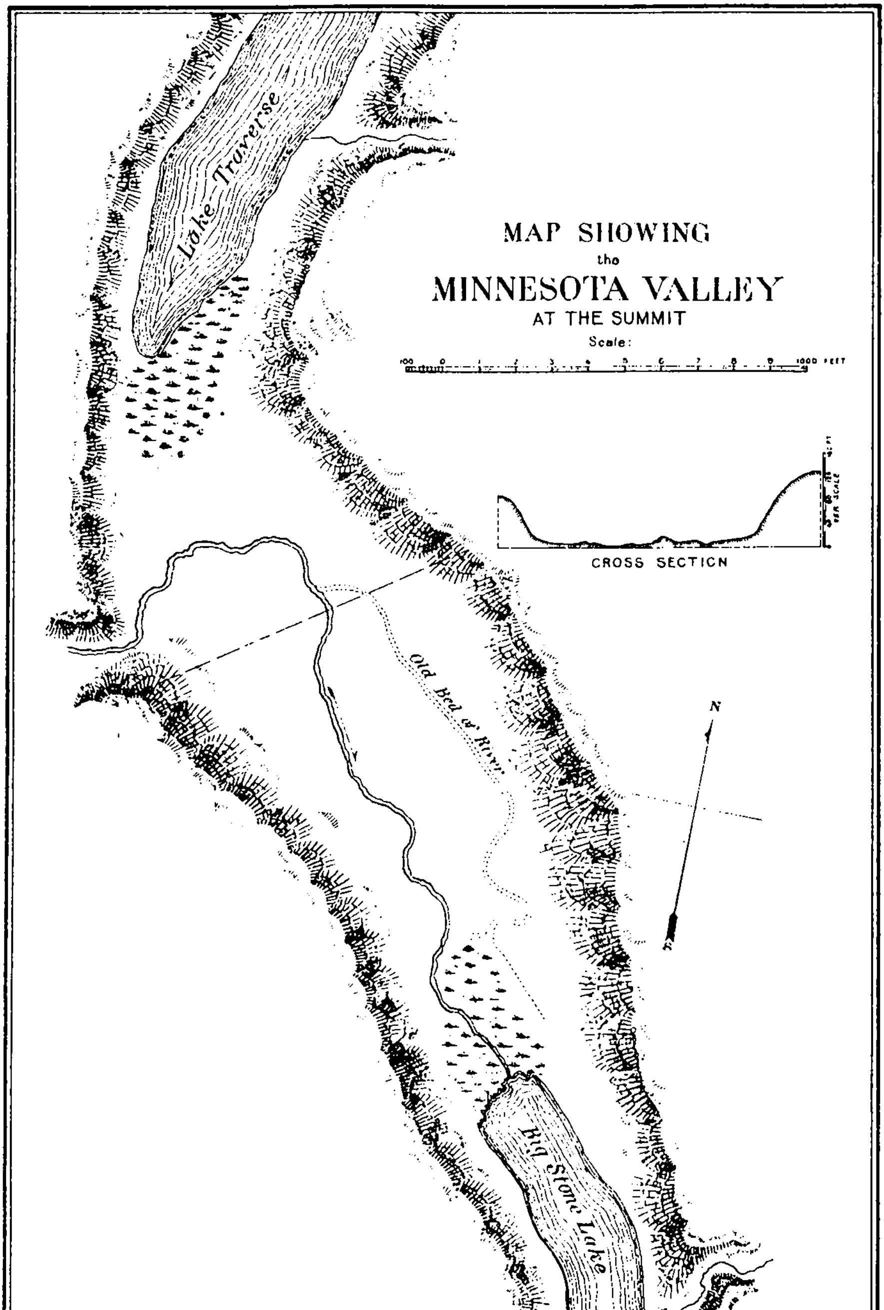
Record of temperatures and specific gravities.

Date.	Time of day.	Station.	Lat. N.	Long. W.	Depth.	Temperature by attached thermometer.	Temperature of the air.	Temp. of specimen at time specific gravity was taken.	Specific gravity.	Specific gravity reduced to 60° F.	Specific gravity reduced to 15° C.
1892.			° ′ ″	° ′ ″		°	°	°			
Aug. 3	12 m ...	....	54 01 30	165 58 30	Surface.	47	53	66	1.0234	1.024240	1.023420
3	6 p. m..	....	54 00 10	164 48 00	....do ...	50	51	66	1.0234	1.024240	1.023420
3	12 p. m.	....	54 30 00	163 36 00	....do ...	52	52	66	1.0236	1.024440	1.023620
4	6 a. m..	....	54 02 00	162 30 00	....do ...	53	52	66	1.0236	1.024440	1.023620
4	12 m ...	....	54 02 12	161 18 00	....do ...	54	55	66	1.0238	1.024640	1.023820
4	6 p. m..	....	54 07 00	160 20 00	....do ...	55	58	66	1.0238	1.024640	1.023820
4	12 p. m.	....	54 13 00	159 26 00	....do ...	54	55	66	1.0240	1.024840	1.024020
5	6 a. m..	....	54 19 00	158 30 00	....do ...	56	55	66	1.0240	1.024840	1.024020
5	12 m ...	....	54 22 00	157 27 00	....do ...	56	55	66	1.0241	1.024940	1.024120
5	6 p. m	....	54 29 00	156 33 00	....do ...	57	55	66	1.0240	1.024840	1.024020
5	12 p. m.	....	54 36 00	155 39 00	....do ...	55	54	66	1.0240	1.024840	1.024020
6	6 a. m..	....	54 45 00	154 45 00	....do ...	55	54	66	1.0241	1.024940	1.024120
6	12 m ...	....	54 50 00	153 52 00	....do ...	55	53	66	1.0240	1.024840	1.024020
6	6 p. m..	....	54 59 00	153 28 00	....do ...	55	54	66	1.0240	1.024840	1.024020
6	12 p. m.	....	55 10 00	153 04 00	....do ...	55	54	66	1.0240	1.024840	1.024020
7	6 a. m..	....	55 16 00	152 41 00	....do ...	55	53	66	1.0239	1.024740	1.023920
7	12 m ...	....	55 27 00	152 15 00	....do ...	55	55	66	1.0240	1.024840	1.024020
7	6 p. m..	....	55 34 00	151 07 00	....do ...	56	55	66	1.0240	1.024840	1.024020
7	12 p. m.	....	55 42 00	149 59 00	....do ...	54	54	66	1.0240	1.024840	1.024020
8	6 a. m.	....	55 47 00	148 52 00	....do ...	53	53	66	1.0241	1.024940	1.024120
8	12 m ...	....	55 53 00	147 42 00	....do ...	55	54	66	1.0240	1.024840	1.024020
8	6 p. m..	....	55 59 00	146 29 00	....do ...	56	54	66	1.0239	1.024740	1.023920
8	12 p. m.	....	56 05 00	145 16 00	....do ...	56	55	66	1.0238	1.024640	1.023820
9	6 a. m..	....	56 12 00	144 03 00	....do ...	55	55	66	1.0239	1.024740	1.023920
9	12 m ...	....	56 16 00	142 50 30	....do ...	57	59	66	1.0238	1.024640	1.023820
9	6 p. m..	....	56 23 00	141 39 00	....do ...	56	55	66	1.0238	1.024640	1.023820
9	12 p. m.	....	56 29 00	140 27 00	....do ...	56	55	66	1.0236	1.024440	1.023620
10	6 a. m..	....	56 35 00	139 19 00	....do ...	58	55	66	1.0234	1.024240	1.023420
10	12 m ...	....	56 46 00	138 05 00	....do ...	59	57	66	1.0234	1.024240	1.023420
10	6 p. m..	....	56 55 00	137 01 00	....do ...	59	59	66	1.0232	1.024040	1.023220
10	12 p. m.	Sitka Bay			....do ...	55	55	66	1.0230	1.023840	1.023020
11	8 a. m..	Sitka, Alaska			....do ...	56	54	66	1.0228	1.023640	1.022820
19	12 m ...	....	55 07 00	134 20 00	....do ...	61	61	66	1.0230	1.023840	1.023020
20	12 m ...	....	52 30 00	132 14 00	....do ...	60	59	66	1.0233	1.024140	1.023320
21	12 m ...	....	51 04 00	128 16 00	....do ...	58	61	66	1.0230	1.023840	1.023020
22	12 m ...	....	50 24 00	125 38 00	....do ...	52	58	66	1.0180	1.018840	1.018020
23	12 m ...	Departure Bay, B. C			....do ...	54	58	66	1.0172	1.018040	1.017220
1893.											
May 20	7 p. m..	Off Point Reyes, Cal			....do ...	54	54	64	1.0248	1.025211	1.024391
20	12 p. m.	....	38 30 00	123 39 00	....do ...	52	52	64	1.0248	1.025211	1.024391
21	6 a. m..	....	39 09 00	123 48 00	....do ...	51	55	63	1.0250	1.025411	1.024591
21	12 m ...	....	39 48 30	123 59 00	....do ...	53	56	63	1.0251	1.025511	1.024691
21	6 p. m..	....	40 27 00	124 09 00	....do ...	51	53	63	1.0250	1.025411	1.024591
21	12 p. m.	....	41 06 00	124 20 00	....do ...	50	52	63	1.0248	1.025211	1.024391
22	6 a. m..	....	41 45 00	124 30 00	....do ...	51	53	63	1.0244	1.024811	1.023991
22	12 m ...	....	42 25 00	124 39 00	....do ...	53	55	63	1.0243	1.024711	1.023891
22	6 p. m..	....	43 18 00	124 34 00	....do ...	52	52	63	1.0240	1.024411	1.023591
22	12 p. m.	....	44 11 00	124 28 00	....do ...	50	49	63	1.0240	1.024411	1.023591
23	6 a. m..	....	45 04 00	124 23 00	....do ...	51	50	63	1.0242	1.024611	1.023791
23	12 m ...	....	45 58 00	124 19 00	....do ...	51	52	63	1.0190	1.019411	1.018591
23	6 p. m..	Off Grays Harbor			....do ...	52	52	63	1.0150	1.015411	1.014591
23	12 p. m.	Off Destruction Island			....do ...	51	51	63	1.0162	1.016611	1.015791
24	6 a. m..	Cape Flattery			....do ...	52	50	63	1.0208	1.021211	1.020391
27	12 m...	Port Townsend			....do ...	50	59	63	1.0226	1.023011	1.022191
29	12 m...	Vancouver, B. C			....do ...	52	55	63	1.0126	1.013011	1.012191
30	12 m...	Comox, B. C			....do ...	56	58	63	1.0180	1.018411	1.016591
June 1	10 a. m.	Alert Bay, B. C			....do ...	49	53	63	1.0216	1.022011	1.021191
1	12 p. m.	Queen Charlotte Sound			....do ...	48	49	63	1.0234	1.023811	1.022091
2	6 a. m..	Off Queen Charlotte Island..			....do ...	49	49	63	1.0234	1.023811	1.022991
2	12 m...	....	51 28 00	130 55 00	....do ...	48	48	63	1.0238	1.024211	1.023391
2	6 p. m..	....	51 52 00	131 52 00	....do ...	47	48	63	1.0240	1.024411	1.023591
2	12 p. m.	....	52 17 00	132 45 00	....do ...	47	48	63	1.0242	1.024611	1.023791
3	6 a. m..	....	52 39 00	133 48 00	....do ...	48	48	63	1.0242	1.024611	1.023791
3	12 m...	....	53 04 00	134 46 00	....do ...	49	50	63	1.0242	1.024611	1.023791
3	6 p. m..	....	53 35 00	135 53 00	....do ...	47	48	63	1.0242	1.024611	1.023791
3	12 p. m.	....	54 06 00	137 00 00	....do ...	46	48	63	1.0244	1.024811	1.023091

Record of temperatures and specific gravities—Continued.

Date.	Time of day.	Station.	Lat. N.	Long. W.	Depth.	Temperature by attached thermometer.	Temperature of the air.	Temp. of specimen at time specific gravity was taken.	Specific gravity.	Specific gravity reduced to 60° F.	Specific gravity reduced to 15° C.
1893.			° ′ ″	° ″ ″		°	°	°			
June 4	6 a. m.	....	54 37 00	138 10 00	Surface	46	47	63	1.0244	1.024811	1.023991
4	12 m.	....	55 06 00	139 17 00	...do...	46	47	63	1.0242	1.024611	1.023791
4	6 p. m.	....	55 43 00	140 15 00	...do...	46	47	63	1.0242	1.024611	1.023791
4	12 p. m.	....	56 20 00	141 11 00	...do...	45	45	63	1.0242	1.024611	1.023791
5	6 a. m.	....	56 58 00	142 09 00	...do...	46	45	63	1.0240	1.024411	1.023591
5	12 m.	....	57 37 00	143 11 00	...do...	47	48	63	1.0240	1.024411	1.023591
5	6 p. m.	....	57 41 00	144 31 00	...do...	46	46	63	1.0242	1.024611	1.023791
5	12 p. m.	....	57 44 00	145 51 00	...do...	46	46	63	1.0242	1.024611	1.023791
6	6 a. m.	....	57 49 00	147 11 00	...do...	44	43	63	1.0242	1.024611	1.023701
6	12 m.	....	57 51 00	148 34 00	...do...	45	46	63	1.0242	1.024611	1.023791
6	6 p. m.	Off Kadiak Island			...do...	45	47	63	1.0240	1.024411	1.023591
6	12 p. m.	St. Paul Harbor			...do...	44	45	62	1.0230	1.023270	1.022450
8	12 m.	St. Paul, Kadiak			...do...	49	50	62	1.0230	1.023270	1.022450
9	12 m.	....	55 41 00	155 19 09	...do...	45	45	62	1.0242	1.024470	1.023650
11	9 a. m.	Humboldt Harbor			...do...	43	50	62	1.0240	1.024270	1.023450
12	12 m.	....	53 07 00	166 15 00	...do...	44	44	62	1.0244	1.024670	1.023850
13	10 a. m.	Amukta Pass			...do...	41	44	63	1.0248	1.025211	1.024391
14	8 p. m.	Analga Pass			...do...	42	46	63	1.0246	1.024011	1.024191
15	12 m.	....	54 19 00	162 10 00	...do...	44	46	63	1.0242	1.024611	1.023791
19	12 m.	Sandy Cove			...do...	42	46	63	1.0240	1.024411	1.023591
20	12 m.	....	54 38 00	159 37 00	...do...	43	46	63	1.0240	1.024411	1.023591
23	12 m.	....	54 57 00	160 06 00	...do...	44	52	63	1.0235	1.023911	1.023091
24	12 m.	Sanborn Harbor			...do...	44	52	63	1.0235	1.023911	1.023091
27	12 m.	....	54 06 00	164 31 00	...do...	47	50	63	1.0238	1.024211	1.023391
30	12 m.	....	53 01 00	170 37 00	...do...	44	45	63	1.0246	1.025011	1.024191

NOTE.—All specimens taken at about 1 foot below the surface, by means of a water bottle.



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3.—A REPORT UPON ICHTHYOLOGICAL INVESTIGATIONS IN WESTERN MINNESOTA AND EASTERN NORTH DAKOTA.

BY ALBERT J. WOOLMAN, A. M.

INTRODUCTION.

The field work described in this report was carried on during the months of July and August, 1892. The writer was assisted during the first part of the season by Ulysses O. Cox, instructor in biology in the State Normal School, Mankato, Minn. The work was conducted under instructions from the United States Commissioner of Fish and Fisheries, Hon. Marshall McDonald, and under the immediate direction of Mr. Richard Rathbun, assistant in charge of inquiry respecting food-fishes.

The object of the investigation was to examine the physical features of Big Stone and Traverse lakes, and to make a careful study of the fishes found in them for the purpose of comparing and contrasting the forms found in these two great river systems—the Minnesota and Red River of the North—this being the place where they most nearly approach; to observe and record any items of interest bearing on the fishes indigenous to these waters, and to note any other facts that would in any way bear on fish-culture, such as geological features, water supply, vegetation, food supply, and contamination of water.

In the identification of species I have been assisted by Dr. Barton W. Evermann, of the United States Fish Commission, and Dr. Carl H. Eigenmann, of the University of Indiana.

The basins and river systems were studied in the following order:

- Lake Traverse Basin:
  - Lake Traverse.
  - Daugherty Creek.
  - Muslinka River.
- Big Stone Lake Basin:
  - Little Minnesota River—
    - At Browns Valley.
    - Near Sisseton Indian Reservation.
    - At the head of Big Stone Lake.
  - Big Stone Lake at Creager's Farm and Ortonville, Minn.
- Minnesota River Basin:
  - Wheatstone Creek.
  - Pomme de Terre River.
  - Chippewa River.
  - Minnesota River at Ortonville and Montevideo, Minn.
- James River at La Moure and Jamestown, N. Dak.
  - Pipestem River.
- Red River of the North and tributaries:
  - Red River of the North at Moorhead, Minn., and Grand Forks, N. Dak.
  - Otter Tail River.
  - Cheyenne River at Lisbon and Valley City, N. Dak.
  - Maple Creek.
  - Buffalo River.
  - Goose River.
  - Red Lake River at Grand Forks and Crookstown, N. Dak.
  - Pembina River.
  - Tongue River.
  - Forest River.
  - Park River.

THE RED RIVER OF THE NORTH.

The Red River of the North is the only large stream within the borders of the United States that finds a northern outlet for its waters. Its course is down a long, gentle slope culminating in a low watershed that separates this system from that of the Mississippi on the south, east, and west. This divide in no place reaches the dignity of a mountain range, but is low, and in places broad and level, and is composed entirely of drift brought down from the northeast and north during glacial times. Maps represent the Red River of the North as the outlet of Lake Traverse and as a broad, marshy river in its upper course. But it is not the outlet of this lake nor has it been for many years. Neither is it broad and marshy as a river.

It is evident that the long trough occupied by Lake Traverse, Big Stone Lake, the Minnesota River, and the Mississippi River was at one time a magnificent waterway draining an inland lake greater in area than Lake Superior. This old river channel has been scooped out 150 to 200 feet below the surrounding country, and is 1 or 2 miles wide, retaining this width with remarkable constancy throughout its 300 miles or more of length.

TRAVERSE AND BIG STONE LAKES.

These two large lakes occupy that part of the valley of "River Warren" that lies between the parallels of 45° 15′ and 45° 55′ north. This section of the valley is over 1¼ miles wide, and of an average depth of 145 feet. The general direction of the valley is north and south, although the middle of this section is strongly curved to the west. The two lakes are about 5 miles apart, separated by sediment piled a few feet above the surface of Traverse Lake. This deposit separating the two lakes is not, however, the divide between the two river systems; the main divide or highest land lies to the north of Traverse Lake. Entering the valley from the west, about a mile below Traverse Lake, is the Little Minnesota River. This stream has worn for itself a valley extending to the northwest commensurate with its size and eroding power; upon reaching the broader valley, it lost its power to erode and at once began to deposit its sediment, which it extended across the valley dividing and separating the two waters, thus forming two lakes from the one that already existed, or perhaps damming the stream before Big Stone Lake had been formed.

It is quite evident from the following that after the Minnesota River had ceased to be the outlet of Lake Winnipeg, the entire valley of 35 miles, forming the semicircle from the head of Lake Traverse to the foot of Big Stone Lake, was one lake:

(1) The granite outcrop at the foot of Big Stone Lake resisted erosion to so great an extent that during the full discharge of water down this passageway it was left projecting above that part of the bed farther

north, which became a basin that would remain filled with water, and it naturally follows that after this water-course had ceased to receive supplies from the north, the small amount of water that would escape from this lake, with its diminishing velocity, would not erode a granite bed sufficiently to rapidly reduce the depth of this lake.

(2) The ancient shore line of Lake Traverse can be traced a mile below the present limit of the lake and would indicate a former union with Big Stone Lake since the days of active running water in this channel. The character of both the fauna and flora would bear out this theory, since the difference in vegetation in the valley and on the hillside is much more marked and pronounced between the lakes than it is below the foot of Big Stone Lake or above the head of Traverse Lake. Likewise the windings of the old bed of the Little Minnesota River would indicate little or no opposition from running waters.

The similarity of species of fishes found in the two lake basins would indicate that these two lakes had at one time been connected and that there was free water communication between the parts, while the number of comparatively unimportant and minor differences (which, however, are quite noticeable and constant, and in some cases reach almost varietal importance) show clearly the landlocked condition of the fishes of Lake Traverse and amount almost to proof that these lakes have not been united in recent years.

LAKE TRAVERSE.

Lake Traverse forms the greater part of the northwestern boundary of Traverse County, one of the western tier of counties in the State of Minnesota. It is a long, narrow body of water, varying from 1 to 1½ miles in width. The valley is of a regular trough shape, sloping from the top of the hills to the bottom of the lake. The water of the lake lies low in this trough, with but a narrow margin of level land between it and the steep hillsides.

The lake is shallow, with a maximum depth of 30 feet and an average of possibly 15 feet, the depth fluctuating to the extent of 2½ to 4 feet in periods of about four years. This variation is closely connected with the rainfall, but is said sometimes to happen without apparent cause. The lake at the time of our visit was about 3 feet deeper than it had been for four years. The water frequently falls so low that the large drift bowlders project from the surface of the water in the middle of the lake. The shore line is quite regular, marking a more than usual stony area in the drift. The water is warm, 77° at the time of our visit in July, and, owing to its shallowness and the high winds that stir the lake to its bed, the top and bottom temperatures are practically the same. The water is comparatively pure, never containing clay in sufficient quantities to cause it to look turbid; it is soft and contains but little mineral salts. The hills on either side of the lake are 150 to 200 feet high and composed entirely of drift, a greater part of which is of large granite boulders which cover the ground thickly and which are piled in great heaps or walls along the southeastern shore of the lake. The bowlders lying near the lake are worn smooth by the action of the waves. Throughout the greater part of the winter the water is frozen, and frequently to the bottom, over much of the lake.

This lake has no outlet, nor is it as long as it is usually represented. Eighteen miles or more of the northern end of what is ordinarily represented as Lake Traverse is a vast meadow land over which the water does not extend. The waters would drain to the south if the present basin were filled to overflowing. The character of the ground is quite different at the opposite ends, the one being a comparatively recently formed dam and the other composed of sediment from a lake bed overgrown with rank vegetation. This great meadow is a wilderness of coarse, wild grasses, 6 to 8 feet high, interspersed with areas of smaller prairie grass that is used by the neighboring farmers for hay. It is 60 or 75 miles in length and somewhere within this area the Boise de Soux River (the nominal head of the Red River of the North) has its source. The Boise de Soux River is a small, sluggish, bayou-like stream only a few feet wide and of uncertain channel.

Traverse Lake has but two small inlets—one from the east, the Muslinka River, and one from the west that has been called Daugherty Creek. These two small streams, together with a small annual rainfall, are the only visible means of water supply. The Muslinka River, the eastern and larger of the two tributaries, is a small stream, 40 or 50 miles long, that flows only during the spring and early summer.

The lake teems with animal and plant life. Most of the water-plants of this section of the country appear to be represented, ranging from the great rushes to the tiny desmids. Bulrushes, beakrushes, nutrushes, sedges, and grasses grow in luxuriance. Several species of *Potamogeton*, milfoil, and bladderwort were observed, but the lake is particularly rich in algæ. Quantities of *Chara*, and a large, coarse *Vaucheria* grow in various places. Species of smaller filamentous algæ and desmids and diatoms are present. The vegetation in the lake does not decay on the bottom, but is washed to the shore.

The lake contains an abundance of animal life; the lower forms are present in great numbers and variety. Crustacean life is abundant. A few crawfish were observed, and the shallow waters near the shore and among the weeds and rocks were filled with *Gammarus*, while swarms of *Daphnia*, *Cyclops*, and other small forms filled the surface waters. Great numbers of insects and their larvæ sported among the stones. The families *Gyrinidæ* and *Hydrophidæ* predominated, and were each represented by several species. Molluscan life was abundant, especially univalves. The genus *Planorbis* was represented by several species; these were slowly crawling over the vegetation or floating leisurely about near the surface of the water with the broad, almost circular foot expanded and protruding just above the surface, while the flat spiral shell hung suspended in the water. The genus *Limnæa* was more abundant, both in variety and numbers. Limpets fastened to the bottom and sides of stones were also abundant.

Though the food supply is plentiful, comparatively few fishes were found in the lake; owing to the great number of bowlders thickly strewn over the bottom of the lake the seine could not be used to good advantage, but from observation and what could be learned from local fishermen, about the only food species taken are pickerel (*Lucius lucius*), catfish (*Ameiurus nebulosus*), and a few strawberry bass (*Pomoxis*); nor are these varieties as abundant as in former years. No small fishes were observed in the lake proper, and frequent attempts with hook and line failed.

The two tributaries of Lake Traverse were examined, which completed the work in this lake.

The specimens obtained give a fair representation of the fish fauna of this basin.

Daugherty Creek, Browns Valley, Minnesota, July 13, 1892.—This is the largest western tributary of Lake Traverse. It flows into the lake about 8 miles from the southern end, and is only a meadow brook 8 or 10 miles long, the outlet of two small "grass lakes." The stream will average 6 feet in width and has a rapid current in the narrow places. The depth of the water varies from 1 to 3 feet. The bed of the stream is of gravel and coarse stones. The banks are overgrown with grass and other prairie vegetation, but no trees are to be found. In the more quiet places the water is matted with water vegetation, *Potamogeton, Myriophillum, Sagittaria, Lemna*, and a few species of algæ. The temperature of the water was 67°.* Numerous small crustaceans and insects sported among the tangled vegetation. As a southern tributary to this stream, a small spring brook added its waters, which were much cooler, 62°. The stream is well stocked with fish, but of few species. During the spring pickerel (*Lucius lucius*) ascend to spawn, and we were informed on good authority that they sometimes fill the stream and can be thrown upon the bank with forks or shovels in large numbers.

Muslinka River, Wheaton, Minn., July 22.—This river rises in the central portion of Grant County, Minn., flows a general southeasterly direction for 25 miles, and joins Lake Traverse at its head, or northern end. The stream lies at the bottom of a broad, shallow valley, one-half to three-fourths mile in width, and is by far the largest and longest tributary of this lake, but it is little more than "a wet-weather drain." It is long and winding, with low banks and a current that moves so slowly that its motion is almost imperceptible; it does but little, except during the season of greatest rainfall, to replenish the waters of the lake. The stream will average 18 feet in width and 2½ feet in depth.

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* The temperatures given in this paper are in Fahrenheit degrees, and were determined by means of a Wilder protected thermometer.

The banks are low and without trees, the prairie grass and other vegetation growing to the water's edge. The bed of the stream is of small gravel, mud, and decayed vegetation, from which grow rushes, pondweeds, and bladderworts (*Utricularia*). The stream was almost entirely devoid of fish life, owing, no doubt, to its having no direct communication with the lake for several months in the year.

Two species of fish were taken, *Lucius lucius* and *Notropis megalops*, and these were very rare. Crawfish were particularly abundant, and one species of water-snail (*Limnæa*) was also abundant. Temperature of the water, 78°; of the air, 75°, cooled by the recent rains.

The following is a list of fishes taken from Lake Traverse basin. The measurements are given in millimeters unless otherwise stated.

ANNOTATED LIST OF THE FISHES OF LAKE TRAVERSE BASIN.

1. **Pimephales notatus** (Rafinesque). *Shiner; Creek Shiner.* Daugherty Creek at Browns Valley, rare. Shape and color much like *P. promelas;* head black, snout blunt; fins dark, snout and lower jaw turbercled; lateral line with 40 scales, not distinct anteriorly.
2. **Notropis megalops** (Rafinesque). *Common Silverside; Brook Shiner.* Muslinka River at Wheaton, 5 specimens. Daugherty Creek at Browns Valley, abundant. This species was particularly abundant. Specimens very dark—much darker than those from Little Minnesota River. Lateral line black; body slightly deeper than in those from Little Minnesota River.
3. **Rhinicthys cataractæ dulcis** (Girard). Daugherty Creek at Browns Valley, 10 specimens. Not common. Body moderately elevated; shoulders heavy; caudal peduncle compressed, but deep; head medium or small; line from snout to top of shoulders slightly concave; eyes small; mouth horizontal and small, maxillary reaching about half the distance from snout to eye. Color dark, almost black above, mottled with black blotches which extend to the lateral line; belly, cheeks, and lower jaws light; dorsal and caudal fins dark; ventral and anal fins light; rays of anal longer than those of any other fin, nearly as long as head; ventrals half as long as anal; dorsal, 7; anal, 7; scales, 63 to 70.
4. **Hybopsis kentuckiensis** (Rafinesque). *Chub; River Chub.* Daugherty Creek at Browns Valley, common. Color dark; caudal spot conspicuous in all specimens. Head $3\frac{1}{2}$ in body.
5. **Semotilus atromaculatus** (Mitchill). *Horned Dace.* Daugherty Creek at Browns Valley, abundant.
6. **Lucius lucius** (Linnæus). *Pike; Northern Pickerel.* Muslinka River at Wheaton, 12 specimens. Daugherty Creek at Browns Valley, abundant. Traverse Lake, not common. This is about the only food-fish in Traverse Lake. It ascends the creeks in great numbers in the spring of the year to spawn.
7. **Eucalia inconstans** (Kirtland). *Brook Stickleback.* Daugherty Creek at Browns Valley, 12 specimens. Color, dark olive with tessellations on sides; males almost black. This species prefers the cold water and sheltered places.

BIG STONE LAKE.

The valley occupied by this lake is very similar in character to that occupied by Lake Traverse. There is a more marked slope of the surface of the country to the south than to the north. The country to the south has suffered more from erosion, deep ravines and waterways having been cut through the drift, and in places touch bedrock. Big Stone Lake is from 35 to 38 miles long and from 1½ to 2 miles wide. The lake lies in more curves than Traverse and is less regular in width. It exceeds Lake Traverse in depth, its maximum depth being 35 feet. The bottom is of sand, and in some places a few inches of mud, strewn with bowlders of various sizes. The temperature of the water at surface and bottom is practically the same, owing to the frequent winds that stir the water to the bottom. This body of water is subject to less fluctuation in depth than Lake Traverse, on account of the outlet, which the latter does not possess.

The water contains but little mineral matter and is always clear and fresh. The lake is said to be supplied with water from large springs in the bottom, but nothing of the kind was observed, though several fine springs along the eastern shore were visited. Besides the springs and the direct surface drainage from a comparatively small area, the lake receives the inflow from Little Minnesota River. The banks, which for the most part are of the same slope and are almost continuous with the higher hills, are composed entirely of drift material, no outcrop occurring except at the foot of the lake. The shore is skirted with a narrow belt of small timber that offers protection and shade. There is very little vegetation in the water. Around the inlet and outlet are a few acres of rushes, and these are bordered by a small area of submerged vegetation.

The lake is covered with ice during the winter, though it never freezes to the bottom. Fish food, such as water insects, larvæ, crustaceans, and mollusks, is not as abundant as in Lake Traverse, yet the supply is apparently sufficient. Two species of water-snail are common, and a few shells of *Anodonta* were observed. It was also reported that these bivalves were numerous about certain islands in the lake.

The young of *Catostomus teres* and *Moxostoma macrolepidotum*, together with *Percopsis guttatus* and a few species of *Etheostoma* and *Notropis*, were also common.

The lake is well stocked with several varieties of good food-fishes, foremost among which are pickerel (*Lucius lucius*), bass (*Micropterus salmoides*), wall-eyed pike (*Stizostedion vitreum*), rock bass (*Ambloplites rupestris*), and crappie (*Pomoxis sparoides*).

The pickerel is one of the most abundant species; specimens weighing from 8 to 12 pounds are often obtained. It is easily taken with the hook, almost anything that will satisfy its voracious appetite or attract its attention serving for bait. The large-mouth black bass is the favorite of the angler, since much more skill is required in its capture. Almost any bait will suffice to take this species here, but the young of *Carpiodes velifer*, 1½ to 2 inches long, and *Fundulus diaphanus*, of about the same size, are found most frequently in bait buckets, while the smaller species of *Pimephales* and *Etheostoma* are not infrequently used.

White or silver bass (*Roccus chrysops*) are common and very abundant in April and May about the mouth of Little Minnesota River or in any other inlet. This species is said to take a fly almost as readily as does a trout, and is captured in this way or with a small minnow. It attains a weight of from 2½ to 3½ pounds, and is a luxury when brought to the table. Yellow perch (*Perca flavescens*) can be taken in large numbers, while large specimens of the two most abundant varieties of sunfish (*Lepomis pallidus* and *Lepomis megalotis*) can be taken from a boat or at almost any point along the shore. Catfish (*Ameiurus nebulosus*) are taken, but are not valued as food. The sheepnose, or grunter (*Aplodinotus grunniens*), is also common, reaching a weight of 6 or 8 pounds, but the larger ones are not prized as food, the flesh being tough and unpalatable, especially after the spawning season.

A sucker (*Ictiobus cyprinella?*) grows to a very large size in this lake. It remains in deep water near the bottom during the day, but is speared at night, when it enters the more shallow water to feed.

Big Stone Lake, Creager's farm, July 16, 1892.—The water at this place, 12 miles from the head of the lake, will average 14 or 16 feet in depth, and the lake is at that point a mile wide. The shore consists of a series of gentle curves and sharp points. The bed of the lake is in places smooth and sandy and at others very rocky, the rocky bays usually alternating with the smooth sandy bottom of the points. The shore, especially on the south side, is skirted with small trees and bushes, of which elm, oak, and box-elder are the most common varieties. At this place we spent an entire day collecting. The fishing was done with a 250-foot seine. Though the bottom of the lake was somewhat stony, the work was very successful, and not only a fair representation of the species of the fish was obtained, but also an indication of the abundance of each species. Every haul of the seine landed perch, bass, suckers, pickerel, white bass, and sunfish. *Percopsis guttatus* was also taken in large numbers.

Big Stone Lake, Ortonville, Minn., July 19, 1892.—Ortonville is at the foot of Big Stone Lake and at the junction of the Wheatstone and Minnesota rivers. The surrounding hills are very high and have been eroded into somewhat rugged cliffs. The banks are well timbered on the south side, along which the bays and inlets are well shaded. The bottom of the lake is composed of sand, thickly strewn with bowlders. The water is not deep, and the bed slopes gradually up toward the foot of the lake and toward the shores. The coves along the eastern bank are filled with granite bowlders, and the points of land extending into the water are composed entirely of this material. The water is clear, containing less vegetation than at the head of the lake. A few rushes grow about the outlet, and the bottom in more shallow places is covered with *Chara* and *Potamogeton*. Water insects and small crustaceans were observed, but were not abundant. The variety of fishes was much greater than at the head of the lake. The following is a list of the fishes taken from Big Stone Lake and its tributaries:

ANNOTATED LIST OF THE FISHES OF BIG STONE LAKE AND TRIBUTARIES.

1. **Ameiurus nebulosus** (Le Sueur). *Catfish; Bullhead.* Little Minnesota River at Browns Valley, 1 large specimen; Big Stone Lake at Ortonville, 5 specimens; Big Stone Lake at Creager's farm, 3.
2. **Catostomus teres** (Mitchill). *White Sucker; Brook Sucker.* Little Minnesota River at Browns Valley, common; Big Stone Lake at Creager's farm, 25 specimens; Big Stone Lake at Ortonville, 10; Little Minnesota River near Indian Agency, 5. At no place were large specimens of this species taken except at Creager's farm, where a large seine was used and several specimens from 12 to 15 inches long were obtained.
3. **Moxostoma macrolepidotum duquesnei** (Le Sueur). *Redhorse; White Sucker.* Little Minnesota River at Browns Valley, 2 specimens; Big Stone Lake at Creager's farm, 16; Big Stone Lake at Ortonville, common. The specimens taken from the river were light in color, with little variation. Those taken from the clearer waters of the lake were steel-blue above, with sides and belly white.
4. **Pimephales notatus** (Rafinesque). *Minnow.* Big Stone Lake at Creager's farm, 6 specimens; Big Stone Lake at Ortonville, 10. Those taken from the latter place were very large, with snouts tubercled.
5. **Notropis deliciosus** (Girard). Little Minnesota River at Browns Valley, 2 specimens; Big Stone Lake at Ortonville, 4.
6. **Notropis megalops** (Rafinesque). *Common Shiner.* Little Minnesota River at Browns Valley, abundant; Little Minnesota River near Indian agency, 10 specimens; Big Stone Lake at Creager's farm, 7; Big Stone Lake at Ortonville, 9. Those taken from the Little Minnesota River were noticeably lighter in color than those from Lake Traverse Basin.
7. **Notropis atherinoides** Rafinesque. Big Stone Lake at Creager's farm, 1 very large specimen. Lateral line with 38 scales. Color dark olive, with sides and belly covered with a thick coat of silvery pigment.
8. **Notropis cayuga** Meek. Little Minnesota River at Browns Valley, abundant. This is a very beautiful little fish, of a light brown or olive color, with dark spots lining the edge of each scale; a dark lateral band about 2 scales in width passes entirely around the blunt snout, not touching the lower lip. This lateral stripe is overlaid with a light coat of silvery pigment; above and bordering this stripe is a distinct narrow line of a lighter color; dorsal line not distinguishable. Back not arched; lower jaw not horizontal, and projecting.
9. **Notropis hudsonius** (Dewitt Clinton). Little Minnesota River at Browns Valley, 4 specimens; Big Stone Lake at Creager's farm, 2 specimens. This fine minnow is known to inhabit a broad area in the valley of the Red River of the North and a limited area in the Minnesota River Valley. The back is slightly elevated, sloping gradually from the snout to the dorsal, the belly is of about the same curvature as the back, so that the lateral line is about the axis of the body; head medium in size, with short blunt snout; lower jaw nearly horizontal, maxillary reaching anterior edge of orbit of large eye; anterior rays of dorsal above or slightly in advance of first rays of ventral, longest dorsal ray reaching slightly beyond anterior margin of anal; caudal peduncle thick. Color, above a dark olive, with vertebral stripe the entire length of body; sides ornamented with a broad lateral stripe that extends around the snout; sides and belly covered with a satin-like pigment; lateral

line slightly curved, complete, with about 38 to 41 scales. The two specimens from the lake were somewhat darker and richer in color, with body and caudal peduncle more slender. These specimens are of the form described recently by Eigenmann & Eigenmann as *Notropis scopifer*.

10. **Hybopsis kentuckiensis** (Rafinesque). *River Chub.* Little Minnesota River at Browns Valley, 2 specimens, both small. This species apparently does not thrive in these waters as it does farther south.

11. **Percopsis guttatus** Agassiz. *Trout Perch.* Little Minnesota River at Browns Valley, rare; Big Stone Lake at Creager's farm, 20 specimens. This is apparently the most common species of small fish at the last-named place, where it is highly prized for bait by the local fishermen. It was taken near shore in about 4 feet of water and usually from over a sandy bottom.

12. **Fundulus diaphanus** (Le Sueur). *Mud Minnow; Top Minnow.* Big Stone Lake at Creager's farm, 7 specimens; Big Stone Lake at Ortonville, 12, taken in shallow water near the shore. Ovaries of females filled with eggs, some of which were ripe, while others were very small. The intestinal canal was filled with a peculiar pin-shaped parasite about a quarter of an inch long.

13. **Lucius lucius** (Linnæus). *Northern Pickerel; Pike.* Little Minnesota River at Browns Valley, 8 large specimens; Big Stone Lake at Ortonville, 3; Big Stone Lake at Creager's farm, 12. This is the most abundant food fish of this region.

14. **Eucalia inconstans** (Kirtland). *Brook Stickleback.* Big Stone Lake at Orton ville. This species does not inhabit the lake to any extent.

15. **Pomoxis annularis** Rafinesque. *Red-eye; Straw Bass; Calico Bass.* Big Stone Lake at Creager's farm, common. An excellent food-fish, thriving in these waters.

16. **Lepomis pallidus** (Mitchill). Big Stone Lake at Ortonville, common. Great numbers are taken with hook and line; worms or insects are used for bait.

17. **Lepomis megalotis** (Rafinesque). *Blue-gill.* Taken only at Ortonville. Numbers and habits about the same as those of *L. pallidus*. Several young specimens taken with the seine.

18. **Micropterus dolomieu** (Lacépède). *Small-mouth Black Bass.* Little Minnesota River at Browns Valley, 3 specimens; Big Stone Lake at Creager's farm, 5. This species was not abundant and only very small specimens were taken.

19. **Micropterus salmoides** (Lacépède). *Large-mouth Black Bass.* Little Minnesota River at Browns Valley, common; Big Stone Lake at Creager's farm, 12 specimens; Big Stone Lake at Ortonville, common. One of the most abundant game fishes and one to which the lake seems particularly well adapted.

20. **Etheostoma aspro** (Cope & Jordan). *Black-sided Darter.* Little Minnesota River at Browns Valley, 5 large specimens. Head 4; depth $5\frac{1}{4}$; dorsal IX or X–11 or 12; anal II,7.

21. **Etheostoma nigrum** Rafinesque. Little Minnesota River at Browns Valley, 2 specimens; Big Stone Lake at Creager's farm, 15; Big Stone Lake at Ortonville, common. Color dark. Head and shoulders heavy, tapering to the long caudal peduncle; cheeks and opercles covered with scales; lateral line with 40 to 52 scales. A specimen from the outlet of Big Stone Lake is somewhat peculiar and may be described as follows: Head, $3\frac{1}{2}$ (without flap, $3\frac{1}{4}$); depth, $5\frac{2}{3}$; eye, $4\frac{1}{2}$ (4 without flap), equaling snout. D. VIII–12; A. 1, 8; scales 4–49–5. Body slender, resembling *Etheostoma olmstedi* in general form, head moderate, caudal peduncle long and slender; mouth large, nearly horizontal; premaxillaries protractile; maxillary reaching vertical of pupil; gill-membranes scarcely connected. Cheeks naked or nearly so; opercles, nape, and breast scaled, belly with ordinary scales; lateral line complete, slightly arched in an anterior portion. Dorsal fin high, longest spine about $1\frac{2}{3}$ in head, soft portion a little higher; anal rays about 2 in head, anal fin smaller than soft dorsal; its base $1\frac{2}{3}$ in that of soft dorsal; pectoral long, as

long as head, almost reaching anal fin; ventrals short, 1⅙ in pectoral. Color of male in alcohol, dusky, with ten or eleven darker vertical bars extending from median line of back to below lateral line, the anterior ones narrow, those on posterior part of body broader; the spaces between these bars with small, dark punctulations; top and sides of head profusely punctulate; a dark suborbital spot; spinous dorsal black on membrane connecting first two or three spines, the rest of spinous part punctate, and edged with black; a small black spot on posterior part; soft dorsal more or less mottled; caudal paler, some black on tip and edges; anal profusely covered with fine dark points, thickest on edge; ventrals blue-black; pectorals pale. Length 2 inches. Found by us only in the Minnesota River at the outlet of the Big Stone Lake. Though differing somewhat from typical specimens of *E. nigrum*, our specimen is apparently a breeding male of that species.

22. **Perca flavescens** (Mitchill). *Yellow Perch; Ringed Perch.* Little Minnesota River at Browns Valley, common; Little Minnesota River near Sisseton Indian agency, 2 specimens; Big Stone Lake at Creager's farm, common; Big Stone Lake at Ortonville, common. Especially numerous in Big Stone Lake.

23. **Stizostedion vitreum** (Mitchill). *Wall-eyed Pike; Pike Perch.* Big Stone Lake at Creager's farm, 6 specimens; Big Stone Lake at Ortonville, 4. An excellent food-fish and frequently taken.

24. **Aplodinotus grunniens** Rafinesque. *Sheepshead; White Perch; Croaker.* Little Minnesota River at Browns Valley, 2 specimens; Big Stone Lake at Creager's farm, 5; Big Stone Lake at Ortonville, 2. This species reaches a weight of 4 to 6 pounds, but is not much prized as food. It is much sought after by the boys for the otolith of the ear—"luck stones in the head."

MINNESOTA RIVER.

The Minnesota River is 255 miles long and occupies a deep, somewhat regular valley from 150 to 250 feet below the level of the surrounding country, and from 1½ to 2½ miles wide. The upper part of this valley extends from Traverse Lake to Mankato in a southeasterly direction for 175 miles. The lower course extends from Mankato in a northeasterly direction to the Mississippi River, 7 miles below the falls of St. Anthony. The river is subject to great fluctuations, as is shown by the flood-plain, which is frequently more than one hundred times the width of the river. The bed is of sand and mud. Huge sand-banks along the shores and in the middle of the stream are common.

Ortonville, Minn., July 18, 1892.—The Minnesota River was examined a mile below Big Stone Lake, just below the mill. The river here during the summer season is a mere brook, winding among the knobs of granite that outcrop in the valley. The size of the stream at the outlet of the lake can scarcely be estimated, since half a mile below it receives a western tributary, the Wheatstone, and a mile below the foot of the lake it is dammed, so that the waters of the two streams are collected, forming a marshy mill-pond from the dam to the lake. Below the dam the course of the river is almost straight for half a mile, and here it is from 3 to 5 miles wide and from 12 inches to 2 feet deep, with a current of possibly 1½ to 2 miles per hour. The immediate banks are low and fringed with willows, and the bed is of fine sand and gravel. In addition to the waters from the lake and the Wheatstone the stream is fed by a few cold springs which bubble from the sand below the mill-dam. Small fish were numerous below the dam, every haul of the seine landing great numbers of *Ictiobus carpio*, *Pimephales notatus*, and young black bass.

Montevideo, Minn., July 19.—The Minnesota River at this place, after flowing 45 or 50 miles and receiving the waters from the Yellow, Lac qui Parle, Pomme de Terre, and Chippewa rivers, is a stream about 100 feet wide and from 4 to 7 feet deep. The flood-plain at this place is more than a mile wide and from 8 to 15 feet above low water. The banks and hills are timbered with a growth of small trees; there is but little vegetation growing in the water. The stream has a current of possibly 2 miles per hour. The bed is of mud, very deep near the shores, and the water is of a light clay color, due to the great quantities of that material held in suspension. The locality was not a good one for making collections. Repeated efforts were made with a 45-foot seine, but comparatively few fishes were taken.

Wheatstone River, Millbank, S. Dak., July 19.—This is a small tributary, about 25 miles in length, rising in Grant County, South Dakota, about 25 miles southeast of Ortonville, flowing in a generally southeasterly direction and joining the Minnesota River almost at the place where it leaves the lake. In fact, sediment brought by this stream has possibly contributed to form the south banks of the lake, much as the sediment of the Little Minnesota River has formed the southern shore of Lake Traverse. The stream was fished at Millbank, 12 miles from its mouth. At this place it is only a meadow brook, a series of long, narrow ponds 3 to 5 feet in depth, connected by shallow ripples only a few inches in depth. The bed is of mud, and the water turbid and warm. The banks of the stream are low and devoid of all vegetable life except grasses, there being neither trees nor shrubs to shelter the water. The water contained considerable pond vegetation, and in places was covered with ditch-weed. Several species of fish, such as *Catostomus teres*, *Ameiurus nebulosus*, *Pimephales notatus*, and a great many pickerel, ascend the stream as far as Millbank to spawn.

Pomme de Terre River, Appleton, Minn., July 20.—This stream is in striking contrast to the other rivers in this vicinity. Instead of bare banks, mud bottoms, and clouded waters, here the banks were well shaded with elm, willow, and box-elder, which grew to the very margin of the stream and overhung the water, shading and in some places almost concealing the stream. The water was clear and cool, 59°, and flowed over a bed of sand and coarse gravel. The mouth of the Pomme de Terre River is 20 miles from Big Stone Lake, and 30 feet lower in altitude. It drains an area of more than 900 square miles, and discharged at the time visited about 80 cubic feet of water per second. It rises in a lake bearing the same name as the river, in Grant County, Minn., 60 miles from Appleton, which is 8 miles from the mouth. The stream is very crooked, but in a general direction flows south. At

Appleton the bed of the stream is 30 feet wide, with a flood-plain three-quarters of a mile wide. The stream receives the waters of several small lakes and tributaries, making an average depth of from 1 to 3 feet. The numerous ripples are shallow, broad, and rapid. In many places the bottom is thickly covered with a rank growth of water vegetation. This grass and weeds fasten to and about the sides of the rocks, reaching a length of from 2 to 3 feet, and forming a thick green mass which entirely hides the bed of the stream, thus affording a splendid place of concealment for small fish, two or three species of which appear to be particularly fond of this retreat.

The bed of the stream is smooth, with nothing to offer obstruction to the seine except a few granite bowlders. Collections were made just below the mill on the north side of the town, where the stream literally swarmed with fish. At this place a high dam is built across the river, which, however, is provided with a fish-ladder, the practical working of which is good. It consists of strong board boxes, 2½ by 4 feet and 14 inches deep, arranged in series, so that fish can easily pass from one to the other. When the water was drawn from the topmost box it was found to contain nearly 200 fish of various sizes, and others before the water was withdrawn could be seen passing from one box to another, and from the last box into the pond above. Crowded about the foot of the ladder were swarms of fish, principally *Catostomus*, *Pimephales*, and *Hybopsis*. A recent law of Minnesota requires the owners of dams to build and maintain fish-ladders of this pattern; and it is hoped that the law will be rigidly enforced.

Chippewa River, Montevideo, Minn., July 19.—The Chippewa River is another northern tributary of the Minnesota, and, like that river, shows signs of having served as a waterway when the supply of water was much greater than at present, the valley being totally out of proportion to the size of the present stream. The area drained by this river is much greater than that drained by the Pomme de Terre, being 1,800 or 1,900 square miles. Montevideo is near the mouth of the stream and the country around is much broken and eroded, the higher lands standing as points or knobs from around which the soil has been removed by erosion. The stream at Montevideo has a broad valley well overgrown with maples, elms, box-elder, and birch, some of which reach a considerable size and might almost be designated as forest trees. The stream flows in a southwesterly direction between the banks of drift, which are 40 feet apart. The depth of the water is about 6 feet. The bed and the banks are of mud for the most part. Three-quarters of a mile below Montevideo a ford was found at a deep, swift ripple, where the bed was of sand and gravel. Patches of waterweed along the edges and in the swifter water were the prevailing vegetation. A few crawfish were taken, and a large bed of clams was discovered, from which were taken four species.

ANNOTATED LIST OF THE FISHES OF THE MINNESOTA RIVER AND TRIBUTARIES.

1. **Lepisosteus osseus** (Linnæus). *Gar Pike; Long-nosed Pike; Needle-billed Pike.* Minnesota River at Ortonville, 1 specimen. Reported common by the local fishermen, but only a very young individual, about 4 inches long, was taken.
2. **Ameiurus nebulosus** (Le Sueur). *Common Bullhead; Horned Pout.* Minnesota River at Ortonville, 1 specimen; Pomme de Terre at Appleton, 7; Chippewa River at Montevideo, 5. No large specimens taken; average 4 or 5 inches.
3. **Noturus gyrinus** (Mitchill). Pomme de Terre at Appleton, 2 specimens; Chippewa River at Montevideo, 2. This species is rare and apparently not widely distributed in this valley.
4. **Catostomus teres** (Mitchill). *Small-scaled Sucker.* Minnesota River at Ortonville, common; Pomme de Terre at Appleton, abundant; Chippewa River at Montevideo, 1 specimen. An abundant and widely distributed species in this region, entering small streams, and apparently preferring quiet or even stagnant water.
5. **Ictiobus carpio** (Rafinesque). Minnesota River at Ortonville, very abundant above the dam; all specimens small; none exceeding 4 inches; too young for certain identification.
6. **Carpiodes velifer** (Rafinesque). *Quillback.* Pomme de Terre River at Appleton, very abundant, but specimens young.
7. **Moxostoma macrolepidotum duquesnei** (Le Sueur). *Redhorse; White Sucker.* Minnesota River at Montevideo, rare. This species apparently prefers the larger streams and lakes.
8. **Campostoma anomalum** (Rafinesque). *Stone-lugger; Stone-roller.* Wheatstone Creek at Millbank, 4 specimens; Pomme de Terre River at Appleton, 6. Rare in this region; taken only from the swift waters of the ripples.
9. **Pimephales notatus** (Rafinesque). Minnesota River at Ortonville, abundant; Pomme de Terre River at Appleton, 6 specimens; Chippewa River at Montevideo, abundant. This species was found collected below the dams of the streams and was particularly numerous below the dam in Pomme de Terre River. The largest specimens averaged 3 inches in length.
10. **Pimephales promelas** Rafinesque. Chippewa River at Montevideo, 15 specimens; Minnesota River at Ortonville, 12. Chin and snout much tubercled; the tubercles on the snout arranged in three rows, three in the first, five in the second, and seven in the third.
11. **Notropis deliciosus** (Girard). Minnesota River at Ortonville, 150 specimens; Wheatstone Creek at Millbank, common; Chippewa River at Montevideo, abundant; Pomme de Terre River at Appleton, abundant; Minnesota River at Montevideo, 5. There is a considerable difference in the size and color of specimens taken from the Minnesota River at Ortonville and those from the Chippewa River. The average measurements of the former are: Length, 56 mm.; head, 13 mm.; depth, 14 mm.; lateral line, 37; scales before dorsal, 13. Those of the Chippewa River measure as follows: Length, 47 mm.; head, 11½ mm.; depth, 11 mm.; lateral line, 36; scales before dorsal, 14.
12. **Notropis whipplii** (Girard). Chippewa River at Montevideo, 2 specimens. A very rare species in these waters. Specimens in good color, and differing only very slightly from those taken in Indiana, Kentucky, and Tennessee, where it is abundant. Average length, 2¼ inches.
13. **Notropis dilectus** (Girard). Pomme de Terre River at Appleton, abundant; Chippewa, at Montevideo, 24 specimens; Minnesota River at Montevideo, 1. This species was far more abundant in Pomme de Terre River, where the largest specimens in the best color were taken. The back is olive green, the

sides, belly, and jaws dashed with carmine red, through which a silvery pigment shows. This is one of the most abundant species found in the boxes of the fish-ladder, and collected about the opening or foot of it. The one specimen taken at Ortonville differs somewhat from the other specimens. The head was more sharply pointed; back not elevated; belly decurved; lateral line parallel with belly; vertebral stripe narrow but distinct; lateral stripe wide and of a deep metallic blue; sides below lateral line washed with red. Scales in lateral lines, 40; scales before dorsal, 14.

14. **Notropis megalops** (Rafinesque). *Common Shiner; Silversides.* Minnesota River at Ortonville, common; Minnesota River at Montevideo, abundant; Wheatstone Creek at Millbank, abundant; Pomme de Terre River at Appleton, common; Chippewa River at Montevideo, common. This species is widely distributed and was very abundant at every station visited.

15. **Notropis heterodon** (Cope). Pomme de Terre River at Appleton, common; Wheatstone Creek at Millbank, 19 specimens.

16. **Notropis scopifer** Eigenmann & Eigenmann. Pomme de Terre River at Appleton, 1 specimen.

17. **Rhinichthys cataractæ dulcis** (Girard). *Dace.* Pomme de Terre River at Appleton, 2 specimens. Length, 2¼ inches. Color, very dark.

18. **Hybopsis kentuckiensis** (Rafinesque). Taken at every station in the Minnesota Valley, but the individuals were neither large in size nor abundant in numbers. There are some external differences in the specimens from various stations. Those from the Minnesota River at Ortonville were all young and light in color; those from the more stagnant waters of Wheatstone Creek are larger and quite dark; while the sides and bellies of many of the specimens from the Pomme de Terre are marked with large, dark spots.

19. **Semotilus atromaculatus** (Mitchill). *Horned Dace; Creek Chub.* Minnesota River at Ortonville, 4 specimens; Wheatstone Creek at Millbank, 4; Pomme de Terre at Appleton, abundant; Chippewa River at Montevideo, 12 specimens. This species, while far from being as abundant here as in the Middle and Southern States, was more plentiful than the last-named species.

20. **Notemigonus chrysoleucus** (Mitchill). *Golden Shiner.* Minnesota River at Ortonville, 1 specimen; Wheatstone Creek at Millbank, 5. A rare species, but the specimens are large and in fine color.

21. **Percopsis guttatus** (Agassiz). *Trout Perch.* Minnesota River at Montevideo, 3 specimens. Specimens from this locality are not so hardy as those taken from the lake.

22. **Fundulus diaphanus** (Le Sueur). *Mud Minnow; Top Minnow.* Minnesota River at Ortonville, 2 specimens; Wheatstone Creek at Millbank, 5; Pomme de Terre River at Appleton, common; Chippewa River at Montevideo, 7; Minnesota River at Montevideo, common. This species prefers the more quiet waters, and was not taken from ripples or swift currents.

23. **Lucius lucius** (Linnæus). *Pike; Northern Pickerel.* Minnesota River at Ortonville, 10 specimens; Wheatstone Creek at Millbank, common; Pomme de Terre at Appleton, 6; Chippewa River at Montevideo, 15; Minnesota River at Montevideo, 4. While this species prefers the lakes, it is by no means confined to these waters, but is common in streams and very abundant in the Chippewa River and Wheatstone Creek. It ascends the latter stream from Big Stone Lake, since the water connection during high water is almost direct.

24. **Eucalia inconstans** (Kirtland). *Brook Stickleback.* Minnesota River at Ortonville, specimens very small and poorly colored.

25. **Ambloplites rupestris** (Rafinesque). *Rock bass; Goggle-eye; Red-eye.* Minnesota River at Ortonville, 3 specimens; Pomme de Terre River at Appleton, 10; Chippewa River at Montevideo, 7; Minnesota River at Montevideo, 2. An excellent food-fish, thriving well in the lakes, but not taken in quantities from the streams.

26. **Lepomis pallidus** (Mitchill). *Blue Sunfish.* Minnesota River at Ortonville, 3 specimens. Rare in the rivers of this region; specimens all small.
27. **Lepomis megalotis** (Rafinesque). *Blue-gill.* Wheatstone Creek at Millbank, rare; Pomme de Terre River at Appleton, 3 specimens.
28. **Micropterus salmoides** (Lacépède). *Large-mouth Black Bass.* Minnesota River at Ortonville, common; Chippewa River at Montevideo, 6 specimens; reported by local fishermen very abundant in the Chippewa River and equally so above the dam at Montevideo.
29. **Micropterus dolomieu** Lacépède. *Small-mouth Black Bass.* Chippewa River at Montevideo, rare; very few specimens were taken.
30. **Etheostoma nigrum** Rafinesque. *Johnny Darter.* Minnesota River at Ortonville, 25 specimens; Wheatstone Creek at Millbank, 1; Pomme de Terre River at Appleton, 1; Chippewa River at Montevideo, 38; Minnesota River at Montevideo, 4. This is by far the most abundant darter in the streams of this region, which seem to be particularly adapted to its growth.
31. **Etheostoma aspro** (Cope & Jordan). *Black-sided Darter.* Minnesota River at Ortonville, 1 specimen; Chippewa River at Montevideo, 45. Not widely distributed in this region, nor large except at the last-named station.
32. **Etheostoma iowæ** (Jordan & Meek). Pomme de Terre River at Appleton, 12 specimens; Wheatstone Creek at Millbank, 3.
33. **Perca flavescens** (Mitchill). *Yellow Perch; Ring Perch.* Minnesota River at Ortonville, common; Wheatstone Creek at Millbank, abundant; Pomme de Terre River at Appleton, 4 specimens.
34. **Stizostedion vitreum** (Mitchill). *Wall-eyed Pike; Pike Perch.* Minnesota River at Ortonville, 3 specimens; Minnesota River at Montevideo, 2.

THE DAKOTA OR JAMES RIVER.

The James River is essentially a prairie stream rising in the southwestern part of Nelson County, North Dakota, near Devil Lake, and flowing in a general southerly direction for nearly 400 miles before joining the Missouri River. It makes its way between a low ridge or elevation on the west side and the Plateau du Coteau des Prairies on the east. The former separates it from the Missouri, and the latter from the Minnesota. It is one of the chief tributaries of the Missouri in North Dakota, but its drainage area is much restricted by the elevations on either side, and hence the amount of water it discharges is relatively small. The stream was examined at two points, La Moure and Jamestown.

La Moure, N. Dak., July 27.—La Moure is on the Fargo and Southwestern branch of the Northern Pacific Railroad, 100 miles southwest of Fargo and over 250 miles from the mouth of the river. Here the valley is not more than 10 or 15 miles wide, the hills rising gently on either side to a height of about 150 feet. The immediate valley or flood-plain of the river is about 2 miles wide, level, and very fertile. The width of the stream will not exceed 15 yards, and its depth will average 3 or 4 feet. The current is slow, not more than half or three-quarters of a mile per hour. The stream is very crooked and has low, steep banks. The bed of the stream is of fine mud, several inches deep, which is overgrown with a thick mat of pond vegetation, consisting of bladderwort, water milfoil, chara, etc., which in places grow entirely across the channel, almost to the surface of the water. The stream was fished at Powers Ford, 3 miles north of the town, where the mud in the bed of the stream gave place to a bed of gravel and the banks were of sufficient slope to permit the landing of the seine. Temperature of the water, 81°.

Jamestown, N. Dak., August 28.—The James River was fished the second time at Jamestown, about 55 miles northeast of La Moure. The character of the country is similar to that around La Moure. The hills, however, are farther from the river. The soil contains a great many more bowlders, but these are mostly small. It is also filled with banks of coarse, water-worn gravel, containing clay and iron nodules. The river at this point is about 18 to 20 feet wide and from 2 to 3 feet deep. The stream is obstructed here by a high dam built for power purposes. The collecting was done below the dam, where the stream is composed of a series of ripples, and the water runs rapidly over a clean gravelly bed. The banks of the stream are composed of drift, covered with vegetation that grows to the water's edge. The banks are also lined with a natural growth of small timber, such as box-elder, maple, elm, and three varieties of willow. There is a scant water vegetation where the stream was examined, which covers the large stones of the bottom. A few crawfish were found, and also a few water-snails. The stream swarmed with small fishes; *Rhinichthys* was taken by hundreds; *Pimephales, Notropis,* and *Etheostoma* were also well represented. The stream at this place is well adapted to darters and dace, being quite clear and cool. The temperature of the water, 60°, would indicate considerable spring water, though no springs were observed.

Pipestem Creek, Jamestown, N. Dak., July 27.—This is a small western tributary of the James River, flowing nearly parallel with, and between, the same two ranges of hills. It is about 50 miles in length, narrow and deep. It is a poor stream in which to make collections, since no ripples were to be found. The water is clear; the temperature 62°.

ANNOTATED LIST OF FISHES FROM THE JAMES RIVER.

1. **Ameiurus nebulosus** (Le Sueur). *Catfish.* Taken at La Moure and Jamestown. Specimens all small at Jamestown; several 12 inches long from La Moure.
2. **Ameiurus natalis** (Le Sueur). *Yellow Cat.* Five specimens taken at La Moure.
3. **Ameiurus melas** (Rafinesque). Taken from the James River and Pipestem Creek; reported common by local fishermen.
4. **Catostomus teres** Mitchill. *White Sucker; Small-scale Sucker.* Taken at both stations; very abundant at La Moure.
5. **Moxostoma macrolepidotum duquesnei** (Le Sueur). *Redhorse; White Sucker.* Taken at Jamestown, but rare.
6. **Campostoma anomalum** (Rafinesque). *Stone-lugger; Doughbelly.* Taken at Jamestown in abundance. This is the first station where this species was taken in large numbers.
7. **Pimephales notatus** (Rafinesque). La Moure and Jamestown. Many small specimens were taken at the first station, less common at the second.
8. **Pimephales promelas** (Rafinesque). Common at La Moure.

9. **Hybognathus nuchalis** (Agassiz). Jamestown, very rare. Seldom met with in this region. Specimens of medium size and in good color.

10. **Notropis megalops** (Rafinesque). La Moure and Jamestown; abundant.

11. **Notropis deliciosus** (Girard). La Moure; Jamestown. Rare at the former, quite common at the latter place. Many specimens infested with a flat white worm, which inhabits the abdominal cavity. These parasites were from 30 to 50 mm. long and about 2 mm. wide.

12. **Notropis cayuga** Meek. James River at Jamestown, 16 specimens, very large.

13. **Hybopsis kentuckiensis** (Rafinesque). *River Chub.* Common in James River and Pipestem Creek.

14. **Semotilus atromaculatus** (Rafinesque). *Creek Chub.* James River and Pipestem Creek. Not common nor large in size.

15. **Rhinichthys atronasus** (Mitchill). *Black-nosed Dace.* Common at La Moure and Jamestown; prefers cool and swift water.

16. **Lucius lucius** (Linnæus). *Pickerel; Pike.* Jamestown, abundant in the mill-pond; very fine specimens taken with hook and line.

17. **Etheostoma nigrum** Rafinesque. *Johnny Darter.* Jamestown; more than a hundred specimens taken from one ripple. Color very dark; V-shaped markings on the side very distinct.

18. **Etheostoma aspro** (Cope & Jordan). *Black-sided Darter.* A single specimen taken at Jamestown.

19. **Etheóstoma iowæ** Jordan & Meek. Jamestown, 50 specimens; more abundant than *E. nigrum.*

Eleven examples give the following measurements:

Length.	Head.	Depth.	Lat. line.	Dorsal.	Anal.
mm.	*mm.*	*mm.*			
50	14	9	55	IX-10	II-8
52	14	10	53	X-11	II-7
50	14	9	53	X- 9	II-7
50	14	10	55	IX-10	II-8
47	13	9	54	IX-11	II-7
53	14	11	50	X-10	II-7
51	14	10	55	IX-11	II-7
46	13	11	55	IX-10	II-8
46	13	9	53	IX-10	II-7
46	13	9	55	IX-11	II-7
47	13	9	55	IX-10	II-7

Scales with pores in lateral line from 25 to 28, very variable.

20. **Perca flavescens** (Mitchill). *Yellow Perch; Ring Perch.* Five small specimens taken at Jamestown; reported common in deep water.

THE RED RIVER OF THE NORTH.

The Red River of the North, in the United States, consists of the upper and middle course of the southern inlet of Lake Winnipeg. It flows in a direction contrary to that of the streams on either side of it, and apparently makes its way against rising ground. The Red River lies wholly within drift territory, but, unlike most other rivers, flows against or opposite to the course of the glacier. This is not the case with many of its tributaries, however, that seem naturally to take a southern course until in the immediate valley or flood-plain of the Red River, when they turn sharply and flow toward the larger stream. The broad valley of the Red River of the North is very level, and widens gradually to the northward. The soil is a deposit of fine sand and clay, the surface of which is generally free from bowlders. The narrow valley that the river now occupies has been cut down by erosion from 50 to 75 feet below the surrounding country. Concerning the formation of the valley or flood-plain, there is abundant evidence everywhere to show that it has been the bed of a great inland lake.

Moorhead, Minn., July 25.—Fished in the Red River of the North, north of that city. The river here is 75 feet wide and very crooked and muddy. It looks like a great drainage ditch, filled with foul, muddy water. The color of the water is very light, owing to the great quantities of very fine light clay held in suspension. The bed of the river is of clay, very uneven, and worn in parallel grooves. The banks are of mud, which, along the water's edge, is soft and deep. The immediate banks of the river are about 10 feet above the water and are covered with a natural growth of ash, elm, oak, box-elder, and maple. There appears to be little or no vegetable life in the stream, not even growing in the water's edge. The great amount of sediment of fine clay in the water appears to be detrimental to both animal and vegetable life, and especially to the latter. No water insects or larvæ were found. A few crawfish were taken, and one empty clam shell was observed. The river was seined with a 45-foot seine, which brought to the shore sufficient numbers of a few specimens of fishes to indicate that they were reasonably abundant. Moon-eyes, or skipjacks, were in greatest abundance; goggle-eyes and suckers were common; two species of catfish were reported numerous by local fishermen; one large ling (*Lota lota maculosa*) was taken; minnows and darters were rare; *Hybopsis storerianus* was common and very large.

Grand Forks, N. Dak., August 9.—The Red River was pretty thoroughly seined at a point 2 miles above the town. The water was not so deep as where it was examined at Moorhead, Minn. The general character of the river remains about the same. The shore lines and flood plains are of the same fine, adhesive mud, and the bottom is of the same tough bowlder clay. The water here has not only cut a ditch through the loose fine material of the lake sediment, but it has worn several feet into the tough clay at the bottom. There is no vegetation in the muddy water, but the flood-plain and the banks seem well adapted to the growth of trees, which cover many miles with a growth of elder, basswood, ironwood, and oak. At the city of Grand Forks, 2 miles below the point where the river was examined, the Red River of the North is joined by the Red Lake River from the northeast. The country between these rivers, for several miles from their union, is of river deposit, and has been covered by a dense growth of large deciduous trees. The water of the river is usually very muddy. The depth of the water is pretty even throughout the summer, but in the spring the water frequently rises 30 feet or more on account of ice gorges.

There are several local fishermen here, who fish principally with trot lines. Catfish, suckers, moon-eyes, and wall-eyed pike are the most common varieties. The catfish grow to a large size. Both genera, *Ameiurus* and *Ictalurus*, are common. One small *Etheostoma* was taken. Two large turtles (too large to be preserved and hence unidentified) were captured with the seine.

Otter Tail River, Breckenridge, Minn., July 23.—This is one of the largest eastern tributaries of the Red River of the North. It rises in a county of the same name, about 50 miles east of Breckenridge. At Breckenridge it joins the Boise de Soux to form the Red River. The Boise de Soux is a continuation in the valley of the Red River, but the Otter Tail is by far the larger stream. The Otter Tail River is a stream 75 to 90 feet wide and 4 to 6 feet deep, though in many places it is much deeper. The current is swift (4 miles per hour), and there is always a good supply of water, since the river is the outlet of several lakes, the largest of which, Otter Tail Lake, has an area of 20 or 30 square miles. The water is turbid and never clear, even during low water, since the sediment carried is a very fine light-colored clay.

The stream rises in a very level or basin-like drift area, flows through drift soil its entire length, nowhere reaching hard bedrock. The course of the stream is exceedingly tortuous. The bed is of smooth, hard clay in the swifter portions, with sand and gravel in other places. The deeper portions of the stream and the shores and eddies are of mud, covered with sand and gravel a few inches deep. The bed and the channel change slightly with every high rise of water. The banks will average 20 feet in height and are steep and but little eroded. The country is level, and the stream has simply eroded the drift to that depth. The drift deposit here is comparatively free from bowlders. Water vegetation is very scant, although mints and cress grow in shallow water along the shores. The banks are lined with small trees and shrubs; willows and box-elders grow to the water's edge.

The stream was fished northeast of the town of Breckenridge, about a mile above the Great Northern Railroad bridge. The chief difficulties in collecting are the swift current and steep banks. The 15 and 45 foot seines were used, but fish life was not found to be abundant. Among the food-fishes taken and those reported most common were suckers (*Moxostoma macrolepidotum duquesnei*), rock bass (*Ambloplites rupestris*), and two varieties of catfish (*Ameiurus nebulosus* and *Ictalurus punctatus*). One specimen of the former weighing about 5 pounds was taken. Temperature of water, 79°.

Cheyenne River, Lisbon, N. Dak., July 26.—The Cheyenne is the largest western tributary of the Red River, and rises about 45 miles southwest of Devil Lake in Wells County, near the source of the James or Dakota River. The two streams flow parallel with each other, about 40 or 50 miles apart, one on either side of a low divide. For 180 miles the Cheyenne flows in a southeasterly direction. At Scovill, 10 miles below Lisbon, the course suddenly changes to northeasterly and continues in that direction for about 50 miles, until it joins the Red River of the North. The country around Lisbon is drift, somewhat eroded and broken. The stream here is about 35 feet deep; its bed is sand and gravel. In the ponds or quiet water the bed is of fine sand, but at the ripples it is of stones and coarse gravel. The stream is very beautiful, and is almost one succession of ripples of clear water. There was but little vegetation in the water. A few pond weeds were observed in the more quiet waters, and the larger stones in the ripples were covered with a short crisp moss. Fishes of several species were numerous, and hundreds were taken at a single haul of the 15-foot seine; minnows and darters were numerous. The stream was well stocked with such food-fishes as pickerel, suckers, catfish, and rock bass. The writer was assured that at the mill-pond 5 miles below Lisbon hundreds of pounds of fish could be taken with a hook, and that the fish frequently stopped the mill by getting into the wheel. This statement was made at other places. The stream is well shaded with trees that grow to the very edge of the water, overhanging and effectually protecting it from the sun in many places.

Valley City, N. Dak., July 28.—Although this point is 40 miles nearer the source than Lisbon, the stream is apparently much larger, being deeper and broader. The river flows through a very beautiful valley, a mile wide, that is densely covered in many places with a growth of small timber. The hills on either side of this valley rise to a height of 100 to 150 feet, and in places are quite abrupt. This water is exceptionally clear for a prairie stream, flowing for much of the distance over clean sand and gravel. It is from 60 to 70 feet wide, and will average at least 4 feet in depth. The banks are steep, and from 10 to 15 feet high from the water to the flood-plain. No shallows or ripples were found, but a ford or crossing is located 7 miles below Valley City. The river was seined just below the milldam, where fish were found in greater abundance than where it was examined at Lisbon. The 30-foot seine was used, and possibly a thousand specimens were taken at every draw. Among the more abundant species were *Pimephales notatus*, *Notropis megalops*, *Catostomus teres*, *Moxostoma macrolepidotum duquesnei*, *Percopsis guttatus*, and *Etheostoma aspro*.

This stream is an excellent one for fish on account of its natural physical features and the abundance of food. Crawfish were abundant. The long grass and other vegetation that grew in tufts and patches were filled with crustaceans and insect larvæ. No contamination of the waters was observed or reported. Two high dams unprovided with fishways were the only bad features of the stream observed.

Maple River, Mapleton, N. Dak., July 29.—This is only a small creek, tributary to the Cheyenne River and lying wholly within or about the western edge of the Red River Valley. The stream flows throughout most of its course parallel with Cheyenne River. The upper course flows south, then, making a sharp turn to the northeast, flows toward the Red River until within a few miles of that stream, where it joins the Cheyenne. The stream has cut for itself only a narrow, shallow valley, and winds leisurely along through the level country with almost an imperceptible current. At the place examined the stream is about 20 feet wide and 2½ or 3 feet deep. The bed is of mud, with but little sand or gravel, covered in many places with a thick growth of weeds, grasses, and rushes. Two species of ditch-weed are common. The banks are almost devoid of vegetation; an occasional willow or box-elder is all that can be found. The stream was thoroughly seined at the railroad bridge, but fish life was not abundant. Crawfish, leeches, small crustaceans, water-snails, and clams were all well represented. A very large species of *Planorbis* was particularly abundant. The water was warm, 78°.

Buffalo River, Hawley, Minn., August 1.—This is a small stream about 50 miles long, rising in the White Earth Indian Reservation, Minn. It flows southwesterly for about half its length, and then turning toward the northwest joins the Red River of the North at Georgetown. Hawley is about 25 miles from the mouth of the stream. At this point the stream is 20 feet wide and 2 feet in average depth. The water is clear and the current rapid. The bed is of sand and small gravel, and almost devoid of vegetation. The low banks are lined with small timber and underbrush. The stream is well stocked with fish, but is obstructed by several dams which prevent the running of the fish. The stream contained rock bass, pickerel, catfish, minnows, and darters. A great many clams were seen, and in several places the bed of the stream was almost covered with these animals. Crawfish were rare. Temperature of the water, 70.5°.

Goose River, Hillsboro, N. Dak., August 4.—Temperature of the water, 70°; of the air, 73°. This is one of the small western tributaries of the Red River of the North, rising in the elevation between Devil Lake and the Red River. The course is southeast to its junction with the Red, 12 miles from where it was examined. This stream has eroded a very deep, wide valley and the water flows at the rate of 4 miles per hour. The stream averages 20 feet in width, but has a flood-plain nearly half a mile wide. The depth varies from 2 to 5 feet, and the water is cloudy. Algæ, water weeds, and grass grow in the stream at the ripples. The banks and flood-plain are covered with trees which form a forest of maple, box-elder, and willow. These trees have fallen into the river until the channel is pretty well filled with brush and logs. The stream has evidently cut through the lake deposit and drift, since the banks and bed, in places, are formed of a tough blue clay and at intervals fragments of slate have accumulated.

The stream was a difficult one in which to make collections, but *Catostomus teres*, *Lucius lucius*, *Moxostoma macrolepidotum duquesnii*, and a few other varieties were common. Many of the fishes, especially of the genus *Notropis*, were profusely covered with immature parasitic trematodea appearing as black dots about the size of a pinhead. Others were affected by what seemed to be a small white worm encysted just under the skin.

Mouse River, Minot, N. Dak., August 6.—This station is located just where the ground begins to rise into the foothills of the mountains. The stream flows through a valley one-half to three-fourths of a mile wide, lined on either side by eroded and rounded hills from 50 to 75 feet high. The stream will average 10 yards in width and from 2 to 2½ feet in depth. The bed is of drift stones, coarse gravel, and mud, the latter always supporting a growth of vegetation, of mints, grasses, or rushes. The stream is a good one for fish; while the water is not clear, it has only enough sediment to cause it to look cloudy in the deeper places. There are numerous ripples in the stream over which the water runs at the rate of 3½ to 4 miles per hour. Several species of fishes are common. Black suckers are reported as being especially abundant during the spring and fall rises. Crawfish were taken by hundreds at almost every haul of the seine; a few clam shells were also observed. Univalves and the small crustaceans were rare, as were also algæ and other vegetation living entirely in the water.

English Cooley, Grand Forks, N. Dak., August 10.—The English Cooley is a small drain 2 miles west of Grand Forks. During a greater part of the year it has no current whatever. The banks are low and the water is filled with vegetation. It contained a few species of fishes, crawfish, and water insects. The predominating fishes are *Catostomus teres* and *Pimephales notatus*, both covered with parasites. The mud in the bottom of the stream was deep and the water at the bottom very clear.

Red Lake River, Grand Forks, N. Dak., August 12.—This is the largest eastern tributary of the Red River of the North, and is different in many respects from the other tributaries of that stream. It drains Red Lake, a double lake 600 square miles in area, lying in the northern part of Red Lake Indian Reservation. The general course of the river is west, although it makes two great curves. Unlike most other streams of this region, this river starts toward the northwest and continues thus until more than half the distance from the lake to the Red River of the North is covered, then it turns suddenly toward the south and southwest and then again takes a northwesterly direction, which it pursues until it joins the Red River of the North. Another stream, Clearwater River, rising south of Red Lake, follows the same general direction as Red Lake River. Red Lake River is nearly as wide as the Red River of the North, but much more shallow. It is very rapid and the waters are of a reddish tinge. This difference in the color in the waters of these two rivers is very marked, especially when the Red Lake River mixes its waters with the whiter waters of the Red River of the North.

The bed of the river is of clean sand, a feature with which we do not meet in any other river of this region, and since the lower course of the stream is through drift, this sand must come from the middle or upper course. Great quantities of sand are brought down and passed into the Red River of the North, from which stream it is dredged up and used for building purposes. The water of Red Lake River is much clearer and cooler than that of the Red River of the North. The water supply of the cities of Grand Forks, N. Dak., and Crookston, Minn., come from this stream, and water taken from the hydrants of these cities is clear and apparently of good quality.

The river was seined 2 miles from its mouth. At this point it averages only about 4 feet in depth, but with a current of 4½ to 5 miles per hour. The bed of the stream here is of hard bowlder clay, and is kept swept clean by the force of the current. The water was so swift that the seine was handled with difficulty. The bed of the stream was almost clear of bowlders, but offered a number of other obstructions in the way of snags, logs, and brush.

The fishes most common were gold-eyes (*Hiodon tergisus*), channel cat (*Ictalurus punctatus*), suckers (*Moxostoma macrolepidotum duquesnii*), and pickerel (*Lucius lucius*). A few clam shells were observed and a few crawfish taken, but animal life was by no means abundant, and no plants were observed growing in the water. The low banks of the river were covered with elm, basswood, cottonwood, and box-elder.

Crookston, Minn., August 20.—Crookston is about 18 miles from the mouth of Red Lake River, and is located at a place where the ground commences to rise toward the east. The river is dammed at this place, and hence this is an excellent point for making collections. It was fished below the dam, where it is possibly 75 or 85 feet wide, with a depth of from 4 to 10 feet. The current is very rapid, but the bed is smooth and the shore on the north side low and hence convenient for landing the seine. In the deepest places the bed is of smooth, hard clay or rock. This is the best point found for collecting. Suckers and gold-eyes were taken in large numbers, while pickerel and pike perch were also common. Catfish and ling were abundant, but only small specimens of the latter were taken.

Tongue River, Bathgate, N. Dak., August 15.—This is a small southern tributary of the Pembina River, rising in a low drift elevation that borders a section of the Red River of the North on the west. It is about 50 miles long; at the place examined, 10 miles from its mouth, it was 25 feet wide and 2 or 3 feet deep. The water was very sluggish and full of lower-life forms of both animals and plants. The bed of the stream is of mud (with a few inches of fine white sand in places) and gives rise to a great quantity of pond vegetation. *Chara*, pondweeds, etc., grew so abundantly that it was difficult wading and almost impossible to drag the bottom of the stream with a seine. Pickerel and suckers were about the only common species of fish.

Pembina River, Neche, N. Dak., August 16.—This is one of the large northern tributaries of the Red River of the North. Much of its course lies near the forty-ninth parallel, which it crosses several times. Neche is 15 miles from the mouth of the river, and lies in a level country, a part of the ancient lake bed. There is little to indicate that this country has been submerged, other than its flatness, presence of gravel, shells, etc., but near Pembina there is proof not only that the level country has been inundated, but that the water has stood several feet above the level. I refer to the Pembina Mountain, an elevation many feet in height near the mouth of the river, bearing on its sides in unmistakable characters the writing of the waves of the ancient Lake Agassiz.

The river at the time it was examined was somewhat swollen from recent rains, and the water was muddy and very swift; the bed of the stream was composed of clay, firmer and harder than the material which composes the steep banks. This material was so loose that at places large quantities of it had slid into the stream. The stream was well stocked with fishes, but limited in variety; several pickerel and a number of suckers weighing from 1½ to 3 pounds were taken; a few darters and minnows were also found.

Park River, Grafton, N. Dak., August 16.—This is a foul, sluggish river, rising in the western part of Walsh County, just beyond the flood-plain or in the low hills bordering the old lake basin on the west, and flowing almost east to the Red River of the North. The town of Grafton is about 20 miles from the mouth of the stream and 40 miles from its source. The river here is about 15 feet wide and 1½ to 3 feet deep. The banks are low, composed of fine sand and clay and other sedimentary deposit. The bed of the stream is of the same material, and overgrown with rank water vegetation. The low flood-plain is covered with a growth of forest trees—ash, elm, basswood, and oak being the most common. Wild gooseberries grow in great abundance among the trees. The stream contains only a few varieties of fishes, and these are poorly represented. The water is cloudy and brackish; from this cause the river was called by the early settlers Salt River.

Forest River, Minto, N. Dak., August 17.—Forest River is a very beautiful little stream of quite a different character from the other streams of this region, and though of nearly the same size and flowing in the same direction as the one last described it differs from it in many respects. The water is clear and sweet, the current swift. The stream is 15 or 18 feet wide, and will possibly average 2 feet in depth, although many places are much deeper. The river was seined just below a low dam at the crossing of the Great Northern Railroad. Although at this place the bed of the stream is mostly composed of mud, the waters of the upper course flow almost entirely over beds of clean sand and gravel, the water at such places being devoid of vegetation. The stream is fed by springs, and the water (whose temperature was 67°) is from 4 to 6 degrees colder than any other stream of this region. The flood-plain is from a half to three-quarters of a mile wide, and is overgrown with a heavy growth of large timber—ash, elm, and oak—with thick underbrush of hazel and wild cherry. The stream is well filled with fishes rich in variety; hundreds of specimens were taken at every haul of the seine. The most plentiful are chubs, pickerel, minnows, and suckers. *Notropis hudsonius* was particularly numerous and very large in size; a number of fine darters were also taken.

Turtle River, Manvel, N. Dak., August 18.—This is a small grassy stream that flows into Morse Slough, a bayou of the Red River of the North. The banks and bed of the stream are of soft mud covered with leaves and grasses. But few fishes were taken, and these were covered with parasites.

Detroit Lake, Detroit City, Minn., August 21.—This is one of the most beautiful lakes in northwestern Minnesota. It has an area of 5 or 6 square miles and the water is deep and clear. It is surrounded by high wooded banks of drift deposit, varying greatly in structure, which gives the lake an exceedingly irregular outline. It is connected by canals (made along natural waterways) with Lakes Sally and Melissa, these two lakes lying more than 6 feet below the surface of Detroit Lake. All, especially Detroit Lake, are well stocked with the game-fishes common to this section of the country. Bass, pickerel, wall-eyed pike, pike perch, and ring perch are abundant, and on this account the lake is fast becoming a favorite resort for the angler and tourist.

Minnewaukan, or Devil Lake, August 5.—This is an isolated body of water lying just beyond the divide that separates the Red River system from the Devil Lake region. It occupies the lowest part of a large basin 50 miles long by 30 miles broad, and being in a district where there is but little rainfall, and receiving no large tributaries, it is rapidly drying up. About the lake, from 1½ to 2½ miles from the present shore line, the country is an old lake bed which the vegetation has not yet covered, and the shells, pebbles, and sands of the lake are lying undisturbed and bare. North and east of the lake a considerable expanse of country presents the unmistakable signs of having been recently submerged, while on the higher rises of ground forest trees grow. These elevations were islands, and plainly show the old water-lines. On the south hills rise to the height of 250 to 400 feet, and are heavily timbered.

The lake is not deep, soundings showing from 22 to 35 feet. There is a difference in the temperature of the water between the bottom and top of the lake of about 2 degrees, the top being 79 and the bottom 77. To the northeast the land is low, indicating an active outlet for the lake when the depth of water was much greater than at present. I was informed by good authority that a few years ago the lake was well stocked with fishes, pickerel being by far the most abundant species. It is also said that these fish were taken with hook and line during the winter season in great numbers, piled up, and sold literally by the cord. Now a pickerel is seldom seen, and the question naturally arises, What has become of the fish? If the fish had been attacked by any disease that would materially reduce the numbers dead fish would have been seen along the shores and in the water, but none has ever been reported. It is well known that the water of this lake is quite brackish, and it has been thought that the rapid evaporation of the water had so increased the percentage of mineral matter as to make it detrimental to fish life. The stickleback (*Eucalia inconstans*), however, not only lives, but increases in a manner quite marvelous. Almost every haul of the seine would land hundreds of these small fish, the greater number of which were very large and almost jet-black in color. In the long grass and shore waters larvæ and small crustaceans were very rare. It may be that this stickleback, which eats the eggs of other species, has by this habit brought about the great depletion of fish in these waters.

ANNOTATED LIST OF FISHES OF THE RED RIVER OF THE NORTH AND ITS TRIBUTARIES.

1. **Ammocœtes branchialis** (Linnæus). *Mud Lamprey; Brook Lamprey.* Cheyenne River at Lisbon, 3 specimens; Red Lake River at Grand Forks, 2; Red Lake River at Crookston, 1. Although few of these parasites were taken, a sufficient number of marks were found on fish to indicate that they were numerous. Species of *Catostomus* and *Moxostoma* appear to suffer most from this animal; and, contrary to popular belief, it is seldom taken in sluggish waters, but in clear, swift streams. In the Cheyenne River a lamprey and its host were taken, the latter bearing marking that would indicate that it had been the victim of several of these creatures.
2. **Lepisosteus osseus** (Linnæus). *Gar Pike.* Otter Tail River at Breckenridge, 1 large specimen. Reported abundant in certain deep places in the river.
3. **Ameiurus nebulosus** (Le Sueur). *Bullhead; Catfish.* Otter Tail River at Breckenridge, 3 specimens; Red River of the North at Moorhead, rare; Cheyenne River at Lisbon, 5; Cheyenne River at Valley City, 4; Maple River at Mapleton, abundant; Buffalo River at Hawley, common; Goose River at Hillsboro, common; Forest River at Minto, 4. This species was reported abundant at almost every place where inquiry was made, especially at stations on the Red River of the North, though comparatively few specimens were observed in the quiet waters and lagoons above the dam in Buffalo River at Hawley. A large specimen weighing about 15 pounds was taken from the Otter Tail River at Breckenridge.
4. **Ameiurus melas** (Rafinesque). Cheyenne River at Valley City, 4 specimens; Maple River at Mapleton, common; Goose River at Hillsboro, 12. The last-named station was the only locality where this species was common. From this stream 12 adults and a large number of young were taken.
5. **Noturus gyrinus** (Mitchill). Maple River at Mapleton, 3 specimens; Cheyenne River at Valley City, 10; Goose River at Hillsboro, 55; Red River of the North at Grand Forks, 4. These specimens were nearly all small; those from Goose River averaged 2¾ inches in length.
6. **Ictalurus punctatus** (Rafinesque). *Blue Cat; Channel Cat.* Otter Tail River at Breckenridge, 1 specimen; Red River of the North at Moorhead, common; Red River of the North at Grand Forks, 4; Red Lake River at Grand Forks, common; Red Lake River at Crookston, 5.
7. **Catostomus teres** (Mitchill). *Black Sucker; Common Sucker; Fine-scaled Sucker.* Cheyenne River at Lisbon, abundant; Cheyenne River at Valley City,

abundant; Maple River at Mapleton, 6; Buffalo River at Hawley, abundant; Goose River at Hillsboro, abundant; Mouse River at Minot, plentiful; English Cooley at Grand Forks, common; Pembina River at Neche, rare; Park River at Grafton, 7. This species was taken from almost every tributary of the Red River of the North, but was not found in the main stream. I was told by the miller at Hawley that great numbers of the young of this species would come almost every day and fasten (suck) themselves onto the boards of the dam, where they would remain for several hours.

8. **Moxostoma macrolepidotum duquesnii** (Le Sueur). *Redhorse; White Sucker.* Red River of the North at Moorhead, abundant; Cheyenne River at Lisbon, common; Cheyenne River at Valley City, abundant; Buffalo River at Hawley, 10 specimens; Red River of the North at Grand Forks, rare; Red Lake River at Grand Forks, common; Park River at Grafton, rare; Red Lake River at Crookston, abundant. This species prefers clear water. It is rare in the Red River of the North, but common in Red Lake River; even near its mouth, at Crookston, it is very abundant, the seine landing 8 or 10 large specimens at a haul.

9. **Notropis megalops** (Rafinesque). *Common Shiner.* Otter Tail River at Breckenridge, abundant; Red River of the North at Moorhead, rare; Cheyenne River at Lisbon, plentiful; Cheyenne River at Valley City, common; Maple River at Mapleton, abundant; Buffalo River at Hawley, abundant; Goose River at Hillsboro, plentiful; English Cooley at Grand Forks, not abundant; Pembina River at Neche, common; Forest River at Minot, common; Red Lake River at Crookston, abundant. This species appears to adapt itself to all conditions of temperature, water, food supply, etc., since it is one of the most widely distributed species of the Cyprinidæ, and thrives equally well in all parts of the great range over which it is distributed.

10. **Notropis deliciosus** (Girard). Otter Tail River at Breckenridge, 28 specimens; Cheyenne River at Valley City, common; Mouse River at Minot, 15; Pembina River at Neche, abundant; Forest River at Lisbon, common; Red Lake River at Crookston, common. These specimens, when compared with others from the Mississippi Valley, show no very marked modifications, except possibly the bodies are somewhat stouter. Largest specimens average 2 inches long.

11. **Notropis dilectus** (Girard). Otter Tail River at Breckenridge, 1 specimen; Cheyenne River at Lisbon and Valley City, common; Buffalo River at Hawley, rare; Red River of the North at Grand Forks, rare; Red Lake River at Crookston, 2. Specimens from Red Lake River were in the best color, and hence more like individuals of this species found in the Mississippi Valley. Those from the Red River of the North were very light, almost translucent. Specimens from the Cheyenne were in good color, the head, sides below lateral line, dorsal, caudal, and pectoral washed with red.

12. **Notropis atherinoides** Rafinesque. Pembina River at Neche, 1 specimen; Red Lake River at Crookston, 25. Specimens from Crookston average 2½ inches in length. This species was taken in abundance by Dr. Eigenmann farther north.

13. **Notropis whipplii** (Girard). Cheyenne River at Lisbon, common. Although home of this species is much farther south, it varies as little in color and markings as any other fish of this region, remaining almost true to the type.

14. **Notropis cayuga** Meek. Buffalo River at Hawley, rare; Maple River at Mapleton, 8 specimens; Cheyenne River at Lisbon, 5; Cheyenne River at Valley City, 6. Specimens in this valley average only about 1½ inches long. The colors are good, the lateral line quite black, just wide enough to cover one row of scales, and quite distinct over opercle and around snout; no vertebral stripe; scales in lateral line 36; these have a peculiar notched

appearance on account of mucous pores. Specimens from Valley City are exceedingly large and fine in color, length 2 inches. Many of the females contained ripe eggs.

15. **Notropis jejunus** (Forbes). Pembina River at Neche, 40 specimens; Red River of the North at Moorhead, 9; Red River of the North at Grand Forks, 6; Forest River at Minto, common; Red Lake River at Crookston, 11. This is a very handsome minnow; body and caudal peduncle deep, with a broad straight lateral stripe of silvery pigment, edged with a dark line above.

16. **Notropis hudsonius** (Dewitt Clinton). Otter Tail River at Breckenridge, 1 specimen; Red River of the North at Moorhead, 5; Cheyenne River at Valley City, 1; Mouse River at Minot, common; Red River of the North at Grand Forks, common; Red Lake River at Grand Forks, rare; Park River at Grafton, 1; Red Lake River at Crookston, rare.

17. **Pimephales notatus** (Rafinesque). Otter Tail River at Breckenridge, rare; Cheyenne River at Lisbon, common; Cheyenne River at Valley City, plentiful; Goose River at Hillsboro, rare; Buffalo River at Hawley, 2; Mouse River at Minot, rare. This species was not taken in as great numbers as *P. promelas* and is possibly not as generally distributed throughout this valley, but is found in purer water and in clearer streams.

18. **Pimephales promelas** Rafinesque. Maple River at Mapleton, 5 specimens; Buffalo River at Hawley, rare; Goose River at Hillsboro, abundant; Cheyenne River at Valley City, common; Forest River at Minot, common. Specimens from Goose River have a small white parasite encysted just under the skin.

19. **Rhinichthys cataractæ dulcis** (Girard). Cheyenne River at Lisbon, abundant; Cheyenne River at Valley City, 24 specimens; Maple River at Mapleton, common; Buffalo River at Hawley, 75; Pembina River at Neche, 3; Forest River at Minot, common; Red Lake River at Crookston, 1. This species thrives better, apparently, farther north than in the localities here given; specimens from Red Lake and Maple rivers were very small. Specimens taken farther north by Dr. Eigenmann were much larger. Our finest specimens were taken from Cheyenne River; at Lisbon, N. Dak., these specimens averaged 55 mm. in length, 11 mm. in depth, and were very plump and round. Color, very dark above, with small round dark spots on sides, from lateral line to belly; caudal spot distinct, with part of caudal peduncle black. Taken only in the swift ripples.

20. **Semotilus atromaculatus** (Mitchill). Maple River at Mapleton, rare; Buffalo River at Hawley, 5 specimens; Pembina River at Neche, 10; Forest River at Minot, 14. Specimens unusually small.

21. **Hybopsis kentuckiensis** (Rafinesque). *River Chub.* Otter Tail River at Breckenridge, common; Cheyenne River at Lisbon, 7 specimens; Cheyenne River at Valley City, rare; Buffalo River at Hawley, 5; Maple River at Mapleton, rare; Forest River at Minot, 2; Red Lake River at Crookston, 14. Not an abundant species in these waters—more rare than the preceding.

22. **Hybopsis storerianus** (Kirtland). Otter Tail River at Breckenridge, 3 specimens; Red River of the North at Moorhead, abundant; Red River of the North at Grand Forks, common; Red Lake River at Grand Forks, 3; Red Lake River at Crookston, 10. Found only in large streams. It reaches a length of 4 inches and is the largest minnow found in this region.

23. **Notemigonus crysoleucas** (Mitchill). Cheyenne River at Lisbon, rare. Rare even in the northern part of the Mississippi Basin.

24. **Hiodon tergisus** Le Sueur. *Moon-eye.* Red River of the North at Moorhead, common; Red River of the North at Grand Forks, abundant; Red Lake River at Crookston, common. Common throughout the basin of the Red River of the North and Lake Winnipeg.

25. **Hiodon alosoides** (Rafinesque). *Moon-eye.* Red River of the North at Moorhead and Grand Forks, rare; Red Lake River at Crookston, rare. This species is not so common as *H. tergisus.*

26. **Percopsis guttatus** Agassiz. *Trout Perch.* Otter Tail River at Breckenridge, 1 specimen; Red River of the North at Moorhead, common; Cheyenne River at Lisbon, 2; Cheyenne River at Valley City, abundant; Goose River at Hillsboro, common; Pembina River at Neche, 4; Red Lake River at Crookston, common. Eight specimens of this species from Cheyenne River, Valley City, measure as follows:

Length.	Head.	Depth.	Eye.	Lat. line.	Dorsal.	Anal.
Mm.	*Mm.*	*Mm.*	*Mm.*			
85	25	15	5	50	10	6
75	23	15	5	52	11	6
73	23	14	5	51	11	7
73	23	15	5	50	10	6
78	23	15	5	53	11	6
76	23	14	5	51	11	7
73	22	14	5	52	11	7
73	22	14	5	52	11	6

The fishes from this stream were in fine color. Light olive on back, shading to lighter on sides, and nearly pure white on the belly; back mottled, with mingled light and dark scales; cheeks and opercles shaded with very small dark dots; dorsal and anal sparingly clotted with black.

27. **Fundulus diaphanus** (Le Sueur). Cheyenne River at Valley City, 2 very small specimens.

28. **Lucius lucius** (Linnæus). *Pickerel; Pike.* Otter Tail River at Breckenridge, 4 specimens; Cheyenne River at Valley City, common; Goose River at Hillsboro, common; Mouse River at Minot, 3; Park River at Grafton, abundant. Preeminently the food and game fish of this section of country. Reported abundant at nearly every station visited, though few were taken with the seine in some localities.

29. **Eucalia inconstans** (Kirtland). *Brook Stickleback.* Maple River at Mapleton, common; Mouse River at Minot, rare; Goose River at Hillsboro, 6 specimens; Red River of the North at Grand Forks, 1; English Cooley at Grand Forks, rare; Forest River at Minot, common; Red Lake River at Crookston, 2. A widely distributed species, quite as common north as south of the divide.

30. **Ambloplites rupestris** (Rafinesque). *Rock Bass; Goggle-eye.* Cheyenne River at Valley City, rare; Maple River at Mapleton, common; Red Lake River at Crookston, 5 specimens. Not rare nor confined to a limited area, but apparently grows more and more scarce as we proceed north. This is the only member of the *Centrarchidæ* found in these waters.

31. **Etheostoma nigrum** Rafinesque. *Johnny Darter.* Otter Tail River at Breckenridge, 2 specimens; Cheyenne River at Lisbon, 4; Cheyenne River at Valley City, 70; Maple River at Mapleton, common; Buffalo River at Hawley, 25; Goose River at Hillsboro, common; Mouse River at Minot, rare; Red Lake River at Crookston, not abundant. More specimens of this darter were taken than any other, and while it may not be more widely distributed than *E. aspro*, the latter is not so abundant in this region.

32. **Etheostoma aspro** (Cope & Jordan). *Black-sided Darter.* Otter Tail River at Breckenridge, 6 specimens; Red River of the North at Moorhead, rare; Cheyenne River at Lisbon, abundant; Cheyenne River at Valley City, abundant; Maple River at Mapleton, rare; Buffalo River at Hawley, 12; Goose River at Hillsboro, common; Mouse River at Minot, 4; Pembina River at Neche, rare; Forest River at Minot, 27; Park River at Grafton, 2; Red Lake River at Crookston, rare. At Minot we obtained 4 very large specimens

from a gravelly ripple where the water was not over 2 inches deep. The largest and finest specimens were taken from the Cheyenne River. One specimen from Valley City measured 3¼ inches long. Six from Lisbon measured as follows:

Length.	Head.	Depth.	Lat. line.	Dorsal.	Anal.
Mm.	*Mm.*	*Mm.*			
66	18	11	60	XIII-13	II, 10
64	18	12	60	XIII-14	II, 10
56	16	10	56	XII-14	II, 10
56	16	9	61	XIII-15	II, 9
58	16	10	58	XIV-14	II, 10
56	16	10	59	XV-14	II, 10

33. Etheostoma guntheri Eigenmann & Eigenmann. Red River of the North at Moorhead, 1 specimen; Red Lake River at Crookston, 6. Color, light olive, with nine or ten very distinct dark bands around the sides.

Measurements of 5 specimens from the Red Lake River are as follows:

Length.	Head.	Depth.	Dorsal.	Anal.	Lat. line.
Mm.	*Mm.*	*Mm.*			
33	9	6	XI-13	II, 12	48
34	9	6	X-12	II, 12	46
32	85	6	XI-12	II, 12	49
30	8	6	XI-13	II, 12	49
32	85	6	XI-13	II, 12	49

The large specimen from the Red River of the North differs very materially from the smaller in color, agreeing, however, in the marking on the anterior dorsal. The rays differ somewhat, and the scaling of the cheeks is not the same in that the specimen from the Red River of the North has cheeks covered with large scales. Length, 54 mm.; head, 13.5 mm.; depth, 85 mm.; D. IX-14; A. II-10; lateral line, 52.

34. Etheostoma iowæ Jordan & Meek. Cheyenne River at Valley City, 1 specimen; Cheyenne River at Lisbon, common; Red Lake River at Crookston, 5; Park River at Grafton, 6.

35. Stizostedion vitreum (Mitchill). *Wall-eye; Pike Perch.* Otter Tail River at Breckenridge, 1 specimen; Cheyenne River at Valley City, 6; Red River of the North at Grand Forks, rare; Red Lake River at Grand Forks, rare; Red Lake River at Crookston, 8. The last-named place is the only locality visited where the local fishermen report this species plentiful enough to furnish any considerable amount of food. From this stream it is taken with hook and line, principally from below the dam. I see no reason why the multitude of fine lakes throughout the State of Minnesota should not be stocked with this fine food-fish, since it could be done at comparatively small cost.

36. Perca flavescens (Mitchill). *Yellow Perch; Ringed Perch.* Forest River at Minot, common; Red Lake River at Crookston, common; Maple Creek at Mapleton, 5 specimens. Not frequently taken in the streams, but said to be found in nearly all the lakes of the State.

37. Aplodinotus grunniens (Rafinesque). *Fresh-water Drum; Grunter; Sheepshead.* Red Lake River at Crookston, 2 specimens. Not common; the fishermen seem to have but little knowledge of it.

38. Lota lota maculosa (Linnæus). *Lawyer; Ling.* Red River of the North at Moorhead, 1 specimen; Red Lake River at Crookston, 3. The one specimen from Moorhead was large, about 18 inches long, while those from Crookston were small. Occasionally taken on a "trot line" from the Red River, but not common.

4.—THE FOOD OF THE OYSTER, CLAM, AND RIBBED MUSSEL.

By John P. Lotsy, Ph. D.

During a stay on the James River, Virginia, in the summer of 1892, I had hoped to study the food supply of both the young (embryonic) and the adult oyster, but as the season was too far advanced to allow the collection of any embryos only the latter part of the investigation proved feasible.

Collections were made at many places on both sides of the James River from Newport News to Old Point Comfort, specimens being obtained from both natural and cultivated beds, from muddy and sandy bottom, and from piles and stones, especially around Fort Wool on the Ripraps. They were taken from various depths, some being gathered on a bottom left exposed at low tide; others were obtained which did not grow on the bottom, but which were, so to speak, suspended in the water near the surface, attached to piles and rocks, also exposed during low tide; still others were collected from deeper places, never uncovered by the tide, growing either on the bottom or on permanently submerged stones and piles. To determine whether any changes in the food supply were dependent upon the season of the year, material was obtained daily from the beginning of June until the end of September, and whenever an opportunity offered shipments brought from farther up the river were examined to see if the greater amount of fresh water there present had any influence on the character of their food.

Before entering further into details it is necessary to note that the oyster is constantly ingesting a stream of water, which, passing the mouth, brings near and into this always opened organ all the objects of greater or less size coming within the influence of this stream. The mere presence, therefore, of particles of various organic matter in its stomach, even in great quantities, does not indicate that the oyster uses them as food, but only proves that these particles were present in the surrounding water at the time of ingestion. This is a consideration too often overlooked. If an animal of the structure of an oyster be placed in a bucket of water in which is suspended a great number of carmine granules, these granules will doubtless be found in the stomach of the animal after a certain length of time, yet nobody would claim that they were the food of the oyster. A similar thing occurs in nature. In the many oysters which I have opened and of which I investigated the stomach contents I never failed to find numerous particles of sand. The finding of some animal or plant or other object in the stomach of the oyster does not prove that it composes any part of its food supply, no matter how numerous the form may be in individuals, but it can only offer a suggestion for further investigation. In order to demonstrate which of these various objects serve as food, it is necessary to prove not only that they are ingested, showing a possible source of nutriment, but also that having passed through the digestive tract only the indigestible parts remain. To conclude from the fact alone of the occurrence of any animal or vegetable in the stomach of an oyster that it forms a part of its food is no more justifiable than to affirm that the fishes brought up by a water-wheel are food for the wheel.

The method followed by me in studying the stomach contents of the oyster was as follows: The oyster was carefully opened, guarding against any injury from the knife except the separation of the muscle which connects the two valves of the shell. The oysters were, as a rule, examined immediately after being taken from the water, usually within fifteen minutes, and very rarely after as long an interval as two hours. After separating the gills at the oral extremity with a scalpel, so that the opening of the mouth was exposed, the tip of a finely drawn-out glass tube having a rubber ball at the other end was introduced into the stomach. The contents of the stomach were now sucked out by removing the hand from the hitherto compressed bulb.

The contents of the stomach of an oyster which has recently fed—in other words, of every oyster collected when the shells are open—present a beautiful dark-golden color. A drop of this material obtained in the manner described above and placed under the microscope for examination shows that the stomach of the adult oyster contains a large number of diatoms, embracing a great many species. The constant occurrence of these forms in great quantities suggested the possibility of their serving as food. In addition to the diatoms a quantity of decaying organic matter at least equal in amount, and also of some of the lower algæ, besides sand, etc., were often found. Rhizopods, a few euglenas, an occasional foraminiferum, and other animals of lower grade were seen, but only once was a copepod found; in fact, animal life was practically absent.

An idea which early occurred to me was the importance of examining simultaneously the stomachs of the other common bivalve mollusks of the James River, to see if any uniformity in the nature of the food in this natural group could be detected. With this object the stomachs of the hard clam or quahog (*Mercenaria mercenaria*), of the soft clam (*Mya arenaria*), and of the ribbed mussel (*Modiola plicatula*) were also examined. In all of these species the contents of the stomach were found to be the same as in the oyster.

The first question to be settled was whether or not the oyster and these other mollusks actually digested the diatoms found in their stomachs; and, second, what part of the additional decaying organic matter was digested. It was possible, for example, that the diatoms, if abundant in the surrounding water, were merely ingested and would pass the intestinal canal unchanged, while the decaying organic matter might be digested. In order to settle this point, several oysters and clams were placed in separate glass dishes, their shells being previously carefully cleaned with a brush. The sea water in these dishes was either naturally very pure or strained through filter paper; after a few hours a considerable quantity of fæces was deposited in the dishes. The excrements of the oyster, as well as those of the mussel and soft clam, are well formed, consisting of a hollow tube or of a solid rod of excrementitious substance; the amount of sand in them is enormous, forming by far the greatest bulk.

The cell walls of the diatoms, on account of the silica which they contain, are indigestible; for this reason it was easy to determine with accuracy whether digestion of the diatoms actually took place, as it had been previously ascertained that very few empty shells of diatoms were present in the stomach, by far the greater number being in fresh condition. The examination of the excrements under the microscope showed that the decaying organic matter had passed through the alimentary canal entirely unchanged. At first it seemed as if the diatoms also were very imperfectly digested, but soon it became evident that this was an error based on superficial examination, since the undigested diatoms were more conspicuous on account of their coloring matter, while the delicate transparent shells of those which had been digested escaped observation. To avoid this error the following method was adopted: The excrements of a certain number of oysters or clams were collected, broken up in water, and well mixed. From this average sample two preparations were made and in each of these twenty-five fields selected at random were counted. I have tabulated below the results of the examination of two such samples. The great difference in the number of diatoms present in each field is due to the fact that the samples were very differently diluted with water.

In Column I, under "dead," is recorded the total number of dead diatoms observed. The letter *d* following a number indicates that not all the diatoms were completely digested, although by far the most were nearly so, only a little of the coloring matter remaining.

Column II shows the number not entirely digested, and the difference between the numbers in the two columns indicates in each instance the number in which only the clean silica skeleton remained.

In none of these cases was the additional decaying organic matter digested. The numbers of individuals examined being very different, having been taken from different localities and representing different genera, the fact that the results coincided so closely in the proportionate number of digested and undigested diatoms seems to indicate a very complete digestion of the ingested diatoms in this group.

Average sample of the excrements of 21 oysters, collected on plants of Mr. Cock, in shallow water, Hampton Creek, Va.

Field No.	Preparation No. 1.			Preparation No. 2.		
	Living.	Dead.		Living.	Dead.	
		Col. I.	Col. II.		Col. I.	Col. II.
1	0	7	1 *d*	0	12	1 *d*
2	2	13	6 *d*	0	21	3 *d*
3	1	4	....	0	16	2 *d*
4	0	8	....	0	20	....
5	1	8 *d*	1 *d*	1	17	1 *d*
6	0	10	....	0	20	....
7	0	7	....	0	22	3 *d*
8	0	13	3 *d*	0	28	4 *d*
9	0	4	1 *d*	0	29	3 *d*
10	0	12	....	0	27	4 *d*
11	0	14	4 *d*	1	20	2 *d*
12	0	16	4 *d*	0	8	1 *d*
13	0	14	1 *d*	0	22	2 *d*
14	0	12	3 *d*	0	18	3 *d*
15	0	15	....	0	10	1 *d*
16	0	13	1 *d*	0	15	2 *d*
17	0	16	1 *d*	0	12	4 *d*
18	0	15	3 *d*	2	13	3 *d*
19	1	35	2 *d*	0	38	3 *d*
20	0	20	1 *d*	0	14	7 *d*
21	0	11	2 *d*	0	23	3 *d*
22	0	17	2 *d*	0	24	4 *d*
23	0	14	2 *d*	0	12	2 *d*
24	0	13	....	0	11	2 *d*
25	0	11	....	1	23	3 *d*
	*5 Living, 1.5 per cent.	322 = 284+38 Entirely digested, 87 per cent. Nearly digested, 12 per cent.		5	475 = 412+63	

Results.

Results of Preparation No. 1:

	Per ct.
Living	1.5
Nearly digested	12
Entirely digested	†87
Total	100

Results of Preparation No. 2:

Living	1
Dead	99
Entirely digested	85
Nearly digested	14
Living	1
Total	100

Average from the two preparations:

Digested		99
Entirely	86	
Nearly	13	
Living		1
Total		100

*These few living diatoms might have been derived from the sea water used for breaking up the excrements. All five belonged to the same species, and as diatoms have a motion of their own it is possible that the same individual figured in each case.

†The smaller species were all entirely digested, so that they seem to offer the best food for the oyster.

Average sample of the excrements of 17 oysters, collected by Mr. R. Armstrong 10 miles up the James River from Newport News, Va.; deep water.

Field No.	Preparation No. 1.			Preparation No. 2.		
	Living.	Dead.		Living.	Dead.	
		Col. I.	Col. II.		Col. I.	Col. II.
1	0	3	....	0	1	....
2	0	4	....	0	8	1 *d*
3	0	5	1 *d*	0	2	3 *d*
4	0	2	....	0	3	....
5	0	3	....	0	3	1 *d*
6	1	2	....	0	2	....
7	0	6	3 *d*	0	1	....
8	0	2	....	0	4	....
9	0	2	....	0	2	2 *d*
10	0	5	....	0	2	....
11	0	4	....	0	2	....
12	0	4	2 *d*	0	2	....
13	0	5	2 *d*	0	3	1 *d*
14	0	3	....	0	3	....
15	0	2	1 *d*	0	2	....
16	0	2	....	0	3	....
17	0	4	....	0	1	....
18	0	3	1 *d*	0	3	....
19	0	2	....	0	2	1 *d*
20	0	1	....	0	2	....
21	0	4	....	0	1	....
22	0	6	1 *d*	0	2	....
23	0	3	1 *d*	0	3	....
24	0	4	....	0	3	....
25	0	1	....	0	2	....
	1	82 = 70+12		0	63 = 54+9*	

Results.

Results from Preparation No. 1:

	Per ct.
Entirely digested	85
Nearly digested	14
Living	1
Total	100

*Results from Preparation No. 2:

Entirely digested	86
Nearly digested	14
Living	0
Total	100

Average from the two preparations:

Digested		99
Entirely	85.5	
Nearly	14	
Living		0.5
Total		100—

*Enormous quantity of sand and many big species of diatoms.

Average sample of the excrements of 4 clams, collected on the flats at the Soldiers' Home, Hampton, Va.

Field No.	Preparation No. 1.			Preparation No. 2.		
	Living.	Dead.		Living.	Dead.	
		Col. I.	Col. II.		Col. I.	Col. II.
1	1	7	2*d*	0	2	....
2	0	3	....	0	1	....
3	0	2	....	0	3	....
4	0	0	....	0	0	....
5	0	3	1*d*	0	1	....
6	0	3	2*d*	0	1	
7	0	2	....	0	2	1*d*
8	0	3	1*d*	0	1	....
9	0	3	1*d*	0	1	....
10	0	0	....	0	4	....
11	0	2	....	0	4	....
12	0	1	....	0	1	....
13	0	3	1*d*	0	0	....
14	0	0	....	0	1	1*d*
15	0	3	....	0	1	....
16	0	5	....	0	5	....
17	0	2	1*d*	0	2	....
18	0	3	....	0	4	2*d*
19	0	2	....	0	2	1*d*
20	0	1	....	0	0	....
21	0	1	....	0	1	....
22	0	1	....	0	1	....
23	0	1	....	0	2	....
24	0	2	....	0	1	1*d*
25	0	2	....	0	2	....
	1*	55=46+9		0	43=37+6	

Results.

Results of Preparation No. 1:

		Per ct.
Living		2
Entirely digested		83
Nearly digested		15
Total		100

Results of Preparation No. 2:

Living		0
Entirely digested		86
Nearly digested		14
Total		100

Average:

Digested		99
Entirely	84.5	
Nearly	14.5	
Living		1
Total		100

* Probably derived from the sea water used to break up the excrements.

There was another possible kind of food yet to be considered, namely, such substances as might be in solution in the water in which the oyster lives. The oysters attached to the stones of the Ripraps, which also showed their stomachs full of diatoms, are surrounded by perfectly clear water, but from a large number of chemical analyses which I have made of similar water on former occasions, after having strained the diatoms, etc., out, I am convinced that hardly a trace of organic matter is to be found dissolved in it, so that this possible source of food can be entirely excluded.

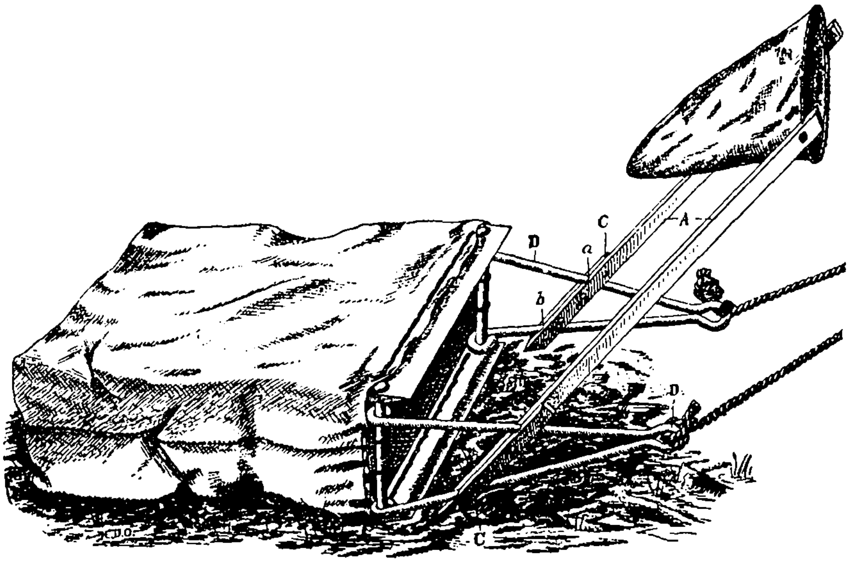
After having determined in this way that the food of the oysters and clams in the James River consists practically of diatoms, the question presented itself, Where do these diatoms come from? The use of the common Müller's pelagic tow net revealed their presence at the surface of the water in enormous quantities, and no difference could be detected in their numbers or distribution during the daytime or nighttime. The occurrence of diatoms in such numbers at the surface explained well their presence in the stomachs of the oysters attached to the stones and piles submerged only a little under water, but this could not account for their presence in those living at the bottom in deeper places, where even at low tide considerable water remained. It was therefore thought advisable to collect at different depths in order to study their perpendicular distribution from the surface to the bottom. The result showed that they occurred in equal quantity at all depths up to 70 feet, which, according to the official maps, is the greatest depth found at the mouth of the James River.

The idea is commonly held that the soft organic mud on the oyster beds stimulates the growth of diatoms, but a microscopic examination of specimens of mud taken from different oyster beds revealed the fact that they were apparently not more numerous in such places than on the sandy bottoms similarly situated, provided that they were continually covered with water. On the other hand, those muddy places which are left dry between the tides were found to be much richer in diatoms than similar sandy places. The species living on the bottom apparently differed from the pelagic ones, but their presence in the stomachs examined indicates that they also served the oyster for food. These observations were made at places where the current was strong. They do not, therefore, by any means preclude the possibility that in stagnant or slowly flowing water muddy banks may form a much better soil for diatoms than sandy ones. The fact that they are more numerous on muddy bottoms near the shore which are left uncovered by the tide even indicates this. We might account for the facts above stated by supposing that the diatoms are swept along so fast by the strong currents that they have not time to settle on these mudbanks, and might perhaps also thus explain the controversy between oyster-growers as to whether muddy or sandy bottoms furnish the most favorable places for planting. That sand is sometimes preferable we learn from the following quotation from Professor Brooks's oyster report. Within the harbor, for instance, considerable "muddy bottom has been utilized by first paving it with coarse beach sand. No spot where there is not a swift current is considered worth this trouble."

This, of course, is in complete harmony with our facts, since the stronger the current the more food that is offered. That there is an abundant food supply for oysters on sandy bottom is proved by the fact that the clams, living upon the same food as the oysters, are often found on pure sand flats.

The fact that the mud bank, on microscopic examination, did not prove to contain more diatoms than the sand did not seem to furnish sufficient evidence on which to base an opinion as to the stimulating power of the mud on the growth of diatoms, as this might possibly be perceptible in the greater quantity of diatoms in the water above. To determine this, diatoms were collected from the water over mud banks and also from over pure sand and the results compared, but no perceptible difference could be detected. The instrument used for this purpose was a Müller's net secured firmly by means of two strong wooden poles to the dredge in such a way that it was immovable. The poles "A" are of strong wood. Two incisions are made in these, extending about half way through the wood at the points *a* and *b* in such a manner that the iron bars D of the dredge fit perfectly in them. A crosspiece C is now screwed on, so as to retain the poles at an angle of about 45° with the bottom when the dredge is lying on it. The net is fastened between the poles near the top, the ring fitting into incisions in either side, enough space being allowed between them and the top for the usual rope of the net to be firmly wound around it in order to keep the latter in position. This arrangement allows the use of both net and dredge separately or together with very little trouble or expense. When the apparatus is in use, the dredge is drawn along on the bottom in the direction of the arrow, while the net is held about a foot above the bottom and a few feet in front of the dredge, so that the mud stirred up by the latter does not interfere with the net, and in the latter only those objects are taken which are normally suspended in the water passing over the mud bank.

In order to study the diatoms over as wide an area as possible, collections were made daily from Newport News down to Hampton, and even from points several miles out in the bay. From these catches



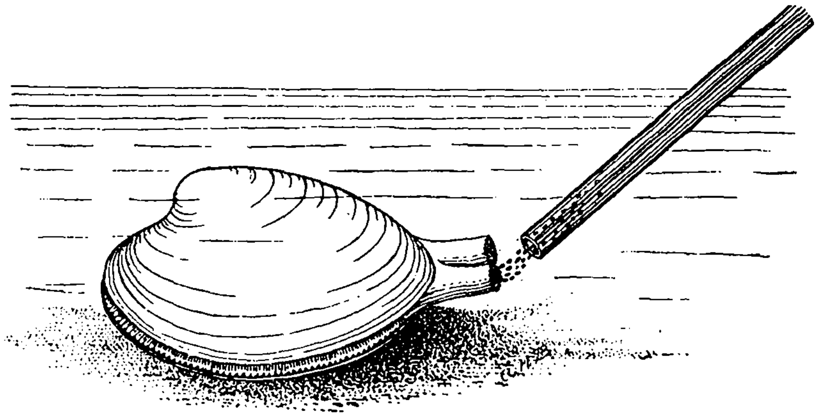
about 50 species of diatoms were drawn on the spot. For staining the diatoms, the lower algæ, and other low forms of life, I employed the method described farther on, which I think offers some advantages worthy of consideration. Several jars full of diatoms were preserved and carried to Baltimore for classification. I have not, however, been able to find a reliable work on the classification of American diatoms, and as specialists assure me that such a one does not exist, this plan had to be abandoned, since the time at my disposal just now does not permit me to undertake it. Nevertheless, such a classification would be of great value, and if the necessary collection of diatoms from different points of the American coast could be obtained to enable such a work to be done on a broad basis, it would also pay from a practical stand-point. It would be of great interest to so determine the habitat of the different species as to ascertain which grow on the bottom and which are freely suspended in the water. At the same time a careful study of the life-history of the diatoms should be made. It does not seem to me that it would be very difficult to fatten oysters by bringing them into ponds in which a large quantity of diatoms had been developed under favorable conditions. To accomplish this satisfactorily, however, a closer study of the life-history of this group would be necessary.

The quantity of diatoms which may be seen on a bottom near the shore, for example, does not in the least furnish us with a basis for measuring the amount of oyster food there present, as many of these forms are firmly fixed to the bottom, and so, of course, are entirely useless for that purpose. Since it is well known that too much fresh water kills the marine diatoms, a careful study of the influence of fresh water upon them would be necessary in order to determine the most promising places for oyster-culture in our rivers. My station last summer, so near the mouth of the river, was not well fitted for this, but I was able to show that oysters coming from 15 miles farther up the river contained in their stomachs the same species of diatoms as those collected around Newport News, or even around Hampton.

As the water surrounding the habitat of the oysters contained, besides diatoms, a great number of copepods, it seems strange that these were not found in the oysters' stomachs also, as the stream of water ingested by the oysters was certainly strong enough to draw the copepods into their mouth along with the other floating particles. The idea naturally suggested itself that perhaps the oyster might possess a power of discrimination between the higher and more active animals, such as copepods and the lower foraminifera, and especially the diatoms, although the fact that its mouth is continuously open does not favor this view. It was thus thought advisable to make some experiments bearing upon this subject. As copepods were not to be obtained easily in pure cultures, it was thought that a substitute for them might be found in finely hashed fish, or, better still, shrimps. It might safely be assumed that if oysters should prove to be able to discriminate between such a food material and diatoms the chances are that they would still more readily distinguish the latter from the actively swimming copepods, since the presence of these would be more readily detected by their movements.

Such a fact, however probable, could not be demonstrated, but the question which could and should be determined by this method was: Do the oyster and the other bivalve mollusks possess in general a power of discriminating between the different kinds of food offered to them? For this purpose it was necessary to obtain, in the first place, cultures of diatoms in which animal life was absent. Since diatoms have never hitherto, so far as I am aware, been obtained in pure culture, some experiments had to be made to accomplish this. I was able to obtain very good cultures, though not pure ones; the latter not being attempted. It seems to me that it would be easy by the method which I employed to obtain cultures of a single species, only contaminated by bacteria. The method was this: Some sea water was placed in an Erlenmeyer flask with a little of the pelagic catch added, in order to give it the necessary elements for the growth of the diatoms. The flask was then plugged with cotton and sterilized by boiling. Afterwards, when it had cooled, a few drops of the pelagic catch containing but a few diatoms were introduced into this sterilized medium. After some days small colonies of diatoms appeared on the wall of the flask, especially on the side turned toward the light. One of these colonies was removed by means of a sterilized platinum needle and introduced into another Erlemeyer flask containing the same medium. This culture was afterwards used for experiments.

The experiments were carried on in the following way: A hash of fish and one of shrimps was suspended in water, the suspension containing particles not larger than a copepod. Clams were first used for the experiments. A culture of diatoms in sufficient quantity to cause a small, well-defined cloud in the water was offered to them by means of a fine glass tube, the end of which was brought close to the ventral opening of the siphon, care being taken (see figure) not to



touch it. The culture was now allowed to flow through, and soon disappeared in the opening of the siphon. Many such cultures were accepted by the clam, but when similar experiments were made with a hash of fish, the result was either that the opening closed as soon as the particles of fish touched it, or the suspension was accepted as before, but almost as soon as taken it was forcibly ejected and often thrown to a distance of six or seven inches. The shrimp hash was rejected in the same manner.

When soft clams were used, the same results were obtained, and when the hash was brought between the open shells of the oyster, the same phenomena were observed, the suspension being rejected and the shells immediately closed, while the diatoms were readily accepted. Though these experiments were repeated over and over again, I always obtained the same results with a single exception in the case of a soft clam, an individual apparently without a discriminating taste, which accepted a great quantity of the hash, but finally rejected it also.

Besides the diatoms some lower algæ were found to be present in the water, especially near the shore, and I have no doubt that in winter and early spring the reproductive spores of the higher algæ growing on oyster beds will prove to be an additional source of oyster food. I therefore made a list of the algæ found during the time of my stay in places where oysters were living in the James River. It should be borne in mind in connection with this list, however, that my visit was made during the hottest months of a very hot summer, a particularly unfavorable season for the growth of algæ. For this reason the small number of species collected is not to be wondered at.*

Algæ collected.

1. Melanophyceæ.
    Fucus vesiculosus.
2. Chlorophyceæ.
    Bryopsis plumosa.
    Ulva lactuca.
    Ulva clathrata.
    Ulva hopkirkii.
    Cladophora, sp.
    Entocladia viridis.
3. Florideæ.
    Dasya elegans.
    Chondria tenuissima.
    Polysiphonia variegata.
    Rhabdonia tenera.
    Ceramium rubrum.
    Gracelaria compressa.
    Polysiphonia urceolata.
4. Cyanophyceæ.
    Lyngbya, sp.
    Oscillaria, sp.

Looking back on our results, we see that the oyster lives almost exclusively on diatoms, and it will be well to recall the structure and physiological properties of these low plants. The diatoms are small, microscopic plants, surrounded by a firm membrane having a structure of a small box; that is, consisting of the two halves of the cell wall, one fitting over the other as the cover does over a pasteboard box. These cell walls, formed of cellulose, are incrusted with an enormous quantity of silica, often arranged in beautiful and delicate designs, so that after the soft parts have been destroyed by heating to incandescence, the perfectly clean silicious skeleton remains, showing all its delicate detail of structure. Inside of this cell wall the plasmatic body of the diatom, provided with a nucleus, is seen during life. In some species more or less definite portions, in others the whole plasma, is diffusely tinged with a brownish color. This color is of particular interest to us, for just as the trees, by means of their green coloring matter, are able to convert inorganic into organic matter—that is, animal food—so are the diatoms in the same way by means of their brown color substance. Let us see what this teaches us, and first glance at the economic peculiarities of higher animal life.

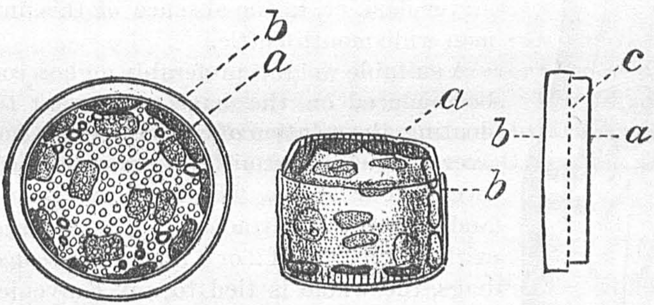
Starting from any animal life, we see that its existence always depends, either directly or indirectly, on the presence of plants, since these alone are able to form organic matter, all animals being destroyers, but never producers, of it. For example, cattle live directly on plants,

*That the flora at Hampton is very much richer is strongly suggested by the fact that in April of this year, during an afternoon walk along the shore, I found in great abundance Phyllitis, Ectocarpus, Pelagella, three genera of which in August no trace was left.

but the lion, devouring the cattle, depends as well on the plants, since without them the existence of his prey would be impossible. Exactly the same thing takes place in the water; the fishes preying on other fishes, these on smaller fishes, these again on other animals. All have to come back finally to animals living on plants. So we see that in the present case our oyster lives directly on plants, and there is no danger, as long as our waters contain the necessary salts for plants to live upon, that the food supply of the oyster will become exhausted, unless, indeed, it should be found that in the embryonic stage the oyster depends upon some more precarious food supply.

One subject of interest remains to be considered, namely, How do diatoms multiply?

This is accomplished as represented in the accompanying figures. The shells *a* and *b* separate as far as possible, so that one fits but slightly over the other. A cross wall *c* is now formed which splits into two, one of these forming the box for each of the two halves. It will be readily understood that in this way every daughter diatom is a little

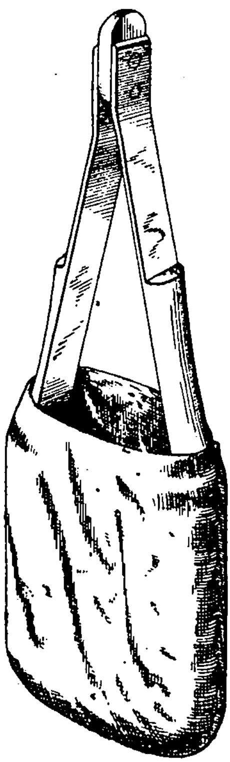


smaller than the mother, since the box of the mother now serves as the cover of the daughter. If this be repeated a certain number of times, the diatoms would finally become too small for existence, but then the small diatom leaves its shell and either simply grows, forming a new cell wall after a certain time, or it finds a mate, the bodies of both merging into one, and in this way the loss of size resulting from this mode of division is compensated.

A SIMPLE METHOD OF STAINING SMALL ORGANISMS.

In the staining of unicellular algæ, diatoms, and the reproductive organs of the higher algæ, as well as many other micro-organisms, the greatest difficulty, as is well known, is encountered in the great loss of specimens entailed by the more or less complicated staining process now in use. The one now commonly employed is as follows: The specimen is hardened in a 1 per cent aqueous solution of chromic acid for twenty-four hours, washed carefully in water until the last trace of the acid is removed, then stained with a solution of carmine. It does not need to be pointed out that by the use of this method it is easy to lose the greater part of the organisms, and the disadvantages of it are increased the more simple the appliances of the laboratory. Hence, during a short stay at the seashore for the purpose of study of these forms, where the equipment of a hastily constructed laboratory is necessarily meager, great inconvenience is experienced.

In order to obviate this difficulty I have used a method which I found both simple and satisfactory. Small bags having the shape represented in the accompanying figure are made of bolting cloth, a fine mesh being used so that the desired organisms can not pass through. The organisms having been removed by means of an ordinary glass tube from the glass dish in which the surface nets were emptied, are now transferred to the bag just described. During this manipulation the little bag is kept open by means of a pair of forceps in the manner indicated, after which the bag is securely closed by tying a string around its mouth. Several bags filled in this way are then placed in an Erlemeyer flask or, in the absence of this, into a common wide-mouth bottle.



A suitable weight, preferably a glass rod, having been placed on the bags to prevent them from floating, the solution of chromic acid is now poured over them and permitted to remain in contact for twenty-four hours. The bags are then removed, and having been attached to a long piece of cord, with an interval of 2 or 3 inches between every two bags, the whole is tied to any convenient object and washed in a stream of water until free from the chromic acid. This usually takes about two hours. The bags are now removed from the water and immersed in the staining fluid for a sufficient time. The excess of stain is washed away in water, and if overstaining has occurred the organisms can be decolorized while still inclosed in the bags by adding a trace of HCl to the water. The bags are now cut open, the stained organisms transferred to a watch glass and mounted. Should they still be overstained they can be further decolorized in the manner stated.

5.—ESTABLISHMENT OF STATIONS FOR THE PROPAGATION OF SALMON ON THE PACIFIC COAST.

By J. J. BRICE, *Commander, United States Navy.*

WASHINGTON, D. C., *November 15, 1892.*

SIR: I have the honor to submit herewith a report of investigations and operations on the Pacific Coast in reference to the establishment of stations for the propagation of salmon.

The salmon, which formerly inhabited the Pacific Coast waters in countless millions, extending from Alaska to Monterey, are becoming each year more reduced in numbers in the yearly run, and the question resolves itself into one of almost final extinction or prompt and active measures for their protection and propagation. The importance of speedily furnishing a supply equal to the demand by artificial means is emphasized in the value of the fish industry on that coast, amounting to something like $7,000,000 yearly.

The seal fisheries are a national question and the most prominent subject before the people, verging on war, yet their actual commercial value is not so great as the fish industry on the Pacific, which is gradually slipping away from us through depletion by indifference and improvident destruction. The ruin has continued without interruption until some of the streams, formerly alive with fish, are now nearly exhausted and becoming as destitute of salmon as the Hudson and the other eastern rivers which were, in early times, abundantly stocked with many species of *Salmonidæ*. This destruction took place before artificial propagation was practiced, an excuse for that day and time; but it also serves as a warning in the present, with our knowledge of artificial means, to protect and guard the Pacific Coast streams from the same misfortune.

To formulate a plan to restore the salmon in their original numbers to the various streams on that coast and offset the yearly catch by artificial propagation has been my duty.

The urgent necessity for speedy action is manifest in the fact that there are many obstacles in the way of the rehabilitation of a river once depleted of its fish, aside from the great increase in the labor and the expense of transporting young fry from remote localities. It was therefore recommended to the United States Fish Commission to establish hatcheries on military or other Government reservations, and similar desirable localities for the production of the different species of salmon, so arranged as to benefit all the streams on the Pacific Coast.

As an experimental effort and the commencement of the system, a hatchery was established at Fort Gaston, Humboldt County, Cal. This is the central hatchery, and has auxiliary or subhatcheries on the neighboring streams which empty directly into the ocean. These auxiliary hatcheries are used for taking the spawn and depositing the young fry on or near the spawning-grounds, and are kept open only during the spawning and hatching season, which would be about four months of the year. Besides the auxiliary station at Redwood River, it is proposed to connect with the Gaston Station two others on the Mad and Eel rivers. There are other streams near by which could be utilized in the same way, all emptying into the sea. In addition to stocking the waters of the Pacific with salmon and other indigenous fish, the central hatchery at Gaston is provided with ponds used for hatching and propagating eastern and foreign fish, such as landlocked salmon, eastern and German trout. Breeding ponds are in use, filled with the two last-mentioned fish, from which many will be distributed in the streams and waters throughout the country.

Other localities have been examined and suitable places inspected for hatcheries, those on the Colville Reservation near the head of the Columbia River and another at Lake Cœur d'Alene being particularly favorable. Military or Government reservations were selected for several reasons, prominent among them being the assured protection of the young fish. For convenience it is also desirable that the hatcheries should be located near the heads of the streams in the vicinity of the spawning-grounds, where fish are more likely to be found ripe and ready for stripping of their eggs. While the system need not be confined to Government reservations, such localities are preferable where facilities for the work meet with the requirements.

The streams should be stocked from the several varieties found on the Pacific Coast, preferably the indigenous or the kind of salmon which visit the particular stream. Great danger attends the introduction in any stream of fish not belonging to the waters. A stronger and more rapacious strange fish is sure to destroy the weaker native occupants of the stream, and give in return for the destruction probably an inferior and less prolific salmon.

The waters in Humboldt County, Cal., are also free from vagrant and predatory fish; consequently the young can be placed in the stream at an early age without molestation except from the trout which inhabit all these waters. The yearling trout is the voracious enemy of the young salmon, and being small himself is capable of pursuing the little fish into shoal water, their haven of refuge from danger. The destruction of salmon fry by these active young trout is very great. Therefore it is not policy to stock the same stream with both salmon and trout. Since there is no comparison in their commercial value there should be no question as to which should receive the attention and protection of the Fish Commission. The Fort Gaston station is on the Trinity River, a tributary to the Klamath. The fish appear here early in the winter months and again in the spring to spawn.

When the salmon enters the river and commences his long journey to the spawning-grounds it is truly the effort of his life, resulting in many cases in death from accident or exhaustion. During this time he eats nothing, a wise provision of nature, otherwise the spawn, which is the most attractive food for fish, would be consumed by the multitudes which throng the streams during the spawning season. The salmon enter the river in good condition, well fortified with fat, upon which they maintain their strength, combined with the constant supply of nutriment from the destruction of the oil-bearing tissues which envelop the ovary and the outside membrane covering, the latter holding the eggs and oily essence surrounding them. Disintegration of the ovary adjuncts and spermatic parts begins shortly after the fish enter the river, in both male and female, but the supply is not so great in the former, because the burden and exertion are less.

The conjunction of natural causes in assisting the salmon in all his movements and in the manner of depositing the eggs is as interesting as it is beautiful. In the operation of spawning, from my own observation, the salmon on arriving at the place selected remains quiet until recovered from the effects of the long journey from the sea, and for this purpose they select a pool where there is protection and concealment, under driftwood or an overhanging bank. In pairs, male and female, they build their nests generally in the swift water on the ripple above or below the pool, the male guarding it with great jealousy by fighting away all intruders. The pool serves as a place of concealment during the day; the spawning and nest-making takes place at night or early in the morning, continuing during the daytime if it is overcast and dark. The act of spawning by the female may go on at intervals for a week before all the eggs are deposited.

The construction of the nest is commenced by digging an elongated hole, extending up and down the stream, and located in the swift water above or below the pool, the fish using the nose and fins in making the excavation, throwing out the sand and gravel in volumes in their effort. The stones and gravel are carried just below the excavation by the current, forming a nest covering a space sometimes more than 6 feet in diameter, the small particles of sand and dirt being carried far down the stream.

It seems strange that a collection of stones and pebbles should form a fish nest, and it becomes a matter of speculation as to the manner of secreting the eggs under a mass of stones. Yet nature has made it very simple, and secured its results in a matter-of-fact way. The eggs are deposited in the hole by the female and impregnated by the male. During the fertilization, which takes from half an hour to fifty minutes, the eggs cling together in a mass and to the bottom of the stream; they then commence to separate, and the gentle current sweeping down through the trough-like hole carries the egg out of the excavation, as it becomes detached from the mass, and onto the nest of stones below, where it tumbles from one stone to another, until it drops into one of the crevices, eventually finding its way to the bottom of the pile or nest, and there lies securely hidden away, well protected from predatory fish, until it is finally hatched.

It takes from forty to sixty days for the eggs to hatch, the time depending upon the temperature of the water. After hatching the fish remain in the nest about twenty days, until the umbilical sac is exhausted, having at this time but one instinct—to hide and burrow deeper into the nest. After the substance of the sac is consumed the little fish approaches the surface to snap at passing particles of food, and in so doing is washed away from the nest and finally makes its way to the shoal water near the shore, gradually dropping downstream until the fall freshets come and carry it into the larger streams, and eventually into the ocean.

Salmon make their nests and spawn differently under different circumstances. If prevented from reaching their spawning-ground, by late freshets or other obstacles, they will spawn in the river or deposit their eggs in the muddy bottom of a pool, if there are no gravel beds available. In both instances most of the eggs are lost. By artificial means as much as 95 per cent of the eggs are hatched; and in depositing the young fry it has been the custom at the Fort Gaston station to place them in the streams near the spawning-grounds five or six weeks after hatching. Young salmon fed abundantly in the ponds for four or five months before they are put in the streams acquire different habits, and are inclined to linger in the fresh water the year round, having become too strong to be carried out by the fall and winter freshets against their inclination. The salmon is very much the victim of circumstances, and in his movements is governed more or less by freshets and the temperature of the water. From the latter he is most naturally controlled in seeking more genial surroundings. The early stage of a little salmon's existence is made up of continuous alarms to avoid danger, and the commencement of his life is spent in hiding and darting about until he gains sufficient strength and activity to venture abroad for food, trusting to speed for safety.

The method of taking salmon for spawn at Fort Gaston consists in running a wire fence diagonally across the stream, near the upper end of which is inserted a V-shaped trap made of the same wire stretched over a wooden frame; the pointed end of the trap is placed upstream and the wire fence extends to the shores from each corner of the lower end. In the lower face of the trap is a hole large enough for the salmon to enter, with converging steel rods, 18 inches long, extending inwardly from around the opening; these are pressed apart as the salmon enters and spring back into place when he is secure inside. The traps are located below the spawning-ground and convenient to the hatchery.

The Fort Gaston station was the experimental attempt in the commencement of a systematic plan to stock yearly the streams on the Pacific with salmon, and in view of the satisfactory results given by this station it is recommended that the system be extended by establishing hatcheries with 4 auxiliary stations each in the following localities: One on the Chilcat River, in Alaska, or in its vicinity; one on Puget Sound; one on the Colville Reservation, Columbia River, and one on Eel River, California. It is also recommended to increase the Gaston station with 3 auxiliary hatcheries, and connect with the McCloud station 4 auxiliary stations.

The following is an estimate of the cost of establishing and maintaining these proposed stations:

Four central hatcheries, buildings, and apparatus, at $2,000	$8,000
Twenty auxiliary hatcheries, at $300 each	6,000
Five superintendents, at $1,200 per year each	6,000
Six laborers, at $40 per month each for twelve months	2,880
Twenty-four laborers, at $40 per month each for four months	3,840
Yearly miscellaneous expenses of each central hatchery, including its auxiliary stations	1,500
Total miscellaneous expenses yearly of five stations, not including the McCloud hatchery	7,500

With this small outlay of public money each important salmon stream on the Pacific Coast could be stocked with young fish artificially hatched far exceeding in numbers the yearly catch or market demand.

As the farmer recognizes the necessity of replenishing his stock every year, in like manner the same prudent forethought is required in regard to the occupants of the streams, and the expenditures for this purpose in the plan suggested are insignificant when compared to the millions of dollars represented in the result.

For the further protection of the fish on that coast, it is suggested that one of the rivers, the Klamath, for instance, and its tributaries, be held by the Government as a fish preserve, prohibiting seining or taking salmon in any way for commercial purposes. A great national nursery would thereby be established, from which not only the Pacific Coast would be benefited, but the whole country. The land extending some distance from the mouth of the Klamath River is, I believe, a Government reservation, requiring no special legislation to close the stream to outside enterprise.

Authorities give the salmon (genus *Oncorhynchus*) on the Pacific Coast as representing five species. The king, quinnat, or chinook salmon has an average weight of 22 pounds; there are 16 rays on the anal fin to distinguish it. The blueback salmon weighs from 5 to 8 pounds and has 14 to 16 rays on its anal fin. The silver salmon, weighing from 3 to 8 pounds, has 13 rays on the anal fin to distinguish it. The dog salmon, with an average weight of 12 pounds, has 14 anal rays. In the fall the male dog salmon is red and his jaws are much distorted. This is also true of the humpback salmon, which is small, weighing up to 6 pounds and having 15 anal rays.

Among the offshoots of the *Salmonidæ* is the steelhead, which, from good authority, is the salmon trout, the same species as the rainbow trout in the streams. In point of fact the steelhead and rainbow trout were originally one and the same fish, so far as at present known from their construction, the difference in size being due to their habits and the extensive surroundings of the steelhead. In construction, except its size, the steelhead is a trout, but in habits a salmon. The rainbow trout may become a salmon trout (or steelhead) when its habits are anadromous, which could occur through accident, such as an unusual freshet in which the rainbow trout is washed into the estuaries of the rivers and the sea. The rich food and boundless extent of territory off the mouths of rivers account for his increase in size and strength. This growth is noticed in the salmon as being comparatively insignificant while remaining in fresh water, but rapid upon its first visit to the sea. Fish food is most plentiful in the ocean near the estuaries of the rivers, as the influence of the fresh-water stream is felt many miles at sea, causing an abundant growth of marine vegetation or vast pastures, attracting the smaller fish and crustacea upon which the salmon feed, returning yearly to their native rivers to spawn.

Very respectfully,

J. J. BRICE,
Commander, U. S. Navy.

HON. MARSHALL MCDONALD,
United States Fish Commissioner.

6.—THE ICHTHYOLOGICAL COLLECTIONS OF THE STEAMER ALBATROSS DURING THE YEARS 1890 AND 1891.

By CHARLES H. GILBERT, PH. D.,
Professor of Zoology in Leland Stanford Junior University.

REPORT ON THE FISHES COLLECTED IN BERING SEA AND THE NORTH PACIFIC OCEAN DURING THE SUMMER OF 1890.

During the summer of 1890 the writer accompanied the *Albatross* as chief naturalist during its exploration of Alaskan waters. The plans for the cruise, outlined by the Commissioner, contemplated a thorough examination of the cod banks of Bristol Bay and the area surrounding the Aleutian Islands, followed by an exploration of the deeper waters of the western portion of Bering Sea. It is much to be regretted that unforeseen hindrances prevented the accomplishment of the latter part of this plan. But two hauls of the beam trawl were taken beyond the 1,000-fathom line in Bering Sea, and the interesting results only emphasize the importance of making a thorough exploration of this region.

The narrative and some of the general results of the cruise have been already given by Commander Z. L. Tanner (Report of Commissioner of Fish and Fisheries for 1889–91, pp. 226–256), and the economic phases have been treated sufficiently by the fishery expert, A. B. Alexander (*l. c.*, pp. 280–290). The present paper contains a list of the fishes collected during the cruise, with notes and descriptions of new or little-known forms.

One hundred and forty-three dredging stations were occupied, numbered 3210 to 3352 inclusive, the large beam trawl being usually employed. Of these, stations 3210 to 3227 form a line extending from a point south of the Sannak Islands westward through Unimak Pass to Unalaska; stations 3228 to 3306 were in the shallow waters of Bristol Bay (3¼ to 81 fathoms) and were very monotonous; stations 3307 and 3308 were in the depressed basin occupying the western portion of Bering Sea and were of extreme interest; stations 3309 to 3336, also very rich in results, were to the northward of Unalaska Island in depths of 19 to 578 fathoms; stations 3337 to 3342 form a line extending across the North Pacific from Unalaska to Vancouver Island, station 3342, taken off Queen Charlotte Island in 1,588 fathoms, proving much the most interesting haul of the cruise; stations 3343 to 3352 were off the coasts of Washington, Oregon, and northern California.

NOTE.—The writer desires to express here his indebtedness to his colleague, Prof. W. W. Thoburn, who rendered very material assistance in preparing this report.

The rich results which invariably followed the use of the trawl at depths of 1,000 fathoms and over indicate the direction which future explorations of the *Albatross* should take in the Pacific. The shallower waters and moderate depths of the continental platform have been fairly, if not exhaustively, explored; but the slope between the 1,000-fathom line and oceanic depths is practically unknown. As already stated, it is especially to be regretted that so little work could be done in the deeper waters of Bering Sea during the summer of 1890.

The most characteristic feature of the fish fauna of California is the extreme abundance and variety of three groups of fishes—the "rock-fishes" (*Sebastodes*), the flounders (including numerous characteristic genera and species), and the viviparous surf-fishes (*Embiotocidæ*). All these are greatly reduced in numbers to the northward, and the fauna of Bering Sea assumes in consequence a very different appearance. The "surf-fishes" wholly disappear before reaching the Aleutian Islands; but two or three species of rockfish are sparingly present, and the flounders are diminished in numbers and represented by forms such as *Hippoglossus*, *Atheresthes*, *Pleuronectes*, and *Limanda*, more nearly allied to those of the North Atlantic than are the predominating species of California.

To replace these lacking forms, we have at the north large additions to the families *Cottidæ*, *Agonidæ*, *Liparididæ*, and *Blenniidæ*, those added being again close affines of North Atlantic species, with which many of them have, indeed, been considered identical. One of the most interesting results of the present investigation has been the discovery that several of these are distinguishable from their North Atlantic representatives by small but constant characters. Should these distinctions be verified, it will indicate that the icy seas of the Arctic have long been a barrier to the passage of these species. Of the marine fishes collected the following only are now considered by us common to the two oceans:

Mallotus villosus.
Pygosteus pungitius.
Icelus bicornis.
Pholis fasciatus.
Stichæus punctatus.
Leptoclinus maculatus.
Leptoblennius nubilus.
Gymnelis viridis.
Hippoglossus hippoglossus.

A reduction in this list may be expected when adequate series from both oceans can be brought together for comparison.

The following species are here described as new:

Raja abyssicola.
Raja aleutica.
Bathylagus borealis.
Sebastolobus altivelis.
Icelus vicinalis.
Icelus canaliculatus.
Icelus spiniger.
Icelinus borealis.
Artediellus pacificus.
Cottus aleuticus.
Acanthocottus sellaris.
Acanthocottus laticeps.
Acanthocottus profundorum.
Triglops beani.
Triglops scepticus.
Triglops xenostethus.
ELANURA, new genus.
Elanura forficata.
Oligocottus acuticeps.
Paricelinus thoburni.
Aspidophoroides bartoni.
Odontopyxis leptorhynchus.
Odontopyxis frenatus.
Xenochirus alascanus.
Paraliparis holomelas.
Paraliparis ulochir.
Careproctus ectenes.
Careproctus colletti.
Careproctus phasma.
Careproctus ostentum.
Careproctus simus.
GYRINICHTHYS, n. gen.
Gyrinichthys minytremus.
RHINOLIPARIS, new genus
Rhinoliparis barbulifer.
Liparis cyclostigma.
Liparis fucensis.
BATHYPHASMA, new genus.
Bathyphasma ovigerum.
LETHOTREMUS, new genus.
Lethotremus muticus.
Leptoblennius mackayi.
LYCONECTES, new genus.
Lyconectes aleutensis.
Lycodes palearis.
Lycodapus extensus.
Lycodapus parviceps.
DEREPODICHTHYS, n. gen.
Derepodichthys alepidotus.
Nematonurus cyclolepis
Chalinura filifera.
Limanda proboscidea.

Family HEPTATREMIDÆ. The Borers.

1. Polistotrema stouti (Lockington).

Numerously represented from stations 3343 (south of Cape Flattery, Washington, 516 fathoms), 3348 and 3350 (near Point Arena, Cal.; 455 and 75 fathoms). The species was not taken in Alaska.

Family PETROMYZONIDÆ. The Lampreys.

2. Entosphenus tridentatus (Gairdner).

A specimen, 11 inches long, presented by the Alaska Commercial Company, had been taken in one of the small streams of Unalaska Island. It appears not to differ from specimens taken in Monterey Bay, California, with which we have compared it.

Family RAJIDÆ. The Skates.

3. Raja parmifera Bean.

The most abundant of the five species which were taken in Alaskan waters. Eleven specimens in all were secured, distributed among 10 dredging stations in Bristol Bay (3252, 3259, 3267, 3270, 3272, 3281, 3282, 3292, 3293, 3310, and 3313), the depth ranging from 16 to 68 fathoms.

The specimen from station 3270, a female, showed the following characters: Uniform dark olive-brown above, without distinct lighter areas; lower side white, the posterior margins of the disk blackish.

Width of mouth $1\frac{3}{8}$ times in its distance from tip of snout; the latter distance half greatest rostral width. Teeth, 30–24. A series of 30 large spines (24, 28, 28 in three other specimens) on median line of back, the anterior one over middle of branchial region, two of the series occupying the space between the dorsal fins. A single strong spine on each shoulder (two of these in most specimens). Prickles on disk comparatively very coarse, with conspicuously stellate bases, not crowded, arranged in somewhat definite areas. A scattered group on terminal half of snout (in other individuals not always recognizable); a patch on anterior and one on posterior portion of orbital rim connected by a line of smaller prickles; a band along the anterior and one along the posterior borders of pectoral fins, the two usually not continuous at the angles; ventral fins with smaller prickles. A well-defined band along each side of median line, continued backwards as conspicuous lateral bands on tail, along the middle of which they increase in size, becoming spines. Both dorsals prickly. A small patch of minute prickles on under side of snout (not present in all specimens). The disk is otherwise smooth.

In the male specimen from station 3282, the armature is essentially as described above, the prickles being smaller, and the lateral series on tail scarcely enlarged. A band of prickles covers all of the angle of pectorals inside the band of bucklers. The snout is naked, except a marginal band, and a patch on tip which extends backwards a short distance on median line. A definite patch of stronger prickles on anterior and one on posterior portion of orbital rim, connected as before by a single series. These patches of orbital prickles are very different from the single series of definitely placed orbital spines, characteristic of *R. rhina*, *R. binoculata*, and *R. inornata*. A series of 25 strong spines along median line, a single spine on each shoulder. Bucklers arranged in 22 series, with 5 in the widest series. The dorsal bands of prickles do not reach the shoulder. Color, light brown, a single pale spot as large as eye at base of each pectoral fin, without definite margins, and not ocellated.

A young female, 205 mm. long, from station 3313, is brown, with scattered, ill-defined black spots, of which two are larger and occupy the position at base of pectorals in which the ocellated spots of other species are found. A pair of round white spots, without darker border on base of pectorals more posteriorly; a pair of smaller light spots on tail at end of basal fourth. Prickles coarse, covering all of disk and tail, except a roundish area on each side of median line, above the branchial region.

No true spines on orbital rim; the latter in common with the whole interorbital area covered with coarse prickles. Median row of spines fully developed and strong, as are also the two scapular spines. The prickles are arranged in quite regular series, those laterally following the rays, those mesially parallel with dorsal row of spines.

This species seems to be confined to Alaskan waters. Among Pacific species it is most nearly related to *R. stellulata* and *R. trachura*, agreeing with both in the wide rostral angle, the rather uniform coloration, and the absence of the definitely placed orbital spines characteristic of other species.

4. **Raja stellulata** Jordan & Gilbert.

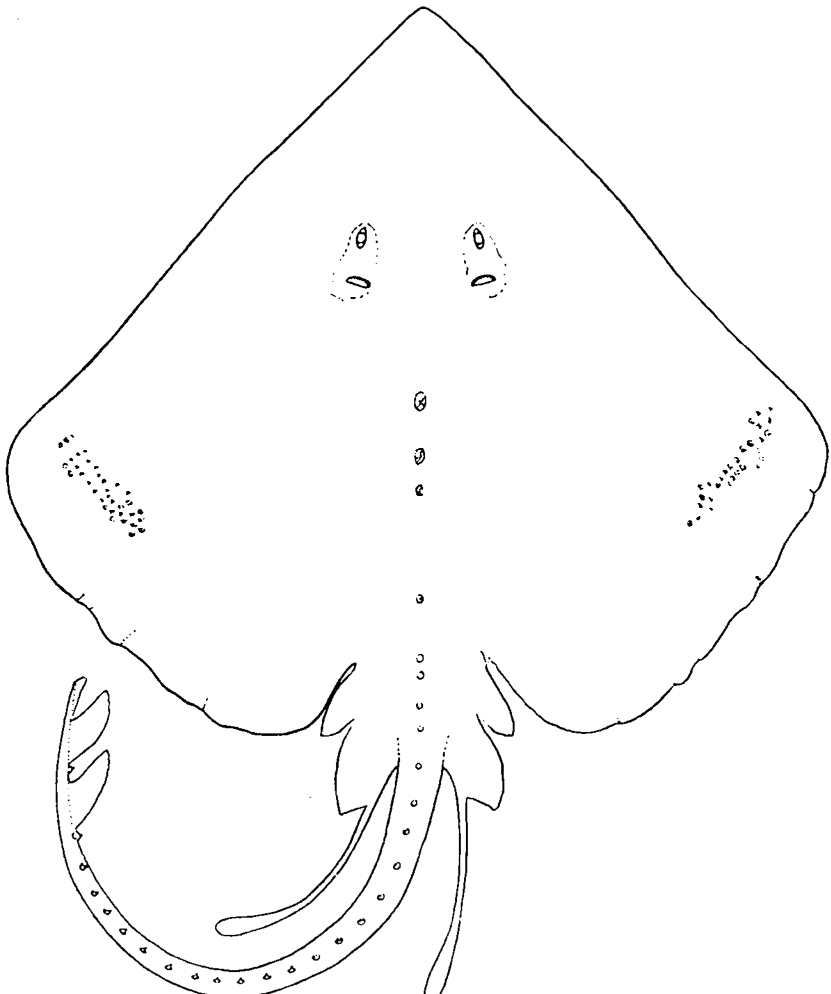
Obtained in Unimak Pass, Bristol Bay, and along the northern shores of Unalaska Island, in depths of 42 to 70 fathoms (stations 3217, 3255, 3258, 3310, and 3312). This species seems to have the most extensive range of any of our Pacific skates from shallow water. We find no difference between these specimens and others from the Santa Barbara Channel, California.

The species does not apparently reach a very large size. A male specimen, 600 mm. in total length, is mature, with claspers 150 mm. long, and the pectoral hooks fully developed. The latter are in 22 series, with 5 hooks in the widest series. The young show a very similar armature to the adults. At no stage is there a trace of orbital spines, the row of orbital prickles being in the young scarcely differentiated from the interorbital band. In a young male, 200 mm. long, the series of median spines on back and tail is strongly developed, and the spines are uniform in size, the two anterior ones separated by an interspace from the third. The two scapular spines are also strong. In older specimens the spines on middle of back diminish in size, the anterior three remaining strong. In some old specimens these reduced spines have entirely disappeared, the median series then appearing to begin over the front of base of ventrals. The color is much as in *R. parmifera*, being brownish, with scattered ill-defined dusky spots. In the young we find at base of pectoral fins a broken dark ring a little larger than pupil. This does not inclose a light spot, is inconspicuous, and soon disappears. The light spots at base of posterior third of pectorals, so conspicuous in the young of *R. parmifera*, and visible even in older specimens, are not present in *R. stellulata*. The prickles in the latter are smaller and more numerous than in *R. parmifera*, but the young resemble each other much more strongly than do the adults of the two species. In neither are prickles developed on the under surface, if we except a small patch near tip of snout, sometimes present in *R. parmifera*.

5. **Raja abyssicola** sp. nov. (Plate 20.)

A single large male specimen taken near Queen Charlotte Island, station 3342, depth 1,588 fathoms, the greatest depth recorded for any species of skate.

As in other deep-sea species of *Raja*, both the upper and under parts are uniform brown in color, the upper surface obscurely marked anteriorly with very small but definitely margined spots of darker brown. Both upper and lower surfaces are covered with long close-set slender bristle-like spines, which are flexible and give a velvety texture to the skin. The extreme anterior margin and a wide strip along posterior margin of disk, the ocular region, the greater part of the upper surface of ventrals and of the basal two-thirds of the under side of the tail, alone naked. No large spines or prickles on orbital rim. A band of enlarged prickles on each side of tail. An uninterrupted series of 24 large spines with very broad bases extends along median line of tail to opposite front of ventrals. After an interruption, it reappears in a series of 3 spines on middle of back. A single spine between dorsal fins. Pectoral hooks very weakly and irregularly developed. They are usually interradial in position, have at most 3 or 4 in a series, and develop irregularly, the spines being sometimes directed backwards instead of inwards. They are not arranged in definite lengthwise series. Some of them remain permanently in an undeveloped condition as elongate soft papillæ, and the gaps in the series indicate the total disappearance of others.



RAJA ABYSSICOLA sp. nov.

Disk very broad, the outer angles of pectorals behind its middle. Anterior profile convex opposite the orbits, strongly concave both in front of and behind this region. Interorbital space deeply concave, the cranial cartilage apparently thin and weak. Teeth, 31-31. Claspers very long and slender, dilated distally, everywhere so readily flexible as to be easily bent at an acute angle. A wide lateral fold along either side of tail. Dorsals very high and near together; caudal fold but little higher than the lateral ones, with which it becomes confluent at tip of tail.

The following table of measurements in millimeters will give the proportions of the type:

Greatest width of disk	730	Distance from tip of snout to front of eye	185
Width at front of eyes	185	Distance between eyes	60
Tip of snout to axil of pectoral	570	Width of spiracles	33
Axil of pectoral to axil of ventral	125	Diameter of eye	33
Axil of ventral to tip of tail	655	Distance from snout to front of upper jaw	190
Origin of first dorsal to tip of tail	148	Distance from snout to nostril	158
Base of first dorsal	48	Distance between outer edges of nasal flaps	103
Oblique height of first dorsal	45	Width of mouth	105
Distance between dorsals	13	Distance from snout to first branchial slit	310
Base of second dorsal	46	Distance from first to fifth slits	112
Length of claspers	255	Distance between inner edges of first slits	212
Distance from tip of snout to outer pectoral angle	555	Distance between inner edges of fifth slits	133
		Distance from snout to vent	610

6. Raja aleutica sp. nov. (Plate 21.)

A single young male specimen, 835 mm. long, from station 3257, north of Sannak Pass, Aleutian Islands; taken at a depth of 81 fathoms.

Closely related to *R. stellulata* and *R. parmifera*, but reaching a much larger size than either, and having the disk everywhere uniformly covered above with very fine close-set stellate prickles very much finer and more numerous than in either species. The species agrees with *R. parmifera* and differs from *R. stellulata* in having the median spines in an uninterrupted series. They are 34 in number and extend from just behind the occiput to the dorsal fin. Two strong spines on the shoulder; orbital rim without spines or enlarged prickles; a wide band of coarser prickles on each side of tail; the extreme margin of disk and the greater part of ventral fins naked; under parts without spines or prickles.

The disk is not so wide as in *R. stellulata*, and the snout is longer and narrower. The anterior margin is gently concave toward outer angle and gently convex in front, the rostral angle being about 90°, the extreme tip forming a slightly projecting rounded lobe. The cranium is abruptly constricted in front of nostrils, as in *R. abyssicola*, leaving a slender flexible cartilaginous rod extending to tip of snout. In the present species the space between the rostral cartilage and the base of the rostral portion of pectoral fin is membranous and lighter in color than the rest of the disk. Interorbital space deeply concave, its width $3\frac{1}{3}$ in length of snout, the latter $2\frac{7}{8}$ in distance from tip of snout to axil of pectorals. Spiracles narrow, $\frac{1}{2}$ diameter of eye. Distance from tip of snout to front of mouth $2\frac{3}{8}$ in distance from tip of snout to vent; the latter equals the length of tail. Teeth $\frac{34}{33}$. Claspers not reaching margin of ventrals; pectoral hooks not developed. Color, brown above, with large, obscure, dusky blotches; white below; the edges of disk, the anal area, and the under side of the tail brown.

This species evidently reaches a very large size. The following is a description of a specimen 4 feet across, taken at station 3223, and supposed to belong to the same species. The specimen was too large for preservation.

Snout long but very broad, thus appearing short and blunt, as in *R. stellulata*, the rostral angle being about 100°, the extreme tip of snout projecting. Anterior lateral profile of disk convex, becoming strongly concave posteriorly near angle. Interorbital width (of cartilage) one-third length of snout measured from its tip to a line joining front of orbits. Interorbital area strongly concave. Eye a trifle less than length of spiracle, one-half interorbital width. No elevated supraocular rim. Length of snout (as above defined) a trifle more than half its greatest width.

Prickles small, uniform, entirely covering upper surface, including fins and tail, excepting only the base of ventrals, which are nearly smooth. No spines or enlarged prickles above orbits. An elongate patch of slightly enlarged prickles in front of each eye, the two converging forward, separated from orbit posteriorly by two-thirds diameter of eye. Prickles somewhat enlarged toward tip of snout, not spine-like. The median row of spines on back begins immediately behind occiput, continues without interruption to dorsal, and contains 39 spines in addition to the 2 between dorsal fins. A narrow band of slightly enlarged prickles on each side of tail. Dorsal fins uniformly prickly. Bucklers on pectorals in 26 rows, 6 or 7 in broadest row. Two or three enlarged spines on shoulder.

Entire under surface of snout and a band extending along most of anterior edge of disk prickly. Under surface of pectorals otherwise smooth. Belly smooth. An area immediately in front of vent minutely prickly, as is also the thoracic region. Lower side of tail prickly except at base. Ventrals smooth below.

Width of disk slightly less than distance from tip of tail to shoulder, $1\frac{1}{6}$ times its own length. Length of tail equaling distance from its root to middle of snout. Teeth $\frac{32}{28}$. Dorsals high, about equal in size, their oblique height equaling length of base, which is one-third greater than interspace. Claspers long, smooth.

Dusky olive, with ill-defined light areas; no ocellated spots. Below white; an elongate brown blotch on each side of snout, and a smaller median streak. Lower side of tail brownish dusky. Angle and posterior margin of disk below broadly edged with brown. A large brownish blotch about anus, and some smaller scattered marks.

7. Raja trachura Gilbert.

A second specimen of this interesting deep-sea ray was dredged at station 3338, south of the Shumagin Islands, Alaska, at a depth of 625 fathoms. The specimen is a female, 222 mm. long, and answers well to the description of the type.

Family CHIMÆRIDÆ.

8. Hydrolagus colliei (Bennett). *Ratfish; Elephant-fish.*

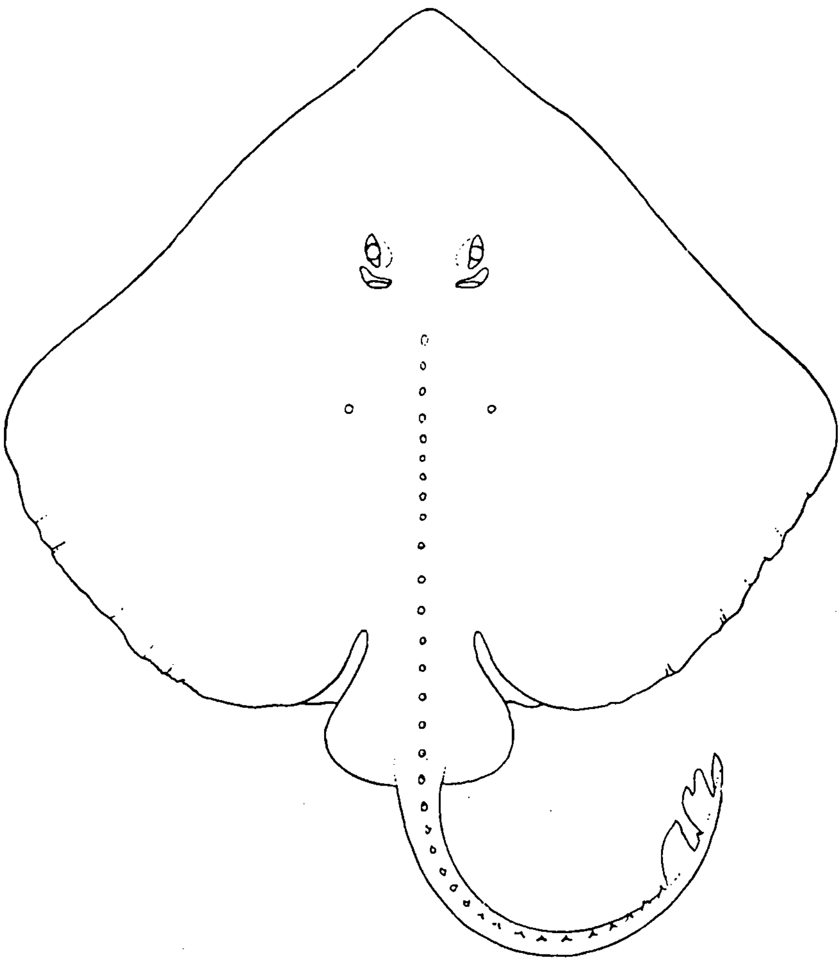
Station 3350, near Point Reyes, Cal.; depth, 75 fathoms.

Family CLUPEIDÆ. The Herrings.

9. Clupea pallasi Cuvier & Valenciennes. *California Herring.*

Clupea mirabilis Girard.

This herring was seen in Departure Bay, Vancouver Island, May 10 to 13; in Unalaska Harbor June 16 and July 31, and in Herendeen Bay, Alaska Peninsula, July 5. In Departure Bay they were swimming in schools about the wharves and ships. It was noticed that when not disturbed all would swim slowly in the same direction with the gill-covers widely open and rigidly set, their oblique silvery surfaces giving bright reflections and rendering the fish very conspicuous when seen from above. If suddenly alarmed, the gill-covers of all were simultaneously closed down, and remained so during whatever rapid maneuvers followed. In this condition it was very difficult to follow their movements. Young salmon were feeding upon them at the time of our visit. In Unalaska Harbor they were present in great numbers the middle of June, but were not seen May 24, at the time of our first visit. They were very large and in excellent condition, and seemed superior to the same species when taken on the California coast.



RAJA ALEUTICA sp. nov.

Family MYCTOPHIDÆ. The Lantern Fishes.

10. Diaphus theta Eigenmann & Eigenmann.

Myctophum protoculus Gilbert. Proc. U. S. Nat. Mus. 1890, 52.

Five specimens from station 3348, taken off the coast of California near Point Arena, Humboldt County, at a depth of 455 fathoms. These are identical with the types of *M. protoculus*, and are in sufficiently good state of preservation to show the division of the luminous spots, a character not visible in the types of *M. protoculus*. It is obvious that the spots are divided into upper and lower halves, which are structurally different, the narrow pigment band indicating this separation on the surface. The species is now known from the above locality, from *Albatross* station 3072 (off the coast of Washington, 584 fathoms), and from the mouths of *Sebastodes* caught near San Diego, Cal.

The specimens before us show great variation in the size of the subocular luminous blotch, and indicate how little dependence can be placed on this as a specific character. In addition to the roundish supra-nasal spot described by Eigenmann, the species possesses a more or less developed subocular bar. In one specimen the latter is a bare line with a minute point separated from it posteriorly. In others it is wider, in extreme specimens reaching one-third the diameter of the pupil. There remains constantly separated from it the small dot already referred to. A peculiar soft flattish body, half as large as pupil, is attached by one edge to the shoulder girdle just above the insertion of the pectoral fin, the other edge remaining free. It is constantly present and uniform in position in all specimens that have come under our observation, including types of *D. theta* and *M. protoculus*. It may be a luminous organ, though it has not strikingly the appearance of one, and its nature must be considered problematical.

11. Nannobrachium leucopsarum Eigenmann.

Numerous specimens from Alaskan waters agree entirely with those from the type locality. Two very closely related species are found among these northern specimens, and both are also present in the dredgings from the Santa Barbara Channel. Both of these are found among the types of *Myctophum nannochir*, and the description of the latter is partly drawn from specimens of each. Such being the case, the name *nannochir* becomes available in connection with the second of these forms, to which I shall here restrict it. The two species are extremely close, and immature or mutilated specimens are often distinguishable with difficulty. The species differ in the following respects:

LEUCOPSARUM.	NANNOCHIR.
Caudal peduncle deep, its least depth about half that of body.	Caudal peduncle long and slender, its least depth two-fifths to one-third that of body.
Head short, $3\frac{2}{3}$ to $3\frac{3}{4}$ in length.	Head longer, $3\frac{1}{4}$ to $3\frac{3}{5}$ in length.
Maxillary shorter, the cheek wider, less tapering posteriorly.	Maxillary long, the preopercle very obliquely placed, the cheek long, tapering to an acute angle posteriorly.
Luminous patches above and below tail occupying the whole length of caudal peduncle, in rare cases somewhat shortened.	Luminous patches on tail short, usually occupying from one-fourth to one-third length of caudal peduncle, rarely longer than this.
Color lighter, the opercle usually with silvery luster, the iris with silvery pigment, and the fins lighter.	Color darker, the opercle black, the iris usually without silvery and the fins uniformly black.
Antro-anal spots usually 6. Ventral spots 4.	Antro-anal spots usually 7. Ventral spots usually 5.

Specimens of *N. leucopsarum* were taken at stations 3227, 3307, 3308, 3325, 3329, 3343, and 3348. The first five mentioned were in Bering Sea, north of Unalaska Island, at depths of 225 to 1,625 fathoms; the last two from off the coasts of Washington and California, depths 516 and 455 fathoms.

12. Nannobrachium nannochir Gilbert.

The present status of this species and its distinctive characters have been discussed under the preceding form. The correlated differences are so constant in our specimens that they can not be ignored, yet are small in amount. They depend neither on age nor sex. From among the original type specimens I select as specific type No. 1459 of the Leland Stanford Junior University Museum, from station 3072.

Specimens in the present collection from stations 3211, 3307, 3308, 3327, 3329, 3338, 3340, 3342, and 3348, including the entire North Pacific and Bering Sea, at depths of 313 to 1,625 fathoms.

Family ARGENTINIDÆ. The Smelts.

13. Mallotus villosus (Müller). *Capelin.*

Dredged in shallow water at three stations in Bristol Bay, Alaska; 3235, 3238, and 3240, depths 11 to 18 fathoms.

14. Thaleichthys pacificus Richardson. *Eulachon; Candle-fish.*

A single fine specimen of the candle-fish was taken near the mouth of the Nushagak River, June 3, 1890.

15. Osmerus dentex Steindachner. *Rainbow Herring.*

Occurs abundantly in the Naknek and Nushagak rivers, and forms an important part of the food supply of the natives. At the time of our visit (June 1–3) it was running rather sparingly. Specimens were secured with the seine in both of the above-mentioned rivers, and in the trawl at station 3231, in Bristol Bay, depth 12 fathoms.

16. Osmerus thaleichthys Ayres.

Several young specimens, probably to be referred to this species, were taken in the Nushagak River near its mouth. They exhibit the characteristic weak dentition of this form, the teeth being barely perceptible on jaws, vomer, and tongue. The scales number 55 and 58 in the course of the lateral line, and the anal rays 14 and 16. The maxillary is short, scarcely reaching to below middle of eye. *O. thaleichthys* has not been previously reported from Alaska.

17. Leuroglossus stilbius Gilbert.

One specimen from station 3330, off the northern shore of Unalaska Island, at the depth of 351 fathoms, and several mutilated examples taken from the stomach of a *Macrurus* at station 3332, in 406 fathoms. The largest of these is 120 mm. long.

Family SALMONIDÆ.

18. Coregonus laurettæ Bean.

A young individual, 125 mm. long, was taken at the mouth of the Nushagak River, June 3. The lower jaw is very slightly longer than the upper; the eye is of moderate size, 4¼ in head; the scales are rather large in size, 84 being present along the lateral line; and the gill-rakers are long and numerous, 25 present on horizontal limb. A similar specimen was taken in the Naknek River (scales 87).

19. Oncorhynchus gorbuscha (Walbaum). *Humpback Salmon.*

The humpback salmon was seen by us at Port Möller, on the northern side of the Alaskan peninsula, during two visits which included the first two weeks and the last week of July. During the first part of this month they were running in small numbers, and as a few scattering ones only had been taken at Unalaska up to June 16, it is safe to indicate the 1st of July as the beginning of their appearance on that part of the coast. In the early part of their run they proved a very acceptable table fish, but later they rapidly deteriorated. On our return to Unalaska, July 31, we learned that they had been running for several weeks, and during several visits in the month of August they were found in incredible numbers crowding into the mouth of the small stream which flows into Captain's Harbor. Both pools and shallows seemed full of them, and large numbers were dying within a few hundred yards of the beach. The spawning season appeared to begin early in August.

20. Oncorhynchus tschawytscha (Walbaum). *Chinook Salmon; Quinnat Salmon; King Salmon.*

While coaling at Departure Bay, Vancouver Island, May 10–13, young individuals of this species were seen feeding on the herring (*Clupea pallasi*), and a number were taken on the trolling line. They were present in company with *O. nerka*. The latter could always be distinguished on the table by its much redder and drier flesh, and will not, as a food-fish, bear comparison with *O. tschawytscha* of the same size. At Unalaska, May 24–27, the run had hardly begun, though a few individuals were seen. A small pond near the stream which flows into the head of Captain's Harbor was full of young salmon of this species, from 2 to 5 inches long, which took the fly greedily. June 3, at the mouth of the Nushagak River, Bristol Bay, an occasional individual was taken. A small run had come into the river a short time before our visit. On June 16 the "king salmon" were running abundantly at Unalaska, but they were not seen on later visits at this point or at Port Möller. It is worthy of note that their period of greatest abundance coincided in time with that of the herring, and their approach to the coast may be determined by the movements of the latter. Their annual appearance in large numbers in Monterey Bay, California, seems to be dependent on the run of anchovies (*Engraulis mordax*).

21. Oncorhynchus kisutch (Walbaum). *Silver Salmon.*

A few individuals of this species were taken at Unalaska May 24–27. It was, as a food-fish, inferior to *O. nerka* and *O. tschawytscha*. Two young specimens were seined at Unalaska June 16, the smaller of which, 190 mm. long, shows very conspicuous parr-marks. These have disappeared in the larger specimen, 225 mm. long, which has also assumed more the proportions and appearance of the adult. In this specimen the spots are more distinct than in the adults, being large, well defined, and close-set on head, back, and dorsal fin, and the caudal fin is very indistinctly marked, the faint spots being confined to the outer ray of both lobes. It is a male, with the testes so well developed as to make it very probable that it would have sought the spawning-grounds within a few months. Three smaller specimens were taken in Herendeen Bay July 5. The smallest of these is 145 mm., the largest 185 mm. long. The distal half of the dorsal fin is black, with the exception of the last two rays, which are entirely white.

22. Oncorhynchus nerka (Walbaum). *Blueback Salmon; Red Salmon.*

This species appeared constantly associated with the king salmon. It was taken by trolling in Departure Bay, Vancouver Island, May 10 to 13, was seined in small numbers at Unalaska May 24 to 27, and was abundant at Unalaska June 16. It had not begun to run at Nushagak June 3, but the young with parr-marks still evident, ranging in size from 95 to 115 mm., were very abundant. The young were doubtless at that time descending the rivers to the sea, and were probably about 20 months old. On July 5 young specimens averaging slightly larger than the above were taken in salt water at Herendeen Bay, Alaskan Peninsula. These range from 120 to 130 mm. in total length; the color is deeper and less silvery than in the Nushagak specimens, and the parr-marks have almost wholly disappeared. The stomachs are full of copepod crustacea, apparently all of one species. The difference in size between the specimens from Herendeen Bay and those from Nushagak may indicate the average amount of growth of the former since reaching salt water. The specimens from Nushagak contained in their stomachs remains of insects and of marine crustacea. They had probably been playing back and forth on the tides.

The young of *O. nerka* are the most slender of all the salmon. They are wholly without spots or freckles on body or fins. The dorsal and anal fins are without prolonged rays or conspicuous color marking. The dorsal fin has a median black blotch and the caudal is slightly dusky on posterior half.

23. Salvelinus malma (Walbaum). *Dolly Varden Trout.*

The Dolly Varden trout was found to be very abundant in the neighborhood of Unalaska, sea-run individuals congregating in great numbers at the mouths and in the lower course of streams when the salmon were running in to spawn. A small stream entering Captain's Harbor, Unalaska Island, has a series of impassable cascades aggregating several hundred feet in height. Above these falls the trout are very abundant, but are dwarfed in size and remarkably brilliant in coloration. They seem to reach no larger size than 8 inches. The largest individual seen during the season was captured in Makushin Bay, Unalaska Island, August 17. It was 24 inches long, with a depth of 6 inches, and weighed 6 pounds. The species was also seined in salt water in Chernoffski Harbor, Unalaska Island.

The black-spotted trout (*Salmo mykiss*), reported by Dr. Bean, from Unalaska, was not seen by us. Its occurrence there must be exceptional.

Family MICROSTOMIDÆ.

24. Bathylagus borealis sp. nov.

A single specimen, 132 mm. long to base of caudal, from station 3327 (north of Unalaska Island, depth 322 fathoms), is taken for the type. A second specimen from the same region, station 3325, depth 284 fathoms.

Head $4\frac{1}{12}$ to base of caudal, depth $5\frac{2}{3}$, eye $2\frac{1}{2}$ in head, snout $2\frac{3}{4}$ in eye. Interorbital width grooved, the groove widening posteriorly, opening onto the flat occipital region, which is not swollen. Width of cartilaginous portion of interorbital space one-third orbit; including the thin membranous plates which overarch the orbits, the interorbital width is three-fourths orbit. The anterior profile of snout declines gently, bringing the mesial portion of premaxillaries on a level with lower margin of pupil. Distance from tip of snout to end of maxillary slightly exceeding length of snout, $2\frac{1}{5}$ in orbit. Opercle with two strong ridges diverging downwards and backwards from behind the eye.

Front of dorsal midway between front of snout and adipose fin. Base of dorsal contained $3\frac{1}{3}$ times in length of head. Ventrals inserted under posterior portion of dorsal. Free portion of adipose fin very long and narrow, rising above the base of the second and third anal rays before the last, its tip reaching rudimentary caudal rays when depressed. Anal fin rather long, the base $1\frac{2}{3}$ in head, the vent immediately before it. Length of tail much exceeding head, $3\frac{2}{3}$ in total length without caudal. Dorsal 8; anal 19; ventral 8; pectoral 8. Scales in about 40 rows, judging from the scars. Head scaleless.

Uniform blackish-brown on sides, the head and ventral region blue-black.

Differing from *B. pacificus* in its much greater depth, longer tail, longer anal fin, and flat occiput.

Family CHAULIODONTIDÆ. The Viper Fishes.

25. Chauliodus macouni Bean.

Two specimens were secured, one at station 3340, south of the Alaskan Peninsula, at a depth of 695 fathoms; another at station 3347, off the northern coast of Oregon, at a depth of 345 fathoms. It is not evident in what respects the Pacific form differs from *C. sloani* of the Atlantic, but as no specimens of the latter are at hand for comparison we follow Dr. Bean in holding them distinct.

26. Cyclothone microdon (Günther).

Taken in Bering Sea, southwest of the Pribilof Islands, at stations 3307 and 3308; depths 1,033 and 1,625 fathoms.

Family DALLIIDÆ.

27. **Dallia pectoralis** Bean. *Alaska Blackfish.*

The blackfish is abundant along the Nushagak River, and there as elsewhere it is an important source of food to the natives. Specimens were presented to us by Mr. Clark, proprietor of the station at Nushagak. The characters assigned by Dr. Gill to his order *Xenomi*, of which *Dallia* is the sole representative, seem to need some modifications. The group is thus defined by him:

"Teleosts with the scapular arch free from the cranium laterally and only abutting on it behind, coracoids represented by a simple cartilaginous plate without developed actinosts, and with the intermaxillary and supramaxillary bones coalescent."

The last of these three characters we have not been able to verify, as the premaxilla, while lying closely appressed to the maxilla, is readily separated from it, the two being in no sense "coalescent." The expression "scapular arch free from the cranium laterally" refers to the simple nature of the post-temporal, which is attached as usual to the epiotic, but seems at first sight to lack entirely the inner fork to join the parotic process of the cranium. Closer examination shows, however, that a strong ligament replaces the lacking arm, and answers to it in all its relations. We find, furthermore, that while in some specimens it retains its ligamentous condition the entire distance between the opisthotic and the simple post-temporal, in others the proximal portion of the ligament is more or less ossified, the bony rod thus formed being an integral part of the post-temporal and representing the proximal portion of the missing fork. As stated, this ossification invades the ligament to a varying extent in different specimens. In at least two which have come under our observation, the fork of the post-temporal thus formed has extended almost the entire distance across to the opisthotic, the shape and relations of the bone being then entirely normal and usual. It is evident that this character is not of high taxonomic value, and would not of itself warrant any very wide separation of *Dallia* from what were at first considered to be its nearest relatives.

The case is different, however, when we come to examine the coracoid portion of the shoulder girdle. As stated by Dr. Gill, we deal here with a cartilaginous plate in which no ossifications occur, and which is followed immediately by the fin rays, without the intervention of actinosts. This coracoid cartilage is an extremely thin and delicate imperforate lamina, usually exhibiting very distinct division into upper and lower halves, which may be taken to represent the hypo- and hyper-coracoid elements. In its distal third the plate begins to break up, by longitudinal subdivision, into a fringe of narrow cartilaginous strips. These approximately equal in number the pectoral rays, and join the latter directly, the basal portion of each pectoral ray forking slightly to receive the tip of the cartilaginous strip.

In the deep-sea spiny eels of the genus *Notacanthus* there is a somewhat similar condition of the coracoid elements, inasmuch as the hypo- and the hyper-coracoid though present, are merely shell-like rudiments surrounded by cartilage, and the actinosts are greatly reduced. It seems probable that we are dealing in the two cases with independent degenerations of the shoulder girdle, and that the two groups are not really related.

Family SYNAPHOBRANCHIDÆ.

28. **Histiobranchus bathybius** (Günther).

A specimen 575 mm. long, from station 3308 in Bering Sea, depth 1,625 fathoms. The color is light brown, darker on head and belly, and on the fins. The depth at vent is 42 mm., the distance of vent from snout 255 mm., the length of the head 59 mm., and length of pectoral fin 17 mm. The vomerine teeth are in an irregular, rather narrow band, reaching posteriorly to opposite hinder margin of orbit.

Family NOTACANTHIDÆ.

29. Macdonaldia challengeri (Vaillant).

Notacanthus rissoanus Günther, Challenger Report, vol. XXII, p. 250, pl. LXI, fig. B; not of Filippi and Verani.

Vaillant was perfectly justified in separating this Pacific form from the Mediterranean *N. rissoanus*, with which Günther had identified it. The lower, heavier spines in both dorsal and anal fins, the more anterior origin of the dorsal, which is a little in advance of base of pectorals, the very short robust ventral spine, and the lower insertion of the pectoral fin sufficiently distinguish the species, in addition to the peculiarities in the shape of the snout and the greatly increased number of anal spines, to which Vaillant calls attention.

The *Albatross* dredged a single specimen, 500 mm. long, at station 3308, west of Pribilof Islands in Bering Sea, at a depth of 1,625 fathoms. Günther's description, above cited, of a fish taken south of Yeddo at a depth of 1,875 fathoms, agrees so well with our specimen that no doubt can exist of their identity. The maxillary spine, not shown in Günther's figure, is very evident in our specimen. The branchiostegal rays are distinctly 6 instead of 5 in number, and the caudal contains 5 instead of 6 rays. There are 35 dorsal spines. The anal spines pass so gradually into the rays that they are distinguishable with difficulty. Definite articulations appear before the rays have lost their spinous character, while still stiff and pungent. Dividing them on the basis of these articulations, the anal fin contains 27 spines and about 153 soft rays.

Family GASTEROSTEIDÆ. The Sticklebacks.

30. Pygosteus pungitius (Linnæus).

Several specimens were secured from the vicinity of Nushagak, one from the Naknek River, and another from the nest of a sea bird on Round Island, of the Walrus Island group, all in Bristol Bay. None of our specimens shows the short ventral spines ascribed to *P. pungitius brachypoda*, their length being in every case 2¼ to 2⅔ length of head. *Brachypoda* was originally described by Dr. Bean from Greenland, and has been given in his recent lists as the common form of Alaska. Awaiting further information, we refer our specimens rather to typical *pungitius*.

31. Gasterosteus cataphractus (Pallas).

Abundant at Departure Bay, Vancouver Island, May 10–13.

Family AMMODYTIDÆ.

32. Ammodytes personatus Girard. *Sand Lance.*

Unalaska, Chernoffski, Herendeen Bay, Hagemeister Island, and generally in shallow water. It forms an important element in the food of the codfish.

Family BERYCIDÆ.

33. Melamphaes lugubris Gilbert.

One specimen from north of Unalaska, station 3327, depth 322 fathoms.

Family BATHYMASTERIDÆ.

34. Bathymaster signatus Cope.

Taken very abundantly in our series of shallow-water dredgings along the southern shore of the Alaskan Peninsula, northward through Unimak Pass and north of Unalaska. The stations at which it was obtained are numbered 3211, 3212, 3213, 3214, 3215, 3217, 3220, 3222, 3223, and 3319; the depths range from 34 to 56 fathoms. In addition, a very few small specimens were secured at stations 3262, 3309, 3321, and

3333, north of the Aleutian Islands, in depths of 19 to 71 fathoms; but the species is evidently not abundant in Bering Sea. No examples were taken in any of the very numerous dredgings made in Bristol Bay.

In life the sides are olive-brown, and the upper parts show faint traces of 6 or 7 broad dusky crossbars, which correspond to or alternate with an equal number below the lateral line. The anal and ventral fins, the branchiostegal and gular membranes, the lower pectoral rays, and the snout are blue-black. Anterior edge of orbit and front edge of preorbital light yellow. The pores on edge of preopercle, two pores above and behind maxillary, and three at upper edge of opercle, bright scarlet. A large black blotch on anterior dorsal rays. Distal half of anterior portion of dorsal fin and upper pectoral rays yellow.

The outer ventral ray is single and inarticulate, followed by five branched rays. Only the first two dorsal rays are spinous, being soft and flexible, but unjointed. The third and all following rays are jointed and forked. All the anal rays are jointed.

A specimen from station 3211, 35 mm. in length to base of caudal, shows that the ventrals occupy very different positions in adults and in young. In the latter they are truly thoracic in position and are inserted as much behind base of pectorals as they are located in advance of this point in adults. A specimen 65 mm. long is entirely similar to adults in this respect.

35. Bathymaster jordani Gilbert.

A single small specimen, agreeing perfectly with the description of the types, from Bristol Bay, station 3262, depth 43 fathoms. The species has been heretofore reported only from Puget Sound and from Wrangell, Alaska, and the present record forms a notable extension of its range. It can be distinguished at sight from *B. signatus*, the common Alaskan form, by its slender body, scaly cheeks, and the enlarged scales of the lateral line.

Family CHIRIDÆ.

36. Pleurogrammus monopterygius (Pallas).

A single specimen of the Atka mackerel, which had been taken several years before in the harbor at Unalaska, was presented by the Alaska Commercial Company. The species is almost unknown at Unalaska.

37. Hexagrammus ordinatus Cope.

This species is closely related to *H. asper*, the dorsal being continuous but well notched at union of soft and spinous portions, the scales ctenoid throughout except on under parts of body, and the cheeks and opercles partly naked. The two species differ conspicuously in shape, color, and fin formulæ.

H. asper is very slender in shape, tapering rapidly from below front of spinous dorsal backward to the very slender caudal peduncle. In *H. ordinatus* the depth is greater and diminishes very slowly backward, the body tapering gradually into a high compressed caudal peduncle. The vertical height of caudal peduncle equals distance from tip of snout to or beyond middle of eye in *H. ordinatus*, while the same measurement is less than length of snout in *H. asper*. In *H. ordinatus* the snout is shorter and more bluntly rounded, the eye smaller, the mouth smaller, and the cheeks shorter and wider. The squamation is also more complete, the cheeks being entirely invested, except for the area immediately overlying the suborbital stay. The snout and the lower side of the head, including the interopercles, are also devoid of scales. The breast is covered with scales which have no spinous points, and the same is true of the ventral scales in adults, but the body is otherwise invested with strongly ctenoid scales, which extend well upon the bases of the fins, the caudal fin being covered to behind its middle.

The upper line of mucous pores is well developed, reaching to opposite middle of soft dorsal. Anteriorly the two lines converge, typically meeting at a point just behind occiput. From this point a few pores may continue forward in a straight line. The fourth line forks above and in advance of the ventral fins, the upper branch extending for a variable distance on sides of abdomen, the lower very short, extending directly to base of ventrals. In *H. asper*, as well as in all other species of *Hexagrammus*, the fourth line is not forked, and bends downward to touch in passing the base of ventral fins.

In younger specimens a black humeral spot is conspicuous, but this grows less evident with age.

The spinous portion of the dorsal fin is shorter, and the soft portion, as well the anal fin, longer than in *H. asper*. Following are the fin-formulæ in ten specimens from Unalaska:

Dorsal.	Anal.	Dorsal.	Anal.	Dorsal.	Anal.
XIX, 24	25	XIX, 23	24	XX, 23	25
XIX, 24	25	XIX, 23	23	XX, 23	25
XIX, 24	24	XIX, 23	24	XX, 23	24
XIX, 23	23				

The last ray of soft dorsal and anal is forked and is counted as one in this table.

The species does not seem to reach as large a size as do other species of the genus. Of numerous specimens, the largest is 285 mm. long. A female, 225 mm. long, contains fully developed eggs. The species was obtained by seining in the harbor at Unalaska. It was not seined elsewhere and did not occur in any of the dredge hauls.

38. Hexagrammus asper Steller.

No adults of this species were obtained by dredging, but young specimens were taken in large numbers in the shallow waters of Bristol Bay at the following stations: 3228, 3229, 3231, 3232, 3233, 3234, 3239, 3240, 3241, 3243, and 3245, at depths of from 4½ to 14½ fathoms. Seining parties brought in the species but once, a single young specimen and one adult appearing at Unalaska among the prevalent *H. ordinatus*. The largest individuals dredged measure about 125 mm. in length, the adult specimen from Unalaska 345 mm.

The characters of the species seem very constant. The dorsal varies from xxiii, 19 to xxiv, 21; the anal from 23 to 24. In 15 specimens the dorsal formulæ run as follows: xxiii, 19; xxiii, 19; xxiii, 20; xxiii, 20; xxiii, 20; xxiii, 20; xxiii, 20; xxiii, 20; xxiii, 21; xxiii, 21; xxiii, 21; xxiii, 21; xxiv, 20; xxiv, 20; xxiv, 20.

The anal fin shows the following counts in 12 specimens: 23, 23, 23, 23, 23, 23, 24, 24, 24, 24, 24, 24.

The body is in young specimens much more slender than in *H. ordinatus*. It is also lighter in color, and lacks the round humeral spot present in the latter. The supraocular flap is somewhat smaller, the cheeks are more extensively naked, the eye is larger, and the mucous canal system less strongly developed. The snout, cheeks, opercles, and lower side of head are naked, with the exception of a patch of small, loosely imbricated scales on the upper posterior part of cheeks and the upper third of opercles. The dorsal line of pores is very inconspicuous, and terminates in front of the middle of spinous dorsal. In none of our specimens are there traces of a line of pores on middle of sides.

The species can be distinguished at once from all others by the slender caudal peduncle, the shallow notch between dorsals, the fin-formulæ, the short upper line of pores which end under anterior half of spinous dorsal, the largely naked cheeks and opercles, the simple unbranched fourth lateral line, and the extreme roughness of the scales.

39. Hexagrammus superciliosus (Pallas).

Taken in abundance with the seine at Unalaska and at Makushin and Chernoffski bays, Unalaska Island. Adults of the species were also dredged at depths of 4½ and 11½ fathoms in Bristol Bay (stations 3244 and 3245).

We find the patch of palatine teeth to be an unreliable character, as five specimens out of the nine examined do not exhibit it. The species is well distinguished by the depth of the dorsal notch, the comparative smoothness of the scales, and the large size of the supraocular flap. The upper line of pores extends well back under base of soft dorsal, and the fourth line is unbranched. The sides of head are scaled, excepting the region over suborbital stay, the snout, and the interopercle.

The normal fin formula seems to be: Dorsal XXI, 23; anal, 22.

Family SCORPÆNIDÆ.

40. Sebastodes introniger Gilbert.

Several specimens were taken in Bering Sea to the north and west of Unalaska Island, in depths of 85 to 350 fathoms (stations 3311, 3317, 3324, and 3331). The species evidently lives at much greater depths than does *S. alutus*. The cranial ridges are well developed and terminate in strong spines. Coronal spines are usually present, but may be absent on one or both sides. In both types of *S. introniger*, taken at a depth of 266 fathoms in the Santa Barbara Channel, California, the coronal spines are wanting, but as they agree with our specimens in all other important details we make the identification without doubt. We append the following account, drawn from Alaska specimens:

Diagnosis: Scales large, ctenoid. Fins scaled. Cranial ridges and spines rather low but strong; coronal and nuchal spines present. Mandibular symphysis prominent, with small symphyseal knob. Peritoneum, mouth, and gill-cavity black or dusky. Color red.

Specific description: Head 2½; eye in head 4. Dorsal XIII-14. Anal III-7 or 8. Pectoral 18. Lateral line 36. Length 14 inches. Mouth large, the maxillary reaching to middle or posterior third of eye, 2 in head, its greatest width one-third its greatest length. Mandible protruding, entering profile in large specimens, less prominent in the young. Symphyseal knob present, but not conspicuous. Teeth on jaws, vomer, and palatines in narrow bands. Eye large, longer than snout, 3½ in head. Interorbital space slightly concave, with two evident longitudinal ridges. Cranial ridges sharp-edged and moderately elevated, the spines strong. Nasal, preocular, supraocular, postocular, tympanic, coronal, parietal, and nuchal spines present; one or both coronal spines occasionally wanting. Preorbital of moderate width, its anterior lobe sometimes ending in a spine, the posterior with a sharp edge bearing one to four spinous points. Preopercular spines large, regularly radiating, the two upper ones approximated and more slender, the others broadly triangular, directed downward and backward. Two spines sometimes present at angle of subopercle. Opercular spines sometimes double. Lower rim of orbit sometimes serrated. Gill-rakers long and slender, the longest one-third diameter of eye; 22 or 23 on lower limb of outer arch.

Spinous dorsal rather low, the twelfth spine one-half the height of the last, which is one-third head; the longest spine 2½ in head. Second anal spine stronger, but scarcely longer than the third, 2½ in head. Pectoral without thickened lower rays, reaching to vent, 4½ in body. Caudal emarginate. Scales large, ctenoid, about 30 tubes present in the lateral line. Small accessory scales numerous. All parts of the head, including cheeks, maxillary, mandible, branchiostegal rays, snout, and interorbital space covered with scales. Gular region scaled. All the fins invested to their tips with fine scales.

Color, uniform bright red, duller than in *S. miniatus*. Smaller specimens reddish. Traces of fine olive-green bars on back. Numerous dark spots along lateral line. A dark blotch on opercle; three bands on cheek, and a blotch in the axil of pectorals. All the fins edged with black.

41. Sebastodes elongatus (Ayres).

A single specimen dredged off the coast of California, north of Point Reyes (station 3350), at a depth of 75 fathoms.

42. Sebastodes zacentrus (Gilbert).

Several specimens were taken north of Point Reyes, on the coast of California, at depths of 75 and 51 fathoms (stations 3350 and 3351). The second anal spine is always very large, but frequently fails to reach tips of soft anal rays when depressed, thus differing from the type specimens. The depth is also greater, 3 instead of $3\frac{1}{3}$ in length.

43. Sebastodes alutus (Gilbert). (Plate 22.)

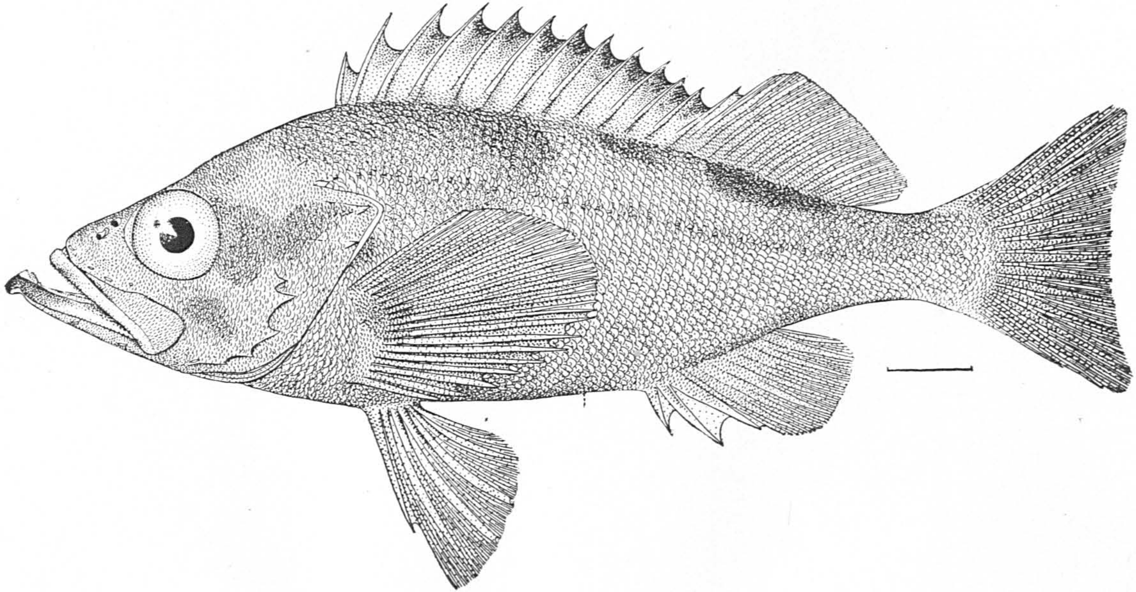
This species was described from a single immature specimen, dredged by the *Albatross* south of Santa Cruz Island, Southern California. No additional material was obtained during the extensive dredging operations of the *Albatross* on the California coast. The species is, however, very abundant in the North Pacific, both north and south of the Aleutian Islands. It was taken at the following dredging stations, located north of Unalaska Island, in the vicinity of Unimak Pass, in Bristol Bay, and south of the Alaskan Peninsula, in depths of 38 to 350 fathoms: 3213, 3214, 3222, 3226, 3262, 3311, 3317, 3319, 3321, 3322, 3324, 3331, 3339, and 3341. A single individual was also taken with hook and line in Unalaska Harbor. At one of the above stations, 48 specimens were taken with the beam trawl. This additional material shows that *S. alutus* is one of the bright-red rockfish, most closely allied perhaps to *S. miniatus*. From the latter it differs conspicuously in the greatly produced mandibular symphysis, with the very pronounced symphyseal knob, as well as in other respects. It is allied also to *S. proriger*, but differs, among other points, in having both postocular and tympanic spines developed. From *S. brevispinis* Bean it differs in its larger eye, larger scales, black peritoneum, and scaly fins.

Following is a detailed description of adult specimens 12 to 18 inches long. In the type, the head is said to be contained $3\frac{3}{8}$ times in the length. This is doubtless a misprint for $2\frac{3}{8}$.

Diagnosis: Scales large, in about 60 oblique series above the lateral line. Soft fins wholly enveloped in fine scales. Cranial ridges all low, the spines slender; coronal and nuchal spines alone absent. Mandible projecting much beyond the upper profile of head, the symphyseal knob very strongly developed in adult specimens; not noticeably so in young. Gill-rakers long and numerous, half as long as eye. Second and third anal spines about equal. General color red, the peritoneum black or dusky, the mouth and gill-cavities dusky.

Description: Head $2\frac{3}{8}$ to $2\frac{3}{4}$ in length; depth, 3 to $3\frac{1}{8}$. Dorsal, XIII–15; anal, III–8; pectoral, 17. Mouth large, maxillary reaching back of pupil, $2\frac{1}{4}$ to $2\frac{1}{6}$ in head. Premaxillaries notched, the symphyseal patch of teeth, however, shutting outside them. Teeth on jaws, vomer, and palatines in very narrow bands except at symphysis and on vomer. A conspicuous depression on each side of symphysis to receive the anterior premaxillary patch. Eye very large, the diameter exceeding snout, $3\frac{1}{8}$ in head. Interorbital space very wide, flat or slightly convex, conspicuously grooved, its width $1\frac{3}{8}$ eye. Cranial ridges all very low, inconspicuous, with small spines or none. Nasal and preocular spines evident, supraocular, postocular, and tympanic spines present but hidden by scales; more conspicuous in the very young. Parietal ridges evident, ending in low spines. Preorbital narrow, its least width one-seventh eye, its anterior edge with two long mucous slits, and in some cases a single backwardly-directed spine. Opercular and humeral spines well developed. Preopercular spines flat, not very large, the upper two approximated, the lower two broadly triangular, tipped with short spines, which are directed downward and backward.

Dorsal spines curved, the longest $2\frac{1}{3}$ to $2\frac{3}{4}$ in head; the twelfth about two-thirds the longest. Soft dorsal about as high as the longest spines. Anal spines strong, the second slightly shorter than third, which equals or slightly exceeds diameter of eye. In young specimens, the second anal spine is longer and constantly equals or exceeds



SEBASTODES ALUTUS (Gilbert).

the third. Soft anal rays higher than soft dorsal, $2\frac{1}{8}$ in head. Caudal well notched. Ventrals long, reaching vent. Pectorals longer, reaching nearly to front of anal. Gill-rakers long, clavate, half diameter of orbit, 25 on anterior limb of arch.

Scales rough ctenoid, covered with many accessory minute ones, which are especially abundant on head and nape. The head is wholly scaled, including the interopercle, maxillary, and mandible, and the outer branchiostegal rays. The anterior surface of the pectorals and the outer caudal rays are closely invested with minute ctenoid scales, which extend well toward the tips; they also invest the soft dorsal and anal fins. About 58 or 60 series of scales above lateral line, running obliquely downward and backward.

Color: Bright carmine red, lighter on belly. Dorsal dusky, edged with black. An elongate olive-brown blotch along base of soft dorsal; a shorter one under the last spines, and a faint one under the middle of spinous dorsal, the latter extending farther down on sides. A dark blotch on back of caudal peduncle. Belly silvery, washed with red. A dark blotch on opercle and one on axil; a crossbar on occiput, one on snout and two bars on cheeks, dusky. Lower lip and tip of mandible blackish; mouth and gill-cavity dusky. Peritoneum jet-black in the young, varying from black to gray in adults. Fins all red, the spinous dorsal broadly margined with blackish.

44. Sebastodes diploproa Gilbert.

Station 3349, near Point Reyes, California, depth 239 fathoms.

45. Sebastolobus alascanus Bean.

Resembling closely *S. macrochir*, but differing constantly in the increased number of dorsal spines, 16 (17 in one specimen) instead of 15, and in the longer second anal spine.

Head $2\frac{2}{3}$ in length; depth 4 (in specimen 360 mm. long). Pores of lateral line 35. Dorsal XVI, 9; anal III, 5; pectoral 21. Mouth large, the maxillary nearly reaching vertical from posterior border of orbit, 2 to $2\frac{1}{3}$ in head; its width greater than diameter of pupil. Premaxillary band of teeth wide, shutting largely outside mandible in front and on the sides; a conspicuous tubercle at tip of each premaxillary with a deep emargination between the two, into which fits the tip of the mandible. A small knob at mandibular symphysis. Eye large, $3\frac{1}{4}$ to $3\frac{1}{2}$ in head, $2\frac{3}{4}$ times the interorbital width. Cranial ridges and spines about as in the other species of the genus, but the occipital ridges not strongly diverging, as in *S. macrochir*. Preorbital posteriorly with a spinous point, as in *S. altivelis*.

Dorsal spines low, the contour of the fin evenly rounded, the spines increasing regularly from the first to the fourth, then as regularly diminishing to the fourteenth; the fifteenth and sixteenth again lengthened. The longest spine is contained from $2\frac{1}{2}$ to $2\frac{3}{4}$ times in the length of the head. Second anal spine longer and stronger than third, equaling or exceeding length of soft rays, its length 2 to $2\frac{1}{4}$ in that of head. Ventrals usually scarcely reaching vent, the pectorals not reaching front of anal. Lower pectoral lobe unusually broad, contains 7 to 9 thickened rays. Head less completely scaled than in *S. altivelis*, the branchiostegals, mandible, maxillary, and lower portion of preopercle wholly naked.

Color red. A black blotch occupies the membranes of the first three dorsal spines, a second extends from the sixth to the eleventh spines. Margin of pectoral and ventral fins black. No black blotch behind second anal spine. Peritoneum and lining of gill-cavity white.

This species differs from *S. altivelis* in the lower, longer, evenly rounded spinous dorsal, the white lining of the gill-cavity, and the partly naked head. It was taken abundantly on the Alaskan expedition, being represented from the following stations: 3227, 3324, 3330, 3331, 3332, 3337, 3338, 3339, 3340, 3343, 3346, 3347, and 3348. These are located in Bering Sea, north of Unalaska Island; in the North Pacific southeast of Unimak Island, and off the coasts of Washington, Oregon, and California. They represent depths of from 109 to 786 fathoms.

46. Sebastolobus altivelis sp. nov. (Plate 23.)

Body slender, depth 3⅘ in length; head 2½; lateral line 33–35 pores. Dorsal xv, 9; anal iii, 5; pectoral 22. Mouth large, 2 in head, maxillary reaching posterior margin of pupil. Mandible laterally and in front shutting within the wide premaxillary band of teeth, its tip fitting into an emargination between premaxillaries, and bearing a short symphyseal knob. Bands of teeth on mandible, vomer, and palatines narrow. Eye very large, 3 in head, 3 times interorbital width. Interorbital narrow, scaled, concave, with 2 low, rounded ridges. Cranial ridges strong, terminating in sharp spines, agreeing with those in *S. alascanus* and *S. macrochir*. Preorbital wide, partially overlapping middle third of maxillary, posteriorly with a forwardly directed triangular spine, in front of which is a long slit-like mucous pore. A blunt tubercle directed forward from front of each premaxillary, less prominent than in *S. alascanus*.

Dorsal spines long and comparatively strong, the third always the highest, the outline of fin behind it straight or concave, never convexly rounded, as in *S. macrochir* and *S. alascanus*. In the type specimen the longest spine is contained 1⅗ times in length of head. The spine before the last is scarcely longer than the one preceding, the last spine again lengthened. Second anal spine usually curved, much longer and stronger than third and longer than soft rays, its length 1⅘ to 2 in head. In the type it is abnormally curved, as shown in the accompanying figure. Ventrals reaching to vent; pectorals to front of anal. Pectoral fin very broad, the lower seven rays thickened and extended beyond membranes, the lobe thus formed subject to much variation, being unusually short in the type. Scales rough ctenoid. Mandible scaled at base only, the head otherwise completely invested, including the branchiostegal rays and membranes. Fin membranes covered with fine ctenoid scales.

Color, red; a dark blotch on membranes between first and third dorsal spines, and a large one beginning back of fourth spine and extending along entire upper edge of fin; edge of pectoral, ventral, anal, and sometimes caudal, black. In some specimens a black blotch on membrane back of second anal spine, as in *S. macrochir*. Opercular lining blackish, this visible externally as a dusky blotch.

The type is a specimen 325 mm. (12¾ inches) long, taken south of the Alaskan Peninsula at a depth of 625 fathoms (station 3338). No other specimens were secured during the Alaskan expedition of 1890, but the species is almost equally abundant with *S. alascanus* in deep water off the coast of California. From *S. alascanus* it is distinguishable at sight by the contour of the spinous dorsal fin, the smaller number of dorsal spines, and the dusky lining of the opercle. From *S. macrochir*, with which it agrees in its fin formula, it is distinguished by the greater height of both dorsal and anal spines, and in the different contour of the spinous dorsal.

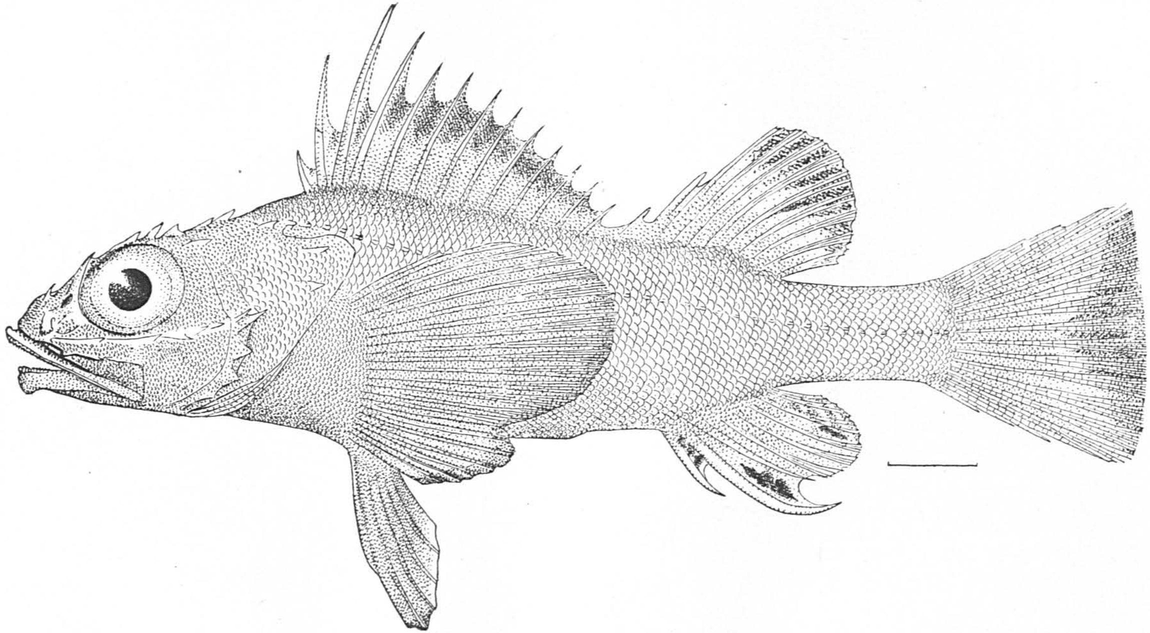
Family COTTIDÆ. The Sculpins.

47. Hemitripterus marmoratus Bean.

Several small specimens were secured at stations 3224, 3257, 3258, and 3311, in Bering Sea, north of Unalaska Island; depths, 70 to 121 fathoms. They agree with the types in having but 14 dorsal spines, the first four of which are not noticeably differentiated. The second dorsal contains 11 or 12 rays, and the anal fin 13. The last two rays of the anal fin are approximated at base, but do not evidently constitute a divided ray.

48. Psychrolutes zebra Bean.

Taken abundantly in shallow water south of the Alaskan Peninsula, thence west to and through Unimak Pass, along the northern shore of Unalaska Island, and in Bristol Bay. The depths range from 31 to 121 fathoms, at stations 3213, 3215, 3216, 3217, 3219, 3222, 3223, 3224, 3225, 3257, 3258, 3259, 3263, 3265, 3272, 3310, 3311, 3313, 3322, and 3334. The spinous dorsal is continuous with soft dorsal, there being no notch between the two.



SEBASTOLOBUS ALTIVELIS sp. nov.

49. Malacocottus zonurus Bean.

Several specimens taken at stations 3227, 3330, 3331, north of Unalaska Island, and at stations 3337 and 3339, south of Unimak Island; depths, 138 to 351 fathoms.

In addition to the characters given by Dr. Bean, we call attention to the following: Nasal spines obsolete. Supraorbital rim low, slightly elevated in front but not behind; the interorbital space wide, shallowly concave. Occiput with two blunt, conical protuberances in lieu of ridges, and without spines. A slight occipital depression. Preopercular angle with three radiating spines of nearly equal length, and a smaller spine directed outward in advance of the middle one of the three; below these a partially concealed spine directed downward and forward. Opercular rib very strong, sharp anteriorly, broadening behind, and provided with three low ridges, not ending in a definite spine. A spinous point on subopercle and one on interopercle; none on shoulder.

Anterior nasal tube short, the posterior margin prolonged into a laciniate flap. Head well provided with slender cutaneous filaments; three on upper portion of eyeball, four in a transverse line behind occiput, a very long one on opercular angle, and numerous shorter ones on opercle, jaws, and along anterior portion of lateral line. Branchiostegals 7. Body without plates or prickles; the head, including upper part of eye, and the upper anterior part of body, with sparsely distributed stellate granulations, visible only in large specimens. In our specimens the brown bar at base of caudal is followed by a wide white bar, sometimes more or less broken; the terminal half of fin blackish, narrowly margined with white.

50. Dasycottus setiger Bean.

Taken at stations 3216, 3257, 3310, 3311, and 3334, located north and south of the Alaskan Peninsula and north of Unalaska Island; depths, 50 to 85 fathoms.

Tubercles on head definitely placed: 1 in front of eye; 4 above orbit, the posterior two the largest; a pair on middle of suborbital stay, with a smaller one above them; 1 on temporal region, and 1 on shoulder; by far the largest pair on occiput, where they are high compressed spines, directed vertically upward, as long as diameter of pupil. Nasal spines obsolete. Cirri are generally distributed over upper part of head and body, the longer ones being specially numerous on maxillary, under surface of mandible, and on the opercle and preopercle. Of the larger ones, two often proceed from one base. A series of short filaments along upper edge of pupil. Mucous pores large, those of the mandibular and buccal series slit-like. In adults, the dorsal bands break up into series of spots and become inconspicuous.

51. Icelus bicornis (Reinhardt).

Not hitherto recorded from Pacific waters. Our specimens are more constant in their characters than the Atlantic individuals reported on by Collett (Den Norske Nordhavs Expedition, 1880, p. 35). A definite narrow band of fine prickles extends along the upper edge of the dorsal series of plates, usually occupying less than half the space between plates and base of dorsals, and extending posteriorly to end of soft dorsal. Similar prickles cover top and sides of head. The plates of the lateral line invariably extend to the root of the caudal fin, and the dorsal series to the back of the caudal peduncle. None of the specimens before us have plates along the base of the anal fin. The species differs conspicuously from *I. spiniger* and *I. canaliculatus* in having a deep pit on occiput, bounded laterally by high occipital ridges, each of which bears two rounded prominences or spines. The preopercular spines are longer and sharper, and the bifurcation of the upper spine deeper than in the species mentioned. In two individuals the upper spine is trifurcate, the branches very long and curving upward. The fin rays in six specimens are as follows: Dorsal VIII–20, IX–19, IX–21, IX–20, IX–20, IX–19; anal 16, 16, 15, 17, 16, 15. These average slightly higher than counts of Atlantic specimens, none of which are at hand for comparison. The Pacific form may prove specifically separable.

The species is represented in our collection principally from Bristol Bay, a few specimens only from farther west in Bering Sea. Stations 3224, 3250, 3251, 3252, 3253, 3254, 3255, 3256, 3279, 3280, 3282, 3283, 3285, 3292, 3293, 3302, 3303, and 3306; depths 17½ to 121 fathoms.

52. Icelus spiniger sp. nov. (Plate 24.)

Closely resembling *I. bicornis*, but differing conspicuously in the armature of the dorsal series of plates, in the comparatively plane occiput, and in other characters. Head 2¾ to 3 in length; depth 5. Caudal peduncle very slender, its depth 2½ in orbit. Mouth large, the maxillary reaching slightly beyond middle of orbit, its length one-half head. Teeth very finely villiform, present in rather wide bands in jaws and on vomer and palatine bones. Nasal spines strong, separated by the high ascending processes of the premaxillaries. Interorbital space very narrow, grooved, its width less than one-half diameter of pupil. The orbital rim becomes elevated anteriorly and posteriorly, and is, at the latter point, strongly denticulated. Behind the orbital region the occiput is shallowly concave, being bounded laterally by two low, evenly rounded ridges, which become narrower posteriorly, and end each in a strong spine projecting backward in line with the series of dorsal prickles. The preopercular spines are similar to those of *I. bicornis*, the uppermost, as in the latter, occasionally simple instead of bifurcate. The second spine is usually directed straight backward, and the two following downward and forward.

The gill-membranes are broadly united, free from the isthmus, and neither pore nor slit exists behind the innermost gill. Branchiostegals, 6. Eye large, longer than snout, 3 to 3½ in head in adults. A slender tentacle present over the posterior part of each orbit. A series of plates extends from nape along each side of dorsals to back of caudal peduncle, and a second series along lateral line, as in *I. bicornis*. The dorsal series contains 28 to 35 plates, each of which bears at its center a single strong spine directed outward and backward. In *I. bicornis* each plate is traversed by an oblique ridge, the edge of which is denticulated, the central tooth being the strongest and corresponding to the single spine present in *I. spiniger*. The latter agrees with *I. canaliculatus* in having an inner series of dorsal plates alternating with the principal series, each of the smaller plates bearing a minute prickle, discernible with difficulty. The plates along the lateral line, 41 to 44 in number, are similar to those in *I. bicornis*, having their upper and posterior free margins serrulate. A few scattered spinous plates present in axillary region. Dorsal fins not connected, the spines very slender and rather high. Pectorals long, reaching front of anal; ventrals not reaching vent.

Dorsal IX–20; anal 17; pectoral 18; ventral I, 3. Longest specimen, 118 mm.

Color: Light olivaceous above, white below, the upper parts mottled with dark brown. The back has four faint black crossbars, the first under spinous dorsal, the second and third under soft dorsal, the fourth at base of caudal. A brown blotch on cheek, one on base of pectoral, and an irregular series along full length of body just under lateral line. Two prominent black blotches on first dorsal; the second dorsal, caudal, and pectoral barred; other fins unmarked. Mouth and gill-cavity white.

Numerous specimens from stations 3216, 3223, 3224, 3225, 3226, 3257, 3258, 3263, 3267, 3278, 3279, 3280, 3292, 3302, 3311, 3334, and 3336, in 17 to 121 fathoms. These stations are located in the vicinity of Unalaska Island and in Bristol Bay, Alaska.

53. Icelus canaliculatus sp. nov. (Plate 24.)

A deep-water species, with conspicuous mucous canals and pores, thin cranial bones, and rather plain blackish coloration. In other characters it stands somewhat intermediate between *I. bicornis* and *I. spiniger*. The dorsal plates have the serrulated cross ridge of *I. bicornis*, while the occiput is but shallowly concave, with low bounding ridges ending behind in strong spines, and the posterior rim of the orbit is elevated and denticulated, as in *I. spiniger*. In its anterior portion, at least, the

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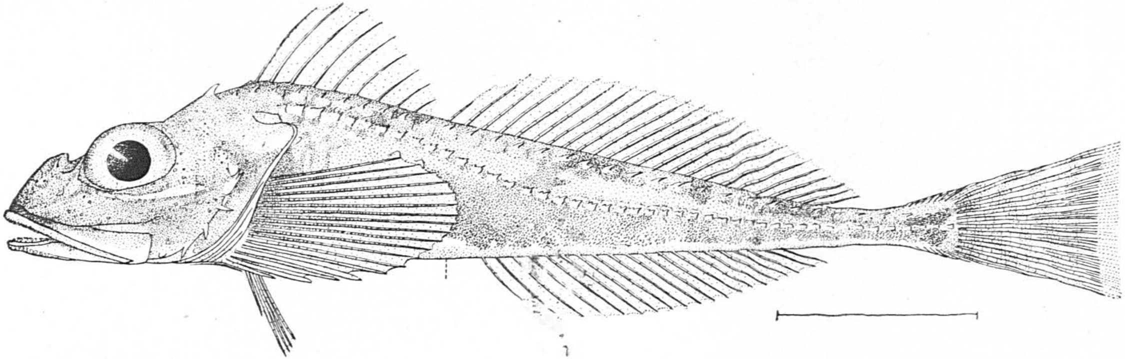
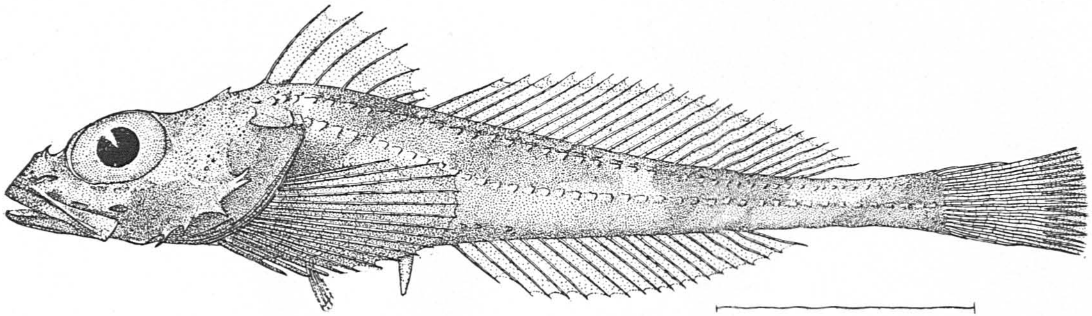


ICELUS SPINIGER sp. nov.



ICELUS CANALICULATUS sp. nov.

series of dorsal plates is accompanied above by a more or less irregular row of smaller plates, which alternate with the larger plates and bear each a small spine.

Head 3 to 3⅓ in length; depth 6. Caudal peduncle long and very slender, its depth less than one-third its length. Maxillary reaching to or nearly to vertical from middle of orbit, 2⅗ to 2⅔ in length of head. Jaws weak; teeth villiform, with widened base, in moderate bands on jaws, vomer, and palatines. Nasal spines strong, projecting above a transverse depression which crosses snout immediately in front of orbits. Interorbital space narrow; its least width 3⅗ times in orbit, its width wholly occupied by the two conspicuous supraorbital mucous canals. Occiput a shallowly depressed pit, bounded anteriorly by the raised orbital region and laterally by low, rounded ridges, each of which terminates behind in a very strong spine. Preopercular spines slender and sharp, the uppermost directed very obliquely upward, sharply notched at tip. The second and third are directed downward and backward, the lowermost downward and forward. The bony stay across cheeks is conspicuously developed, and bears a distinct spine just behind eye. A series of mucous slits along under side of suborbital stay. A sharp spine on subopercle. Gill-membranes broadly united, free from the isthmus. Branchiostegals, 6. A distinct slit-like pore behind fourth gill. Eye large, 3 in head, longer than snout. Top and sides of head with many minute scattered whitish pores. A minute filament near tip of maxillary.

Plates of lateral line 43 to 46 in number, their upper and posterior edges free, denticulated. Dorsal series with 45 plates, each of which is crossed obliquely by a raised spiny ridge, the central portion of which is highest. Between the upper angles of these plates is a second series of small plates alternating with the first, each bearing a spine or prickle. These spines are occasionally doubled or trebled, especially in the anterior part of the series, and then recall strikingly the arrangement in *Icelinus*. Axil of pectorals with from 20 to 26 plates similar to those of the lateral line and showing a tendency to regular arrangement. Two or three similar plates along anterior part of base of anal, and a few scattered plates on each side between lateral and dorsal series.

Dorsal VII or VIII, 23 or 24; anal 19; pectoral 16; ventral I, 3. Lateral line 43 to 46. Length 110 mm.

Color: Light olivaceous above, blackish below, except lower jaw; back with four black crossbars, evident but not conspicuous. Opercles black. Fins all dark. Pectorals mottled with slate color. Base of caudal fin light. Mouth and gill-cavity dark.

The types were taken north of Unalaska, at station 3329, at a depth of 399 fathoms.

54. Icelus vicinalis sp. nov.

This species is extremely close both to *I. canaliculatus*, with which it was found associated, and to *I. euryops* Bean. From *I. canaliculatus* it differs in the following respects:

(*a*) The coloration, though similar in pattern, is much lighter. The belly is dusky, but not deep brown; the isthmus usually becomes abruptly white under the branchiostegal membranes, and the latter are white or dusky, not blue-black as in *I. canaliculatus*. The floor and anterior part of the roof of the mouth and the gill-cavities are white, not blackish. The nostril tube is white, not black.

(*b*) The occipital ridge is lower and less conspicuous and the spines shorter, but both are obvious. The small spinous point on suborbital stay is less developed.

(*c*) The dorsal spines are 9 in number in all our specimens.

(*d*) A closely crowded series or narrow band of prickles accompanies the dorsal series, as in *I. canaliculatus*. It is noticeable, however, that those of the series which occupy a position corresponding to the interspace between the dorsal plates are somewhat enlarged, and recall the alternating plates of *Icelinus*. The region between the lateral line and the dorsal series is almost completely invested with spinous scales in most specimens, while in *I. canaliculatus* few or none are present;

(e) The head is densely covered with small spinous scales or prickles, especially numerous on top of head and on opercles. In *I. canaliculatus* the head is either naked or sparsely covered, and the opercles are almost or quite naked.

(f) Three pairs of slender filaments on top of head, the anterior pair the largest, placed above back of orbit; the second pair is in front of and slightly within the occipital ridges, the third pair on occipital spines. An additional pair on opercles seems to be less constant. The supraocular pair alone is present in *I. canaliculatus.*

(g) The mucous canals and pores, though large, are less developed than in *I. canaliculatus*, the fish having in general the bathybial characteristics less pronounced.

The agreement with *I. euryops* is closer than with *I. canaliculatus.* In fact it seems to differ from *I. euryops* only in the much smaller eye and somewhat wider interorbital space, agreeing with *I. euryops* in all those respects in which it differs from *I. canaliculatus.* In *I. vicinalis* the eye is $2\frac{5}{8}$ to 3 in head, and but $1\frac{1}{2}$ times length of snout, and the least interorbital width is 11 or 12 times in head. In *I. euryops* (co-type No. 45367, U. S. Nat. Mus.) the eye is $2\frac{1}{8}$ times in head and twice the length of the snout, and the least interorbital width 16 times in head. It does not seem probable that the species will vary to that extent.

Dorsal IX–21 to 23; anal 18; pectoral 18; caudal 9. Head $3\frac{1}{7}$ to $3\frac{1}{4}$ in length; depth $5\frac{2}{3}$. Maxillary reaching middle of pupil, $2\frac{1}{4}$ in head. Upper preopercular spine slender, forked at tip, directed upward and backward; the second and third spines simple, slender, directed downward and backward, the fourth downward and forward. Interorbital space shallowly grooved, the groove widening backward into an occipital depression bounded in front by the somewhat elevated interocular space, laterally by the occipital ridges. The supraorbital rim is elevated in front and behind. The occipital ridges are low, broad, and rounded anteriorly, becoming narrower and more crest-like posteriorly. In addition to the prickles and plates already mentioned, there is a band of spinous scales behind axil of pectorals.

Spinous dorsal low, the longest spine $2\frac{1}{2}$ in head, the longest ray of soft dorsal 2 in head. Pectorals reaching beginning of horizontal portion of lateral line, the lower rays thickened, their membranes incised. Ventrals short, scarcely reaching vent. Anal papilla large.

Color in spirits: Light-brown above, with four blackish crossbars, one under spinous dorsal joining the dark axillary patch, two under soft dorsal, and one at base of tail merging into the uniform deep brown of the under parts. Head, light brown above and below; subocular ring dark brown, this streak widening forward and crossing upper and lower lips. A small brown patch at base of exposed portion of maxillary. Opercle blackish. Upper half of pectorals light, with or without a brown basal bar, the distal portion indistinctly barred with light brown. Lower half of pectorals and all of ventrals dark brown or black. Dorsals blackish, darkest above crossbars on back. Anal black. Caudal whitish, dusky above toward tip.

Numerous specimens 50 to 110 mm. long, from stations 3324, 3330, 3331, and 3332, Bristol Bay, Alaska, at depths of 109, 351, 350, and 406 fathoms, respectively.

The following notes are drawn from one of the co-types (No. 45367, U. S. N. M.) of *I. euryops*, kindly loaned to us for that purpose by Dr. Bean.

Specimen 77 mm. long, 65 mm. to base of caudal fin. Head 22 mm. to end of opercular spine; depth 11; orbit $10\frac{1}{2}$; snout $5\frac{1}{2}$; maxillary 11; interorbital width $1\frac{1}{3}$.

Dorsal IX–23; anal 19; pectoral 18; caudal 9. Preopercular spines as in *I. vicinalis*, the upper spine abnormal on one side, showing three points instead of two. Below the forked spine are three others—one directed backward and a little downward, one nearly vertically downward, and one downward and forward. Nasal spines strong. Occipital ridges obvious, with easily perceptible slender spines about as in *I. vicinalis*, the ridges broadly rounded anteriorly, scarcely ridge-like until immediately in front of spines. Head rather closely invested with scales, scarcely so rough or so numerous as in *I. vicinalis*, but more so than in *I. canaliculatus.* Opercle covered with scales. Filaments as in *I. vicinalis*—one pair above eyes, one anteriorly on occiput, and one occupying tips of occipital spines. The pair on opercles can not be made out.

Armature of body as in less strongly scaled specimens of *I. vicinalis*. Lateral line provided with the usual spinous scales, 43 to 44 in number; 40 scales in the dorsal series, which extends to base of caudal. Above it is a rather crowded irregular series of smaller scale-like prickles, some of which are larger than the others and alternate rather regularly with the plates of the principal series; posteriorly the smaller of the upper series are absent, the alternating larger ones alone present. Ten or twelve small spinous plates are irregularly disposed between lateral line and dorsal series. A patch of spinous plates behind pectorals.

Color evidently as in *I. vicinalis*, though very greatly faded from exposure to light. The back shows traces of two dark crossbars under soft dorsal; one occupies end of caudal peduncle, and a very indistinct one extends downward from spinous dorsal, which is black posteriorly. Belly, and under parts generally, dusted with fine black specks, the isthmus becoming abruptly white. Nostril tube white. Subocular region blackish, the color continued forward onto the preorbital, opposite the front end of which it crosses upper and lower lip. A dark blotch on maxillary in advance of tip. Pectorals dusky.

55. Icelus scutiger Bean.

This species is distinguished from all others in the genus by the absence of the series of enlarged spinous plates along the base of the dorsal fin. Our specimens agree with the types in having the sides above lateral lines densely covered with scales. These are not uniform in size, and are arranged in rather irregular oblique series. The sides behind pectorals contain larger spinous plates, and the tail below lateral line is densely scaled, leaving only a narrow naked strip along each side of anal base. As stated, the upper half of head is densely covered with small prickles. As in other species of *Icelus*, the upper preopercular spine may be simple or bifurcate. The latter condition obtains in most of our specimens. All of the preopercular spines are weaker than in other species of the genus.

Compared with the nearest allies, *I. euryops* and *I. canaliculatus*, the species is further distinguished by its more robust body (the depth approximately 5 in length instead of nearly 6), by the smaller eye (in which the snout is contained $1\frac{1}{4}$ times instead of nearly twice), the narrower interorbital space, the very slight development of the occipital crests, the obsolescence of the occipital spines, and the great height of the spinous dorsal fin in the male specimens. It has also a shorter second dorsal fin, the formula in 11 specimens being IX-19, IX-19, IX-19, IX-19, IX-19, IX-20, X-19, X-19, X-20, X-20, X-20. It has less the appearance of a deep-water species, the mucous canals and pores being less conspicuous and the color lighter, with no brownish-black or blue-black tints. In alcoholic specimens the upper parts are light brown, the lower side of head and belly, including the ventral fins, whitish. A vertical black bar occupies base of upper half of pectorals, a streak extending from its lower end out along middle ray of fin. The black bars characteristic of its congeners are here represented by irregular, rather sharply defined blotches on back and sides. These extend also onto spinous and soft dorsal fins. A distinct dark streak runs forward from eye, crossing premaxillaries, and leaving tip of snout pale. Mouth and gill-cavities white.

Numerous specimens were taken at station 3339, south of the Alaskan Peninsula, at a depth of 138 fathoms.

56. Icelinus borealis sp. nov. (Plate 25.)

Very similar to *I. oculatus*, but differing in the large size of the preopercular spine, the smaller, less elliptical, eye, the wider interocular space less abruptly expanding anteriorly, the lower occipital ridges, and in the much smaller size.

Body slender, tapering rapidly backward to caudal peduncle, whose least depth is $3\frac{3}{4}$ to $4\frac{1}{4}$ in its length; depth $4\frac{3}{4}$ to $5\frac{1}{2}$ in length, in specimens $1\frac{3}{4}$ to $3\frac{1}{4}$ inches long.

Head long, smaller than in *I. oculatus*, 2¾ in length. The occipital ridges blunt, the included space gently concave, not pit-like. Interorbital space wider than in *I. oculatus*, not distinctly concave, the median ridge very faint, the width about one-fourth eye (in *oculatus* about one-tenth eye). Supraocular and occipital ridges rugose or minutely pitted. Two conspicuous mucous pores behind each eye, the anterior margins of the pores often elevated to form a spinous projection. Eye small, 4 in head. Mouth large, extending beyond vertical from pupil, 2¼ in head. Teeth in narrow bands on jaws, vomer and palatines. The two anterior pores on mandible open together at symphysis, as in all the other species of the genus except *I. oculatus*, where they open separately, on either side of the symphysis. Preopercular spine large, about as large as eye, with three antler-like processes directed upward. Below this is a weak spinous projection directed backward (wanting in many specimens) and two stronger ones downward and forward. A spinous point at the lower angle of subopercle; an indistinct spine terminating occipital ridge.

Armature of sides as in *I. oculatus*, the dorsal series of plates extending continuously onto back of caudal peduncle. No scattered plates behind pectorals. A large, rather broad, supraorbital flap, bifid or trifid, or occasionally with more than three terminal filaments; the height of flap equals or slightly exceeds diameter of pupil. A white filament near tip of maxillary; two pairs on occipital ridges; one, not wholly constant, on cheeks overlying suborbital stay; a few scattered ones accompanying plates of lateral line. None of the dorsal spines elevated. Pectoral fins reaching slightly beyond origin of anal. Dorsal IX or X–16 or 17; anal 12 to 14; pectoral 16; lateral line 39. Length 75 mm.

Color: Olivaceous above, sides of head and body vermiculated and blotched with olive brown, especially along middle of sides; white below, nearly to lateral line. The back with four black crossbars, as in *I. oculatus*. A dark blotch on cheek, and a dark streak forward from eye. Membrane between first two spines of first dorsal dark, usually a black terminal bar posteriorly; second dorsal, pectorals, and caudal with faint oblique bars. No dusky patch at base of pectoral. Anal translucent.

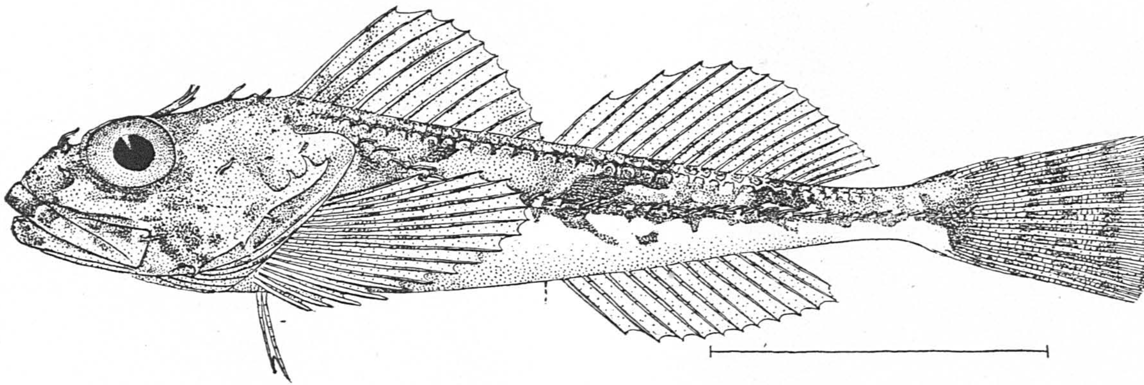
Numerous specimens taken both north and south of the Aleutian Islands and in Bristol Bay, at stations 3213, 3214, 3222, 3223, 3224, 3226, 3235, 3258, 3265, 3286, 3293, 3303, 3319, 3321. The depths range from 11 to 121 fathoms. It is impossible to compare this or any other described species of *Icelinus* with *Icelinus australis* Eigenmann, described from partially digested specimens. From Eigenmann's description of the preopercular spine, it is even doubtful whether his species is a member of the genus *Icelinus*.

57. Artediellus pacificus sp. nov.

Very closely related to *A. uncinatus*, differing in the entire obsolescence of the occipital protuberances or ridges, in the increased number of cirri on the head, the more numerous pores of the lateral line, the greater number of rays in the pectoral fins, and the reduction in the rays of the caudal. This diagnosis is the result of a comparison of our type with Collett's description of *Centridermichthys uncinatus* (Norske Nord-Havs Expedition, 1880, 29), no typical specimens being at hand for comparison. Specimens of *Artediellus* from the coast of Massachusetts also differ from Collett's description and may be specifically or subspecifically separable.

Length of head (measured to end of opercular flap) 2¾ to 2$\frac{9}{10}$; depth 4½. Least depth of caudal peduncle 1¾ times in orbit; its length, from base of last anal ray, 2⅝ in head.

Head evenly rounded in all directions, the orbital region not elevated, the snout not angulated. Mouth slightly larger in males than in females, reaching vertical from middle or posterior margin of pupil, 2½ to 2¾ in head. Lower jaw shorter than the upper, a portion of the premaxillary band of teeth projecting beyond the mandible in closed mouth. Teeth cardiform, in rather broad bands in jaws, and in patches of varying size on vomer and palatines. In some specimens a few teeth



ICELINUS BOREALIS sp. nov.

occur in a single convex series on front of vomer, and but three or four form a line on palatines; in others, we find an irregular double series or a narrow band on each of these bones. The teeth are always strong, and are probably in adult specimens never entirely wanting on either vomer or palatines. Longitudinal diameter of orbit 3½ in head. Interorbital space very narrow, shallowly concave, entirely occupied by the supraocular canals, which unite in a single pore opposite posterior margin of orbit. Least interocular width two-thirds pupil. Premaxillary processes projecting but little beyond the profile. Nasal spines very small. Both pairs of nostrils in short tubes, the posterior situated on anterior orbital rim.

Occiput with two very inconspicuous low rounded ridges, appreciated with difficulty, and sometimes entirely wanting. No trace of the occipital spine which is seen in Massachusetts specimens of *Artediellus*, nor of the conical protuberance described and figured by Collett. Barbels numerous. Maxillary barbel large and conspicuous, sometimes simple, more often compound, furnished with from one to four short lateral branches. A well-developed supraocular cirrus, and a pair of cirri on posterior margin of occiput, the latter occupying the position of occipital spines. A short cirrus near base of opercular flap, and two or three on preopercle, two of which are usually at base of the preopercular spines. Two cirri on anterior part of trunk, one immediately above base of pectorals, the other half way between lateral line and front of spinous dorsal. Sometimes additional cirri above front of lateral line and on lower margin of subocular ring. A series of four or five very short cirri crosses the eye horizontally immediately above the pupil. Gill-membranes broadly united, joined to the isthmus anteriorly, with a wide free margin. Gills 3½, no slit or pore behind last arch. Preopercular spines as in *A. uncinatus*, the upper one without smaller basal spine.

Dorsal fins well separated, low in females, extraordinarily developed in males, the spinous dorsal in the latter well overlapping front of second dorsal and having all of the spines exserted, the median ones for half their length. These exserted spines have their free portions narrowly margined with membrane, which widens at their tips to form a cutaneous flap. Soft dorsal also somewhat elevated in males. Ventral fins reaching half way to vent in females, about three-fourths this distance in males.

Dorsal VII or VIII–12 or 13; anal 11 or 12; pectoral 23 (22 to 24); ventral I, 3; caudal with 9 divided rays (not 11 as in *C. uncinatus*); lateral line 24 (22 to 26).

A series of five wide mucous slits running along lower edge of suborbital ring and across cheeks. Pores of lateral line minute, at the ends of short downwardly-directed branches, the main line opening in a large slit like pore at base of caudal.

Color much as in *A. uncinatus*, the lower parts whitish, unmarked, the dorsal region of the trunk crossed by three wide dark bars, which often in adults break up into spots separated by vermiculations of the lighter ground color. One of these bars is below the spinous dorsal, running downward and forward to base of pectorals; the second is under soft dorsal, the third on caudal peduncle. Top and sides of head generally dark, with fine light dots or vermiculations. A light streak sometimes present, extending from preopercular spine forward and inward, meeting its fellow immediately behind eyes. This V-shaped mark is usually absent or inconspicuous, but is sometimes in young specimens formed of bright silvery-white pigment. Other silvery spots or blotches may occur on the lighter intervals of the back or sides. Pectorals, dorsal, and caudal cross-banded; a black blotch at base of upper and one at base of lower pectoral rays. Tips of elongate dorsal spines of the male black. Ventrals and anal unmarked.

Taken abundantly at stations 3216, 3219, 3222, 3228, 3251, 3252, 3254, 3259, 3265, 3267, 3272, 3273, 3278, 3279, 3280, 3281, 3282, 3285, 3293, 3294, 3302, 3306, and 3323, at depths of from 8 to 61 fathoms. The above stations are in Bristol Bay, excepting 3216 (south of Sannak Island) and 3323 (north of Unalaska Island).

58. Cottus aleuticus sp. nov.

Uranidea microstoma, Lockington, Proc. U. S. Nat. Mus. 1880, 58; not of Hæckel.

In appearance resembling *C. philonips*; the head small, its width but one-fourth greater than its depth, the body low and but little compressed, the depth at shoulders but little greater than the width. Caudal peduncle moderate, not slender, its length from base of last anal ray $1\frac{3}{8}$ to $1\frac{4}{5}$ in head; measured from last dorsal ray but little more than half as long. Depth of caudal peduncle $4\frac{1}{6}$ to $4\frac{1}{8}$ in head.

Head small, $3\frac{1}{4}$ to $3\frac{1}{2}$ in length; depth 5 to $5\frac{1}{8}$. Mouth small, variable, maxillary reaching vertical from front or middle of pupil, $2\frac{2}{3}$ to 3 in head. Vomerine patch of teeth small, the palatines toothless. Preorbital as wide as eye, produced anteriorly into a convex lobe which conceals all but the widened tip of the maxillary. Both pairs of nostrils opening in short but evident tubes, a character not known by us to exist in any other species of the genus. Eye $4\frac{1}{8}$ to $4\frac{2}{3}$ in head. Interorbital space narrow, the least width of the bone slightly less than half the vertical diameter of orbit, in adults 160 mm. long, much narrower in younger specimens. In this respect our specimens differ conspicuously from the types of *C. microstomus*, in which the interorbital width is said to equal vertical diameter of eye. As in *C. philonips*, we have but a single preopercular spine, which is straight and directed obliquely upward. Preopercular margin below the spine evenly rounded. Subopercular spine well developed.

Lateral line complete, following outline of back to opposite last dorsal ray, where it abruptly declines to middle of caudal peduncle. Body naked or with a narrow band of prickles extending from upper axil of pectorals along under side of lateral line.

Dorsals more or less joined at base in all our specimens, but varying in the height of the connecting membrane, which usually joins well up on first ray of soft dorsal, sometimes at its extreme base. The spinous dorsal is long, with 9 spines in 13 specimens examined, 10 spines in 5 specimens. The first two spines are very closely approximated, and spring from a single wide interspinal. The first spine is easily overlooked, as has been done by us (Investigations in the Columbia River Basin, 1894, p. 54), and possibly also by Lockington in his description of *C. microstomus*. Spinous dorsal low, the soft dorsal higher, the longest rays equaling length of snout and half eye, the last rays when depressed not quite reaching base of caudal. Anal fin much shorter than soft dorsal, its last ray under the fourth or fifth before the last ray of dorsal. Caudal truncate, slightly rounded when spread, its length $1\frac{1}{2}$ to $1\frac{3}{8}$ in head, its rays twice forked. Pectorals reaching to or nearly to front of anal. Ventrals varying in length, not quite reaching vent in any of our specimens. Pectoral rays all simple. Dorsal and anal rays all simple except the last, which is usually divided to the base in the dorsal, and sometimes divided in the anal.

Dorsal IX or X, 18 or 19; anal 13 or 14; pectoral 13 to 15; ventral I, 4; caudal 8 or 9 (forked rays); 35 to 37 pores in lateral line.

Head and body light brown, mottled or spotted above, the darker markings on back often arranged as six crossbars, of which two are below spinous dorsal, three below soft dorsal, and one on caudal peduncle. These are usually broken up into spots or reticulations, and are often obscure, sometimes wanting. Usually a light bar downward and backward from eye. Rays of dorsals, pectorals, and caudal crossed with series of dark blotches. Ventrals and anal light, very obscurely barred with darker.

This species was very abundant in the small stream passing through the village of Iliuliuk, Unalaska, living both in the upper strictly fresh-water portion of the stream and in the lower more or less brackish part. A specimen transferred to the salt-water aquarium on the *Albatross* seemed to suffer no inconvenience from the change of water and lived for several days. This is probably the *Uranidea microstoma* of Lockington, based on specimens collected near St. Paul, Kadiak, and considered by the describer to be identical with other specimens examined by him from the Aleutian Islands. Four specimens were collected by us May 26, 1889, in a small stream entering Departure Bay, Vancouver Island. These exhibit perfectly the differences separating *C. aleuticus* from its nearest ally, *C. philonips*.

59. Cottus asper (Richardson).

Five specimens taken in a small stream emptying into Departure Bay, Vancouver Island. The head is naked in all of these and the prickles absent on belly, along bases of spinous dorsal and anal fins, and on caudal peduncle.

	First dorsal.		Second dorsal.		Anal.		
Rays	VIII	IX	21	22	16	17	18
Specimens	1	4	3	2	1	1	3

60. Acanthocottus sellaris sp. nov.

Cottus quadrifilis Bean, in Nelson's Report, Natural History Collections in Alaska, 1887, 309, pl. XVIII; not *Porocottus quadrifilis* Gill.

Head cuboid, the anterior profile of snout subvertical, the greatest width a trifle more than the depth at occiput. Cheeks subvertical. Interorbital region elevated, the supraorbital rim furnished posteriorly with a low tubercle which usually bears an inconspicuous cirrus. The interorbital space is rather wide, transversely concave, its least width $2\frac{1}{5}$ in eye. Occipital depression well marked, the ridges unbroken, straight, converging rapidly backward, the distance between their tips but two-thirds that between their anterior ends. From the latter two low ridges converge for a short distance upon the floor of occipital depression. The ridges do not terminate in spines, but bear small cirri similar to those above eye. Like the latter, these cirri may be indistinct or wanting. Maxillary reaching vertical from posterior margin of pupil, $2\frac{4}{5}$ in head; eye $3\frac{2}{3}$, slightly exceeding snout. Nasal spines very strong. Two short spines diverge from angle of preopercle, the upper one slightly curved, directed upward and backward, half the diameter of orbit, the lower directed straight backward, two-fifths the length of the upper one. Below these are a short spinous projection concealed in the skin, and a longer spine directed downward and forward. Opercle with three lengthwise ridges, the uppermost ending in a definite sharp spine. Subopercular spine well developed; a spine also at posterior end of interopercle and one at shoulder. Gill-membranes broadly joined to isthmus, with a wide free fold posteriorly.

A few small prickly plates behind axil of pectorals; skin otherwise smooth. Occiput and nape thickly covered with minute dermal papillæ, interspersed with very small mucous pores, which are distributed also over the anterior part of the head. Pores on mandible and preopercular margin small, not better developed than in other species of *Acanthocottus*. Lateral line giving off pairs of short diverging branches, at the tips of which are the pores. Dorsals connected at extreme base, soft dorsal terminating slightly behind the anal. Fins all low. Ventrals reaching vent. Pectorals to opposite third ray of anal.

The following is a table of fin rays in ten specimens:

	Spinous dorsal.	Second dorsal.		Anal.			Pectoral.	Caudal.
Number of rays	VIII	13	14	10	11	12	16	9
Number of specimens	10	2	8	2	7	1	10	10

Head $2\frac{4}{5}$ to 3 in length; depth $3\frac{7}{8}$. Pairs of pores in lateral line 32 to 34. Branchiostegals 6.

Color in spirits: Upper parts brownish, with two very conspicuous white saddle-shaped bars extending downward and forward from back. The first of these, about as wide as orbit, extends from below the dorsal notch in a straight line toward lower axil of pectorals, including above the posterior margin of spinous dorsal and the extreme basal portion of first rays of soft dorsal. The second bar includes dorsally the terminal portion of soft dorsal upon which it extends and the anterior portion of caudal peduncle. Like the anterior bar, it is variable in width; it extends forward and downward to below caudal peduncle. The ground color becomes intensified along the margins of these light bars. Caudal with a light basal bar which becomes widened and pure white in its lower half, adding a third to the series of conspicuous light markings. In some specimens these white bars are tinged with brownish; hence less conspicuous. Under parts whitish. Lips and lower jaw with light and dark crossbars, which are often indistinct. Branchiostegal membranes sometimes with indistinct crossbars. The darker interspaces below soft dorsal and on caudal peduncle usually encircle the body below, but are sometimes (in males) broken on middle of sides with spots and blotches of white (see figure in Nelson's report cited above). Axil of pectorals usually with two round white spots, most distinct in males. Basal portion of anterior face of pectorals dusky or black, in males with two round white spots; fin distally barred with light and dark. Caudal crossbarred. Anal and ventrals with faint crossbars or plain. Dorsals blackish.

Taken abundantly in Bristol Bay, Alaska, at stations 3229, 3230, 3231, 3232, 3233, 3234, 3244, 3247, and 3300; depths, 5 to 17 fathoms.

We are unable to follow Dr. Bean in identifying this fish with *Porocottus quadrifilis* Gill (Proc. Acad. Nat. Sci. Phila. 1859, 166). The latter is described as having a single hooked preopercular spine, an opercle without rib or spine, and large pores on head and lower jaw. None of these statements apply to the present species. *P. quadrifilis* is also said to have five branchiostegal rays, but this is possibly an error. It is also described as having a slender superciliary filament, and one on each side of nape. We do not find, to offset these, any details in the original description which agree strikingly with our fish, even the color being inapplicable.

61. Acanthocottus polyacanthocephalus (Pallas)

This species closely resembles *A. humilis*, but differs in the much deeper and less-depressed head and body, the larger preopercular spines, the shorter and usually less-pronounced occipital crests, the absence of spinous plates on sides of body, and the presence of 10 (very rarely 9) spines in the dorsal fin. The coloration is also different, the dark bars on back being much better defined, not breaking up at an early age, as in *A. humilis*, into small black spots and blotches. None of our specimens show a pore behind the last gill, though this is constantly present in *A. humilis*. In both species the top and sides of head, including nape, are covered with small dermal warts. Both agree, also, in possessing supraorbital and occipital tubercles, behind the former of which is a cluster of short diverging ridges. Neither species seems to possess filaments on the head. In a highly colored male of *A. polyacanthocephalus*, exhibiting round white spots on lower part of sides and with horny tubercles on the inner surfaces of the pectoral rays, the sides of the body both above and below the lateral line are beset with sparse strong-embedded spines directed backward. All other specimens are naked, and it is probable that *A. polyacanthocephalus* never develops the circular spinous plates characteristic of *A. humilis* and some other species.

The following table gives the fin rays in 32 specimens:

	Spinous dorsal.		Soft dorsal.				Anal.		
Rays	IX	X	13	14	15	16	11	12	13
Specimens	2	30	2	19	10	1	1	18	13

Taken at Makushin Bay, Unalaska Harbor, and near mouth of Unalaska River; at Shaw Bay, Unimak Island; at Herendeen Bay, and at the following stations in Bristol Bay: 3229, 3231, 3232, 3233, 3291, 3296, 3303; depth, 7¼ to 33 fathoms.

62. Acanthocottus humilis (Bean).

This species has a very slender body and an extremely wide, flat head, the latter strikingly triangular when viewed from above, due to the regular way in which it tapers toward the snout. The species is further distinguished by possessing but 9 dorsal spines and by the presence of an irregular series of circular spinous plates above the lateral line. These plates are not present in very young individuals. They are beginning to make their appearance in a specimen 6 inches long, and are invariably present in all our larger specimens. In adults the region below the lateral line contains strong spinous prickles, mostly concealed in the skin and directed backward. Some of the anterior ones may be broader and may have more than one point, but none are circular with a rosette of short spinous points, as is the case with the dorsal series.

Occipital crests long, gently converging behind, suddenly diverging near their posterior ends. Distance from supraorbital to occipital tubercle 1½ times the distance between the two supraorbital tubercles (the two measurements about equal in *A. polyacanthocephalus*). A sharp ethmoidal ridge extends backward from the level of the nasal spines to above front of pupil. Preopercular spines varying in length as in other species, the upper spine in older specimens usually not equaling diameter of eye. Pore behind last gill-arch always present. Spinous dorsal low, an unusually long interval between the two dorsals. Below are the fin rays in 23 specimens:

	First dorsal.			Second dorsal.			Anal.		
Rays..........	VIII	IX	X	15	16	17	13	14	15
Specimens....	1	21	1	6	16	1	1	14	8

The type of *A. humilis* has dorsal X–16; anal 13. According to Mr. Barton A. Bean, two specimens in the United States National Museum, collected by L. M. Turner, at St. Michaels, have dorsal IX–15, anal 14, and dorsal X–15, anal 14.

In the young, the dark dorsal bands are less sharply defined than in *A. polyacanthocephalus*, and in adult specimens they entirely disappear, breaking up into sharply marked black spots and vermiculating blotches and lines, which closely cover the upper parts.

Specimens were taken in the seine at the mouth of the Nushagak River, and one with a hand line at station 3290, Bristol Bay, 16 fathoms. All others were dredged in Bristol Bay, at depths of 3¼ to 21 fathoms, stations 3228, 3229, 3230, 3233, 3242, 3243, 3244, 3245, 3248, and 3250.

A. humilis closely resembles the description of *A. jaok*, with which it may well be identical. We do not venture to make this identification, as *A. jaok* is said to have but 7 dorsal spines, a number we have not found in *A. humilis*.

63. Acanthocottus verrucosus (Bean).

Heretofore known only from the type (3½ inches long) collected by Dr. Bean at Plover Bay, Siberia. The *Albatross* collected numerous specimens, the largest 16 inches (405 mm.) long. Adults possess the same combination of characters assigned to the immature type, having the top of the head strongly verrucose, the preopercular spine short, supraorbital and occipital filaments present, and the rays of dorsal and anal fins numerous. In addition they exhibit spinous plates along the sides, extremely high vertical fins, and very large supraorbital and occipital tubercles, from the summits of which the filaments arise.

The spinous plates above the lateral line are similar to those found in *A. humilis*, the anterior ones at least being circular, with a depressed center, and having the margin provided with a series of short, strong spines, sometimes interrupted for a short distance anteriorly. Under soft dorsal and on caudal peduncle the plates are smaller and less regular, being often much reduced in size, bearing 2 or 3 prickles directed backward from the margin. Below the lateral line are plates similar to those above, but fewer.

Cephalic tubercles are undeveloped in the young, but become very conspicuous in half-grown and adults. One above posterior margin of orbit and one at hinder edge of occiput are the largest and bear the short filaments. These rise very abruptly without evident connection with ridges. Behind the supraorbital tubercle is a smaller one, sometimes accompanied by one or two still smaller elevations, recalling in their arrangement the digitate postocular ridges of *A. humilis* and *A. polyacanthocephalus*. A smaller tubercle is present also immediately in advance of the principal occipital one. Preopercular spine short, the upper one not exceeding, sometimes much less than, longitudinal diameter of orbit. A well-developed pore behind last gill. Dorsals very high, without appreciable interspace, the longest spine sometimes equaling length of snout and eye, 2⅛ in head, equaling the longest rays of soft dorsal.

Fin rays are as follows in 16 specimens:

	First dorsal.		Second dorsal.				Anal.			
Rays	X	XI	15	16	17	19	12	13	14	17
Specimens	15	1	2	9	4	1	1	10	4	1

The largest specimen is nearly uniform in the coloration of the upper parts, showing but faint traces of the dark bars usually found in this group. In all other specimens these are distinctly marked, though more irregular and less sharply defined than in *A. sellaris* and *A. polyacanthocephalus*. As usual, there is a broad bar under spinous dorsal, two narrower ones under soft dorsal, and a fourth on end of caudal peduncle. The ground color is unusually pale. In a highly colored male the lower part of sides is blackish, provided with roundish large white spots, the margins of which are often made conspicuous by a series of minute black specks. The fins are conspicuously barred. In most specimens a broad band of the light ground color crosses occipital region and extends backward and downward, including margin of preopercle above the spines and the greater portion of the opercle.

Taken at Unalaska, and in Bristol Bay at stations 3228, 3231, 3232, 3233, 3234, 3245, 3293, and 3300; depths, 5 to 30 fathoms.

64. **Acanthocottus laticeps** sp. nov. (Plates 26 and 27.)

Cottus tænioptcrus Bean, in Turner's Contributions to the Natural History of Alaska, p. 94, plate 6; not of Kner.

Differing from *A. tænioptcrus* Kner in the following respects:

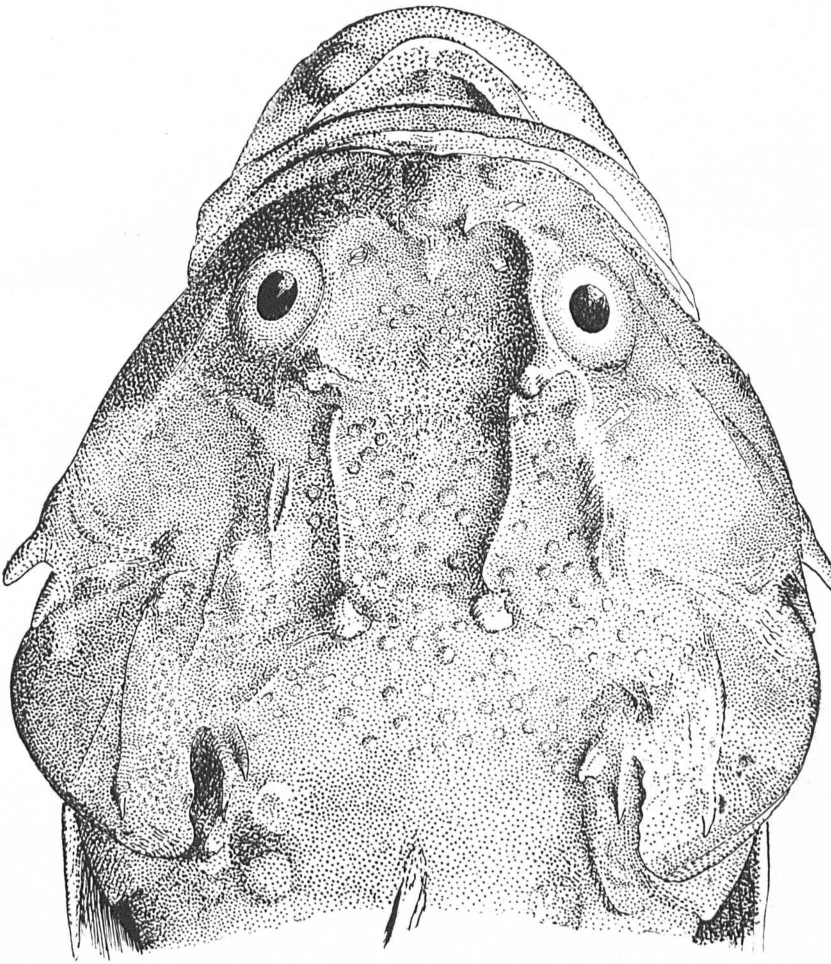
(1) The interorbital width is greater, 1¾ times the diameter of the eye in *laticeps*, equaling the eye in *tæniopterus*.

(2) Similarly the distance between the anterior ends of occipital ridges is 1⅔ times diameter of eye in *laticeps*, equal to eye in *tæniopterus*.

(3) Conspicuous supraorbital and occipital tubercles in *laticeps*, each surmounted by a fleshy filament; in *tæniopterus* "crown and occiput are without prominences or spines, covered only with naked warty skin."

(4) In *laticeps* the preopercle has two diverging spines, a single downwardly directed spine below them. In *tæniopterus* are two downwardly directed spines below the angle.

(5) The ventrals are much shorter, not reaching vent when depressed, while in *tæniopterus* they reach the anal papillæ. The dorsals are also much lower in *laticeps*.



ACANTHOCOTTUS LATICEPS sp. nov.

The principal features of this species are the very broad, flat head, the short, wide snout, the projecting lower jaw, the two pairs of cephalic tubercles provided with filaments, the verrucose head, the very short preopercular spines, the large pore behind the last gill, the presence of circular spinous plates above the lateral line and prickles below it.

Head and anterior part of body broad, depressed, the depth of head at occiput $1\frac{2}{3}$ in its greatest width, its length $2\frac{2}{3}$ in body. Body tapering to a slender caudal peduncle, whose least height is equal to diameter of eye. Depth of body 4 to $4\frac{2}{3}$ in length. Interorbital space very wide, shallowly concave, its width $1\frac{1}{4}$ times diameter of orbit, and 4 to $4\frac{1}{2}$ in head. The low supraocular ridge ends in a blunt tubercle above hinder margin of eye, which grows higher with age. Occiput depressed, bounded by two low ridges which converge very strongly toward the nape, where they curve out again in low, rounded tubercles. The inclosed depressed area is twice as wide anteriorly as it is at the narrowest posterior part. A strong temporal ridge, less distinct in young specimens. Nasal spines very small. Mouth wide, transverse, oblique, the maxillary reaching vertical from hinder edge of pupil, $2\frac{1}{3}$ in head. Mandible with its triangular tip protruding well beyond upper jaw in adults, the jaws nearly equal in young. Length of snout equal to interorbital width. Bands of short cardiform teeth on the jaws, and a broad patch on vomer; none on palatines. A conspicuous pore behind last gill. Gill-membranes almost wholly joined to the isthmus, the free border scarcely noticeable, its width less than one-third the diameter of the small pupil. Eye small, shorter than snout, $5\frac{1}{2}$ to $6\frac{1}{2}$ in head. Preopercle with two short strong spines diverging backward, and a strong concealed point below directed downward and forward. Upper preopercular spine about equal to eye, but little longer than the lower, reaching one-third the distance from its base to the tip of the opercular flap. Opercle with a well-marked longitudinal rib, ending in a sharp point. Scapular and subopercular spines present. Entire top and sides of head, nape, and anterior dorsal region covered with small dermal warts. Supraorbital and occipital tubercles with short filaments.

Space above the lateral line with an irregular series or double series of large round spinous tubercles. A few scattered plates on sides below the lateral line. Axil smooth. Plates of lateral line concealed in skin.

Spinous dorsal low, its longest spine $1\frac{1}{2}$ in second dorsal, 3 in head. In some specimens a single line of small sharp tubercles, resembling spines, extends along each side of the rays of the second dorsal. The two dorsals are separated by a narrow space. Pectorals large, reaching front of anal, the lower rays much thickened. Caudal rounded. Ventrals reaching two-thirds distance to vent. Dorsal IX-14; anal 13; pectoral 18; ventral I, 3; lateral line 36-40. Length 6-11 inches.

Color: Dark olive-brown above, with faint traces of blackish bars; sides spotted or marbled with whitish. Belly, and lower parts generally, white. A blackish blotch on cheeks, one on opercle, and a third on front of mandible. Pectoral rays dusky, the membrane whitish, the fins crossed by three or four wavy black bars, which sometimes join, inclosing oblong or roundish white areas. Spinous dorsal not banded, the dusky and translucent areas variously arranged. Soft dorsal, with five oblique broad dusky bars. Anal with four bars, sometimes uniting to inclose white spots. Caudal similar to pectoral and anal. Brilliantly colored males are largely black on sides and below, with many large, rounded, partially-confluent, pearly-white spots.

Thirteen specimens from the Nushagak River, near its mouth; one from Herendeen Bay, on the northern side of the Alaskan Peninsula.

65. Acanthocottus profundorum sp. nov. (Plate 27.)

A deep-sea form, allied to *A. bathybius* Günther, from which it differs in the obsolescence of the occipital and nasal spines, the absence of the accessory spine in advance of upper preopercular spine, and in the more numerous rays of dorsal and anal fins. From above, the head appears smooth and evenly rounded, without projecting spines or ridges. The occipital depression is very shallow, the occipital ridges depressed, scarcely noticeable, ending in depressed spines which are made out with difficulty.

Nasal spines undeveloped, the nasal bone small, posteriorly pointed, but not furnished with a projecting spine. Upper preopercular spine strongly compressed, curved upward, not reaching opercular margin, its length equaling diameter of eye. No spine at its base in front, as in *A. bathybius*. Below it are two short, strong spines directed downward and backward, and one more slender downward and forward. Opercle with a longitudinal rib ending in a short spinous point. A short spine on angle of opercle, and one below it on interopercle. Mucous canals everywhere greatly enlarged, giving a spongy texture to the entire head; series of very conspicuous pores on the preopercle, the mandible, and below suborbital chain.

Head 2⅗ in length; depth 5. Dorsal VII–13; anal 10 or 11; pectoral 17 or 18; ventral I, 3. Lateral line with 17 pores.

Mouth broad, oblique, maxillary reaching middle of pupil, 2⅛ in head. Mandible slightly protruding. Minute teeth in upper jaw anteriorly in two rather distinct rows, laterally in narrow bands. Teeth on vomer, none on the palatines. Eye longer than snout, 3⅗ to 4 in head. Interorbital width one-half diameter of orbit. Gill-membranes widely joined, with a wide, free posterior edge. No slit or pore behind last gill. Body smooth, without plates, granulations, or filaments. No plates developed in connection with the lateral line. Pores of lateral line in a double series; the two closely approximated, those of the lower series much the largest. Longest rays of second dorsal half length of head, twice the longest dorsal spine. Pectoral reaching front of anal or slightly beyond. Ventrals short, not nearly reaching vent. Upper parts very light-brownish, the belly and sides below lateral lines dark brown. Fins blackish. Mouth and gill-cavity dark.

Three specimens, 49 to 55 mm. long, from station 3329, north of Unalaska Island; depth 399 fathoms.

66. Gymnacanthus pistilliger (Pallas).

We agree entirely with Dr. Bean and Mr. Dresel (Proc. U. S. Nat. Mus. 1884, 251) in considering the North Pacific species, *G. pistilliger*, distinct from the North Atlantic form, *G. tricuspis*. We have not had an opportunity to make direct comparison between the two, but find the following differences on comparing our specimens with the current descriptions of *G. tricuspis*. *G. pistilliger* has a different fin formula, the spines and rays of dorsal and anal fins being fewer in number. This is shown by the following table, based on an examination of 40 specimens:

	Spinous dorsal.		Soft dorsal.				Anal.		
Rays	IX	X	13	14	15	16	15	16	17
Specimens ...	10	30	1	17	21	1	2	28	10

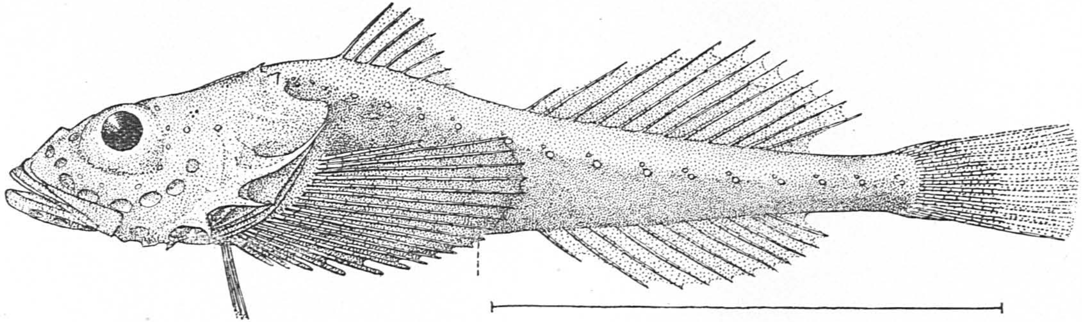
The normal formula may therefore be given: Dorsal IX or X–13 to 15; anal 15 to 17. The type of *G. pistilliger* is said to have dorsal IX–13; anal 16; and its synonyms, *G. ventralis* Cuvier & Valenciennes and *G. intermedius* Temminck & Schlegel, have respectively dorsal IX–13, anal 17, and dorsal IX–13, anal 14.

In *G. tricuspis*, the formula is dorsal XI or XII (rarely X)–15 to 17; anal 16 to 19.

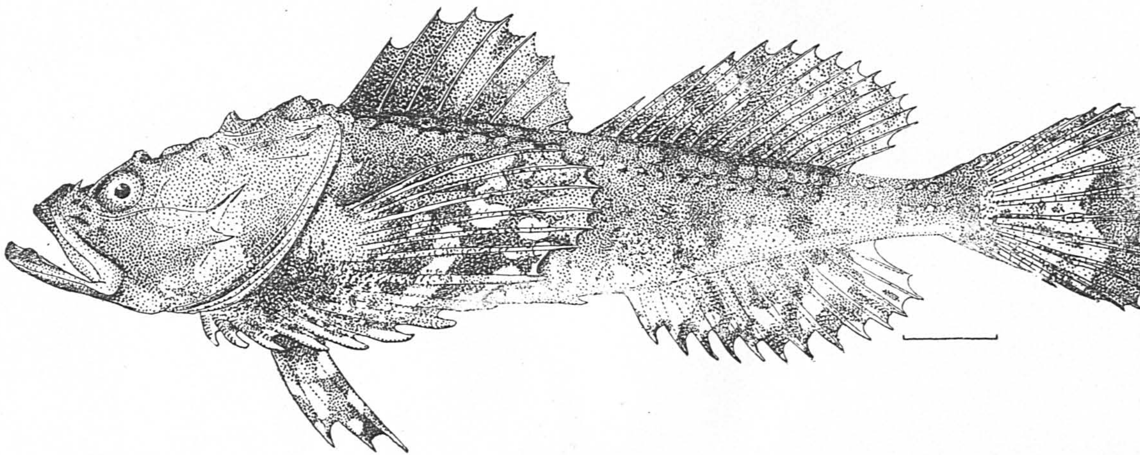
The dorsal fins are more widely separated in *G. pistilliger*, where the interspace is equal to half or more than half the diameter of the pupil.

The vertebræ are fewer in number, 12+24, instead of 12+28.

In *G. pistilliger* an obtuse prominence above the hinder margin of orbit bears in young individuals a slender cirrus, which frequently disappears in adults. Behind the eye a continuous occipital ridge bears three smaller bony prominences, the first



ACANTHOCOTTUS PROFUNDORUM sp. nov.



ACANTHOCOTTUS LATICEPS sp. nov.

immediately behind the eye, the second and third approximated at posterior end of ridge. These bear no cirri. *G. tricuspis* has no tubercles on occiput.

In males of *G. pistilliger* the postaxial region is furnished with a number of very slender filaments, each of which is expanded at tip into a compressed frond-like lamina, having the free edge more or less laciniate or fringed. These expanded tips are bright white and very conspicuous. No trace of them is present in females, but they develop in males at a very early age. These agree with the structures described by Pallas, on which he based the name *pistilliger*. They seem to be absent in *G. tricuspis*.

The upper preopercular spine is sharply bifurcate in even our smallest specimens (50 mm.), but in these no trace of a second medial upwardly directed spine is present. The latter is evident in specimens 70 mm. and more in length, and a small concealed prominence representing a third spine is exceptionally present.

The following table gives in millimeters the total length, the depth of body, and length of head in eight specimens:

Total length.	Length of head.	Depth.
Mm.	*Mm.*	*Mm.*
156	44	27
145	39½	25½
142	38½	24½
135	38	24½
135	40	25
134	37	24
125	34½	21
93	25½	16

Very young specimens show no groups of granulations on head or nape, these being usually wanting in specimens less than 100 mm. long. In older specimens they are variously developed, the degree of armature dependent neither on age nor sex. They are never armed on interorbital space, being unlike *G. galeatus* in this respect, the granulations being confined to the occipital and nuchal regions, with an additional elongate patch on the upper part of the opercle. In highly developed males the dorsal and ventral rays are accompanied with series of tubercles.

The color is brown above, with very narrow vermiculating lines of lighter; black blotch on cheeks, more conspicuous in males, and four inconspicuous crossbars on back. The darker dorsal area is bounded below lateral line by an irregular series of dark streaks or blotches. In males the lower jaw and preopercle are cross-banded with black and light yellow; the abdomen, the lower half of sides in front of anus, and the prepectoral region, have large roundish white spots, separated by vermiculating areas rendered dusky by aggregations of coarse black dots. Ventrals dusky and silvery, the latter frequently forming crossbands. Spinous dorsal dusky or black, with irregular series of white spots not confined to basal parts of fin. In both sexes the pectorals, second dorsal, and caudal are translucent or yellowish, crossed by narrow black bars.

The females are more numerous than the males in our collection, but the disparity in numbers is not so great as has been found by other writers. In 45 specimens examined as to this, 17 are males, 28 females. Taken abundantly in Bristol Bay at stations 3230, 3231, 3232, 3233, 3237, 3238, 3239, 3240, 3241, 3242, 3243, 3244, 3245, 3246, 3289, 3291, 3296, 3300; depths, 3½ to 26 fathoms.

67. Gymnacanthus galeatus Bean.

A single male specimen, 210 mm. long, from Chernoffski Harbor, Unalaska Island. The sexual peculiarities are less strongly marked than in much smaller males of *G. pistilliger*.

The ventrals extend but little beyond the front of the anal fin, and are unmarked. The abdomen is also plain, without the round white spots characteristic of male specimens of *G. pistilliger* and *G. tricuspis*. These marks were apparently absent also in the type, as no mention is made of them. The spinous dorsal is not greatly elevated, its longest spine being contained 2½ times in the head. It is without distinctive markings, being colored like the soft dorsal, light yellowish, cross-banded with darker. Anal papilla short, 5 mm. in length.

Plates on head as in description, covering the interorbital region, crown, occiput, and nape as far back as front of dorsal; present also on upper part of opercle and in a vertical streak immediately behind eye. A very prominent tubercle over hinder margin of eye, a constriction behind it. Occipital region broadly rounded, without tubercles or conspicuous prominences of any kind, but with three smooth areas corresponding in position with the tubercles of *G. pistilliger*, and perhaps present as such in the young. The anterior one is slightly elevated. No superciliary filaments. Preopercular spines massive, short, with a single fork at tip, no accessory spines developed. Axil with prickly scales but without filaments.

Dorsal XI-16; anal 19; lateral line 43; head 52 mm. long; depth 32 mm. The depth is 6½ in the total length, not 7½ as described for the type.

This species is much more nearly related to *G. tricuspis* than to *G. pistilliger*. We have had no opportunity to compare it with the former, and follow Dr. Bean in considering it distinct.

68. Enophrys diceraus (Cuvier & Valenciennes).

Several adults taken with seine at Herendeen Bay, Alaska Peninsula. There are 6 or 7 strong barbs inclined forward on the upper surface of the preopercular spine, which is very long, slender, and straight, reaching to below middle of spinous dorsal. Filaments arranged as in *E. claviger*, but those on posterior part of body much more numerous. Anal papilla very large, 27 mm. in a specimen 195 mm. long. There seem to be no prickles on region above lateral line or on abdomen.

Fin rays in 7 specimens are as follows:

	Spinous dorsal.	Soft dorsal.		Anal.		
Rays	VIII	13	14	10	11	12
Specimens	7	4	3	1	2	4

Stomachs filled with molluscan shells, mainly limpets.

69. Enophrys claviger (Cuvier & Valenciennes).

A single specimen, 25 mm. long, from station 3233, Bristol Bay, Alaska; depth, 7½ fathoms.

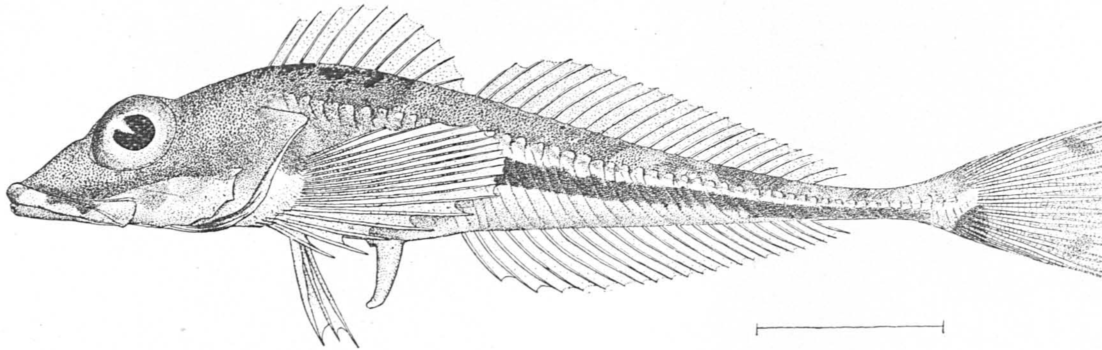
The upper preopercular spine is long and very slender, extending to below middle of spinous dorsal, bearing small serrations on anterior and posterior edges of basal half, but without larger teeth or accessory spinules. Area above lateral plates thickly beset with minute prickles; posterior part of abdominal region and the area above anal fin similarly beset with prickles which scarcely project beyond the small tubercles in which they occur. A few larger postaxial prickles and a small number of white filaments scattered along middle of sides. Filaments also at base of preopercular spines and 2 or 3 at tip of maxillary.

Dorsal VIII-14; anal 11; lateral line 35. It does not seem to us probable that this is the young of *E. diceraus*, as Dr. Bean would have it.

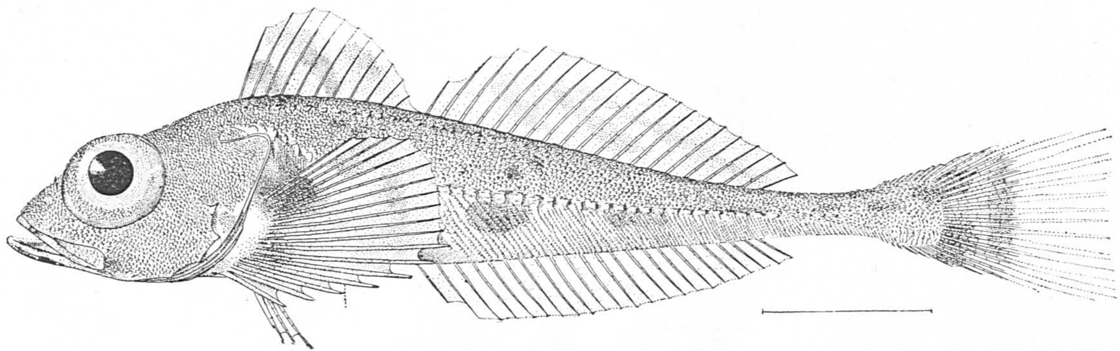
70. Triglops beani sp. nov. (Plate 28.)

Triglops pingeli Bean, Proc. U. S. Nat. Mus. 1883, p. 355, not of Reinhardt.

Diagnosis: This is the Pacific representative of the Atlantic *T. pingeli*, from which it differs in the greater slenderness of the body, particularly of the caudal peduncle, in the somewhat smaller eye, the more pointed snout, the less fine subdivision of the



TRIGLOPS BEANI sp. nov.



TRIGLOPS SCEPTICUS sp. nov.

lateral folds, the less complete investment of the fins with prickly scales, and above all in the peculiar coloration of the male.

Dorsal X or XI, 23 to 26; anal 24 to 26; caudal 12; pectoral 18; ventral I, 3; lateral line 48 to 50; branchiostegals 6.

Description: Body heavy at shoulders, tapering rapidly to the slender caudal peduncle. Depth, 6 in length; depth of caudal peduncle, one-fourth its length from base of last dorsal ray. Head, 3$\frac{4}{7}$ to 3$\frac{3}{5}$ in length; its greatest width slightly less than its depth; its lower profile straight, the upper descending in a gentle, even curve. Mouth nearly horizontal, the maxillary almost reaching vertical from middle of eye, 2$\frac{1}{6}$ to 2$\frac{1}{4}$ in head. Villiform teeth on jaws and vomer, none on palatines. Snout longer than eye, 3$\frac{1}{6}$ to 3$\frac{1}{8}$ in head; eye, 3$\frac{1}{4}$ to 3$\frac{3}{8}$. Supraorbital rim slightly elevated, a groove-like depression behind it. Interorbital space rather wide, forming a shallow groove; its width 3$\frac{1}{3}$ to 5 in diameter of orbit. Occipital ridges obsolete, a faint trace of them sometimes present, never ending in a spine. Opercle with 4 spinous points, the lowermost directed downward and forward, the others radiating downward and backward. Branchiostegal membranes broadly united, free from the isthmus.

Longest dorsal spine, 3$\frac{7}{8}$ to 4 in head. Base of spinous dorsal, 1$\frac{9}{10}$ to 1$\frac{1}{2}$ in head; base of soft dorsal, 2$\frac{5}{8}$ to 3 in length of head and body; base of anal, 2$\frac{9}{10}$ in head and body. Caudal slightly emarginate, 2$\frac{1}{10}$ in head. Head and upper part of body densely covered with very fine prickles, much finer than in *T. scepticus*. The lower side of head, the maxillaries and a narrow strip along the lower side of cheeks naked. The usual series of enlarged prickles along the base of dorsals. Lateral folds few in number, scarcely exceeding the scutes of the lateral line. They leave a wide, naked strip along the base of anal and do not encircle the caudal peduncle below. Breast with 5 or 6 cross folds similar to those on sides. The scales along margins of folds very small, those of successive folds widely separated, not overlapping, as in *T. scepticus*.

Color: Light olive brown above, whitish on lower parts of sides and below; the breast and belly, including area in front of pectorals, silvery. Back crossed with four saddle-shaped black blotches, most distinct in the males. The first of these is under the middle of the spinous dorsal and extends obliquely forward to the upper axil of pectorals. The second and third are under the soft dorsal, narrowing rapidly downward to lateral line. The fourth is on the back of caudal peduncle. In males, the lower ends of these crossbars are connected by a narrow lengthwise jet-black streak extending from shoulder below lateral line nearly to base of caudal. The narrow interval between this streak and lateral line is occupied by a bright silvery streak, interrupted by the dark crossbars. A black blotch at base of upper and one at base of lower caudal rays, and a small black spot near tips of the outer caudal rays; the fin otherwise unmarked. An indistinct, dusky blotch below the eye, and a dusky streak along under side of suborbital stay, extending forward along the margin of the preorbital, to tip of snout. A blotch on middle of maxillary and upper lip. Front of lower lip dusky. A dark blotch on opercle, and a dusky bar on branchiostegal membranes.

In the females the general pattern of coloration is the same, but the darker markings are less distinct, and the black lateral streak of the males is represented by a disconnected series of irregular dark blotches and vermiculations. In both sexes the dorsals and pectorals are crossed by narrow, dusky bars, formed by series of dark streaks on the rays. Mouth whitish. Gill-cavity silvery white, except the lining of opercle and outer half of branchiostegal membrane, which is dusky.

Taken very abundantly at the following stations, located both north and south of the Aleutian Islands and in Bristol Bay: 3214, 3217, 3220, 3231, 3232, 3233, 3235, 3237, 3238, 3241, 3248, 3250, 3264, 3265, 3275, 3281, 3284, 3287, 3289, 3290, 3291, 3294, 3296, 3298, 3300, 3302. The depths range from 7$\frac{1}{4}$ to 42 fathoms. Specimens 82 to 140 mm. in length.

71. Triglops scepticus sp. nov. (Plate 28.)

Very closely related to *T. beani* and *T. pingeli*, but different in the following respects: The eye is much larger, the snout shorter, and the maxillary shorter and broader. The maxillary bone and the lower half of cheeks are invested with prickles, not naked. The lower thickened portion of pectoral fin is produced to form a lobe. The scales on the upper half of the body are much coarser. The dorsal series of enlarged prickles is much less conspicuous. The lateral folds are much more numerous, averaging about four to one pore of the lateral line, reaching to or nearly to the anal fin and encircling the caudal peduncle below. The ventral fins are much narrower and nearer together. The lateral line has a much more pronounced upward curve over the base of the pectorals. A short, high occipital ridge is present, but does not terminate in a distinct spine. (Occipital ridge obsolete in *T. beani*, a bare trace of it sometimes visible.)

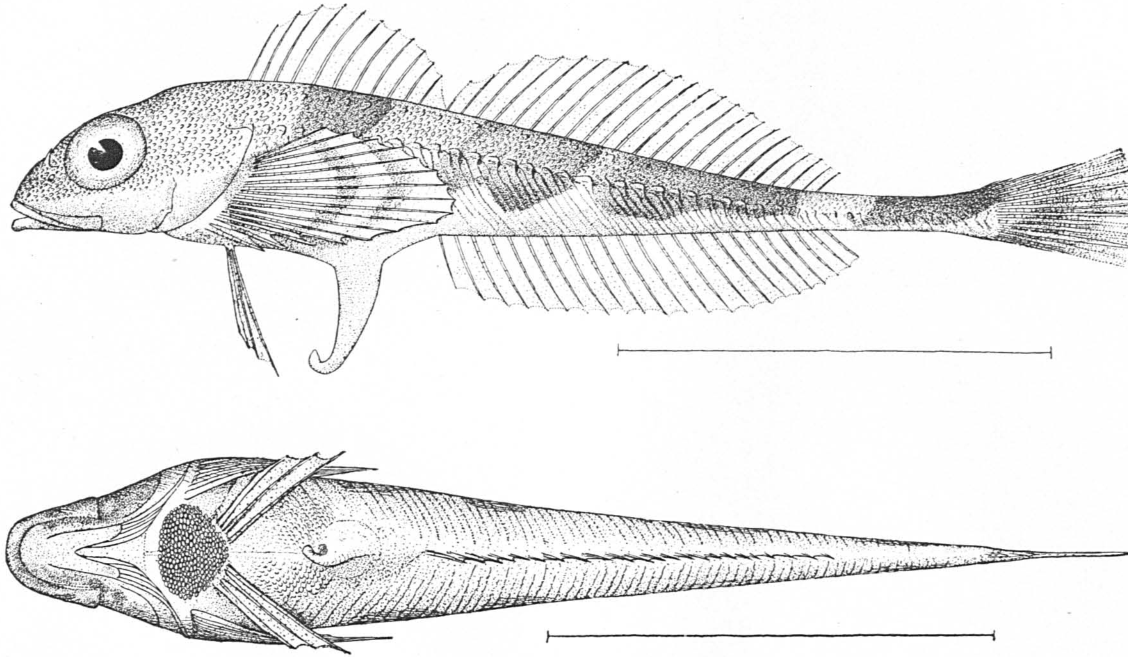
Dorsal, XI, 21 to 23; anal, 22 to 24; pectoral, 19 (18 on left side in two specimens); ventral I, 3; caudal with 12 fully developed rays; lateral line, 46 or 47; branchiostegals, 6.

Body very robust, the upper profile descending rapidly from front of dorsal in a regular curve to tip of the short snout. Depth, $5\frac{2}{3}$ to $5\frac{1}{2}$ in length. Least depth of caudal peduncle, $4\frac{1}{4}$ to $4\frac{4}{5}$ in its length from base of last anal ray.

Head of moderate length, $3\frac{1}{8}$ to $3\frac{1}{2}$ in body; its width is $1\frac{1}{3}$ to 2 in its length. Maxillary reaching to or nearly to vertical from middle of pupil, $2\frac{1}{4}$ to $2\frac{1}{2}$ in head. Mandible slightly projecting. Teeth on jaws and vomer, none on palatines. Two blunt spines on occiput. Eye very large, $1\frac{1}{2}$ times the interorbital width and $2\frac{1}{2}$ in head. Preopercle armed with five small spinous points, the upper one pointing upward and backward, the second and third backward, and the lower two pointing forward. Opercle ending in a triangular spine. Branchiostegal membranes broadly united, free from the isthmus posteriorly.

The upper part of the body and the top and sides of head, including all of cheeks, the lower, anterior, and upper parts of eye, and exposed portion of the maxillary, thickly covered with prickly plates. These are much larger, more spinous and scale-like than in *T. pingeli*, and are on sides loosely arranged in series. Spines and rays of dorsal, caudal, and pectoral fins, covered with series of prickles nearly to their tips, except the lower thickened rays of pectorals, which are naked. A row of enlarged plate-like scales along the lateral line, becoming very indistinct posteriorly. They are more numerous and less distinct than in *T. pingeli*, 38 in number to opposite the last ray of second dorsal. A similar series along the base of dorsal fins ending opposite the posterior part of second dorsal. The lower half of the body is crossed at short intervals by transverse undulating folds of skin, about 180 in number, the edge of each fold with small rough scales, causing it to appear sharply and finely serrate. These scales are much larger and more spinous than in *T. pingeli* and those of successive folds meet and overlap. The folds reach from the lateral line quite to the anal fin, and behind the anal completely encircle the caudal peduncle. In *T. pingeli* the space along the anal and the lower sides of caudal peduncle is naked.

Dorsal fins not connected, the membrane from last dorsal spine connecting with extreme base of first soft ray. Spinous dorsal higher than soft dorsal; the dorsal spines contained $2\frac{1}{8}$ times in length of head. Rays and spines slender. Base of anal equal in length to that of second dorsal, a little more than one-third length of body. Caudal truncate, with a number of short auxiliary rays above and below, and 12 fully developed rays, each of which is twice bifurcate. Pectorals reaching beyond front of anal, the longest ray $1\frac{1}{3}$ to $1\frac{2}{3}$ in length of head. The lower rays are enlarged and exserted, forming a distinct lobe, some of the rays of which are longer than upper part of the fin. Ventrals reaching beyond vent, very narrow at base, inserted close together, the outer ray not provided with the broad membranous flap present in *T. pingeli*.



TRIGLOPS XENOSTETHUS sp. nov. Lateral and ventral views.

Color: Olivaceous above, light yellow with more or less silvery on sides of head and belly. Traces of four saddle-shaped bands of darker color reaching across back and below lateral line; one under first dorsal, two under second dorsal, and one on back of caudal peduncle. More or less of the outer portion of gill-membranes black, edged posteriorly with white. Gill-cavity black and roof of mouth dusky. Peritoneum silvery grayish. Dorsal and caudal fins indistinctly blotched with black, the blotch on the dorsal corresponding more or less closely to the bars on the back. A large black blotch on upper part of pectoral and on sides of body just above axil.

Several specimens, from 68 to 155 mm. in length, taken from stations 3215, 3222, 3223, 3224, 3225, 3309, and 3339, south of Sannak and north of Unalaska Island, in 43 to 138 fathoms.

72. Triglops xenostethus sp. nov. (Plate 29.)

Differing widely from other species of *Triglops* in the investment of the breast, which is without trace of folds and is covered by small, closely imbricated spinous scales, not arranged in series. In all other species of the genus the breast is crossed by a few cutaneous folds similar to those on sides of body. In *T. xenostethus* the sides of the abdomen are covered similarly to the breast, but the scales are arranged in more or less evident series, some of which can be traced above into the cutaneous folds. The body is not slender, the lateral folds are not very numerous, the scales on head and on upper part of body are very coarse.

Dorsal XI–23; anal 23; pectoral 16; ventral I, 3; lateral line 43; branchiostegals 6.

Body shaped as in *T. pingeli*, rather heavy at shoulders, tapering gradually backward, its depth 6 in length. Caudal peduncle slender, its least depth 4⅔ in its length, which is two-thirds length of head.

The upper profile of head descends rapidly in a strong convex curve, unbroken to tip of snout. Mouth large, maxillary reaching vertical from middle of pupil, 2⅔ in head. Eye 3⅙ in head, snout 3¾. Interorbital space very narrow, one-fifth orbit, the orbital rim not elevated, the space neither grooved nor ridged. A pair of broadly rounded occipital ridges, not ending in spines. Nasal spines short and inconspicuous, a broad depression behind them. Preopercle with four ill-defined projections between the mucous pores, but without definite spines Gill-membranes as usual. Pectoral rays apparently all simple, the lower ones thickened. Prickles covering dorsal region and back and sides of head unusually coarse and few in number. The usual series of enlarged prickles along either side of base of dorsals. Folds below lateral line numerous, very oblique, two or three to each plate of the lateral line. On sides of abdomen anteriorly to vent the prickly scales bordering the folds form a dense mass in which the linear arrangement is still faintly visible. The breast is covered with a very dense patch of similar scales still more closely crowded. The lower part of cheeks and opercles and the preorbital region naked. Very light grayish above, with the usual four crossbars, those under soft dorsal and on back of tail broader than usual. Under parts whitish, becoming bright silvery on breast and belly. A series of irregular silvery white blotches along lower margins of the dorsal crossbars. Pectorals dusky at base of upper and lower rays, with two convex dusky bars on distal half. Snout and cheeks more or less dusky.

A single specimen 66 mm. long, from station 3220, north of Unalaska Island, at a depth of 34 fathoms.

ELANURA gen. nov.

Most nearly related to *Prionistius*, from which it differs in the presence of a series of enlarged scutes along each side of base of dorsal fins, in the presence of spinous cross folds on the breast, and in the very deeply forked caudal fin. From *Triglops* it differs in the forked caudal, in the great elongation of the body, and in the lengthened dorsal and anal fins. It agrees with *Triglops* and *Prionistius* in all other important structural details, including the exserted, more or less produced lower pectoral rays.

73. Elanura forficata sp. nov. (Plate 30.)

Most closely related to *Prionistius macellus*, with which it agrees in its extreme elongation, in the production of its exserted pectoral rays, and in the investment of the spines and rays of dorsal, caudal, and pectoral fins with series of minute prickles (not "serrations"). The caudal fin is very widely forked, not merely emarginate as in *P. macellus*; the dorsal series of spinous scutes is present, and also the customary plates on the breast. The ventrals occupy the usual position and extend well beyond the vent. The interorbital region is a wide shallow groove, unlike the narrow space in *P. macellus*. There is a narrow naked streak on cheeks following the lower line of the suborbital stay. The coloration is peculiar.

Dorsal XI–29 or 30; anal 30 to 32; pectoral 21; caudal 11; ventral I, 3; lateral line 54 to 56; branchiostegals 6.

Description Extremely elongate, heaviest at the shoulders, tapering slowly and regularly backward, the ventral region often distended. The depth varies from $6\frac{7}{8}$ to $7\frac{1}{3}$ in length, equaling or nearly equaling length of snout and eye. Length of caudal peduncle, from last anal ray to base of median caudal rays, varying from $\frac{5}{6}$ to $1\frac{1}{6}$ times length of snout and eye. Body everywhere compressed, slightly deeper than wide, the greatest width and depth of head about equal. Depth of caudal peduncle greater in females than in males, averaging three-sevenths diameter of eye in the former, two-fifths eye in the latter.

Occipital region of head nearly square in cross section, tapering regularly. A pair of inconspicuous low ridges diverging from behind eye; a pair of cross grooves, one immediately behind eyes, the other on middle of occiput, hardly noticeable in the young. Supraocular rim protruding laterally, anteriorly, and posteriorly, deeply incurved above middle of eye. The interorbital space is wide, evenly concave, its greatest width over front of eye equaling length of snout, its least width one-half diameter of orbit. Snout sharp, with greatly convex upper profile, showing a faint transverse groove behind nasal spines. Its length is less than diameter of eye, $3\frac{1}{2}$ to $3\frac{5}{8}$ in length of head. Mouth slightly oblique, reaching a vertical half way between front and middle of pupil, $2\frac{1}{8}$ (in young) to $2\frac{1}{2}$ in length of head. Eye $3\frac{1}{10}$ (in young) to $3\frac{1}{6}$ in head. Gill-membranes widely joined, free from the isthmus. A well-developed slit behind last gill. The nasal spines are minute, as in *T. macellus*, barely visible. Upper preopercular spine short and simple, three lower ones developed as thin rounded lobes, irregularly serrate or spinous.

Squamation as in *Triglops*; the body above the lateral line and the top and sides of head thickly covered with small spinous scales. Lower side of head, including lower parts of cheek and preopercle and a narrow strip along lower half of preorbital, the suborbital ring, and the suborbital stay naked. The series of slightly enlarged dorsal scutes is very irregularly developed, the plates varying from 14 to 34 in 6 specimens counted. Lateral line slightly depressed above axil of pectorals, thence ascending by a gently convex curve, sometimes nearly straight, with 54 to 56 scutes of the usual character, having undulating folds descending obliquely from the posterior margins. Numerous secondary folds are also present, averaging about 2 to each scute of the lateral line, the total number of folds counted along lower half of sides being in adults about 135. The anterior base and the axil of pectorals and a strip encircling breast in front of ventral fins naked, the breast with a few (5 to 10) transverse folds similar to those on sides. The lateral folds leave a wide naked strip along base of anal fin and do not encircle caudal peduncle below.

Dorsal spines long and extremely slender, the longest $2\frac{1}{4}$ to $2\frac{1}{2}$ in head. The two fins are separate, the membrane of the last spine extending to base of first soft ray. Soft dorsal very long, its base $2\frac{1}{4}$ to $2\frac{3}{8}$ in length. It ends slightly in advance of last anal ray. Base of anal $2\frac{1}{6}$ to $2\frac{1}{8}$ in length. Anus anterior in position, nearly midway between axil of ventrals and front of anal. Ventrals inserted in the usual position, their distance from snout $3\frac{3}{4}$ or 4 in length. Along their outer margin they are provided with a wide cutaneous fold, as in *Triglops beani*. They extend well beyond the vent in both sexes, reaching in males to or nearly to the front of anal. Pectorals usually with 21 rays, the lower 7 simple, thickened, exserted, 2 or 3 of them often as long as or longer than the branched rays above, the fin thus appearing notched or lobed. The longest rays extend well beyond front of anal, and are contained $1\frac{1}{4}$ to $1\frac{1}{3}$ times in head. Caudal fin very sharply and deeply forked, especially in male specimens, where the median rays are but half the length of the longest ones. The caudal varies in length from five-sixths length of head (in males) to two-thirds length (in females), and contains 11 rays, the lowermost (corresponding to the uppermost developed ray) shortened and unbranched, as in *Triglops*.

Coloration similar in the two sexes. Light-brownish above (in spirits), the back crossed with the usual four saddle-shaped blotches; the first one broad, under the first seven or eight dorsal spines; the second narrow, under the fifth to the tenth rays of second dorsal; the third and fourth very narrow, under last dorsal rays and on back of caudal peduncle. Between the second and third bars are two or three similar fainter ones equally dividing the interspace. The bars are continued to below the lateral line, where they immediately fork, giving rise thus to a series of vertical dark blotches mostly arranged in pairs; the interspaces between some of the anterior pairs are provided each with a bright silvery spot. Under side of head and body whitish, the breast and anterior part of belly more or less silvery. Lining of opercle jet-black, the color descending onto the uppermost branchiostegal rays. An ill-defined dark blotch below eye, from which runs a narrow streak along preorbital to front of snout, where it crosses upper lip. Lower lip black, except laterally. No distinct markings on basal portion of pectorals; a small faint spot at base of its upper rays, and a number of very faint bars sometimes visible in females. Males with two conspicuous jet-black bars crossing terminal half of the lower thickened pectoral rays. Tips of the narrow caudal lobes jet-black; no other markings visible.

Several specimens, from 115 to 245 mm. long, from stations 3213, 3214, and 3222, south of Sannak and north of Unimak Islands, at depths of 38 to 50 fathoms.

74. Prionistius macellus Bean.

The elongation of the lower exserted pectoral rays and the "serrations" (*i. e.*, minute spinous scales) on the fin rays are characters which *Prionistius* shares with other related forms. The slenderness of the body, the emargination of the caudal fin, and the elongate dorsal and anal fins are also present in *Elanura forficata*, where the two former characters are carried to an extreme. The characteristic features of *Prionistius* are the naked breast and the absence of the usual series of enlarged plates along base of dorsal fin.

Four specimens, 77 to 87 mm. long, were secured at stations 3214, 3218, and 3223, south of Sannak and north of Unimak Islands, Alaska, at 38 to 56 fathoms. The ventral fins seem to be not more advanced in position than in the other species. In other respects our specimens agree well with Dr. Bean's admirably full description.

75. Hemilepidotus jordani Bean.

Taken abundantly in most localities visited, with hand lines at Unimak Island, Amak Island, and Unalaska Island, and with beam trawl both north and south of the Alaskan Peninsula and the Aleutian Islands, at stations 3213, 3214, 3215, 3217, 3220, 3222, 3259, 3262, 3266, 3281, 3291, 3292, 3294, 3322, and 3333, at depths of 19 to 50 fathoms. The fin rays range higher than in the types, as shown by the counts in seven specimens.

	Spinous dorsal.		Soft dorsal.		Anal.	
Rays	III, VII	III, VIII	21	22	17	18
Specimens	1	6	2	5	3	4

76. Oligocottus acuticeps sp. nov.

Most nearly related to *O. globiceps*, with which it agrees in the slender curved preopercular spine, not forked at tip, and in the absence of prickles on body. It differs strikingly in the small head, which tapers rapidly forward to the sharp slender snout, and in the narrow mouth with lateral cleft, as seen in all other species of the genus except *globiceps*.

Head 3½ to 3⅘ in length, slenderer and with sharper snout than in *O. maculosus*. Length of snout equaling diameter of eye, 4 in head. Interorbital space slightly concave, its width one-half eye. Maxillary reaching a vertical just in front of pupil, 3 in head. Cardiform teeth on jaws, vomer and palatine bones.

Preopercular spine slender, sharp, curved upward and inward, neither notched nor forked. Preopercular margin unarmed below it. Nasal spines sharp. Occiput without ridges or spines. Opercle thickened above, ending behind in a rounded lobe; without definite ridge or spine. Branchiostegals 6. No evident pore behind last gill. Gill-membranes broadly united, free from the isthmus.

A cirrus at inner base of nasal spines; 3 pairs evenly spaced on top of head, one above orbits, one posteriorly on occiput, and one midway between these two; a cirrus at angle of opercle; one above each pore of anterior portion of lateral line. Sides of body otherwise smooth, without further cirri and without axillary or other prickles.

Dorsal fins usually slightly joined at base. Pectorals reaching to or slightly beyond front of anal fin. Ventrals short, equaling length of snout and eye, extending little more than half way to front of anal. Anus anterior in position, thus differing from *O. maculosus* and *O. analis*, its distance from base of ventrals but half its distance from front of anal fin. Pores of lateral line 33, each of the anterior 15 usually accompanied by a cirrus. Fin rays in seven specimens are as follows:

	Spinous dorsal.		Soft dorsal.		Anal.	
Rays	VII	VIII	15	16	12	13
Specimens	2	5	3	4	3	4

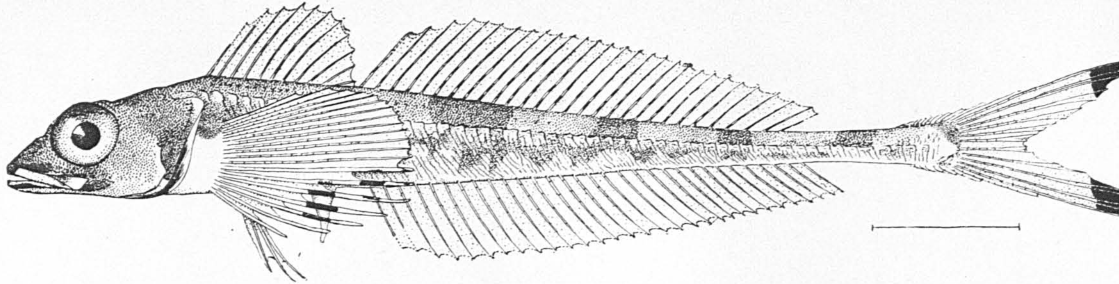
Color varying with the surroundings, often nearly uniform bright green. When dark markings are present, we usually find six short, wedge-shaped dorsal bars, widening rapidly below and joining one another by their extreme tips. Below these a dusky, wavy lengthwise streak and another wider one below lateral line. The latter is marked posteriorly by round white spots, the size of pupil. Occiput dusky. A black bar from eye to snout; one from eye to behind maxillary; one from eye to base of preopercular spine. The interval between these subocular bars may be silvery white. The spinous dorsal often shows two dark bars, as in *O. globiceps*. Ventrals plain. Fins otherwise finely mottled or indistinctly barred. Some or all of these dark markings may be absent.

Four specimens, the largest 47 mm. long, from tide pools at Unalaska, are the types of the species. Three others were taken in Departure Bay, Vancouver Island.

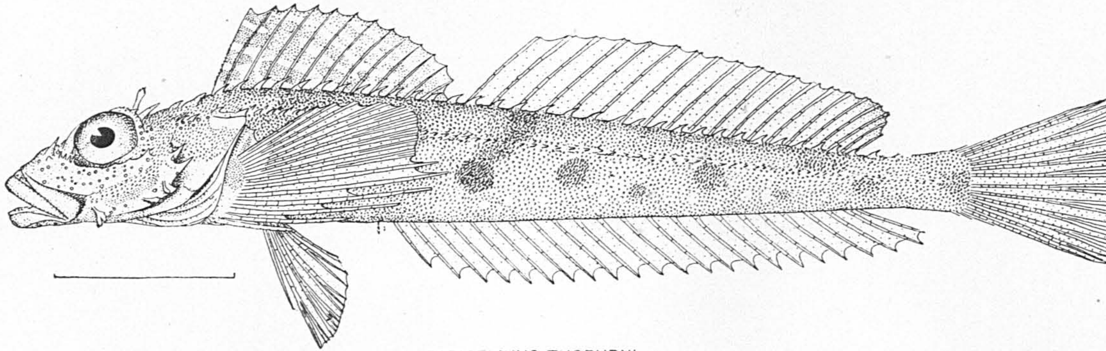
77. Paricelinus thoburni sp. nov. (Plate 30.)

A single specimen, 165 mm. long, was dredged at station 3350, off the coast of Oregon, at a depth of 75 fathoms.

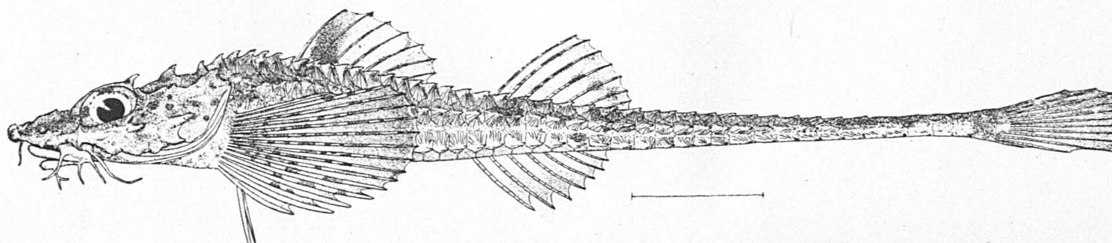
Our specimen agrees in most of its characters with *P. hopliticus* Eigenmann, but differs from the description of the latter (The West American Scientist, October, 1889, p. 131) in the following important respects: *P. thoburni* does not possess a pair of long barbels at the chin, but has others, not mentioned, above eye and along margin of preopercle. The suborbital stay does not possess two strong upwardly directed spines behind eye, but is thickly beset with a number of crowded smaller



ELANURA FORFICATA sp. nov.



PARICELINUS THOBURNI sp. nov.



ODONTOPYXIS FRENATUS sp. nov.

spines. The maxillary is contained 3 times, not $3\frac{1}{2}$, in head. A distinct slit exists behind fourth gill-arch. The origin of the spinous dorsal is above the middle of opercle, not over its posterior portion. The lower portion of pectoral fin has its rays very much exserted and somewhat produced, apparently not the case in *P. hopliticus*. Following is a detailed description of our type:

Diagnosis: Elongate, with slender spinous head. Branchiostegal membranes broadly united, free from the isthmus. Preopercular spine simple; a distinct slit behind last gill-arch. Teeth in jaws and on vomer and palatines. A palmate supraorbital cirrus; others present on preopercle. Nasal spine strong. Body thickly beset with short, stiff villiform prickles. A series of plates along each side of base of dorsals, bearing each a strong spine. Plates of lateral line spinous. Both dorsals and the anal fin very long. Caudal rounded. Pectorals with the lower rays simple, exserted, produced. Ventrals broad, I, 5.

Paricelinus is thus not very closely related to any other genus. It seems to stand nearest *Icelus* (rather than *Icelinus*), but differs widely in the structure of its ventrals and pectorals, in the very spinous head, and in the nature of the body covering.

Dorsal XIII–19; anal 23; pectoral 15; ventral I, 5; lateral line 43 on right side, 44 on the left; branchiostegals 6. Very slender and elongate, the ventral line straight, the dorsal outline descending rapidly forward to the slender sharp snout and declining very gently backward to the comparatively short and compressed caudal peduncle. Body highest at the shoulders, compressed, everywhere deeper than wide. Depth 7 in length. Depth of caudal peduncle half its length from base of last dorsal ray.

Head $3\frac{3}{4}$ in length, narrow, its greatest width equaling its depth, its profile convex above the orbits. Mouth nearly horizontal, the maxillary reaching a vertical midway between front of eye and front of pupil, $2\frac{3}{4}$ in head. Teeth cardiform, in rather broad bands on jaws, vomer, and palatines. Snout slightly greater than length of eye, $3\frac{1}{3}$ in head; eye $3\frac{2}{3}$. Supraorbital rim greatly elevated, the interorbital space a deep narrow groove, with a pair of low, rounded, lengthwise ridges along its floor. Interorbital width $3\frac{1}{6}$ in diameter of orbit. The anterior half of supraorbital rim is smooth, its posterior portion beset with crowded clusters of short, strong spines, occupying the upper posterior quadrant of the orbital rim. Three of these spines, somewhat larger than the others, lie one on either side, the other in front of the supraorbital cirrus. Upper margin of suborbital stay continuous with that of preorbital, elevated to form a thin knife-like crest which is irregularly serrate, with short spinous teeth, the anterior of which are the largest. Between this ridge and the eye lies a deep narrow groove. A strong postocular spine is directed backward, followed after an interval by two similar spines on occiput, the two series thus formed diverging backward. Nasal spines very strongly developed. The upper edge of the posterotemporal is minutely serrated. In advance of this is a series of three spines parallel with the occipital series, the posterior one remote from the two anterior. Opercle unarmed. Preopercle with three simple strong spines directed backward, the middle one on a line with suborbital stay and slightly the longest, its length three-fourths diameter of pupil. Branchiostegal membranes broadly united, free from the isthmus for its entire width. Gills $3\frac{1}{2}$, a distinct and comparatively long slit behind the fourth arch. Gill-rakers undeveloped, tubercular.

Body covered with slender, short, villiform prickles, which leave only a very narrow naked strip along base of anal, and are continuous over the dorsal series of plates, reaching base of the dorsal fins. A narrow band of prickles occupies axil of pectorals, behind which is a wide naked area extending downward and backward to behind base of ventrals, the two areas separated by a narrow mesial band of prickles on belly. Similar prickles cover continuously the occiput, the opercles, and the portion of cheeks and preopercles which lie above suborbital stay. A narrow lengthwise band of prickles on cheeks below suborbital stay; the lower side of head, together with snout and interorbital region, otherwise naked.

A series of 34 broad plates along each side of dorsal fins, extending from the nape to the middle of caudal peduncle. Each plate is transversely angulated, the outer half directed outward and downward, the inner half nearly horizontally inward, the angle bearing a very strong, compressed, backwardly-hooked spine. The dorsal fins thus occupy the middle of a flat dorsal strip, bounded by the two series of spines. A number of enlarged spine-like prickles accompany the lateral line, each pore of which lies in the axil of one such. Anteriorly these prickles are arranged somewhat definitely in pairs, two to each pore, but this arrangement is lost posteriorly. A series of enlarged prickles is placed convexly at base of caudal fin. The upper unmodified rays of the pectoral fin and all rays of dorsal and caudal fins accompanied by series of prickles; other fins and the thickened pectoral rays smooth. Body without filaments. No barbels at chin, nor on mandible elsewhere. A slender tentacle, palmated at tip, above posterior portion of orbit, its length slightly less than diameter of pupil. A slender branched tentacle near base of middle and lowermost preopercular spines, and a simple one at an equal distance below them. A similar broadly palmated tentacle on cheeks behind end of maxillary, lost on one side in our specimen, but the scar apparent.

Dorsal fins separate, the membrane from last spine joining base of first soft ray. Spines very slender, the sixth the longest, 2⅛ in head, very slightly shorter than the soft rays. Base of spinous dorsal 1⅕ in head, of soft dorsal 2⅜ in length of head and body. Front of anal under twelfth dorsal spine, the longest ray one-third head, the length of the base slightly less than half head and body. Caudal rounded, 1⅜ in head. The lower six pectoral rays simple, thickened, exserted, the membrane very deeply incised; the upper three longer than the branched rays above, the longest extending to opposite fifth anal ray. Ventrals broad, the inner rays shorter than the outer, which extend to opposite second anal ray.

Color in life: Light olivaceous, with four brown crossbands, one under spinous dorsal, three under soft dorsal. A series of nine roundish dusky spots along middle of sides below lateral line. Back and sides with small golden spots and streaks; a distinct series of round blue spots above lateral line, and some scattered blue spots and blotches on back and head, Iris green and dusky. Spinous dorsal light green, crossed by narrow yellow lines. Soft dorsal translucent, shaded with reddish and bluish. Ventrals translucent, posteriorly greenish, with white pigment. Pectorals translucent, the rays crossed with reddish and greenish bars, which are little conspicuous. Supraorbital cirrus green; preopercular cirri white.

Named for my esteemed colleague, Prof. W. W. Thoburn, from whom I have received important assistance in the preparation of this report.

78. Blepsias cirrhosus (Pallas).

Not rare at Unalaska, where numerous specimens were taken in the seine. Not seen elsewhere, and not taken with the beam trawl.

79. Nautichthys oculofasciatus (Girard).

Numerous immature specimens were taken in Bristol Bay and south of the Alaskan Peninsula, at depths of 5 to 50 fathoms. Stations 3213, 3217, 3220, 3222, 3231, 3232, 3233, 3234, 3236, 3246, 3274, 3281, 3290, 3291, 3292, 3293, 3294, 3296, 3300, and 3302.

Family AGONIDÆ.

80. Aspidophoroides inermis (Günther).

Not abundant. A few individuals taken north and south of the Aleutian group and in Bristol Bay, at depths of 34 to 59 fathoms. Stations 3213, 3219, 3220, 3265, and 3322.

81. Aspidophoroides bartoni sp. nov.

Very close to *A. monopterygius*, with which Alaskan specimens have been identified by Dr. T. H. Bean. From this species it differs in the much lower ridges, which are slightly rounded rather than sharply carinate, and leave the intervening faces shallowly concave instead of deeply so. The plates of the lower lateral ridge do not in the young bear backwardly directed spinous points as they do in *A. monopterygius*. The keel in front of the ventral fin, prominent in *A. monopterygius*, is here nearly or quite obsolete. The same is true of the keel below the eye, and the occipital ridge. The plates in front of pectorals also protrude less, and in general the angles and prominences are less marked. The space between the dorsal ridges is less, its greatest width being half length of head behind middle of eye in adults, and behind posterior margin of eye in young. In *A. monopterygius* the same width equals half head behind front of eye in adults, behind middle of eye in young. Some of these differences scarcely admit of quantitative statements, but are sufficiently evident on comparing specimens from the Atlantic and the Pacific.

General proportions, fin rays, and color are the same in the two species.

Taken very abundantly both north and south of the Aleutian Islands and in Bristol Bay, at depths of 11½ to 121 fathoms. Stations 3213, 3223, 3224, 3225, 3238, 3245, 3246, 3248, 3250, 3251, 3252, 3253, 3255, 3256, 3258, 3263, 3267, 3272, 3273, 3278, 3280, 3281, 3282, 3283, 3284, 3285, 3286, 3287, 3291, 3292, 3293, 3294, 3296, 3299, 3300, 3301, 3302, 3303, 3306, 3309, and 3311.

This species is named for Mr. Barton A. Bean, of the U. S. National Museum, from whom I have received many courtesies during the preparation of this paper.

82. Siphagonus barbatus (Steindachner).

Stations 3239, 3240, 3242, 3243, 3244, 3245, and 3258 in Bristol Bay; depth, 4½ to 70 fathoms. The dark band on sides is often very strongly marked; the barbel varies much in length; the fins vary from dorsal VII to VIII–6 to 8; anal 9 to 12.

83. Brachyopsis dodecaedrus (Tilesius).

A few specimens taken in Bristol Bay, at stations 3239, 3240, 3242, and 3248; depth, 4½ to 31 fathoms. In males the colors are much brighter than in females, recalling *B. verrucosus*. The bars on dorsal fins in males intense black and bright white, instead of olive brown and whitish, as in females. Males show also a larger black patch on last anal rays, and have the interradial membrane of ventral jet black. In none of our specimens does the caudal fin show transverse lines of brown points, as described by Cuvier. In both males and females the caudal is dusky or black; the median rays lighter, the outer ones white. Dorsal IX or X—7 or 8; anal 14 to 16. In life the ground color of upper parts is light olivaceous. The median portion of the pectoral fins is largely red, divided by narrow lemon yellow lines into quadrangular areas, each of which has a black spot in its center. Median portion of caudal yellow at base, becoming reddish distally. A faint, long, reddish streak below lateral line.

84. Odontopyxis frenatus sp. nov. (Plate 30.)

Body slightly depressed, tapering regularly backward from occiput, the depth about seven-eighths of the width at base of pectorals. The ridges are prominent, the dorsal and dorso-lateral ridges provided with strong spines, the ventral and ventro-lateral series with weak or scarcely discernible spines, all decreasing in size backward, becoming obsolete on caudal peduncle. Dorsal face deeply concave anteriorly, its ridges coalescing from 3 to 4 plates behind the dorsal fin. Other faces much less concave, the ventral ridges coalescing 3 or 4 plates behind the anal fin. Plates in dorsal series 44 or 45; 5 or 6 pairs between occiput and first dorsal, 9 or 10 under first dorsal, 2 or 3 between dorsals, 7 or 8 under second dorsal, 17 or 18 behind dorsals. About 25 plates on breast, consisting of a strong median series which bears a well-marked rounded ridge, a strong lateral series at edge of breast also projecting, and a number of small plates occupying the concave intermediate areas. In young specimens the breast plates have central elevations and bear each a backwardly-directed spine. These disappear in adults. A number of small irregular plates in front of and on base of pectorals. Membranous intervals behind and around vent smaller than in *A. acipenserinus*, occupied by eight or nine irregularly arranged plates, not in pairs and not corresponding to those of the ventral series, between which they are intercalated. Medial part of branchiostegal membrane and the gular region covered with roundish plates, the whole forming a halbert-shaped patch. Lateral line running on a series of small plates occupying the middle of the lateral face. Anteriorly these entirely disappear, the lateral line ascending and running on the upper lateral series. About five large plates, sometimes bearing spines, lie behind upper axil of pectorals, between this ascending portion of the lateral line and the inferior lateral series of plates.

Head depressed, tapering rapidly to the snout; depth of head at occiput two-thirds its width at preopercular spine, the latter contained 6¼ times in length of body. Eye large, the orbit about equaling length of snout behind the serrated rostral ridge, 3½ to 3⅔ in head. Snout somewhat variable in length, averaging one-third head. Supraocular ridges strong, rugose, ending in a short, strong spine. An inner pair of ridges occupies the floor of the interorbital groove, very broad and closely joined anteriorly. The triangular space included between these latter ridges is flat and opens posteriorly onto the depressed occipital area. Occipital ridges low, rounded, ending in very strong spines which form the first of the dorsal series; two or three small, rounded projections may occur on anterior ridges of occipital spines. The top and sides of head are more or less closely beset with very fine prickles, which are most thickly clustered on occiput, interorbital area, upper part of opercles, suborbital chain, and sides of snout. A row of prickles on eyeball, just above pupil. Temporal ridge uneven, sometimes interrupted with a long, strong posterior spine. A strong spine, sometimes with an accessory tubercle, on middle of cheeks. Preorbital with two pairs of spines placed vertically, the upper ones directed outward and upward, the lower spines directed downward and backward. Rostral ridges rough, usually terminating posteriorly in a pair of spinous projections, which are located midway between tip of snout and front of pupil. Anteriorly, at tip of snout, these ridges expand to form such a vertically projecting, rounded, spinous lobe, the posterior spine of which is much the strongest and points backward and outward. In the very young the last-mentioned spines alone are present on snout, and are directed very obliquely backward. Anteriorly ridges converge from them to tip of snout and are very minutely serrulate. These ridges afterward increase in height and in strength of serrations, and become the spinous lobes already described. Two strong diverging spines at angle of preopercle and two rounded lobes below them. Three large plates and a number of smaller ones occupy cheeks below suborbital stay. Posterior portion of mandible expanded into a rough, projecting, bony prominence.

Mouth horizontal, overpassed by the snout in adults for a distance equaling half or less than half diameter of orbit; the snout not noticeably projecting in the very young. Maxillary reaching slightly beyond front of orbit, equaling half length of snout and eye. Teeth in broad bands in jaws; a distinct patch on front of vomer; none on palatines. Branchiostegal membranes broadly joined with a very narrow free fold posteriorly or with none.

Six pairs of barbels on under side of head: One on under side of snout in front of premaxillaries; two at end of maxillary; one near middle of maxillary; one on lower lip just below angle of mouth; one forked for half its length, at middle of side of lower lip. In their distribution, relative lengths, and in the constantly bifid character of the last described, they correspond exactly with the barbels of *L. decagonus*, but the latter has apparently none on under side of snout.

Interspace between dorsals somewhat variable, three-fourths to seven-eighths diameter of orbit. The anal begins two plates in advance of second dorsal. Pectorals 5½ in length of body, the lower rays graduated, four to six of the lower ones thickened, with exserted tips. Ventral fins nearly twice as long in males as in females, in the latter less than diameter of orbit. Caudal slender, 1⅘ in head. Head 4⅙ to 4¼ in length. Dorsal VI to VIII-7 or 8; anal 6 or 7; pectoral 15; ventral I, 2; caudal with 11 rays and a rudiment of a twelfth below. Lateral line 40.

Color, light grayish or brownish, pale below. A bluish-black stripe from rostral spines to front of orbit. Suborbital, preopercle, and opercle with numerous dark spots. A dark blotch on the side, opposite middle of first dorsal; a faint dark bar under the anterior and a similar one under posterior part of second dorsal. Both dorsals with indefinite oblique dark bands. Pectorals dark except the lower proximal part, with narrow bars of black; ventrals light in females, dark in males; anal dark posteriorly; caudal dark, faintly barred.

Stations 3219, 3225, 3226, 3227, 3255, 3256, 3257, 3258, 3263, 3269, 3279, 3282, 3309, 3311, 3313, and 3330, located on both sides of the Alaskan Peninsula and both north and south of the Aleutian Chain; depth, 16 to 351 fathoms.

85. Odontopyxis leptorhynchus sp. nov.

Very close to *O. frenatus*, with which it agrees in the arrangement of plates, the spines on head, and the barbels. It is distinguishable at once by the elongate slender snout and differs also in the following numerous details: Body somewhat broader and more depressed, its greatest depth a little less than two-thirds its greatest width, which occurs across preopercular spines. The body narrows rapidly backward to below spinous dorsal, as in young *O. frenatus* of the same size. Compared with *O. frenatus* of the same size, the plates on body are much less spinous, the superior and inferior lateral series and the ventral series in some specimens bearing spines on a few of the anterior plates only; the spines of dorsal series are lower. Five plates before dorsal, 10 under spinous dorsal, 2 between dorsals, 7 under second dorsal, and 16 on caudal peduncle. The inferior lateral ridges rise anteriorly, greatly constricting the lateral face under anterior part of spinous dorsal. It then descends slightly and becomes almost or quite obsolete, the series of plates ending behind the upper pectoral rays. In *O. frenatus* the constriction of the lateral face does not occur, the ridge is strongly marked anteriorly, and ends below middle of pectoral base. In *O. leptorhynchus* we have therefore a much narrower interval between the anterior ends of the upper and the lower lateral series. This interval is occupied by but 3 plates, arranged in a series, decreasing in size backward.

The upper preopercular and the humeral spines are much larger than in *O. frenatus*, the former greatly overpassing the second spine. The rostral spines are similar, but the terminal plate is roughened but not serrate, the posterior spine not detached. Snout greatly produced into a narrow triangular piece, which overpasses the snout for a distance equaling two-thirds diameter of orbit in a specimen 100 mm. long. In specimens of *O. frenatus* of this length the ends of the rostrum can barely be seen from below. A few prickles present on upper side of rostrum, and the usual series above pupil. Minutely serrated ridges on sides of snout, and one below eye. No prickles on top or sides of head. Plates on branchiostegal membranes and on gular region smaller and more numerous than in *frenatus*. Twenty plates on breast, without spines, or the young with very small ones.

Head 4 in length. Snout $2\frac{2}{3}$ in head in a specimen 100 mm. long. Eye $3\frac{1}{4}$, equaling length of maxillary. Interorbital width two-thirds eye. Branchiostegal membranes broadly united, extensively free laterally, joined to isthmus mesially to extreme posterior margin, or leaving a very narrow margin free. Teeth present on jaws and on vomer, none on palatines. Dorsals VI to VIII-6 or 7; anal 6 or 7; pectoral 14; ventral I, 2. Pectorals long, reaching to or beyond middle of spinous dorsal, as long as snout and eye. Ventrals equaling length of snout.

Color darker than in *O. frenatus*, the under parts unmarked anteriorly, dotted posteriorly with brown; upper parts dark brown in spirits, with six or seven more or less distinct black bands, which are margined narrowly with lighter. A black streak forward from eye, and several black spots and blotches on sides of head. Caudal blackish. Soft dorsal dusky, obscurely marked with lighter; spinous dorsal black, sharply blotched with pure white. Ventrals and lower pectoral rays white, the upper part of pectorals with obscure bars of black.

A few specimens from stations 3215, 3219, 3222, 3229, 3259, 3265, and 3267, north and south of the Alaskan Peninsula, in 32 to 59 fathoms.

86. Xenochirus triacanthus Gilbert.

A single specimen dredged at station 3350, near Point Reyes, Cal., at a depth of 75 fathoms. In life olive brown, with small pearly spots on back.

87. Xenochirus alascanus sp. nov.

Most nearly related to *X. pentacanthus*, with which it agrees in having a rostral plate bearing three spines and in having the branchiostegal membranes without free fold. It differs conspicuously in the broader head, with its much heavier spines and ridges, in the presence of deep postocular and nuchal pits, in the smooth breast and cheeks, in the different coloration and fin rays, and in many other details. Head 4¼ to 4⅜ in length; width of head equaling or slightly exceeding length of snout and eye. Depth of body equals length of snout and half eye. Fin rays in eight specimens as follows:

	Spinous dorsal.			Soft dorsal.		Anal.	
Rays	V	VI	VII	6	7	7	8
Specimens	1	4	3	6	2	7	1

Pectorals 15 or 16; ventrals I, 2; lateral line 39 or 40.

A decided pit behind the eyes, and a deep transverse nuchal depression, the two separated by the prominent occipital region. Snout of moderate length, much depressed behind the spines, 3⅔ to 3⅞ in head. Eye 3 in head in adults. Interorbital space wider, much more deeply concave, the supraocular ridges very heavy, minutely roughened, ending posteriorly in robust spines. Rostral armature as in *X. pentacanthus*, consisting of a small apical plate bearing three small diverging spines, behind which are two longer ones. Preorbital with a small spinous point directed backward. A spine posteriorly on bony bridge across cheeks. Below this bridge the cheeks are entirely mailed by three rounded plates, which bear no spines, except in young specimens, and are so intimately joined that the sutures are difficult to discover. In *X. pentacanthus* the plates are much smaller and do not entirely cover the cheeks, leaving soft areas surrounding them, and the two posterior plates bear spines. Maxillary 3⅞ in head, barely reaching front of orbit. Teeth on jaws, vomer, and palatines. The usual row of 5 or 6 prickles on eyeball. Preopercle with three diverging spines at angle, a rounded lobe beneath them. Spines and ridges otherwise as in *X. pentacanthus*, but stronger and rougher. Three or four strong plates present on gular membrane; a few weak ones, or none, on branchiostegal membrane mesially. Two barbels at tip of each maxillary, and a pair, often double, on under side of mandible arising from the margin of the anterior pair of mandibular pores. The symphyseal pore has its margin sometimes provided with very short barbel-like elevations.

Space between dorsal ridges very deeply concave in front of dorsal fins; the single ridge behind dorsal fins provided with very short, scarcely perceptible, double spines. Lower lateral series of plates continued forward to axil of pectorals (becoming indistinct anteriorly in *X. pentacanthus*). Ventral series anteriorly with few short spines or none; this series strongly spined in *X. pentacanthus*. Plates on breast arranged alike in the two species, but in *X. alascanus* they are more finely striate and bear neither spines nor raised centers, except in very young specimens. In *X. pentacanthus* the elevated centers may or may not bear short spines. Seven plates before dorsal, 8 or 9 under spinous dorsal, 2 or 3 between dorsals, 7 or 8 under soft dorsal, 13 or 14 behind dorsals. Distance from snout to nape equals or slightly exceeds distance from nape to first dorsal. Front of anal under end of spinous dorsal or slightly behind that point, more anteriorly placed than in *X. pentacanthus*. Ventrals 2¼ to 2⅜ in head. Lower pectoral rays produced, with incised membranes, as long as head behind rostral spines.

Color lighter than in *X. pentacanthus*, more or less finely speckled above, usually with five or six dusky crossbars on back. A series of linear dark blotches below the lateral line. The head is often finely speckled with brown and shows traces of a brown bar forward from eye to snout. Dorsals, caudal, and upper half of pectoral light, finely speckled with brown, the caudal shaded with dusky. Ventrals and anal white.

Taken rather abundantly in the vicinity of Unimak Pass, both north and south of the islands, at depths of 35 to 138 fathoms. Stations 3216, 3219, 3223, 3225, 3226, 3257, 3258, 3263, 3309, 3310, 3311, 3313, 3322, 3334, 3336, and 3339.

88. **Bathyagonus nigripinnis** Gilbert.

In adult specimens the lower pectoral rays show a tendency to elongate, as in *Xenochirus*, but the fin is never distinctly notched. The lower jaw always strongly protrudes, and the genus differs further in the very thin cranial bones and the inordinate development of the mucous system. In addition to the specific characters mentioned in the original description, we note that the eyeball does not exhibit the usual row of prickles, and that two barbels are usually present at end of maxillary, either black or white in color.

The skull is firmer than indicated in the original description, the mucous channels less conspicuous. Eye 3 in head. Interorbital width 3 in orbit. Anterior part of supraorbital ridge strongly flattened and finely rugose. One occipital spine only.

In life, the body is translucent-grayish, the fins blackish, the lower side of head, the belly, the anal fin, and the lower pectoral rays bright blue with golden reflections.

The majority of the specimens were obtained north of Unalaska Island; it was also taken south of the islands, and off the coast of Washington. Stations 3210, 3316, 3324, 3325, 3329, 3330, 3331, 3332, 3337, and 3343; depths 109 to 483 fathoms.

89. **Hypsagonus quadricornis** (Cuvier & Valenciennes).

Taken north and south of the Aleutian Islands in shallow water; also at one station in Bristol Bay. Stations 3213, 3214, 3217, 3220, 3223, 3224, 3262, and 3322; depths from 34 to 121 fathoms.

Our specimens agree perfectly with the description of *Hypsagonus* (*Cheiragonus*) *gradiens* Herzenstein (Bull. Acad. Imp. des Sci. de St. Petersburg, XIII, 116, May 29, 1890) described from the Gulf of Awatscha in Kamchatka. Dr. G. A. Boulenger, of the British Museum, has kindly compared one of our specimens with the type of *Aspidophorus quadricornis* Cuvier & Valenciennes, and states that they are undoubtedly identical.

Body short, much compressed, the head also narrow and compressed, especially above and in front. Nasal spines short and strong, a slender barbel of varying length in front of them on middle line of snout. Ocular region abruptly rising above the short slender snout, the eyes vertical, overarched by the supraorbital rim which bears posteriorly a strong vertical spine. Interorbital space with a deep median groove and without ridges, the occipital region depressed below the bottom of the groove. No deep pit on occiput, the space being gently concave transversely, bounded laterally by moderate ridges, which bear posteriorly a spine preceded by a long tubercle. A strong spine at lower inferior border of orbit. A strong spine at upper preopercular angle and three smaller ones below it. A strong spine above the base of pectoral, behind and above which on sides are two strong spines nearly in line with the upper lateral series of plates. Surface of opercles with a few short spinous processes, but without definite spine. Vomer and palatines toothless. Branchiostegal membranes broadly joined, forming a free fold across the isthmus. Mouth narrow, horizontal, terminal, the lower jaw included. Maxillary reaching vertical slightly behind front of orbit, 3⅘ in head. Eye large, 3 in head; snout 4; interorbital width over middle of orbit, ¼ head behind snout.

Nape rising very abruptly from occiput to front of dorsal, the outline thence descending to near front of second dorsal, when it again ascends. The points of origin of the two dorsals are therefore prominent, the profile concave behind them. Body deepest under first dorsal spine, the depth 3⅞ in length. Greatest width of body near ventral outline immediately behind ventral fin, 5½ in length.

A series of small plates along base of spinous and anterior portion of soft dorsal, bearing one spinule to each ray; plates all concealed, the spines alone projecting. Upper lateral series of plates very small, bearing each a minute spinous point. This series is narrowly separated from base of spinous dorsal and runs along base of soft dorsal, the two series uniting immediately behind the latter, bearing each a pair of diverging spines. Lateral series with very strong spines, the largest being the anterior one of the lower lateral series. The upper lateral series is incomplete anteriorly, ending under the eighth dorsal spine. It is apparently completed by two very strong spines, which belong, however, to the series of the lateral line. Ventral series of spines small, running along immediate base of anal fin, the pairs uniting behind the anal, the resulting plates bearing a pair of spines. As in the case of the dorsal series, this union is more or less irregular and incomplete, the corresponding plates sometimes failing to unite, and then either maintaining their opposite position or alternating. Lateral line with few widely spaced pairs of pores, those of each pair approximated, horizontally instead of vertically placed. The interspaces bear in the posterior part of the body a minute prickle each; in the case of the two or three anterior pairs these become very strong spines, nearly on a line with the incomplete upper lateral series of plates. Anus anterior, nearly midway between base of ventrals and front of anal.

First dorsal spine vertically over upper axil of pectoral. The fin is rigidly spread in alcoholic specimens. The third and fourth spines are longest and about equal length of snout and eye; interspace between dorsals equaling half length of orbit; anal much longer than second dorsal, its first ray under last dorsal spine, its last ray slightly in advance of the last ray of soft dorsal; anal membranes deeply incised, especially anteriorly; caudal short, rounded; pectoral of two distinct divisions, the upper portion consisting of four or five rays joined by membrane, the lower part of eight entirely disconnected rays. These upper and lower portions of the fin are used alternately in pushing the fish forward on the bottom, the upper lobe bending downward and forward for the purpose. In the aquarium the fish appears to walk, resting alternately on the upper and lower pectoral rays and on the front rays of the anal. The longest pectoral rays reach to or just beyond front of anal. Ventrals short, not reaching vent in females, reaching to or slightly beyond vent in males. Dorsal IX to XI-6 or 7; anal 9 or 10; pectoral 13 or 14; ventral I, 2; caudal 13; vertebræ 8 + 28; lateral line 7 to 9.

Color: Blackish or grayish violet, paler below. Breast and belly in front of vent marbled with darker. Anterior part of sides to opposite last dorsal spines dark, the darker region limited by a still darker band, which runs up on the fin. Posterior part of body paler, usually with three darker crossbars, the last of which often broadens out to occupy all of the caudal peduncle. Caudal with a dark bar at base and another at posterior margin, the extreme edge white. The dark vertical bars are continued on to the anal fin; anal rays also spotted with black near the tips. Ventral with a black bar or spot at base; sometimes a second on middle of fin. Pectorals indefinitely crossbarred, largely pale on basal portion. The color varies greatly, the lighter areas on body and fins often with dusky marblings.

90. Podothecus acipenserinus (Tilesius).

One of the most abundant species obtained, occurring everywhere in shallow water around the Aleutian Islands and in Bristol Bay. Vertebræ, 13 + 28. Stations 3213, 3215, 3216, 3219, 3238, 3239, 3240, 3246, 3248, 3249, 3250, 3251, 3252, 3259, 3264, 3265, 3266, 3267, 3269, 3271, 3272, 3273, 3278, 3279, 3280, 3281, 3283, 3284, 3285, 3286, 3287, 3290, 3291, 3293, 3294, 3296, 3298, 3299, 3300, 3301, 3302, 3303, 3309, and 3334; depths, 11½ to 71 fathoms.

Family LIPARIDIDÆ.

91. Paraliparis holomelas sp. nov.

Closely allied to *P. cephalus* and *P. mento*, differing in its uniform coloration, its more inferiorly placed horizontal mouth, and the distinctly included lower jaw.

Head about 5 in length; depth about 6. Dorsal 58 to 61; anal 54.

Head very large and heavy, with very broadly rounded snout and much swollen occipital and nuchal regions. The highest point is over upper opercular angle, from which the profile descends rapidly backward, though much less so than in *P. cephalus*. Snout very blunt, evenly rounded, very slightly projecting beyond the mouth, its width equaling the length of snout and eye, half the length of the head. Eye two-thirds interorbital width, $3\frac{3}{5}$ in head. Mouth large, horizontal, quite at lower side of snout, entirely below the eye; maxillary reaching a vertical slightly behind posterior margin of orbit, $1\frac{3}{4}$ in head. Teeth acute, arranged in oblique series in each jaw, forming a very narrow band in mandible, a broader band in upper jaw. Very large mucous slits on head, 5 forming a series from tip of snout below eye and across cheeks, 6 along mandible and preopercle. Gill-slit wide, extending from above opercular flap nearly to middle of base of pectorals, its length $2\frac{1}{4}$ in that of head. Opercle forming posteriorly a narrow angular flap, projecting above base of pectorals. No pseudobranchiæ.

Vent below opercular flap, or somewhat in advance of that point, nearer to base of pectorals anteriorly than to first anal ray. Pectorals inserted very low, the base of upper lobe vertical, the base of notch and lower lobe horizontal, the upper end of base below the level of the eye. Pectorals with two wholly distinct lobes, the interspace without free membranous margin, the skin of abdomen directly continuous at this point with that of shoulder girdle. On dissecting off the integument, however, the interspace between the lobes is seen to be provided with two or three short, widely spaced rays, as in all other species examined by us. The upper lobe is long, reaching beyond front of anal, with the rays close set, 18 in number, included in the membranes to their tips. Lower lobe consisting of five or six slender, almost filamentous rays, the longest reaching front of anal, all of them free to the base, without connecting membrane. Anterior (lower) ends of shoulder girdles approximate, the rays separated by a distance equaling half diameter of pupil. Dorsal beginning above base of pectorals.

Color uniformly black, including fins and lining of mouth and gill-cavity.

Two specimens, 95 and 100 mm. long, from north of Unalaska Island; depths 406 and 1,625 fathoms; stations 3308 and 3332.

92. Paraliparis ulochir sp. nov.

Differing from other Pacific species in the high insertion of the pectorals and their short horizontal limb, and from *P. holomelas* in having the fins not divided into two separate lobes. In general appearance greatly resembling *P. holomelas*, being also uniformly black in color, having the same broadly rounded snout, horizontal mouth with included lower jaw, and prominent occipital and nuchal region. The maxillary reaches vertical just behind pupil and is contained $2\frac{1}{10}$ times in head. Teeth acute, in rather broad bands in both jaws. Snout broad and short, very slightly projecting beyond the mouth, the distance from tip of snout to front of eye $4\frac{1}{2}$ in length of head. Eye large, 3 to $3\frac{1}{4}$ in head, nearly twice the bony interorbital width. Gill-opening a narrow slit, restricted to area above base of pectorals, not longer than diameter of pupil. Opercle forming a short pointed lobe posteriorly, which touches base of upper pectoral ray. The head is denuded of skin, so the nature of the mucous pores can not be made out.

Dorsal beginning above upper base of pectorals. Pectorals placed higher than in any other species known, its base describing a gentle even curve, convex backward, horizontal for a very short distance anteriorly. Its upper end is above level of pupil, and its lower anterior end is vertically below posterior margin of orbit. The upper and lower rays of the fin are fine and crowded, the middle third of the base being occupied by 4 or 5 more widely spaced rays. The fin has 25 rays, of which 9 belong to the lower lobe. The upper lobe extends beyond origin of anal fin. None of the rays are free. The lower anterior ends of the pectorals are closely approximated, without perceptible interspace. Vent anterior in position; a distinct though short anal papilla. Distance from vent to anterior end of pectoral base one-third its distance from front of anal. Head about 5 in length, equaling the depth. Dorsal about 65. Anal about 60. Longest specimen 85 mm. Uniformly black, including mouth and branchial cavity.

The types of this species were taken by the *Albatross* in 1890 in the Gulf of California, station 3010; depth, 1,005 fathoms. A single young specimen taken in Alaska north of Unalaska Island, station 3332; depth 406 fathoms.

93. Paraliparis cephalus Gilbert.

Several more or less mutilated specimens were taken north of Unalaska Island and near Port Reyes, Cal.; stations 3225, 3330, and 3348; depths 284 to 455 fathoms.

In this species the pectoral is inserted very low, its upper edge entirely below the eye. The lower jaw shuts within the upper, but the symphysis protrudes. The disproportion in size of head and body is more exaggerated in the young than in adults. In very small examples the head is almost spherical, diminishing abruptly to the very slender tail. No pseudobranchiæ.

94. Careproctus ectenes sp. nov.

An extremely elongate form; depressed, but narrow anteriorly; the head as seen from above appearing shovel-shaped, with truncate snout. The nape is not elevated and the cheeks are not gibbous. The width anteriorly everywhere exceeds the depth. The mouth is inferior and transverse, overlapped by the short, depressed snout for a distance equaling diameter of pupil; the width of mouth nearly twice distance from symphysis of lower jaw to angle of mouth, the latter reaching vertical from about front of pupil. Teeth small, weakly tricuspid, in narrow bands, the lower jaw containing 10 series in each half, the upper 11. Eye large, contained 1¼ times in total interorbital width, equaling length of snout, contained 3½ times in head. Nostril with a very short tubular rim. Mucous pores large; texture of head and body firmer than in most deep-sea liparids. Gill-opening reduced to a narrow slit entirely above the pectorals, its width equaling one-half diameter of orbit. Opercle produced into a narrow spinous process, forming with its membranous flap a quadrate projection over middle of slit.

Disk small, under the opercles and posterior part of cheeks, round in shape, slightly smaller than eye, its diameter one-fourth length of head. The vent is separated from disk by about two-thirds diameter of disk. Distance from vent to front of anal, one-half its distance from tip of snout. Head 5½ in total length; depth of head, two-thirds its length; width of head, three-fourths its length. Body extremely slender, its depth at middle of total length equaling diameter of eye; at base of caudal equaling two-thirds diameter of pupil. Dorsal beginning slightly behind axil of pectorals. Distance from origin of anal to tip of snout one-half its distance from base of caudal. Upper lobe of pectorals extending slightly past front of anal, the lower lobe to opposite the vent. Rays of lower lobe partly free. Dorsal with about 51 rays, pectorals with 29. Color nearly uniform dusky-brownish; lighter on snout, belly, and under side of head. Mouth, gill-cavity, and peritoneum white.

Three specimens, the largest 78 mm. long, from north of Unalaska Island, station 3331; depth 350 fathoms.

95. Careproctus colletti sp. nov.

Closely related to *C. reinhardti*, from which it differs principally in the elongation and exsertion of the lower pectoral rays. These extend in all specimens to or nearly to the origin of the anal fin, and are always free for the greater part of their length. The head is blunt and heavy, with subvertical cheeks and bluntly rounded snout, the latter not projecting beyond the mouth. Nape not elevated. Mouth terminal at lower side of snout, slightly oblique, its lateral cleft about two-thirds its width. Lower jaw shutting within the upper. The angle of mouth reaches a vertical midway between front of eye and front of pupil. Teeth lanceolate, acute, without trace of basal cusps.

Head 5 in length; greatest depth (at occiput) 6. Diameter of eye equals length of snout, $3\frac{3}{4}$ in head, $1\frac{7}{8}$ in interorbital width. Gill-opening a narrow slit entirely above base of pectorals, its length three-fourths diameter of eye. The opercle is produced posteriorly into a rounded lobe, which overlaps the gill-opening. Disk oblong, of moderate size, placed under the posterior part of head behind the eyes, forming in alcoholic specimens a very deep, cup-shaped depression with incurved edges. Diameter of disk about equaling that of eye; disk separated from vent by half its diameter.

Upper pectoral lobe reaching origin of anal fin; the rays of lower lobe elongate and extensively free, longer than upper lobe and reaching to or nearly to front of anal. The intermediate rays are not as short as in *C. reinhardti*, and hardly form a separate division of the fin, the rays being gradually and uniformly shortened from above downward to origin of lower lobe. Pectoral rays 29. Dorsal beginning immediately behind the head. Distance from tip of snout to origin of anal $3\frac{3}{8}$ in length. Series of conspicuous mucous pores on head, as in *C. reinhardti*. Color in spirits, dusky; the tip of snout, under side of head, opercles, abdomen, and posterior portion of vertical fins black; inside of mouth and gill-cavity dusky; peritoneum black.

Five specimens, the longest 85 mm., from station 3338, south of Alaska Peninsula; depth 625 fathoms.

Named in honor of Prof. Robert Collett, the distinguished author of the Fishes of the Norwegian North Atlantic Expedition.

96. Careproctus phasma sp. nov.

Closely related to *Careproctus spectrum* Bean, from the same region; differing in the much larger sucking disk and the narrower gill-slit, the latter confined to area above base of pectorals, its anterior margin formed of the broadly and evenly rounded opercular lobe. Head broad and flat above, subquadrate, with nearly vertical cheeks. Snout very obtuse, broadly rounded, much blunter than in *C. spectrum*, very slightly overlapping the mouth. Width of snout $1\frac{7}{8}$ in length of head. Mouth very broad, somewhat oblique, reaching a vertical from slightly behind front of eye, its width more than twice the amount of lateral cleft taken axially. Teeth minute, acute, in a moderate band in each jaw, arranged in oblique series within the band. Nostril opening in a short but conspicuous tube, the tube absent and the pore smaller in *C. spectrum*. Eye 4 in head, 2 in total interorbital width. Mucous pores small. Gill-slit short, slightly less than diameter of orbit, overlapped for almost its entire extent by the broadly rounded opercular flap, its inferior margin attached to base of upper pectoral ray.

Sucking disk comparatively large, much larger than in *C. spectrum*, $1\frac{1}{3}$ times the diameter of the eye, $3\frac{1}{4}$ in head. It is very nearly round, the transverse diameter equaling or slightly exceeding the longitudinal diameter. Vent immediately behind edge of sucking disk. Anal papilla slender, half as long as diameter of eye. Pectoral fin very broad, barely reaching front of anal, the lower rays equaling the upper, extensively free at tip; 34 rays in the pectoral fin, the lower lobe containing 8 or 9. Dorsal beginning behind the gill-opening at a distance equaling diameter of eye, the fin with 53 rays. Skin exceedingly soft, thick, and lax in the alcoholic specimen, forming folds on head and body and concealing the rays of the fins. Color uniform white in spirits.

Two specimens, 80 to 85 mm. long, from Bristol Bay, stations 3254 and 3256; depths 46 and 49 fathoms.

97. Careproctus ostentum sp. nov.

Differing from *C. spectrum* in the minute size of the sucking disk, which is reduced to a mere rudiment entirely concealed by the anterior (lower) lobes of the pectoral fins, about 1 mm. in diameter in a specimen 78 mm. long. The snout is longer and more pointed than in *C. phasma* or *C. spectrum*, its width little greater than its length, $2\frac{1}{4}$ in head. Mouth with very distinct lateral cleft, its width less than its length. Maxillary reaching a vertical line crossing orbit behind pupil, $1\frac{9}{10}$ in head. Teeth minute, in narrow bands, indistinctly tricuspid. Eye equaling length of snout, $1\frac{1}{2}$ in total width of interorbital area. The true bony interorbital width is much narrower than this. The epidermis of the head is largely lost, and the width of the gill-slit can not be determined. A short nostril tube. Fins as in *C. spectrum* and *C. phasma*. Skin loose, thinner than in *C. phasma*. Color white or slightly brownish, minutely punctulate with black.

Three specimens from north of Unalaska Island, stations 3324 and 3331; depths 109 and 350 fathoms.

98. Careproctus simus sp. nov.

A species with very heavy head and body and inferior transverse mouth, overlapped by the thick rounded snout. The appearance is much that of *Rhinoliparis barbulifer*, but the anterior parts are much heavier, the nape more elevated, the snout shorter and blunter, and the latter without barbels. The snout extends beyond front of eyes for a distance (measured axially) equal to two-thirds diameter of orbit, and projects beyond the mouth for one-half that distance. Mouth transverse, its width nearly twice the distance from symphysis of lower jaw to angle of mouth, the latter reaching a vertical midway between front of eye and pupil. Teeth indistinctly tricuspid, in narrow bands, 11 or 12 series in each half of lower jaw, 8 or 9 in the upper. Nostrils without tube. Eye large, one-third length of head, equaling snout, $1\frac{1}{2}$ in total interorbital width. Gill-slit moderate, two-fifths of it opposite upper pectoral rays, its width two-thirds diameter of eye. The opercle is prolonged into an acute lobe overlapping middle of slit.

Disk rather small, round, under posterior part of eye; its diameter seven-ninths that of eye. Vent immediately behind it, equidistant from front of anal and angle of mouth. Pectorals inserted high, the upper edge on a level with the middle of eye. The fin is continuous, the median rays greatly shortened, the lower ones again longer, with exserted free tips. The upper lobe extends beyond front of anal and equals length of head behind snout. The lower rays are two-thirds the length of the upper ones. Pectoral with 33 rays. Origin of dorsal fin just behind axil of pectorals, continuous posteriorly with the caudal fin, which is very narrow and not distinct. Origin of anal at end of first third of length. Whitish or light brown, dusky posteriorly on body and fins. Mouth, gill-cavity, and peritoneum white.

One specimen, 80 mm. long, from north of Unalaska Island, station 3331; depth 350 fathoms.

GYRINICHTHYS gen. nov. (LIPARIDIDÆ.)

Teeth simple, not tricuspid. Body attenuate posteriorly, as in *Paraliparis*, the tail scarcely distinct. Disk small under the posterior part of the head; the vent immediately behind it. Pectorals without anterior lobe, the rays progressively shortened, none of them exserted or with free tips. Gill-openings reduced to a minute round pore, well above base of pectorals. (Type *G. minytremus* sp. nov.)

99. Gyrinichthys minytremus sp. nov.

Body in the type greatly distended with eggs; the original shape difficult to ascertain, tapering posteriorly into an extremely slender compressed tail. Head slender, not greatly depressed, the depth and width about equal. Nuchal region not elevated, the profile rising but little behind the snout, which is blunt, with almost vertical profile. Mouth very small, almost entirely transverse at end of snout, with but little lateral cleft, the angle of mouth scarcely reaching vertical from nostril. Jaws even; the snout very slightly protruding beyond premaxillaries. Teeth slender, acicular, without cusps, the inner teeth longest. Bands of teeth very narrow, with but five or six oblique series in each half of each jaw. The teeth are directed backward, but are scarcely depressible. Nostrils without tube. Eye large, $1\frac{1}{2}$ in total interorbital width, equaling length of snout. Gill-opening a small pore, scarcely larger than nostril, well separated from upper margin of pectoral. Disk of moderate size, round, its diameter equaling half length of head. Vent close behind disk, separated from it by one-sixth its distance from front of anal fin.

Pectoral small, its upper edge on a level with lower margin of eye, the two fins converging under the throat, the anterior rays progressively shortened, all included within the membrane. Dorsal without any detached anterior portion, beginning well behind the head, at a distance from gill-opening equaling one-half length of head. Like the anal, it is continuous with the very narrow caudal fin, there being no notch or evident separation between them. Distance from tip of snout to front of anal $1\frac{2}{3}$ in distance of latter from base of caudal. Dorsal with about 45 rays. Caudal with a very narrow base, containing apparently 14 rays, its length equaling that of snout and eye. Color light brownish, everywhere dusted with minute black specks, which are largest on back and tail. Lining of mouth and gill-cavity and peritoneum white.

A single specimen, 67 mm. long, from station 3331, north of Unalaska Island; depth 350 fathoms.

Eggs large, visible through the abdominal wall, about $3\frac{1}{2}$ mm. in diameter.

RHINOLIPARIS gen. nov. (LIPARIDIDÆ.)

Allied to *Paraliparis*, from which it differs in the greatly produced snout, which much overlaps the mouth and bears at its tip a pair of barbels. No sucking disk. Vent anterior, between the pectoral fins. Pectorals deeply notched, continuous. Gill-openings narrow, mostly above the pectorals. Teeth acute, in a broad band in each jaw, arranged in oblique series within the band. (Type *R. barbulifer* sp. nov.)

100. Rhinoliparis barbulifer sp. nov.

Slender, compressed, the greatest depth just in front of dorsal, the nuchal region not greatly swollen. Body tapering into an extremely slender, almost filamentous tail. Mouth small, horizontal, inferior, overpassed by the broadly rounded, very soft snout for a distance equaling diameter of pupil. At the tip of the snout, separated by a space half as wide as pupil, are two barbels directed forward, each as long as the interspace. Maxillary reaching vertical from posterior border of orbit, $2\frac{1}{4}$ in head. Eye large, slightly less than one-third head. Bony portion of interorbital width narrow, three-fourths diameter of pupil. Gill-slit narrow, beginning opposite upper pectoral rays, two-thirds diameter of orbit. No pseudobranchiæ. Opercle prolonged posteriorly into a narrow pointed flap. Round mucous pores along under side of snout and suborbital and on under side of mandible.

Pectorals of two lobes, the lower narrow, containing but 4 or 5 rays, the upper with about 15, one or two widely spaced rays connecting the two, none of the rays free. The fin is inserted high, the upper end of base on a level with upper edge of pupil. Below, the fins are not approximated as closely as usual, the lowermost rays of the two fins separated by an interspace as wide as pupil, inserted vertically below middle of cheeks. The dorsal originates slightly in front of gill-slit.

Vent anterior in position, its distance from front of pectorals two-fifths its distance from front of anal fin. Head $5\frac{2}{3}$ in length; depth 7. Length of specimen described 85 mm. In spirits, light gray, dusky along bases of dorsal and anal fins, and on the nape. The black lining of abdominal cavity, gill-cavity, and mouth can be seen through the transparent integuments. Eye also black. Barbels transparent, hence very inconspicuous.

Several specimens taken north of Unalaska Island, stations 3227, 3325, 3326, 3329, 3330, 3331, and 3332; depths 225 to 576 fathoms.

101. Liparis pulchellus (Ayres).

A single specimen dredged in Bristol Bay, Alaska, station 3269; depth 16 fathoms.

102. Liparis cyclopus Günther.

Two specimens from Bristol Bay, Alaska (station 3230; depth, $3\frac{1}{4}$ fathoms), are referred to this species. Garman places *L. cyclopus* in the synonymy of *L. calliodon*, but our specimens are undoubtedly distinct from the species described by Garman under this name (Discoboli, p. 54, pl. VI, figs. 1-5) from a specimen said to originate from San Francisco. Our Alaska specimens are much more slender, with wide, depressed head, without nuchal elevation, with the dorsal fin beginning posteriorly slightly in front of the vertical from the vent, and the disk separated from the vent by a distance less than its own diameter. The mouth is also much smaller, not at all oblique, its angle in advance of vertical from front of eye. Dorsal 33; anal 30; caudal 12; pectoral 29. Gill-slit extending downward to opposite the upper three or four pectoral rays. Dorsal and anal fins not joined to caudal. Disk $2\frac{1}{4}$ in head.

103. Liparis agassizii Putnam.

Several young examples were dredged in Bristol Bay, Alaska; stations 3241, 3247 and 3301; depths 14 and 17 fathoms.

104. Liparis cyclostigma sp. nov.

A robust, compressed species, with broad, gently convex head, the nape not elevated, a comparatively wide gill-opening, a single continuous dorsal fin, the dorsal and anal broadly joined to the caudal, and the coloration peculiar. Profile gently and evenly declining from nape to end of premaxillary processes, thence descending more steeply to tip of snout. Interorbital space very wide, equaling length of snout and half of eye, $2\frac{3}{8}$ in head. Distance from tip of snout to front of exposed portion of eye $2\frac{9}{10}$ in head.

Head $3\frac{3}{8}$ in length. Mouth terminal, broad and transverse with but little lateral cleft, the two jaws equal, the lower not included. The maxillary is entirely bound down by skin of head, reaching vertical from front of pupil, the angle of mouth in advance of eye. Bands of teeth extremely broad, the teeth very small, all tricuspid, the outer ones minute, those toward inner margin of jaw increasing in size. The anterior series in each jaw are nearly transverse, the lateral series becoming successively more and more oblique, the uppermost nearly parallel with the jaw; about 20 series in each side of lower jaw, 30 on each side of upper jaw. The width of band in upper jaw equals two-thirds diameter of exposed portion of eye, which is one-fourth length of snout, two-sevenths interorbital width. Nostrils without tube. Lower lip distinct on lateral three-fifths or two-thirds of mandible. Gill-opening wide, extending downward to opposite base of fifteenth pectoral ray, the length of the slit $2\frac{2}{3}$ in head. Disk large, oblong, its longitudinal diameter $2\frac{1}{8}$ in head, equaling its distance from anus and twice the distance of the latter from base of first anal ray. Pyloric cœca 28.

Pectoral very broad, inserted low, its upper margin on a level with premaxillaries, much below the eye. The rays decrease but little in length from the first to the twentieth, and form a very broad evenly rounded lobe. Below the twentieth the rays decrease gently and have exserted tips, until the shortest ray equals two-thirds the longest upper ray. There follow three or four somewhat longer rays, the tips still further exserted, then four or five rays which decrease rapidly, the shortest anterior one equaling diameter of eye. Longest pectoral ray $1\frac{1}{3}$ in head. Base of first dorsal ray in a vertical passing through axil of pectoral. Longest dorsal ray $1\frac{2}{3}$ in head, the last rays rapidly shortened so as to produce a notch at union with the caudal, the last ray less than two-thirds the longest, the dorsal membrane joining at end of basal third of caudal. The anal fin is equal in height to the dorsal, but the last rays are but little shortened, so that no notch exists posteriorly. It forms a much broader union with the caudal, which it joins at the end of its basal two-thirds. Caudal broad, rounded, the outer rays four-fifths the length of middle rays, which equal the length of head without the snout. Dorsal 44; anal 34; pectoral 42; caudal 14.

Colors in life: Olivaceous above, overlaid with light grayish. Belly and lower side of head light yellow. Body and fins with large brownish-red spots and blotches, usually roundish, each having a darker margin surrounded with a light ring.

A single specimen, 360 mm. long, from Bristol Bay (station 3252), in $29\frac{1}{4}$ fathoms.

105. Liparis fucensis sp. nov.

Liparis calliodon Garman, The Discoboli, Mem. Mus. Comp. Zool. XIV, No. 2, p. 54; not *Cyclopterus callyodon* Pallas.

Numerous specimens dredged by the *Albatross* in the Straits of Fuca on a subsequent expedition (August, 1891) serve as the types of this species. It is probably the same as that described by Garman as *Liparis calliodon*, his description being based on specimens "said to have been taken near San Francisco." It is not evident from the text whether the same specimens served as basis for the figures (plate VI, figs. 1–5), concerning which we have no separate data.

Following is a description of the types from *Albatross* Station 3451, Straits of Fuca, depth 106 fathoms: Moderately elongate, compressed; head depressed, with the gibbous snout and occiput separated by the depressed interorbital area which forms a shallow transverse groove. Snout not blunt, the mouth terminal, nearly horizontal, with included mandible, the maxillary reaching to or nearly to the vertical from front of pupil, 3 in head. Teeth all tricuspid. Eye of moderate size, contained $5\frac{5}{8}$ in length of head, 1 to $1\frac{1}{3}$ times in bony interorbital width, $1\frac{2}{3}$ times in snout. The posterior nostril without tube, the anterior with a short tube, less than diameter of pupil. Gill-slit comparatively wide, its width equaling length of snout and half eye, overlapped by a conspicuous triangular prolongation of the opercle. The slit extends down to opposite the upper third of the pectoral fin.

Disk circular, of rather small size, distant from tip of snout $1\frac{1}{2}$ times its own diameter, from vent $1\frac{1}{4}$ times. Diameter of disk, $2\frac{3}{4}$ times in head. Distance from tip of snout to vent, $1\frac{3}{8}$ to $1\frac{5}{8}$ in distance from tail.

Pectorals extending to a vertical midway between vent and front of anal. Lower rays produced, forming a narrow distinct lobe. The first 5 dorsal rays spinous, unsegmented, shorter than the succeeding segmented rays, from which they are not separated by notch. Dorsal and anal free from caudal, the last rays being rapidly shortened, giving a rounded contour to the posterior portions of the two fins.

Head $3\frac{1}{4}$ to $3\frac{1}{2}$ in length; depth 4 to $4\frac{2}{5}$; dorsal v, 30; anal 28 or 29; caudal 18 or 20; pectoral 38 or 39.

Two styles of coloration are observed: One, plain olive-brown, with minute dark points, whitish below; the other, with numerous narrow lengthwise streaks of light olive and dark olive-brown, which extend forward on top and sides of head; in both cases the belly is whitish and the fins dusky, mottled with darker, the mottlings forming indistinct crossbars on the caudal fin.

106. Neoliparis callyodon (Pallas.)

Liparis mucosus Garman, The Discoboli, Mem. Mus. Comp. Zool. XIV, No. 2, p. 52; p. 52; not of Ayres.

Several young specimens were taken from under stones between tidemarks at Unalaska May 24 and June 16, 1890.

BATHYPHASMA gen. nov.

A deep-sea Liparid, differing from typical members of the genus *Liparis* in having the teeth long and slender, acuminate, sharp, with no trace of lateral lobes. The ventral disk is large, and occupies the position usual in *Liparis*. An approach to the condition here found is evident in *Actinochir major*, in which, according to Lütken, the teeth are at first tricuspid, becoming mostly simple with age. In *Bathyphasma* the ventral disk is simple, without the intramarginal papillæ which are usually present in *Liparis* and correspond to the tips of the spines and rays.

107. Bathyphasma ovigerum sp. nov.

Occipital region greatly elevated, the upper profile of head strongly decurved above the orbits, a line from occiput to end of premaxillary processes forming an angle of 45 degrees with axis of body. In front of tips of premaxillary processes the snout descends almost vertically. Posteriorly the body tapers uniformly and slowly, the width of base of tail equaling one-half diameter of eye. Length of head equaling depth of body, 3⅗ in length. Mouth large, horizontal, not overpassed by the snout; the lower jaw slightly shorter than the upper, not distinctly included. The maxillary reaches a vertical from posterior edge of orbit, its length 2⅛ in head, its width 1⅝ in head. Upper lip complete, the fold of lower lip extending half way from angle of mouth to symphysis.

Bands of teeth very wide in the front of each jaw, becoming narrower laterally where the series are few in number and nearly parallel with the jaw. Anteriorly the series grow more and more oblique, until at front of jaw they are nearly transverse. The teeth are all simple and slender, without cusps, directed very obliquely backward, and movably implanted so as to admit of still further depression. The outer teeth in both jaws are very short, the inner ones growing gradually longer and becoming acicular; 16 series of teeth on each side of lower jaw, 22 series on each side of upper jaw.

Posterior nostril in a short, wide tube. Eye large, the diameter of its exposed portion 2½ in total interorbital width, 7 in head. Cheeks and temporal region swollen, the suborbital stay running in a notable depression between the two. Gill-slit wide, extending downward to opposite upper pectoral rays, longer than snout, 2⅗ in head. Mucous pores minute, on sides of snout, mandible, and preopercle, none visible on top of head.

Disk large, nearly round, its center slightly in advance of gill-slit, its length 3½ in head, the distance from its posterior margin to vent equaling four-fifths its own diameter. A small anal papilla. Pyloric cœca 19.

Pectoral with 34 rays, not notched, the lower rays regularly diminishing in length to the fifth or sixth before the last, the next two or three abruptly lengthened and exserted. The longest ray of upper lobe equals length of snout and eye; the longest rays of lower lobe equals length of snout and half eye. The dorsal fin begins slightly behind upper axil of pectorals and contains 43 rays, the longest of which equals the distance from tip of snout to front of pupil. The origin of anal fin is half the diameter of the eye in front of the middle of body. It contains 34 rays. Caudal ray long and slender, with 12 rays, its basal two-fifths confluent with dorsal and anal, its length equal to that of pectoral fin.

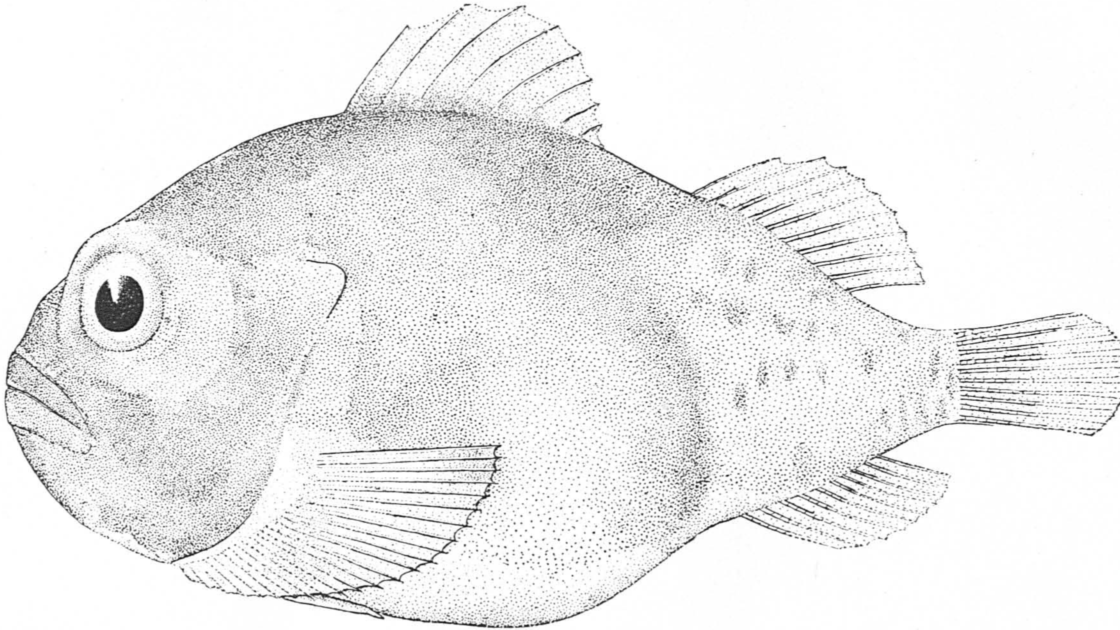
Skin thin, not conspicuously lax. Head, body, and fins white, inconspicuously mottled with light brown. A single specimen, 315 mm. in total length, from station 3342, off Queen Charlotte Islands, depth 1,588 fathoms.

The type is a male with well-developed testes, and contained in its mouth when captured a spherical mass of eggs evidently belonging to this species. The eggs measure 4½ mm. in diameter, and are well along in their development, the embryos distinctly visible through the very tough egg-membranes. The general form of head and body can be made out, and the long, continuous dorsal and anal fins running backward into the tail. It is probable that the male fish protects the eggs in this manner until after hatching.

Family CYCLOPTERIDÆ.

108. Eumicrotremus orbis (Günther).

Three young specimens, the largest 27 mm. long, were dredged south of Sannak Islands and in Bristol Bay (stations 3213, 3258, and 3274; depths 19 to 70 fathoms). Fin-rays in our specimens are as follows: Dorsal VI or VII–9 or 10; anal 8 to 10. We agree with Garman in considering it advisable to distinguish the north Pacific form from *E. spinosus*, until adequate series can be compared.



LETHOTREMUS MUTICUS sp. nov.

LETHOTREMUS gen. nov. (CYCLOPTERIDÆ.)

Differing from *Eumicrotremus* in the total absence of the bony plates and in the absence of pores on sides of head or body.

109. Lethotremus muticus sp. nov. (Plate 31.)

Represented by three young specimens, the largest 30 mm. long. They closely resemble in form, fin-rays, and general appearance *Eumicrotremus orbis*, but differ, in addition to the generic characters already stated, in the much larger eye, the lower spinous dorsal, and the extreme reduction of the posterior nasal tube. In young specimens of *E. orbis*, the posterior nasal tube is much longer than the anterior, and equals half the diameter of the eye. In *L. muticus* both tubes are short and the posterior is little more than an elevated rim to the nasal opening.

Dorsal VII-11; anal 10; pectoral 23. Depth 2 to 2½ in length; head 2⅓ to 2¼. Eye very large, 2⅓ to 2½ in head, equaling interorbital width. In *E. orbis* of equal size the length of the slit is slightly less than its distance from upper base of pectorals. Diameter of ventral disk five-sixths length of head, equal to width of mouth. No barbels or filaments. Origin of spinous dorsal slightly in advance of gill-slit. The distance between dorsals equals half the diameter of the eye. Origin of anal under that of second dorsal. No notch between upper and lower portions of pectoral fin, the lower rays thickened but not lengthened, the length of upper ray equaling that of snout and eye. Vent separated from disk by slightly more than half its distance from front of anal.

Color in spirits: Brownish above, white below, the upper parts finely freckled with small black specks.

Three specimens from stations 3223 and 3258, near Unimak Pass, depths 56 and 70 fathoms. The naked specimens from the Atlantic, reported on by Dr. Günther, under the name *Eumicrotremus spinosus*, are probably referable to this genus.

Family BATRACHIDÆ. The Toadfishes.

110. Porichthys notatus Girard.

Near Point Reyes, California; station 3351; depth 51 fathoms.

Family TRICHODONTIDÆ.

111. Trichodon trichodon (Tilesius).

An adult specimen was taken from the stomach of a codfish at station 3260, Bristol Bay, 13 fathoms. Others were seined at Herendeen Bay.

Family BLENNIIDÆ. The Blennies.

112. Chirolophus polyactocephalus (Pallas).

Two specimens, stations 3213 and 3274, north and south of the Alaska Peninsula; depths 41 and 19 fathoms.

113. Pholis fasciatus (Bloch & Schneider).

Several specimens of this species have 86 to 89 dorsal spines and 42 to 44 soft rays in the anal. The coloration agrees more closely with that described by Cuvier & Valenciennes for Atlantic specimens (*Gunnellus grœnlandicus* Cuvier & Valenciennes, Hist. Nat. des Poissons, XI, 442, pl. 340). Ground color yellowish gray; base of dorsal occupied by 10 or 11 oblong blotches of dark brown which extend to the tips of the fins; these blotches each divided upon the fin by a median spot of the ground color. The areas of the ground color alternating with these blotches is finely speckled with brown, a larger spot of brown usually occupying a median position upon the fin. Middle and lower part of sides occupied by vermiculating brown lines on the ground color, these vermiculations arranged in more or less distinct crossbars, about 20 in number. They reach to or nearly to the mid-ventral line; and the posterior ones are often continued faintly onto the anal fin. Pectoral and caudal fins yellow, unmarked. A brown blotch across snout and tip of mandible followed by a narrow yellowish bar descending to front of eye. Interorbital space crossed by a broad brown bar with blackish margins, which becomes much narrower below and traverses the eye and the cheeks. Behind this is a broader yellow bar margined behind with a narrow brown line.

Specimens were dredged at stations 3230, 3232, 3233, and 3234, in Bristol Bay; depths 3½ to 10½ fathoms.

114. Pholis ornatus (Girard).

Taken in the seine at Unalaska and Herendeen Bay, entering fresh water.

115. Anoplarchus atropurpureus (Kittlitz).

Found upon the rocks between tide marks at Unalaska.

116. Stichæus punctatus (Fabricius).

Notogrammus rothrocki Bean.

A single specimen, 86 mm. long, was dredged in Bristol Bay, Alaska, station 3239, depth 11½ fathoms. Several larger individuals were seined in Karta Bay, Prince of Wales Island, Alaska, July 12, 1889.

The position of the lateral line in this species is incorrectly given as "median" by Jordan & Gilbert in the Synopsis, pp. 755 and 775. Cuvier and Valenciennes, in their description drawn from the writings of Fabricius, state that the lateral line runs along the upper fifth of the height of the body and terminates at about the middle of the length. This correctly describes its position in all our specimens, where it originates immediately above the opercle, exhibits at first a rather strong upwardly convex curve, then runs nearly parallel to the back, separated from the base of the dorsal fin by one-fifth the height of the body. It is very distinct throughout its course, and terminates at about the middle of the length. The narrow brown streak described as bounding the lateral line above, in *Notogrammus rothrocki*, is conspicuous in our smallest specimen (86 mm.). The branchiostegal membranes are very narrowly joined anteriorly, forming a narrow free fold across the isthmus, from which they are entirely distinct. Narrow bands of teeth in the jaws, and on vomer and palatines. The outer series in upper jaw and the inner series in the lower jaw enlarged.

Dorsal XLVII or XLVIII; anal I, 32 to 35. The membrane from last dorsal spine joins extreme base of upper caudal ray; anal wholly distinct.

We have not the material for a comparison of Pacific with Atlantic representatives of this species, and the published descriptions of the latter lack detail.

117. Leptoclinus maculatus (Fries).

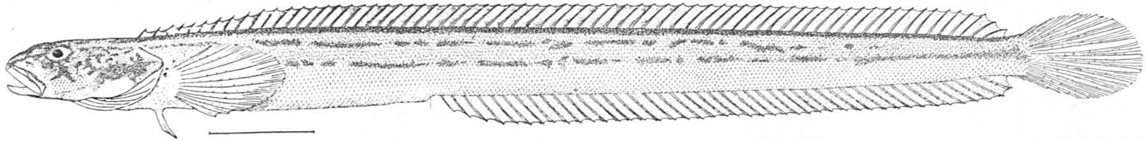
A few young specimens of this species, hitherto known only from the North Atlantic, were taken at stations 3223, 3252, 3253, 3257, 3258, 3259, 3279, and 3309, the first one in Unimak Pass, the others in Bristol Bay, depths 29½ to 81 fathoms. Having no Atlantic specimens of this species, we are unable to satisfy ourselves of the identity of the two.

118. Lumpenus anguillaris (Pallas). Seined at Unalaska.

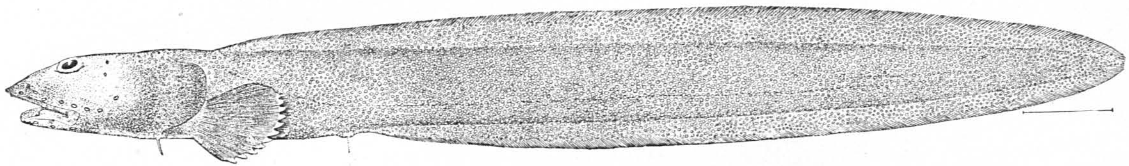
119. Lumpenus mackayi sp. nov. (Plate 32.)

Very elongate, the depth $\frac{1}{13}$ or $\frac{1}{14}$ the length. Head compressed and high, especially anteriorly, the upper profile of snout very convex, the upper jaw decidedly longer than the lower. Mouth nearly horizontal. Maxillary reaching vertical from front or middle of pupil, its length 3⅜ to 3¾ in head. Teeth small, in a narrow band in jaws. A single series of weak teeth on palatines. Vomer toothless. Gill-openings continued forward to below middle of cheeks, the membranes then narrowly joined to isthmus. Gill-rakers short and weak, about 10 on horizontal limb of arch. Eye small, its horizontal diameter one-half longer than its vertical, slightly longer than interorbital width, 2 in snout, 8 in head. Distance from snout to nape equals length of postorbital part of head. Opercles large, continued to beyond base of pectorals.

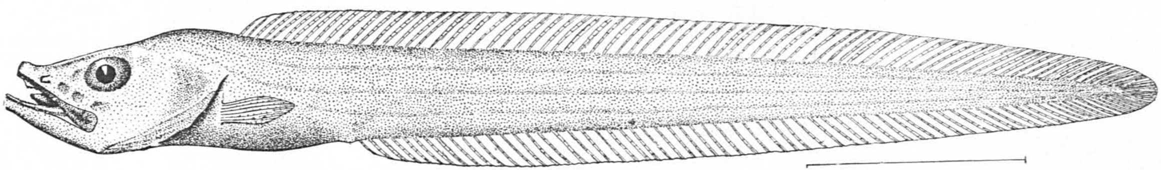
Report U. S. F. C. 1892. Ichthyological Collections. (To face page 450.)



LUMPENUS MACKAYI sp. nov.



LYCODOPSIS CROTALINUS Gilbert.



LYCODAPUS FIERASFER Gilbert.

Dorsal beginning immediately above upper end of gill-slit, the spines short, strong and pungent, not flexible. Some of the anterior spines are short, but not free, the fin increasing in height to opposite front of anal, the longest spine equaling length of snout. The membrane of the last spine joins base of upper rays of caudal. Anal with two strong spines similar to those of dorsal fin, the second twice the length of the first and three-fourths that of highest dorsal spines. Anal rays all forked; the posterior longest, equaling length of snout and eye, free from the caudal. Caudal fin rounded in the younger specimens, lanceolate in adults, becoming in the latter three-fourths as long as head. Ventrals short, of one short spine and three simple rays, the fin one-fourth length of head. Pectorals large, the middle rays longest, two-thirds length of head. Scales small, smooth, elongate, imperfectly imbricated; partially embedded or altogether wanting on anterior part of back. Cheeks scaled, head otherwise naked. Faint traces of a lateral line sometimes visible on middle of sides anteriorly. Head $6\frac{2}{3}$ in length; depth 13 to 14. Dorsal LXIX; anal II, 41. Length 290 mm.

Color in spirits: Light olivaceous (light yellowish in life), a continuous jet-black streak from occiput along each side of dorsal to base of caudal, with two interrupted black streaks below it, the lowermost running on middle of sides. Top and sides of the head darker, variously marked with anastomosing black lines and spots. Opercles blackish. Dorsal and caudal fins dusky translucent, without distinctive markings. Anal and ventrals white. Pectorals white or dusky. Roof of mouth black. Peritoneum black dorsally, white ventrally.

Several specimens were seined near the mouth of the Nushagak River, Alaska.

120. Leptoblennius nubilus (Richardson).

Our specimens seem to agree in structural details with descriptions of *L. nubilus* from the North Atlantic, except that the ventral fins have but three soft rays. We have no specimens for comparison, and make the identification with some doubt. Pacific specimens seem lighter in color, with the dusky mottlings confined to the dorsal region and with a very distinct series of oblong brown blotches along lateral line, alternating with a lower series of small faint round spots. Under parts immaculate. The mottlings along base of dorsal frequently unite to form a series of oblong blotches alternating with those of lateral line. Other specimens show no traces of dorsal blotches. Dorsal fin translucent, faintly mottled with darker. Caudal with brownish crossbars. Fins otherwise unmarked. Fins and proportions as described for *L. nubilus*. Dentition also as in the latter; mandible with a single series of conical teeth, which widens at symphysis into an irregular double series or narrow patch; a similar series of conical teeth in premaxillaries, within which is a band of fine villiform teeth. Palate smooth.

Numerous specimens from Bristol Bay, Alaska, dredged at stations 3241, 3242, 3243, and 3244; depths, $4\frac{1}{2}$ to 14 fathoms.

121. Poroclinus rothrocki Bean.

A single specimen from north of Unalaska Island, station 3312, depth 45 fathoms. Depth at nape $\frac{1}{17}$ length, the body tapering uniformly backward. Vent placed anteriorly, its distance from snout $1\frac{2}{3}$ to $1\frac{3}{4}$ in its distance from base of caudal. Head $6\frac{1}{4}$ in length. Snout compressed, slightly projecting, the lower jaw included. Maxillary reaching vertical from front of pupil, $3\frac{1}{3}$ to $3\frac{1}{2}$ in head. Teeth acute, in narrow bands in the jaws, a single well-marked series on vomer and a patch on front of palatines, those on vomer and palatines fully as large as those on jaws and equally developed in young and adults. Eyes large, close together, the interorbital space convex, its width about half pupil. Diameter of orbit equals length of maxillary, about $3\frac{1}{2}$ in head. Nostril tubes well developed, half diameter of pupil. Gill-openings narrower than in other described members of this group, extending forward below the vertical from posterior part of cheeks, where they are firmly joined to isthmus, across which they do not form a fold. Gill-rakers obsolete.

Dorsal beginning over end of opercular flap, its distance from nape equaling distance of latter from posterior margin of pupil. Membrane of last spine slightly joined to base of caudal. Anterior dorsal spines short, but well connected by membrane. Anal with three distinct spines, shorter than the rays that follow, the second the longest, all as strong as dorsal spine, and fully connected by membrane. Rays all branched at tip. Membrane of last ray joined only slightly to base of caudal. Caudal sharply pointed in our specimens, the median rays longest, about as long as head. Pectorals evenly rounded, the median rays longest, 14 or 15 in number, all branched. Ventrals well developed, about two-fifths as long as head, consisting of one short, sharp spine and three rays, the spine not closely joined to rays.

Lateral line indistinct, usually appearing obsolete, more evident toward head, consisting of a series of distinct pores along median line. Scales very small, cycloid, imbricated, covering body, including abdomen, breast, and nape. Cheeks scaled, the head otherwise naked, or sometimes with a small patch of scales on upper part of opercles. D. LVII to LX; A. III, 40 to 42.

Color: Sides with a series of 10 to 12 narrow white crossbars, the first in front of dorsal fin, the last under last dorsal spine, the bars about one-fifth interspaces. Above lateral line they are conspicuously margined with darker; below lateral line they broaden out and become forked, forming Λ-shaped markings. Upper caudal rays at base with an oval white ring inclosing a darker area; this mark more conspicuous in the young. Belly and ventrals white, other fins dusky, but without definite markings.

Family CRYPTACANTHODIDÆ.

122. Delolepis virgatus Bean.

A decayed specimen was found on the beach at Unalaska.

LYCONECTES gen. nov. (CRYPTACANTHODIDÆ.)

Differing from *Cryptacanthodes* principally in the absence of palatine teeth, agreeing with it in general appearance and in most details of structure. Mouth subvertical; lower jaw projecting; premaxillary protractile. Teeth strong, conic, wide-set, in more than one series. Mucous pits prominent on head. Gill-opening narrow, ceasing opposite middle of base of pectorals, the membranes widely joined to isthmus. Dorsal and anal wholly joined to caudal, the latter extending well beyond them. Dorsal fin composed of spines only. No ventral fins. Body naked. No lateral line. Type *L. aleutensis*.

123. Lyconectes aleutensis sp. nov. (Plate 34.)

Head $7\frac{1}{3}$ in length, without caudal; depth $14\frac{1}{2}$. Dorsal LXIX; anal 49; pectoral 13; caudal 18. Head square in cross section, the upper and lower surfaces plain, the cheeks vertical, the depth and width equal. Mouth still more oblique than in *Cryptacanthodes maculatus*, with much heavier mandible and less expanded maxillary, the exposed portion of the latter with vertical axis, not extending beyond vertical from middle of the eye. Teeth all similar, few in number; those in premaxillary arranged in two series, the inner of which are smaller than outer, from which they are separated by a wide interspace. Teeth in mandible in a single series laterally, becoming a sparsely filled patch toward symphysis. Four or five similar conical teeth on head of vomer. Palatines toothless. A long nostril tube overhangs the upper lip. Upper lip separated by a fold from forehead, the upper jaw protractile. Eye extremely small, sunken in the socket, which it does not nearly fill, its diameter slightly less than half interorbital width. The supraorbital rim is not elevated, and contains no conspicuous projections. Suborbital rim swollen, with an enlarged mucous channel; a conspicuous series of mucous pits along each mandible and the margin of the preopercle; two series on top of head, diverging backward from above the eyes. Otherwise no pits or projection on head. A shallow triangular depression on occiput. Gill-slit much less oblique than margin of preopercle, its length 1¼ times the distance between lower ends of gill-slits, the latter reaching the vertical from middle of opercles.

Dorsal fin of rather flexible spines, not concealed in heavy fin membranes. The origin of dorsal falls immediately behind axil of pectorals. Hinder margin of occiput midway between front of dorsal and middle of eye. Origin of anal well in advance of middle of length, its distance from tip of snout contained 1⅞ times in its distance from base of caudal. Pectoral short, rounded, its base separated by a wide prepectoral area from gill-slit, the width of area three-fourths length of fin, the latter equaling distance from tip of snout to middle of eye. No ventrals. Body covered with lax naked skin, which also covers but does not obscure rays of dorsal and anal fins. No pores to lateral line.

Color in life: Reddish on head, body, and fins, due to the blood vessels in the skin.

A single specimen, 180 mm. long, dredged north of Unalaska Island, at station 3312; depth 45 fathoms.

Family PTILICHTHYIDÆ.

124. Ptilichthys goodei Bean.

A third specimen of this little-known fish was taken by dredging in shallow water at the entrance to Unalaska Harbor, station 3311; depth, 85 fathoms.

The genus *Ptilichthys*, of which this species is the sole representative, has been doubtfully referred by Dr. Bean to the *Mastacembelidæ*, a family of fresh-water fishes inhabiting the East Indies, characterized by having the shoulder girdle posteriorly placed and not articulating with the cranium (order *Opisthomi* Gill). The necessity for preserving intact the unique type of the species prevented Dr. Bean from making any anatomical examination of *Ptilichthys*, and it was reserved for Dr. Theodore Gill, in the Standard Natural History, 1885, p. 259, to express his disbelief in the relationships which had been suggested and to make the fish the type of a peculiar family, the *Ptilichthyidæ*, to be placed provisionally among the blennioid series. His adherence to this view is again expressed in his list of "Families and Subfamilies of Fishes," appearing as the sixth memoir of volume VI, of the National Academy of Sciences. He has doubtless indicated the proper position of this peculiar fish as nearly as we are now able to determine it. An examination of its shoulder girdle shows it to be entirely normal. The post-temporal is not furcate, but is a very slender bony rod attaching to the epiotic region of the skull and giving loose attachment posteriorly to the almost equally slender posterotemporal. The latter overlaps the upper end of the clavicle in the usual manner. A postclavicle was not detected. The coracoid portion consists of a roundish oblong, perforated hypercoracoid meeting the hypocoracoid directly, without intervening cartilage. The curved line separating the two bones corresponds distally with the interspace between the first (upper) and second actinosts. The hypocoracoid is broad and short. Its mesially directed (*i. e.*, inferior) process joins at its tip the clavicle, but is elsewhere separated from the latter by the usual elongate membranous interspace. The actinosts are four in number, of large size, hour-glass shaped.

The jaws are normal, the premaxillary alone occupying the front and sides of upper jaw and bearing the teeth, while the maxillary is a broad bone lying behind it, overlapped proximally by the maxillary process of the palatines. Both vomer and palatines seem to be toothless. The alimentary canal is almost perfectly straight, with the anterior portion entirely enveloped in the long, narrow liver. At the pylorus occurs a short and abrupt V-shaped flexure, scarcely noticeable on account of the closeness with which the sides are joined and the fact that the width of the flexure is no greater than the cross diameter of the tube. Pyloric cœca are not evident. An air bladder is entirely wanting. The ovary is single, apparently without oviduct, and contains in our specimen eggs which are comparatively very large.

Family LYCODIDÆ.

125. Lycodopsis crotalinus Gilbert. (Plate 32.)

One specimen from station 3210, south of Sannak Islands; depth, 483 fathoms.

Colors in life: Head and body light brown, the lower parts darker; snout, suborbital region, and a band across pectorals greenish gilt; no light bar on head.

Depth $12\frac{3}{5}$ in length; head $5\frac{1}{3}$; maxillary $2\frac{1}{3}$ in head; eye 7, equal to interorbital width; width of bone between orbits 17 in head; snout $3\frac{1}{3}$ in head; teeth above in a narrow band, reaching only about half way of gape. In the mandible teeth are absent on posterior two-fifths of gape. The gill-slit extends a little farther forward below than above. Ventrals as long as pupil. Longest pectoral ray $2\frac{3}{5}$ in head. Head wholly scaled behind eyes. Lateral line not evident.

The stomach contained remains of crustacea.

126. Lycodes diapterus Gilbert.

Taken abundantly north of Unalaska at stations 3227, 3324, 3326, 3329, 3330, 3331, and 3332; depths 109 to 576 fathoms.

127. Lycodes brevipes Bean.

Numerous specimens from stations 3216, 3225, 3226, 3227, 3263, 3309, 3310, 3311, 3313, and 3330, located north and south of the Aleutian Islands and in Bristol Bay; depths 58 to 351 fathoms.

128. Lycodes palearis sp. nov.

Very close to *L. brevipes* Bean, differing constantly in the longer ventrals, the greater development of mandibular and labial folds, the more numerous white bars, and the smaller eye. Head naked. Nape more or less naked, the scaleless area variable in extent, sometimes confined to its anterior third, sometimes reaching nearly to front of dorsal. Body sparsely covered with imbedded scales; axil naked. Lateral line short, decurved, extending scarcely beyond middle of pectorals. Teeth present in jaws, vomer, and palatines, those on premaxillaries laterally in a single series which widens anteriorly into a rather broad patch, the outer teeth somewhat enlarged, especially in front. All the premaxillary teeth shut outside the mandibular series, which are opposed to those on vomer and palatines. Mandibular teeth arranged similarly to those in upper jaw, the lateral series somewhat enlarged, continuous with the inner edge of the symphyseal patch. Vomerine teeth bluntly conic, 3 or 4 in number; palatines in a single series.

Snout long, prominent, the upper jaw projecting beyond the lower for a distance equaling two-thirds diameter of orbit. Upper lip thin, much expanded laterally, continuous posteriorly with the lower lip, which forms a wide, free membranous lobe opposite middle of each mandible. Anteriorly the lower lip becomes abruptly contracted and adnate to the jaw, leaving the symphyseal portion without free margin. Inner edges of mandibles with wide membranous borders, which increase in width anteriorly, where they terminate in a pair of acutely pointed free flaps. These free flaps and membranous margins are very conspicuous in both young and old specimens. In *L. brevipes* they are very inconspicuous, becoming evident in adults only. Dorsal with about 105 rays, counted to middle of caudal; anal about 90; pectoral 18. Head $5\frac{1}{4}$ in length; depth $9\frac{1}{2}$ to 11 in length, $2\frac{1}{6}$ in head. Eye 5 to 6 in head, $1\frac{1}{2}$ to 2 in snout. Ventrals $1\frac{1}{2}$ to $1\frac{1}{8}$ in eye, twice as long as in *L. brevipes*. Pectorals $1\frac{1}{8}$ in head. Anal origin under eighteenth dorsal ray.

General color brownish olive, growing lighter on the lower parts. Dorsal with 14 to 16 white vertical bars, extending in young specimens across back and sides and onto anal fin; in adults confined to the fins and frequently indistinct or wanting. Anterior dorsal angle frequently black, separated from remainder of fin by a curved white bar. Dorsal and anal not black-margined as in *L. brevipes*. In the latter the white lateral bars are 9 to 12 in number and are usually confined to upper half of body. There is also no black spot on anterior dorsal rays.

Three specimens, 113 to 166 mm. long, from stations 3253 and 3254 in Bristol Bay, in 36 and 46 fathoms.

129. Aprodon corteziana Gilbert.

One specimen from station 3349, off the coast of northern California; depth 239 fathoms.

The depth in this species varies from $7\frac{1}{2}$ to 9, the head from $4\frac{1}{8}$ to $4\frac{1}{2}$ in length.

130. Maynea pusilla Bean.

A few small specimens from north of Unalaska, at stations 3224, 3227, 3330, and 3331; depth 121 to 351 fathoms.

131. Gymnelis viridis (Fabricius).

Two specimens from between tide marks at Unalaska, one from station 3256 in Bristol Bay; depth 49 fathoms.

132. Lycodapus fierasfer Gilbert. (Plate 32.)

Several specimens from station 3324, in Bering Sea, north of Unalaska Island; depth, 109 fathoms. The statement in the original description (Proc. U. S. Nat. Mus. 1890, 108), "ventrals narrow," etc., applies instead to the pectorals, the ventrals being absent in this genus.

133. Lycodapus extensus sp. nov.

An extremely slender elongate form, with head smaller than in *L. fierasfer*, but otherwise resembling that species more than *L. parviceps*. The head is $6\frac{2}{3}$ in length, the depth of body $15\frac{1}{8}$. Gill-openings as in *L. fierasfer*, extending well above base of ventrals. Skin thin, the mucous pores inconspicuous, evident on mandible and along margin of preopercle. Upper profile of head longitudinally concave, shaped as in *fierasfer*, but slenderer, its depth greater than that of body. Mouth oblique, the maxillary reaching vertical from middle of eye, $2\frac{1}{3}$ in head. Teeth in narrow bands in both jaws, tapering laterally to single series. Vomerine teeth more numerous than in *L. parviceps* or *L. fierasfer*, small, not canine-like, in a single series. Palatine teeth wanting, as in some individuals of *L. fierasfer*. Eye $4\frac{1}{4}$ in head. Interorbital space $1\frac{1}{8}$ in eye. Snout $3\frac{3}{8}$ in head. Occiput midway between front of dorsal and anterior nostril. Pectorals slenderer and longer than in *fierasfer*, $2\frac{3}{8}$ in head. Head and trunk contained $2\frac{3}{6}$ times in tail. Dorsal 96, the extreme end of the tail wanting.

Color, light brownish, the black peritoneum visible through the skin of the abdomen. Mouth and gill-cavity largely dusky. A narrow dark-brown streak along base of dorsal and anal, occupying, toward tip of tail, the entire height of both fins.

A single specimen, 92 mm. long, from station 3324, north of Unalaska Island; depth 109 fathoms.

134. Lycodapus parviceps sp. nov.

Similar to *L. fierasfer*, differing in the much smaller head, longer, slenderer body, the thicker skin with more evident mucous pores, and in the more restricted gill-openings. Head short, $7\frac{2}{3}$ in length ($5\frac{1}{2}$ to $5\frac{2}{3}$ in *fierasfer*); depth 11. Upper profile of head nearly straight, not longitudinally concave, as in *fierasfer*. Head deeper and narrower, the snout less spatulate. Skin thicker. A conspicuous series of pores on mandible and along preopercular margin. Gill-slit very oblique, as in *fierasfer*, extending anteriorly as far as vertical from eye, the membranes then narrowly united, free from the isthmus except at extreme front. The gill-slit is superiorly much more restricted than in *fierasfer*, not extending above base of pectorals, while in the latter it extends above them for two-thirds diameter of eye.

Mouth oblique, the maxillary reaching vertical from middle of eye, $2\frac{1}{6}$ in head. The jaws are even at tip, the mandible slightly included laterally. Mandibular teeth in a moderate band anteriorly, the inner series enlarged, narrowing posteriorly to a single row. Premaxillary teeth of uniform size, in a narrow band throughout.

Vomer with four canine-like teeth. Palatine teeth small, in a single close-set series. Eye 4½ in head; least interorbital width 5; snout 3½. Distance from origin of dorsal to occiput slightly less than that from occiput to posterior nostril. Head and trunk contained 3½ in tail. Pectorals 2⅔ in head. Dorsal about 100; anal about 85; both counted to middle of caudal. Pectorals 9. No ventrals.

Body brownish in spirits, fins whitish-translucent; everywhere dusted with black specks. Tail and fins distinctly blackish posteriorly. Orbit blackish above. Gill-cavity silvery, blackish anteriorly. Mouth blackish, except anteriorly. Peritoneum black, the color not showing through the abdominal wall.

A single specimen, 115 mm. long, from station 3324, north of Unalaska Island; depth 109 fathoms.

DEREPODICHTHYS gen. nov. (LYCODIDÆ.)

A slender deep-sea Lycodid without scales or lateral line and with the ventral fins reduced each to a slender unbranched filament, the two very closely approximated, springing from a common projecting base, which is located far forward below the eye, as in Ophidioids. Gill-opening a narrow vertical slit, little wider than base of pectorals. Teeth cardiform, curved, few in number, in narrow bands or irregular single series on jaws, vomer, and palatines.

Derepodichthys alepidotus, type.

135. Derepodichthys alepidotus sp. nov.

Head and body very long and slender, the former resembling a *Lycodes* in appearance, being moderately compressed, with a flattish occiput and a gently rounded, decurved rostral profile. Mouth slightly oblique, quite at lower side of snout, the lower jaw shorter, fitting within the upper. Maxillary and premaxillary entirely concealed within the thick skin of the upper lip, which is directly continuous with that of the forehead, the upper jaw being therefore nonprotractile. Angle of mouth under front of pupil, its distance from tip of snout 2⅔ in head. Teeth as described under the genus. Eye small, not filling the elongate orbit, the diameter of exposed portion of eyeball slightly less than three-fourths length of snout, the latter 3½ in head. A series of large mucous pores on snout and lower part of cheeks; a second series on mandible; no pores on body. Gill-slit vertical, not continued forward, its lower end slightly above base of lower pectoral rays. Length of slit one-fourth length of head, slightly less than distance between slits. Head 8½ in total length depth of head and body 2⅙ in head; width of head 2⅔ in its length. Distance from tip of snout to base of ventrals 2½ in length of head. Distance from tip of snout to front of dorsal 5½ in total length; from tip of snout to vent 3⅔ in total.

Pectorals long and slender, reaching half way to vent, 1½ in head. Dorsal and anal confluent with the caudal, concealed in the thick integument so that the rays can not be counted.

Color in spirits light brownish, the dorsal and pectorals whitish, the anal with a dark margin, which becomes black posteriorly. Lips dusky. Abdominal region blue-black.

A single specimen, 110 mm. long, dredged off Queen Charlotte Island, station 3342; depth 1,588 fathoms.

Family GADIDÆ. The Cods.

136. Lota maculosa (Le Sueur). *Ling.*

A young specimen was taken at Nushagak.

137. Antimora microlepis Bean.

Several specimens taken at stations 3330, 3331, 3342, and 3348, in Bering Sea, at depths of 350 and 351 fathoms, and off the coasts of the Queen Charlotte Islands and of California at depths of 1,588 and 455 fathoms.

138. Gadus macrocephalus Tilesius. *Pacific cod.*

It has been frequently pointed out and is well known to fishermen that the Pacific codfish has a smaller air-bladder, or "sound," than the Atlantic cod. Pending an examination of this question, which we are not now in a position to make, we propose to recognize the Pacific fish as a distinct species. A report on the cod banks of Bering Sea, based on the operations of the *Albatross*, has been given by A. B. Alexander. (Report of Commissioner of Fish and Fisheries, 1889–91, p. 280.) An occasional specimen was taken in the dredge, the species being recorded from stations 3224, 3226, 3285, 3291, and 3301, in Bering Sea; depths 17 to 128 fathoms.

139. Pollachius chalcogrammus (Pallas).

A few adults were taken by trolling in Captains Harbor, Unalaska. Young specimens, 4 to 6 inches long, were dredged in great abundance in the shallow water of Bristol Bay and around the Aleutian Islands, at stations 3217, 3222, 3231, 3232, 3233, 3234, 3235, 3236, 3237, 3238, 3239, 3240, 3245, 3246, 3248, 3250, 3252, 3253, 3255, 3256, 3259, 3273, 3278, 3279, 3281, 3282, 3285, 3286, 3294, 3298, 3301, 3309, and 3310; depths 5 to 71 fathoms.

Family MACRURIDÆ.

140. Macrurus acrolepis Bean.

Not taken in Alaskan waters, but found abundant off Vancouver Island, Washington and Oregon, at stations 3340, 3346, 3347, and 3348; depths 345 to 786 fathoms.

141. Macrurus cinereus sp. nov.

Snout high and blunt, but little overlapping the mouth, terminating in a pointed prolongation of the median ridge, which bears at its tip a bony tubercle furnished with radiating ridges. The nasal ridges also terminate in shorter and smaller, but similar tubercles, the outline between rostral and nasal tubercles concave. Length of snout slightly less than diameter of orbit, $3\frac{4}{5}$ to 4 in head, its tip overpassing the premaxillaries for two-thirds its length. Mouth of moderate size, the maxillary reaching vertical from hinder margin of orbit, equaling length of snout and half of eye. Teeth finely villiform in both jaws, the outer series not at all enlarged, the mandibular band narrow. Barbel short and slender, its length less than half diameter of pupil. Interorbital width six-sevenths diameter of orbit, equaling length of snout. Preopercle greatly expanded, much overlapping the interorbital below, leaving exposed only the extreme posterior angle. Gill-membranes narrowly joined, with a posterior fold free from the isthmus. Gill-rakers short, compressed, almost tubercular, 2+12.

Origin of dorsal well behind base of pectorals. Second dorsal spine long and filamentous, strongly serrate, except on extreme base and tip. Length of spine five-sixths to six-sevenths head. Base of first dorsal equaling diameter of orbit. Interspace between dorsals two-thirds to two-fifths base of first dorsal. Pectoral long and slender, equaling length of head behind anterior nostril opening, about as long as the filamentous outer ventral ray. Vent immediately in front of anal origin. Scales on sides well imbricated, each with 7 to 9 parallel ridges, which bear short sharp spines directed very obliquely backward.

Dorsal II, 10 or 11; ventral 9. Seven scales between lateral line and base of first dorsal.

Color uniform light-grayish on body and fins, with the exception of the blackish pectorals and ventrals. Sides of head silvery. Mouth, gill-cavity, and peritoneum brownish or purplish black, gill membranes and gular membrane dusky.

Numerous specimens from north of Unalaska Island (stations 3307 and 3329, depths 1,033 and 399 fathoms), and from the North Pacific, south of Ookamok Island (station 3340, depth 695 fathoms).

142. Nematonurus cyclolepis sp. nov.

A species with the general appearance (including the protruding snout, inferior mouth, and comparatively weak dentition) of *N. armatus* and *N. affinis*, but with the dorsals less widely separated, the vent anterior in position, and the scales unarmed, as in *Moseleya longifilis*.

Head smooth, compressed, without conspicuous ridges. Median and lateral rostral ridges terminating in slightly projecting points; the median process, a short portion of the median ridge, and the edge of the membrane connecting median with lateral processes with spinous scales and points. Snout projecting beyond the premaxillaries for two-thirds its length, which is contained $3\frac{3}{4}$ times in head. Eye small, less than snout, very slightly exceeding interorbital space, $4\frac{1}{3}$ in head. Mouth small, wholly inferior, maxillary reaching vertical from posterior margin of pupil, $2\frac{2}{3}$ in head. Premaxillary teeth in two series—the outer similar to those in mandible, not enlarged or canine-like; the inner series smaller, directed obliquely backward. A single series of teeth in mandible, not widening into a patch at symphysis. Barbel thick at base, two-thirds length of snout. Preopercle incurved above the angle, the lower limb expanded, the marginal region striate.

First dorsal inserted behind axil of pectoral. Second spine broken in both specimens, the basal portion smooth, a single sharp barb showing that the spine is serrate. The base of the fin equals the length of the snout. Interspace between dorsals exceeding length of first dorsal base by one-third to two-fifths length of latter. Vent immediately in advance of origin of anal, under middle of interspace between dorsals. The dorsal is low and inconspicuous and the anal higher, as usual in this group. Pectorals very slender, $1\frac{2}{10}$ in length of head. Outer ventral ray filamentous, reaching third or fourth anal ray. Dorsal II, 8 or 9; ventral 12.

Scales mostly lost. The few remaining on head are either entirely smooth or bear a single median keel, with one or two low spinous points. Those on body are without spines, and are either entirely smooth or show traces of a low median keel. Six scales in an oblique series between lateral line and middle of base of dorsal. Color dark brown, the anterior portion of back and sides with small scattered black spots. Opercles, lower side of head (including gill-membranes and ventral area) black, as are also the mouth and gill-cavity and the peritoneum.

Two specimens, the longest 150 mm., from station 3342, off Queen Charlotte Island, depth 1,588 fathoms.

143. Chalinura filifera sp. nov.

Related to *C. serrula* Bean, from the same region and depth, differing in the larger eye, shorter mental barbel, longer snout, longer pectoral fins, shorter interspace between dorsals, and the longer dorsal fin. Snout short, slightly exceeding diameter of eye, $3\frac{2}{10}$ in head; the median ridge and the nasal ridges terminate each in a much projecting point, furnished each with a short rosette of radiating spines and ridges. The outline between these points is concave. Tip of snout projecting beyond the premaxillaries for a distance equaling that which separates the central rosette from one of the lateral ones. Infraorbital ridges inconspicuous, not reaching angle of preopercle behind or bony portion in front.

Mouth large, slightly oblique, with extensive lateral cleft, the maxillary reaching vertical from posterior margin of pupil, $2\frac{2}{3}$ in head, equaling distance from tip of snout to middle of eye. Outer series of teeth in premaxillary strong, succeeded by a narrow band of smaller cardiform teeth. Mandibular teeth similar to inner band of upper jaw, the band becoming slightly wider at the prominent symphysis. Barbel short, one-half to two-fifths length of snout. Eye large, the diameter of orbit slightly less than interorbital width or length of snout, 4 in head. Angle of preopercle produced backward, concealing all but the extreme posterior angle of interopercle, the margin appearing serrulate when divested of skin. Gill-membranes joined to isthmus, with a posterior free margin. Gill-rakers very short and heavy, 1 + 11.

Dorsal beginning vertically above base of pectorals; the second spine extremely long and slender, smooth basally, the terminal half rather strongly toothed. It becomes very slender toward the tip, and terminates in a long membranous filament. In one specimen it exceeds length of head, in the others it equals five-sixths that length. Length of base of first dorsal equaling one-third length of head. Interspace between dorsals short, two-fifths to three-fourths length of snout. Pectorals very long and slender, equaling the head without the snout. Outer ventral rays very long and filamentous, equaling length of head. Vent immediately in advance of anal origin. Scales rather thin, those on back and sides with about five diverging ridges, each of which bears a number of short rigid spinules directed very obliquely backward, the posterior projecting but little beyond the margin of the scale. Eight or nine scales in an oblique series between the middle of first dorsal and the lateral line.

Dorsal II, 12 to 14; pectoral 20 to 22; ventral 9 or 10.

Dark brown, the fins, gill-membranes, lips, nostrils, and under side of snout black. Anterior part of mouth and lining of gill-cavity purple. Peritoneum blackish brown.

Three specimens, 520 to 550 mm. long, were dredged in 1,588 fathoms off Queen Charlotte Island, at station 3342.

Family PLEURONECTIDÆ. The Flounders.

144. Citharichthys sordidus (Girard).

At stations 3351 and 3352 off northern California; depths 26 and 51 fathoms.

145. Citharichthys stigmæus Jordan & Gilbert.

At station 3350, near Point Reyes, Cal.; depth 75 fathoms.

146. Hippoglossus hippoglossus (Linnæus). *Halibut.*

A few small specimens dredged at stations 3218, 3230, 3238, and 3239; depths 3¼ to 41 fathoms. Taken with hand lines on all the cod banks.

147. Atheresthes stomias Jordan & Gilbert. *Arrow-toothed Halibut.*

At stations 3215, 3216, 3218, 3221, 3223, 3224, 3225, 3227, 3259, 3263, 3264, 3267, 3321, 3324, 3331, 3332, and 3339, located north and south of the Aleutian Islands and in Bristol Bay; depths 32 to 406 fathoms.

148. Eopsetta jordani (Lockington). *California Sole.*

Station 3351, near Point Reyes, Cal.; depth 51 fathoms.

149. Hippoglossoides elassodon Jordan & Gilbert.

North and south of the Aleutian Islands, and Bristol Bay; stations 3216, 3217, 3218, 3225, 3257, 3259, 3284, 3310, 3311, 3313, 3314, 3321, 3323, and 3334; depths 25 to 85 fathoms. In four specimens we find the following fin formulæ: D. 86, A. 65; D. 87, A. 69; D. 79, A. 67; D. 84, A. 63.

150. Lyopsetta exilis (Jordan & Gilbert).

At station 3351, off northern California; depth 51 fathoms.

151. Lepidopsetta bilineata (Ayres).

Taken abundantly at Unalaska and Chernoffski harbors, at Herendeen Bay, and Hagemeister Island, and at stations 3213, 3214, 3215, 3217, 3218, 3219, 3222, 3232, 3233, 3235, 3237, 3238, 3239, 3242, 3244, 3245, 3246, 3248, 3249, 3250, 3251, 3252, 3258, 3259, 3264, 3265, 3266, 3267, 3268, 3269, 3270, 3271, 3272, 3273, 3275, 3278, 3279, 3280, 3282, 3283, 3284, 3285, 3286, 3287, 3289, 3290, 3291, 3292, 3293, 3294, 3295, 3298, 3299, 3300, 3301, 3302, 3303, and 3323; depths 4½ to 70 fathoms. This species is variable in the height of the anterior arch to the lateral line, which is sometimes strong, sometimes little marked.

152. Limanda aspera (Pallas).

An excellent food-fish, taken in abundance at Herendeen Bay and at stations 3230, 3233, 3234, 3235, 3238, 3239, 3240, 3241, 3242, 3243, 3244, 3248, 3251, 3252, 3266, 3267, 3269, 3282, 3283, 3286, 3298, 3299, 3301, and 3303 in Bristol Bay; depths 3¼ to 53 fathoms.

153. Limanda proboscidea sp. nov. (Plate 33.)

Bearing some resemblance to *L. ferruginea* (Storer) but having fewer rays in dorsal and anal, larger scales and longer snout. Profile sharply angulated above front of upper eye, the snout convexly protruding. Form varying from very slender to broadly elliptical, the two outlines equally curved. Depth 2¼ to 2½ in length. Head large, 3 to 3½ in length, in a specimen 7 inches long. Caudal peduncle short, widening backward, its least depth twice its length. Mouth oblique, the maxillary reaching beyond front of lower eye, 4 in head. Teeth narrow, little compressed, in a single series on both sides of the jaw, extending farther back on the blind side. Eyes on right side. Lower eye well in advance of upper, the diameter of upper eye 5½ to 6 in head, 1½ in snout. Vertical from front of upper eye falling midway between front of orbit and front of pupil of lower eye. Interorbital space a very narrow sharp ridge, naked in females, with a single series of ctenoid scales in males. Gill-rakers short, about equal to diameter of pupil, 13 or 14 in number, 9 or 10 on lower limb.

Scales loosely imbricated, ctenoid in males on colored side, smooth in females. Blind side of both sexes smooth. Head scaled on eyed side in males; the opercle, subopercle, interopercle, and preopercle mostly naked in females. Head on blind side naked. Rays of vertical fins with single series of ctenoid scales. Dorsal fin beginning slightly behind front of upper eye, the first three rays usually higher and with membranes more deeply incised than in those which follow. Highest portions of both dorsal and anal fins behind the middle of the body. The fins about equal, their longest rays equal to the snout and eye. Caudal two-thirds head. Pectorals short, one-third head. Ventrals reaching beyond front of anal, 3½ in head. The usual small antrose spine in front of anal fin.

D. 63–67; A. 47–49; Lateral line 86–95. Length 7½ inches.

Color: Light grayish or brownish, thickly covered with small whitish spots. Entire left side with margins of dorsal, caudal and anal fins bright lemon-yellow (as in *ferruginea*). Vertical fins grayish with an occasional dark-brown ray.

Several specimens from stations 3239, 3240, and 3248 in Bristol Bay; depths 11½ to 21 fathoms; one young specimen from Herendeen Bay.

154. Platichthys stellatus (Pallas). *Great California Flounder.*

Mouth of the Nushagak River, and stations 3229, 3235, 3239, 3240, and 3269, Bristol Bay; depths 8 to 16 fathoms.

155. Pleuronectes quadrituberculatus Pallas.

Numerously represented at Chernoffski Harbor and Herendeen Bay, and at stations 3240, 3244, 3251, and 3252 in Bristol Bay; depths 4½ to 29½ fathoms.

156. Pleuronectes glacialis Pallas.

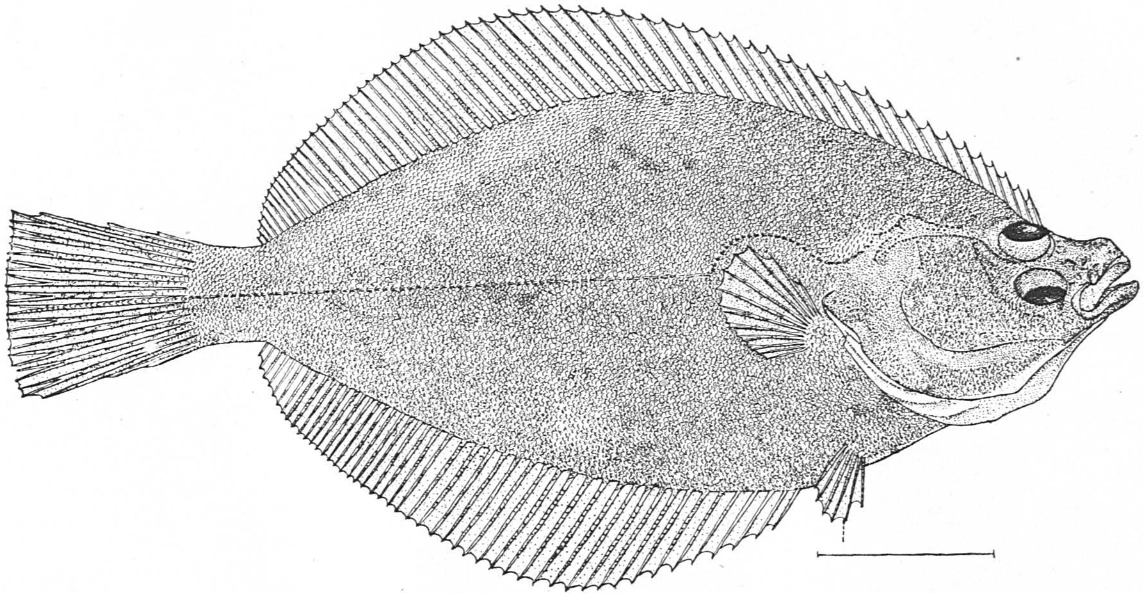
Found abundant in the mouths of the Naknek and Nushagak rivers, and at station 3232 in Bristol Bay; depth 10½ fathoms.

157. Glyptocephalus zachirus Lockington.

Bering Sea and North Pacific generally; stations 3227, 3259, 3322, 3323, 3324, 3331, 3334, 3349, and 3351; depths 35 to 350 fathoms.

158. Microstomus pacificus (Lockington). *Slippery Sole.*

Stations 3216 (south of Alaska Peninsula, 61 fathoms), 3333 (north of Unalaska, 19 fathoms), 3343, 3347, 3348, and 3349 (coasts of Washington, Oregon, and northern California; depths, 239 to 516 fathoms). This species is dredged in abundance in the vicinity of San Francisco, at depths of 15 to 50 fathoms.



LIMANDA PROBOSCIDEA sp. nov.

REPORT UPON THE FISHES COLLECTED BY THE STEAMER ALBATROSS OFF THE COAST OF CALIFORNIA, BETWEEN POINT CONCEPTION AND POINT ARENA, IN MARCH AND APRIL, 1890.

During parts of March and April, 1890, the U. S. Fish Commission steamer *Albatross* made an investigation of the fishing-grounds on the coast of California from Point Conception to Point Arena, in continuation of the inquiries conducted the previous year to the southward of Point Conception. On the earlier expedition the writer acted as chief naturalist of the *Albatross*, and the new fishes obtained at that time have been described by him in a paper published in 1890, in the Proceedings of the United States National Museum.* The collection of fishes made on the latter cruise was also referred to him and is discussed in the present paper. It consists largely of the same species secured south of Point Conception, but was found to contain representatives of one undescribed genus and four new species.

The cruise of March and April, 1890, is fully described by Lieut. Commander Z. L. Tanner, U. S. N., the commanding officer of the steamer *Albatross*, in his report for that year, pp. 219–226; and the fishery results are discussed by Mr. A. B. Alexander, fishery expert of the *Albatross*, in the same connection, pp. 275–279.†

The investigations were carried from the shallow water along shore into a depth of 627 fathoms, the fishery work having been conducted chiefly by means of the beam trawl, which was employed at 113 separate stations. The positions of the different stations, the depth of water, character of bottom found at each, with other data, are given in the report of Lieut. Commander Tanner above referred to.

Family HEPTATREMIDÆ.

1. **Polistotrema stouti** (Lockington).

Stations 3103 and 3126; depths 67 and 456 fathoms.

Family SCYLLIORHINIDÆ. The Cat Sharks.

2. **Catulus xaniurus** Gilbert.

Stations 3126, 3196, and 3200, in 200 to 456 fathoms,

In two young specimens, 105 and 110 mm. long, a series of spines is developed on each side of the middle line of back, larger than the prickles and firmly set. These begin above the second or third gill-slit, continue to slightly beyond front of first dorsal fin, and contain 15 to 18 spines. A similar series of latéral spinelets is described by Eigenmann in young of *Scylliorhinus ventriosus* = *Catulus uter* J. & G. (West American Scientist, Nov., 1889, p. 151). It is not improbable that they may

* Scientific results of explorations by the U. S. Fish Commission steamer *Albatross*, No. XII.—A preliminary report on the fishes collected by the steamer *Albatross* on the Pacific Coast of North America during the year 1889, with descriptions of 12 new genera and 92 new species, by Charles H. Gilbert; Proc. U. S. Nat. Mus. 1890, 49–126.

† Report upon the investigations of the U. S. Fish Commission steamer *Albatross* from July 1, 1889, to June 30, 1890, by Lieut. Commander Z. L. Tanner, U. S. N., commanding. Report U. S. Fish Comm. for 1889–1891, 207–342.

be found characteristic of Scyllioid sharks. No trace of them is found in older specimens. They strongly resemble the primary definitely placed spines of *Raja*, and have doubtless, as in the latter, some taxonomic value.

Young specimens have the dorsal and anal fins occupying somewhat different positions from that found in adults, and of different relative sizes. In a specimen 110 mm. long the dorsals are very narrow, and the anterior dorsal is much farther back, being mostly behind the ventrals instead of terminating above their posterior line of insertion. The anal is very long, separated from caudal by a hardly appreciable space, and in front slightly overlapping the first dorsal. In a specimen 240 mm. long the anal is still disproportionately long, separated from caudal by about one-fifth base of fin instead of one-half base of fin, as in adults. The first dorsal has apparently shifted forward, as it now terminates slightly behind ventrals.

A male specimen, 430 mm. long, has the claspers projecting but little beyond the ventrals. It differs as follows from the original description: The distance from tip of snout to front of mouth is more than half the greatest width of snout. The first dorsal is more posteriorly placed, extending behind the vertical from ventrals, the length of its base contained but 1⅖ times in the space between dorsals. This posterior position of the first dorsal may be a case of retarded development, as the fin shifts forward during growth. The scales on side of tail are smaller and less crowded than those forming the upper caudal band, but are otherwise wholly similar, each possessing a strong central spine and a pair of shorter lateral cusps, and having the central portion deeply grooved.

Family GALEIDÆ. The Requiem Sharks.

3. **Rhinotriacis henlei** Gill.

One specimen from station 3100, in 29 fathoms.

Family RAJIDÆ. The Skates.

4. **Raja stellulata** Jordan & Gilbert.

Stations 3105, 3129, 3189, 3196, 3204, and 3208, in 200 to 218 fathoms.

No series of young is at hand. In a single young male, 130 mm. long, there is no trace of spines or papillæ on the orbital rim, but those along middle of back are very large, as is also a large spine on each shoulder. The prickles are coarse, entirely covering the disk and tail above, none on the lower side. The prickles on sides of disk are in rows following the pectoral rays, those on middle of back are in lengthwise series, and those below eye are in rows parallel with its lower border. This serial arrangement of prickles I have noticed also in the young of *Catulus xaniurus.*

In four larger specimens, 300 to 390 mm. long, there is no trace of ocular spines. Of primary spines there seem to be 3 or 4 behind the occiput, the most anterior occupying the position of the single postoccipital spine in *R. inornata*, and a series of 17 to 20 on middle of tail. The interspace on middle of back is apparently filled in later by 6 or 7 spines, which are just appearing in one of the large specimens and are smaller than the caudal series in all the others. No ocellated spot appears at base of pectorals, an ill-defined darker spot occupying this position in one specimen.

5. **Raja inornata** Jordan & Gilbert.

Stations 3106, 3115, and 3147, in 43 to 76 fathoms. The collection presents a very interesting series from unhatched young to adults, and throws some light on the development of the spines and on the early stages of fins and tail.

The first spines to appear correspond exactly in position with those described below in *Raja rhina*. There are three definitely placed on the orbital rim, one occupying a median position behind the occiput, and a continuous series along median line of tail. The postoccipital spine can be always identified by its relation to a conspicuous short double series of pores. These series are curved, and each presents its convex side toward the middle line of the back. It is between the posterior diverging ends of these series that the spine in question is found.

In a young specimen, 145 mm. long, taken from the egg, having the yolk nearly absorbed, no spines are externally visible. They are fully developed, however, and lie declined and hidden beneath the epidermis. The three ocular spines, the postoccipital spine, and the caudal series are all present. No rudiments of spines are visible in the mid-dorsal region, between the postoccipital spine and the middle of the ventrals. On freeing them from the epidermis the spines can be readily elevated and depressed. The posterior attachment of the base is, however, firm, and will not permit the elevation of the spine beyond a certain point. Later, a firm anterior attachment is formed, the spine in the meantime breaking through the skin. When it first appears it is still movable, but soon becomes rigid.

In still younger embryos, 120 and 125 mm. in length, the spines are represented by elongate soft, dermal papillæ, of about the same size and shape as the future spines. They occupy the same definite positions found characteristic for the spines of this and related species. The papillæ lie declined beneath the epidermis, through which they are visible as short white lines. No rudiments appear between the postoccipital papilla and the base of the ventrals.

A specimen 190 mm. long has the spines fully developed and the mid-dorsal series nearly complete. Thus the caudal series continues forward beyond base of ventrals for about three spines, and is then followed after a short interval by three stronger spines, the anterior of which is the postoccipital spine, as indicated by its characteristic position. In another specimen, 200 mm. long, a continuous dorsal series is present from the postoccipital spine to tail, without evidence that those on middle of back appeared later than the others. In this specimen are rudiments of the additional ocular spines which appear later, one papilla being present above middle of orbit, a second over spiracle. In later stages the growth of these secondary ocular spines may be traced, their development being often accompanied by the total disappearance of the primary spines. The secondary spines may disappear in turn. The growth of the mid-dorsal series I have been unable to trace. Specimens show much variation with respect to their development. In one, 340 mm. long, no spines are present between the postoccipital spine and the tail. In another, the series is complete except the two immediately following the postoccipital spine, these two being still represented by dermal papillæ.

In an embryo, 145 mm. long, the tail is produced 31 mm. beyond the second dorsal, and forms a depressed tapering appendage which becomes very slender toward the tip. The lateral folds and the median dorsal fold are continued some distance along this appendage, but are very low. Aside from this, there is no indication of the future caudal fin. In a younger embryo, 125 mm. long, the unabsorbed yolk being still large (about 25 mm. in diameter), the tail is proportionately longer than in the last, 86 mm. in length, the terminal portion projecting 32 mm. beyond the dorsal fin. As in the first described, the lateral caudal fold is distinct, highest in the region of the dorsal fins, thence declining in front and behind, disappearing before reaching either base or tip of tail. No trace is present of a median fold connecting the two dorsals. Such a fold appears to extend from second dorsal around tip of tail, becoming continuous with the anal fold, which is arrested definitely at a distance of 4 mm. behind the vertical from second dorsal. The latter folds may, however, be exaggerated, or may be entirely due to the shriveling of the specimens.

The youngest embryo described is light brownish in color, with a series of whitish or light-yellowish crossbars down the middle of back and tail. The same colors appear on pectorals in the form of rounded spots and blotches. A round black spot has appeared at base of each pectoral, surrounded by an area of light yellowish. In a second embryo, of about equal size, the bands on back of tail seem to bear a definite relation to the spines. In an older embryo, with the yoke nearly absorbed, the color has undergone considerable modification. The bands and the lighter areas have disappeared, and the disk is sparsely covered with small, round black spots, the largest nearly equaling diameter of pupil.

6. Raja rhina Jordan & Gilbert.

In two young males, 154 and 225 mm. long, the spines are well developed and exactly correspond. In each there are three spines on the orbital rim, one at the upper and one at the lower anterior angle of the eye and one at its upper posterior angle; a very large one on median line behind occiput, and a strong median series on tail, beginning opposite posterior base of ventral fin. This is the invariable arrangement in the young, but is modified later on by the disappearance of some of the original spines and the development of others. Thus, in a specimen 450 mm. long the lower preorbital spine has nearly disappeared, and the others are evident, but accompanied by additional spines which have been interposed. As in younger specimens, there is a single postoccipital spine and no mid-dorsal series, but some of the original spines on middle of tail have apparently been lost and replaced by others, as the lining and spacing is now irregular. The taxonomic value of these first spines appears from the fact that they exactly correspond in the young of a number of related species, and from the further fact that their rudiments are found occupying definite positions during the later larval stages, some of which are described above in the nearly related *R. inornata*. The same arrangement is found also in the young of *R. binoculata*. The first prickles to appear are those on under side of snout, where they form a sparse band or a single definite series along the edge and an elongate median patch in front.

In two young males, 154 and 225 mm. long, the claspers measured from inner base respectively 7 and 10 mm., in both cases overpassed by the ventrals.

Stations 3147, 3163, 3193, 3197, and 3208, in 56 to 203 fathoms.

7. Raja binoculata Girard.

The young can be at once distinguished by the very conspicuous ocellated spots. In a specimen 190 mm. long the black center, the wide, yellowish ring, and the outer black ring are very strongly marked. These spots are only faintly indicated in the young of related species. The spines are, as usual at this stage, just appearing from beneath the epidermis. Caudal spines 15 or 16 in number.

Family ALEPOCEPHALIDÆ.

8. Alepocephalus tenebrosus Gilbert.

One specimen each from stations 3104 and 3186, in 391 and 328 fathoms. Differing from original description as follows: The distance of ventrals from head equals length of head behind front of pupil. Interorbital space gently convex. Base of anal fin slightly exceeding that of dorsal.

Family CLUPEIDÆ. The Herrings.

9. Clupanodon cæruleus (Girard). *California Sardine.*

Station 3167; depth 33 fathoms.

10. Alosa sapidissima (Wilson). *Common Shad.*

Three specimens of this introduced food-fish were taken in Drake Bay. Each is about 150 mm. long.

Family ENGRAULIDIDÆ. The Anchovies.

11. Engraulis mordax Girard. *California Anchovy.*

Stations 3099, 3154, 3167, and 3182; depths 11 to 33 fathoms.

Family MYCTOPHIDÆ. The Lantern Fishes.

12. Nannobrachium leucopsarum Eigenmann & Eigenmann.

Stations 3112, 3126, 3127, 3128, 3198, 3199, 3200, and 3201; depths 233 to 627 fathoms.

Family ARGENTINIDÆ. The Smelts.

13. **Leuroglossus stilbius** Gilbert. (Plate 34.)

Stations 3126 and 3188; depths 456 and 316 fathoms. In the specimen from 3126 the mandible has a single series of conical close-set teeth, which work against the palatine and vomerine series above. They seem to grow slightly larger laterally. The tongue seems to have some slight asperities, but no teeth can be detected.

14. **Osmerus thaleichthys** Ayres.

Stations 3099, 3134, 3135, 3136, and 3182, in 17 to 20 fathoms. Our specimens vary so much in the curvature of the maxillary and in the length of the paired fins that I am unable to recognize *O. attenuatus* as a distinct species. The head is 4 in length, and the anal contains 18 or 19 rays in two specimens which differ widely in the curvature of the maxillary.

Family STERNOPTYCHIDÆ.

15. **Sternoptyx diaphana** Hermann. Stations 3127 and 3188; depths 418 and 316 fathoms.

Family CHAULIODONTIDÆ. The Viper Fishes.

16. **Chauliodus macouni** Bean. Stations 3127, 3128, and 3201; depths 280 to 627 fathoms.

17. **Cyclothone microdon** (Günther). Station 3127; depth 418 fathoms.

Family SYNGNATHIDÆ. The Pipefishes.

18. **Siphostoma californiense** (Storer). Monterey and at station 3141; depth 24 fathoms.

Family AULORHYNCHIDÆ.

19. **Aulorhynchus flavidus** Gill. Monterey.

Family ATHERINIDÆ. The Silversides.

20. **Atherinopsis californiensis** Girard. *California Smelt; Pescado del Rey.* Monterey.

21. **Atherinops affinis** (Ayres). *Little Smelt; Pescadillo del Rey.* Santa Barbara and Drake Bay. Dorsal fin with 6 or 7 spines, 52 to 56 series of scales, and 4 rows between lateral line and base of first dorsal.

22. **Atherinops insularum** Gilbert. Two typical specimens from Drake Bay, with 62 to 68 scales in lateral line and 5 dorsal spines. It is possible that intermediate forms will be found and the species proved untenable.

Family BERYCIDÆ.

23. **Melamphaes cristiceps** Gilbert. Station 3127; depth 418 fathoms.

Family ECHENEIDIDÆ.

24. **Remora remora** (Linnæus). *Remora; Sucker.* Three specimens from Santa Barbara.

Family SCIÆNIDÆ. The Croakers.

25. **Genyonemus lineatus** (Ayres). *Little Roncador.* Stations 3099, 3100, 3132, 3134, and 3136; depths 7 to 33 fathoms.

Family EMBIOTOCIDÆ. The Surf Fishes.

26. **Brachyistius rosaceus** (Jordan & Gilbert). Stations 3101, 3115, 3132, 3147, and 3156; depths 33 to 56 fathoms.

27. **Cymatogaster aggregatus** Gibbons. *Viviparous Perch.* Drake Bay and stations 3100, 3101, 3115, 3149, 3152, and 3156; depths 29 to 50 fathoms.

28. **Hypocritichthys analis** (A. Agassiz). Stations 3100, 3135, and 3137; depths 11 to 29 fathoms.

29. **Hyperprosopon argenteus** Gibbons. Monterey.

30. **Holconotus rhodoterus** Agassiz. San Simeon Bay.

31. **Amphisticus argenteus** Agassiz. Monterey, San Simeon Bay, and Santa Barbara.

32. **Phanerodon furcatus** Girard. Station 3137; depth 11 fathoms.

33. **Damalichthys argyrosomus** (Girard). Station 3149; depth 45 fathoms.

Family GOBIIDÆ. The Gobies.

34. **Lepidogobius lepidus** (Girard). Stations 3115, 3153, and 3154; depths 20 to 43 fathoms.

Family CHIRIDÆ.

35. **Zaniolepis latipinnis** Girard. Stations 3115, 3149, 3156, 3173, and 3175; depths 43 to 62 fathoms.

36. **Oxylebius pictus** Gill. Station 3102; depth 27 fathoms.

Family SCORPÆNIDÆ.

37. **Sebastodes goodei** Eigenmann & Eigenmann. *Rockfish.*

Stations 3113, 3125, and 3190; depths 53 to 70 fathoms.

Gill-rakers 10 or 11 + 23 to 25. Peritoneum silvery, with scattered stellate black spots. In three young specimens the occipital spines are evident, the others concealed or not developed. The young show five dusky bars downward from back, under front, middle, and end of spinous dorsal, below soft dorsal, and on caudal peduncle. The head is contained $2\frac{3}{8}$ times in the length; the depth, $3\frac{3}{8}$. The second anal spine is as long as the third, but does not reach its tip when fin is declined.

38. **Sebastodes jordani** sp. nov.

Most nearly allied to *S. goodei*, from which it differs in the much slenderer body, the longer anal spines, the black peritoneum, and the more numerous gill-rakers. From *entomelas* and *ovalis* this species differs in the obsolescence of the cranial ridges, as well as in other details.

Body very slender, the depth 4 in the length, the least depth of caudal peduncle three-fourths diameter of eye. Head very slender, $2\frac{4}{5}$ in length, tapering regularly to the very sharp snout. Mandible projecting, its tip entering profile, provided with a rather small but distinct symphyseal knob. Maxillary reaching vertical from middle of eye, $2\frac{1}{2}$ in head. Snout $3\frac{5}{6}$ in head. Interorbital width $4\frac{3}{5}$. Eye large, $3\frac{5}{8}$. Interorbital width flat or slightly convex, wholly scaled over, the orbital ridges obsolete, or a faint trace only of the supraorbital, which is always without spine. The occipital ridges are low and sharp, terminating each in a spinous point. In addition to these, the tympanic spines are sometimes weakly developed, and the nasal spines are present. The head is otherwise wholly smooth. Preorbital very narrow below eye, wide anteriorly, without distinct lobes but with one or two weak spinous points. Gill-rakers long and very slender, 29 present on horizontal limb of outer arch, the longest equaling one-half diameter of orbit. Preopercular spines 5, comparatively slender, all directed backward.

Dorsal spines very slender, the fourth the longest, or the fourth and fifth equal, contained 2⅜ to 2¾ in length of head. Dorsal very deeply notched, the twelfth spine but one-fourth as long as the longest, and barely connected at base with the eleventh. Soft dorsal scarcely as high as the spinous. First anal spine very short, the second very slightly stronger than the third, and nearly or quite as long measured from base, its length 3½ in head. The second spine appears much shorter than the third when the fin is declined. Longest soft ray of anal 2⅜ in head. Caudal deeply notched. Anus anterior in position, midway between first anal spine and base of ventrals; the tips of the ventrals extend to or beyond it, and the pectorals extend beyond tips of ventrals.

D. XIII, 14 or 15; A. III, 9 or 10. Pores in lateral line, 54 to 58.

Scales small, everywhere ctenoid, entirely covering head, including maxillaries, mandibles, and snout, except a triangular area on top of snout, beneath which lie the premaxillary spines. Color as in *S. goodei*, dusky olive above, bright silvery on sides of head and body and below; probably with some red in life. Fins unmarked. Mouth and gill-cavities pure white, the peritoneum jet black.

Specimens ranging in size from 165 mm. to 215 mm. from stations 2935, 3103, and 3114; depths 62 to 124 fathoms.

• Named for David Starr Jordan, president of the Leland Stanford Junior University, the most successful worker in the genus *Sebastodes*.

39. Sebastodes saxicola (Gilbert).

Stations 3103, 3104, 3113, 3114, 3115, 3125, 3129, 3161, 3183, 3184, 3189, 3192, 3194, 3196, 3197, 3206, 3207, 3208, and 3209; depths 43 to 391 fathoms.

Gill-rakers constantly 10+22 or 23. The second anal spine varies somewhat in length, always extending slightly beyond tip of third anal spine when the fin is declined, usually not reaching tips of soft anal rays, its length 2⅕ to 2⅛ in that of head. Young specimens have faint dark bars occupying usual position; a jet-black blotch on middle of soft dorsal with a light streak below it separating it from the back.

40. Sebastodes diploproa (Gilbert).

Stations 3105, 3129, 3161, 3170, 3188, 3189, 3191, 3193, 3195, 3196, 3197, 3204, and 3208; depths 160 to 316 fathoms, excepting station 3197 (77 fathoms), from which there are 11 young specimens 2 to 3 inches long, supposed to belong to this species. All these show the characteristic silvery-white coloration on lower half of sides. There are traces of dark bars on the sides; one on nape and under front of spinous dorsal; two on sides diverging downward from behind middle of spinous dorsal; one under middle of soft dorsal. There are corresponding dusky marks on the fins, that on soft dorsal being a distinct blackish blotch. The projecting lobes of the premaxillaries are evident in the youngest specimens. Fins and spines of head about as in adults.

The gill-rakers in this species are 9 or 10 + 23 to 25. The maxillary is 2⅛ to 2½ in head. The interorbital space is very slightly more than one-half eye. The ventral fins extend nearly to vent. Pectorals 1⅗ in head. There is considerable variation in the direction of the upper preopercular spines, which are directed sometimes straight forward, sometimes obliquely forward and downward. Lower preorbital spine directed obliquely downward and backward.

41. Sebastodes aurora (Gilbert).

Stations 3195, 3199, and 3205; depths 233 to 252 fathoms. Gill-rakers very large and thick, comparatively few in number, 7 on vertical limb, and 14 or 15 movable ones and about 3 tubercles on horizontal limb of gill-arch. The coronal spines are an inconstant feature of this species, absent nearly as often as present. In one specimen a slight prominence on one side indicates its position.

42. Sebastodes rhodochloris (Jordan & Gilbert). *Flyfish.*

Stations 3183 and 3189; depths 162 and 218 fathoms. Gill-rakers 6 + 18.

43. Sebastodes chlorostictus (Jordan & Gilbert). *Pesca vermiglia.*

Station 3129; depth 204 fathoms. The preorbital spines can not be used to distinguish this species from *S. eos* Eigenmann. If the two are distinct, they are distinguishable by the scaliness of the maxillary and mandible, the length of the second anal spine, and the color of the peritoneum.

44. Sebastodes rupestris (Gilbert).

Station 3189; depth 218 fathoms. A single specimen, 5 inches long. The species is evidently allied to the *rosaceus* group, but is without the pink spots. Below the lateral line is a single black streak, which grows more intense opposite the dark vertical bars. The interorbital space contains two low inconspicuous ridges; its width is contained $2\frac{1}{4}$ times in diameter of eye. No spine or a very weak one at lower angle of suboporcle

45. Sebastodes elongatus (Ayres). *Reina.*

Stations 3106, 3113, 3125, 3129, 3161, 3163, 3203, 3204, and 3207; depths 65 to 204 fathoms.

Gill-rakers 9 or 10 + 20 to 22, extending full length of arch. In the young the lateral stripes are broken up into smaller blotches, the interruptions to the dorsal stripe leaving a series of saddle-like blotches along the back, which correspond in position with those of *S. saxicola*. There is one under first dorsal spines, one under middle, and one under end of spinous dorsal, one under soft dorsal, and one on back of caudal peduncle. This correspondence is interesting in connection with similar color marks discovered in the young of *S. diploproa* and those known to occur in the young of the *rosaceus* group.

46. Sebastodes auriculatus (Girard).

Stations 3097, 3100, 3132, 3150, 3154, and 3181; depths 16 to 33 fathoms. In one specimen the gill-rakers are 7+15. On the upper limb two only are long and compressed; the others are round and thick, but slightly movable. On lower limb all those enumerated are compressed. In front is a mass that might represent rudiments of one or more.

47. Sebastolobus alascanus Bean.

Stations 3112, 3126, 3161, 3170, 3186, 3187, 3191, 3195, 3196, 3199, 3204, and 3208; depths 191 to 456 fathoms. Dorsal usually with 16 spines, with 17 in two specimens noted. In the young the fins are colored as in adults, not black as in *S. altivelis*. Inside of mouth and gill-cavity white.

48. Sebastolobus altivelis Gilbert.

Stations 3104, 3112, 3127, 3128, 3188, and 3202. In very young specimens all the fins are black, and the intense black lining to gill-cavity is externally visible, making sides of head appear dusky. The mouth is posteriorly black. The branchiostegal membranes are lined with white on basal part and edged with black. The spinous dorsal is without black blotches, nearly uniformly dark in color. The spines vary much in height, but the third is always the highest. The second anal spine is always much longer than the third, reaching if uninjured beyond tips of soft rays.

Family COTTIDÆ. The Sculpins.

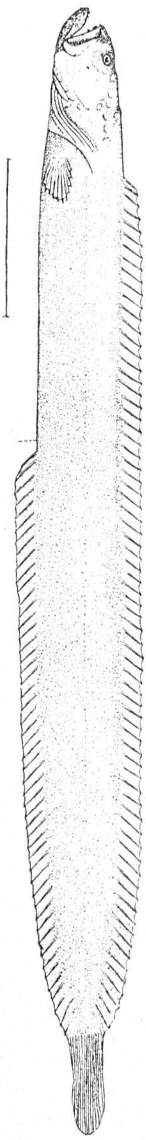
49. Icelinus quadriseriatus (Lockington).

Stations 3115, 3152, 3154, 3155, 3166, 3167, and 3179; depths 20 to 47 fathoms.

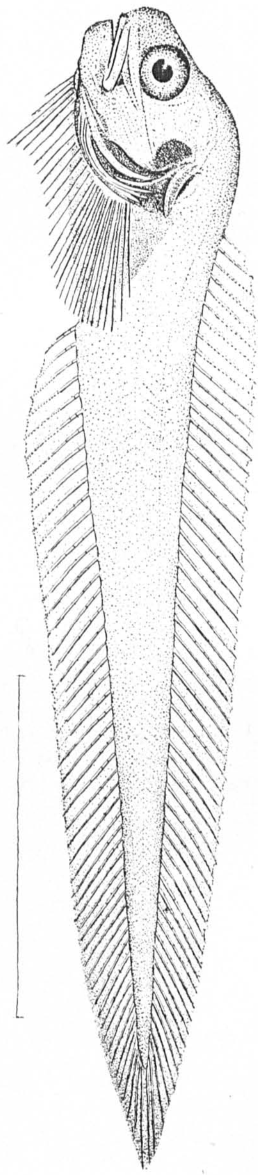
50. Icelinus tenuis Gilbert.

Stations 3106 and 3129; depth 77 to 204 fathoms. These specimens are slenderer than indicated in the original description, the depth being contained $6\frac{1}{2}$ times in the length. In two specimens the second dorsal spine is filamentous as well as the first, reaching in one specimen beyond front of second dorsal.

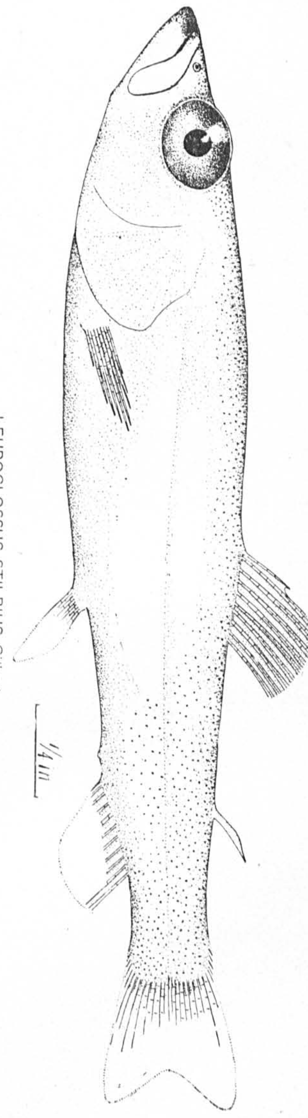
PLATE 34.



LYCONECTES ALEUTENSIS Gilbert.



PARALIPARIS DACTYLOSUS sp. nov.



LEUROGLOSSUS STILBIUS Gilbert.

51. Icelinus filamentosus Gilbert.

Stations 3113, 3125, 3129, 3146, 3161, 3183, 3184, and 3209; depths 62 to 204 fathoms. The preopercular spine increases disproportionately with age. In specimens 2 to 3 inches long it is short and slender, with but two upwardly directed cusps. In adults it is the most massive found in the genus, and is furnished with four upwardly directed barbs, the basal one of which may be minute or rudimentary.

52. Chitonotus megacephalus Lockington.

Stations 3115, 3176, and 3179; depths 30 to 43 fathoms. Two specimens have a small preopercular spine, with one terminal and two upwardly-directed points. The mouth does not extend to opposite posterior border of orbit.

53. Leptocottus armatus Girard. Station 3097; depth 12 fathoms.

54. Oligocottus analis Girard. Monterey.

55. Oligocottus maculosus Girard. Monterey.

56. Radulinus asprellus Gilbert. Stations 3103, 3171, 3172, 3173, 3175, and 3194; depths 52 to 92 fathoms.

Family AGONIDÆ.

57. Brachyopsis verrucosus Lockington. Stations 3152, 3155, 3182; depths 36, 35, and 11 fathoms.

58. Brachyopsis xyosternus Jordan & Gilbert. Station 3182; depth 11 fathoms.

59. Odontopyxis trispinosus Lockington. Stations 3129, 3137, 3152, 3153, 3154, 3155, 3157, and 3166; depths 11 to 47 fathoms, excepting station 3129 (204 fathoms).

60. Xenochirus triacanthus Gilbert. Stations 3103, 3113, 3114, 3145, 3156, 3157, and 3171; depths 47 to 76 fathoms.

61. Xenochirus pentacanthus Gilbert. Stations 3161, 3189, 3191, 3193, and 3204; depths 160 to 218 fathoms.

62. Xenochirus latifrons Gilbert.

Stations 3103, 3129, 3147, 3156, 3161, 3174, 3189, 3193, 3194, 3204, 3206, and 3209; depths 50 to 218 fathoms. The gill-membranes have always a distinct free edge except at middle line, where a frenum joining middle of membrane to isthmus may come out to the very margin. Plates on cheeks are always absent, and other diagnostic marks are constant.

Family LIPARIDÆ.

63. Careproctus melanurus Gilbert.

Stations 3112, 3186, 3189, and 3199; depths 218 to 328 fathoms. Three specimens from station 3112 are graduated in size, measuring 65, 78, and 95 mm. The disk becomes relatively smaller with age, measuring 4, $4\frac{1}{2}$, and $4\frac{3}{8}$ mm. The position remains the same, as does that of vent.

64. Paraliparis cephalus Gilbert.

Stations 3112 and 3126; depths 296 and 456 fathoms.

65. Paraliparis dactylosus sp. nov. (Plate 34.)

Very close to *P. ulochir*, but with the upper insertion of the pectoral much lower, opposite the lower margin of pupil, and the head and body much more slender and elongate. Shape of head much the same as in *P. ulochir*, the snout broadly rounded, slightly if at all overlapping the horizontal mouth; the cheek vertical. Occiput and nape not conspicuously swollen. Lower jaw included. Maxillary reaching vertical behind middle of pupil, $2\frac{3}{5}$ in head. Eye large, 3 in head. Bony interorbital space 5.

Snout $4\frac{1}{2}$. Gill-opening a narrow slit, extending to opposite third or fourth pectoral ray, its length equaling diameter of pupil. Teeth acute, in narrow bands in the two jaws, each band made up of oblique rows. Opercle produced into a pointed lobe, which is separated from upper pectoral ray by a distance equaling diameter of pupil.

Dorsal beginning slightly behind upper base of pectoral. Pectorals inserted lower than in *P. ulochir*, the upper ray on a level with or below margin of pupil. As in *P. ulochir*, the two lobes are joined by a series of about 8 more widely-spaced rays. None of the rays are free. The anterior ends of the fins meet under the throat, at a point vertically below the pupil. Pectoral rays 30, of which about 10 constitute the lower lobe. The upper rays extend beyond front of anal, but the lower lobe is apparently much shorter. Vent anterior in position, its distance from pectoral symphysis one-half its distance from front of anal. Head 5 in length; depth $6\frac{1}{2}$. Length of longest specimen 78 mm. Dorsal *ca.* 56. Anal *ca.* 46. Each of the types has lost the epidermis. In this condition the head and body are light or slightly dusky, except the eyes, opercles, gill-membranes, and abdomen, which are black. Gill-cavity and mouth black. Probably black everywhere in life. Three specimens from station 3112, off Santa Cruz, California; depth 296 fathoms.

Family TRIGLIDÆ. The Gurnards.

66. Porichthys notatus Girard.

Stations 3099, 3100, 3103, 3114, 3130, 3145, 3149, 3166, and 3190; depths 9 to 62 fathoms.

Family BLENNIIDÆ. The Blennies.

67. Gibbonsia evides (Jordan & Gilbert).

Monterey. This species is distinguished from *Gibbonsia elegans*, found south of Point Conception, by the longer and lower soft dorsal and by the less variegated coloration.

68. Exerpes fucorum (Jordan & Gilbert.) Monterey Bay.

69. Xiphidion mucosum Girard. San Simeon Bay.

70. Cebedichthys violaceus (Girard). San Simeon Bay.

Family LYCODIDÆ. The Eelpouts.

71. Lyconectes aleutensis Gilbert. (Plate 34.)

A single young specimen from station 3161; depth, 191 fathoms. Agreeing with the typical example, but having head and body marked with numerous small, round, black spots.

72. Lycodopsis pacificus Collett.

Stations 3147, 3156, 3174, 3189, 3194, and 3197. Station 3194 is recorded with a depth of 218 fathoms. With this exception the depths range from 50 to 92 fathoms. One specimen contains eggs two-thirds the size of buckshot.

73. Lycodes diapterus Gilbert.

Stations 3104, 3105, 3112, 3187, 3189, 3191, 3193, 3195, 3196, 3198, 3199, and 3201; depths 160 to 391 fathoms. There is great variation in the development of the white vertical bars in this species. They seem to be usually but not always present in specimens from 7 to 10 inches long. The bars usually fork below, becoming Λ-shaped, and do not extend onto the fins. One specimen, 5 inches long, has the top of the head and half the predorsal area naked. In larger specimens the head is minutely scaled as far forward as the eyes.

74. Aprodon corteziana Gilbert.

Stations 3105, 3129, 3161, 3186, 3199, and 3204; depths 191 to 328 fathoms.

LYCONEMA gen. nov. (LYCODIDÆ.)

Generic characters as in *Lycodes*, but the lower jaw covered with a dense mass of slender filaments or barbels, between which can be seen the mucous pores of the mandible. In *Iluocœtes* the mandible is provided with a series of hollow tubes, which are doubtless the produced margins of the pores.

Type, *Lyconema barbatum* sp. nov.

75. Lyconema barbatum sp. nov. (Plate 35.)

A dense fringe of filaments covers the entire under surface of lower jaw, extending to behind angle of mouth. A series of filaments is found also laterally on the throat, and a few scattering ones are sometimes present on the branchiostegal membranes. Upper jaw without barbels. Body slender, the depth 11½ in the length; head 6½ in length. Upper jaw overlapping the lower. Mouth small, the maxillary reaching vertical from front of pupil, 3 in head. Teeth all conical, none of them much enlarged. Those in lower jaw in a patch or irregular double series, narrowing to a single series laterally. In upper jaw there is a single series, the teeth of which increase in size toward the middle line, the middle teeth being almost canine-like. Behind the latter is found a short inner series of small teeth directed backward. Teeth on vomer and palatines in single series.

Gill-slits continued forward to slightly beyond bases of ventrals and to the level of lower edge of base of pectorals. Width between gill-slits one-half diameter of eye. Pseudobranchiæ well developed. Eye 3½ in head. Snout 4½. Posterior line of occiput midway between origin of dorsal and front of pupil or front of eye. Origin of anal fin at end of first third of length of body.

Ventrals very short, one-half to two-fifths diameter of orbit. Pectorals broad, with the posterior edge emarginate, some of the upper and the lower rays longer than the intermediate ones. Length of fin $1\frac{8}{10}$ in head.

Dorsal 103; anal 91; each counted to middle of caudal; pectoral 15.

Scales showing traces of definite arrangement in series, widely separated anteriorly, becoming crowded toward end of tail. They are continued up on the vertical fins, but are absent on head, on anterior half of nape, and on the pectoral fins. The lateral line is very faintly shown, and only for a short distance behind head, where its course is obliquely downward. The usual series of mucous pores present, but not conspicuous.

In spirits this species has an olive-brown ground color, becoming white on under side of head and on abdomen. A series of eight or nine brown spots half as large as eye along middle of sides, those posteriorly continued downward onto the base of the anal, the last two or three reaching the edge of the fin and there developing into intense black blotches. A similar series of smaller spots corresponding in position to those just described occurs along the base of dorsal. They are also continued as faint bars on the fin, at the margin of which they each develop a black blotch, those posteriorly wider and more intense. An intermediate series of spots alternates with the two just described. An elliptical jet-black spot occupies the greater part of caudal fin and is narrowly margined all around with white. The peritoneum is jet-black, the mouth and gill-cavities white.

Twelve specimens, the longest 150 mm., from station 3129 (lat., N. 36° 39′ 40″; long., W. 122° 01′; depth 204 fathoms).

76. Maynea brunnea Bean.

Station 3188; depth 316 fathoms. The teeth on the palatines are in a single series instead of a wide band, as stated in the original description.

77. Lycodapus fierasfer Gilbert. Station 3202; depth 382 fathoms.

78. Lycodapus dermatinus sp. nov. (Plate 35.)

Very similar to *L. fierasfer*, but the head, body, and fins covered with a thick, loose skin which contains numerous pores or openings for the mucous canals. One series of these runs along the middle of sides and forms the lateral line; it rises anteriorly above the gill-opening and is continued forward on top of head, the two meeting between eyes. A second series runs between eye and upper lip and curves around on middle of cheek, running upward to behind eye. One series runs along a fold bordering mandible, one along preopercular margin, and one on opercle. In *L. fierasfer* a few pores are visible on mandible, and one or two can frequently be made out on preopercular margins. The skin is very thin and delicate and the fin rays are very evident through the membrane. The general proportions and the dentition of the type are essentially as in *L. fierasfer*, but the vomerine teeth are longer and hooked backward.

Head $4\frac{3}{4}$ in length; depth $1\frac{5}{8}$ in head; maxillary $2\frac{1}{5}$ in head. Mandible heavier than in *L. fierasfer*. Eye 5 in head; snout 4. Origin of dorsal vertically above axil of pectorals. Length of head and trunk one-third total length. Teeth in narrow bands in the jaws, a single series on vomer and palatines. Gill-membranes very narrowly joined below and free from the isthmus, as in *L. fierasfer*. Dorsal 70; anal 60; pectorals much longer than in *L. fierasfer*.

The general color in spirits is light brownish-yellow, made somewhat dusky by the pigment spots in the skin. The body, and especially the fins, grows darker posteriorly.

One specimen, 113 mm. long, from station 3162 (lat., N. 37° 54′ 10″; long., W. 123° 30′; depth 552 fathoms).

79. Melanostigma pammelas sp. nov. (Plate 35.)

Well distinguished from *M. gelatinosum* by the wider, blunter head, the smaller, less oblique mouth, the uniform black coloration, and the arrangement of the teeth in the jaws in two series. As in *M. gelatinosum*, the head and body are enveloped in a loose, thin skin, which is thrown into folds in alcoholic specimens, and entirely conceals the anterior portions of the dorsal and anal fins. On dissection the dorsal is seen to have its origin close behind the head, at a point over middle of pectoral fin. The anal begins immediately behind the vent. The rays of both fins are enveloped in a gelatinous subcutaneous tissue.

The head is broad, with its greatest width equaling its greatest depth. The mouth is broad, somewhat oblique, with equal jaws, the maxillary reaching vertical from front of pupil. Both jaws with the teeth in two distinct series in front, in a single series laterally in lower jaw. The outer teeth in front are enlarged, almost canine-like. Eye large, 3 in head, twice the length of the short, broad snout. Gill-opening a small pore above the base of the pectorals, its diameter about one-half that of the eye.

Head 8 in total length; depth $12\frac{1}{2}$. Pectoral narrow, its length $2\frac{2}{3}$ in head.

Color intense black on head and abdomen, brownish-black elsewhere.

The type of the species is a specimen 104 mm. long, from station 3202 (lat., N. 36° 46′ 10″; long., W. 121° 58′ 45″; depth 382 fathoms). Three other specimens are at hand from station 3126 (lat., N. 36° 49′ 20″; long., W. 122° 12′ 30″; depth 456 fathoms). In the smallest, 56 mm. long, the head and abdomen are jet-black, but the rest of body is only slightly dusky.

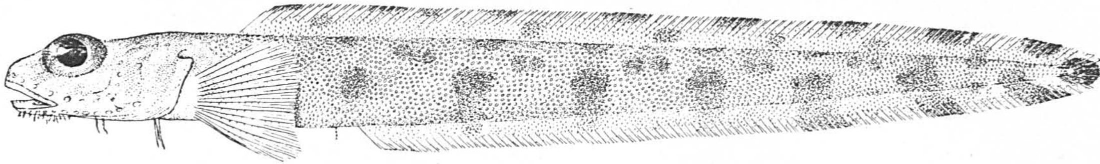
Family OPHIDIIDÆ.

80. Otophidium taylori (Girard).

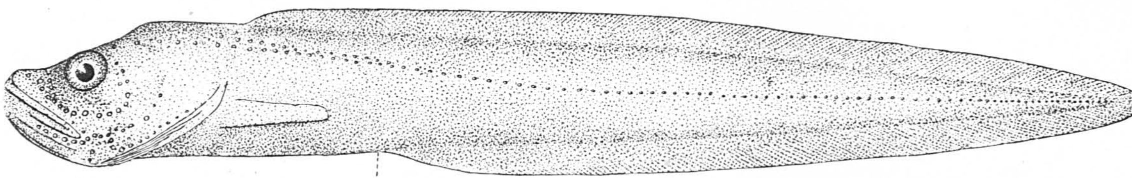
Stations 3103, 3136, and 3163; depths 7 to 69 fathoms. The lateral line varies greatly in length. In none of the specimens does it reach the end of the tail. It frequently differs widely on two sides of the same fish, and varies in length from one-half to seven-eighths of the total length.

81. Catætyx rubrirostris Gilbert.

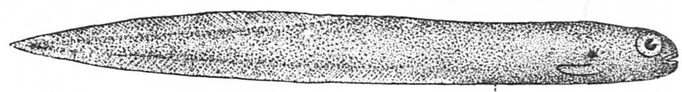
Three specimens, stations 3199 and 3200; depths 233 and 269 fathoms. Head $4\frac{4}{11}$ to $4\frac{7}{11}$ in length. Distance from snout to origin of dorsal 3 to $3\frac{1}{5}$ in length. Distance of dorsal from occiput greater than from latter to tip of snout. Maxillary $2\frac{1}{5}$ in head. Eye longer than snout, $4\frac{2}{3}$ in head.



LYCONEMA BARBATUM sp. nov.



LYCODAPUS DERMATINUS sp. nov.



MELANOSTIGMA PAMMELAS sp. nov.

Family GADIDÆ. The Codfishes.

82. **Antimora microlepis** Bean.
Stations 3126 and 3188; depths 456 and 316 fathoms.

83. **Microgadus proximus** (Girard).
Stations 3097 and 3100; depths 12 and 29 fathoms.

84. **Merluccius productus** (Ayres).
Stations 3103, 3125, 3173, and 3193; depths 62 to 160 fathoms.

Family MACRURIDÆ. The Grenadiers.

85. **Macrurus liolepis** Gilbert. Station 3126; depth 456 fathoms.

Family PLEURONECTIDÆ. The Flounders and Soles.

86. **Citharichthys sordidus** (Girard).
Stations 3099, 3113, 3114, 3115, 3170, 3185, and 3197; depths 20 to 167 fathoms.

87. **Citharichthys stigmæus** Jordan & Gilbert.
Stations 3130, 3135, 3137, and 3185; depths 9 to 41 fathoms. Taken also in Drake Bay. Gill-rakers, 9 on horizontal limb of anterior arch. Two specimens, 45 and 50 mm. long, show white spots, each with a black half ring on the outer side, symmetrically arranged along bases of dorsal and anal. There are four distinct pairs of these, two unpaired placed more anteriorly along dorsal base, and a few fainter ones midway between these rows and the lateral line, and alternating with them. There are some other scattered light spots. The abdomen is crossed by a broad, black, vertical streak. If this is the usual coloration of the young, it must be a very transitory stage, as other specimens, a little smaller and a little larger, show traces only of the spots.

88. **Paralichthys californicus** (Ayres). Monterey Bay.

89. **Eopsetta jordani** (Lockington).
Stations 3106, 3115, 3135, 3149, 3150, 3151, 3153, 3176, and 3190; depths 15 to 77 fathoms.

90. **Lyopsetta exilis** (Jordan & Gilbert).
Stations 3103, 3113, 3114, 3129, 3156, 3161, 3184, 3189, 3193, 3197, and 3201; depths 50 to 280 fathoms.

91. **Psettichthys melanostictus** Girard.
Stations 3100 and 3135; depths 29 and 15 fathoms. Taken also in Drake Bay.

92. **Pleuronichthys decurrens** Jordan & Gilbert.
Stations 3101, 3107, 3115, 3147, 3150, 3161, and 3190; depths 21 to 191 fathoms.

93. **Parophrys vetulus** Girard.
Stations 3099, 3113, and 3115; depths 20 to 70 fathoms.

94. **Isopsetta isolepis** (Lockington).
Stations 3099, 3152, and 3153; depths 20, 36, and 32 fathoms.

95. **Lepidopsetta bilineata** (Ayres).
Stations 3100, 3150, 3151, and 3190; depths 21 to 53 fathoms.

96. **Glyptocephalus zachirus** Lockington.
Stations 3105, 3114, 3172, and 3197; depths 62 to 217 fathoms.

97. **Microstomus pacificus** (Lockington).
Stations 3105, 3113, 3114, 3115, 3129, 3161, 3166, 3167, 3171, 3172, 3190, 3195, and 3197; depths 33 to 252 fathoms.

FISHES COLLECTED BY THE STEAMER ALBATROSS ON THE COASTS OF ALASKA AND WASHINGTON DURING THE SUMMER OF 1891.

During the summer of 1891 the *Albatross* was detailed to convey to Bering Sea the United States Bering Sea commissioners, and Fish Commission work was therefore necessarily abandoned. The only collecting done in Alaskan waters was on August 3, when five hauls of the beam trawl (Nos. 3438 to 3442, inclusive) were taken in depths of 20 to 51 fathoms off the south and west sides of St. Paul Island. Nothing of special interest was secured, as will appear from the list which follows. On her return late in August an exploration was made of the Straits of Fuca and Hood Canal. Twenty-four hauls of the beam trawl were taken in depths of 14 to 351 fathoms, and in addition some shore collecting at Port Angeles, Wash. While no forms were obtained which had not been previously reported on, the dredging in the Straits of Fuca was of especial interest, as demonstrating the presence of a number of Alaskan species not previously known to range so far south.

FISHES DREDGED NEAR ST. PAUL ISLAND, ALASKA.

1. **Hemitripterus marmoratus** Bean.

One specimen, 5 inches long, from station 3440. A detailed description follows; D. XIV, 12; A. 13; lateral line 43. Head 2⅔ in length to base of caudal; depth 4. Eye 1½ in the snout, about 5 in the head. Body densely covered with small, conical protuberances, each with a short filamentous tip; these are about one-sixteenth of an inch long on the back, where they are longest and thickest, and become much shorter below. Head and fins less densely covered; the lips, occipital area, and an area around the eyes nearly smooth. A few cirri scattered over the head; a thick fringe around the margin of the lower jaw. The cirri at the base of the nasal spines are rather large, 1½ in the eye, and bifid or trifid at tip. Head rather broad and flat, provided with blunt, bony protuberances. Interorbital area broad, deeply concave, separated from the concave occipital area by a transverse ridge. Nasal spines sharp, separated by a width equal to the diameter of the eye. Supraocular ridge prominent, with a notch, bordered posteriorly by two bony knobs; occipital ridge with three, paroccipital with two prominent knobs. Preopercular spines very blunt, the second the longest.

Mouth wide; lower jaw somewhat projecting; teeth sharp, in cardiform bands on the jaws, vomer, and palatines, the vomerine patch divided by a median groove. Gill-membranes united, forming a broad, free fold. No slit behind the fourth gill. Pseudobranchiæ large. Pyloric cœca 8. The base of the first dorsal is equal to the length from its front to the snout; the dorsals are separated by a space equal to two-thirds the diameter of the eye. Second dorsal about 1½ in the base of the spinous dorsal. Dorsal spines all with long, free tips, the second and third spines longest; the fin without distinct notch. The anal begins under the origin of the soft dorsal, the length of its base nearly equaling that of the spinous dorsal. The pectorals reach the posterior edge of the spinous dorsal. Ventrals about equaling length of snout.

General color gray, with dark marblings. Top of head darker, the under parts light. A black spot on the spinous dorsal covering the first three membranes; also a dark blotch on its posterior part. Two black blotches below the soft dorsal are continued upward on the fin. Outer third of the pectorals blackish; ventrals dark, with light tips. Tail with a light bar across its middle. Posterior half of occipital, supraocular and nasal region, lips, and cheeks all with darker areas.

2. **Icelus bicornis** (Reinhardt). Stations 3439, 3440, and 3441.
3. **Triglops beani** Gilbert. Station 3438.
4. **Hemilepidotus hemilepidotus** (Tilesius). Numerous specimens, less than an inch long, taken at the surface near St. Paul Island.
5. **Aspidophoroides bartoni** Gilbert. Stations 3439, 3440, 3441, and 3442.
6. **Odontopyxis frenatus** Gilbert. Station 3440.
7. **Lycodes brevipes** Bean. Stations 3440, 3441, and 3442.
8. **Lycodes palearis** Gilbert. Stations 3439 and 3442.
9. **Gymnelis viridis** (Fabricius). Stations 3441 and 3442.
10. **Pollachius chalcogrammus** (Pallas). Stations 3440, 3441, and 3442.

In addition to these there are mentioned by Commander Tanner, in his report on the cruise (in Report U. S. Fish Commissioner, 1892), young cod (*Gadus macrocephalus*), tomcod (*Microgadus proximus*), and flounders (*Limanda aspera* and *Lepidopsetta bilineata*). Specimens of none of these were included in the material submitted to me. The "eels" referred to by Captain Tanner were probably Lycodids.

FISHES DREDGED IN THE STRAITS OF FUCA.

1. **Raja inornata** Jordan & Gilbert. A male specimen, 17 inches long, from station 3450. Spines and prickles in greatly reduced numbers. Four strong supra-ocular spines, a strong spine anteriorly on middle of back, and a row of strong spines on the tail. A few small prickles on interorbital space and on each side the middle line of back. Upper surface otherwise smooth. Below smooth, except snout and anterior line of pectorals.
2. **Raja stellulata** Jordan & Gilbert. Stations 3447, 3450, and 3466.
3. **Hydrolagus colliei** (Bennett). Station 3447.
4. **Diaphus theta** Eigenmann. Stations 3450 and 3459.
5. **Bathymaster jordani** Gilbert. Stations 3464 and 3465.
6. **Sebastolobus alascanus** Bean. Stations 3450, 3452, and 3460.
7. **Sebastodes alutus** (Gilbert). Stations 3449, 3453, 3459, and 3462.
8. **Sebastodes caurinus** (Richardson). Station 3449.
9. **Psychrolutes zebra** Bean. Stations 3451, 3460, and 3464.
10. **Icelinus borealis** Gilbert. Stations 3460, 3464, 3465, and 3466.
11. **Triglops beani** Gilbert. Stations 3464 and 3465.
12. **Nautichthys oculofasciatus** Girard. Station 3465.
13. **Aspidophoroides inermis** (Günther). Station 3465.
14. **Hypsagonus quadricornis** (Cuvier & Valenciennes). Stations 3464 and 3465.
15. **Xenochirus alascanus** Gilbert. Stations 3443, 3445, 3446, 3456, 3457, 3459, and 3461.
16. **Liparis dennyi** Jordan & Starks. Stations 3443, 3445, 3453, 3458, 3459, 3460, 3461, 3465, and 3466.
17. **Liparis fucensis** Gilbert. Stations 3445, 3450, 3451, 3458, and 3459.
18. **Liparis cyclopus** Günther. Stations 3443 and 3445.
19. **Chirolophus polyactocephalus** (Pallas). Station 3465.
20. **Gadus macrocephalus** Tilesius. Stations 3447, 3460, and 3462.

21. **Atheresthes stomias** Jordan & Gilbert. Stations 3448, 3450, 3460, and 3466.

22. **Hippoglossoides elassodon** Jordan & Gilbert. Station 3460.

23. **Parophrys vetulus** Girard. Station 3460.

24. **Microstomus pacificus** (Lockington). Stations 3443, 3447, 3451, and 3466.

25. **Glyptocephalus zachirus** Lockington. Stations 3447, 3448, 3456, and 3460.

The following 26 species of shore fishes were taken with the seine at Port Angeles, Wash.:

Ammodytes personatus.
Clupea pallasi.
Oncorhynchus kisutch (young).
Hypomesus pretiosus.
Aulorhynchus flavidus.
Cymatogaster aggregatus.
Embiotoca jacksoni.
Damalichthys argyrosomus.
Hexagrammus decagrammus.
Ophiodon elongatus.
Psychrolutes zebra.
Artedius fenestralis.
Acanthocottus polyacanthocephalus.
Enophrys bison.
Leptocottus armatus.
Oligocottus maculosus.
Blepsias cirrhosus.
Siphagonus barbatus.
Liparis fucensis.
Pholis ornatus.
Lumpenus anguillaris.
Microgadus proximus.
Citharichthys sordidus.
Parophrys vetulus.
Lepidopsetta bilineata.
Platichthys stellatus.

At Neah Bay, Washington, were obtained: *Ammodytes personatus*, *Gasterosteus cataphractus*, and young examples of *Bathymaster jordani*.

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