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BUREAU OF FISHERIES

U. S. Bureau of Commercial Fisheries.

# REPORT

OF THE

# UNITED STATES COMMISSIONER OF FISHERIES

FOR THE FISCAL YEAR 1913

WITH

# APPENDIXES

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## Report of the United States Commissioner of Fisheries

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# REPORT OF THE UNITED STATES COMMISSIONER OF FISHERIES FOR THE FISCAL YEAR ENDING JUNE 30, 1913

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# REPORT

OF THE

# COMMISSIONER OF FISHERIES.

DEPARTMENT OF COMMERCE,
BUREAU OF FISHERIES,
*Washington, December 13, 1913.*

SIR: There is submitted herewith a report giving an outline review of the operations of the Bureau of Fisheries during the fiscal year ended June 30, 1913.

## PROPAGATION AND DISTRIBUTION OF FOOD FISHES.

### GENERAL EXTENT OF THE WORK.

In this most extensive and important branch of the Bureau of Fisheries no material changes were made in 1913 in the methods heretofore pursued, but the extension of the work into new fields through the establishment and operation of inexpensive auxiliary stations at advantageous points resulted in an output exceeding that of any previous year, though the available expenditures were not increased. In other words, notwithstanding the higher cost of labor and materials the Bureau has succeeded in producing fish at a smaller cost per unit than ever before.

The outcome of fish-cultural operations in any given field is governed largely by local climatic conditions prevailing during the comparatively short spawning seasons of the various species. Storms, freshets, and drought prevent the ascent of river fish to their spawning grounds, rendering ineffective the preparations made for taking their eggs; abnormal heat or cold, with sudden changes in water temperature, may cause heavy losses of eggs and fry in the early stages of development; still other natural agencies often interfere with the most carefully planned operations. The most serious conditions with which the Bureau has to contend, however, are of an artificial nature. The construction of dams without efficient fishways; the operation of nets in prohibited waters or at the mouths of streams, thus preventing the adult fish from reaching their spawning grounds; and the destruction of fishes and fish food through water pollution, are some of the factors which nullify the fish-cultural work of the Bureau in some sections of the country; while the failure of some of the States to enact or enforce adequate protective laws, and the disposition of others to appropriate to their own use fields which have been developed and are already occupied by the Bureau, tend to hamper and curtail its activities.

Despite the scope and magnitude of its operations, the Bureau has difficulty, with its present facilities, in meeting the constantly growing demands from all sections of the country for fish to stock public and private waters. Salmonoid fishes, which are propagated by the artificial manipulation of the eggs, can be produced in sufficient numbers; but with a fuller realization of the benefits accruing from the maintenance of fish ponds on farms, as an inexpensive and ready food supply for home consumption, the demands for the black basses, crappies, sunfishes, catfishes, and other species adapted to pond culture, which are obtainable only through natural reproduction, have increased out of all proportion to the annual supplies available.

Following is a summarized statement of the output of food and game fishes during the fiscal year 1913. The total production, amounting to more than 3,863,000,000, showed a substantial gain over the previous year. More than 85 per cent of the product was distributed in the form of fry, and over 10 per cent was fertilized eggs which were either transferred to outside agencies for the completion of incubation or planted on the natural spawning grounds because of overcrowded condition of the hatcheries. The 45 species handled include the most important fishes of the coastal and interior waters.

SUMMARY, BY SPECIES, OF THE DISTRIBUTION OF FISH AND FISH EGGS DURING THE FISCAL YEAR 1913.

| Species. | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Total. |
|---|---|---|---|---|
| Catfish |  |  | 62,446 | 62,446 |
| Carp |  |  | 79,160 | 79,160 |
| Buffalofish |  | 3,080,000 | 4,212 | 3,084,212 |
| Shad | 3,394,000 | 133,244,850 |  | 136,638,850 |
| Whitefish | 73,720,000 | 393,880,000 |  | 467,600,000 |
| Lake herring |  | 4,730,000 |  | 4,730,000 |
| Silver salmon | 102,000 | 14,184,283 | 69,800 | 14,356,083 |
| Chinook salmon | 38,583,873 | 33,319,423 | 97,760 | 72,001,056 |
| Blueback salmon | 2,000,000 | 80,340,902 |  | 82,340,902 |
| Humpback salmon |  | 153,680 |  | 153,680 |
| Dog salmon |  | 19,479,000 |  | 19,479,000 |
| Steelhead trout | 980,000 | 4,300,225 | 138,410 | 5,418,635 |
| Rainbow trout | 1,106,000 | 901,370 | 1,150,957 | 3,158,327 |
| Atlantic salmon |  | 3,492,464 | 4,304 | 3,496,768 |
| Landlocked salmon | 224,000 | 253,546 | 80,196 | 557,742 |
| Black-spotted trout | 13,305,000 | 766,950 | 7,174,060 | 21,246,010 |
| Loch Leven trout |  |  | 75,200 | 75,200 |
| Lake trout | 6,612,000 | 20,594,600 | 3,024,924 | 30,231,524 |
| Brook trout | 1,239,000 | 5,280,452 | 6,014,645 | 12,534,097 |
| Grayling | 903,000 | 2,613,000 |  | 3,516,000 |
| Smelt | 4,500,000 | 1,850,000 | 27,000 | 6,377,000 |
| Pike and pickerel |  |  | 9,004 | 9,004 |
| Crappie and strawberry bass |  |  | 79,279 | 79,279 |
| Rock bass |  |  | 64,743 | 64,743 |
| Warmouth bass |  |  | 1,390 | 1,390 |
| Small-mouth black bass |  | 234,300 | 107,641 | 341,941 |
| Large-mouth black bass |  | 26,250 | 1,231,052 | 1,257,302 |
| Sunfish (bream) |  |  | 203,623 | 203,623 |
| Pike perch | 46,200,000 | 148,510,000 |  | 194,710,000 |
| Yellow perch | 11,000,000 | 365,723,000 | 25,132 | 376,748,132 |
| White perch | 20,000,000 | 449,120,000 | 721 | 469,120,721 |
| Striped bass |  | 7,234,000 |  | 7,234,000 |
| Yellow bass |  |  | 255 | 255 |
| Cod | 6,800,000 | 221,012,000 |  | 227,812,000 |
| Pollock | 133,739,000 | 430,060,000 |  | 563,799,000 |
| Haddock | 57,868,000 | 68,257,000 |  | 126,125,000 |
| Flatfish |  | 809,270,000 |  | 809,270,000 |
| Lobster |  | 199,680,000 | 200 | 199,680,200 |
| Total | 422,275,873 | 3,421,591,295 | 19,726,114 | 3,863,593,282 |

The distribution of this output necessitated 641,250 miles of travel, 123,394 of which were performed by the Bureau's cars and the remainder by detached messengers. All transportation was paid for with the exception of 12,314 miles of car travel and 81,355 miles by messengers.

## STATIONS OPERATED.

The permanent hatcheries operated in 1913 numbered 34, and the subhatcheries, auxiliaries, and egg-collecting stations numbered 102. These were located in 30 States and Alaska. The hatcheries may be conveniently classified as follows:

| Location and character of operations. | Number. |
|---|---|
| Atlantic rivers, for salmon, shad, striped bass, yellow perch, and white perch | 4 |
| Pacific rivers, for salmon and steelhead trout | 5 |
| Great Lakes, for whitefish, cisco, lake trout, and pike perch | 4 |
| Interior waters, for bass, sunfish, crappie, trout, etc. | 18 |
| Atlantic coast, for cod, haddock, pollock, flounder, and lobster | 3 |
| Total | 34 |

A full list of the hatcheries operated, and the subsidiary stations under each, with the period of operation and the species handled, is here given. The main stations, arranged in alphabetical order, are those for which a superintendent and other employees are provided by law. The subordinate stations, which are sometimes as fully equipped and important as the others, but have no special superintendent and often no permanent personnel whatever, are arranged under their respective head stations.

Fish-Cultural Stations Operated During the Fiscal Year 1913.

| Designation. | Period of operation. | Species handled. |
|---|---|---|
| Afognak, Alaska | Entire year | Blueback and humpback salmon. |
| Eagle Harbor, Alaska | May 30-June 30 | Blueback salmon. |
| Uganak Lake, Alaska | June 11-June 30 | Do. |
| Baird, Cal | Entire year | Chinook salmon. |
| Battle Creek, Cal | Oct.-Jan | Do. |
| Hornbrook, Cal | Oct.-May | Silver salmon and rainbow trout. |
| Mill Creek, Cal | Oct.-Jan | Chinook salmon. |
| Baker Lake, Wash | Entire year | Chinook, blueback, and silver salmon and steelhead trout. |
| Birdsview, Wash | do | Chinook, blueback, silver, dog, and humpback salmon and steelhead trout. |
| Brinnon, Wash | do | Dog salmon and steelhead trout. |
| Darrington, Wash | do | Silver, chinook, and dog salmon and steelhead trout. |
| Duckabush, Wash | do | Chinook, silver, and dog salmon and steelhead trout. |
| Elwell Creek, Wash | Sept. 11-June 30 | Chinook and silver salmon and steelhead trout. |
| Illabott Creek, Wash | Entire year | Chinook, silver, and dog salmon and steelhead trout. |
| Quilcene, Wash | do | Silver and dog salmon and steelhead trout. |
| Battery, Md | May 6-May 25 | Yellow perch, shad, and white perch. |
| Boothbay Harbor, Me | Entire year | Cod, flatfish, haddock, and lobster |
| Portland, Me | July 1-Nov. 30; May 5-June 30 | Lobster. |

FISH-CULTURAL STATIONS OPERATED DURING THE FISCAL YEAR 1913—Continued.

| Designation. | Period of operation. | Species handled. |
|---|---|---|
| Bozeman, Mont | Entire year | Brook, black-spotted, rainbow, steelhead, and lake trout and grayling. |
| O'Dell Creek, Mont | Apr. 1-May 12 | Grayling. |
| Red Rock, Mont | May 1-June 30 | Do. |
| South Meadow Creek, Mont. | Apr. 1-June 26 | Grayling and rainbow trout. |
| Yellowstone Park, Wyo | July 1-Sept. 10; June 6-June 30. | Black-spotted trout. |
| Beaver Dam, Wyo | July 23-July 27 | Do. |
| Clear Creek, Wyo | July 5-July 27 | Do. |
| Columbine Creek, Wyo | July 9-July 19 | Do. |
| Cub Creek, Wyo | July 5-Aug. 20 | Do. |
| Lake Camp, Wyo | July 1-Sept. 10; June 6-June 30. | Do. |
| Thumb Camp, Wyo | July 1-Aug. 17; June 12-June 30. | Do. |
| Bryan Point, Md | Feb. 11-May 22 | Yellow perch and shad. |
| Cape Vincent, N. Y | Entire year | Whitefish, cisco, lake, brook, and rainbow trout, pike perch, yellow perch, and landlocked salmon. |
| Mud Creek, N. Y | Apr | Pike perch. |
| Three Mile Bay, N. Y | Nov | Whitefish and cisco. |
| Clackamas, Oreg | Entire year | Chinook and silver salmon, brook, rainbow, black-spotted, and steelhead trout. |
| Applegate Creek, Oreg | Sept. 10-May 31 | Silver salmon and steelhead trout. |
| Big White Salmon River, Wash. | Aug. 1-Feb. 28 | Chinook salmon. |
| Eagle and Tanner Creeks, Oreg. | Sept. 1-Oct. 31 | Do. |
| Eagle Creek, Oreg | Apr. 1-June 20 | Steelhead trout. |
| Illinois River, Oreg | Sept. 1-Jan. 1 | Chinook and silver salmon. |
| Little White Salmon River, Wash. | Entire year | Chinook salmon. |
| Lower Rogue River, Oreg | Aug. 15-Mar. 31 | Do. |
| Rogue River, Oreg | Entire year | Chinook and silver salmon, steelhead and black-spotted trout. |
| Upper Clackamas River, Oreg. | do | Chinook and silver salmon, and steelhead trout. |
| Willamette Falls, Oreg | June 15-July 15 | Shad. |
| Cold Springs, Ga | Entire year | Large-mouth black bass, sunfish, and catfish. |
| Harris Pond, Ga | do | Catfish and sunfish. |
| Craig Brook, Me | do | Atlantic, landlocked, and chinook salmon, brook, rainbow, and Scotch sea trout, and hybrids. |
| Upper Penobscot, Me | Jan.-June | Atlantic salmon. |
| Duluth, Minn | Entire year | Lake, rainbow, brook, and steelhead trout, whitefish, pike perch, and landlocked salmon. |
| Grand Marais, Minn | Sept. 25-Dec. 3 | Lake trout. |
| Grand Portage, Minn | Nov. 5-Dec. 2 | Do. |
| Isle Royale, Mich | Oct. 14-Nov. 10 | Do. |
| Keweenaw Point, Mich | Oct. 6-Oct. 22 | Do. |
| Le Claire Point, Minn | July 1-Oct. 5 | Sturgeon. |
| Little Brule, Minn | Nov. 11-Dec. 6 | Lake trout. |
| Marquette, Mich | Oct. 11-Nov. 13 | Do. |
| Munising, Mich | Oct. 14-Nov. 10 | Do. |
| Ontonagon, Mich | do | Do. |
| Edenton, N. C | Entire year | Shad and black bass. |
| Weldon, N. C | Mar. 15-May 15 | Striped bass. |
| Erwin, Tenn | Entire year | Rainbow and brook trout, large-mouth and small-mouth black bass, rock bass, sunfish, yellow perch, yellow catfish, and carp. |
| Gloucester, Mass | do | Cod, pollock, haddock, flatfish, and lobster. |
| Boston, Mass | Oct. 11-Nov. 15; Apr. 20-June 30. | Lobster. |
| Portsmouth, N. H | May 1-June 30 | Do. |
| Rockport, Mass | Oct. 1-June 30 | Lobster, cod, and haddock. |
| Green Lake, Me | Entire year | Landlocked salmon, brook trout, lake trout, and smelt. |
| Grand Lake Stream, Me | do | Landlocked salmon and brook trout. |
| Homer, Minn | do | Rainbow trout, buffalo-fish, catfish, yellow perch, large-mouth and small-mouth black bass, crappie, sunfish, and rock bass. |
| La Crosse, Wis | do | Buffalo-fish, catfish, yellow perch, large-mouth and small-mouth black bass, crappie, sunfish, and rock bass. |
| Leadville, Colo | do | Brook, rainbow, and black-spotted trout. |
| Cheesman Lake, Colo | Apr. 10-May 16 | Rainbow trout. |
| Edith Lake, Colo | Oct. 15-Nov. 20 | Brook trout. |
| Eldora Lake, Colo | Oct. 15-Nov. 18 | Do. |
| Engelbrecht Lake, Colo | Oct. 9-Nov. 16 | Do. |

FISH-CULTURAL STATIONS OPERATED DURING THE FISCAL YEAR 1913—Continued.

| Designation. | Period of operation. | Species handled. |
|---|---|---|
| Leadville, Colo.—Continued. | | |
| Miklick Ponds, Colo | Nov | Brook trout. |
| Musgrove Lakes, Colo | Oct. 10-Dec. 2 | Do. |
| Seven Lakes, Colo | June 16-July 15 | Black-spotted trout. |
| Smith Ponds, Colo | Oct. 26-Dec. 6 | Brook trout. |
| Mammoth Spring, Ark | Entire year | Small-mouth and large-mouth black bass, crappie, catfish, sunfish, and rock bass. |
| Friars Point, Miss | May 5-June 30 | Large-mouth black bass, catfish, and sunfish. |
| Marked Tree, Ark | July 1-Sept. 10 | Large-mouth black bass, crappie, sunfish, catfish, pickerel, and buffalo-fish. |
| Manchester, Iowa | Entire year | Brook and rainbow trout, small-mouth black bass, and rock bass. |
| Bellevue, Iowa | July 15-Sept. 1; Apr. 1-May 17 | Black bass, sunfish, catfish, pike, crappie, and buffalo-fish. |
| North McGregor, Iowa | July 15-Aug. 1; Apr. 25-May 15 | Black bass and catfish. |
| Nashua, N. H | Entire year | Brook, rainbow, and steelhead trout, chinook salmon, and small-mouth black bass. |
| Neosho, Mo | do | Rainbow trout, large-mouth and small-mouth black bass, rock bass, crappie, sunfish, and carp. |
| Northville, Mich | do | Lake, brook, and rainbow trout, small-mouth and large-mouth black bass, crappie, catfish, and yellow perch. |
| Algonac, Mich | May 1-May 21 | Pike perch. |
| Au Sable, Mich | Nov. 5-Nov. 9 | Lake trout. |
| Bay City, Mich | Mar. 22-May 3 | Pike perch and yellow perch. |
| Belle Isle, Mich | Oct. 24-Dec. 10 | Whitefish. |
| Charity Island, Mich | Oct. 9-Nov. 30 | Do. |
| Charlevoix, Mich | Nov. 5-Nov. 22; Feb. 17-May 10 | Lake trout and whitefish. |
| Cheboygan, Mich | Oct. 18-Nov. 6 | Lake trout. |
| Detour, Mich | Oct. 14-Nov. 9 | Do. |
| Detroit, Mich | Entire year | Whitefish, yellow perch, and pike perch. |
| Fairport, Mich | Nov. 1-Nov. 20 | Lake trout. |
| Frankfort, Mich | Nov. 6-Nov. 20 | Do. |
| Grand Haven, Mich | Nov. 5-Nov. 20 | Do. |
| Grassy Island, Mich | Oct. 21-Dec. 7 | Whitefish. |
| Great Lake George, Mich | Oct. 17-Nov. 16 | Do. |
| Manistique, Mich | Oct. 28-Nov. 21 | Lake trout. |
| Port Huron, Mich | May 3-May 17 | Pike perch. |
| St. James, Mich | Nov. 1-Nov. 22 | Lake trout. |
| St. Joseph, Mich | Oct. 21-Nov. 20 | Do. |
| Sault Ste. Marie, Mich | Feb. 15-May 15 | Whitefish and lake trout. |
| Put-in Bay, Ohio | Entire year | Whitefish, pike perch, and yellow perch. |
| Kellys Island, Ohio | Nov. 12-Dec. 4 | Whitefish. |
| Middle Bass, Ohio | Nov. 18-Dec. 4 | Do. |
| Monroe Piers, Mich | Nov. 1-Dec. 8 and Apr | Whitefish and pike perch. |
| North Bass, Ohio | Nov. 12-Dec. 7; Apr. 17-May 8 | Whitefish, pike perch, and yellow perch. |
| Port Clinton, Ohio | Nov. 10-Dec. 7; Apr. 8-Apr. 29 | Whitefish and pike perch. |
| Toledo, Ohio | Apr. 7-Apr. 30 | Pike perch. |
| Quincy, Ill | Entire year | Large-mouth and small-mouth black bass, rock bass, pike perch, yellow perch, sunfish, catfish, crappie, buffalo-fish, and carp. |
| St. Johnsbury, Vt | do | Brook, rainbow, and steelhead trout, silver and landlocked salmon, and small-mouth black bass. |
| Darling Pond, Vt | July 19-Dec. 6 | Brook trout. |
| Holden, Vt | Entire year | Brook and steelhead trout. |
| Lake Mitchell, Vt | Sept. 4-Nov. 30 | Brook trout. |
| Lake Wantastiquet, Vt | Sept. 16-Dec. 4 | Do. |
| Orleans, Vt | Apr. 16-May 16 | Steelhead trout. |
| Swanton, Vt | Mar. 12-May 23 | Pike perch and yellow perch. |
| San Marcos, Tex | Entire year | Black bass, rock bass, crappie, and sunfish. |
| Spearfish, S. Dak | do | Brook, Loch Leven, rainbow, black-spotted, lake, and steelhead trout. |
| Schmidt Lakes, S. Dak | Oct. 20-Dec. 20 | Brook trout. |
| Sand Creek, S. Dak | Oct. 20-Jan. 15 | Do. |
| Tupelo, Miss | Entire year | Large-mouth black bass, rock bass, sunfish, warmouth bass, crappie, catfish, and yellow perch. |
| Rosedale, Miss | July-Dec | Large-mouth black bass, rock bass, yellow bass, crappie, sunfish, catfish, and white bass. |

FISH-CULTURAL STATIONS OPERATED DURING THE FISCAL YEAR 1913—Continued.

| Designation. | Period of operation. | Species handled. |
|---|---|---|
| White Sulphur Springs, W. Va. | Entire year | Brook, rainbow, and blackspotted trout, small-mouth and large-mouth black bass. |
| Woods Hole, Mass. | do | Cod and flatfish. |
| Noank, Conn. | Mar. 8-Mar. 25 | Flatfish. |
| Plymouth, Mass. | Nov. 19-Mar. 25 | Cod. |
| Sagamore, Mass. | do | Do. |
| Waquoit, Mass. | Jan. 13-Mar. 25 | Flatfish. |
| Wickford, R. I. | Feb. 19-Mar. 25 | Do. |
| Wytheville, Va. | Entire year | Brook and rainbow trout, large-mouth and small-mouth black bass, rock bass, and sunfish. |
| Yes Bay, Alaska | do | Blueback salmon. |

## FISH-CULTURAL RELATIONS WITH THE STATES AND WITH FOREIGN COUNTRIES.

The Bureau has continued and extended its cooperative relations with the State fishery authorities, and in 1913 allotted large numbers of eggs to be hatched under State auspices and considerable numbers of young fish, for planting in local waters. The States which requested this kind of aid from the Bureau number 25 and include nearly all that are engaged in practical fish culture. A list of the States, and the allotments to each, is shown in the following table:

ALLOTMENTS OF FISH AND FISH EGGS TO STATE FISH COMMISSIONS IN THE FISCAL YEAR 1913.

| State and species. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| California: | | | |
| Brook trout | 150,000 | | |
| Chinook salmon | 16,942,873 | | |
| Grayling | 50,000 | | |
| Landlocked salmon | 10,000 | | |
| Colorado: Blackspotted trout | 2,000,000 | | |
| Connecticut: | | | |
| Brook trout | 25,000 | | |
| Lake trout | 50,000 | | |
| Yellow perch | 5,000,000 | | |
| Delaware: Black bass | | | 150 |
| Georgia: | | | |
| Black bass | | | 2,500 |
| Sunfish | | | 700 |
| Idaho: Brook trout | | | 1,650 |
| Maine: | | | |
| Brook trout | 100,000 | | |
| Landlocked salmon | 100,000 | | |
| Maryland: Black bass | | | 600 |
| Massachusetts: | | | |
| Catfish | | | 300 |
| Chinook salmon | 50,000 | | |
| Pike perch | 4,000,000 | | |
| White perch | 15,000,000 | | |
| Yellow perch | 5,000,000 | | |
| Michigan: | | | |
| Grayling | 50,000 | | |
| Lake trout | 3,000,000 | | |
| Pike perch | 41,700,000 | | |
| Yellow perch | | 3,500,000 | |
| Minnesota: | | | |
| Lake trout | 500,000 | | |
| Landlocked salmon | 10,000 | | |
| Steelhead trout | 100,000 | | |
| Missouri: Rainbow trout | | | 37,800 |

ALLOTMENTS OF FISH AND FISH EGGS TO STATE FISH COMMISSIONS IN THE FISCAL YEAR 1913—Continued.

| State and species. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Montana: | | | |
| Blackspotted trout | 2,038,500 | | |
| Brook trout | 200,000 | | |
| Grayling | 588,000 | | |
| Rainbow trout | 50,000 | | |
| Whitefish | 3,000,000 | | |
| Nevada: | | | |
| Brook trout | 50,000 | | |
| Rainbow trout | 50,000 | | |
| Silver salmon | 100,000 | | |
| New Hampshire: | | | |
| Chinook salmon | | | 7,900 |
| Steelhead trout | 75,000 | | |
| New Jersey: | | | |
| Landlocked salmon | 8,000 | | |
| Rainbow trout | 50,000 | | |
| Steelhead trout | 100,000 | | |
| White perch | | 2,000,000 | |
| Yellow perch | | 2,000,000 | |
| North Dakota: Steelhead trout | 200,000 | | |
| Ohio: Whitefish | 19,280,000 | | |
| Oregon: | | | |
| Blackspotted trout | 625,000 | | |
| Blueback salmon | 2,000,000 | | |
| Brook trout | 300,000 | | |
| Chinook salmon | 21,491,000 | | |
| Rainbow trout | 380,000 | | |
| Pennsylvania: | | | |
| Lake trout | 100,000 | | |
| Whitefish | 40,920,000 | | |
| Utah: | | | |
| Brook trout | | | 12,000 |
| Catfish | | | 72 |
| Small-mouth black bass | | | 160 |
| Vermont: | | | |
| Brook trout | | 50,000 | |
| Lake trout | 150,000 | | |
| Landlocked salmon | 10,000 | | |
| Steelhead trout | 30,000 | | |
| Washington: | | | |
| Blackspotted trout | 400,000 | | |
| Steelhead trout | 200,000 | | |
| Wisconsin: | | | |
| Lake trout | 2,500,000 | | |
| Whitefish | 5,000,000 | | |
| Wyoming: | | | |
| Black bass | | | 60 |
| Blackspotted trout | 2,200,000 | | |
| Brook trout | 225,000 | | 560 |
| Grayling | 50,000 | | |
| Lake trout | 50,000 | | 2,000 |
| Rainbow trout | 148,000 | | |
| Steelhead trout | 100,000 | | |
| Total | 196,506,373 | 7,550,000 | 66,452 |

In response to requests coming through diplomatic channels, in return for courtesies received, the Bureau furnished the following numbers of eyed eggs to the authorities of the countries indicated:

SHIPMENT OF EGGS TO FOREIGN COUNTRIES DURING THE FISCAL YEAR 1913.

| Country. | Species. | Number. |
|---|---|---|
| British Columbia | Whitefish | 5,000,000 |
| Canada | Brook trout | 150,000 |
| | Steelhead trout | 100,000 |
| Germany | Rainbow trout | 100,000 |
| India | do | 10,000 |
| Japan | do | 250,000 |
| Total | | 5,610,000 |

REVIEW OF FISH-CULTURAL OPERATIONS.

*Pacific coast and Alaska stations.*—No improvement has occurred in the conditions which have prevailed for some years in the Sacramento River and tributaries, resulting in a general decline of the salmon runs, and a relative falling off in the output of the Bureau's California stations. A large run of salmon was reported in the Sacramento River in the fall of 1912, but owing to extremely low water during the spawning season comparatively few of the fish were able to enter the tributaries on which the hatcheries are located. Later on, unusually heavy freshets partly wrecked the retaining racks and permitted the impounded fish to escape. An attempt was made late in the fall to secure eggs from commercial fishermen operating in the Sacramento River, near Tehama, Cal., but no ripe fish were found, and the fishermen abandoned the work early on account of the low market value of their catch. The entire collection of chinook salmon eggs for the Baird, Battle Creek, and Mill Creek stations amounted to 20,111,800. Low-water stages also existed throughout the season in Cottonwood Creek, at Hornbrook, Cal., and in the Klamath River, at Klamathon, Cal., reducing the collections of rainbow trout and silver salmon eggs at these points below those of the preceding year.

Increased efforts and the generally favorable climatic conditions prevailing in Oregon resulted in substantial gains in the output of fish from the stations in that State. There was an unusually heavy run of chinook salmon in the Columbia River and tributaries, continuing from early in September until late in the fall. On the Little White Salmon River 30,595,000 eggs were secured, filling the hatchery to its capacity and necessitating the transfer of large numbers of eggs to other stations to relieve the congested condition. The collections at the Big White Salmon station were supplemented by eggs derived from brood fish purchased of trap fishermen operating in the Columbia River, the fish thus obtained being towed to the station and held in a small stream on the reservation for the ripening of their eggs. The output of salmon fry at the two Columbia River stations was the largest in their history. The egg collections on the Little White Salmon exceeded those of any previous year by 12,000,000, and when the work was discontinued on October 7, owing to lack of hatching facilities, ripe salmon were still available.

The same conditions governing the run of salmon in the Columbia River existed in other streams in Oregon, and resulted in an increased output of silver salmon and steelhead trout. The Cazadero field station, on the upper Clackamas River, having been cut off from the free passage of fish by the recent construction of an 80-foot dam, a new site for the conduct of operations was selected at a point on the river 30 miles distant from Portland, the land for the purpose and the water supply for the hatchery being donated to the Bureau by the Portland Railway, Light & Power Co.

The year's fish-cultural operations at Baker Lake and auxiliary stations, in Washington, were attended with gratifying results, the output of chinook, blueback, silver and dog salmons, and steelhead trout being substantially larger than in either of the two previous years. The total egg collections of all species numbered 46,330,500, as compared with an aggregate of 23,535,800 in 1912, and the output of fry was correspondingly increased. At the other Puget Sound stations there was a slight falling off in the output of silver salmon, owing to the destruction of the retaining racks by freshets during the spawning season, but the losses were more than offset by the collections at two new field stations established and operated for the first time on Elwell Creek, near Sultan, and on the Sauk River, near Darrington. A new station was also operated on the Dusenwallops River, a tributary of Hood Canal, Puget Sound, near Brinnon, Wash., where 8,360,000 dog salmon eggs were gathered. The work of the Baker Lake station, which is located in an almost inaccessible region on Baker Lake, at the foot of Mount Baker, was greatly facilitated by the establishment of a telephone line connecting the station with Concrete, Wash., the nearest railroad station, 18 miles distant. The Birdsview station, on the Skagit River, was improved by the erection of new hatchery and other buildings.

The eruption of Katmai Volcano, on the Alaska peninsula, June 6, 1912, covered the island of Afognak with volcanic ash and sand to an average depth of 9 inches. It is estimated that 20,000 salmon perished at the head of Litnik Lake, while thousands ascending tributary streams during the spawning season in July were driven back into the ocean. These conditions curtailed the work of the Afognak station, the total output for the year 1913 amounting to 12,551,102 blueback and 151,800 humpback salmon fry. Owing to the accumulation of volcanic ash in the hatching troughs, great difficulty was experienced in holding the comparatively small number of eggs collected, and heavy losses of both eggs and fry resulted through suffocation. In May, 1913, two temporary field stations were located in connection with the Afognak station—one on a small stream tributary to Eagle Harbor and one at Uganak Lake, Kodiak Island. Racks were constructed and the salmon runs were investigated with the view of ascertaining if the conditions warrant the establishment of permanent stations in these fields.

At the Yes Bay, Alaska, station there was a slight shortage in the collection of blueback salmon eggs, owing to low-water stages early in the season, followed later by heavy rains and freshets, which partly destroyed the retaining racks and allowed the escape of several thousand ripe fish. During the early part of the season the eggs collected were of poor quality, owing, it is supposed, to the low water which caused the fish to remain in the lake too long after their eggs matured. The eggs improved in quality as the season advanced, the operations resulting in a total yield of 66,125,000, a shortage of 5,875,000 as compared with the take of last year. Many improvements were made to the buildings and apparatus during the year, the most important of which was the installation and operation of 160 additional hatching troughs.

The condition of the salmon fisheries of the Pacific coast warrants continuous and systematic investigation and makes imperative the greatest possible exertions on the part of the Bureau to propagate the various salmons on a more extensive scale and to distribute the young fish in a manner which will insure the largest results. The superintendent of the California stations reports that a large percentage of the young salmon liberated in the Sacramento River perish on the lowlands, because of irrigating ditches and overflows or easements of the river. The subject has been forcefully treated in various reports from the Bureau's representatives and demands the serious attention of the State authorities. Another feature of the salmon situation in California which may necessitate a complete change in the method of planting is the enormous destruction caused by trout and other predaceous fishes while the young are on their way to the sea.

Better conditions obtain in the States of Oregon and Washington. The irrigation of arid lands is not practiced so extensively as in California, and most of the hatcheries are located nearer tidewater, thereby lessening the loss of young salmon by attacks of predaceous fishes during passage to the sea. Extensive field operations were conducted in Oregon and Washington during 1913, and plans have been made for still greater expansion of the work during the next fiscal year. In the Columbia basin, investigations are now being made, with the view of establishing a station at Swan Falls, Idaho, for the propagation of the early run of chinook salmon.

The results this year at the Quilcene and Duckabush stations, which were operated for the first time in 1912, indicate that the establishment of inexpensive egg-collecting camps on streams tributary to Hood Canal will result in good returns of silver and dog salmon. An additional station on the Sauk River, at Darrington, Wash., plans for which are now being drawn, will add materially to the output of salmon from the Washington stations.

In view of the accepted belief that the salmon fisheries can be more effectively aided and maintained through the liberation of fingerling fish, arrangements have been made to increase the facilities at all the Pacific coast stations, including those in Alaska, for the purpose of rearing a larger number of salmon fry to the fingerling stage than ever before.

*Commercial fishes of the Great Lakes.*—The extensive and long-continued operations of the Bureau in the Great Lakes are addressed to the lake trout, whitefish, cisco or lake herring, and pike perch. In addition to the stations belonging to the Government, several hatcheries, abandoned by the State of Michigan for a number of years because of the discontinuance of work of this character, were leased by the Bureau and operated with temporary personnel.

The most important fish-cultural work of the Duluth, Minn., station—the maintenance of the lake trout fisheries of Lake Superior—was slightly interfered with by storms occurring at the height of the spawning season, which not only reduced the egg collections considerably below what had been anticipated, but also impaired to some extent the quality of the eggs secured. The spawning season in the various fields of this lake extended from September 25 to December 6, and resulted in the collection of 10,035,000 eggs, which stock was augmented by the transfer of 5,000,000 green eggs from the Manistique field, a subsidiary of the Northville station. The output of lake trout from Duluth consisted of 1,260,000 eyed eggs, for the stocking of various Government, State, and private hatcheries, and 6,825,000 fry and fingerling fish, for liberation on the spawning grounds in Lake Superior. Additional transfers of eggs of commercial species from other stations to Duluth comprised 20,000,000 whitefish eggs from Put-in Bay station and 25,000,000 pike-perch eggs from Detroit, which were hatched and distributed with only normal losses, the whitefish being deposited in Lake Superior and the pike perch utilized in filling applications for the stocking of various inland lakes in Minnesota and adjacent States.

In the fields operated from the Michigan stations the spawning season of the lake trout opened October 21, a week later than usual, and was just at its height at the beginning of the close season on November 20, when under the State law it became necessary to suspend operations. The collections of eggs at all points numbered 53,907,500, and had the open season been extended a week it is estimated that many million more eggs might have been secured. Approximately 14,000,000 eggs were utilized in stocking various Government and State hatcheries, and 13,500,000 fry were hatched and returned to the spawning grounds in Lakes Michigan and Huron. The whitefish spawning season in Michigan waters extended over a period of two months from October 9, the largest egg collections being obtained from the Detroit River fields, where fishing was conducted under the auspices of the State game, fish, and forestry warden's department. Extensive collections of eggs were made also at Charity Island, in Saginaw Bay, the brood fish being secured from pound nets operated by a fisherman under a special contract. Work in this field was brought to a sudden close at the height of the season by a disastrous windstorm, which put every net out of commission.

An experimental whitefish collecting station, operated for the first time in the American waters of upper Lake St. George, gave unsatisfactory results, as most of the fish were taken illegally by natives in the vicinity. The work of collecting pike-perch eggs for the Detroit hatchery was conducted from April 9 to May 21 in Saginaw Bay and the Canadian waters of the St. Clair River, 216,550,000 being obtained from fields which had yielded only 21,000,000 eggs in the spring of 1912.

The whitefish spawning season in Lake Erie, extending from November 12 to December 10, was not interfered with to any extent by storms, and the work accomplished was the most successful in the history of the Put-in Bay station, 350,080,000 eggs of good quality being secured from fields which yielded only 82,000,000 in 1912. An encouraging feature of the work was the interest displayed in it by many of the commercial fishermen, to whose assistance a considerable measure of the success may be attributed. Approximately 111,000,000 of the eggs secured were transferred in the green or eyed state to Government and State hatcheries, and 197,300,000 strong, healthy fry were hatched from the remainder and liberated in Lake Erie. The pike-perch work, on the other hand, proved very disappointing, especially in view of the encouraging prospects early in the spring, when brood fish were on the spawning grounds in the lake in large numbers. The prevalence of violent winds prevented the installation of the fishermen's nets for a month beyond the usual time, and before they could be operated to any extent most of the fishes had been driven from the grounds by the immense quantities of mud and filth discharged into the lake as a result of one of the heaviest floods ever experienced. The entire crop of eggs, amounting to 133,500,000, was developed at the Put-in Bay station, and the 46,500,000 fry produced were returned to the lake, no shipments of either eggs or fry being sent to other hatcheries.

No cisco work was attempted by the Bureau in Lake Erie, as arrangements for covering all available territory for the collection of eggs of that species had been made by the Ohio Fish Commission. The propagation of yellow perch and sauger, instituted in connection with the work of the Put-in Bay station in the spring of 1912, was again undertaken, but with poor results. Saugers for some unknown reason were very scarce, and the few eggs secured proved worthless, while the muddy condition of the water supply interfered with the hatching of the yellow-perch eggs to such an extent that only 3,000,000 fry were produced from the 8,064,000 eggs collected.

In Lake Ontario the newly developed fields for the collection of eggs of the whitefish, cisco, lake trout, and pike perch were operated during the respective spawning seasons. Three-Mile Bay and waters in the immediate vicinity of the Cape Vincent station yielded 1,160,000 whitefish and 5,350,000 cisco eggs; 144,160 lake-trout eggs were secured from the Pigeon Island fishery, while 3,937,500 pike-perch eggs of fair quality were obtained in Mud Creek. Far more satisfactory results might have been accomplished in all these fields had not the work been hampered during the entire period of operations by the unfavorable weather and water conditions prevailing. These eggs, together with 40,750,000 eggs of whitefish, lake trout, and pike perch transferred from other stations, were successfully hatched and distributed, most of the fry being liberated in Lake Ontario.

The collections of pike-perch eggs for the Swanton, Vt., station were only about half as large as those of the preceding year, the comparative failure being partially due to the scarcity of female fish on the spawning grounds. Male fish were there in great abundance, and later in the season a consignment of green females was tranferred from the Canadian fishing grounds in the north end of Missisquoi Bay and placed in a rude inclosure which had been provided for them in Lake Champlain, in the vicinity of the field of operations. They were held in good condition so long as a sufficient depth of water could be maintained in the inclosure, but before their eggs had matured in considerable numbers the water in the lake receded and became so warm that, in order to prevent the total loss of the impounded fish, the bulk of them were liberated before they had ripened.

With the view of being nearer the fishing grounds, and also in order that the Bureau might conduct its operations independently of the various persons controlling the river shores heretofore occupied, steps were taken in advance of the spawning season to establish a collecting and penning station on Lake Champlain, at Sandy Point, and while the outcome of the operations was not as favorable as had been anticipated it is believed the change in location prevented what would have otherwise been an almost complete failure, and that the difficulties encountered this season may be largely overcome another year by providing more suitable impounding facilities. The collections numbered 111,037,500, and the output of fry was 58,280,000. In connection with the pike-perch work, 23,300,000 eggs of the yellow perch were secured, 11,000,000 of which were utilized in filling applications from State fish commissions. The remainder were hatched and the fry returned to the spawning grounds.

Reports as to the abundance of the Lake Champlain whitefish in the vicinity of the Swanton station having led to the belief that there was a possibility of satisfactory results in the artificial propagation of this species, steps were taken during the fall of 1912 to impound brood fish in the inclosure at Sandy Point. In the three days mmediately preceding the opening of the fishing season several hundred brood fish were captured and penned, and throughout the open season all the seines within reach of the station were regularly visited by spawn takers, but in no instance was a ripe female secured. From the experience gained the conclusion has been reached that the spawning of the Lake Champlain whitefish occurs after the formation of ice in the lake, at a time when spawn-taking operations could not be successfully conducted.

*The marine stations.*—The Boothbay Harbor station, in cooperation with the fishery authorities of the State of Maine, collected during the year 16,965 egg-bearing lobsters, constituting the largest brood stock ever secured for the pound established in connection with that station. This stock was carried through the winter with only nominal losses, but the egg collections fell behind those of the preceding year, owing partly to the smaller average size of the lobsters and partly to the unusually large percentage of barren ones. This latter condition was brought about, it is believed, by the abnormally mild winter, which caused many of the lobsters to lose their eggs in the pound. The impounded lobsters yielded 161,064,000 eggs, an average of 12,122 per lobster. The loss on the eggs during incubation was insignificant, and the resulting fry were liberated in excellent condition.

An unusually large body of haddock made its appearance on the Maine coast near the Boothbay Harbor station about the middle of April and afforded excellent fishing for a month. During this period approximately 100,000,000 eggs were secured from the gill-net fishermen and transferred to the station, but the losses during incubation—always heavy on eggs of this species—reduced the stock to such an extent that only 22,967,000 fry were produced.

In marked contrast to the abundance of haddock was the great scarcity of flatfish during the spawning season, not only in fields contiguous to the Boothbay Harbor station, but in all waters along the Maine coast where they are usually found. The diligent operation of fyke nets at all likely points within reach of the station throughout the spawning season, extending from February 25 to the last week in April, resulted in a collection of only 4,007 breeders. Part of this stock was allowed to spawn naturally in the retaining tables, in accordance with past custom, but, owing to lack of room, many of the fish were stripped and the eggs fertilized artificially. The 452,386,000 eggs obtained produced 413,961,000 fry, the loss in hatching amounting to only about 9 per cent, as compared with 12 per cent the preceding year. There appears to be a growing sentiment in favor of the flatfish among the commercial fishermen of Maine, and it is believed the time is approaching when the Bureau will not be compelled, as at present, to rely solely on its own efforts in obtaining brood fish of this species.

Owing to the nonappearance of the usual inshore run of cod along the Maine coast the efforts of the Bureau to secure eggs in Casco Bay and at Cape Elizabeth proved nearly futile. A small run of fish appeared during the spring in the immediate vicinity of the Boothbay Harbor station, and had fishing operations in these waters been conducted with gill nets there is reason to believe that considerable collections of eggs might have been made. Equipped as the fishermen were, however, with short trawl lines, they met with poor results. The egg collections from all points amounted to 9,089,000 and the fry distributed numbered 5,611,000.

The year's work at the Gloucester station involved the handling of 1,431,588,000 eggs of four species of marine fishes and the lobster and the distribution of 825,050,000 fry hatched therefrom. Fish-cultural operations were continued uninterruptedly from November 1 to the close of the fiscal year, and at many times during this period eggs of the various species were received in such quantities that it was impossible to handle them all with the limited facilities available. The surplus eggs were transferred to the Woods Hole station when practicable, but plants of eggs of pollock, cod, and haddock aggregating 198,407,000 were made in the harbor off Gloucester, owing to the lack of hatching facilities at either station.

During the pollock spawning season, extending from November 1 to the end of January, 856,680,000 eggs were collected from fish taken by a fleet of gill-net steamers, and 430,060,000 fry of good quality were hatched and distributed on the natural spawning grounds off Cape Ann.

Eggs of the cod in considerable numbers began coming in immediately after the close of the pollock season, and with the exception of four days, lots were received daily from February 16 to April 7, the total collections amounting to 170,840,000. This noteworthy record is attributed to the mild weather prevailing throughout the spawning period. The eggs were generally of good quality, and in addition to the transfer of 13,096,000, owing to the crowded condition of the hatchery, 105,150,000 fry were produced for distribution along the Massachusetts coast.

Haddock eggs to the number of 135,800,000 were received between March 17 and April 15, at a time when the hatchery was so crowded that only about half of them could be handled with the apparatus available. The 77,932,000 eggs retained yielded 45,290,000 fry.

On account of inability to obtain brood fish in the usual numbers, the results of the flatfish work were only two-thirds as large as in the previous season. The 580 brood fish handled yielded 253,365,000 eggs, from which 230,070,000 fry were hatched and distributed. Early in the season these eggs were handled in Chester jars, but later, when all jars were needed for the cod and haddock eggs, the flatfish eggs were placed in scrim-covered floating boxes, made of 2 by 3 inch spruce, 5 feet long, 3 feet wide, and 2 feet deep, from 40,000,000 to 50,000,000 eggs to the box, and development proceeded fully as well as in the jars.

On May 1 the lobsters which had been carried through the winter in the compartment live-car at the Gloucester station were removed to the hatchery and stripped, 453 survivors of the 636 lobsters originally placed in the car yielding 4,811,000 eggs. The spring collection of lobsters for the Gloucester station was the poorest in years, only 543 breeders being secured. These yielded 8,767,000 eggs, giving a total of 13,578,000 for the season. At the close of the year 3,000,000 of these eggs were still in process of hatching.

The work of the Woods Hole station was confined principally to the propagation of cod and flatfish. In November a brood stock of cod was purchased from commercial fishermen and placed in the pool and live-cars to ripen. On November 20 the first consignment of cod eggs was received from the steamer *Phalarope*, operating in the field near Sagamore, Mass., and fair collections were received from that source until Christmas time, when for some reason the fish left the spawning grounds. Slightly more than 45,000,000 eggs were received from the field, and these, added to the yield of the brood stock, gave a total of 216,794,000, from which 110,251,000 fry were hatched and distributed.

Contrary to the conditions experienced at the other marine stations, flatfish were found in abundance in the territory surrounding the Woods Hole station, and the prospects early in the season seemed very promising. It soon transpired, however, that the mild weather, to which was attributed the plentiful supply of brood fish, was having a very detrimental effect upon the eggs, which in the majority of cases failed to develop, the season's collections of 541,114,000 producing only 165,239,000 fry. No lobster work was undertaken at the Woods Hole station the past season, as previous experience had shown that the supply of brood lobsters available on the southern Massachusetts coast was not sufficient to warrant the expense of collecting them. Efforts in this direction will therefore be confined for the present to the Gloucester station.

*Anadromous fishes of the Atlantic coastal streams.*—The fish-cultural season on the Susquehanna River was marked by peculiar conditions, high winds and correspondingly high or low tides being prevalent most of the time and interfering greatly with the operations of the fishermen. Yellow-perch eggs were received at Battery station daily from March 17 to March 22, when a heavy southwest storm arose, accompanied by rising temperature, and before its subsidence the spawning season of yellow perch had ended. The egg collections amounted to 286,325,000, and the output of fry to 229,060,000. Collections of white-perch eggs were begun April 8 and discontinued May 20, the 573,000,000 obtained yielding 372,450,000 fry, in addition to 20,000,000 eyed eggs shipped to applicants.

The collections of shad eggs for the Battery station extended from April 19 to May 20 and numbered only 6,861,000, as compared with a take of 12,175,000 in 1912. In addition to the growing scarcity of shad in this river, a most discouraging feature of the shad work is the constantly increasing number of set nets operated by commercial fishermen. The use of these permits destruction by eels of most of the eggs contained in fish taken, owing to the time that elapses between the capture and the tending of the nets.

On the Potomac River some difficulty was experienced in the yellow-perch work by the mild open winter, which permitted extended operations by the commercial fishermen and depleted the supply of brood fish to such an extent that it was impossible to secure a sufficiently large stock of breeders to fill the Bryan Point hatchery with eggs. The collections were made between February 21 and March 14, and resulted in obtaining 10,301 brood fish, about half the number desired. The spawning of these fish was completed by March 24, the total yield of eggs amounting to 124,800,000, an average of 12,115 per fish. A consignment of 3,900,000 eyed eggs was transferred to Central station, and the remaining stock produced 113,923,000 healthy fry, which were distributed in the tributaries of the Potomac River from Broad Creek, Md., to Occoquan Creek, Va.

A new feature of the shad work on the Potomac River was the conversion of a large scow into an auxiliary hatchery, capable of carrying 3,000,000 eggs, by installing thereon a table of 32 McDonald jars and a gasoline pumping plant of a capacity of 2,000 gallons per minute. The water for this hatchery was pumped into a 50-gallon barrel elevated 3 feet above the hatching table, and the connections were arranged for a gravity flow of water to the jars. The scow, thus fitted up and provided with a force of two experienced shad culturists, was moored in Occoquan Bay, Va., for the purpose of promptly and properly caring for all eggs that might be secured within a 24-hour period from the gill-net fishermen operating in that vicinity, such collections being transferred to the main hatchery every night by the steamer *Phalarope*. The provision of this subsidiary hatchery will be the means of saving large numbers of eggs that would otherwise be lost through failure to give them attention as soon as taken, the location in question being too far distant from the Bryan Point hatchery to permit of frequent transfers of eggs by messenger.

The shad spawning season opened April 12 and extended to May 17, by which time the shad run had ceased. The egg collections, amounting to 30,919,000, produced 28,428,000 excellent fry, which were carefully distributed over the spawning grounds in the Potomac River. The high percentage of hatch was due to the holding of all eggs delivered at the station for 48 hours before measuring them, and returns to the fishermen were made on the basis of that measurement.

In Albemarle Sound and the contiguous waters seaward, shad were more plentiful than for many years. The mild winter caused spawning fish to make their appearance in the sections operated from the Edenton station somewhat earlier than usual, the first eggs being secured March 20. Five days later the receipts of eggs at the station had become so enormous as to tax the hatching facilities, and shortly afterward the superintendent was compelled to discontinue collections for several days to relieve the congested condition. In the course of the spawning season, which lasted 46 days, there were three additional periods when eggs came in faster than they could be cared for, and on this account many eggs were lost. The season's collections amounted to 138,912,000, and had it not been for the limited hatching facilities they might have been at least 30 per cent greater. The output of fry amounted to 92,522,000, an increase of 20 per cent over that of the preceding year.

The propagation of white perch at the Edenton station having been decided on, three trips were made during March by spawn takers, with collecting outfit, to the spawning grounds of the species, about 20 miles below the station in Albemarle Sound. Practically no fish were secured, and from the information gained it was concluded that the spawning season would not occur until sometime in April, at which time the station force was fully occupied with the shad work. An attempt to propagate the hickory shad at the Edenton station also proved futile, owing to inability to secure the cooperation of the commercial fishermen.

In advance of the spawning season of the striped bass on the Roanoke River it became necessary to renew the hatchery and boiler house, the old plant having been carried away during a 45-foot rise in the river in March. The new hatchery, consisting of a 48 by 16 foot floor built on elevated timbers, and securely wired and anchored to the ground, with the view of resisting future floods, was completed and ready for the reception of eggs by the opening of the spawning season, April 25. The ideal fishing conditions—a series of small swells in the river, serving to keep the water roily so that the fish can not see and avoid the nets—were entirely absent during the season.

No rise of any consequence occurred after April 12, and while striped bass in unusual numbers were in evidence, the returns to the commercial fishermen were the smallest ever known. Notwithstanding the unfavorable weather conditions, more eggs were secured than last year, and the output of fry was greater than in any previous season. The comparative success is attributable in some measure to the proportionately larger number of ripe males secured, and also to the fact that more females in spawning condition were available than heretofore, both these propitious features being made possible by the very conditions which militated against successful fishing operations. Male and female fish, clustered together in the act of spawning, were easily distinguishable in the clear water of the river, and owing to its low stage it was comparatively easy to surround with a net and capture fish so clustered. By means of the motor launch recently provided for the work on this river, the eggs were collected from the commercial fishermen with greater facility than ever before, and to this fact may be attributed the higher percentage of hatch attained. The egg collections numbered 10,383,000, and the output of fry aggregated 7,234,000.

*Propagation of the trouts and pond fishes.*—At the trout stations of the Bureau the work in general was similar to that of preceding years. The supply of brook-trout eggs derived from brood fish carried in ponds and collected from wild stock was supplemented by the purchase of eggs from commercial dealers, this course having proved more economical for some stations than the collection of eggs from waters available for the purpose. The total output of fry and fingerling trout exceeded that of last year. Owing to unfavorable weather conditions during the spawning season, fewer rainbow trout were produced than in 1912, the falling off in this branch of the work being more noticeable in Colorado than elsewhere.

In the Yellowstone National Park the provision of additional facilities, the establishment of new field stations, and the extension of operations over a wider territory permitted the collection of approximately 29,000,000 blackspotted trout eggs, more than the number secured in that field in any previous year. The fish-cultural possibilities of Yellowstone Lake and tributary streams are practically unlimited and plans will be made another year to increase still further the output of blackspotted trout from this field, which at the present time is the Bureau's only source of supply for eggs of *Salmo lewisi*, one of the most important species of trout.

A new branch of fish culture undertaken in connection with the work of the St. Johnsbury station was the propagation of steelhead trout in streams tributary to Lake Memphremagog. By means of a trap installed in the Willoughby River, brood fish were intercepted and penned in a spring-fed stream entering the river just above the trap. Operations at this point extended from April 16 to May 16 and resulted in the collection of 176,305 eggs, which were taken by the trap attendant from time to time as the fish ripened, and transferred in fruit jars by express to the St. Johnsbury station. From the experience gained it is believed this will prove a valuable source for egg collections of that species. It was noted that the eggs and fry were much smaller than those of the steelhead trout of the Pacific coast, resembling more closely the eggs and fry of the domesticated rainbow trout. The propagation of steelhead trout from eggs derived from tributaries of Lake Superior, inaugurated in the spring of 1912, could not be resumed the past season, as the waters during the spawning period were too high to permit of successful seining operations. Work in this direction at the Duluth station was therefore limited to the hatching of 50,000 eggs transferred from the Pacific coast, the resulting fry being liberated in June in the streams where this excellent species has established itself.

In connection with the acclimatization of the steelhead trout in the Great Lakes region, reference to which has been made in previous reports, the following information from a Wisconsin correspondent is of interest:

> About 1906 several pound-net fishermen in the vicinity of Sheboygan and Port Washington, Wis., caught from 100 to 300 steelhead trout, averaging about 1 pound in weight, most of them being returned to the water. Within the next few years these fish increased in numbers and in size, and at the present time they form an important item in the shipments of all pound-net fishermen on Lake Michigan. In 1912 figures obtained from fishermen between Port Washington and Sheboygan showed the catch for that year to be in the neighborhood of 7,000 and 8,000 pounds, and the catch for 1913 promises to be heavier. The largest specimens taken in the vicinity weighed 22 pounds, but the average weight is 7 pounds. Compared with the lake trout the steelheads have less entrails, are more game, and are found nearer the shore. Many have been caught going upstream. About two-thirds of those caught are spawners, some of them being so weak at spawning time as to be easily caught, giving the impression that they die after spawning. Most of the fish are taken in pound nets and trap nets, in from 1 to 12 fathoms of water. They are not as good "leaders" as lake trout, and will often gill themselves in the nets, or jump high into the air in an effort to escape. The meat of the steelhead resembles very much that of the Pacific coast salmon, except that it is not quite so red. The market price is the same as for the lake trout. Its food consists of lake chubs and lake herring, of which there is such an abundant supply as to be no hindrance to the future increase of these fish.

The experience with the Scotch sea trout at the Craig Brook, Me., station has demonstrated that the species is worthy of extended efforts to propagate and disseminate it. There are now on hand at that station 16 lots of these fish, ranging from fry to specimens 6 years old, all of which originated from one lot of eggs shipped from England in 1891. They have succeeded excellently in the fresh water of the station and have been found to be almost immune to attacks of the troublesome thyroid disease.

In the spring of 1913 a very promising field for the collection of grayling and rainbow trout eggs was opened in Madison Valley, Mont., and operated as an auxiliary of the Bozeman station. During the spawning season, extending through the month of April and the first half of May, 2,445,800 grayling eggs and about 260,000 rainbow-trout eggs were secured near the towns of Ennis and McAllister, Mont. If the conditions for the propagation of grayling in this field prove as favorable as the prospects now indicate, it is the intention to abandon the old grayling station at Red Rock, Mont., which, owing to its almost inaccessible location, is very expensive to operate.

The propagation of the blackspotted trout at Derby Dam, on the Truckee River, was not undertaken the past season, in view of the small numbers of trout ascending to the dam as a consequence of the great diversion of water from the river for agricultural purposes. The work on this river will not be resumed until a more favorable location for a field station can be found.

Taken as a whole the work at the pond stations during the year was satisfactory, the increase in the output of the black basses, sunfishes, and catfishes being due to the adoption of improved methods, and a more comprehensive knowledge of the factors governing the successful propagation of these fishes. While sudden changes in water temperature during the spawning season at some of the northern and western stations curtailed the work somewhat, the output of the southern stations was materially increased over that of last year.

*Rescue of food fishes from overflowed waters.*—This is regarded as one of the most important and immediately effective branches of the Bureau's work in the conservation of fishery resources, as it means the saving of hundreds of thousands of valuable food fishes which would otherwise be lost.

On the Mississippi and Illinois Rivers there was varying success in the different fields. Protracted drought and consequent low-water stages interfered with the work on the upper and lower Mississippi River, but operations were conducted under more favorable auspices on the Illinois River, and nearly half a million black bass, crappie, sunfish, catfish, and other river species were rescued from the sloughs and bayous which had been cut off from the main river, and utilized for stocking inland lakes and streams. In addition to this output many thousands of fish taken from waters where they would ultimately have perished from drought or cold were liberated in the main river.

*Miscellaneous fish-cultural notes.*—The season's operations with the buffalo-fish at Manchester and auxiliary stations were somewhat disappointing, owing to the great difficulty in obtaining ripe fish, and the heavy mortality of the eggs secured, as a result of the low-water temperatures prevailing during most of the spawning season.

The experience of the past two years' operations had led to the conclusion that the spawning of the buffalofish would begin at a water temperature of about 60 degrees, which had occurred during those years about April 25. This year, however, the first spawn was taken on April 18, in a water temperature of 52 degrees, and some eggs were taken each day afterward up to and including April 26, when the water temperature reached 59 degrees. The great irregularity in the development of the brood fish—some days all of them being hard and on others all spent—made it impracticable to send out spawn-takers with the seine boats, and the best that could be done was to meet incoming boats and look over the catch. The 23 fish spawned yielded 5,046,000 eggs, only 80,000 of which hatched. All lots of eggs that were an entire loss died within 48 hours after being taken, large air bubbles collecting on them and causing them to float out of the jars.

At the North McGregor station six ripe fish yielded 500,000 eggs. These were held in a floating box in a water temperature of 60 degrees, in the hope that enough additional eggs could be obtained to warrant their transfer to the Manchester station. The lot looked well up to the seventh day, but eventually the eggs became coated with sediment and all were lost.

The experience thus far gained seems to demonstrate the necessity of warmer water than that available at either Manchester or its substations, and the only apparent way of overcoming the difficulty would be the installation at one of the stations of a small pumping plant, with settling tank and filter, which, in view of the expense involved, seems hardly justifiable.

Evidence of the good results of the present efforts in the artificial propagation and the protection of the lobster appears from the fact that the lobster fishermen along the Maine coast last year had a very successful and remunerative season. Numerous reports have been received to the effect that lobsters are becoming more plentiful, and that the increase is quite general along the coast. The Maine fishermen and also the dealers in that State are unstinted in their praise of the Bureau's work in this direction.

Arrangements have been made to transfer several carloads of live lobsters from the Maine coast for deposit at points in Puget Sound, about the San Juan Islands. These transfers will be continued annually until the feasibility of establishing this valuable crustacean on the Pacific coast has been demonstrated.

The adult lake sturgeon, referred to in the last annual report as being retained in a pen at the mouth of Rainy River, at Le Claire Point, Minn., with the view of gaining information as to the spawning habits of the species, escaped from the inclosure during a period of exceptionally high water early in October. Efforts to overcome the existing obstacles to the artificial propagation of the sturgeon will be renewed at the first opportunity.

In order to add to the commercial value of the eastern fisheries an attempt will be made to establish the humpback salmon on the Atlantic coast by the annual transfer of large numbers of eggs of that species from the Pacific coast, for development at the New England stations, the resulting fry to be placed in suitable streams in the State of Maine.

## BIOLOGICAL INVESTIGATIONS, SURVEYS, AND EXPERIMENTS.

### AID TO THE OYSTER INDUSTRY.

The Bureau has continued to devote to the oyster industry as much attention as the facilities and resources provided by Congress will permit. The field, however, is very large and varied, and the Bureau is unable to meet all the legitimate demands that are made on it for expert assistance and advice.

In December, 1912, the steamer *Fish Hawk* was ordered to Matagorda Bay, Tex., for the purpose of conducting a survey of the oyster beds in response to the request of the Fish and Oyster Commission of the State. Inquiries relating to the establishment of a biological station on the Gulf coast of Florida were conducted on the way and the vessel arrived off Lavaca Bay, Tex., early in February.

After consultation with the Texas commissioner and with persons interested in the oyster business it was determined that the survey should be confined to Lavaca Bay as the area of greatest present and prospective commercial importance. The recent triangulation by the United States Coast and Geodetic Survey had been carried to the mouth of this bay, and by the use of this and the recovery of an old point it was possible to extend the triangulation as far as required by means of the sextant. This preliminary work was completed in March, and the examination of the oyster beds commenced immediately. The weather was unusually tempestuous, and practically all the signals were destroyed by a tornado soon after their establishment. Despite the difficulties the work was completed about the middle of May. At the end of the fiscal year the smooth sheets were complete, and the report and chart will be ready for the printer by January 1, 1914.

Investigations and experiments respecting enemies of the oyster which annually cause large losses to the oyster industry have been continued as opportunity offered. During the spring the attention of the Bureau was again called to the prevalence of "green gill" over a large area in Chesapeake Bay. This peculiar condition, in reality harmless both to oysters and those who consume them, on account of popular prejudice has caused heavy loss by completely destroying the market for the affected oysters. The Bureau had no facilities for immediately investigating the matter, as the only qualified assistant was engaged in the Texas survey previously described, and the trouble had abated by the time he was available, only to grow virulent as soon as he was irrevocably detailed to other work.

The oyster interests of Long Island Sound are urging the study of the starfish and the drill, which annually cause heavy loss to the oyster growers, but the Bureau can not carry on the work continuously and systematically with its present force. These are but instances of the Bureau's failure to provide the assistance asked for by the fisheries, owing to the wholly inadequate personnel allowed it for the purpose.

## PROGRESS IN MUSSEL CULTURE.

Marked progress has been made during the year in the cultivation of pearly fresh-water mussels, which are the objects of an extensive fishery and support numerous plants at which buttons are made.

The station at Fairport, Iowa, and the field parties operating in connection therewith have achieved practical results in the propagation of mussels. The work was conducted at 15 localities in the Mississippi Valley, 10 of which were on the Mississippi River. Over 150 million young mussels were planted, of which 57 million were liberated in Lake Pepin, 25 million in the vicinity of Fairport, and the remainder at other places in Iowa and Minnesota, and in Wisconsin, Illinois, Indiana, and Arkansas. As a necessary part of these operations there were handled about 100,000 food and game fishes of various species, of which a large number were rescued from overflowed lands and returned to the rivers. The field explorations were considerably curtailed on account of the embarrassment occasioned by the delay in the passage of the appropriation bill. An examination was made, however, of the mussel resources of the Illinois River, and a reconnoissance of a large number of lakes and streams in Minnesota opened up new fields for mussel culture and suggested new sources of supply of commercial shells.

Investigations in the field and laboratory have resulted in the discovery of the hosts and breeding habits of certain important commercial mussels and promise to result in the propagation of valuable species which previously could not be cultivated because of ignorance of fundamental facts. Research into the causes and phenomena of pearl formation have been continued.

INVESTIGATIONS OF LAKES AND STREAMS.

The investigation of the Illinois River in respect to the effects of the discharge of sewage through the Chicago Drainage Canal were brought to a conclusion during the year and a report thereon has been prepared. This is one of the most important studies of the effects of stream pollution on the fishes and fisheries, and it is believed that the results will be of great value in connection with the solution of problems which are yearly growing more acute. This work was conducted in cooperation with the Illinois Natural History Survey under conditions of great advantage to the Government.

The waters of the Truckee River Basin in California and Nevada have been under investigation at various times during the year. As has been indicated in previous reports of the Bureau, the use of the waters of this system for irrigation purposes has already reached a stage resulting in the destruction of large numbers of valuable food fishes. It appears inevitable that with the growth of the area irrigated the streams eventually will be reduced, in places, to practically dry beds at certain seasons, and the native fishes will become a negligible factor in the food supply. It is possible that a way may be found to compensate for this deficiency by introducing other species of nonmigratory habit which can be acclimatized in the permanent waters, but it is yearly becoming more evident that it will be necessary in some cases to make a frank recognition of the fact that more and cheaper food can be produced by the irrigation of the land than by the conservation of the fishes in the streams. It is the purpose of the present investigation to determine if it be possible to develop the one source of food supply while maintaining the other.

During the summer of 1912 the Bureau continued its examinations of lakes in Washington and Idaho to determine their physical and biological characteristics, particularly as they may affect the culture and acclimatization of fishes. It frequently happens that disappointing results follow the planting of fish in lakes which superficially appear to be admirably adapted to the purpose, and recent investigations have shown that the failures are often due to deficiencies in the physical conditions of the deeper waters. This work is demanded not only for the information of the Bureau in connection with its fish-cultural operations, but has been urgently requested by the State authorities. Similar work has been carried on for several years in Wisconsin in cooperation with the Wisconsin Geological and Natural History Survey. A reconnoissance was also made of a number of lakes in the Superior National Forest Reserve in northeastern Minnesota, which differ much in the character of their fauna from the lakes of more calcareous water farther south.

At the close of the fiscal year investigations were begun on Lake Champlain in cooperation with the State of Vermont, to determine whether it be possible to establish and maintain a commercial fishery for whitefish without jeopardizing fishing for pleasure and sport, which now yields remunerative business to guides, boatmen, and the keepers of pleasure resorts.

### OTHER INVESTIGATIONS AND EXPERIMENTS.

The field work of the biological survey of San Francisco Bay was concluded during the year and considerable progress was made in the study of the collections which have been assigned to various specialists. The general report dealing largely with the economic results of the survey is in an advanced stage of preparation. This investigation was made by the steamer *Albatross* pending the passage of an appropriation for repairs, without which she was unseaworthy and unfit to leave sheltered waters.

During July and August, 1912, the schooner *Grampus* was employed in an investigation of the oceanography of the Gulf of Maine, with the purpose of determining the physical and biological conditions governing the distribution of fish food and young fishes. The work was supplemented during the winter and spring by observations off the coast in the vicinity of Gloucester and on Georges Banks in connection with the otter-trawl investigations.

A related inquiry respecting the spawning of haddock was conducted off the coast of Massachusetts and New Hampshire during the spring, use being made of the facilities afforded by the recently established gill-net fishery for haddock. The spawning grounds of this species, which is extensively propagated by the Bureau, appear to be less restricted than has been generally supposed. The inquiry is to be continued as opportunity is afforded.

Terrapin culture at Beaufort reached a stage which justified the Bureau in issuing a circular descriptive of its methods and commending it as promising commercial returns to persons undertaking it on a practical scale. Considerable interest has been manifested in the project, and experiments are being conducted under private auspices in North Carolina and Florida.

During the spring, experiments in frog culture and in artificial production of the natural food of fishes were begun at the Edenton, N. C., station.

Considerable progress has been made during the year in the accumulation of material toward a series of publications on the life histories of important food fishes and other valuable aquatic animals. This necessarily is slow work and to a very large extent the data are collected as opportunity offers in connection with other investigations. The early larval stages of many American food fishes are unknown, and in order that the breeding grounds and the habitats of the young may be determined it is necessary to collect specimens and make drawings until a series is completed. This part of the investigation has yielded gratifying results, and there are now on hand several reports on the subject. It is the purpose of the Bureau to have the completed papers cover the points of which understanding is essential for the regulation and protection of the fisheries, and thus to meet a popular demand for information which there is now no means of satisfying.

### WORK AT THE BIOLOGICAL LABORATORIES.

The marine laboratories at Woods Hole, Mass., and Beaufort, N. C., were opened at the beginning of the fiscal year, but were operated with considerable embarrassment owing to the inadequacy of the emergency appropriations made available pending the passage of the sundry civil bill. The months of June, July, August, and the first half of September comprise the period of greatest activity in scientific field and laboratory work, owing not only to the clemency of the weather and the greater opportunities afforded for study, but also to the availability at that time of a considerable number of qualified investigators who are occupied in university duties at other seasons.

The inadequacy of the permanent scientific staff of the Bureau makes it necessary to depend for much of its research on temporary assistants who can be engaged only when not engaged in their customary duties. It follows, therefore, that the monthly requirements during the first two months of the year are much in excess of the prorated allowance made by Congress for the purpose of conducting operations until the passage of the regular appropriation. Moreover, it is necessary to arrange for the employment of temporary assistants considerably in advance of the beginning of the fiscal year, not only because the best men will have made other arrangements before the end of June, but also because much of the work must be begun in June or earlier, and continuously prosecuted over the end of the fiscal year in order to produce results warranting the expenditures.

Therefore, unless confidence can be felt that appropriations will be available when due, the laboratory and field work can not be arranged for with proper regard to economy and efficiency, and this was the condition confronting the Bureau at the beginning of the fiscal year. A number of investigators had already reached the laboratories before it became apparent that the appropriations would not be available. Some of these were employed at reduced salaries and others elected to carry on work under the authority possessed by the Bureau to afford facilities to properly qualified investigators.

Under the conditions the work at both Woods Hole and Beaufort was satisfactory, and there were completed a number of researches of practical value, the most important of which related to the habits of fishes and the effects of water pollutions. Further work was conducted on the life history of the oyster drill with a view to finding a weak point at which this destructive oyster enemy may be attacked. At Beaufort the spawning season of the southern flounder was determined and experiments will be conducted during the next fiscal year to develop the possibility of its propagation at the station.

At the close of the year the permanent laboratory at the Fairport, Iowa, station was ready for occupancy. This station, which combines facilities for fish culture, mussel culture, practical shell testing, and biological and chemical investigations and experiments is designed as a center of a large part of the Bureau's activities in the Mississippi Valley.

## DISEASES OF FISHES.

During the year the Bureau has received growing and insistent demands for the investigation of various fish diseases and for the study of the relations of industrial and other contaminations to the fish life in streams. These demands, which have come from Government, State, and private fish-cultural establishments, and from State, municipal, and private interests, are of a character that makes them entirely appropriate for attention at the hands of the Federal fishery service; but, owing to the lack of facilities, the Bureau has been able to do very little to help either itself or the general public in this respect.

The cooperative investigation of cancerous tumors in trout, in which the Bureau has been associated with the New York Laboratory for the Study of Malignant Disease, has been brought to a close by the completion of a report dealing with the cause and nature of the disease and its relation to human health. This but clears the ground for that part of the work which vitally concerns the Bureau, namely, the investigation of the means of preventing and curing the disease in streams and hatcheries. The cooperating institution is not concerned in this phase of the subject and any constructive work in the interests of the fisheries must be conducted by the Bureau.

From every consideration of economy adequate means should be provided for such investigations. At one hatchery alone—Holden, Vt.—over 350,000 trout died from an epidemic in May and June. This was practically the entire stock on hand and the cost to produce these fish, to say nothing of their ultimate value, was greater than would suffice to pay for an assistant qualified to find means of prevention of the losses.

## ALASKA FISH AND FUR INDUSTRIES.

### SALMON SERVICE.

Details regarding the administration of the salmon and other fisheries of Alaska will be found in a special report issued as a separate document.[a] As complete returns from these fisheries are not obtainable until late fall or early winter of each year, the information here presented is for the calendar year 1912.

For the purpose of enforcing the fishery laws and the regulations made thereunder, there has been the usual inspection of fishing grounds, apparatus, and methods; and information regarding the various branches of the fishing industry has been obtained and appears in the special report.

The laws and regulations have, in general, been well received by the fishing interests, and, with rare exceptions, have been respected throughout Alaska, so far as the field agents of the Bureau have been able to determine. The region is so vast, however, and the facilities so lamentably inadequate for reaching the various fishing localities, many in number and widely separated, that personal inspection in many cases was utterly impossible. Unfortunately this applies more particularly to the fisheries for which there is the greatest need of regular inspection. This fact, together with the limited personnel, and the limited appropriation available for traveling expenses, enables the Bureau at the best to possess no definite knowledge and but scant information regarding a large number of the fishing localities and operations.

The inspection of the canneries, salteries, and hatcheries was more satisfactory. One agent covered the territory from Dixon Entrance on the south to Cordova on the north. Of the 53 canneries operated in that region he visited all but 5 at least once, and most of the salteries and minor establishments; and each of the hatcheries was visited and inspected. Several of the more accessible places were each visited two or three times. In the Bristol Bay region it was not possible to reach all the canneries and fisheries, and only those at or near Nushagak were visited. In central Alaska an agent was able to visit the canneries at the Kusilof and Kenai Rivers, and the inspector kept in close touch with the fishing operations in and about the Afognak reservation during the season.

The season of 1912 was marked by an unusually heavy run of salmon on the south side of Bristol Bay, which resulted in an increase of nearly 40 per cent over the 1911 pack of that region. There was also an unprecedented run of humpback salmon in central Alaska

[a] Alaska Fishery and Fur Industries in 1912, Bureau of Fisheries Document No. 780.

and a large run in Bering Sea. A slight decline in the humpback run occurred in southeast Alaska, where the red salmon practically held their own. There was a shortage of red salmon in the Nushagak region and in central Alaska, which induced an increased pack of the inferior species in those regions.

The Alaska fisheries as a whole were more productive in 1912 than ever before. This was owing largely to the great increase in the catch of the cheaper grades of salmon. The net increase in the salmon catch over 1911 was over 16,963,000 fish. The value of the product of all the fisheries showed an increase over that for 1911 of more than $2,000,000. The aggregate catch of salmon was 60,938,945, from which were prepared 4,056,021 cases of canned salmon valued at $16,295,480, and in addition to these were minor products of the salmon fisheries valued at $837,652. The number of salmon canneries increased from 64 to 87, the majority of the new plants being in southeast Alaska.

In 1911 the five private hatcheries took 167,146,800 red salmon eggs and the two Government hatcheries 102,520,000, making a total of 269,666,800, from which were hatched and liberated 153,868,800 fry by the private and 87,729,700 by the Government hatcheries, a total of 241,598,500. In 1912 the private hatcheries took 86,295,000 red salmon eggs and the Government hatcheries 80,814,470, a total of 167,109,470, which is a decrease of 102,557,330 as compared with 1911.

Under the provision of law exempting from taxation the output of the salmon canneries at the rate of 10 cases of canned salmon for each thousand red or king salmon fry liberated, the companies maintaining private hatcheries were entitled to receive in 1912 rebates on 153,868,800 fry, or $61,744.

The order of the Secretary of Commerce and Labor of December 19, 1907, closing Wood and Nushagak Rivers to salmon fishing, remains in force and no commercial fishing was carried on in those streams. With the cooperation of the companies operating canneries in the Nushagak region, Wood River was again racked in 1912, and a tally was kept of the red salmon ascending that stream to Lake Aleknagik for spawning purposes. The number of fish thus counted was 325,264, as against 354,299 in 1911. The number of salmon caught in the Nushagak region was 3,866,950, an increase of 1,053,313 over that for the previous year. In the five years from 1908 to 1912 the catch in the Nushagak region has decreased 37 per cent, while the number escaping to the spawning beds has decreased 87 per cent. In 1908 the number escaping was 30 per cent of the entire run; in 1912 it was but 7.7 per cent. This indicates a very serious condition if natural propagation alone is to be depended upon to keep up the supply of salmon in that region.

The usual statistical canvass of the Alaska fisheries showed 24,263 persons engaged in the various branches of the industry, $38,263,457 invested, and products valued at $18,877,480.

A feature of the Alaska fisheries is a growing appreciation of the value of products formerly regarded as useless and the equipment of a number of small plants designed to utilize such materials. Only a very small fraction of the multitude of natural aquatic products of Alaska—fishes, mollusks, crustaceans, etc.—has as yet been utilized by man. It is known that many of these possess a high food value, but methods of preparing them as food have not been developed. Of fishes alone there are more than 300 species, of which fewer than a score are as yet utilized by man as food. How many more can be found to possess considerable economic food value remains to be determined, but that the number is large is reasonably certain. Perhaps the most promising is the herring (*Clupea pallasii*), a very abundant fish, at present utilized chiefly in the manufacture of fertilizer and oil, but used to some extent fresh, frozen, or pickled, or as bait in the halibut fishery. A closely related species, the Atlantic herring (*Clupea harengus*), is the fish which supports the largest fishery in the world, also the American sardine and smoked-herring industries, in which a vast amount of money is invested and whose output is worth millions of dollars. There is no inherent reason why the Pacific herring may not be prepared for sardines and in the numerous other ways in which the Atlantic herring is utilized.

The eulachon, the capelin, and the surf smelt, three most delicious fishes, literally swarm in untold numbers in Alaskan waters, but as yet are utilized scarcely at all. The Dolly Varden trout, so abundant as to be a great nuisance and very destructive to salmon spawn, should be studied with reference to its utilization as food. The score or more of surf fishes, rock cods, greenlings, Atka mackerel, sculpins, and sand lances, are all promising species to experiment with. There are also the clams, crabs, and numerous other crustaceans and mollusks, related species of which in other countries support important fisheries, yet nothing is done with them in Alaska.

Under date of November 18, 1912, after a hearing given at Seattle, Wash., on October 18, the Secretary issued an order prohibiting, until further notice, all commercial fishing for salmon (1) in all streams flowing into Cook Inlet, together with their lakes and tributary waters; (2) in Eyak Lake and its tributary waters, except that fishing is permitted, under specified restrictions, in Eyak River below the lake; (3) in Anan or Humpback Creek, its lagoon, lakes, and tributary waters, together with the region within 500 yards of the mouth of the creek; and (4) in Naha Stream, its lagoon, lakes, and tributary waters, above a line connecting Loring Point and House Point. The order became effective January 1, 1913.

By order of the Secretary, dated March 21, the natives of the Afognak reservation were given permission to conduct commercial fishing in the reserved waters under certain restrictions. The business was placed in charge of an inspector, who issued permits to those entitled to receive them, promulgated regulations in accordance with general orders from the Department, kept in daily touch with the fishery, and enforced compliance with the regulations. The total number of licenses issued was 93, of which 7 were to white men. The salmon taken numbered about 175,000 fish, including about 17,000 handled at the hatchery. This catch was somewhat disappointing. The eruption of Katmai Volcano June 6 covered Afognak Island so completely with ashes that fishing was entirely suspended for more than two weeks and was nowhere fully resumed. This no doubt had a serious effect on the catch, which otherwise would in all probability have been much greater. Besides the immediate effects on the fishery there will no doubt be after effects from which the fishery will not recover for some years.

## FUR-SEAL SERVICE.

The sealing operations on the Pribilof Islands during the season of 1912 were conducted, as in 1910 and 1911, under the direct control of the fur-seal agents of the Bureau. The treaty of July 7, 1911, which makes pelagic sealing unlawful, went into effect December 15, 1911, and, as a result, there was no pelagic sealing during the season of 1912. This was the first season, therefore, since the beginning of pelagic sealing that the fur-seal herd was not subject to the ravages of the sealing fleet. To this essential protective measure the herd made an immediate response. It was possible for the first time in the history of the fur seal to take an actual census of the herd. An actual count was made of all the active bulls, all the idle and young bulls, all the hauling-ground bulls, all the 3-year-old males marked and reserved for breeders, all the pups, and, by evident deduction, all the cows. The only classes not actually counted were the yearling males and females, the 2-year-old males and females, the unbranded 3-year-old males, and an uncertain number of 4-year-old males, all of which were estimated conservatively at 48,000.

The census of the herd showed seals of the various classes present on the islands as follows:

| | |
|---|---|
| Active bulls, with harems (actual count) | 1,358 |
| Idle and young breeding-ground bulls (actual count) | 312 |
| Hauling-ground bulls (actual count) | 302 |
| Branded reserve bulls (actual count) | 2,000 |
| Pups (actual count) | 81,984 |
| Breeding cows (equal to the pups in number) | 81,984 |
| Remaining nonbreeding seals (estimate) | 48,000 |
| Total | 215,940 |

The census for 1911 was based chiefly on estimates and was evidently an underestimate. Nevertheless, it is believed that there were on the islands in 1912 at least 30,000 seals that would not have been there if pelagic sealing had continued. During the season of 1911 the pelagic sealers took 14,511 skins, according to the report of Messrs. C. M. Lampson & Co., of London. This number included some skins from the Commander Islands herd. It is well known that the pelagic sealers kill many seals they do not recover and that the actual number of skins marketed is far below and probably is less than half the number of seals actually killed. With this exceedingly low estimate it is evident that the loss actually sustained by the Pribilof herd in 1911 could not have been less than 15,000 breeding females; and it is safe to assume that as great a loss would have occurred in 1912 if pelagic sealing had gone on. These 15,000 breeding females thus saved produced 15,000 pups, making 30,000 seals on the islands in 1912 as the immediate response to the cessation of pelagic sealing.

In 1913 a census of the seal herd made under the same conditions as in 1912 and participated in by two or three cooperating agents of the Bureau gave the following result, the number of the pups being accurately determined by actual count after the harems had broken up in August and the equivalent number of breeding females being necessarily present:

| | |
|---|---|
| Active bulls, with harems (actual count) | 1,403 |
| Idle and young bulls (actual count) | 364 |
| Bachelors, 1, 2, 3, and 4 years old (count and estimate) | 47,000 |
| Cows 1 and 2 years old (count and estimate) | 35,000 |
| Breeding cows (equal to pups) | 92,269 |
| Pups (actual count) | 92,269 |
| Total | 268,305 |

The number of skins shipped in 1912 was 2,880 from St. Paul Island and 884 from St. George Island, a total of 3,764. These, together with 9 skins from the previous season which had been sent to Washington for experimental purposes, were sold at auction in London, January 17, 1913, by Messrs. C. M. Lampson & Co., acting as agents for this Government. The net proceeds of the sale were $130,640.57, for which sum a certified check was duly received and covered into the United States Treasury. Under the leasing system which prevailed prior to 1910 the Government would have received only $38,589.25 for the season's take of skins.

The fox skins obtained on the Pribilof Islands in the winter of 1911–12 consisted of 109 blues and 27 whites on St. Paul, and 275 blues and 2 whites on St. George, a total of 384 blues and 29 whites. They were sent to London and sold at auction March 7, 1913, by Messrs. C. M. Lampson & Co., acting as agents for this Government. The net proceeds of the sale were $20,505.17, for which sum a certified check was duly received and covered into the Treasury. A choice lot of 28 skins from St. Paul Island sold for $131 per skin. Under the old leasing system the Government received nothing for the fox skins.

On June 30, 1913, the positions of agent and three assistant agents, fur-seal fisheries, ceased to exist through failure of Congress to provide for them. The sundry civil appropriation bill for the year 1914 substituted for the foregoing the positions of two agents and caretakers.

### MINOR FUR-BEARING ANIMALS.

The warden and four deputy wardens, for which provision was made in the sundry civil bill making appropriations for the fiscal year 1912, spent the entire year in Alaska, establishing headquarters in certain of the more important fur-producing regions where they could keep in touch with the trappers and hunters and see that the law and regulations were observed. A study of the habits of the various species of fur-bearing animals was thus possible, and a large amount of valuable information was obtained. Specimens were also collected for the purpose of making possible a study of the condition of the fur at different seasons in the various fur-producing regions of Alaska. Such specimens are very useful in arriving at decisions as to the proper dates for close seasons in the different parts of Alaska.

The cooperative arrangement made with the governor of Alaska for the purpose of securing a more effective enforcement of the fur and game laws of the Territory has been continued, in part. By this arrangement the warden and the four deputy wardens were to be appointed as special game wardens and five of the Alaska game wardens were to be appointed special fur wardens. In the early part of 1913 the governor found it impracticable to continue longer the services of the special game wardens appointed by him. The Bureau, however, finds it desirable to continue the services of the special fur wardens. They are paid a nominal salary of $10 per month and are invested with the same authority for enforcing the provisions of the law and regulations as are the regular wardens. The scope of territory to be covered makes it necessary to secure the assistance of as many agents as possible.

During the past year three convictions have been had for violation of the act of April 21, 1910, for the protection of the fur-bearing animals in Alaska. The convictions were for violations in widely separated portions of Alaska, and it is believed that they will have a deterrent effect upon those disposed to violate the law.

The regulations issued by the Department have proved satisfactory in most respects and have had a very good influence upon the hunters and trappers who, in the main, are in sympathy with the efforts of the Government to conserve the fur resources of Alaska. One immediate effect has been a very marked improvement in the quality of furs shipped from the Territory. Several large buyers of Alaska furs state that the improvement has been 25 to 30 per cent. This was due to the fact that the hunters and trappers were more careful to observe the close season and local buyers were less disposed to purchase unprime skins.

As a result of the inquiries made by the warden and the deputy wardens, together with information received from persons interested in the preservation of the fur resources of Alaska, the desirability of revising the regulations promulgated March 8, 1911, was shown. Revised regulations were accordingly drafted and approved by the Secretary under date of March 26, 1913. The principal changes in the new regulations are: (1) The close season on sea otter is extended to November 1, 1920, and that on beaver to November 1, 1918; (2) minor changes are made in the open and close seasons for several of the other fur bearers; (3) the close season on the black bear is removed; and (4) prohibition is placed upon the taking or selling of unprime skins.

The following statement shows by species the number and value of furs shipped from Alaska in the year ending November 15, 1912:

| Species. | Number. | Average value. | Total value. |
|---|---|---|---|
| Bear, black | 698 | $7.50 | $5,212.50 |
| Bear, brown | 19 | 9.00 | 171.00 |
| Bear, glacier | 5 | 15.00 | 75.00 |
| Bear, polar | 9 | 40.00 | 360.00 |
| Beaver | 89 | 10.00 | 890.00 |
| Ermine | 7,957 | 1.36 | 10,821.52 |
| Fox, black | 3 | 600.00 | 1,800.00 |
| Fox, blue | 502 | 45.00 | 22,590.00 |
| Fox, blue, Pribilof Islands | 384 | 56.53 | 21,708.48 |
| Fox, cross | 603 | 17.00 | 10,251.00 |
| Fox, red | 8,018 | 8.50 | 68,153.00 |
| Fox, silver gray | 142 | 250.00 | 35,500.00 |
| Fox, white | 3,108 | 12.50 | 38,850.00 |
| Fox, white, Pribilof Islands | 29 | 17.29 | 501.43 |
| Hare, Arctic | 55 | .40 | 22.00 |
| Lynx | 2,720 | 21.50 | 58,480.00 |
| Marten | 12,999 | 12.50 | 162,487.50 |
| Muskrat | 123,925 | .40 | 49,570.00 |
| Mink | 31,363 | 4.50 | 141,133.50 |
| Otter, land | 1,480 | 14.00 | 20,720.00 |
| Otter, sea | 1 | 200.00 | 200.00 |
| Reindeer, fawn | 4 | 1.00 | 4.00 |
| Seal, fur | 3,764 | 37.52 | 141,290.32 |
| Seal, hair | 333 | 1.50 | 499.50 |
| Squirrel | 611 | .08 | 48.88 |
| Wolf | 103 | 9.00 | 927.00 |
| Wolverine | 189 | 10.00 | 1,890.00 |
| Total | | | 794,156.63 |

A number of permits have been issued authorizing the taking and shipping of various fur-bearing animals, principally foxes, for breeding purposes. Applications for permits for such operations became so frequent as to cause concern in regard to the maintenance of the natural supply of wild stock. The Department decided to issue further permits for the shipment of foxes from Alaska only to bona fide owners or operators of fox ranches and to make such permits applicable only to foxes which had been bred and reared on these ranches. It was also decided to discontinue the issuance of permits authorizing the capture in Alaska of any fur-bearing animal during the close season prescribed for the species concerned.

Recently the rearing of foxes for their pelts has attracted a great deal of attention, and public interest has been aroused by the reports of extraordinary prices paid for certain varieties for breeding purposes. To develop the possibilities of fox farming in Alaska the Secretary of Commerce has decided to lease certain islands for the purpose, making announcement to this effect in a widely distributed circular.

## COMMERCIAL FISHERIES.

### OYSTER INDUSTRY.

In the recent canvass of the oyster industry the statistics for the New England and South Atlantic States covered the season ending in 1910; for the Middle Atlantic States, except Maryland and Virginia, and for the Gulf States they covered 1911; and for Maryland and Virginia and the Pacific Coast States they covered 1912. The total number of persons engaged in the oyster industry of the United States, as shown by the statistics for the various sections of the country, was 67,257; the yearly wages paid, combining the different sections, amounted to $10,876,801; and the investment in vessels, boats, fishing apparatus, shore and accessory property and cash capital, not including the value of oyster grounds or the cash capital for the New England States, was $16,880,032. The output of oysters was 32,988,815 bushels, valued at $15,377,983.

About 46 per cent of the quantity and 65 per cent of the value were from planted grounds, the output in many of the States depending largely—in some of them entirely—upon oyster culture. In the New England States 93 per cent, on the Pacific coast 73 per cent, and in New York 86 per cent of the oyster product is derived from private beds. Virginia ranks first among the States in quantity and New York first in value of oysters produced; while Maryland, ranking second in quantity, is third in value of oyster output. A summary of the oyster product of the United States is given in the following table.

OYSTER PRODUCT OF THE UNITED STATES.

| Region. | Private grounds. | | Public grounds. | | Total. | |
|---|---|---|---|---|---|---|
| | *Bushels.* | *Value.* | *Bushels.* | *Value.* | *Bushels.* | *Value.* |
| New England States (1910) | 5,549,318 | $3,439,450 | 392,703 | $157,584 | 5,942,021 | $3,597,034 |
| Middle Atlantic States (1911-12) | 7,090,883 | 5,204,124 | 11,815,193 | 4,059,432 | 18,906,076 | 9,263,556 |
| South Atlantic States (1910) | 456,194 | 171,298 | 1,244,804 | 192,886 | 1,700,998 | 364,184 |
| Gulf States (1911) | 2,080,005 | 634,147 | 4,146,136 | 842,819 | 6,226,141 | 1,476,966 |
| Pacific Coast States (1912) | 157,243 | 659,430 | 56,336 | 16,813 | 213,579 | 676,243 |
| Total | 15,333,643 | 10,108,449 | 17,655,172 | 5,269,534 | 32,988,815 | 15,377,983 |

The oyster industry of various sections has been presented in detail in previous reports. The only portions of the country that remain to be considered are Maryland, Virginia, and the Pacific Coast States.

Maryland ranks first among the States in the number of persons engaged in the oyster industry, which, in 1912, was 24,287, who received $2,724,641 in wages. The yield of oysters was 5,510,421 bushels, valued at $2,127,759, of which only about 5 per cent, or 280,010 bushels, valued at $149,069, were from planted grounds. The output would probably have been much larger had it not been for a severe freeze lasting for about six weeks, during which time the taking of oysters was practically discontinued. In some localities, especially in Kent and Queen Anne Counties, the oysters were more plentiful and in better condition than for many years. The product was taken chiefly with dredges and tongs. Patent tongs are used in a few localities, mainly at Solomons in Calvert County and at Rock Hall in Kent County; they are employed mostly where the water is too deep for common tongs and dredging is not allowed. The principal oyster centers in the State are Baltimore, Crisfield, Cambridge, St. Michaels, Oxford, Chester, Annapolis, Tilghman, and Whitehaven. Out of a total of 3,769,766 gallons of oysters shucked in the State, 1,447,527 gallons were opened at Baltimore, 686,800 gallons at Crisfield, 612,717 gallons at Cambridge, and the remainder at other localities. Baltimore has also an important oyster-canning industry, which is carried on in connection with the canning of fruit and vegetables. The canned-oyster product amounted to 10,170,608 cans, valued at $775,907.

Virginia ranks next to Maryland in the number of persons engaged in the oyster industry, which was 16,487 in 1912, and the wages paid amounted to $2,112,170. The oyster output was 6,206,098 bushels, valued at $2,286,340, of which 36.38 per cent, or 2,257,873 bushels, valued at $1,128,830, were from planted grounds.

Statistics of the oyster industry of Maryland and Virginia in 1912 are given in detail in the following table.

## OYSTER INDUSTRY OF MARYLAND AND VIRGINIA, 1912.

### MARYLAND.

| Items. | Private areas. | | Public areas. | | Total. | |
|---|---|---|---|---|---|---|
| | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* |
| **Persons engaged:** | | | | | | |
| On vessels fishing | 3 | | 4,086 | | 4,089 | |
| On vessels transporting | 8 | | 808 | | 816 | |
| In shore or boat fisheries | 524 | | 8,930 | | 9,454 | |
| Shoresmen | 45 | | 9,883 | | 9,928 | |
| Total | 580 | | 23,707 | | 24,287 | |
| **Wages paid:** | | | | | | |
| Dredging | | $790 | | $466,385 | | $467,175 |
| Tonging | | 35,068 | | 967,184 | | 1,002,252 |
| Transporting | | 590 | | 101,197 | | 101,787 |
| Planting and transporting | | 5,020 | | | | 5,020 |
| Wholesale trade | | 4,855 | | 1,143,552 | | 1,148,407 |
| Total | | 46,323 | | 2,678,318 | | 2,724,641 |
| **Vessels, boats, apparatus, and other property:** | | | | | | |
| Vessels fishing | 1 | 500 | 771 | 542,375 | 772 | 542,875 |
| Net tonnage | 7 | | 7,895 | | 7,902 | |
| Vessels transporting | 4 | 3,000 | 299 | 351,125 | 303 | 354,125 |
| Net tonnage | 35 | | 7,286 | | 7,321 | |
| Gasoline boats | 25 | 8,675 | 1,324 | 260,765 | 1,349 | 269,440 |
| Sail and row boats | 146 | 4,480 | 3,203 | 235,720 | 3,349 | 240,200 |
| Apparatus—vessel fisheries— | | | | | | |
| Dredges | | | 3,017 | 34,927 | 3,017 | 34,927 |
| Tongs | 6 | 30 | 73 | 509 | 79 | 539 |
| Apparatus—boat fisheries— | | | | | | |
| Dredges | 8 | 60 | 1,595 | 14,029 | 1,603 | 14,089 |
| Tongs | 170 | 776 | 9,240 | 47,516 | 9,410 | 48,292 |
| Shore and accessory property | | 12,215 | | 1,665,985 | | 1,678,200 |
| Cash capital | | 1,900 | | 795,500 | | 797,400 |
| Total | | 31,636 | | 3,948,451 | | 3,980,087 |
| **Planting operations:** | | | | | | |
| Oyster grounds owned or leased ... acres | [a] 3,445.00 | 186,525 | | | [a] 3,445.00 | 186,525 |
| Oyster grounds under culture ... acres | 2,270.00 | | | | 2,270.00 | |
| Grounds planted during the year ... acres | 219.00 | | | | 219.00 | |
| Materials planted during the year— | | | | | | |
| Seed oysters . bushels | 68,160 | 18,416 | | | 68,160 | 18,416 |
| Oyster shells ... do | 26,350 | 948 | | | 26,350 | 948 |
| Total | | 19,364 | | | | 19,364 |
| Oysters on private areas at the end of the year, bushels | 769,785 | 210,028 | | | 769,785 | 210,028 |
| **Products:** | | | | | | |
| Vessel fisheries— | | | | | | |
| With dredges—market oysters ... bushels | 150 | 60 | 1,852,940 | 830,605 | 1,853,090 | 830,665 |
| With tongs—market oysters ... bushels | 1,150 | 608 | 17,430 | 7,063 | 18,580 | 7,671 |
| Total | 1,300 | 668 | 1,870,370 | 837,668 | 1,871,670 | 838,336 |
| Boat fisheries— | | | | | | |
| With dredges—market oysters ... bushels | 6,050 | 3,075 | 446,758 | 175,618 | 452,808 | 178,693 |
| With tongs— | | | | | | |
| Market oysters, bushels | 272,660 | 145,326 | 2,900,333 | 961,777 | 3,172,993 | 1,107,103 |
| Seed oysters, bushels | | | 12,950 | 3,627 | 12,950 | 3,627 |
| Total | 278,710 | 148,401 | 3,360,041 | 1,141,022 | 3,638,751 | 1,289,423 |
| Grand total | 280,010 | 149,069 | 5,230,411 | 1,978,690 | 5,510,421 | 2,127,759 |

[a] Includes 330.50 acres held by tenure other than lease.

OYSTER INDUSTRY OF MARYLAND AND VIRGINIA, 1912—Continued.

MARYLAND—Continued.

| Items. | Private areas. | | Public areas. | | Total. | |
|---|---|---|---|---|---|---|
| | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* |
| Wholesale trade: | | | | | | |
| Market oysters sold in the shell...........bushels.. | | | | | 136,617 | $139,820 |
| Oysters sold opened.galls.. | | | | | a3,769,766 | 3,588,873 |
| Oysters canned.......cans.. | | | | | 10,170,608 | 775,907 |
| Oyster shells sold.bushels.. | | | | | 4,893,297 | 73,128 |
| Crushed oyster shells sold...............tons.. | | | | | 10,000 | 54,375 |
| Lime from oyster shells, tons.................. | | | | | 3,968 | 8,070 |
| Total.......... | | | | | | 4,640,173 |
| Expenses connected with the wholesale trade.............. | | | | | | 872,326 |

VIRGINIA.

| Items. | Private areas. | | Public areas. | | Total. | |
|---|---|---|---|---|---|---|
| | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* |
| Persons engaged: | | | | | | |
| On vessels fishing.......... | 155 | | 509 | | 664 | |
| On vessels transporting.... | 160 | | 657 | | 817 | |
| In shore or boat fisheries... | 3,624 | | 7,736 | | 11,360 | |
| Shoresmen............... | 3,646 | | | | 3,646 | |
| Total.......... | 7,585 | | 8,902 | | 16,487 | |
| Wages paid: | | | | | | |
| Dredging............... | | $49,245 | | $108,900 | | $158,145 |
| Tonging................ | | 188,288 | | 1,013,743 | | 1,202,031 |
| Transporting............ | | 23,670 | | 75,060 | | 98,730 |
| Planting and transplanting | | 107,894 | | | | 107,894 |
| Protecting oysters from natural enemies........ | | 199 | | | | 199 |
| Wholesale trade.......... | | 545,171 | | | | 545,171 |
| Total.......... | | 914,467 | | 1,197,703 | | 2,112,170 |
| Vessels, boats, apparatus, and other property: | | | | | | |
| Vessels fishing............ | 32 | 77,450 | 92 | 53,125 | 124 | 130,575 |
| Net tonnage.......... | 324 | | 807 | | 1,131 | |
| Vessels transporting....... | 84 | 60,000 | 454 | 296,400 | 538 | 356,400 |
| Net tonnage.......... | 1,035 | | 5,065 | | 6,100 | |
| Gasoline boats............ | 398 | 132,510 | 954 | 214,145 | 1,352 | 346,655 |
| Sail and row boats ........ | 1,947 | 54,203 | 3,964 | 217,960 | 5,911 | 272,163 |
| Apparatus—vessel fisheries— | | | | | | |
| Dredges.............. | 96 | 1,735 | 334 | 4,040 | 430 | 5,775 |
| Tongs................ | 2 | 25 | 9 | 65 | 11 | 90 |
| Apparatus—boat fisheries— | | | | | | |
| Dredges.............. | 77 | 825 | 509 | 4,722 | 586 | 5,547 |
| Tongs................ | 2,094 | 7,847 | 6,256 | 27,529 | 8,350 | 35,376 |
| Shore and accessory property............. | | 497,520 | | | | 497,520 |
| Cash capital............. | | 528,200 | | | | 528,200 |
| Total.......... | | 1,360,315 | | 817,986 | | 2,178,301 |
| Planting operations: | | | | | | |
| Oyster grounds owned or leased.... ......acres.. | b59,272.60 | 767,015 | | | b59,272.60 | 767,015 |
| Oyster grounds under culture.............acres.. | 25,979.34 | | | | 25,979.34 | |
| Grounds planted during the year..........acres.. | 2,671.11 | | | | 2,671.11 | |
| Materials planted during the year— | | | | | | |
| Seed oysters...bush.. | 1,291,090 | 266,194 | | | 1,291,090 | 266,194 |
| Oyster shells....do.... | 743,250 | 21,897 | | | 743,250 | 21,897 |
| Total.......... | | 288,091 | | | | 288,091 |

a Exclusive of opened oysters bought from dealers in Virginia.
b Includes 2,469.96 acres used for bedding oysters, but does not include oyster grounds held by riparian right.

## Oyster Industry of Maryland and Virginia, 1912—Continued.

VIRGINIA—Continued.

| Items. | Private areas. | | Public areas. | | Total. | |
|---|---|---|---|---|---|---|
| | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* |
| Planting operations—Contd. Expenses connected with planting— | | | | | | |
| Planting and transplanting | | 675 | | | | $675 |
| Protecting oysters from natural enemies | | 366 | | | | 366 |
| Total | | 1,041 | | | | 1,041 |
| Oysters on private areas at the end of the year, bushels | 5,872,440 | 1,899,819 | | | 5,872,440 | 1,899,819 |
| Products: Vessel fisheries— | | | | | | |
| With dredges—market oysters....bushels.. | 485,639 | $230,030 | 171,795 | $60,572 | 657,434 | 290,602 |
| With tongs—market oysters.....bushels.. | 1,500 | 800 | 6,825 | 2,600 | 8,325 | 3,400 |
| Total | 487,139 | 230,830 | 178,620 | 63,172 | 665,759 | 294,002 |
| Boat fisheries— | | | | | | |
| With dredges—market oysters....bushels.. | 93,600 | 48,970 | 216,300 | 84,715 | 309,900 | 133,685 |
| With tongs— Market oysters, bushels | 1,660,603 | 842,864 | 1,769,755 | 675,974 | 3,430,358 | 1,518,838 |
| Seed oysters, bushels | 16,531 | 6,166 | 1,783,550 | 333,649 | 1,800,081 | 339,815 |
| Total | 1,770,734 | 898,000 | 3,769,605 | 1,094,338 | 5,540,339 | 1,992,338 |
| Grand total | 2,257,873 | 1,128,830 | 3,948,225 | 1,157,510 | 6,206,098 | 2,286,340 |
| Wholesale trade: | | | | | | |
| Market oysters sold in the shell...........bushels.. | | | | | 400,628 | 278,138 |
| Oysters sold opened.galls.. | | | | | 2,347,434 | 2,181,007 |
| Oysters canned......cans.. | | | | | 134,784 | 8,356 |
| Oyster shells sold.bush.. | | | | | 1,907,488 | 41,406 |
| Crushed oyster shells sold...............tons.. | | | | | 8,400 | 37,300 |
| Lime from oyster shells, tons | | | | | 23,627 | 107,383 |
| Total | | | | | | 2,653,590 |
| Expenses connected with the wholesale trade | | | | | | 257,739 |

NOTE.—In Maryland the revenue to the State from leases on oyster grounds, license fees, and other sources, in 1912, was $83,997, and the cost of administration was $117,949. In Virginia the revenue to the State was $61,305. There was considerable interchange of persons, boats, and apparatus between private and public areas in both of these States, but in the above table they are shown where they did the most work.

## Comparative Statistics of the Oyster Product of Maryland and Virginia for Various Years from 1880 to 1912.[a]

| Years. | Maryland. | | Virginia. | |
|---|---|---|---|---|
| | *Bushels.* | *Value.* | *Bushels.* | *Value.* |
| 1880 | 10,600,000 | $4,730,476 | 6,837,320 | $2,218,376 |
| 1887 | 8,148,217 | 2,683,435 | 2,921,139 | 1,002,901 |
| 1888 | 8,531,658 | 2,877,790 | 3,664,433 | 1,836,012 |
| 1890 | 10,450,087 | 4,854,746 | 6,074,025 | 2,482,348 |
| 1891 | 9,945,058 | 5,295,866 | 6,162,086 | 2,524,348 |
| 1897 | 7,254,934 | 2,885,202 | 7,023,848 | 2,041,683 |
| 1901 | 5,685,561 | 3,031,518 | 7,885,447 | 2,923,456 |
| 1904 | 4,429,650 | 2,417,674 | 7,612,289 | 3,459,676 |
| 1908 | 6,232,000 | 2,228,330 | 5,075,000 | 2,347,780 |
| 1912 | 5,510,421 | 2,127,759 | 6,206,098 | 2,286,340 |

[a] The statistics for 1908 in this table are from data published by the Bureau of the Census. The products of Virginia for 1887 do not include those of the James and Potomac Rivers.

In the Pacific Coast States in 1912 there were 800 persons engaged in the oyster industry, and the amount of wages paid was $260,895. The output was 213,579 bushels of market and seed oysters, having a value of $676,243, of which 157,243 bushels, valued at $659,430, were from private grounds.

In California the oyster industry, including the cultivation of oysters and the oyster trade, centers in San Francisco, and the oyster grounds are located chiefly in San Francisco Bay, although there are oyster grounds also in Tomales and Humboldt Bays. In San Francisco Bay sting rays are abundant at times, and in order to protect the oysters from them stockades are built around the oyster grounds. These are usually made of pickets, 2 by 3 inches in size, and from 14 to 16 feet high. The oyster product of the State is all obtained from private grounds, and the season extends practically through the entire year. The yield of oysters was 68,037 bushels, valued at $280,344, of which all except 600 bushels of native oysters, valued at $1,800, were eastern oysters grown from seed oysters brought from the Atlantic coast and planted on the local beds. In addition to the eastern and native oysters produced on the west coast, market oysters from the Atlantic coast are also handled by the dealers at San Francisco.

In Oregon the oyster grounds are in Yaquina Bay. The product of native and eastern oysters in 1912 was 2,213 bushels, valued at $9,050. In Washington the oyster grounds are in Willapa Bay, Grays Harbor, and in the bays and inlets in Puget Sound. As in other States on the Pacific coast these oyster grounds are usually exposed at low tide, and in winter the oysters are in danger of freezing when the tide is out. In order to retain water on the grounds dikes have been built in some localities. Shells have been planted on grounds inclosed by dikes for the purpose of rendering the bottom suitable for oyster planting, and also to secure a set of oyster spat. Both native and eastern oysters are used for planting purposes. Some Japanese oysters were planted in Willapa Bay about 10 years ago. In 1912 about 20,000 of these oysters were planted as an experiment within the dikes on private beds in Hood Canal. The oyster product of Washington amounted to 143,329 bushels of native and eastern oysters, having a value of $386,849, about 61 per cent of which were from planted grounds.

Following are detailed statistics of the oyster industry of the Pacific Coast States in 1912:

## OYSTER INDUSTRY OF THE PACIFIC COAST STATES, 1912.

| Items. | California. | | Oregon. | | | | | | Washington. | | | | | | Grand total. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Private areas. | | Private areas. | | Public areas. | | Total. | | Private areas. | | Public areas. | | Total. | | | |
| | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* |
| Persons engaged: | | | | | | | | | | | | | | | | |
| On vessels fishing | | | | | | | | | 12 | | | | 12 | | 12 | |
| On vessels transporting | 3 | | | | | | | | 5 | | | | 5 | | 8 | |
| In shore or boat fisheries | 119 | | 18 | | | | 18 | | 390 | | 99 | | 489 | | 626 | |
| Shoresmen | 90 | | | | | | | | 64 | | | | 64 | | 154 | |
| Total | 212 | | 18 | | | | 18 | | 471 | | 99 | | 570 | | 800 | |
| Wages paid: | | | | | | | | | | | | | | | | |
| Dredging | | | | | | | | | | $5,033 | | | | $5,033 | | $5,033 |
| Tonging | | $12,008 | | $1,600 | | $2,000 | | $3,600 | | 40,435 | | $13,525 | | 53,960 | | 69,568 |
| Transporting | | 4,240 | | | | | | | | 10,375 | | | | 10,375 | | 14,615 |
| Planting and transplanting | | 42,535 | | | | | | | | 34,035 | | | | 34,035 | | 76,570 |
| Protecting oysters from natural enemies | | | | | | | | | | 1,180 | | | | 1,180 | | 1,180 |
| Wholesale trade | | 69,571 | | | | | | | | 24,358 | | | | 24,358 | | 93,929 |
| Total | | 128,354 | | 1,600 | | 2,000 | | 3,600 | | 115,416 | | 13,525 | | 128,941 | | 260,895 |
| Vessels, boats, apparatus, and other property: | | | | | | | | | | | | | | | | |
| Vessels fishing | | | | | | | | | 7 | 27,000 | | | 7 | 27,000 | 7 | 27,000 |
| Net tonnage | | | | | | | | | 59 | | | | 59 | | 59 | |
| Vessels transporting | 5 | 32,500 | | | | | | | 12 | 22,000 | | | 12 | 22,000 | 17 | 54,500 |
| Net tonnage | 82 | | | | | | | | 78 | | | | 78 | | 160 | |
| Gasoline boats | 11 | 9,550 | 4 | 1,600 | | | 4 | 1,600 | 35 | 18,350 | | | 35 | 18,350 | 50 | 29,500 |
| Sail and row boats | 134 | 21,750 | 43 | 2,455 | | | 43 | 2,455 | 545 | 24,459 | | | 545 | 24,459 | 722 | 48,664 |
| Apparatus—vessel fisheries—dredges | | | | | | | | | 16 | 323 | | | 16 | 323 | 16 | 323 |
| Apparatus—boat fisheries— | | | | | | | | | | | | | | | | |
| Dredges | | | | | | | | | 2 | 30 | | | 2 | 30 | 2 | 30 |
| Tongs | 178 | 1,254 | 50 | 800 | | | 50 | 800 | 694 | 3,457 | | | 694 | 3,457 | 922 | 5,511 |
| Shore and accessory property | | 275,350 | | | | | | | | 55,775 | | | | 55,775 | | 331,125 |
| Cash capital | | 1,085,000 | | | | | | | | 46,000 | | | | 46,000 | | 1,131,000 |
| Total | | 1,425,404 | | 4,855 | | | | 4,855 | | 197,394 | | | | 197,394 | | 1,627,653 |
| Planting operations: | | | | | | | | | | | | | | | | |
| Oyster grounds owned or leased ... acres | [a]35,448.12 | 449,775 | 41.83 | 16,000 | | | 41.83 | 16,000 | 15,934.05 | 832,830 | | | 15,934.05 | 832,830 | 51,424.00 | 1,298,605 |
| Oyster grounds under culture ... acres | [b]6,717.00 | | 41.83 | | | | 41.83 | | 4,450.15 | | | | 4,450.15 | | 11,208.98 | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Grounds planted during the year... acres.. | 100.00 | | | | | | | | 529.00 | | | | 529.00 | | 629.00 | |
| Materials planted during the year— | | | | | | | | | | | | | | | | |
| Seed oysters, bushels | 8,600 | 24,239 | | | | | | | 108,005 | 141,391 | | | 108,005 | 141,391 | [b] 116,605 | 165,630 |
| Oyster shells, bushels | 6,000 | 600 | | | | | | | 33,650 | 4,550 | | | 33,650 | 4,550 | 39,650 | 5,150 |
| Total | | 24,839 | | | | | | | | 145,941 | | | | 145,941 | | 170,780 |
| Expenses connected with planting— | | | | | | | | | | | | | | | | |
| Planting and transplanting | | 2,026 | | | | | | | | 12,275 | | | | 12,275 | | 14,301 |
| Protecting oysters from natural enemies | | 8,915 | | | | | | | | | | | | | | 8,915 |
| Total | | 10,941 | | | | | | | | 12,275 | | | | 12,275 | | 23,216 |
| Oysters on private areas at the end of the year— | | | | | | | | | | | | | | | | |
| Native....bushels.. | 3,100 | 6,390 | 500 | 900 | | | 500 | 900 | 555,425 | 832,570 | | | 555,425 | 832,570 | 559,025 | 839,860 |
| Eastern......do.... | 98,500 | 311,000 | 500 | 1,500 | | | 500 | 1,500 | 191,310 | 532,775 | | | 191,310 | 532,775 | 290,310 | 845,275 |
| Total | 101,600 | 317,390 | 1,000 | 2,400 | | | 1,000 | 2,400 | 746,735 | 1,365,345 | | | 746,735 | 1,365,345 | 849,335 | 1,685,135 |
| Products: | | | | | | | | | | | | | | | | |
| Vessel fisheries—with dredges— | | | | | | | | | | | | | | | | |
| Market oysters, native.....bushels.. | | | | | | | | | 4,300 | 12,200 | | | 4,300 | 12,200 | 4,300 | 12,200 |
| Market oysters, eastern..bushels.. | | | | | | | | | 22,230 | 84,017 | | | 22,230 | 84,017 | 22,230 | 84,017 |
| Total | | | | | | | | | 26,530 | 96,217 | | | 26,530 | 96,217 | 26,530 | 96,217 |
| Boat fisheries— | | | | | | | | | | | | | | | | |
| With dredges— | | | | | | | | | | | | | | | | |
| Market oysters, native, bushels | | | | | | | | | 20 | 72 | | | 20 | 72 | 20 | 72 |
| Market oysters, eastern, bushels | | | | | | | | | 1,305 | 4,906 | | | 1,305 | 4,906 | 1,305 | 4,906 |

[a] Estimated.

[b] Includes 54,315 bushels of eastern oysters, valued at $139,453.

OYSTER INDUSTRY OF THE PACIFIC COAST STATES, 1912—Continued.

| Items. | California. | | Oregon. | | | | | | Washington. | | | | | | Grand total. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Private areas. | | Private areas. | | Public areas. | | Total. | | Private areas. | | Public areas. | | Total. | | | |
| | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* |
| **Products**—Continued. | | | | | | | | | | | | | | | | |
| Boat fisheries—Contd. | | | | | | | | | | | | | | | | |
| With tongs— | | | | | | | | | | | | | | | | |
| Market oysters, native, bushels | 600 | $1,800 | 413 | $1,450 | 600 | $2,000 | 1,013 | $3,450 | 42,530 | $206,613 | | | 42,530 | $206,613 | 44,143 | $211,863 |
| Market oysters, eastern, bushels | 67,437 | 278,544 | 1,200 | 5,600 | | | 1,200 | 5,600 | 15,408 | 61,228 | | | 15,408 | 61,228 | 84,045 | 345,372 |
| Seed oysters, native, bushels | | | | | | | | | 1,800 | 3,000 | 55,736 | $14,813 | 57,536 | 17,813 | 57,536 | 17,813 |
| Total | 68,037 | 280,344 | 1,613 | 7,050 | 600 | 2,000 | 2,213 | 9,050 | 61,063 | 275,819 | 55,736 | 14,813 | 116,799 | 290,632 | 187,049 | 580,026 |
| Grand total | 68,037 | 280,344 | 1,613 | 7,050 | 600 | 2,000 | 2,213 | 9,050 | 87,593 | 372,036 | 55,736 | 14,813 | 143,329 | 386,849 | 213,579 | 676,243 |
| Wholesale trade: | | | | | | | | | | | | | | | | |
| Market oysters sold in the shell, native, bushels | 10,867 | 43,078 | | | | | | | | | | | 8,658 | 49,003 | 19,525 | 92,081 |
| Market oysters sold in the shell, eastern, bushels | 48,914 | 186,440 | | | | | | | | | | | 4,577 | 19,898 | 53,491 | 206,338 |
| Oysters sold opened, native ... gallons | 4,950 | 17,325 | | | | | | | | | | | 40,137 | 114,278 | 45,087 | 131,603 |
| Oysters sold opened, eastern ... gallons | 57,886 | 204,894 | | | | | | | | | | | 2,537 | 5,501 | 60,423 | 210,395 |
| Oyster shells sold, bushels | 63,700 | 2,345 | | | | | | | | | | | 5,600 | 830 | 69,300 | 3,175 |
| Total | | 454,082 | | | | | | | | | | | | 189,510 | | 643,592 |
| Expenses connected with wholesale trade | | 25,267 | | | | | | | | | | | | 16,338 | | 41,605 |

NOTE.—In addition to the oyster grounds shown for Washington in the above table as owned or leased, there are 22,477.89 acres which have been taken up, but have not been used for oyster planting. In Washington the revenue to the State from sales and leases of oyster grounds, tonging licenses, and commodity tax, in 1912, was $3,085. California and Oregon derive no revenue from oyster grounds. There was considerable interchange of persons, boats, and apparatus between private and public areas in Washington and Oregon, but in the above table they are shown where they did the most work.

COMPARATIVE STATISTICS OF THE OYSTER PRODUCT OF THE PACIFIC COAST STATES FOR VARIOUS YEARS FROM 1880 TO 1912.[a]

| Years. | California. | | Oregon. | | Washington. | | Total. | |
|---|---|---|---|---|---|---|---|---|
| | *Bushels.* | *Value.* | *Bushels.* | *Value.* | *Bushels.* | *Value.* | *Bushels.* | *Value.* |
| 1880 | (b) | (b) | (b) | (b) | 15,000 | $10,000 | (b) | (b) |
| 1888 | 130,000 | $509,175 | 4,125 | $6,250 | 60,993 | 86,574 | 195,118 | $601,999 |
| 1889 | 146,150 | 571,525 | 1,666 | 3,125 | 125,790 | 128,604 | 273,606 | 703,254 |
| 1890 | 151,325 | 592,137 | 1,470 | 2,758 | 148,150 | 147,930 | 300,945 | 742,825 |
| 1891 | 158,130 | 618,455 | 1,622 | 3,043 | 166,428 | 154,961 | 326,180 | 776,459 |
| 1892 | 178,645 | 698,257 | 1,633 | 3,062 | 164,924 | 147,995 | 345,202 | 849,314 |
| 1895 | 163,636 | 539,497 | 1,480 | 2,220 | 108,067 | 109,232 | 273,183 | 650,949 |
| 1899 | 420,000 | 867,000 | 985 | 1,625 | 98,355 | 174,567 | 519,340 | 1,043,192 |
| 1904 | 188,613 | 628,023 | 992 | 1,488 | 191,208 | 402,012 | 380,813 | 1,031,523 |
| 1908 | 104,000 | 337,000 | 1,300 | 4,200 | 204,000 | 352,500 | 209,300 | 693,700 |
| 1912 | 68,037 | 280,344 | 2,213 | 9,050 | 143,329 | 386,849 | 213,579 | 676,243 |

a The statistics for 1908 in this table are from data published by the Bureau of the Census.
b Statistics not available.

VESSEL FISHERIES AT BOSTON AND GLOUCESTER.

Statistics of the vessel fisheries at Boston and Gloucester, Mass., have been collected and published as monthly and annual bulletins, giving the quantity and value of fishery products landed by American fishing vessels at each of these ports during the calendar year.

In 1912 there were landed at Boston 3,676 trips, amounting to 100,300,080 pounds of fish, valued at $2,731,391, and at Gloucester 3,973 trips, aggregating 82,403,979 pounds, valued at $2,047,868, a total of 7,649 trips and 182,704,059 pounds of fresh and salted fish, valued at $4,779,259. The receipts at Boston were all fresh fish except 143,000 pounds of salted mackerel, valued at $9,442, while at Gloucester they included 51,263,695 pounds of fresh fish, valued at $1,055,295 and 31,140,284 pounds of salted fish, valued at $992,573. Compared with 1911 there was an increase of 849 trips at the two ports, but a decrease of 2,449,308 pounds in the quantity and of $245,238 in the value of the products. The catch of cod and cusk did not vary materially from that of the previous year, but there was considerable decrease in the value. There was an increase in the catch of haddock and halibut, but a decrease in that of hake, pollock, mackerel, and other species. The dealers at Gloucester imported during the year 3,637,169 pounds of salted cod from Newfoundland and Nova Scotia.

Statistics of these fisheries are given in detail by months and fishing grounds in the following tables.

QUANTITY AND VALUE OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE YEAR 1912, SHOWN BY MONTHS.

| Month. | Number of trips. | Cod. | | | | Cusk. | | | | Haddock. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Fresh. | | Salted. | | Fresh. | | Salted. | | Fresh. | | Salted. | |
| | | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* |
| LANDED AT BOSTON. | | | | | | | | | | | | | |
| January | 192 | 765,550 | $36,590 | ... | ... | 146,400 | $4,594 | ... | ... | 1,997,300 | $66,355 | ... | ... |
| February | 258 | 1,363,700 | 52,647 | ... | ... | 187,600 | 4,596 | ... | ... | 5,367,200 | 135,071 | ... | ... |
| March | 322 | 3,074,900 | 95,074 | ... | ... | 235,900 | 5,396 | ... | ... | 6,134,700 | 134,889 | ... | ... |
| April | 306 | 2,446,400 | 71,600 | ... | ... | 402,900 | 8,084 | ... | ... | 5,239,600 | 79,834 | ... | ... |
| May | 230 | 2,301,100 | 55,757 | ... | ... | 469,600 | 8,274 | ... | ... | 2,552,900 | 64,450 | ... | ... |
| June | 256 | 1,772,500 | 61,861 | ... | ... | 198,700 | 3,351 | ... | ... | 4,128,200 | 62,089 | ... | ... |
| July | 335 | 1,682,700 | 67,869 | ... | ... | 98,400 | 2,042 | ... | ... | 3,705,750 | 70,212 | ... | ... |
| August | 371 | 3,528,300 | 85,085 | ... | ... | 189,000 | 3,236 | ... | ... | 5,204,550 | 60,299 | ... | ... |
| September | 398 | 1,797,250 | 66,613 | ... | ... | 202,300 | 3,852 | ... | ... | 5,754,200 | 95,205 | ... | ... |
| October | 388 | 2,521,650 | 95,160 | ... | ... | 394,900 | 6,777 | ... | ... | 6,040,500 | 132,264 | ... | ... |
| November | 374 | 1,093,500 | 50,700 | ... | ... | 360,000 | 6,615 | ... | ... | 3,452,400 | 119,151 | ... | ... |
| December | 246 | 1,065,750 | 45,426 | ... | ... | 180,400 | 4,359 | ... | ... | 3,199,900 | 143,175 | ... | ... |
| Total | 3,676 | 23,413,300 | 784,382 | ... | ... | 3,066,100 | 61,176 | ... | ... | 52,777,200 | 1,162,994 | ... | ... |
| LANDED AT GLOUCESTER. | | | | | | | | | | | | | |
| January | 350 | 192,218 | 7,807 | 88,432 | $4,873 | 17,830 | 359 | 1,255 | $32 | 739,217 | 21,789 | 3,400 | $55 |
| February | 278 | 164,890 | 7,040 | 729,010 | 33,490 | 6,131 | 134 | 2,141 | 53 | 428,674 | 10,783 | 6,295 | 93 |
| March | 436 | 2,184,545 | 50,319 | 255,566 | 12,317 | 34,981 | 570 | 5,185 | 130 | 1,960,361 | 45,459 | 5,124 | 77 |
| April | 428 | 1,734,089 | 34,924 | 635,597 | 23,195 | 282,988 | 4,153 | 4,005 | 100 | 3,991,868 | 51,751 | 10,665 | 161 |
| May | 265 | 1,705,416 | 31,167 | 1,571,494 | 54,256 | 613,064 | 8,373 | 2,235 | 57 | 354,842 | 6,828 | 24,290 | 339 |
| June | 189 | 2,078,995 | 34,640 | 4,144,695 | 130,172 | 344,197 | 4,475 | 11,755 | 294 | 278,617 | 1,988 | 47,495 | 623 |
| July | 229 | 979,990 | 16,486 | 2,250,260 | 72,913 | 502,038 | 6,517 | 54,388 | 1,227 | 638,490 | 4,482 | 60,643 | 807 |
| August | 202 | 1,303,920 | 22,037 | 2,302,621 | 73,217 | 619,988 | 8,049 | 33,219 | 746 | 687,870 | 4,815 | 46,265 | 581 |
| September | 189 | 838,450 | 14,803 | 1,883,938 | 61,519 | 467,229 | 5,942 | 22,145 | 497 | 632,790 | 4,938 | 50,370 | 688 |
| October | 147 | 615,767 | 12,176 | 1,821,846 | 72,971 | 238,270 | 3,114 | 10,755 | 248 | 462,305 | 5,528 | 34,589 | 533 |
| November | 592 | 127,385 | 3,109 | 2,314,617 | 98,606 | 77,057 | 1,000 | 9,880 | 223 | 96,970 | 2,978 | 21,695 | 327 |
| December | 668 | 179,855 | 8,561 | 188,232 | 9,053 | 47,295 | 615 | 6,406 | 158 | 175,585 | 8,535 | 11,610 | 174 |
| Total | 3,973 | 12,105,520 | 243,069 | 18,186,308 | 646,582 | 3,251,068 | 43,301 | 163,369 | 3,765 | 10,447,589 | 169,874 | 322,441 | 4,458 |
| Grand total | 7,649 | 35,518,820 | 1,027,451 | 18,186,308 | 646,582 | 6,317,168 | 104,477 | 163,369 | 3,765 | 63,224,789 | 1,332,868 | 322,441 | 4,458 |
| Grounds E. of 66° west long. | 741 | 10,838,253 | 269,819 | 14,988,605 | 521,029 | 2,602,783 | 41,444 | 75,041 | 1,728 | 6,110,770 | 140,993 | 156,409 | 2,177 |
| Grounds W. of 66° west long. | 6,908 | 24,680,567 | 757,632 | 3,197,703 | 125,553 | 3,714,385 | 63,033 | 88,328 | 2,037 | 57,114,019 | 1,191,875 | 166,032 | 2,281 |
| Landed at Boston in 1911 | 3,971 | 21,704,300 | 714,514 | ... | ... | 2,916,800 | 61,058 | ... | ... | 47,687,300 | 1,126,744 | ... | ... |
| Landed at Gloucester in 1911 | 2,829 | 12,272,843 | 279,974 | 19,729,034 | 886,490 | 3,516,702 | 60,596 | 248,018 | 6,221 | 8,024,102 | 131,128 | 463,774 | 8,550 |

| Month. | Hake. | | | | Pollock. | | | | Halibut. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fresh. | | Salted. | | Fresh. | | Salted. | | Fresh. | | Salted. | |
| | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* |
| LANDED AT BOSTON. | | | | | | | | | | | | |
| January | 296,800 | $11,925 | | | 114,900 | $4,146 | | | 14,900 | $2,122 | | |
| February | 302,250 | 12,465 | | | 169,150 | 6,223 | | | 56,700 | 6,360 | | |
| March | 595,700 | 20,101 | | | 146,300 | 5,399 | | | 46,200 | 6,222 | | |
| April | 475,500 | 9,733 | | | 164,700 | 4,306 | | | 91,350 | 11,255 | | |
| May | 838,300 | 10,685 | | | 294,250 | 4,843 | | | 80,400 | 7,304 | | |
| June | 951,100 | 14,394 | | | 274,800 | 6,970 | | | 80,630 | 7,380 | | |
| July | 699,500 | 12,872 | | | 254,200 | 8,862 | | | 166,000 | 13,679 | | |
| August | 552,900 | 8,838 | | | 501,800 | 9,689 | | | 90,545 | 8,080 | | |
| September | 1,124,100 | 20,697 | | | 622,500 | 16,054 | | | 70,590 | 7,962 | | |
| October | 3,118,200 | 40,128 | | | 954,550 | 19,039 | | | 107,650 | 12,832 | | |
| November | 1,982,200 | 34,954 | | | 599,200 | 8,357 | | | 27,475 | 5,048 | | |
| December | 445,000 | 16,750 | | | 169,680 | 3,095 | | | 13,950 | 2,602 | | |
| Total | 11,381,550 | 213,542 | | | 4,266,030 | 96,983 | | | 846,390 | 90,846 | | |
| LANDED AT GLOUCESTER. | | | | | | | | | | | | |
| January | 58,015 | 1,636 | 5,230 | $98 | 405,173 | 15,607 | 12,056 | $182 | 46,992 | 6,431 | 382 | $33 |
| February | 7,952 | 255 | 1,370 | 20 | 203,611 | 8,442 | 15,292 | 230 | 141,685 | 13,795 | 5,655 | 463 |
| March | 27,233 | 428 | 995 | 14 | 169,913 | 5,744 | 8,270 | 124 | 220,123 | 20,317 | 45 | 4 |
| April | 234,539 | 2,191 | 2,203 | 33 | 213,821 | 4,248 | 14,725 | 222 | 153,225 | 17,231 | 860 | 68 |
| May | 691,472 | 5,354 | 8,716 | 118 | 976,806 | 8,014 | 19,885 | 275 | 178,133 | 14,264 | 232 | 19 |
| June | 474,713 | 3,359 | 83,508 | 1,044 | 141,245 | 1,095 | 82,125 | 1,179 | 432,443 | 29,214 | 47,156 | 3,753 |
| July | 351,359 | 2,443 | 47,127 | 592 | 189,555 | 1,361 | 37,247 | 555 | 229,446 | 15,671 | 2,173 | 174 |
| August | 477,010 | 3,338 | 33,458 | 417 | 41,935 | 336 | 32,385 | 487 | 266,882 | 25,104 | 11,408 | 913 |
| September | 630,310 | 5,306 | 35,006 | 524 | 69,178 | 553 | 23,191 | 349 | 263,182 | 28,965 | 393,327 | 39,288 |
| October | 356,865 | 4,090 | 32,465 | 517 | 122,400 | 1,348 | 22,247 | 368 | 158,635 | 18,692 | 18,496 | 1,852 |
| November | 480,715 | 5,529 | 13,065 | 210 | 4,290,451 | 44,165 | 24,485 | 368 | 77,653 | 12,576 | 965 | 97 |
| December | 117,000 | 3,894 | 6,555 | 101 | 3,269,231 | 50,659 | 15,405 | 232 | 45,847 | 7,459 | 204 | 21 |
| Total | 3,907,183 | 37,823 | 269,698 | 3,688 | 10,093,319 | 141,572 | 307,313 | 4,571 | 2,214,246 | 209,719 | 480,903 | 46,685 |
| Grand total | 15,288,733 | 251,365 | 269,698 | 3,688 | 14,359,349 | 238,555 | 307,313 | 4,571 | 3,060,636 | 300,565 | 480,903 | 46,685 |
| Grounds E. of 66° west longitude | 3,345,860 | 51,869 | 241,540 | 3,301 | 459,335 | 9,864 | 145,667 | 2,175 | 2,262,611 | 214,490 | 479,439 | 46,560 |
| Grounds W. of 66° west longitude | 11,942,873 | 199,496 | 28,158 | 387 | 13,900,014 | 228,691 | 161,646 | 2,396 | 798,025 | 86,075 | 1,464 | 125 |
| Landed at Boston in 1911 | 11,337,925 | 227,327 | | | 5,095,840 | 121,381 | | | 748,850 | 65,811 | | |
| Landed at Gloucester in 1911 | 6,759,243 | 77,118 | 355,418 | 6,167 | 9,651,178 | 119,580 | 878,946 | 15,889 | 2,341,928 | 198,767 | 410,967 | 35,171 |

QUANTITY AND VALUE OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE YEAR 1912, SHOWN BY MONTHS—Continued.

| Month. | Mackerel. | | | | Other fish.[a] | | | | Total. | | | | Grand total. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fresh. | | Salted. | | Fresh. | | Salted. | | Fresh. | | Salted. | | | |
| | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* |
| LANDED AT BOSTON. | | | | | | | | | | | | | | |
| January | | | | | | | | | 3,335,850 | $125,732 | | | 3,335,850 | $125,732 |
| February | | | | | | | | | 7,446,600 | 217,362 | | | 7,446,600 | 217,362 |
| March | | | | | | | | | 10,233,700 | 267,081 | | | 10,233,700 | 267,081 |
| April | | | | | 6,100 | $90 | | | 8,826,550 | 184,902 | | | 8,826,550 | 184,902 |
| May | | | | | | | | | 6,536,550 | 151,313 | | | 6,536,550 | 151,313 |
| June | 295,750 | $29,564 | 40,600 | $805 | 82,000 | 510 | | | 7,783,680 | 186,119 | 40,600 | $805 | 7,824,280 | 186,924 |
| July | 241,595 | 21,892 | 2,000 | 110 | 1,014,350 | 93,370 | | | 7,862,495 | 290,798 | 2,000 | 110 | 7,864,495 | 290,908 |
| August | 378,275 | 20,272 | 4,600 | 1,896 | 637,100 | 49,840 | | | 11,082,470 | 245,339 | 4,600 | 1,896 | 11,087,070 | 247,235 |
| September | 1,547,175 | 72,994 | 95,800 | 6,631 | 159,300 | 19,036 | | | 11,277,415 | 302,413 | 95,800 | 6,631 | 11,373,215 | 309,044 |
| October | 8,400 | 665 | | | 3,040 | 549 | | | 13,148,890 | 307,414 | | | 13,148,890 | 307,414 |
| November | 25,425 | 3,109 | | | 8,000 | 135 | | | 7,548,200 | 228,069 | | | 7,548,200 | 228,069 |
| December | | | | | | | | | 5,074,680 | 215,407 | | | 5,074,680 | 215,407 |
| Total | 2,496,620 | 148,496 | 143,000 | 9,442 | 1,909,890 | 163,530 | | | 100,157,080 | 2,721,949 | 143,000 | 9,442 | 100,300,080 | 2,731,391 |
| LANDED AT GLOUCESTER. | | | | | | | | | | | | | | |
| January | | | | | 4,387,500 | 131,625 | 4,119,128 | $76,821 | 5,846,945 | 185,254 | 4,229,883 | 82,094 | 10,076,828 | 267,348 |
| February | | | | | 612,500 | 18,375 | 222,200 | 4,925 | 1,565,443 | 58,824 | 981,963 | 39,274 | 2,547,406 | 98,098 |
| March | | | | | | | | | 4,597,156 | 122,837 | 275,185 | 12,666 | 4,872,341 | 135,503 |
| April | | | | | 54,000 | 1,080 | | | 6,664,530 | 115,578 | 668,055 | 23,779 | 7,332,585 | 139,357 |
| May | | | | | | | 54,200 | 1,121 | 4,519,733 | 74,000 | 1,681,052 | 56,185 | 6,200,785 | 130,185 |
| June | 12,060 | 944 | 368,000 | 20,240 | 749,000 | 9,408 | 107,600 | 2,556 | 4,511,270 | 85,123 | 4,892,334 | 159,861 | 9,403,604 | 244,984 |
| July | 82,080 | 4,503 | 10,000 | 450 | 791,720 | 8,214 | | | 3,764,678 | 59,677 | 2,461,838 | 76,718 | 6,226,516 | 136,395 |
| August | 23,580 | 778 | 42,600 | 2,386 | 1,050,630 | 10,678 | 7,000 | 210 | 4,471,815 | 75,135 | 2,508,956 | 78,957 | 6,980,771 | 154,092 |
| September | 7,290 | 622 | 693,600 | 52,573 | 854,800 | 4,727 | | | 3,763,229 | 65,856 | 3,101,577 | 155,438 | 6,864,806 | 221,294 |
| October | 21,510 | 1,299 | 262,600 | 22,386 | 40,000 | 450 | | | 2,015,752 | 46,697 | 2,202,998 | 98,875 | 4,218,750 | 145,572 |
| November | 17,100 | 1,244 | 28,200 | 2,975 | 16,000 | 240 | 320,308 | 5,819 | 5,183,331 | 70,841 | 2,733,215 | 108,625 | 7,916,546 | 179,466 |
| December | | | | | 525,000 | 15,750 | 5,174,816 | 90,362 | 4,359,813 | 95,473 | 5,403,228 | 100,101 | 9,763,041 | 195,574 |
| Total | 163,620 | 9,390 | 1,405,000 | 101,010 | 9,081,150 | 200,547 | 10,005,252 | 181,814 | 51,263,695 | 1,055,295 | 31,140,284 | 992,573 | 82,403,979 | 2,047,868 |
| Grand total | 2,660,240 | 157,886 | 1,548,000 | 110,452 | 10,991,040 | 364,077 | 10,005,252 | 181,814 | 151,420,775 | 3,777,244 | 31,283,284 | 1,002,015 | 182,704,059 | 4,779,259 |
| Grounds E. of 66° west longitude | 123,000 | 18,191 | 450,200 | 25,432 | 5,647,540 | 180,353 | 9,998,252 | 181,604 | 31,390,152 | 927,023 | 26,535,153 | 784,006 | 57,925,305 | 1,711,029 |
| Grounds W. of 66° west longitude | 2,537,240 | 139,695 | 1,097,800 | 85,020 | 5,343,500 | 183,724 | 7,000 | 210 | 120,030,623 | 2,850,221 | 4,748,131 | 218,009 | 124,778,754 | 3,068,230 |
| Landed at Boston in 1911 | 2,588,694 | 142,114 | 131,200 | 9,755 | 1,549,200 | 106,578 | | | 93,628,909 | 2,565,527 | 131,200 | 9,755 | 93,760,109 | 2,575,282 |
| Landed at Gloucester in 1911 | 510,140 | 30,132 | 1,307,900 | 101,886 | 8,159,545 | 186,567 | 16,763,520 | 304,979 | 51,235,681 | 1,083,862 | 40,157,577 | 1,365,353 | 91,393,258 | 2,449,215 |

[a] Includes herring from Newfoundland—5,525,000 pounds frozen, $165,750, and 9,998,252 pounds salted, $181,604.

| Fishing grounds. | Number of trips. | Cod. | | | | Cusk. | | | | Haddock. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Fresh. | | Salted. | | Fresh. | | Salted. | | Fresh. | | Salted. | |
| | | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* |
| LANDED AT BOSTON. | | | | | | | | | | | | | |
| *East of 66° west longitude.* | | | | | | | | | | | | | |
| La Have Bank | 16 | 261,000 | $7,125 | ........ | ........ | 48,500 | $895 | ........ | ........ | 682,600 | $10,452 | ........ | ........ |
| Western Bank | 22 | 699,100 | 21,535 | ........ | ........ | 38,000 | 936 | ........ | ........ | 126,000 | 1,950 | ........ | ........ |
| Quereau Bank | 15 | 280,800 | 9,184 | ........ | ........ | 13,400 | 261 | ........ | ........ | 7,000 | 134 | ........ | ........ |
| Cape Shore | 217 | 3,276,500 | 118,812 | ........ | ........ | 802,100 | 16,919 | ........ | ........ | 3,829,700 | 108,883 | ........ | ........ |
| *West of 66° west longitude.* | | | | | | | | | | | | | |
| Browns Bank | 84 | 755,000 | 23,868 | ........ | ........ | 370,500 | 7,021 | ........ | ........ | 1,850,000 | 33,084 | ........ | ........ |
| Georges Bank | 564 | 7,420,200 | 210,749 | ........ | ........ | 303,000 | 6,260 | ........ | ........ | 15,286,700 | 306,683 | ........ | ........ |
| Cashes Bank | 8 | 28,400 | 807 | ........ | ........ | 81,200 | 1,226 | ........ | ........ | 7,000 | 194 | ........ | ........ |
| Clark Bank | 5 | 67,700 | 2,093 | ........ | ........ | 2,800 | 43 | ........ | ........ | 131,000 | 1,515 | ........ | ........ |
| Fippenies Bank | 1 | 2,000 | 100 | ........ | ........ | 4,000 | 120 | ........ | ........ | 2,000 | 100 | ........ | ........ |
| Middle Bank | 371 | 526,300 | 21,903 | ........ | ........ | 188,700 | 3,968 | ........ | ........ | 1,843,300 | 64,339 | ........ | ........ |
| Jeffreys Ledge | 374 | 574,250 | 24,700 | ........ | ........ | 326,700 | 6,387 | ........ | ........ | 1,195,050 | 43,733 | ........ | ........ |
| South Channel | 868 | 5,837,150 | 211,694 | ........ | ........ | 310,400 | 6,033 | ........ | ........ | 22,923,400 | 459,033 | ........ | ........ |
| Nantucket Shoals | 35 | 422,000 | 13,554 | ........ | ........ | 2,900 | 58 | ........ | ........ | 107,800 | 1,719 | ........ | ........ |
| Off Highland Light | 11 | 11,000 | 494 | ........ | ........ | 4,600 | 118 | ........ | ........ | 155,400 | 5,249 | ........ | ........ |
| Off Chatham | 244 | 929,550 | 32,030 | ........ | ........ | 39,800 | 758 | ........ | ........ | 3,441,600 | 84,636 | ........ | ........ |
| Shore, general | 841 | 2,322,350 | 85,734 | ........ | ........ | 529,500 | 10,173 | ........ | ........ | 1,188,650 | 41,290 | ........ | ........ |
| Total | 3,676 | 23,413,300 | 784,382 | ........ | ........ | 3,066,100 | 61,176 | ........ | ........ | 52,777,200 | 1,162,994 | ........ | ........ |
| LANDED AT GLOUCESTER. | | | | | | | | | | | | | |
| *East of 66° west longitude.* | | | | | | | | | | | | | |
| La Have Bank | 54 | 913,726 | 18,076 | 75,822 | $2,765 | 555,800 | 7,442 | 4,049 | $93 | 613,055 | 6,020 | 815 | $11 |
| Western Bank | 57 | 1,361,230 | 23,947 | 1,391,980 | 44,996 | 402,458 | 5,221 | 22,770 | 515 | 87,640 | 675 | 43,225 | 625 |
| Quereau Bank | 109 | 2,314,063 | 38,092 | 4,180,422 | 132,691 | 138,725 | 1,818 | 20,167 | 477 | 80,160 | 564 | 37,850 | 508 |
| Green Bank | 3 | ........ | ........ | 17,180 | 745 | ........ | ........ | 375 | 8 | ........ | ........ | ........ | ........ |
| Grand Bank | 17 | 350,365 | 6,043 | 1,560,171 | 55,014 | 250 | 3 | ........ | ........ | ........ | ........ | 4,335 | 60 |
| St. Peters Bank | 5 | 8,885 | 155 | 723,835 | 22,187 | ........ | ........ | ........ | ........ | ........ | ........ | 2,220 | 28 |
| Bacalieu Bank | 1 | ........ | ........ | 20,965 | 749 | ........ | ........ | 55 | 1 | ........ | ........ | ........ | ........ |
| Off Newfoundland | 74 | ........ | ........ | 2,812,146 | 103,767 | ........ | ........ | ........ | ........ | ........ | ........ | 29,857 | 392 |
| Cape North | 10 | 555,545 | 9,398 | 887,851 | 27,296 | 1,990 | 26 | 760 | 19 | 2,165 | 16 | 3,075 | 42 |
| Cape Shore | 97 | 618,031 | 13,798 | 238,003 | 9,557 | 555,830 | 7,329 | 26,025 | 596 | 677,005 | 12,243 | 1,790 | 26 |
| Gulf of St. Lawrence | 23 | 76,845 | 1,263 | 1,863,420 | 71,779 | 2,730 | 35 | 840 | 19 | ........ | ........ | 19,690 | 279 |
| Greenland | 1 | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ |
| St. Anns Bank | 8 | 83,428 | 1,647 | 692,260 | 27,895 | 2,200 | 29 | ........ | ........ | 2,640 | 29 | 13,552 | 206 |
| The Gully | 5 | 38,735 | 744 | 25,910 | 1,120 | 40,800 | 530 | ........ | ........ | 2,805 | 27 | ........ | ........ |
| Labrador Coast | 7 | ........ | ........ | 498,640 | 20,468 | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ |

QUANTITY AND VALUE OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE YEAR 1912, SHOWN BY MONTHS—Continued.

| Fishing grounds. | Number of trips. | Cod. | | | | Cusk. | | | | Haddock. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Fresh. | | Salted. | | Fresh. | | Salted. | | Fresh. | | Salted. | |
| | | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* |
| **LANDED AT GLOUCESTER—continued.** | | | | | | | | | | | | | |
| *West of 66° west longitude.* | | | | | | | | | | | | | |
| Browns Bank | 111 | 1,899,492 | $35,896 | 521,243 | $19,518 | 1,079,630 | $14,442 | 19,971 | $453 | 1,896,236 | $14,634 | 41,005 | $586 |
| Georges Bank | 268 | 2,778,632 | 56,855 | 2,663,170 | 105,454 | 312,981 | 4,166 | 68,357 | 1,584 | 3,253,537 | 37,098 | 124,902 | 1,693 |
| Cashes Bank | 5 | 21,095 | 392 | ...... | ...... | 53,715 | 733 | ...... | ...... | 350 | 2 | ...... | ...... |
| Middle Bank | 25 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... |
| South Channel | 27 | 420,957 | 8,538 | ...... | ...... | 21,475 | 278 | ...... | ...... | 670,560 | 8,156 | ...... | ...... |
| Nantucket Shoals | 59 | 8,245 | 137 | ...... | ...... | ...... | ...... | ...... | ...... | 100 | 1 | ...... | ...... |
| Shore, general | 3,007 | 656,246 | 28,038 | 13,290 | 581 | 82,484 | 1,249 | ...... | ...... | 3,161,336 | 90,409 | 125 | 2 |
| Total | 3,973 | 12,105,520 | 243,069 | 18,186,308 | 646,582 | 3,251,068 | 43,301 | 163,369 | 3,765 | 10,447,589 | 169,874 | 322,441 | 4,458 |
| Grand total | 7,649 | 35,518,820 | 1,027,451 | 18,186,308 | 646,582 | 6,317,168 | 104,477 | 163,369 | 3,765 | 63,224,789 | 1,332,868 | 322,441 | 4,458 |

| Fishing grounds. | Hake. | | | | Pollock. | | | | Halibut. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fresh. | | Salted. | | Fresh. | | Salted. | | Fresh. | | Salted. | |
| | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* |
| **LANDED AT BOSTON.** | | | | | | | | | | | | |
| *East of 66° west longitude.* | | | | | | | | | | | | |
| La Have Bank | 76,000 | $1,495 | ...... | ...... | 4,700 | $120 | ...... | ...... | 44,700 | $4,371 | ...... | ...... |
| Western Bank | 38,000 | 595 | ...... | ...... | 69,000 | 2,498 | ...... | ...... | 171,700 | 17,127 | ...... | ...... |
| Quereau Bank | 6,000 | 90 | ...... | ...... | ...... | ...... | ...... | ...... | 110,400 | 8,583 | ...... | ...... |
| Cape Shore | 1,274,300 | 32,832 | ...... | ...... | 210,130 | 5,761 | ...... | ...... | 154,400 | 18,258 | ...... | ...... |
| *West of 66° west longitude.* | | | | | | | | | | | | |
| Browns Bank | 222.400 | 5,666 | ...... | ...... | 99,400 | 2,498 | ...... | ...... | 74,150 | 9,849 | ...... | ...... |
| Georges Bank | 545,100 | 8.921 | ...... | ...... | 282,200 | 6,490 | ...... | ...... | 165,500 | 17,125 | ...... | ...... |
| Cashes Bank | 255,000 | 4,055 | ...... | ...... | 6,500 | 138 | ...... | ...... | 2,000 | 180 | ...... | ...... |
| Clark Bank | 21,300 | 316 | ...... | ...... | 3,800 | 101 | ...... | ...... | 1,700 | 149 | ...... | ...... |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fippenies Bank | 6,000 | 300 | | | | | | | | | | |
| Middle Bank | 1,034,500 | 26,165 | | | 189,800 | 5,008 | | | 6,200 | 933 | | |
| Jeffreys Ledge | 1,153,400 | 25,791 | | | 888,400 | 20,991 | | | 14,185 | 1,213 | | |
| South Channel | 4,325,700 | 66,295 | | | 608,000 | 14,227 | | | 84,475 | 11,164 | | |
| Nantucket Shoals | 8,100 | 154 | | | 77,400 | 2,254 | | | 1,600 | 123 | | |
| Off Highland Light | 14,100 | 638 | | | 6,300 | 231 | | | 200 | 24 | | |
| Off Chatham | 304,400 | 7,741 | | | 162,900 | 4,246 | | | 5,600 | 673 | | |
| Shore, general | 2,097,250 | 32,488 | | | 1,657,500 | 32,420 | | | 9,580 | 1,074 | | |
| Total | 11,381,550 | 213,542 | | | 4,266,030 | 96,983 | | | 846,390 | 90,846 | | |
| **LANDED AT GLOUCESTER.** | | | | | | | | | | | | |
| *East of 66° west longitude.* | | | | | | | | | | | | |
| La Have Bank | 554,648 | 4,395 | 16,092 | $208 | 62,455 | 504 | 3,500 | $54 | 132,700 | 12,418 | | |
| Western Bank | 421,325 | 3,553 | 45,105 | 598 | 49,225 | 397 | 31,685 | 457 | 365,318 | 30,054 | 8,987 | $724 |
| Quereau Bank | 340,762 | 2,683 | 86,699 | 1,182 | 22,150 | 215 | 56,922 | 850 | 627,432 | 55,516 | 24,121 | 1,977 |
| Green Bank | 19,560 | 230 | 1,785 | 27 | | | 540 | 9 | 58,583 | 8,615 | | |
| Grand Bank | 21,270 | 149 | 7,410 | 94 | | | 5,830 | 98 | 90,210 | 7,526 | 4,362 | 373 |
| St. Peters Bank | | | 15,970 | 199 | | | 7,450 | 111 | | | 2,148 | 172 |
| Bacalieu Bank | 3,000 | 36 | 3,740 | 65 | | | | | 15,500 | 1,163 | 2,185 | 219 |
| Off Newfoundland | | | 7,368 | 100 | | | 6,095 | 92 | | | 2,470 | 208 |
| Cape North | 20,950 | 147 | 17,660 | 221 | 995 | 8 | 10,260 | 141 | 28,270 | 2,323 | 2,982 | 239 |
| Cape Shore | 512,620 | 5,098 | 20,068 | 309 | 39,335 | 350 | 7,485 | 115 | 220,227 | 27,893 | 145 | 11 |
| Gulf of St. Lawrence | 11,130 | 78 | 9,248 | 121 | 240 | 2 | 10,560 | 160 | 146,911 | 9,644 | 27,762 | 2,207 |
| Greenland | | | | | | | | | | | 13,885 | 1,389 |
| St. Anns Bank | | | 5,995 | 94 | 290 | 2 | 5,140 | 85 | | | 1,340 | 135 |
| The Gully | 46,295 | 488 | 4,400 | 83 | 815 | 7 | 200 | 3 | 96,260 | 10,999 | | |
| Labrador Coast | | | | | | | | | | | 389,052 | 38,906 |
| *West of 66° west longitude.* | | | | | | | | | | | | |
| Browns Bank | 1,007,166 | 7,559 | 17,213 | 232 | 86,671 | 692 | 33,553 | 504 | 41,678 | 3,836 | 950 | 78 |
| Georges Bank | 152,837 | 1,330 | 10,770 | 152 | 53,498 | 460 | 126,962 | 1,875 | 390,641 | 39,644 | 514 | 47 |
| Cashes Bank | 50,295 | 387 | | | 3,780 | 31 | | | | | | |
| Middle Bank | | | | | | | | | | | | |
| South Channel | 150,135 | 1,715 | | | 14,185 | 115 | | | | | | |
| Nantucket Shoals | | | | | 542,740 | 4,107 | | | | | | |
| Shore, general | 595,190 | 9,975 | 175 | 3 | 9,216,940 | 134,682 | 1,131 | 17 | 516 | 88 | | |
| Total | 3,907,183 | 37,823 | 269,698 | 3,688 | 10,093,319 | 141,572 | 307,313 | 4,571 | 2,214,246 | 209,719 | 480,903 | 46,685 |
| Grand total | 15,288,733 | 251,365 | 269,698 | 3,688 | 14,359,349 | 238,555 | 307,313 | 4,571 | 3,060,636 | 300,565 | 480,903 | 46,685 |

QUANTITY AND VALUE OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE YEAR 1912, SHOWN BY FISHING GROUNDS—Continued.

| Fishing grounds. | Mackerel. | | | | Other fish. | | | | Total. | | | | Grand total. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fresh. | | Salted. | | Fresh. | | Salted. | | Fresh. | | Salted. | | | |
| | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* |
| LANDED AT BOSTON. | | | | | | | | | | | | | | |
| *East of 66° west longitude.* | | | | | | | | | | | | | | |
| La Have Bank | | | | | | | | | 1,117,500 | $24,458 | | | 1,117,500 | $24,458 |
| Western Bank | | | | | 2,600 | $208 | | | 1,144,400 | 44,849 | | | 1,144,400 | 44,849 |
| Quereau Bank | | | | | | | | | 417,600 | 18,252 | | | 417,600 | 18,252 |
| Cape Shore | 117,600 | $17,795 | 40,600 | $805 | 119,940 | 14,395 | | | 9,784,670 | 333,655 | 40,600 | $805 | 9,825,270 | 334,460 |
| *West of 66° west longitude.* | | | | | | | | | | | | | | |
| Browns Bank | | | | | 15,000 | 1,632 | | | 3,386,450 | 83,618 | | | 3,386,450 | 83,618 |
| Georges Bank | 20,400 | 2,040 | | | 1,440,050 | 125,024 | | | 25,463,150 | 683,292 | | | 25,463,150 | 683,292 |
| Cashes Bank | | | | | 14,400 | 1,728 | | | 394,500 | 8,328 | | | 394,500 | 8,328 |
| Clark Bank | | | | | | | | | 228,300 | 4,217 | | | 228,300 | 4,217 |
| Fippenies Bank | | | | | | | | | 14,000 | 620 | | | 14,000 | 620 |
| Middle Bank | 207,500 | 10,231 | 1,800 | 96 | | | | | 3,996,300 | 132,547 | 1,800 | 96 | 3,998,100 | 132,643 |
| Jeffreys Ledge | | | | | 15,100 | 1,561 | | | 4,167,085 | 124,376 | | | 4,167,085 | 124,376 |
| South Channel | | | | | [a] 21,600 | 1,927 | | | 34,110,725 | 770,373 | | | 34,110,725 | 770,373 |
| Nantucket Shoals | 900 | 24 | | | [b] 40,500 | 360 | | | 661,200 | 18,246 | | | 661,200 | 18,246 |
| Off Highland Light | | | | | | | | | 191,600 | 6,754 | | | 191,600 | 6,754 |
| Off Chatham | 717,175 | 44,966 | 32,800 | 3,972 | | | | | 5,601,025 | 175,050 | 32,800 | 3,972 | 5,633,825 | 179,022 |
| Shore, general | 1,433,045 | 73,440 | 67,800 | 4,569 | [c] 240,700 | 16,695 | | | 9,478,575 | 293,314 | 67,800 | 4,569 | 9,546,375 | 297,883 |
| Total | 2,496,620 | 148,496 | 143,000 | 9,442 | 1,909,890 | 163,530 | | | 100,157,080 | 2,721,949 | 143,000 | 9,442 | 100,300,080 | 2,731,391 |
| LANDED AT GLOUCESTER. | | | | | | | | | | | | | | |
| *East of 66° west longitude.* | | | | | | | | | | | | | | |
| La Have Bank | | | | | | | | | 2,832,384 | 48,855 | 100,278 | 3,131 | 2,932,662 | 51,986 |
| Western Bank | | | | | | | | | 2,687,196 | 63,847 | 1,543,752 | 47,915 | 4,230,948 | 111,762 |
| Quereau Bank | | | | | | | | | 3,523,292 | 98,888 | 4,406,181 | 137,685 | 7,929,473 | 236,573 |
| Green Bank | | | | | | | | | 78,143 | 8,845 | 19,880 | 789 | 98,023 | 9,634 |
| Grand Bank | | | | | | | | | 462,095 | 13,721 | 1,582,108 | 55,639 | 2,044,203 | 69,360 |
| St. Peters Bank | | | | | | | | | 8,885 | 155 | 751,623 | 22,697 | 760,508 | 22,852 |
| Bacalieu Bank | | | | | | | | | 18,500 | 1,199 | 26,945 | 1,034 | 45,445 | 2,233 |
| Off Newfoundland | | | | | [d] 5,525,000 | 165,750 | [d] 9,998,252 | $181,604 | 5,525,000 | 165,750 | 12,856,188 | 286,163 | 18,381,188 | 451,913 |
| Cape North | | | | | | | | | 609,915 | 11,918 | 922,588 | 27,958 | 1,532,503 | 39,876 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cape Shore | 5,400 | 396 | 394,600 | 23,127 | | | | | 2,628,448 | 67,107 | 688,116 | 33,741 | 3,316,564 | 100,848 |
| Gulf of St. Lawrence | | | 15,000 | 1,500 | | | | | 237,856 | 11,022 | 1,946,520 | 76,065 | 2,184,376 | 87,087 |
| Greenland | | | | | | | | | | | 13,885 | 1,389 | 13,885 | 1,389 |
| St. Anns Bank | | | | | | | | | 88,558 | 1,707 | 718,287 | 28,415 | 806,845 | 30,122 |
| The Gully | | | | | | | | | 225,710 | 12,795 | 30,510 | 1,206 | 256,220 | 14,001 |
| Labrador Coast | | | | | | | | | | | 887,692 | 59,374 | 887,692 | 59,374 |
| *West of 66° west longitude.* | | | | | | | | | | | | | | |
| Browns Bank | | | | | 920 | 92 | | | 6,011,793 | 77,151 | 633,935 | 21,371 | 6,645,728 | 98,522 |
| Georges Bank | | | | | [e] 44,000 | 718 | | | 6,986,126 | 140,271 | 2,994,675 | 110,805 | 9,980,801 | 251,076 |
| Cashes Bank | | | | | | | | | 129,235 | 1,545 | | | 129,235 | 1,545 |
| Middle Bank | 80,820 | 3,522 | 23,000 | 1,088 | | | [d] 7,000 | 210 | 80,820 | 3,522 | 30,000 | 1,298 | 110,820 | 4,820 |
| South Channel | | | | | | | | | 1,277,312 | 18,802 | | | 1,277,312 | 18,802 |
| Nantucket Shoals | 8,460 | 737 | 918,600 | 70,798 | | | | | 559,545 | 4,982 | 918,600 | 70,798 | 1,478,145 | 75,780 |
| Shore, general | 68,940 | 4,735 | 53,800 | 4,497 | [f] 3,511,230 | 33,987 | | | 17,292,882 | 303,213 | 68,521 | 5,100 | 17,361,403 | 308,313 |
| Total | 163,620 | 9,390 | 1,405,000 | 101,010 | 9,081,150 | 200,547 | 10,005,252 | 181,814 | 51,263,695 | 1,055,295 | 31,140,284 | 992,573 | 82,403,979 | 2,047,868 |
| Grand total | 2,660,240 | 157,886 | 1,548,000 | 110,452 | 10,991,040 | 364,077 | 10,005,252 | 181,814 | 151,420,775 | 3,777,244 | 31,283,284 | 1,002,015 | 182,704,059 | 4,779,259 |

[a] Butterfish, 6,500 pounds, value $325; and swordfish, 15,100 pounds, value $1,602.
[b] Menhaden, 40,000 pounds, value $300; and swordfish, 500 pounds, value $60.
[c] Herring, 14,100 pounds, value $225; menhaden, 42,000 pounds, value $210; and swordfish, 184,600 pounds, value $16,260.
[d] Herring.
[e] Shad.
[f] Bluebacks, 2,355,200 pounds, value $21,213; butterfish, 1,200 pounds, value $48; herring, 345,600 pounds, value $5,243; menhaden, 439,200 pounds, value $2,278; shad, 368,400 pounds, value $5,068; and swordfish, 1,630 pounds, value $137. All other items under "Other fish" are swordfish.

Approximately two-thirds of the fishery products landed at Boston and Gloucester, Mass., by American fishing vessels during the year, or 68.29 per cent of the quantity and 64.20 per cent of the value, were from fishing grounds lying directly off the coast of the United States; 11.67 per cent of the quantity and 11.63 per cent of the value from grounds off the coast of Newfoundland; 19.53 per cent of the quantity and 22.89 per cent of the value from grounds off the Canadian Provinces; and less than 1 per cent of the quantity and 1.27 per cent of the value from the coasts of Greenland and Labrador. Newfoundland herring constituted 8.49 per cent of the quantity and 7.26 per cent of the value of the products of the vessel fisheries of these ports. The herring were taken on the treaty coast of Newfoundland, but cod and other species from that region were obtained chiefly from fishing banks on the high seas. The fish caught by American fishing vessels off the Canadian Provinces were all from offshore fishing grounds. The catch from each of these fishing regions is given in detail in the following table:

QUANTITY AND VALUE OF FISH LANDED BY AMERICAN FISHING VESSELS AT BOSTON AND GLOUCESTER, MASS., IN 1912, FROM GROUNDS OFF THE COASTS OF THE UNITED STATES, NEWFOUNDLAND, AND CANADIAN PROVINCES.

| Species. | United States. | | Newfoundland.[a] | | Canadian Provinces. | | Total. | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* |
| Cod: | | | | | | | | |
| Fresh.... | 24,680,567 | $757,632 | 359,250 | $6,198 | 10,479,003 | $263,621 | 35,518,820 | $1,027,451 |
| Salted ... | 3,197,703 | 125,553 | 5,632,937 | 202,930 | 9,355,668 | 318,099 | 18,186,308 | 646,582 |
| Cusk: | | | | | | | | |
| Fresh.... | 3,714,385 | 63,033 | 250 | 3 | 2,602,533 | 41,441 | 6,317,168 | 104,477 |
| Salted ... | 88,328 | 2,037 | 430 | 9 | 74,611 | 1,719 | 163,369 | 3,765 |
| Haddock: | | | | | | | | |
| Fresh.... | 57,114,019 | 1,191,875 | ........... | .......... | 6,110,770 | 140,993 | 63,224,789 | 1,332,868 |
| Salted.... | 166,032 | 2,281 | 36,412 | 480 | 119,997 | 1,697 | 322,441 | 4,458 |
| Hake: | | | | | | | | |
| Fresh.... | 11,942,873 | 199,496 | 43,830 | 415 | 3,302,030 | 51,454 | 15,288,733 | 251,365 |
| Salted.... | 28,158 | 387 | 36,273 | 485 | 205,267 | 2,816 | 269,698 | 3,688 |
| Pollock: | | | | | | | | |
| Fresh.... | 13,900,014 | 228,691 | ........... | .......... | 459,335 | 9,864 | 14,359,349 | 238,555 |
| Salted.... | 161,646 | 2,396 | 19,915 | 310 | 125,752 | 1,865 | 307,313 | 4,571 |
| Halibut: | | | | | | | | |
| Fresh.... | 798,025 | 86,075 | 164,293 | 17,304 | 2,098,318 | 197,186 | 3,060,636 | 300,565 |
| Salted.... | 1,464 | 125 | 414,102 | 41,267 | 65,337 | 5,293 | 480,903 | 46,685 |
| Mackerel: | | | | | | | | |
| Fresh.... | 2,537,240 | 139,695 | ........... | .......... | 123,000 | 18,191 | 2,660,240 | 157,886 |
| Salted.... | 1,097,800 | 85,020 | ........... | .......... | 450,200 | 25,432 | 1,548,000 | 110,452 |
| Herring: | | | | | | | | |
| Fresh.... | 359,700 | 5,468 | 5,525,000 | 165,750 | ........... | .......... | 5,884,700 | 171,218 |
| Salted.... | 7,000 | 210 | 9,998,252 | 181,604 | ........... | .......... | 10,005,252 | 181,814 |
| Swordfish: | | | | | | | | |
| Fresh.... | 1,687,300 | 148,096 | ........... | .......... | 122,540 | 14,603 | 1,809,840 | 162,699 |
| Other fish: | | | | | | | | |
| Fresh.... | 3,296,500 | 30,160 | ........... | .......... | ........... | .......... | 3,296,500 | 30,160 |
| Total... | 124,778,754 | 3,068,230 | 22,230,944 | 616,755 | 35,694,361 | 1,094,274 | 182,704,059 | 4,779,259 |

[a] Includes 13,885 pounds of salted halibut, valued at $1,389, from Greenland; and 498,640 pounds of salted cod, valued at $20,468; and 389,052 pounds of salted halibut, valued at $38,906, from the Labrador coast.

The mackerel fishery continues to be unsuccessful. The catch of mackerel in New England in 1912 amounted to 31,861 barrels fresh and 8,267 barrels salted, as against 43,541 barrels fresh and 6,633 barrels salted in the previous year. The quantity landed at Boston during the year was 2,496,620 pounds fresh, valued at $148,496, and 143,000 pounds salted, valued at $9,442; and at Gloucester 163,620 pounds fresh, valued at $9,390, and 1,405,000 pounds salted, valued at $101,010. In 1913 to July 1 the catch of fresh mackerel was 22,837 barrels and of salted mackerel 1,523 barrels, the quantity of fresh mackerel being about double that for the same period in 1912. The mackerel fishery on the southern grounds in the spring of 1913 was a failure owing to scarcity of fish. The dogfish, however, were not so troublesome to the netters as in recent previous years. The catch on the Cape Shore was quite successful, although the fleet was late in getting to that ground.

The Newfoundland herring fishery, during the season of 1912–13, was engaged in by 42 American vessels, 6 of which made second trips. The catch amounted to 47,184 barrels, or 10,511,468 pounds, of salted herring, and 10,609 barrels, or 2,652,308 pounds, of frozen herring. The fish were obtained from Bay of Islands and Bonne Bay, 22 trips being from the former and 26 from the latter locality. There was a large decrease in the catch of both salted and frozen herring as compared with the previous season.

An event of great importance to the local fisheries and also to the wide extent of territory contributing to and supplied by the fishing industry of Boston is the construction of the new fish wharf at South Boston. No expense has been spared to make this the best equipped dock for handling fish in the United States. The wharf facilities will be extensive, affording accommodations for 40 vessels to discharge fish at one time, and by lying two abreast, as is frequently done at T Wharf, 80 vessels can discharge their cargoes. Boston has long needed better facilities for handling its fish supply than those at T Wharf, the accommodations there being cramped and congested for both dealers and fishermen. Under such conditions it is hardly possible to handle fish in the most sanitary manner. The new dock will be equipped with every known device for the proper care of fish from the time they leave the vessel until they are ready for shipment.

### OTTER-TRAWL FISHERY.

The otter-trawl fishery at Boston, which began with one steamer in 1905, has gradually grown to a fishery of considerable importance, and in 1912, and up to July 1, 1913, was participated in by six specially constructed steamers. These are owned and operated by a company at Boston, no other firm having engaged in this method of fishing in New England. An otter trawler from New York also landed fish at Boston for several months in 1912.

The introduction of this method of fishing has greatly disturbed New England vessel owners and line fishermen in general, it being claimed by them that if continued any great length of time on a large scale the fishing grounds will eventually be destroyed. On the other hand, those using or advocating the use of otter trawls in the capture of ground fish assert that this apparatus is no more destructive to fish or injurious to the fishing grounds than other forms of fishing gear now employed in the various branches of the fishing industry.

In the calendar year 1912 the otter-trawl fleet landed at Boston over 16,000,000 pounds of fish, of which nearly 14,000,000 pounds were haddock. It is probable that in 1913 this amount will be exceeded by several million pounds.

This fleet of vessels has confined its fishing chiefly to Georges Bank and adjacent grounds. In March, however, owing to the scarcity of fish on Georges, a portion of the fleet fished on Western Bank, which was the first time since this method of fishing was introduced in New England that vessels operating otter trawls have operated on other fishing grounds than Georges. Several trips were made to Western Bank, after which the entire fleet repaired to Georges and the South Channel, shifting from one ground to the other according to the abundance or scarcity of fish found. At times the otter trawlers have landed a part of their catch of haddock at Portland, Me., for canning purposes.

This fishery has been under constant investigation by the Bureau for the purpose of determining, among other things, the extent of the destruction of immature fish, which is an unavoidable feature of this method, varying with the grounds and the season. Agents of the Bureau have been placed on the trawling vessels in order to obtain information as to the composition of each haul of the net, and a vast amount of data has thus been secured. It is expected that the inquiry will be practically completed by the end of the calendar year 1913, and a report will then be prepared as soon as practicable giving the results of the inquiry and containing recommendations, as required by Congress. The work of the Bureau has been facilitated by the owners of the trawling fleet, who have made no objection to the presence of the agents on board any or all of the vessels.

### GILL-NET FISHING FOR COD AND HADDOCK.

The style of gill nets used on the Great Lakes was introduced into New England fisheries about three years ago. The first year a few vessels or power boats were brought by lake fishermen for the purpose of testing the fishing grounds in the vicinity of Cape Ann. The result of the experiment was very satisfactory, and the following year, 1911, about 20 vessels were employed, a number of which were Gloucester vessels, manned by fishermen from that port. In the winter of 1912 a number of captains, who had generally followed the haddock fishery in winter, engaged in net fishing, which increased the netting fleet to 38 vessels. Few fish were taken by this method that year during the winter months, and not until early spring were any considerable quantities caught, and only a portion of the fleet realized enough profit on their catch to pay for the gear purchased. In the early inception of this method of fishing only grounds in the immediate vicinity of Cape Ann were resorted to, but during the past season scarcely any fish were caught close inshore, and the fleet was compelled to seek fishing banks lying from 8 to 12 miles offshore.

About 20 years ago cod gill-net fishing was extensively carried on in Ipswich Bay and on other local grounds, but in recent years, owing to the scarcity of fish on those grounds, only a small number of vessels have employed gill nets for the capture of cod. The difference between cod gill nets and the nets introduced by lake fishermen is chiefly in the manner in which they are set and hauled, size of mesh, and kind of floats and sinkers used. Cod gill nets are 35 fathoms long, from 6 to 8 feet deep, and the size of mesh is 9½ and 10 inches. Large glass globes attached at regular intervals along the head rope serve as floats. On the footrope opposite each globe is attached a brick. The buoyancy of the floats combined with the weight of the bricks keeps the nets perpendicular in the water. They are set and hauled from dories.

The nets introduced by the lake fishermen are 50 fathoms long, from 6 to 8 feet deep, and the size of mesh is 6 and 6½ inches. The twine generally used is linen, although cotton twine is now employed to some extent. The floats are of wood and aluminum. To keep the net in an upright position when set a lead sinker is attached to the foot line opposite each float. These nets, like cod nets, are set at and near the bottom, but instead of being set from dories they are payed out over the stern from boxes while the vessel is going at slow speed. A box contains 4 nets of 50 fathoms each, and 12 boxes of nets constitute a string. The number of boxes set at one time depends upon the condition of the weather. The nets are hauled by a lifter, sometimes called an "iron man," rigged on the port side just aft of the wheelhouse. A separate engine is used for operating the lifter. The fish, on coming to the surface, are taken from the nets and placed in boxes. Each vessel or boat has three strings of nets. The weather permitting, one string is in the water, one on the vessel ready to set as soon as a haul has been made, and another on the wharf undergoing repairs, no mending being done on the vessel. Haddock is the principal species taken, but cod and pollock are also obtained in considerable quantities.

## PACIFIC COAST FISHERIES.

The salmon fisheries of the Pacific coast were in a prosperous condition in 1912, but the pack of canned salmon was slightly smaller than in the previous year, although there was a large increase in the pack in Alaska. The year was not a prosperous one for the purse-seine fishery for salmon on Puget Sound. Compared with the previous year, however, there was an increase from 136 to 170 in the number of purse-seine boats employed in this fishery. The halibut catch in 1912 varied but little from that of the previous year, being about 35,000,000 pounds. The product in 1912 was reported to have been marketed at higher prices on the average than in 1911. The cod fishery was carried on by 7 firms having 13 vessels, 8 of which sailed from San Francisco and 5 from Puget Sound ports, and the catch for the year amounted to about 9,300,000 pounds.

The work of collecting statistics of the quantity and value of fishery products landed at Seattle, Wash., by American fishing vessels and boats, and also by freight steamers, was begun about the middle of February, 1912. The only fish reported to have been landed that month, after this work began, was 629,625 pounds of fresh halibut from Flattery Bank, valued at $27,773. An interruption in the work occurred early in July on account of the resignation of the local agent at Seattle, and consequently the returns for July and August are incomplete. The work was resumed early in August and continued to the end of April the following year.

The principal species of fish landed at Seattle during the period covered by the returns were halibut, herring, and salmon. Black cod, cod, and various other species were also landed in considerable quantities. The products were obtained chiefly from Alaska, Flattery Bank, and Puget Sound. Statistics of the quantity and value of fishery products landed at this port, so far as available, are given by months from March to December, 1912, and from January to April, 1913, in the following tables.

QUANTITY AND VALUE OF CERTAIN FISHERY PRODUCTS LANDED AT SEATTLE, WASH., BY AMERICAN FISHING VESSELS AND BOATS, AND FREIGHT STEAMERS, FROM MARCH, 1912, TO APRIL, 1913.

| Months.[a] | Number of trips. | Black cod. | | | | Cod. | | | | Halibut. | | | | Herring. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Fresh. | | Salted. | | Fresh. | | Salted. | | Fresh. | | Salted. | | Fresh. | | Salted. | |
| | | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* |
| 1912. | | | | | | | | | | | | | | | | | |
| March | 78 | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | 2,931,919 | $152,331 | ........ | ........ | ........ | ........ | ........ | ........ |
| April | 91 | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | 3,940,289 | 165,509 | ........ | ........ | ........ | ........ | ........ | ........ |
| May | 93 | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | 3,685,635 | 104,497 | ........ | ........ | ........ | ........ | ........ | ........ |
| June | 86 | 40,000 | $1,135 | ........ | ........ | ........ | ........ | ........ | ........ | 3,296,000 | 152,312 | ........ | ........ | ........ | ........ | ........ | ........ |
| July | 16 | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | 1,086,000 | 38,520 | ........ | ........ | ........ | ........ | ........ | ........ |
| August | 86 | 39,065 | 1,095 | ........ | ........ | 28,195 | $1,300 | 100 | $5 | 3,062,995 | 143,774 | ........ | ........ | 2,400 | $120 | ........ | ........ |
| September | 110 | 15,095 | 2,490 | 400 | $20 | 3,825 | 135 | 704,000 | 18,325 | 2,950,930 | 139,090 | ........ | ........ | ........ | ........ | 125,100 | $4,255 |
| October | 78 | 2,200 | 110 | ........ | ........ | ........ | ........ | 9,300 | 480 | 2,681,430 | 167,080 | 16,800 | $855 | ........ | ........ | 224,125 | 7,615 |
| November | 104 | 2,255 | 105 | 7,700 | 280 | ........ | ........ | ........ | ........ | 2,310,045 | 145,045 | ........ | ........ | 23,520 | 596 | 2,085,390 | 35,875 |
| December | 76 | 1,500 | 70 | 6,510 | 275 | ........ | ........ | 15,000 | 375 | 1,073,935 | 65,600 | 35,690 | 1,070 | ........ | ........ | 5,231,450 | 134,129 |
| Total | 818 | 100,115 | 5,005 | 14,610 | 575 | 32,020 | 1,435 | 728,400 | 19,185 | 27,019,178 | 1,273,818 | 52,490 | 1,925 | 25,920 | 716 | 7,666,065 | 181,874 |
| 1913. | | | | | | | | | | | | | | | | | |
| January | 78 | 9,100 | 364 | 8,600 | 430 | ........ | ........ | ........ | ........ | 763,810 | 60,079 | 200 | 10 | 21,180 | 191 | 3,488,450 | 48,257 |
| February | 66 | 11,835 | 407 | 200 | 15 | ........ | ........ | ........ | ........ | 2,236,390 | 173,028 | ........ | ........ | 512,100 | 4,029 | 73,975 | 1,156 |
| March | 94 | 31,380 | 1,345 | 700 | 53 | ........ | ........ | ........ | ........ | 3,568,500 | 241,274 | ........ | ........ | 722,220 | 3,277 | 3,500 | 175 |
| April | 97 | 21,440 | 712 | 600 | 30 | ........ | ........ | ........ | ........ | 2,777,055 | 186,883 | ........ | ........ | 195,200 | 895 | 10,900 | 477 |
| Total | 335 | 73,755 | 2,828 | 10,100 | 528 | ........ | ........ | ........ | ........ | 9,345,815 | 661,264 | 200 | 10 | 1,450,700 | 8,392 | 3,576,825 | 50,065 |

[a] Statistics from March to July, inclusive, include fish landed at Tacoma.

QUANTITY AND VALUE OF CERTAIN FISHERY PRODUCTS LANDED AT SEATTLE, WASH., BY AMERICAN FISHING VESSELS AND BOATS, AND FREIGHT STEAMERS, FROM MARCH, 1912, TO APRIL, 1913—Continued.

| Month.[a] | Salmon. | | | | | | | | | | Other fish, fresh. | | Total. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coho, or silver. | | Dog, or chum. | | Humpback, or pink. | | King, or spring. | | Sockeye, or red. | | | | Fresh. | | Salted. | |
| | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Pounds.* | *Value.* |
| 1912. | | | | | | | | | | | | | | | | |
| March | | | | | | | 18,000 | $2,025 | | | | | 2,949,919 | $154,356 | | |
| April | | | | | | | 264,900 | 27,519 | | | | | 4,205,189 | 193,088 | | |
| May | | | | | | | 237,300 | 20,700 | | | | | 3,922,935 | 125,257 | | |
| June | | | | | | | 544,700 | 59,423 | | | 15,000 | $600 | 3,895,700 | 213,470 | | |
| July | 8,000 | $400 | 11,000 | $550 | | | 428,400 | 35,176 | | | 13,500 | 540 | 1,546,900 | 75,186 | | |
| August | 176,820 | 10,370 | 1,001,144 | 58,098 | 6,017,038 | $438,388 | 399,651 | 31,447 | 1,580,912 | $192,612 | 129,310 | 3,492 | 12,437,530 | 880,096 | 100 | $5 |
| September | 942,890 | 68,645 | 4,711,346 | 242,166 | 4,640,195 | 247,625 | 679,080 | 50,000 | 6,143,740 | 660,515 | 117,285 | 5,635 | 20,204,386 | 1,416,361 | 829,500 | 22,600 |
| October | 675,250 | 26,665 | 470,955 | 5,385 | | | 53,425 | 3,130 | | | 26,440 | 1,645 | 3,909,700 | 204,015 | 250,225 | 8,950 |
| November | 308,955 | 10,760 | 911,470 | 10,300 | | | 9,270 | 625 | | | 97,435 | 4,480 | 3,602,950 | 171,911 | 2,093,000 | 36,155 |
| December | 5,000 | 265 | 130,730 | 3,935 | | | 3,225 | 265 | | | 185,595 | 11,705 | 1,399,985 | 81,840 | 5,288,050 | 135,849 |
| Total | 2,116,915 | 117,105 | 7,236,645 | 320,434 | 10,657,233 | 686,013 | 2,637,951 | 230,430 | 7,724,652 | 853,127 | 584,505 | 28,097 | 58,135,194 | 3,516,180 | 8,461,565 | 203,559 |
| 1913. | | | | | | | | | | | | | | | | |
| January | 350 | 25 | 76,705 | 2,165 | | | 16,770 | 1,418 | | | 143,055 | 10,159 | 1,030,970 | 74,401 | 3,497,250 | 48,697 |
| February | | | | | | | 19,345 | 2,227 | | | 159,910 | 11,561 | 2,939,580 | 191,252 | 74,175 | 1,171 |
| March | | | 3,500 | 350 | | | 15,910 | 1,693 | 590 | 25 | 240,010 | 18,290 | 4,582,770 | 266,254 | 4,200 | 228 |
| April | | | | | | | 140,040 | 12,364 | 5,700 | 435 | 160,515 | 9,881 | 3,299,950 | 211,170 | 11,500 | 507 |
| Total | 350 | 25 | 80,205 | 2,515 | | | 192,065 | 17,702 | 6,290 | 460 | 704,090 | 49,891 | 11,853,270 | 743,077 | 3,587,125 | 50,003 |

[a] Statistics from March to July, inclusive, include fish landed at Tacoma.

SHAD AND HERRING FISHERIES OF CHESAPEAKE BAY.

Inquiries conducted by the Bureau show that the spring fishing season of 1913 was the poorest in many years in most parts of the Chesapeake Basin, and the aggregate catch of the principal spring fish—shad and herring—much less than in recent years. The effects of the diminished run of fish will be seen from three to five years hence, when the reduced progeny of the 1913 season's supply comes back to spawn.

The conditions in the Potomac River, which may be taken as typical for all the major streams, were in some respects the worst in 40 years. The upper reaches of the river were almost barren of fish during the entire season, and nearly all the shad and herring fishermen failed to meet expenses. At Ferry Landing, Va., the largest seine on the river, 1,200 fathoms long, discontinued operations in the middle of the season owing to the scarcity of fish. In former years this celebrated fishing shore, with a smaller seine, sometimes yielded 200,000 or more herring at a haul, and up to 10 or 15 years ago took probably 15,000 to 30,000 fish at a haul on an average. Only a few years back from 1,000 to 1,500 shad were frequently taken at one set of the seine. In 1913 the largest haul was 3,000 herring and 100 shad, while many times only 6 to 20 shad were taken.

The shad hatcheries operated by the Bureau on the Potomac and Susquehanna Rivers had a very unsuccessful season. Their operations afford a good criterion of the condition of the fishery in the fresh waters, because the whole field is covered and nearly every ripe fish that is caught by the fishermen is stripped of its eggs by spawn takers sent out from the hatcheries.

Shad culture on a scale that is entirely feasible can, with minor protective legislation, maintain the shad fishery in almost any stream, but shad culture under existing conditions is deprived of one very essential requirement, namely, an adequate supply of ripe eggs for hatching purposes.

The immediate cause of the failure of the shad and herring fisheries in 1913 is the diminished run of spawning fish into Chesapeake Bay from the sea and the enormous quantity of apparatus among which a limited catch had to be divided. Inasmuch as the great bulk of the yield is taken in salt water, the remnant that was able to reach the spawning grounds in the streams was insignificant and wholly inadequate to maintain the supply.

The remote cause of the present condition is excessive fishing in former years and the lack of even the minimum amount of protection that is demanded by regard for the most elementary principles of fishery conservation. Fish entering Chesapeake Bay have to run through such a maze of nets that the wonder is that any are able to reach their spawning grounds and deposit their eggs. The mouth of every important shad and herring stream in the Chesapeake Basin is literally clogged with nets that are set for the special purpose of intercepting every fish, whereas a proper regard for the future welfare of the fisheries and for the needs of the migrating schools would cause the nets to be set so as to insure the escape of a certain proportion of the spawning fish.

Adequate protection of the fishes is compatible with great freedom of fishery and with a large and increasing yield. A very slight curtailment of the catch, perhaps as little as 10 per cent in any given year, may be sufficient to perpetuate the species and result in increased production in a few years. To disregard a requirement so small and to permit the continuance of an evil so serious simply invites and encourages the destruction of a most valuable food supply.

These conditions demand the immediate attention of the States and the application of a radical remedy. Their failure or inability to meet the situation by individual and cooperative action would seem to call for interference on the part of the Federal Government, a course which is being strongly urged by many thoughtful persons in the case of fishes which are migratory and can not be regarded as the property of any particular State.

### PASSING OF THE STURGEON.

The story of the sturgeons is one of the most distressing in the whole history of the American fisheries. These large, inoffensive fishes of our seaboards, coast rivers, and interior waters were for years considered to be not only valueless but nuisances, and whenever they became entangled in the fishermen's nets they were knocked in the head or otherwise mortally wounded and thrown back into the water. Even in the present generation we have seen the shores of the Potomac River in the vicinity of Mount Vernon lined with the decomposing carcasses of these magnificent fishes, witnesses to the cruelty, stupidity, and profligacy of man, and the same thing has been observed everywhere in our country.

The next chapter in the story was the awakening of the fishermen to the fact that the eggs of the sturgeons had value as caviar and that the flesh had value as food. Then followed the most reckless, senseless fishing imaginable, with the result that in a comparatively few years the best and most productive waters were depleted, and what should have been made a permanent fishery of great profit was destroyed. Even after the great value of the sturgeon began to be appreciated by every one, the immature and unmarketable fish incidentally caught in seines, gill nets, and pound nets received no protection whatever in most waters and were ruthlessly destroyed as nuisances, the decline being thus doubly accelerated.

On the Atlantic coast the catch of the sturgeon fell from 7,000,000 pounds to less than 1,000,000 in 15 years; on the Pacific coast the same meteoric history was enacted, a catch of over 3,000,000 pounds annually in the early nineties being followed by a few hundred thousand pounds in later years of the same decade, with no improvement since that time, while on the Great Lakes the yield declined more than 90 per cent in 18 years. In the American waters of the Lake of the Woods, one of the most recent grounds for the exploitation of the sturgeon, the catch decreased over 96 per cent in 10 years, notwithstanding a more active prosecution of the fishing.

The sturgeon fishery as a whole reached its climax about 1890. For two or three years the annual catch was 12,000,000 to 15,000,000 pounds. At the present time the total yield does not exceed 1,000,000 pounds, and everywhere there is a steady downward trend in the catch. Some rivers that formerly supported a flourishing fishery are now absolutely depleted. The scarcity of the sturgeon and the demand for their flesh and eggs have run up the price to an extraordinary figure, never attained by any other fish, either in America or elsewhere. A mature female sturgeon often brings the fisherman more than $150 and it is a poor fish that can not be sold for $20 to $30 on the rivers of the east coast.

The most serious aspect of the sturgeon fishery is that, owing to the decimation of the schools of breeding fish and to peculiarities in spawning habits, it has been impossible as yet to inaugurate sturgeon culture anywhere in America. Attempts at artificial propagation have proved utter failures on the Great Lakes, Lake of the Woods, Lake Champlain, Delaware River and other waters, and the expenditure of considerable sums of money by the Bureau has sometimes failed to yield a single batch of eggs suitable for incubation.

Everywhere in America, under existing conditions, the sturgeons are doomed to commercial extinction, and it requires no prophet to foretell that in a comparatively few years the sturgeon will be practically extinct.

What is demanded in every State in which these fishes exist or have existed is absolute prohibition of capture or sale for a long term of years, certainly not less than 10. To advocate any less radical treatment would be only trifling with the situation.

A possible relief may be afforded by the Bureau through the transplanting in our waters of young sturgeon from other countries; and it may be noted that a supply of young fish of a very desirable species inhabiting the Danube River and the Caspian Sea has been kindly offered by the Roumanian Government. The successful administration of the sturgeon fisheries of southeastern Europe and the feasibility of undertaking the importation of young fish best adapted for American waters should receive attention.

## FLORIDA SPONGE FISHERIES.

After seven years of earnest but futile effort the Bureau has found the act of June 20, 1906, for the protection of the sponge fisheries unenforceable in all of its provisions. The purpose of this law was to protect the sponges off the coast of Florida outside of territorial jurisdiction by preventing diving for them at all times in certain depths of water, and at certain times in all depths, and to prevent the taking, by whatever means, outside of the 3 mile limit, of sponges less than 4 inches in diameter. The offenses at which the act was aimed are not specifically prohibited, but they were supposed to be prevented by the prohibition of certain subsidiary acts—the landing, curing, or offering for sale in the United States of sponges taken in contravention of the real purpose of the law. To secure a conviction it is therefore necessary to establish a connection between (1) the act of taking under the objectionable circumstances and (2) certain subsequent and secondary acts which in themselves are innocuous. A diving vessel operating during the close season can not be interfered with until the sponges are landed, cured, or offered for sale in the United States. The sponges, therefore, must be followed or traced from their beds in the high seas to a point of territorial jurisdiction, a requirement which it is usually impossible to satisfy.

Acting through customs officers of the Treasury Department, various arrests of persons and seizures of vessels and sponges have been made, but no convictions have been secured except in one lot of cases in which the accused pleaded guilty and took appeals which have not yet been brought to issue. In these the evidence on which the prosecution based its action was the sworn statement of the master of each vessel, in which the facts necessary for conviction were admitted. After this experience the masters of the sponging vessels have refused to make further admissions of this character and no other sufficient evidence is obtainable, as the terms of the law are such that no further seizures or arrests can be made unless the offenders again furnish evidence against themselves.

The various defects already referred to were called to the attention of Congress, and on July 12, 1912, the Senate passed a bill (S. 6385) designed to correct them. Opposition to this measure developed among certain persons interested in the sponge fishery, and the House Committee on Merchant Marine and Fisheries conducted a hearing on the subject on August 1, 1912, since which time no action has been taken.

Efforts to enforce the law have continued, but the Bureau is now confronted with an opinion of the Solicitor of the Department holding that while the Secretary is empowered to direct the agents of the Department to perform such duties, not inconsistent with law, as may be necessary to enforce the provisions of the act, he is not authorized to direct them to make arrests or seizures. As the law can not be enforced without making arrests and seizures, the act of June 20, 1906, which fails to provide authority for such powers, is inadequate in that respect, in addition to its other defects.

The present situation in respect to the law is regrettable, not only on account of its failure to protect the sponge fisheries, but also from the fact that it is being openly flouted and there is being developed among a foreign population, a considerable proportion of which is seeking and attaining citizenship, a contempt for the laws of the land.

The law should be so amended as to make it enforceable, or it should be promptly repealed. The latter course would be regrettable because of the large interests involved in the sponge fisheries and the valuable product whose unnecessary destruction would thereby be condoned and facilitated.

## MISCELLANEOUS ACTIVITIES AND RELATIONS OF THE BUREAU.

### NEW STATIONS AND LABORATORIES.

The fish-cultural station in Jefferson County, Ky., authorized by Congress in 1911, has been located at Louisville, and 20 acres of land adjoining the State Fair Grounds were donated by the State of Kentucky for the purpose by a deed dated November 6, 1912. Construction work was delayed by floods, but was finally begun the latter part of February, 1913, and at the close of the fiscal year excellent progress had been made. The water supply for ponds and hatchery is from two wells 8 inches in diameter which have been sunk to a depth of 100 feet, in addition to which there is a well 60 feet deep for domestic purposes.

Plans for suitable pump houses have been prepared and the contract for their construction has been let. It is proposed to equip the wells with two electrically driven pumps each having a capacity of over 600 gallons per minute. A steel water tower and tank have been contracted for, several ponds have been excavated, and nearly all the supply and drain pipes have been laid. A dwelling for the superintendent has been completed at a cost of $5,958. This is a two-story, eight-room building with attic and cellar, heated with hot water.

For the fish-cultural station in South Carolina, authorized in 1911, 50 acres of land were purchased for $6,000 in December, 1912, near Orangeburg, a town somewhat south of the center of the State on the Southern and Atlantic Coast Line Railways. The tract contains several natural ponds, and the water supply is derived from springs. Construction work was begun the latter part of May, 1913, and by the end of the fiscal year the excavation of ponds was well under way, and plans had been prepared for the necessary buildings.

The Bureau has as yet been unable to acquire title to the site selected for the new hatching station near Saratoga, Wyo., for which Congress made provision in 1911.

The laboratory building at the Fairport, Iowa, station has been completed. It is a two-story, frame building with basement and attic, and contains 36 rooms. In addition to the various laboratory and office rooms, there are bedrooms, dining room, and kitchen for the use of investigators while temporarily on duty at the station. Three steam turbine-driven centrifugal pumps have been installed, having an aggregate of 75 horsepower, and discharging 2,300 gallons of water per minute against heads varying from 60 to 167 feet.

At the Homer, Minn., and Leadville, Colo., stations small cottages have been erected, and at Homer a contract has been let for a road across the station grounds connecting with the county highway.

At Birdsview, Wash., a new salmon hatchery 40 by 84 feet, of frame construction, was built for $2,663. The hatchery contains 52 troughs and has a capacity of 8,000,000 eggs. Darrington, Wash., has been selected as a site for an additional auxiliary salmon hatchery, but delay has been experienced in acquiring title to the property.

Final selection of a point for the biological laboratory on the Gulf coast of Florida has not been made. Various localities have been examined, and every effort will be put forth to obtain a site that will fulfil all the requirements of a marine station.

The sundry civil bill approved June 23, 1913, contained provision for two new fish-cultural stations—one in Rhode Island, the other in Utah.

## PUBLICATIONS.

During the year the following pamphlets were published by the Bureau, besides the monthly statements of fishery products landed at Gloucester and Boston:

Some hydroids of Beaufort, North Carolina. By C. McLean Fraser. Bulletin, vol. xxx, 1910, p. 337-388, 52 text fig. 1912.

Preliminary examination of halibut fishing grounds of the Pacific coast. By A. B. Alexander. With introductory notes on the halibut fishery, by H. B. Joyce. 56 p. 1912.

Notes on a new species of flatfish from off the coast of New England. By W. C. Kendall. Bulletin, vol. xxx, 1910, p. 389-394, pl. LVII. 1912.

Mussel resources of the Holston and Clinch Rivers in eastern Tennessee. By R. E. Coker. 1912.

Alaska fisheries and fur industries in 1911. B. W. Evermann, Chief of Alaska Fisheries Service. 98 p. 1912.

Age at maturity of the Pacific coast salmon of the genus Oncorhynchus. By C. H. Gilbert. Bulletin, vol. XXXII, 1912, p. 1-22, pl. I-XVII. 1913.

A new species of trout from Lake Tahoe. By John O. Snyder. Bulletin, vol. XXXII, 1912, p. 23-28. 1912.

Condition and extent of the natural oyster beds and barren bottoms of Mississippi Sound, Alabama. By H. F. Moore. 61 p., 5 pl., 1 chart. 1913.

The distribution of fish and fish eggs during the fiscal year 1912. 108 p. 1913.
Identification of the glochidia of fresh-water mussels. By Thaddeus Surber. 10 p., 3 pl., 1912.
Report of the Commissioner of Fisheries for the fiscal year ended June 30, 1912. 69 p. 1913.
Description of a new darter from Maryland. By Lewis Radcliffe and William W. Welsh. Bulletin, vol. XXXII, 1912, p. 29–32, pl. XVIII. 1913.
Condition and extent of the natural oyster grounds and barren bottoms of Mississippi east of Biloxi. By H. F. Moore. 41 p., 6 pl., 1 chart. 1913.
The sense of smell in fishes. By G. H. Parker and R. E. Sheldon. Bulletin, vol. XXXII, 1912, p. 33–46. 1913.
The fishes of Monterey Bay and tributaries. By John O. Snyder. Bulletin, vol. XXXII, 1912, p. 47–72, pl. XIX–XXIV, 3 text fig. 1913.
Anatomy and histology of the alimentary tract of the king salmon. By Charles W. Greene. Bulletin, vol. XXXII, 1912, p. 73–100, pl. XXV–XXVIII. 1913.
Notes on the natural hosts of fresh-water mussels. By Thaddeus Surber. Bulletin, vol. XXXII, 1912, 101–116, pl. XXIX–XXXI, 1 text fig. 1913.

A new series of publications has lately been inaugurated under the title "Economic circulars," with independent serial numbers. These circulars are the medium for brief advance reports upon investigations, to be more fully treated in subsequent papers, and also for timely information not requiring more lengthy treatment. Often the subject matter will be of interest to certain industries or localities only, and for this reason the economic circulars will not be distributed to addresses upon the regular and permanent mailing lists but to special lists or upon individual request.

## APPROPRIATIONS.

The total of appropriations for the Bureau for the fiscal year 1913 amounted to $944,790, as follows:

| | |
|---|---|
| Salaries | $390,790 |
| Miscellaneous expenses: | |
| Administration | 10,000 |
| Propagation of food fishes | 335,000 |
| Inquiry respecting food fishes | 40,000 |
| Statistical inquiry | 7,500 |
| Maintenance of vessels | 60,000 |
| Alaska Fisheries Service | 90,000 |
| Beam-trawl investigation | 5,000 |
| Protection of sponge fisheries | 3,500 |
| Preparation of reports on fisheries of the Philippine Islands | 3,000 |
| Total | 944,790 |

An itemized statement of expenditures authorized by the foregoing appropriation has been made as required by law.

## FISHERY MATTERS IN CONGRESS.

An act to create a legislative assembly in the Territory of Alaska approved August 24, 1912, contained a special provision denying to the legislature any authority to alter, amend, modify, or repeal any laws of the United States applicable to Alaska affecting fish, game, fur seals, or other fur-bearing animals. Notwithstanding this prohibition, the legislature, at its first session beginning in March, 1913, considered various fishery bills, and even passed a measure increasing the tax on canned salmon, one half this revenue to be for Territorial uses, the other for conservation of the fisheries under direction of the Bureau of Fisheries.

An act to give effect to the convention between the Governments of the United States, Great Britain, Japan, and Russia, for preservation and protection of the fur seals and sea otter which frequent the waters of the North Pacific Ocean, concluded in Washington, July 7, 1911, passed Congress and was approved August 24, 1912. An important provision of this act is the establishment of a five-year close season on the Pribilof Islands, during which time all killing of seals is prohibited except for the food purposes of the natives.

## EXECUTIVE ORDERS AND PROCLAMATIONS AFFECTING THE FISHERIES.

Satisfactory information having been received that the Governments of Great Britain, Japan, and Russia had taken the necessary steps to give effect to the first article of the convention concluded July 11, 1911, for the preservation and protection of fur seals and sea otter in the North Pacific Ocean, the President, on May 31, 1913, issued the following proclamation:

Whereas, by the first article of the Convention between the Governments of the United States, Great Britain, Japan and Russia for the preservation and protection of the fur seals and sea otter which frequent the waters of the North Pacific Ocean, concluded at Washington July seventh, nineteen hundred and eleven, it is provided as follows:

The High Contracting Parties mutually and reciprocally agree that their citizens and subjects respectively, and all persons subject to their laws and treaties, and their vessels, shall be prohibited, while this Convention remains in force, from engaging in pelagic sealing in the waters of the North Pacific Ocean, north of the thirtieth parallel of north latitude and including the Seas of Bering, Kamchatka, Okhotsk and Japan, and that every such person and vessel offending against such prohibition may be seized, except within the territorial jurisdiction of one of the other Powers, and detained by the naval or other duly commissioned officers of any of the Parties to this Convention, to be delivered as soon as practicable to an authorized official of their own nation at the nearest point to the place of seizure, or elsewhere as may be mutually agreed upon; and that the authorities of the nation to which such person or vessel belongs alone shall have jurisdiction to try the offense and impose the penalties for the same; and that the witnesses and proofs necessary to establish the offense, so far as they are under the control of any of the Parties to this Convention, shall also be furnished with all reasonable promptitude to the proper authorities having jurisdiction to try the offense;

And, whereas, by an Act entitled "An Act to give effect to the Convention between the Governments of the United States, Great Britain, Japan and Russia for the preservation and protection of the fur seals and sea otter which frequent the waters of the North Pacific Ocean, concluded at Washington July seventh, nineteen hundred and eleven," approved August 24, 1912, it is provided that the President of the United States shall determine by proclamation when the other parties to said Convention, by appropriate legislation or otherwise, shall have authorized the naval or other officers of the United States, duly commissioned and instructed by the President to that end to arrest, detain, and deliver to the proper officers of such parties, vessels and subjects under their jurisdiction, offending against said Convention or any statute or regulation made by those Governments to enforce said Convention; and that his determination shall be conclusive upon the question;

Now, therefore, I, Woodrow Wilson, President of the United States of America, by virtue of the power and authority conferred upon me by the said Act approved August 24, 1912, do hereby declare that satisfactory information has been received by me that the Governments of Great Britain, Japan and Russia have authorized the naval or other officers of the United States to arrest, detain, and deliver to the proper officers of such Governments, respectively, all persons and vessels subject to their jurisdiction, offending against said Convention, or against any statute or regulation made by those Governments to enforce its provisions; and I do further declare that from and after the date of this Proclamation any person or vessel subject to the jurisdiction of the United States offending or being about to offend against the prohibitions of said Convention, or of said Act, or of the regulations made thereunder, may be seized and detained by the naval or other duly commissioned officers of any of the parties to the said Convention other than the United States, except within the territorial jurisdiction of one of the other of said parties, on condition, however, that such person or vessel so seized and detained shall be delivered as soon as practicable at the nearest point to the place of seizure, with the witnesses and proofs necessary to establish the offenses so far as they are under the control of such party, to the proper official of the United States, whose courts alone shall have jurisdiction to try the offense and impose the penalties for the same.

By an Executive order dated March 3, 1913, the islands of the entire Aleutian Chain, Alaska, were reserved and set apart as a preserve and breeding ground for native birds, for the propagation of fur-bearing animals, and for the encouragement and development of the fisheries. Jurisdiction over the wild birds, game and fur-bearing animals was placed with the Department of Agriculture, and jurisdiction over the fisheries, seals, sea otter, cetaceans, and other aquatic species with the Department of Commerce.

## PERMANENT INTERNATIONAL COUNCIL FOR EXPLORATION OF THE SEA.

The eleventh annual session of the Permanent International Council for the Exploration of the Sea was held in Copenhagen, Denmark, in September, 1912. All of the affiliated countries were represented by delegates and experts, and the United States for the first time had official connection with the council. The participation of this country was regarded as one of the leading features of the meeting, and much satisfaction was expressed that the United States had entered into cooperative study of the Atlantic Ocean in the interests of the fishing industry. One full session of the council was devoted to a discussion of the special investigations that might be carried on by the United States and of the valuable results that might be expected from the coordination of fishery work on the two sides of the North Atlantic. The subject was considered also at the meetings of the various sections into which the council is naturally divided.

At the concluding session of the council, formal resolutions were passed with reference to the special lines of biological and physical research that are desirable on the North American coasts by way of supplement to the work already done on the west coast of Europe. The cooperative investigations recommended for the United States have direct relation to problems now receiving the attention of the council, some of which (as, for example, the variation in the abundance of the common mackerel) are of great interest in America at the present time, while others (such as the biological and economic effects of trawl-net fishing) are certain to be most important to us in the near future.

Occasion having arisen for the election of a new president of the council, the unanimous choice of the delegates was Geheimrat Fritz Rose, vice president of the council and president of the semiofficial Deutsche See-Fischerei Verein. In the reorganization of the executive body of the council, the matter of the representation of the United States thereon was brought up. In view of the recent adhesion of this country to the membership and the difficulty of sending delegates to attend the purely business meetings, the United States delegate advised that, for the present, no position on the executive board was desired. Ultimately, however, it will become necessary for the United States, as one of the great fishing nations in this affiliation, to assume its share of responsibility and labor connected with the administration of the business affairs of the council.

In view of the various and diverse subjects that come before the council at the meetings of the sections devoted to hydrographic, planktonic, and fishery investigations, it is impossible for one delegate adequately to represent the United States and to derive the proper benefit from participation in the meetings. It is therefore important that hereafter the United States have two delegates in attendance, and thus conform with the practice of the other nations.

## SOME NEEDS OF THE SERVICE.

### NEW OFFICE BUILDING, WITH LABORATORIES AND PUBLIC AQUARIUM.

The present office building of the Bureau of Fisheries is entirely unsuitable for the purpose, being antiquated, overcrowded, and insanitary. The office and laboratory accommodations impede the transaction of business and retard development along several important lines. Whether or not the Bureau is provided with administrative offices in a general department building or in a special structure in close proximity to the parent headquarters is immaterial. There are urgently needed, however, peculiar laboratory accommoations, a model hatchery equipment, and aquarium facilities which can not be afforded in a large department building; and incidental thereto there should be provided a national aquarium, which can be maintained at minimum cost as an essential part of the experimental work of the Bureau in the study of water animals and of fish-culture methods.

### A LOBSTER-REARING PLANT.

More than 10 years ago the Bureau, with the aid of a special appropriation from Congress, devised and carried to a successful stage of perfection a feasible method of rearing lobsters. This work was undertaken in the well-founded belief that lobster culture would and should be made more effective by carrying the newly hatched young beyond the helpless free-swimming age to the point where they develop their crushing claws, go to the bottom, and assume the form and habits of the adults.

The Government has never made any use of the knowledge thus acquired, but the State of Rhode Island, continuing the experimental work, has achieved marked success and has demonstrated the practicality of the method when employed on a large scale.

As an aid to an industry that is in a critical state, it is recommended that Congress be asked to provide for a lobster-rearing station, either as an independent plant or as an adjunct of one of the existing marine hatcheries of the Bureau. For this purpose a sum not exceeding $20,000 would be required for construction and for operating expenses for one year. No facilities for holding and rearing young lobsters now exist at any of the established stations.

### STATE COOPERATION.

With the increasing activity in all branches of the fisheries there exists increasing need for active cooperative endeavor on the part of the States to make more effective the work of artificial propagation as carried on under Federal and State auspices. There can be no question that a large amount of such work is now rendered entirely futile by the lack of cooperation or the total indifference of the States. Attention is drawn elsewhere to the great damage that is being done to the shad and alewife fisheries on the Atlantic coast by failure to enact and enforce suitable protective laws. The cases of other fisheries similarly neglected might be cited.

It may well be questioned whether the Bureau is justified in spending money in behalf of the artificial propagation of certain fishes in certain waters when there is every reason to believe that the expenditures are for the most part utterly wasted. The situation demands the attention of Congress and the adoption of a definite policy to meet the case. The question arises whether the Federal Government should not insist, as a condition of continued Government aid in behalf of the State fisheries, on an amount of protection for the fishes cultivated that common sense shows to be necessary for the maintenance of the supply. The alternative course would seem to be the assumption of Federal jurisdiction over migratory fishes and fishes in interstate waters.

### A FISHERIES RESEARCH LABORATORY ON THE PACIFIC COAST.

The Bureau now has two laboratories on the Atlantic coast, one in the Mississippi Valley, and one authorized on the Gulf of Mexico for the scientific and practical investigation of problems relating to the fisheries. On the Pacific coast it is unprovided with laboratory facilities, and it is felt that this deficiency should be corrected as speedily as possible.

The fisheries of the Pacific coast, including Alaska, are valued at upward of $22,000,000, and their products are of such character as to enter into consumption in all parts of the country. There are many potential products which are not yet utilized for lack of definite information concerning their qualities and merits, and there are others the handling of which can be greatly improved. The Bureau believes that if it were provided with the equipment needed for practical investigation and experiment it could increase the volume, improve the quality, and cheapen the cost of the yield of these important fisheries and at the same time lower the price to the consumer.

This form of aid to the fishing industry is believed to be a strictly pertinent function of the Federal Government, and the early establishment of an up-to-date research station is strongly advocated.

### INCREASED FACILITIES FOR ALASKA FISHERIES SERVICE.

The attention of Congress has been drawn by the Secretary, in deficiency and regular estimates submitted on behalf of the Bureau, to the urgent need for additional men and vessels to enforce the Alaska fishery laws and to make inspections and investigations on which to base recommendations for new laws, new regulations, or amendments to existing laws. To properly carry out the duties imposed by Congress there should be a thorough patrol of the fishing districts of Alaska each season by agents of the Bureau. This involves travel along 25,000 miles of shore, and necessitates a considerable addition to the present force of men and a number of small vessels by means of which the agents may be transported from fishery to fishery without being under the necessity, as at present, of being entirely dependent on the favor of the fishery operators. The minimum requirements in this respect have been embodied in estimates for the fiscal year 1915, and favorable action thereon by Congress would seem to be demanded by the great magnitude of the interests at stake.

### RELIEF FROM INCONGRUOUS DUTIES.

It is recommended that the Secretary take under consideration the advisability of appealing to Congress for relief from the necessity of administering the laws and regulations affecting the fur-bearing animals of the Territory of Alaska. This subject is not even remotely related to the legitimate functions of the Bureau of Fisheries, but comes naturally under the jurisdiction of another Government bureau. The continued administration of this incongruous service with the absurdly small and inexperienced force allowed by Congress is not only imposing on the Bureau an uncongenial duty, which it is not equipped to perform, but is distracting and diverting much attention that belongs to and is required by the fishing industry.

This recommendation does not apply to the aquatic animals whose pursuit constitutes a "fishery," but only to the strictly terrestrial mammals.

### A FISHERY EXPERIMENT STATION.

Fish culture has reached a high degree of perfection in the United States, and the magnitude of the operations as a whole leaves little to be desired. There is, however, much room for effective work in fish culture similar to that conducted in animal and plant industry at agricultural experiment stations; and one of the great and growing needs of the service is an experiment station for study of fish diseases and of problems in fish breeding.

The matter of improving the food and game qualities of fishes by selective breeding is a subject to which practically no attention has as yet been given in this country, but the possibilities are alluring and the project is well worthy of support from Congress, in view of the great improvements that have been produced in domestic animals and plants by the application of scientific methods.

The serious aspect of disease among cultivated fishes has frequently been set forth in the Bureau's reports and brought directly to the attention of Congress. An experiment station would no doubt pay for itself every year in the actual money value of fish saved that are now lost at the hatching stations all over the country because of lack of knowledge of the proper means for preventing and curing the various destructive maladies to which domesticated or semi-domesticated fish are liable.

## INCREASED AID TO THE SHELLFISH INDUSTRIES.

The oyster fishery of this country is the most valuable fishery in the world, and its yield to the fishermen of approximately $16,000,000 annually is greater than that of the combined fisheries of Norway, which constitute one of that country's greatest assets. Shellfish, including oysters, create more than one-third of the value of aquatic products of the United States, and they afford food of vast importance to the people, yet the aid given to the industry by the Government is far less than that extended in propagating such fishes as black bass, whose chief value is to afford sport and recreation rather than food.

The oyster, and most of the other shellfishes, owing to their peculiar habits and methods of breeding, can not be propagated as are the true fishes. Oyster culture is of necessity a private enterprise, but it presents many difficulties and dangers which the growers are not in a position to combat, for lack of proper knowledge, and this knowledge can not be obtained excepting through investigations and experiments which the Government alone is in a position to conduct.

The Bureau is without the means, and particularly the personnel, to carry on this much-needed work, although the deficiency and the necessity which it creates have been repeatedly pointed out in these reports and in the estimates for appropriations.

Those interested in the oyster fishery in particular have repeatedly pointed out, with justice, the difference between the lack of consideration which is accorded their industry and the assistance which is received by agricultural interests. Farmers encountering difficulty find help available, but the oystermen laboring under much greater disadvantage find it withheld for the reason that the Bureau has not been provided with the means for extending it. In all justice and for the very practical consideration that our food supplies should be increased and assured, this condition should be corrected without further delay.

Respectfully,

H. M. SMITH,
*Commissioner.*

To Hon. WILLIAM C. REDFIELD,
*Secretary of Commerce.*

# THE DISTRIBUTION OF FISH AND FISH EGGS DURING THE FISCAL YEAR 1913

ROBERT S. JOHNSON
*Assistant in Charge of Fish Culture*

Appendix I to the Report of the Commissioner of Fisheries for 1913

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## INDEX TO SPECIES DISTRIBUTED.

# THE DISTRIBUTION OF FISH AND FISH EGGS DURING THE FISCAL YEAR 1913.

## CHARACTER OF THE WORK.

More than 95 per cent of the output of the fish-cultural stations consists of important commercial species, notably the salmons, shad, whitefish, pike perch, yellow perch, white perch, lake trout, cod, pollock, haddock, flatfish, and lobsters. These are hatched in lots of many millions annually and planted by the Bureau, the fresh-water species principally in the large coastal streams and in the Great Lakes, the marine species upon the inshore fishing grounds of the Atlantic.

The cultivation of the fishes of the interior waters, generally classed as game fishes, although a comparatively small factor in the total output, is a very important feature of the Bureau's work, supplying as it does various kinds of young fish for public streams, lakes, and ponds, fishing preserves, private ponds, private streams, etc., in all parts of the United States. Among the fishes most extensively produced for these purposes are several species of trout, the grayling, the basses, crappies, bream, and catfishes; various others also are handled.

The trouts and other species of Salmonidæ, whose eggs can be artificially manipulated, are produced in adequate numbers. The black basses and allied species are not susceptible to artificial propagation, and for its supplies of such fishes the Bureau must depend largely upon the natural reproduction of brood fish held in ponds prepared for the purpose. This supply is far short of the demand. During the early stages of their existence young bass in ponds are exposed to dangers of many kinds. Snakes, frogs, turtles, various water insects, fish-eating birds, amphibious animals, all are destructive to the fry, while the larger specimens of young of the same school prey upon their weaker brethren.

The degree of success attained in this work is also governed largely by the state of the weather and other natural conditions beyond the control of the Bureau. Located as they are, along the shoal pond margins, the nests receive the full effect of atmospheric changes. A sudden fall in temperature will often cause the parent fish to desert their nests, and the eggs and young, being extremely sensitive, are frequently killed by the cold or their development retarded. Another unfavorable feature connected with the location of the nests in shallow water is that they are subjected to the full force of surface drainage and washings following heavy rains. Roily water is exceedingly injurious to the ova and young of the black bass, and as heavy rains and sudden temperature changes are conditions which must be expected during the season of the year when these fishes spawn, the results of the Bureau's pond-cultural operations are hazardous and uncertain in the extreme. One year a station may have a good output, and the next year, apparently under similar conditions, very few young fish will be produced. What has been said regarding the difficulties met with in black bass culture applies with equal force to the crappies, sunfishes, catfishes, and the rock bass.

With its present facilities the Bureau would be quite powerless to cope with the situation, so far as the demands for the pond fishes are concerned, were it not for the valuable fields afforded for rescue work by the overflow of certain rivers to which these fishes are indigenous. These rivers periodically overflow their banks, the flood waters covering many thousands of acres of the adjacent lowlands. During this flood period, which occurs when the river fishes are spawning, they seek the quiet overflow waters to deposit their eggs. Before the fry hatched from these eggs have become strong, the receding waters cut off their return to the main channels, and thus many thousands of young bass and other fishes are imprisoned in land-locked waters, where they would eventually and inevitably perish from drought or cold unless removed. For a number of years past the Bureau has been collecting young fishes from these temporary lakes and ponds, returning a liberal percentage of them to the original streams, and utilizing the surplus for distribution to applicants and for stocking public waters in various sections of the country.

## METHOD OF DISTRIBUTION.

The first consideration in the Bureau's distribution of fishes is to make ample return to the waters from which eggs or fish have been collected. The remainder of the product is consigned to suitable public or private waters upon application indorsed by a United States Senator or Representative, the Bureau furnishing to persons interested an application blank for this purpose. The blank calls for a description of the waters to be stocked, and by this information is determined the species of fish that is suitable and the number that may be allotted to the water area in question. Certain predaceous species, such as the basses and perches, are not furnished for waters inhabited by trout or other valuable fishes to which they would be destructive. Nor, of course, are species like trout and salmon furnished for waters already stocked with fish that would prey upon them.

The fish are carried to their destination in railroad cars equipped for the purpose or by messengers who accompany the shipments in baggage cars, and are delivered to the applicant free of charge, at the railroad station nearest the point of deposit. The applicant is advised by telegraph when the shipment will arrive and is expected to make due provision for care of the fish until planted. Definite instructions in this respect are furnished at the time of shipment.

During the past fiscal year (July 1, 1912, to June 30, 1913) the Bureau received 10,284 applications for fish, and a very large per cent of them were for the basses, crappies, sunfishes, and catfishes, for stocking artificial ponds on farms.

The difficulties and uncertainties encountered in the production of such fishes make it impossible for the Bureau to fill applications for them as promptly as those calling for the fishes propagated by the artificial manipulation of their eggs. It is the policy of the Bureau to fill all applications in the order in which they are received and to arrange for the delivery of the fish as soon as practicable thereafter.

### SIZE OF FISH WHEN DISTRIBUTED.

Fishes are distributed at various stages of development, according to the species, the numbers in the hatcheries, and the facilities for rearing. The commercial fishes—such as the shad, whitefish, lake trout, pike perch, cod, etc., hatched in lots of many millions—are necessarily planted as fry shortly after hatching. Atlantic salmon, landlocked salmon, and various species of trout are reared, in such numbers as the hatchery facilities permit, to fingerlings from 1 to 6 inches in length; the remainder are distributed as fry.[a]

The basses, bream, and other sunfishes are distributed from some three weeks after they are hatched until they are several months of age. When the last lots are shipped the basses usually range from 4 to 6 inches and the sunfishes from 2 to 4 inches in length. The numerous fishes collected in overflow lands—basses, crappie, sunfishes, catfishes, yellow perch, and others—are 2 to 6 inches in length when taken and distributed.

Eggs are distributed only to State hatcheries and, occasionally, to applicants who have hatchery facilities.

### SIZE OF ALLOTMENTS.

The Bureau does not attempt to furnish to any one applicant more than a brood stock of fish for a given private pond or stream, it being expected that these will be protected until they have had

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[a] The varying usage in the classification of young fish as to size has caused such confusion and difficulty that the Bureau has adopted uniform definitions, as follows:

*Fry*—fish up to the time the yolk sac is absorbed and feeding begins.

*Advanced fry*—fish from the end of the fry period until they have reached a length of 1 inch.

*Fingerlings*—fish between the length of 1 inch and the yearling stage, the various sizes to be designated as follows: No. 1, a fish 1 inch in length and up to 2 inches; no. 2, a fish 2 inches in length and up to 3 inches; no. 3, a fish 3 inches in length and up to 4 inches, etc.

*Yearlings*—fish that are 1 year old, but less than 2 years old from the date of hatching; these may be designated no. 1, no. 2, no. 3, etc., after the plan prescribed for fingerlings.

time to reproduce. The number of fish in an allotment is, however, a variable quantity, depending upon the species and the age at which distributed. Brook trout, which are distributed both as fry and fingerlings, are allotted in much larger numbers as fry than as fingerlings 3 or 4 inches long. Pike perch, which, owing to their excessive cannibalism, can not be reared and are consequently distributed as fry, may be supplied in lots of half a million, where an equal water area would receive only 200 or 300 young bass from 2 to 5 inches long. These latter larger fish have a much better chance of reaching maturity than have the fry, and the actual value for stocking purposes of a few hundred fingerling bass may therefore equal many thousand times this number of pike-perch fry.

Owing to the Bureau's inability to produce the black basses, crappies, catfishes, and sunfishes in sufficient numbers to meet the demands, the allotments of such species are necessarily limited to the smallest number needful to form the nucleus for a brood stock for the water area to which assigned.

## SPECIES CULTIVATED.

The species handled by the Bureau in 1913 numbered some 50 fishes and the lobster. Of these, the following were artificially propagated:

THE CATFISHES (SILURIDÆ):
- Horned pout, bullhead, yellow cat (*Ameiurus nebulosus*).
- Marbled cat (*Ameiurus nebulosus marmoratus*).

THE SUCKERS AND BUFFALO-FISHES (CATOSTOMIDÆ):
- Small-mouth buffalo-fish (*Ictiobus bubalus*).
- Common buffalo-fish (*Ictiobus cyprinella*).
- Black buffalo-fish (*Ictiobus urus*).

THE SHADS AND HERRINGS (CLUPEIDÆ):
- Shad (*Alosa sapidissima*).

THE SALMONS, TROUTS, WHITEFISHES, ETC. (SALMONIDÆ):
- Common whitefish (*Coregonus albus* and *C. clupeaformis*).
- Lake herring, cisco (*Leucichthys artedi*).
- Chinook salmon, king salmon, quinnat salmon (*Oncorhynchus tschawytscha*).
- Silver salmon, coho (*Oncorhynchus kisutch*).
- Blueback salmon, redfish, sockeye (*Onchorhynchus nerka*).
- Humpback salmon (*Oncorhynchus gorbuscha*).
- Dog salmon (*Oncorhynchus keta*).
- Steelhead trout, hardhead (*Salmo gairdneri*).
- Rainbow trout (*Salmo irideus*).
- Atlantic salmon (*Salmo salar*).
- Landlocked salmon (*Salmo sebago*).
- Blackspotted trouts: Yellowstone Lake trout or cut-throat trout (*Salmo lewisi*); Tahoe trout (*Salmo henshawi*).
- Scotch sea trout (*Salmo trutta*). Introduced species.
- Loch Leven trout (*Salmo trutta levenensis*). Introduced species, propagated in limited numbers for observation.
- Lake trout, Mackinaw trout, longe, togue (*Cristivomer namaycush*).
- Brook trout, speckled trout (*Salvelinus fontinalis*).
- Sunapee trout (*Salvelinus aureolus*).

THE GRAYLINGS (THYMALLIDÆ):
- Montana grayling (*Thymallus montanus*).

THE SMELTS (ARGENTINIDÆ):
- American smelt (*Osmerus mordax*).

THE BASSES, SUNFISHES, AND CRAPPIES (CENTRARCHIDÆ):
- Crappie (*Pomoxis annularis*).
- Strawberry bass, calico bass (*Pomoxis sparoides*).
- Rock bass, red-eye, goggle-eye (*Ambloplites rupestris*).
- Warmouth, goggle-eye (*Chænobryttus gulosus*).
- Small-mouth black bass (*Micropterus dolomieu*).
- Large-mouth black bass (*Micropterus salmoides*).
- Bluegill bream, bluegill sunfish (*Lepomis pallidus*).
- Other sunfishes, chiefly *Eupomotis gibbosus*.

THE PERCHES (PERCIDÆ):
- Pike perch, wall-eyed pike, yellow pike, blue pike (*Stizostedion vitreum*).
- Yellow perch, ring perch (*Perca flavescens*).

THE SEA BASSES (SERRANIDÆ):
- Striped bass, rockfish (*Roccus lineatus*).
- White perch (*Morone americana*).

THE CODS (GADIDÆ):
- Cod (*Gadus callarias*).
- Haddock (*Melanogrammus æglefinus*).
- Pollock (*Pollachius virens*).

THE FLOUNDERS (PLEURONECTIDÆ):
- Winter flounder, American flatfish (*Pseudopleuronectes americanus*).

CRUSTACEANS:
- American lobster (*Homarus americanus*).

The fishes rescued from overflowed lands in the Mississippi Basin and returned to the original streams were as follows:

THE CATFISHES (SILURIDÆ):
- Spotted cat, blue cat, channel cat (*Ictalurus punctatus*). Only limited numbers obtainable.
- Horned pout, bullhead, yellow cat (*Amciurus nebulosus*).

THE SUCKERS AND BUFFALO-FISHES (CATOSTOMIDÆ):
- Small-mouth buffalo-fish (*Ictiobus bubalus*).
- Common buffalo-fish (*Ictiobus cyprinella*).
- Black buffalo-fish (*Ictiobus urus*).

THE MINNOWS AND CARPS (CYPRINIDÆ):
- Carp (*Cyprinus carpio*). Distributed in rare instances on special request and for waters unsuited to other species.

THE PIKES AND PICKERELS (ESOCIDÆ):
- Pike (*Esox lucius*). Restored to the streams; not distributed.
- Pickerel (*Esox reticulatus*). Restored to the streams; not distributed.

THE BASSES, SUNFISHES, AND CRAPPIES (CENTRARCHIDÆ):
- Crappie (*Pomoxis annularis*).
- Rock bass, red-eye, goggle-eye (*Ambloplites rupestris*).
- Warmouth, goggle-eye (*Chænobryttus gulosus*).
- Large-mouth black bass (*Micropterus salmoides*).
- Small-mouth black bass (*Micropterus dolomieu*).
- Bluegill bream, bluegill sunfish (*Lepomis pallidus*).
- Other sunfishes, chiefly *Eupomotis gibbosus*.

THE PERCHES (PERCIDÆ):
- Yellow perch, ring perch (*Perca flavescens*).

THE SEA BASSES (SERRANIDÆ):

Yellow bass (*Morone interrupta*).

THE SMELTS (ARGENTINIDÆ):

American smelt (*Osmerus mordax*).

Certain introduced species are propagated to a limited extent, as follows:

THE MINNOWS AND CARPS (CYPRINIDÆ):

Goldfish (*Carassius auratus*). Propagated for ornamental purposes; not distributed.

Ide (*Leuciscus idus*). Cultivated variety, golden ide. Propagated for ornamental purpose; not distributed.

## SUMMARIZED STATEMENT OF DISTRIBUTION.

The following table shows the number of eggs and fish actually distributed during the fiscal year 1913, or in other words, the output of the hatcheries with all losses in transportation deducted.

SUMMARY BY SPECIES OF THE DISTRIBUTION OF FISH AND FISH EGGS DURING THE FISCAL YEAR 1913.

| Species. | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Total. |
|---|---|---|---|---|
| Catfish | | | 62,446 | 62,446 |
| Carp | | | 79,160 | 79,160 |
| Buffalo-fish | | 3,080,000 | 4,212 | 3,084,212 |
| Shad | 3,394,000 | 133,244,850 | | 136,638,850 |
| Whitefish | 73,720,000 | 393,880,000 | | 467,600,000 |
| Lake herring | | 4,730,000 | | 4,730,000 |
| Silver salmon | 102,000 | 14,184,283 | 69,800 | 14,356,083 |
| Chinook salmon | 38,583,873 | 33,319,423 | 97,760 | 72,001,056 |
| Red or sockeye salmon | 2,000,000 | 80,340,902 | | 82,340,902 |
| Humpback salmon | | 153,680 | | 153,680 |
| Dog salmon | | 19,479,000 | | 19,479,000 |
| Steelhead trout | 980,000 | 4,300,225 | 138,410 | 5,418,635 |
| Rainbow trout | 1,106,000 | 901,370 | 1,150,957 | 3,158,327 |
| Atlantic salmon | | 3,492,464 | 4,304 | 3,496,768 |
| Landlocked salmon | 224,000 | 253,546 | 80,196 | 557,742 |
| Blackspotted trout | 13,305,000 | 766,950 | 7,174,060 | 21,246,010 |
| Loch Leven trout | | | 75,200 | 75,200 |
| Lake trout | 6,612,000 | 20,594,600 | 3,024,924 | 30,231,524 |
| Brook trout | 1,239,000 | 5,280,452 | 6,014,645 | 12,534,097 |
| Smelt | 4,500,000 | 1,850,000 | 27,000 | 6,377,000 |
| Grayling | 903,000 | 2,613,000 | | 3,516,000 |
| Crappie and strawberry bass | | | 79,279 | 79,279 |
| Rock bass | | | 64,743 | 64,743 |
| Warmouth bass | | | 1,390 | 1,390 |
| Small-mouth black bass | | 234,300 | 107,641 | 341,941 |
| Large-mouth black bass | | 26,250 | 1,231,052 | 1,257,302 |
| Sunfish (bream) | | | 203,623 | 203,623 |
| Pickerel | | | 7,504 | 7,504 |
| Pike | | | 1,500 | 1,500 |
| Pike perch | 46,200,000 | 148,510,000 | | 194,710,000 |
| Yellow perch | 11,000,000 | 365,723,000 | 25,132 | 376,748,132 |
| Striped bass | | 7,234,000 | | 7,234,000 |
| White perch | 20,000,000 | 449,120,000 | 721 | 469,120,721 |
| Yellow bass | | | 255 | 255 |
| Cod | 6,800,000 | 221,012,000 | | 227,812,000 |
| Pollock | 133,739,000 | 430,060,000 | | 563,799,000 |
| Haddock | 57,868,000 | 68,257,000 | | 126,125,000 |
| Flatfish | | 809,270,000 | | 809,270,000 |
| Lobster | | 199,680,000 | 200 | 199,680,200 |
| Total | 422,275,873 | 3,421,591,295 | 19,726,114 | 3,863,593,282 |

ALLOTMENTS OF FISH AND EGGS TO STATE FISH COMMISSIONS FOR THE FISCAL YEAR 1913.

| State and species. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| California: | | | |
| Brook trout | 150,000 | | |
| Chinook salmon | 16,942,873 | | |
| Grayling | 50,000 | | |
| Landlocked salmon | 10,000 | | |
| Colorado: | | | |
| Blackspotted trout | 2,000,000 | | |
| Connecticut: | | | |
| Brook trout | 25,000 | | |
| Lake trout | 50,000 | | |
| Yellow perch | 5,000,000 | | |
| Delaware: | | | |
| Black bass | | | 150 |
| Georgia: | | | |
| Black bass | | | 2,500 |
| Sunfish | | | 700 |
| Idaho: | | | |
| Brook trout | | | 1,650 |
| Maine: | | | |
| Brook trout | 100,000 | | |
| Landlocked salmon | 100,000 | | |
| Maryland: | | | |
| Black bass | | | 600 |
| Massachusetts: | | | |
| Catfish | | | 300 |
| Chinook salmon | 50,000 | | |
| Pike perch | 4,000,000 | | |
| White perch | 15,000,000 | | |
| Yellow perch | 5,000,000 | | |
| Michigan: | | | |
| Grayling | 50,000 | | |
| Lake trout | 3,000,000 | | |
| Pike perch | 41,700,000 | | |
| Yellow perch | | 3,500,000 | |
| Minnesota: | | | |
| Lake trout | 500,000 | | |
| Landlocked salmon | 10,000 | | |
| Steelhead trout | 100,000 | | |
| Missouri: | | | |
| Rainbow trout | | | 37,800 |
| Montana: | | | |
| Blackspotted trout | 2,038,500 | | |
| Brook trout | 200,000 | | |
| Grayling | 583,000 | | |
| Rainbow trout | 50,000 | | |
| Whitefish | 3,000,000 | | |
| Nevada: | | | |
| Brook trout | 50,000 | | |
| Rainbow trout | 50,000 | | |
| Silver salmon | 100,000 | | |
| New Hampshire: | | | |
| Chinook salmon | | | 7,900 |
| Steelhead trout | 75,000 | | |
| New Jersey: | | | |
| Landlocked salmon | 8,000 | | |
| Rainbow trout | 50,000 | | |
| Steelhead trout | 100,000 | | |
| White perch | | 2,000,000 | |
| Yellow perch | | 2,000,000 | |
| North Dakota: | | | |
| Steelhead trout | 200,000 | | |
| Ohio: | | | |
| Whitefish | 19,280,000 | | |
| Oregon: | | | |
| Blackspotted trout | 625,000 | | |
| Sockeye salmon | 2,000,000 | | |
| Brook trout | 300,000 | | |
| Chinook salmon | 21,491,000 | | |
| Rainbow trout | 380,000 | | |
| Pennsylvania: | | | |
| Lake trout | 100,000 | | |
| Whitefish | 40,920,000 | | |
| Utah: | | | |
| Brook trout | | | 12,000 |
| Catfish | | | 72 |
| Small-mouth black bass | | | 160 |

ALLOTMENTS OF FISH AND EGGS TO STATE FISH COMMISSIONS FOR THE FISCAL YEAR 1913—Continued.

| State and species. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Vermont: | | | |
| Brook trout | | 50,000 | |
| Lake trout | 150,000 | | |
| Landlocked salmon | 10,000 | | |
| Steelhead trout | 30,000 | | |
| Washington: | | | |
| Blackspotted trout | 400,000 | | |
| Steelhead trout | 200,000 | | |
| Wisconsin: | | | |
| Lake trout | 2,500,000 | | |
| Whitefish | 5,000,000 | | |
| Wyoming: | | | |
| Black bass | | | 60 |
| Blackspotted trout | 2,200,000 | | |
| Brook trout | 225,000 | | 500 |
| Grayling | 50,000 | | |
| Lake trout | 50,000 | | 2,000 |
| Rainbow trout | 148,000 | | |
| Steelhead trout | 100,000 | | |
| Total | 196,506,373 | 7,550,000 | 66,452 |

SHIPMENT OF EGGS TO FOREIGN COUNTRIES DURING THE FISCAL YEAR 1913.

| Country. | Species. | Eggs. | Country. | Species. | Eggs. |
|---|---|---|---|---|---|
| British Columbia | Whitefish | 5,000,000 | India | Rainbow trout | 10,000 |
| Canada | Brook trout | 150,000 | Japan | Rainbow trout | 250,000 |
| Do | Steelhead trout | 100,000 | | | |
| Germany | Rainbow trout | 100,000 | Total | | 5,610,000 |

## DETAILS OF OUTPUT FOR 1913.

The more generally favorable weather conditions prevailing in 1913 during the spawning season of the commercial species, and the improved quality of the eggs collected as a consequence thereof, enabled the Bureau to increase its output of fish and eggs over that of 1912 by 175,672,225, or 4.76 per cent, notwithstanding the fact that the number of eggs collected exceeded by only 54,543,843, or 1 per cent, the collections of 1912. The species produced in larger numbers in 1913 included haddock, pollock, the silver, chinook, and dog salmons, Atlantic salmon, brook, blackspotted, lake, and Loch Leven trouts, buffalo-fish, grayling, striped bass, large-mouth black bass, whitefish, and white perch.

The following table shows the work of the different stations in 1913, the period of operation, and the eggs and fish delivered by each station for distribution. It will be noted that transfers of fish and eggs from station to station are frequent, serving economy and convenience in transportation where the shipment consists of eggs, and giving advantageous distribution centers in the case of young fish.

STATIONS OPERATED AND THE OUTPUT OF EACH FOR THE FISCAL YEAR 1913.

| Station and period of operation. | Species. | Output. Eggs. | Output. Fry. | Output. Fingerlings, yearlings, and adults. | Total. |
|---|---|---|---|---|---|
| Afognak, Alaska: | | | | | |
| Entire year | Red salmon | | 12,551,102 | | 12,551,102 |
| | Humpback salmon | | 151,800 | | 151,800 |
| | Silver salmon | | 214,000 | | 214,000 |
| Baird, Cal.: [a] | | | | | |
| Entire year | Chinook salmon | 495,275 | 2,195,100 | | 2,690,375 |
| Battle Creek, Cal.: | | | | | |
| Nov.-Jan. | Chinook salmon | 6,270,540 | | | 6,270,540 |
| Hornbrook, Cal.: [a] | | | | | |
| Feb.-May | Rainbow trout | 833,000 | 86,580 | | 919,580 |
| | Silver salmon | 100,000 | 17,320 | | 117,320 |
| Mill Creek, Cal.: [a] | | | | | |
| Dec.-Feb. | Chinook salmon | 10,327,058 | | | 10,327,058 |
| Baker Lake, Wash.: | | | | | |
| Entire year | Sockeye salmon | | 5,559,000 | | 5,559,000 |
| | Chinook salmon | | 18,600 | | 18,600 |
| | Silver salmon | | 2,076,000 | | 2,076,000 |
| | Steelhead trout | | 12,400 | | 12,400 |
| Birdsview, Wash.: [a] | | | | | |
| Entire year | Blueback salmon | | 192,700 | | 192,700 |
| | Chinook salmon | | 5,800 | | 5,800 |
| | Dog salmon | | 211,300 | | 211,300 |
| | Humpback salmon | | 1,880 | | 1,880 |
| | Silver salmon | 2,000 | 4,211,407 | | 4,213,407 |
| | Steelhead trout | 780,000 | 499,000 | | 1,279,000 |
| Darrington, Wash.: | | | | | |
| Entire year | Dog salmon | | 9,886,000 | | 9,886,000 |
| | Chinook salmon | | 547,500 | | 547,500 |
| | Silver salmon | | 600,200 | | 600,200 |
| | Steelhead trout | | 114,000 | | 114,000 |
| Duckabush, Wash.: [a] | | | | | |
| Entire year | Chinook salmon | | 5,550 | | 5,550 |
| | Dog salmon | | 5,831,000 | | 5,831,000 |
| | Silver salmon | | 45,000 | | 45,000 |
| | Steelhead trout | 200,000 | 258,000 | | 458,000 |
| Illabott, Wash.: [a] | | | | | |
| Entire year | Chinook salmon | | 131,450 | | 131,450 |
| | Dog salmon | | 197,700 | | 197,700 |
| | Silver salmon | | 1,618,010 | | 1,618,010 |
| | Steelhead trout | | 73,050 | | 73,050 |
| Quilcene, Wash.: | | | | | |
| Entire year | Dog salmon | | 3,353,000 | | 3,353,000 |
| | Silver salmon | | 230,500 | | 230,500 |
| | Steelhead trout | | 34,000 | | 34,000 |
| Sultan, Wash.: | | | | | |
| Entire year | Chinook salmon | | 145,000 | | 145,000 |
| | Silver salmon | | 1,973,500 | | 1,973,500 |
| | Steelhead trout | | 486,700 | | 486,700 |
| Battery, Md.: | | | | | |
| Apr.-May | Shad | | 5,831,850 | | 5,831,850 |
| | White perch | 20,000,000 | 445,850,000 | | 465,850,000 |
| | Yellow perch | | 229,360,000 | | 229,360,000 |
| Boothbay Harbor, Me.: | | | | | |
| Entire year | Cod | | 5,611,000 | | 5,611,000 |
| | Flatfish | | 413,961,000 | | 413,961,000 |
| | Haddock | | 22,967,000 | | 22,967,000 |
| | Lobster | | 186,000,000 | 200 | 186,000,200 |
| Bozeman, Mont.: | | | | | |
| Entire year | Blackspotted trout | | 24,000 | 1,642,360 | 1,666,360 |
| | Brook trout | | | 390,615 | 390,615 |
| | Grayling | 903,000 | 2,613,000 | | 3,516,000 |
| | Lake trout | | | 11,200 | 11,200 |
| | Rainbow trout | 230,000 | 215,800 | 59,500 | 505,300 |
| | Steelhead trout | | | 34,200 | 34,200 |
| Yellowstone, Wyo.: [a] | | | | | |
| July-Aug. | Blackspotted trout | 13,305,000 | | | 13,305,000 |

[a] For convenience in handling, transfers were made as follows:
Baird to Central Station, 20,000 chinook salmon eggs.
Hornbrook to Manchester, 10,000 rainbow trout eggs; to Clackamas, 23,700 rainbow trout eggs.
Mill Creek to Baird, 2,000,000 Chinook salmon eggs.
Birdsview to St. Johnsbury, 100,000 silver salmon eggs, and 100 000 steelhead trout eggs; to Duluth, 50,000 steelhead trout eggs; to Nashua, 100,000 steelhead trout eggs; to Spearfish, 100,000 steelhead trout eggs.
Duckabush to Quilcene, 2,000,000 dog salmon eggs.
Illabott Creek to Birdsview, 20,000 steelhead trout eggs.
Yellowstone Park to Bozeman, 2,067,000 blackspotted trout eggs; to Leadville, 6,499,000 blackspotted trout eggs; to Spearfish, 3,185,000 blackspotted trout eggs.

STATIONS OPERATED AND THE OUTPUT OF EACH FOR THE FISCAL YEAR 1913—Contd.

| Station and period of operation. | Species. | Output. | | | Total. |
|---|---|---|---|---|---|
| | | Eggs. | Fry. | Fingerlings, yearlings, and adults. | |
| Bryans Point, Md.:[a] Mar-May | Shad | | 28,408,000 | | 28,408,000 |
| | Yellow perch | | 113,923,000 | | 113,923,000 |
| Cape Vincent, N. Y.: Entire year | Brook trout | | 880,000 | | 880,000 |
| | Lake herring | | 4,730,000 | | 4,730,000 |
| | Lake trout | | 3,229,000 | | 3,229,000 |
| | Landlocked salmon | | 2,400 | | 2,400 |
| | Pike perch | | 13,800,000 | | 13,800,000 |
| | Rainbow trout | | 43,000 | | 43,000 |
| | Whitefish | | 23,900,000 | | 23,900,000 |
| | Yellow perch | | | 220 | 220 |
| Central Station, Washington, D. C.:[a] Entire year | Black bass | | | 1,600 | 1,600 |
| | Brook trout | | 19,400 | | 19,400 |
| | Catfish | | | 2,350 | 2,350 |
| | Chinook salmon | | | 18,450 | 18,450 |
| | Crappie | | | 1,345 | 1,345 |
| | Pike perch | | 1,400,000 | | 1,400,000 |
| | Rainbow trout | | 14,390 | | 14,390 |
| | Rock bass | | | 7,000 | 7,000 |
| | Shad | | 850,000 | | 850,000 |
| | Small-mouth black bass | | | 3,640 | 3,640 |
| | Smelt | | | 27,000 | 27,000 |
| | Sunfish | | | 11,012 | 11,012 |
| | Warmouth bass | | | 1,115 | 1,115 |
| | Whitefish | | 480,000 | | 480,000 |
| | White perch | | | 721 | 721 |
| | Yellow perch | | 3,640,000 | 200 | 3,640,200 |
| Clackamas, Oreg.: Entire year | Brook trout | | 70,600 | | 70,600 |
| | Chinook salmon | | 7,121,873 | | 7,121,873 |
| | Rainbow trout | | 58,649 | | 58,649 |
| Applegate, Oreg.:[a] Entire year | Silver salmon | | 1,468,000 | | 1,468,000 |
| | Steelhead | | 867,000 | | 867,000 |
| Big White Salmon, Wash.:[a] Dec.-Feb | Chinook salmon | | 13,676,400 | | 13,676,400 |
| Eagle and Tanner Creeks, Oreg.:[a] Oct.-June | Chinook salmon | 528,000 | | | 528,000 |
| | Steelhead trout | | 25,000 | | 25,000 |
| Little White Salmon, Wash.:[a] Entire year | Chinook salmon | 19,713,000 | 5,403,000 | | 25,116,000 |
| Lower Rogue River, Oreg.: Entire year | Chinook salmon | | 537,050 | | 537,050 |
| | Silver salmon | | 1,730,346 | | 1,730,346 |
| Rogue River, Oreg.: Entire year | Black-spotted trout | | 17,950 | | 17,950 |
| | Chinook salmon | 1,250,000 | 3,532,100 | | 4,782,100 |
| | Rainbow trout | | 197,000 | | 197,000 |
| | Steelhead trout | | 1,903,075 | | 1,903,075 |
| Willamette River, Oreg.: July-June | Shad | | 2,566,000 | | 2,566,000 |
| Cold Springs, Ga.: Entire year | Black bass | | 16,500 | 121,193 | 137,693 |
| | Carp | | | 400 | 400 |
| | Catfish | | | 4,954 | 4,954 |
| | Rock bass | | | 1,050 | 1,050 |
| | Small-mouth black bass | | | 12 | 12 |
| | Sunfish | | | 25,770 | 25,770 |
| | Warmouth bass | | | 125 | 125 |
| Craig Brook, Me.:[a] Entire year | Atlantic salmon | | 10,000 | 4,304 | 14,304 |
| | Brook trout | | 40,000 | 28,627 | 68,627 |

[a] For convenience in handling, transfers were made as follows:
Bryans Point to Central Station, 3,900,000 yellow perch eggs and 894,000 shad eggs.
Central Station to White Sulphur Springs, 25 small-mouth black bass fingerlings.
Applegate to Rogue River, 1,582,100 steelhead trout eggs.
Big White Salmon to Clackamas, 2,945,000 chinook salmon eggs.
Eagle and Tanner Creeks to Clackamas, 893,000 steelhead trout eggs.
Little White Salmon to Big White Salmon, 4,412,000 chinook salmon eggs.
Craig Brook to Upper Penobscot, 3,616,100 Atlantic salmon eggs.

STATIONS OPERATED AND THE OUTPUT OF EACH FOR THE FISCAL YEAR 1913—Contd.

| Station and period of operation. | Species. | Output. | | | Total. |
|---|---|---|---|---|---|
| | | Eggs. | Fry. | Fingerlings, yearlings, and adults. | |
| Craig Brook, Me.—Contd. Upper Penobscot, Me.: Mar.-May | Atlantic salmon | | 3,482,464 | | 3,482,464 |
| Duluth, Minn.:[a] Entire year | Brook trout | | | 249,000 | 249,000 |
| | Lake trout | 1,100,000 | 3,815,000 | 3,010,000 | 7,925,000 |
| | Landlocked salmon | | | 13,000 | 13,000 |
| | Pike perch | | 14,950,000 | | 14,950,000 |
| | Rainbow trout | | | 500 | 500 |
| | Steelhead trout | | | 49,500 | 49,500 |
| | Whitefish | | 16,200,000 | | 16,200,000 |
| Edenton, N. C.: Entire year | Black bass | | | 11,235 | 11,235 |
| | Shad | 3,394,000 | 95,589,000 | | 98,983,000 |
| | White perch | | 3,270,000 | | 3,270,000 |
| Weldon, N. C.: April-May | Striped bass | | 7,234,000 | | 7,234,000 |
| Erwin, Tenn.:[a] Entire year | Black bass | | | 600 | 600 |
| | Brook trout | | | 168,700 | 168,700 |
| | Carp | | | 850 | 850 |
| | Catfish | | | 50 | 50 |
| | Rainbow trout | | | 295,200 | 295,200 |
| | Rock bass | | | 1,825 | 1,825 |
| | Small-mouth black bass | | | 875 | 875 |
| | Sunfish | | | 13,200 | 13,200 |
| Gloucester, Mass.:[a] Entire year | Cod | 6,800,000 | 105,150,000 | | 111,950,000 |
| | Flatfish | | 230,070,000 | | 230,070,000 |
| | Haddock | 57,868,000 | 45,290,000 | | 103,158,000 |
| | Lobster | | 14,480,000 | | 14,480,000 |
| | Pollock | 133,739,000 | 430,060,000 | | 563,799,000 |
| Green Lake, Me.:[a] Entire year | Brook trout | | 1,575,000 | 65,963 | 1,640,963 |
| | Lake trout | | 48,600 | | 48,600 |
| | Landlocked salmon | 46,000 | 160,000 | 36,200 | 242,200 |
| | Smelt | 4,500,000 | 1,850,000 | | 6,350,000 |
| Grand Lake Stream, Me.:[a] Entire year | Brook trout | | 1,688 | | 1,688 |
| | Landlocked salmon | 178,000 | 91,146 | 31,496 | 300,642 |
| Homer, Minn.:[a] Entire year | Black bass | | | 2,570 | 2,570 |
| | Catfish | | | 1,500 | 1,500 |
| | Crappie | | | 3,300 | 3,300 |
| | Rock bass | | | 475 | 475 |
| | Small-mouth black bass. | | | 450 | 450 |
| | Sunfish | | | 7,050 | 7,050 |
| | Yellow perch | | | 350 | 350 |
| Leadville, Colo.:[a] Entire year | Blackspotted trout | | 725,000 | 3,738,000 | 4,463,000 |
| | Brook trout | 1,205,000 | 360,000 | 2,382,500 | 3,947,500 |
| | Rainbow trout | | 154,000 | 114,000 | 268,000 |
| Mammoth Spring, Ark.:[a] Entire year | Black bass | | | 25,251 | 25,251 |
| | Buffalo-fish | | | 1,000 | 1,000 |
| | Catfish | | | 14,515 | 14,515 |
| | Crappie | | | 3,299 | 3,299 |
| | Pickerel | | | 7,504 | 7,504 |
| | Rock bass | | | 3,725 | 3,725 |
| | Small-mouth black bass. | | | 47,088 | 47,088 |
| | Sunfish | | | 9,853 | 9,853 |

[a] For convenience in handling, transfers were made as follows:

Duluth to Bozeman, 50,000 lake trout eggs; to Spearfish, 30,000 lake trout eggs; to Green Lake, 50,000 lake trout eggs; to Clackamas, 30,000 lake trout eggs.

Erwin to Cold Springs, 5,100 rock bass fingerlings; to Wytheville, 2,500 sunfish fingerlings.

Gloucester to Woods Hole, 9,973,000 pollock eggs and 6,206,000 cod eggs.

Green Lake to Duluth, 15,000 landlocked salmon eggs; to Cape Vincent, 5,000 landlocked salmon eggs.

Grand Lake Stream to St. Johnsbury, 25,000 landlocked salmon eggs; to Green Lake, 60,250 landlocked salmon eggs.

Homer to Central Station, 1,000 sunfish fingerlings.

Leadville to Wytheville, 314,000 brook trout eggs; to Clackamas, 100,000 brook trout eggs; to Northville, 50,000 brook trout eggs.

Mammoth Spring to Quincy, 4,715 small-mouth black bass fingerlings; to Tupelo, 3,600 rock bass fingerlings; to Leadville, 1,050 small-mouth black bass fingerlings; to Central Station, 240 small-mouth black bass fingerlings; to Cold Springs, 3,500 small mouth black bass fingerlings.

STATIONS OPERATED AND THE OUTPUT OF EACH FOR THE FISCAL YEAR 1913—Contd.

| Station and period of operation. | Species. | Output. Eggs. | Output. Fry. | Output. Fingerlings, yearlings, and adults. | Total. |
|---|---|---|---|---|---|
| Mammoth Spring, Ark.—Continued. | | | | | |
| Friar Point, Miss.:[a] June | Black bass | | | 7,400 | 7,400 |
| | Sunfish | | | 1,350 | 1,350 |
| Manchester, Iowa:[a] Entire year | Brook trout | 500 | | 873,900 | 874,400 |
| | Rainbow trout | | | 151,400 | 151,400 |
| | Rock bass | | | 1,800 | 1,800 |
| | Small-mouth black bass. | | | 11,200 | 11,200 |
| Bellevue, Iowa: May-Sept | Black bass | | | 27,950 | 27,950 |
| | Buffalo-fish | | 80,000 | | 80,000 |
| | Catfish | | | 100 | 100 |
| | Crappie | | | 7,800 | 7,800 |
| | Pike | | | 1,500 | 1,500 |
| | Sunfish | | | 1,000 | 1,000 |
| North McGregor, Iowa: July | Black bass | | | 7,100 | 7,100 |
| | Catfish | | | 300 | 300 |
| Nashua, N. H.: Entire year | Brook trout | | 462,000 | 80,500 | 542,500 |
| | Chinook salmon | | | 80,500 | 80,500 |
| | Rainbow trout | | 41,000 | | 41,000 |
| | Small-mouth black bass. | | 21,800 | | 21,800 |
| Neosho, Mo.:[a] Entire year | Black bass | | | 24,890 | 24,890 |
| | Carp | | | 145 | 145 |
| | Crappie | | | 2,235 | 2,235 |
| | Rainbow trout | 33,500 | | 158,210 | 191,710 |
| | Rock bass | | | 23,548 | 23,548 |
| | Small-mouth black bass. | | | 1,270 | 1,270 |
| | Sunfish | | | 19,718 | 19,718 |
| Northville, Mich.: Entire year | Brook trout | | 527,200 | 229,500 | 756,700 |
| | Lake trout | 5,512,000 | 60,000 | | 5,572,000 |
| | Rainbow trout | | 82,000 | 7,500 | 89,500 |
| | Small-mouth black bass. | | | 43,675 | 43,675 |
| Charlevoix, Mich.: Feb.-May | Lake trout | | 10,444,000 | | 10,444,000 |
| | Whitefish | | 15,000,000 | | 15,000,000 |
| Detroit, Mich.:[a] Entire year | Pike perch | 41,700,000 | 23,000,000 | | 64,700,000 |
| | Whitefish | 5,320,000 | 120,000,000 | | 125,320,000 |
| | Yellow perch | | 3,500,000 | | 3,500,000 |
| Sault Ste. Marie, Mich.: Feb.-May | Lake trout | | 3,000,000 | | 3,000,000 |
| | Whitefish | | 21,000,000 | | 21,000,000 |
| Put-in Bay, Ohio:[a] Entire year | Pike perch | | 46,500,000 | | 46,500,000 |
| | Whitefish | 68,400,000 | 197,300,000 | | 265,700,000 |
| | Yellow perch | | 3,000,000 | | 3,000,000 |
| Quincy, Ill.:[a] Entire year | Black bass | | | 261,948 | 261,948 |
| | Buffalo-fish | | 3,000,000 | 3,212 | 3,003,212 |
| | Carp | | | 77,765 | 77,765 |
| | Catfish | | | 38,392 | 38,392 |
| | Crappie | | | 60,325 | 60,325 |
| | Pike perch | | 1,400,000 | | 1,400,000 |
| | Rock bass | | | 3,000 | 3,000 |
| | Sunfish | | | 38,875 | 38,875 |
| | Yellow bass | | | 255 | 255 |
| | Yellow perch | | | 25,887 | 25,887 |

[a] For convenience in handling, transfers were made as follows:

Friar Point to Mammoth Spring, 5,150 black bass fingerlings and 656 sunfish fingerlings.

Manchester to Quincy, 3,950 rock bass fingerlings; to Duluth, 42,000 rainbow trout eggs; to Homer, 43,000 brook trout eggs and 100 rock bass fingerlings.

Neosho to Quincy, 12,389 rock bass fingerlings and 1,390 small-mouth black bass fingerlings; to Leadville, 800,000 rainbow trout eggs.

Detroit to Central Station, 500,000 whitefish eggs and 7,000,000 pike perch eggs; to Sault Ste. Marie, 20,000,000 whitefish eggs; to Charlevoix, 15,000,000 whitefish eggs; to Duluth, 25,000,000 pike perch eggs; to Quincy, 2,000,000 pike perch eggs.

Put-in-Bay to Duluth, 20,000,000 whitefish eggs; to Cape Vincent, 25,000,000 whitefish eggs.

Quincy to Tupelo, 1,500 yellow perch fingerlings; to Bozeman, 450 sunfish fingerlings, 180 large-mouth black bass fingerlings, 1,300 catfish fingerlings, and 180 crappie fingerlings; to Clackamas, 400 catfish fingerlings, 180 crappie fingerlings and 600 sunfish fingerlings; to Neosho, 8,000 crappie fingerlings; to Northville, 300 catfish fingerlings, 1,200 crappie fingerlings, 150 sunfish fingerlings, and 200 yellow perch fingerlings; to Rosedale, 400 yellow perch fingerlings; to Cold Springs, 1,830 yellow perch fingerlings, 110 large-mouth black bass fingerlings and 2,750 rock bass fingerlings; to Central Station, 400 crappie fingerlings; to Leadville, 225 catfish fingerlings and 750 large-mouth black bass fingerlings.

STATIONS OPERATED AND THE OUTPUT OF EACH FOR THE FISCAL YEAR 1913—Contd.

| Station and period of operation. | Species. | Output. | | | Total. |
|---|---|---|---|---|---|
| | | Eggs. | Fry. | Fingerlings, yearlings, and adults. | |
| St. Johnsbury, Vt.:[a] Entire year | Brook trout | 30,000 | 1,027,000 | 140,529 | 1,197,529 |
| | Lake trout | | | 3,724 | 3,724 |
| | Rainbow trout | | 10,351 | | 10,351 |
| | Silver salmon | | | 69,800 | 69,800 |
| | Small-mouth black bass. | | 48,500 | 2,305 | 50,805 |
| | Steelhead trout | | 28,000 | 24,300 | 52,300 |
| Holden, Vt.:[a] Entire year | Brook trout | | 337,000 | 121,956 | 458,956 |
| | Steelhead trout | | | 34,395 | 34,395 |
| Swanton, Vt.:[a] Apr.-May | Pike perch | 4,500,000 | 47,530,000 | | 52,030,000 |
| | Yellow perch | 11,000,000 | 12,300,000 | | 23,300,000 |
| San Marcos, Tex.: Entire year | Black bass | | | 646,788 | 646,788 |
| | Crappie | | | 610 | 610 |
| | Rock bass | | | 5,100 | 5,100 |
| | Sunfish | | | 7,750 | 7,750 |
| Spearfish, S. Dak.: Entire year | Black-spotted trout | | | 1,790,000 | 1,790,000 |
| | Brook trout | | | 618,000 | 618,000 |
| | Loch Leven trout | | | 75,200 | 75,200 |
| | Rainbow trout | | | 74,550 | 74,550 |
| Tupelo, Miss.: Entire year | Black bass | | 11,000 | 80,253 | 91,253 |
| | Catfish | | | 800 | 800 |
| | Crappie | | | 1,305 | 1,305 |
| | Rock bass | | | 300 | 300 |
| | Sunfish | | | 70,750 | 70,750 |
| | Warmouth bass | | | 150 | 150 |
| Rosedale, Miss.:[a] Sept.-Jan | Black bass | | | 340 | 340 |
| | Crappie | | | 2,210 | 2,210 |
| White Sulphur Springs, W. Va.:[a] Entire year | Black bass | | | 2,642 | 2,642 |
| | Black-spotted trout | | | 9,700 | 9,700 |
| | Brook trout | 3,500 | | 509,675 | 513,175 |
| | Rainbow trout | 4,500 | | 73,574 | 78,074 |
| | Small-mouth black bass. | | 164,000 | 303 | 164,303 |
| Woods Hole, Mass.: Entire year | Cod | | 110,251,000 | | 110,251,000 |
| | Flatfish | | 165,239,000 | | 165,239,000 |
| Wytheville, Va.:[a] Entire year | Black bass | | | 13,200 | 13,200 |
| | Brook trout | | | 172,350 | 172,350 |
| | Rainbow trout | 5,000 | | 219,875 | 224,875 |
| | Rock bass | | | 17,370 | 17,370 |
| | Small-mouth black bass. | | | 200 | 200 |
| | Sunfish | | | 200 | 200 |
| Yes Bay, Alaska: Entire year | Red salmon | 2,000,000 | 62,038,100 | | 64,038,100 |
| Total[b] | | 122,275,873 | 3,422,485,381 | 19,774,171 | 3,804,535,425 |

[a] For convenience in handling, transfers were made as follows:
St. Johnsbury to Holden, 601,254 brook trout eggs.
Holden to St. Johnsbury, 525 brook trout fingerlings and 4,550 steelhead trout fingerlings.
Swanton to Cape Vincent, 12,250,000 pike perch eggs.
Rosedale to Tupelo, 1,450 large-mouth black bass fingerlings and 150 crappie fingerlings.
White Sulphur Springs to Central Station, 1,300 brook trout fingerlings, 1,200 rainbow trout fingerlings and 25 small-mouth black bass fingerlings.
Wytheville to Erwin, 1,000 rainbow trout fingerlings and 288,000 rainbow trout eggs; to Cape Vincent, 50,000 rainbow trout eggs; to Central Station, 20,000 rainbow trout eggs; to Northville, 100,000 rainbow trout eggs; to Leadville, 400,000 rainbow trout eggs; to Spearfish, 153,000 rainbow trout eggs; to St. Johnsbury, 50,000 rainbow trout eggs; to Nashua, 75,000 rainbow trout eggs.
[b] Totals show gross output of stations without deducting the following losses in transit: Fry, 894,086; fingerlings, 48,057.

The eggs hatched at the main stations listed in the foregoing table are in many cases obtained from auxiliary sources, usually temporary stations occupied during the season only, or, in some instances, mere camps which are shifted from year to year. In the Great Lakes and off the New England coast collections are made by the Bureau's vessels or boats in favorable localities. The following temporary stations and collecting points furnished eggs of the given species for the main hatcheries during 1913:

LIST OF EGG-COLLECTING STATIONS, FISCAL YEAR 1913.

| Station. | Period of operation. | Species handled. |
|---|---|---|
| Alaska: | | |
| Eagle Harbor | May 30-June 30 | Red salmon. |
| Uganik Lake | June 11-June 30 | Do. |
| Arkansas: | | |
| Marked Tree | July 1-Sept. 10 | Miscellaneous native fish. |
| Colorado: | | |
| Cheesman Lake | Apr. 10-May 16 | Rainbow trout. |
| Edith Lake | Oct. 15-Nov. 20 | Brook trout. |
| Eldora Lake | Oct. 15-Nov. 18 | Do. |
| Englebrecht Lake | Oct. 9-Nov. 16 | Do. |
| Miklich Lake | Nov. 15-Nov. 23 | Do. |
| Musgroves Lake | Oct. 10-Dec. 2 | Do. |
| Seven Lakes | June 16-July 15 | Blackspotted trout. |
| Smith Ponds | Oct. 26-Dec. 6 | Do. |
| Connecticut: | | |
| Noank | Mar. 8-Mar. 25 | Flatfish. |
| Georgia: | | |
| Harris Pond | Entire year | Catfish and sunfish. |
| Maine: | | |
| Portland | July 1-Nov. 30<br>May 5-June 30 | Lobster. |
| Massachusetts: | | |
| Boston | Apr. 20-June 30<br>Oct. 11-Nov. 15 | Do. |
| Plymouth | Nov. 19-Mar. 25 | Cod. |
| Rockport | Oct. 1-June 30 | Lobster. |
| Sagamore | Nov. 19-Mar. 25 | Cod. |
| Waquoit | Jan. 13-Mar. 25 | Flatfish. |
| Michigan: | | |
| Algonac | May 1-May 21 | Pike perch. |
| Au Sable | Nov. 5-Nov. 9 | Lake trout. |
| Bay City | Mar. 22-May 3 | Pike perch and yellow perch. |
| Belle Isle | Oct. 24-Dec. 10 | Whitefish. |
| Charity Island | Oct. 9-Nov. 30 | Do. |
| Cheboygan | Oct. 18-Nov. 6 | Lake trout. |
| Detour | Oct. 14-Nov. 9 | Do. |
| Fairport | Nov. 1-Nov. 20 | Do. |
| Frankfort | Nov. 6-Nov. 20 | Do. |
| Grand Haven | Nov. 5-Nov. 20 | Do. |
| Great Lake George | Oct. 17-Nov. 16 | Whitefish. |
| Isle Royal | Oct. 14-Nov. 10 | Lake trout. |
| Keweenaw Point | Oct. 6-Oct. 22 | Do. |
| Manistique | Oct. 28-Nov. 21 | Do. |
| Marquette | Oct. 11-Nov. 13 | Do. |
| Monroe Piers | Nov. 1-Dec. 8<br>Apr. 30 | Whitefish and pike perch. |
| Munising | Oct. 14-Nov. 10 | Lake trout. |
| Ontonagon | do | Do. |
| Port Huron | May 3-May 21 | Pike perch. |
| St. James | Nov. 1-Nov. 22 | Lake trout. |
| St. Joseph | Oct. 21-Nov. 20 | Do. |
| Minnesota: | | |
| Grand Marais | Sept. 25-Dec. 3 | Do. |
| Grand Portage | Nov. 5-Dec. 3 | Do. |
| Le Claire Point | July 1-Oct. 5 | Sturgeon. |
| Little Brule | Nov. 11-Dec. 6 | Lake trout. |
| Montana: | | |
| O'Dell Creek | Apr. 1-May 12 | Grayling. |
| Red Rock | May 1-June 30 | Do. |
| South Meadow Creek | Apr. 1-June 26 | Grayling and rainbow trout. |
| New Hampshire: | | |
| Portsmouth | May 1-June 20 | Lobster. |
| New York: | | |
| Mud Creek | Apr. 1-Apr. 30 | Pike perch. |
| Three Mile Bay | November | Whitefish and cisco. |

LIST OF EGG-COLLECTING STATIONS, FISCAL YEAR 1913—Continued.

| Station. | Period of operation. | Species handled. |
|---|---|---|
| Ohio: | | |
| Kellys Island | Nov. 12–Dec. 4 | Whitefish. |
| Middle Bass Island | Nov. 18–Dec. 4 | Do. |
| North Bass | Nov. 12–Dec. 7<br>Apr. 17–May 8 | Whitefish, pike perch, and yellow perch. |
| Port Clinton | Nov. 10–Dec. 7<br>Apr. 17–May 8 | Whitefish and pike perch. |
| Toledo | Apr. 7–Apr. 30 | Pike perch. |
| Oregon: | | |
| Eagle Creek | Apr. 1–June 20 | Steelhead trout. |
| Illinois River | Sept. 1–Jan. 1 | Chinook and silver salmon. |
| Upper Clackamas | Entire year | Chinook and silver salmon and steelhead trout. |
| Rhode Island: | | |
| Wickford | Feb. 19–Mar. 25 | Flatfish. |
| South Dakota: | | |
| Schmidts Lake | Oct. 20–Dec. 20 | Brook trout. |
| Sand Creek | Oct. 20–Jan. 15 | Do. |
| Vermont: | | |
| Darling Pond | July 19–Dec. 6 | Do. |
| Lake Mitchell | Sept. 4–Nov. 30 | Do. |
| Lake Wantastiquet | Sept. 16–Dec. 4 | Do. |
| Orleans | Apr. 16–May 16 | Steelhead trout. |
| Washington: | | |
| Brinnon | October | Silver, dog, and Chinook salmon and steelhead trout. |
| Elwell Creek | Sept. 11–June 30 | Chinook and silver salmon and steelhead trout. |
| Wyoming: | | |
| Beaver Dam | July 23–July 27 | Blackspotted trout. |
| Clear Creek | July 5–July 27 | Do. |
| Columbine Creek | July 9–July 19 | Do. |
| Cub Creek | July 5–Aug. 20 | Do. |
| Lake Camp | July 1–Sept. 10<br>June 6–June 30 | Do. |
| Thumb Camp | July 1–Aug. 17<br>June 12–June 30 | Do. |

## DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913.

### CATFISH.

| Disposition. | Fingerlings, yearlings, and adults. |
|---|---|
| Arkansas: | |
| Mammoth Spring, Spring River Lakes | 600 |
| Many Islands, Spring River | 265 |
| Marked Tree, St. Francis River | 13,550 |
| Mena, Mena City Lake | 100 |
| Colorado: | |
| Grand Junction, Nelson Lake | 200 |
| Stratton, Prairie View Pond | 75 |
| Georgia: | |
| Adairsville, Culberson Pond | 100 |
| Avera, Long Branch | 100 |
| Barnesville, Wellmaker's pond | 100 |
| Bethlehem, Marbles Creek | 65 |
| Bremen, East Lake | 150 |
| Buena Vista, Bridge Creek | 200 |
| Chickamauga, Doty's ponds | 125 |
| Clarksville, Beaver Dam Creek | 200 |
| College Park, South Lake | 200 |
| Comer, South River | 100 |
| Crawfordville, Holden's pond | 150 |
| Cuthbert, Ellis mill pond | 250 |
| Douglasville, Eason pond | 150 |
| Upshaw's mill pond | 150 |
| Fairburn, Green's pond | 50 |
| Hearn's pond | 50 |
| Fayetteville, Whitewater mill pond | 300 |
| Graysville, Chickamauga Creek | 250 |
| Greenville, Tigner's pond | 50 |
| Wimbish pond | 50 |
| Harris, Bonner's pond | 34 |
| Georgia—Continued | |
| Jefferson, North Oconee River | 100 |
| Lafayette, Mahan's pond | 100 |
| Lumpkin, Adams's mill pond | 300 |
| Hobbs's pond | 200 |
| Middleton's pond | 100 |
| McDonough, Lowe's pond | 75 |
| Manchester, Routon's pond | 100 |
| Middleton, Beaver Dam Creek | 100 |
| Monroe, Booth's pond | 65 |
| Oakwood, Walnut River, branch of | 100 |
| Renfroes, Kid Pond | 100 |
| Rock Mart, Nichol's pond | 100 |
| Temple, Wren's pond | 150 |
| Thomson, Harrison's pond | 150 |
| Three Notch, Mary Van Bream Pond | 150 |
| Trimble, Trimble Pond | 100 |
| Warm Springs, Parham's pond | 140 |
| Idaho: | |
| Boise, Shamberger Reservoir | 35 |
| Illinois: | |
| Assumption, Spring Lake | 150 |
| Carrollton, Hubbard's pond | 200 |
| Decatur, Decatur Club Lake | 200 |
| Nicholls Lake | 200 |
| Galesburg, Humphreys Lake | 200 |
| Hinsdale, Salt Lake | 300 |
| Hollidayboro, East Pond | 400 |
| Hollidayboro Lakes | 400 |
| Joliet, Du Page River | 300 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

CATFISH—Continued.

| Disposition. | Fingerlings, yearlings, and adults. |
|---|---|
| Illinois—Continued. | |
| Meredosia, Illinois River | 350 |
| Mount Zion, Banton's pond | 300 |
| Munster, Swift's pond | 300 |
| Oakland, Embarras River | 450 |
| Odell, Odell Pond | 150 |
| Sandwich, Fox River | 300 |
| Watseka, Iroquois River | 300 |
| Indiana: | |
| Angola, Buck Lake | 200 |
| Center Lake | 200 |
| Chesbro Lake | 150 |
| Crooked Lake | 200 |
| Gage Lake | 200 |
| Golden Lake | 200 |
| Howard Lake | 150 |
| Lake James | 200 |
| Lake Jimerson | 150 |
| Loon Lake | 150 |
| Silver Lake | 200 |
| Snow Lake | 200 |
| Boonville, Allendale Lake | 100 |
| Brookville, Crystal Pond | 100 |
| Charlestown, Beechwood Lake | 200 |
| Dugger, Taylor's pond | 100 |
| Fairmount, Winston's pond | 25 |
| Freetown, Salt Creek | 200 |
| Indianapolis, White River | 100 |
| Jeffersonville, Burtt's quarry pond | 100 |
| Liberty, Whitewater River, East Fork | 400 |
| Middletown, Riley's pond | 25 |
| Morris, Bischoff's pond | 400 |
| Plymouth, Twin Lake | 200 |
| Iowa: | |
| Bussey, Way's pond | 100 |
| Coin, Christensen's pond | 100 |
| Dyersville, Maquoketa River | 400 |
| Earlville, Garrett's mill pond | 100 |
| Pleasantville, Van Zee's pond | 100 |
| Waterloo, Cedar River | 100 |
| Kansas: | |
| Fort Scott, Fern Lake | 200 |
| Scott City, Wilkin's pond | 75 |
| Kentucky: | |
| Beaver Dam, Leach's pond | 95 |
| Boyd, Lake Hill | 150 |
| Covington, Lubrecht's pond | 100 |
| Crofton, Crofton Lake | 150 |
| Franklin, McFarland's pond | 100 |
| Fulton, Creede's pond | 50 |
| Grayson Springs, Harrell's pond | 95 |
| Guthrie, Bland's pond | 150 |
| Haldeman, Haldeman Reservoir | 100 |
| Hyattsville, Hyatts Lake | 150 |
| Lebanon, Big Pond | 150 |
| Monticello, Swamp Pond | 500 |
| Pineville, Clear Creek | 300 |
| Stephensburg, Blue Lake | 95 |
| Stethton, Blakely's pond | 95 |
| Maine: | |
| Norway, Mud Pond | 150 |
| Maryland: | |
| Bel Air, Finney's ice pond | 100 |
| Great Falls, Potomac River | 40 |
| Tuxedo, Corridon Pond | 100 |
| Massachusetts: | |
| Boston, Charles River | 300 |
| Fitchburg, Whalom Lake | 300 |
| Michigan: | |
| Burr Oak, Hog Lake | 375 |
| Cass City, Cass River | 200 |
| Edwardsburg, Miller Pond | 250 |
| Indian River, Burt Lake | 465 |
| Jackson, Portage Lakes | 500 |
| Upper Spring Arbor Lake | 250 |
| Lakeview, Tamarack Lake | 100 |
| Michigan—Continued. | |
| Manns Siding, Bass Lake | 125 |
| Prescott, Mills Lake | 250 |
| Mississippi: | |
| Corinth, Vandiver's lake | 200 |
| Prairie, Brand's pond | 300 |
| Sessums, Foster's pond | 100 |
| Strong, Dream Lake | 100 |
| Williams Lake | 100 |
| Montana: | |
| Benton, Johnson Pond | 180 |
| Chinook, Hedge Reservoir | 180 |
| Galata, Dry Run Reservoir | 180 |
| Harlem, Lake Arbo | 180 |
| Kalispell, Emmert Lake | 180 |
| Nebraska: | |
| Verdon, Harden's lake | 200 |
| Spring Lake | 100 |
| New Hampshire: | |
| Bellows Falls, Connecticut River | 450 |
| Manchester, Merrimac River | 150 |
| New York: | |
| Addison, Canisteo River | 250 |
| Central Bridge, Schoharie River | 250 |
| Colliersville, Goodyear Lake | 250 |
| Corinth, Bonita Lake | 250 |
| Hudson River | 250 |
| Palmer Lake | 250 |
| Ithaca, Experimental ponds | 150 |
| Middletown, Wallkill River | 140 |
| Millford, Susquehanna Lake | 500 |
| Oneonta, Emmons Lake | 250 |
| Ravena, Smith's pond | 100 |
| Schenevus, Schenevus Creek | 250 |
| Sterlington, Potlake Lake | 140 |
| Unadilla, Susquehanna River | 250 |
| Walden, Dwaarkill River | 140 |
| Wallkill, Dwaarkill River | 280 |
| North Carolina: | |
| Charlotte, Anchor Mill Reservoir | 100 |
| Gold Hill, Isenhour Pond | 25 |
| Klutt's pond | 25 |
| Guilford College, Ash Pond | 25 |
| Madison, Beaver Island Pond | 25 |
| Dan River | 25 |
| Hogans Creek | 25 |
| Hogans Pond | 15 |
| Matthews, Paddle Pond | 150 |
| North Wilkesboro, Mulberry Creek | 50 |
| Rockwell, Holshouser's pond | 25 |
| Troutman, Norwood Creek | 25 |
| Walnut Cove, Dan River | 10 |
| Willow Springs, Rowland's pond | 25 |
| Ohio: | |
| Amanda, Crystal Springs Pond | 25 |
| Archers Fork, Hille's pond | 25 |
| Bidwell, Jones's pond | 25 |
| Bradford, Greenville Creek | 50 |
| Stillwater River | 50 |
| Cambridge, Wills Creek | 50 |
| Canfield, Mahoning Lake | 200 |
| Carey, Fruth's pond | 100 |
| Carthage, Lady of the Woods Lake | 200 |
| Columbus, Deer Creek | 375 |
| Little Darby Creek | 75 |
| Hillsboro, Trimble Lake | 100 |
| Lakeside Park, Buckeye Lake | 75 |
| Mount Orab, Sterling Pond | 100 |
| North Feesburg, Liming's pond | 150 |
| Springfield, Broadway Lake | 50 |
| Xenia, Hawkin's pond | 50 |
| Oklahoma: | |
| Apache, Chandler Creek | 100 |
| Goose Lake | 100 |
| Stock Pond | 200 |
| Ardmore, City Lake | 300 |

Distribution of Fish and Fish Eggs, by Locality and Species, Fiscal Year 1913—Continued.

CATFISH—Continued.

| Disposition. | Fingerlings, yearlings, and adults. |
|---|---|
| Oklahoma—Continued. | |
| Bison, Baker's pond | 100 |
| Boynton, Sunny Lakes | 100 |
| Duncan, Cockran's pond | 100 |
| Erick, Pearl Lake | 100 |
| Fletcher, Crystal Lake | 100 |
| Kremlin, Boyd's lake | 100 |
| Muskogee, Lieber's pond | 100 |
| Pawnee, Lillie's lake | 100 |
| Pryor, Radium Creek | 100 |
| Stillwater, Pot Pond | 100 |
| Stuart, Coal Creek | 100 |
| Oregon: | |
| Albany, Willamette River | 100 |
| Clatskanie, Nehalem River | 100 |
| Klamath Falls, Lost River | 200 |
| Pennsylvania: | |
| Arcola, Perkiomen Creek | 200 |
| Belleville, West Branch Pond | 100 |
| Collegeville, Perkiomen Creek | 100 |
| Falls, Susquehanna River | 300 |
| Goldsboro, Susquehanna River | 400 |
| Graters Ford, Perkiomen Creek | 100 |
| Greencastle, First Dam Creek | 200 |
| Muddy Run | 200 |
| Hosensack, Hancock's pond | 100 |
| Indian Pond | 100 |
| Lancaster, Pequea Creek | 300 |
| Malvern, Thomas Pond | 100 |
| Marietta, Duffy's pond | 100 |
| Norristown, Schuylkill River | 100 |
| Oaks, Perkiomen Creek | 100 |
| Philadelphia, Fairmount Park Aquarium | 100 |
| League Island Park Lakes | 300 |
| Rahns, Perkiomen Creek | 100 |
| Reedsville, Peachy Dam | 100 |
| Spring City, Blackrock Pond | 200 |
| Yankee Pond | 200 |
| York, Rouse's pond | 75 |
| South Dakota: | |
| Bellefourche, Bellefourche Diversion Dam | 200 |
| Bruce, West Lake Oakwood | 200 |
| Colome, Choteborsky Lake | 100 |
| Colomb Lake | 100 |
| Draper, Craig Pond | 100 |
| Frost's pond | 100 |
| McGilvra's pond | 100 |
| Esmond, Esmond Pond | 100 |

| Disposition. | Fingerlings, yearlings, and adults. |
|---|---|
| South Dakota—Continued. | |
| Flandreau, Big Sioux River | 200 |
| Hamill, Lake Wamblee | 300 |
| Kadoka, Washechek's lake | 100 |
| Pierre, Winneconjou Pond | 100 |
| Sinai, Lake Sinai | 200 |
| Tennessee: | |
| Hampton, Ewing's lake | 100 |
| Johnsonville, Story's pond | 50 |
| McKenzie, Clear Lake | 100 |
| Milan, Ragsdale's pond | 50 |
| Nunnelly, Mud Lake | 50 |
| Shouns, Johnson's pond | 50 |
| Utah: | |
| Provo, Utah Lake | 72 |
| Vermont: | |
| Brattleboro, Connecticut River | 300 |
| Virginia: | |
| Charlottesville, Mount Eagle Pond | 100 |
| Rivanna River | 300 |
| West Virginia: | |
| Benwood Junction, Lake Riedel | 150 |
| Berkeley Springs, Cacapon Creek | 950 |
| Clarksburg, West Fork Pond | 400 |
| Elkins, Tygarts Valley River | 300 |
| Grafton, Tygarts Valley River | 600 |
| Wells's pond | 400 |
| Great Cacapon, Cacapon River | 800 |
| Martinsburg, Evans's pond | 200 |
| Mill Creek, Crickard's pond | 100 |
| Moundsville, Jones's pond | 150 |
| Palmer, Holly River | 100 |
| Shepherdstown, Potomac River | 2,310 |
| Terra Alta, Ashby's pond | 200 |
| Villanova, Gillespie's pond | 100 |
| Weston, Leggett's pond | 100 |
| Wisconsin: | |
| Eland Junction, Norrie Lake | 300 |
| La Crosse, Black River | 400 |
| Mississippi River | 400 |
| Wyoming: | |
| Hanna, Troublesome Pond | 200 |
| Stephenson Reservoir | 200 |
| Hudson, Popoagie River | 400 |
| Hulett, Moore's pond | 100 |
| Parkman, Northwood Reservoir | 100 |
| Rawlins, North Brown Canon Lake | 500 |
| Sheridan, Hamm's pond | 100 |
| Upton, Piney Reservoir | 100 |
| Total [a] | 62,446 |

CARP.

| Disposition. | Fingerlings, yearlings, and adults. |
|---|---|
| Connecticut: | |
| Waterbury, Lake Quassapaug | 40 |
| Delaware: | |
| Mount Pleasant, Brick Mill pond | 50 |
| Georgia: | |
| Adrian, Durden's pond | 100 |
| Griffin, Experiment Station pond | 200 |
| Monroe, Peter's pond | 200 |
| Norwood, Bradshaw's pond | 200 |
| Sycamore, Green Pond | 150 |
| Illinois: | |
| Meredosia, Illinois River | 74,825 |
| Mississippi River | 2,000 |
| Iowa: | |
| Lenox, Krohmer's pond | 60 |
| Kentucky: | |
| Covington, Foltz's pond | 100 |
| Woodburn, Hobb's pond | 150 |
| Maryland: | |
| Frederick Road, Springfield Pond | 50 |
| Severn, Severn Ponds | 80 |

| Disposition. | Fingerlings, yearlings, and adults. |
|---|---|
| Massachusetts: | |
| Boston, exhibition tank | 20 |
| North Scituate, Mushquashiat Pond | 20 |
| Missouri: | |
| Neosho, Hearrell Branch | 145 |
| New York: | |
| Mastic, Home Creek | 20 |
| North Carolina: | |
| Marshall, Teague's pond | 100 |
| Wilbon, Powell's pond | 150 |
| Ohio: | |
| Holmesville, Burns's pond | 150 |
| South Carolina: | |
| Gramling, Tiger River pond | 100 |
| Tennessee: | |
| Chilhowee, Carpenter's pond | 100 |
| Knoxville, Hansley's lake | 100 |
| West Virginia: | |
| Colcord, Meadow Pond | 50 |
| Total | 79,160 |

[a] Lost in transit, 515 fingerlings.

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

### BUFFALO-FISH.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Arkansas: | | |
| Marked Tree, St. Francis River | | 1,000 |
| Illinois: | | |
| Belleville, Heinemann's lake | | 70 |
| Meredosia, Illinois River | | 300 |
| Meredosia Bay | 3,000,000 | |
| Mississippi River | | 560 |
| Iowa: | | |
| Bellevue, Mississippi River | 80,000 | |
| Ohio: | | |
| Port Clinton, Lake Erie | | 2,250 |
| Pennsylvania: | | |
| Philadelphia, Fairmount Park Aquarium | | 32 |
| Total | 3,080,000 | 4,212 |

### SHAD.

| Disposition. | Eggs. | Fry. |
|---|---|---|
| District of Columbia: | | |
| Washington, Potomac River | | 850,000 |
| Georgia: | | |
| Swainsboro, Little Ohoopee River | | 300,000 |
| Maryland: | | |
| Broad Creek, Potomac River | | 1,512,000 |
| Havre de Grace, Chesapeake Bay | | 5,831,850 |
| Pamunkey Creek, Potomac River | | 4,213,000 |
| Piscataway Creek, Potomac River | | 6,029,000 |
| Swan Creek, Potomac River | | 3,642,000 |
| North Carolina: | | |
| Castle Hayne, North East River | | 200,000 |
| Comfort, Trent River | | 400,000 |
| Edenton, Albemarle Sound | 3,394,000 | 91,439,000 |
| Faison, Goshen River | | 200,000 |
| Fayetteville, Cape Fear River | | 200,000 |
| Goldsboro, Little River | | 200,000 |
| Neuse River | | 200,000 |
| Greensboro, Buffalo Creek | | 200,000 |
| Ivanhoe, Black River | | 200,000 |
| Jacksonville, New River | | 200,000 |
| North Carolina—Contd. | | |
| Maysville, White Oak River | | 200,000 |
| Newbern, Neuse River | | 450,000 |
| Pollocksville, Trent River | | 200,000 |
| Six Runs, Six Runs | | 300,000 |
| Wallace, North East River | | 200,000 |
| Washington, Pamlico River | | 300,000 |
| Wilmington, Cape Fear River | | 200,000 |
| Virginia: | | |
| Dogue Creek, Potomac River | | 5,543,000 |
| Hunters Creek, Potomac River | | 759,000 |
| Little Hunting Creek, Potomac River | | 1,010,000 |
| Mount Vernon, Potomac River | | 1,849,000 |
| Occoquan Creek, Potomac River | | 3,491,000 |
| Pohick, Potomac River | | 360,000 |
| Oregon: | | |
| Willamette, Willamette River | | 2,316,000 |
| Washington: | | |
| Arlington, Stilaquamish River | | 250,000 |
| Total | 3,394,000 | 133,244,850 |

### WHITEFISH.

| | | |
|---|---|---|
| Michigan: | | |
| Ann Arbor, for research work | 80,000 | |
| Belle Isle, Detroit River | | 38,500,000 |
| Lake St. Clair | | 15,000,000 |
| Caseville, Lake Huron | | 10,000,000 |
| Detour, Lake Huron | | 6,000,000 |
| Detroit, Detroit Aquarium | 240,000 | |
| Detroit River | | 45,000,000 |
| Escanaba, Lake Michigan | | 3,000,000 |
| Fish Island, Lake Superior | | 1,200,000 |
| Holland, Black Lake | | 300,000 |
| Indian River, Burt Lake | | 300,000 |
| Isle Royal, Lake Superior | | 2,400,000 |
| Manistee, Lake Michigan | | 400,000 |
| Manistique, Lake Michigan | | 1,000,000 |
| Marquette, Lake Superior | | 3,750,000 |
| North Point, Lake Huron | | 5,000,000 |
| Michigan—Continued. | | |
| Norwood Reef, Lake Michigan | | 5,000,000 |
| Old Mission Point, Lake Michigan | | 5,000,000 |
| St. Joseph, Lake Michigan | | 500,000 |
| Sand Bay, Lake Michigan | | 5,000,000 |
| Sulphur Island, Lake Huron | | 5,000,000 |
| Whitefish Point, Lake Superior | | 11,000,000 |
| Minnesota: | | |
| Duluth, Lake Superior | | 150,000 |
| Grand Portage, Lake Superior | | 2,200,000 |
| Ranier, Rainy Lake | | 500,000 |
| Robbindale, Lower Twin Lake | | 300,000 |
| Susie Island, Lake Superior | | 2,400,000 |

DISRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

WHITEFISH—Continued.

| Disposition. | Eggs. | Fry. | Disposition. | Eggs. | Fry. |
|---|---|---|---|---|---|
| Montana: | | | Ohio—Continued. | | |
| Kalispell, State fish commission | 2,000,000 | ........... | Cleveland, State fish commission | 19,280,000 | ........... |
| Somers, State fish commission | 1,000,000 | ........... | Isle St. George, Lake Erie | .......... | 20,000,000 |
| New York: | | | Kelleys Island, Lake Erie | .......... | 45,000,000 |
| Battery Park, New York Aquarium | 100,000 | ........... | Locust Point, Lake Erie | .......... | 12,300,000 |
| Cape Vincent, Lake Ontario | .......... | 6,000,000 | Marblehead, Lake Erie | .......... | 20,000,000 |
| Fox Island, Lake Ontario | .......... | 1,500,000 | Middle Bass Island, Lake Erie | .......... | 30,000,000 |
| Fuller Bay, Lake Ontario | .......... | 1,500,000 | Port Clinton, Lake Erie | .......... | 20,000,000 |
| Grenadier Island, Lake Ontario | .......... | 7,500,000 | Put-in-Bay, Lake Erie | .......... | 20,000,000 |
| Hayes Point, Lake Ontario | .......... | 1,500,000 | Toledo, Lake Erie | .......... | 10,000,000 |
| Stony Point, Lake Ontario | .......... | 1,900,000 | Pennsylvania: | | |
| Syracuse, Oneida Lake | .......... | 480,000 | Erie, State fish commission | 40,920,000 | ........... |
| Tibbitts Point, Lake Ontario | .......... | 1,000,000 | Fairmount Park, Fairmount Park Aquarium | 100,000 | ........... |
| Wilson Bay, Lake Ontario | .......... | 3,000,000 | Wisconsin: | | |
| Ohio: | | | Madison, State fish commission | 5,000,000 | ........... |
| Catawba Island, Lake Erie | .......... | 15,000,000 | Superior, Lake Superior | .......... | 3,300,000 |
| Cedar Point, Lake Erie | .......... | 5,000,000 | British Columbia: | | |
| | | | Victoria, fisheries department | 5,000,000 | ........... |
| | | | Total | 73,720,000 | 393,880,000 |

LAKE HERRING.

| Disposition. | Fry. |
|---|---|
| New York: | |
| Grenadier Island, Lake Ontario | 3,230,000 |
| Hayes Point, Lake Ontario | 500,000 |
| Wilson Bay | 1,000,000 |
| Total | 4,730,000 |

SILVER SALMON.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Alaska: | | | |
| Afognak, Letnik Lake | ........... | 214,000 | ........... |
| California: | | | |
| Klamath, Klamath River | ........... | 17,320 | ........... |
| Maine: | | | |
| Brownsville, Pleasant River | ........... | ........... | 45,800 |
| Grindstone, Penobscot River | ........... | ........... | 24,000 |
| Nevada: | | | |
| Carson City, State fish commission | 50,000 | ........... | ........... |
| Verdi, State fish commission | 50,000 | ........... | ........... |
| New York: | | | |
| Battery Park, New York Aquarium | 2,000 | ........... | ........... |
| Oregon: | | | |
| Applegate, Applegate Creek | ........... | 1,468,000 | ........... |
| Grants Pass, Rogue River | ........... | 1,730,346 | ........... |
| Washington: | | | |
| Baker Lake, Baker Lake | ........... | 2,076,000 | ........... |
| Birdsview, Day Creek | ........... | 35,000 | ........... |
| Grandy Creek | ........... | 2,931,407 | ........... |
| Phinney Creek | ........... | 35,000 | ........... |
| Skagit River | ........... | 1,210,000 | ........... |
| Darrington, Bennetts Slough | ........... | 600,200 | ........... |
| Duckabush, Duckabush River | ........... | 45,000 | ........... |
| Illabott, Illabott Creek | ........... | 1,618,010 | ........... |
| Quilcene, Little Quilcene River | ........... | 57,000 | ........... |
| Big Quilcene River | ........... | 173,500 | ........... |
| Sultan, Elwell Creek | ........... | 1,973,500 | ........... |
| Total | 102,000 | 14,184,283 | 69,800 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

CHINOOK SALMON.

| Disposition. | Eggs. | Fry. | Fingerlings yearlings, and adults. |
|---|---|---|---|
| California: | | | |
| Baird, McCloud River | | 2,195,100 | |
| Brookdale, State fish commission | 300,000 | | |
| Sacramento, State fish commission | 600,000 | | |
| San Francisco, State fish commission | 1,500,000 | | |
| Sisson, State fish commission | 14,522,873 | | |
| Truckee, State fish commission | 20,000 | | |
| Massachusetts: | | | |
| Wilkinsonville, State fish commission | 50,000 | | |
| New Hampshire: | | | |
| Blodgetts Landing, Lake Sunapee | | | 30,000 |
| Laconia, State fish commission | | | 7,900 |
| Newbury, Lake Sunapee | | | 41,410 |
| New York: | | | |
| Arden, Applicant | 100,000 | | |
| Forest Lake | | | 18,450 |
| Oregon: | | | |
| Bonneville, State fish commission | 21,491,000 | | |
| Clackamas, Clackamas River | | 7,121,873 | |
| Grants Pass, Rogue River | | 537,050 | |
| Rogue River, Rogue River | | 157,100 | |
| Trail, Rogue River | | 3,475,000 | |
| Washington: | | | |
| Baker, Baker Lake | | 18,600 | |
| Big White Salmon | | 2,950,000 | |
| Columbia River | | 4,550,000 | |
| Spring Creek | | 6,076,400 | |
| Birdsview, Skagit River | | 5,800 | |
| Darrington, Bennetts Slough | | 447,500 | |
| Skagit River | | 100,000 | |
| Duckabush, Duckabush River | | 5,550 | |
| Illabott, Illabott Creek | | 131,450 | |
| Little White Salmon, Little White Salmon River | | 5,403,000 | |
| Sultan, Elwell Creek | | 145,000 | |
| Total [a] | 38,583,873 | 33,319,423 | 97,760 |

[a] Lost in transit, 1,190 fingerlings.

RED OR SOCKEYE SALMON.

| Disposition. | Eggs. | Fry. |
|---|---|---|
| Alaska: | | |
| Afognak, Letnik Bay | | 12,551,102 |
| Yes Bay, McDonald Lake | | 28,085,600 |
| Yes River | | 33,952,500 |
| Oregon: | | |
| Bonneville, State fish commission | 2,000,000 | |
| Washington: | | |
| Baker, Baker Lake | | 5,559,000 |
| Birdsview, Grandy Creek | | 192,700 |
| Total | 2,000,000 | 80,340,902 |

HUMPBACK SALMON.

| Disposition. | Fry. |
|---|---|
| Alaska: | |
| Afognak, Letnik Bay | 151,800 |
| Washington: | |
| Birdsview, Grandy Creek | 1,880 |
| Total | 153,680 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

DOG SALMON.

| Disposition. | Fry. |
|---|---|
| Washington: | |
| Birdsview, Skagit River | 196,300 |
| Grandy Creek | 15,000 |
| Darrington, Bennetts Slough | 8,005,000 |
| Sauk River | 236,000 |
| Skagit River | 1,645,000 |
| Duckabush, Duckabush River | 5,831,000 |
| Illabott, Illabott Creek | 197,700 |
| Quilcene, Big Quilcene River | 2,541,000 |
| Little Quilcene River | 686,000 |
| Penny Creek | 126,000 |
| Total | 19,479,000 |

STEELHEAD TROUT.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Michigan: | | | |
| Watersmeet, Henderson Creek | | | 6,000 |
| Minnesota: | | | |
| Duluth, Lester River | | | 7,000 |
| French River, French River | | | 7,000 |
| St. Paul, State fish commission | 100,000 | | |
| Montana: | | | |
| Harlowton, Fish Creek | | | 8,000 |
| Lebo Creek | | | 8,000 |
| Mussellshell River | | | 8,000 |
| Manhattan, Spring Creek | | | 2,500 |
| Roundup, Parrot Creek | | | 800 |
| Sheridan, Lower Branham Lake | | | 1,200 |
| Upper Branham Lake | | | 1,200 |
| Twodot, Musselshell River | | | 2,000 |
| Wilsall, Shields River | | | 2,500 |
| New Hampshire: | | | |
| Laconia, State fish commission | 75,000 | | |
| New Jersey: | | | |
| Hackettstown, State fish commission | 100,000 | | |
| New York: | | | |
| Raquette Lake, applicant | 50,000 | | |
| North Dakota: | | | |
| Grand Forks, applicant | 25,000 | | |
| Mercer, Brush Lake | | | 4,750 |
| St. Johns, Gravel Lake | | | 4,000 |
| State fish commission | 200,000 | | |
| Oregon: | | | |
| Applegate, Applegate Creek | | 867,000 | |
| Eagle Creek, Eagle Creek | | 25,000 | |
| Trail, Red Blanket Creek | | 15,000 | |
| Rogue River | | 1,888,075 | |
| Vermont: | | | |
| Barton, Barton River | | 18,000 | 6,950 |
| Greensboro, Caspian Lake | | 10,000 | 5,260 |
| Hardwick, East Long Pond | | | 1,000 |
| Marshfield, Niggerhead Pond | | | 8,750 |
| Winooski River | | | 7,500 |
| Montpelier, Dog River | | | 8,750 |
| Newport, Clyde River | | | 1,900 |
| Orleans, Willoughby River | | | 17,350 |
| Roxbury, State fish commission | 30,000 | | |
| Washington: | | | |
| Arlington, Lake Armstrong | | 15,000 | |
| Baker, Baker Lake | | 12,400 | |
| Billingham, Good Lake | | 15,000 | |
| Squalicum Lake | | 15,000 | |
| Birdsview, Grandy Creek | | 175,000 | |
| Skagit River | | 139,000 | |
| Creston, Wilson Creek | | 15,000 | |
| Darrington, Bennetts Slough | | 114,000 | |
| Duckabush, Duckabush River | | 258,000 | |
| Dupont, Sequalchee Lake | | 15,000 | |
| Ferndale, Lake Terrill | | 15,000 | |
| Illabott, Illabott Creek | | 73,050 | |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

STEELHEAD TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Washington—Continued. | | | |
| Mineral, Mineral Lake | | 15,000 | |
| Round Top Creek | | 10,000 | |
| North Yakima, Nelson Spring Creek | | 15,000 | |
| Port Angeles, Elwha River | | 15,000 | |
| Quilcene, Big Quilcene River | | 34,000 | |
| Seattle, State fish commission | 100,000 | | |
| Sultan, Elwell Creek | | 486,700 | |
| Walla Walla, State fish commission | 100,000 | | |
| Wenatchee, Entiat River | | 20,000 | |
| Lake Chelan | | 20,000 | |
| Wisconsin: | | | |
| Donaldson, Black Oak Lake | | | 8,000 |
| Iron River, Little Muscallonge Lake | | | 10,000 |
| Wyoming: | | | |
| Sheridan, State fish commission | 100,000 | | |
| Canada: | | | |
| Southhampton, Canadian Government | 100,000 | | |
| Total [a] | 980,000 | 4,300,225 | 138,410 |

RAINBOW TROUT.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Arizona: | | | |
| Holbrook, Becker's pond | | | 2,000 |
| Kingman, Oak Creek | | | 1,000 |
| Arkansas: | | | |
| Gravette, White's pond | | | 5,000 |
| California: | | | |
| Bridgeport, Walker River and tributaries | | | 5,000 |
| Hornbrook, Cottonwood Creek | | 86,580 | |
| Colorado: | | | |
| Breckenridge, Spruce Creek | | 22,900 | |
| Buffalo, Lake Cheeseman | | | 30,000 |
| Colorado Springs, Reservoir No. 5 | | | 1,500 |
| Denver, Cherry Vale Trout Ponds | | | 1,000 |
| Leadville, Arkansas River | | 30,000 | 15,000 |
| Eagle River | | 15,000 | |
| Lake Creek | | 20,000 | |
| Meadow Creek | | | 1,000 |
| Otto Creek | | | 2,000 |
| Rock Creek | | 25,000 | |
| Savage Lake | | | 4,000 |
| Shippy Pond | | | 1,000 |
| Taylor Creek | | | 3,000 |
| Willow Creek | | 25,000 | |
| Malta, Eagle River | | 10,000 | |
| Gore Creek | | 5,000 | |
| Pueblo, Arkansas River | | | 2,500 |
| Salida, Arkansas River | | | 20,000 |
| England's pond | | | 1,000 |
| Poncha Creek | | | 5,000 |
| South Arkansas River | | | 5,000 |
| Singleton, Singleton Lake | | | 3,000 |
| Connecticut: | | | |
| Norfolk, Blackberry River | | | 640 |
| District of Columbia: | | | |
| Washington, Aquarium, Central Station | | | 15 |
| Georgia: | | | |
| Calhoun, Wright's spring pond | | | 400 |
| Chatsworth, Mill Creek | | | 2,400 |
| Clayton, Kingwood Lake | | | 2,000 |
| Eton, Mill Creek | | | 350 |
| Graysville, Chickamauga Creek | | | 210 |
| Menlo, Ledbetter's pond | | | 140 |
| Ringgold, East Chickamauga Creek | | | 1,000 |
| Illinois: | | | |
| Arlington Heights, Kellogg's pond | | | 100 |
| Indiana: | | | |
| La Porte, Hoover Creek | | | 600 |
| Mishawaka, Willow Creek | | | 500 |
| Morgantown, Spicer's pond | | | 500 |

[a] Lost in transit, 3,985 fingerlings.

Distribution of Fish and Fish Eggs, by Locality and Species, Fiscal Year 1913—Continued.

RAINBOW TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults, |
|---|---|---|---|
| Iowa: | | | |
| Arlington, Brush Creek | | | 1,000 |
| Joy Springs Creek | | | 1,000 |
| Decorah, Bear Creek | | | 1,600 |
| Trout River | | | 16,800 |
| Lansing, Bacon Creek | | | 300 |
| Capoli Creek | | | 300 |
| Cavers Creek | | | 300 |
| Clear Creek | | | 300 |
| Clear Creek, tributary of | | | 300 |
| Delormo Creek | | | 300 |
| French Creek | | | 300 |
| Horseshoe Creek | | | 300 |
| Marquette Creek | | | 300 |
| Roggensack's pond | | | 5,000 |
| Scholtes Creek | | | 300 |
| Thompsons Creek | | | 600 |
| Twin Creeks | | | 300 |
| Nora Springs, Fee's pond | | | 300 |
| North McGregor, Bloody Run | | | 1,200 |
| Crimmons Creek | | | 2,600 |
| Osage, Burr Oak Creek | | | 600 |
| Postville, Smith Spring Brook | | | 300 |
| Yellow River | | | 600 |
| Kentucky: | | | |
| Cornettsville, Big Leatherwood Creek | | | 1,500 |
| Farmers, Triplett Creek | | | 1,000 |
| Fullerton, Farley's pond | | | 1,000 |
| Louisville, applicant | 500 | | |
| Maloneton, Farley's pond | | | 3,000 |
| Mount Sterling, Lulbegrud River | | | 8,000 |
| Versailles, Spring Hill Pond | | | 300 |
| Spring Lake | | | 1,000 |
| Louisiana: | | | |
| Minden, Gladney's pond | | | 600 |
| Maryland: | | | |
| Chevy Chase, Rock Creek | | 10,300 | |
| Monkton, Holmes Branch | | | 2,000 |
| Mount Winans, Lakeland Lake | | | 500 |
| Oakland, Big Youghiogheny River | | | 8,000 |
| Browning's pond | | | 200 |
| Lake Ford | | | 900 |
| Muddy Creek | | | 200 |
| White Oak Run | | | 200 |
| Massachusetts: | | | |
| Clinton, Tadmore Brook | | 5,000 | |
| Millbury, Ramshorn Brook | | 5,000 | |
| Michigan: | | | |
| Central, Montreal River, branch of | | | 400 |
| Crystal Falls, Paint River | | | 1,000 |
| Gaylord, Pigeon River | | 31,000 | |
| Grayling, Tillula Lake | | | 4,000 |
| Indian River, Sturgeon River | | 20,000 | |
| Mandan, Silver River | | | 200 |
| Phoenix, Garden City River | | | 400 |
| Ravenna, Crockery Creek | | | 4,000 |
| Watersmeet, Henderson Creek | | | 6,000 |
| Wingleton, Pere Marquette River | | 31,000 | |
| Minnesota: | | | |
| Harmony, Odessa Creek | | | 600 |
| Willow Creek | | | 600 |
| Houston, Badger Valley Creek | | | 600 |
| Crystal Valley Creek | | | 600 |
| Dailey Creek | | | 600 |
| Looney Valley Creek | | | 600 |
| Money Creek | | | 600 |
| Story Valley Creek | | | 300 |
| Lanesboro, Duschee Creek | | | 600 |
| Mask Creek | | | 600 |
| Torgeson Creek | | | 600 |
| Watson Creek | | | 600 |
| Park Rapids, Fish Hook Creek | | | 600 |
| Preston, Camp Creek | | | 3,000 |
| Middle Branch | | | 600 |
| Partridge Creek | | | 1,000 |
| Watson Creek | | | 15,000 |

## Distribution of Fish and Fish Eggs, by Locality and Species, Fiscal Year 1913—Continued.

### RAINBOW TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Minnesota—Continued. | | | |
| Stockton, Stockton Creek | | | 400 |
| Stockton Creek, east branch | | | 400 |
| Stockton Creek, west branch | | | 600 |
| Winona, Millers Creek | | | 1,000 |
| Missouri: | | | |
| Arlington, Gasconade River | | | 620 |
| Bourbon, Blue Spring Branch | | | 620 |
| Browns Spring, Rainbow Lake | | | 30,000 |
| Chicopee, Current River | | | 800 |
| Dixon, Gasconade River | | | 620 |
| Fanning, Brush Creek | | | 620 |
| Lebanon, Hahatonka Lake | | | 6,000 |
| Niangua River | | | 1,550 |
| Marshfield, James River | | | 310 |
| Osage River | | | 310 |
| Mountain Grove, Bryant Spring Creek | | | 10,000 |
| Neosho, Indian Creek | | | 5,000 |
| Hickory Creek | | | 5,000 |
| Schuler's pond | | | 1,600 |
| Shoal Creek | | | 16,000 |
| White Lake No. 1 | | | 550 |
| Newburg, Little Piney River | | | 620 |
| Yancy Mill Lake | | | 2,000 |
| Niangua, Osage Fork River | | | 620 |
| Potosi, applicant | 33,000 | | |
| Rolla, Gasconade River | | | 775 |
| Little Piney River | | | 775 |
| Little Piney River, upper | | | 2,763 |
| Mill Creek No. 2 | | | 1,842 |
| South Spring Creek | | | 921 |
| Yancy Mill Lake | | | 922 |
| St. Clair, Indian Creek | | | 620 |
| St. Joseph, State fish commission | | | 37,800 |
| Thayer, Greer Spring Creek | | | 2,000 |
| Winona, Current River, west fork | | | 800 |
| Montana: | | | |
| Anaconda, State fish commission | 50,000 | | |
| Cascade, Spring Creek | | 4,000 | |
| Columbus, Armstrong Lake | | | 7,500 |
| Beaver Pond | | 4,000 | |
| Elk Lake | | | 9,000 |
| Fiddler Creek | | | 6,000 |
| Fulkerson Lake | | 8,000 | |
| Lower West Rosebud Lake | | | 7,500 |
| Mystic Lake | | | 6,000 |
| Pitchfork Creek | | | 6,000 |
| Spring Creek | | | 4,500 |
| Stillwater River | | 8,000 | |
| Helena, Chessman Lake | | 16,000 | |
| Maudlow, Spring Creek | | | 1,000 |
| Norris, Madison Lake | | 155,000 | |
| O'Dell Creek, O'Dell Creek | | 20,800 | |
| Nevada: | | | |
| Carson City, State fish commission | 50,000 | | |
| Springdale, Kimball's pond | | | 500 |
| Tecoma, Hoppie Lake | | | 500 |
| New Hampshire: | | | |
| Concord, Massassecum Brook | | 5,000 | |
| Newbury, Lake Sunapee | | 16,000 | |
| New Jersey: | | | |
| Hackettstown, State fish commission | 50,000 | | |
| Princeton, applicant | 4,500 | | |
| Salem, Cedar Run | | | 2,500 |
| New York: | | | |
| Albany, Glen Lake | | 5,000 | |
| Battery Park, New York Aquarium | 5,000 | | |
| Benson Mines, Star Lake | | 10,000 | |
| Calverton, Peconic River, tributary | | | 560 |
| Callicoon, North Branch | | | 4,000 |
| Gloversville, County Line Lakes | | 10,000 | |
| Stony Creek | | | 1,500 |
| Hornell, Canisteo River | | | 4,000 |
| Long Lake West, Bear Pond | | | 500 |
| Bettner Ponds | | | 500 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

RAINBOW TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| New York—Continued. | | | |
| Oneonta, Knapp Brook | | | 1,000 |
| Light company pond | | | 2,500 |
| Woods Brook | | | 1,500 |
| Patterson, Croton River | | | 2,500 |
| Tabor Brook | | | 1,500 |
| Portage, Letchworth Park Home Pond | | 8,000 | |
| Poughkeepsie, Rudco Lake | | | 1,500 |
| Rome, Big Alder Creek | | 4,000 | |
| Little Alder Creek | | 4,000 | |
| Point Rock Creek | | 4,000 | |
| Syracuse, Butternut Creek | | | 375 |
| Limestone Creek | | | 375 |
| Onondaga Creek | | | 375 |
| Pebble Hill Pond | | 3,000 | |
| Pecks Brook | | | 125 |
| Towners, Croton River, Middle Fork | | | 2,000 |
| North Carolina: | | | |
| Asheville, Lake Tahkuostee | | | 1,200 |
| Black Mountain, Swannanoa River, Little Lefthand Fork | | | 2,000 |
| Swannanoa River, Long Branch | | | 2,000 |
| Swannanoa River, North Fork | | | 4,000 |
| Swannanoa River, Randolph Branch | | | 2,000 |
| Swannanoa River, Sugar Fork | | | 2,000 |
| Boonford, Big Crabtree Creek | | | 5,000 |
| South Toe River | | | 6,300 |
| Brevard, Batsons Creek | | | 1,200 |
| Buck Horn Creek | | | 1,200 |
| Bushy Creek | | | 75 |
| Cannon Creek | | | 75 |
| Deer Park Lake | | | 1,275 |
| Dunn's creek | | | 800 |
| Kings Creek | | | 1,350 |
| Nicholson Creek | | | 150 |
| Seniard Lake | | | 2,400 |
| Tuckers Creek | | | 1,200 |
| Williamson's creek | | | 150 |
| Bryson City, Brush Creek | | | 2,100 |
| Marr Creek | | | 1,200 |
| Cherryfield, Cherryfield Creek | | | 150 |
| Conway, Martin's pond | | | 225 |
| Dillsboro, Shell Creek | | | 2,100 |
| Elk Park, Watauga Creek | | | 5,000 |
| Graphiteville, Pritchards Creek | | | 1,000 |
| Hendersonville, Big Hungary Creek | | | 2,000 |
| Clear Creek | | | 1,200 |
| Green River | | | 4,000 |
| Kanuga Creek | | | 1,200 |
| Laurel Fork Creek | | | 1,200 |
| Horse Shoe, Boring Mill Creek | | | 75 |
| Bradleys Creek | | | 75 |
| Mills River | | | 150 |
| Queens Creek | | | 75 |
| Hot Springs, Spring Creek | | | 2,100 |
| Lenoir, Reed's pond | | | 400 |
| Linville Falls, Linville River | | | 8,000 |
| Marion, Armstrong Creek | | | 3,000 |
| Big Buck Creek | | | 6,000 |
| Garden Creek | | | 1,000 |
| Gladys Creek | | | 2,000 |
| Lick Log Creek | | | 2,000 |
| Singe Cat Creek | | | 2,000 |
| Stony Creek | | | 2,400 |
| Morganton, Catawba River, Upper South Fork | | | 4,000 |
| Henry River, North and South Forks | | | 4,000 |
| Old Fort, Bird Creek | | | 1,000 |
| Bird Creek, East Fork | | | 1,000 |
| Bird Creek, Middle Fork | | | 1,000 |
| Catawba River | | | 1,000 |
| Laurel Creek | | | 150 |
| North Cedar Creek | | | 150 |
| South Cedar Creek | | | 150 |
| Taylor Creek | | | 150 |
| Penrose, Clayton's pond | | | 800 |
| Clayton Lake | | | 1,600 |
| Grassey Creek | | | 150 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

RAINBOW TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults, |
|---|---|---|---|
| North Carolina—Continued. | | | |
| Penrose, Hogshead Creek | | | 1,600 |
| Lake Aikenside | | | 1,200 |
| Laurel Creek | | | 150 |
| Mill Creek | | | 1,600 |
| Pinebluff, Lumber River, tributaries | | | 300 |
| Ronda, Lake Neuchatel | | | 75 |
| Spring Hope, Griffin's pond | | | 2,000 |
| Spruce Pine, Grave Yard Creek | | | 1,200 |
| Sylva, Callowhee Creek | | | 1,800 |
| Lilley Creek | | | 2,100 |
| Tuckaseigee River, branch | | | 3,000 |
| Trivett, Beaver Dam Creek | | | 5,000 |
| Tuxedo, Bats Fork Creek | | | 2,000 |
| Cabin Creek | | | 150 |
| Green River | | | 1,500 |
| Paces Creek | | | 1,200 |
| Rock Creek | | | 1,275 |
| Wehutty, Ducktown Creek | | | 5,000 |
| North Dakota: | | | |
| New Salem, Silver Spring Pond | | | 200 |
| Springbrook Pond No. 1 | | | 100 |
| St. John, Gravel Lake | | | 500 |
| Ohio: | | | |
| Akron, Cuyahoga River | | | 500 |
| Cleveland, Rockledge Brook | | | 1,000 |
| Columbus, Spring Lakes | | | 1,000 |
| Mansfield, Dickson Lake | | | 1,000 |
| Koogles Run | | | 1,000 |
| Rockyford Creek, North Branch | | | 1,500 |
| Washington Courthouse, Walnut Creek | | | 1,000 |
| Oklahoma: | | | |
| Enid, Government Park Lake | | | 15,000 |
| Lawton, Rowell Spring Creek | | | 5,000 |
| Oregon: | | | |
| Baker, Antone Creek | | 2,000 | |
| Goose Creek | | 2,000 | |
| Magoon Lake | | 2,000 | |
| Pine Creek | | 2,000 | |
| High Lake | | 2,000 | |
| Rock Creek | | 2,000 | |
| Strawberry Lake | | 2,000 | |
| Ballston, Davidson Lake | | 2,000 | |
| Bonneville, State fish commission | 180,000 | | |
| Grants Pass, Bolen Lake | | 2,925 | |
| Hermiston, Cold Spring Reservoir | | 2,000 | |
| Klamath Falls, Four Mile Lake | | 2,850 | |
| Lake of the Woods | | 2,925 | |
| La Grande, Mill Creek | | 1,000 | |
| Lakeview, Dog Lake | | | 4,000 |
| Lebanon, South Santiam River | | 4,000 | |
| McCoy, Jenkins Pond | | 2,000 | |
| Milwaukee, Crystal Lake | | 1,649 | |
| Oregon City, Buckner Creek | | 2,000 | |
| Buckner Creek, tributary | | 1,000 | |
| Molalla River, North Fork | | 2,000 | |
| Molalla River, South Fork | | 4,000 | |
| Pine Creek | | 2,000 | |
| Portland, State fish commission | 200,000 | | |
| The Dalles, Lost Lake | | 3,000 | |
| Trail, Elk Creek | | 100,000 | |
| Rogue River | | 97,000 | |
| Troutdale, Jackson Run | | 1,000 | |
| Union, Catenni Creek | | 2,000 | |
| Wallowa, Minam Lake | | 2,000 | |
| Yoncalla, Adams Creek | | 2,000 | |
| Pennsylvania: | | | |
| Chambersburg, Birch Creek | | | 2,000 |
| Carbaugh Creek | | | 1,500 |
| Falling Spring Creek, North Branch | | | 5,000 |
| Falling Spring Creek, South Branch | | | 5,000 |
| Hoosiac Creek | | | 1,500 |
| Cherry Tree, Killen Run | | | 1,600 |
| Easton, Bushkill Creek | | | 500 |
| Echo Lake, Big Bushkill Creek and tributaries | | | 4,000 |
| Lancaster, Kurtz's run | | | 1,200 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

RAINBOW TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Pennsylvania—Continued. | | | |
| Lanesboro, Starucca Creek | | | 4,500 |
| Tunkhannock Creek | | | 5,000 |
| Latrobe, Indian Camp Run | | | 200 |
| Kellery Run | | | 200 |
| Lewisburg, Bull Run | | | 1,500 |
| Ligonier, McGinnis Run | | | 4,500 |
| Lorane, Jackson Pond | | | 200 |
| Mill Hall, Columbine Creek | | | 800 |
| Mocanaqua, Novak's pond | | | 300 |
| Monessen, Nash's pond | | | 300 |
| Pottsville, West Creek | | | 2,000 |
| Reading, Wyomissing Creek | | | 4,800 |
| Renovo, Bakers Run | | | 1,200 |
| Benjamin Run | | | 600 |
| Big Run and branches | | | 1,200 |
| Cranberry Run | | | 600 |
| Drurys Run and branches | | | 1,200 |
| Halls Run | | | 600 |
| Hyner Run and branches | | | 900 |
| Paddys Run and branches | | | 500 |
| Young Womans Creek and branches | | | 1,500 |
| Royersford, Birch Run | | | 600 |
| Mingo Creek | | | 1,000 |
| Scranton, Roaring Brook | | | 250 |
| Tamaqua, Keefers Run | | | 400 |
| Lizard Creek | | | 600 |
| Locust Creek | | | 600 |
| Owl Creek | | | 600 |
| Pine Creek | | | 300 |
| Rabbit Run | | | 600 |
| Weldy Run | | | 400 |
| Titusville, Killwell Creek | | | 450 |
| McLaughlin Creek | | | 450 |
| Oil Creek | | | 300 |
| Pine Creek | | | 600 |
| Waynesboro, Pass Run | | | 500 |
| Winburne, Six Mile Run | | | 5,000 |
| Rhode Island: | | | |
| West Gloucester, Big Pond | | 10,000 | |
| South Carolina: | | | |
| Greenville, Gap Creek | | | 1,600 |
| Oil Camp Creek | | | 2,000 |
| Perry Lake | | | 2,000 |
| Upper Tyger Creek | | | 1,600 |
| River Falls, Devils Fork Creek | | | 1,000 |
| Gap Creek | | | 2,000 |
| Fall Creek | | | 2,000 |
| Little River | | | 1,000 |
| Middle Saluda River | | | 2,000 |
| River View, Cox Creek | | | 150 |
| Middle Saluda River | | | 225 |
| Slick Rock Branch | | | 150 |
| Walhalla, Chattooga River | | | 150 |
| East Devils Fork Creek | | | 150 |
| Little River | | | 1,000 |
| Middle Devils Fork Creek | | | 150 |
| Smeltzer's creek | | | 1,000 |
| Whitewater River | | | 225 |
| West Union, Cane Creek | | | 2,000 |
| South Dakota: | | | |
| Buffalo, Jones Creek | | | 3,000 |
| Buffalo Gap, Beaver Creek | | | 750 |
| Colome, Burnt John Creek | | | 600 |
| Elmore, Ice Box Creek | | | 400 |
| Spearfish Creek | | | 1,400 |
| Spearfish Creek, East Fork | | | 300 |
| Faith, Pine Creek | | | 500 |
| Hermosa, Battle Creek | | | 450 |
| Red Earth Creek | | | 450 |
| Hill City, Newton Creek | | | 300 |
| Sheridan Pond | | | 300 |
| Spring Creek | | | 600 |
| Hot Springs, Cascade Creek | | | 300 |
| McIntosh, Stinking Creek | | | 1,000 |
| Nahant, Tilson Creek | | | 300 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

RAINBOW TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| South Dakota—Continued. | | | |
| Rapid City, City Springs Pond | | | 300 |
| Rapid Creek | | | 600 |
| Slate Creek | | | 300 |
| Ree Heights, Meppen's pond | | | 500 |
| Rochford, Castle Creek | | | 600 |
| Little Rapid Creek, North Branch | | | 900 |
| Rapid Creek | | | 900 |
| Rapid Creek, South Branch | | | 750 |
| Silver Creek | | | 600 |
| Savoy, Roberts Pond | | | 400 |
| Spearfish Creek | | | 1,100 |
| Spearfish, Hilton Creek | | | 1,650 |
| Lindley Spring Run | | | 450 |
| Normal Lake | | | 600 |
| Ralph's pond | | | 300 |
| Robinson's lake | | | 400 |
| Schmidt Lake | | | 600 |
| Toomy's spring run | | | 450 |
| Sturgis, Bear Butte Creek | | | 20,900 |
| Boulder Park Pond | | | 900 |
| Frederick's pond | | | 150 |
| Tilford, Big Elk Creek | | | 300 |
| Whitewood, Crow Creek | | | 450 |
| Niva Pond | | | 450 |
| Peterson Pond | | | 450 |
| Tennessee: | | | |
| Afton, Moors Creek | | | 2,800 |
| Chilhowee, Adams Creek | | | 5,000 |
| Elizabethton, Doe River | | | 5,000 |
| Elkmont, Jakes Creek | | | 1,600 |
| Little River | | | 4,000 |
| Little River, East Fork | | | 1,600 |
| Little River, West Fork | | | 1,600 |
| Erwin, Dicks Creek | | | 10,500 |
| Martin's creek | | | 6,000 |
| North Indian Creek | | | 33,000 |
| Rock Creek | | | 6,000 |
| South Indian Creek | | | 12,000 |
| Franklin, Big Parketh River | | | 2,000 |
| Lick Creek | | | 6,000 |
| Gray, Cedar Creek | | | 3,000 |
| Greenville, Middle Creek | | | 10,000 |
| Johnson City, Chickasaw Pond | | | 200 |
| Hart's pond | | | 450 |
| Lawrenceburg, Shoal Creek, Beelers Fork | | | 2,000 |
| Limestone, Henley's pond | | | 1,200 |
| Mayland, Cooper Lake | | | 10,000 |
| Shell Creek, Birch Creek | | | 1,200 |
| Sparta, Officer's pond | | | 1,000 |
| Townsend, Cove Creek | | | 1,600 |
| Tarwater's pond | | | 400 |
| Tracy City, Fiery Gizzard Creek | | | 6,800 |
| Utah: | | | |
| Ogden, North Ogden Fish Hatchery Pond | | | 1,000 |
| Ogden River, branch of | | | 1,000 |
| Rice Creek | | | 2,000 |
| Wellsville, Darley Creek | | | 1,000 |
| North Field Creek | | | 1,000 |
| Vermont: | | | |
| Edgewater, Nigger Head Pond | | 2,825 | |
| Plainfield, Winooski River | | 4,701 | |
| Randolph, White River, Randolph Branch | | 2,825 | |
| Virginia: | | | |
| Alleghany, Sweet Springs Creek | | | 1,000 |
| Bedford City, Stony Creek | | | 3,500 |
| Clifton Forge, Wilson's creek | | | 5,000 |
| Covington, Falling Spring Run | | | 1,000 |
| East Radford, Little River | | | 5,000 |
| Elgin, Thornton River | | | 4,000 |
| Fredericksburg, Hess Run | | | 300 |
| Glenita, Clinch River, tributary of | | | 400 |
| Gordonsville, Annandale Pond | | | 1,000 |
| Jordan, Chrystley Run | | | 300 |
| Konarock, South Fork River and tributaries | | | 50,000 |
| La Crosse, Taylor's ice pond | | | 700 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

RAINBOW TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Virginia—Continued. | | | |
| Laurel Dale, White Top Creek | | | 900 |
| Lynchburg, Reveley's pond | | | 1,000 |
| Manteo, Waltons Fork Creek | | | 5,000 |
| Meadow View, Kestner's pond | | | 100 |
| Millboro, Bubbling Spring Creek | | | 5,000 |
| Mill Creek | | | 5,000 |
| Mount Vernon, George Washington Run | | 4,000 | |
| Natural Bridge, Cedar Creek | | | 1,000 |
| New Castle, Meadow Creek | | | 500 |
| Sinking Creek | | | 1,900 |
| Pulaski, Peak Creek, North Fork | | | 2,000 |
| Sproul Ponds | | | 1,200 |
| Ray, John's creek | | | 5,000 |
| Rural Retreat, Cripple Creek | | | 3,000 |
| St. Clair, Bluestone River | | | 5,000 |
| Shuff, Rich Creek | | | 200 |
| Trevilians, Rocky Creek | | | 2,500 |
| Vienna, Captain Hickory Creek | | | 700 |
| Wytheville, Walker Pond | | | 1,000 |
| Washington: | | | |
| Big Lake, Big Lake | | | 4,000 |
| Collins, Johnson Lake | | 2,000 | |
| Ritzville, York Lake | | | 3,000 |
| Seattle, Long Lake | | | 3,000 |
| Stratford, Round Lake | | | 2,000 |
| West Virginia: | | | |
| Bunker Hill, Edgewood Spring Pond | | | 5,000 |
| Charlestown, Elliott's run | | | 2,400 |
| Coalton, Roaring Creek | | | 400 |
| Durbin, Shavers Creek, East Fork | | | 300 |
| Fayette, Wolf Creek | | | 300 |
| Harman, Dove's ponds | | | 650 |
| Hinton, Little Bluestone Creek | | | 5,000 |
| Ingleside, East Pond | | | 200 |
| Kegley, Johnston's pond | | | 100 |
| Marlinton, Greenbrier River | | | 5,000 |
| Martinsburg, Hoke's run | | | 250 |
| Mill Creek | | | 250 |
| Tuscarora Creek | | | 250 |
| Midvale, Elk River, Middle Fork | | | 5,000 |
| Mount Jackson, Cove River | | | 400 |
| Morlan, Shank's pond | | | 150 |
| Piedmont, Potomac River, North Fork | | | 8,000 |
| Pleasant Dale, Laurel Run | | | 300 |
| Raleigh, Beaver Run | | | 8,000 |
| Reedsville, Fields Creek | | | 300 |
| Renick, Big Spring Pond | | | 300 |
| Rippon, Shenandoah River and tributaries | | | 1,200 |
| Spangler, Big Run | | | 500 |
| Elk River | | | 5,000 |
| Ralston Run | | | 500 |
| Tygarts Valley River, Left Fork | | | 800 |
| Windy Run | | | 500 |
| Spring Creek, Culbertson Creek | | | 800 |
| Waiteville, Potts Creek, North Branch | | | 300 |
| Wheeling, State Fair Aquarium | | | 4 |
| White Sulphur Springs, Howard Creek | | | 1,205 |
| William, Schmick Ponds | | | 3,000 |
| Wisconsin: | | | |
| Bloomer, Conroy Creek | | | 2,000 |
| Duncan Creek | | | 3,000 |
| Hay Creek | | | 2,000 |
| Blue Mounds, Avangs Creek | | | 3,000 |
| Handels Creek | | | 3,000 |
| McKinleys Creek | | | 3,000 |
| Steyer's creek | | | 2,800 |
| Walnut Hollow Creek | | | 3,000 |
| Boyd, Gustafson Creek | | | 1,000 |
| Hay Creek | | | 2,000 |
| Lutz Creek | | | 1,000 |
| Paint Creek | | | 2,000 |
| Shilts Creek | | | 1,000 |
| Brule, Brule River | | | 1,000 |
| Hoodoo Lake | | | 4,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

RAINBOW TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Wisconsin—Continued. | | | |
| Cashton, Coon Creek | | | 3,700 |
| Centuria, Sargent Pond | | | 200 |
| Chippewa Falls, Duncan Creek | | | 400 |
| Colfax, Bronken Creek | | | 2,200 |
| Eighteen Mile Creek | | | 2,000 |
| Eighteen Mile Creek, North Fork | | | 2,000 |
| Eighteen Mile Creek, South Fork | | | 1,000 |
| Mirror Lake | | | 3,400 |
| Otter Creek | | | 2,000 |
| Pleasant Valley Creek | | | 200 |
| Trout Creek | | | 2,000 |
| Cumberland, Clam River, South Fork of South Fork | | | 1,000 |
| Hay River | | | 3,000 |
| Elroy, Seymour Creek | | | 900 |
| Genoa, Spring Creek | | | 500 |
| Kendall, Lumsden Creek | | | 500 |
| Tunnell Creek | | | 500 |
| Ladysmith, Big Thornapple Creek | | | 600 |
| Little Thornapple Creek | | | 400 |
| Merrill, Blue Lake | | | 3,750 |
| Richland Center, Horse Creek | | | 1,000 |
| Pine River, East Branch | | | 1,000 |
| Stanley, Eau Claire River, North Fork | | | 5,600 |
| Turtle Lake, Turtle Creek | | | 3,000 |
| Westby, Kickapoo River | | | 600 |
| Wyoming: | | | |
| Beulah, Boyden's pond | | | 250 |
| Sand Pond | | | 200 |
| Big Horn, Mortensen's pond | | | 600 |
| Lander, Roaring Fork Lakes | | | 200 |
| Laramie, applicant | 25,000 | | |
| State fish commission | 100,000 | | |
| Moorcroft, Arch Creek | | | 15,000 |
| Butts Lake | | | 600 |
| Newcastle, Beaver Creek | | | 450 |
| Ranchester, Eaton's pond | | | 300 |
| Wolf Creek | | | 800 |
| Sheridan, Bunny Lake | | | 5,000 |
| Hilman Creek | | | 5,000 |
| State fish commission | 48,000 | | |
| Sundance, Houston Creek | | | 250 |
| Miller Creek | | | 250 |
| Germany: | | | |
| Hamburg, German Government | 100,000 | | |
| India: | | | |
| Calcutta, British Government | 10,000 | | |
| Japan: | | | |
| Tokyo, Imperial Household Department | 250,000 | | |
| Total [a] | 1,106,000 | 901,370 | 1,150,957 |

ATLANTIC SALMON.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Maine: | | | |
| Craig Brook, Alamoosook Lake | | | 5 |
| East Orland, Alamoosook Lake | | | 4,299 |
| Kennebunk, Little River | | 10,000 | |
| Staceyville, Penobscot River | | 1,400,000 | |
| Upper Penobscot, Penobscot River | | 2,082,464 | |
| Total | | 3,492,464 | 4,304 |

LANDLOCKED SALMON.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| California: | | | |
| Sisson, State fish commission | 10,000 | | |
| Maine: | | | |
| Bingham, Pierce River | | 5,000 | |
| Bodfish Crossing, Midday Pond | | 5,000 | |
| Bridgton, Highland Lake | | | 1,500 |

[a] Lost in transit, 1,400 fry and 3,353 fingerlings.

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LANDLOCKED SALMON—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Maine—Continued. | | | |
| Brooks, Mixer Pond | | | 1,000 |
| Brownfield, Moore Pond | | | 1,500 |
| Bucksport, Upper Patten Pond | | 10,000 | |
| Deering Junction, Highland Lake | | | 1,500 |
| Farmington, Varnum Pond | | 5,000 | 1,400 |
| Franklin, Molasses Lake | | 5,000 | |
| Fryeburg, Lake Kezar | | | 1,500 |
| Grand Lake Stream, Grand Lake | | 91,146 | 31,496 |
| Green Lake, Green Lake | | 8,000 | |
| Hartland, Great Moose Lake | | | 1,500 |
| Harrington, Schoodic Pond | | 5,000 | |
| Island Falls, Mattawamkeag Lake | | 5,000 | |
| Jackman, Clear Water Pond | | 5,000 | |
| Duncan Lake | | 5,000 | |
| Enchanted Lake | | 5,000 | |
| Fish Pond | | 5,000 | |
| Moose Pond | | 5,000 | |
| Kineo, Moosehead Lake | | 20,000 | 5,000 |
| Kingman, Pleasant Lake | | | 1,800 |
| Newport, Lake Sebasticook | | | 1,500 |
| Norcross, Third Jo Merry Lake | | | 1,500 |
| North Anson, Great Embden Pond | | | 1,000 |
| Lake Embden | | | 1,500 |
| North Belgrade, State fish commission | 100,000 | | |
| Oakland, East Pond | | | 1,100 |
| Otis, Great Brook | | 21,000 | |
| Green Lake | | 21,000 | |
| Phillips Lake, Phillips Lake | | | 1,500 |
| Poland Spring R. R. station, Lower Range Lake | | | 1,500 |
| Presque Isle, Squawpan Lake | | | 1,500 |
| Rand Cove, Schoodic Lake | | | 2,000 |
| Rumford Falls, Howard Lake | | | 1,500 |
| Skowhegan, Wentworth Pond | | 5,000 | |
| Springvale, Mousam Lake | | 5,000 | |
| Strong, Sweets Pond | | | 1,200 |
| Tunk Pond, Tunk Pond | | | 1,500 |
| Waldoboro, Kaler Pond | | 5,000 | 2,000 |
| Massachusetts: | | | |
| Plymouth, applicant | 10,000 | | |
| Minnesota: | | | |
| Ely, Burntside Lake | | | 2,000 |
| Knife River, Echo Lake | | | 4,000 |
| Nine Mile Lake | | | 2,000 |
| Tettegouche Lake | | | 2,000 |
| St. Paul, State fish commission | 10,000 | | |
| New Hampshire: | | | |
| Laconia, Lake Winnesquam | | 5,000 | |
| Warner, Lake Winnepaukeet | | 5,000 | |
| New Jersey: | | | |
| Hackettstown, State fish commission | 8,000 | | |
| New York: | | | |
| Battery Park, New York Aquarium | 1,000 | | |
| Delhi, applicant | 20,000 | | |
| Long Lake West, applicant | 5,000 | | |
| South Pond | | 2,400 | |
| Raquette Lake, applicant | 50,000 | | |
| Vermont: | | | |
| Roxbury, State fish commission | 10,000 | | |
| Wisconsin: | | | |
| Donaldson, Black Oak Lake | | | 2,700 |
| Total [a] | 224,000 | 253,546 | 80,196 |

BLACKSPOTTED TROUT.

| | | | |
|---|---|---|---|
| Colorado: | | | |
| Alamosa, Fountain's pond | | | 2,000 |
| Almont, East River | | | 12,000 |
| Taylor River | | | 15,000 |
| Anson, Anson Creek | | | 10,000 |
| Antero, Antero Lake | | | 75,000 |
| Antonito, Conejos River | | | 20,000 |
| La Manga Creek | | | 8,000 |
| Los Pinos Creek | | | 12,000 |

[a] Lost in transit, 500 fingerlings.

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BLACKSPOTTED TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Colorado—Continued. | | | |
| Arkansas Junction, Frying Pan River, North Fork | | | 5,000 |
| Aspen, Castle Creek | | | 15,000 |
| Hunters Creek | | | 12,000 |
| Lincoln Creek | | | 12,000 |
| West Castle Creek | | | 12,000 |
| Willow Creek | | | 10,000 |
| Austin, Surface Creek | | | 12,000 |
| Bear Creek, Bear Creek | | | 10,000 |
| Breckenridge, Blue Creek | | | 10,000 |
| Spruce Creek | | | 5,000 |
| Buena Vista, Chalk Creek | | | 15,000 |
| Cottonwood Lakes | | | 85,000 |
| Middle Cottonwood Creek | | | 8,000 |
| North Cottonwood Creek | | | 8,000 |
| South Cottonwood Creek | | | 10,000 |
| Buffalo, Buffalo Creek | | | 25,000 |
| Cascade, Cascade Creek, North and South Forks | | | 8,000 |
| Cebolla, Gunnison River | | | 150,000 |
| Colorado Springs, Cascade Creek | | | 4,000 |
| Cheyenne Creek | | | 4,000 |
| Colorado Springs Lake | | | 80,000 |
| East Beaver Creek | | | 15,000 |
| Gould Creek | | | 15,000 |
| Middle Beaver Creek | | | 25,000 |
| Reservoir No. 5 | | | 70,000 |
| Creede, applicant | 500,000 | | |
| Little Squaw Creek | | | 8,000 |
| Red Mountain Creek | | | 8,000 |
| Rio Grande | | | 60,000 |
| Trout Creek | | | 8,000 |
| De Beque, Big Creek | | | 10,000 |
| Buzzard Creek | | | 10,000 |
| Grove Creek | | | 10,000 |
| Hawkshurst Creek | | | 10,000 |
| Mesa Creek and tributaries | | | 12,000 |
| Plateau Creek | | | 10,000 |
| Salt Creek | | | 10,000 |
| Del Norte, Francisco Creek | | | 10,000 |
| North Pinos Creek | | | 10,000 |
| Denver, State fish commission | 2,000,000 | | |
| Dillon, Blue River | | | 75,000 |
| Boulder Creek | | | 5,000 |
| Brush Creek | | | 6,000 |
| Cataract Creek | | | 5,000 |
| Elliott Creek | | | 5,000 |
| Keystone Creek | | | 5,000 |
| Otter Creek | | | 5,000 |
| Pass Creek | | | 5,000 |
| Rock Creek | | | 5,000 |
| Slate Creek | | | 8,000 |
| Slate Creek Lake | | | 6,000 |
| Snake River, North Fork | | | 5,000 |
| Straight Creek | | | 10,000 |
| Durango, Bear Creek | | | 6,000 |
| Cascade Creek | | | 10,000 |
| Lost Trail Creek | | | 8,000 |
| Pole Creek | | | 8,000 |
| Rio Grande | | | 10,000 |
| Ten Mile Creek | | | 5,000 |
| Ute Creek | | | 8,000 |
| Eastonville, Reservoir No. 1 | | | 3,000 |
| Fairplay, Crooked Creek | | | 10,000 |
| Four Mile Creek | | | 10,000 |
| Pennsylvania Creek | | | 5,000 |
| Rich Creek | | | 10,000 |
| Sacramento Creek | | | 5,000 |
| South Platte River, Middle Fork | | | 10,000 |
| South Platte River, South Fork | | | 8,000 |
| Twelve Mile Creek | | | 6,000 |
| Florence, Ophir Creek | | | 5,000 |
| South Hardscrabble Creek | | | 8,000 |
| Fraser, Fraser River | | 12,000 | |
| Frisco, Miners Creek | | | 5,000 |
| North Ten Mile Creek | | | 8,000 |
| West Ten Mile Creek | | | 8,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BLACKSPOTTED TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Colorado—Continued. | | | |
| Fort Collins, Buckhorn Creek | | | 12,000 |
| Cache La Poudre River | | | 12,000 |
| Cache La Poudre River, North Fork | | | 12,000 |
| Lone Pine Creek | | | 12,000 |
| Granby, Illinois Creek | | 12,000 | |
| Willow Creek | | 8,000 | |
| Grand Junction, Kannah Creek | | | 10,000 |
| West Creek | | | 15,000 |
| Grand Lake, Stillwater Creek | | 10,000 | |
| Granger, Embargo Creek | | | 10,000 |
| Grant, Geneva Creek | | | 30,000 |
| Gypsum, Sweetwater Lake | | | 15,000 |
| Hartsel, Platte River, South Fork | | | 25,000 |
| Hayden, Big Union Creek | | | 12,000 |
| Hill, Hill Creek | | | 5,000 |
| Hotchkiss, Lareux Creek | | | 12,000 |
| Idaho Springs, Chicago Creek, South Fork | | | 5,000 |
| City Lake | | | 5,000 |
| South Beaver Creek | | | 8,000 |
| Ivanhoe, Ivanhoe Creek | | | 17,000 |
| Frying Pan River | | | 25,000 |
| Lyle Creek | | | 5,000 |
| Kokomo, Ten Mile Creek | | | 20,000 |
| Lake George, South Platte River | | | 15,000 |
| Leadville, Arkansas River | | | 135,000 |
| Colorado Gulch Creek | | | 12,000 |
| Crooked Lake | | 29,000 | |
| Elk Creek | | 29,000 | |
| Emerald Lake | | | 50,000 |
| Empire Gulch Creek | | | 12,000 |
| Fraser River | | 93,000 | |
| Frying Pan River | | | 25,000 |
| Grand Lake | | 80,000 | |
| Grand River | | 95,000 | |
| Grand River, North Fork | | 95,000 | |
| Half Moon Creek | | | 27,000 |
| Lake Creek | | | 40,000 |
| Monarch Lake | | 30,000 | |
| Porcupine Gulch Creek | | | 8,000 |
| Rock Creek | | | 30,000 |
| St. Louis Creek | | 29,000 | |
| Stillwater Creek | | 20,000 | |
| Timberline Lake | | | 4,000 |
| Turquoise Lake | | | 100,000 |
| Twin Lakes | | | 100,000 |
| Wheeler Creek | | 40,000 | |
| Willow Creek | | 75,000 | 27,000 |
| Windsor Lake | | | 10,000 |
| Loveland, Cache La Poudre River, South Fork | | | 12,000 |
| Lyons, applicant | 400,000 | | |
| Malta, Lake Creek, North Fork | | | 12,000 |
| Mancos, West Mancos River | | | 10,000 |
| Marshall, South Boulder Creek | | | 120,000 |
| Mears Junction, Poncha Creek | | | 12,000 |
| Minturn, Cross Creek | | | 15,000 |
| Eagle River | | | 20,000 |
| Gore Creek | | | 15,000 |
| Lake Creek | | | 10,000 |
| Rock Creek | | | 15,000 |
| Willow Creek | | | 15,000 |
| Monte Vista, Alamosa River | | | 15,000 |
| Rock Creek | | | 12,000 |
| Montrose, Big Red Creek | | | 5,000 |
| Clear Creek | | | 5,000 |
| Horsefly Creek | | | 6,000 |
| Montrose, Little Cottonwood Creek | | | 5,000 |
| Little Red Creek | | | 5,000 |
| Roubideaux Creek | | | 6,000 |
| Tabeguache Creek | | | 6,000 |
| Mustang, Graneros Creek | | | 8,000 |
| Greenhorn River | | | 10,000 |
| St. Charles River | | | 10,000 |
| Nast, Frying Pan River | | | 5,000 |
| Frying Pan River, South Fork | | | 5,000 |
| Frying Pan River, Upper South Fork | | | 8,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BLACKSPOTTED TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults, |
|---|---|---|---|
| Colorado—Continued. | | | |
| New Castle, Divide Creek | | | 12,000 |
| Munson Creek | | | 10,000 |
| West Divide Creek | | | 10,000 |
| Newett, Teeter's pond | | | 3,000 |
| Norrie, Chapmans Creek | | | 15,000 |
| Deeds Creek | | | 5,000 |
| Foster Creek | | | 5,000 |
| Frying Pan River | | | 15,000 |
| Gowen Creek | | | 5,000 |
| Kochs Lake | | | 12,000 |
| West Chapman Creek | | | 6,000 |
| North Cheyenne, North Cheyenne Canyon Creek | | | 8,000 |
| Ouray, Uncompahgre River, East Fork | | | 8,000 |
| Pagosa Springs, Piedra River, East Fork | | | 10,000 |
| Piedra River, Middle Fork | | | 8,000 |
| San Juan River, Beaver Fork of West Fork | | | 6,000 |
| San Juan River, East Fork | | | 8,000 |
| San Juan River, West Fork | | | 8,000 |
| San Juan River, Rainbow Fork of West Fork | | | 6,000 |
| Pando, Eagle River | | | 30,000 |
| Paonia, East Muddy Creek | | | 10,000 |
| Hubbard Creek | | | 10,000 |
| Terror Creek | | | 10,000 |
| West Muddy Creek | | | 10,000 |
| Parlin, Cochetopa Creek | | | 15,000 |
| Parshall, Battle Creek | | 8,000 | |
| Beaver Creek | | 10,000 | |
| Grand River | | 20,000 | |
| Grand River, Williams Fork | | 12,000 | |
| Grand River, South Fork of Williams Fork | | 10,000 | |
| Pitkin, Snipe Creek | | | 5,000 |
| Platte Canyon, South Platte River | | | 100,000 |
| Pueblo, Arkansas River | | | 5,000 |
| Rico, Dolores River | | | 10,000 |
| Horse Creek | | | 8,000 |
| Ryman Creek | | | 6,000 |
| Scotch Creek | | | 10,000 |
| Silver Creek | | | 8,000 |
| Ridgway, Trout Lake | | | 20,000 |
| Salida, Arkansas River | | | 150,000 |
| Cochetopa Creek | | | 8,000 |
| Poncha Creek | | | 8,000 |
| Slate Creek | | | 15,000 |
| South Arkansas Creek | | | 8,000 |
| Sargents, Marshall Creek | | | 12,000 |
| Sellar, Frying Pan River, North Fork | | | 5,000 |
| Shawnee, Deer Creek | | | 25,000 |
| Snow Mass, Snow Mass Creek | | | 15,000 |
| South Fork, Alder Creek | | | 10,000 |
| Bear Creek | | | 8,000 |
| Rio Grande River, South Fork | | | 10,000 |
| Sulphide, Middle Boulder Creek | | | 25,000 |
| Sunset, Four Mile Creek | | | 10,000 |
| Tabernash, Meadow Creek | | 8,000 | |
| Tennessee Pass, West Tennessee Creek | | | 8,000 |
| Trout Lake, Trout Lake | | | 25,000 |
| Villa Grove, Saguache River | | | 20,000 |
| Walcott, Eagle River | | | 50,000 |
| Webster, South Platte River | | | 20,000 |
| Westcliffe, Horn Lake | | | 5,000 |
| Macey Creek | | | 5,000 |
| Whitewater, Kalmah Creek | | | 12,000 |
| North Kalmah Creek | | | 10,000 |
| Youmans, Big Blue Creek | | | 8,000 |
| Big Blue Creek, East Fork | | | 5,000 |
| Fall Creek | | | 5,000 |
| Idaho: | | | |
| Coeur d'Alene, Wolf Lodge Creek | | | 10,000 |
| Enaville, Little North Fork Creek | | | 8,000 |
| Fort Hall, Spring Creek | | | 4,000 |
| Malad, Stuart's pond | | | 2,000 |
| Mullan, Wellington Lake | | | 8,000 |
| Rathdrum, Lake Chilco | | | 16,000 |
| Roberts, Seamon's pond | | | 4,000 |
| Spring Creek | | | 2,000 |
| Oxford, Gooseberry Creek | | | 4,000 |
| Grove Lake | | | 4,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BLACKSPOTTED TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Michigan: | | | |
| Detroit, Detroit Aquarium | 25,000 | | |
| Montana: | | | |
| Anaconda, Josephine Pond | | | 5,000 |
| State fish commission | 2,038,500 | | |
| Armstead, Barrett Creek | | | 10,000 |
| Briggs Run | | | 4,000 |
| Clarks Canyon Bayou | | | 6,000 |
| Grayling Creek | | | 2,000 |
| Medicine Lodge Creek | | | 12,000 |
| Selway Creek | | | 6,000 |
| Spring Creek | | | 4,000 |
| Wild Rose Lake | | | 6,000 |
| Ballantine, Arrow Creek | | | 7,500 |
| Lake McDonald | | | 20,000 |
| Belt, Little Belt Creek | | | 16,000 |
| Logging Creek | | | 16,000 |
| Pilgrim Creek | | | 16,000 |
| Bozeman, Bear Creek | | | 5,000 |
| Bridger Creek | | | 45,000 |
| Buckskin Creek | | | 12,500 |
| Buffalo Horn Creek | | | 5,000 |
| Camp Creek | | | 25,000 |
| Eight Mile Creek | | | 10,000 |
| Elbow Creek | | | 10,000 |
| Elk Creek | | | 21,000 |
| Meadow Creek | | | 5,000 |
| Middle Creek | | | 30,000 |
| Middle Creek Lakes | | | 25,000 |
| Mill Creek | | | 15,000 |
| Porcupine Creek | | | 4,000 |
| Reese Creek | | | 15,000 |
| South Fork Creek | | | 7,500 |
| Spring Creek | | 24,000 | 15,000 |
| Squaw Creek | | | 2,000 |
| Story Creek | | | 15,000 |
| Butte, applicant | 256,500 | | |
| Fort Benton, Shoukin Creek | | | 20,000 |
| Darby, Bitter Root River, East Fork | | | 12,000 |
| Bitter Root River, West Fork | | | 12,000 |
| Dell, Morrison Lake | | | 6,000 |
| Gardiner, applicant | 900,000 | | |
| Grannis Siding, Shields River | | | 40,000 |
| Hamilton, Bitter Root River | | | 32,000 |
| Bitter Root River, East Fork | | | 20,000 |
| Blodgett Creek | | | 16,000 |
| Girds Creek | | | 16,000 |
| Lick Creek | | | 16,000 |
| Lost Horse Creek | | | 18,000 |
| Lost Horse Creek, South Fork | | | 16,000 |
| Rock Creek | | | 20,000 |
| Roaring Lion Creek | | | 16,000 |
| Skalkaho Creek | | | 20,000 |
| Sleeping Child Creek | | | 16,000 |
| Haugan, Big Creek | | | 6,000 |
| Josephine, Sixteen Mile Creek | | | 40,000 |
| Lennep, Little Cottonwood Creek | | | 8,000 |
| Lewistown, Antelope Creek | | | 720 |
| Howell Spring Pond | | | 320 |
| Regis Pond | | | 5,000 |
| Spring Creek | | | 20,000 |
| Waite Spring Pond | | | 320 |
| Lima, Big Sheep Creek | | | 20,000 |
| Little Sheep Creek | | | 14,000 |
| Livingston, Adair Creek | | | 800 |
| Billman Creek | | | 12,000 |
| Fleshman Creek | | | 12,000 |
| Hill Pond | | | 700 |
| Holliday Creek | | | 15,700 |
| Shields River | | | 16,000 |
| Swindlehurst's pond | | | 10,000 |
| Tobin Creek | | | 800 |
| Manhattan, Ellingsen Pond | | | 4,000 |
| Mill Creek, Big Timber Creek | | | 10,000 |
| Boulder Creek | | | 15,000 |
| West Boulder Creek | | | 10,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BLACKSPOTTED TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| **Montana**—Continued. | | | |
| Missoula, Big Blackfoot River | | | 22,000 |
| Bitter Root River | | | 22,000 |
| Grant Creek | | | 14,000 |
| Grove Creek | | | 12,000 |
| Lo Lo Creek | | | 20,000 |
| Miller Creek | | | 10,000 |
| O'Brien Creek | | | 10,000 |
| Rattlesnake Creek | | | 14,000 |
| Mitchell, Little Prickly Pear Creek | | | 15,000 |
| Monarch, Hoover Creek | | | 10,000 |
| Tillinghast Creek | | | 16,000 |
| Neihart, Belt Creek | | | 20,000 |
| Belt Creek, South Fork | | | 10,000 |
| O'Brien Creek | | | 8,000 |
| Norris, Parent Lake | | | 5,000 |
| St. Regis, St. Regis River | | | 12,000 |
| Superior, Flat Creek | | | 6,000 |
| Wilsall, Daisy Dean Creek | | | 15,000 |
| Elk Creek | | | 20,000 |
| Winston, Sweeney's lake | | | 5,000 |
| Wyola, Little Big Horn River | | | 18,000 |
| Yantic, Clear Creek | | | 16,000 |
| **Nebraska:** | | | |
| Chadron, Chadron Creek | | | 40,000 |
| **New Mexico:** | | | |
| Capitan, Rio Ruidoso | | | 20,000 |
| Carlsbad, Lake Bujac | | | 8,000 |
| Dexter, Lake Durand | | | 4,000 |
| Glorieta, Irving Springs | | | 4,000 |
| Mora River | | | 20,000 |
| Pecos River | | | 40,000 |
| Las Vegas, Gallinas River | | | 20,000 |
| Magdalena, South Diamond Creek | | | 6,000 |
| Tulerosa Creek | | | 10,000 |
| Mountain Air, Barranca River | | | 8,000 |
| Raton, Cimman Point Creek | | | 8,000 |
| Ribera, Pecos River | | | 8,000 |
| Rowe, Pecos River | | | 40,000 |
| Santa Fe, Santa Fe River | | | 15,000 |
| Tesuque River | | | 15,000 |
| Taiban, Taiban Creek | | | 4,000 |
| Thoreau, Cottonwood Creek | | | 8,000 |
| Tres Piedras, San Antonito Creek | | | 10,000 |
| Tusas Creek | | | 6,000 |
| Ute Park, Rio Grande and tributaries | | | 40,000 |
| Wagon Mound, Tilsons Springs | | | 4,000 |
| **New York:** | | | |
| Battery Park, New York Aquarium | 25,000 | | |
| **Oregon:** | | | |
| Baker, Salmon Creek | | | 6,000 |
| Duncan, Meacham Creek | | | 12,000 |
| Eugene, McKenzie River | | | 38,000 |
| Independence, Berry Creek | | | 6,000 |
| Teal Creek | | | 6,000 |
| Lakeview, Crooked Creek | | | 46,000 |
| Oregon City, Buckner Creek | | | 6,000 |
| Canyon Creek | | | 10,000 |
| Cedar Creek | | | 10,000 |
| Clackamas River | | | 18,000 |
| Deep Creek | | | 10,000 |
| Newell Creek | | | 10,000 |
| Ramsby Creek | | | 6,000 |
| Rock Creek | | | 10,000 |
| Pendleton, Desolation Creek | | | 10,000 |
| Winam Creek | | | 8,000 |
| Portland, Lechler Lake | | | 4,000 |
| State fish commission | 625,000 | | |
| Tillamook City, Nestucca River | | | 14,000 |
| Trail, Rogue River | | 17,950 | |
| Yamhill, McCoy Creek | | | 10,000 |
| **South Dakota:** | | | |
| Custer, French Creek | | | 75,000 |
| Iron Creek | | | 35,000 |
| Elmore, Beaver Creek | | | 20,000 |
| Fountain City Creek | | | 20,000 |
| Miller Creek | | | 20,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BLACKSPOTTED TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| South Dakota—Continued. | | | |
| Elmore, Spearfish Creek | | | 85,000 |
| Spearfish Creek, East Fork | | | 10,000 |
| Spearfish Creek, South Fork | | | 20,000 |
| Englewood, Box Elder Lake | | | 6,000 |
| Jim Creek | | | 9,000 |
| Middle Box Elder Creek | | | 6,000 |
| Whitewood Creek | | | 25,000 |
| Fairburn, French Creek | | | 40,000 |
| Faith, Pine Creek | | | 3,000 |
| Hermosa, Lower Spring Creek | | | 30,000 |
| Hill City, Battle Creek | | | 40,000 |
| French Creek | | | 20,000 |
| Spring Creek | | | 50,000 |
| Hot Springs, Cascade Creek | | | 15,000 |
| Iron Creek, Bear Gulch Creek | | | 21,000 |
| Maitland, Blow's pond | | | 2,500 |
| Mystic, Rapid Creek | | | 111,000 |
| Nahant, North Rapid Creek, East Branch | | | 15,000 |
| Pluma, Elk Creek | | | 50,000 |
| Pringle, Cold Spring Creek | | | 15,000 |
| Rapid City, Rapid Creek | | | 40,000 |
| Rochford, Deffenbaugh's pond | | | 6,000 |
| Little Rapid Creek | | | 69,000 |
| Rapid Creek | | | 37,500 |
| Savoy, Spearfish Creek | | | 60,000 |
| Spearfish, Crow Creek | | | 7,500 |
| Iron Creek | | | 20,000 |
| Johnson Creek | | | 40,000 |
| Lost Cabin Creek | | | 4,500 |
| Spearfish Creek | | | 300,000 |
| Spring Gulch Creek | | | 30,000 |
| Sturgis, Alkali Creek | | | 70,000 |
| Tilford, Big Elk Creek | | | 40,000 |
| Washington: | | | |
| Bellingham, Canyon Lake | | | 30,000 |
| Curlew, Kettle River | | | 20,000 |
| Heisson, State fish commission | 400,000 | | |
| Malo, St. Peters Creek | | | 10,000 |
| Orient, Big Boulder Creek | | | 20,000 |
| Republic, Granite Creek | | | 8,000 |
| Seattle, Lake Crescent | | | 30,000 |
| Toroda, Toroda Creek | | | 16,000 |
| White Salmon, Spencer's pond | | | 4,000 |
| Spring Creek Pond | | | 6,000 |
| West Virginia: | | | |
| Durbin, Big Run | | | 9,700 |
| Wyoming: | | | |
| Beulah, Crystal Spring Pond | | | 34,000 |
| Sand Creek | | | 8,000 |
| Stouts Spring Run | | | 10,000 |
| Cody, Shoshone River, South Fork | | | 25,500 |
| Lander, Baldwin Creek | | | 45,000 |
| Popo Agie Creek | | | 45,000 |
| Squaw Creek | | | 45,000 |
| North Fork Creek | | | 50,000 |
| Lost Springs, Card's ponds | | | 9,000 |
| Slough Pond | | | 3,000 |
| Willow Pond | | | 3,000 |
| Newcastle, Beaver Creek | | | 20,000 |
| Sheridan, State fish commission | 2,200,000 | | |
| Sundance, South Miller Creek | | | 10,000 |
| Yellowstone National Park, Boat House Creek | 725,000 | | |
| Cub Creek | 400,000 | | |
| De Lacy Creek | 850,000 | | |
| Duck Lake | 50,000 | | |
| Grebe Lake | 300,000 | | |
| Hatchery Creek | 460,000 | | |
| Indian Creek | 100,000 | | |
| Number Two Creek | 400,000 | | |
| Soldier Creek | 300,000 | | |
| Transportation Creek | 350,000 | | |
| Total [a] | 13,305,000 | 766,950 | 7,174,060 |

[a] Lost in transit, 6,000 fingerlings.

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LOCH LEVEN TROUT.

| Disposition. | Fingerlings. |
|---|---|
| South Dakota: | |
| Savoy, Little Spearfish Creek | 75,200 |

LAKE TROUT.

| Disposition. | Eggs. | Fry. | Fingerlings. |
|---|---|---|---|
| Connecticut: | | | |
| Hadlyme, State fish commission | 50,000 | | |
| Idaho: | | | |
| Coeur d'Alene, Coeur d'Alene Lake | | | 1,600 |
| Rathrum, Twin Lakes | | | 1,600 |
| Soda Springs, Government Reservoir | | | 1,200 |
| Maine: | | | |
| Bryant Pond, Lake Christopher | | 10,600 | |
| Farmington, Varnum Lake | | 5,000 | |
| Franklin, Donnell's pond | | 8,000 | |
| Jackman, Clear Water Pond | | 5,000 | |
| Onawa, Lake Onawa | | 10,000 | |
| Michigan: | | | |
| Alpena, Lake Huron | | 964,000 | |
| Atwood Reef, Lake Michigan | | 1,088,000 | |
| Beulah, Crystal Lake | | 100,000 | |
| Big Rock Reef, Lake Michigan | | 4,096,000 | |
| Detour, Lake Huron | | 1,000,000 | |
| Detroit, Detroit Aquarium | 12,000 | | |
| State fish commission | 3,000,000 | | |
| Escanaba, Lake Michigan | | 300,000 | |
| Fish Island, Lake Superior | | 480,000 | |
| Fishermans Island, Lake Michigan | | 960,000 | |
| Fishing Shoals, Lake Superior | | | 420,000 |
| Frankfort, Lake Michigan | | 100,000 | |
| Isle Royal, Lake Superior | | 500,000 | 580,000 |
| Long Point, Lake Superior | | 480,000 | |
| McCargoes Cove, Lake Superior | | 480,000 | |
| Marquette, Lake Superior | | 625,000 | |
| Munising, Lake Superior | | 625,000 | |
| Nine Mile Point, Lake Michigan | | 960,000 | |
| Norwood Reef, Lake Michigan | | 1,088,000 | |
| Ontonagon, Lake Superior | | 625,000 | |
| Sand Bay Reef, Lake Michigan | | 1,088,000 | |
| Tobins Harbor, Lake Superior | | | 380,000 |
| West Branch, Loon Lake | | 58,000 | |
| Whitefish Point, Lake Superior | | 1,700,000 | |
| Minnesota: | | | |
| Duluth, Lake Superior | | | 190,000 |
| Grand Marais, Lake Superior | | | 792,000 |
| Grand Portage, Lake Superior | | | 238,000 |
| St. Paul, State fish commission | 500,000 | | |
| Stannard Rock, Lake Superior | | | 240,000 |
| New Hampshire: | | | |
| Chesham, Silver Lake | | | 477 |
| Laconia, Lake Winnisquam | | | 769 |
| Weirs, Lake Winnepesaukee | | 10,000 | 769 |
| New York: | | | |
| Carmel, Lake Gleneida | | 40,000 | |
| Charity Shoals, Lake Ontario | | 525,000 | |
| Grenadier Island, Lake Ontario | | 1,050,000 | |
| Fox Island, Lake Ontario | | 175,000 | |
| Fuller Bay, Lake Ontario | | 325,000 | |
| Lake Placid, Lake Placid | | 25,000 | |
| Raquette Lake, applicant | 200,000 | | |
| Sabattis, applicant | 50,000 | | |
| Stoney Point, Lake Ontario | | 660,000 | |
| Wilson Bay, Lake Ontario | | 429,000 | |
| Pennsylvania: | | | |
| Bellefonte, State fish commission | 100,000 | | |
| Vermont: | | | |
| Barnet, Laird Lake | | | 471 |
| Barton, Hartwell Pond | | | 500 |
| Greensboro, Caspian Lake | | | 738 |
| Lyndonville, State fish commission | 150,000 | | |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LAKE TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings. |
|---|---|---|---|
| Washington: | | | |
| Newport, Davis Lake | | | 1,600 |
| Nighthawk, Palmer Lake | | | 1,600 |
| Reardan, Little Falls Lake | | | 1,600 |
| Wisconsin: | | | |
| Donaldson, Black Oak Lake | | | 50,000 |
| Fifield, Homestead Lake | | | 20,000 |
| Madison, State fish commission | 2,500,000 | | |
| Phelps, North Long Lake | | | 50,000 |
| Stone Lake, Stone Lake | | | 50,000 |
| Wyoming: | | | |
| Sheridan, Kearney Lake | | | 2,000 |
| Story, State fish commission | 50,000 | | |
| Total [a] | 6,612,000 | 20,594,600 | 3,024,924 |

BROOK TROUT.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Arizona: | | | |
| Flagstaff, East Clear Creek | | | 6,400 |
| West Beaver Creek | | | 5,600 |
| Arkansas: | | | |
| Hot Springs, Gulfha Creek | | | 2,000 |
| California: | | | |
| San Diego, Cedar Creek | | | 4,800 |
| Sisson, State fish commission | 150,000 | | |
| Colorado: | | | |
| Antero, South Platte River | | | 13,000 |
| Antonito, Conejos River and tributaries | | | 20,000 |
| Arkansas Junction, Arkansas River | | | 10,000 |
| Lake Creek | | | 10,000 |
| Tennessee River | | | 10,000 |
| Aspen, Hallams Lake | | | 2,500 |
| Independence Lake | | | 10,000 |
| Maroon Creek | | | 15,000 |
| Maroon Lake | | | 10,000 |
| Meadow Lake | | | 10,000 |
| Taylors Lake | | | 10,000 |
| Weller Lake | | | 10,000 |
| Austin, Dillon Pond | | | 2,000 |
| Baileys, Deer Creek | | | 10,000 |
| South Platte River, North Fork | | | 60,000 |
| Boulder, Gold Lake | | | 10,000 |
| Middle Boulder River | | | 22,000 |
| Buena Vista, Day Pond | | | 6,000 |
| Buffalo, Buffalo Creek | | | 20,000 |
| South Platte River | | | 25,000 |
| Cathers Springs, Little Fountain Creek | | | 15,000 |
| Central City, South Boulder Creek | | | 8,000 |
| Cimarron, Big Blue River | | | 10,000 |
| Big Cimarron River | | | 10,000 |
| Chipeta Creek | | | 10,000 |
| Coal Creek | | | 10,000 |
| Currecanti Creek | | | 10,000 |
| Dago Gulch Creek | | | 10,000 |
| Dry Creek | | | 15,000 |
| Happy Canon Creek | | | 10,000 |
| Little Blue River | | | 10,000 |
| Squaw Creek | | | 10,000 |
| Van Place Lake | | | 8,000 |
| Veo Creek | | | 10,000 |
| Willow Creek | | | 10,000 |
| Colorado Springs, Fursman Lake | | | 6,000 |
| Turkey Creek | | | 5,000 |
| Cotopaxi, Arkansas River | | 10,000 | |
| Creede, Miners Creek | | | 8,000 |
| Rio Grande River | | | 30,000 |

[a] Lost in transit, 2,000 fry.

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Colorado—Continued. | | | |
| Curtin, Uneva Lake | | | 10,000 |
| Del Norte, Los Pinos Creek, North Fork | | | 10,000 |
| Delta, Alfalfa Creek | | | 4,000 |
| Buttermilk Creek | | | 5,000 |
| East Roubideaux Creek | | | 10,000 |
| Escalante Creek | | | 10,000 |
| Curtis Pond | | | 3,000 |
| Currant Creek | | | 5,000 |
| Doughspoon Creek | | | 5,000 |
| Dry Creek | | | 8,000 |
| Hartford's pond | | | 3,000 |
| Horseshoe Lake | | | 12,000 |
| Kelso Creek | | | 8,000 |
| Lone Star Pond | | | 5,000 |
| Morse's pond | | | 3,000 |
| Parker's pond | | | 3,000 |
| Rinehart's pond | | | 3,000 |
| Vizne Creek | | | 4,000 |
| Ward Creek | | | 5,000 |
| Young's creek | | | 8,000 |
| Dotsero, Gypsum Creek | | | 10,000 |
| Durango, Florida Creek | | | 10,000 |
| Hermosa Creek | | | 10,000 |
| Junction Creek | | | 8,000 |
| Lightner Creek | | | 8,000 |
| Pine River | | | 10,000 |
| Eagle, Brush Creek | | | 20,000 |
| Eastabrook, Craig Creek | | | 15,000 |
| Eldora, Boulder Creek | | | 15,000 |
| Lake Eldora | | | 40,000 |
| Eldorado Springs, South Boulder Creek | | 10,000 | |
| Empire, Bard Creek | | | 12,000 |
| Clear Creek | | | 12,000 |
| Clear Creek, West Branch | | | 12,000 |
| Florence, Beaver Creek | | 10,000 | |
| East Beaver Creek | | 10,000 | |
| Fort Collins, Spring Creek | | | 5,000 |
| Frisco, Excelsior ponds | | | 3,000 |
| Georgetown, Clear Creek, South Branch | | | 11,000 |
| Leavenworth Creek | | | 6,000 |
| Grant, Geneva Creek | | | 10,000 |
| Granite, Lower Twin Lake | | | 20,000 |
| Pine Creek | | | 10,000 |
| Twin Lakes Creek | | | 15,000 |
| Hartsel, South Platte River | | | 15,000 |
| Hillside, North Brush Creek | | | 2,000 |
| Spruce Creek | | | 2,000 |
| Hotchkiss, Clear Fork Creek | | | 8,000 |
| Crystal Creek | | | 8,000 |
| Smiths Fork Creek | | | 10,000 |
| Howard, Arkansas River | | 15,000 | |
| Idaho Springs, Chinns Lake | | | 16,000 |
| Fall River | | | 10,000 |
| Lake Edith | | | 27,000 |
| Reynolds Lake | | | 6,000 |
| Sherwin Lake | | | 20,000 |
| Slater Lake | | | 6,000 |
| Kremmling, Pass Creek | | | 8,000 |
| Red Dirt Creek | | | 8,000 |
| Lake City, Henson Creek | | | 8,000 |
| Leadville, Arkansas River | | | 22,000 |
| Lake Creek | | | 34,000 |
| Musgrove Lake | | 20,000 | |
| Savage Lake | | | 10,000 |
| Smith Pond | | 45,000 | |
| Turquoise Lake | | | 22,000 |
| Tennessee River | | | 12,000 |
| Los Pinos, Los Pinos River, South Branch | | | 10,000 |
| Loveland, Benson's lake | | | 5,000 |
| Malta, Big Thompson Creek | 30,000 | | |
| Boulder Creek | | | 10,000 |
| Pine Creek | | | 10,000 |
| Meredith, Jakeman Creek | | | 5,000 |
| Minturn, Echo Lake | | | 6,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Colorado—Continued. | | | |
| Montrose, Cedar Creek | | | 10,000 |
| Cottonwood Creek | | | 10,000 |
| Horsefly Creek | | | 10,000 |
| Mexican Gulch Creek | | | 15,000 |
| Red Canon Creek | | | 10,000 |
| Monte Vista, Rock Creek | | | 8,000 |
| Nast, Frying Pan River | | | 10,000 |
| Frying Pan River, Ivanhoe Branch | | | 15,000 |
| Frying Pan River, South Fork | | | 10,000 |
| Ivanhoe Creek | | | 5,000 |
| New Castle, Adams Lake | | | 10,000 |
| Deep Lake | | | 10,000 |
| Parkdale, Arkansas River | | 10,000 | |
| Parshall, Bull Run | | | 4,000 |
| Ute Creek | | | 4,000 |
| Pitkin, Armstrong Creek | | | 10,000 |
| North Quartz Creek | | | 8,000 |
| Warm Springs Creek | | | 3,000 |
| Platte Canon, South Platte River | | | 20,000 |
| Pueblo, Arkansas River | | | 3,000 |
| Quinns Spur, Upper Savage Lake | | | 10,000 |
| Ruedi, Beaver Lake | | | 12,000 |
| Rocky Fork Creek | | | 5,000 |
| Saguache, Big Bend Creek | | | 5,000 |
| Long Branch | | | 6,000 |
| Tomichi Creek | | | 10,000 |
| Salida, Arkansas River | | | 60,000 |
| Little Arkansas River | | | 5,000 |
| Miklich's ponds | | | 9,000 |
| Poncha Creek | | | 5,000 |
| Poncha Creek tributaries | | | 8,000 |
| Silver Creek | | | 5,000 |
| Sargents, Tomichi River | | | 15,000 |
| Sloss, Frying Pan River | | | 5,000 |
| South Fork, Rio Grande, South Fork | | | 10,000 |
| Steamboat Springs, Big Creek | | | 8,000 |
| Fish Creek | | | 8,000 |
| Grizzley Creek, North Fork | | | 8,000 |
| Mad Creek Lakes | | | 4,000 |
| Mad Creek, North Fork | | | 8,000 |
| Slater Creek | | | 8,000 |
| Walton Creek | | | 8,000 |
| Whisky Creek and tributaries | | | 8,000 |
| Willow Creek | | | 8,000 |
| Tennessee Pass, Homestake Creek | | | 8,000 |
| Tomasville, Chapman Lake | | | 15,000 |
| Englebrechts Lake | | | 300,000 |
| Lake Howard | | | 11,000 |
| Lime Lake | | | 5,000 |
| Spring Creek | | | 8,000 |
| Wagon Wheel Gap, East Bellows Creek | | | 5,000 |
| Webster, South Platte River | | | 10,000 |
| Wheeler, Black Lake | | | 6,000 |
| West Ten Mile Creek | | | 15,000 |
| Wellington Lake, Wellington Lake | | | 112,000 |
| Woodland Park, Echo Lake | | | 10,000 |
| Hay Creek, North and South Forks | | | 8,000 |
| Long Lake | | | 10,000 |
| Mirror Lake | | | 10,000 |
| Rainbow Lake | | | 10,000 |
| Silver Creek | | | 10,000 |
| Silver Lake | | | 10,000 |
| Yampa, Service Creek | | | 8,000 |
| Connecticut: | | | |
| Bridgeport, Far Mill River | | | 1,000 |
| East Canaan, Whiting River | | | 400 |
| East Hampton, Elbow Bridge Brook | | | 300 |
| Green River | | | 300 |
| Sawmill Brook | | | 300 |
| Tartia Brook | | | 300 |
| Forestville, Copper Mine Creek | | 40,000 | |
| Greenwich, Byram River, East Branch | | 10,000 | |
| Hartford, West Brook | | 12,000 | 300 |
| Jewett City, Broad Brook | | | 300 |
| Hell Hollow Brook | | | 300 |
| Mount Misery Brook | | | 300 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Connecticut—Continued. | | | |
| Jewett City, Pratt Brook | | | 300 |
| Robbins Brook | | | 300 |
| Meriden, Highland Lake | | 30,000 | |
| Pipesdale Brook and tributaries | | 15,000 | |
| Naugatuck, Great Brook | | | 2,000 |
| New Hartford, Farmington River | | | 400 |
| Norfolk, Pond Hill Pond | | 30,000 | |
| Norwich, Broad Brook | | 20,000 | |
| Choates Brook | | 10,000 | |
| Kimball Brook | | 10,000 | |
| Pine Meadow, Farmington River, East Branch | | | 4,000 |
| Simsbury, Spring Pond | | | 1,000 |
| Stratton Brook | | | 6,000 |
| Westminster Farm Pond | | | 300 |
| South Norwalk, Calvin Brook | | 10,000 | |
| Weston River | | 20,000 | |
| Tariffville, Salmon Brook | | | 3,980 |
| Waterbury, Abbott's brook | | | 1,000 |
| Boughton Brook | | | 1,000 |
| Chestnut Hill Brook | | | 1,000 |
| Dallas Brook | | | 1,000 |
| Giles Brook | | | 1,000 |
| Hancock Brook | | | 1,000 |
| Hop Brook | | | 1,000 |
| Kanes Brook | | | 1,000 |
| Lead Mine Brook | | | 1,000 |
| Lilly Brook | | | 1,000 |
| Linsley Brook | | | 1,000 |
| Loughlin's brook | | | 1,000 |
| Morris Brook | | | 1,000 |
| Osborns Brook | | | 1,000 |
| Pearl Lake | | 5,000 | |
| Peck's brook | | | 1,000 |
| Pomperaug River | | | 1,000 |
| Rag Hollow Brook | | | 1,000 |
| Roaring Brook | | 5,000 | |
| Todd Hollow Brook | | | 1,000 |
| Welton Brook | | | 1,000 |
| Welton's pond | | 5,000 | |
| Hill's brook | | 5,000 | |
| Hog Brook | | 5,000 | |
| Long Hill Brook | | 5,000 | |
| Nichols Brook | | 5,000 | |
| Ponds Brook | | 5,000 | |
| Pritchards Pond | | 5,000 | |
| Shaddrach Brook | | 5,000 | |
| Snagg Brook | | 5,000 | |
| Ten Mile Brook | | 5,000 | |
| Windsor, Mayloo Pond | | | 200 |
| Windsor Locks, State fish commission | 25,000 | | |
| District of Columbia: | | | |
| Washington, Aquarium, Central Station | | | 15 |
| Idaho: | | | |
| Athol, Trapper Creek | | | 280 |
| Boise, Spring Lake | | | 600 |
| Dubois, Dry Creek | | | 450 |
| Fort Hall, Spring Creek | | | 1,350 |
| Idaho Falls, Birch Creek | | | 300 |
| Hell Creek | | | 150 |
| Idaho Commercial Trout Co. ponds | | | 300 |
| Indian Creek | | | 300 |
| Willow Creek | | | 450 |
| Malad, Dives Run | | | 300 |
| Hunsaker Pond | | | 300 |
| Meadow Creek, Rock Creek | | | 420 |
| Rigby, Granite Creek | | | 500 |
| Granite Pond | | | 400 |
| Roberts, Crystal Lake | | | 750 |
| Sandpoint, Thompson Pond | | | 200 |
| Summit Siding, Skin Creek | | | 280 |
| Illinois: | | | |
| Fox, Crystal Spring Pond | | | 300 |
| Indiana: | | | |
| Frankfort, Lockwood Lake | | | 2,000 |
| Michigan City, Kilnitz Creek | | | 5,000 |
| North Liberty, Schrader's pond | | | 5,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Iowa: | | | |
| Arlington, Deep Creek | | | 1,000 |
| Phillips Creek | | | 800 |
| McGregor, Bloody Run | | | 400 |
| Manchester, Spring Branch | | | 10,000 |
| Nora Springs, Spring Lake | | | 600 |
| North McGregor, Bloody Run | | | 800 |
| Postville, Swingood Spring Branch | | | 400 |
| Strawberry Point, Cass Lake | | | 1,000 |
| Waukon, Sherman Creek | | | 800 |
| Kentucky: | | | |
| Morehead, Garten Lake | | | 4,000 |
| Olive Hill, Denues Pond | | | 500 |
| Shelby, Goodwater Lake | | | 300 |
| Maine: | | | |
| Bangor, Crosby Pond | | 20,000 | |
| Mass Bog Pond | | 10,000 | |
| Upper Hathorn Bog | | 10,000 | |
| Biddeford, Batson River | | 15,000 | |
| Boiling Spring Brook | | 5,000 | |
| Cascade Brook | | 15,000 | 500 |
| Cold Spring Brook | | 35,000 | |
| Deep Brook | | 15,000 | |
| Dyer Brook | | 10,000 | 500 |
| Goose Fair Brook | | 15,000 | |
| Hill Brook | | 10,000 | 500 |
| Kimball Brook | | | 500 |
| Little Milliken Brook | | 5,000 | 500 |
| Lord Brook | | 15,000 | |
| Murch Brook | | 5,000 | |
| Ricker Brook | | 10,000 | |
| Sandy Brook | | 10,000 | 500 |
| Silley Brook | | 10,000 | |
| Tapley Brook | | 5,000 | |
| Towle Brook | | 5,000 | |
| Whitehouse Brook | | 5,000 | |
| Bigelow, Cranberry Peak Pond | | 20,000 | |
| Mount Bigelow Pond | | 20,000 | 1,800 |
| Stratton Brook | | 20,000 | |
| Stratton Brook Pond | | 20,000 | |
| Bingham, East Carry Pond | | 30,000 | |
| Rowe Pond | | | 2,000 |
| Boothbay Harbor, Adam's pond | | 15,000 | |
| Campbell's pond | | 15,000 | |
| Bridgton Junction, Crystal Lake | | 40,000 | |
| Long Lake | | 25,000 | |
| Bucksport, Patten Pond | | | 4,000 |
| Toddy Pond | | | 2,500 |
| Cumberland Center, Piscataqua River | | | 1,500 |
| Dedham, Green Lake | | 100,000 | |
| Phillips Lake | | 50,000 | |
| Dead River Station, Nash Stream | | 15,000 | |
| Dennysville, Dennys River | | | 2,000 |
| East Orland, Craig Pond | | | 872 |
| Heart Pond | | | 2,425 |
| Toddy Pond | | | 4,330 |
| Ellsworth, Quarry Pond | | 5,000 | |
| Farmington, Beaver Pond | | 20,000 | |
| Big Island Pond | | 20,000 | |
| Big Northwest Pond | | 20,000 | |
| Indian Creek | | 10,000 | |
| Little Island Pond | | 50,000 | |
| Long Pond | | 20,000 | |
| Lower Pond | | 20,000 | |
| Meadow Grounds Pond | | 20,000 | |
| Natanias Pond | | 20,000 | |
| Rock Pond | | 20,000 | |
| Round Pond | | 20,000 | |
| Secret Pond | | 10,000 | |
| Seven Ponds Creek | | 30,000 | |
| Franklin, Spring River Lake | | 35,000 | |
| Grand Lake Stream, Grand Lake Stream | | 1,688 | |
| Green Lake, Mann's brook | | | 10,403 |
| Greenville Junction, Arnold Pond | | 20,000 | |
| Horseshoe Pond | | 20,000 | |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Maine—Continued. | | | |
| Holeb, McKinney Brook | | | 500 |
| Island Falls, Mattawamkeag Lake | | 50,000 | |
| Jackman, Attean Lake | | | 1,000 |
| Bass Lake | | | 500 |
| Bengman Pond | | | 500 |
| Berry Pond | | | 500 |
| Bickford Pond | | 40,000 | |
| Bog Brook | | 15,000 | 500 |
| Cold Stream Pond | | | 500 |
| Deer Pond | | 15,000 | 500 |
| Grace Pond | | 20,000 | |
| Hale Pond | | | 500 |
| Hatchery Brook | | | 1,000 |
| Heald Pond | | | 500 |
| Horatio Pond | | | 500 |
| Indian Pond | | 15,000 | |
| Jones Pond | | | 500 |
| Lake Parlin | | | 500 |
| Lake Wood | | 20,000 | 1,000 |
| Long Pond | | | 500 |
| Lowell Pond | | 15,000 | |
| Mac Pond | | | 500 |
| Moose Pond | | | 500 |
| Mud Pond | | 40,000 | |
| Newton Pond | | | 460 |
| Rancourt Pond | | | 500 |
| Sugar Berth Pond | | | 500 |
| Toby Ponds | | 30,000 | |
| Williams Brook | | | 1,000 |
| Kennebunk, Kennebunk River tributaries | | | 500 |
| Machias, Cathance Lake | | | 2,000 |
| Madison, Hayden Lake | | | 4,800 |
| Manset, Stanley Pond | | | 2,000 |
| Mapleton, Alder Brook | | 15,000 | |
| Monmouth, Purgatory Pond | | | 4 500 |
| Sand Pond | | | 4,000 |
| Mosquito, State fish commission | 100,000 | | |
| North Ellsworth, Branch Pond | | 50,000 | |
| Orland, Craig Pond | | | 1,500 |
| Presque Isle, Pennington Brook | | 10,000 | |
| Presque Isle Creek | | | 1,500 |
| White's brook | | | 1,000 |
| Rangeley, Haley Pond | | | 2,000 |
| Schoodic, Schoodic Lake | | 40,000 | |
| Searsport, Swan Lake | | 20,000 | |
| Strong, Cranberry Peak Pond | | 10,000 | |
| Tunk Pond, Tunk Pond | | 50,000 | |
| Waldoboro, Medomak River | | 20,000 | |
| Walker, Squawpan Lake | | 50,000 | |
| Waterville, Missalauskee Lake | | 26,667 | |
| West Ellsworth, Pattens Pond | | 75,000 | |
| West Kennebunk, Swan Pond | | 15,000 | |
| West Paris, Abbott Pond | | | 2,000 |
| Concord River | | | 1,000 |
| Shagg Pond | | | 2,000 |
| Twenty-Mile River | | | 2,000 |
| Maryland: | | | |
| Altamont, Little Youghiogheny River | | | 3,000 |
| Clearspring, Big Springs Run | | | 800 |
| Frostburg, Savage River | | | 9,500 |
| Gunpowder, Gunpowder River | | | 800 |
| Hagerstown, Lisheigs Run | | | 200 |
| Hampstead, Murphy's run | | | 490 |
| Kitzmiller, Laurel Run | | | 10,000 |
| Lost-Land Run, North and South Branches | | | 600 |
| Wolf Den Run | | | 400 |
| Lonaconing, Poplar Lick Creek | | | 5,700 |
| Little Savage River | | | 7,600 |
| Mud Lick Run | | | 4,700 |
| Monkton, Holme's branch | | | 400 |
| Little Gunpowder and tributaries | | | 2,800 |
| Mountain Lake Park, Block Run | | | 5,000 |
| Broadford Run | | | 5,350 |
| Comegys Run | | | 600 |
| Little Youghiogheny River | | | 600 |
| Lost-Land Run | | | 4,750 |
| Trout Run | | | 4,750 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Maryland—Continued. | | | |
| Oakland, Arnold Run | | | 3,800 |
| Big Run | | | 3,800 |
| Dunkard Lick Run | | | 3,800 |
| Edgewood Lake | | | 2,850 |
| Grove Run | | | 4,000 |
| Millers Run | | | 3,800 |
| Muddy Creek | | | 9,500 |
| North Cherry Creek | | | 4,750 |
| Round Glade Run | | | 3,800 |
| Spring Pond | | | 2,000 |
| Thurmont, Hunting Creek | | | 10,000 |
| Massachusetts: | | | |
| Athol, Swift River, East Branch | | | 500 |
| Baldwinville, Norcross Pond | | | 1,000 |
| Conway, Lowells Pond | | | 300 |
| Dedham, Weld's ponds | | 5,000 | |
| Gardner, Bennet Brook | | | 1,000 |
| Brigham Brook | | | 1,000 |
| Cook Brook | | | 1,000 |
| Cunnistowe Brook | | | 1,000 |
| Hale Brook | | | 1,000 |
| Mare Meadow Brook | | | 1,000 |
| Tanyard Brook | | | 1,000 |
| Whitcomb Brook | | | 1,000 |
| Greenfield, Stone Brook | | | 300 |
| Holyoke, Stony Brook | | | 300 |
| Lancaster, Peterson's pond | | | 1,500 |
| Monson, Conant Brook | | 15,000 | |
| New Salem, Tire Brook | | | 1,000 |
| North Falmouth, Ashumet Pond | | 20,000 | |
| Otter River, Bailey Brook | | | 300 |
| Bigelow Brook | | | 300 |
| Brigham Brook | | | 300 |
| Perley Brook | | | 300 |
| Underwood Pond | | | 300 |
| Vining Brook | | | 300 |
| Rockland, Silver Brook | | | 3,000 |
| Washington, Westfield River | | 15,000 | |
| Westfield, Little River | | 25,000 | |
| Michigan: | | | |
| Alpena, Comstock Creek | | | 1,500 |
| Muskrat Creek | | | 1,500 |
| Norwegian Creek | | 2,700 | |
| Wildcat Creek | | | 4,000 |
| Baldwin, Pere Marquette River | | | 10,000 |
| Bellaire, Shanty Creek | | 5,000 | |
| Bitely, Cedar Creek | | 5,000 | |
| Black River, Black River | | | 15,000 |
| Boyne Falls, Boyne River | | 10,000 | |
| Branch, Weldon Creek | | 5,000 | |
| Carp Lake, Carp River | | 2,500 | 7,500 |
| Central Lake, Central Lake | | 5,000 | |
| Clare, Clear Creek | | 5,000 | |
| Five Lake Creek | | 5,000 | |
| Halstead Creek | | 5,000 | |
| Henderson Creek | | 5,000 | |
| Lowery Creek | | 5,000 | |
| McEwan Creek | | 5,000 | |
| McKinley Creek | | 5,000 | |
| Mater Creek | | 5,000 | |
| Moose Creek | | 5,000 | |
| Number Four Creek | | 5,000 | |
| Pump House Creek | | 5,000 | |
| Tobacco River | | 5,000 | |
| Tobacco River, South Branch | | 10,000 | |
| Crystal Falls, Paint River | | | 900 |
| Dryden, Belle River | | 5,000 | |
| East Tawas, Pickett Creek | | | 50,000 |
| Emery Junction, Hale Creek | | | 20,000 |
| Farwell, Littlefield Creek | | 10,000 | |
| Grayling, Au Sable River, North Branch | | 11,000 | |
| Black River | | 13,000 | |
| Pigeon River | | 11,000 | |
| Sturgeon River | | 11,000 | |
| Harrietta, McKinley Creek | | 3,000 | |
| Slagle River | | | 10,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| **Michigan**—Continued. | | | |
| Hillman, Cold Creek | | 10,000 | |
| Deer Creek | | | 2,000 |
| Webber Creek | | 12,000 | |
| Indian River, Little Pigeon River | | 19,500 | |
| Pigeon River | | 27,500 | |
| Interlochen, Platte River | | 10,000 | |
| Isle Royale, Big Siskiwit Creek | | | 4,000 |
| Little Siskiwit Creek | | | 4,000 |
| Washington Club Creek | | | 4,000 |
| Kaleva, Cedar Creek | | 10,000 | |
| Leetsville, Rapid River | | 10,000 | |
| Lewiston, Gilchrist Creek | | | 15,000 |
| Hunt Creek | | | 12,000 |
| Little Manistee, Little Manistee River | | 20,000 | |
| Marcellus, Brandy Brook | | 7,500 | |
| School Creek | | 7,500 | |
| Millersburg, Indian River | | 5,000 | |
| Little Ocqueoc River | | 10,000 | |
| Ocqueoc River | | 20,000 | |
| Rainy River, North Fork | | 5,000 | |
| Newayo, Biglow Creek | | 15,000 | |
| Penanger Creek | | 5,000 | |
| Niles, Campbell's ponds | | | 2,000 |
| Lake Chapin | | 20,000 | |
| Nirvana, Sanburn Creek | | 15,000 | |
| Ossineke, Devil River | | | 15,000 |
| Peacock, Sable River | | 10,000 | |
| Pellston, Maple River | | 10,000 | |
| Provemont, Peters Creek | | | 2,000 |
| Riverview, Black Creek | | | 2,500 |
| Cold Creek | | | 1,000 |
| Ox Bo Creek | | | 2,000 |
| Rocky Creek | | | 4,000 |
| Rose Center, Spring Brook | | 5,000 | |
| Willow Creek | | 5,000 | |
| Thompsonville, Betsey River | | | 10,000 |
| Little Betsey River | | 10,000 | |
| Traverse City, Boardman River | | | 5,500 |
| Tustin, Pine River | | 10,000 | |
| Walton Junction, Manistee River | | 10,000 | |
| White Cloud, White River | | 20,000 | 15,000 |
| Wingleton, Sweetwater Creek | | 15,000 | |
| **Minnesota:** | | | |
| Caledonia, Badger Creek | | | 5,000 |
| Beaver Creek | | | 5,000 |
| Crooked Creek | | | 5,000 |
| Crystal Valley Creek | | | 5,000 |
| Dexter Creek | | | 5,000 |
| Eastcott Creek | | | 5,000 |
| Irish Creek | | | 5,000 |
| Thompson Creek | | | 5,000 |
| South Fork Creek | | | 5,000 |
| Winnebago Creek | | | 5,000 |
| Carlton, Blackhoof Creek | | | 7,000 |
| Otter Creek | | | 7,000 |
| Duluth, Woodland Brook | | | 5,000 |
| Harmony, Tostenson Creek | | | 800 |
| Knife River, Baptism River | | | 24,000 |
| Beaver River | | | 4,000 |
| Crystal Brook | | | 4,000 |
| Gooseberry River | | | 4,000 |
| Knife River | | | 4,000 |
| Split Rock River | | | 4,000 |
| Temperance River | | | 4,000 |
| Tettegouche River | | | 8,000 |
| Lamoille, Big Trout Creek | | | 2,000 |
| Cedar Valley Creek | | | 3,000 |
| Little Trout Creek | | | 3,000 |
| Pickwick Creek | | | 2,000 |
| Pine Creek | | | 3,000 |
| Richmond Creek | | | 3,000 |
| Rutherford Creek | | | 3,000 |
| Lanesboro, Diamond Creek | | | 800 |
| Gribbins Creek | | | 400 |
| Onstim Creek | | | 400 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Minnesota—Continued. | | | |
| Lanesboro, Sletvold Creek | | | 400 |
| Torgerson Creek | | | 400 |
| Lewiston, Enterprise Creek | | | 2,000 |
| Ferguson Creek | | | 2,000 |
| Rush Creek | | | 3,000 |
| Stockton Valley Creek | | | 2,000 |
| White Water River, South Branch | | | 3,000 |
| Minnesota City, Bear Valley Creek | | | 2,000 |
| Rollingstone Creek | | | 3,000 |
| Ruppecht Valley Creek | | | 2,000 |
| Speltz Valley Creek | | | 3,000 |
| Straight Valley Creek | | | 2,000 |
| Plainview, Beaver Creek | | | 2,000 |
| Logan Creek | | | 2,000 |
| Middle Creek | | | 2,000 |
| East Indian Creek | | | 3,000 |
| West Indian Creek | | | 2,000 |
| White Water River | | | 3,000 |
| White Water River, North Branch | | | 2,000 |
| Preston, Big Spring Creek | | | 5,000 |
| Camp Creek | | | 400 |
| Douschell Creek | | | 5,000 |
| North Branch Creek | | | 400 |
| South Branch Creek | | | 800 |
| Sugar Creek | | | 5,000 |
| Trout Run | | | 5,800 |
| Watson Creek | | | 800 |
| Willow Creek | | | 5,400 |
| Wisel Creek | | | 800 |
| Red Wing, Hay Creek | | | 6,400 |
| Wells Creek | | | 600 |
| Rushford, Coledge Creek | | | 400 |
| Diamond Creek | | | 400 |
| Enterprise Creek | | | 400 |
| Ferguson Creek | | | 400 |
| Hemingway Creek | | | 400 |
| Mead Creek | | | 400 |
| Overland Creek | | | 400 |
| St. Charles, Campbells Branch | | | 3,000 |
| Carters Run | | | 2,000 |
| Crows Creek | | | 2,000 |
| Demuths Creek | | | 2,000 |
| Hemingway Creek | | | 2,000 |
| Holmes Spring Creek | | | 2,000 |
| Holts Spring Creek | | | 2,000 |
| Logan Branch | | | 2,000 |
| Loys Spring Creek | | | 2,000 |
| Nichols Creek | | | 3,000 |
| Omaree Creek | | | 3,000 |
| Pettis Creek | | | 2,000 |
| Pfuls Spring Creek | | | 2,000 |
| Pine Creek | | | 3,000 |
| Quincy Creek | | | 2,000 |
| Rush Creek | | | 3,000 |
| Trout Run | | | 2,000 |
| Troy Creek | | | 2,000 |
| Whitewater River | | | 3,000 |
| Whitewater River, Middle Branch | | | 3,000 |
| Whitewater River, North Branch | | | 3,000 |
| Whitewater River, South Branch | | | 3,000 |
| Winona, Bear Valley Creek | | | 3,000 |
| Corey Valley Creek | | | 2,000 |
| Dearing Valley Creek | | | 2,000 |
| East Burns Valley Creek | | | 2,000 |
| Gilmore Valley Creek | | | 2,000 |
| Ginthen Valley Creek | | | 3,000 |
| Middle Valley Creek | | | 2,000 |
| Millers Creek | | | 2,000 |
| Morey Creek | | | 3,000 |
| Pleasant Valley Creek | | | 3,000 |
| Rupprecht Valley Creek | | | 3,000 |
| Speltz Valley Creek | | | 3,000 |
| Stockton Valley Creek | | | 3,000 |
| Straight Valley Creek | | | 3,000 |
| West Burns Valley Creek | | | 2,000 |
| Wiscoy Creek | | | 3,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Missouri: | | | |
| St Louis, applicant | 500 | | |
| Montana: | | | |
| Armstead, Horse Prairie Creek | | | 450 |
| Warm Spring Brook | | | 150 |
| Belt, Belt Creek | | | 750 |
| Highwood Creek | | | 750 |
| Belton, McDonald Creek | | | 750 |
| Big Timber, Deer Creek | | | 4,000 |
| Bozeman, Asbestos Creek | | | 2,000 |
| Beaver Creek | | | 1,000 |
| Bostwick Creek | | | 3,000 |
| Bridger Creek | | | 10,485 |
| Buck Creek | | | 1,000 |
| Buffalo Horn Creek | | | 2,000 |
| Cache Creek | | | 1,000 |
| Chapman Pond | | | 400 |
| Cherry Creek, tributaries | | | 4,000 |
| Cottonwood Creek | | | 2,000 |
| Cottonwood Creek, North Fork | | | 5,000 |
| Dailey Creek | | | 2,000 |
| Greek Creek | | | 2,000 |
| Hell Roaring Creek | | | 3,500 |
| Johnson Creek | | | 1,000 |
| Lansing Creek | | | 4,000 |
| Logger Creek | | | 6,000 |
| Lost Creek | | | 1,000 |
| Meadow Creek | | | 2,500 |
| Moose Creek | | | 3,000 |
| Olson Creek | | | 2,000 |
| Pasha Creek | | | 500 |
| Porcupine Creek | | | 2,000 |
| Rainbow Lake | | | 10,000 |
| Rocky Creek | | | 4,000 |
| Sago Creek | | | 5,000 |
| Sales Creek | | | 4,000 |
| Spanish Creek, tributaries | | | 25,000 |
| Spanish Creek, Middle Fork | | | 4,000 |
| Spanish Creek, North Fork | | | 4,000 |
| Spanish Creek, South Fork | | | 4,000 |
| Specimen Creek | | | 2,000 |
| Squaw Creek | | | 1,500 |
| Swan Creek | | | 1,500 |
| Taylor Creek | | | 2,000 |
| Taylors Fork Creek | | | 1,500 |
| Trail Creek | | | 7,200 |
| Twin Lake | | | 5,000 |
| West Fork Creek | | | 2,000 |
| Wilson Creek | | | 2,000 |
| Corwin, Bassett Creek | | | 2,500 |
| Dillon, Selway Creek | | | 300 |
| Divide, Jimmie New Run | | | 150 |
| Drummond, Shoop Lake | | | 400 |
| Edgar, Pryor Creek | | | 280 |
| Gardiner, Glenn Creek | | | 26,000 |
| Geyser, Arrow Creek | | | 750 |
| Cottonwood Creek | | | 750 |
| Davis Creek | | | 750 |
| Martin Creek | | | 500 |
| Hamilton, Skalkaho Creek | | | 400 |
| Jefferson City, Prickley Pear Pond | | | 1,600 |
| Kalispell, Smiths Spring Creek | | | 500 |
| Spring Creek | | | 500 |
| State fish commission | 200,000 | | |
| Lennep, Little Cottonwood Creek | | | 600 |
| Lewistown, Armells Creek, East Fork | | | 750 |
| Armells Creek, Middle Fork | | | 300 |
| Spring Creek | | | 300 |
| Livingston, Bauman's pond | | | 1,000 |
| Deep Creek | | | 5,000 |
| Fleshman Creek | | | 8,000 |
| Mission Creek | | | 10,000 |
| Pine Creek | | | 5,000 |
| Suce Creek | | | 5,000 |
| Trail Creek | | | 5,000 |
| Lombard, Sixteen Mile Creek | | | 2,500 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Montana—Continued. | | | |
| Manhattan, Baker Creek | | | 10,000 |
| Camp Creek | | | 10,000 |
| Bulls Run | | | 5,000 |
| North Fork Creek | | | 1,000 |
| Spring Creek | | | 10,000 |
| Martinsdale, Cottonwood Creek | | | 4,800 |
| Melrose, Canyon Creek Lake | | | 450 |
| Moore, Dockens Creek | | | 750 |
| Judith River | | | 7,200 |
| Rock Creek | | | 750 |
| Neihart, Sawmill Creek | | | 500 |
| Philipsburg, Adams Lake | | | 200 |
| Red Lodge, Rock Creek Lakes | | | 2,500 |
| Rimini, Ten Mile Creek and tributaries | | | 1,000 |
| Salesville, Cherry Creek | | | 6,000 |
| Sheridan, Indian Creek | | | 600 |
| Mill Creek | | | 600 |
| Wisconsin Creek | | | 600 |
| Stevensville, Mill Creek Lake | | | 400 |
| Sumatra, Herbold's pond | | | 1,000 |
| Three Forks, Orsten's pond | | | 450 |
| Townsend, Crow Creek | | | 15,000 |
| Deep Creek | | | 15,000 |
| Greyson Creek | | | 10,000 |
| Twodot, Agnes Creek | | | 600 |
| Wilsall, Horse Creek | | | 7,500 |
| Winston, Antelope Creek | | | 1,200 |
| Yakt, Pine Creek | | | 280 |
| Nevada: | | | |
| Verdi, State fish commission | 50,000 | | |
| New Hampshire: | | | |
| Berlin, Chandler Brook | | | 4,000 |
| Charlestown, Benware Brook | | 15,000 | |
| Reservoir Brook | | 15,000 | 2,000 |
| Claremont, Copeland Brook | | | 2,000 |
| Concord, Cunningham's pond | | | 100 |
| Great Brook | | | 300 |
| Kimball Brook | | | 200 |
| One Stock Brook | | | 300 |
| Trout Brook | | | 200 |
| Stevens Brook | | | 300 |
| White Rock Brook | | | 200 |
| Whittemore Brook | | | 200 |
| Epsom, Porter Bickford Brook | | | 2,000 |
| Fabyans, Ammonoosuc River | | 10,000 | |
| Anderson Lake | | 3,000 | |
| Bear Brook | | 3,000 | |
| Black Brook | | 8,000 | |
| Bretton Woods Lake | | 5,000 | |
| Clay Brook | | 3,000 | |
| Clinton Brook | | 5,000 | |
| Crawford Brook | | 5,000 | |
| Deception Brook | | 3,000 | |
| Jefferson Brook | | 5,000 | |
| Grafton, Wildmeadow Brook and Pond | | | 500 |
| Greenfield, Farrington Brook | | 10,000 | |
| Gulf Brook | | 5,000 | |
| Hartshorn Brook | | 5,000 | |
| Smith Brook | | 10,000 | |
| South Brook | | | 2,000 |
| Lee, Knowlton's pond | | | 1,000 |
| Newbury, Lake Sunapee | | 49,900 | |
| Peterborough, Town Line Brook | | | 2,000 |
| Potter Place, Lake Pleasant | | | 10,000 |
| Sanbornville, Mountain Lake | | | 500 |
| Warner, Asquel Brook | | | 1,500 |
| French Brook | | | 2,000 |
| Meadow Brook No. 1 | | | 2,000 |
| Meadow Brook No. 2 | | | 1,500 |
| Smith Brook | | 5,000 | |
| Stevens Brook | | | 2,000 |
| Webb, Perry Brook | | | 300 |
| West Swanzey, Bolles Brook | | | 300 |
| Branch Brook | | | 500 |
| Perry Brook | | | 500 |
| Winchester, Mira Brook | | | 700 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| New Jersey: | | | |
| Bloomsbury, Braun's pond | | | 500 |
| Paterson, Stalters Brook | | | 1,000 |
| Stalter's pond | | | 1,000 |
| Princeton, applicant | 3,500 | | |
| New Mexico: | | | |
| Dexter, Lake Van | | | 1,600 |
| Glorieta, Mora River | | | 8,000 |
| Pecos River | | | 16,000 |
| Hagerman, Hagerman Reservoir | | | 800 |
| Las Vegas, Gallinas River | | | 10,000 |
| Magdalena, South Diamond Creek | | | 3,000 |
| Raton, Rayole River | | | 16,000 |
| Ribera, Pecos River | | | 10,000 |
| Rowe, Pecos River | | | 20,000 |
| Taiban, Taiban River | | | 800 |
| Ute Park, Rio Grande | | | 15,000 |
| New York: | | | |
| Apulia, Butternut Creek | | 25,000 | |
| French Brook | | 5,000 | |
| Markham Hollow Brook | | 10,000 | |
| Mills Brook | | 10,000 | |
| Ranger Brook | | 10,000 | |
| Battery Park, New York Aquarium | 5,000 | | |
| Beaver River, Beaver River | | | 500 |
| Benson Mines, Little River | | 15,000 | |
| Twin Lakes | | | 500 |
| Big Indian, Esopus Creek | | | 1,000 |
| Boiceville, Travers Hollow Brook | | | 200 |
| Brewster, Croton River, Middle Branch | | | 1,500 |
| Cairo, Bunker Hill Creek | | 5,000 | |
| Cambridge, Devils Hollow Brook | | 5,000 | |
| Dunraven, Delaware River, East Branch | | | 1,500 |
| Ellenville, Rondout Creek, East Branch | | | 200 |
| Vernooy Kill Creek | | | 300 |
| Elmira, Hoffman's pond | | | 500 |
| Erieville, Hamilton Brook | | | 1,000 |
| Morrow Brook | | | 500 |
| Perry Smith Brook | | | 500 |
| Wagoner Brook | | | 1,000 |
| Forestport, Little Woodhull Creek | | | 600 |
| Fulton Chain, Bisby Lake | | 30,000 | |
| Little Moose Lake | | 30,000 | |
| Georgetown, Morris Brook | | | 1,000 |
| Otselic Brook | | | 1,000 |
| Great Bend, Black Creek | | 20,000 | |
| Halfway, De Montfredie Brook | | 15,000 | |
| Harrisville, South Creek Lake | | 15,000 | |
| Ligas Lake | | 15,000 | |
| Homer, Crouse's pond | | 15,000 | 300 |
| Kerhonkson, Mill Brook | | | 300 |
| Lake Placid, Ausable River | | 10,000 | |
| Chub River | | 10,000 | |
| Lake Placid | | 30,000 | |
| Lisle, Dudley Creek | | | 300 |
| Long Eddy, Basket Brook | | | 1,000 |
| Margaretville, Delaware River, East Branch | | | 1,500 |
| Morrisonville, Riley Pond | | | 500 |
| State Road Brook | | | 1,000 |
| Newark, Military Brook | | 5,000 | |
| New City, Thornfield Brook | | | 500 |
| New Lebanon, Burnemead Brook | | | 1,000 |
| Cold Spring Brook | | | 1,000 |
| Dean Brook | | | 1,000 |
| Shaker Brook | | | 1,000 |
| West Meadow Brook | | | 1,000 |
| Wyomonock Creek | | | 2,000 |
| Northville, Charley Lake | | | 1,500 |
| Hayes Lake | | | 1,500 |
| Oneonta, Baker Brook | | 5,000 | |
| Butternut Creek | | 20,000 | |
| Charlotte Creek | | 35,000 | |
| Hackley's creek | | 5,000 | |
| Keyes Brook | | 5,000 | |
| Meridale Pond | | 10,000 | |
| Otego Creek | | 20,000 | |
| Otego Creek, tributary | | 15,000 | |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| New York—Continued. | | | |
| Oneonta, Pool Brook | | 6,000 | |
| Powell Creek | | 5,000 | |
| Robinson Creek | | 5,000 | |
| Owego, Talcott Brook | | 5,000 | |
| Catalonk Creek | | 15,000 | |
| Doolittle Creek | | 5,000 | |
| East Creek | | 10,000 | |
| Owego Creek | | 5,000 | |
| West Creek | | 15,000 | |
| Patterson, Croton River | | | 1,500 |
| Quaker Brook | | | 1,000 |
| Piercefield, Catamount Lake | | | 1,000 |
| Port Henry, Club House Brook and Pond | | 15,000 | |
| Ledge Pond | | 10,000 | |
| Little Club House Pond | | 5,000 | |
| Lower Moss Pond | | 10,000 | |
| Upper Club House Brook | | 5,000 | |
| Upper Moss Pond | | 10,000 | |
| Schroon River | | 10,000 | |
| Port Jervis, Bemis Brook | | | 400 |
| Richland, Hilton Brook | | | 100 |
| Orwell Brook | | | 200 |
| Pekin Brook | | | 200 |
| Potter Brook | | | 200 |
| Richmondville, Panther Creek | | 8,000 | |
| Rome, Direnn Creek | | 20,000 | |
| Fish Creek | | 20,000 | |
| Pringle Brook | | 20,000 | |
| Roaring Brook | | 10,000 | |
| Schenevus, Elk Creek | | 20,000 | |
| Shokan, Maltby Hollow Creek | | | 200 |
| Shushan, Battenkill River | | 15,000 | |
| Camden Brook | | 25,000 | |
| Sidney, Hyatt Brook | | | 200 |
| Masonville Brook | | | 200 |
| Peckham Brook | | | 200 |
| Rogers Hollow Brook | | | 200 |
| South Berlin, Fuller Brook | | | 1,000 |
| Hemlock Branch | | | 1,000 |
| Kronk Brook | | | 1,000 |
| Springville, Smith Brook | | 6,000 | |
| St. Regis Falls, St. Regis River | | 20,000 | |
| Syracuse, Bear Trap Creek | | | 300 |
| Carpenter Brook | | 35,000 | |
| Elmwood Brook | | | 300 |
| Geddes Brook | | | 300 |
| Pebble Hill Pond | | 5,000 | |
| Swamp Brook | | | 300 |
| Unadilla, Cans Creek | | 20,000 | |
| Oulcout Creek | | 20,000 | |
| Rogers Hollow Creek | | 20,000 | |
| Utica, Jones's pond | | 5,000 | |
| Wallace, Wessels Creek | | | 300 |
| Warwick, Double Kill Run | | | 3,500 |
| Watertown, Deer Lick Creek | | 10,000 | |
| Felts Mills Creek | | 20,000 | |
| French Creek | | 10,000 | |
| Johnsons Creek | | 10,000 | |
| Kings Creek | | 10,000 | |
| Martin Creek | | 10,000 | |
| Tolley Pond | | 10,000 | |
| Willsboro, Higby Brook | | | 300 |
| Sky Pond | | | 300 |
| Warm Pond | | | 300 |
| North Carolina: | | | |
| Andrews, East Buffalo Creek | | | 225 |
| Santeetlah Creek | | | 225 |
| Apalachia, Bear Creek | | | 3,000 |
| Bethania, Hunter's pond | | | 75 |
| Biltmore, Cane Creek, Rocky Fork | | | 2,150 |
| Brevard, Brushy Creek | | | 2,000 |
| Buckhorn Creek | | | 150 |
| Cannon Creek | | | 2,000 |
| Carson Creek | | | 2,000 |
| Cedar Rock Creek | | | 1,200 |
| Grogan Creek | | | 150 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| North Carolina—Continued. | | | |
| Brevard, Grohe's creek | | | 2,000 |
| Nicholson's creek | | | 2,000 |
| Rocky Creek | | | 2,000 |
| Williamson's Creek | | | 800 |
| Cherryfield, Cherryfield Creek | | | 2,000 |
| Mount Walter Creek | | | 500 |
| Oliver's creek | | | 1,000 |
| Paxton Creek | | | 1,750 |
| Weams Creek | | | 2,000 |
| Elk Park, Belch Creek | | | 4,000 |
| Boons Fork Creek | | | 5,000 |
| Elk Creek, South Fork | | | 500 |
| Little Elk Creek | | | 1,200 |
| North Toe River | | | 500 |
| High Point, Spring Branch | | | 150 |
| Horse Shoe, Queens Creek | | | 150 |
| Lake Toxaway, French Broad River, West Fork | | | 500 |
| Linville Falls, Catawba River, North Fork | | | 300 |
| Minneapolis, Fall Branch | | | 2,000 |
| Montezuma, Grandmother Creek | | | 3,000 |
| Kawana Lake | | | 2,000 |
| Kentucky Creek | | | 2,000 |
| Linville River | | | 4,000 |
| Linville River, West Fork | | | 2,000 |
| Toe River, East Fork | | | 1,200 |
| Murphy, Dinkins Creek | | | 75 |
| Palmer Creek | | | 75 |
| Old Fort, Bird Creek, West Fork | | | 1,200 |
| Jaret's creek | | | 1,000 |
| Penrose, Cherrytree Creek | | | 1,200 |
| Gash's creek | | | 150 |
| Glady Creek | | | 150 |
| Lydays Creek | | | 150 |
| Patty Creek | | | 1,600 |
| Shoal Creek | | | 2,000 |
| Tom's creek | | | 500 |
| Turkey Creek | | | 2,000 |
| Pisgah Forest, Black Snake Creek | | | 250 |
| Lambs Creek | | | 150 |
| Silver Creek | | | 2,400 |
| Suttons Creek | | | 2,000 |
| Turkey Creek | | | 150 |
| Wilsons Creek | | | 2,000 |
| Rutherfordton, Kettle House Branch | | | 1,000 |
| Saluda, Cove Creek | | | 300 |
| Gads Creek | | | 150 |
| Gilbert Creek | | | 300 |
| Selica, Mill Creek | | | 1,000 |
| Sylva, White Rock Creek | | | 2,000 |
| Wolf Creek | | | 2,000 |
| Tryon, Pocolet River, tributary | | | 825 |
| Tuxedo, Cherry Creek | | | 2,000 |
| Freemans Creek | | | 150 |
| Green River, branch | | | 150 |
| Rock Creek | | | 3,000 |
| Violet, Elbow Creek | | | 3,000 |
| Shoals Creek | | | 3,000 |
| Slate Creek | | | 4,000 |
| Waynesville, West Fork Pigeon River | | | 225 |
| North Dakota: | | | |
| Mott, Cannon Ball River | | | 8,000 |
| New Salem, Silver Spring Pond | | | 600 |
| Springbrook Pond | | | 400 |
| Ohio: | | | |
| Bellefontaine, Mad River | | 10,000 | |
| Stony Creek | | 5,000 | |
| Stony Creek, tributary | | 5,000 | |
| Garrettsville, Stewart Creek | | | 5,000 |
| Kinsman, Bidwell Creek | | | 5,000 |
| Mansfield, Bently Lake | | 2,000 | |
| Pleasant Valley Run | | 12,000 | |
| Portsmouth, Turkey Creek | | | 10,000 |
| Oklahoma: | | | |
| Enid, Spring Lake | | | 300 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Oregon: | | | |
| Bonneville, State fish commission | 300,000 | | |
| Carlton, North Yamhill River | | 1,000 | |
| Duncan, Meacham Creek | | 2,000 | |
| Forest Grove, Unscheid's pond | | 1,000 | |
| Gibbon, Umatilla River | | 4,000 | |
| Hood River, Hood River | | 2,000 | |
| Lakeview, Rock Creek | | | 1,000 |
| McMinnville, Baker Creek | | 2,000 | |
| Oregon City, Trout Creek | | 4,000 | |
| Pendleton, Bear Creek | | 2,000 | |
| Birch Creek, East Fork | | 2,000 | |
| McKay Creek | | 2,000 | |
| Pilot Rock, Big Creek | | 4,000 | |
| Bridge Creek | | 1,000 | |
| Butter Creek, East Fork | | 4,000 | |
| Cable Creek | | 1,000 | |
| Camas Creek | | 4,000 | |
| Desolation Creek | | 4,000 | |
| Five Mile Creek | | 1,000 | |
| Hidiway Creek | | 4,000 | |
| Owens Creek | | 4,000 | |
| Snipe Creek | | 1,000 | |
| Winam Creek | | 3,000 | |
| Sheridan, Bible Creek | | 2,000 | |
| Willamina, Willamina River | | 2,000 | |
| Pennsylvania: | | | |
| Allentown, Trout Creek | | | 210 |
| Austin, Bark Shanty Run | | | 1,000 |
| Berg Run | | | 1,000 |
| Big Moores Run | | | 1,500 |
| Birch Run | | | 1,000 |
| Cowley Run | | | 1,500 |
| East Deering Run | | | 1,000 |
| Freeman Run | | | 1,000 |
| Little Moores Run | | | 1,000 |
| Little Nelson Run | | | 1,000 |
| Nelson Run | | | 1,000 |
| Prouty Run | | | 1,000 |
| Sinnamahoning River | | | 1,000 |
| South Woods Run | | | 1,500 |
| West Branch Run | | | 1,000 |
| Bainbridge, Lindimuth Run | | | 800 |
| Bath, Edgewood Pond | | | 500 |
| Beartown, Lincoln's run | | | 420 |
| Shirk's run | | | 400 |
| Benton, Brink River | | | 300 |
| Bully Run | | | 100 |
| Fishing Creek | | | 300 |
| Keefer Run | | | 100 |
| Kile's brook | | | 100 |
| Long Run | | | 100 |
| Raven Creek | | | 200 |
| Savage Run | | | 300 |
| Spring Run | | | 100 |
| Bethlehem, Monocacy Creek | | | 1,000 |
| Bingham, Railroad Run | | | 225 |
| Wolf Run | | | 225 |
| Boiling Springs, Boiling Springs Lake | | | 275 |
| Bradford, Buck Lick Creek | | | 75 |
| Chapple Fork Creek | | | 875 |
| Fuller Brook | | | 75 |
| Gilbert Run | | | 75 |
| Lynn Valley Creek | | | 75 |
| North Branch | | | 75 |
| Oil Valley Creek | | | 75 |
| Quaker Run | | | 875 |
| Sugar Run | | | 950 |
| Tuna Creek, East Branch | | | 875 |
| Tuna Creek, West Branch | | | 875 |
| Willow Creek | | | 875 |
| Wintergreen Run | | | 875 |
| Wolf Run | | | 600 |
| Brandamore, Long's run | | | 800 |
| Brockwayville, Whetstone Run | | | 1,000 |
| Brookland, Little Cushing Creek | | | 2,000 |
| Bushkill, Beaver Dam Brook | | | 5,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Pennsylvania—Continued. | | | |
| Cammal, Trout Run | | | 1,500 |
| Carlisle, Letort Spring Run | | | 1,000 |
| Catawissa, Roaring Creek | | | 1,000 |
| Central, Hog Run | | | 200 |
| Painter Run | | | 200 |
| Cherry Tree, Shryhock Run | | | 800 |
| Silver Run | | | 800 |
| Clarendon, Big Arnot Creek | | | 225 |
| Farnsworth Creek | | | 225 |
| Four Mile Run | | | 225 |
| Little Arnot Creek | | | 225 |
| Tionesta Creek | | | 225 |
| Wildcat Creek | | | 75 |
| Clearfield, Big Three Run | | | 165 |
| Fork Run | | | 165 |
| Lick Run | | | 110 |
| Little Three Run | | | 110 |
| Stone Run | | | 165 |
| Trout Run | | | 110 |
| Cly, Hay Run | | | 800 |
| Coles Creek, Coles Creek, tributary of | | | 400 |
| Coudersport, Allegheny River | | | 800 |
| Allegheny Creek | | | 400 |
| Baker Creek | | | 800 |
| Bark Mill Branch | | | 400 |
| Bark Shanty Run | | | 400 |
| Bly Branch | | | 400 |
| Brown Hollow Run | | | 400 |
| Chappel Branch | | | 400 |
| Clark Run | | | 400 |
| Colcord Branch | | | 400 |
| Colesburg Creek | | | 400 |
| Creamery Run | | | 400 |
| Dingee Branch | | | 400 |
| Dingman Run | | | 400 |
| Earl Run | | | 400 |
| East Cowley Run | | | 400 |
| Elm Flat Run | | | 400 |
| Ellison Branch | | | 400 |
| Ensign Run | | | 400 |
| First Fork Run | | | 400 |
| Foumes Branch | | | 400 |
| Fox Run | | | 400 |
| Freeman Run | | | 400 |
| Frink Run | | | 400 |
| Gale Run | | | 400 |
| Glover Branch | | | 400 |
| Hendrix Run | | | 400 |
| Hoxie Run | | | 400 |
| Inez Run | | | 400 |
| Left Rees Creek | | | 400 |
| Lewis Branch | | | 400 |
| Lookout Branch | | | 400 |
| Metzgar Branch | | | 400 |
| Mill Creek | | | 400 |
| Mitchell Branch | | | 400 |
| Neff Branch | | | 400 |
| Nelson Creek | | | 800 |
| North Branch Run | | | 400 |
| North Hollow Run | | | 400 |
| Oswayo Creek | | | 400 |
| Phelps Spring Run | | | 400 |
| Pine Run | | | 400 |
| Prosser Hollow Run | | | 400 |
| Quimby Branch | | | 400 |
| Raymond Branch | | | 400 |
| Rees Hollow Run | | | 400 |
| Ross Run | | | 400 |
| Seven Bridges Run | | | 400 |
| Sinnemahoning Creek | | | 400 |
| Smith Run | | | 400 |
| South Woods Branch | | | 400 |
| State Road Run | | | 800 |
| Stephens Run | | | 800 |
| Steer Brook | | | 400 |
| Sweden Run | | | 400 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Pennsylvania—Continued. | | | |
| Coudersport, Swing Run | | | 400 |
| Taggart Run | | | 400 |
| Thompson Branch | | | 400 |
| Tolls Run | | | 400 |
| Turnpike Run | | | 400 |
| Walker Run | | | 400 |
| Wambold Run | | | 400 |
| West Cowles Creek | | | 400 |
| Whitney Creek | | | 400 |
| Windfall Run | | | 400 |
| Cresco, Bushkill River | | | 3,000 |
| Cressona, Bartlesback Creek | | | 200 |
| Deitus Creek | | | 200 |
| Panther Creek | | | 200 |
| Curwensville, Andersons Creek | | | 1,000 |
| Bear Run | | | 500 |
| Bilgers Run | | | 500 |
| Blooms Run | | | 500 |
| Hartshorn Run | | | 500 |
| Montgomery Run | | | 1,500 |
| Norris Run | | | 500 |
| Roaring Run | | | 500 |
| Twin Run | | | 500 |
| Delta, Keyser's pond | | | 210 |
| Downingtown, Broad Run and tributaries | | | 1,000 |
| Pine Run | | | 210 |
| Driftwood, Gore Draft Run | | | 500 |
| Hick Run | | | 1,000 |
| Laurel Run | | | 1,000 |
| Miller Run | | | 1,000 |
| Mix Run | | | 1,000 |
| Mix Run, Little Fork | | | 500 |
| Page Run | | | 1,000 |
| Red Run | | | 1,000 |
| Sander Draft Run | | | 500 |
| White Oak Run | | | 500 |
| Wykoff Run | | | 1,000 |
| Easton, Bushkill Creek | | | 840 |
| Fern Glen, Crooked Run No. 1 | | | 200 |
| Crooked Run No. 2 | | | 200 |
| Roberts Run | | | 200 |
| Florin, Big Spring Run | | | 540 |
| Galeton, Back of Lot Brook | | | 1,000 |
| Beech Creek | | | 75 |
| Buckseller Run | | | 1,075 |
| California Creek | | | 1,075 |
| Commission Run | | | 1,000 |
| Cushing Creek | | | 1,075 |
| Daggett River | | | 1,000 |
| Gale Run | | | 1,000 |
| Hopperhouse Hollow Run | | | 1,000 |
| Indian Run | | | 75 |
| Jacobs River | | | 75 |
| Joes Creek | | | 75 |
| Johnson Brook | | | 75 |
| Judson Run | | | 1,000 |
| Kettle Creek | | | 75 |
| Lahyman Branch | | | 1,000 |
| Little Kettle Creek | | | 75 |
| Lossey Run | | | 1,075 |
| Meeker Run | | | 75 |
| Nine Mile Run | | | 75 |
| Painter Run | | | 1,000 |
| Phoenix Creek | | | 75 |
| Pine Creek | | | 950 |
| Pine Creek, South Branch | | | 1,000 |
| Slider Branch | | | 75 |
| Sunken Branch | | | 1,075 |
| Toms Cabin Run | | | 1,000 |
| Wetmore Run | | | 1,000 |
| Gap, Cattail Run | | | 1,200 |
| Ellmaker Run | | | 800 |
| Livingstons Hollow Run | | | 1,200 |
| Umbletown Run | | | 1,200 |
| Glasgow, Curtic Run | | | 240 |
| Hallton, Big Run | | | 220 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Pennsylvania—Continued. | | | |
| Hecla, Cold Run | | | 500 |
| Hoadleys, Middle Creek | | | 400 |
| Spring Creek | | | 200 |
| Wangum Creek | | | 300 |
| Hughesville, Shingle Run | | | 200 |
| Hull, East Fork Creek | | | 75 |
| Proudy Creek | | | 75 |
| Hydetown, Wheeler Run | | | 150 |
| Indian Creek, Mill Run | | | 400 |
| Nicolay Run | | | 200 |
| Jamison City, Rough Run | | | 200 |
| Jersey Shore, Chatams Run | | | 300 |
| Frusworth Run | | | 300 |
| Johnstown, Alwin Run | | | 400 |
| Baker Run | | | 600 |
| Beaver Run | | | 500 |
| Beaver Dam Run | | | 500 |
| Bens Creek | | | 600 |
| Bens Creek, North Fork | | | 100 |
| Bens Creek, South Fork | | | 100 |
| Big Spring Run | | | 300 |
| Blue Hole Run | | | 300 |
| Breastwork Run | | | 900 |
| Calendar Run | | | 800 |
| Canfield Run | | | 100 |
| Caples Run | | | 200 |
| Card Machine Run | | | 200 |
| Clear Run | | | 200 |
| Clear Shade Run | | | 300 |
| Conemaugh River, South Fork | | | 800 |
| Cub Run | | | 300 |
| Daily Draft Run | | | 200 |
| Dalton Run | | | 600 |
| Dark Shade Run | | | 300 |
| Deeters Creek | | | 200 |
| Gray Run | | | 100 |
| Henaaries Creek | | | 800 |
| Hincksons Run | | | 100 |
| Imgrunt Run | | | 200 |
| Johns Mill Run | | | 200 |
| Jones Mill Run | | | 300 |
| Kimberlens Run | | | 200 |
| Laurel Run | | | 200 |
| Laurel Run No. 1 | | | 100 |
| Laurel Run No. 2 | | | 100 |
| Laurel Hill Run | | | 200 |
| Lick Run | | | 200 |
| Little Mill Creek | | | 100 |
| Little Shade Run | | | 300 |
| Mill Creek | | | 300 |
| Miller Run | | | 600 |
| Millstone Run | | | 200 |
| Mishler Run | | | 100 |
| Picking Run | | | 200 |
| Piney Run | | | 200 |
| Piney Run No. 1 | | | 100 |
| Piney Run No. 2 | | | 100 |
| Pletcher Run | | | 300 |
| Powder Mill Run | | | 500 |
| Red Run | | | 300 |
| Rhodes Creek | | | 200 |
| Risinger Run | | | 100 |
| Roaring Run | | | 200 |
| Salt Lick Run | | | 500 |
| Sandy Run | | | 300 |
| Shannon Run | | | 700 |
| Shingle Run | | | 500 |
| Solomons Run | | | 200 |
| Stuart Run | | | 200 |
| Sugar Run | | | 300 |
| Three Spring Run | | | 200 |
| Tub Mill Run | | | 600 |
| Wildcat Run | | | 300 |
| Kellettville, Fork Run | | | 150 |
| Four Mile Run | | | 150 |
| Little Salmon Branch | | | 150 |

Distribution of Fish and Fish Eggs, by Locality and Species, Fiscal Year 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Pennsylvania—Continued. | | | |
| Kellettville, Salmon Creek | | | 150 |
| Six Mile Run | | | 150 |
| Kingston, Pikes Creek | | | 500 |
| Kinzers, Londonland Run | | | 1,000 |
| Meadowbrook Run | | | 1,200 |
| Lancaster, Blue Ball Run | | | 1,600 |
| Cattail Run | | | 1,600 |
| Gest's run | | | 1,200 |
| Gontners Run | | | 1,600 |
| Herr's run | | | 1,200 |
| Kelly Creek | | | 1,100 |
| Landis Run | | | 1,200 |
| Stehmans Run | | | 1,600 |
| Trout River | | | 2,000 |
| Welks Run | | | 1,600 |
| Lanesboro, Brushville Creek | | | 1,000 |
| Canawacta Creek | | | 500 |
| Cascade Creek | | | 1,000 |
| Dodge Brook | | | 500 |
| Egypt Creek, East Branch | | | 500 |
| Egypt Creek, West Branch | | | 1,000 |
| Hemlock Creek, East Branch | | | 1,000 |
| Hemlock Creek, West Branch | | | 1,000 |
| Roaring Brook | | | 500 |
| Wildcat Creek | | | 500 |
| Latrobe, Ranando Hollow Run | | | 200 |
| Laubachs, Hess Spring Creek | | | 100 |
| Wymans Brook | | | 100 |
| Leola, Carpenter's run | | | 1,200 |
| Groffs Run | | | 1,200 |
| Leslie Run, Leslie Run | | | 1,300 |
| Shaffors Run | | | 200 |
| Lewisburg, Bull Run | | | 200 |
| Lewistown, Alafrata Run | | | 275 |
| Strode Run | | | 275 |
| Lilly, Bens Creek | | | 200 |
| Blairs Creek | | | 200 |
| McHugh Creek | | | 200 |
| Lititz, Middle Creek | | | 1,600 |
| Stony Creek | | | 300 |
| McAuley, Tidewater Pond | | | 500 |
| Mahaffey, Beaver Run | | | 225 |
| Boiling Spring Run | | | 225 |
| Campbell Run | | | 225 |
| Curry Run | | | 225 |
| Deer Run | | | 225 |
| Hazlett Run | | | 225 |
| Laurel Run | | | 225 |
| Lick Run | | | 225 |
| McCracken Run | | | 225 |
| McGees Run | | | 225 |
| Rock Run | | | 225 |
| Rogue Harbor Run | | | 225 |
| Sawmill Run | | | 225 |
| Snyder Run | | | 225 |
| Whisky Run | | | 225 |
| Wilson Run | | | 225 |
| Mainville, Furnace Run | | | 100 |
| Mapleton, Beach Run | | | 700 |
| Campbells Creek | | | 1,400 |
| Chilcotts Run | | | 700 |
| Glasgows Creek | | | 700 |
| Greenlands Run | | | 700 |
| Laurel Run | | | 1,400 |
| Proughs Branch | | | 700 |
| Scrub Run | | | 1,400 |
| Smiths Mill Run | | | 700 |
| Snopps Run | | | 700 |
| Swopes Branch | | | 700 |
| Trough Creek | | | 1,400 |
| Marietta, Duffy Creek | | | 400 |
| Dugan Run | | | 400 |
| Evans Creek | | | 600 |
| Marsh Creek, Asaph Run | | | 1,500 |
| Marsh Creek | | | 1,500 |
| Strait Run | | | 1,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Pennsylvania—Continued. | | | |
| Mauch Chunk, Dill Down Creek | | | 500 |
| Mud Run | | | 1,000 |
| Mayburg, Bopps Creek | | | 300 |
| Mill Hall, Fox Hollow Creek | | | 200 |
| Panther Run | | | 300 |
| Minersville, Black Creek | | | 200 |
| Buckhorn Creek | | | 200 |
| Dyer Run | | | 200 |
| Montoursville, Loyalsock Creek | | | 100 |
| Mount Union, Boohers Gap Run | | | 700 |
| Carmichael Branch | | | 700 |
| Carters Run | | | 1,400 |
| Licking Creek | | | 1,400 |
| Long Hollow Run | | | 1,400 |
| Old Womans Gap Run | | | 1,400 |
| Roaring Run | | | 700 |
| Roberts Run | | | 1,400 |
| Scrub Gap Run | | | 1,400 |
| Singers Gap Run | | | 1,400 |
| New Ringgold, Irish Run | | | 280 |
| Newville, Laurel Run | | | 1,125 |
| Nisbet, Bender Run | | | 200 |
| Nordmont, Bashley Run | | | 100 |
| Birch Creek | | | 100 |
| Cherry Run | | | 100 |
| Deep Hollow Run | | | 100 |
| Dutchman Run | | | 100 |
| Elk Run | | | 100 |
| Ellison Run | | | 100 |
| Falls Run | | | 100 |
| Floodwood Run | | | 100 |
| Fritz Run | | | 100 |
| Gansell Run | | | 100 |
| Gloss Creek | | | 100 |
| Hunter Run | | | 100 |
| Lake Run | | | 100 |
| Loyalsock Creek | | | 200 |
| Main Branch | | | 100 |
| Mill Creek | | | 100 |
| Moss Run | | | 100 |
| Muncy Creek | | | 100 |
| Oub Leb Run | | | 100 |
| Pond Branch | | | 100 |
| Public Run | | | 100 |
| Rock Run | | | 100 |
| Rusty Run | | | 100 |
| Shanerberg Run | | | 100 |
| Slip Run | | | 100 |
| South Branch | | | 100 |
| Spicewood Run | | | 100 |
| Spring Run | | | 100 |
| Suman Run | | | 100 |
| Oil City, Cherry Run | | | 300 |
| Holman Run | | | 150 |
| Horse Creek | | | 300 |
| Muskrat Run | | | 300 |
| Pithole Creek | | | 300 |
| Stewarts Run | | | 300 |
| Orviston, Big Run | | | 500 |
| Big Run, Middle Branch | | | 500 |
| Hayes Run | | | 500 |
| Marsh Creek, North Fork | | | 500 |
| Two Run Creek | | | 500 |
| Walker Branch | | | 500 |
| Palmerton, Blue Mountain Creek | | | 280 |
| Penfield, Bear Camp Run | | | 400 |
| Penllyn, Hoover's lake | | | 1,000 |
| Philipsburg, Ardells Run | | | 600 |
| Barkers Run | | | 600 |
| Bark Shed Run | | | 600 |
| Beaver Run | | | 700 |
| Benners Run | | | 600 |
| Bigelow Run | | | 700 |
| Big Spring Run | | | 600 |
| Bilgers Run | | | 600 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Pennsylvania—Continued. | | | |
| Philipsburg, Black Bear Run | | | 700 |
| Black Moshannon Creek | | | 600 |
| Bushkill Creek | | | 5,500 |
| Butlers Run | | | 600 |
| California Run | | | 600 |
| Clover Run | | | 600 |
| Cold Springs Run | | | 600 |
| Cold Stream Creek | | | 3,000 |
| Cold Stream Pond | | | 700 |
| Corbin Run | | | 600 |
| Curry Run | | | 600 |
| Dayton Run | | | 600 |
| Deep Rock Run | | | 600 |
| Echo Run | | | 700 |
| Flat Rock Run | | | 600 |
| Forge Run | | | 600 |
| Four Mile Run | | | 600 |
| Hutton Run | | | 600 |
| Huzzards Run | | | 700 |
| Laurel Run | | | 600 |
| Little Beaver Run | | | 600 |
| McCords Run | | | 600 |
| Moravian Run | | | 600 |
| Morgan Run | | | 600 |
| Nasons Run | | | 600 |
| North Run | | | 700 |
| One Mile Run | | | 700 |
| Pine Run | | | 600 |
| Potters Run | | | 600 |
| Sensers Run | | | 600 |
| Seven Springs Run | | | 600 |
| Shields Run | | | 600 |
| Six Mile Run | | | 600 |
| Slate Run | | | 600 |
| Sleepy Hollow Run | | | 700 |
| Smays Run | | | 700 |
| Splash Run | | | 600 |
| Spruce Run | | | 600 |
| Star Mill Run | | | 600 |
| Sterling Run | | | 600 |
| Tomahawk Run | | | 600 |
| Tom Tit Run | | | 600 |
| Trout Run | | | 600 |
| Turtle Spring Run | | | 600 |
| Twiggs Run | | | 600 |
| Vails Run | | | 600 |
| Winburne Run | | | 600 |
| Wolf Run | | | 600 |
| Picture Rocks, Big Run | | | 300 |
| Laurel Run | | | 300 |
| Lick Run | | | 200 |
| Roaring Run | | | 200 |
| Rock Run | | | 300 |
| Pottsville, Adam's run | | | 500 |
| Black Creek | | | 500 |
| Cold Run | | | 300 |
| Deep Creek | | | 2,000 |
| Dyer's run | | | 500 |
| Indian Run | | | 500 |
| Long Run | | | 300 |
| Schaffer Creek | | | 2,000 |
| Pottstown, Powderdale Creek | | | 280 |
| Quarryville, Conowingo Creek | | | 2,000 |
| Muddy Run | | | 1,200 |
| Octararo Creek, branch of | | | 1,200 |
| Ralston, Abbott Run | | | 100 |
| Acid Run | | | 100 |
| Bear Trap Run | | | 100 |
| Elk Lick Run | | | 100 |
| Heilman Run | | | 100 |
| Hound Run | | | 100 |
| Long Run | | | 100 |
| Mill Run | | | 100 |
| Miners Run | | | 100 |
| Pleasant Run | | | 300 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Pennsylvania—Continued. | | | |
| Ralston, Potash Run | | | 100 |
| Rock Run | | | 300 |
| Rock Run, Right Fork | | | 200 |
| Short Run | | | 100 |
| Slack Run | | | 100 |
| Wolf Run | | | 100 |
| Yellow Dog Run | | | 100 |
| Reading, Big Cacoosing Creek | | | 200 |
| Brunacle Creek | | | 200 |
| Little Cacoosing Creek | | | 100 |
| Mill Creek | | | 200 |
| Neversink Creek | | | 200 |
| Plum Creek | | | 100 |
| Six Penny Creek | | | 100 |
| Willow Creek | | | 100 |
| Wyomissing Creek | | | 5,000 |
| Reedsville, Alexander Run | | | 500 |
| Coffee Run | | | 500 |
| Havice Valley Run | | | 1,000 |
| Honey Creek | | | 1,000 |
| Kishacoquillas Creek | | | 1,000 |
| Lancaster Valley Creek | | | 1,000 |
| Laurel Run | | | 1,000 |
| Lingle Run | | | 500 |
| Peachey Run | | | 1,000 |
| Tea Creek | | | 500 |
| Treasters Run | | | 1,000 |
| West Branch | | | 1,000 |
| Rhoads Station, Clarks Run | | | 220 |
| Jonathan Run | | | 165 |
| Wallace Run | | | 275 |
| Rockport, Indian Run | | | 1,200 |
| Rapps Creek | | | 1,200 |
| Shaffer's run | | | 1,000 |
| Taylors Run | | | 200 |
| Roulette, Curd Creek | | | 1,000 |
| Fish Hollow Creek | | | 1,000 |
| Fishing Creek | | | 1,500 |
| Fishing Creek, East Branch | | | 1,000 |
| Fishing Creek, Spencer Branch | | | 1,000 |
| Lanigar Creek | | | 1,000 |
| Reed Run | | | 1,000 |
| Sartwell Creek | | | 1,500 |
| Trout Brook | | | 1,000 |
| Royersford, Mancill's run | | | 140 |
| Pine Swamp Creek | | | 140 |
| Powdermill Run | | | 140 |
| Royal Spring Creek | | | 140 |
| St. Marys, Big Run | | | 200 |
| Dents Run | | | 225 |
| Hellfire Run | | | 225 |
| Hicks Run | | | 500 |
| Little Dents Run | | | 300 |
| Little Wolf Lick Run | | | 300 |
| Sand Lick Run | | | 225 |
| Sawdust Run | | | 225 |
| Trout Run | | | 300 |
| Trout Run, Park Branch | | | 300 |
| Trout Run, Ten Acre Branch | | | 300 |
| Wolf Lick Run | | | 300 |
| Scranton, Roaring Brook | | | 400 |
| Shenandoah, Mud Run | | | 200 |
| Slate Run, Bolden Run | | | 1,000 |
| Callahan Run | | | 1,500 |
| Cedar Run | | | 2,000 |
| County Line Branch | | | 1,000 |
| Cushman Creek | | | 500 |
| Cushman Fork Run | | | 2,000 |
| Daugherty Run | | | 1,500 |
| Dyer Branch Run | | | 1,000 |
| Frances Creek | | | 500 |
| Jacobs Run | | | 1,000 |
| Little Slate Run | | | 1,500 |
| Manor Fork Run | | | 1,500 |
| Morris Run | | | 2,000 |

Distribution of Fish and Fish Eggs, by Locality and Species, Fiscal Year 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Pennsylvania—Continued. | | | |
| Slate Run, Nabal Run | | | 1,500 |
| Otter Run | | | 500 |
| Pine Creek | | | 2,000 |
| Pine Bottom Creek | | | 1,000 |
| Red Run | | | 1,500 |
| Slate Run | | | 2,000 |
| Trout Run | | | 2,000 |
| Willcox Run | | | 1,000 |
| Spartansburg, Spring Creek | | | 300 |
| Stroudsburg, Bear Lick Creek | | | 350 |
| Broadhead Creek, East Branch | | | 350 |
| Broadhead Creek, Levis Branch | | | 350 |
| Broadhead Creek, West Branch | | | 350 |
| Browns Run | | | 280 |
| Buck Hill Creek | | | 350 |
| Little Bushkill Creek | | | 350 |
| Marchells Creek | | | 350 |
| Mill Creek | | | 350 |
| Pocono Creek | | | 210 |
| Saw Creek | | | 350 |
| Spoke Factory Run | | | 210 |
| Stony Run | | | 350 |
| Tionesta, Bates Run | | | 150 |
| Bear Creek | | | 150 |
| Big Coon Creek | | | 150 |
| Council Run | | | 150 |
| Davis Run | | | 150 |
| Dawson Run | | | 150 |
| Fork Run | | | 150 |
| Hunter Run | | | 150 |
| Jakes Run | | | 150 |
| Jamison Run | | | 150 |
| Johns Run | | | 150 |
| Jug Handle Run | | | 150 |
| Korb Run | | | 150 |
| Lamentation Run | | | 150 |
| Laurel Run | | | 450 |
| Little Coon Creek | | | 150 |
| Little Hickory Creek | | | 150 |
| Little Tionesta Creek | | | 150 |
| McCarthy Run | | | 150 |
| Mix Run | | | 450 |
| Peters Run | | | 150 |
| Pigeon Run | | | 150 |
| Piney Run | | | 300 |
| Rath's run | | | 150 |
| Recks Run | | | 150 |
| Ross Run | | | 150 |
| Sibble Run | | | 150 |
| Sugar Run | | | 150 |
| Tubs Run | | | 150 |
| Vockroth Run | | | 150 |
| West Hickory Creek | | | 150 |
| Titusville, Abbey Run | | | 150 |
| Armstrong Brook | | | 150 |
| Barton Run | | | 150 |
| Beaver Run | | | 150 |
| Bowers Run | | | 75 |
| Duffield Run | | | 150 |
| Foster Run | | | 75 |
| Gillespie Run | | | 150 |
| Glaspy Run | | | 150 |
| Glen Run | | | 150 |
| Grove Run | | | 75 |
| Haworth Run | | | 150 |
| Hindle Run | | | 75 |
| Little Oil Creek | | | 150 |
| McKay Run | | | 75 |
| McKenzie Run | | | 75 |
| Myers Run | | | 75 |
| Noel Run | | | 150 |
| Pithole Creek, West Branch | | | 150 |
| Prenatt's run | | | 75 |
| Richey Run | | | 75 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Pennsylvania—Continued. | | | |
| Titusville, Sheffers Run | | | 75 |
| Shirley Run | | | 150 |
| Smith Run | | | 75 |
| Sugar Creek and branches | | | 975 |
| Three Bridge Run | | | 150 |
| Vincent Run | | | 225 |
| Welsh Run | | | 75 |
| Woodcock Run | | | 150 |
| Tobyhanna, Kessler Run | | | 210 |
| Polly's run | | | 140 |
| Tobyhanna Creek | | | 280 |
| Trout Run, Black's creek | | | 1,000 |
| Flook's run | | | 1,000 |
| Four Mile Run | | | 1,000 |
| Gray's run | | | 300 |
| Little Pine Creek and tributaries | | | 500 |
| Miller Run | | | 500 |
| Six Mile Run | | | 1,000 |
| Trout Run | | | 1,000 |
| Troy, Becker Run | | | 100 |
| Brandy Run | | | 100 |
| Bullard Creek | | | 100 |
| Chaces Run | | | 100 |
| Cleveland Run | | | 100 |
| Covert Creek | | | 100 |
| Fall Brook | | | 100 |
| Fellows Creek | | | 100 |
| Forbes Creek | | | 100 |
| Griffin Creek | | | 100 |
| Keith Creek | | | 100 |
| Kiff Creek | | | 100 |
| Kinnon Run | | | 100 |
| Little Falls Creek | | | 100 |
| Miller Run | | | 100 |
| Morgan Creek | | | 100 |
| Morris Run | | | 100 |
| Palmer Run | | | 100 |
| Rathbone Creek | | | 100 |
| Sherman Run | | | 100 |
| Sylvan Run | | | 100 |
| Tamarack Run | | | 100 |
| Webber Creek | | | 100 |
| Wilkins Run | | | 100 |
| Tryonville, Olson Creek | | | 300 |
| Tyler, Little Laurel Run | | | 220 |
| Waterville, Bark Cabin Run | | | 100 |
| Bear Run | | | 100 |
| Bonnell Run | | | 100 |
| Buckeye Branch | | | 400 |
| Carson Run | | | 100 |
| Coal Run | | | 100 |
| English Run | | | 100 |
| Little Pine Creek | | | 100 |
| Otter Run and tributaries | | | 400 |
| Pine Run | | | 100 |
| Pine Bottom Creek | | | 100 |
| Rogers Run | | | 100 |
| Waynesboro, Antietam Creek | | | 110 |
| Antietam Creek, West Branch | | | 110 |
| Cascade Run | | | 110 |
| Mackeys Run | | | 220 |
| Old Forge Run | | | 110 |
| West Chester, Chester Creek | | | 1,500 |
| Lady Run | | | 350 |
| Little Broad Run | | | 500 |
| Taylors Run Lake | | | 1,000 |
| West Grove, White Clay Creek | | | 1,200 |
| Weissport, Mahoning Creek | | | 210 |
| Sawmill Creek | | | 140 |
| White Rock, Walker's run | | | 400 |
| Williamsburg, Canoe Creek | | | 165 |
| Clover Creek | | | 165 |
| Fox Run | | | 165 |
| Piney Creek | | | 165 |
| Reservoir Run | | | 165 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Pennsylvania—Continued. | | | |
| Williamsport, Big Bear Creek | | | 1,000 |
| Lycoming Creek | | | 8,000 |
| Mill Creek and tributaries | | | 3,000 |
| Windber, Berkeybile Run | | | 200 |
| Big Paint Creek | | | 200 |
| Bolls Creek | | | 200 |
| One Mile Run | | | 200 |
| Racing Fork Creek | | | 200 |
| Seese Creek | | | 200 |
| Winburne, Black Bear Run | | | 2,000 |
| Black Moshannon Creek | | | 2,000 |
| South Carolina: | | | |
| Walhalla, Howards Creek | | | 150 |
| South Dakota: | | | |
| Big Bend, Prairie Creek | | | 12,000 |
| Buffalo, Jones Creek | | | 8,000 |
| Cavite, White River | | | 20,000 |
| Deadwood, Spruce Creek | | | 8,000 |
| Elmore, Ice Box Canyon Creek | | | 13,000 |
| M. and M. Creek | | | 10,000 |
| Spearfish Creek, South Branch | | | 12,000 |
| Spearfish River | | | 50,000 |
| Squaw Creek | | | 12,000 |
| Wildcat Creek | | | 10,000 |
| Englewood, Chipmunk Creek | | | 5,000 |
| Jim Creek | | | 600 |
| Spearfish Creek, Goddard Branch | | | 5,000 |
| Spearfish Creek, South Fork | | | 5,000 |
| Galena, Bear Butte Creek | | | 20,000 |
| Hermosa, Squaw Creek | | | 20,000 |
| Hot Springs, Palmer Lake | | | 400 |
| Nemo, Box Elder Creek | | | 25,000 |
| Pactola, Gilbert's pond | | | 5,000 |
| Presho, Medicine Creek | | | 5,000 |
| Rapid City, Rapid Creek | | 25,000 | |
| Rockford, Castle Creek, North Fork | | | 12,000 |
| Castle Creek, South Fork | | | 8,000 |
| Little Rapid Creek, West Fork | | | 18,000 |
| Rapid Creek | | | 250 |
| St. Onge, Lower False Bottom Creek | | | 5,000 |
| Savoy, Spearfish Creek | | | 20,000 |
| Spearfish, Cook Creek | | | 15,000 |
| Crow Creek | | | 2,500 |
| Franklin Run | | | 10,000 |
| Helmers Spring Branch | | | 12,000 |
| Higgens Gulch Creek | | | 5,000 |
| Hilton Gulch Creek | | | 10,000 |
| Hosser Creek | | | 3,000 |
| Hosser Creek, Murray Branch | | | 3,000 |
| Johnson Creek | | | 2,500 |
| Jones Spring Branch | | | 3,000 |
| Linley Spring Branch | | | 3,000 |
| McGoffin Creek | | | 12,000 |
| McGregor Creek | | | 12,000 |
| Miller Creek | | | 12,000 |
| Normal Lake | | | 10,000 |
| Smith Spring Creek | | | 8,000 |
| Spearfish Creek | | | 23,000 |
| Spring Branch | | | 10,000 |
| Willow Creek | | | 5,000 |
| Sturgis, Warren Creek | | | 600 |
| Sundance, Houston Creek | | | 15,000 |
| Morgan's creek | | | 3,000 |
| North Miller Creek | | | 18,000 |
| South Miller Creek | | | 18,000 |
| Tilford, Morse Creek | | | 15,000 |
| Tennessee: | | | |
| Dante, Donaldson Spring Branch | | | 1,200 |
| Knobs Fork Creek | | | 2,000 |
| Gray, Cox's branch | | | 1,200 |
| Hodge's branch | | | 5,000 |
| Hampton, Laurel Fork Creek | | | 9,100 |
| Johnson City, Hart's pond | | | 225 |
| Wofford's pond | | | 1,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Tennessee—Continued. | | | |
| Roan Mountain, Doe River and tributaries | | | 6,000 |
| Townsend, Forge Creek | | | 6,000 |
| Little River | | | 18,000 |
| Mill Creek | | | 6,000 |
| Rabbit Creek | | | 6,000 |
| Utah: | | | |
| Ogden, Coldwater Pond | | | 1,000 |
| Randolph, Bear Lake | | | 12,000 |
| Vermont: | | | |
| Arlington, Battenkill River | | 6,000 | |
| Beaver Brook | | | 1,000 |
| Hopper Brook | | | 1,000 |
| Lid Hollow Brook | | | 1,000 |
| South Fork Creek | | | 1,000 |
| Whitman Brook | | | 700 |
| Barton, Barton River | | 15,000 | |
| Barre, White River Branch | | | 5,700 |
| Beebe Junction, Brainard Brook | | 3,000 | |
| Johns River | | 6,000 | |
| Studdub Brook | | 4,000 | |
| Bellows Falls, Morse Brook | | 5,000 | |
| Bennington, Basin Brook | | 3,000 | |
| Bickford Hollow Brook | | 3,000 | |
| Big Hell Hollow Brook | | 3,000 | |
| Brown Brook | | 3,000 | |
| Bushnell Brook | | 3,000 | |
| Chase Brook | | 3,000 | |
| Chase Brook No. 2 | | 3,000 | |
| City Stream | | 3,000 | |
| Dewey Brook | | 3,000 | |
| Dunville Stream | | 5,000 | |
| Evans Brook | | 3,000 | |
| Furnace Brook | | 5,000 | |
| Glastenbury Stream | | 3,000 | |
| Little Hell Hollow Brook | | 3,000 | |
| Perre Thompson Brook | | 3,000 | |
| Rider Brook | | 3,000 | |
| Roaring Branch | | 5,000 | |
| Rockwood Brook | | 3,000 | |
| South Stream | | 5,000 | |
| Stachia Brook | | 3,000 | |
| Stratton Brook | | 3,000 | |
| Walters Brook | | 3,000 | |
| Walloomsac River | | 5,000 | |
| Webb Brook | | 3,000 | |
| Bloomfield, Dennis Pond | | | 500 |
| Brandon, Mill River | | | 500 |
| Sugar Hollow Brook, East Branch | | | 2,000 |
| Brattleboro, Ames Hill Brook | | | 700 |
| Broad Brook | | | 1,000 |
| Jacobs Brook | | | 700 |
| Meadow Brook | | | 500 |
| Putney Falls Brook | | | 700 |
| Stark Brook | | | 500 |
| Bristol, New Haven River | | | 1,500 |
| Canaan, Forest Brook | | 5,000 | |
| Forest Lake | | 10,000 | |
| Lewis Pond | | 10,000 | |
| Little Averill Lake | | 10,000 | |
| Nulhegan Stream | | 10,000 | |
| Roaring Brook | | 5,000 | |
| Clarendon, Tinmouth River | | | 1,250 |
| Cuttingsville, Shrewsbury Pond | | | 1,500 |
| Danville, Joe's brook | | 5,000 | |
| East Clarendon, Morin Pond | | | 1,000 |
| East Dorset, Meadow Brook | | 9,000 | |
| East Putney, Putney Hollow Brook | | | 4,000 |
| Edgewater, Kelley Brook | | 3,000 | |
| Lanesboro Brook | | 5,000 | |
| Niggerhead Pond | | 20,000 | |
| Niggerhead Ledge Brook | | 4,000 | |
| Ely, Bannock Brook | | 5,000 | |
| Enosbury Falls, Bakersfield Brook | | | 2,000 |
| Brady Brook | | | 1,000 |
| Cold Hollow Brook | | | 2,000 |

Distribution of Fish and Fish Eggs, by Locality and Species, Fiscal Year 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Vermont—Continued. | | | |
| Enosbury Falls, Ladd Brook | | | 1,000 |
| Mineral Spring Brook | | | 1,000 |
| Sand Hill Brook | | | 2,000 |
| Stoneville Brook | | | 1,000 |
| Greensboro, Caspian Lake | | | 6,400 |
| Lamoille River | | 5,000 | |
| Long Pond Brook | | 5,000 | |
| Porter Brook | | 8,000 | |
| Taylor Brook | | 5,000 | |
| Groton, Darling Pond | | 100,000 | 20,000 |
| Hardwick, Bailey Brook | | 5,000 | |
| Bunker Brook | | 5,000 | |
| Paine Brook | | 5,000 | |
| Porter Brook | | 5,000 | |
| Holden, Clover Vale Brook | | 10,000 | |
| Crandall Brook | | | 10,000 |
| Elliott Run | | | 5,000 |
| Furnace Brook | | 50,000 | |
| Hyde Park, Corey Pond | | 10,000 | |
| Island Pond, Buck Brook | | 5,000 | |
| Carroll Brook | | 5,000 | |
| Dalloff Brook | | 5,000 | |
| Ferrin River | | 10,000 | |
| Mill Brook | | 5,000 | |
| Nulhegan River | | 10,000 | |
| Nulhegan River, North Branch | | 10,000 | |
| Ossogochee Brook | | 5,000 | |
| Pay Brook | | 5,000 | |
| Smith Brook | | 5,000 | |
| Thompson Brook | | 5,000 | |
| Yellow Branch | | 8,000 | |
| Jamaica, Bald Mountain Brook | | | 1,500 |
| Johnson Brook | | | 700 |
| Kidder Brook | | | 1,000 |
| Pikes Falls Brook | | | 1,500 |
| Jericho, Lee River | | 10,000 | |
| Johnson, Gibson Brook | | 10,000 | |
| Lanesboro, Bennett's pond | | 10,000 | |
| Lyndon, Gilbert Brook | | 5,000 | |
| Hawkins Brook | | 8,000 | |
| Houghton Brook | | 6,000 | |
| Sheldon Brook | | 5,000 | |
| South Wheelock Brook | | 10,000 | |
| Lyndonville, Willow Pond | | | 5,500 |
| Manchester, Battenkill River | | 15,000 | 1,000 |
| Battenkill River, West Branch | | | 6,250 |
| Dorset Creek | | | 5,000 |
| Lye Brook | | | 1,000 |
| Paulet River | | | 1,000 |
| West Brook | | | 1,000 |
| Marshfield, Carpenter Brook | | | 500 |
| Kenney's pond | | 20,000 | |
| Niggerhead Brook | | 4,000 | |
| Ormsbee Brook | | 4,000 | |
| Middlebury, Hendrick Brook | | | 500 |
| Mills Brook | | | 2,000 |
| North Branch | | | 500 |
| Middlesex, Long Brook | | 6,000 | |
| Montpelier, Bennett's brook | | 5,000 | |
| Dog Pond Brook | | 3,000 | |
| Dwinell Brook | | | 1,000 |
| East Roxbury Pond | | 20,000 | 500 |
| Mallory Brook | | 5,000 | |
| Shady Rill Brook | | 5,000 | |
| Verge Pond | | | 1,250 |
| Williamstown Gulf Branch | | | 4,000 |
| Morrisville, Bugbee Brook | | 2,000 | |
| Burke Brook | | 2,000 | |
| Darling Brook | | 3,000 | |
| McNall Brook | | 5,000 | |
| Terrill Brook | | 5,000 | |
| Newport, Burgoine Brook | | 5,000 | |
| North Bennington, Brown Brook | | 3,000 | |
| North Dorset, Bebee Brook | | 5,000 | |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Vermont—Continued. | | | |
| Northfield, Bull Run Brook | | 4,000 | |
| Mudgett's brook | | 3,000 | |
| Norwich, Cassingham Brook | | 3,000 | |
| Dotham Brook | | 5,000 | |
| Goodrich Brook | | 5,000 | |
| Lake Mitchell | | 50,000 | 18,000 |
| Mary Jarvis Brook | | 3,000 | |
| New Boston Brook | | | 2,000 |
| Whitcomb Brook | | 3,000 | |
| Orleans, Brighton Brook | | 3,000 | |
| Dewey Brook | | 3,000 | |
| Dutton Brook | | 5,000 | |
| Gallup Brook | | 5,000 | |
| Long Pond | | 10,000 | |
| Missisquoi River | | 25,000 | |
| Perry Brook | | 4,000 | |
| Willey Creek | | 6,000 | |
| Willoughby Lake | | 5,000 | |
| Willoughby River | | 10,000 | |
| Pittsford, Cooley Creek | | 5,000 | |
| Furnace Brook, West Branch | | 5,000 | |
| Plainfield, Beaver Brook | | 5,000 | |
| Lye Brook Pond | | | 500 |
| Pigeon Pond, tributary | | 6,000 | |
| Poultney, Poultney River | | | 8,000 |
| Proctorsville, Twenty-Mile Brook | | | 4,000 |
| Williams River | | | 10,000 |
| Randolph, Adams Brook | | 4,150 | |
| Alco Pond | | 10,000 | |
| Annis Brook | | 3,000 | |
| Ayers Brook | | | 6,000 |
| Bass Brook | | 4,150 | |
| Bear Hill Brook | | 3,000 | |
| Blanchard Brook | | 3,000 | |
| Bowman Brook | | 3,000 | |
| Chandler Brook | | 4,150 | |
| Clough Brook | | 3,000 | |
| Cold Spring Brook | | | 1,000 |
| East Hill Brook | | 3,000 | |
| Eldredge Brook | | 3,000 | |
| Fishers Brook | | 3,000 | |
| Guild Brook | | 3,000 | |
| Gulf Brook | | 5,000 | |
| Halfway Brook | | 8,000 | |
| Holman Brook | | 4,150 | |
| Howard Hill Brook | | 3,000 | |
| Mafeba Lake | | | 1,700 |
| Meadow Brook | | 3,000 | |
| Morse Brook | | 4,150 | |
| Mud Pond | | | 1,000 |
| Peth Brook | | 4,150 | |
| Poverty Lane Brook | | 3,000 | |
| Purney Brook | | | 1,000 |
| Riford Brook | | | 2,500 |
| Roods Brook | | 3,000 | |
| Roxbury Brook | | 3,000 | |
| Snow's brook | | | 700 |
| Soper Brook | | 4,100 | |
| Spears Brook | | 3,000 | 1,000 |
| White River, Middle Branch | | 16,000 | |
| White River, Randolph Branch | | 10,000 | |
| White River, tributaries | | 5,000 | |
| Rocky Point, Little Osmer Brook | | 4,000 | |
| Stillwater Brook | | 5,000 | |
| Rutland, Atwood Brook | | 4,000 | 1,000 |
| Blueberry Hill Brook | | 5,000 | |
| Britton Brook | | 5,000 | 1,000 |
| Britton Pond | | 15,000 | |
| Castleton River | | 15,000 | |
| Cold River, South Branch | | | 1,000 |
| Connor Brook | | 3,000 | 1,250 |
| Dim's brook | | | 1,250 |
| Dunkley's brook | | | 1,700 |
| Eddy Mill Brook | | | 1,000 |
| Hewitt Brook | | | 1,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Vermont—Continued. | | | |
| Rutland, Kill Brook | | | 3,000 |
| Mill River | | | 2,000 |
| Phillip's brook | | 5,000 | |
| Roger's brook | | | 2,000 |
| Spooner Brook | | 5,000 | |
| Spring Lake | | 20,000 | |
| Wheeler Brook | | 5,000 | 1,000 |
| St. Johnsbury, Blodgett Brook | | 3,000 | |
| Clay Hill Brook | | 5,000 | |
| Frog Pond | | 3,000 | |
| Lawrence Pond | | 5,000 | |
| Sleepers River, West Branch | | 5,000 | |
| Sleepers River, Wheelock Branch | | 25,000 | |
| State fish commission | | 50,000 | |
| Sharon, Fales Pond | | | 1,250 |
| Lake Mitchell | | 50,000 | |
| Willow Pond | | | 300 |
| Shelburne, Greystone Pond | | | 500 |
| South Ryegate, Baileys Pond | | 5,000 | |
| Mount Pleasant Pond | | 5,000 | |
| Stowe, Lake Mansfield | | | 5,485 |
| Sunderland, Battenkill River | | | 1,250 |
| Beaver Meadows Brook | | | 1,000 |
| Dyer Brook | | | 700 |
| Lathrop Brook | | | 1,000 |
| Lye Brook | | | 1,250 |
| Tanner Brook | | | 700 |
| Taftsville, Beaver Brook | | | 800 |
| Townshead, Main Brook | | | 2,000 |
| Waterbury, Lake Mansfield | | 20,000 | |
| West Burke, Beaver Brook | | | 1,000 |
| West Hartford, Jericho Brook | | 4,000 | |
| Little Brook | | | 1,700 |
| Podunk Brook | | | 2,000 |
| Porter Brook | | | 2,000 |
| Rockland Brook | | | 700 |
| Sawyer Brook | | | 700 |
| Sherburne-Warren Brook | | | 3,000 |
| Sunny Brook | | | 1,000 |
| Tiger Town Brook | | 4,000 | |
| Woodland Farm Brook | | 3,000 | |
| Weston, Lake Wantastiquet | | 35,000 | |
| West Townsend, Acton Brook | | | 1,000 |
| Carr Brook | | | 1,000 |
| Silver Brook | | | 700 |
| Wilmington, Ballou Brook and tributaries | | | 2,000 |
| Woodstock, Black Pond | | | 1,500 |
| Bridgewater Brook | | | 700 |
| Brook-Farm Brook | | | 2,000 |
| Deerin Ponds | | | 1,000 |
| English Mills Brook | | | 3,000 |
| Grey Camp Trout Pond | | | 700 |
| Happy Valley Brook | | | 700 |
| Mecawe Lake | | | 12,000 |
| Pomfret Brook | | | 500 |
| Virginia: | | | |
| Arrington, Elk Creek | | | 1,000 |
| Big Island, Battery Creek | | | 1,500 |
| Snow Creek | | | 300 |
| Buena Vista, Stations Creek | | | 200 |
| Clairmont, Marion Brook | | | 200 |
| Clifton Forge, Wilson Creek | | | 2,000 |
| Covington, Mill Run | | | 200 |
| Dayton, Cooks Creek | | | 400 |
| Eagle Mountain, Patterson Creek | | | 1,750 |
| Edinburg, Evans's pond | | | 200 |
| Elgin, Piny Run | | | 2,000 |
| Fredericksburg, Baldwin's run | | | 500 |
| Hess Run | | | 200 |
| Front Royal, Happy Creek | | | 300 |
| Herndon, Rocky Run | | 10,000 | 400 |
| Hot Springs, Francisco Spring Branch | | | 100 |
| Indian Rock, North Creek | | | 1,250 |
| Mount Jackson, Glorif Run | | | 6,000 |
| Laurel Dale, White Top Creek | | | 3,100 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Virginia—Continued. | | | |
| Leesburg, Big Spring Branch | | 9,400 | |
| Leonards, Wolf Run | | | 300 |
| Lexington, Buffalo River, South Fork | | | 200 |
| Luray, Jeremy's run | | | 800 |
| Millboro, Big Spring Creek | | | 6,000 |
| Palmyra, Taylor's pond | | | 1,000 |
| Richmond, Burke's pond | | | 100 |
| Rural Retreat, James Creek | | | 300 |
| Shanklin, Little Back Creek | | | 500 |
| Washington: | | | |
| Birdsview, Mill Creek | | | 900 |
| Boyds, Deadman Creek | | | 600 |
| Colfax, South Palouse River | | | 600 |
| Elma, Cloquallum Creek | | 2,000 | |
| Goldendale, Scammon's pond | | 3,000 | |
| Guy, South Palouse River | | | 840 |
| Keechelus, Lake Keechelus | | | 1,200 |
| Metaline Falls, Sullivan Lake | | | 800 |
| Newport, Davis Creek | | | 400 |
| Republic, Long Lake | | | 400 |
| Seattle, Collin's pond | | 4,000 | |
| Laurel Creek | | 2,000 | |
| Snoqualmie River, Middle Fork | | | 600 |
| Snoqualmie River, North Fork | | | 600 |
| Snoqualmie River, South Fork | | | 600 |
| Tarboy, San Pail Lake | | | 400 |
| Walla Walla, Hawthorne Brook | | 2,000 | |
| West Virginia: | | | |
| Belington, Hunters Fork Creek | | | 400 |
| Johnsons Mill Pond | | | 400 |
| Bluefield, Paoliello's pond | | | 1,000 |
| Burner, Club House Run | | | 2,000 |
| Harper Run | | | 2,000 |
| Little River | | | 2,000 |
| Span Oak Run | | | 2,000 |
| Cass, Cheat River | | | 2,000 |
| Deer Creek | | | 500 |
| Clover Lick, Clover Creek | | | 2,000 |
| Laurel Run | | | 280 |
| Coalton, Roaring Creek | | | 500 |
| Durbin, Lambert Run | | | 500 |
| Fayette, Wolf Creek | | | 780 |
| Harman, Dove's pond | | | 490 |
| Horton, Big Run | | | 2,600 |
| Greenbrier River, West Fork | | | 1,400 |
| Laural Fork Run | | | 1,400 |
| Seneca Creek | | | 2,100 |
| Teter Camp Run | | | 700 |
| Keyser, New Creek | | | 2,000 |
| Marlinton, Cochrans Creek | | | 500 |
| Dauthord's creek | | | 2,500 |
| Laurel Creek | | | 300 |
| Williams River | | | 1,250 |
| May, Greenbrier River, tributary | | | 400 |
| Orndorf Creek | | | 400 |
| White Camp Creek | | | 400 |
| Midvale, Cassity Creek | | | 9,000 |
| Kettle Creek | | | 9,000 |
| Middle Fork Creek | | | 14,000 |
| Pleasant Run | | | 9,000 |
| Stone Coal Creek | | | 9,000 |
| Morgantown, Coburn Creek | | | 400 |
| Seebert, Cranberry River | | | 2,000 |
| Sitlington, Sitlington Creek | | | 500 |
| Spangler, Conley Run | | | 500 |
| White Sulphur Springs, Howard Creek | | | 2,400 |
| Winterburn, Greenbrier River | | | 1,000 |
| Little River | | | 1,000 |
| Long Run | | | 1,950 |
| Wisconsin: | | | |
| Alma, Alitz Creek | | | 500 |
| Balk's creek | | | 500 |
| Baums Valley Creek | | | 100 |
| Big Waumandee Creek | | | 2,000 |
| Braem's creek | | | 500 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Wisconsin—Continued. | | | |
| Alma, Deer Creek | | | 500 |
| Gaeble Creek | | | 500 |
| Hutchison Creek | | | 500 |
| Johns Valley Creek | | | 2,100 |
| Kaste's creek | | | 500 |
| Lee Valley Creek | | | 500 |
| Leonhardy Creek | | | 500 |
| Little Waumandee Creek | | | 2,100 |
| Mill Creek | | | 500 |
| Mueller's creek | | | 500 |
| Netting Creek | | | 500 |
| Norwegian Valley Creek | | | 2,000 |
| Pine Creek | | | 600 |
| Piper Valley Creek | | | 2,000 |
| Risch Creek | | | 500 |
| Schaub's creek | | | 500 |
| Schoepp's creek | | | 500 |
| Schmidt Creek | | | 500 |
| Schultz Creek | | | 500 |
| Spring Creek | | | 500 |
| Tamarack Creek | | | 500 |
| Trout Creek | | | 500 |
| Trout Valley Creek | | | 2,000 |
| Waumandee Creek | | | 100 |
| Wingert Creek | | | 500 |
| Amery, Bear Creek | | | 190 |
| Athens, Black Creek | | | 570 |
| Augusta, Bear Grass Creek | | | 4,000 |
| Beef River, North Branch | | | 200 |
| Coon Fork Creek | | | 200 |
| Hay Creek | | | 200 |
| Horse Creek | | | 200 |
| Travis Creek | | | 200 |
| Baldwin, Rush River | | | 2,500 |
| Black River Falls, Allen's creek | | | 500 |
| Amundson Creek | | | 500 |
| Bacon Creek | | | 1,000 |
| Clear Creek | | | 500 |
| Douglas Creek | | | 1,000 |
| Gebhart Creek | | | 1,000 |
| Kenyon Creek | | | 500 |
| Levis Creek, South Branch | | | 500 |
| Morey Creek | | | 500 |
| Moseley Creek | | | 500 |
| Pappoose Creek | | | 500 |
| Peterson Run | | | 500 |
| Roaring Creek | | | 1,000 |
| Slosser Creek | | | 1,000 |
| Smith Creek | | | 500 |
| Snow Creek | | | 500 |
| Stein Creek | | | 500 |
| Stony Creek | | | 1,000 |
| Thompson Creek | | | 500 |
| Town Creek | | | 500 |
| Trout Run | | | 1,000 |
| Van Hersett Creek | | | 500 |
| Visneau Creek | | | 500 |
| Blair, Fly Creek | | | 200 |
| Johnson Coulee Creek | | | 300 |
| Lake Coulee Creek | | | 300 |
| Matson Creek | | | 200 |
| Reynolds Creek | | | 300 |
| Salva Coulee Creek | | | 200 |
| Shephard Creek | | | 300 |
| Strums Creek | | | 200 |
| Tippen Coulee Creek | | | 200 |
| Trump Coulee Creek | | | 200 |
| Vasse Coulee Creek | | | 200 |
| Welch Coulee Creek | | | 300 |
| Bloomer, Duncan Creek | | | 380 |
| McCann Creek | | | 3,380 |
| Sand Creek | | | 3,380 |
| Trout Creek | | | 3,190 |
| Blue Mounds, Camp Creek | | | 5,000 |
| Frances Creek | | | 5,000 |
| Garfort Creek | | | 5,000 |
| Ryan's creek | | | 5,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Wisconsin—Continued. | | | |
| Boyd, Black Creek | | | 2,000 |
| Jackson Creek | | | 2,000 |
| Jenneman Creek | | | 2,000 |
| Kuhn Creek | | | 2,000 |
| Muskrat Creek | | | 2,000 |
| Pinter Creek | | | 2,000 |
| Schaller Creek | | | 2,000 |
| Swanson Creek | | | 2,000 |
| Turner's creek | | | 2,000 |
| Brule, Brule River | | | 8,950 |
| Sand Creek | | | 3,000 |
| Spring Creek | | | 3,000 |
| Wheaton Creek | | | 190 |
| Cable, Big Brook | | | 5,000 |
| Namekagon River | | | 570 |
| Twin Brooks | | | 3,000 |
| Carson, Douglas Creek | | | 160 |
| Foster Brook | | | 160 |
| Fur Creek | | | 160 |
| Hoffman Creek | | | 160 |
| Little Coon Creek | | | 160 |
| Rowes Creek | | | 160 |
| Cashton, Bohemian Valley Creek | | | 500 |
| Brush Creek | | | 500 |
| Cannon Valley Creek | | | 500 |
| Coles Valley Creek | | | 500 |
| Coon Creek | | | 500 |
| Grononns Creek | | | 500 |
| Halls Valley Creek | | | 500 |
| Hay Creek | | | 500 |
| Jersey Stream | | | 500 |
| Lyons Valley Creek | | | 500 |
| Manspi Valley Creek | | | 500 |
| Meisner Brook | | | 500 |
| Paulson Brook | | | 500 |
| Pleasant Valley Creek | | | 500 |
| Plum Valley Creek | | | 500 |
| Russell Valley Creek | | | 500 |
| Speck Brook | | | 500 |
| Timber Valley Creek | | | 500 |
| Twenty Four Valley Creek | | | 500 |
| Witchman Brook | | | 500 |
| Chetek, Moose Ear Creek | | | 570 |
| Colfax, Bronken Creek | | | 1,500 |
| Cumberland, Clam River | | | 1,000 |
| Clam River, North Fork of South Fork | | | 1,000 |
| Hickey Creek | | | 1,000 |
| McKenzie River | | | 1,000 |
| Miller Creek | | | 1,000 |
| Sand Creek | | | 1,000 |
| Spring Brook | | | 1,000 |
| Spring Creek | | | 1,000 |
| Yellow River | | | 1,500 |
| Dodgeville, Furnace Branch | | | 300 |
| Durand, Big Arkansaw Creek | | | 3,000 |
| Breunig Creek | | | 2,000 |
| Herron Creek | | | 3,000 |
| Little Arkansaw Creek | | | 2,000 |
| York Creek | | | 2,000 |
| Eagle River, Seven Pail Creek | | | 600 |
| Eau Claire, Alder Creek | | | 500 |
| Alphonse Creek | | | 1,000 |
| Apple Creek | | | 1,000 |
| Ash Creek | | | 1,000 |
| Awnsie Creek | | | 1,000 |
| Badger Creek | | | 500 |
| Balsam Creek | | | 500 |
| Beaver Creek, North Fork | | | 500 |
| Beaver Falls Creek | | | 500 |
| Beech Creek | | | 1,000 |
| Bessie Creek | | | 1,500 |
| Birch Creek | | | 500 |
| Branshaw Creek | | | 1,000 |
| Brogan Creek | | | 1,000 |
| Cat Creek | | | 1,000 |
| Charles Creek | | | 1,000 |

Distribution of Fish and Fish Eggs, by Locality and Species, Fiscal Year 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Wisconsin—Continued. | | | |
| Eau Claire, Conklin Creek | | | 1,000 |
| Daisy Creek | | | 1,000 |
| Dale Creek | | | 500 |
| David Creek | | | 1,000 |
| Deans Creek | | | 1,500 |
| Deer Creek | | | 500 |
| Dodge Creek | | | 500 |
| Downs Creek | | | 1,000 |
| Elinore Creek | | | 1,000 |
| Ella Creek | | | 1,500 |
| Evans Creek | | | 1,000 |
| Fern Creek | | | 1,500 |
| Fish Creek | | | 1,000 |
| Fletcher Creek | | | 1,000 |
| Four Mile Creek | | | 500 |
| Gladys Creek | | | 1,000 |
| Gold Creek | | | 500 |
| Gorton Creek | | | 1,000 |
| Grace Creek | | | 500 |
| Graham Creek | | | 500 |
| Grape Creek | | | 1,000 |
| Grassy Creek | | | 500 |
| Gray Creek | | | 500 |
| Hair Creek | | | 1,000 |
| Hansens Creek | | | 500 |
| Iron Creek | | | 500 |
| Jackson Creek | | | 500 |
| Jacobson Creek | | | 1,000 |
| Jeskie Creek | | | 1,000 |
| Jim Creek | | | 1,000 |
| Junior Creek | | | 1,000 |
| Kelly Creek | | | 1,000 |
| Lamb Creek | | | 1,000 |
| Lillie Creek | | | 1,000 |
| Little Rock Creek | | | 500 |
| Long Creek | | | 500 |
| Louis Creek | | | 1,000 |
| Lowe's creek | | | 1,000 |
| McCann Creek | | | 1,000 |
| Maple Creek | | | 500 |
| Mink Creek | | | 500 |
| Minnie Creek | | | 500 |
| Moon Creek | | | 1,000 |
| Mud Creek | | | 500 |
| Muskrat Creek | | | 500 |
| Niagara Creek | | | 500 |
| Nine Mile Creek | | | 1,000 |
| North Creek | | | 500 |
| One Mile Creek | | | 500 |
| Otto Creek | | | 500 |
| Peach Creek | | | 1,000 |
| Pebble Creek | | | 1,000 |
| Penn Creek | | | 1,000 |
| Pine Creek | | | 500 |
| Pussie Creek | | | 1,000 |
| Rainbow Creek | | | 500 |
| Ridge Creek | | | 1,000 |
| Rilette Creek | | | 1,000 |
| Rock Creek | | | 500 |
| Sandy Creek | | | 500 |
| Sharp Creek | | | 1,000 |
| Sheep Creek | | | 1,000 |
| Sherman Creek | | | 1,000 |
| Spring Creek | | | 500 |
| Squirrel Creek | | | 500 |
| Stony Creek | | | 500 |
| Stony Brook | | | 500 |
| Stout Creek | | | 500 |
| Ten Mile Creek | | | 500 |
| Thorson Creek | | | 500 |
| Trout Creek | | | 1,000 |
| Valley Brook | | | 1,000 |
| Violet Creek | | | 1,000 |
| Wessley Creek | | | 500 |
| Willow Creek | | | 500 |
| Wright's creek | | | 1,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Wisconsin—Continued. | | | |
| Eleva, Big Creek | | | 4,000 |
| Trout Creek | | | 4,000 |
| Ellsworth, Big Coulee Creek | | | 900 |
| Big River | | | 1,350 |
| Brush Creek | | | 900 |
| Cafe Creek | | | 1,350 |
| Carlson Spring Run | | | 450 |
| Cave Creek | | | 900 |
| Gilberts Spring Creek | | | 900 |
| Goose Creek | | | 900 |
| Isabelle Creek | | | 1,350 |
| Little Coulee Creek | | | 900 |
| Little Trimbelle Creek | | | 1,350 |
| Lost Creek | | | 1,350 |
| Murphy Spring Run | | | 450 |
| Rush River | | | 1,800 |
| South Fork Creek | | | 1,350 |
| Spring Brook | | | 900 |
| Trimbelle Creek | | | 1,800 |
| Ferryville, James Creek | | | 100 |
| Fountain City, Bohn Valley Creek | | | 2,000 |
| Bohris Valley Creek | | | 100 |
| Eagle Valley Creek | | | 2,100 |
| Hentger Valley Creek | | | 100 |
| Pine Creek | | | 2,000 |
| Piper Valley Creek | | | 100 |
| Schaffner Valley Creek | | | 2,100 |
| Foxboro, Big Balsam Creek | | | 6,000 |
| State Line Creek | | | 4,000 |
| Friendship, Fairbank's creek | | | 1,500 |
| Schoonover Creek | | | 1,500 |
| White Creek | | | 800 |
| Galesville, American Valley Creek | | | 3,000 |
| Bear Creek | | | 1,000 |
| Beaver Creek, North Branch | | | 1,500 |
| Beaver Creek, South Branch | | | 1,000 |
| Big Tamarack Creek | | | 2,000 |
| Corrigan's creek | | | 1,000 |
| Dutch Creek | | | 4,000 |
| Ettrich Creek | | | 3,000 |
| Fox Creek | | | 2,000 |
| Fox Coulee Creek | | | 1,000 |
| French Creek | | | 4,500 |
| Galloway Creek | | | 1,000 |
| Grant Creek | | | 1,000 |
| Hardie Creek | | | 1,000 |
| Holcomb Coulee Creek | | | 4,000 |
| Irish Valley Creek | | | 3,000 |
| Little Tamarack Creek | | | 1,000 |
| McCarthys Creek | | | 1,000 |
| Norway Coulee Creek | | | 4,000 |
| Norwegian Valley Creek | | | 2,000 |
| Silver Creek | | | 3,000 |
| Tamarack Creek | | | 1,500 |
| Glenwood City, Anderson Creek | | | 500 |
| Bellew Creek | | | 500 |
| Big Beaver Creek | | | 500 |
| Blues Creek | | | 500 |
| French Creek | | | 500 |
| Hay River, South Fork | | | 500 |
| Huggins Creek | | | 500 |
| Johns Creek | | | 500 |
| Little Beaver Creek | | | 500 |
| Little Bolen Creek | | | 500 |
| Owens Creek | | | 500 |
| Preschls Creek | | | 500 |
| Sand Creek, North Fork | | | 500 |
| Sand Creek, South Fork | | | 500 |
| Scotty's creek | | | 500 |
| Smiths Creek | | | 500 |
| Sullivan's creek | | | 500 |
| Tiffany Creek, North Fork | | | 500 |
| Tiffany Creek, South Fork | | | 500 |
| Vans Creek | | | 500 |
| Vierons Creek | | | 500 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Wisconsin—Continued. | | | |
| Greenwood, Davis Creek | | | 200 |
| Guile Creek | | | 100 |
| Rocky Run | | | 200 |
| Wayne Creek | | | 100 |
| Wedges Creek | | | 200 |
| Hillsboro, Cancutt Creek | | | 400 |
| Devils Run | | | 400 |
| Happy Hollow Creek | | | 400 |
| Meadow Brook | | | 400 |
| Silver Creek | | | 400 |
| Skunk Run | | | 400 |
| Slater Creek | | | 400 |
| Werner Creek | | | 800 |
| Werner Creek, branch of | | | 400 |
| Iron River, Hill Creek | | | 4,000 |
| Kendall, Brainard's creek | | | 400 |
| Davis Creek | | | 400 |
| Foxes Creek | | | 400 |
| La Crosse, Bohemian Creek | | | 400 |
| Chipmunk Creek | | | 400 |
| Coon Creek | | | 800 |
| Fishback Creek | | | 400 |
| Halfway Creek | | | 800 |
| Mormon Creek | | | 800 |
| Sand Lake Creek | | | 400 |
| Timber Creek | | | 800 |
| Mauston, Alder Creek | | | 1,000 |
| Bruer Creek | | | 800 |
| Fellond Creek | | | 1,000 |
| Gospel Point Creek | | | 500 |
| Indian Creek | | | 1,000 |
| Madden's creek | | | 400 |
| Mile Creek | | | 800 |
| Seven Mile Creek | | | 800 |
| Spring Creek | | | 1,000 |
| Medford, Beaver Creek | | | 4,000 |
| Melvina, Anderson Creek | | | 400 |
| Brown's creek | | | 400 |
| Cannon Valley Creek | | | 400 |
| Chamber's creek | | | 400 |
| Olson Creek | | | 400 |
| Schotten Valley Creek | | | 400 |
| Mellen, Devils Creek | | | 4,000 |
| McCarthy Creek | | | 4,380 |
| Minnon Creek | | | 4,000 |
| Montreal Creek | | | 4,000 |
| Penokee Creek | | | 4,000 |
| Silver Creek | | | 4,000 |
| Trout Brook | | | 4,000 |
| Tylers Fork River | | | 4,000 |
| Menomonie, Anderson Creek | | | 200 |
| Annis Creek | | | 240 |
| Asylum Creek | | | 220 |
| Balsbaugh Creek | | | 200 |
| Beaver Creek | | | 200 |
| Big Elk Creek | | | 200 |
| Big Hay Creek | | | 400 |
| Big Meadows Creek | | | 200 |
| Bishop Creek | | | 200 |
| Biss Creek | | | 200 |
| Blair Creek | | | 200 |
| Bolan Creek | | | 200 |
| Borland Creek | | | 200 |
| Clacks Creek | | | 200 |
| Coon Creek | | | 200 |
| Cowan Creek | | | 200 |
| Cranberry Creek | | | 200 |
| Denning Run | | | 200 |
| Drowley's run | | | 200 |
| Dushane Creek | | | 400 |
| Eau Galle River | | | 400 |
| Eddy Creek | | | 200 |
| Eighteen Mile Creek | | | 200 |
| Fall Creek | | | 200 |
| Galloway Creek | | | 200 |
| Gilbert Creek | | | 400 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Wisconsin—Continued. | | | |
| Menomonie, Hay River | | | 400 |
| Hay River, South Fork | | | 400 |
| Home Farm Run | | | 200 |
| Johns Creek | | | 240 |
| Iron Creek | | | 240 |
| Irvine Creek | | | 400 |
| Kings Creek | | | 200 |
| Knights Creek | | | 200 |
| Knipple Creek | | | 240 |
| La Forge Creek | | | 200 |
| Lambs Creek | | | 200 |
| Lambs Creek, North Fork | | | 200 |
| Little Beaver Creek | | | 200 |
| Little Elk Creek | | | 200 |
| Little Hay Creek | | | 200 |
| Little Missouri River | | | 200 |
| Little Otter Creek | | | 200 |
| Little Sand Creek | | | 200 |
| Losbys Run | | | 200 |
| Louis Creek | | | 200 |
| Lynch Creek | | | 200 |
| McCarthy Creek | | | 200 |
| Missouri River | | | 200 |
| Mud Creek | | | 200 |
| Palmer's run | | | 200 |
| Paradise Creek | | | 200 |
| Parker Run | | | 200 |
| Pine Creek | | | 400 |
| Popple Creek | | | 200 |
| Roach Creek | | | 200 |
| Rock Creek | | | 200 |
| Rush Creek | | | 200 |
| Sand Creek | | | 200 |
| Shafer Creek | | | 200 |
| Simonson Creek | | | 200 |
| Sinking Creek | | | 200 |
| Sly Creek | | | 200 |
| Smith Creek | | | 200 |
| Spring Creek | | | 200 |
| Stoner Creek | | | 200 |
| Thum Creek | | | 200 |
| Tiffany Creek | | | 200 |
| Trout Creek | | | 200 |
| Varney Creek | | | 200 |
| Webber Creek | | | 200 |
| White Creek | | | 200 |
| Wilcox Creek | | | 240 |
| Wilson Creek | | | 240 |
| Wilson Creek, North Branch | | | 240 |
| Wolfs Run | | | 200 |
| Merrill, Averill Creek | | | 2,000 |
| Barnes Creek | | | 2,000 |
| Copper River | | | 2,500 |
| Devils Creek | | | 2,000 |
| New Wood River | | | 2,000 |
| Pine River | | | 2,500 |
| Prairie River | | | 2,500 |
| Smith Creek | | | 2,000 |
| Millston, Alvard Creek | | | 500 |
| Baumel Creek | | | 500 |
| Clear Creek | | | 500 |
| Covey Creek | | | 500 |
| Dunham Creek | | | 500 |
| Eldsmoe Creek | | | 500 |
| Fisher Creek | | | 500 |
| Fisher Creek, South Fork | | | 500 |
| Gebhardt Creek | | | 500 |
| Glens Creek | | | 500 |
| Houser Creek, East Fork | | | 500 |
| Indian Creek | | | 500 |
| Ketchum Creek | | | 500 |
| Lambert Creek | | | 500 |
| Larkin Creek | | | 500 |
| Mattison Creek | | | 500 |
| Pangratz Creek | | | 500 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Wisconsin—Continued. | | | |
| Millston, Pigeon Creek | | | 500 |
| Rudd Creek | | | 500 |
| Spring Creek | | | 1,000 |
| Stanton Creek | | | 500 |
| Stanton Creek, East Fork | | | 500 |
| Wyman Creek | | | 1,000 |
| Wyman Creek, East Fork | | | 500 |
| New Lisbon, Brewer Creek | | | 800 |
| Fairbanks Creek | | | 800 |
| Hoten Creek | | | 800 |
| Jackson Creek | | | 800 |
| Macomber Creek | | | 800 |
| Mead Creek | | | 800 |
| Northcott Brook | | | 800 |
| Rosland Creek | | | 800 |
| Schoonover Creek | | | 800 |
| Webster Creek | | | 800 |
| Newry, Coon Creek, branch of | | | 2,000 |
| Ellefson Spring Creek | | | 1,000 |
| Norwalk, Brunner Creek | | | 2,000 |
| Cook Creek | | | 800 |
| Devils Hollow Creek | | | 400 |
| Dreier Run | | | 400 |
| Farmers Valley Creek | | | 800 |
| Fels Creek | | | 2,000 |
| Moores Creek | | | 800 |
| Orienta, Reefer Creek | | | 15,000 |
| Pepin, Big Plum Creek | | | 450 |
| Bogus Creek | | | 450 |
| Bogus Creek, North Branch | | | 450 |
| Ell Creek | | | 450 |
| Ell Creek, North Branch | | | 450 |
| Little Plum Creek | | | 450 |
| Lost Creek | | | 450 |
| Lost Creek, West Branch | | | 450 |
| Porcupine Creek | | | 450 |
| Roaring River | | | 450 |
| Roaring River, East Fork | | | 450 |
| Sixteen Creek | | | 450 |
| Redgranite, Bruce Creek | | | 2,000 |
| Richland Center, Ash Creek | | | 5,000 |
| Big Bear Creek | | | 5,000 |
| Big Willow Creek | | | 5,000 |
| Brush Creek | | | 10,000 |
| Fancy Creek | | | 5,000 |
| Fancy Creek, East Branch | | | 500 |
| Hawkins Creek | | | 5,000 |
| Little Bear Creek | | | 5,000 |
| Little Willow Creek | | | 5,000 |
| Melancthon Creek | | | 5,500 |
| Mill Creek | | | 5,000 |
| Pine River, West Branch | | | 5,000 |
| Souls Creek | | | 5,000 |
| Water Villa Branch | | | 2,000 |
| Willow Creek | | | 500 |
| River Falls, Kinnickinnick Creek | | | 2,250 |
| Sparta, Beemer Creek | | | 400 |
| Parks Creek | | | 800 |
| Sopher Creek | | | 3,000 |
| Spring Valley, Burghardt Creek | | | 700 |
| Cady Creek | | | 700 |
| Cave Creek | | | 500 |
| Eau Galle River | | | 1,400 |
| French Creek | | | 700 |
| Gilbert Creek | | | 1,400 |
| Gilbert Creek, North Fork | | | 700 |
| Gilbert Creek, South Fork | | | 700 |
| Knights Creek | | | 700 |
| Loomis Creek | | | 200 |
| Lousy Creek | | | 700 |
| Mines Creek | | | 700 |
| Rush River | | | 1,400 |
| Stanley, Divine Creek | | | 380 |
| Swim Creek | | | 4,000 |
| Stone Lake, Big Godfrey Creek | | | 5,000 |
| Hay Creek | | | 5,000 |
| Sissibagama Creek | | | 5,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Wisconsin—Continued. | | | |
| Thorp, Bolin Creek | | | 500 |
| Chapman Creek | | | 1,500 |
| Sterling Creek | | | 500 |
| Tomah, Allen Creek | | | 500 |
| Bear Creek | | | 900 |
| Big Creek | | | 600 |
| Billings Creek | | | 400 |
| Brandy Creek | | | 500 |
| Brush Creek | | | 500 |
| Clear Creek | | | 500 |
| Clifton Creek | | | 500 |
| Coles Creek | | | 900 |
| Council Creek | | | 500 |
| Deer Creek | | | 900 |
| Dixon Creek | | | 500 |
| Dodgeville Creek | | | 400 |
| Dustin Creek | | | 400 |
| Jenning's creek | | | 500 |
| La Crosse River | | | 500 |
| La Fleur Creek | | | 500 |
| Little Lemonweir River | | | 400 |
| Little Silver Creek | | | 400 |
| Mill Creek | | | 1,000 |
| Mud Creek | | | 500 |
| Pine Creek | | | 500 |
| Prairie Creek | | | 500 |
| Robinson Creek | | | 500 |
| Rudd's creek | | | 500 |
| Sand Creek | | | 500 |
| Saw Creek | | | 500 |
| Silver Creek | | | 500 |
| Soney Creek | | | 500 |
| Sparta Creek | | | 900 |
| Squaw Creek | | | 500 |
| Tomahawk, Armstrong Creek | | | 100 |
| Avril Creek | | | 100 |
| Berry Creek | | | 100 |
| Big Pine Creek | | | 100 |
| Crocker's creek | | | 100 |
| Forest Creek | | | 500 |
| Hay Creek | | | 100 |
| Kuehling's run | | | 100 |
| Little Rice Creek, North Branch | | | 100 |
| Little Rice Creek, South Branch | | | 100 |
| Little Somo River | | | 100 |
| Lonely Creek | | | 100 |
| Manson Creek | | | 100 |
| New Wood Creek, North Branch | | | 100 |
| New Wood Creek, West Branch | | | 100 |
| Noisy Creek | | | 500 |
| Pine Creek, South Branch | | | 100 |
| Prairie River, North Branch | | | 100 |
| Rocky Run | | | 100 |
| Skanawan Creek | | | 100 |
| Somo River, Middle Branch | | | 100 |
| Somo River, North Branch | | | 100 |
| Somo River, South Branch | | | 100 |
| Spring Creek | | | 100 |
| Squaw Creek | | | 100 |
| Trout Creek | | | 100 |
| Willow Creek | | | 100 |
| Viroqua, Beabout Creek | | | 1,400 |
| Bishop Branch | | | 1,400 |
| Brookville Creek | | | 1,400 |
| Brown's branch | | | 1,400 |
| Brush Hollow Creek | | | 1,400 |
| Carey's creek | | | 2,400 |
| Cedar Branch | | | 1,400 |
| Cheatham Branch | | | 1,400 |
| Cook Branch | | | 1,400 |
| Coon Creek, Timber Coulee Fork | | | 400 |
| Conaway Creek | | | 1,400 |
| Elk Run | | | 1,400 |
| Getters Creek | | | 1,400 |
| Harrison Branch, North Folk | | | 2,400 |
| Harrison Branch, South Fork | | | 1,400 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Wisconsin—Continued. | | | |
| Viroqua, Lee's branch | | | 2,000 |
| Pine Hollow Creek | | | 1,400 |
| Purdy Branch | | | 1,400 |
| Rogers Creek | | | 2,400 |
| Sees Branch | | | 400 |
| Sidie Branch | | | 2,400 |
| Spring Lake | | | 400 |
| Springville Branch | | | 2,400 |
| Wascott, Bergen Creek | | | 22,000 |
| Westby, Beard Branch | | | 400 |
| Clockmaker Run | | | 400 |
| Coon River, East Branch | | | 400 |
| Coon Creek, South Branch | | | 4,000 |
| Hanson Spring Brook | | | 400 |
| Jefson Spring Run | | | 400 |
| Kickapoo Branch | | | 2,000 |
| Knapp Run | | | 400 |
| Mortorud Run | | | 400 |
| Rogstad Branch | | | 400 |
| Rulland Creek | | | 400 |
| Sanding Creek | | | 2,000 |
| Sease Branch | | | 400 |
| Sending Spring Run | | | 400 |
| Sloan Creek | | | 400 |
| Springdale Run | | | 400 |
| Spring Valley Creek | | | 4,400 |
| Swenson Branch | | | 400 |
| Timber Coulee Creek | | | 400 |
| Tveidt Run | | | 400 |
| Wheeler, Big Beaver Creek | | | 1,000 |
| Big Otter Creek | | | 3,000 |
| Blank's creek | | | 1,000 |
| Lamb's creek | | | 1,000 |
| Little Beaver Creek | | | 1,000 |
| Little Otter Creek | | | 1,000 |
| Messenger Creek | | | 1,000 |
| Phoebe Creek | | | 1,000 |
| Sink Creek | | | 1,000 |
| Wilton, Beechers Creek | | | 400 |
| Billings Creek | | | 400 |
| Cold Spring Creek | | | 400 |
| Dorset Creek | | | 400 |
| Hibbards Creek | | | 400 |
| Indian Creek | | | 400 |
| Kickapoo River | | | 400 |
| Sinks Creek | | | 400 |
| Slaton Creek | | | 400 |
| Summerfeldt Creek | | | 400 |
| Thurows Creek | | | 400 |
| Winneboujou, Brule River | | | 8,000 |
| Cutlers Creek | | | 4,000 |
| Little Brule River | | | 6,000 |
| Long Lake | | | 6,000 |
| Lucius Lake | | | 4,000 |
| Nebagamon River | | | 6,000 |
| Woodruff, Squirrel Creek | | | 160 |
| Wyoming: | | | |
| Basin, Paint Rock Creek | | | 420 |
| Ten Sleep Creek, East and West Forks | | | 420 |
| Beulah, Red Cannon Creek | | | 2,500 |
| Sand Creek | | | 27,500 |
| Cody, Bobcat Creek | | | 280 |
| Boulder Creek | | | 280 |
| Clearwater Creek | | | 280 |
| Crandall Creek | | | 280 |
| Dick Creek | | | 280 |
| Fish Hawk Creek | | | 280 |
| Frances Fork Creek | | | 280 |
| Gunbarrel Creek | | | 280 |
| Gunnell Creek | | | 280 |
| Ishawooa Creek | | | 280 |
| Jones Creek | | | 280 |
| Middle Creek | | | 280 |
| Shoshone River, North Fork | | | 280 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

BROOK TROUT—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Wyoming—Continued. | | | |
| Cody, Shoshone River, South Fork | | | 700 |
| Spring Creek | | | 280 |
| Sunlight Creek | | | 280 |
| Sweetwater Creek | | | 280 |
| Timber Creek | | | 280 |
| Wood River, Middle Fork | | | 280 |
| Wood River, North Fork | | | 280 |
| Wood River, South Fork | | | 280 |
| Laramie, applicant | 50,000 | | |
| State fish commission | 100,000 | | |
| Ranchester, Soldier Creek | | | 20,000 |
| Tongue River | | | 2,100 |
| Sheridan, Little Goose Creek | | | 560 |
| State fish commission | 75,000 | | |
| Wolf, Decker's pond | | | 1,050 |
| Yellowstone Park, Blacktail Creek | | | 22,500 |
| Canada: | | | |
| Southampton, Canadian Government | 150,000 | | |
| Total [a] | 1,239,000 | 5,280,452 | 6,014,645 |

[a] Lost in transit, 19,436 fry and 17,170 fingerlings.

GRAYLING.

| Disposition. | Eggs. | Fry. |
|---|---|---|
| California: | | |
| Sisson, State fish commission | 50,000 | |
| Michigan: | | |
| Paris, State fish commission | 50,000 | |
| Montana: | | |
| Anaconda, State fish commission | 588,000 | |
| Bozeman, Red Rock Lake | | 573,000 |
| Butte, applicant | 100,000 | |
| Ennis, Madison River | | 640,000 |
| Harlowton, Musselshell River | | 39,000 |
| Norris, Bear Creek | | 50,000 |
| Cedar Creek | | 50,000 |
| Jack Creek | | 100,000 |
| North Meadow Creek | | 115,000 |
| Odell Creek | | 130,000 |
| South Meadow Creek | | 170,000 |
| Red Rock, Red Rock Lake | | 655,000 |
| Twodot, Big Elk Creek | | 26,000 |
| West Gallatin, West Gallatin Creek | | 65,000 |
| New York: | | |
| New Milford, applicant | 15,000 | |
| Wyoming: | | |
| Laramie, applicant | 50,000 | |
| Story, State fish commission | 50,000 | |
| Total | 903,000 | 2,613,000 |

CRAPPIE AND STRAWBERRY BASS.

| Disposition. | Fingerlings. | Disposition. | Fingerlings. |
|---|---|---|---|
| Arkansas: | | Arkansas—Continued. | |
| Abbott, Little's pond | 80 | Mammoth Spring, Martins Creek | 120 |
| Conway, McCulloch & Allinder's pond | 80 | Spring River | 300 |
| Danville, Clear Lake | 80 | Marked Tree, St. Francis River | 1,779 |
| El Dorado, Lake Eagle | 80 | Russellville, Illinois River | 120 |
| Heber Springs, Little Red River | 80 | Texarkana, Twin Ponds | 70 |
| Hope, Pleasure Lake | 350 | Van Buren, Lee's creek | 80 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

CRAPPIE AND STRAWBERRY BASS—Continued.

| Disposition. | Fingerlings. |
|---|---|
| Connecticut: | |
| Danbury, Keystone Lake | 200 |
| Delaware: | |
| Wilmington, Brandywine Creek | 500 |
| Delaware River | 500 |
| Georgia: | |
| Sulphur Springs, Little River | 135 |
| Illinois: | |
| Belleville, Four Mile Lake | 200 |
| Casey, Weaver's pond | 200 |
| Cherry Point, Grove Pond | 100 |
| Chicago, Barrington Ponds | 150 |
| Clinton, Weldon Springs Lake | 300 |
| Coulterville, Illinois Central Railroad Lake | 200 |
| Decatur, Decatur Club Lake | 2,450 |
| Effingham, Grenel's pond | 100 |
| Hinsdale, Salt Creek | 500 |
| Honey Bend, Crawford Ponds | 100 |
| Jacksonville, Nichols Park Lake | 200 |
| La Harpe, Prairie Pond | 200 |
| Litchfield, Chatauqua Lake | 300 |
| Marshall, Chrystal Lake | 300 |
| Martinsville, Buckle Pond | 200 |
| Mascoutah, Schroeder's pond | 200 |
| Meredosia, Illinois River | 150 |
| Mississippi River | 100 |
| Millstadt, Bluffside Lake | 200 |
| Mitchell, Long Lake | 750 |
| Momence, Kankakee River | 400 |
| Oakland, Embarras River | 400 |
| Rockefeller, Lake Era | 300 |
| Shipman, Clarks Lake | 200 |
| Sigel, Sonne's pond | 100 |
| Watseka, Iroquois River | 400 |
| Iowa: | |
| Anamosa, Buffalo River | 400 |
| Ayrshire, Silver Lake | 500 |
| Bellevue, Mississippi River | 7,800 |
| Casey, Skellenger's pond | 100 |
| Chester, Upper Iowa River | 800 |
| Clarion, Elm Lake | 400 |
| Dyersville, Maquoketa River | 400 |
| Eldora, Iowa River | 800 |
| Fort Atkinson, Turkey River | 400 |
| Harlan, Willow Shade Pond | 100 |
| Hazleton, Otter Creek | 500 |
| Sewal, Collins Pond | 700 |
| Worthington, Maquoketa River | 400 |
| Kansas: | |
| Alma, Mill Creek | 300 |
| Attica, Campbell's pond | 100 |
| Edna, Kendalls Elm Lake | 100 |
| Fort Scott, Marmaton River | 300 |
| Mill Creek | 300 |
| Paint Creek | 300 |
| Fredonia, Coleman Pond | 100 |
| Frater Lake | 200 |
| Pierce's lake | 150 |
| Frontenac, Fishing Club Ponds | 400 |
| Jones's pond | 100 |
| Harper, Island Pond | 100 |
| Huron, Anthony's pond | 900 |
| Kling, Cement Company Lake | 300 |
| Medicine Lodge, Best's pond | 300 |
| Ellis Lake | 100 |
| Neutral, Ransom's lake No. 2 | 200 |
| Tyro, Tyro Lake | 200 |
| Vermillion, Midland Pond | 100 |
| Kentucky: | |
| Bowling Green, Doore's pond | 100 |
| Clinton, Sunset Pond | 100 |
| Danville, Cecils Pond | 100 |
| Dix River | 200 |
| Fidelio, Cherry's pond | 100 |
| Kentucky—Continued. | |
| Fredonia, Brasher's pond | 100 |
| Garner Lake | 100 |
| Mun's pond | 100 |
| Slick Bank Pond | 100 |
| Greenbrier, Lake Greenbrier | 200 |
| Greenville, Finley's pond | 100 |
| Guthrie, Northington's pond | 100 |
| Harrodsburg, Spring Lake | 100 |
| Hempridge, Sessee's pond | 100 |
| High Bridge, Dorman's pond | 100 |
| Howell, King Pond | 100 |
| Wilson's pond | 100 |
| La Center, Baker's pond | 200 |
| Lawrenceburg, Lake Geronimo | 200 |
| Marrs Lake | 100 |
| Lexington, Belmont Pond | 400 |
| Louisville, Cardinal Hill Pond | 100 |
| Deer Lick Pond | 100 |
| Harris Lake | 100 |
| Klondyke Pond | 100 |
| Lake Lansdowne | 400 |
| Liter's pond | 100 |
| Ohio River | 6,200 |
| Shadyside Lake | 200 |
| Wagner's pond | 100 |
| Middlesborough, Fern Lake | 725 |
| Nicholasville, Bryant's pond | 100 |
| Farra's pond | 100 |
| Simpson Lake | 100 |
| Paducah, Goodman's pond | 100 |
| Russellville, Browning Pond | 100 |
| Noe Pond | 100 |
| Orange Pond | 100 |
| Wild Goose Pond | 100 |
| Shelby City, Smith's pond | 100 |
| Shelbyville, Hall's lake | 200 |
| Lake Jonoreckqua | 200 |
| Snook Pond | 100 |
| Stanley Lake | 100 |
| Stanley's pond | 100 |
| Spring Station, Blackburn's pond | 600 |
| Canewood Pond | 100 |
| Stanford, Bright's pond | 75 |
| Fish's pond | 100 |
| Sturgis, Willingham's pond | 100 |
| Wilmore, Lowry Pond | 100 |
| Maryland: | |
| Landover, Indian Pond | 150 |
| Washington Junction, Doubs Creek | 200 |
| Massachusetts: | |
| Plymouth, South Triangle Pond | 400 |
| Michigan: | |
| Bellaire, Intermediate Lake | 200 |
| Clyde, Pettibone Lake | 100 |
| Spring Lake | 100 |
| White Lake | 150 |
| Doster, Pine Lake | 150 |
| Grand Rapids, Grand River | 100 |
| Indian River, Indian River | 150 |
| Rose Center, Green Lake | 100 |
| North Buckhorn Lake | 150 |
| Minnesota: | |
| Hokah, Pettibone Park Lake | 300 |
| Lanesboro, Root River | 200 |
| Root River, branch of | 200 |
| Root River, North Branch | 200 |
| Root River, South Branch | 200 |
| Le Roy, Little Iowa River | 200 |
| Mill Pond | 100 |
| Preston, Root River, North Branch | 200 |
| Root River, South Branch | 200 |
| Rochester, Zumbro River, South Branch | 200 |
| Rushford, Root River | 200 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

CRAPPIE AND STRAWBERRY BASS—Continued.

| Disposition. | Fingerlings. |
|---|---|
| Minnesota—Continued. | |
| Spring Valley, Deer Creek | 200 |
| Taylors Falls, St. Croix River | 400 |
| Mississippi: | |
| Centerville, Anderson's pond | 60 |
| Ingleside Pond | 100 |
| Lake View | 100 |
| Columbus, Tombigbee River | 400 |
| Edwards, Kids Lake | 200 |
| King Lake | 100 |
| Whites Mill Pond | 25 |
| Gloster, Fern Lake | 30 |
| Jackson's pond | 30 |
| Ratcliff Creek | 60 |
| Hickory, Caraway's pond | 100 |
| Jackson, Fair Ground Pond | 200 |
| Manhattan Pond | 200 |
| Round Hole Lake | 325 |
| Learned, Clear Lake | 60 |
| Martin, Placid Pond | 60 |
| Shannon, Crubaugh's pond | 100 |
| Smith Station, Gibbs Lake | 200 |
| Ginn Lake | 50 |
| Montgomery's pond | 50 |
| Stallo, Jackson's pond | 500 |
| Utica, Carmichael's pond | 60 |
| Vicksburg, Long Lake | 300 |
| West Point, Malone's pond | 100 |
| Missouri: | |
| Blackburn, Blackburn Pond | 200 |
| Bridgeton, Edrus Lake | 500 |
| Centralia, Lake Dutcher | 200 |
| Chilhowie, Osborn's pond | 100 |
| Clayton, Wolff's lake | 100 |
| Clinton, Fish Lake | 300 |
| Drexel, Silver Lake | 100 |
| Silver Pond | 100 |
| Firma, Piscatorial Lake | 300 |
| Huntsville, Clear Ridge Pond | 100 |
| Rutherford's pond | 100 |
| Kansas City, Fairmount Lake | 300 |
| Witte's lake | 200 |
| Witte's pond | 200 |
| Lebanon, Mayfield's pond | 100 |
| Liberty, Petty's lake | 100 |
| Marshall, Lake Saline | 200 |
| Marceline, Marceline City Reservoir | 200 |
| Santa Fe Reservoir | 200 |
| Medford, Medford Reservoir | 300 |
| Oak Grove, Deep Water Pond | 100 |
| Mill Pond | 100 |
| Parkville, Emily Heights Pond | 100 |
| Pendleton, Lake Farm Pond | 600 |
| Pierce City, Saulsbury's pond | 100 |
| St. James, Dellacella Ponds | 300 |
| St. Joseph, Missouri River | 150 |
| South Greenfield, Dicus Pond | 100 |
| Montana: | |
| Kalispell, Emmert Lake | 160 |
| New York: | |
| Chatham, Kinderbrook Creek | 100 |
| Ithaca, Experimental Ponds | 200 |
| Gloversville, East Garoga Lake | 300 |
| West Garoga Lake | 300 |
| Petersburg, Taconce Lake | 400 |
| Ohio: | |
| Chippewa Lake, Chippewa Lake | 200 |
| Dunkirk, Groat's pond | 100 |
| Fredericksburg, Salt Creek | 100 |
| Lima, Lake Picquita | 100 |
| Perry, Brown's pond | 100 |
| Ravenna, Crystal Lake | 200 |
| Salem, Salem Country Club Pond | 300 |
| Wharton, Wise Pond | 100 |
| Oklahoma: | |
| Ardmore, Chickasaw Lake | 1,000 |
| McCullom's lake | 100 |
| Pats Lake | 200 |
| Oklahoma—Continued. | |
| Elgin, Shirk's pond | 100 |
| Willow Pond | 100 |
| Guthrie, Overtons Lake | 200 |
| Reddingtons Lake | 200 |
| Twin Lakes | 200 |
| Walkers Lake | 200 |
| Lawton, Chandler Creek | 300 |
| Durbar Pond | 100 |
| Indian Creek | 100 |
| Lake Gondola | 200 |
| Little Medicine Creek | 200 |
| Medicine Creek | 200 |
| Medicine Lake | 200 |
| Medicine Park Lake | 200 |
| Shirk's pond | 100 |
| Simpson's pond | 200 |
| Spencer Creek | 100 |
| McAlester, McAlester Country Club Lake | 300 |
| Marietta, Blake Lake | 100 |
| Campbell's pond | 100 |
| Grassey Pond | 100 |
| High Lake | 100 |
| Hovenkamp Lake | 200 |
| McKinney Lake | 100 |
| Marietta Lake | 100 |
| Piland's pond | 100 |
| Mustang, Henry's lake | 100 |
| Noble, Montgomery Lake | 100 |
| Purcell, Black Jack Pond | 200 |
| Conkling's pond | 100 |
| Shawnee, Lomey's pond | 200 |
| Waterloo, Schwake's pond | 100 |
| Oregon: | |
| Carlton, Carlton Lake | 180 |
| Pennsylvania: | |
| Hamburg, Schmick's pond | 100 |
| Mohrsville, Beckers Mill Pond | 100 |
| Philadelphia, Fairmount Park Aquarium | 130 |
| Ryde, Juniata River | 400 |
| South Dakota: | |
| Ardmore, Pease Lake | 200 |
| Murdo, Railroad Pond | 100 |
| Philip, Grindstone Creek | 100 |
| Plankinton, Fish Lake | 300 |
| Pukwana, Millage's pond | 100 |
| Tennessee: | |
| Hampton, Biggars Pond | 100 |
| Cakes Pond | 300 |
| Henning, Rice's pond | 80 |
| Norma, Lake Christine | 1,400 |
| Texas: | |
| Dallas, Weichsell's pond | 50 |
| Greenville, Compress Pond | 25 |
| McCombs Lake | 25 |
| Wise's pond | 25 |
| Livingston, Israel Pond | 25 |
| New Braunfels, Comal Creek | 100 |
| Comal River | 100 |
| San Antonio, Elmendorf Lake | 35 |
| San Marcos, San Marcos River | 150 |
| Tenaha, Oxner Lake | 25 |
| Waxahachie, Brown's pond | 25 |
| Spalding Lake | 25 |
| Vermont: | |
| Ludlow, Lake Okemo | 200 |
| Virginia: | |
| Beaver Dam, Little River | 500 |
| Thompson's pond | 100 |
| Ellerson, Rutland Club Lake | 200 |
| Emporia, Mill Pond | 350 |
| Leesburg, Lime Kiln Pond | 100 |
| Manchester, Collom Pond | 200 |
| Selden's pond | 200 |
| Petersburg, Spicers Pond | 200 |
| Richmond, Darbytown Pond | 200 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

CRAPPIE AND STRAWBERRY BASS—Continued.

| Disposition. | Fingerlings. | Disposition. | Fingerlings. |
|---|---|---|---|
| Virginia—Continued. | | Washington—Continued. | |
| Richmond, Ellerslie Pond | 100 | Tacoma, Balches Lake | 90 |
| Gerheart Pond | 200 | Church Lake | 90 |
| Glendale Pond | 200 | Gravelly Lake | 90 |
| Hopewell Pond | 200 | Kreger Lake | 90 |
| Johnson's pond | 200 | Osting Lake | 90 |
| Joseph Bryan Pond | 200 | Rapjohn Lake | 90 |
| Licking Creek Club Pond | 200 | Spanaway Lake | 90 |
| Powells Pond | 400 | Steilacoom Lake | 90 |
| Providence Forge Pond | 100 | West Virginia: | |
| Water View Mill Pond | 100 | Shepherdstown, Potomac River | 1,345 |
| Westham Club Pond | 200 | Wisconsin: | |
| Yaley's pond | 200 | Mercer, Trude Lake | 500 |
| Washington: | | Wyoming: | |
| Moab, Newman Lake | 200 | Shoshoni, Power Pond | 300 |
| Spokane, Clear Lake | 200 | | |
| Tacoma, American Lake | 90 | Total [a] | 79,279 |

ROCK BASS.

| | | | |
|---|---|---|---|
| Alabama: | | Kansas: | |
| Altoona, Durham Spring Pond | 100 | Lillis, Midland Pond | 400 |
| Bessemer, Veitch's lake | 100 | Kentucky: | |
| Erin, Ramsey's pond | 100 | Banklick, William's pond | 100 |
| Girard, McMurrain's pond | 150 | Chilesburg, Crimms Quarry Pond | 150 |
| Midland City, Byrd Pond | 150 | Franklin, Roark's pond | 100 |
| Montgomery, Crescent Lake | 500 | Steward's pond | 100 |
| Oneonta, Sand Lake | 200 | Guthrie, Hibiscus Lake | 200 |
| Russellville, Devany Pond | 150 | Hodgenville, Ford's pond | 100 |
| Arkansas: | | Stark's pond | 200 |
| Alexander, Blevins's pond | 250 | Hyattsville, Hurt's pond | 100 |
| Elkins, Mountain Brook Lake | 400 | La Grange, Morgan's pond | 100 |
| Hackett, Forbes's pond | 400 | Lebanon, Jackson's pond | 100 |
| Hoxie, Phoenix Cotton Oil Co.'s pond | 250 | Middlesborough, Fern Lake | 200 |
| Georgia: | | Mount Sterling, Cooper's pond | 100 |
| Adel, Hutchison's pond | 100 | Munfordville, Chapman's pond | 100 |
| Atlanta, Whiteman's pond | 75 | Shelbyville, Watkins Pond | 100 |
| Blue Ridge, Anderson's pond | 75 | Stanford, Shanks's pond | 100 |
| Bronwood, Horseshoe Lake | 300 | Louisiana: | |
| Crawfordville, Chapman's pond | 75 | Shreveport, Big Lake | 100 |
| Dawson, Baldwin's pond | 150 | Maryland: | |
| Fairburn, Brantley's pond | 150 | Cropley, Potomac River | 200 |
| Brassell's pond | 100 | Ellicott City, Powell's pond | 230 |
| Hill City, Copeland's pond | 150 | Long Green Station, Quarry Pond | 100 |
| Madison, Poplar Pond | 75 | Rogers, Robinson's pond | 230 |
| Norristown, Mule Pen Pond | 350 | Massachusetts: | |
| Rome, Simpson's pond | 100 | Hingham, Foley's pond | 100 |
| Roswell, Bowen's lake | 150 | Norfolk, Hillside Pond | 100 |
| Lummus's pond | 150 | Minnesota: | |
| Ocmulgee Lake | 150 | Rochester, Zumbro Mill Pond | 250 |
| Rutledge, Estes Pond | 75 | Mississippi: | |
| Stone Mountain, Venable Lake | 150 | Amory, Pride Pond | 100 |
| Tate, Creole Quarry Pond | 75 | Booneville, Mason's lake | 175 |
| Etowah Quarry Pond | 75 | Brooksville, Hendrix Pond | 100 |
| Valdosta, Fly Pond | 100 | Edwards, Marsh's pond | 150 |
| Illinois: | | Gloster, Berryhill's pond | 150 |
| Belleville, Fern Glen Lake | 300 | Jackson, Raines's pond | 225 |
| Heinemann Lake | 400 | Simmon's pond | 225 |
| Decatur, Decatur Club Lake | 1,750 | Learned, Haman's pond | 150 |
| Edwardsville, Oak Hill Pond | 100 | McComb, Illinois Central Reservoir | 150 |
| Peoria, Exposition Park Lake | 200 | Natchez, Mount Airy Pond | 150 |
| Shipman, Olmsted's pond | 100 | New Albany, Thompson's pond | 150 |
| Toulon, Craig's pond | 100 | Ripley, Nance's pond | 300 |
| Indiana: | | Starkville, Cunningham's pond | 150 |
| Bloomfield, Emery's pond | 150 | Waynesboro, Pattons Creek | 100 |
| Brazil, Macbeth's pond | 100 | West Point, Hamlin's ponds | 200 |
| Chandler, Locust Pond | 150 | Missouri: | |
| Ferdinand, Muller's pond | 100 | Bunceton, Doublin Branch | 300 |
| Morris, Merkel's pond | 150 | Coal Bank Creek | 300 |
| Osgood, Hallgarth's pond | 100 | Stephens Branch | 300 |
| Rushville, Green's pond | 150 | Cabool, Coyle Lake | 300 |
| Iowa: | | Crane, Crane Creek | 400 |
| Chester, Upper Iowa River | 225 | Independence, Rose Hill Lake | 100 |
| Malvern, Craig's pond | 200 | Whites Lake | 400 |

[a] Lost in transit, 3,180.

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

ROCK BASS—Continued.

| Disposition. | Fingerlings. |
|---|---|
| Missouri—Continued. | |
| Marshall, Hennesy Lake | 400 |
| Nadja, Spring Lake | 200 |
| Neosho, Hickory Creek | 1,598 |
| Nevada, State Hospital Lake | 300 |
| Oak Grove, Bluewater Pond | 400 |
| Osborn, McQuate's pond | 300 |
| Pearl, Shady Brook Pond | 150 |
| Rolla, Big Beaver Creek | 800 |
| Big Dry Fork Creek | 400 |
| Kentuck Creek | 600 |
| Lake Frisco | 450 |
| Little Beaver Creek | 400 |
| Little Piney Creek | 400 |
| North Mill Creek | 450 |
| Renix Lake | 300 |
| Springfield, Tawasentha Lake | 400 |
| New York: | |
| Middletown, Wallkill River | 350 |
| Whitestone, Fort Totten Pond | 350 |
| North Carolina: | |
| Candor, Clark's pond | 150 |
| Catawba, Bridge's pond | 200 |
| Davidson, Linden Pond | 100 |
| Durham, Chemical Company Pond | 100 |
| Eno River | 800 |
| Goldsboro, Foldsame Pond | 200 |
| Kinston, Marston's pond | 300 |
| Matthews, Lilly's pond | 100 |
| Ohio: | |
| Batavia, Nepper's pond | 150 |
| Blue Ash, Clift Farm Lake | 150 |
| Chippewa Lake, Chippewa Lake | 400 |
| Congress Lake, Congress Lake | 500 |
| Springfield, Red Bud Lake | 100 |
| Williamsburg, Deeny's pond | 100 |
| Oklahoma: | |
| Ardmore, Cruce Lake | 300 |
| Dings Lake | 300 |
| Fairview Lake | 200 |
| Maxwell's pond | 100 |
| Potter Lake | 300 |
| Enid, Matthews's pond | 100 |
| Spring Creek | 200 |
| Mangum, Cowan's pond | 100 |
| Milburn, Smedley's pond | 100 |
| Young's pond | 100 |
| Morrison, Turner's pond | 100 |
| Stillwell, English's pond | 100 |
| Shawnee, Maud Lake | 300 |
| Tulsa, Frye's pond | 100 |
| Warner, Switzer's pond | 100 |
| Pennsylvania: | |
| Chester, Ridley Creek | 400 |
| Lebanon, Conewago Lake | 300 |
| Water House Lake | 300 |
| Lehighton, Parryville Pond | 230 |
| Pottsville, Rilands Pond | 230 |
| Rhode Island: | |
| Slocum, Gray's pond | 100 |
| South Carolina: | |
| Catawba, Lesslie's pond | 200 |
| Donalds, Cedar Pond | 200 |
| White Oak Pond | 400 |
| Newberry, Digby's pond | 100 |
| Lawrens, Bolt Branch | 400 |
| Rock Hill, Crockett Farm Pond | 300 |
| Massey's pond | 300 |
| Spartanburg, Moss Springs Pond | 100 |
| Walhalla, Devil's Fork Creek | 200 |
| Oconee Creek | 200 |
| Tennessee: | |
| Chattanooga, Lake Lookout | 225 |
| Niota, Schumann's pond | 75 |
| Texas: | |
| Belcherville, Benton Pond | 60 |
| Bering, Valda Lake | 75 |
| Burton, Eberhardt's pond | 50 |
| Mayfield Pond | 50 |
| Texas—Continued. | |
| Carmine, Nagel's pond | 50 |
| Crystal City, Coleman's pond | 75 |
| Popper's pond | 75 |
| Denison, Duck Creek | 50 |
| Paw Paw Creek | 50 |
| Shawnee Lake | 100 |
| Eddy, Bridgewater's pond | 50 |
| Wilkinson's lake | 50 |
| Elgin, Christian's lake | 50 |
| Thomas's pond | 50 |
| Fate, McLendon's pond | 50 |
| Fort Worth, Duringer Lake | 125 |
| Frankston, De Long Lake | 100 |
| Giddings, Boettcher Lake | 50 |
| Kluge's pond | 50 |
| Gilmer, Highland Pond | 175 |
| Reynold's pond | 175 |
| Holland, Houston's pond | 50 |
| Reed's pond | 50 |
| Houston, Bering's pond | 75 |
| Joaquin, Blackmon's pond | 75 |
| Marion, Ebert's pond | 50 |
| New Braunfels, Comal River | 200 |
| Paige, Sunny Slope Pond | 50 |
| Purdon, Peden's pond | 40 |
| San Antonio, Dullnig's lakes | 150 |
| Reichert's pond | 100 |
| Spofford, Stratton's pond | 100 |
| Terrell, Ables Pond | 100 |
| Britton's pond | 100 |
| Childress Pond | 100 |
| Cook's pond | 100 |
| Dennis Pond | 100 |
| Edwards's pond | 100 |
| Elliott's pond | 100 |
| Evans Lake | 100 |
| Fleetwood's pond | 100 |
| Flowers Pond | 100 |
| Garland Pond | 100 |
| Harmon Pond | 100 |
| Henderson Pond | 100 |
| Hopkins Pond | 100 |
| Johnson Pond | 100 |
| McClung's pond | 100 |
| Martin's pond | 100 |
| Moore Pond | 100 |
| Muckleroy's lake | 100 |
| Mullins Pond | 100 |
| Roberts Lake | 100 |
| Sandford's pond | 100 |
| Stallings's pond, No. 1 | 100 |
| Stallings's pond, No. 2 | 100 |
| Stoys Pond | 100 |
| Waters Pond | 100 |
| Virginia: | |
| Bedford City, McGhee's pond | 100 |
| Bridgewater, Crystal Lake | 500 |
| Burnt Chimney, Cox's pond | 100 |
| Charlottesville, Rappahannock River | 300 |
| Danville, Haymore Pond | 100 |
| Hill's pond | 100 |
| Merriewold Lake | 400 |
| Dillwyn, Rolfton Pond | 300 |
| East Radford, Sale's pond | 100 |
| Evington, Davis's pond | 100 |
| Ould's pond | 300 |
| Glasgow, Moose Pond | 200 |
| Lanexa, Woodward's pond | 200 |
| Lynchburg, Carroll's pond | 200 |
| Mineral, Loving's pond | 300 |
| Palmyra, Cunningham Creek | 500 |
| Paynes Siding, Isaac Walton Pond | 400 |
| Philpott, De Hart's pond | 100 |
| Hartville Pond | 100 |
| Providence Forge, Providence Forge Pond | 500 |
| Remington, Rose Dale Pond | 200 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

ROCK BASS—Continued.

| Disposition. | Fingerlings. |
|---|---|
| Virginia—Continued. | |
| Richmond, Youngs Pond | 500 |
| Ringgold, McLaughlin's pond | 430 |
| Rock Castle, Finch's pond | 500 |
| Roxbury, Cosby Mill Pond | 500 |
| Salem, Roanoke River | 500 |
| Scottsville, Chester Pond, No. 1 | 300 |
| Chester Pond, No. 2 | 300 |
| Smithfield, Porter's pond | 400 |
| Somerset, Yager's pond | 300 |
| State Farm, State Farm Pond | 300 |
| Stuart, Mayo River | 250 |
| Thaxton, Sublett's pond | 100 |
| Tunstall, Hampstead Pond | 400 |
| Walkers, Christian's pond | 500 |
| Vaidens Pond | 1,000 |
| Virginia—Continued. | |
| Warren, Black Rock Pond | 200 |
| Windsor, Porters's pond | 400 |
| Wytheville, Baumgardner's pond | 300 |
| Washington: | |
| Tacoma, American Lake | 300 |
| Gravelly Lake | 300 |
| Steilacoom Lake | 200 |
| West Virginia: | |
| Colcord, White Oak Pond | 200 |
| Mullens, Barkers Creek | 100 |
| Shepherdstown, Potomac River | 7,000 |
| Woodlands, Meadowdale Pond | 200 |
| Yoho's pond | 200 |
| Total [a] | 64,743 |

WARMOUTH BASS.

| Disposition. | Fingerlings. |
|---|---|
| Maryland: | |
| Great Falls, Potomac River | 1,115 |
| Georgia: | |
| Norcross, Lake Hoyle | 125 |
| Mississippi: | |
| Yazoo City, Ewing Pond | 150 |
| Total | 1,390 |

SMALL-MOUTH BLACK BASS.

| Disposition. | Fry. | Fingerlings. |
|---|---|---|
| Arkansas: | | |
| Mammoth Spring, Spring River | | 8 |
| Many Islands, Spring River | | 95 |
| St. Francis, St. Francis River | | 1,350 |
| Sylamore, North Sylamore Creek | | 180 |
| South Sylamore Creek | | 180 |
| Colorado: | | |
| Arboles, Piedra River | | 300 |
| Littleton, South Platte River | | 200 |
| Connecticut: | | |
| Norwich, Gardner Lake | | 120 |
| State Line, Forest Lake | | 200 |
| Delaware: | | |
| Harrington, Smith's pond | | 120 |
| Seaford, Williams Pond | | 120 |
| Townsend, Noxentown Pond | | 120 |
| Florida: | | |
| Tavares, Lake Tavares | | 400 |
| Georgia: | | |
| Atlanta, aquarium, State Capitol | | 12 |
| Concord, Evergreen Pond | | 650 |
| Lake Park, White Water Club Pond | | 400 |
| Idaho: | | |
| Hauser, Mud Lake | | 100 |
| Illinois: | | |
| Anna, Kohler Pond | | 250 |
| Barstow, Rock River | | 2,000 |
| Dixon, Rock River | | 300 |
| Lake Villa, Douglas Lake | | 225 |
| Indiana: | | |
| Anderson, Fall Creek | | 600 |
| Killbuck Creek | | 400 |
| White River | | 600 |
| Indiana—Continued. | | |
| Brooklyn, White Lick Creek | | 500 |
| Columbia City, Cedar Lake | | 600 |
| Round Lake | | 600 |
| Tippecanoe Lake | | 600 |
| Corydon, Indian Creek | | 150 |
| Culver, Lake Maxinkuckee | | 1,000 |
| Dupont, Guthries Park Pond | | 500 |
| Indianapolis, Buck Creek | | 1,000 |
| Eagle Creek | | 1,250 |
| Sugar Creek | | 1,250 |
| White River | | 1,000 |
| North Vernon, Otter Creek | | 250 |
| Vincennes, Frisz Lake | | 150 |
| Iowa: | | |
| Chester, Upper Iowa River | | 225 |
| Decorah, Iowa River | | 2,000 |
| Mason City, Lime Creek | | 1,500 |
| New London, Sunapee Lake | | 200 |
| Riceville, Little Cedar River | | 100 |
| Kansas: | | |
| Garnett, Cedar Creek | | 250 |
| Kentucky: | | |
| Auburn, Clear Fork Creek | | 600 |
| Bowling Green, Drakes Creek | | 1,400 |
| Barren River | | 1,400 |
| Buchanan, Big Sandy River | 15,000 | |
| Cadiz, Donaldson Creek | | 900 |
| Central City, Martwick Pond | | 600 |
| Clermont, Echo Lake | | 1,400 |
| Crab Orchard, Dix River | 5,000 | |
| Danville, Dix River | 20,000 | |
| Frankfort, Elkhorn River | 15,000 | |
| Hopkinsville, Little River | | 2,200 |
| Little River, Sinking Fork | | 1,400 |
| Hyattsville, Hiatt's pond | 5,000 | |

[a] Lost in transit, 450.

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

SMALL-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings. |
|---|---|---|
| Kentucky—Continued. | | |
| Lancaster, Hanging Fork River | 15,000 | |
| Lebanon, Office Pond | | 1,400 |
| Salt River, Rolling Fork | | 1,400 |
| Maine: | | |
| Ayers Junction, Meddybemps Lake | 1,200 | |
| Oakland, Little Pond | 1,200 | |
| Sherman Station, Salmon Stream Lake | 1,200 | |
| Maryland: | | |
| Baltimore, Magothy River | | 120 |
| Cropley, Potomac River | | 120 |
| Detour, Double Pipe Creek | | 60 |
| Eccleston, The Caves Pond | | 60 |
| Great Falls, Potomac River | | 3,640 |
| Hagerstown, Antietam River | 15,000 | |
| Jones Station, Park Lake | 6,000 | |
| Timonium, Price's lake | | 60 |
| Westminster, Myers Lake | 5,000 | |
| Massachusetts: | | |
| Ashburnham, Vankeag Lake | 1,200 | |
| Charlton Depot, Williams Meadow Pond | 800 | |
| Congamond, Congamond Lake | | 100 |
| Ipswich, Symond's pond | 800 | |
| Lee, Greenwater Lake | 1,200 | |
| Stockbridge Lake | 1,200 | |
| Lynn, Upper Pond | 400 | |
| Orleans, Bucks Pond | 1,200 | |
| Palmer, State fish commission | 1,200 | |
| Webster, Webster Lake | 1,200 | |
| Peter Pond | 800 | |
| West Barnstable, Joshua Pond | | 100 |
| Williamsburg, Highland Lake | 1,000 | |
| Michigan: | | |
| Athens, Nottawa River | | 800 |
| Baldwin, Little Star Lake | | 800 |
| Bellaire, Grass Lake | | 600 |
| Calumet, Beaver Lake | | 162 |
| Breakfast Lake | | 324 |
| Deer Lake | | 324 |
| Central Lake, Intermediate Lake | | 600 |
| Clarkston, Deer Lake | | 800 |
| Davisburg, Big Lake | | 800 |
| Drayton Plains, Loon Lake | | 800 |
| Eagle Harbor, Duncans Bay | | 170 |
| East Tawas, Bass Lake | | 2,000 |
| Ellsworth, Chain of Lakes | | 600 |
| Fenton, Donavan Lake | | 800 |
| Haslett, Pine Lake | | 800 |
| Holly, Bush Lake | | 800 |
| Humboldt, Flat Lake | | 162 |
| Silver Lake | | 162 |
| Ishpeming, Flat Lake | | 400 |
| Lakeland, Zuke Lake | | 2,000 |
| Lake Station, Crooked Lake | | 600 |
| Linden, Days Lake | | 800 |
| Milford, Steeple Hill Lake | | 1,000 |
| Muskegon, Wolf Lake | | 800 |
| Otsego Lake, Otsego Lake | | 3,000 |
| Palatka, Chicagon Lake | | 160 |
| Spring Lake, Spring Lake | | 2,000 |
| Turtle, Bear Lake | | 600 |
| Clearwater Lake | | 400 |
| Hawk Lake | | 600 |
| Independence Lake | | 600 |
| Little African Lake | | 400 |
| Ormes Lake | | 600 |
| Rowe Lake | | 400 |
| Vicksburg, Thurgirls Lake | | 800 |
| Watersmeet, Allen Lake | | 560 |
| Bass Lake | | 400 |
| Beaver Lake | | 560 |
| Darling Lake | | 160 |
| Michigan—Continued. | | |
| Watersmeet, Duck Lake | | 760 |
| East Bear Lake | | 760 |
| Lake Marion | | 560 |
| Lake Mary | | 160 |
| Reef Lake | | 400 |
| Round Lake | | 560 |
| Wolf Lake | | 400 |
| Wingleton, Hammond Lake | | 800 |
| Minnesota: | | |
| Duluth, Evens Lake | | 340 |
| Ely, Burntside River | | 340 |
| Le Roy, Minnesota River | | 180 |
| Wildwood Pond | | 180 |
| Ogema, White Earth Lake | | 360 |
| Osakis, Osakis Lake | | 360 |
| St. Peter, Lake Emily | | 100 |
| Lake Jefferson | | 100 |
| Lake Washington | | 100 |
| Spring Valley, Spring Creek | | 225 |
| Taylors Falls, St. Croix River | | 360 |
| Watab, Little Rock Lakes | | 360 |
| Nebraska: | | |
| Gordon, Clear Lake | | 200 |
| Horseshoe Lake | | 275 |
| New Hampshire: | | |
| Antrim, Gregg Pond | 1,200 | |
| Wildwood Pond | 400 | |
| Berlin, Head Pond | 800 | |
| Canaan, Crystal Lake | 1,200 | |
| Milford, Baboosic Lake | 1,200 | |
| Pittsfield, Jenness Pond | 800 | |
| Plaistow, Angle Pond | 800 | |
| Walpole, Connecticut River | 800 | |
| New York: | | |
| Clayton, St. Lawrence River | | 5,800 |
| La Grange, Ikes Pond | | 200 |
| Monroe, Mountain View Lake | | 100 |
| Roscoe, Lakewood Lake | | 100 |
| Walden, Wallkill River | | 300 |
| West Pawling, Whaley Pond | | 100 |
| North Carolina: | | |
| Gela, Lake Caldwell | | 585 |
| Liberty, Coxe's pond | | 290 |
| Ohio: | | |
| Akron, Cuyahoga River | | 300 |
| Dayton, Patterson's pond | | 75 |
| Tiffin, Sandusky River | | 300 |
| Oregon: | | |
| Carlton, Carlton Lake | | 100 |
| Pennsylvania: | | |
| Greensburg, Keystone Lake | | 200 |
| Lancaster, Conestoga River | | 200 |
| Peach Bottom, Susquehanna River | | 240 |
| Philadelphia, Darby Creek and tributaries | | 200 |
| Tionesta, Allegheny River | | 280 |
| Tennessee: | | |
| Perryville, Buffalo River | | 75 |
| Utah: | | |
| Provo, Utah Lake | | 160 |
| Vermont: | | |
| Brandon, Lake Hortonia | 6,000 | |
| Cambridge, Half Moon Pond | 1,500 | |
| Medcalf Pond | 1,500 | |
| Concord, Hall's pond | | 200 |
| Danville, Mud Pond | 2,000 | |
| Enosburg, Lake Carmi | 2,000 | |
| Fletcher, Metcalf Pond | | 200 |
| Groton Pond, Groton Lake | 2,000 | |
| Hardwick, Valley Lake | 2,000 | |
| Jamaica, Adams Pond | | 400 |
| Johnson, Lamoille River | 2,000 | |
| Lyndonville, Center Pond | 4,000 | |
| Middlebury, Otter Creek | 9,000 | |
| Miles Pond, Miles Pond | | 300 |

Distribution of Fish and Fish Eggs, by Locality and Species, Fiscal Year 1913—Continued.

SMALL-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Finger-lings. |
|---|---|---|
| Vermont—Continued. | | |
| Morrisville, Big Pond | 1,000 | |
| Collins Pond | 2,000 | |
| Lake Lamoille | 2,000 | |
| Proctor, Burr Pond | 1,500 | |
| Rutland, Burr Pond | 1,500 | |
| East Pittsford Pond | 1,500 | |
| Meadow Lake | 2,000 | |
| South Ryegate, Halls Pond | 1,500 | |
| Round Pond | 1,500 | 200 |
| Walden, Cole's pond | 2,000 | |
| Swanton, Lake Champlain | | 600 |
| West Danville, Joe's pond | | 200 |
| Wolcott, Wolcott Pond | | 200 |
| Virginia: | | |
| Ashby Station, Shenandoah River | 15,000 | |
| Fredericksburg, Rappahannock River | | 200 |
| Great Falls, Potomac River | | 230 |
| Salem, Roanoke River | | 200 |
| Washington: | | |
| Calvert, Buckeye Lake | | 100 |
| Calvert Lake | | 100 |
| Loon Lake, Loon Lake | | 200 |
| West Virginia: | | |
| Capon Springs, Cacapon River | 18,000 | |
| Keyser, Pattersons Creek | | 216 |
| Martinsburg, Back Creek | | 200 |
| Opequon Creek | | 200 |
| Potomac River | | 324 |
| Renick, Greenbrier River | 10,000 | |
| Romney, Potomac River, South Branch | | 200 |
| Wellsburg, Buffalo Creek | 10,000 | |
| Cross Creek | 10,000 | |
| Wheeling, State Fair Aquarium | | 17 |
| Wisconsin: | | |
| Amery, Clare Lake | | 360 |
| Round Lake | | 360 |
| Armstrong Creek, Lake Gordon | | 324 |
| Lake Hilbert | | 324 |
| Lake Laura | | 324 |
| Baldwin, Balsam Lake | | 360 |
| Cable, Wiley Lake | | 360 |
| Chetek, Bass Lake | | 360 |
| Centuria, Balsam Lake | | 540 |
| Donaldson, Donahue Lake | | 320 |
| Wisconsin—Continued. | | |
| Donaldson, Goose Lake | | 320 |
| Little Bass Lake | | 150 |
| Moon Lake | | 395 |
| Sand Lake | | 150 |
| Spring Lake | | 320 |
| Dunbar, Coleman Lake | | 324 |
| Moon Lake | | 274 |
| Elcho, Bass Lake | | 340 |
| Enterprise Lake | | 415 |
| Otter Lake | | 340 |
| Pine Lake | | 340 |
| Fond du Lac, Lake de Neveu | | 1,450 |
| Hayward, Bass Lake | | 1,080 |
| Hurley, Price Lake | | 75 |
| Iron River, Crooked Lake | | 340 |
| Pike Lakes | | 340 |
| La Crosse, French Creek | | 100 |
| Gibbs Chute Creek | | 100 |
| Hammond Chute Creek | | 100 |
| Running Creek | | 100 |
| Shingle Creek | | 100 |
| Smith Creek | | 100 |
| Manitowoc, Pigeon Lake | | 480 |
| Mercer, Trude Lake | | 300 |
| Mosinee, Half Moon Lake | | 75 |
| Lake Mosinee | | 75 |
| Wisconsin River | | 75 |
| Nashville, Crystal Lake | | 340 |
| Horseshoe Lake | | 170 |
| Little Sand Lake | | 170 |
| Mole Lake | | 340 |
| Pickerel Lake | | 340 |
| Nye, Big Lake | | 360 |
| Church Pine Lake | | 360 |
| Lake Nakomis | | 360 |
| Round Lake | | 360 |
| Pelican, Pelican Lake | | 75 |
| Superior, Amnicon Lake | | 510 |
| Three Lakes, Planting Ground Lake | | 75 |
| Vudesare, Birch Lake | | 320 |
| Pine Lake | | 320 |
| Wild Rose, Silver Lake | | 320 |
| Williams Bay, Lake Geneva | | 2,000 |
| Total | 234,300 | 107,641 |

LARGE-MOUTH BLACK BASS.

| Disposition. | Fry. | Finger-lings, yearlings, and adults. |
|---|---|---|
| Alabama: | | |
| Alton, Queenstown Lake | | 300 |
| Anniston, Cane Creek | | 300 |
| Choccolocco Creek | | 300 |
| Chulafinnee Creek | | 200 |
| Hillaby Creeks | | 100 |
| Oxford Lake | | 300 |
| Rock Creek | | 100 |
| Young's pond | | 200 |
| Bell Factory, Flint River | | 1,000 |
| Belle Mina, Beaver Dam Creek | | 500 |
| Piney Creek | | 1,000 |
| Alabama—Continued. | | |
| Bessemer, West Lake | | 180 |
| Birmingham, Cahawba Lake | | 200 |
| Central Waterworks Reservoir | | 450 |
| Giles Pond | | 400 |
| Lake Alethea | | 300 |
| McDermott's lake | | 300 |
| Mountain Lake | | 200 |
| Warren's lake | | 300 |

a Lost in transit, 3,376 fingerlings.

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Alabama—Continued. | | |
| Blount Springs, Mill Creek | | 200 |
| Carrollton, Bear Creek | | 100 |
| Lubbub Creek | | 200 |
| Lubbub Creek Pond | | 225 |
| Courtland, Big Nance Creek | | 2,000 |
| Cuba, Culpepper's pond | | 100 |
| Jarman Lake | | 200 |
| Cullman, Ryans Creek | | 300 |
| Decatur, Swan Lake | | 300 |
| Epes, Herrings Pond | | 100 |
| Hylton's pond | | 100 |
| Eutaw, Big Creek | | 300 |
| Lamb's pond | | 300 |
| Flomaton, Brown & Kiser's pond | | 465 |
| Fort Payne, Black Oak Creek | | 300 |
| Crystal Lake | | 300 |
| Sand Valley Creek | | 100 |
| Town Creek | | 300 |
| Grimes, Johnson Lake | | 100 |
| Hackleburg, Brewer Pond | | 200 |
| Haleyville, Bear Creek | | 200 |
| Flat Creek Pond | | 200 |
| Wiley Pond | | 200 |
| Huntsville, Brahan Spring Pond | | 200 |
| Briar Fork Creek | | 700 |
| Indian Creek | | 1,400 |
| Mastin Lake | | 200 |
| Jeff, Trout Bayou | | 150 |
| Kaolin, Young's pond | | 100 |
| Millport, Gentrys Mill pond | | 100 |
| Paint Rock, Paint Rock River | | 1,000 |
| Panola, Lake Lala | | 250 |
| Price's lake | | 450 |
| Phil Campbell, Bishop's ponds | | 400 |
| Russellville, Burgess Pond | | 200 |
| Hale's pond | | 200 |
| Hurst's pond | | 200 |
| Lake Charles | | 200 |
| Lake Galey | | 200 |
| Sheffield Pond | | 200 |
| Sloss Lake | | 200 |
| Scottsboro, Kirby Creek | | 500 |
| Seale, Dudley's pond | | 250 |
| Spruce Pine, Hamilton Creek | | 200 |
| Sulligent, Maddox Pond | | 100 |
| Town Creek, Meadow Lake | | 1,000 |
| Tuscaloosa, Coobs Creek | | 100 |
| Cribbs Creek | | 100 |
| Union Springs, Pond Place Pond | | 100 |
| Valley Head, Burlison's pond | | 100 |
| Vance, A. G. S. Reservoir | | 100 |
| Vance Ponds | | 100 |
| Whitney, Lake St. Ashville | | 100 |
| Woodstock, Herring Lake | | 150 |
| Ray's pond | | 150 |
| Arkansas: | | |
| Arlberg, Little Red River | | 120 |
| Argenta, Hills Lake | | 1,700 |
| Atkins, Lake Galla | | 200 |
| Blevins, Slagle's pond | | 100 |
| Clarksville, Spadra Creek | | 240 |
| Danville, Dutch Creek | | 80 |
| Dardanelle, Spring Pond | | 100 |
| Venus Lake | | 100 |
| Dermott, Bartholomew Bayou | | 400 |
| Dierks, Holly Creek | | 250 |
| Edmondson, Long Lake | | 750 |
| Elkins, White River | | 90 |
| Arkansas—Continued. | | |
| Farrell, Farrell Lake | | 600 |
| Harris Lake | | 600 |
| Hardy, Forty Islands Creek | | 300 |
| Spring River | | 900 |
| Higden, Little Red River | | 60 |
| Hot Springs, Spring Lake | | 100 |
| Imboden, Spring River | | 1,200 |
| Lancaster, Frog Bayou | | 80 |
| Little Rock, Club Lake | | 800 |
| Faulkner's lake | | 600 |
| Malvern, Throne's pond | | 500 |
| Mammoth Spring, Spring River | | 525 |
| Many Islands, Myatt Creek | | 900 |
| Spring River | | 70 |
| Marked Tree, St. Francis River | | 411 |
| Meadows, Frog Bayou | | 50 |
| Mena, Mena City Lake | | 170 |
| Miller, Little Red River | | 60 |
| Monticello, Bermuda Stock Pond | | 200 |
| Mulberry, Mulberry River | | 380 |
| Little Mulberry Creek | | 300 |
| Ozark, Horsehead Creek | | 80 |
| Mulberry River | | 400 |
| Plainview, Lumber Pond | | 600 |
| Pocahontas, Black River | | 450 |
| Eleven Points River | | 450 |
| Rosston, Haynie's pond | | 600 |
| Rottaken, Big Lake | | 400 |
| Clear Creek | | 300 |
| Fish Creek | | 200 |
| Fourche Bayou Creek | | 200 |
| Grassy Lake | | 400 |
| Horseshoe Lake | | 200 |
| Kuykendall Lake | | 400 |
| Lorance Creek | | 300 |
| Maple Creek | | 200 |
| Pennington Bayou | | 200 |
| Wolf Bayou | | 300 |
| Russellville, Berryhill Lake | | 80 |
| Illinois River | | 120 |
| Scotts, Chinault Lake | | 600 |
| Horseshoe Lake | | 760 |
| Old River | | 760 |
| Plum Bayou Lake | | 160 |
| Shirley, Red River | | 60 |
| Texarkana, Hay's pond | | 600 |
| Thompson, Mountain Lake | | 90 |
| Toltec, Mound Lake | | 600 |
| Van Buren, Lee's creek | | 50 |
| Vandervoort, Hickory Pond | | 300 |
| Wilmot, Lake Enterprise | | 150 |
| California: | | |
| East Auburn, Imperial Lake | | 166 |
| Colorado: | | |
| Boulder, Boulder Lake | | 150 |
| Burk Lake | | 150 |
| Dollar Lake | | 120 |
| Hygiene Lake | | 150 |
| Denver, Keiss Reservoir | | 80 |
| Perrin Lake | | 80 |
| Florence, Sanders Lake | | 40 |
| Fort Collins, Drake & Culver pond | | 80 |
| Grand Junction, Grand River | | 225 |
| Gunnison River | | 225 |
| Redlands Pond | | 150 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Colorado—Continued. | | |
| Niwot, Ward Lake | | 80 |
| Steamboat Springs, Yampa River | | 150 |
| Sterling, Point of Rocks Lake | | 160 |
| Connecticut: | | |
| Coscob, Pipe Stove Lake | | 50 |
| Danbury, Keystone Lake | | 50 |
| Greenwich, Putuam Lake | | 60 |
| Twin Brothers Brook | | 50 |
| Mystic, Beebe Pond | | 25 |
| South Norwalk, Crystal Lake | | 30 |
| Holy Ghost Pond | | 45 |
| Waterbury, Lake Quassapaug | | 25 |
| Westbrook, Chapman mill pond | | 30 |
| Delaware: | | |
| Harrington, Courseys Pond | | 100 |
| Laurel, Chipmans Mill pond | | 100 |
| Records Mill pond | | 25 |
| Trussoun Mill pond | | 25 |
| Milton, Fanganikj Lake | | 50 |
| Lavinas Lake | | 75 |
| Old Flume Mill Pond | | 50 |
| Russell's lake | | 100 |
| Wilmington, Brandywine Creek | | 420 |
| Delaware River | | 500 |
| Richardson Creek | | 50 |
| Florida: | | |
| Cypress, Burns Pond | | 500 |
| De Funiak Springs, New Home Pond | | 1,000 |
| East Lake, Lake Weir | 2,250 | |
| Florence Villa, Lake Lucerne | | 400 |
| Lake Park, Red Eye Pond | | 2,000 |
| Leesburg, Dupuy's lake | 1,500 | |
| Manatee, Johnson's pond | | 2,000 |
| Milton, Collins Mill Creek | | 500 |
| Mohawk, Lake Mabel | | 450 |
| Monticello, Facilio's pond | | 500 |
| Silver Lake | | 2,000 |
| Wolf Pond | | 1,000 |
| St. Petersburg, Saw Grass Lake | | 2,000 |
| Santos, Bryant Pond | | 1,500 |
| Wildwood, Waldron Lake | | 1,000 |
| Georgia: | | |
| Albany, Muckalee Creek | | 1,000 |
| Ashburn, Lake Minnie | | 500 |
| Athens, Oconee River | | 1,000 |
| Atlanta, Lake Brookhaven | | 250 |
| Smith & Williamson's mill pond | | 1,000 |
| Augusta, Big Spirit Creek | | 4,000 |
| Hancock Lake | | 4,000 |
| Tabb Pond | | 2,200 |
| Baconton, Adams's pond | | 2,000 |
| Bainbridge, Lake Douglas | | 1,000 |
| Ball Ground, Sharp Mountain Creek | 2,000 | |
| Beards Creek, Swindle's mill pond | | 1,000 |
| Berryton, Turner's pond | | 1,000 |
| Blythe, Templeton's pond | | 1,000 |
| Box Springs, Lake Mohignac | | 2,500 |
| Braswell, Lake Robert | | 500 |
| Bronwood, Oliver Mill Ponds | 1,000 | |
| Cedartown, Davis's pond | | 1,000 |
| Chatsworth, Holly Creek | | 3,500 |
| Rock Creek | | 2,000 |
| Georgia—Continued. | | |
| Clarkston, Morris's pond | | 500 |
| Clayton, Chattooga River | | 2,000 |
| Conyers, Big Haynes Creek | | 200 |
| Cordele, Collins's pond | | 500 |
| Ray's pond | | 500 |
| Covington, Alcovy Creek | | 500 |
| Yellow River | | 500 |
| Crawfordville, Little River | | 500 |
| Reed Lakes | | 1,000 |
| Cuthbert, Bridges Pond | 2,250 | |
| Butler's pond | 1,250 | |
| Dunn's pond | 1,000 | |
| Gormley Pond | 1,000 | |
| Dallas, Humphries Mill pond | | 500 |
| Douglas, Forkey Creek | | 2,000 |
| Story Pond | | 500 |
| Eatonton, Jones Pond | | 1,000 |
| Lake Imperial | | 1,000 |
| Faceville, Betts Mill pond | | 1,000 |
| Fairburn, Brantley's pond | | 1,000 |
| Hormsbys Mill pond | | 1,000 |
| Fayetteville, Bartlett Pond | | 500 |
| Bennetts Mill pond | 1,000 | |
| Gainesville, Lake Lanier | | 1,000 |
| Glenn, Barrett's pond | | 750 |
| Glenville, Norman's pond | | 175 |
| Graysville, Hurricane Creek | | 1,000 |
| Hagan, Hodges's pond | | 500 |
| Kennedy's pond | | 500 |
| Harrison, Brantley Ponds | | 1,000 |
| Hillsboro, Cedar Creek | | 2,000 |
| Cedar Creek Pond | | 500 |
| Hughland, Battle Pond | | 175 |
| Jackson, Ocmulgee Lake | | 2,000 |
| Jasper, Mill Creek | 2,000 | |
| Jefferson, Gordon's pond | | 300 |
| Mulberry River | | 2,000 |
| Pond Fork River | | 1,000 |
| Stark's pond | | 1,000 |
| Walnut River | | 1,000 |
| Junction City, Porter Lake | | 1,000 |
| Leary, Corson's pond | | 1,000 |
| Daniell's pond | | 1,000 |
| Lumpkin, Hodchodkee Creek | | 1,000 |
| McCollum, Thompson's pond | | 1,000 |
| Mableton, Mable's pond | | 500 |
| Macon, Nelsons Mill pond | | 1,000 |
| Madison, Silver Lake | | 1,000 |
| Manassas, Cartee's pond | | 500 |
| Mariette, Waterworks Lake | | 1,000 |
| Milledgeville, Beever's pond | | 375 |
| Colony Pond | | 1,000 |
| White Lake | | 1,000 |
| Mitchell, Lyons's pond | | 1,000 |
| Monticello, Ocmulgee River Pond | | 3,000 |
| Still House Lake | | 2,000 |
| Moreland, Bingham's pond | | 500 |
| Newborn, Child's pond | | 2,000 |
| Nickajack, Nickajack Creek | | 3,000 |
| Osierfield, Tucker's pond | | 125 |
| Palmetto, Winkles's pond | | 1,000 |
| Pearson, Poplar Branch Pond | | 1,500 |
| Preston, Chattanoochee Creek | | 2,000 |
| Schlatterville, Dowling's pond | | 500 |
| Senoia, Brown's pond | | 500 |
| Stone Mountain, Venable Lake | | 500 |
| Talking Rock, Hamrick's run | | 500 |
| Tarrytown, Cypress Creek Pond | | 175 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Georgia—Continued. | | |
| Thomasville, Hambleton Pond | | 500 |
| Tiger, Little Creek | | 1,000 |
| Trimble, Guin Pond | | 2,000 |
| Union City, Lake Nelida | | 1,000 |
| Valdosta, Boyds Lake | | 500 |
| Lake Laurel | | 500 |
| Indian Pond | | 500 |
| Ocean Pond | | 573 |
| Vidalia, Darby's pond | | 175 |
| Ways Station, Ogeechee River | | 2,000 |
| Willacoochee, Haskins's pond | | 625 |
| Wrens, Ex Gin Pond | | 1,000 |
| Wildwood, Popes Creek | | 1,000 |
| Woodburn, Lake Lookout | | 2,000 |
| Idaho: | | |
| Genesee, Brigham Lake | | 75 |
| Idaho Falls, Rainbow Ponds | | 16 |
| Soda Springs, Homer Creek Reservoir | | 32 |
| Illinois: | | |
| Anna, Eddleman's pond | | 200 |
| Belleville, Heinemann Lake | | 375 |
| Carthage Junction, Orchard City Lake | | 800 |
| Carterville Burr Pond | | 200 |
| Centralia, Lake Centralia | | 600 |
| Decatur, Decatur Club Lake | | 1,100 |
| Dixon, Rock River | | 600 |
| Dupo, Falling Spring Lake | | 100 |
| Duquoin, Forester Mine Pond | | 375 |
| Eldorado, Boyd Pond | | 400 |
| Elizabeth, Apple River | | 525 |
| Flora, Flora Reservoir | | 200 |
| Glen Carbon, Barnsback Lake | | 200 |
| Golconda, Grassy Pond | | 200 |
| Riggs Ponds | | 200 |
| Hallidayboro, Hallidayboro Pond | | 375 |
| Herrin, Cash's pond | | 375 |
| Highland, Gravel Lake | | 400 |
| Oak Hill Lake | | 400 |
| Marshall, Crystal Lake | | 800 |
| Meredosia, Illinois River | | 400 |
| Nashville, Carlsbad Lake | | 400 |
| Oakland, Embarras River | | 65 |
| Sandwich, Fox River | | 300 |
| Sparta, Country Club Lake | | 400 |
| Crothers Lake | | 200 |
| Tiskilwa, Illinois & Mississippi Canal | | 600 |
| Toulon, Green's pond | | 200 |
| Vienna, Chestnut Hill Lake | | 400 |
| Xenia, Brinton's lake | | 200 |
| Indiana: | | |
| Acton, Buck Creek | | 200 |
| Albion, Rittenhouse Lake | | 125 |
| Anderson, Arcade Pond | | 150 |
| Perry's pond | | 300 |
| West Brook | | 150 |
| Angola, Lake James | | 250 |
| Atwood, Huffman Lake | | 250 |
| Boonville, Waterworks Lake | | 300 |
| Bremen, Lake of the Woods | | 250 |
| Brooklyn, Jewel Lake | | 250 |
| Cambridge City, Whitewater River, West Fork | | 300 |
| Cedar Lake, Cedar Lake | | 375 |
| Columbia City, Loon Lake | | 250 |
| View Pond | | 100 |
| Corydon, Gilham Lake | | 100 |
| Kings Cave Lake | | 100 |
| Crandall, Big Indian Creek | | 300 |
| Indiana—Continued. | | |
| Crawfordsville, Water Babble Ponds | | 300 |
| Culver, Lake Maxinkuckee | | 250 |
| De Long, Tippecanoe River | | 250 |
| Elkhart, Elkhart River | | 250 |
| Elwren, Richland Creek | | 300 |
| Evansville, Davidson's lake | | 100 |
| Keil's lake | | 100 |
| Welborn's pond | | 100 |
| Ferdinand, Silver Lake | | 100 |
| Franklin, Sugar Creek | | 300 |
| Fremont, Lake George | | 250 |
| Fort Wayne, St. Marys River | | 250 |
| Fulton, South Lake | | 250 |
| Goodland, Moran Pond | | 125 |
| Greenfield, Spring Lake | | 150 |
| Greens Fork, Greens Fork Creek | | 300 |
| Hammond, City Park Lake | | 125 |
| Hartford City, Newbauer's gravel pond | | 150 |
| Howe, South Twin Lake | | 250 |
| Huntingburg, Ash Pond | | 100 |
| City Waterworks Lake | | 200 |
| Pearl Pond | | 125 |
| Salamonie River | | 250 |
| Indianapolis, Eagle Creek | | 400 |
| Hanch's pond | | 200 |
| White River | | 350 |
| Jasper, Calumet Lake | | 150 |
| Prospect Pond | | 150 |
| Kentland, Woodruff Lake | | 125 |
| Lake Gage, Perch Lake | | 125 |
| Larwill, Big Cedar Lake | | 250 |
| Leesburg, James Lake | | 250 |
| Oswego Lake | | 250 |
| Lena, Alma Lake | | 200 |
| Liberty, Poplar Springs Pond | | 200 |
| Whitewater River, East Fork | | 300 |
| Marion, Mississinewa River | | 300 |
| Milroy, Barton's pond | | 100 |
| Muncie, White River | | 450 |
| New Albany, Graf Pond | | 150 |
| Noblesville, Carr's pond | | 150 |
| North Vernon, Miller Pond | | 100 |
| Muskatatuck River | | 150 |
| Odon, Spring Pond | | 250 |
| Otis, Hildebrand's lake | | 125 |
| Peru, Eel River | | 250 |
| Mississinewa River | | 250 |
| Plymouth, Lake of the Woods | | 375 |
| Pretty Lake | | 250 |
| Twin Lakes | | 375 |
| Ray, Clear Lake | | 250 |
| Long Lake | | 250 |
| Richmond, Ballinger's lake | | 150 |
| Richmond Lake | | 300 |
| Roann, Lukens Lake | | 125 |
| Rose Lawn, Kankakee River | | 250 |
| Seelyville, Phillips Pond | | 100 |
| Sellersburg, Quarry Pond | | 150 |
| Shelbyville, Big Lewis Creek | | 300 |
| Little Blue River | | 300 |
| South Bend, Clear Lake | | 250 |
| St. Josephs Lake | | 250 |
| Stewartsville, Toots Lake | | 150 |
| Sunman, Longs Mill Pond | | 125 |
| Summitville, McLain's pond | | 150 |
| Roseboom's pond | | 150 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Indiana—Continued. | | |
| Templeton, Big Pine Creek | | 250 |
| Terre Haute, Parker's pond | | 100 |
| Thorntown, Sugar Creek | | 450 |
| Union City, Little Missionowa Ponds | | 150 |
| Valparaiso, Flint Lake | | 250 |
| Long Lake | | 250 |
| Vincennes, Wabash Lake | | 500 |
| Vistula, Stone Lake | | 250 |
| Wabash, Mississinewa River | | 250 |
| Walkerton, Koontz Lake | | 250 |
| Washington, Holder's pond | | 200 |
| Waveland, Sugar Creek | | 450 |
| White Pigeon, Hunters Lake | | 250 |
| Stone Lake | | 250 |
| Winona, Winona Lake | | 375 |
| Worthington, Eel River | | 400 |
| Iowa: | | |
| Albia, Albia City Reservoir | | 100 |
| Amana, Amana Lake | | 200 |
| Anamosa, Buffalo River | | 120 |
| Arlington, Bear Creek | | 20 |
| Austinville, Austinville Pond | | 80 |
| Ayrshire, Silver Lake | | 100 |
| Bellevue, Mississippi River | | 14,100 |
| Bloomfield, Burchett Lake | | 100 |
| Burlington, Lone Tree Lake | | 400 |
| Chester, Upper Iowa River | | 120 |
| Clarion, Elm Lake | | 240 |
| Clear Lake, Clear Lake | | 80 |
| Coggon, Buffalo Creek | | 80 |
| Wapsie Bayou | | 80 |
| Colfax, Ellsworth's pond | | 100 |
| Creston, Summit Lake | | 200 |
| Decorah, Power Company Lake | | 40 |
| Drakeville, Calvert's pond | | 100 |
| Dyersville, Marquette River | | 120 |
| Eldora, Iowa River | | 60 |
| Fairfield, New Pond | | 150 |
| Waterworks Pond | | 150 |
| Fort Atkinson, Turkey River | | 80 |
| Fort Madison, Chapman's pond | | 50 |
| Glenwood, Glenwood Lake | | 150 |
| Hampton, Beeds Lake | | 40 |
| Independence, Wapsipinicon River | | 4,800 |
| Le Mars, Dalton's pond | | 40 |
| Grimes Lake | | 40 |
| Lime Springs, upper Iowa River | | 4,600 |
| Lorimor, Willow Pond | | 100 |
| Manning, Great Western Pond | | 100 |
| Mason City, Lime Creek | | 80 |
| McIntire, Wapsipinicon River | | 100 |
| Minden, Hesleys Lake | | 100 |
| Monona, Monona Lake | | 20 |
| Ottumwa, Burns Lake | | 250 |
| Morriseyville Lake | | 150 |
| Riceville, Little Cedar River | | 60 |
| Ruthven, Lost Island Lake | | 100 |
| Tama, Deer Creek | | 200 |
| Tingley, Farm Pond | | 200 |
| Wapello, Heins Lake | | 100 |
| Waterloo, Cedar River | | 4,850 |
| Kansas: | | |
| Baileyville, Horseshoe Pond | | 200 |
| Columbus, Crystal Lake | | 250 |
| Spring Lake | | 250 |
| Fort Scott, Paint Creek | | 300 |
| Galena, Evans Pond | | 250 |
| Hillsdale, Bull Creek | | 400 |
| Kansas—Continued. | | |
| Huron, Huron Pond | | 400 |
| Independence, Bennetts Lake | | 200 |
| Sawyer's pond | | 100 |
| Kingman, Long Pond | | 100 |
| Wrenchey's pond | | 100 |
| Paola, Wea Creek | | 250 |
| Peabody, Doyle Creek | | 200 |
| Tyro, Tyro Lake | | 250 |
| Kentucky: | | |
| Albany, Cumberland River, tributaries | | 200 |
| Albia, Caney Creek | | 400 |
| Allensville, Bibb's pond | | 175 |
| Bourbon, Crystal Lake | | 200 |
| Bowling Green, Covington's pond | | 175 |
| Martin's pond | | 175 |
| Smith's pond | | 175 |
| Toop's pond | | 175 |
| Brumfield, Crane's pond | | 200 |
| Burkesville, Alexander's pond | | 200 |
| Burnside, Cumberland River | | 400 |
| Cadiz, Muddy Fork Creek | | 250 |
| Cave City, Curd's pond | | 125 |
| Well's pond | | 125 |
| Covington, Decker's lake | | 100 |
| Meadowbrook Lake | | 100 |
| Crofton, Crofton Lake | | 175 |
| Danville, Dix River | | 400 |
| Elizabethtown, Bailey's pond | | 325 |
| Farmers, Triplett Creek | | 200 |
| Ferguson, Darby's pond | | 175 |
| Franklin, Anderson Pond | | 100 |
| Butt's pond | | 100 |
| Dunn's branch | | 100 |
| Garrison's pond | | 100 |
| Harris Pond | | 100 |
| Haydon's pond | | 100 |
| Lake Thelma | | 150 |
| Laney's pond | | 100 |
| Lick Creek | | 150 |
| McGlothlin's pond | | 100 |
| Reden Mill Pond | | 150 |
| Robbin's pond | | 100 |
| Terrapin Creek | | 100 |
| Whippoorwill Creek | | 100 |
| Fredonia, Livingston Creek | | 250 |
| Willow Pond | | 200 |
| Georgetown, North Elkhorn Creek | | 400 |
| Glasgow, Beaver Creek | | 300 |
| Redford's willow pond | | 125 |
| Greensburg, Green River | | 400 |
| Guthrie, Elk Fork Creek | | 300 |
| Harlan, Kentucky River, Martins Fork | | 400 |
| Hartford, Rough River | | 300 |
| Herndon, Dawson's pond | | 200 |
| Nance's pond | | 100 |
| Redford Pond | | 100 |
| Hodgenville, Allen Pond | | 75 |
| Creal's pond | | 150 |
| Cundiff's pond | | 150 |
| McDowell Lake | | 200 |
| Martin's pond | | 325 |
| Miller's pond | | 175 |
| Munford's pond | | 225 |
| Walter's pond | | 300 |
| Weldon Pond | | 275 |
| Wyatt's pond | | 225 |
| Howell, Crenshaw's pond | | 200 |

Distribution of Fish and Fish Eggs, by Locality and Species, Fiscal Year 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Kentucky—Continued. | | |
| Hunters, The Cedars Pond | | 200 |
| La Grange, Highland Lake | | 200 |
| Irwin Pond | | 100 |
| Rayan's pond | | 100 |
| Lawrenceburg, Crook's pond | | 200 |
| Rice's pond | | 200 |
| Lebanon, Fairview Lake | | 200 |
| McElroy's pond | | 400 |
| Lexington, Darby's pond | | 200 |
| Liberty, Green River | | 400 |
| Louisville, Lake Lansdowne | | 800 |
| Shadyside Lake | | 100 |
| Silver Lake | | 400 |
| McBrayer, Salt River | | 500 |
| Madisonville, Eastern Lake | | 300 |
| Spring Lake | | 300 |
| Marion, Piney Creek | | 150 |
| Maysville, Kirk's pond | | 25 |
| Locust Lake | | 25 |
| Robinson's pond | | 25 |
| Middlesboro, Fern Lake | | 1,000 |
| Millersburg, Kates Pond | | 200 |
| Monticello, Beaver Creek | | 600 |
| Morning View, Morning View Lake | | 100 |
| Mount Sterling, Anderson's pond | | 200 |
| Morris Pond | | 200 |
| New Hope, New Hope Lake | | 200 |
| Newport, Horseshoe Pond | | 100 |
| Newtown, Elkhorn River | | 400 |
| Nicholasville, Ambrose Lake | | 200 |
| Church Pond | | 200 |
| Lake Mingo | | 400 |
| Olive Hill, Tygart Creek | | 400 |
| Olmstead, Shady Grove Pond | | 17 |
| Wyatt's pond | | 125 |
| Owensboro, Bud Lake | | 175 |
| Paris, Backwoods Pond | | 200 |
| Bedford's pond | | 200 |
| Ferguson's pond | | 200 |
| Hall's pond | | 200 |
| Lowry Pond | | 200 |
| Woodford's pond | | 200 |
| Petersburg, Woolper Creek | | 150 |
| Pineville, Clear Creek | | 400 |
| Princeton, Woods Pond | | 150 |
| Richmond, Lakes Reba | | 400 |
| Shackleford's pond | | 400 |
| Russellville, Miller's pond | | 125 |
| Ryan's pond | | 200 |
| Pulliam Pond | | 125 |
| Mud River | | 125 |
| Sanders, Carlisle's pond | | 100 |
| Somerset, Condiff's pond | | 200 |
| Stanford, Dishon's pond | | 200 |
| Dix River | | 400 |
| Hanging Fork Creek | | 200 |
| Stearns, Rock Creek | | 400 |
| Sturgis, Cannon Pond | | 100 |
| Tip Top, Montgomery's pond | | 225 |
| Orthober pond | | 225 |
| Tip Top Lake | | 150 |
| Tonieville, Harned's pond | | 150 |
| Trenton, Byar's pond | | 100 |
| Crutchfield's pond | | 175 |
| Vanarsdell, Salt River | | 500 |
| Vanceburg, Kinniconick Creek | | 75 |
| Waynesburg, Buck Creek | | 400 |
| Gilmore Creek | | 200 |
| White Station, Goodloe's lake | | 200 |
| Williamsburg, Cumberland River | | 200 |
| Winchester, Electric Light Pond | | 200 |
| Strong's pond | | 200 |
| Woodburn, Buckner Pond | | 100 |
| Clear Pond | | 125 |
| Crystal Pond | | 175 |
| Double Pond | | 100 |
| McElwain's pond | | 125 |
| Pope's pond | | 100 |
| Willow Pond | | 100 |
| Louisiana: | | |
| Arcadia, James's pond | | 100 |
| Bayou Sara, Troy Lake | | 100 |
| Greenwood, Lake Hayes | | 120 |
| Gulletts, Glenwood Farm Pond | | 100 |
| Saal Pond | | 200 |
| Gurley, Highland Pond | | 200 |
| Island Pond | | 250 |
| Lindsay, McKowen's pond | | 500 |
| Mills Pond | | 200 |
| Marion, Dukes Pond | | 75 |
| Fitzgerald's pond | | 75 |
| New Orleans, City Park Lake | | 300 |
| Seaboard Pond | | 100 |
| Ponchatoula, Tangipahoe River | | 300 |
| Ruston, Lyle's pond | | 100 |
| Sheppard Lake | | 100 |
| Shreveport, Bayou Pierre Lake | | 100 |
| Spring Lake | | 100 |
| Stevendale, Jumping Gulley Pond | | 200 |
| Maryland: | | |
| Alberton, Wheelright's pond | | 400 |
| Alesia, Big Gunpowder River Dam | | 250 |
| Ammendale, Hughes's pond | | 125 |
| Annapolis, Junior Republic Pond | | 125 |
| Baltimore, Monocacy River | | 450 |
| Berlin, Trappe Creek | | 200 |
| Betterton, Lloyds Creek | | 100 |
| Bishop, St. Martins River | | 200 |
| Bowie, Spring Lake | | 250 |
| Buck Lodge, Darby's mill pond | | 125 |
| Chestertown, Ratcliffe Pond | | 100 |
| Contee, Carroll's pond | | 125 |
| Cropley, Potomac River | | 500 |
| Cumberland, Potomac River | | 365 |
| Potomac River, North Branch | | 125 |
| Detour, Double Pipe Creek | | 500 |
| Elkton, Back Creek Mill Pond | | 50 |
| Frederick, Monocacy River | | 250 |
| Greenmount, Gunpowder Falls Creek | | 250 |
| Greensboro, Choptank River | | 75 |
| Hagerstown, Antietam Creek | | 500 |
| Hoods Mill, Patapsco River | | 250 |
| Hyattsville, Anacostia River, Northwest Fork | | 250 |
| Jefferson, Catoctin Creek | | 250 |
| Keymar, Big Pipe Creek | | 250 |
| Lansdowne, Lake Rosalie | | 125 |
| Maple Grove, Gunpowder Falls Creek, tributary | | 125 |
| Marydel, Choptank Mill Pond | | 50 |
| Millington, Millington Mill pond | | 50 |
| Unicorn Roller Mill pond | | 75 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Maryland—Continued. | | |
| Mount Washington, Lake Roland | | 250 |
| Mount Winans, Silver Lake | | 125 |
| Oxenhill, Jenkin's pond | | 250 |
| Pocomoke, Pocomoke River | | 300 |
| Wagram Pond | | 200 |
| Welbourn Pond | | 100 |
| Portobella, Flag Lake | | 125 |
| Rockville, Rock Creek | | 250 |
| Roxbury, Antietam Creek | | 250 |
| Silver Springs, Northwest Branch | | 220 |
| Taneytown, Bear Branch | | 250 |
| Fish Pond | | 250 |
| Williamsport, Conococheague Creek | | 500 |
| Potomac River | | 250 |
| Massachusetts: | | |
| Mount Hermon, St. Patricks Pond | | 50 |
| Plymouth, South Triangle Pond | | 150 |
| Wareham, Little Sandy Pond | | 50 |
| White Pond | | 50 |
| Worcester, Asnebumskett Pond | | 50 |
| Michigan: | | |
| Alpena, Grand Lake | | 400 |
| Arnheim, Otter Lake | | 250 |
| Central, Gratiot Lake | | 175 |
| Charlotte, Burnett Park pond | | 75 |
| Clare, Dewey Lake | | 120 |
| Champion, White Deer Lake | | 200 |
| Crystal Falls, Holmes Lake | | 250 |
| Delaware, Beaver Lake | | 175 |
| Bete Grise Bayou | | 175 |
| Deer Lake | | 175 |
| Lac La Belle | | 175 |
| Lake Bailey | | 250 |
| Detroit, Detroit Aquarium | | 80 |
| Gaylord, Otsego Lake | | 160 |
| Harrison, Budd Lake | | 210 |
| Hillman, Long Lake | | 300 |
| Iron River, Chicagoan Lake | | 350 |
| Jones, Birch Lake | | 75 |
| Shavehead Lake | | 75 |
| Kenton, Lake Thirty Three | | 250 |
| Lawrence, Deep Lake | | 25 |
| Long Lake, North Lake | | 120 |
| Mandan, Breakfast Lake | | 175 |
| Lake Addie | | 175 |
| Lake Medora | | 175 |
| Schlatter Lake | | 175 |
| Newaygo, Turtle Lake | | 50 |
| Norwalk, Bear Lake | | 75 |
| Peacock, Big Bass Lake | | 75 |
| Ramona, Diamond Lake | | 75 |
| Rose Center, Bennet Lake | | 80 |
| Southbranch, Bobs Pond | | 80 |
| Traverse, Boardman Lake | | 800 |
| Union City, Lee Lake | | 75 |
| Turtle Lake | | 75 |
| White Cloud, Snyder Lake | | 75 |
| Minnesota: | | |
| Beaudette, Four Mile Bay | | 100 |
| Brimson, Bates Lake | | 100 |
| Indian Creek | | 125 |
| Indian Lake | | 100 |
| Carlton, Chub Lake | | 120 |
| Deerwood, Lake Prano | | 90 |
| Duluth, Caribou Lake | | 90 |
| Deep Water Lake | | 60 |
| Island Lake | | 90 |
| Lake Fredenburg | | 110 |
| Minnesota—Continued. | | |
| Duluth, Lake Gladys | | 90 |
| Rice Lake | | 90 |
| Schultz Lake | | 60 |
| Ely, Little Long Lake | | 100 |
| Shin Lake | | 100 |
| Stony River | | 100 |
| Jenkins, Hay Lake | | 90 |
| Knife River, Micmac Lake | | 100 |
| Moose Lake | | 100 |
| Nine Mile Lake | | 100 |
| Lutsen, Lake Christina | | 90 |
| Mahtowa, Park Lake | | 150 |
| Moose Lake, Moose Lake | | 300 |
| Pengilly, Swan Lake | | 150 |
| Rollins Siding, Brown Lake | | 100 |
| Moose Lake | | 100 |
| White Lake | | 100 |
| Wolf Lake | | 100 |
| Sawyer, Big Lake | | 90 |
| Moosehorn Lake | | 90 |
| Perch Lake | | 90 |
| Taylors Falls, St. Croix River | | 70 |
| Virginia, Sand Lake | | 150 |
| Wolf Station, Lake Crystal | | 150 |
| Mississippi: | | |
| Aberdeen, Arratt Pond | | 500 |
| Dead River Club Lake | | 500 |
| Homer Pond | | 500 |
| Horseshoe Lake | | 150 |
| Nash Lake | | 150 |
| Pea Ridge Lake | | 500 |
| Quofoloma Lake | | 150 |
| Tombigbee River | | 1,000 |
| Twin Lake | | 500 |
| Ackerman, Rock Pond | | 500 |
| Amory, Tombigbee River | | 1,000 |
| Basic City, Malpus Pond | | 100 |
| Belden, Ritter's pond | | 500 |
| Bentonia, Fairview Pond | | 100 |
| Booneville, Booneville Lake | | 200 |
| Burton's pond | | 200 |
| Clear Lake | | 1,000 |
| Gin Branch Pond | | 100 |
| Jones's lake | | 150 |
| Brookhaven, Brickyard Pond | | 50 |
| Caraway's pond | | 50 |
| Canton, Big Lake | | 200 |
| Brown Lake | | 200 |
| Canton Farm pond | | 150 |
| Foot's pond | | 200 |
| McBride's pond | | 200 |
| Mosby Pond | | 200 |
| Peach Lake | | 200 |
| Rick's lake | | 300 |
| Round Lake | | 200 |
| Williams's lake | | 406 |
| Centerville, Lake Antoinette | | 200 |
| Clayton, Clear Lake | | 100 |
| Columbia, Simmon's pond | | 400 |
| Simmons Mill pond | | 200 |
| Spring Pond | | 200 |
| Corinth, Artesian Lake | 4,000 | |
| Bills Park Lake | | 1,000 |
| Calacanthis Lake | | 1,000 |
| Eates Pond | | 1,000 |
| Long Hollow Pond | 1,000 | |
| Sharp's pond | | 1,000 |
| Smith's pond | 1,000 | |
| Strickland's lake | 1,000 | |
| Surratt's lake | 2,000 | |
| Turner's pond | | 1,000 |
| Tuscumbia Cutoff Lake | | 1,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Mississippi—Continued. | | |
| Corinth, Vandiver's lake | | 1,000 |
| Weedon's pond | | 1,000 |
| Waukomis Lake | | 1,200 |
| Dubard, Alligator Pond | | 100 |
| Edwards, Crissler's pond | | 350 |
| Hewes's pond | | 150 |
| Egypt, King's pond | | 500 |
| Linn's pond | | 500 |
| Fenwick, Fenwick Pond | | 250 |
| Flora, Hawkins's ponds | | 200 |
| Lipscomb's pond | | 100 |
| Grisham's pond | | 100 |
| Forest, Wicker's pond | | 24 |
| Greenwood Springs, Buttahatchie River | | 500 |
| Greenwood Springs, Sipsy River | | 500 |
| Guntown, Brownlee Lake | | 16 |
| Public Pond | | 16 |
| Hattiesburg, Longre & Mitchell Lake | | 200 |
| Hazlehurst, Branard's lake | | 25 |
| Ellis Lake | | 25 |
| Lake Hazel | | 25 |
| Martin's pond | | 25 |
| Hodges, Hodges Reservoir | | 200 |
| Horn Lake, Coggin's pond | | 100 |
| Winn's pond | | 200 |
| Holly Springs, Wall's Pond | | 500 |
| Houlka, Hollingsworth Pond | | 500 |
| Houston, Evans's pond | | 500 |
| Huffman's pond | | 500 |
| Lake View | | 500 |
| Lowry's pond | | 500 |
| Mary Alma Lake | | 500 |
| Iuka, Iuka Lake | | 32 |
| Lake Como | | 66 |
| Jackson, Cades Lake | | 200 |
| Clear Lake | | 200 |
| Crowder's lake | | 30 |
| I. C. Pond | | 300 |
| Lynch Creek | | 200 |
| Mule Jail Lake | | 200 |
| Oak Ridge Lake | | 200 |
| Spring Lake | | 200 |
| Johnson Junction, Park Lake | | 400 |
| Kewanee, Wright's pond | | 200 |
| Lake, Brown's ponds | | 300 |
| Lexington, Acona Mill pond | | 600 |
| Louisville, Bethedan Pond | | 200 |
| McLean's pond | | 200 |
| Water Valley Lake | | 200 |
| Lucedale, Jones's pond | | 100 |
| Lyman, Reservoir Pond | | 200 |
| McComb, Clear Creek | | 50 |
| Clement Lake | | 50 |
| Illinois Central Lake | | 300 |
| Lake McComb | | 50 |
| McRaven, East Pond | | 200 |
| Macon, Dugan Pond | | 500 |
| Lillie Pond | | 600 |
| Marshall Lake | | 1,000 |
| Minor Pond | | 600 |
| Magnolia, Mullin's branch | | 50 |
| Strickland's branch | | 50 |
| Mantee, Durham's pond | | 500 |
| McGee's pond | | 500 |
| Moseley Pond | | 500 |
| Meridian, Ethridge Pond | | 25 |
| Fishing Club Pond | | 300 |
| Lake Nani Waiah | | 25 |
| Queen City Pond | | 50 |
| Rolling Pond | | 200 |
| Mississippi—Continued. | | |
| Meridian, Wagner Pond | | 50 |
| Waterworks Pond | | 50 |
| Minter City, Virginia Lake | | 300 |
| Mize, Robinson's pond | | 100 |
| Moon, Moon Lake | | 50 |
| Monticello, Lambert's pond | | 200 |
| Morton, Vinsons Mill pond | | 200 |
| Muldon, Evans's lake | | 400 |
| Myrtle, Frazier's pond | | 500 |
| Neshoba, Henderson's pond | | 200 |
| Watkin's pond | | 200 |
| New Albany, Clear Pond | | 500 |
| Pinedale Pond | | 500 |
| Rainey's pond | | 500 |
| Sanford's pond | | 500 |
| New Augusta, Barbara Pond | | 150 |
| McSwain's pond | | 200 |
| Newton, Chapman's pond | | 50 |
| Walker's pond | | 200 |
| Osborn, Boyd's pond | | 200 |
| Love's pond | | 200 |
| Ovett, Smith's pond | | 150 |
| Pelahatchie, Patrick's pond | | 24 |
| Philadelphia, Hester's pond | | 200 |
| Kantarka Pond | | 200 |
| Pearl River | | 200 |
| Shocalo Pond | | 200 |
| Silver Loaf Pond | | 200 |
| West View Pond | | 200 |
| Picayune, Tate's pond | | 100 |
| Pontotoc, Brown's pond | | 1,000 |
| Davis Pond | | 500 |
| Pontotoc Pond | | 1,000 |
| Prentiss, Polk Lake | | 200 |
| Raymond, Ratliff's pond | | 50 |
| Wade's pond | | 25 |
| Redwood, Cole's pond | | 200 |
| Richton, Conway's pond | | 200 |
| Robinwood, Robinson's pond | | 200 |
| Saltillo, Bucy's pond | 1,000 | |
| Park's pond | 1,000 | |
| Saltillo Lake | | 500 |
| Sandersville, Andrews Mill pond | | 200 |
| Seminary, Oakatoma Pond | | 200 |
| Pearson & Watson Pond | | 200 |
| Senatobia, Willow Pond | | 200 |
| Sessums, Foster's pond | | 150 |
| Sherard, Dogwood Lake | | 50 |
| Shuqualak, Anderson's ponds | | 400 |
| East Side Lake | | 500 |
| Floore's pond | | 500 |
| Goodwin's pond | | 500 |
| Hamilton's pond | | 200 |
| Ogletree Lake | | 500 |
| Pine Grove Pond | | 200 |
| Prince's pond | | 500 |
| Quarles Pond | | 500 |
| Stevens's pond | | 500 |
| Walton's pond | | 500 |
| Water Lily Pond | | 500 |
| West End Lake | | 500 |
| Stallo, Jackson's pond | | 50 |
| Starkville, Ellis Pond | | 40 |
| Gillis Pond | | 40 |
| Jones's pond | | 150 |
| Kennard's pond | | 80 |
| McPherson Lake | | 200 |
| Montgomery's pond | | 200 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Mississippi—Continued. | | |
| Starkville, Park Lake | ...... | 30 |
| Robson's pond | ...... | 80 |
| Sander's pond | ...... | 30 |
| Sudduth's pond | ...... | 150 |
| Sykes Pond | ...... | 40 |
| Talking Warrior Lake | ...... | 200 |
| Watt's pond | ...... | 200 |
| Wellborn pond | ...... | 80 |
| Stringer, Stringer's pond | ...... | 100 |
| Strongs, Dream Lake | ...... | 150 |
| Sturges, Hutchinson's pond | ...... | 200 |
| Summerland, Williams's pond | ...... | 100 |
| Taylorville, Keys Mill pond | ...... | 200 |
| Terry, Jones's pond | ...... | 100 |
| Tishomingo, Holley's lake | ...... | 200 |
| Tunica, Kinney Lake | ...... | 50 |
| Tupelo, Beaver Lake | ...... | 500 |
| Chiwappa Creek | ...... | 500 |
| Parham Pond | ...... | 500 |
| Ray's lake | ...... | 200 |
| Town Creek | ...... | 500 |
| Vaiden, Armstrong's pond | ...... | 200 |
| Union, Frog Hollow Pond | ...... | 200 |
| Utica, Downing's pond | ...... | 15 |
| Waynesboro, Bushby's pond | ...... | 100 |
| Weir, Black's pond | ...... | 200 |
| Fry's pond | ...... | 200 |
| Stubblefield's pond | ...... | 200 |
| Whitesand, Trexler's pond | ...... | 200 |
| Wiggins, Batson's pond | ...... | 100 |
| West Point, Brogan's pond | ...... | 500 |
| Cottrell's pond | ...... | 500 |
| Hamlin's ponds | ...... | 1,000 |
| Twin Ponds | ...... | 200 |
| Westbrook's pond | ...... | 500 |
| Missouri: | | |
| Ash Grove, Spring Lake | ...... | 200 |
| Birch Tree, Current River, Jacks Fork | ...... | 100 |
| Bunceton, Doctors Creek | ...... | 250 |
| Idlewood Lake | ...... | 425 |
| Lamine River | ...... | 425 |
| Moniteau Creek | ...... | 425 |
| Petite Saline Creek | ...... | 425 |
| Cabool, Piney River | ...... | 450 |
| Centralia, Lake Dutcher | ...... | 275 |
| Clinton, Fish Lake | ...... | 600 |
| Dexter, Spring Hill Lake | ...... | 300 |
| Dodson, Rule Farm Lake | ...... | 600 |
| Ethel, Ethel Pond | ...... | 100 |
| Fortescue, Big Lake | ...... | 100 |
| Harviell, Cane Creek | ...... | 300 |
| Helena, Lillibridge Lake | ...... | 180 |
| Hutton Valley, Hickory Grove Pond | ...... | 150 |
| Independence, Juanita Lake | ...... | 450 |
| Milton's lake | ...... | 300 |
| Jasper, Birds Lake | ...... | 200 |
| Coon Creek | ...... | 300 |
| Jaudon, Grant's pond | ...... | 300 |
| Jefferson City, Moreau Creek | ...... | 400 |
| Joplin, Thomas Lake | ...... | 300 |
| Kansas City, Fairmount Lake | ...... | 450 |
| Kiger Farm Lake | ...... | 250 |
| Lamar, Gregory Lake | ...... | 650 |
| Spring River, North Fork | ...... | 650 |
| Lisle, Lisle Pond | ...... | 450 |

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Missouri—Continued. | | |
| La Plata, Love Lake | ...... | 200 |
| Santa Fe Lake | ...... | 200 |
| Macon, Blees Lake | ...... | 150 |
| Martin City, Oak Park Lake | ...... | 450 |
| Mexico, Quitapahila Lake | ...... | 828 |
| Monteer, Current River, Jacks Fork | ...... | 450 |
| Nevada, Katy Allen Pond | ...... | 300 |
| State Hospital Lake | ...... | 150 |
| Newburg, Little Piney River | ...... | 450 |
| New London, Salt River | ...... | 400 |
| Noel, Elk River | ...... | 1,800 |
| Ozark, Finley River | ...... | 450 |
| Pleasant Hill, Kellogg's lake | ...... | 395 |
| Lake Leonard | ...... | 450 |
| Smith's lake | ...... | 300 |
| Randolph, Winn's lake | ...... | 400 |
| Rolla, Big Dry Fork Creek | ...... | 150 |
| Big Piney River | ...... | 450 |
| Big Spring Creek | ...... | 200 |
| Burpois Creek | ...... | 450 |
| Cave Springs Creek | ...... | 450 |
| Gasconade River | ...... | 450 |
| Little Beaver Creek | ...... | 200 |
| Little Dry Fork Creek | ...... | 300 |
| Little Piney Creek | ...... | 850 |
| Mill Creek | ...... | 300 |
| North Mill Creek | ...... | 200 |
| South Spring Creek | ...... | 350 |
| St. Genevieve, Schwartz's pond | ...... | 250 |
| Savannah, Blakeslee's lake | ...... | 80 |
| Seneca, Big Lost Creek | ...... | 300 |
| Wappapello, St. Francis River | ...... | 100 |
| Watson, Brown's pond | ...... | 150 |
| Wayland, Hill Slough | ...... | 100 |
| Willow Springs, Frisco Pond | ...... | 900 |
| Worth, Dye's pond | ...... | 90 |
| Montana: | | |
| Bascom, Holman's pond | ...... | 24 |
| Eureka, Rock Lake | ...... | 34 |
| Whitefish, Blanchard Lake | ...... | 34 |
| Nebraska: | | |
| Crawford, White Clay Creek | ...... | 20 |
| Scottsbluff, Airedale Pond | ...... | 30 |
| Verdon, Harden's lake | ...... | 225 |
| Wayside, Baird's pond | ...... | 35 |
| New Hampshire: | | |
| Plymouth, Loon Lake | ...... | 50 |
| New Jersey: | | |
| Alloway, Elkinton | ...... | 80 |
| Beaver Lake, Lake Pochuck | ...... | 50 |
| Blairstown, Cedar Lake | ...... | 50 |
| Fairview Lake | ...... | 50 |
| Boonton, Mountain Lakes | ...... | 80 |
| Bound Brook, Middle Brook | ...... | 25 |
| Branchville, Culver Lake | ...... | 200 |
| Chatsworth, Bridge Creek | ...... | 100 |
| Cranford, Rahway River | ...... | 80 |
| Egg Harbor, Park Lake | ...... | 200 |
| Hackettstown, Allamuchy Pond | ...... | 80 |
| Guard Lock Pond | ...... | 80 |
| Hammonton, Hammonton Lake | ...... | 200 |
| Harrisonville, Oliphant Lake | ...... | 80 |
| Lake Hopatcong, Lake Hopatcong | ...... | 200 |
| Lakewood, Johnson's lake | ...... | 60 |
| Polypod Pond | ...... | 200 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| New Jersey—Continued. | | |
| Lambertville, Emery's pond | | 40 |
| Lucaston, Silver Lake | | 100 |
| Mount Holly, Rancocas River | | 200 |
| Upper Rancocas Creek | | 100 |
| Murray Hill, Passaic River | | 100 |
| Neshanic, South Branch River | | 50 |
| Netcong, Budd Lake | | 50 |
| Newark, Weequahic Lake | | 330 |
| New Egypt, Oakford Lake | | 100 |
| Pennington, Jacobs Creek | | 25 |
| Pompton Lakes, Pequannock River | | 50 |
| South Dennis, Clint Mill Pond | | 200 |
| South Ogdensburg, Hawthorne Lake | | 50 |
| Spring Lake, Spring Lake | | 200 |
| Swartswood, Little Swartswood Lake | | 50 |
| Waldwick, Rosecrans Pond | | 200 |
| West End, Shadow Lawn Lake | | 100 |
| Williamstown, Faraway Lake | | 100 |
| McClure's lake | | 200 |
| New York: | | |
| Addison, Goodhue Lake | | 80 |
| Bay Shore, Brightwater Lakes | | 400 |
| Chatham, Kinderhook Creek | | 640 |
| Clayton, St. Lawrence River | | 100 |
| Colliers, Goodyear Lake | | 225 |
| Corinth, Bull Head Pond | | 25 |
| Effner Lake | | 50 |
| Hunt Lake | | 50 |
| Jenney Lake | | 50 |
| Corning, Denison Park Lake | | 80 |
| Cornwall, Bug Meadow Lake | | 200 |
| Sutherland Pond | | 200 |
| Fallsburg, Kiamesha Lake | | 120 |
| Gouverneur, Oswegatchie River | | 50 |
| Hammondsport, Lake Keuka | | 175 |
| Hempstead, Slivers Lake | | 150 |
| Highland Falls, Roe Park Lake | | 200 |
| Java Center, Java Lake | | 75 |
| Mastic, Home Creek | | 300 |
| Millbrook, Tyrrel Lake | | 80 |
| Monticello, Class Pond | | 40 |
| Ogdensburg, St. Lawrence River | | 100 |
| Perhonkson, Parry's pond | | 80 |
| Petersburg, Taconee Lake | | 40 |
| Poughkeepsie, Bahret's pond | | 40 |
| Fairview Lake | | 100 |
| Redwood, Grass Lake | | 125 |
| Round Lake, Round Lake | | 200 |
| Roscoe, Florence Lake | | 100 |
| Schroon Lake, Schroon Lake | | 1,000 |
| Sterlington, Potake Lake | | 300 |
| Troy, Crooked Lake | | 200 |
| Crystal Lake | | 200 |
| Hayner Pond | | 200 |
| Hudson River | | 300 |
| Walden, Walkill River | | 500 |
| Wallkill, Shawankill River | | 200 |
| Warrensburgh, Echo Lake | | 80 |
| Whitestone, Fort Totten Pond | | 200 |
| Yulan, Montgomery Pond | | 50 |
| Washington Lake | | 80 |
| North Carolina: | | |
| Advance, Pack's pond | | 75 |
| Angier, Adams's pond | | 300 |
| Adams's pond No. 2 | | 100 |
| Buies Creek | | 100 |
| North Carolina—Continued. | | |
| Angier, Collins's pond | | 100 |
| Piney Branch Pond | | 150 |
| Smith's pond | | 150 |
| Apex, Castleberry's pond | | 100 |
| Lawrence's pond | | 100 |
| Sears's pond | | 100 |
| Ararat, Bryant's pond | | 75 |
| Asheboro, Little River | | 75 |
| Bladensboro, Horse Pen Creek | | 200 |
| Biscoe, Page's pond | | 200 |
| Bowden, Rowland Lumber Co. pond | | 300 |
| Burlington, Graves Pond | | 150 |
| Sartin's pond | | 150 |
| Somers's pond | | 100 |
| Cairo, Johnsons Mill pond | | 150 |
| Calypso, Sutton's pond | | 300 |
| Cameron, Baldwin Pond | | 100 |
| McDugald Pond | | 200 |
| Pierce's pond | | 100 |
| Candor, Cheeks Creek | | 200 |
| Chadbourn, Hughes Mill Pond | | 200 |
| Pages Mill pond | | 200 |
| Charlotte, Lakewood Park Lake | | 300 |
| Clarkton, Highs Mill pond | | 150 |
| Clayton, Stallings's pond | | 100 |
| Coats, Spring Branch Pond | | 100 |
| Turlington's pond | | 150 |
| Colon, Baling Pond | | 200 |
| Moffitt's pond | | 100 |
| Concord, Big Coldwater Creek | | 150 |
| Buffalo Creek Pond | | 100 |
| Rocky River | | 300 |
| Cordova, Hitchcock Creek | | 100 |
| Council, Carvers Creek | | 200 |
| Creswell, Lake Phelps | | 400 |
| Dunn, Grantham's pond | | 525 |
| Surles Mill pond | | 400 |
| Elkton, Smiths Mill pond | | 200 |
| Enfield, Woodlawn Pond | | 158 |
| Fayetteville, Blounts Creek pond | | 150 |
| Campbell Pond | | 300 |
| Cross Creek Pond | | 100 |
| Ecles Pond | | 150 |
| Huske Pond | | 150 |
| McNeil's pond | | 100 |
| Parkland Lake | | 250 |
| Rockfish Creek, tributary of | | 150 |
| Sky Pond | | 200 |
| Fremont, Dickinson pond | | 100 |
| Gastonia, Beal's lake | | 200 |
| Cobb's lake | | 200 |
| Lake Giles | | 200 |
| Limberger Pond | | 200 |
| Long Creek Pond | | 300 |
| McAllister's lake | | 200 |
| Gibsonville, Lakeview Mill pond | | 200 |
| Godwin, Shop Branch | | 200 |
| Goldsboro, Country Club Lake | | 327 |
| Griffin's pond | | 200 |
| Lake Genoa | | 300 |
| Graham, Little Alamance Creek | | 150 |
| Greensboro, Boren's pond | | 75 |
| Gulf Lake | | 75 |
| Hilton's pond | | 75 |
| McKnight's pond | | 75 |
| Phipps's pond | | 75 |
| Willow Brook | | 75 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| North Carolina—Continued. | | |
| Hamlet, Fallen Creek Pond | | 100 |
| Havelock, Catfish Lake | | 300 |
| Henderson, Henderson Club Pond | | 300 |
| Hiddenite, Stevenson Branch Pond | | 75 |
| Hildebran, Henry River Pond | | 150 |
| Holly Springs, Adams's pond | | 100 |
| Ivanhoe, Beatty's pond | | 150 |
| Jackson Springs, Blue's pond | | 100 |
| Pooles Mill pond | | 100 |
| Jacksonville, New River | | 175 |
| Jonesboro, Big Creek | | 100 |
| Kannapolis, Kannapolis Lake | | 200 |
| Kernersville, Abbotts Creek Pond | | 75 |
| Smith's pond | | 75 |
| Kinston, Moseley's pond | | 100 |
| Lake Waccamaw, Waccamaw Lake | | 400 |
| Liberty, Polecat Creek | | 150 |
| Quarter Pond | | 75 |
| Lillington, Shaws Pond | | 100 |
| Lincolnton, Catawba River, South Fork | | 200 |
| Littleton, Big Stone House Mill Pond | | 200 |
| Louisburg, Jackson's pond | | 550 |
| Stalling's pond | | 200 |
| McCullers, Mill Pond | | 100 |
| Macclesfield, Brown's pond | | 200 |
| Magnolia, Newkirk Mill Pond | | 200 |
| Marshville, Lanes Creek | | 100 |
| Matthews, Goose Creek Mill Pond | | 200 |
| Stevens's pond | | 150 |
| Maxton, Lumber River | | 300 |
| Monroe, Richardson Mill pond | | 100 |
| Shute's pond | | 150 |
| Totten Fish Pond | | 100 |
| Morganton, Catawba River | | 150 |
| Johns River | | 150 |
| Lower Creek | | 150 |
| Lower Fork River | | 150 |
| Pools Mill pond | | 150 |
| Upper Creek | | 375 |
| Morrisville, Crabtree Creek | | 200 |
| Kit Creek | | 150 |
| Sears's pond | | 175 |
| Searl's pond | | 100 |
| Stirrup Prong Creek | | 150 |
| Morven, Pratt's pond | | 150 |
| Robinson Pond | | 100 |
| Mount Airy, Buckshoal Pond | | 75 |
| Fishers River | | 150 |
| Mount Holly, Catawba River | | 500 |
| Dutchman's creek | | 200 |
| Mount Olive, Goodson's pond | | 300 |
| Williams Mill pond | | 300 |
| Neuse, Barton Creek | | 100 |
| Newbern, Neuse River and tributaries | | 175 |
| Newport, Cypress Pond | | 200 |
| North Wilkesboro, Mulberry Creek | | 450 |
| Oxford, Tabs Creek Pond | | 300 |
| Parkton, Davis Mill Pond | | 150 |
| Pelham, Wolf Island Mill pond | | 75 |
| North Carolina—Continued. | | |
| Pembroke, Buies Mill Pond | | 400 |
| Pinehurst, McKenzie's pond | | 200 |
| Pinnacle, Smoak's pond | | 75 |
| Pleasant Garden, Polecat Creek | | 75 |
| Pollocksville, Clay Hill Branch | | 200 |
| Prentiss, League Lake | | 1,000 |
| Raeford, Beaver Dam Creek | | 200 |
| Raleigh, Beaver Dam Fishing Club Pond | | 350 |
| Milburnie Fishing Club Pond | | 350 |
| Panther Branch Fishing Club Pond | | 350 |
| Sorrell Branch | | 300 |
| Sherwood Pond | | 200 |
| Williams's pond | | 100 |
| Ramseur, Brush Creek Pond | | 75 |
| Deep River | | 225 |
| Jordan's pond | | 75 |
| Mill Stone Creek Pond | | 75 |
| Patterson Pond | | 75 |
| Red Springs, Graham Lake | | 300 |
| Jobs Pond | | 200 |
| Reidsville, Glady Creek Pond | | 75 |
| Poplar Lake | | 150 |
| Spring Branch Pond | | 75 |
| Troublesome Pond | | 75 |
| Rockford, Fanbush Pond | | 75 |
| Rockingham, Bushby Branch Pond | | 100 |
| Dockery Mill pond | | 100 |
| Ellerbe Springs Pond | | 100 |
| Everett's pond | | 200 |
| Harringtons Mill pond | | 200 |
| Hinsons Mill pond | | 200 |
| Lake Dockery | | 200 |
| Rocky Point, North East Cape Fear River | | 300 |
| Roseboro, Little Coharie Creek | | 300 |
| Rosehill, Halls Mill pond | | 150 |
| Rosindale, Clarks Mill pond | | 200 |
| Rutherfordton, Brittains Mill Pond | | 100 |
| Salisbury, Dutch Second Creek | | 75 |
| Fishing Mill pond | | 75 |
| Little Crane Creek | | 75 |
| Medlin's pond | | 75 |
| Turflin Pond | | 75 |
| Scotland Neck, Hyman Pond | | 150 |
| Shelby, Broad River | | 300 |
| Shoals, Davis Creek | | 75 |
| Dills Creek | | 75 |
| Halls Creek | | 75 |
| Kittles Creek | | 75 |
| Stow Creek Pond | | 75 |
| Siloam, Ararat River | | 75 |
| Southern Pines, Suburb Pond | | 100 |
| Spero, Haskets Creek | | 75 |
| Stanley, Dutchman Creek | | 200 |
| South Fork River | | 300 |
| Statesville, Back Creek | | 75 |
| Big Rocky Creek | | 75 |
| Buffalo Shoal Pond | | 75 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| North Carolina—Continued. | | |
| Statesville, Catawba River | | 75 |
| Duck Creek | | 150 |
| Elk Creek | | 150 |
| Fifth Creek | | 150 |
| Fourth Creek | | 75 |
| Hunting Creek | | 75 |
| Little Rocky Creek | | 150 |
| Nesbitt Creek | | 75 |
| Snow Creek | | 75 |
| Third Creek | | 75 |
| Town Creek | | 150 |
| Stokesdale, Hilton's pond No. 2 | | 75 |
| Sunbury, Cross Mill Pond | | 250 |
| Swans Station, Big Juniper Pond | | 200 |
| Upper Little River | | 300 |
| University, Double Spring Pond | | 100 |
| Morgan's creek | | 150 |
| New Hope Creek | | 200 |
| Wade, Olive Park Pond | | 100 |
| Wadesboro, Baucom's pond | | 100 |
| Walnut Cove, Dan River | | 150 |
| Wake Forest, Oneal's pond | | 100 |
| Warsaw, Coopers Mill pond | | 200 |
| Weldon, Roanoke River | | 750 |
| Whiteville, Richardsons Mill pond | | 400 |
| Wilbon, Burt's pond | | 175 |
| Wilmington, Greenfield Lake | | 775 |
| Winston-Salem, Jenkins's pond | | 75 |
| Waterworks Pond | | 75 |
| Ohio: | | |
| Antwerp, Maumee River | | 275 |
| Aurora, Harmons Pond | | 35 |
| Blue Ash, Clarke's lake | | 100 |
| Cambridge, Near Cut Lake | | 150 |
| Wills Creek | | 300 |
| Canfield, Lake Taylor | | 200 |
| Cecil, Maumee River | | 550 |
| Celina, Grand Reservoir | | 300 |
| Chippewa Lake, Chippewa Lake | | 1,225 |
| Cleveland, Mayfield Pond | | 200 |
| Spring Pond | | 100 |
| Columbus, Alumn Creek | | 300 |
| Bass Lake | | 150 |
| Big Walnut Creek | | 600 |
| Esswein Lake | | 600 |
| Little Walnut Creek | | 300 |
| Spring Lake | | 600 |
| Congress Lake, Congress Lake | | 450 |
| Covington, Covington Mill pond | | 150 |
| Painter Creek | | 150 |
| Stillwater River | | 300 |
| Dayton, Miami River | | 600 |
| Eaton, Seven Mile Creek | | 300 |
| Farmersville, Big Twin Creek | | 300 |
| Findlay, Auglaize River, Blanchards Fork | | 70 |
| Fort Jennings, Auglaize River | | 350 |
| Fremont, Green Creek | | 100 |
| Sandusky River | | 275 |
| Geneva, Grand River | | 275 |
| Georgetown, Moore Pond | | 100 |
| Geauga Lake, Geauga Lake | | 275 |
| Harpster, Lewis Lake | | 100 |
| Ohio—Continued. | | |
| Hillsboro, Clear Creek | | 100 |
| Rocky Fork Creek | | 300 |
| Hudson, Glass Pond | | 175 |
| Kent, East Twin Lake | | 275 |
| Lake Stewart | | 275 |
| Lima, Rhodes Pond | | 150 |
| Rimer Quarry Pond | | 100 |
| Watkins Pond | | 150 |
| Lorain, Anderson's pond | | 100 |
| McCutchenville, Mohawk Lake | | 100 |
| Mansfield, Clear Fork River, North Fork | | 150 |
| Midland City, Gem Valley Pond | | 150 |
| Millbury, Quarry Pond | | 100 |
| Mount Blanchard, Blanchard River | | 275 |
| Mount Orab, Sterling Pond | | 100 |
| Napoleon, Maumee River | | 175 |
| Oak Harbor, Portage River | | 275 |
| Oakwood, Auglaize River | | 275 |
| Okolona, Maumee River | | 275 |
| Ontario, Vogel Lake | | 350 |
| Palmyra, Mahoning River | | 525 |
| Peninsula, Clear Lake | | 70 |
| Crystal Pond | | 35 |
| Ravenna, Muzzy Lake | | 200 |
| Sandy Lake | | 200 |
| Valedge Pond | | 100 |
| Russells Point, Indian Lake | | 300 |
| Lewistown Pond | | 150 |
| Sandusky, Hoover Pond | | 175 |
| Springfield, Cliff Lake | | 300 |
| Little Miami River | | 300 |
| Storms Station, Paint Creek | | 300 |
| Sycamore, Honey Creek | | 275 |
| Walton's pond | | 100 |
| Tiffin, Lake Mohawk | | 275 |
| Toledo, Silica Lake | | 275 |
| Upper Sandusky, Sandusky River | | 275 |
| Urbana, Brush Lake | | 150 |
| Crane's pond | | 150 |
| Long Pond | | 150 |
| Wapakoneta, Auglaize River | | 300 |
| Washington Court House, Rattlesnake River | | 300 |
| Waynesburg, Sandy Creek and canal | | 350 |
| Wellsville, Smith's pond | | 200 |
| Youngstown, Crystal Lake | | 100 |
| Pine Lake | | 300 |
| Oklahoma: | | |
| Ada, Lake Ada | | 200 |
| Altus, City Reservoir | | 375 |
| Ardmore, Bass Lake | | 200 |
| Chickasaw Lake | | 450 |
| City Lake | | 300 |
| Dick Lake | | 250 |
| Gorman Lake | | 300 |
| Kirkpatrick Lake | | 300 |
| Lorena Park Lake | | 150 |
| Luna Lake | | 250 |
| Miller Lake | | 200 |
| Van Guilder Lake | | 300 |
| Aylesworth, Madill-Durant Lake | | 300 |
| Bartlesville, Silver Lake | | 400 |
| Berwyn, Young Lake | | 300 |
| Big Cabin, Rock Creek Lake | | 150 |
| Bixby, Allen Lake | | 150 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Oklahoma—Continued. | | |
| Brinkman, Lampert's pond | | 100 |
| Bristow, Kelly Lake | | 100 |
| Bunch, Long Foot Pond | | 300 |
| Carnegie, Washita River | | 150 |
| Casey, Marameo Pond | | 150 |
| Marameo Lake | | 150 |
| Castle, Davenport's pond | | 150 |
| Chattanooga, Bowlby's pond | | 75 |
| Chickasha, Jack Hollow Lake | | 100 |
| Lake Lanier | | 100 |
| Tony Lake | | 75 |
| Chicotah, Sunnyslope Pond | | 150 |
| Chouteau, Adkins' lake | | 150 |
| Beaver Lake | | 150 |
| Claremore, Humphreys Pond | | 300 |
| Comanche, Impson's pond | | 75 |
| Cordell, Miller's pond No. 2 | | 150 |
| Covington, Keller's pond | | 75 |
| Coweta, Baker Pond | | 100 |
| Crescent, Cedar Lake | | 150 |
| Swains Pond | | 75 |
| Custer, Fifer's pond | | 75 |
| Davis, Brady Lake | | 100 |
| Capps Lake | | 100 |
| Cedar Grove Lake | | 100 |
| Eaves Park Lake | | 150 |
| Honey Grove Lake | | 100 |
| Paynes Retreat Lake | | 100 |
| Dewey, Willow Lake | | 100 |
| Doby Springs, Bradford's pond | | 125 |
| Duncan, Weaver Lake | | 150 |
| El Reno, Bellany Lake | | 150 |
| Cora Bell Lake | | 100 |
| El Reno Rod and Gun Club Lake | | 150 |
| Erick, Meadow Brook Dairy Pond | | 75 |
| Eufaula, East Eufaula Lake | | 300 |
| Piney Creek | | 300 |
| Fallis, Lake Charles | | 300 |
| Glencoe, Wills Lake | | 150 |
| Gravette, Lucas & Yocom Pond | | 250 |
| Guthrie, Ellison Lake | | 100 |
| McCall Lake | | 100 |
| Overtons Lake | | 100 |
| Redingtons Lake | | 100 |
| Spring Lake | | 100 |
| Twin Lakes | | 100 |
| Walkers Lake | | 100 |
| Williams Lake | | 100 |
| Hartshorne, Choctaw Lake | | 300 |
| Lake Savage | | 300 |
| Haskell, Cox Pond | | 150 |
| Lake Concharty | | 150 |
| O. K. Lake | | 150 |
| Hugo, Krauter Lake | | 100 |
| Kulli Chitto Lake | | 200 |
| Indiahoma, Baldwin's pond | | 75 |
| South Farm Pond | | 75 |
| Lawton, Allison's pond | | 50 |
| Bath Lake | | 150 |
| Blue Beaver Creek | | 100 |
| Gondola Lake | | 100 |
| Lawtonka Lake | | 200 |
| Lloyds Pond | | 150 |
| Little Medicine Creek | | 150 |
| Lexington, Conkling's pond No. 1 | | 75 |
| Oak Hill Pond | | 75 |
| McAlester, Hardy's pond | | 100 |
| Highlands Lake | | 100 |
| Lake Talawanda | | 300 |
| Oklahoma—Continued. | | |
| McAlester, McAlester Country Club Lake | | 250 |
| Mountain Gap Lake | | 300 |
| Wild Horse Lake | | 200 |
| Mangum, Elm Spring Pond | | 150 |
| Trotter's pond | | 160 |
| Marietta, Horseshoe Pond | | 100 |
| Kirkpatrick Lake | | 100 |
| Rock Creek | | 160 |
| Massey, Massey Pond | | 100 |
| Milton, Wolf Creek | | 150 |
| Moore, Kalivoda Lake | | 75 |
| Mountain View, Jones Pond | | 75 |
| Pecan Creek | | 160 |
| Saddle Mountain Creek | | 150 |
| Stinking Creek | | 150 |
| Sugar Creek | | 150 |
| Mulhall, Twenty-one Pond | | 50 |
| Muskogee, Illinois River | | 500 |
| Illinois River, Barren Fork | | 400 |
| Mountain Creek | | 300 |
| Silver Creek | | 300 |
| Spring Valley Lake | | 300 |
| New Castle, Haun's pond | | 75 |
| Oklahoma City, Folly Lodge Lake | | 100 |
| Houghton Lake | | 75 |
| Waldons Lake | | 175 |
| Okmulgee, Phillips Pond | | 100 |
| Owasso, Owasso Lake | | 300 |
| Pauls Valley, Thompson Lake | | 75 |
| Perry, Perry Country Club pond | | 50 |
| Prague, Erets Lake | | 450 |
| Pryor, Fairview Lake | | 150 |
| Midway Lake | | 300 |
| Sulphur Creek | | 150 |
| Whitaker Park Pond | | 150 |
| Wolf Creek | | 150 |
| Purcell, Crawford's pond | | 100 |
| Randlett, Suters Lake | | 60 |
| Red Fork, Lake Sue | | 300 |
| Russet, White Pond | | 150 |
| Sapulpa, Euchre Creek | | 200 |
| Rock Creek | | 300 |
| Seminole, Rock Pond | | 150 |
| Shawnee, Lakeside Pond | | 200 |
| Maud Lake | | 500 |
| Spiro, Spiro Pond | | 350 |
| Stillwater, Boomer Creek | | 160 |
| Ritter Lake | | 150 |
| Stillwater Reservoir | | 150 |
| Yost Lake | | 450 |
| Stratford, Demonstration Pond | | 150 |
| Tulsa, Ketchum Lake | | 300 |
| Owen Park Pond | | 300 |
| Verden, Williams Lake | | 75 |
| Vinita, Little Cabin Creek | | 300 |
| Locust Creek | | 150 |
| West Cabin Creek | | 300 |
| White Oak Creek | | 300 |
| Wagoner, Horseshoe Lake | | 150 |
| Vann's lake | | 300 |
| Wardsville, Triplet Lake No. 1 | | 150 |
| Waurika, Fletcher's pond | | 225 |
| Wayne, Dulony's pond | | 75 |

## Distribution of Fish and Fish Eggs, by Locality and Species, Fiscal Year 1913—Continued.

### LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Oklahoma—Continued. | | |
| Westville, Smith's pond | | 150 |
| Wright, Holzman Lake | | 50 |
| Wyandotte, Lost Creek | | 150 |
| Yukon, Big Pond | | 75 |
| Long Pond | | 75 |
| Shelby's pond | | 75 |
| Pennsylvania: | | |
| Akron, Cocalico Creek | | 200 |
| Arcola, Perkiomen Creek | | 110 |
| Skippack Creek | | 110 |
| Brandamoore, Brandywine Creek | | 220 |
| Cambridge Springs, Edinboro Lake | | 80 |
| Cedar Knoll, Brandywine Creek | | 220 |
| Chambersburg, Conococheague Creek | | 20 |
| Chester, Chester River | | 75 |
| Crum Creek | | 75 |
| Ridley Creek | | 75 |
| Collegeville, Perkiomen Creek | | 110 |
| Skippack Creek | | 110 |
| Cossart, Newlins Mill pond | | 160 |
| Pyle Dam | | 120 |
| Doylestown, Mill Creek | | 110 |
| Neshaminy Creek | | 220 |
| Pine Run | | 110 |
| Falls, Silver Lake | | 250 |
| Susquehanna River | | 250 |
| Fort Loudon, Conococheague Creek | | 150 |
| Gardners, Conewago Creek | | 300 |
| Gettysburg, March Creek | | 300 |
| Goldsboro, Susquehanna River | | 250 |
| Graters Ford, Perkiomen Creek | | 110 |
| Skippack Creek | | 110 |
| Greencastle, Conococheague Creek | | 20 |
| West Conococheague Creek | | 20 |
| Honey Brook, Brandywine Creek, East Branch | | 80 |
| Brandywine Creek, West Branch | | 80 |
| Hosensack, Hancock's pond | | 110 |
| Hosensack Pond | | 100 |
| Huntingdon, Raystown Branch | | 40 |
| Icedale, Brandywine Creek | | 220 |
| Indiana, Yellow Creek | | 300 |
| Lancaster, Conestoga River | | 120 |
| Meadville, Sugar Lake | | 80 |
| Mechanicsburg, Conodoguinet Creek | | 40 |
| Mercersburg, Conococheague Creek, West Branch | | 150 |
| Mehoopany, Susquehanna River | | 540 |
| Middleburg, Middle Creek | | 300 |
| Mifflin, Tuscarora Creek | | 20 |
| Monocacy, Monocacy Creek | | 70 |
| Mount Holly Springs, Mountain Creek Pond | | 180 |
| Mount Union, Aughwick Creek | | 80 |
| Juniata River | | 120 |
| Mount Wolf, Laurel Creek | | 250 |
| Little Conewago Creek | | 250 |
| Pennsylvania—Continued. | | |
| Myerstown, Swatara Creek | | 20 |
| Neshaminy Falls, Neshaminy Creek | | 180 |
| New Oxford, Conewago Creek | | 300 |
| Newton-Hamilton, Juniata River | | 20 |
| Norristown, Schuylkill River | | 110 |
| Oaks, Skippack Creek | | 110 |
| Orbisonia, Aughwick Creek | | 300 |
| Black Log Creek | | 150 |
| Shade Creek | | 150 |
| Palm, Perkiomen Creek | | 220 |
| Pequea, Pequea Creek | | 75 |
| Susquehanna River | | 375 |
| Philadelphia, Fairmount Park Aquarium | | 25 |
| Phoenixville, French Creek | | 20 |
| Schuylkill River | | 100 |
| Pittsburgh, Straub's pond | | 180 |
| Point View, Juniata River, Frankstown Branch | | 20 |
| Rahns, Perkiomen Creek | | 110 |
| Skippack Creek | | 110 |
| Reading, Maiden Creek | | 20 |
| Muddy Creek | | 20 |
| Northkill Creek | | 20 |
| Tulpehocken Creek | | 20 |
| Ryde, Juniata River | | 40 |
| Sabula, Sabula Lake | | 300 |
| Safe Harbor, Susquehanna River | | 75 |
| St. Peters, French Creek | | 180 |
| Scotland, Conococheague Creek | | 20 |
| Shenks Ferry, Susquehanna River | | 75 |
| Shirleysburg, Aughwick Creek | | 300 |
| Spring City, Mill Pond | | 20 |
| Sprogel's run | | 50 |
| Stony Creek | | 50 |
| Telford, Perkiomen Creek, Northeast Branch | | 180 |
| Topton, Saucony Creek | | 110 |
| Washington Borough, Susquehanna River | | 75 |
| West Chester, Brandywine Creek | | 75 |
| Winfield, Penn's creek | | 200 |
| Wrightsville, Kreidler's creek | | 120 |
| Susquehanna River | | 120 |
| Wycombe, Neshaminy Creek | | 180 |
| Yerkes, Perkiomen Creek | | 110 |
| Skippack Creek | | 110 |
| York, Beaver Creek | | 125 |
| Bennett's creek | | 125 |
| Bermuda Creek | | 125 |
| Big Conewago Creek | | 125 |
| Bull Run Creek | | 125 |
| Cabin Creek | | 125 |
| Codorus Creek | | 125 |
| Codorus Creek, South Fork | | 125 |
| Codorus Creek, West Fork | | 125 |
| Conewago Creek | | 250 |
| Fishing Creek | | 125 |
| Fox Creek | | 125 |
| Kreutz Creek | | 125 |
| Little Conewago Creek | | 125 |
| Ore Valley Pond | | 125 |
| Otter Creek | | 125 |
| Yorkhaven, Susquehanna River | | 500 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Rhode Island: | | |
| Westerly, Paucatuck River | | 45 |
| South Carolina: | | |
| Florence, Muldraws Mill pond | | 1,750 |
| Sumter, McGirt Mill Pond | | 600 |
| South Dakota: | | |
| Aberdeen, Lake Minneeho | | 90 |
| Ardmore, Pease Lake | | 30 |
| Belle Fourche, Diversion Dam | | 105 |
| Castle Rock, Castle Rock Lake | | 70 |
| Chamberlain, Martin's lake | | 70 |
| Martin's pond | | 70 |
| Gregory, Osler Lake | | 70 |
| Hamill, Lake Wamblee | | 35 |
| Philip, Buzzard Creek Pond | | 30 |
| Haagenson's pond | | 75 |
| Pierre, Binder's pond | | 75 |
| Zigler's pond | | 75 |
| Presho, Johnson's pond | | 15 |
| Rapid City, Quincy Pond | | 75 |
| West Channel Lake | | 45 |
| Scenic, Cook's pond | | 30 |
| Shoemaker, Willow Creek | | 35 |
| Watertown, Lake Kampeska | | 660 |
| Lake Pelican | | 2,740 |
| Wewela, Newman's pond | | 35 |
| Tennessee: | | |
| Adams, Dillard's pond | | 150 |
| Elk Fork Creek | | 150 |
| Fort's ponds | | 450 |
| Ashland City, Sycamore Creek | | 300 |
| Bells, Booth's pond | | 100 |
| Bethel Springs, Cude's pond | | 90 |
| Buffalo Valley, Bate's pond | | 150 |
| Chattanooga, Caldwell Pond | | 375 |
| Hixon Lake | | 300 |
| McCallie Lake | | 300 |
| Clarksville, Davies Pond | | 150 |
| Minnow Pond | | 150 |
| Red River | | 300 |
| Red River, Big West Fork | | 800 |
| Red River, Little West Fork | | 300 |
| Sunny Lake | | 150 |
| Cleveland, Candies Creek | | 300 |
| Hall's pond | | 150 |
| Rainbow Lake | | 300 |
| Wildwood Lake | | 150 |
| Columbia, Duck River | | 300 |
| Fountain Creek | | 300 |
| Rutherford Creek | | 300 |
| Cowan, Moore's pond | | 40 |
| Decherd, Criswell's pond | | 40 |
| Donelson, Massey's pond | | 150 |
| Farner, Plumley Branch | | 150 |
| Rock Creek Pond | | 150 |
| Turtletown Creek | | 300 |
| Fayetteville, Elk River | | 450 |
| West Mulberry Creek | | 450 |
| Franklin, Big Harpeth River | | 450 |
| South Harpeth River | | 150 |
| Gallatin, Rogan Pond | | 150 |
| Graham, Garners Creek | | 150 |
| Greenbrier, Red River, Sulphur Fork | | 150 |
| Greenville, Lick Creek, Long Fork | | 200 |
| Tennessee—Continued. | | |
| Hampton Station, Darden's pond | | 150 |
| Fortson's pond | | 150 |
| Murphy's ponds | | 300 |
| Winter's pond | | 150 |
| Harriman, Emory River | | 225 |
| Lakeview Lake | | 75 |
| Watson's pond | | 75 |
| Henry, Outing Lake | | 150 |
| Hollow Rock, Railroad Pond | | 100 |
| Huntland, Mingo Pond | | 150 |
| Jasper, Town Creek | | 150 |
| Jefferson City, Holston River | | 300 |
| Kingston Springs, Brush Creek | | 200 |
| Lawrenceburg, Shoal Creek | | 150 |
| Shoal Creek, North Fork | | 150 |
| Shoal Creek, South Fork | | 150 |
| Lewisburg, Hill Pond | | 150 |
| Lexington, Freestone Pond | | 100 |
| Lookout Station, Lake Lookout | | 80 |
| Loudon, Paint Rock Creek | | 300 |
| Martel, Howard's pond | | 150 |
| Martha, Wood's pond | | 150 |
| Mitchellville, Gossett's pond | | 100 |
| Road Pond | | 100 |
| Round Pond | | 100 |
| McKenzie, Clear Lake | | 300 |
| Morrison, Barren Fork River | | 225 |
| Mount Pleasant, Big Bigbee Creek | | 300 |
| Sugar Creek, East Fork | | 150 |
| Wilson's pond | | 150 |
| Murfreesboro, Lake Excelsior | | 40 |
| Stockird's pond | | 40 |
| Nashville, Caney Fork River | | 500 |
| Lake Alberta | | 150 |
| Lake Beasley | | 200 |
| Smith Fork River | | 500 |
| New Market, Taylor's pond | | 100 |
| New River, New River | | 225 |
| Norma, New River | | 300 |
| Normandy, Isham Pond | | 40 |
| Nunnelly, Piney River | | 300 |
| Oakdale, Emory River | | 150 |
| Obion, Obion River | | 200 |
| Orlinda, Rose's pond | | 150 |
| Round Pond | | 150 |
| Petersburg, Cane Creek | | 150 |
| Pierce Station, Morris Pond | | 150 |
| Powell, Silver Lake | | 150 |
| Probst, Lost Creek | | 300 |
| Pulaski, Richland Creek | | 450 |
| Quebeck, Caney Fork Creek | | 150 |
| Rockford, Little River | | 300 |
| Rossville, Wolf River | | 90 |
| Roland, Sparkman's pond | | 75 |
| Sailors Rest, Yellow Creek | | 450 |
| St. Bethlehem, Gun Sink Pond | | 150 |
| Johnson's pond | | 150 |
| Sparta, Blue Spring Creek | | 150 |
| Town Creek | | 150 |
| Springfield, Porter's pond | | 300 |
| Sycamore Creek | | 450 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Tennessee—Continued. | | |
| Trenton, Powell's pond | | 180 |
| Walling, Henderson's pond | | 75 |
| Wartrace, Duck River, Garrison Fork | | 120 |
| Waverly, Big Richland Creek | | 200 |
| Blue Creek | | 200 |
| Hurricane Creek | | 300 |
| Trace Creek | | 250 |
| Wetmore, Prendergast Pond | | 300 |
| White Bluff, Harpeth River | | 300 |
| Turnbull Creek | | 250 |
| Whitwell, Sequatchie River | | 150 |
| Wildersville, Rush's pond | | 100 |
| Spring Pond | | 100 |
| Texas: | | |
| Aguilares, Yates's pond | | 1,850 |
| Alanreed, Meadow Pond | | 800 |
| Alba, Hodges's ponds | | 1,500 |
| Low's ponds | | 3,000 |
| Outing Club Lake | | 2,500 |
| Albany, Davis Pond | | 800 |
| Newcomb Pond | | 655 |
| Aledo, Trinity River, Clear Fork | | 2,400 |
| Alpine, Thomas Pond | | 60 |
| Alvin, Slataper's pond | | 1,000 |
| Annona, English Lake | | 1,500 |
| Asherton, Engel's pond | | 1,000 |
| Sullivan's pond | | 200 |
| Athens, Mills Ponds | | 2,000 |
| Atlanta, Baucum's pond | | 1,000 |
| Bivin's pond | | 1,000 |
| Chandler's pond | | 1,000 |
| Dunlap's pond | | 1,000 |
| Westbrook's pond | | 125 |
| Axtell, McGinty's lake | | 75 |
| Bagwell, Dearth's pond | | 750 |
| Bailey, Taylor's pond | | 800 |
| Bangs, Rutledge's lake | | 500 |
| Bardwell, Stovell's pond | | 2,500 |
| Bassett, Stine's pond | | 750 |
| Bastrop, Byar's pond | | 60 |
| Bay City, Moore's pond | | 700 |
| Beaumont, Neches River | | 450 |
| Beckville, Crawford Mill pond | | 1,550 |
| Bedias, Kerr & Bracewell's gin pond | | 1,500 |
| Lee Lake | | 1,100 |
| Belcherville, Benton's pond | | 125 |
| Bellville, Clear Creek | | 4,500 |
| Bettie, Brison's pond | | 3,000 |
| Lindsey's pond | | 3,000 |
| Big Wells, Vincent Lake | | 5,900 |
| Birome, Birome Pond | | 1,500 |
| Bishop, Bishop Lake | | 1,500 |
| Blossom, Gray's pond | | 275 |
| Oliver Pond | | 275 |
| Read's pond | | 275 |
| Blum, Brook's pond | | 500 |
| Wade's ponds | | 1,000 |
| Bonham, Bonham Cotton Mill Pond | | 1,500 |
| Club Lake | | 3,000 |
| Bon Weir, Stark Fish Pond | | 3,100 |
| Bovina, Robbin's pond | | 650 |
| Brady, Dutton's pond | | 100 |
| White Lake | | 1,100 |
| Brazos, Headquarters Lake | | 700 |
| Brenham, Watson Lakes | | 1,455 |
| Bronson, Spring Branch | | 900 |
| Brownwood, Brownwood Lake | | 6,500 |
| Camp's pond | | 675 |
| Fairland Lake | | 1,200 |
| Moore's lake | | 500 |
| Texas—Continued. | | |
| Bullard, Stripling's pond | | 380 |
| Burton, Jaroszewsky's pond | | 808 |
| Calvert, Beard's pond | | 90 |
| Cameron, Cameron Pond | | 500 |
| Carmine, Roemer's pond | | 800 |
| Carthage, Foster's lake | | 900 |
| Sycamore Lakes | | 1,000 |
| Wall's pond | | 3,000 |
| Center, Clear Spring Pond | | 2,250 |
| Center Point, Medina River | | 4,000 |
| Channing, Grapevine Creek | | 2,000 |
| Running Water Creek | | 1,000 |
| Chester, Willow Lake | | 1,000 |
| Chillicothe, Hill Crest Pond | | 810 |
| Christine, Lake Como | | 1,000 |
| Clarksville, McCarver's pond | | 1,500 |
| Red River Lake | | 5,250 |
| Clint, Turner's lake | | 650 |
| Coleman, Bachelor Prong Lake | | 1,560 |
| Columbus, White's pond | | 800 |
| Comfort, Guadalupe River | | 4,000 |
| Concord, Thomason's pond | | 2,000 |
| Cookville, Smith's lake | | 385 |
| Coolidge, Keeling's pond | | 3,000 |
| Corsicana, Benton Lake | | 1,000 |
| Drane's pond | | 1,500 |
| Fish Tank No. 1 | | 3,000 |
| Crockett, Bermuda Lake | | 1,000 |
| Collin's pond | | 1,000 |
| Woolly's pond | | 1,000 |
| Crystal City, Moklatix Pond | | 100 |
| Raymond Lake | | 2,740 |
| Dallas, Country Club Lake | | 1,500 |
| Meadow Pond | | 1,100 |
| O'Neil's pond | | 1,500 |
| Wah Hoo Club Lake | | 5,100 |
| Del Rio, Devils River | | 200 |
| Thomas Pond | | 100 |
| Denison, Rod and Gun Club Lake | | 600 |
| Shawnee Lake | | 8,500 |
| Detroit, Angora Lake | | 750 |
| Dooley Lake | | 1,500 |
| Roger's pond | | 750 |
| Scrap Pond | | 750 |
| Whitner Pond | | 750 |
| Dunlay, Medina Valley Pond | | 11,733 |
| Eden, Brady Creek | | 1,000 |
| Edgewood, Edgewood Club Lake | | 90 |
| McClellan's pond | | 90 |
| Melton Lake | | 1,100 |
| Edna, Alligator Lake | | 520 |
| Rice Canal | | 1,900 |
| Ellinger, Holan's pond | | 1,500 |
| Elm Mott, Club Lake | | 3,600 |
| Elysian fields, Owen's pond | | 290 |
| Emhouse, Reid Lake | | 2,500 |
| Tinkle's pond | | 2,025 |
| Encinal, Lenz's pond | | 1,600 |
| Rettaber's pond | | 1,200 |
| Ennis, Caldwell's pond | | 1,500 |
| Cerf's pond | | 1,000 |
| Ferris Lake | | 1,000 |
| Pecan Grove Pond | | 1,000 |
| Pound Lake | | 1,000 |
| Sand Lake | | 3,500 |
| Eustace, Lock Lake | | 1,000 |
| Falfurrias, Jones's pond | | 600 |
| La Tasa Lake | | 600 |
| Brooks's pond | | 650 |
| Ferris, Brick Company Pond | | 1,000 |
| Floyd, Greenwade's pond | | 1,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Texas—Continued. | | |
| Fluvanna, Browning's pond | | 400 |
| Fort Stockton, Comanche Creek | | 2,400 |
| Fort Worth, Fosdick's pond | | 3,000 |
| Triplett's lake | | 3,000 |
| Foukes Spur, Lake View | | 3,500 |
| Fowlerton, Alligator Lake | | 3,000 |
| Frio River | | 3,000 |
| Franklin, Mosquito Pond | | 350 |
| Frisco, Frisco Lake | | 2,200 |
| Roger's pond | | 630 |
| Gainesville, Bentley's lake | | 500 |
| Garland, Dausye Lake | | 240 |
| Lenard Creek | | 340 |
| Garza, Bermuda Pond | | 100 |
| Gates, Texas Company Lake | | 125 |
| Germania, Osborne's pond | | 300 |
| Giddings, Carmean's lake | | 1,100 |
| Miertschin's pond | | 800 |
| Gilmer, Bay Pond | | 175 |
| Mont's pond | | 107 |
| Gladewater, Tuttle's pond | | 1,000 |
| Glidden, Clapp's lake | | 3,600 |
| Deer Lake | | 2,700 |
| Goodnight, Buffalo Ponds | | 200 |
| Horse Pond | | 100 |
| Spring Creek Pond | | 200 |
| Gordon, Elmhurst Lake | | 1,500 |
| Jamieson's pond | | 1,500 |
| Miller's pond | | 1,500 |
| Newton Pond | | 1,500 |
| Providence Lake | | 1,500 |
| Twin Lakes | | 1,500 |
| Grand Prairie, Hughes's pond | | 215 |
| Willow Pond | | 90 |
| Grapeland, Elcaney Pond | | 2,500 |
| Neel Pond | | 1,000 |
| Grapevine, Grapevine Club Lake | | 1,500 |
| Greenbrier, Beckham's pond | | 400 |
| Duck Creek | | 5,250 |
| Greenbrier Creek | | 1,010 |
| Greenbrier Lake | | 400 |
| Indian Creek | | 800 |
| Mud Creek | | 400 |
| Sand Pond | | 3,750 |
| Williams Creek | | 2,250 |
| Greenville, Camp's lake | | 500 |
| Gresham, Sweet Gum Lake | | 800 |
| Groveton, Southside Pond | | 6,000 |
| Hallsburg, Clear Lake | | 2,500 |
| Hawkins, Mill Creek | | 3,500 |
| Hebronville, Edds Pond | | 1,250 |
| Helmic, Railroad Pond | | 2,000 |
| Henderson, Swinney Lake | | 1,000 |
| Henrietta, Canyon Pond | | 1,000 |
| Horseshoe Lake | | 2,000 |
| Neville Lake | | 1,000 |
| Honey Grove, Gauldin Lake | | 1,500 |
| Hubbard, Bjurstrum's pond | | 380 |
| Blue Pond | | 380 |
| Lofgren's pond | | 380 |
| Snag Pond | | 487 |
| Hutchins, Dallas Club Lake | | 4,000 |
| Jacksboro, Carroll's creek | | 8,500 |
| Daugherty Lake | | 800 |
| Knox Lake | | 1,475 |
| Jacksonville, Black Pond | | 1,000 |
| Boles Lake | | 1,400 |
| Parrish Lake | | 90 |
| Jonesville, Brown's pond | | 1,000 |
| Kaufman, Allen's pond | | 1,100 |
| Boykin's pond | | 1,000 |
| Carlisle's pond | | 1,000 |
| Texas—Continued. | | |
| Kaufman, Crawfish Lake | | 525 |
| Crown Lake | | 1,000 |
| Gilmore Pond | | 1,000 |
| Jones's lake | | 1,000 |
| Lawson's pond No. 1 | | 1,000 |
| Mulkey's pond | | 1,000 |
| Nash's pond No. 1 | | 1,000 |
| Nash's pond No. 2 | | 1,000 |
| Osborne Lake | | 1,000 |
| Seine Lake | | 1,500 |
| Kemp, Berry Lake | | 2,000 |
| Clear Lake | | 2,000 |
| Club Lake | | 2,500 |
| Kemp Benny Lake | | 2,900 |
| Long Lake | | 2,000 |
| Kent, Tatum's spring | | 612 |
| Kerens, Perry's pond | | 75 |
| Kerrville, Barnett Pond | | 3,000 |
| Beck's lake | | 1,500 |
| Goat Creek | | 780 |
| Gregory Lake | | 780 |
| Guadalupe River, North Fork | | 1,000 |
| Johnson Pond | | 790 |
| Lackey Pond | | 3,000 |
| Louis Lake | | 3,000 |
| Kilgore, Hamilton's pond | | 1,130 |
| Kosse, Denny Lake | | 1,000 |
| La Mesa, Garland's pond | | 650 |
| Lampasas, Campbell's pond | | 500 |
| Collins's pond | | 500 |
| Culver Pond No. 2 | | 500 |
| Laredo, McDermott Pond | | 2,000 |
| Webb Lake | | 1,850 |
| Leander, Faubion's pond | | 350 |
| Leesburg, Turner Mill Pond | | 240 |
| Lewisville, Heath Lake | | 180 |
| Lexington, Beasley's pond | | 3,400 |
| Lillian, Casteven's pond | | 1,500 |
| Llano, Llano River | | 5,400 |
| Lone Oak, Allmon's pond | | 600 |
| Barnett Pond No. 1 | | 700 |
| Barnett Pond No. 2 | | 1,500 |
| Roberts's pond | | 700 |
| Loraine, Davis Pond | | 300 |
| Lott, Barlow Pond | | 1,800 |
| Franzel's pond | | 1,800 |
| Hunt Pond | | 1,700 |
| Looka's pond | | 3,600 |
| Lovelady, Jackson Lake | | 3,250 |
| Loving Lake | | 800 |
| Lubbock, Coleman Pond | | 650 |
| Lufkin, Boynton Lake | | 2,000 |
| Lyons, Bates Pond | | 800 |
| Englemann's pond | | 800 |
| Fahnert's pond | | 500 |
| Hruska's pond | | 500 |
| Oppermann's pond | | 800 |
| Pivonka's pond No. 1 | | 500 |
| Pivonka's pond No. 2 | | 500 |
| Vest's pond | | 800 |
| McDade, Bostic's pond | | 860 |
| McKinney, Atkinson Creek | | 4,500 |
| Burrus Pond | | 3,000 |
| Doe Branch | | 2,300 |
| McKinney Club Lake | | 3,000 |
| McKinney's pond | | 2,700 |
| Madisonville, Menefee's pond | | 3,000 |
| Marion, Ebert's pond | | 575 |
| Mart, Drinkard's pond | | 1,000 |
| Megargel, Railway Pond | | 800 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Texas—Continued. | | |
| Memphis, Lone Spring Pond | | 800 |
| Meridian, Finley's pond | | 500 |
| Mertzon, Shallow Well Lake | | 500 |
| Mesquite, Duff Lake | | 1,100 |
| Florence Lake | | 1,100 |
| Marshall's lake | | 1,100 |
| Mexia, Benton's pond | | 1,000 |
| Redfield Pond | | 1,000 |
| Miles, Willow Creek | | 500 |
| Mineral Wells, Bluff Creek | | 2,600 |
| Eagle Creek | | 2,400 |
| Mineola, County Farm Pond | | 1,500 |
| Glade Creek Pond | | 90 |
| Holland Club Lake | | 620 |
| Lloyd and Denton Pond | | 1,500 |
| Mill Lake | | 1,500 |
| Red Bud Lake | | 620 |
| Russell's lake | | 1,500 |
| Mount Calm, City Waterworks Pond | | 400 |
| Gin Pond | | 400 |
| Old Town Pond | | 185 |
| Prairie Hill Lake | | 380 |
| Mount Pleasant, Tennison's pond | | 3,000 |
| Mount Selman, Brock Lake | | 500 |
| Mount Vernon, Sharber's pond | | 800 |
| Williams Lake | | 800 |
| Naples, Pastime Pond | | 880 |
| New Baden, Persimmon Pond | | 900 |
| New Boston, Lumber Company Lake | | 2,000 |
| New Braunfels, Bear Creek | | 2,400 |
| Comal River | | 3,000 |
| Guadalupe River | | 3,535 |
| Newcastle, Chandler's pond | | 250 |
| Lake Newcastle | | 250 |
| Newsome, Bermuda Lake | | 1,000 |
| Elwood Club Lake | | 1,250 |
| Oake Lake | | 1,000 |
| Nixon, Allen's pond | | 950 |
| Campbell Pond | | 1,200 |
| Nocona, Jarrard Pond | | 100 |
| Onalaska, West Lumber Co.'s upper pond | | 3,000 |
| Otto, Jund's pond | | 500 |
| Paducah, Nash Pond | | 375 |
| Paige, Behren's pond | | 100 |
| Fox Pond | | 871 |
| Kissmann's pond No. 1 | | 800 |
| Kissmann's pond No. 2 | | 868 |
| Laake's pond | | 100 |
| Rhode's ponds | | 100 |
| Ruehrmond's pond | | 800 |
| Schellstede's pond | | 800 |
| Paris, Bouvelard Farm Pond | | 1,500 |
| Edzard's pond | | 750 |
| Lake Riga | | 275 |
| Oneta Lake | | 750 |
| Theilman Lake | | 600 |
| Williams's pond No. 2 | | 1,500 |
| Perry, Eckert's pond | | 600 |
| Pittsburg, Cole's pond | | 420 |
| Efurd's pond | | 1,125 |
| Ferndale Club Lake | | 1,250 |
| Jackson's pond | | 1,250 |
| Willow Pond | | 1,250 |
| Plano, Bishop's pond | | 2,000 |
| Plainview, Advance Lake | | 3,250 |
| Lackey's pond | | 650 |
| Little Gem Lake | | 1,950 |
| Texas—Continued. | | |
| Plateau, Akard's pond | | 612 |
| Pledger, Matthews Lake | | 2,400 |
| Point, Simmons Pond | | 800 |
| Thornton's pond | | 325 |
| Poteet, Martin's pond | | 1,000 |
| Pritchett, Goffey's pond | | 75 |
| Mathis Pond | | 1,500 |
| Panky's pond | | 107 |
| Purdon, Baker's pond | | 380 |
| Moore's pond | | 175 |
| Putnam, Wathen Lake | | 1,500 |
| Retrieve, Lake Charlotte | | 600 |
| Riesel, Klatt's pond | | 1,000 |
| Krueger's pond | | 1,500 |
| Sunsworth Lake | | 1,500 |
| Turner's pond | | 1,500 |
| Wehring's pond | | 1,000 |
| Richards, Hamilton Pond | | 2,475 |
| Rockdale, Alligator Lake | | 440 |
| Clear Lake | | 1,000 |
| Hicks Lake | | 1,000 |
| Lee Pond | | 1,000 |
| White Perch Club Lake | | 1,600 |
| Rockwall, Leonard Lake | | 600 |
| Willis Lake | | 1,250 |
| Rogers, Kirksey's pond | | 500 |
| Lake Odom | | 500 |
| Rosebud, Gregory's pond | | 5,100 |
| Stillwell's pond | | 5,400 |
| Winkleman's pond | | 1,700 |
| Rotan, Ace Pond | | 1,400 |
| Bostick Pond | | 400 |
| Forrester's pond | | 1,550 |
| Loving Pond | | 1,830 |
| Royse City, Bois D'Arc Lake | | 230 |
| Royse City Lake | | 300 |
| Sabinal, Frio River | | 500 |
| Frio River, West Branch | | 500 |
| Saginaw, Beall's pond No. 1 | | 650 |
| Beall's pond No. 2 | | 650 |
| Lake Wandry | | 1,300 |
| San Antonio, Fest and McAskill Lake | | 600 |
| Medina Valley Pond | | 5,867 |
| Salado River | | 2,600 |
| San Benito, Stegman Lake | | 2,500 |
| San Marcos, San Marcos River | | 7,000 |
| Santo, Ramsey Pond | | 500 |
| Savoy, Large's pond | | 550 |
| Seguin, Guadalupe River | | 4,400 |
| Sherman, Evans Pond | | 1,100 |
| Gunter's lake | | 1,000 |
| Sierra Blanca, Hardwick Pond | | 650 |
| Smithville, Lake Louise | | 60 |
| Spring Branch | | 60 |
| Willow Branch | | 5,600 |
| Snyder, Fuller's pond | | 500 |
| Huffman's pond | | 500 |
| Thompson's pond | | 400 |
| Spofford, Dutch Battle Ground Creek | | 500 |
| West's pond | | 500 |
| Streetman, Gilbert's pond | | 2,000 |
| Sulphur Springs, Adams Pond | | 420 |
| Eberta Lake | | 1,250 |
| Railroad Pond | | 1,250 |
| Swearingen, Beef Pond | | 600 |
| Talpa, Laughlin Lake | | 500 |
| Taylor, Hurta's pond | | 90 |
| Temple, West Falls Pond | | 560 |
| Tenaha, Lake Cliff | | 3,250 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Texas—Continued. | | |
| Terrell, Adcock's pond | | 1,100 |
| Breeden Pond | | 500 |
| Butler's pond | | 1,100 |
| Cariker Pond | | 1,000 |
| Charlton's pond | | 550 |
| Davis Pond | | 1,100 |
| Griffith's lake | | 1,100 |
| Griffith's pond | | 550 |
| King Pond | | 1,000 |
| Lewis Pond | | 500 |
| Lockhead Pond | | 1,000 |
| Lumkin's pond | | 1,100 |
| McGinnis Pond | | 1,000 |
| Morrow's pond | | 1,100 |
| Noble's pond | | 1,100 |
| Powell's pond | | 550 |
| Raley & Gell Pond | | 550 |
| Thorndale, Schroeder's pond | | 800 |
| Thorndale Club Lake | | 90 |
| Timpson, McLeroy's pond | | 25 |
| Tioga, Roger's pond | | 2,100 |
| Trinity, Manry Lake | | 1,000 |
| Robb's lake | | 3,000 |
| Skains Lake | | 1,500 |
| Tyler, Holtzclaw's pond | | 3,000 |
| Uvalde, Nueces River | | 2,750 |
| Vernon, Castleberry's pond | | 800 |
| Kell's pond | | 400 |
| Long's pond | | 400 |
| Waco, City Hall Fountain | | 200 |
| Cooper's pond | | 185 |
| Driskell Neall Lake | | 600 |
| Waco Fish Pond | | 12,300 |
| Waskom, Shady Pond | | 1,000 |
| Waxahachie, Bermuda Lake | | 230 |
| Webb, El Pato Pond | | 4,250 |
| West, Elm Lake | | 300 |
| Westville, Lumber Company Pond | | 1,000 |
| Whitesboro, Whitesboro Lake | | 2,800 |
| Wichita Falls, Lake Creek Lake | | 2,400 |
| Waggoner's lake | | 1,600 |
| Wills Point, Clear Lake | | 125 |
| Wolfe City, Floyd's pond | | 800 |
| Mill Pond | | 2,400 |
| Warren's pond | | 800 |
| Woodward, Woodward Creek | | 200 |
| Woodward Lake No. 1 | | 200 |
| Woodward Lake No. 2 | | 200 |
| Yorktown, Hillside Pond | | 1,800 |
| Vermont: | | |
| Lyndonville, Chandler Pond | | 100 |
| Virginia: | | |
| Abingdon, Holston River, South Fork | | 800 |
| Amelia, Crystal Lake | | 200 |
| Barbours Creek, Craigs Creek | | 200 |
| Bedford City, Nichols Lake | | 100 |
| Bridgewater, Cooks Creek | | 150 |
| Catron's Siding, Cripple Creek | | 500 |
| Charlottesville, Moores Creek | | 150 |
| Tudor Grove Pond | | 150 |
| Covesville, Hardware Creek | | 300 |
| Cullen, Blackstock's pond | | 200 |
| Culpeper, Rappahannock River | | 400 |
| Dixondale Wharf, Beaverdam Creek | | 100 |
| Edinburg, Stoney Creek | | 200 |
| Virginia—Continued. | | |
| Elliston, Stiles's pond | | 100 |
| Ewing, Indian Creek | | 100 |
| Farmville, Edmunds's pond | | 100 |
| Green Bay, Wing's pond | | 100 |
| Griffith, Cowpasture River | | 550 |
| Guinea, Copley's pond | | 80 |
| Po River | | 180 |
| Purks's pond | | 100 |
| Sunnyside Pond | | 40 |
| Ivor, Worrell's pond | | 150 |
| Kincaid, Jackson River | | 550 |
| Lawyers, Flat Creek | | 200 |
| Lester Manor, Walkerton Pond | | 200 |
| Wolverton Mill Pond | | 200 |
| Lexington, Buffalo River | | 200 |
| Lightfoot, Newman's pond | | 200 |
| Marion, Spruce Creek | | 500 |
| Newcastle, Craigs Creek | | 100 |
| Johns Creek | | 300 |
| Norfolk, Water Company Pond | | 100 |
| North End, Fishing Bay Pond | | 125 |
| Lake Grinels | | 125 |
| Parr, Craig River | | 200 |
| Petersburg, Burge's pond | | 600 |
| Estes Pond | | 200 |
| Haywood Mill pond | | 300 |
| Jackson Pond | | 100 |
| Kanes Mill pond | | 300 |
| Old Town Creek Pond | | 500 |
| Ruffins Mill pond | | 350 |
| Potts Valley Junction, New River | | 200 |
| Proffit, Miller's pond | | 100 |
| Providence Forge, Mirror Lake | | 650 |
| Providence Forge Pond | | 300 |
| Randolph, Big Bluestone Creek | | 200 |
| Richmond, Capitol Square Pond | | 50 |
| Chesterfield Club Pond | | 200 |
| Christian Mill pond | | 200 |
| Diascond Pond | | 300 |
| Forest Hill Park Lake | | 300 |
| Fulton Club Pond | | 200 |
| Harnish's pond | | 200 |
| Johnson's pond | | 200 |
| Joseph Bryan Pond | | 300 |
| Licking Creek Pond | | 200 |
| Loch Gregor Pond | | 100 |
| Maddison Pond | | 200 |
| Oklahoma Creek Pond | | 175 |
| Valdens Pond | | 300 |
| Water View Pond | | 150 |
| Yahleys Mill pond | | 200 |
| Rock Castle, Dungeness Pond | | 100 |
| Tilman's pond | | 100 |
| Seneca, Seneca Creek | | 200 |
| Spencer, South Mayo Creek | | 150 |
| Stony Creek, Chappells Mill pond | | 350 |
| Fishing Club Pond | | 200 |
| Houle's pond | | 200 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Virginia—Continued. | | |
| Stony Creek, Sapponey Mill pond | | 200 |
| Suffolk, Lake Savage | | 400 |
| Taylorstown, Catoctin Creek | | 250 |
| Toano, Carlton's pond | | 175 |
| Wheeler, Butchers Branch | | 500 |
| Indian Creek | | 500 |
| Winchester, Hillyard Pond | | 100 |
| Windsor, Bracey's pond | | 300 |
| Braswell's pond | | 300 |
| Woods Lane, Travis's mill pond | | 100 |
| Woodstock, Shenandoah River, North Fork | | 300 |
| Washington: | | |
| Almira, Boundary Lake | | 75 |
| Anacortes, Hummels Lake | | 80 |
| Boyds, Lost Lake | | 80 |
| Bryant, Sunday Lake | | 40 |
| Granite Falls, Wall Lake | | 40 |
| Marble, Lake Maria | | 40 |
| Oroville, Hershberger Lakes | | 150 |
| Republic, Mud Lake | | 40 |
| Swan Lake | | 40 |
| Spokane, Silver Lake | | 80 |
| Stanwood, Lake Ketchum | | 80 |
| Winona, Big Cove Lake | | 75 |
| West Virginia: | | |
| Albright, Cheat River | | 120 |
| Big Creek, Guyandotte River | | 400 |
| Blue Creek, Elk River | | 500 |
| Buckhannon, Buckhannon River | | 400 |
| Charleston, Elk River | | 150 |
| Davy, Indian Creek | | 300 |
| Guyandotte River, Clear Fork | | 300 |
| Elkins, Tygarts Valley River | | 880 |
| Elm Grove, Big Wheeling Creek | | 300 |
| Fairmont, Tygarts Valley River | | 300 |
| Glendon, Birch River | | 400 |
| Grafton, Tygarts Valley River | | 160 |
| Great Cacapon, Great Cacapon River | | 1,300 |
| Jacksonburg, Fishing Creek, South Fork | | 380 |
| Kendalia, Blue Creek | | 400 |
| Keyser, Pattersons Creek | | 75 |
| Sanders's pond | | 300 |
| Martinsburg, Back Creek | | 500 |
| Opequon Creek | | 700 |
| Mill Creek, Tygarts Valley River | | 400 |
| Moorefield, Potomac River, South Branch | | 2,125 |
| Morgantown, Cheat River | | 120 |
| Dunkard Creek | | 50 |
| Monongahela River | | 240 |
| Moundsville, Fish Creek | | 300 |
| Mullens, Barker's creek | | 300 |
| Guyandotte River | | 500 |
| Guyandotte River, Slab Fork | | 400 |
| New Martinsville, Big Fishing Creek | | 80 |
| Owensport, Little Kanawha River | | 200 |
| Parkersburg, Little Kanawha River | | 220 |
| Paw Paw, Potomac River | | 240 |
| West Virginia—Continued. | | |
| Pine Grove, Fishing Creek, North Fork | | 120 |
| Porters Falls, Fishing Creek | | 300 |
| Romney, Potomac River, South Branch | | 885 |
| Ronceverte, Greenbrier River | | 880 |
| St. Albans, Coal River | | 100 |
| Shepherdstown, Potomac River | | 1,600 |
| Sistersville, Middle Island Creek | | 80 |
| Sitlington, Sitlington Creek | | 880 |
| Terra Alta, Lake Terra Alta | | 75 |
| Webster Springs, Elk River | | 320 |
| Wheeling, Fish Creek | | 300 |
| State Fair Aquarium | | 2 |
| White Sulphur, Greenbrier River | | 240 |
| Williamson, Tug River | | 400 |
| Wisconsin: | | |
| Antioch, Bebor's lake | | 175 |
| Athelstane, Elbow Lake | | 250 |
| Blair, Trempealeau Pond | | 300 |
| Campbellsport, Forest Lake | | 350 |
| Coloma, Crystal Lake | | 175 |
| Pleasant Lake | | 175 |
| Wood Lake | | 175 |
| Cusson, Booher Lake | | 100 |
| Devils Lake, Devils Lake | | 350 |
| Eland Junction, Norrie Lake | | 850 |
| Elkhart, Crystal Lake | | 350 |
| Fairchild, Beaver Creek | | 200 |
| Fond du Lac, Lake de Nevue | | 350 |
| Hackley, Big Twin Lake | | 250 |
| Lake Helen | | 125 |
| Little Bass Lake | | 300 |
| Little Twin Lake | | 250 |
| Hancock, Fish Lake | | 350 |
| Hartford, Pike Lake | | 350 |
| Hatfield, Lake Arbutus | | 400 |
| Independence, Big Elk Creek | | 100 |
| Bugle Lake | | 100 |
| Lower Elk Creek | | 100 |
| Trempealeau River | | 300 |
| Iron River, Armstrong Lake | | 125 |
| Big Angus Lake | | 125 |
| Bismarck Lake | | 125 |
| Bladder Lake | | 125 |
| Camp Four Lake | | 125 |
| Camp Twenty Lake | | 125 |
| Crow Lake | | 125 |
| Eagle Lake | | 125 |
| Finger Lake | | 125 |
| Fire Lake | | 125 |
| Hart Lake | | 125 |
| Iron Lake | | 125 |
| Little Angus Lake | | 125 |
| Lost Lake | | 125 |
| Moon Lake | | 125 |
| Mud Lake | | 125 |
| Pine Lake | | 125 |
| La Crosse, Blacksnake Creek | | 200 |
| Lake Beulah, Lake Beulah | | 350 |
| Laona, Birch Lake | | 175 |
| Langer Lake | | 275 |
| Rat Lake | | 300 |
| Silver Lake | | 175 |
| Manitowoc, English Lake | | 175 |
| Gass Lake | | 175 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LARGE-MOUTH BLACK BASS—Continued.

| Disposition. | Fry. | Fingerlings, yearlings, and adults. |
|---|---|---|
| Wisconsin—Continued. | | |
| Manitowoc, Gatemans Lake | | 175 |
| Glomsky's lake | | 175 |
| Harp Lake | | 175 |
| Hartlaub's lake | | 175 |
| Hemptons Lake | | 175 |
| Kastbaum's lake | | 175 |
| Schisel's lake | | 175 |
| Mauston, Lemonweir Mill Pond | | 175 |
| Lemonweir River | | 175 |
| Mauston Mill Pond | | 175 |
| Mellen, English Lake | | 90 |
| Mineral Lake | | 90 |
| Merton, Lake Keesus | | 350 |
| North Lake, North Lake | | 350 |
| Okauchee, Okauchee Lake | | 525 |
| Pelican, Pelican Lake | | 300 |
| Plainfield, Fish Lake | | 175 |
| Gilbert Lake | | 175 |
| Koosle Lake | | 175 |
| Lake Huron | | 175 |
| Long Lake | | 175 |
| Pine Lake | | 175 |
| Random Lake, Random Lake | | 350 |
| Sauk City, Koenigs Mill Pond | | 300 |
| Schleisingerville, Cedar Lake | | 350 |
| Sheboygan Falls, Gerbers Lake | | 350 |
| Jetzers Lake | | 350 |
| Spring Green, Wisconsin River | | 400 |
| Spring Lake, Spring Lake | | 175 |
| State Line, Bass Lake | | 300 |
| Birch Lake | | 125 |
| Crystal Lake | | 125 |
| Lac Vieux Desert Lake | | 300 |
| Pot Fish Lake | | 125 |
| Stevens Point, Big Plover River | | 350 |
| Rocky Run | | 175 |
| Wisconsin River | | 525 |
| Sturgeon Bay, Sturgeon Bay | | 525 |
| Three Lakes, Big Fork Lake | | 125 |
| Big Stone Lake | | 125 |
| Butternut Lake | | 125 |
| Cook Lake | | 125 |
| Elm Lake | | 125 |
| Island Lake | | 125 |
| Wisconsin—Continued. | | |
| Three Lakes, Long Lake | | 250 |
| Medicine Lake | | 125 |
| One Stone Lake | | 125 |
| Range Line Lake | | 125 |
| Spirit Lake | | 125 |
| Town Line Lake | | 125 |
| Tomah, Water Mill Pond | | 350 |
| Van Ostand, Edith Lake | | 250 |
| Wabeno, Buck Lake | | 300 |
| Deer Lake | | 300 |
| East Branch Lake | | 300 |
| Jungle Lake | | 175 |
| Slogenhoff Lake | | 300 |
| Warrens, Razins Pond | | 400 |
| Warrens Pond | | 400 |
| Waupaca, Mirror and Shadow Lakes | | 350 |
| Whitewater, Whitewater Lake | | 350 |
| Wonewoc, Alcott Pond | | 175 |
| Baraboo River | | 175 |
| Baraboo River, West Branch | | 175 |
| Castle Rock Pond | | 175 |
| Crawfish Pond | | 175 |
| Horseshoe Pond | | 175 |
| Mill Pond | | 175 |
| North Branch | | 175 |
| Peters's pond | | 175 |
| Rodgers Pond | | 175 |
| Roehling's pond | | 175 |
| Tank Pond | | 175 |
| Timber Lake | | 175 |
| West's pond | | 175 |
| Wolfenden's pond | | 175 |
| Wyoming: | | |
| Casper, Casper Storage Reservoir | | 45 |
| Hat Six Lake | | 30 |
| Gillette, Lake De Smet | | 60 |
| Glendo, North Platte River | | 30 |
| Pine Bluff, Little Moon Lake | | 30 |
| Rawlins, North Brown Canon Lake | | 30 |
| South Brown Canon Lake | | 60 |
| Sheridan, Dinwiddie Lake | | 40 |
| Total[a] | 26,250 | 1,231,052 |

[a] Lost in transit, 1,250 fry and 3,908 fingerlings.

SUNFISH (BREAM).

| Disposition. | Fingerlings, yearlings, and adults. |
|---|---|
| Alabama: | |
| Altoona, Durham Spring Pond No. 2 | 100 |
| Hurst's pond No. 1 | 100 |
| Hurst's pond No. 2 | 100 |
| Andalusia, Knox Pond | 900 |
| Anniston, Jelk's pond | 75 |
| Johnson's pond | 150 |
| Lake Keifer | 150 |
| Weatherly Pond | 350 |
| Alabama—Continued. | |
| Bessemer, West Lake | 180 |
| Birmingham, Brewster's lake | 75 |
| Feeneker's pond | 600 |
| Scott's branch | 900 |
| Carrollton, Bonner Mill Pond | 200 |
| Coalfire Creek | 200 |
| Lubbubb Creek | 200 |
| Centerville, Spring Hill Pond | 400 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

SUNFISH (BREAM)—Continued.

| Disposition. | Fingerlings, yearlings, and adults. |
|---|---|
| **Alabama—Continued.** | |
| Clayton, Bickley's pond | 250 |
| Fenn's pond | 150 |
| Fillingim's pond | 150 |
| Comer, Holly Creek | 600 |
| Cuba, McGowen's pond | 250 |
| Cullman, Brogden River | 75 |
| Cossey's pond | 300 |
| Graham's pond | 75 |
| Demopolis, Cement Company Pond | 900 |
| Elamville, Shepard Pond | 150 |
| Eufaula, Guice Lake | 200 |
| Wilson Pond | 150 |
| Eutaw, Kings Pond | 400 |
| Fayette, Mount Pleasant Pond | 900 |
| White's pond | 400 |
| Fort Payne, Crystal Lake | 225 |
| Sauty Creek | 225 |
| Town Creek | 225 |
| Gadsden, Big Canoe Creek | 600 |
| Greensboro, Lavender's pond | 600 |
| Ryan's pond | 600 |
| Greenville, Andress pond | 300 |
| Pine Barren Creek | 450 |
| Sirmons Mill pond | 450 |
| Thagard's pond | 300 |
| Haleyville, Bohannon Pond | 600 |
| Hartselle, Pike Road Pond | 900 |
| Huntsville, Farmer's lake | 75 |
| Jasper, Black Water Pond | 3,000 |
| Livingston, Hunter's pond No. 1 | 600 |
| Hunter's pond No. 2 | 900 |
| Millbrook, Young's pond | 200 |
| Montgomery, Hallonquist Lake | 300 |
| Howard's lake | 300 |
| Oneonta, Sand Lake | 150 |
| Opp, Benton's pond | 450 |
| Ozark, Mixson's pond | 150 |
| Phil Campbell, Dunkin's pond | 300 |
| Shirey's pond | 900 |
| Phoenix, Harden's lake | 40 |
| Russellville, Roberson Pond | 900 |
| Sanie, Margaret Lake | 475 |
| Seale, Dudley's pond | 600 |
| Speigner, Shelton Spring Pond | 500 |
| Stevenson, Stevenson Cotton Mill pond | 900 |
| Tanner, Peek's pond | 600 |
| Union Springs, Cope's pond | 100 |
| Veto, Hodge's pond | 750 |
| **Arkansas:** | |
| Alma, Big Clear Creek | 400 |
| Brentwood, Brown's pond | 400 |
| Cushman, Cushman Lake | 250 |
| Hatfield, Martin's pond | 100 |
| Little Rock, Pinehurst Lake | 275 |
| McKinney, Fern Springs Pond | 100 |
| Mabelvale, Thompson's pond | 275 |
| Mammoth Springs, Bellamy's pond | 75 |
| Mansfield, Brickyard Pond | 550 |
| Many Islands, Spring River | 25 |
| Marked Tree, St. Francis River | 6,248 |
| Monticello, McCandless Pond | 100 |
| Newport, Newport Lake | 475 |
| Warren, Town Branch | 100 |
| **Florida:** | |
| High Springs, Blue Pond | 100 |
| Jacksonville, Solace Lake | 100 |
| Monticello, Wolf Pond | 100 |
| Newberry, Cheves Pond | 100 |
| Santos, Lake Madonna | 200 |
| Tallahassee, Black Water Lake | 60 |
| Theressa, Alligator Pond | 100 |
| **Georgia:** | |
| Allapaha, Baker's pond | 150 |
| Sherrod Mill pond | 200 |
| Arlington, Eunice Lake | 75 |
| Harrison Lake | 100 |
| Atlanta, East Lake | 750 |
| Ricket's pond | 25 |
| Silver Lake | 300 |
| Whiteman's pond | 50 |
| Zimmer's pond | 1,140 |
| Augusta, Hammond Mill pond | 100 |
| I. A. C. Reservoir | 200 |
| Avera, Long Branch | 100 |
| Bainbridge, Batteau Pond | 300 |
| Four Mile Pond | 300 |
| Ball Ground, Robert's pond | 50 |
| Bemiss, Beaverdam Pond | 200 |
| Box Springs, Lake Samoki | 300 |
| Bremen, Little River | 250 |
| Buena Vista, Hornady's pond | 200 |
| Shoal Creek Pond | 200 |
| Tyler's lake | 100 |
| Bullochville, Routon's pond | 35 |
| Cairo, Blackshear Pond | 150 |
| Carrollton, Davis Pond | 50 |
| Cave Springs, Connors Pond | 150 |
| Cedartown, Hick's pond | 50 |
| Chatsworth, Holly Creek | 700 |
| Chickamauga, Arnold's pond | 100 |
| Wellborn's pond | 100 |
| Collins, Powell's pond | 100 |
| Columbus, Ram Pond | 200 |
| Cross Keys, Brookhaven Lake | 600 |
| Cusseta, Gordy's pond | 200 |
| Log Cabin Pond | 100 |
| Cuthbert, Bridge's pond | 50 |
| Ellis Mill pond | 150 |
| Danville, White's pond | 100 |
| Dawson, Lee's pond | 25 |
| Douglas, McClellan Pond | 100 |
| Vicker's pond | 400 |
| Fayetteville, Bennetts Mill pond | 300 |
| Whitewater Pond | 300 |
| Fort Gaines, Harrisons Mill pond | 175 |
| Graysville, Chickamauga Creek | 175 |
| Greenville, McGehee's pond | 50 |
| Terrell's pond | 100 |
| Helena, Gum Swamp Creek | 75 |
| Hollysprings, Howell's pond | 25 |
| Jackson, Ocmulgee Lake | 125 |
| Lady Lake, Cup Lake | 200 |
| Lizella, Newberry's pond | 100 |
| Manassas, Sapp's pond | 100 |
| Marietta, Chamberlain Lake | 25 |
| Mayfield, Cason's pond | 100 |
| Lake George | 100 |
| Long Creek | 100 |
| Menlo, Lawrence Pond | 150 |
| Polk's pond | 50 |
| Monroe, East Lake | 300 |
| North Lake | 300 |
| Norcross, Lake Hoyle | 150 |
| Ochlocknee, Bay Pond | 175 |
| Beverly's pond | 100 |
| Ohoopee, Hall's pond | 100 |
| Omaha, Heard's pond | 100 |
| Oslerfield, Dicksons Mill pond | 150 |
| Pelham, Budgass Pond | 100 |
| Waid Pond | 100 |
| Perry, Aultman's pond | 40 |
| Quitman, Lucas Pond | 200 |
| Ramhurst, Walley's pond | 125 |
| Renfroes, Holloman's pond | 100 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

SUNFISH (BREAM)—Continued.

| Disposition. | Fingerlings, yearlings, and adults. |
|---|---|
| Georgia—Continued. | |
| Rome, De Sota Park Lake | 150 |
| Roswell, Oliver's pond | 100 |
| Sparks, Gedden's pond | 140 |
| Summerville, Davis Fish Pond | 50 |
| Sylvester, Chapman's pond | 100 |
| Jernigan Pond | 100 |
| Talbotton, Barksdale Pond | 100 |
| Jordan's pond | 100 |
| Talking Rock, Hamrick's pond | 25 |
| Teloga, Sitton's pond | 150 |
| Thomasville, Magnolia Lake | 500 |
| Smith's lake | 150 |
| Tunnell Hill, Catoosa Fishing Club Lake | 175 |
| Union City, Silver Lake | 35 |
| Valdosta, Hammock Lake | 400 |
| Vienna, Lewis Pond | 100 |
| Warrenton, Harris Pond | 200 |
| Willacoochee, Haskin's pond | 100 |
| Illinois: | |
| Burksville, Coday Pond | 100 |
| Colfax, Gillan's pond | 100 |
| Crystal Lake, Crystal Lake | 625 |
| Decatur, Decatur Club Lake | 3,050 |
| Golconda, Clark's pond | 200 |
| Herrin, Childress Pond | 100 |
| Hinsdale, Salt Creek | 200 |
| Hunt City, Bowman's pond | 100 |
| Marshall, Heath's pond | 100 |
| Meredosia, Illinois River | 450 |
| Meredosia Bay | 1,000 |
| Mitchell, Long Lake | 1,000 |
| Momence, Kankakee River | 300 |
| Munster, Swift's pond | 200 |
| Tamaroa, Marshalek's pond | 150 |
| Taylorville, Park Lake | 300 |
| Watseka, Iroquois River | 200 |
| Indiana: | |
| Bass Lake Junction, Bass Lake | 500 |
| Batesville, Crystal Pond | 100 |
| Evansville, Davidson's pond | 100 |
| Fairmount, Hill's pond | 100 |
| Scott's pond | 100 |
| Fremont, Lake George | 400 |
| Hazleton, Fairview pond | 100 |
| Topeka, Atwood Lake | 300 |
| Dallas Lake | 300 |
| Hockenburg Lake | 300 |
| Long Lake | 300 |
| Messic Lake | 300 |
| Washington, Nixon's pond | 100 |
| Iowa: | |
| Bellevue, Mississippi River | 850 |
| Chester, upper Iowa River | 800 |
| Donnellson, Klingler Pond | 100 |
| Dunlap, Roberts Lake | 100 |
| Harlan, Jorgenson's pond | 100 |
| Lime Springs, upper Iowa River | 1,000 |
| New London, Sunapee Lake | 300 |
| Oxford, Harker's pond | 200 |
| South Amana, Shady Lawn Lake | 100 |
| Wapello, Heins's pond | 100 |
| Waterloo, Cedar River | 150 |
| Kansas: | |
| Baxter Springs, Ransom's lake | 400 |
| Bonner Springs, McKeown Lake | 400 |
| Kingman, Shady Grove Lake | 300 |
| Spring Pond | 200 |
| Mound City, Thornes Reserve pond | 400 |
| Kentucky: | |
| Anchorage, Demaree's pond | 100 |
| Homewood Pond | 100 |
| Bloomfield, Sugar Valley Pond | 100 |
| Kentucky—Continued. | |
| Buechel, Snarenberger's pond | 100 |
| Covington, Geisen's pond | 100 |
| Crofton, Crofton Lake | 200 |
| Devon, Middendorf's pond | 100 |
| Eminence, Smith's pond | 100 |
| Franklin, Milliken's pond | 100 |
| Georgetown, Pullen's pond | 100 |
| Hodgenville, Holland's pond | 100 |
| Jetts, Henton's pond No. 1 | 100 |
| Henton's pond No. 2 | 100 |
| La Grange, Bourne's pond | 100 |
| Lawrenceburg, Carroll's pond | 200 |
| Leathers's pond | 100 |
| Maple Ridge Pond | 100 |
| Lebanon, Hillhurst Pond | 100 |
| Livia, Collins's pond | 100 |
| Louisville, Lake Lansdowne | 400 |
| Paris, Pryor Pond | 100 |
| Pulaski, Mound Lake | 100 |
| Sebree, Rolands Mill pond | 100 |
| Sparta, Eagle Pond | 100 |
| Tip Top, Cedar Grove Pond | 100 |
| Trenton, Williams's pond | 100 |
| Tyrone, Lillard's lake | 100 |
| Riverside Pond | 100 |
| Louisiana: | |
| Covington, Ellis's pond | 900 |
| Gretna, Fos Canal | 1,800 |
| McManus, Colony Lawn Lake | 900 |
| Maryland: | |
| Great Falls, Potomac River | 11,000 |
| Woodsboro, Meadow Pond | 75 |
| Massachusetts: | |
| Boston, Lily Pond | 100 |
| Michigan: | |
| Clarkston, Parkinson's lake | 300 |
| Clyde, Fish Lake | 300 |
| Davisburg, Long Lake | 300 |
| Edwardsburg, Miller Pond | 300 |
| Farmington, Gibson Lake | 150 |
| Minnesota: | |
| Caledonia, Schicks Lake | 350 |
| Hokah, Pettibone Park Lake | 500 |
| Homer, Mississippi River | 3,500 |
| Mississippi: | |
| Ackerman, Woodward's pond | 450 |
| Yokanookany Pond | 900 |
| Amory, Brown's pond | 600 |
| Artesia, Guerry's pond | 300 |
| Batesville, Maxey's pond | 300 |
| Bay Springs, Eatahoma Pond | 1,200 |
| Blue Mountain, Mountain View Lake | 400 |
| Bolton, Brownsville Pond | 450 |
| Gaddis's pond | 450 |
| Booneville, Burton's pond | 900 |
| Brandon, Stubblefield's pond | 900 |
| Canton, Big Lake | 300 |
| Oil Mill Pond | 900 |
| Coldwater, Progress Farm Pond | 300 |
| Crawford, Blue Pond | 300 |
| Isle Pond | 300 |
| Ledbetter's pond | 300 |
| Fayette, Krauss Ponds | 300 |
| Guntown, Webb Pond | 500 |
| Jackson, Ashland Pond | 300 |
| Laurel, Euberson Lake | 1,200 |
| Lexington, Ashley's lake | 300 |
| Meridian, Brawner Pond | 300 |
| Lauderdale Lake | 300 |
| Lyle's pond | 300 |
| New Pond | 450 |
| South Lake | 900 |
| Thames Lake | 300 |

Distribution of Fish and Fish Eggs, by Locality and Species, Fiscal Year 1913—Continued.

SUNFISH (BREAM)—Continued.

| Disposition. | Fingerlings, yearlings, and adults. |
|---|---|
| Mississippi—Continued. | |
| Meridian, Weems's lake | 300 |
| Neshoba, Holley's pond | 300 |
| Pullin's pond | 300 |
| New Albany, Connor's pond | 300 |
| Taylor's pond | 900 |
| Thompson's pond | 900 |
| Newton, Byrd's pond | 400 |
| Osborn, Montgomery Pond | 300 |
| Pachuta, Phalti Lake No. 2 | 1,000 |
| Picayune, Puyper's pond | 400 |
| Pontotoc, Brown Lake | 300 |
| Prentiss, Polk and McPheil Pond | 300 |
| Raymond, Spangler's pond | 900 |
| Red Banks, Woods's pond | 900 |
| Ripley, Nance's pond No. 2 | 400 |
| Shuqualak, Mack's pond | 1,200 |
| Starkville, Montgomery's pond | 300 |
| Owens's pond No. 1 | 300 |
| Owens's pond No. 2 | 300 |
| Smyrna Pond | 450 |
| Stonington, Stonington Pond | 300 |
| Strong, Hanging Kettle Creek | 900 |
| Watson's pond | 900 |
| Sumner, Cassity Creek | 150 |
| Tupelo, Beech Pond | 450 |
| King Creek | 4,000 |
| Park Lake | 9,500 |
| Ritter's pond | 700 |
| Town Creek | 3,500 |
| Trapp's pond | 500 |
| Union, Walters's pond | 300 |
| Vaiden, Lowe's pond | 300 |
| Verna, Dunaway's pond | 900 |
| Vicksburg, Schlottman's pond | 300 |
| Vossburg, Donald's pond | 450 |
| Waynesboro, Savannah Pond | 300 |
| Weir, Bywyah Pond | 450 |
| Wesson, Austin's pond | 300 |
| Beauregard Pond | 300 |
| Emery Lake | 300 |
| Williams's pond | 300 |
| West Point, Yeates's pond | 300 |
| Missouri: | |
| Bunceton, Castleman's branch | 500 |
| Layton's creek | 500 |
| Chilhowie, Osborn's pond | 400 |
| Exeter, Cliff Ranch Pond | 400 |
| Cole's pond | 400 |
| McMurtle Run | 400 |
| Owl Creek | 800 |
| Grandview, Lake Claire | 400 |
| Lebanon, Oak Pond | 300 |
| Lowry City, Walker's pond | 400 |
| Neosho, Hearrell Branch | 918 |
| Hickory Creek | 7,500 |
| Parkville, Emily Heights Pond | 400 |
| Pleasant Hill, Kellogg Lake | 685 |
| Willow Lake | 400 |
| Potosi, Quaker Pond | 300 |
| Rolla, Little Beaver Creek | 500 |
| North Mill Creek | 800 |
| Wildcat Creek | 500 |
| Vermont, Harned's lake | 300 |
| Wayne, Bradley Mill Pond | 400 |
| Montana: | |
| Kalispel, Emmert Lake | 250 |
| Nebraska: | |
| Crete, Plachy's pond | 100 |
| New Jersey: | |
| Woodbury, Woodbury Creek Pond | 125 |
| New York: | |
| Bay Shore, Brightwater Lakes | 125 |
| Ithaca, Experimental Ponds | 150 |
| New York—Continued. | |
| Petersburg, Taconee Lake | 600 |
| Riverdale, Steiner Lake | 125 |
| North Carolina: | |
| Davidson, Linden Pond | 100 |
| Dunn, Jernigan's pond | 200 |
| Forest City, McKinney's pond | 50 |
| Fremont, Yelverton's pond | 270 |
| Gela, Lake Caldwell | 200 |
| Glen Alpine, Landreau's pond | 200 |
| Harrisburg, Rocky River Pond | 50 |
| Henderson, Sandy Creek | 600 |
| Hendersonville, Laurelia Lily Pond | 200 |
| Kenly, Boswell Pond | 400 |
| Kinston, Webb's pond | 90 |
| Littleton, Johnstons Mill pond | 200 |
| Panacea Pond | 200 |
| Ryders Ponds | 200 |
| Maxton, Lumber River | 50 |
| Monroe, Belk's pond | 50 |
| Morven, McLaurin's pond | 50 |
| Mount Gilead, Stanback's pond | 50 |
| North Wilkesboro, Mulberry Creek | 300 |
| Prentiss, League Lake | 100 |
| Raleigh, Baker Pond | 270 |
| Beaver Dam Pond | 270 |
| Roaring River, Hose Creek | 100 |
| Rockingham, Everett Pond | 50 |
| Rosindale, Clark Mill pond | 200 |
| Rural Hall, Stauber's pond | 100 |
| Sanford, Haky's pond | 90 |
| Swann Station, Barbecue Creek | 270 |
| Wadesboro, Bancom Mill pond | 50 |
| Marshall's pond | 50 |
| Warsaw, Coopers Mill Pond | 270 |
| Weldon, Roanoke River | 500 |
| Winston-Salem, Hege's lake | 100 |
| Holton's pond | 100 |
| Zebulon, Chamblee Pond No. 1 | 90 |
| Chamblee Pond No. 2 | 90 |
| Robertson's pond | 90 |
| Ohio: | |
| Bridgeport, Kennedy's pond | 100 |
| Cambridge, Wills Creek | 100 |
| Canfield, Mahoning Lake | 100 |
| Clinton, Luna Lake | 100 |
| Congress Lake, Congress Lake | 500 |
| Edison, Whetstone River, East Branch | 260 |
| Kent, West Twin Lake | 200 |
| Ravenna, Forest Pond | 100 |
| Oak Grove Pond | 100 |
| Shady Brook Pond | 100 |
| St. Clairsville, Puritan Pond | 100 |
| Sycamore, Sandusky River | 200 |
| Waynesburg, Sandy Creek and Canal | 500 |
| Youngstown, Lake Ellen | 100 |
| Lake Hamilton | 400 |
| Pine Lake | 400 |
| Oklahoma: | |
| Canton, Billing's pond | 100 |
| Doby Springs, Bradford's pond | 300 |
| Durant, Williams's pond | 200 |
| Kiowa, Wilson's pond | 100 |
| Lawton, Lake Lawtonka | 300 |
| Oklahoma City, Bisbee's pond | 100 |
| Steanson's pond | 200 |
| Sapulpa, Butcher's pond | 250 |
| Rock Creek | 250 |
| Wanette, Meinert's pond | 300 |
| Wright Station, Pot Hollow Pond | 100 |
| Oregon: | |
| Albany, Channel Lake | 300 |
| Halsey, Muddy Creek | 300 |
| Klamath Falls, Lost River | 150 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

SUNFISH (BREAM)—*Continued.*

| Disposition. | Fingerlings, yearlings, and adults. |
|---|---|
| Pennsylvania: | |
| Birdell, Brandywine Creek | 100 |
| Bowers, Sacony Creek | 200 |
| Cossart, Pyle's dam | 200 |
| Icedale, Brandywine Creek | 100 |
| Lancaster, Pequea Creek | 200 |
| Lebanon, Conewago Lake | 100 |
| Light Lake | 200 |
| Mount Gretna Lake | 100 |
| Pequea, Susquehanna River | 200 |
| Philadelphia, Fairmount Park Aquarium | 300 |
| Reading, Maiden Creek | 300 |
| Tulpehocken Creek | 200 |
| Rowland, Lackawaxen River | 200 |
| Lake Teedyuscung | 200 |
| Little Tink Pond | 200 |
| Wescolang Lake | 200 |
| Stroudsburg, Lehman Lake | 200 |
| Tacony, Shuman's pond | 100 |
| West Chester, Brandywine Creek | 100 |
| South Carolina: | |
| Aiken, Old Ford Pond | 200 |
| Thorpe's pond | 200 |
| Alcolu, Slowdens Mill pond | 400 |
| Angelus, Knight's pond | 340 |
| Bethune, Johnson's pond | 200 |
| Blaney, Kirkland Pond | 400 |
| Chappells, Webb's pond | 200 |
| Columbia, Adams Mill pond | 400 |
| Congaree, Rain Pond | 200 |
| Donalds, Oak Pond | 100 |
| Edmund, Thrasher Pond | 400 |
| Fountain Inn, Lake Jean | 125 |
| Gaffney, Little's pond | 100 |
| Greenville, Catawba Creek | 100 |
| Hartsville, Boggy Swamp Pond | 330 |
| Lawton's pond | 330 |
| Kershaw, Kirkley's pond | 200 |
| Laurens, Bolt Branch | 125 |
| Monetta, Jordan's pond | 200 |
| Neeses, Williams's pond | 200 |
| Orangeburg, Great Branch Pond | 400 |
| Otranto, Goose Creek Lake | 400 |
| Pomaria, Aull's pond | 200 |
| Crims Creek | 200 |
| Koon's pond | 200 |
| Salley, Dean Pond | 200 |
| Salley's pond | 200 |
| Sawyer's pond | 200 |
| Selvern, Gunter's pond | 200 |
| Summerville, Flood Gate Pond | 200 |
| Sumter, Pocalla Springs Pond | 100 |
| Swansea, Sandy Run | 100 |
| Wagener, Horsey's pond | 200 |
| Walhalla, Oconee Creek | 100 |
| Westminster, Bruner's pond | 100 |
| Westville, Gaskin's pond | 200 |
| Winnsboro, Duck Pond | 200 |
| South Dakota: | |
| Komer, Koenig's pond | 100 |
| Oral, Graves's pond | 100 |
| Watertown, Lake Kampesca | 1,800 |
| Tennessee: | |
| Austral, Lake Pleasant | 100 |
| Bartlett, Hood's pond | 100 |
| Bethpage, Beechwood Pond | 150 |
| Cohutta, Mitchell's pond | 100 |
| Dutch, Coffman's pond | 100 |
| Erwin, Banner's pond | 100 |
| Franklin, McDaniel's pond | 100 |
| Greenback, Kidd's pond | 100 |
| Greenville, Bowser's pond | 100 |
| High Point Lake | 350 |
| Tennessee—Continued. | |
| Hunter, May's run | 200 |
| Knoxville, Limestone Lake | 100 |
| Tindell's pond | 100 |
| Wayland's pond | 100 |
| Lookout Station, Lake Lookout | 700 |
| Manchester, Big Duck River | 400 |
| Noeton, Hipshire's pond | 100 |
| Orlinda, Kelly's pond | 150 |
| Paris, L. & N. R. R. Dam | 100 |
| Shouns, Freestone Pond | 100 |
| Somerville, Albright's pond | 80 |
| Tennessee City, Lake View | 100 |
| Texas: | |
| Atlanta, Chamblee's pond | 100 |
| Beaumont, Garrison Lake | 50 |
| Dallas, Joyce Pond | 100 |
| Denison, Iron Ore Creek | 100 |
| Shawnee Creek | 100 |
| Egan, Moore's pond | 100 |
| Fate, McLendon's pond | 100 |
| Garrison, Gum Pond | 50 |
| Henderson, Bessie Beall Pond | 100 |
| Hillsboro, Pott's pond | 100 |
| Houston, Bering's pond | 100 |
| Lindale, Morris Pond | 200 |
| Stewart Lake | 100 |
| Marshall, Bonita Lake | 150 |
| Bream Fish Lake | 150 |
| Mineola, Andrew's lake | 150 |
| Cochrane's lake | 150 |
| Falkner's lake | 150 |
| Gaston Lake | 150 |
| Grassy Lake | 150 |
| Greenville Railroad Pond | 150 |
| Lander's lake | 150 |
| Mansell's lake | 150 |
| Patten's lake | 150 |
| Ponta, Rice Pond | 100 |
| San Antonio, Dullnig Lakes | 200 |
| West Lake | 25 |
| Willson Lake | 25 |
| Temple, Temple Ice Pond | 100 |
| Terrell, Allen's pond No. 1 | 100 |
| Allen's pond No. 2 | 100 |
| Bass Pond | 100 |
| Boat Lake | 100 |
| Campbell Pond | 100 |
| Cartwright's pond | 100 |
| City Park Lake | 200 |
| Corley's lake | 100 |
| Cowles Lake | 100 |
| Darst Pond | 100 |
| Hamilton's lake | 100 |
| Hopkins' pond | 100 |
| Horn Pond | 100 |
| Jim's pond | 100 |
| Levy Pond | 100 |
| Lowrie Pond | 100 |
| Overton's pond | 100 |
| Pace's pond | 100 |
| Porter's pond | 100 |
| Thompson's pond | 100 |
| Warren's pond | 100 |
| Weatherford Lake | 100 |
| Weatherford Pond | 100 |
| Tyler, Brumby Lake | 250 |
| Burleson Lake | 250 |
| Chinquapin Lake | 250 |
| Hamilton Mill pond | 250 |
| Hill's lake | 250 |
| Hitts Mill pond | 250 |
| Saline Creek | 250 |
| Waco, Fountain Lake | 100 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

SUNFISH—Continued.

| Disposition. | Fingerlings, yearlings, and adults. | Disposition. | Fingerlings, yearlings, and adults. |
|---|---|---|---|
| Texas—Continued. | | Washington: | |
| Weimar, Pecan Pond | 50 | Spokane, Gravelly Lake | 150 |
| Zavalla, Rocky Head Pond | 50 | Williams' lake | 300 |
| Virginia: | | Tacoma, American Lake | 150 |
| Burnley, Cason's pond | 200 | Steilacoom Lake | 150 |
| Chula, Carter's pond | 100 | West Virginia: | |
| Coeburn, Grizzle & Deel pond | 100 | Fairmont, Tygart Valley River | 100 |
| Drakes Branch, Eggleston's pond | 100 | Liverpool, Deer Lick Pond | 100 |
| Maurertown, Shenandoah River, North Branch | 300 | Romney, Haines' pond | 200 |
| Midlothian, Ittner's pond | 200 | Terra Alta, Slaubaugh's pond | 200 |
| Montpelier, DuPont's pond | 12 | Webster Springs, Gregory's pond | 150 |
| Newcastle, Given's pond | 100 | Wisconsin: | |
| Norfolk, Hermitage Ponds | 200 | La Crosse, French Lake | 300 |
| Smithfield, Vellines Pond | 100 | Rice Lake | 300 |
| Staunton, Edgerock Lake | 100 | Zeisler's lake | 300 |
| Wytheville, Valley View Pond | 100 | Total [a] | 203,623 |

PIKE AND PICKEREL.

| | | | |
|---|---|---|---|
| Arkansas: Marked Tree, St. Francis River | 7,504 | Iowa: Bellevue, Mississippi River | 1,500 |

PIKE PERCH.

| Disposition. | Eggs. | Fry. |
|---|---|---|
| Connecticut: | | |
| Hazardville, Scantic River | | 200,000 |
| Watertown, Holcomb Pond | | 500,000 |
| Illinois: | | |
| Grayslake, Chittendens Lake | | 400,000 |
| Druse Lake | | 400,000 |
| La Grange, Illinois River | | 50,000 |
| Meredosia, Meredosia Bay | | 150,000 |
| Rockefeller, Lake Eara | | 390,000 |
| Massachusetts: | | |
| Palmer, State fish commission | 4,000,000 | |
| Westfield, Hampden Ponds | | 300,000 |
| Southwick Ponds | | 300,000 |
| Michigan: | | |
| Ada, Thornapple River | | 500,000 |
| Alden, Torch Lake | | 750,000 |
| Algonac, St. Clair River | | 5,000,000 |
| Alpena, Lake Huron | | 4,000,000 |
| Bay City, Saginaw Bay | | 5,500,000 |
| Bellaire, Grass Lake | | 750,000 |
| Belle Isle Park, Detroit River | | 1,500,000 |
| Beulah, Crystal Lake | | 750,000 |
| Detroit, State fish commission | 41,700,000 | |
| Elk Rapids, Elk Lake | | 500,000 |
| Farwell, Otter Lake | | 500,000 |
| Grass Lake, Tims Lake | | 500,000 |
| Hillman, Lake Fifteen | | 500,000 |
| Holly, Hankinson Lake | | 250,000 |
| School Lot Lake | | 250,000 |
| Interlochen, Grass and Duck Lakes | | 500,000 |
| Lake George, Bingo Lake | | 250,000 |
| Lake George | | 250,000 |
| Provemont, Lake Leelanau | | 750,000 |
| Turtle, Honeymoon Lake | | 200,000 |
| Long Lake | | 200,000 |
| Wetmore, Long Lake | | 300,000 |
| Minnesota: | | |
| Carlton, Chub Lake | | 150,000 |
| Hay Lake | | 150,000 |

[a] Lost in transit, 2,905 fingerlings.

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

PIKE PERCH—Continued.

| Disposition. | Eggs. | Fry. |
|---|---|---|
| **Minnesota—Continued.** | | |
| Cromwell, Island Lake | | 200,000 |
| Duluth, Schultz Lake | | 200,000 |
| Erskine, Lake Sarah | | 200,000 |
| Knife River, Lax Lake | | 225,000 |
| Nine Mile Lake | | 225,000 |
| Mankota, Lake Washington | | 425,000 |
| Pengilly, Swan Lake | | 375,000 |
| New Hampshire: | | |
| Concord, Penacook Lake | | 400,000 |
| New York: | | |
| Battery Park, New York Aquarium | 500,000 | |
| Binghamton, Susquehanna River | | 500,000 |
| Canastota, Oneida Lake | | 300,000 |
| Cape Vincent, St. Lawrence River | | 2,000,000 |
| Carleton Island, St. Lawrence River | | 3,000,000 |
| Highland Falls, Roe Lake | | 300,000 |
| Hudson, Copake Lake | | 400,000 |
| Lake Charlotte | | 400,000 |
| Mud Creek, Lake Ontario | | 4,000,000 |
| Pine Bush, Shawangunk Kill River | | 400,000 |
| Roscoe, Tennanah Lake | | 400,000 |
| Wayland, Loon Lake | | 400,000 |
| West Winfield, Cedar Lake | | 400,000 |
| North Dakota: | | |
| Burnstad, Red Lake | | 150,000 |
| Cayuga, Lake Towaukon | | 150,000 |
| Jamestown, Spiritwood Lake | | 300,000 |
| Lisbon, Sheyenne River | | 400,000 |
| Mott, Cannon Ball River | | 500,000 |
| Turtle Lake, Turtle Lake | | 240,000 |
| Ohio: | | |
| Isle St. George, Lake Erie | | 5,000,000 |
| Kellys Island, Lake Erie | | 10,000,000 |
| Middle Bass Island, Lake Erie | | 10,000,000 |
| Monroe, Lake Erie | | 10,000,000 |
| Oak Harbor, Portage River | | 1,500,000 |
| Put-in-Bay, Lake Erie | | 10,000,000 |
| Pennsylvania: | | |
| Chester, Shoens Pond | | 180,000 |
| Doylestown, Neshaminy Creek | | 240,000 |
| Echo Lake, Echo Lake | | 400,000 |
| Kreamer, Middle Creek | | 400,000 |
| New Milford, Middle Lake | | 500,000 |
| Susquehanna, Page's pond | | 300,000 |
| Susquehanna River | | 500,000 |
| **Vermont:** | | |
| Alburg, Lake Champlain | | 2,000,000 |
| Point Farm Creek | | 1,000,000 |
| Brandon, Fern Lake | | 400,000 |
| High Pond | | 500,000 |
| Lake Hortonia | | 500,000 |
| Burlington, Potash Brook | | 100,000 |
| Shelburne Bay | | 200,000 |
| Winooski River | | 1,700,000 |
| Concord, Hall's pond | | 500,000 |
| East Highgate, Lake Carmi | | 500,000 |
| Enosburg Falls, Lake Carmi | | 500,000 |
| Greensboro, Long Pond | | 500,000 |
| Highgate, Missisquoi River | | 3,000,000 |
| Hyde Park, Lake Eden | | 300,000 |
| Lunenburg, Neal's lake | | 400,000 |
| Middlebury, Lake Dunmore | | 1,500,000 |
| Morrisville, Lake Lamoille | | 400,000 |
| North Ferrisburg, Little Otter Creek | | 500,000 |
| Rocky Point, Groton Pond | | 500,000 |
| Rutland, Lake Bomoseen | | 1,000,000 |
| Shelburn, La Platte River | | 200,000 |
| Swanton, Lake Champlain | | 7,130,000 |
| Missisquoi River | | 19,700,000 |
| Vergennes, Little Otter Creek | | 500,000 |
| Otter Creek | | 1,000,000 |
| Wells River, Wells River | | 500,000 |
| **Virginia:** | | |
| Adams Grove, Parsons Mill pond | | 120,000 |
| Danville, Dan River | | 120,000 |
| Drewryville, Ellis Lake | | 120,000 |
| South Boston, Dan River | | 120,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

PIKE PERCH—Continued.

| Disposition. | Eggs. | Fry. |
|---|---|---|
| West Virginia: | | |
| Shelton, Elk River | | 500,000 |
| Wisconsin: | | |
| Amery, Round Lake | | 200,000 |
| Sucker Lake | | 200,000 |
| Boyd, Cold Water Creek | | 100,000 |
| Otter Creek | | 100,000 |
| Pike Lake | | 100,000 |
| Upper Hay Creek | | 100,000 |
| Cable, Perry Lake | | 150,000 |
| Swensen Lake | | 150,000 |
| Colfax, Lake Colfax | | 250,000 |
| Crandon, Acmabet Lake | | 200,000 |
| Lake Metonga | | 200,000 |
| Rich's lake | | 200,000 |
| Rollingstone Lake | | 200,000 |
| Squaw Lake | | 200,000 |
| Cumberland, Lake Vermilion | | 175,000 |
| Long Lake | | 250,000 |
| Turtle Lake | | 250,000 |
| Donaldson, Landing Lake | | 200,000 |
| Pickerel Lake | | 200,000 |
| Elcho, Otter Lake | | 200,000 |
| Fifield, Long Lake | | 150,000 |
| Gordon, Bond Lake | | 150,000 |
| Clear Lake | | 150,000 |
| Eau Claire Lake | | 150,000 |
| Whitefish Lake | | 150,000 |
| Gillett, Savage Lake | | 300,000 |
| Hayward, Hansen Lake | | 150,000 |
| Medford, Hull's lake | | 150,000 |
| Mellen, Lake Gallilee | | 225,000 |
| Nashville, Battawegamog Lake | | 200,000 |
| Crane Lake | | 200,000 |
| Rice Lake | | 200,000 |
| Newald, Lily Lake | | 400,000 |
| Pelican, Pelican Lake | | 300,000 |
| Phelps, Bass Lake | | 200,000 |
| Phillips, Bass Lake | | 150,000 |
| Lake Duroys | | 150,000 |
| Long Lake | | 150,000 |
| Solon Springs, Twin Lake | | 150,000 |
| Stanley, Jump River | | 200,000 |
| Outles Lake | | 150,000 |
| Pike Lake | | 150,000 |
| Stone Lake, Whitefish Lake | | 150,000 |
| Sand Lake | | 150,000 |
| Superior, Aminicon Lake | | 400,000 |
| Three Lakes, Eagle River | | 600,000 |
| Long Lake | | 300,000 |
| Moccasin Lake | | 200,000 |
| Spirit Lake | | 200,000 |
| Wabeno, Nimley Lake | | 100,000 |
| Richardson's lake | | 200,000 |
| Shoe Lake | | 100,000 |
| Zarline Lake | | 100,000 |
| Total [a] | 46,200,000 | 148,510,000 |

[a] Lost in transit, 70,000 fry.

YELLOW PERCH.

| Disposition. | Eggs. | Fry. | Fingerlings. |
|---|---|---|---|
| Connecticut: | | | |
| Deep River, State fish commission | 5,000,000 | | |
| Newton, Taunton Lake | | | 200 |
| Waterbury, Long Meadow Pond | | | 200 |
| Delaware: | | | |
| Felton, Lakeside Pond | | 400,000 | |
| Mordington Mill pond | | 400,000 | |
| District of Columbia: | | | |
| Washington, Potomac River | | 2,140,000 | |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

YELLOW PERCH—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings. |
|---|---|---|---|
| Georgia: | | | |
| Cairo, Cross Roads Pond | | | 22 |
| Empire, Carnes Pond | | | 60 |
| Jackson, Ocmulgee Lake | | | 60 |
| Tifton, Ferry Lake | | | 150 |
| Goodman Lake | | | 150 |
| Gunn Lake | | | 75 |
| Williams's lake | | | 75 |
| Illinois: | | | |
| Decatur, Decatur Club Lake | | | 580 |
| Everett, Armour's lake | | | 375 |
| Grayslake, Druse Lake | | | 240 |
| Greenville, De Moulin's lake | | | 250 |
| Watseka, Iroquois River | | | 250 |
| Wilmington, Forked Creek | | | 375 |
| Indiana: | | | |
| Albion, Conrad Lake | | | 200 |
| Indianapolis, White River | | | 500 |
| Jeffersonville, Government Pond | | | 200 |
| Marion, Andrew's pond | | | 200 |
| Iowa: | | | |
| Amana, Amana Lake | | | 900 |
| Bedford, Cobb's pond | | | 150 |
| Centerville, Sanders's pond | | | 150 |
| Chariton, Crystal Lake | | | 300 |
| Creston, Summit Lake | | | 450 |
| Lenox, Beach's pond | | | 300 |
| Leon, Caster Lake | | | 150 |
| Lime Springs, Upper Iowa River | | | 1,500 |
| Kansas: | | | |
| Kingman, Anawalt's pond | | | 142 |
| Crappie Club Lake | | | 143 |
| Hamilton Pond | | | 143 |
| Lakeside Pond | | | 143 |
| Riverside Pond | | | 143 |
| Russell Pond | | | 143 |
| Spring Lake | | | 143 |
| Kentucky: | | | |
| Erlanger, Stock Farm Pond | | | 100 |
| Julien, Stamper's pond | | | 100 |
| Willow Pond | | | 100 |
| Louisville, Lake Lansdowne | | | 300 |
| Morehead, Triplett Creek | | | 250 |
| Mount Sterling, Rayborn's pond | | | 100 |
| Waterworks Lake | | | 150 |
| New Hope, Belle of Nelson Pond | | | 100 |
| Owensboro, Raid's lake | | | 600 |
| Somerset, Pitman Creek | | | 300 |
| Williamsburg, Cumberland River | | | 400 |
| Maryland: | | | |
| Accokeek Creek, Potomac River | | 39,225,000 | |
| Annapolis, Severn River | | 1,000,000 | |
| Broad Creek, Potomac River | | 15,514,000 | |
| Bush River Station, Bush River | | 5,000,000 | |
| County Bridge, Bohemia River | | 5,000,000 | |
| Elkton, Elk River | | 30,000,000 | |
| Frederick, Bush Creek | | 3,800,000 | |
| Furnace, Furnace Creek | | 20,000,000 | |
| Georgetown, Sassafras River | | 4,000,000 | |
| Great Falls, Potomac River | | | 200 |
| Gunpowder, Gunpowder River | | 5,000,000 | |
| Hagerstown, Antietam Creek | | 500,000 | |
| Conococheague Creek | | 500,000 | |
| Potomac River | | 1,000,000 | |
| Harford, Swan Creek | | 37,060,000 | |
| Havre de Grace, Chesapeake Bay | | 40,000,000 | |
| Highfield, Lake Royer | | 400,000 | |
| Lapidum, Susquehanna River | | 25,000,000 | |
| McDaniel, Lovers Cove | | 300,000 | |
| Middle River, Middle River | | 1,000,000 | |
| North East, North East River | | 18,900,000 | |
| Piscataway Creek, Potomac River | | 9,500,500 | |
| Pohick Creek, Potomac River | | 6,000,000 | |
| Queenstown, Queenstown Creek | | 300,000 | |
| Robinson Point, Elk River | | 6,000,000 | |
| Showell, St. Martins River, Showell Fork | | 300,000 | |
| Smithsburg, Raven Rock Reservoir | | 500,000 | |
| Swan Creek, Potomac River | | 6,533,500 | |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

YELLOW PERCH—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings. |
|---|---|---|---|
| Maryland—Continued. | | | |
| Townpoint, Bohemia River | | 15,000,000 | |
| Williamsport, Conococheague Creek | | 500,000 | |
| Potomac River | | 1,000,000 | |
| Massachusetts: | | | |
| Lee, Greenwater Pond | | 300,000 | |
| Upper Goose Pond | | 300,000 | |
| Palmer, State fish commission | 5,000,000 | | |
| Ware, Hardwick Lake | | 400,000 | |
| Michigan: | | | |
| Brighton, Beech's lake | | | 375 |
| Detroit, State fish commission | | 3,500,000 | |
| Holly, Long Lake | | | 200 |
| Newaygo, Great Marl Lake | | | 250 |
| Kimbell Lake | | | 250 |
| Pickerel Lake | | | 250 |
| Rose Center, Bennett Lake | | | 250 |
| Buckhorn Lake | | | 375 |
| North Buckhorn Lake | | | 375 |
| Mississippi: | | | |
| Corinth, Farm Lake | | | 100 |
| Erwin, Lake Washington | | | 400 |
| Hernando, Dockery Pond | | | 150 |
| Moon, Moon Lake | | | 300 |
| West Point, Harmon Lake | | | 300 |
| Sand Creek Lake | | | 200 |
| New Hampshire: | | | |
| Newport, Rockybound Pond | | | 200 |
| New Jersey: | | | |
| Morris Plains, Jacqui's pond | | 300,000 | |
| Newark, State fish commission | | 2,000,000 | |
| Waldwick, Hohokus River | | 400,000 | |
| New York: | | | |
| Battery Park, New York Aquarium | 1,000,000 | | |
| Camden, Fish Creek | | | 100 |
| Cornwall, Sutherland's pond | | | 250 |
| Edmeston, Summit Lake | | | 120 |
| Garrison, Reeve's pond | | 200,000 | 125 |
| Mastic, Home Creek | | | 125 |
| North Carolina: | | | |
| Lexington, Nokomis Cotton Mill pond | | | 200 |
| Maxton, Lumber River | | | 200 |
| Oxford, Cannady's lake | | | 300 |
| Rockingham, Ranch Pond | | | 200 |
| Salisbury, Josey's pond | | | 200 |
| South River | | | 400 |
| Towflings Ice Pond | | | 200 |
| Stovall, Gregory Pond | | | 200 |
| Taylorsville, Adams's pond | | | 200 |
| Williamston, Foster Mill pond | | | 300 |
| Ohio: | | | |
| Chippewa Lake, Chippewa Lake | | | 300 |
| Leetonia, Cherry Valley Pond | | | 250 |
| Put-in-Bay, Lake Erie | | 3,000,000 | |
| Youngstown, Lake Hamilton | | | 250 |
| Oklahoma: | | | |
| Ardmore, City Lake | | | 150 |
| Bliss, Salt Valley Creek | | | 400 |
| McAlester, Cole's lake | | | 300 |
| Okmulgee, Lake Park Lake | | | 1,000 |
| Oregon: | | | |
| Carlton, Carlton Lake | | | 250 |
| Pennsylvania: | | | |
| Cambridge Springs, Edinboro Lake | | | 375 |
| Choconut, Quaker Lake | | 400,000 | |
| Ebensburg, Lake Rowena | | 300,000 | |
| Frazer, Ridley Creek | | 400,000 | |
| Hosensack, Hancock's pond | | | 200 |
| Walters Pond | | | 200 |
| Lenape, Brandywine Creek | | 500,000 | |
| Lititz, Hammer Creek Pond | | 300,000 | |
| Munster, Clearfield Pond | | 200,000 | |
| Naomi Pines, Naomi Lake | | 500,000 | |
| Washington Borough, Susquehanna River | | 1,000,000 | |
| Williamsburg, Flowing Spring Ponds | | 200,000 | |
| Rhode Island: | | | |
| Kenyon, Ninigret Pond | | | 100 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

YELLOW PERCH—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings. |
|---|---|---|---|
| South Dakota: | | | |
| Kadoka, Lake Lorelei | | | 200 |
| Weta, Weta Lake | | | 200 |
| Tennessee: | | | |
| Knoxville, Fresh Water Lake | | | 300 |
| Vermont: | | | |
| Alburg, Point Farm Creek | | 200,000 | |
| East Fairfield, Black Creek | | 500,000 | |
| Kings Hill Pond | | 100,000 | |
| Metcalf Pond | | 900,000 | |
| Enosburg Falls, Inland Pond | | 500,000 | |
| Lyndonville, Center Pond | | 400,000 | |
| Chandler Pond | | 400,000 | |
| Lilly Pond | | | 100 |
| Pasture Pond | | 400,000 | |
| Milton, Round Pond | | 400,000 | |
| Plainfield, Lake Nelson | | 400,000 | |
| Rutland, Otter Creek | | 500,000 | |
| Swanton, Missisquoi River | | 5,000,000 | |
| West Danville, Joe's pond | | 1,400,000 | |
| Virginia: | | | |
| Ashburn, Goose Creek | | 500,000 | |
| Dogue Creek, Potomac River | | 9,000,000 | |
| Emporia, Goodwyn's pond | | 300,000 | |
| Little Hunting Creek, Potomac River | | 13,371,500 | |
| Pohick Creek, Potomac River | | 14,778,500 | |
| Richmond, Licking Creek Pond | | 300,000 | |
| Rock Castle, Finch's pond | | 400,000 | |
| Washington: | | | |
| Tacoma, American Lake | | | 125 |
| Gravelly Lake | | | 125 |
| Steilacoom Lake | | | 250 |
| West Virginia: | | | |
| Charleston, White City Lake | | | 250 |
| Wisconsin: | | | |
| Elkhart Lake, Elkhart Lake | | | 300 |
| La Crosse, Bank Creek | | | 100 |
| Broken Gun Creek | | | 75 |
| Flat Pond | | | 75 |
| Second Bank Creek | | | 100 |
| Sheboygan Falls, Sheboygan River | | | 300 |
| Total [a] | 11,000,000 | 365,723,000 | 25,132 |

STRIPED BASS.

| Disposition. | Eggs. | Fry. | Fingerlings. |
|---|---|---|---|
| North Carolina: | | | |
| Weldon, Roanoke River | | 7,234,000 | |

WHITE PERCH.

| Disposition. | Eggs. | Fry. | Fingerlings. |
|---|---|---|---|
| Connecticut: | | | |
| Forestville, Grannis's pond | | 200,000 | |
| Ridgefield, Great Pond | | 300,000 | |
| Rockville, Poehnert's pond | | 200,000 | |
| Simsbury, Wood's pond | | 300,000 | |
| Maine: | | | |
| Bar Mills, Eagles Pond | | 400,000 | |
| North Berwick, Ell Pond | | 300,000 | |
| Maryland: | | | |
| Annapolis, Sodens Pond | | 200,000 | |
| Bohemia River, Bohemia River | | 15,000,000 | |
| Bush River, Bush River | | 10,000,000 | |
| Chase, Dundee Creek | | 500,000 | |
| Elk River, Elk River | | 25,800,000 | |
| Furnace, Furnace Creek | | 10,000,000 | |
| Gunpowder, Gunpowder River | | 10,000,000 | |
| Havre de Grace, Chesapeake Bay | | 279,650,000 | |
| Susquehanna River | | 58,000,000 | |
| McDaniels, Lovers Cove | | 300,000 | |
| Pond Cove | | 300,000 | |

[a] Lost in transit, 1,525 fingerlings.

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

WHITE PERCH—Continued.

| Disposition. | Eggs. | Fry. | Fingerlings. |
|---|---|---|---|
| Maryland—Continued. | | | |
| Queenstown, Blunts Creek | | 200,000 | |
| Robinson Station, Magothy River | | 500,000 | |
| Spesutie Narrows, Chesapeake Bay | | 10,000,000 | |
| Swan Creek, Chesapeake Bay | | 10,000,000 | |
| Townpoint, Elk River | | 5,000,000 | |
| Massachusetts: | | | |
| Congamond, Congamond Lake | | 500,000 | |
| Fitchburg, Ward Pond | | 300,000 | |
| Hudson, Lake Boon | | 400,000 | |
| Palmer, State fish commission | 15,000,000 | | |
| New Hampshire: | | | |
| Greenfield, Gould Pond | | 300,000 | |
| Otter Lake | | 300,000 | |
| Lakewood, Ossipee Lake | | 500,000 | |
| Newport, Long Pond | | 300,000 | |
| Newton Junction, Country Pond | | 400,000 | |
| New Jersey: | | | |
| Newark, State fish commission | | 2,000,000 | |
| New York: | | | |
| Great Neck, applicant | 5,000,000 | | |
| Middletown, Ketchums's pond | | 400,000 | |
| Wallkill, Shawangunk Kill River | | 500,000 | |
| Wayland, Loon Lake | | 800,000 | |
| North Carolina: | | | |
| Edenton, Edenton Bay | | 3,270,000 | |
| Pennsylvania: | | | |
| Washington Borough, Susquehanna River | | 1,000,000 | |
| Vermont: | | | |
| Barton, Parker Pond | | 300,000 | |
| Hardwick, Greenwood Lake | | 400,000 | |
| North Bennington, Lake Paran | | 300,000 | |
| Virginia: | | | |
| Montpelier, Du Pont's pond | | | 121 |
| West Virginia: | | | |
| Shepherdstown, Potomac River | | | 600 |
| Total | 20,000,000 | 449,120,000 | 721 |

YELLOW BASS.

| | | | |
|---|---|---|---|
| Illinois: | | | |
| Jacksonville, Nichols Park Lake | | | 255 |

SMELT.

| | | | |
|---|---|---|---|
| Maine: | | | |
| Green Lake, Green Lake | | 500,000 | |
| Otis, Green Lake | | 1,350,000 | |
| Maryland: | | | |
| Great Falls, Potomac River | | | 27,000 |
| New York: | | | |
| Delhi, applicant | 4,500,000 | | |
| Total | 4,500,000 | 1,850,000 | 27,000 |

COD.

| Disposition. | Eggs. | Fry. |
|---|---|---|
| Maine: | | |
| Boothbay Harbor, Boothbay Harbor | | 1,206,000 |
| Hodgdons Cove | | 1,863,000 |
| Linekin Bay | | 676,000 |
| Townsend Gut | | 757,000 |
| Southport, Deckers Cove | | 649,000 |
| Ebencook Harbor | | 460,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

COD—Continued.

| Disposition. | Eggs. | Fry. |
|---|---|---|
| Massachusetts: | | |
| Beverly, Massachusetts Bay | | 32,260,000 |
| Falmouth, Eel Pond | | 2,400,000 |
| Nantucket Sound | | 16,580,000 |
| Vineyard Sound | | 2,925,000 |
| Gloucester, Atlantic Ocean | 6,800,000 | 22,700,000 |
| Ipswich Bay | | 4,910,000 |
| Gosnold, Buzzards Bay | | 7,678,000 |
| Vineyard Sound | | 72,107,000 |
| Manchester, Massachusetts Bay | | 7,880,000 |
| Marblehead, Massachusetts Bay | | 10,500,000 |
| Rockport, Atlantic Ocean | | 6,010,000 |
| Ipswich Bay | | 20,890,000 |
| Tisbury, Nantucket Sound | | 7,329,000 |
| West Tisbury, Vineyard Sound | | 1,232,000 |
| Total | 6,800,000 | 221,012,000 |

POLLOCK.

| Disposition. | Eggs. | Fry. |
|---|---|---|
| Massachusetts: | | |
| Annisquam, Ipswich Bay | | 6,350,000 |
| Beverly, Massachusetts Bay | | 69,370,000 |
| Eastern Point, Atlantic Ocean | | 540,000 |
| Gloucester, Annisquam River | | 1,040,000 |
| Atlantic Ocean | 133,739,000 | 46,370,000 |
| Ipswich Bay | | 37,420,000 |
| Ipswich, Ipswich Bay | | 7,000,000 |
| Lanesville, Ipswich Bay | | 57,370,000 |
| Manchester, Massachusetts Bay | | 44,000,000 |
| Marblehead, Massachusetts Bay | | 35,000,000 |
| Rockport, Atlantic Ocean | | 31,610,000 |
| Ipswich Bay | | 74,390,000 |
| Salem, Massachusetts Bay | | 19,000,000 |
| Total | 133,739,000 | 430,060,000 |

HADDOCK.

| Disposition. | Eggs. | Fry. |
|---|---|---|
| Maine: | | |
| Boothbay Harbor, Boothbay Harbor | | 22,967,000 |
| Massachusetts: | | |
| Beverly, Massachusetts Bay | | 6,110,000 |
| Gloucester, Atlantic Ocean | 57,868,000 | 15,000,000 |
| Marblehead, Massachusetts Bay | | 5,540,000 |
| Rockport, Atlantic Ocean | | 11,270,000 |
| Ipswich Bay | | 7,370,000 |
| Total | 57,868,000 | 68,257,000 |

FLATFISH.

| Disposition. | Fry. |
|---|---|
| Maine: | |
| Boothbay, Linekin Bay | 64,473,000 |
| Sheepscot River | 3,024,000 |
| Boothbay Harbor, Boothbay Harbor | 49,666,000 |
| Hodgdons Cove | 6,040,000 |
| Linekin Bay | 76,483,000 |
| Mill Cove | 71,887,000 |
| Townsend Gut | 21,425,000 |
| East Boothbay, Linekin Bay | 28,814,000 |
| Southport, Deckers Cove | 9,166,000 |
| Ebencook Harbor | 49,333,000 |
| Sheepscot River | 18,270,000 |
| West Boothbay Harbor, West Boothbay Harbor | 15,380,000 |
| Massachusetts: | |
| Beverly, Massachusetts Bay | 22,000,000 |
| Essex, Essex River | 13,100,000 |
| Massachusetts—Continued. | |
| Falmouth, Eel Pond | 100,000 |
| Great Harbor | 10,421,000 |
| Nantucket Sound | 92,080,000 |
| Waquoit Bay | 5,359,000 |
| Gloucester, Annisquam River | 41,370,000 |
| Gloucester Harbor | 97,710,000 |
| Gosnold, Hadley Harbor | 4,338,000 |
| Vineyard Sound | 41,293,000 |
| Lanesville, Ipswich Bay | 8,000,000 |
| Manchester, Massachusetts Bay | 29,290,000 |
| Rockport, Rockport Harbor | 18,600,000 |
| Wickford, Wickford Harbor | 11,648,000 |
| Total | 809,270,000 |

DISTRIBUTION OF FISH AND FISH EGGS, BY LOCALITY AND SPECIES, FISCAL YEAR 1913—Continued.

LOBSTER.

| Disposition. | Fry. |
|---|---|
| Maine: | |
| Barnard, Bass Harbor | 2,700,000 |
| Biddeford, Wood Island Harbor | 1,000,000 |
| Biddeford Pool, Biddeford Pool Harbor | 3,000,000 |
| Boothbay, Back River | 2,000,000 |
| Boothbay Harbor | 5,500,000 |
| Squirrel Island Harbor | 500,000 |
| Bristol, Christmas Cove | 1,500,000 |
| Johns Bay | 2,000,000 |
| Cape Porpoise, Cape Porpoise Harbor | 3,000,000 |
| Corea, Indian Harbor | 4,000,000 |
| Crockett River, Crockett River | 375,000 |
| Cushing, Medencook River | 6,000,000 |
| Deer Isle, Grays Cove | 1,300,000 |
| East Boothbay, Linekin Bay | 3,500,000 |
| Eastport, Broad Cove | 5,000,000 |
| East Stuban, Dyers Bay | 5,000,000 |
| Friendship, Friendship Harbor | 5,500,000 |
| Georgetown, Fire Isle Harbor | 3,000,000 |
| Harmons Harbor | 5,000,000 |
| Gouldsboro, Corea Harbor | 200,000 |
| Prospect Harbor | 300,000 |
| Harpswell, Harpswell Sound | 1,500,000 |
| Quohog Bay | 8,000,000 |
| Isle of Shoals, Isle of Shoals Harbor | 1,500,000 |
| Jonesport, Monsapec Reach | 1,000,000 |
| Kennebunk Port, Kennebunk Port Harbor | 4,000,000 |
| Kittery, Pepperell Cove | 4,000,000 |
| Matinicus, Matinicus Harbor | 1,000,000 |
| Millbridge, Dyers Bay | 1,000,000 |
| Monhegan, Monhegan Harbor | 1,500,000 |
| Mount Desert, Seal Harbor | 200,000 |
| Southwest Harbor | 4,400,000 |
| New Harbor, New Harbor | 2,500,000 |
| North Cutler, Northwest Harbor | 2,500,000 |
| Starboard Isle Harbor | 2,500,000 |
| North Haven, North Haven Harbor | 1,800,000 |
| Ogunquit, Wells Bay | 2,000,000 |
| Pemaquid Harbor, Pemaquid Harbor | 5,000,000 |
| Port Clyde, Port Clyde Harbor | 1,500,000 |
| Portland, Peak Island Roads | 2,500,000 |
| Portland Harbor | 2,500,000 |
| Prospect Harbor, Prospect Harbor | 4,000,000 |
| Rockland, Rockland Harbor | 5,000,000 |
| Rockport, Rockport Harbor | 3,000,000 |
| Sagadahoc, Sagadahoc Bay | 1,000,000 |
| Maine—Continued. | |
| St. George, Matinicus Harbor | 3,000,000 |
| Seal Harbor | 6,000,000 |
| South Addison, Little Kennebec River | 500,000 |
| Wass Cove | 500,000 |
| South Hancock, Skillings River | 2,000,000 |
| Sorrento, Sorrento Harbor | 2,000,000 |
| Southport, Ebencook Harbor | 3,500,000 |
| Pig Cove | 5,000,000 |
| Spruce Head, Penobscot Bay | 8,750,000 |
| Stonington, Stonington Harbor | 3,600,000 |
| Swans Island, Swans Island Harbor | 3,600,000 |
| Tremont, Duck Cove | 400,000 |
| Vinal Haven, Penobscot Bay | 1,750,000 |
| Sandy Cove | 3,000,000 |
| Wells, Wells Bay | 2,000,000 |
| West Bath, New Meadows Cove | 1,000,000 |
| Westport, Goose Rock Passage | 1,000,000 |
| Hocomock Bay | 1,000,000 |
| White Island, Penobscot Bay | 125,000 |
| Winter Harbor, Winter Harbor | 2,000,000 |
| Wiscasset, Sheepscot River | 500,000 |
| York, York Harbor | 2,000,000 |
| Massachusetts: | |
| Beverly, Massachusetts Bay | 2,200,000 |
| Boston, Boston Harbor | 500,000 |
| Hull, Hull Harbor | 500,000 |
| Gloucester, Annisquam River | 1,200,000 |
| Atlantic Ocean | 1,930,000 |
| Ipswich Bay | 600,000 |
| Massachusetts Bay | 300,000 |
| Lanesville, Ipswich Bay | 500,000 |
| Manchester, Massachusetts Bay | 1,300,000 |
| Marblehead, Massachusetts Bay | 1,000,000 |
| Rockport, Atlantic Ocean | 2,450,000 |
| Ipswich Bay | 400,000 |
| Rockport Harbor | 600,000 |
| Salem, Massachusetts Bay | 400,000 |
| New Hampshire: | |
| Hampton, Atlantic Ocean | 300,000 |
| Hampton Harbor | 2,500,000 |
| Rye Harbor | 1,000,000 |
| Isle of Shoals, Gosport Harbor | 300,000 |
| New Castle, Little Harbor | 4,000,000 |
| New Jersey: | |
| Cape May, Atlantic Ocean | [a]200 |
| Cape May Harbor | 200,000 |
| Total [b] | 199,680,200 |

[a] Adult lobsters.

[b] Lost in transit, 800,000 fry.

# ALASKA FISHERIES AND FUR INDUSTRIES IN 1913

BARTON WARREN EVERMANN
*Chief of Alaska Fisheries Service*

Appendix II to the Report of the U. S. Commissioner of Fisheries for 1913

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## GENERAL ADMINISTRATIVE REPORT.



## FISHERY INDUSTRIES.

## FUR-SEAL SERVICE.

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# ALASKA FISHERIES AND FUR INDUSTRIES IN 1913.

## GENERAL ADMINISTRATIVE REPORT.

By Barton Warren Evermann,
*Chief, Alaska Fisheries Service.*

As in the annual reports of the Alaska Fisheries Service for 1911 and 1912, the reports on the fur-seal service, the Alaska salmon and other fisheries, and the minor fur industries are combined in one general report.

The returns from these industries in 1913 may be stated as follows:

| | |
|---|---|
| Fisheries | $15,739,068 |
| Pribilof furs (seal and fox) | 83,667 |
| Minor furs | 678,062 |
| Total | 16,500,797 |

For the fisheries the figures are less than for last year, when the value was $18,877,480; and as 1913 was the first year of the five-year close season on the Pribilofs, the catch of seals was arbitrarily reduced to such number as the natives required for food. The value of the seal catch was thus only $66,095, as compared with $141,290.32 in 1912, and this with an also lessened take of foxes, valued at $17,572, against $22,209.91 in 1912, totals only $83,667 from the Pribilof Islands, a decrease of $79,883.23 as compared with the 1912 total for these islands. The minor furs, from the mainland chiefly, showed an important increase, from $630,656 in 1912 to $678,062 in 1913.

### SALMON FISHERIES.

#### INSPECTION.

The inspection of the salmon and other fisheries of Alaska was carried on during the season of 1913 in accordance with the general plan of previous years. The field force was assigned as follows: In western Alaska, Assistant Agent H. C. Fassett canvassed the fisheries of the Kvichak Bay region and westward to Port Moller, and Deputy Fur Wardens G. Dallas Hanna and Claude J. Roach carried on the investigations at Nushagak Bay and Wood River. In central Alaska Inspector E. M. Ball was on duty for the Afognak-Kodiak region. In southeast Alaska Assistant Agent Ward T. Bower conducted the inspection and canvass for fishery statistics, assisted by Deputy Wardens E. P. Walker and Fred H. Gray; also by James H. Lyman, of the Yes Bay station force. Agent H. O. Smith reached southeast Alaska in time to take part in the closing portion of the season's work.

Detailed reports on the salmon inspection are published on page 37 and following.

### NEW STEAMER FOR PATROL WORK.

In the fall of 1912 the Bureau purchased the steamer *Wigwam* from the Alaska Packers Association, and the vessel was given the new name *Osprey*. The vessel was built in 1895 at San Francisco, and is of 40 tons gross measurement, 72 feet in length, 17 feet beam, and 6 feet in depth. It is of staunch construction, and within the last few years has been rebuilt in many essentials. Before purchase it was put in first-class shape in accordance with recommendations of the Steamboat-Inspection Service.

The vessel is equipped with a Scotch boiler, and a compound engine, and has a dynamo directly connected to a high-speed Corliss engine. A steam winch is on the main deck forward, while below is a forecastle with quarters for six men; also three more of the crew may be quartered on the boat deck in the pilot-house structure. The galley and dining room are on the main deck forward immediately below the pilot house. The after cabin is arranged to accommodate four persons. It is finished in Spanish cedar and is provided with folding berths. The vessel has two masts.

The appropriation for a crew was not effective until July 1, 1913, and it was necessary to defer putting the vessel in commission until then. During the winter it was upon the ways at Semiahmoo, Wash. A crew was provided consisting of master, engineer, two firemen, seaman, and cook, and on July 8 the *Osprey* sailed from Semiahmoo for Alaska to enter upon patrol and other work in the southeast district. The vessel has been in commission continuously since that time. During the active salmon-fishing season operations were confined more particularly to the more open and exposed waters in the upper part of southeast Alaska, with headquarters at Juneau. The Ketchikan and Wrangell districts were covered by smaller chartered boats. Winter headquarters have been selected at Wrangell, which is a central point and has good harbor facilities.

From July until the end of the year the *Osprey* logged approximately 7,000 knots. Under normal conditions a speed of more than 8 nautical miles per hour is maintained easily. On the average a ton of coal is good for 50 miles' steaming. With bunker space for only 7½ tons this gives a steaming radius of but 350 miles. This is entirely inadequate for the service demanded of the *Osprey*, and, as a makeshift, the expedient was resorted to of carrying sack coal in the after hold, a most unsatisfactory proceeding.

At the earliest opportunity the vessel should be converted to an oil burner. The steaming radius can thus be more than doubled, and the cost of operation will be reduced. Another point is that the identity of the boat will be less obvious. Since so few cannery tenders in southeast Alaska are now operated by steam, the appearance of smoke affords most conspicuous notice of approach and may give sufficient warning to enable any violators of the law to remove all evidence of their illegal fishing.

Aside from the positions of master and engineer, much trouble has been experienced in keeping a crew on the *Osprey*. This is because of the fact that in fixing the rates of pay Congress did not make provision for subsistence allowances. After each man pays his share of the mess bill the net wage balance is so small as to offer no inducement for service. Either a 20 per cent increase in pay should be made by Congress covering these positions, or the equivalent in subsistence allowances should be granted. It is the universal custom on all commercial craft in Alaska waters to furnish employees with subsistence, and in order to secure good men the Government must at least meet the rates generally prevailing for similar service. The scheme followed in the Lighthouse Service or in the Coast and Geodetic Survey could well be adopted.

Another necessity is the addition of one or two seamen to the regular crew. This is essential to keep the vessel in good condition, particularly during the several months' active patrol duty when running is constant and heavy.

## COOPERATION WITH THE TERRITORIAL LEGISLATURE.

As provided in the enabling act creating a legislative assembly for the Territory of Alaska, the legislature convened at Juneau, March 3, 1913. In response to a request made by the governor of Alaska the Department of Commerce sent Assistant Salmon Agent Ward T. Bower to be present at Juneau during the session for the purpose of furnishing to committees and members information regarding fishery matters when requested by them to do so. The questions considered by the legislature are discussed on pages 37 to 46 of this report.

## FUR-SEAL SERVICE.

During the entire fiscal year 1912–13, Agent Lembkey and Assistant Agent Proctor were resident on the seal islands, the former in charge on St. Paul, the latter on St. George. Assistant Agents Judge and Clark who had been continuously on the islands since June, 1911 (excepting in the case of Mr. Judge, who in the middle of the summer of 1912 made a trip on the *Homer* to San Francisco for the purpose of purchasing supplies), returned in October to Washington, where they were assigned to duty until in May, 1913, when they were ordered to San Francisco to purchase supplies for the islands.

The steamer *Homer* was again chartered for the purpose of carrying supplies to the islands and bringing down the skins in the fall. The vessel sailed from San Francisco with the supplies on board June 23. Fred M. Chamberlain, who had been appointed naturalist, fur-seal service, vice M. C. Marsh, resigned, and George A. Clark, who had been appointed special investigator to take the census of the seal herd, took passage on the steamer to the islands. The steamer arrived at St. Paul Island July 13. After landing the supplies, including coal from Unalaska, for which a special trip had to be made, the seal and fox skins were taken on board August 8, and the *Homer* sailed for San Francisco, where she arrived August 24, Messrs. Lembkey and Clark returning on the vessel.

### SALE OF FUR-SEAL SKINS AND FOX SKINS.

In former years the fur-seal skins taken on the Pribilof Islands were shipped to London for sale, that being the principal market of the world for such skins. In some years London received as many as 100,000 from the Pribilofs alone. It was thought that if the Government could secure even approximately the same price for skins sold in the United States that could be obtained in London a change of market was demanded by business and patriotic considerations. The take of sealskins in 1913, owing to the establishment of a close season on seals, numbered but 2,296, and the occasion was deemed auspicious for making an attempt to build up an American industry dependent upon the selling and dyeing of fur-seal skins.

After due consideration the Department decided to send the sealskins to the St. Louis market for sale at auction by Messrs. Funsten Bros. & Co. The previous administration had considered the advisability of selling the skins in America, and this year Funsten Bros. & Co. was the only firm actively soliciting the business at the time when it was necessary for arrangements to be made. More favorable commission rates were secured from the St. Louis firm than had previously been secured at the London market in respect to both fur-seal skins and fox skins and, in addition, transportation rates from the Pribilof Islands to St. Louis were much less than to London.

The year's shipment of sealskins was, therefore, consigned to Messrs. Funsten Bros. & Co., at St. Louis, Mo., where, with the exception of 400 skins which were withdrawn from immediate sale by the Department at the request of the chairman of the Committee on Expenditures in the Department of Commerce, House of Representatives, they were sold on December 16, 1913. The gross proceeds of the sale amounted to $54,579, or an average price of $28.78 per skin.

Excluding 20 defective blue fox skins which were shipped directly to Washington for examination, the 1913 shipment of fox skins from the Pribilof Islands consisted of 405 blue fox skins and 31 white fox skins. These skins were included with the consignment of fur-seal skins to Messrs. Funsten Bros. & Co. and were sold by that firm on the same date as the sealskins. The 405 blue fox skins sold for $17,094, or an average of $42.20 per skin, and the 31 white fox skins for $458, or a total of $17,552. It is worthy of mention that one lot of six blue fox skins sold for $948, or at an average price of $158.

The net proceeds to the United States Government on account of the sale of sealskins and the fox skins here noted, after deducting freight, commission, and miscellaneous expenses, were $67,660.51.

There yet remain for sale at the close of 1913 the 400 sealskins withdrawn from the December, 1913, sale, as noted above. The estimated value of these is $11,516. The 20 defective blue fox skins which were shipped to Washington were found to be nearly worthless and were disposed of by informal sale for $20 for the lot.

### FUR-SEAL SKINS TAKEN BY COAST INDIANS.

Usually in the months of April and May the Alaska fur-seal herd migrates northward along the coast of the Pacific States, British Columbia, and southeast Alaska, en route to the breeding grounds on the Pribilof Islands. By the terms of the convention of July 7, 1911, certain Indians dwelling on the Pacific coast are permitted to kill fur seals under prescribed regulations. The only Indians to avail themselves of this privilege were residents of the La Push Reservation near the mouth of Quiniault River in the southwestern part of Clallam County, Wash.

The first seal was killed April 14 and the last on May 25, the total being 91, of which 90 were reported as females. The best day was April 15, when 42 were taken. All killing was by means of spears. The table which follows shows dates of killing.

DATES OF KILLING AND SEX OF FUR SEALS TAKEN BY INDIANS OFF COAST OF WASHINGTON, SEASON OF 1913.

| Date. | Females. | Males. | Total. | Date. | Females. | Males. | Total. |
|---|---|---|---|---|---|---|---|
| 1913. | | | | 1913. | | | |
| Apr. 14 | 2 | | 2 | Apr. 25 | 3 | | 3 |
| 15 | 42 | | 42 | 26 | 3 | | 3 |
| 17 | 1 | | 1 | 28 | 2 | | 2 |
| 18 | 7 | 1 | 8 | 30 | 1 | | 1 |
| 20 | 12 | | 12 | May 1 | 4 | | 4 |
| 21 | 6 | | 6 | 25 | 1 | | 1 |
| 22 | 4 | | 4 | Total | 90 | 1 | 91 |
| 23 | 2 | | 2 | | | | |

There were 13 Indians engaged in killing. One got 17 seals, while the two next successful hunters got 13 each. The others varied from 11 down to 1 each. The largest skin as to dimensions was $55\frac{1}{2}$ inches long by 31 inches wide. The heaviest skin was reported as weighing

13 pounds and 14 ounces. The smallest skin was 30½ inches long, 18 inches wide, and weighed 3 pounds. The averages for the 91 skins are: Length, 43 inches; width, 24 inches; weight, 6 pounds 14 ounces. All skins were measured, weighed, and authenticated June 4 and 5, at Mora, Wash., by Donald S. McLeod, local agent of the bureau with station at Seattle, Wash. A leather tag was attached to each skin, and a certificate issued to accompany same.

Since the international convention of July 7, 1911, which among other things prohibits the natives from killing fur seals by means of firearms, no seals have been taken by the natives in the vicinity of Sitka. The last hunt was in the spring of 1911, as the seals were migrating northward, and the number killed was 139. In 1910 it was 135, and in 1909, 397. After the prohibition against firearms became effective, it seemed the natives were too proud to resort to the primitive spears of a generation before, and moreover, there were only a few of the older natives left who were experienced in the use of spears. The recent extension of fishing operations has afforded ample employment for all natives who formerly spent part of each spring in sealing.

## MINOR FUR INDUSTRIES.

### FIELD WORK.

The field force employed to enforce the regulations in regard to the capture of fur-bearing animals in Alaska other than fur seals consisted of Warden Harry J. Christoffers and a corps of deputies, namely, G. Dallas Hanna, who was transferred to the Pribilof Islands during the year and was succeeded by Ernest P. Walker; Claude J. Roach, who resigned August 7 and was succeeded by Calvin F. Townsend; Fred H. Gray, and Logan I. Evans. Mr. Christoffers was on duty at Seward and later at Fairbanks. Messrs. Evans and Townsend were detailed at different times under the immediate direction of Warden Christoffers. Messrs. Hanna and Roach were at various places, including the Nushagak region, where they had local charge of the fisheries inspection work and also attended to the taking of the census of red salmon ascending Wood River. Messrs. Walker and Gray were detailed to southeast Alaska.

Early in 1913 the governor of Alaska found it impracticable to continue for the Territory the services of the warden and four deputy wardens of the Bureau's force, who had been appointed special game wardens to assist in a more effective enforcement of the game laws. The Bureau, however, finds it desirable to continue as special fur wardens the services of the four regular game wardens appointed by the governor under the reciprocal arrangement of last year. They are paid a nominal salary and are invested with full powers to enforce the provisions of the fur laws.

## ENFORCEMENT OF REGULATIONS.

*Seizures and confiscations.*—The revised regulations for the protection of the fur-bearing animals in Alaska, approved by the Secretary of Commerce, under date of March 26, 1913, contain the following provisions:

No person shall purchase, offer to purchase, sell, offer for sale, or export, or have in possession the unprime skin or pelt of any fur-bearing animal in the Territory of Alaska.

It shall be the duty of the fur warden, deputy fur wardens, special fur wardens, and other officers designated by the Secretary of Commerce to seize and confiscate all unprime skins found in the unlawful possession of any person in Alaska or in process of shipment from Alaska.

In accordance with these provisions the deputy wardens stationed at Nushagak seized in that vicinity during the spring of 1913 approximately 1,200 muskrat skins, 80 mink skins, and 24 fox skins, all of which were unprime and had been taken during the close seasons. These skins were delivered into the custody of the United States marshal at Valdez, Alaska.

After giving due consideration to the matter the Secretary ordered that these skins be confiscated and sold for the account of the United States Government. This action on the part of the Secretary was sustained by an opinion of the solicitor of the Department. The skins have since been shipped to St. Louis, where they will be sold at the Funsten Fur Exchange at public auction for the account of the United States.

In southeast Alaska a number of unprime mink skins found in the possession of various parties were seized and confiscated.

The present regulations prohibit the killing of any beaver prior to November 1, 1918. At Quadra Lake, southeast Alaska, in the fall of 1913, deputy warden Fred H. Gray learned of the trapping of a beaver. An investigation was made which led to the arrest of an Indian, Frank Mark, and to the seizure of a fresh beaver skin. Mark confessed his guilt, and he was taken to Ketchikan, where he pleaded guilty in the United States Commissioner's court. The minimum fine of $200 was imposed. The circumstances showed that Mark was not making a regular practice of trapping beaver.

*Unprime skins.*—The more responsible furriers are in hearty sympathy with the Department regulation which prohibits the handling of unprime skins in the Territory of Alaska and makes any unprime skin subject to confiscation.

It is hoped that trappers can soon be brought to a realization of the fact that it is directly to their interest to take no unprime furs, for even though the number so taken be smaller, the aggregate price will be even greater than would be realized from a larger number of animals taken when the fur is not prime.

The under side of a prime skin is of a yellowish white color. When the fur begins to grow unprime the flesh side of the skin takes on a bluish coloration, first on the back of the head, and it then extends back and finally envelops the whole skin. In the fall when the skin is beginning to grow prime again the bluish coloration disappears, first from the extremities and finally from the head. The absence of the long guard hair from the fur is an indication of unprimeness. Bluish spots on the flesh side of the skin indicate an unprime state. Skins showing dark patches on the under side, with fur coming through, are not necessarily unprime, as this may be due to a diseased condition of the animal.

*Poison.*—The killing of fur-bearing animals with poison is contrary to the Department's regulations, and during the last year or so its use has been much lessened. Certain trade publications, however, continue to advertise the sale of poison, thereby ignoring the Government regulations which have been thoughtfully framed with a view to perpetuating the supply of fur-bearing animals, and tempting hunters and trappers to transgress. Attention is invited to the Criminal Code of Alaska (Title I, chap. 13, sec. 186), which states that all persons concerned in the commission of a crime, whether they directly commit the act constituting the crime or aid and abet in its commission, though not present, are principals, and to be tried and punished as such. Thus, since it is illegal to kill fur-bearing animals with poison, any person selling it for this purpose becomes liable as contributing to the commission of a crime.

## NEW REGULATIONS.

*Bounty on wolves.*—Among the memorials addressed to Congress by the Legislature of Alaska at its first session was one asking that a bounty be placed upon wolves. Favorable action in this direction is recommended. Wolves are destructive to deer, and as the latter are of far greater economic value, means should be taken to reduce the number of wolves. A bounty of $10 on each wolf killed in the Territory, together with the market value of the skin, amounting usually from $2 to $5, would insure a return sufficiently remunerative to stimulate an active campaign against wolves. They are particularly bad in southeast Alaska.

*Beaver.*—The close season on beaver has been extended to November 1, 1918. By that time it is hoped that they will have become sufficiently numerous again to permit of their being trapped.

*Black bear.*—In response to a general request by residents of Alaska, one feature of the regulations issued by the Secretary of Commerce under date of March 26, 1913, places the black bear, along with the wolf and wolverine, in the list of fur-bearing animals that may be legally killed at any time.

## STATISTICS OF MINOR FURS SHIPPED FROM ALASKA.

Under the regulations all shipments of furs from Alaska must be reported to the Bureau of Fisheries, Washington, D. C., upon appropriate blanks provided for the purpose. One form of blank covers shipments by mail, and the contents of each package must be certified on the blank by the postmaster. The other form of blank covers all shipments other than by mail. Care should be exercised to report on this blank all furs taken out as personal baggage.

A statement for the year ending November 15, 1913, based upon the reports referred to and the customs records, is embraced in the table below. This shows furs exported to the value of $678,062.91 as compared with $630,656.40 for the previous year, an increase of approximately $47,406.51 in the value of the so-called minor furs; that is, furs from Alaska other than fur seal and fox from the Pribilof Islands. The Pribilof furs are shown separately (p. 10) because taken by the Federal Government under special restrictions of law and therefore not a comparable factor in statistics showing gain or loss in quantity of catch taken by private persons or firms.

Among the approximate gains shown in furs other than from the Pribilofs are the following: Mink, $68,000; red fox, $38,000; blue fox, $19,000; white fox, $10,000; black fox, $4,000; muskrat, $4,000; black bear, $12,000; glacier bear, $2,000, and wolverine, $1,000. Among the losses there are: Marten, $89,000; silver gray fox, $16,000; land otter, $7,000, and ermine, $4,000. These variations are caused by fluctuations in values as well as by differences in the number of skins taken.

MINOR FURS SHIPPED FROM ALASKA IN 1912 AND 1913.[a]

| Species. | 1912 | | | 1913 | | |
|---|---|---|---|---|---|---|
| | Number of pelts. | Average value per pelt. | Total value. | Number of pelts. | Average value per pelt. | Total value. |
| Bear: | | | | | | |
| Black | 698 | $7.50 | $5,212.50 | 1,363 | $12.57 | $17,132.91 |
| Brown | 19 | 9.00 | 171.00 | 38 | 9.00 | 342.00 |
| Glacier | 5 | 15.00 | 75.00 | 111 | 22.50 | 2,497.50 |
| Grizzly | ..... | ..... | ..... | 12 | 40.00 | 480.00 |
| Polar | 9 | 40.00 | 360.00 | 72 | 40.00 | 2,880.00 |
| Beaver | 89 | 10.00 | 890.00 | 25 | 10.00 | 250.00 |
| Ermine | 7,957 | 1.36 | 10,821.52 | 6,559 | .96 | 6,296.64 |
| Fox: | | | | | | |
| Black | 3 | 600.00 | 1,800.00 | 24 | 253.00 | 6,072.00 |
| Blue | 502 | 45.00 | 22,590.00 | 892 | 46.59 | 41,558.28 |
| Cross | 603 | 17.00 | 10,251.00 | 768 | 14.24 | 10,936.32 |
| Red | 8,018 | 8.50 | 68,153.00 | 10,820 | 9.80 | 106,036.00 |
| Silver gray | 142 | 250.00 | 35,500.00 | 132 | 147.30 | 19,443.60 |
| White | 3,108 | 12.50 | 38,850.00 | 3,756 | 12.93 | 48,565.08 |
| Hare, arctic | 55 | .40 | 22.00 | 49 | .40 | 19.60 |
| Lynx | 2,720 | 21.50 | 58,480.00 | 4,772 | 12.35 | 58,934.20 |
| Marten | 12,999 | 12.50 | 162,487.50 | 9,682 | 7.56 | 73,195.92 |
| Mink | 31,363 | 4.50 | 141,133.50 | 47,062 | 4.46 | 209,896.52 |
| Muskrat | 123,925 | .40 | 49,570.00 | 163,616 | .33 | 53,993.28 |

[a] Neither the fur seal nor the fox skins from the Pribilof Islands are included here, being subject of special Federal administrative control and not the usual market conditions. For statistics of these, see p. 10.

MINOR FURS SHIPPED FROM ALASKA IN 1912 AND 1913—Continued.

| Species. | 1912 | | | 1913 | | |
|---|---|---|---|---|---|---|
| | Number of pelts. | Average value per pelt. | Total value. | Number of pelts. | Average value per pelt. | Total value. |
| Otter: | | | | | | |
| Land | 1,480 | $14.00 | $20,720.00 | 1,300 | $10.70 | $13,910.00 |
| Sea | 1 | 200.00 | 200.00 | | | |
| Reindeer | 4 | 1.00 | 4.00 | 5 | 1.00 | 5.00 |
| Seal, hair | 333 | 1.50 | 499.50 | 1,458 | 1.17 | 1,705.86 |
| Squirrel | 611 | .08 | 48.88 | 34 | .08 | 2.72 |
| Wolf | 103 | 9.00 | 927.00 | 163 | 7.00 | 1,141.00 |
| Wolverine | 189 | 10.00 | 1,890.00 | 242 | 11.44 | 2,768.48 |
| Total value | | | 630,656.40 | | | 678,062.91 |

TERRITORIAL TAX ON FURS EXPORTED FROM ALASKA.

The general revenue act of the legislature of May 1, 1913 (chap. 52), provides a tax upon furs exported from Alaska at the rate of one-half of 1 per cent of the gross value thereof, and prohibits any shipment of furs without first obtaining from the clerk of the court of the district whence the shipment emanates a license permit which must be paid for at the rate above specified. This act places additional duties and limitations upon various Federal officers not within the jurisdiction of the legislature, a proceeding declared invalid by the Attorney General of the United States; hence the proper execution of the tax law as it now stands seems most difficult or even impossible of accomplishment.

The portion of the act referring to an export tax on furs is as follows:

FURS: One-half of one per cent of the gross value of any furs, the product of Alaska, exported from the Territory and it shall be unlawful and punishable under this act for any person to ship from the Territory of Alaska any furs without having first paid for and obtained a license permit as herein provided; and no custom officer shall issue a manifest for nor postmaster receipt for mailing any furs unless the shipper thereof shall present a certificate for this license fee signed by the clerk of the district court of the division in which the furs were shipped.

PROPAGATION OF FUR-BEARING ANIMALS.

During the last year or so much activity has developed in Alaska in the propagation of fur-bearing animals, especially foxes. This activity has been stimulated by reports from eastern Canada, particularly Prince Edward Island, where fox raising is said to have made large fortunes for those engaged in the enterprise, and by the appearance of agents and representatives of fox-raising companies in New Brunswick and elsewhere, who have offered and paid what really seemed to be fabulous prices for live foxes to be taken east and utilized as breeding stock. There has been some competition, in consequence of which two or three breeders of blue foxes on islands in central Alaska have received very satisfactory prices. Permits have been issued by the Secretary of Commerce for the exportation of live fur-bearing animals, and during the year 161 blue foxes, 24 silver-gray, and 10 cross foxes, or a total of 195, were shipped from Alaska.

Permits have not been issued for the exportation of wild stock but only to owners of fox ranches in Alaska for the shipment of domestic stock, i. e., animals that have been bred and reared in domestication. Permits are not transferable and are revocable at the discretion of the Secretary of Commerce. Only one shipment may now be made on a single permit, and it is required that holders of permits return them to the Bureau of Fisheries as soon as used, or upon the date of their expiration, as the case may be.

The policy regarding exportation of wild stock as breeders has, however, been under consideration with a view to possible change, and such exportation may be permitted another year.

### Aleutian Islands Reservation.

The Aleutian Islands Reservation was established March 3, 1913, by the following Executive order:

#### EXECUTIVE ORDER.

It is hereby ordered that all islands of the Aleutian chain, Alaska, including Unimak and Sannak Islands on the east, and extending to and including Attu Island on the west, be and the same are hereby reserved and set apart as a preserve and breeding ground for native birds, for the propagation of reindeer and fur bearing animals, and for the encouragement and development of the fisheries. Jurisdiction over the wild birds and game and the propagation of reindeer and fur bearing animals is hereby placed with the Department of Agriculture, and jurisdiction over the fisheries, seals, sea otter, cetaceans and other aquatic species, is placed with the Department of Commerce and Labor.

It is unlawful for any person to kill any otter, mink, marten, sable or fur seal, or other fur bearing animal within the limits of Alaska Territory, except under such regulations as may be prescribed by the Secretary of Commerce and Labor; and it is unlawful for any person to kill any game animals or birds in Alaska or ship such animals or birds out of Alaska except under the provisions of law and under such regulations as may be prescribed by the Secretary of Agriculture.

Within the limits of this reservation it is unlawful for any person to hunt, trap, capture, wilfully disturb, or kill any bird of any kind whatever, or take the eggs of any such bird, except under such rules and regulations as may be prescribed by the Secretary of Agriculture.

Warning is expressly given to all persons not to commit any of the acts herein enumerated and which are prohibited by law.

The establishment of this reservation shall not interfere with the use of the islands for lighthouse, military, or naval purposes, or with the extension of the work of the Bureau of Education on Unalaska and Atka Islands.

This reservation to be known as the Aleutian Islands Reservation.

Wm. H. Taft.

The White House,
*March 3rd, 1913.*

To carry out the purposes of the Executive order, regulations for the administration of the reservation, to be mutually agreed upon by the Departments of Agriculture and Commerce, will be promulgated later.

### LEASING ISLANDS FOR PROPAGATION OF FUR-BEARING ANIMALS.

During the year active steps have been taken by the Government with a view to the encouragement of fox farming in Alaska, and to this end announcement has been made by the Secretary of Commerce with respect to leasing certain islands in Alaska for the propagation of fur-bearing animals for a term of five years from July 1, 1914, at an annual rental of $200. Sealed proposals for the exclusive right to occupy said islands for this purpose will be received by the Secretary of Commerce up to noon of May 1, 1914. Details in regard to this matter were set forth in the following circular issued by the Secretary of Commerce under date of January 1, 1914:

#### PROPAGATION OF FOXES AND OTHER FUR-BEARING ANIMALS.

*Announcement of the intention of the Secretary of Commerce to lease certain islands in Alaska for the purpose of propagating fur-bearing animals.*

Paragraph 4 of the act entitled, "An act making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and eighty, and for other purposes," approved March 3, 1879, provides—

"That authority be, and is hereby, given to the Secretary of the Treasury to lease at his discretion for a period not exceeding five years, such unoccupied and unproductive property of the United States under his control, for the leasing of which there is no authority under existing law, and such leases shall be reported annually to Congress."

Section 10 of the act entitled, "An act extending the homestead laws and providing for right of way for railroads in the District of Alaska, and for other purposes," approved May 14, 1898, provides that—

"The Annette, Pribilof Islands, and the islands leased or occupied for the propagation of foxes be excepted from the operation of this act."

An Executive order, dated February 2, 1904, is as follows:

"Upon the recommendation of the Secretary of the Treasury and the Secretary of Commerce and Labor, it is hereby ordered that the authority of the Secretary of the Treasury to lease certain islands in Alaska for the propagation of foxes, and all duties and powers pertaining thereto, shall be transferred to and be vested in the Secretary of Commerce and Labor."

1. The Secretary of Commerce will lease to the highest responsible bidders the exclusive right to propagate foxes and other fur-bearing animals on any or all of the following listed islands (which records show were leased prior to May 14, 1898, and that they are not now under lease) for a term of five years, at an annual rental of not less than $200 for each island. Every such lease shall be duly executed in triplicate, and will not be transferable.

| Name. | Location. |
|---|---|
| Chirikof Island | Southwest of Kodiak Island. |
| Long Island | Near Kodiak Island. |
| Marmot Island | East of Afognak Island. |
| Simeonof Island | Shumagin Group. |
| Little Naked Island | One of Naked Islands, Prince William Sound. |
| Middleton Island | Gulf of Alaska. |
| Pearl Island | One of Chugach Islands. |
| Elizabeth Island | One of Chugach Islands. |
| Aghiyuk Island | One of Semidi Islands. |
| Chowiet Island | One of Semidi Islands. |

2. No persons other than American citizens or companies or corporations organized under the laws of a State or Territory will be permitted by lease or otherwise to occupy the islands named herein for the purpose of propagating fur-bearing animals; and the Secretary of Commerce will vacate and declare any lease forfeited if the same be held or operated for the use, benefit, or advantage, directly or indirectly, of any persons other than American citizens or companies or corporations organized under the laws of a State or Territory.

3. The Secretary of Commerce will terminate any lease given to any person, company, or corporation upon full and satisfactory proof of the violation of any of the provisions of the lease or of the law and regulations for the protection of fur-bearing animals of Alaska on the part of the said person, company, or corporation.

4. Each lessee will be required to make detailed annual reports, in reference to his operations on the islands leased, to the Secretary of Commerce, on blanks furnished by the Department of Commerce, covering all such facts as may be required with respect to such operations for the information of the Department. Such reports shall be sworn to by the superintendent, manager, or other person having knowledge of the facts, a separate blank form being used for each island in cases where more than one island is leased by a person, company, or corporation.

Such reports shall be for the year ending March 31, and shall be forwarded to the Secretary of Commerce not later than April 30 of each year.

5. All persons, companies, or corporations holding any island by lease from this Department shall permit at all times free inspection of such island by the agents and representatives of the Department; and such agents and representatives shall have at all times free and unobstructed access to all corrals, pens, or other structures used for propagation operations thereon except at such times when the presence of persons other than the caretakers in or about the corrals, pens, or other structures would be recognized as detrimental to the welfare of the propagation operations.

6. The Secretary of Commerce will receive sealed proposals until 12 o'clock noon, on May 1, 1914, for the exclusive right to propagate foxes and other fur-bearing animals upon any or all of the islands named herein for a term of five (5) years from the first day of July, 1914, agreeable to the provisions of the Statutes of the United States.

7. The right is reserved to reject any and all proposals deemed to be not in accordance with the best interests of the United States.

8. As a guaranty of good faith, each proposal must be accompanied by a properly certified check drawn on a United States national bank, payable to the order of the Secretary of Commerce, in the sum of fifty dollars ($50) for each island named in the proposal. The check of the successful bidder will be retained and forfeited to the United States unless he execute the lease and bond required.

9. Proposals for leasing islands should be addressed to the Secretary of Commerce, Washington, D. C., and indorsed on the outside of the envelope, "Proposal for leasing an island (or islands) in Alaska for the purpose of propagating fur-bearing animals."

William C. Redfield,
*Secretary.*

## FOX BREEDING.

As previously stated, the Bureau is desirous of encouraging fox farming, especially on those Alaskan islands not productive in other respects, but suitable to an industry like this. The get-rich-quick possibilities, however, glowingly put forth with such strong appeal to the trappers, traders, and others in Alaska during the last year or two, have led to unfortunate ventures, which are much to be deplored and which might have been prevented by adequate understanding of the facts.

To the enthusiast the proposition has seemed all too simple. The black, silver-gray, and cross foxes are varieties of the red; the white fox is a variety of the blue. Starting with a pair of blacks or silver grays, or even a pair of reds, from which he was assured at least one or two blacks would be found in the first litter and would in turn breed true, it was easy for the prospective fox breeder to calculate that in the second year, or the third at most, there would be at least 10 good blacks or silver grays, 5 of which would be females, each to produce 8 to 10 pups the next year, and so on; and as blacks and silver grays were reported to be worth many thousands of dollars each as breeders, it was easy to compute the great and rapid gain and consequent wealth in a few years.

The fallacies in this reasoning are several. The desired blacks or silvers may not appear in the litter of the red fox. A pair of reds may not produce a black, or if so, only rarely. The blacks or silvers may not breed true; whether they will or not depends upon their own history. The fox breeder is not ordinarily in possession of the knowledge necessary to enable him to discover and interpret the facts in regard to his stock.

There is no inherent reason, however, why fox farming should not be a success in Alaska. Although on a number of islands various persons and companies have had such indifferent success that most of them have abandoned the undertaking, a few who have persisted are now getting fair profits. The reasons for failure seem to be chiefly these: Imperfect knowledge of the business or lack of experience; ignorance of elementary principles of animal breeding, and especially ignorance of the breeding, feeding, and other habits of foxes; turning the business over to unreliable keepers, with lack of personal supervision; difficulty in getting proper fox food; and great destruction of young by natural enemies, such as eagles. Perhaps the most serious difficulty has been the absence of intelligent supervision.

The factors to be considered in the business of fox raising, as in any other business enterprise, are the capital, operating expenses, and market prices of the product. Although the data at hand are meager, the Bureau offers the following suggestions:

SUGGESTIONS TO PROSPECTIVE FOX BREEDERS.

If one of the listed islands is leased, the minimum charge will be $200 per year, which would make $1,000 for the period of the lease, which is five years. Buildings should not be expensive. The cost of breeding stock will depend upon the number and kind of foxes with which operations are begun. Silver and black foxes at the present time command high prices. Breeders of these varieties can probably not be obtained for less than several hundred dollars each. A pair of red foxes will, however, occasionally produce one or more pups of these desirable color varieties. A person who has not sufficient capital to enable him to buy breeders of the choice varieties can start with a few pairs of reds, which are relatively cheap, and by selective breeding should be able in a few years to establish a strain of silver or black which will breed true. The man who pursues this method must be willing to wait several years for profits.

Operating expenses would vary with the accessibility of the island, the number of people employed, and the presence of natural food. There should be at least two persons on the island, although in favorable situations one caretaker may be enough. On some islands the foxes find sufficient food, while on others there is so little that practically the entire supply must be furnished from elsewhere. Salmon and other kinds of fish and whale meat are used.

No definite statement can be made as to the prices one may expect to obtain for fox skins. The blue fox skins taken on the Pribilof Islands in the winter of 1911–12 sold in London at an average price of $56.53 per skin. Of that lot, 28 choice skins from St. Paul Island (one of the Pribilofs) brought a little more than $131 each. At the sale at St. Louis, in December, 1913, of the fox skins taken on those islands in the winter of 1912–13, one lot of six blue-fox skins sold for $158 each. These are perhaps the best prices that blue-fox skins ever brought, and whether they will be maintained can not be predicted. With the large and increasing demand for all furs, however, there would seem to be no reason why fox skins should not continue to command good prices. Skins of silver-gray foxes have been sold at much higher prices than the above, and black-fox skins the highest of all.

In addition to the islands listed for leasing in the announcement, there are other unoccupied islands in Alaska available for fur farming, which could be obtained under the general land laws. There are several persons operating fox ranches in Alaska from whom breeding stock of blue, silver, cross, and black foxes can probably be purchased.

### Notes on Fox Farms in Alaska.

The following data on fox ranches in various parts of Alaska have been furnished the Bureau by the wardens on duty in those regions:

*Vicinity of Haines.*—There has been much activity in fox farming in the vicinity of Haines during the past year. In the early part of August T. D. Lahey and Charles Handley of that place had in pens 31 young foxes ranging in age from three to five months. Among them were one black fox and five silver grays, the remainder being red or showing tendency to the cross variety. Mr. Lahey stated that when young they were all red, but as they grew toward maturity they acquired the silver gray phase. These foxes were captured in the country back from Haines.

When taken by steel traps the legs of the young foxes are sometimes quite badly injured, but nearly all recover. Two in the pens had deformed fore legs caused by the traps, but they seemed as active as the others. All were confined in pens of chicken-wire netting and were tame and playful and appeared to be in fine condition. They were fed once a day, in the morning, when each was given a ration of about a half pound of fish.

The pens at Haines were of a temporary character, pending the completion of more extensive quarters on the south side of the Chilkat River at the place known locally as Long Bridge, which is 18 miles out from Haines.

The permanent breeding inclosure now used, at the new establishment, consists of two rows of pens, 10 in a row, each pen being 30 by 40 feet. These two rows of pens face upon an inner range 40 by 300 feet. Surrounding all is an outer fence 350 feet by 180 feet. The fences extend 10 feet above ground and 3 feet below the surface; posts are set 10 feet apart. The walls of the fencing are of No. 16 gauge wire of 2-inch mesh, while the overhang, which is 2 feet wide, is of No. 18 gauge, with same size opening. From information at hand, it would seem that this is a well-ordered establishment.

*Samalga Island.*—An interesting report has been received from Mr. Samuel Applegate, of Unalaska, with reference to the propagation of blue foxes on Samalga Island, which is located southwest of Umnak Island in the eastern Aleutians. Samalga Island is 3¾ miles long and has an average width of one-fourth mile. It is low with a rocky reef-like formation running through it, and is quite heavily covered with grass. The shore runs bare from 250 to 400 yards around the whole island. This is the only island in the district upon which foxes have been placed for the purpose of breeding them for their pelts.

In the fall of 1897, Mr. Applegate first stocked the island with 13 blue foxes. They were allowed to run wild, and were not fed, as there appeared to be plenty of natural food. Two natives were employed during the winter months as watchmen.

The first foxes were killed in 1901, and up to and including 1912 the total number killed has been 570. During this period of 12 years, 3 years were allowed to pass without any killing, as the natives reported that the animals seemed to be scarce. At the time of killing in the winter of 1911–12 there were more foxes on the island than usual, and instructions were left with the natives to take up to 100 skins at the next season's killing, if they thought it safe. Of the 570 skins taken in the 12 years referred to, 546 were marketed.

The price of the fur fluctuates from season to season and depends upon the demand, which is determined by the prevailing fashion. The average price of fox skins from Samalga for the 12 years ending with 1912 is nearly $47, gross. The average price per year has ranged all the way from $22.48 in 1901 to $72.18 in 1912. Thus the gross return has been approximately $25,000.

As to conditions upon the island and the breeding habits of the foxes, Mr. Applegate states it as his opinion that during the first two or three years they increase at a rapid rate, but after that the rate is very slow. Litters run all the way from 4 to 14, with an average of about 8 at a birth. Casualties are high, it being estimated that on the average not more than two foxes from a litter reach maturity. It is more likely less than two. Mr. Applegate thinks in this connection that some of the matured vixens may prove to be wholly sterile, or perhaps bear young only part of the time. This peculiarity, he states, has been observed for some years past by fox breeders who make a specialty of raising silver foxes, and doubtless it holds good with blue foxes, and in fact with all foxes, even in a wild state.

Samalga Island has always appeared to be well adapted to foxes, which have the freedom of the whole island, plenty of natural food, and nothing to disturb them but the birds; yet it has seemed unsafe to take more than 50 or 60 pelts a season. The principal loss is caused by eagles, and to a less degree by ravens and even large sea gulls. While the young foxes a few days or a few weeks old are playing outside their burrows they fall easy prey to eagles and ravens. The natives say that when they find an eagle's nest in the vicinity of an island inhabited by foxes, the nest is a mass of little fox bones. Mr. Applegate has paid a bounty of 25 cents to natives for each eagle killed. From 1907 to 1911 they killed 583 eagles.

It is said that occasionally a mother fox will abandon her young when a few days old and they die of starvation. On Samalga Island an entire litter of very small foxes has been seen lying in a heap all dead, possibly abandoned by the old one, but it would seem more reasonable that the mother fox had lost her life and the young were thus left to perish. It is further averred that most female foxes if they get a good chance will kill the young of other females, especially when the young are very small.

*Semidi Islands.*—Perhaps the earliest attempt at fox raising in the region of the Kodiak group of islands was made by the Semidi Propagating Co. in 1885, when the Semidi Islands were stocked with blue foxes. About the same time this company also stocked Marmot, Whale, and Long Island with blue foxes, but for some reason all of these ventures have proved unprofitable. Marmot was abandoned some years ago; Whale and Long Island have produced nothing in recent years; and the Semidi Islands were without a keeper for three years until this winter, the number of foxes being so limited as not to warrant the expense of holding a watchman there continuously.

*Chirikof Island.*—Chirikof Island, about 70 miles southwest of Kodiak Island, is controlled by the Semidi Propagating Co., of which P. D. Blodgett, of Kodiak, Alaska, is manager. This island is 15 miles long and 3 miles wide, and, except for one hill, is low and flat and untimbered. It was stocked with blue foxes in 1891, and during the last five years has been a paying enterprise, producing annually from 50 to 60 skins, which have a market value of $50 or $60 each. Under Mr. Blodgett's management production has been restricted to the number here shown, which returns a revenue sufficient to meet the expense of maintaining three keepers on the island. Two years hence, at the expiration of his contract with the company as manager, a wholesale slaughter will be ordered; and if expectations are realized several hundred skins will be secured, as it is conservatively estimated that there are now 600 foxes on the island. By the terms of his agreement with the company, five pairs must be left on the island, and he believes it will be practically impossible to reduce the stock below that number in one season.

In one very important particular, this ranch is in a class by itself. It is self-supporting, which means that feeding is not necessary. Up to the present time the beaches have produced an ample supply of food, but should this fail the keepers are instructed to kill cattle, also raised on the island, for fox food.

The foxes are caught alive in box traps, thus making possible an examination of the fur before the animals are killed. In this way only prime skins are taken.

*Ugak Island.*—Ugak Island, off the east coast of Kodiak, near the entrance to Ugak Bay, was first stocked with silver gray foxes about 1891 by Oliver Smith, who three years later introduced blue foxes on the island. The two kinds of foxes did not thrive well together, for the natural enmity between them led to continual fighting, which finally resulted in the extermination of the blue ones.

Mr. Smith retained possession of the ranch for 10 years, but what degree of success attended his work has not been learned. About 11 years ago O. B. Anderson acquired possession of the island, and remained in control until the spring of 1912, when he presented the property, with what few foxes were left, to his friend August Olson, of Kodiak, Alaska, who is the present owner. During the 11 years Mr. Anderson held the island it produced an average of 10 skins a year, having a value of something like $100 each. In April, 1912, he came to Kodiak with 20 silver gray fox skins, from which he expected to realize at least $3,500, values ranging from about $100 for the poorest to $500 for the best.

Though the beaches furnish a large part of the food of the foxes on this island, some feeding is required. For this purpose dried, salt, and fresh fish are used.

The island comprises an area of probably 600 acres, is comparatively high, and without timber except alder and birch brush. It and a small island off the west coast, near the mouth of Red River, claimed by Frank Peterson, are now stocked with silver gray foxes. These islands, because of the frequent and prolonged wind storms which prevail in the fall, can not be visited at that season without excessive cost.

*Abram's Island.*—About 10 years ago Abram Gregorioff, of Kodiak, began the raising of blue foxes on what is known as Abram's Island, which is located in Marmot Bay, a short distance from the northern end of Spruce Island. It has an area of about 400 acres, is high and well covered with spruce. Most of the shore is rocky and precipitous, a condition which is not favorable to the best results. Those who have given careful consideration to matters of this kind are convinced that the islands most suitable for fox raising have considerable beach area.

This ranch has produced only a few skins, probably less than 40 in the 10 years of its operation. The quality of the fur has been good, and in recent years the skins sold for approximately $50 each.

Where the foxes run at large, as they do on most of the ranches in this region, the number of animals on hand can not be definitely determined. An estimate of the number of foxes now on this island is placed at 8 or 10 pairs. Scarcity of food is the chief factor in retarding the development and productivity of this farm.

*Noonyack Island.*—Noonyack Island, situated about one-fourth mile north of Spruce Island, is occupied as a fox ranch by Abram Gregorioff, who placed thereon in 1898 one pair of blue foxes obtained from the fox ranch on Derinoff Island.

Since 1898 about 30 skins have been sold from this ranch, the values and dates of sale of which have not been obtained. In 1911, 3 male and 2 female live blue foxes were sold for $187.50, and in 1912 a pair was sold for $100.

The present stock on the island is estimated at 5 pairs, and the value of the property as follows:

Buildings, $1,100; vessels, $25; stock, $1,000; total, $2,125.

*Hog Island.*—Hog Island, which is located in Marmot Bay 3 miles east of the village of Afognak, has an area of about 50 acres and is comparatively low land, wooded with spruce. It was originally stocked with cross foxes by Christensen and Johanson in 1897 or 1898. Some three years later, silver grays were put on the island, but their introduction proved to be an unwise venture, for the consequent fighting between the two species brought about the extermination of both. The island was then stocked with blue foxes, and, in 1904, it was transferred to Alex Friedolin, of Afognak, to whom it now belongs. As a fox-raising establishment it has been virtually a nonproducer. There is room for doubt whether it has even held its own, for losses by starvation and by theft have kept the stock reduced to or below the original number. If given proper care and plenty of food, a limited number of foxes can be successfully reared on this island, for its location is favorable in that it is far enough away from neighboring land to preclude the probability of any loss in that direction. It is a case of constant feeding, however, as the beaches contribute nothing in the way of food.

Last year Mr. Friedolin sold two pairs of live foxes for $110 a pair, and one skin from a fox that starved to death for $40. That was the banner year for Hog Island. He does not know how many foxes are left, but thinks there are not more than six or eight.

*Dry Island.*—Dry Island, stiuated near the west end of Kupreanof Straits, has an area of about 200 acres, is low, flat, and covered with scrub spruce.

In June, 1894, Charles Peterson and Charles Eckstrom, of Afognak, formed a partnership and settled thereon to engage in fox raising. These men still occupy this island. Their present investment is valued at $6,300 (buildings, $1,000; vessels, $300; and stock, $5,000). They do all the necessary work themselves and employ no special labor.

Their original stock consisted of one pair of silver-gray foxes from Nagai Island and one female silver-gray from Afognak Island. In 1896 they placed on the island two more female silver-grays purchased from M. L. Washburn, of Kodiak, but where these came from originally is not known to the Bureau. In January, 1901, four pairs of blue foxes from Derinoff Island and in September following six male and seven female blues from the same island were added. At the present time it is estimated that there are 25 pairs of blues on this island.

During the first 10 years of their work they tried breeding the silver-gray fox, but the wild, savage nature of this species made domestication unprofitable on such a small island. Some 10 years ago the silver-grays were killed off and blue foxes substituted. Since that time, by giving undivided attention to the business, their enterprise has grown steadily until last year they were able to sell 18 pairs of live foxes at $110 a pair and several skins at substantially the same rate.

These men aim to keep at least 30 pairs of breeders on the island; and they have some wonderful breeders in their stock, too. Only last season two foxes produced a litter of 11 pups each, and reared them without the loss of one. 'Twenty-two foxes from two mothers makes the value of those two particular foxes far exceed the worth of their fur.

One noteworthy fact in connection with this ranch is that although the foxes run wild they are noticeably tame and to some degree have really been domesticated. Some of them have their dens or burrows under the outbuildings within a very few steps of the owner's dwelling, and it is no uncommon sight to see them running around the yard when strangers are not present.

This farm is one of those where constant feeding is necessary. Messrs. Peterson and Eckstrom salt from 6,000 to 10,000 salmon annually for fox food, and also do considerable line fishing for cod and other salt-water species which are fed fresh.

The success which these men have achieved in fox raising is attributed to the intelligent care and attention they have always given their animals, and their generous manner of feeding. Were it not for a liberal allowance of food they might experience a considerable loss on account of the proximity of Kodiak Island, to which their foxes would escape if food were not abundant.

Sales from this fox farm have been made yearly since 1902, when 15 blue fox skins were marketed at $17 each. In other years the prices have fallen below this figure only twice, and in 1909 50 skins were sold for $40 each. The highest price received was for three skins in 1912 at $50 each. In 1904, 1911, and 1912 live foxes were sold for $60, $70, $75, $110, and $100 a pair, some 25 or 30 pairs being sold during those years.

*Alf's Island.*—In 1904 Alf. Packirin, of Uyak, established a fox farm on a small island in Uyak Bay. This island, of about 40 acres in area and locally known as Alf's Island, is generally flat and covered with birch and cottonwood. The stock consists of about 30 blue foxes, which run wild on the island and are fed on fresh and dried fish. The annual output averages 12 skins, worth at the present time about $50 each.

*Raspberry Island.*—There are two fox farms on this island. The first of these is owned and operated by Ingwald Loe, who started in 1911 with two pairs of blue foxes.

In laying out the corral, a trench 2 feet deep was dug around a space 40 by 60 feet, and into this trench were set the posts to support the wire netting. The fence was made of 6-foot galvanized wovenwire fencing, such as is commonly used around chicken yards. The lower edge of the wire was secured to poles laid in the trench, which was then filled with stones and earth. Thus far the fence stood 2 feet under ground and 4 above it. To the top of this wire was laced another piece of 6-foot fencing which was stretched around the inclosure, thus making the top of the completed fence 10 feet above the ground. Brackets nailed on the inside at the top of each post support a 2-foot band of fencing wire laid and fastened horizontally to prevent the foxes climbing over the fence. In like manner a partition fence was built across the inclosure, dividing the corral into two pens each 30 by 40 feet. Near the center of each pen a shallow hole was excavated into which a box about 2 feet wide, 2 feet high, and 10 feet long, with entrances cut in both ends, was built and covered with earth. One pair of blue foxes was placed into each pen.

Mr. Loe has since increased his corrals by building six more pens of the same size and construction, except that the outer fence is 2 feet higher, and has increased his stock by the addition of one pair of foxes.

His animals are very restless, continually running around the pens looking for a way of escape as most wild animals do when closely confined. Whether they will breed under such conditions is yet to be learned. This spring should supply the answer.

The other fox farm on Raspberry Island is on the north shore within a short distance of Loe's ranch and is owned by Charles W. Pajoman and Fred Larsensen of Afognak. They established their ranch in July, 1912, stocking it with blue foxes, two pairs each from Dry, Hog, and Noonyack Islands. One fox died and the skin was sold for $75. Their stock in October, 1913, consisted of five male and six female blue foxes. It is intended to increase the stock this winter by the addition of three pairs of blue foxes from Hog Island. The ranch consists of 12 corrals, each 30 by 40 feet, with wire fence 12 feet high, having an overhang at the top 2 feet wide.

On this ranch the male and female foxes are kept apart until just before the mating season.

The present equipment is valued as follows: Buildings, $1,000; stock, $550; vessels, $150; total, $1,700.

## FUR-BEARING ANIMALS ON ALASKA PENINSULA.

Of the fur-bearing animals of the western Alaska Peninsula, land otter and mink are quite numerous. There are no marten in the region, and likewise no muskrats. There are not many ermine and but few are trapped. The lynx is but rarely reported and is not taken west of Chignik. There are practically no foxes save reds on the peninsula and Unimak Island; occasionally a cross fox is found, but this variety is extremely scarce. About 20 years ago wolves were plentiful on the peninsula, and quite a number could be found on Unimak Island. Some 12 or 15 years ago, when prospectors began coming into the country, the use of poison resulted in the destruction of most of the wolves, and a great many foxes and wolverines were killed off. Wolves are now so scarce on Unimak Island and the western end of the peninsula that one would be regarded as a curiosity. During the winter of 1912–13 natives of Bear River killed two brown peninsula bears and one black bear. The latter kind is exceedingly rare in the region.

It is undoubtedly true that during the last decade the fur animals of the Alaska Peninsula have been much reduced in abundance, but it is confidently believed that not only will the depletion be checked, but that, through the rigorous application of present laws and regulations, there will be a notable increase. An augmented force of game and fur wardens and more frequent visits to the region in question are desirable, and, in fact, necessary to bring about this result.

In some of the western Alaska regions, notably along the southern shore of the peninsula, there is a disposition upon the part of the natives to disregard the fur and game laws, consulting as these natives do only their own pleasure and convenience in the matter, under the placid belief that any existing restrictions have been made for the whites alone. No execeptions are provided in favor of the natives, and every opportunity is being taken to correct the misapprehention under which they are laboring. It is an inherent characteristic of the natives to kill game whether or not they have use for it. For example, they have been known to kill food animals like caribou and leave the carcasses where they fell without any pretense of using them. This practice is to be condemned and deprecated from every point of view, and earnest effort must be made to implant in the mind of the native a proper appreciation and understanding of the harm resulting from such wanton destruction of animal life.

Some of the trappers of the Alaska Peninsula region would like to have the open season for foxes extended in the spring two weeks after the present closing date of March 1. They claim that the fur is prime until this date, and that they would rather have the season lengthened in the spring and shortened in the fall, for during the latter period the fur is less apt to be prime. An extension of the spring season is undesirable, as it would lap over into the breeding season.

Some six or seven years ago Radion Duskin, a trader of Belkofsky, put a few red foxes on Dolgoi Island, a good-sized island south of the peninsula and to the eastward of Belkofsky, and now claims ownership of all furs on the island. It is stated that the Russians introduced silver-gray foxes there in their time, and that there are now some cross foxes to be found. The island is also the home of a considerable number of land otter.

Deer Island is trapped by everyone who cares to go there. The Russians put silver-grays there, and now a few cross and red foxes are on the island; with very rarely a silver. On Ukolnoi Island there are a few red foxes and land otter. No one claims title to the furs, and the animals are trapped by anyone who cares to go after them. On Tigalda Island, west side of Unimak Pass, there are some silver gray and a few cross foxes; also there are a few on Akun and Akutan Islands.

It is said that natives from Belkofsky have stocked the Iliasik Islands, opposite that town, with red foxes, where there were none before, and now claim all the furs of those islands. There are said to be no other fur animals on the Iliasik Islands, and so far everyone has respected the claims of the natives to the stock placed there.

## FUR-BEARING ANIMALS OF THE AFOGNAK-KODIAK REGION.

The species of fur animals in this region are the sea otter, land otter, fur seal, silver-gray fox, cross fox, red fox, creole fox, ermine, and brown bear.

*Sea otter.*—This valuable and interesting animal is said to be generally distributed throughout the waters of the Afognak-Kodiak region, but is now very scarce. Formerly it was quite abundant, and large catches were made, particularly to the westward in the vicinity of the Sannak and Shumagin Islands. The fabulously high prices which the skins command have caused the sea otter to be hunted most relentlessly, until the species has nearly reached the point of commercial extinction.

Realizing the danger of actual extermination, the Department, in 1910, established a close period for the sea otter until November 1, 1920. This prohibition, however, applied only to Territorial waters, the United States having no jurisdiction beyond the 3-mile limit. On the high seas the sea otter had no protection. Citizens of the United States could hunt it anywhere outside the 3-mile limit. So could the citizens of British Columbia, Japan, or any other country; and many did so, particularly the Japanese.

Fortunately, the fur-seal treaty of July 7, 1911, signed by the United States, Great Britain, Japan, and Russia, contains a clause making it unlawful for the subjects of any of the nations signatory to the treaty to "kill, capture, or pursue beyond the distance of 3 miles from the shore line of its territories sea otters in any part of the waters mentioned," that is, "in the waters of the North Pacific Ocean north of the thirtieth parallel of north latitude, and including the Seas of Bering, Kamchatka, Okhotsk, and Japan." This treaty is now in force, and it is therefore unlawful to kill, capture, or pursue sea otter anywhere in Alaskan waters or in the waters of the North Pacific. It is hoped that enough individuals are left to reestablish the species and that in time it may again become so abundant as to permit a large annual catch.

Rumors have been heard to the effect that last winter some of the Sannak Island natives hunted sea otter, but owing to the present law they let the skins go for a mere pittance. It has also been intimated that under the guise of cattle raising there has been netting of sea otter about the Sannak Island reefs, even to the extent of moving some of the cattle to Caton Island, which is more favorably situated in some respects for sea-otter hunting, in order to keep people in ignorance of the real purpose in view.

The Department has not been aware of any violations of the law as rumored, but hereafter vigilant watch will be kept of this region, and any persons caught hunting or killing sea otter will be prosecuted to the fullest extent of the law.

Early this year the idea became prevalent in the Kodiak region that it had become lawful for natives to kill sea otter with bow and arrow, and that a special tag had been prepared to be attached to all skins taken in this manner. This idea was, of course, entirely erroneous, for the killing of sea otter is absolutely prohibited in the Territory of Alaska, in the waters thereof, or on the high seas by any person subject to the jurisdiction of the four countries named in the convention of 1911. The impression regarding a special tag for sea-otter skins probably arose from some misunderstanding in connection with the tags prepared for attachment to fur-seal skins lawfully taken on the high seas by Indians, Aleuts, or other aborigines dwelling on the coast of Alaska.

*Land otter.*—The land otter occurs on Afognak and probably on all of the adjacent islands. It was formerly a rather abundant animal and, by some reports, is still quite common. One person reports it as holding its own; another as fairly plentiful; another as plentiful on Shuyak Island, scarce on Spruce Island, not very plentiful on Kodiak, but more so on Afognak, and scarce on the smaller islands; still another says it is getting scarcer; and another, one of the best trappers on Kodiak Island, reports that the supply is growing less. The land otter seems to have few enemies except man.

During the past two years Inspector Ball has traveled extensively over Afognak Island and has given much attention to the abundance of the various fur animals. In a report made in November, 1913, he regards the land otter as the most abundant and most valuable fur animal of the Afognak Reservation. Its tracks were found along the shores of every lake visited and in several places on the ocean beach.

The land otter is said to breed in this region in May in holes or burrows in the banks or near streams or lakes, and to have an average of six young in a litter. The young are said to follow the mother, often traveling great distances, even crossing Shelikof Straits.

Considerable divergence of opinion exists as to the period during which the pelts are prime. One person says from November 1 to April 1; another, November 16 to April 1; another, November 1 to March 1; another, December 1 to March 1; while another says only in the winter months, December, January, and February. One dealer states that when trapping began in October the percentage of unprime skins was very high.

The land otters were very seriously affected by the volcanic ash thrown out by Katmai Volcano in the eruption of June, 1912. So seriously were they injured that many of the skins taken in the winter of 1912–13 were worthless. Just how the ash affected the fur is not fully understood. The fur looks as if the animal had been sheared and the little fur remaining is matted and tangled like sheep's wool. The only part of the pelt not seriously affected is a narrow strip along the middle of the back. The parts most affected are the belly and the lower parts of the sides, which suggests that the injury was caused by the cutting of the volcanic ash when the animal was traveling through or sliding over it. It is the opinion of Mr. Ball that the injury done to the land otters of that region by the volcanic ash is very serious. Many of the skins taken in the winter following the eruption were worthless as fur, while all showed more or less wear which was believed to have been caused by the ash.

In view of these facts and upon the recommendation of Mr. Ball, the Department, on October 29, 1913, issued an order establishing a closed period for land otters in the Afognak Reservation until November 16, 1915.

*Fox.*—In the Afognak region foxes are said to be most abundant on Kodiak Island, though they occur in some numbers on Afognak and neighboring islands. They were formerly common on Shuyak Island, but all were poisoned about 5 years ago and probably none is found there now. The common fox of the region is, of course, the red fox, with a proportion of the various color phases known as silver, cross, and creole foxes.

The general opinion is that foxes are becoming scarce on these islands. The silver fox is said to be very rare and the cross scarce.

The volcanic eruption already referred to seems to have affected the foxes seriously. Perhaps half the skins taken in the winter of 1912–13 showed spots about the size of a man's hand just over the rump, where the fur was much worn. Practically all the skins so injured were taken in the northern part of Kodiak Island. The injury to the skins was so great as to seriously impair their value.

The foxes on Afognak Island were nearly all exterminated. In extended trips over the island made by Mr. Ball in the summer of

1913 the track of only one fox was observed. Only one fox was captured in the previous winter. In view of these facts the Department, on October 29, issued an order establishing a close period for foxes in the Afognak Reservation until November 16, 1918. The order is as follows:

REGULATIONS FOR THE PROTECTION OF FUR-BEARING ANIMALS IN THE AFOGNAK RESERVATION, ALASKA.

[Department Circular No. 252, Bureau of Fisheries, Alaska Fisheries Service.]

*To whom it may concern:*

On account of the scarcity of foxes and land otters in the Afognak Reservation, caused largely by the recent volcanic activities in that region, it is hereby ordered that the pursuit, capture, or killing of foxes in the Afognak Reservation shall be unlawful until November 16, 1918, and the pursuit, capture, or killing of land otter in the Afognak Reservation shall be unlawful until November 16, 1915.

WILLIAM C. REDFIELD,
*Secretary.*

The mating season for the foxes in the Afognak region begins in March and the young are born in May or late April. The dens are usually under roots of trees or in holes or crevices in the rocks, wherever suitable openings can be found. The number of young may vary from 3 to 14, the average being 6 or 7. One fox was killed at Uganik that contained 11 unborn young. One was killed on Long Island that carried 14 young. The natural food of the foxes in this region consists of fish, birds, small mammals, mollusks, sand fleas, and other crustaceans, and such other animal material as can be picked up along the shore. They doubtless are quite destructive to ptarmigan and other ground nesting birds and to shrews, mice, and other small mammals. They will eat almost any kind of meat, and no inconsiderable portion of their food is furnished by the carcasses of various marine animals which wash up on shore. It is said that an experiment was conducted by the Semidi Propagating Co. for the purpose of determining the best artificial food. They tried various kinds, weighing the food and the foxes daily, and reached the conclusion that dried fish is the best artificial food. It is generally believed that the female carries food to the young, and that the male will kill and eat the young when food is scarce.

Among the enemies of the foxes, eagles are perhaps the worst. Next to them come ravens and sea gulls. When the young foxes are from a few days to a few weeks old, and begin to play about their burrows, the eagles and ravens swoop down upon them and carry them off to eat or feed to their young. Even the large sea gulls will sometimes pick up young foxes and carry them off. Mr. S. Applegate, who has for many years operated a fox farm on Samalga Island, is of the opinion that the natural mortality among young foxes is 65 to 75 per cent.

In the Afognak region the fur of the foxes is prime in December and January only, according to one dealer. Another says from November 1 to April 1; another, from November 16 to March 1; and still another, during December, January, and February. The present regulation provides an open season from November 16 to March 1, which seems to meet the conditions fully and the approval of the trappers and dealers.

The usual method of capture is by means of steel traps and "klipses," a Russian device, set in the trails. This method is practiced until the snows become heavy; after that a favorite method is still hunting on moonlight nights.

*Ermine.*—Ermine, or weasels, are found on all the islands of the Afognak region. Formerly they were very plentiful, but they are becoming more and more scarce every year. About the villages, where even the children do trapping, they are most rare. In the less frequented parts of the islands, particularly along the streams and shores, they are still rather common. There seems to be great irregularity, however, in the abundance of these little animals, just as there is with rabbits; one year they may be very numerous, the next year very scarce, and the next year abundant again.

The weasels feed chiefly on birds such as ptarmigan, sparrows, pine siskins and redpolls, and mice, shrews, fish, and any other flesh they can get. They are said to store their food. They breed in April and May and produce 4 to 7 young. The usual methods of capture are by means of figure-4 traps and deadfalls.

The present open season, November 16 to March 15, appears to cover properly the period during which the fur is prime.

*Brown bear.*—The brown bears of Afognak and neighboring islands are classed as game animals by the Alaska game law. As they are also fur-bearing animals their consideration in this report is proper. Brown bears are found in considerable numbers on Kodiak and Afognak Islands, and probably a few occur on Raspberry and Shuyak Islands. The species on Kodiak is the one known as *Ursus middendorffi* Merriam. Probably it is the same species found on Afognak, Shuyak, and Raspberry Islands, but this is not known to be the fact. Very little appears to be known about the breeding habits of these big brown bears. Some of the Afognak hunters claim that they breed at any time. No one could be found who claimed to have seen one of these bears carrying unborn young. Some hunters think they have three cubs at a litter, but sometimes fewer, and that they do not breed every year.

Their food consists chiefly of fish, roots, and berries. They go into hibernation in December, several occupying one hole, and do not come out until in March or early April.

The pelts are in prime condition from November 15 to May 31.

### Hunters and Trappers.

A list of the hunters and trappers of the Kodiak-Afognak region would include practically every native man and every boy over 12 years of age, for they all hunt and trap more or less each season. A list compiled in December, 1912, contained 223 names, classified by localities as follows:

| | |
|---|---|
| Ousinka settlement, Kodiak post office | 21 |
| Karluk trappers, Uyak post office | 34 |
| Uganik trappers, Afognak post office | 9 |
| Little Afognak trappers, Afognak post office | 11 |
| Afognak trappers, Afognak post office | 93 |
| Kodiak trappers, Kodiak post office | 6 |
| Wood Island trappers, Kodiak post office | 13 |
| Eagle Harbor and south, Kodiak post office | 36 |
| Total | 223 |

The general opinion is that these people as a rule have no scruples about hunting or trapping out of season, and they will do so if they think they can avoid being caught. They were in the habit of going into the field with their guns and traps several days before the season opened, ostensibly to build or repair barabaras, but in reality to hunt foxes and land otters.

Since the Department now has a representative stationed at Afognak who acts as fur warden, conditions have much improved.

When the open season begins each trapper will put out 10 to 50 traps for foxes and land otters, and perhaps as many more for ermine. After heavy snows have fallen, trapping is abandoned because the alternate thawing and freezing covers the traps with ice, so that they will not operate. Trapping then gives way to hunting, which continues with varying interest until the end of the season. At first the trappers manifest considerable energy and enthusiasm and give faithful attention to their traps; but after two or three weeks their zeal languishes and they return to their homes, leaving their traps set and without attention for several days. During these intervals of neglect, animals are caught, die in the traps, and the skins become ruined either through decay or the attacks of bears and eagles.

Some of the trappers sell their furs for cash; others trade them for groceries and clothing; while still others hypothecate their catch for provisions and then, forgetting who grubstaked them, sell where they can get the best price. Nearly all the skins are sold as fast as caught. There were, in 1912, three principal buyers at Kodiak and three at Afognak.

Some idea of the importance of the Afognak-Kodiak region as to fur production can be gained from the following statements:

One firm at Kodiak in the season of 1911–12 handled 27 land otters, 122 ermine, 18 cross foxes, 24 red foxes, 5 silver foxes and 2 wolverines, the latter from the Kenai Peninsula.

Another dealer at Ousinka in the season of 1910–11 handled 2 silver and 4 red foxes, 1 land otter, and 400 ermine; in 1911–12, 1 silver and 6 red foxes, 2 land otters, and 389 ermine.

A dealer at Afognak in 1911–12 handled 16 land otters, 2 silver and 25 red foxes, 112 ermine, 17 mink, and 2 wolverines.

Another Afognak dealer handled in the season of 1911–12, 201 ermine, 35 land otters, 7 mink, 10 cross, 2 blue, 2 red, and 2 silver foxes.

The total shipments for the season of 1912–13 from the Afognak-Kodiak region for which the Bureau has reports were as follows:

| | |
|---|---|
| Ermine | 321 |
| Fox, blue | 89 |
| Fox, black | 3 |
| Fox, cross | 95 |
| Fox, red | 350 |
| Fox, silver | 27 |
| Otter, land | 162 |
| Wolf | 1 |
| Wolverine | 4 |

# FISHERY INDUSTRIES.

By WARD T. BOWER and HARRY CLIFFORD FASSETT, *Assistant Agents.*

As in similar reports for previous years, the Territory of Alaska is here considered in the four coastal geographic sections generally recognized as follows: Southeast Alaska, embracing all that narrow strip of mainland and the numerous adjacent islands from Portland Canal northwestward to and including Yakutat Bay; central Alaska, the region on the Pacific from Yakutat Bay westward, including Prince William Sound, Cook Inlet, and Chignik; western Alaska, the shores of Bering Sea, tributary waters, and the islands in Bering Sea; and Arctic Alaska, all that portion of Alaska facing on or tributary to the Arctic Ocean.

In the following pages are given not only detailed reports and statistical tables dealing with the various fishery industries, but there are presented also the salient features from reports on certain subjects which were the objects of special investigation or inquiry.

## TERRITORIAL LEGISLATION.

The act of Congress of August 24, 1912, created a Territorial legislature for Alaska, and the first session of this body occurred at Juneau during the period of 60 days ending May 1, 1913. The enabling act conferred upon the legislature various powers and duties, and at the same time imposed certain limitations, among which was the proviso, in substance, that the authority granted the legislature to alter, amend, modify, and repeal laws in force in Alaska should not extend to fisheries laws nor to the laws of the United States providing for taxes on business and trade. In reference to the matter of revenue it was further provided that all taxes shall be uniform upon the same class of subjects, and shall be levied and collected under general laws, and assessments shall be according to actual value thereof.

### FISHERY TAXES.

Under the authority which it was assumed Congress had granted in the enabling act the Legislature of Alaska passed a general revenue measure which so far as it affects the fisheries provides—

For a tax of 7 cents per case on red and king salmon and one-half cent per case on cohos, pinks, and chums, this in addition to the Federal tax of 4 cents per case on all species of salmon.

That one-half of the additional or Territorial tax on canned salmon should be kept in the Territorial treasury to be expended under direction of the Bureau of Fisheries in the preservation and propagation of fish.

Cold-storage plants handling fish are taxed from $10 to $500 per annum, according to the amount of business done.

Fishing vessels of 30 tons or more net register are taxed at the rate of $1 per ton annually.

There are several other features more or less directly affecting the fishing industry, including the tax of 10 cents per ton on freight shipped into or out of the Territory, the employers' liability act, and the poll-tax measure. No attempt was made to tax fishing gear.

The clerk of the United States court is made ex-officio tax collector, and the act imposes various duties on other Federal officers, including fisheries agents and their deputies.

All of this legislation has been challenged by the fishing interests. The intention of Congress is apparently clear that the Legislature of Alaska shall have no jurisdiction in the matter of fishery laws, except possibly as regards taxation. In reference to taxation the language is not altogether conclusive. The clause in the enabling act referring to laws of the United States providing for taxes on business and trade evidently refers to section 460 of the act of May 3, 1899, as amended by section 29 of the act of June 6, 1900, which was undoubtedly enacted for the sole purpose of raising revenues for the Government and in no way for the purpose of regulating the various enterprises enumerated and taxed. In other words, it is purely a revenue measure. By the act of January 27, 1905, the revenues collected under that law were covered into the Alaska fund.

The act of 1912 prohibits the legislature from in any way altering, amending, modifying, or repealing the act creating the Alaska fund, as well as laws enacted for the purpose of contributing to that fund.

Cognizance must be taken, however, of what may perhaps be properly considered as a conflict in the language of section 9 of the enabling act providing for uniform tax measures upon the same class of subjects, and that assessments shall be according to actual values.

The controversy aroused by this legislation has not yet been settled. Upon one feature of the law only has opinion been rendered, namely, that concerning collection of taxes by Federal officials. The Attorney General of the United States has recently declared this feature of the Territorial act null and of no effect, since Section II of the enabling act provides that no one holding a commission as an officer of the United States in Alaska shall hold any office under the Territory.

The Territorial revenue measure did not become operative until 90 days after its passage on May 1, hence practically all of the pack of red salmon in the Bristol Bay region, as well as a good share of the entire pack of all species in Alaska, was completed this season before the tax measure became effective. At least one company has already paid the new Territorial tax on this season's business.

### POLLUTION OF WATERS.

An act of the legislature which has a direct and considerable bearing upon the fisheries question is that prohibiting the pollution of certain waters by means of sawdust and other lumbering waste. This is an excellent measure which ought to be enforced diligently, as there is no doubt but that sawdust is very destructive to fish life, particularly when it is deposited in waters where it will settle upon spawning grounds. This measure is in line with similar acts now effective in many of the States.

### ALIEN FISHERMEN.

The legislature passed a bill to prohibit the taking of fish, whales, or other marine animals in Alaska waters by aliens. On the last day of the session, Gov. Walter E. Clark vetoed this measure on the ground that it was not within the province of the legislature to act in the matter. Gov. Clark's veto message sets forth in very able manner certain facts affecting vitally the fishery matters in their relation to the Territorial legislature, and in connection therewith the following excerpt from the message is herewith reproduced:

So far as the fisheries are concerned the subject of this bill is not one for the Territory, but for the Nation; and so far as the interests of aliens are affected, the matter is peculiarly one for the Nation, because of its international character. Thus two very strong reasons are interposed, either of which alone would make it impossible for me to join in the passage of the bill.

It is a popular notion that the Alaska fisheries belong to the Territory, but they will not belong to the Territory prior to statehood. The doctrine that the fisheries in navigable waters of the coast belong to the sovereign power was established even prior to the independence of the United States. The control of the fisheries which are not within the State waters belongs, therefore, to Congress, and this control has not been delegated to the Territorial Legislature. Indeed, it is specifically provided in our enabling act that "the authority herein granted to the legislature to alter, amend, modify, and repeal laws in force in Alaska shall not extend to the * * * fish * * * laws." The act of June 14, 1906, the provisions of which are distinctly modified by this bill, is one of the principal fishery laws passed by Congress for this Territory. It is wrong from every point of view to pass a bill in violation of the enabling act on the theory that Congress will not affirmatively disapprove it. Besides, the probability of such inaction by Congress in the present case does not exist.

The first Legislature of Alaska ought not deliberately to pass an act calculated to embarrass the Federal Government in its international relations, and such an action is not worthy of our better judgment and of our trusteeship of legislative authority and power granted by the Nation for the people of the Territory. If this bill provided for the exclusion of aliens from our boundaries, no person would question the gravity of the action, even if authorized by the Congress of the United States. Yet the bill does undertake to exclude aliens from participation in a great industry; and the effect is not far different. I appeal to the legislature to refrain from finally passing an act which, in all probability, would be rejected on the broadest grounds of national and international interest if presented in the Congress itself.

No effort was made to pass the alien measure over Governor Clark's veto.

### FISH-TRAP CONTROVERSY.

Early in the session of the legislature, and notwithstanding the seemingly direct prohibition in the enabling act, Delegate Wickersham, who represented Alaska in Congress, took the stand that the Territory had authority to legislate in all matters pertaining to the fisheries of Alaska. As a result of this opinion, bills were introduced in both branches of the legislature to prohibit the use of fish traps in Alaska waters, and a heated discussion was precipitated, which soon resolved itself into a controversy between trap fishermen and purse-seine fishermen. Various hearings were held by the joint fisheries committee of the two houses, at which representatives of both sides were heard at length.

Action was deferred in the hope that an opinion could be obtained from the Attorney General of the United States as to the legislature's authority in the matter. No opinion was received, but the general view entertained by legal authorities is that the Legislature of Alaska had no jurisdiction. Near the close of the session the antitrap bill was called up in the senate and met with defeat.

Failing to effect the passage of the antitrap bill, the legislature then memorialized Congress as to what it considered best for the Territory in the way of fisheries legislation. Following is an outline of the memorials:

For Government ownership of hatcheries.

For patrol to prevent encroachment of alien halibut fishermen.

That herring and other food fishes be not used for oil and fertilizer after 1917.

To rescind the order creating the Aleutian Islands Reservation.

That returns from seal fisheries and sale of public lands be applied to road fund.

To abolish jiggers on fish traps; limit lead on traps to 600 feet; limit traps to a distance of 1 mile from streams; remove traps from channels less than 1 mile in width; the Bureau of Fisheries to establish markers at stream mouths, places to be designated by practical fishermen; the Government to operate all hatcheries; that the inspection system affecting fishing operations be expanded; condemnation of general features of the Jones bill, particularly with reference to creation of Alaska fund; objection to any law granting title to tide lands or waters, or making special reservations for fishing any certain kind of gear; prohibition as to taking salmon by spear or gaff for commercial use; establishment of close season for southeast Alaska on ed and humpback salmon September 1 to December 1.

Much opposition developed to some of the proposed fishing limitations, the contention being that it was drawn especially to favor the interests of the purse-seine fishermen, and that it was unfair to the owners of fish traps. Practically all of the discussion and activity regarding fishery matters before the legislature centered in and had bearing upon the fish-trap and purse-seine controversy.

It will be remembered that the purse seine is a greater employer of labor than the trap, hence the advocates of the purse seine are strong numerically. It is the cannery owners who operate chiefly the more expensive trap, and the question thus becomes a dispute between capital and labor. The cannery men maintain that the sweeping abolition of their most economical form of gear would be confiscatory and ruinous to an industry having millions invested in the Territory; that it would react with greatest force upon those advocating it; that traps insure a fresher and better quality of fish; and that the plea of the purse-seine fishermen that traps are destroying the runs of salmon is not borne out by fact or statistics. It is upon the score of killing excessive numbers of salmon that the friends of the purse seine denounce the trap.

To have the benefit of impartial opinion in the controversy, Governor Clark, at the instance of a member of the legislature, asked the Secretary of Commerce to send a representative of the Bureau of Fisheries to appear before the legislature. The Secretary accordingly directed Assistant Agent Bower to proceed to Juneau and lend every proper effort toward an understanding of any and all fishery matters to which the legislature might desire to give consideration.

Since the trap and purse-seine question is a very important one, and as there may be future use for certain facts in relation to it, some of the testimony given before the joint fisheries committee, and the general attitude of the Department in the matter, may with propriety be repeated here.

It is important to realize at once the two-fold nature of the question. The purse-seine fishermen protest against the trap, which is a labor-saving device and economy to the cannerymen, upon the ground that it is dangerous to the supply of fish. An employer's right to use labor-saving devices can not, for itself alone, be successfully assailed. The public rights in natural resources, on the other hand, can and should be protected. The burden of proof, however, seems to rest upon the purse-seine fishermen, who must show that the trap is a wasteful or monopolistic mode of capture.

It is unanimously agreed that, except a safe breeding reserve, all the fish our waters will yield may very properly be taken for economic uses. It is also unquestionably proved, by the history of the fisheries the world over, that any appliance for wholesale capture may exhaust the supply if operated without regulation. For the preservation of the supply of fish, therefore, it is necessary to limit the catch. This may be accomplished (1) by the use of an easily controlled form of fishing apparatus; (2) proper close seasons; (3) restriction of fishing areas as necessary; (4) limiting distance intervals between apparatus; (5) limiting or prohibiting fishing in streams; (6) licensing of fishing gear; (7) adequate provisions for enforcement of the law.

Every type of apparatus must, of course, be operated under certain restrictions adapted to its character. There are two general classes of fishing gear, namely, fixed and mobile. The one awaits the coming of the fish, the other seeks to follow the fish in their movements. In the first-named class is the trap. In the second is the purse seine. These two forms of gear operate in Alaska under the following restrictions:

Fixed gear: It is prohibited to build a trap (1) in any stream or channel less than 500 feet in width; (2) within 500 yards of the mouth of any red-salmon stream less than 500 feet wide; (3) in any stream or channel of over 500 feet wide for more than one-third the distance across it; or (4) in any place within 600 yards laterally or 100 yards endwise from any other fixed fishing appliance (laterally obviously means sidewise; that is, along the shore).

Seines and other movable gear: It is prohibited (1) to set any seine for a distance greater than one-third the width of any stream, estuary, or lagoon (practically the same as applies to the trap, except the trap can not be put in waters less than 500 feet wide; the seine can be used there so long as it does not sweep the channel for a distance greater than one-third its width); (2) within 100 yards outside the mouth of any red-salmon stream where the same is less than 500 feet in width; (3) to operate any seine or other appliance within 100 yards of any other seine or fishing appliance.

It will be noted that for red-salmon streams less than 500 feet wide, a trap must remain at least 500 yards away from the mouth and a seine only 100 yards away, a difference of 400 yards in favor of the seine.

Following are statistics of gear used in 1911: In all Alaska there were 263 seines, 1,734 gill nets, and 152 traps. In southeast Alaska, the section most concerned in the present discussion, there were 91 traps which caught 9,341,136 salmon, or an average of 102,649 per trap. In the same region there were 227 seines which caught 17,149,869 salmon, or an average of 75,546 per seine. The surprising feature of these seasonal figures is that on the average the catch of each purse seine was within 27,000 salmon of the catch of each trap. But as there were many more seines than traps the total catch by seines was nearly double that of the traps.

The foregoing figures are for the season of 1911. During 1912 the total catch in Alaska by means of traps was 19,921,000 salmon, while all other forms of gear combined caught 41,020,000. This is 32 per cent for traps and 68 per cent for the other kinds of apparatus, and makes a total catch of more than 61,000,000 salmon in Alaska during 1912.

In southeast Alaska in 1912 there were 346 seines which caught 14,728,000 salmon, an average of 42,566 each; 377 gill nets which took 767,000 salmon, or an average of 2,034 each; and 176 traps which took 13,885,000 salmon, or an average of 78,892 each. We note that the catch by traps, comparing the two years 1911 and 1912, drops on an average from 102,000 to 78,000, and the catch in the case of seines declined from 75,000 to 42,000 on the average.

For the purpose of comparison, the figures for seines in 1912 are not of great use for the reason that most of them operated only part of the season because of the strike. It is only fair to say that on the average the seines fished only half of the season of 1912. But even so, the seines in southeast Alaska caught about a million more salmon than the traps. It is significant to note that the average for traps fell from about 102,000 in 1911 to less than 79,000 in 1912. A possible reason for this exists in the fact that in the scramble for traps in 1912, many sites were tried which proved to be poor.

The total amount of fishing gear used in Alaska, aside from lines, during 1912 was: 413 seines, an increase of 150 over 1911; 273 traps, an increase of 121 over 1911; and 1,954 gill nets, an increase of 220 over 1911. Of the increase of gear by sections, the most notable was on traps in southeast Alaska, where the number rose from 91 in 1911 to 176 in 1912.

In considering the question of depletion of waters, it is not proper to select any individual stream or any particular year as a basis for final conclusions. There are offyears and variations and fluctuations just as in the case of crops raised by the farmer. Tides, ice, and winds may influence the movements of salmon.

The problem in the perpetuation of the fishery is to determine the escape of breeding salmon necessary to keep up the supply, and since 1908 the Department has been conducting an elaborate system of actually counting the number of brood salmon escaping the fishermen's nets and passing up Wood River, a tributary to Bristol Bay. The idea is to correlate the escape with future returns and thus fix a definite limit upon the number that may be taken for commercial use. A continuance of these investigations is necessary for a few years longer before definite conclusions can be drawn, but important facts are already available as to what a region will stand in the face of heavy trap fishing.

For years the lagoon at Chignik has been studded with a network of from ten to fifteen or twenty traps, some of them with leads several thousand feet long. Notwithstanding the apparent impossibility of any fish passing this network of traps, it may be said that during 1911, when the Government made an exploration of the region, not only did the traps farthermost upstream fish quite well, but also there were evidences of what appeared to be a good escape to the spawning grounds above, a very remarkable condition. Chignik has not had the benefit of any hatchery support.

It is hardly to be conceived that trap fishing will ever deplete the waters of Cook Inlet, especially since traps and all commercial fishing for salmon have been barred in the tributary streams. The waters of the inlet are very turbid, and it is well established that the fish do not follow any particularly defined course. Good catches have been made by gill nets several miles offshore.

Traps extend out into a channel but a comparatively short proportion of its width, therefore large numbers of fish have ample opportunity to pass unobstructed. In some places the fish strike in toward the shore much more freely than at other points, hence certain spots are recognized as better trap sites than others. But there is ample proof that great quantities of salmon travel away from the shore line. Specific places may be cited, as, for example, Nushagak Bay, where fishing covers all sections of the channel, which is several miles wide. In southeast Alaska the fact that considerable numbers of salmon are caught in movable forms of apparatus far outside the range of any traps is good evidence that they frequent off shore waters. At no point in Alaska is it legal to extend a trap more than one-third across any body of water. It is but rarely ever necessary to consider this feature in southeast Alaska, as most of the channels where traps are located are several miles wide, and traps are but rarely of greater length in this region than 1,000 or 1,500 feet. On account of the rugged shores and deep waters it is impossible to build them of greater length. Nevertheless, a limit should be placed on the length of traps, as is customary elsewhere—notably the traps of Puget Sound.

A great deal has been said at times as to the waste caused by traps, but the facts do not bear out the contention that they are wasteful of food fishes. They may take a negligible number of fishes not at present utilized, such as sculpins, flounders, and trout. If such fishes as sharks, dogfish, sculpins, and trout can be captured and destroyed, there is a direct benefit to the salmon industry. Trout and sculpins are very destructive to young salmon.

From one point of view the purse seine is more wasteful than the trap. Seine boats are sometimes gone from the canneries for several days and the fish grow stale in the hold of the boat, particularly if the fishing is poor—which means visits to a number of small streams before a catch can be obtained that justifies a return to the cannery, or justifies a call of a run boat or collecting boat. The fish from traps are necessarily superior in quality to at least some of the seine fish, for with but very rare exceptions they are alive in the pot and spiller until a comparatively short time before being canned or otherwise used.

Against the charges of the purse seiners that the traps are monopolistic, it is to be noted that there were twenty independent traps in southeast Alaska in 1912, owned by individuals or groups of individuals wholly or nearly all residents of Alaska. One phase of the independent trap situation is that an individual stands an equal chance with the largest company in developing a new site, as favorable locations are not known until tried. Thus, if the independent owner by good fortune gets the better location, the preponderance of capital in the hands of the large company can hardly eject him.

On the other hand, in the case of the individual who can not command sufficient capital to build a trap, the seine or other less expensive apparatus is perforce his choice, and he then wants to abolish all traps, as they are in direct competition with him. But, as in other industries, competition when conducted legitimately invariably inures to the public good.

In the matter of preventing too heavy a drain upon the supply of salmon, a point in favor of the purse seine is that it can not operate in many places during stormy weather, and the fish have an opportunity to escape, whereas, unless conditions are unusually bad, a trap is likely to catch considerable numbers of fish when a purse seine can not be operated profitably.

On the other hand, however, it is the well-known habit of salmon to school outside the mouths of streams before ascending for spawning purposes. They are fish that have passed the traps. It is here that the purse seine is used most assiduously. Conditions were particularly bad in this regard during the summer of 1911, when some of the streams were so low that the fish were much hindered and sometimes absolutely prevented from ascending. Of course, this afforded great opportunity for the purse seine.

Originally the canneries depended chiefly upon seines to supply their fish. It is within the last few years that traps have come so largely into use, their vogue being due primarily to strengthened faith in their economy as a fishing appliance. Moreover, the fishermen's strike in 1912 revealed to the cannerymen the disadvantage of depending upon the fishermen with movable gear, and the higher wages demanded led to the adoption of traps in still greater numbers. A case in point is a large company which has operated four canneries in southeast Alaska for a number of years past, and used seine-caught fish exclusively until this season, when it began to install traps. All of this means that eventually a limit must be placed upon traps as well as other forms of gear, chiefly purse seines. To this end a Federal license system will be most helpful.

Regulation, in fact—the susceptibility of the fishing device to regulation—is perhaps the prime factor in the whole question. As already stated, any form of gear unrestricted could deplete the resources; therefore every form that is allowed must be regulated. If a particular kind of gear is not susceptible of regulation, or is less susceptible than some other, that other is to that extent more de-desirable in the interests of the fish supply. It is upon these considerations that the Federal Government bases its chief argument in behalf of traps. The trap has a definite location; consequently it can be inspected at any time, as the officers know where to find it. The purse seine moves constantly from place to place; therefore it is quite impossible for the Government, with present facilities, to regulate this form of apparatus—a regulation most essential because of the admitted tendency to operate purse seines in prohibited waters, notably entirely across stream mouths, and, of course, without detection. A purse seine can go into the mouth of a stream and get away unnoticed with a good catch of fish. An inspection force greatly disproportionate to reasonable requirements in such matters would be needed to look after seines.

Traps are in operation to-day on the Atlantic coast in the shad fishery, on the Great Lakes in whitefish operations, and in the Pacific States in salmon work. In regions where they are regulated, and are opened at certain times to let fish pass, the fishery is in no danger of extermination. In view of this fact and the history of the commercial fisheries everywhere, it must be conceded that the apparently irreconcilable differences in the purse-seine and fish-trap controversy in Alaska emphasize the necessity for unbiased legislation and regulation of Alaska fisheries such as the Federal Government, with its broader vision, can alone supply.

## FEDERAL REGULATIONS.

### Streams Closed to Commercial Fishing.

The canning interests in general agree that the closing of streams tributary to Cook Inlet, also Eyak Lake and stream, Anan Creek, and Naha stream, by order of the Secretary of Commerce of November 18, 1912, has been an excellent move in the preservation of Alaska's fishery resources.

As enumerated in the 1912 Alaska fisheries report, there are now closed to commercial fishing, by authority of the Secretary of Commerce, or by Executive order of the President, the following waters:

Western Alaska: Wood and Nushagak Rivers.

Central Alaska: All streams flowing into Cook Inlet; all streams on Afognak Island; Eyak Lake, including a limitation on fishing in Eyak River.

Southeast Alaska: Anan Creek, Naha Stream, Yes Bay and Stream.

The time is near at hand when it will undoubtedly be in the interests of the salmon fisheries of Alaska to close other streams to commercial fishing, or at least limit either the season or form of gear, or both. The judicious application of Federal authority along these lines is in close keeping with the true principles of conservation.

### PATROL IN SOUTHEAST ALASKA.

During the months of July and August, while salmon fishing in southeast Alaska was heaviest, a patrol was maintained to enforce the fisheries laws and regulations. This was conducted on a more extensive scale than heretofore. The Juneau region was covered chiefly by the newly purchased fisheries steamer *Osprey*, while the chartered power boats *Truth* and *Standard* operated in the Ketchikan and Wrangell regions, respectively. In addition the launch *Lue* was chartered for several trips in the Juneau and Icy Strait section, while a patrol of waters near the Yes Bay hatchery was maintained by a small launch attached to the station. During the 50 days or so of active patrol work, the first three named boats logged approximately 9,000 nautical miles. To this must be added the 800 miles covered by the two smaller boats. The total sum chargeable to this phase of the work, including charter of boats, salaries of regular employees, and all expenses, is approximately $5,000.

All told, five agents and deputies were engaged throughout the heaviest part of the fishing season, primarily to prevent infractions of the law, and at the same time to take the necessary steps to apprehend any offenders. Incidental work included the charting of traps and various fishery establishments, the distribution of laws and the posting of notices in regard thereto, the observance of salmon runs in various streams, and the enforcement of the fur laws. Visits to fishing grounds were regarded as more important than visits to canneries. The several patrol boats were on the move each day, unless detained by heavy weather or for other good cause, daily runs varying usually from 50 to 150 miles for each of the larger boats.

Particular attention was paid to the observance of the weekly close season, from 6 o'clock Saturday evening until 6 o'clock Monday morning, both as regards the proper closing of traps and the cessation of fishing by seines and gill nets. There has also been a constant tendency of seiners and others to haul their nets entirely across the mouths of streams, a practice contrary to law.

In the testimony of the commercial fishermen who appeared in Juneau last spring before the joint fisheries committee of the legislature, nearly every one freely admitted that there was frequent violation of the law, particularly in the matter of operating nets entirely across stream mouths, and often fish were driven downstream from spawning beds into the nets waiting below. They said this was due largely to the fact that with but one fisheries agent looking after all of southeast Alaska, such a practice could be carried on with little or no fear of detection.

While, as a result in part of the agitation at Juneau during the session of the legislature, a much more effective patrol system was inaugurated this season in southeast Alaska, there is need of considerable more expansion along this line. More men and boats are needed. As a beginning, the steamer *Osprey* was put in commission this season, and three additional agents were detailed into this section of Alaska, where, by reason of the extent and character of operations, there is greatest need of regulation of fishing if the potential value of the waters is to be preserved. But rather than to be dependent upon the unsatisfactory method of chartering boats to further the needs of the patrol system, the Bureau should have in service at least three fast power boats of 65 feet or upwards in length and of staunch and seaworthy construction to withstand the sudden and violent gales of southeast Alaska, and to navigate, where necessary, outside waters.

### Inspection of Canneries.

During the last year or so there has developed a feeling among various cannery men that a Government inspector should be stationed at each cannery to pass upon the condition of fish packed, also to see that sanitary features are fully observed, in manner similar to the Federal inspection of meat-packing houses and product. The theory of extending such inspection to Alaska is sound, but no funds are available for the employment of the force of 50 or more competent inspectors required to put the plan into effect. The managers of two companies, realizing the practical benefits of announcing the sale of goods packed under Federal supervision, have stated their willingness to pay the salary and expenses of an authorized and impartial Government inspector stationed at each of their plants. There are practical difficulties in the way of accepting pecuniary aid from private enterprise, however, therefore provision by Congress of a personnel and funds is the proper way to effectuate the plan.

### Fishways.

There are several streams in southeast Alaska well adapted as natural breeding grounds for salmon, but impassable to the fish by reason of falls at or near salt water. It is hoped that steps can soon be taken to open up these waters either by blasting out resting places for the fish, or, better still, by installing suitable fishways. Of course, it is realized that it is difficult to do much, or even anything, in the case of various high and precipitous falls, but there are several streams where comparatively little work would make them available to spawning salmon. In the case of two or three streams not far from Wrangell, it would seem that a few well-placed charges of powder would meet all requirements. Work of this character should be done during the winter, when the water is low.

As an example of the streams under discussion, there may be cited Mill Creek, which is 7 miles from Wrangell. At the mouth of this stream there is one almost sheer drop of 6 or 8 feet, even at higher stages of the tide, and above this is a series of cascades with a fall of probably 25 feet in a distance of about 75 yards. Were a fishway installed at the first drop, and a few resting places blasted out in the series of cascades, salmon could get into the stream above, which is about a mile long, and then pass into a fine lake 2½ miles in length. Each season considerable numbers of salmon collect off the mouth of the stream, but their attempts to pass the falls are without exception unsuccessful. It is particularly desirable to open up a stream like Mill Creek, which heads in a lake and therefore will be ascended by red salmon. When funds are made available, effective work can be done in accomplishing this end.

### Lights on Fish Traps.

Under date of August 8, 1913, the Bureau of Lighthouses issued circular letter No. 329 to lighthouse inspectors, stating that the Secretary of Commerce had approved the following regulation, which will be included in permits that may be granted by the War Department for the erection of fishing structures and appliances in navigable waters of the United States:

Fishing structures and appliances in navigable waters of the United States shall be lighted for the safety of navigation, as follows:

The lights shall be displayed between sunset and sunrise. They shall be placed at each end of the structure, excepting where the inner end terminates in such situation that there is no practicable navigation between it and the high-water line of the adjacent coast, in which case no inner light shall be displayed. The outer light shall be white and the inner light shall be red. The size, capacity, and manner of maintenance of the lights shall be such as may be specified in the War Department permit authorizing the erection of the structure or appliance.

When several structures or appliances are placed on one line, with no navigable passage between them, they will be considered, for lighting purposes, as one structure.

### Trap-Site Surveys.

In anticipation of early revision by Congress of the present Alaska fisheries laws, there has been considerable activity this season in the matter of surveying trap sites. Several of the larger companies as well as a number of individual trap owners have been to considerable expense in having surveys made. Since there has been no definitely established standard for surveying or determining the exact size and position of fish-trap sites, these efforts would seem to be somewhat premature. However, in the event of much-needed trap legislation by Congress, possibly at least a part of the work already done may be made to apply to future requirements.

## VIOLATIONS OF LAW AND REGULATIONS.

As in past seasons every effort has been made by the Bureau's agents and deputies to insure full observance of the fisheries laws and regulations. In this connection acknowledgment is made of valuable assistance and counsel through the cooperation of the United States attorneys and marshals.

The case of M. Kono and 20 other Japanese fishermen arrested during November, 1911, for herring fishing on Sunday was tried May 6, 1913, in the district court at Ketchikan. Judge Lyons decided that violation of the fisheries law as charged in the indictment was a misdemeanor, hence defendants might appear by counsel for arraignment and trial. The jury brought in a verdict of guilty and on May 8—two days later—the court imposed a fine of $50 upon each of the 21 defendants. This fine is in addition to the cash bail of $1,000, which was forefeited upon failure of defendants to appear for rendition of judgment. In his instructions to the jury in this case Judge Lyons quoted section 5 of the fisheries law, which provides for a close season on salmon in certain waters of Alaska from 6 o'clock Saturday evening to 6 o'clock of the following Monday morning, and then quoted section 11, which subjects all species of fish to the provisions of the act. Judge Lyons stated that the provisions of section 5 are made applicable to all fishing within the waters of Alaska, including fishing for herring.

On December 22, 1913, in the United States commissioner's court at Craig a fine of $200 was placed upon Nels Husvig for wanton waste of herring contrary to the provisions of law. Complaint was made by Deputy Warden Walker, and a plea of guilty was entered. Large quantities of the smaller-sized herring had been thrown overboard.

The trial of W. E. Ludy, watchman, charged with failure to close Alaska Packers Association trap No. 9 on Sunday, July 28, 1912, occurred in the district court at Ketchikan May 7 and 8, 1913. The true bill rendered by the grand jury in October, 1912, included both W. E. Ludy, watchman, and the Alaska Packers Association, owner. Upon request of defendants separate trials were granted and the case against Ludy was called first. After two days devoted to the submission of testimony and arguments by counsel the case went to the jury and a verdict of not guilty was returned. In view of this verdict, the following day United States Attorney Rustgard moved a dismissal of the case against the Alaska Packers Association.

While on a trip up the west coast of Prince of Wales Island Sunday, August 24, 1913, Agent Smith and Deputy Lyman discovered driven trap No. 14, operated by the Craig cannery of the Lindenberger Packing Co., to be fishing illegally. The case was tried before the United States commissioner at Ketchikan August 27, and upon pleas of guilty being entered the company was fined $100, and Erick Peterson, trap watchman, was fined $10.

The case against the Alaska Pacific Fisheries and A. Carlson, owner and watchman, respectively, of a floating trap said to have been fishing illegally on Sunday, August 4, 1912, near the entrance to Yes Bay, as charged in a true bill returned by the grand jury at Ketchikan at the succeeding fall term, has not come to trial. A continuance was granted both at the spring and fall terms of court at Ketchikan this year.

While on patrol duty Sunday, July 27, 1913, in Cholmondeley Sound, Deputy Lyman discovered that the walls of the heart of floating trap No. 4 belonging to the Alaska Pacific Fisheries were in fishing position contrary to law. The watchman claimed that no instructions had been given him as to the method of closing the trap against fishing. An information was accordingly filed with the United States commissioner at Ketchikan, naming the Alaska Pacific Fisheries, owner, and Chris Adams, watchman, as defendants. Upon citation, the defendants appeared in the commissioner's court on July 30 to answer to the information. The testimony that the heart walls were in fishing position was not controverted, but the court decided that since counsel for the defense had introduced testimony that holes existed in the trap, amounting to 30 square feet or more, a passage for the fish existed, and the defendants were accordingly discharged. This decision has occasioned some surprise, for the law says nothing about holes, but states that the heart walls must be lifted or lowered for a distance of 25 feet on each side next the pot so as to permit the full and unobstructed passage of salmon and other fishes.

Early in the fishing season one of the deputies discovered a gill net stretched entirely across the mouth of the red salmon stream at the head of Nakat Inlet. Every effort was made to apprehend the guilty parties, learned to be Indians, but their identity was not ascertained. Violations of the law of this character are most vicious and harmful, for there is no more certain way of destroying the fishing industry than by preventing at least a reasonable escapement up the streams for spawning purposes.

A report was received from the deputy collector of customs at Cordova that fishing apparatus had been set, by persons unknown, in Eyak Lake, contrary to the closing order promulgated by the Secretary of Commerce on November 18, 1912. An order of seizure was issued and a special deputy marshal was named to take the gear, but by the time that officer arrived it had been removed. No further action occurred.

There has been some dissension and complaint among the fishing interests of southeast Alaska, and particularly at Hetta Inlet, as to the time when seining operations shall cease in accordance with the provisions of the weekly close period. Six o'clock in the evening is the hour prescribed by law, but as there has been considerable variation in the time kept at different canneries, one crew would sometimes fish an hour or so longer than another. To avoid infractions of the law or further trouble, directions were given to have the crews fishing at Hetta make their time uniform. Where variations in time are more than nominal, the companies fishing later than the standard time of a given region will be subject to prosecution.

Various rumors and vague reports were received from time to time as to alleged illegal fishing, but no direct evidence would be forthcoming or could be obtained. It is usually the case that those who note infractions of the law feel that they can not jeopardize their business relations by reporting the matter in a way that will permit of an action at law. If a more vigorous and healthy public sentiment can be developed along this line, the way of the transgressor will be made much more difficult.

Because of the unattractive price on chums, a number of cannery men were not very scrupulous as regards the section of law prohibiting the wanton waste of salmon or other food fishes. Several cases were investigated, and one was brought to the attention of a grand jury, but the evidence did not warrant further action.

It has been construed recently that violations of the fisheries laws and regulations fall within the misdemeanor class, hence an alleged violator may, in the discretion of the prosecuting officer, either be tried before a United States commissioner, sitting as a justice of the peace, ex officio, or said United States commissioner may sit as a committing magistrate merely to give a preliminary hearing to determine whether the evidence justifies binding the defendant over to the grand jury.

Pursuant to an opinion by United States Attorney Rustgard it was determined this season that in the event of violation of the fisheries laws or regulations complaint would be made against the company or corporation involved, as well as against the individual fishermen, watchmen, or other person or persons immediately concerned in the violation.

If it is found that difficulty exists in obtaining convictions in fisheries violations, there is good ground to ask Congress that greater powers be vested in the fisheries agents and deputies. This might consist of more extended authority in the matter of confiscation and destruction of gear operated illegally. This is along the line of similar powers conferred upon collectors of customs and other Government officers.

The practice in the Bering Sea region of putting pink salmon labels on the pack of chum salmon is contrary to the provisions of law, and hereafter must be discontinued. The chum salmon of Bering Sea is no better than the chum of southeast Alaska, and there appears to be no justification for the use of a pink salmon label in western Alaska on the chum pack.

So far as the interior of Alaska is concerned no serious violations of the fisheries laws have been reported. Two nets were removed from a small stream near Hot Springs and one from Clear Creek near Fairbanks. It was reported that a trap entirely blocked the Chatanika, but the trap was removed before the arrival of the warden and evidence could not be obtained of the guilty parties. It was reported that at Chicken Creek near Eagle prospectors blocked the stream with traps in the fall until they obtained sufficient whitefish to freeze for their individual use during the winter. It was reported at Fairbanks that fish were being used for fertilizer, but upon investigation it was found that the report was based upon the use of a single load of offal from fish being dried.

## OBSERVATIONS IN THE WOOD RIVER AND NUSHAGAK REGIONS.

During the fishing season of 1913 the Bureau was represented in the Nushagak Bay region by Deputy Fur Wardens Hanna and Roach, on special detail for the purpose. Having arrived at Nushagak overland from Bethel early in the spring they began active operations in relation to the fisheries on June 5. On that date they went to Lake Aleknagik and began overhauling the gear to be used in connection with the investigation of the run of salmon in Wood River.

The construction of the rack, begun on June 14, was completed on June 21, and the actual counting of the fish was begun the next day. The census was taken in the same manner as in the preceding five years, and covered the period from June 22 to July 28, both inclusive. The maximum daily count was 121,981 red salmon. This occurred on July 5, while the next largest count was 100,383 on July 1. The run on the day following each of these dates was very much reduced, in view of which fact it would seem that the season's run reached its maximum on July 3 and 4, when 91,203 and 91,186 fish were counted, respectively. The maximum run in 1911 occurred on July 15, and in 1912 on July 8.

The following statement shows the tally of red salmon at the Wood River (Lake Aleknagik) rack in 1913:

| | No. | | No. | | No. |
|---|---|---|---|---|---|
| June 22 | 246 | July 5 | 121,981 | July 18 | 529 |
| 23 | 4,180 | 6 | 11,977 | 19 | 297 |
| 24 | 2,991 | 7 | 33,698 | 20 | 690 |
| 25 | 2,560 | 8 | 31,323 | 21 | 306 |
| 26 | 1,737 | 9 | 35,991 | 22 | 1,658 |
| 27 | 7,489 | 10 | 27,907 | 23 | 538 |
| 28 | 12,528 | 11 | 20,038 | 24 | 304 |
| 29 | 16,022 | 12 | 18,917 | 25 | 1,841 |
| 30 | 47,134 | 13 | 14,296 | 26 | 463 |
| July 1 | 100,383 | 14 | 4,651 | 27 | 1,212 |
| 2 | 36,192 | 15 | 3,228 | 28 | 1,022 |
| 3 | 91,203 | 16 | 2,788 | | |
| 4 | 91,186 | 17 | 3,603 | Total | 753,109 |

The relation of the catch of salmon in the Nushagak region to the escapement into Wood River is shown in the following table:

RED SALMON RUN IN NUSHAGAK BAY AND TRIBUTARIES, 1908–1913.

| Year. | Nushagak Bay catch. | Wood River tally. | Total. | Per cent of escape. |
|---|---|---|---|---|
| 1908 | 6,140,031 | 2,600,655 | 8,740,686 | 30 |
| 1909 | 4,687,635 | 893,244 | 5,580,879 | 16 |
| 1910 | 4,384,755 | 670,104 | 5,054,859 | 13.2 |
| 1911 | 2,813,637 | 354,299 | 3,167,936 | 11.1 |
| 1912 | 3,866,950 | 325,264 | 4,192,214 | 7.7 |
| 1913 | 5,236,008 | 753,109 | 5,989,117 | 12.5 |

From the foregoing it will be observed that the escape in 1912 was 7.7 per cent, while in 1913 it was 12.5 per cent. The total Nushagak run of red salmon, including both the catch and the count at the rack, increased from 4,192,214 in 1912 to 5,989,117 in 1913, a gain of 30 per cent.

Attention has already been called to the fact that in considering these figures it must be remembered that an unascertained number of red salmon ascend to spawning beds in the Nushagak River. This number, however, is small compared with the number ascending Wood River. While the count of those entering Lake Aleknagik does not therefore show the escape for the entire bay, it does nevertheless show the relative escape year by year. It may be assumed that the run into Nushagak River is an approximately constant factor as to the percentage of the entire run, and does not vitiate the deductions that may be drawn from a study of the Wood River counts and the Nushagak Bay catches.

During the season officers of the Northwestern Fisheries Co. and of the Alaska Fishermen's Packing Co. (Libby, McNeill & Libby) made a trip to Lake Aleknagik to inspect the spawning beds and to make a personal investigation of rumors current for several seasons that the Government rack is a detriment to the salmon industry because, it is alleged, fish do not lead through it. The absurdity of these reports was readily established, as all operations were found to be conducted properly and there was no evidence that the salmon did not pass through the rack. During the course of the season 124 dead salmon were found about the mouth of Lake Aleknagik, all of which had died from gill-net injuries received before they entered Wood River. The presence of the Government rack for counting operations had nothing to do with the death of these fish. The derogatory rumors respecting the rack have been spread by persons utterly uninformed as to the real situation.

Observation was made at the rack again this year of the proportion of salmon showing injuries from gill nets operated on Nushagak Bay. It was determined that the number thus injured and escaping comprised 17 per cent of the total number of red salmon entering Lake Aleknagik.

Operations at the rack were facilitated very largely through assistance rendered by the Alaska Packers Association. The Alaska Portland Packers Association furnished a boat for towing equipment to the rack site.

The Department's order of December 17, 1907, closing Wood and Nushagak Rivers to commercial fishing, was disregarded this season by some natives who operated stake nets in the restricted region and sold the catch to neighboring canneries. It is the purpose hereafter to allow the use of native stake nets in the closed waters for domestic purposes only. During the past season most of the 236 stake nets in operation were outside of the closed region.

A patrol was again maintained this season to see that fishing boats from the canneries did not invade the restricted waters. To insure a uniform determination season by season of the mouths of Wood and Nushagak Rivers, fixed range markers have been established. These markers are of iron pipe set 40 feet apart, the first being 12 feet back from the edge of the tundra bank. The bearing of the Wood River ranges above Snag Point is NE., while those for the Nushagak River are at Picnic Point and bear N. From these ranges piles are fixed offshore for the guidance of the fishermen.

## AFOGNAK RESERVATION.

### FISHING REGULATIONS.

On March 21, 1912, the following order was issued by the Secretary permitting a limited amount of commercial fishing in the reserved waters of the Afognak Island Reservation:

*To whom it may concern:*

A proclamation by the President of the United States, promulgated December 24, 1892, created the Afognak Forest and Fish Culture Reserve, which is now a part of the Chugach National Forest. The proclamation states that—

"There is hereby reserved from occupation and sale, and set apart as a Public Reservation, including use for fish culture stations, said Afognak Island, Alaska and its adjacent bays and rocks and territorial waters, including among others the Sea Lion Rocks, and Sea Otter Island: *Provided*, That this proclamation shall not be so construed as to deprive any bona fide inhabitant of said Island of any valid right he may possess under the Treaty for the cession of the Russian possessions in North America to the United States, concluded at Washington, on the thirtieth day of March, eighteen hundred and sixty-seven.

"Warning is hereby expressly given to all persons not to enter upon, or to occupy, the tract or tracts of land or waters reserved by this proclamation, or to fish in, or use any of the waters herein described or mentioned."

Sections 3 and 7 of "An act to establish the Department of Commerce and Labor," approved February 14, 1903, transfer the supervision and control of the salmon fisheries of Alaska to the Department of Commerce and Labor.

In the exercise of the authority derived from these sources the following regulations governing the reserved waters herein defined are hereby established and promulgated:

1. No person or persons other than the natives of Afognak Island now resident thereon will be permitted to fish in the reserved waters.

2. Licenses for fishing will be granted to the said natives upon application to the Secretary of Commerce and Labor or such representative of the Department of Commerce and Labor as may from time to time be designated by the Secretary.

3. The kinds and amounts of apparatus to be used, the places where and the manner in which it may be operated, and the time when it may be employed will be determined by the Secretary of Commerce and Labor and will be subject to changes or modifications from time to time at his discretion.

The foregoing regulations were supplemented by order of February 6, 1913, extending privileges to residents of certain near-by islands; also placing white men married to native women on the same basis with regard to fishing rights as the natives. The supplemental order is as follows:

*To whom it may concern:*

Department circular No. 238, issued March 21, 1912, for the regulation of fishing in the waters of Afognak Reservation, Alaska, is hereby amended so as to grant to natives of Spruce, Whale, Dry, and Raspberry Islands, Alaska, the same fishing privileges in Afognak waters now accorded natives of Afognak Island. White men married to native women will be granted the same privileges as the natives.

Early in the year the question arose as to the fishing privileges to be accorded those persons entitled to fish in the reserve who moved away from Afognak during the previous winter and who expected to return temporarily with the opening of the spring fishing season. The decision was reached that if the absence should be of a sufficiently permanent character whereby they could no longer be termed residents of Afognak they should be denied licenses if they returned temporarily for that purpose. In other words, their ordinary birthright privilege of fishing would be surrendered if they acquired a residence elsewhere. If, however, a native should seek employment elsewhere for a time, but in reality still called Afognak his home and he should be recognized commonly as an Afognak native in contradistinction, for instance, to a Kodiak native, he would as a matter of equity be entitled to fish in Afognak waters. If a native should surrender his fishing privilege by acquiring a residence elsewhere the surrender need not necessarily be permanent, for, under proper bona fide intentions, it might be possible to reacquire a residence on Afognak and attendant fishing privileges. But to preclude the possibility of fraud the right under this proviso must be clearly established.

Immediate supervision of fishing operations was placed in the hands of E. M. Ball, inspector, Alaska salmon fisheries, on duty in this region, and the report herewith is derived largely from his notes. Additional regulations to meet local conditions for the season were issued by Mr. Ball on May 24, 1913, covering the following points:

1. Fishing in Letnik Bay, for commercial purposes, is prohibited throughout the season. Only the general fishery law shall apply in all other localities within the reservation.

2. Fishing gear is restricted to the use of haul or drag seines not exceeding 200 fathoms in length.

3. Orderly conduct of operation is required at all times.

4. Licenses to fish in the reserved waters of Afognak will be revoked for any violation of this order.

The Malena fishery, where last year a midweek close period of 36 hours was enforced, is so located that winds from the west and southwest interrupt fishing, and in this way several days' protection is afforded, thus making unnecessary any further special regulation on the subject.

It has been suggested that the Sunday closing provided by statute is of doubtful benefit to the small streams of this locality, as the protective period is too short to give the salmon more than an opportunity to approach the streams. The movement of these fish into fresh water is deliberate, and before the demands of nature have become sufficiently urgent to induce them to leave the sea they may be taken by the fishing gear on Monday. The catch on Monday is usually better than on any other day of the week. On account of this habit of the salmon to school off stream mouths, the efficacy of the close period in allowing an escapement of breeding salmon upstream is much lessened when fishing gear such as purse seines and beach seines are allowed too close to stream mouths. The theory has been advanced that this condition may be bettered by establishing a continuous close season for a period of from 5 to 10 days while the run of salmon is good. Such action, however, would likely meet with considerable opposition at the hands of the fishing interests.

### Catch of Salmon.

During the fishing season of 1913 licenses were issued to 71 persons to fish in the waters of Afognak Reservation. Though the fishermen departed to the several fields in May, it was not until late in June that the number of salmon coming to the streams was enough to warrant continuous operations. Eleven crews, of from four to seven men each, operated at the several fisheries of the island. They moved from one field to another as they felt disposed, being actuated in this regard entirely by the reported runs of salmon.

The first sockeyes appeared early in May, as is usual in this region, but their movement into the streams was checked by the large quantity of volcanic ash from the Katmai eruption of 1912, that was being washed from the hills by melting snow and heavy rains of the month. Letnik Bay and stream, which receives the hatchery run, fared worse in this regard than any of the other localities, and at one time it was feared that no fish might appear. On July 7, when the rack across the stream was removed, only 48 red salmon had entered the lake. Ordinarily this date would have marked the end of the running season. The number of salmon attracted to Letnik Bay was markedly less than in 1912, when the decline was approximately 50 per cent. Figures for this year taken from the hatchery records show that 3,367 sockeyes and 6,882 humpbacks reached the spawning grounds covered by hatchery operations.

The production of the Afognak commercial fisheries for 1913 is shown, by locality and species, in the following table, which does not include the hatchery fish in Letnik stream:

CATCH OF SALMON IN THE AFOGNAK RESERVATION, SEASON OF 1913.

| Locality. | Sockeyes. | Humpbacks. | Cohos. | Total. |
|---|---|---|---|---|
| Malena | 41,536 | 8,472 | | 50,008 |
| Paramanoff | 26,958 | 288 | | 27,246 |
| Seal Bay | 20,173 | 859 | | 21,032 |
| Little Afognak | 8,682 | 1,443 | 4,113 | 14,238 |
| Izhut Bay | 3,188 | 15,793 | | 18,981 |
| Danger Bay | 451 | 20,818 | | 21,269 |
| Total | 100,988 | 47,673 | 4,113 | 152,774 |

Compared with 1912, the foregoing shows a gain of about 18,000 sockeyes; humpbacks are practically the same, while cohos have fallen off about 4,000. Most of the places fished show a larger catch of sockeyes than in 1912. Seal Bay leads with an increase of 7,744; Paramanoff comes second with 6,693; Little Afognak third with 1,665; while Izhut and Danger Bays, where no sockeyes were taken last year, produced 3,188 and 451, respectively. Malena shows a falling off of 1,154, but this decline may be only apparent, as the figures for last year included, as far as possible, all salmon consumed fresh by the fishermen or salted by them for winter use, whereas for this year no similar figures were obtained.

The only localities fished for humpbacks were Danger and Izhut Bays, and only at these places because of their relative proximity to the Kodiak cannery. The superabundance of humpbacks throughout the region during the season made it unnecessary and unprofitable for the cannery boats to go to the more distant places for this species. Though some humpbacks were taken at all the island fisheries, the catch except at the two fields just named was merely incidental to the operations for sockeyes. Positive evidence that the run was good in all localities is lacking, but it is probable that there was no great disparity in the number of humpbacks coming to the several streams.

This condition may also be true in regard to the number of cohos selecting these waters for spawning purposes. Fishing was carried on only at Little Afognak, and the catch was limited by reason of the fact that the Kodiak cannery had about made a capacity pack before the appearance of the cohos. Other localities, doubtless, would have shown a run equal to that of last year. Dog salmon were very scarce, only a few being taken during the season.

The total value to the fishermen of the salmon taken from Afognak waters was $4,155, or $243 less than the amount reported as the value of last year's catch. The fishermen were paid at the rate of $35 per thousand for sockeyes and cohos and at the rate of $10 per thousand for humpbacks. All salmon taken commercially from Afognak waters were sold to the Kodiak Fisheries Co. at Kodiak.

### Eruption of Katmai Volcano.

In view of the important and more or less disastrous effect which the eruption of Katmai Volcano in June, 1912, had upon the fisheries, fur animals, and other animal and plant life of the Afognak Island Reservation, E. M. Ball, inspector, Alaska salmon fisheries, then at Afognak, was instructed to make a special investigation of the subject. He did so, and his report, which covers well many phases of the matter, is here presented.

The data which are presented in this report were obtained from two sources; direct examinations, and conversations with fishermen, boatmen, and miners. The results of personal investigations treat almost exclusively of conditions on Afognak Island; while the information received from individuals refers to localities beyond the reach of the writer. Where a number of opinions are concerned, each differing widely in essential features, it is not always easy to ascertain the facts. First reports are often unduly colored by the stress of the moment, and, therefore, in the light of subsequent events, are subject to modification. Enough is known, however, now three months after the eruption in question, to warrant the preparation of a brief report thereon, and its effect upon the animal and vegetable life of Afognak Island.

*Description of volcano.*—The Alaska Peninsula forms an important link in the chain of volcanoes which extend the entire length of the Pacific coast of the American Continents; and, as a region of volcanic activities, it is, perhaps, second only to the great centers of the Torrid Zone. These activities are made known by the smoking volcanoes of Redoubt and Iliamna on the shore of Cook Inlet, Pavlof on the western end of the peninsula, and Shishaldin on Unimak Island. Many others less notable occupy the intermediate territory, some of which are of comparatively recent discovery.

To this class belongs Katmai Volcano, a peak 7,500 feet high. It is located near latitude 58° 16′ and longitude 155°, or about 20 miles north of Katmai Bay and 60 miles west of Afognak. Information as to its general appearance is not obtainable, but prospectors and hunters who in other years had traveled through that section of the country tell us that the volcano is not marked by any great prominence and is not readily distinguishable from several peaks in its vicinity of approximately the same elevation. Neither they nor those who have always lived in this region have any knowledge either direct or traditional of its former activities. As far as the Kodiak group of islands is concerned, many believe that indications of a previous eruption can be found several inches below the surface of the ground in a layer of soil which in color and composition resembles the ashes now covering the islands; but the acceptance of such evidence as a scientific fact is questionable.

*The eruption.*—In the history of volcanoes elsewhere, it has been recorded that approaching eruptions were preceded by rumbling noises and trembling movements of the earth. In this instance, however, no warning was given to the people of Afognak that a volcanic outburst had occurred until mid afternoon, June 6, 1912, when a dark cloud was observed rising from the west. It is not improbable that there were light convulsions of the earth, which, because of their frequency in this region, passed unnoticed.

The day on which the eruption began was one of more than ordinary pleasantness. The warmth and brightness of the sun, coupled with a gentle breeze from the west, made it an ideal summer day. Air temperatures at morning, noon, and night were 52°, 58°, and 52° F., respectively; and water temperatures for the same hours were 41°, 42°, and 49° F.

Many interesting phenomena, particularly the rise, spread, and rapidity of the eastward movement of the ash clouds, might have been observed at the beginning of the eruption if the village of Afognak had been situated on the west coast of the island where the mountains of the mainland are clearly visible on bright days. Located as it is on the lowlands of the eastern shore, the view to the west is shut off by forest and mountains. For this reason the cloud attracted no attention until its crest rose high above the hills, when its blackness and otherwise peculiar aspect became the subject of some comment. The first impression received by those who had lived in other parts of the land was that a thunder storm, characteristic of more tropical regions, was approaching; but being unaccompanied by lightning and apparently no wind, the cloud was next supposed to be due to a probable fire on the peninsula. By this time the silence was ominous, and even the birds seemed to feel impending disaster, yet no special apprehension was noted among the people of the island.

The shower of ashes began about 6 p. m. The hills were then enveloped in an amber-colored haze, the sky was overcast in all directions except a narrow border along the northeastern horizon, and the air seemed strangely warm. As the storm progressed, the shower increased in density until absolute darkness prevailed; even artificial light could be detected only a short distance. This sudden and early darkness became all the more alarming, because during June there is no night in this latitude, merely twilight from 10 p. m. till 2 a. m.

Probably an hour after the ashes began falling the first rumbling noises were heard, suggestive of the detonation of distant blasting or firing of heavy artillery. Soon thereafter lightning was observed, the flashes becoming more frequent as the night advanced. Some observers describe these flashes as being balls of fire which would burst with a loud report into a shower of sparks. Thunder seemed nearly incessant. The highly electrified condition of the atmosphere was shown on the set of wireless instruments at the Federal hatchery. Although the aerial switch was open, tiny blue flames could be seen on the switchboard and the tuning and induction coils. Whenever the lightning flash was near these flames would shoot out with a keen report like that of a rifle. Associated with these phenomena were the earthquakes, which varied in violence from gentle vibrations to shocks that made the buildings creak and tremble. The most violent convulsions were of several seconds' duration and were usually attended by rumblings.

Beginning about noon, Thursday, June 6, and ending Sunday morning, the 9th, this eruption may have been a continuous operation; but observations made at Afognak seem to show that the discharges were intermittent. This conclusion is based on the fact that there were three distinct showers of ashes, separated by short intervals of comparative quiet.

The first break in the storm came on the morning of the 7th and continued for a space of 10 hours. About 4 o'clock that afternoon the second shower began, bringing with it all the phenomena of the first, but with renewed energies. This was the period of greatest distress to man and beast; to man, mentally, in that the end of it all was uncertain; to the beasts and birds in that there was no escape from the blinding, suffocating dust which was carried into every nook and crevice. Alarm was felt lest the ashes be followed by poisonous gases from which there could be likewise no possible escape. But after 23 hours of uninterrupted fury the second storm had spent itself.

Daylight came at 3 p. m. on Saturday the 8th, only to be dispelled in 5 hours by the third storm which, however, was of short duration and without the violence of the preceding storms. Though the air was full of ashes many days, Sunday morning marked the end of the eruption as far as it had any effect upon the daily seasons. Throughout the storms the air was cool and remarkably free from fumes; temperatures, after the sudden decline at the beginning of the eruption, fluctuated but little; air held close to 44° F., water at 39°.

*Region affected.*—The region affected by this eruption lies almost entirely east of the volcano. Though traces of dust have been reported from Fairbanks, Alaska, and British Columbia and Puget Sound points, the eastern limit to which any appreciable quantity of ashes was carried should be fixed well out in the North Pacific Ocean. To the west ashes are not found more than about 25 miles from the volcano. The ash clouds moved eastward across Shelikof Strait to Afognak and Kodiak Islands, spreading north and south as they advanced until by the time the one hundred and fifty-second meridian was reached they covered a zone nearly 150 miles in width. The northern boundary of this zone can be represented by a line extended from Hallo Bay on the peninsula northeastward to Barren Islands and beyond; its southern limit is shown by extending a line from a point 25 miles west of Katmai Bay to Cape Karluk, thence crossing Kodiak Island to Shearwater Bay. Within the affected zone as applied to the islands, a belt 50 miles wide with Kupreanof Strait as its center embraces the area most heavily covered with ashes.

*Quantity and character of material ejected.*—Over the central region ash fell to a depth of 10 inches. It is found in three layers, representing the three showers. The first layer, measuring 3 inches in depth, consists of fine gray sand whose grains are of three kinds; some are nearly white and opaque, others are transparent resembling small particles of sal ammoniac, and the rest are black or dark amber and susceptible to magnetic influences. The second layer, 5 inches deep, is composed entirely of fine brown dust, which when falling so filled the air that it affected the eyes, nasal passages, and throat of everyone. The third and uppermost layer measured 2 inches in depth and it also is a flour-like dust of a light gray color.

North and south from this central region the ashes gradually diminish in depth until the border of the affected area is reached, each layer being proportionately reduced.

Besides the dust and sand ejected by Katmai Volcano a considerable quantity of pumice stone was thrown out. These stones ranged in size from small particles to those several inches in diameter, and they varied in color as did the ashes. All this coarser material fell on the mainland not many miles from the volcano. The streams and rivers of the vicinity carried it to the ocean where it formed into large fields that were moved here and there by winds and tides and piled 2 or 3 feet deep on the beaches of the islands.

*Immediate effect of eruption.*—The winter and spring had been favorable seasons; deciduous bushes were opening into full foliage; perennial plants had made a remarkable growth,, particularly in the lowlands; the birds of summer were nesting and filling the land with song; salmon were entering the streams and lakes and were appearing in good numbers in the bays; even the mosquitoes and sand flies were making their presence known. The snow had gone except on the tops of the hills; the lakes had been free from ice since early in February; streams were very clear and at their normal flow.

But in the immediate effect of this eruption, these things were laid waste and made hideous and appalling by the mantle of ashes which fell over them. Trees were loaded to the breaking point and the plants were in great part buried. With the possible exception of some of the small rodents, mammals were not seriously affected, only as it may have been more difficult to find food. But many of the smaller birds perished, while the living members of their species had flown to other regions. Only the eagles, ravens, magpies, gulls, and ptarmigans remained to the end in the face of destruction to their nests and young. Half-grown ravens were found dead where they had fallen from the nest, driven therefrom no doubt by hunger or fright; and it seems probable that in like manner death came to all other young birds unable to fly. As the slightest interference or molestation is often enough to cause birds to forsake their nests, there is every reason to presume that all nests, whether built on the ground or in the trees and bushes, were abandoned under the shower of sand. Of all the birds on the island, the ptarmigans probably suffered greatest loss, for they alone were incapable of flight to regions beyond the stricken zone; and as they live, feed, and nest exclusively on the ground, and inhabit the higher untimbered sections of the southern end of the island where the greatest quantity of ashes fell, their suffering must have been acute and little hope can be entertained that all survived. The food supply was cut off, nests and young destroyed, and an endless field of dry ashes lay about them. The condition of the birds, however, did not more than equal the plight of the fish in the streams.

Many of the streams were occupied by spawning steelheads, and those lake-fed were filled with ascending red salmon. These fish, as long as they had strength to stand against the current, could not be moved by the turbid waters from obedience to the commands of nature; but as the water became almost liquid mud their gills were loaded with sediment until suffocation resulted and they were finally washed to the bays with the sand and mud. Fortunately the run of salmon had just begun and therefore the loss of fish for the whole island was small. An approximate loss of 4,000 red salmon resulted in the Letnik stream, where the fish were being held for cultural purposes. At the other fisheries the loss was negligible, but few fish having entered the streams.

Ocean waters, except where affected by streams, were only slightly discolored for a few days, and it did not seem possible that in waters of considerable depth there could be any great upsetting of natural conditions. It appears, however, that the change was great enough to cause the cod to abandon their banks; where heretofore they could be had in abundance none can now be taken.

Another most striking and noteworthy effect of this eruption on marine creatures was the destruction of sea urchins, which in large numbers were cast upon the shores or drifted about the bays and straits. There was also a considerable loss of mollusks, particularly clams and cockles, which is hard to understand in view of the fact that their native element is mud.

In order to determine, if possible, what had been the effect of the ashes upon the food supply of the fishes in fresh water, an examination was made of all the principal water systems of the island. It was found on the eastern half, which is heavily wooded with spruce and less mountainous than the western side, that the lakes and streams had not been choked with ashes and little wash from the surrounding country had taken place. In these waters, especially the lake and streams of Little Afognak, the supply of mollusks and worms was adequate and some larval forms were collected. No crustaceans could be found.

The streams and lakes of the west side of the island are almost destitute of fish food. In this more mountainous section where the fall of ashes was heavy, the streams were literally choked with sand and mud; old channels were obliterated and the water spread in a thin sheet over the meadows. Those discharging into lakes formed large sand bars at their mouths, sometimes several feet in depth and of considerable area.

In the examination of lakes, all operations were conducted from the shore and with much difficulty, there being such an accumulation of ashes in the lakes that the net was often filled and wrecked by overloading. But when successfully landed, the search through the sand for living creatures was often fruitless, only a few mollusks appearing as the result of efforts made on Paramanoff Lake and its streams. This region forms one of the most barren fields, not alone of small organisms but fish life as well, that can be found on the island. By seining in the creeks with the plankton net two small trout were caught, one about 3 inches long, the other about 5. In the stomach of the smaller fish were eight minute worms, some sand and vegetable matter; the stomach of the larger specimen contained one maggot and three salmon eggs.

As a water system destitute of fish food, the Malena Lakes and streams comprise an area which is almost the equal of Paramanoff. Not taking into account the salmon that had entered the lakes to spawn, the only fish found in the upper lake were sticklebacks. In the lower lake, sticklebacks and salmon fingerlings were observed, and a mixed collection of about 40 specimens was made in order to ascertain by examination of stomach contents what food these fish were finding. Only juices were found in the stomachs of the salmon, and that was also very generally the case with the sticklebacks, though one specimen had eaten a small mollusk, and two or three others had found a few small worms. All of the fish were in a much emaciated condition, which alone would seem sufficient evidence of the scarcity of food.

Better conditions were found in the Letnik Lake region where the small streams had generally cleaned themselves of ashes by the end of August. From the gravel bottoms of these streams many mollusks and worms were collected. The larger streams were still gorged with sand, therefore it seems probable that whatever fish food may have abounded in them had been completely destroyed, and this view was confirmed by the unsuccessful efforts to find living organisms within those areas. In the shoal places of the lake, mollusks, large and small, were present in fair abundance, so also were small bugs and worms, but in the deeper waters dredgings were without results. Specimens of young fish were collected in the small streams and lake. Those from streams were strong and well fed, but the lake fish were lean and weak.

These investigations, however, offer no convincing proof that any great destruction of fish food resulted as a consequence of the eruption, though they may show an impoverished condition of the waters. Unfortunately nothing is known of the scarcity or abundance of fish food in these lakes and streams before the volcanic eruption. Data of that kind would now be valuable for purposes of comparison, for only in that way could the destruction be determined. The almost total absence of mosquitoes and sand flies during the summer is attributed to the immediate effect of the ashes upon their larval forms and breeding places; and this condition, coupled with the fact that these insects had been veritable pests in past summers, establishes conclusively that the weaker forms of life were destroyed in large numbers.

*Later effects.*—For several days after the eruption, the fate of vegetation on the southern part of the island could not be told. It seemed certain that the greater part of it could never penetrate or push its way through 10 inches of compact ash; the danger was wholly one of being smothered, as the ash possessed no inherent properties that would be detrimental to plant life. In the course of a few days, some of the more robust plants were able to throw off the weight of ash and continue their growth; but there was no general renewal of plant life until near the end of June, when the rains came and caused the hitherto unbroken surface to crack in all directions and break into small sections like parched clay. Through the interstices thus formed, plants made a remarkable growth, so that by the end of summer the hills and valleys were covered with a rank vegetation which, viewed from a distance, seemed barely less luxuriant than in previous seasons. Close examination, however, revealed the fact that this vegetation was made up almost exclusively of stout-stemmed plants, the most conspicuous members of the group being the hellebore, water hemlock, broad-leaved dock, and the fire-weed, which outnumbers all the other species.

But of all the plants, probably none will be as seriously affected as the mosses, not alone on account of their greater abundance but rather because of their delicacy. One species bears a berry which s an important food of the ptarmigan in the fall and early winter.

Associated with the mosses are the "marowskas" and cranberries, both of which are of some importance in that they form a part of the food supply of the people of the island. They were so nearly wiped out by the ash that none could be gathered this year.

The grasses suffered extensively on the southern end of the island; probably three-fourths of the crop was destroyed. This is an economic loss to the owners of cattle, for they have been unable to harvest sufficient hay to carry their stock through the winter. An abundant supply could be had from the northern end of the island where the grass was only slightly affected; but the people lack the means of transportation and, therefore, as available provender, it need be given no consideration.

If the destruction of plant life were expressed in figures, it would be fair to estimate that 70 per cent of the flora on the southern end of the island had been destroyed and that there was a gradual falling away to a loss of 20 per cent on the northern end.

The most amazing effect of the volcanic ash upon aquatic plants is shown by the retarded growth of the kelp on the reefs and rocks of the stricken region. Opinions differ as to the degree of injury. Many believe that the kelp is dead, and, as confirmation of their judgment, they point to its black and withered condition. But admitting that appearances strongly favor this view, it seems, nevertheless, too early to give unqualified endorsement thereto. The destruction of the kelp would mean an inestimable loss to the cattle, as it forms one of their staple foods during the winter and very materially helps out an inadequate supply of hay.

In the mountainous sections, the rains kept the streams and lakes very muddy, thus preventing or delaying the appearance of the salmon on the spawning grounds. About the middle of August so much ash was washed into the streams that several hundred spawning salmon perished in exactly the same manner as happened at the beginning of the eruption. It is an interesting evidence of the objectionable condition of these waters that many of the salmon would ascend the streams a short distance, and then return to the sea, repeating many times these erratic movements.

Of the ground-nesting birds, the ptarmigans are the most important and, perhaps, the ones most unlikely to nest in the ashes. Their nests are always carefully concealed in the dry grass and weeds of the open country or under the scrub spruce where the branches are close to the ground. All such places being covered with ashes, it seems improbable that any nests were built after the eruption, and this doubt is strengthened by the fact that no young birds were seen during the summer. On the other hand, the gulls resumed their nesting before the end of June, the ashes presenting no special hindrance to them, as they require very little material for nests. The number of ducks and small migratory birds breeding on the island was considerably less than usual.

Mammals in general were able to weather the distressing conditions, though at times they may have found it difficult to obtain food. In a way, the land otters are the most fortunate of these animals, for they can go to salt water for food when the fish are scarce in the lakes and streams.

*Probable future effects.*—The conditions of to-day do not warrant the assumption that the Kodiak group of islands has been permanently injured by this eruption, though a few years may be required for nature in her varied forms to work out a complete readjustment of these changes. Surely, the soil will be enriched and vegetation will renew itself until the islands are more luxuriantly clothed than ever; the wash of ashes from the hills will cease and the streams will eventually clear themselves. What enriches the soil may also enrich the waters by contributing to conditions that will bring about an increased supply of fish food which in turn means an increased supply of fish.

### Effects of Katmai Eruption Evident in 1913.

The question has been raised as to what effect the fine volcanic material from the 1912 eruption may have had upon the spawning grounds of the salmon in this region. It was found that in still lake waters not in proximity to the mouth of a stream this material settled and formed a very solid though thin layer of soil, but where it was deposited by the streams—often to a depth of several feet—it has the characteristics of quicksand and is extremely dangerous to cross. Such places have been used by only a small number of spawning salmon, and it may be safely asserted that they are now wholly unfit for the deposit of spawn. In the streams and unnamed creeks of the southern end of the island, very little of this material remains, and what little was found in the streams during the summer consisted almost entirely of sand, which can hardly be considered more injurious to the spawning beds than the ordinary sediment and slime so generally present in these streams, particularly those that are lake fed.

That the spawning beds were temporarily injured can not be denied, but the continual flow of water during the winter was sufficient to remove most of the objectionable material. This fact was demonstrated by the presence of an unusual number of young cohos in all streams this season. However, from examinations of streams and lakes at Seal Bay, Paramanoff, and Malena, it is believed that but comparatively few sockeyes ascended to the spawning grounds. These observations were made the latter part of July and early in August, after the run was practically over.

An examination of Letnik Stream was made from May to July during the migration of sockeye yearlings to determine the effect upon young salmon of the eruption of Katmai Volcano the year before. Collecting stations were established at the foot of the lake and at the head o the bay, about 2 miles below where the stream enters salt water. The number of young salmon collected was so very meager as to justify the conclusion that there had been a heavy loss, due no doubt to the fact that only a few adult salmon reached the spawning grounds the previous season when the eruption occurred. Tests made on Letnik Lake showed that there is now an ample supply of the small form of crustacean upon which young salmon feed.

The project of stocking Afognak Island with reindeer was not consummated this year, delay being deemed desirable to permit of a better growth of moss following its destruction by the volcanic eruption of 1912. Under normal conditions, Afognak Island should be well adapted to the propagation of reindeer, and their introduction will, it is believed, prove a pronounced and direct boon to the natives, as well as an indirect benefit to the other inhabitants of the island.

### Dolly Varden Trout.

A noteworthy catch of Dolly Varden trout was made at Paramanoff, where 1,300 were taken in two seine hauls about July 20. These fish weighed approximately 1½ pounds each and had an average length of about 16 inches. The other fisheries produced a few Dolly Vardens of the same average size, and in some instances, particularly at Malena, examples were taken weighing some 10 pounds each. It is a peculiar circumstance that these larger fishes are rarely seen in the streams and lakes, though the smaller ones are quite numerous.

Ever since the inception of fish-cultural work on Letnik Lake, Dolly Varden trout have been very abundant, and that fact has presented a serious problem in connection with the proper disposition of hatchery fry. Rearing to the fingerling stage so far as circumstances and facilities will permit is the solution of the difficulty. In the spring of 1910 it was observed that the hatchery stream was literally teeming with Dolly Varden trout of uniform size and weight. The average length was from 10 to 12 inches and the weight from 8 to 10 ounces. An examination of the stomachs of many taken in seines revealed the fact that they were gorged with salmon fry, and their excellent condition was added proof that they had been well fed during the winter. In October and November, 1911, thousands of Dolly Vardens gathered at the outlet of the flume discharging from the hatchery and were taken by seines, as many as a small dory full at one haul. These fish were of all sizes, but the average length was about 10 inches and weight a third of a pound. Throughout the winter wire traps were set for them, and in this manner several hundred more were destroyed.

The construction of barricades to prevent the incoming of Dolly Vardens from the sea is of doubtful value. From observations of Letnik stream it would seem that there is more of a movement from the lake to the sea than from the sea to the lake. Since Dolly Vardens are not known to spawn in salt or brackish water, their presence there can be accounted for only by the obvious fact that they descended from fresh water. Thus a barricade would have the effect of retaining the undesirable Dolly Vardens in the waters of the lake. During the past summer while an examination of Letnik stream with reference to the migration of young salmon was being made, the presence of many Dolly Vardens above the rack was noted, but none could be seen below it. Some approached too near the rack and were drawn between the slats, where they died. From May 26 to June 9 more than 500 were thus destroyed.

The extermination or at least great destruction of Dolly Vardens in Letnik Lake can probably be best accomplished by netting them at the mouths of the streams where they congregate during the spawning season in September and October. It is reported that at the Afognak hatchery this year Dolly Varden trout have been notably scarce. This may be due either to the seining operations in the fall of 1911 or the volcanic eruption in 1912, or to both causes.

## HATCHERIES.

### EXTENT OF OPERATIONS.

Seven salmon hatcheries were operated in Alaska during the season of 1913. Of these, two are operated by the Government and five by private companies. The two Federal stations are located at Yes Lake and on Afognak Island. There were also two small temporary experimental field stations operated by the Government, one at Eagle Lake and the other at Uganik Lake, both on Kodiak Island. Of the private establishments, the Alaska Packers Association has one on Naha stream and another on Karluk River; the Northwestern Fisheries Co. has plants at Quadra Lake and at Hetta Lake, while the North Pacific Trading & Packing Co. and the North Alaska Salmon Co. operate jointly a hatchery at Klawak.

The largest of the hatcheries is the Fortmann plant on Naha stream, with a normal capacity of 110,000,000 red salmon eggs. The Government stations are each adapted to the handling of about 72,000,000 eggs. The Karluk hatchery can handle comfortably 48,000,000, Quadra 17,000,000, Hetta 12,000,000, and Klawak 10,000,000. These figures represent normal capacity, and if necessary a very material increase can be made by putting more eggs in each basket. The basket of usual size holds 60,000 red salmon eggs, though 70,000 or more may be crowded in if urgently required. In the latter event they are more difficult of manipulation. The total hatchery capacity in Alaska is now approximately 350,000,000 red salmon eggs per year. There has been no change in the number of permanent stations operated since the completion of the Government hatchery at Afognak in 1908.

The season of 1912–13 resulted in a collection of 167,189,470 red salmon eggs, from which 150,970,355 fry were released. This was a pronounced falling off from the total of 240,597,800 fry released the previous season. The season of 1913–14 is still less productive, as the total number of red salmon eggs collected was only about 134,000,000.

Following is a table of hatchery operations for the 1913 season:

OPERATIONS OF ALASKA HATCHERIES IN 1913.

| Stations. | Red or sockeye salmon eggs taken in 1912. | Red or sockeye salmon fry liberated, 1912–13. | Per cent of loss. | Red or sockeye salmon eggs taken in 1913. |
|---|---|---|---|---|
| Yes Lake | 66,125,000 | 60,422,100 | 5.5 | [1] 49,050,000 |
| Afognak | 14,689,470 | 12,551,100 | 14.6 | [2] 10,989,000 |
| Eagle Lake | | | | 2,180,000 |
| Uganik Lake | | | | 1,970,000 |
| Fortmann (Naha) | 23,160,000 | 20,800,000 | 10.1 | 9,480,000 |
| Karluk | 45,600,000 | 41,803,155 | 8.3 | 34,629,160 |
| Quadra | 10,000,000 | 8,127,000 | 18.7 | 18,400,000 |
| Hetta | 3,780,000 | [3] 3,592,000 | 4.9 | [4] 4,082,000 |
| Klawak | 3,835,000 | 3,675,000 | 4.1 | 3,645,000 |
| Total | 167,189,470 | 150,970,355 | | 134,425,160 |

[1] Also 5,280,000 humpback eggs taken at Ketchikan substation.
[2] A collection of 13,900,000 humpback eggs also made.
[3] Includes 542,000 fry planted after July 1, 1913, but here included to show product of 1912 take of eggs.
[4] Last report received; later figures will show slightly increased take.

NOTE.—Of the Yes Bay collections, 2,000,000 sockeye eggs were shipped in the fall of 1912, also again in 1913, to the Oregon Fish Commission

### HATCHERY REBATES.

A credit upon the Federal fishery tax in Alaska is allowed operators of private salmon hatcheries at the rate of 10 cases of canned salmon, or the tax equivalent of 40 cents for every thousand red or king salmon fry liberated. This is an equitable rate, as it has been found that year in and year out it costs on the average nearly 40 cents to produce 1,000 healthy red salmon fry at the private hatcheries. The rebate system, however, has met with some disfavor at the hands of Alaska people, and apparently the time will come when all private hatcheries in Alaska will be taken over by the Government, fair compensation therefor being allowed present owners. This plan meets with the approval both of the Bureau of Fisheries and the owners of hatcheries, and legislation by Congress on the subject may soon be expected.

It is now provided by law that returns of the number of fry released must be made under oath by private salmon hatchery operators for each year ending June 30. The following table shows the rebate certificates allowable for the fiscal year ended June 30, 1913:

REBATES CREDITED TO PRIVATE SALMON HATCHERIES DURING FISCAL YEAR ENDED JUNE 30, 1913.[1]

| Owners. | Location. | Red salmon fry liberated. | Rebate due. |
|---|---|---|---|
| Alaska Packers Association | Naha stream | 20,800,000 | $8,320 |
| Do | Karluk River | 41,803,155 | 16,721 |
| Northwestern Fisheries Co | Quadra Lake | 8,127,000 | 3,250 |
| Do | Hetta Lake | 3,592,000 | 1,436 |
| North Pacific Trading & Packing Co., and North Alaska Salmon Co. | Klawak Lake | 3,675,000 | 1,470 |
| Total | | 77,997,155 | 31,197 |

[1] In the case of the hatcheries where the seasonal distribution of fry is not completed before July 1, the remaining fry are shown in the subsequent fiscal year's report.

### HATCHERY INSPECTION.

Instead of the customary annual inspection of the private hatcheries in Alaska, this year representatives of the Bureau of Fisheries visited these plants two and in some instances three times during the season. This is in line with the new policy of keeping in closer touch with the work as conducted at these stations, although the general annual inspection heretofore made, together with other sources of information, sufficed to check up very closely the output and activities of each hatchery.

#### YES BAY.

During the 1912–13 season at the Yes Bay station, 66,125,000 red salmon eggs were taken. This was a falling off of 5,875,000 from the previous season's take. It is estimated that the take would have been 75,000,000 had not a number of spawning salmon escaped by reason of high water. Plants aggregating 60,422,100 fry were made during the first six months of the year 1913. On October 22, 1912, a shipment of 2,000,000 eggs was made to the Oregon Fish Commission. It is through the month of September that practically all of the eggs are taken at Yes Bay. During the 1913–14 season the aggregate number of red salmon eggs secured was 49,050,000. Of this year's collection, a shipment of 2,000,000 eggs was also made in October to the Oregon Fish Commission.

The salt solution was again used this season very successfully in removing any dead eggs occurring in the baskets, thus effecting a great saving in labor as compared with the old process of hand picking. Most of the eggs were run through the solution during the month of November. The eggs taken during the early part of the season when the water is warmer begin to hatch when about 80 days old, while the eggs taken near the end of the season when the water is cooler do not begin to hatch until when about 140 days old. The mean temperature of the water during the period of incubation at the Yes Bay station averages about as follows: September, $51\frac{2}{3}°$; October, $46\frac{1}{2}°$; November, $38\frac{1}{2}°$; December, $35\frac{1}{3}°$; January, $32\frac{1}{4}°$; February, $33\frac{2}{5}°$, and March, 33° F.

Restrictions of commercial fishing operations on Yes Bay were enforced this year as usual. The purpose of this is to permit a sufficient escape of spawning salmon to supply the needs of the hatchery. In line with the present-day policy to feed young salmon before planting, several ponds have been in process of construction with the close of the calendar year at the Yes Bay station. Also last year 160 fry troughs were constructed and placed in position under the hatching troughs for the purpose of holding a larger number of young fish in the hatchery.

Early in the year two experimental troughs were constructed, one with a very smooth bottom while the other was rather rough. These were painted with asphaltum and fry were placed in each to ascertain any possible difference that the condition of the bottom might have upon them. It developed that in the case of the smooth-bottomed trough the fry remained near the head and but few died, while in the rough-bottomed trough the fry seemed uneasy and kept working down to the foot screen. The loss in this trough was much greater than in the one with the smooth bottom. This experiment seems to show the necessity of having a smooth bottom in all troughs containing fry.

For the purpose of collecting humpback eggs, a temporary field station was installed at Ketchikan. New troughs with a capacity of 6,000,000 eggs were built and baskets were transferred from the Yes Bay station. The water supply came from a near-by power flume.

Operations were confined chiefly to the month of September, when collections aggregated 5,280,000 humpback eggs.

During the month of May, 1913, observations were made in a limited way by the superintendent of the Yes Bay station for the purpose of obtaining information as to the number of young sockeye salmon passing into Yes Bay. At 6 o'clock on the evening of May 4 a small net was placed in Yes River, just above tide water, at a point near the cannery. One end of the net was made fast ashore and the other end was attached to a large rock only 3 feet out from the same shore. At 8 o'clock on the following morning this small section of net contained 1,310 yearling sockeye salmon, averaging 3 inches in length. The river at this point is about 20 feet wide. The next night a net was set near the foot of the lake where the river at the time was about 50 feet wide. The net in this instance covered about 10 feet of the stream. It should be noted that the lead line was about a foot from the bottom. The next morning 575 yearling sockeye salmon were taken from the net. On May 16 this net was again set near the foot of the lake, but owing to very high water only 50 yearling sockeyes were caught. All fish taken in the three sets were in excellent condition.

The fact that a small piece of net only 3 feet long, set in a stream 20 feet wide, will catch 1,310 sockeye yearlings in one night would seem to be very good evidence that the aggregate number of young salmon thus moving to the sea during the entire period of the spring migration is of highly satisfactory proportions. That the Yes Bay hatchery is a potent factor in this result almost goes without saying, as practically all of the sockeyes passing into Yes Lake are spawned at the hatchery.

TABLE OF THERMAL RECORDS AT YES BAY STATION.

| Date. | Air. | | Water. | | Rain. | Snow. |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Maximum. | Minimum. | | |
| 1912. | | | | | *Inches.* | *Inches.* |
| July | 79 | 54 | 64 | 50 | 4.41 | .......... |
| August | 73 | 51 | 61 | 49 | 5.15 | .......... |
| September | 68 | 32 | 59 | 47 | 14.99 | .......... |
| October | 53 | 33 | 49 | 42 | 19.01 | .......... |
| November | 49 | 25 | 44 | 35 | 14.55 | 1.00 |
| December | 49 | 25 | 39 | 33 | 12.84 | 45.40 |
| 1913. | | | | | | |
| January | 38 | −2 | 34 | 32 | 4.78 | 64.70 |
| February | 38 | 18 | 34 | 32 | 6.57 | 5.95 |
| March | 42 | 12 | 36 | 32 | 7.37 | 7.35 |
| April | 53 | 33 | 41 | 32 | 7.79 | 5.40 |
| May | 61 | 37 | 41 | 34 | [illegible].42 | .......... |
| June | 70 | 44 | 50 | 38 | 2.94 | .......... |
| Total | .......... | .......... | .......... | .......... | 109.82 | 129.80 |

### Afognak.

At the Afognak station during 1912 the take of red salmon eggs numbered 14,689,470. In addition, 3,271,740 humpback eggs were taken. Plants of sockeye fry made principally during February and March, 1913, aggregated 12,551,100. The loss during the period of incubation was 14½ per cent. So much trouble was caused by heavy deposits of fine sediment in the fry troughs that it was deemed best to plant the young fish early in the season at places about the lake where the streams did not wash in quantities of ash. The take of eggs was greatly lessened by the loss of spawning fish following the fall of ash from the Katmai volcanic eruption June 6 to 9, 1912. This same influence has undoubtedly been responsible in considerable measure for the lessened take during 1913, when but 10,989,000 sockeye eggs were obtained. The take of humpback eggs was larger, numbering 13,900,000. While the propagation of sockeye salmon is more to be desired when spawning fish are available, there is nevertheless a very good field in Alaska for the propagation of humpbacks. It has been shown that the propagation of cohos is not advisable, at least in conjunction with sockeye operations, as many of the young cohos remain in fresh water for a year and prey upon the sockeyes. The humpbacks, however, go to sea soon after hatching.

No fish-cultural operations were undertaken at Malena Lake this year, as an inspection during the month of August disclosed that the spawning creek at the head of the upper lake was almost filled with volcanic ash.

### Eagle Lake.

With a view to expanding fish-cultural work in the Afognak-Kodiak region, experimental operations were undertaken this year under direction of the superintendent of the Afognak station at Eagle Lake, which is a few miles from Eagle Harbor on the south side of Kodiak Island, and about 60 miles from Afognak. A barrier was put across the river a short distance below the outlet of Eagle Lake in order to make an accurate count of the number of salmon entering its waters. As a result, it was ascertained that from July 1 to August 12 a total of 5,416 sockeyes and 1,811 humpback salmon passed into the lake. Temporary hatching troughs were set up, and from August 14 to September 1 a take of 2,180,000 sockeye eggs was made. The eggs were cared for until well eyed and with the approach of cold weather, which necessitated discontinuance of this experimental work, the eggs were planted at appropriate places in the lake.

During the course of the season's operations upwards of 5,000 Dolly Varden trout were destroyed.

Under present conditions it is not believed that Eagle Lake offers a suitable place for fish-cultural operations. The water is impregnated with volcanic ash, the result of the Katmai eruption of 1912, and as a result successful hatchery operations on an appropriate scale are practically impossible, or at least appear to be until such time as the ashes have become incorporated with soil and erosion shall have ceased. The new growth of vegetation is improving conditions in this regard.

### UGANIK LAKE.

Experimental hatchery operations were also conducted this season as an adjunct to the Afognak work at Uganik Lake, which place is about 40 miles from Afognak.

At the beginning of the season a barrier was put across the river between the lake and the bay in an effort to get an accurate count of the fish entering the lake, but on account of swift current and for other reasons it was impossible to maintain the barrier. During the period from August 7 to September 8 a total of 1,970,000 sockeye eggs were taken and placed in temporary hatching troughs. With the approach of cold weather, when the eggs were well eyed, they were planted in gravel in suitable lagoons of the lake.

The result of the experiment at Uganik seems to justify the conclusion that a suitable site is afforded for a moderate-sized salmon hatchery. The sockeyes at Uganik have long been recognized for their superior size. It is reported that about 48,000 sockeyes were taken by commercial fishing interests this season from Uganuk Bay.

### FORTMANN.

The Fortmann hatchery of the Alaska Packers' Association is located on Heckman Lake of the Naha system, 8 miles above Loring, in southeast Alaska. It is the largest salmon hatchery, public or private, in the world, having a capacity of upwards of 110,000,000 red-salmon eggs. During the 1912–13 egg collecting season 23,160,000 eggs of this species were taken, from which during 1913 a total of 20,800,000 young fish were liberated, the loss being a little over 10 per cent. The fry passed from the hatching troughs into nursery ponds, where they were fed on fish prepared for the purpose, and after they had attained a growth which enabled them to move about in strong and vigorous fashion, they were allowed to pass from the ponds into the Naha stream system of lakes and connecting waters, most of them to remain there through one winter before going to sea.

The egg-taking season of 1913, which extended from August 24 to October 16, resulted in the collection of but 9,480,000 red-salmon eggs. This is the poorest take in the 13 years the station has been operated. The situation simply was that the run of breeding salmon did not materialize, and bore out the fishing records as well as the returns at other hatcheries, Quadra excepted, that southeast Alaska had an off year for red salmon. At Quadra, about 60 miles south of the Fortmann hatchery, the take of 18,400,000 eggs was better than ever before.

On the theory that most of the red salmon in Alaska return when 5 years old, some interesting comparisons are possible by going back a few years in the record of eggs taken at the Fortmann hatchery. In 1906 the take was 105,000,000 eggs, while five years later in 1911 it was 107,000,000. The 1907 take was 41,000,000 and that of 1912 was 23,000,000. In 1908 the take was 24,000,000 and 1913 produced but 9,000,000 eggs. Round figures only are given.

Thus it will be seen that there is a much more pronounced corollary in the five-year cycles than in the four-year periods. If the five-year cycle theory is a correct index, as it seems to be, a light take was to be expected for 1913, since 1908 was a poor season, comparatively speaking. Carrying this reasoning to future years, 1914 ought to be better, as the 1909 take was 53,000,000; then might come a poorer take in 1915, as the 1910 collection dropped to 34,000,000. Then in 1916 should come a heavy run, for in 1911, five years before, the take was 107,000,000, while in 1906, another five-year cycle back, the take was 105,000,000. These figures certainly form the basis for interesting speculation, both as to the take of eggs at the hatcheries and the runs of red salmon that may be anticipated by the cannerymen.

### KARLUK.

At the Karluk hatchery of the Alaska Packers' Association, located on Kodiak Island, the season of 1912–13 was productive of 45,600,000 red-salmon eggs, from which in 1913 a total of 41,803,155 free-swimming fry were liberated in the Karluk River. The loss was thus $8\frac{1}{3}$ per cent. The 1913–14 season resulted in a take of 34,629,160 red-salmon eggs, the period of collection extending from June 21 to October 11. Each female produced on the average 3,109 eggs.

### QUADRA.

Egg taking for the season of 1912–13 at the Quadra Lake hatchery began August 16 and was completed November 12, 1912. From 3,135 females there were obtained 10,000,000 eggs, an average of 3,190 per fish. The eggs eyed in from 42 to 55 days and the hatching period varied from 111 to 135 days. Water temperatures ranged between 36° and 42° F. From the take of 10,000,000 eggs a total of 8,127,000 fry resulted. The first plant occurred December 7 and the last April 7. A total of 7,000,000 fry were liberated in the three ponds adjoining the hatchery, 897,000 went into the hatchery creek and the remaining 230,000 were carried overland to a stream tributary to Marten Arm.

An interesting fact in connection with the take of eggs is that out of the 2,145,000 eggs taken from August 16 to September 2, only

1,000,000 fry resulted, a loss of 56 per cent. These eggs were taken by the old process, and were allowed to stand in pans too long before washing up. They were also subject to shock from concussion during the very tender period of an hour or so while water hardening.

From September 3 on to the end of the season the remaining 7,855,000 eggs were taken by the modified process of incision and immediate washing, and there was a loss of but 720,000 or approximately 9 per cent. This is a positive demonstration of the pronounced value of the new method of egg taking as compared with the old.

Finishing touches, including painting, have been made to the new hatchery building erected in June, 1912, upon the site of the old building. The new structure is 87 feet long and 24 feet wide, has 10-foot walls, and is provided with a gable roof. The building is 6 feet wider and a few feet longer than the old structure, and is devoted entirely to hatchery work. In the old building a section of 12 feet at one end was partitioned off as quarters for employees. A separate building, 16 by 24 feet, has since been erected for use as a dwelling. The equipment of the hatchery, which formerly consisted of 30 troughs of two lengths, has been supplemented by the construction of 20 additional troughs. The normal capacity of the station is now about 17,000,000 red-salmon eggs. Another fry pond has been in process of construction this summer.

The take of eggs for the 1913–14 season began August 11, and resulted in a collection of 18,400,000 eggs. This is by far the largest number in the history of the station. When egg taking was discontinued because of lack of further hatchery space it was estimated that there were still fish enough in the lake for 4,000,000 eggs. The hatchery barrier was removed and these fish were allowed to go up stream to spawn naturally.

Judging by fishing operations, also by egg collections at the Fortmann and Yes Bay stations, the run of red salmon in southeast Alaska was lighter than usual. It would seem that the explanation of the very heavy take at the Quadra hatchery lies in the fact that fishing operations off the stream at the foot of the lake were prosecuted less vigorously this season than heretofore and more spawning fish got up to the lake. This suggests the urgent need of caution in not fishing too close to the stream mouth in future.

### Hetta.

During the period from September 1 to December 14, 1912, a take of 3,780,000 red-salmon eggs was made at the Hetta hatchery. A total of 1,265 females were handled for an average of slightly under 3,000 eggs each. The eggs were of very good quality, the loss of 188,000 running under 5 per cent. Up-to-date methods of fish culture were followed. The first fry were planted March 1 and the last July 16, 1913, the total number liberated being 3,592,000. The season at Hetta is long drawn out by reason of the late take in the fall, and cold water during the winter which retards development.

Egg taking for the 1913-14 season began August 8, which is the earliest take in the history of the station, and at last reports 4,082,000 red salmon eggs had been secured. The take of eggs at Hetta has dwindled considerably during the last few years, and the cause is ascribed to overfishing of Hetta Inlet.

It has been suggested that fishing should be prohibited inside of a line from Graveyard Point to Moses Point, thus allowing many more spawning salmon to get up to the lake. The area mentioned is not more than 500 yards across at the widest place, and it is here that the fish school preparatory to ascending the stream. As high as 14 purse seines were operating at one time this season in the region mentioned and just outside. An examination of the records shows that the catch of red salmon in this section in 1911 was about 51,000, in 1912 it was 60,000, and in 1913 it numbered approximately 50,000. The keen competition of so many different crews means a continuance of fishing throughout the long hours of daylight and its conduct in a manner that will put the utmost number of fish into the boats. Distance restrictions are doubtless worked to the fullest limit of the law. Indeed it would be very strange if there were not some who were not overly scrupulous in this regard. In any event the conformation of the bay which receives the stream at Hetta permits the laying out of seines in a manner not violating the law and yet effectually deterring any considerable number of fish from reaching the stream.

It is believed that while the statistics of the catch of sockeyes for southeast Alaska indicate a continuance of the supply, these figures really point to increased activity in the pursuit and that in small streams like the one at Hetta where an active seine fishery is conducted up to the 100-yard limit, there must eventually be depletion.

To insure a good supply of salmon at the Hetta hatchery there should be at least a 500-yard zone off the stream mouth where no commercial fishing shall take place. It has been stated by A. J. Young, superintendent of the hatchery, that if all commercial fishing were prohibited off Hetta Inlet up to July 1 of each season, the June run of sockeyes would thus be permitted to reach the lake and a good take of eggs would follow. Mr. Young's opinion is well worth careful consideration, as he has long been familiar with conditions in the region, both as a commercial fisherman and hatchery employee.

The improvements of a fixed character begun in 1912 were completed this year. The old hatchery building was torn down and a new building was erected on the lake front near the old site. The new building is 66 feet long, 34 feet wide, and has 10 foot walls. It has a shingled gable roof and is lighted by 12 windows. The same troughs and such lumber from the old building as could be utilized were put into the new building. Water from the spring which supplies the hatchery is conveyed through a new 4-inch log pipe line 310 feet in length. The hatchery is heated by two large stoves. If required, there is ample floor space in the new building for the installation of a number of additional hatching troughs. A new dwelling for employees has also been erected. This is a single-story building 20 by 24 feet, containing three rooms. Both new buildings have been neatly painted. A notable improvement under way late this season is a large pond in which fry may be placed and fed before final liberation. Heretofore all plants have been of fry. The construction of this pond is in line with modern ideas of rearing young salmon before planting.

### KLAWAK.

During the 1912-13 season at Klawak, egg taking began August 16 and was completed September 29, 1912. A total of 3,835,000 eggs were taken from 1,434 female red salmon, or an average of 2,675 per fish. The eggs were taken by the modern method of incision and proved to be of very good quality, the loss during incubation being 160,000 or only a little more than 4 per cent. The first plant of fry occurred November 28, 1912, and the last February 4, 1913. The total of the plants was 3,675,000. The approximate mean temperatures of the hatchery water supply during the season were as follows: August, 51° F.; September, 50°; October, 46°; November, 40°; December, 38¾°, January, 38°, and February, 38°.

Heretofore the output of the hatchery has been liberated in the form of fry, but this summer a pond 16 by 24 feet was constructed and in future a part of the output at least will be fed and the fish will be released when 2 inches or so in length. Additional pond space is required here as at all of the Alaska stations to give sufficient room for the rearing of young salmon.

The take of red-salmon eggs during 1913-14 season at Klawak numbered 3,645,000. Egg-taking operations were confined to the months of August and September, when all told 1,215 fish were stripped.

### ETOLIN ISLAND.

The hatchery, which was operated for 14 years as a private enterprise by Capt. John C. Callbreath, on waters tributary to McHenry Inlet, has been closed since 1906. However, up to the present season, it has been the custom to lift over the barricade on the stream all red salmon which endeavored to reach the spawning grounds above. Capt. Callbreath was a strong believer in the parent stream theory, and thought to build up a strong run of reds by excluding and destroying the humpback salmon, which species also ascended to the dam in considerable numbers. He thought that the destruction of the humpbacks would mean more food for the young red salmon during their sojourn in the lake. Recent observations have clearly demonstrated the absurdity of the view that destroying humpback salmon will conserve the fry food in a lake. The humpback fry do not feed in fresh water, but go to sea as soon as able to swim. The destruction of this fish can accomplish no useful purpose, and is a plain violation of the wanton waste section of the law.

Upon the assumption that Capt. Callbreath's practice of destroying humpbacks during the last few years arose from a misunderstanding both of the habits of the salmon and of supposed private rights acquired by the maintenance of a hatchery during earlier years on the stream in question, the Bureau invited the citation of any documentary proof of a grant or privilege exempting the stream from the operation of the general fisheries law, under which law the maintenance of a barricade is a punishable offense, as is also the wanton waste of salmon. No such proof of exemption being forthcoming, the barricade in the stream was destroyed this season, and the waters assumed the status of other open streams in southeast Alaska. The last salmon were put over the barricade in 1912, and numbered 2,435 adult sockeyes, of which 1,282 were males and 1,153 females.

The efforts of Capt. Callbreath afford a most interesting sidelight on the history of the Alaska salmon fisheries, and since their value from a scientific viewpoint is considerable, it is the more unfortunate that the heavy expenditure of time and money involved should have been proportionately so unprofitable in a practical way.

### HATCHERY METHODS.

Within the last few years there have been certain radical departures in the methods of spawn taking. To insure thorough understanding of these, it seems appropriate to bring the matter to attention at this time.

Each ripe female salmon should be killed by a blow on the head, following which an incision should be made in the abdominal wall from the pectoral fins to the region of the vent. The eggs will flow in a mass into the spawning pan placed beneath. Immediately after being fertilized they should be washed by immersing in the stream and pouring the water off. Repeating the process two or at most three times will be sufficient. It is entirely unnecessary to have the eggs remain in milt and water any longer than is required in the washing process following immediately after the application of the milt.

After washing, each pan of eggs should be poured into a bucket partly filled with water and placed in the bed of the stream where the water is several inches deep, so that the temperature in the bucket will be the same as that of the stream. After filling the bucket about half full of eggs, it should be allowed to remain undisturbed for about an hour, or until such time as the eggs have become fully water hardened and are entirely separated. While standing in the bucket the eggs will absorb sufficient water to increase their size about 40 per cent, hence the buckets must not be filled over half full.

During this period of absorption the eggs are extremely sensitive and must remain absolutely undisturbed. The process of handling eggs by the improved methods now in vogue is described in some detail upon pages 80–82 of the Alaska Fisheries Report for 1911.

In connection with hatchery operations, attention is again called to the fact that greater care ought to be exercised in planting young fish.

A feeling has often prevailed that responsibility at the hatchery ceases when the fish are ready for planting. Greater caution and care, and more intelligent thought should be devoted to the selection of suitable places for the release of the hatchery product. Rather than promiscuous dumping of the fish in open lake waters, it would be much better to select protected tributary streams wherein to release them, guarding, however, against places infested with trout or other destructive agents. No fish culturist would think of having even one Dolly Varden trout in the rearing pond or hatching trough containing young salmon, in fact every means at his command would be exercised to remove the trout; yet the next day, perhaps, he will complacently carry out several hundred thousand fine young salmon and unhesitatingly dump them into waters where trout abound, often making no effort to destroy a single one of the trout.

Setting gill nets off the mouths of streams wherein plants are made is a good way to destroy trout. On every lake where fish-cultural operations are conducted, gill nets or suitable forms of traps ought to be in the water every month of the year—even set beneath the ice—to catch Dolly Varden or other species of trout. By this means thousands of young salmon will be saved.

Hatchery work is highly perfected up to the time of planting, but there is room for improvement in the latter operation. This matter was referred to more fully in the Alaska Fisheries Report for 1911, pages 86 to 88.

## NEED OF ADDITIONAL HATCHERIES.

Hatcheries have done much good in the way of preserving the salmon industry in the face of heavy fishing. No one can state definitely what would have happened had there been no fish-cultural effort, but considering the great saving over nature's method it seems indisputable that there has been a proportionately increased production of young fish, the result of artificial propagation. A tendency has existed, however, in some quarters to consider hatcheries as a cure-all for every evil, past, present, or future. But it is only reasonable to say that along with hatcheries must go a proper regulation of fishing, else benefits are to a greater or less degree annulled.

The two Government and five private hatcheries in Alaska are doing good work even in the face of an ever-increasing commercial demand for red salmon. Recent advances in the science of salmon culture, including the planting of fingerlings rather than fry, will make hatchery work still more helpful. Alaska now needs at least five additional hatcheries, two in the Bristol Bay region, one in the Chignik section, and at least two more in southeast Alaska—one perhaps in the vicinity of Sitka and the other on the Chilkoot.

## GENERAL STATISTICS OF THE ALASKA FISHERIES FOR 1913.

The total investment in the Alaska fisheries in 1913 was $37,047,305, a decrease of $1,216,152 from 1912. Approximately 85 per cent of the investment was in the salmon industry. The number of persons engaged in 1913 was 21,721 as compared with 24,263 in 1912, a decrease of 2,542 persons. The total value of the products in 1913 was $15,739,068 as against $18,877,480 in 1912, a decline of $3,138,412. The principal item in the decrease was canned salmon.

SUMMARY OF INVESTMENTS IN THE FISHERIES OF ALASKA IN 1913.

| Industries. | Southeast Alaska. | Central Alaska. | Western Alaska. | Total. |
|---|---|---|---|---|
| Salmon canning | $11,946,974 | $5,920,255 | $13,474,441 | $31,341,670 |
| Salmon pickling | 61,439 | 88,858 | 295,080 | 445,377 |
| Salmon mild curing | 1,107,911 | 36,360 | 21,595 | 1,165,866 |
| Herring fishery | 259,725 | 1,755 | | 261,480 |
| Halibut fishery | 2,360,025 | | | 2,360,025 |
| Cod fishery | | 581,107 | | 581,107 |
| Whale fishery | 891,780 | | | 891,780 |
| Total | 16,627,854 | 6,628,335 | 13,791,116 | 37,047,305 |

SUMMARY OF PERSONS ENGAGED IN THE FISHERIES OF ALASKA IN 1913.

| Races. | Southeast Alaska. | Central Alaska. | Western Alaska. | Total. |
|---|---|---|---|---|
| Whites | 5,750 | 2,026 | 4,116 | 11,892 |
| Natives | 2,949 | 598 | 617 | 4,164 |
| Japanese | 868 | 254 | 571 | 1,693 |
| Chinese | 875 | 328 | 858 | 2,061 |
| Miscellaneous | 338 | 316 | 1,257 | 1,911 |
| Total | 10,780 | 3,522 | 7,419 | 21,721 |

SUMMARY OF PRODUCTS OF THE ALASKA FISHERIES IN 1913.

| Products. | Quantity. | Value. | Products. | Quantity. | Value. |
|---|---|---|---|---|---|
| Salmon: | | | Cod.......pounds.. | 11,916,900 | $357,711 |
| Canned.......cases.. | 3,739,185 | $13,531,604 | Herring.......do.... | 10,413,926 | 106,105 |
| Mild-cured....pounds.. | 6,012,486 | 543,362 | Herring oil.......gallons.. | 260,000 | 52,000 |
| Pickled.......barrels... | 38,332 | 270,249 | Herring fertilizer..pounds.. | 2,400,000 | 33,000 |
| Fresh (including local), pounds | 820,956 | 65,727 | Whale oil.......gallons.. | 466,500 | 139,950 |
| Frozen.......pounds.. | 701,418 | 28,057 | Whale fertilizer....pounds.. | 1,330,000 | 17,600 |
| Dry-salted.......do.... | 121,282 | 1,235 | Trout.......do.... | 51,633 | 3,660 |
| Halibut: | | | Black cod.......do.... | 49,144 | 2,494 |
| Fresh (including local), pounds | 3,642,163 | 114,277 | Miscellaneous fresh fish, local.......pounds.. | 75,000 | 6,000 |
| Frozen.......pounds.. | 9,987,310 | 454,320 | Total | | 15,739,068 |
| Dry-salted.......do.... | 21,159 | 830 | | | |
| Fletched.......do.... | 37,152 | 1,887 | | | |

## SALMON FISHERIES.

### FISHING CONDITIONS.

#### Southeast Alaska.

In southeast Alaska this year there was a pronounced scarcity of red salmon as compared with the previous season, cannerymen on the average getting only about one-fifth as many reds. At one or two canneries in the Icy Strait region the pack of reds was larger this year. Generally speaking, southeast Alaska had a satisfactory season for pinks, although some of the traps in the Ketchikan section did not do very well, except during one rather short period, stormy weather causing considerable damage to the gear and lessening the catch. During the period when the run was at its height many of the purse-seine boats were on limit.

There were no serious disturbances in the way of strikes by fishermen this year, as had been the case in 1912. None of the large power-seine boats from Puget Sound invaded southeast Alaska to fish through the season for salmon. Prospects were much more alluring nearer home, and, moreover, it was demonstrated in 1912 that the large deep-water purse-seine rig is rather too unwieldy for profitable operation on many of the smaller arms and reaches of southeast Alaska waters.

In Icy Strait there was no heavy run of chum salmon early in the season as was the case in 1912. On account of the low price, most of the canneries made no effort to can chums; in fact, in many instances fishermen were instructed to return them alive, if possible, from the seines or other gear used. No doubt there was a considerable waste of chums in some places. Investigations were made in two instances where it was reported that the waste was of a most wanton character, but sufficient evidence could not be adduced to justify prosecution. At some of the plants only the best and brightest of the chum salmon were canned, those remaining being given to the Indians for food, or disposed of to halibut fishermen for bait. The cold-storage plants took quite a number of chums, and the shipment fresh to Seattle also afforded a means for disposing of the not over-esteemed chum salmon in southeast Alaska this season. At a number of the canneries as much effort was made to pack chums as the other species. It may be said that this proved not an unwise course, for late in the fall the price of chums advanced. This was brought about by the demand for chums to round out orders and thus help sell the better grades.

In southeast Alaska most of the canneries outfitted for a lighter pack than the previous year, in consequence of which operations, generally speaking, came to a close much earlier than usual. Some of the packs were completed the latter part of August. The low price and big pack anticipated on Puget Sound had much to do with shortening the season.

There were a few storms in southeast Alaska during the fore part of the season and again toward the close, but for two weeks in August there was even no rain in the Ketchikan region. The creeks were low, thus retarding the ascent of salmon, and catches were good. During this period all canneries ran to capacity.

### CENTRAL ALASKA.

Cook Inlet and central Alaska have in general experienced unsatisfactory results this season. There was a good showing of early kings in Cook Inlet, but the heavy run of reds was of very short duration, the fish coming with a rush later than usual and in some instances showing quite an advanced sexual development. Weather conditions were favorable. A striking feature was the almost utter absence of pinks, the season being in this respect like that of 1911. It is reported that later in the season there was a good run of cohos, but the cannerymen did not wait for this run. As in Bristol Bay, it is doubtful whether it will ever be found profitable to await the main run of the late-coming cohos in the Cook Inlet region.

Reports indicate that there was an unusual amount of vegetable growth in the waters of Cook Inlet this season. To this growth there were frequently attached small particles of pumice which had an erosive effect upon wire trap leads. It also formed in a blanket-like mass on the web. Much trouble was occasioned from this source, and its presence was possibly accountable in a measure for the lighter catch this season in Cook Inlet.

In the Karluk region the present season has been comparatively poor. Possibly the Katmai volcanic disturbance in June, 1912, with its widespread deposit of ash over land and sea, may have influenced the run of salmon in central Alaska.

At Chignik the situation has changed considerably. While formerly nearly all of the fish were taken by traps located within the lagoon, a large tidal estuary at the head of Chignik Bay, this year the greatest part of the salmon were caught in traps located far down the shores of the bay. The new order of things has resulted in a lessening of the tension formerly existing between the canneries, due to disputes arising from the locations of traps in the lagoon, and the difficulty of holding a trap in position after it was driven on account of the ice.

### WESTERN ALASKA.

The favorable weather throughout Alaska meant more perhaps in western Alaska than elsewhere, and, coupled with the heavy run of salmon, made possible the largest pack ever recorded for that region. The previous winter was unusually mild, and when the fleet of cannery ships arrived in Bering Sea the fore part of May no ice was encountered, while the earliest comers found the rivers open and the ground almost entirely free from snow and ice. Ordinarily most vexatious delays occur because of the heavy ice floes.

Thus western Alaska had the best season in its history for red salmon. This was the occasion of surprise in some directions, but careful study of the situation might have yielded a correct forecast as to expectations for the season.

True it is that predicting salmon runs is fraught with many hazards, but using certain hypotheses as to cycles of return, and taking into account additional knowledge recently acquired through scale study as to the age of salmon, a forecast of the Bristol Bay runs may be made with what would seem to be reasonable accuracy. For the purposes of these deductions, it must first be accepted that in Bering Sea red salmon return in the fourth and fifth years. Evidence of this is had in catches of recent years; 1908 was a big year, and 1909 was also; 1912 was a big year, while 1913 was still larger. On this basis the four-year fish from 1912 will return in 1916, and the five-year fish in 1917; the four-year fish from 1913 will return in 1917, and the five-year fish in 1918. Thus, of the years 1916, 1917, and 1918 the return in 1917 ought to be the largest, as it will have the benefit of both the five-year fish from 1912 and the four-year fish from 1913. However, 1916 should be a very good season with the return of the four-year fish from 1912, while the 1918 season should also be good, having the benefit of the five-year fish from 1913. Tabulating this we have:

| Year of large run. | Return of 4-year fish. | Return of 5-year fish. |
|---|---|---|
| 1908 | 1912 | 1913 |
| 1912 | 1916 | 1917 |
| 1913 | 1917 | 1918 |

The approximate catch of red salmon in the Bristol Bay region during the past 10 years has been as follows:

| | Number. | | Number. |
|---|---|---|---|
| 1904 | 12,000,000 | 1909 | 15,600,000 |
| 1905 | 14,100,000 | 1910 | 11,600,000 |
| 1906 | 11,000,000 | 1911 | 9,000,000 |
| 1907 | 10,200,000 | 1912 | 19,900,000 |
| 1908 | 17,000,000 | 1913 | 21,500,000 |

It will be observed from the foregoing that there are two quite good years followed by a like period of lean production. Thus, 1904 and 1905 were good; 1906 and 1907, light; 1908 and 1909, good; 1910 and 1911, light; and 1912 and 1913, good. Carrying this further, we may reasonably expect 1914 and 1915 to be lean—1915 being the lighter of the two—and 1916 and 1917 to be good seasons.

The northwestern shore of the Alaska Peninsula from Port Heiden southwestward to Nelson Lagoon has attracted the itinerant attention of salmon fishermen for many years. Dating from about the year 1900 several packing schemes have been promoted in a more or less desultory manner. Of these the only one surviving at the present time is the salting establishment at Nelson Lagoon, although operations of a similar character on a small scale were also conducted at Port Heiden this year. It has been commonly conceded that while there are a number of streams in this region having regular runs of red salmon in moderate abundance, their distance from each other and the general lack of refuge for vessels operating on the coast has precluded the location of any large establishment.

In 1911, however, a practical fisherman on a prospecting trip from a cannery then newly established on the south coast of the peninsula, learning of the great masses of salmon which school off the coast between Cape Seniavin and Port Moller, conceived the idea of taking them by means of purse seines. As a result the large cannery at Port Moller, operated this year for the first time, was established. From the report of the superintendent the new departure was so sucessful that the same method of fishing will be depended upon henceforth as the principal means of capture; in fact, he freely predicts that within a few years the greater part of the salmon taken by Bering Sea canneries will be caught with purse seines.

## SALMON CANNING.

### Changes and Improvements in Canneries and Equipment.

Early during the season of 1913 the two canneries operated formerly in the Bristol Bay region by the Alaska Fishermen's Packing Co. passed into the hands of Libby, McNeill & Libby. One of these plants is located at Nushagak and the other on the west side of Kvichak Bay near the mouth of Graveyard Creek. Also the same company acquired the cannery of the Yakutat & Southern Railway Co. at Yakutat in southeast Alaska. These plants, together with the one operated at Kenai, give Libby, McNeill & Libby four canneries in Alaska. The three canneries purchased this season will be operated under the names used before the transfer of ownership was effected. Libby, McNeill & Libby contracted for the entire output of canned salmon put up this season by the Taku Canning & Cold Storage Co. at Taku Harbor, in southeast Alaska.

Among the western Alaska plants, the cannery of the Pacific American Fisheries at Port Moller was operated for the first time this season. The buildings for this plant were erected in 1912. Extensive improvements were made at the Clark Point cannery of the Alaska Packers Association on Nushagak Bay. Important changes in the way of new buildings were made at the cannery of the Columbia River Packers' Association, also on Nushagak Bay. Extensive building operations were carried on at the cannnery of the Bristol Bay Packing Co., at Pederson Point, Kvichak Bay. The cannery of the Naknek Packing Co. on Naknek River, was largely rebuilt along modern lines. The work of rebuilding the plant of the Alaska Packers Association at Koggiung was completed during the summer, and this establishment is now a splendid example of the most modern type of cannery. Extensive changes were also undertaken at one of the Alaska Packers Association canneries on the Naknek River.

At a suitable site on the upper side of Pederson Point, on the eastern shore of Kvichak Bay, the North Alaska Salmon Co. this season completed the principal buildings for a new cannery which it is contemplated to operate hereafter in lieu of the cannery at Hallerville on the Kvichak River. The machinery from the latter plant will be moved to the new location. The channel of the river at the old site has silted up to such an extent that the plant is difficult of access even for light-draft boats.

In southeast Alaska the cannery of Swift, Arthur & Co. was used as a mild-cure plant this year, and the name of the firm was changed to the Swift-Arthur-Crosby Co. The combination floating cannery and cold-storage plant on the ship *William H. Smith*, located last season at Saginaw Bay by the Weiding & Independent Fisheries Co., was not operated in Alaska this year. The ship *Glory of the Seas*, operated as a floating cannery in 1912 by the Alaska Fish Co., was sold this season to the Glacier Fisheries Co. and converted into a cold-storage plant. The Alaska Fish Co. absorbed the Oceanic Packing Co. and transferred its operations to the plant built by the latter concern in 1912 at Waterfall, on the west coast of Prince of Wales Island. The cannery was enlarged this year by the Alaska Fish Co.

Among the cannery changes and additions of a more or less extensive nature, mention is made of the construction of buildings and the installation of machinery by the North Pacific Trading & Packing Co., at Klawak, for the manufacture of fertilizer and oil. This company has also erected buildings and installed cold-storage facilities for mild-cure operations.

*Fish hopper.*—A long stride in advance of customary methods of handling salmon in the fish house was seen at a cannery in the Bristol Bay region this summer. Here, instead of the usual bins or compartments on the outer floor of the butchering room, a great hopper, somewhat resembling the amidship section of a vessel, was built through the center of the room. The outer end of the hopper was higher by about 18 inches than the inner end, the slant or pitch to the floor causing the fish to gravitate to the lower end. In the center of the inner bulkhead was a small port or gate from which the fish were drawn as desired and fed to the butchering machines set close-by.

The bottom of the hopper at this end being at the same height as the heading table of the iron chinks, no hooking or pewing was necessary. In sorting kings and cohos were readily distinguished by their larger size, while dog salmon, which in Bering Sea run with the reds, were easily separated after butchering because of their paler flesh. The sides and floor of the hopper were of heavy tongue-and-groove planking so tightly joined that the fish-house floor was perfectly dry and clean. For cleaning the hopper a chute led from the lower end immediately in front of the gate down through the cannery floor into the water below. The chute was covered by a grating, which permitted slime to drain off at all times.

There are several advantages in this arrangement, chief of which is the fact that the first fish dumped into the hopper is the first one out; each is butchered in the order of its arrival in the cannery. No fish accumulate in the bottom of a bin or tank, where they may remain all day long before being put in the cans. The hopper idea is an improvement worthy of general adoption.

*Filling machines for flat cans.*—Pound for pound, there is a larger return from salmon packed in 1-pound flat and half-pound flat containers than in the 1-pound tall can. Heretofore it has been customary to fill the flat cans by hand, but this year machines designed to do this mechanically were taken to Alaska, and their successful operation will no doubt be followed by an increasing output of the more favorably regarded flat packages. The extra labor and time involved in the hand process of filling flat cans have been the difficult features to overcome from the cannerymen's point of view.

*Plan to avoid pewing salmon.*—There is considerable controversy over the question of pewing or forking salmon, some cannerymen maintaining that after the fish is dead this does no harm and that the pew marks can not be detected later; others hold a contrary opinion and take pains that no fish are pewed or hooked in any part except the head or tail, which are at present waste portions. It is a fact, nevertheless, that too much attention to such details can not be given, for the more tenderly the fish is handled the finer should be the resultant food product. In Bristol Bay, where red salmon are taken in enormous numbers, it is said to be practically impossible to obviate the necessity for pewing except at undue expense, yet since no effort has ever been made to handle them in any other manner, the statement is not conclusive. A packing concern which has recently entered the Alaska field has announced its intention of trying out a scheme devised by an agent of this Bureau whose observations of the methods of the fishery cover a wide range and a long period of time.

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Briefly stated, the idea is to equip gill-net boats, trap scows, and transporting lighters with stout bags made of heavy netting, the upper edges of which are strongly reinforced by bolt roping, so that the entire contents of a compartment may be lifted at a single operation. In gill-net boats the bags will hang by their upper meshes over short pins set in the gunwales and thwarts; in scows and lighters they will secure to iron rods set into stanchions, forming compartments of convenient size, each holding probably not to exceed 1,000 red salmon. For removing salmon from drag seines a light, portable gallows from which to operate a hand brail is suggested. Salmon are almost invariably alive when drawn ashore in this class of nets, and it is difficult to pew an individual fish in the head or tail even when an effort is made to do so. The necessity of avoiding it, however, is apparent, as at this time every stab made with a pew leaves an ugly mark in the flesh which shows plainly in the canned product.

### PROCESSING CANNED SALMON.

Since the more or less general adoption of the so-called sanitary can in Alaska, beginning in 1911, there has been much discussion of new elements of processing, such as time of cooking, temperature, length of exhaust, and other important points. Out of this discussion and resultant activity there has grown a standard of finished product quite satisfactory to both producer and consumer. Cans have been improved, new machinery has been perfected, cannery men say that stale or slightly sour fish can not be packed successfully in the improved sanitary cans, and in fact the whole operation of salmon packing has made notable advances along scientific and carefully thought-out lines. But the end of development, particularly from the producers' point of view, has by no means been reached. Processing methods and the machinery used in connection therewith are still in a state of transition.

The two general classes of processing canned salmon now followed are commonly termed the sanitary and old-style methods. There is also a modified system now somewhat in vogue which combines the old style of can with the more modern method of exhausting and cooking.

Of the canneries operated in Alaska, 52 per cent have installed the so-called sanitary machinery. In southeast and central Alaska there is approximately an equal division as to the number using the new and old styles, but in western Alaska there is a pronounced leaning in favor of the sanitary type.

The principle of rendering the flesh of salmon or other fish sterile and capable of being kept in a condition fit for human consumption for an indefinite period consists simply of treating with heat to a degree and for a length of time sufficient to destroy completely all organic life—to annihilate the minute organisms and their spores which inhabit the flesh of the fish, as well as those which may enter during the process of packing—and then seal tightly in a container so that there may be no bacteriological development through the admission of air.

A leak in the container will result usually in the formation of gases that will cause pronounced distension of the ends, and it has come to be generally recognized that a swelled or bulged end is diagnostic of spoiled contents. This is a proper criterion for casual and external determination of quality, though it does not always follow that a slightly distended end necessarily means a spoiled can. It sometimes happens that a perfectly good can of salmon may, in the course of its long journey from the cannery to the retailer's shelf, receive jars and jolts that will cause the ends to bulge in a most suspicious manner. No conscientious salesman thinks of offering such a can for sale, and the consequent loss eventually falls upon the packer. The obvious preventive remedy is the creation of a vacuum within the can to insure a continuously collapsed state of the ends. Thus in the processing of salmon there are two distinct steps, the first being that of securing the required exhaust or vacuum, and second, the cooking proper.

Under the old method of canning the first cooking, which takes place immediately after the top has been soldered on the filled can and central vent stopped up, is known as the exhausting process. After the contents have thus been well heated, the top is punctured, permitting the expanded air and the gases liberated by the heat to escape or blow off, and the vent thus created is quickly soldered before the can and its contents can cool and fill up with air again. A strong vacuum is thus secured, as the excess air has been exhausted. This involves an expenditure of considerable time and labor, some little fuel and other materials, and the employment of certain machinery, much of which is done away with by the modern sanitary system of exhausting.

As a modification of the old method, a practice came into vogue in which the filled can, after having the top soldered on, was given its exhaust heat with the central vent open, the small aperture being stopped with solder after the exhausting was regarded as ended. This was accomplished either by use of the old style of cannery equipment in which the filled cans with this vent were given the exhaust heat in the same sort of cooking cylinders or retorts as are used for the final treatment, or by the employment of elongated steam boxes through which the cans with the vent open were slowly conveyed. The principle involved in these cases is the same. With the vent open the excess of air, which it is the aim to expel, or exhaust, escapes gradually and evenly through this opening, and is thus a distinct advantage over the old-style method of "blowing," whereby more or less of the oils and juices of the fish are violently expelled with the suddenly liberated gases. This loss of juice is certainly a strong argument against the earlier method of processing. Where this practice of blowing is followed it may be detected by the presence of the second solder dot where the vent hole has been stopped. This improvement on the old-style method affects a considerable saving of time and labor; also a little in material. It is a good method if old-style cans are to be used, and has been adopted by a number of cannery men. Others have held back, however, believing that it would not be long before a decided advance in methods of exhausting would occur. Subsequent events seem to have justified their judgment.

The sanitary method which has come into vogue during the last few years has for its features an improved style of can, and in the exhausting process the top is but loosely placed on the can, thus allowing a gradual expulsion of air, as in the vented top of the modified old style.

In the process of exhausting the cans, there is a certain, though perhaps relatively slight, loss of the more volatile oils through vaporization. It is of importance therefore to see that over-exhausting does not occur. Any objection in this direction is probably wholly overcome in a lately perfected vacuum machine which exhausts the cans without heat or steam immediately after they come from the filling machines. There is strong likelihood that this or some form of vacuum process involving the same principle will supplant present-day methods. The new cannery of the Pacific American Fisheries at Port Moller was this season equipped with old-style machinery in anticipation of having the cold exhaust vacuum machines ready for use next year. The merits of this new form of machine lead to the conclusion that it will be generally adopted before long.

A noteworthy exception in the matter of exhausting cans has been in vogue for years at the cannery of the Seufert Bros. Co., The Dalles, Oreg. At this plant the cans are given no exhaust whatsoever. They are sealed tightly, are given a careful cold test for leaks, and then go to the retorts, where they are cooked 70 minutes at 240° F. It is stated that there is no resultant trouble from swells. Possibly there may be some chance of extending this simplified process to Alaska.

Exhaust boxes, varying somewhat in style of construction and arrangement, are the same in both the modified old-style and the present sanitary systems. The methods of processing after exhausting are similar in all systems.

Most of the exhaust boxes used in connection with sanitary cans are about 30 feet long, with the cans traversing the full length seven times. Each run is supposed to take a minute and a half, with a total of about 10 minutes for a can to pass entirely through the box, but as a matter of fact the time is often nearer 9 minutes. The heat is theoretically supposed to be maintained at the boiling point, but was never found to be in excess of 210° and more often less, usually about 206° to 208°. In one cannery the exhausters were similar in all respects except width, having 9 runs instead of 7. In practice the cans required a full 10 minutes to pass through. The heat was the same. At still another cannery, using the same type of apparatus, the exhausters were 45 feet long and it took 15 minutes for a can to traverse the 7 runs, with the heat maintained theoretically at 212°. This was the first year the sanitary system had been used at this plant, and the management very evidently was not disposed to take any chances with a weak vacuum.

The experience in this regard is interesting. It was soon found that the fish upon leaving the exhaust had dried out alarmingly. A dozen cans carefully weighed beforehand were found to have lost a good half ounce apiece during the passage through the box. This was at a temperature of 210°. The length of one of the boxes was therefore cut down to 30 feet, so that a can was in the exhauster only 10 minutes with the same temperature of 210°. This was found to give a satisfactory vacuum without noticeable loss in weight. By the time these changes had been completed the packing season was at its height, and as there was more time and labor required than could then be devoted to remodeling the other boxes, the remodeled box was left as it stood, but the temperature was cut down to 200°. The cans had been cooking for only 75 minutes at 240° in the final heat, but after the change this was increased to 85 minutes for both boxes.

It is believed that a temperature of more than 210° with the top loose all around the rim, as in the clinching method used with sanitary cans, is dangerous, for the following reason. As the heat surrounding the thin shell of tin forming the can liberates the juices of the fish content the juices gravitate to the bottom and are drawn out to the sides, against which they cling by capillary attraction. The extraction of these juices is assisted by the salt with which the can has previously been charged, and as soon as the liquor reaches above the top of the flesh it will be found to stand at a slightly higher level all round the side of the can. Between this level and the lip of the can the distance is very short, and after this stage has been reached any rise of temperature to or above the boiling point will almost instantly affect the free liquor and by the combined action of ebullition and capillary attraction carry it out over the lip of the can. It seems quite evident that a sufficient vacuum may be secured without danger of loss in weight by a temperature of a few degrees below the boiling point maintained for a slightly longer period of time than present practice prescribes.

Tops sometimes come off the sanitary cans inside the exhausters and cause no little trouble and delay. In at least two canneries limited numbers of cans were run through the boxes without tops by way of experiment. No mechanical trouble was developed, and the contents showed up well after coming out. There was no apparent loss of juice in either instance, and it should be noted that in neither was the temperature above 210°. One foreman reported that the surface of the exposed flesh seemed somewhat paler than normal, as if it might have been bleached out by the steam, while another claimed that he could observe no difference in color.

*Heat units in salmon canning.*—From a study of the methods used at a number of canneries, under the different systems considered here, a summary of the averages indicates that there is but little difference in the total number of heat units applied in the different processes. For purpose of comparison the arbitrary formula of degrees of heat (Fahrenheit scale) multiplied by the number of minutes at which this was maintained was adopted. Following is the tabulated summary:

| Process. | Exhausting. | | Cooking. | | Total heat units. |
|---|---|---|---|---|---|
| | Minutes. | Temperature. | Minutes. | Temperature. | |
| Sanitary | 11 | 208 | 93 | 241 | 24,700 |
| Modified | 16 | 204 | 86 | 240 | 23,900 |
| Old style | 40 | 220 | 60 | 240 | 23,200 |

In addition to the foregoing, it is the custom at all canneries, no matter what the system, to allow about five minutes at the beginning of the high temperature cook to work up the required heat of the retort, and when cooking is complete there is a like period for reducing the temperature and pressure before opening the doors.

*Cans.*—The form of can used and the methods of manipulating it, particularly as regards the manner of closing and the use of solder, are highly important phases of the canning industry. The paramount advantage of the sanitary over the other systems is undoubtedly in the superior type of can employed. While the sanitary system is comparatively new in the salmon packing industry, it has been employed by fruit and vegetable canners of this country for several years, and in Europe, particularly in Germany, its use is almost universal. The cans used in this system have already become popular with the consuming public; and by reason of the fact that the contents of such packages are commercially known and pushed forward as "sanitary," they are in stronger demand than are those of a similar sort packed in the old-style containers.

The sanitary can is readily distinguishable by the apparent absence of solder in the seams and the real absence of the one or two dots of solder which are to be found on one of the ends of the tins packed under other methods. As a matter of fact, the long side seam of the sanitary can is treated with both solder and flux, the latter usually of an acid character, but inasmuch as a properly made can will have no trace of either solder or flux on the inside, to all essential purposes it is a solderless and acidless container. The tops and bottoms are merely crimped on without acid or solder by machines called "double seamers," because they fold the flanges of side and end over twice in the crimping process.

The cans used in the old-style and modified systems are identical in character, solder and flux being used in side, top, and bottom seams. There is no difference whatever in the container before it is filled. They may be distinguished from each other by the solder dots which are to be found on one end of the can. A single dot in the center may denote a can which has been processed under the modified method, while two solder dots indicate the old-style process.

Most all of the sanitary cans used in southeast Alaska, and to a certain extent in the more remote sections of the Territory, are manufactured in the States and shipped empty to Alaska in the same cases in which, at the rate of 48 each, they are subsequently returned filled with salmon. The bulk of the empty cans thus makes the freight rates disproportionate with the weight involved. To reduce this item of expense, one of the large can companies has lately perfected plans and machinery to collapse the body of the can so that 400 may be packed in the ordinary 48 1-pound tall salmon case. Upon arrival at destination the collapsed bodies are run through a simple reshaping machine at the rate of about 70 per minute, and the bottoms may then be put on in the same manner as are the tops. It will be seen that in shipment the collapsed cans require only about one-sixth of the cubical space as compared with cans in the round at the rate of 48 to the case. One cannery man in southeast Alaska, figuring conservatively, says that using the collapsible cans on a 30,000-case pack he can effect a saving of $2,000 a season on the basis of present freight rates.

Another change which is being developed in the manufacture of sanitary cans is the use of a paper gasket to effectuate a tight joint, instead of the rubber-like compound generally used heretofore. The paper form is said to be a decided improvement.

*Lacquering.*—The amount of solder or acid left on the inside of the long body-seam of properly made old-style cans is so trifling as to be practically negligible, and the quantity which finds its way within through either of the end seams is equally insignificant, but the fact that these agents are so used remains to prejudice the mind of the up-to-date consumer.

From the inception of the canning industry it has, with few exceptions, been the custom to coat all cans with some protecting medium; the reasons for this, as stated by Cobb,[a] are: (1) That the English market which, at the beginning especially, absorbed the greater part of these goods, insisted on their shipments being finished in this way, and (2) from the fact, as the canners speedily found out, that if they did not protect their cans in some way enormous losses through rust would ensue. The use of lacquer has been the means employed to afford the necessary protection. To secure good results in lacquering, however, it is necessary to have dry weather, a condition rarely assured in Alaska, particularly in the Bristol Bay region. Also there has always been the danger of fire owing to the highly inflammable character of commercial lacquering fluids. It is not surprising therefore, to find salmon packers largely adopting a compromise scheme whereby objectionable features in lacquering may be overcome. The plan is, briefly, to use only lacquered tops and bottoms, leaving the body to be protected by the label. The tops and bottoms can be purchased already lacquered.

Unfortunately, however, this does not entirely solve the problem. The thin film of varnish on the end piece has some hard knocks to withstand before the final casing of the can takes place, and a large percentage become marred and scratched. Where the ends of the can are the same, either entirely plain or bearing similarly stamped designs, this is not so serious a defect because it seldom happens that both ends of one can are defaced. But when an otherwise perfect can is badly marred on the end which is intended to be the top after the label has been put on, the matter becomes grave. A great deal depends upon the good appearance of a pack, and defaced tops in any quantity are a distinct defect.

As most of the scratches have been ascribed to the coolers in which the cans are cooked and handled on the cooking floor, a new type of cooler has been brought out. This has sides extending above the tops of the cans and cross braces in each corner, thus protecting the tops from contact with the bottom of any other cooler which may be placed above. The new coolers are undoubtedly a great improvement over the old type, but they have by no means entirely solved the problem.

The damp heat of exhausters and retorts may not be responsible for as many abrasions of varnished surfaces as some cannery men imagine, but that it does affect the lacquer to an extent to render it tender is the firm conviction of many. It is also believed that the softened varnish is further imperiled in the strong lye bath with which

[a] The salmon fisheries of the Pacific Coast, by John N. Cobb. Bureau of Fisheries Document No. 751.

it heretofore has been customary to treat the cans upon removal from the retorts. Part of the lye-bath treatment is the brisk scrubbing of the can tops with stiff brushes, and it has been conclusively demonstrated that under this action slightly scratched surfaces have been almost entirely denuded of their coat of lacquer. To avoid this as much as possible, some canners have adopted the plan of washing and spraying the cans both before entering and after leaving the exhaust boxes. The strong lye bath is then less necessary, and in fact has been eliminated to a considerable extent at quite a number of canneries. Instead, the cans are merely rinsed in a tank of warm water in which a small quantity—about a pound or two per day—of caustic soda has been dissolved. In spite of all these precautions, however, defaced cans continue to occur, which is further argument against the use of the prelacquered tops.

Another phase is that in the double-seaming process the thin coating of varnish is broken through entirely around the rim of the can, leaving it without protection from rust at a point where the metal, already strained by the bending and crimping to which it has been subjected, stands in need of greatest protection.

Labels, which are ordinarily attached by means of simple flour-and-water paste, afford only partial protection from rust. As a matter of fact, with the type of labeling machine commonly employed it is necessary to apply the paste rather freely, and the moisture thus coming in contact with an unlacquered or unprotected surface has been found to cause corrosion and pitting and in time will show through the label itself. Unlacquered fruit, vegetable, and milk cans subjected to the salt air and moist climate of coastal Alaska are found to rust under the paste of their labels, and the same is true to a greater or less extent of unlacquered salmon cans.

Whether the old plan of lacquering the entire can will be resumed is uncertain, yet many packers are paying constantly more and more attention to this feature of their work. A rusted can handed out by a retailer is open to the suspicion of being old and shopworn and an inferior article. It would seem very questionable, therefore, whether in the long run it will be deemed profitable to use the prelacquered end in Alaska as against the earlier plan of lacquering the entire can.

*Do-overs.*—The matter of do-overs is one that should receive most serious consideration at the hands of the cannery men. A few do-overs appearing in a well-established trade in salmon will work irreparable damage to the sales of a thoroughly wholesome and marketable product. Every do-over should be destroyed at the cannery.

The sanitary system of processing has produced a new type of do-over which in western Alaska is commonly referred to as a "slack" can. This is one which has been insufficiently exhausted, necessitating another treatment, as follows: The cans are laid on their sides in the coolers with the long body seam uppermost. They are then retorted for from 20 to 30 minutes at a temperature ranging between 230° and 240° F., after which they are punctured at the edge of the solder streak of the body seam, blown, and quickly soldered. The contents of cans so treated are in all instances believed to be perfectly good, the package merely having lacked that amount of vacuum required by packing-house standards; this is supplied by the additional treatment.

While it is not fair to stigmatize this product with the odium attaching to the term "do-over," it is nevertheless not a first-grade commodity. The fact that the blow mark is placed on the side seam, where it may be thought a drop of solder formed when the can was made, and where it is certain to be covered later by a label which will conceal it from the view of the innocent consumer, shows that the packers themselves do not feel sure of it. Certainly they will not guarantee it, and just as certainly they will not try to market it in the British market. Like all second-grade goods, it is chiefly sold in blank to dealers who brand it with proprietary labels and distribute it chiefly in the American market.

### Cannery Labor.

The question of securing competent or even fairly reliable help to perform the general inside work at the canneries in Alaska has in recent years grown to be one of the most vexatious problems with which cannery operators have had to contend. It would seem that with the introduction of various improved mechanical devices and the proportionately lessened number of employees required, conditions in this regard would now be better. But unfortunately such is not the case. Formerly most of the labor was performed by Chinese, who were reliable and competent for every class of inside cannery work; but now it is very difficult to obtain Chinese labor, and the result has been a miscellaneous collection of Mexicans and Japanese, Filipinos and other Orientals, who are not as tractable and dependable as the Chinese.

The importation of cannery labor is essential, as Alaska can not begin to supply the demand. With the exception of those in the Afognak and Kodiak regions and a few other places, the native Indians of central and western Alaska are as a rule unreliable as cannery hands; moreover, their numbers are pitifully few. In southeast Alaska several thousand natives, including men, women, and children, are given employment at the canneries, and they do quite well. Nevertheless, the fact remains that it is necessary to import help to take care of the salmon harvest, and since there are but relatively few Chinese now available, the natural result is the heterogenous Oriental element above named. In consequence of this, constant vigilance must be exercised by the cannery operators to keep things going properly. But even the exercise of every precaution is not sufficient, for occasionally there are labor troubles that mean heavy loss to the salmon packer.

It therefore becomes a matter of no little interest to note the manner whereby the management of the Taku Canning & Cold Storage Co. in southeast Alaska bettered the situation this season in such successful fashion that an expansion of the idea may do much toward solving a most vexatious problem.

Rather early in the season, 18 Japanese who had contracted to work at the Taku cannery throughout the season ignored their agreement, and left under the pretext that they were afraid the organization was not sufficiently solvent to pay them off should they remain. That this was merely a subterfuge is evidenced by the fact that a properly secured bond was no inducement for them to continue work. Badly in need of help to recruit his much-crippled force, and with no adequate local labor resources, Manager J. L. Carlson decided to inaugurate the plan of importing white girls experienced in cannery work in the States. Accordingly a few days later 10 girls arrived from Astoria, Oreg., and were employed throughout the season. They were more rapid and efficient workers than the Oriental and Indian labor previously engaged, and were fully competent to perform the various duties about the lines of machinery, as well as lacquering and labeling, also hand filling the flat cans. Particularly in the latter were they preferable to the native Indian women, both by reason of their efficiency and neatness. Separate quarters and mess arrangements were provided. The success of the undertaking was so pronounced that the idea might with profit be applied at other canneries.

### Disasters and Losses in the Salmon Industry.

Relatively speaking, losses either in the way of life or of property in the salmon industry have been remarkably light this season. So far as reported, the only accidental loss of life was the drowning of three fishermen on Nushagak Bay.

On July 7, while opposite Funter Bay, the cannery tender *Jack Horner*, operated by the Pacific American Fisheries at Excursion Inlet, took fire as a result of the engine's back-firing. The 10 men aboard at the time were transferred to the tender *Concord*, which fortunately happened to be nearby. The *Jack Horner* was taken in tow, and was finally beached at Point Howard. Though the vessel was destroyed, it is noteworthy that the fuel tanks did not explode;

only the water tank in the engine room burst. This was one of the largest and best-equipped cannery tenders in southeast Alaska. It was 72 feet in length, of 50 tons gross register, and was built at Seattle in 1911.

While enroute from Cook Inlet to Puget Sound, the steam cannery tender *Kayak*, belonging to the Seldovia Salmon Co. struck at Point Carrew, near Yakutat, on the night of August 26, and became a total loss. On account of a severe gale, an effort was being made to get into Yakutat Harbor, but the channel was missed and the disaster followed. The 10 men comprising the crew took to the boats, and after a trying experience finally got ashore. The *Kayak* was built at Alameda in 1901, was 91 feet in length, and registered 115 tons, gross.

The power cannery tender *Kake*, belonging to the Kake Packing Co., was wrecked November 1 on Clatsop Spit, at the mouth of the Columbia River. The vessel left Kake, Alaska, October 14 with the intention of proceeding to Astoria, Oreg., for the winter. The 60 cases of half-pound cohos, and 258 cases of 1-pound tall chums, carried as ballast, may be considered as a total loss, although some 38 cases were picked up on the beach in a badly damaged condition. The wreck of the vessel was sold by the underwriters for a small sum.

When the steamer *State of California* was wrecked in Gambier Bay on August 17 the Alaska Sanitary Packing Co., of Wrangell, sustained a loss of 650 cases of salmon, all pinks.

During a gale on May 15, the cannery ships *Tacoma*, of the Alaska Packers Association, and *St. Nicholas*, of the Columbia River Packers Association, went ashore on the flats at the west entrance to Nushagak estuary, between Protection Point and the mouth of the Igushik River. Both vessels were floated later, having suffered no serious damage. About the same time the ship *Standard*, of the North Alaska Salmon Co., went ashore near Cape Constantine, and was badly pounded before working off.

During a blow on May 28, about 19,000 cases of tin plate were lost overboard from a lighter alongside one of the Alaska Packers Association ships in the Naknek roadstead. On account of this accident, it became necessary to have a steamer make the long run to Larsens Bay and return to replenish the supply of tin.

### Canneries Operated.

During 1913 there were 42 canneries in operation in southeast Alaska, 9 less than in 1912; 14 in central Alaska, the same as 1912, while in Western Alaska this season there were 23 canneries in operation, a gain of 1 over the previous year. Thus the totals are 87 for 1912 and 79 for 1913.

COMPANIES CANNING SALMON IN ALASKA, NUMBER AND LOCATION OF CANNERIES OPERATED, AND NUMBER OF TRAPS OWNED BY EACH.

| Names. | Canneries. | Location. | Traps. |
|---|---|---|---|
| Southeast Alaska: | | | |
| Admiralty Trading Co. | 1 | Gambier Bay | 4 |
| Alaska Fish Co. | 1 | Waterfall | 1 |
| Alaska Pacific Fisheries | 3 | Chilkoot Inlet | [a]6 |
| | | Yes Bay | [b]7 |
| | | Chomley | [b]5 |
| Alaska Packers Association | 2 | Loring | [c]7 |
| | | Wrangell | [d]4 |
| Alaska Sanitary Packing Co. | 1 | Wrangell | ........ |
| Astoria & Puget Sound Canning Co. | 1 | Excursion Inlet | 4 |
| F. C. Barnes Co. | 1 | Lake Bay | 5 |
| Deep Sea Salmon Co. | 1 | Ford Arm | 2 |
| Fidalgo Island Packing Co. | 1 | Ketchikan | 3 |
| Hawk Fish Co. | 1 | Hawk Inlet | 4 |
| Hidden Inlet Canning Co. | 1 | Hidden Inlet | ........ |
| Hoonah Packing Co. | 1 | Hoonah | 6 |
| Irving Packing Co. | 1 | Karheen | 3 |
| Kake Packing Co. | 1 | Kake | 4 |
| The Kasaan Co. | 1 | Kasaan | 2 |
| Kulu Island Packing Co. | 1 | Beauclaire | ........ |
| Lindenberger Packing Co. | 2 | Roe Point | [e]3 |
| | | Craig | 3 |
| George T. Myers & Co. | 1 | Chatham | 4 |
| North Pacific Trading & Packing Co. | 1 | Klawak | ........ |
| Northwestern Fisheries Co. | 4 | Hunter Bay | [b]1 |
| | | Quadra | 1 |
| | | Santa Ana | [b]1 |
| | | Dundas Bay | 3 |
| Pacific American Fisheries | 1 | Excursion Inlet | 15 |
| Pacific Coast & Norway Packing Co. | 1 | Petersburg | 4 |
| Pillar Bay Packing Co. | 1 | Pillar Bay | 2 |
| Pure Food Fish Co. | 1 | Ketchikan | ........ |
| Sanborn-Cram Co. | 1 | Burnett Inlet | [b]4 |
| Shakan Salmon Co. | 1 | Shakan | 1 |
| Skowl Arm Packing Co. | 1 | Skowl Arm | ........ |
| Starr-Collinson Packing Co. | 1 | Moira Sound | [b]1 |
| Sunny Point Packing Co. | 1 | Chomley | ........ |
| Taku Canning & Cold Storage Co. | 1 | Taku Harbor | [a]8 |
| Tee Harbor Packing Co. | 1 | Tee Harbor | 6 |
| Thlinket Packing Co. | 1 | Funter Bay | 13 |
| Walsh-Moore Canning Co. | 1 | Ward Cove | ........ |
| Wiese Packing Co. | 1 | Rose Inlet | ........ |
| Yakutat & Southern Ry. Co. | 1 | Yakutat | ........ |
| Central Alaska: | | | |
| Alaska Packers Association | 4 | Kasilof | 18 |
| | | Larsen Bay | ........ |
| | | Alitak | ........ |
| | | Chignik | 13 |
| Columbia River Packers Association | 1 | Chignik | 13 |
| Fidalgo Island Packing Co. | 1 | Port Graham | 2 |
| Kadiak Fisheries Co. | 1 | Kodiak | ........ |
| Libby, McNeill & Libby | 1 | Kenai | 11 |
| Northwestern Fisheries Co. | 4 | Orca | ........ |
| | | Kenai | 10 |
| | | Uyak | ........ |
| | | Chignik | 11 |
| Pacific American Fisheries | 1 | King Cove | 3 |
| Seldovia Salmon Co. | 1 | Seldovia | 3 |
| Western Alaska: | | | |
| Alaska Fishermen's Packing Co. | 2 | Nushagak Bay | ........ |
| | | Kvichak Bay | ........ |
| Alaska Packers Association | 8 | Nushagak Bay (2) | 5 |
| | | Kvichak River (2) | 1 |
| | | Naknek River (3) | ........ |
| | | Ugaguk River | ........ |
| Alaska-Portland Packers Association | 1 | Nushagak Bay | 3 |
| Alaska Salmon Co. | 1 | Wood River | ........ |
| Bristol Bay Packing Co. | 1 | Kvichak Bay | ........ |
| Columbia River Packers Association | 1 | Nushagak Bay | ........ |
| Midnight Sun Packing Co. | 1 | Kotzebue Sound | 2 |
| Naknek Packing Co. | 1 | Naknek River | ........ |
| North Alaska Salmon Co. | 4 | Nushagak Bay | ........ |
| | | Kvichak River (2) | 1 |
| | | Ugaguk River | ........ |
| Northwestern Fisheries Co. | 1 | Nushagak Bay | ........ |
| Pacific American Fisheries | 1 | Port Moller | 1 |
| Red Salmon Canning Co. | 1 | Ugashik River | ........ |

[a] 2 floating. [b] All floating. [c] 6 floating. [d] 3 floating. [e] 2 floating.

The foregoing list does not show independent traps selling fish to canneries.

### CANNERIES NOT OPERATING IN 1913.

Nine of the canneries in southeast Alaska were not operated this year, as follows:

| | Location of plant. |
|---|---|
| Point Ward Packing Co | Point Ward. |
| Canoe Pass Packing Co | Canoe Pass. |
| Herbert Hume Packing Co | Nakat Harbor. |
| Metlakahtla Industrial Co | Metlakahtla. |
| Revilla Fish Products Co | Ketchikan. |
| Swift, Arthur-Crosby Co. [a] | Heceta Island. |
| St. Elias Packing Co | Dry Bay. |
| Alaska Fish Co | Ship *Glory of the Seas.* |
| Weiding & Independent Fisheries | Ship *William H. Smith.* |

With the exception of the Metlakahtla Industrial Co., the St. Elias Packing Co., and the Alaska Fish Co., all of the foregoing plants were first operated as canneries in 1912.

### THE SALMON CATCH AND FORMS OF GEAR.

In the southeast Alaska salmon canning industry there were in operation 127 stationary and 36 floating traps, a total of 163 traps; in central Alaska there were 84 traps in the canning industry, 2 in mild-cure work, and 1 in pickling operations, a total of 87 traps, all stationary; and in western Alaska there were 13 traps devoted to the canning industry and 4 to pickling, a total of 17 traps, all stationary. Assembling the foregoing figures, there is a total of 231 stationary and 36 floating traps, or a grand total of 267 traps throughout Alaska for the year 1913. During 1912 there were 273 traps devoted to canning and 5 to pickling, of which 242 were stationary and 36 floating. Thus there were 11 less traps in operation in 1913 than in 1912. The falling off occurred in southeast Alaska. Fewer canneries were in operation in 1913, and while some companies put in traps for the first time this year, other companies lessened their number.

In all of the branches of the salmon industry there was a total of 238 purse and drag seines operated in Alaska in 1913 as compared with 474 the previous year. The falling off was due to the absence of the fleet of Puget Sound purse seiners, which invaded southeast Alaska in 1912, and also to the fact that fewer canneries were operated. In the matter of gill nets, the figures for 1913 show 2,470 as compared with 2,240 the year before. The gain was chiefly in mild-cure operations.

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[a] Mild-cure operations in 1913.

SALMON TAKEN IN 1913, BY SPECIES AND APPARATUS, FOR EACH GEOGRAPHIC SECTION OF ALASKA.

| Apparatus and species. | Southeast Alaska. | Central Alaska. | Western Alaska. | Total. |
|---|---|---|---|---|
| | *Number.* | *Number.* | *Number.* | *Number.* |
| Seines: | | | | |
| Coho, or silver | 168,430 | 28,466 | 17 | 196,913 |
| Dog, or chum | 1,543,682 | 6,868 | 1,964 | 1,552,514 |
| Humpback, or pink | 12,382,921 | 1,013,714 | ............ | 13,396,635 |
| King, or spring | 963 | 1,534 | 142 | 2,639 |
| Red, or sockeye | 779,877 | 1,835,283 | 523,805 | 3,138,965 |
| Total | 14,875,873 | 2,885,865 | 525,928 | 18,287,666 |
| Gill nets: | | | | |
| Coho, or silver | 116,251 | 2,365 | 80,935 | 199,551 |
| Dog, or chum | 12,193 | 3,159 | 272,993 | 288,345 |
| Humpback, or pink | 16,317 | 5,102 | 192,022 | 213,441 |
| King, or spring | 47,271 | 22,369 | 75,088 | 144,728 |
| Red, or sockeye | 347,000 | 414,512 | 20,341,920 | 21,103,432 |
| Total | 539,032 | 447,507 | 20,962,958 | 21,949,497 |
| Traps: | | | | |
| Coho, or silver | 291,731 | 102,914 | 7,090 | 401,735 |
| Dog, or chum | 973,962 | 42,780 | 67,700 | 1,084,442 |
| Humpback, or pink | 13,101,582 | 101,403 | 190,000 | 13,392,985 |
| King, or spring | 18,289 | 45,947 | 3,842 | 68,078 |
| Red, or sockeye | 1,119,081 | 2,548,701 | 604,917 | 4,272,699 |
| Total | 15,504,645 | 2,841,745 | 873,549 | 19,219,939 |
| Lines: | | | | |
| Coho, or silver | 42,601 | ............ | ............ | 42,601 |
| King, or spring | 327,675 | ............ | ............ | 327,675 |
| Total | 370,276 | ............ | ............ | 370,276 |
| Dip nets: Red, or sockeye | ............ | 86,200 | ............ | 86,200 |
| Spears: Humpback, or pink | ............ | 1,550 | ............ | 1,550 |
| Total: | | | | |
| Coho, or silver | 619,013 | 133,745 | 88,042 | 840,800 |
| Dog, or chum | 2,529,837 | 52,807 | 342,657 | 2,925,301 |
| Humpback, or pink | 25,500,820 | 1,121,769 | 382,022 | 27,004,611 |
| King, or spring | 394,198 | 69,850 | 79,072 | 543,120 |
| Red, or scokeye | 2,245,958 | 4,884,696 | 21,470,642 | 28,601,296 |
| Grand total | 31,289,826 | 6,262,867 | 22,362,435 | 59,915,128 |

Figures for the proportion of catch by the principal forms of gear show that in southeast Alaska the total catch by seines dropped from 50 per cent in 1912 to 48 per cent in 1913, while the trap catch increased from 47 per cent in 1912 to 50 per cent in 1913. In central Alaska, however, the reverse occurred, for the seine catch increased from 40 to 47 per cent, while the trap catch decreased from 50 per cent in 1912 to 46 per cent in 1913. In western Alaska seines were used for the first time this year, except in an experimental way, and the catch thus made was about 2 per cent of the total. The catch by traps dropped from 6 per cent to 4 per cent this year, and the gill net catch increased from 93 to 94 per cent.

PERCENTAGE OF TOTAL CATCH OF SALMON BY THREE PRINCIPAL FORMS OF GEAR.

| Apparatus. | Southeast Alaska. | | Central Alaska. | | Western Alaska. | |
|---|---|---|---|---|---|---|
| | 1912 | 1913 | 1912 | 1913 | 1912 | 1913 |
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Seines | 50 | 48 | 40 | 47 | ......... | 2 |
| Traps | 47 | 50 | 50 | 46 | 6 | 4 |
| Gill nets | 2 | 2 | 9 | 7 | 93 | 94 |

Considering Alaska as a whole, 30 per cent of the salmon caught in 1913 were taken by seines, 32 per cent in traps, and 36 per cent by means of gill nets. The year before, seines took 31 per cent, traps 33 per cent, and gill nets 34 per cent. Thus, for all Alaska, 1913 shows as to proportion of catch a gain of 1 per cent for seines, a loss of 1 per cent for traps, and a gain of 2 per cent for gill nets.

The total catch of salmon in 1913 was 59,915,128 as against 60, 938, 945 in 1912, a decrease of 1, 023,817. The number of reds was about the same this year; kings gained 66,000; pinks gained approximately 2,970,000; cohos fell off 620,000; and chums declined 3,433,000 in number this year.

### STATISTICS.

The number of canneries in operation in Alaska during 1913 was 79 as compared with 87 for 1912. The total investment declined from $33,759,295 in 1912 to $31,341,670 for 1913. The decrease was chiefly in southeast Alaska.

The number of persons employed in 1912 was 17,705 and 16,513 in 1913, a decrease of 1,192 persons, also almost wholly in the southeast section. Although there was a decrease of about 7 per cent this year, it is interesting to note that both the numbers of whites and natives show slight gains. This condition should inure to the benefit of Alaska. Of the Oriental element, Japanese and Filipinos are supplanting the declining numbers of Chinese.

In 1912 the pack of canned salmon was 4,054,641 cases, valued at $16,291,927, while in 1913 it was 3,739,185 cases, valued at $13,531,604, a decrease of 315,456 cases and $2,760,323 in value. By sections the case pack comparison is as follows: Southeast Alaska declined from 2,033,648 to 1,782,898 cases, a difference of 250,750 cases; central Alaska dropped from 625,062 to 447,249 cases, a loss of 177, 813 cases; but in western Alaska there was an increase from 1,395,931 cases in 1912 to 1,509,038 cases in 1913, a gain of 113,107 cases. Comparisons by species show the following: The pack of cohos declined from 166,198 to 75,779 cases, a loss of 90,419 cases; chums dropped from 664,633 to 290,918, a loss of 373,715 cases; and kings went from 43,317 down to 34,370, a decline of 8,947 cases; but pinks increased from 1,280,138 to 1,372,881, a gain of 92,743 cases; and reds also gained from 1,900,355 to 1,965,237, an increase of 64,882 cases. The net decrease, however, for 1913 was 315,456 cases, due chiefly to the lighter pack of chums.

## INVESTMENT IN THE SALMON-CANNING INDUSTRY IN 1913.

| Items. | Southeast Alaska. | | Central Alaska. | | Western Alaska. | | Total. | |
|---|---|---|---|---|---|---|---|---|
| | *No.* | *Value.* | *No.* | *Value.* | *No.* | *Value.* | *No.* | *Value.* |
| Canneries | 42 | $3,946,518 | 14 | $1,416,880 | 23 | $3,136,351 | 79 | $8,499,749 |
| Working capital | | 4,298,930 | | 2,147,600 | | 5,374,900 | | 11,821,430 |
| Wages paid | | 1,946,736 | | 893,250 | | 2,516,956 | | 5,356,942 |
| Vessels: | | | | | | | | |
| Power vessels over 5 tons | 111 | 611,149 | 44 | 471,740 | 55 | 924,120 | 210 | 2,007,009 |
| Net tonnage | 2,118 | | 1,790 | | 4,822 | | 8,730 | |
| Launches under 5 tons | 39 | 47,860 | 16 | 20,527 | 18 | 27,851 | 73 | 96,238 |
| Sailing | 8 | 214,000 | 11 | 412,236 | 34 | 864,932 | 53 | 1,491,168 |
| Net tonnage | 10,131 | | 19,844 | | 41,856 | | 77,831 | |
| Boats, sail and row | 636 | 45,241 | 442 | 41,832 | 1,056 | 207,688 | 2,134 | 294,761 |
| Lighters | 242 | 121,112 | 188 | 119,666 | 145 | 163,852 | 575 | 404,630 |
| Pile drivers | 38 | 124,363 | 31 | 86,316 | 19 | 41,375 | 88 | 252,054 |
| Apparatus: | | | | | | | | |
| Haul seines | 60 | 14,200 | 47 | 17,385 | | | 107 | 31,585 |
| Fathoms | 7,419 | | 11,449 | | | | 18,868 | |
| Purse seines | 184 | 81,767 | 6 | 4,221 | 6 | 4,164 | 196 | 90,152 |
| Fathoms | 33,432 | | 1,130 | | 1,440 | | 36,002 | |
| Gill nets | 257 | 30,477 | 183 | 17,064 | 1,624 | 192,883 | 2,064 | 240,424 |
| Fathoms | 62,175 | | 19,495 | | 234,981 | | 316,651 | |
| Traps, driven | 127 | 872,039 | 84 | 271,538 | 13 | 19,369 | 224 | 662,946 |
| Traps, floating | 36 | 92,553 | | | | | 36 | 92,553 |
| Dip nets | 18 | 29 | | | | | 18 | 29 |
| Total | | 11,946,974 | | 5,920,255 | | 13,474,441 | | 31,341,670 |

## PERSONS ENGAGED IN THE SALMON-CANNING INDUSTRY IN 1913.

| Occupations and races. | Southeast Alaska. | Central Alaska. | Western Alaska. | Total. |
|---|---|---|---|---|
| Fishermen: | | | | |
| Whites | 584 | 752 | 2,027 | 3,363 |
| Indians | 1,157 | 220 | 45 | 1,422 |
| Japanese | 2 | | | 2 |
| Miscellaneous [a] | 2 | | | 2 |
| Total | 1,745 | 972 | 2,072 | 4,789 |
| Shoresmen: | | | | |
| Whites | 1,157 | 474 | 1,520 | 3,151 |
| Indians | 1,431 | 265 | 475 | 2,171 |
| Chinese | 865 | 328 | 857 | 2,050 |
| Japanese | 787 | 252 | 571 | 1,610 |
| Miscellaneous [a] | 336 | 316 | 1,257 | 1,909 |
| Total | 4,576 | 1,635 | 4,680 | 10,891 |
| Transporters: | | | | |
| Whites | 293 | 171 | 360 | 824 |
| Indians | 2 | 6 | 1 | 9 |
| Total | 295 | 177 | 361 | 833 |
| Grand total: | | | | |
| Whites | 2,034 | 1,397 | 3,907 | 7,338 |
| Indians | 2,590 | 491 | 521 | 3,602 |
| Chinese | 865 | 328 | 857 | 2,050 |
| Japanese | 789 | 252 | 571 | 1,612 |
| Miscellaneous [a] | 338 | 316 | 1,257 | 1,911 |
| Total | 6,616 | 2,784 | 7,113 | 16,513 |

[a] Filipinos, Mexicans, negroes, Porto Ricans, etc., are included under the miscellaneous heads.

OUTPUT OF CANNED SALMON IN 1913, BY SPECIES AND SIZE OF CASES.[a]

| Products. | Southeast Alaska. | | Central Alaska. | | Western Alaska. | | Total. | |
|---|---|---|---|---|---|---|---|---|
| | *Cases.* | *Value.* | *Cases.* | *Value.* | *Cases.* | *Value.* | *Cases.* | *Value.* |
| Coho, or silver: | | | | | | | | |
| ½-pound flat | 3,587 | $20,038 | | | | | 3,587 | $20,038 |
| 1-pound flat | 266 | 1,058 | | | | | 266 | 1,058 |
| 1-pound tall | 52,643 | 175,750 | 13,244 | $44,582 | 6,039 | $20,226 | 71,926 | 240,558 |
| Total | 56,496 | 196,846 | 13,244 | 44,582 | 6,039 | 20,226 | 75,779 | 261,654 |
| Dog, or chum: | | | | | | | | |
| ½-pound flat | 985 | 2,968 | | | | | 985 | 2,968 |
| 1-pound flat | 2,619 | 7,333 | | | | | 2,619 | 7,333 |
| 1-pound tall | 254,040 | 553,053 | 5,038 | 11,118 | 28,236 | 69,476 | 287,314 | 633,647 |
| Total | 257,644 | 563,354 | 5,038 | 11,118 | 28,236 | 69,476 | 290,918 | 643,948 |
| Humpback, or pink: | | | | | | | | |
| ½-pound flat | 20,822 | 87,198 | | | | | 20,822 | 87,198 |
| 1-pound flat | 3,258 | 9,375 | | | | | 2,258 | 9,375 |
| 1-pound tall | 1,265,657 | 3,241,633 | 49,309 | 126,360 | 33,835 | 86,021 | 1,348,801 | 3,454,014 |
| Total | 1,289,737 | 3,338,206 | 49,309 | 126,360 | 33,835 | 86,021 | 1,372,881 | 3,550,587 |
| King, or spring: | | | | | | | | |
| ½-pound flat | 369 | 2,701 | | | 1,216 | 7,786 | 1,585 | 10,487 |
| 1-pound tall | 841 | 2,698 | 15,393 | 61,882 | 16,551 | 63,986 | 32,785 | 128,566 |
| Total | 1,210 | 5,399 | 15,393 | 61,882 | 17,767 | 71,772 | 34,370 | 139,053 |
| Red, or sockeye: | | | | | | | | |
| ½-pound flat | 19,936 | 150,467 | 4,957 | 33,401 | 4,148 | 36,014 | 29,041 | 219,882 |
| 1-pound flat | 11,735 | 63,034 | | | | | 11,735 | 63,034 |
| 1-pound tall | 146,140 | 668,256 | 359,308 | 1,638,311 | 1,419,013 | 6,346,879 | 1,924,461 | 8,653,446 |
| Total | 177,811 | 881,757 | 364,265 | 1,671,712 | 1,423,161 | 6,382,893 | 1,965,237 | 8,936,362 |
| Grand total | 1,782,898 | 4,985,562 | 447,249 | 1,915,654 | 1,509,038 | 6,630,388 | 3,739,185 | 13,531,604 |

[a] Half-pound cases contain 48 ½-pound cans, but for convenience in comparing with the 1-pound cases, which contain 48 cans, they have been reduced one-half in number, thus equaling in weight the 1-pound cases.

OUTPUT OF CANNED SALMON, 1907–1913.[a]

| Products. | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | Total. |
|---|---|---|---|---|---|---|---|---|
| | *Cases.* | *Cases.* | *Cases.* | *Cases.* | *Cases.* | *Cases.* | *Cases.* | *Cases.* |
| Coho, or silver: | | | | | | | | |
| ½-pound flat | 485 | 105 | | 163 | 1,574 | 2,719 | 3,587 | 8,633 |
| 1-pound flat | 3,933 | 2,414 | 1,206 | 2,249 | 1,075 | 17 | 266 | 11,160 |
| 1-pound tall | 80,772 | 66,309 | 55,350 | 111,614 | 131,259 | 163,462 | 71,926 | 680,692 |
| Total | 85,190 | 68,828 | 56,556 | 114,026 | 133,908 | 166,198 | 75,779 | 700,485 |
| Dog, or chum: | | | | | | | | |
| ½-pound flat | 246 | | | | | 2,795 | 985 | 4,026 |
| 1-pound flat | 664 | 107 | | | 7,245 | | 2,619 | 10,635 |
| 1-pound tall | 183,262 | 218,406 | 120,712 | 254,218 | 316,550 | 661,838 | 287,314 | 2,042,300 |
| Total | 184,172 | 218,513 | 120,712 | 254,218 | 323,795 | 664,633 | 290,918 | 2,056,961 |
| Humpback, or pink: | | | | | | | | |
| ½-pound flat | 8,795 | | | 3,188 | 4,836 | 13,712 | 20,822 | 51,353 |
| 1-pound flat | 7,406 | 569 | | 7,900 | 9,437 | | 3,258 | 28,570 |
| 1-pound tall | 545,772 | 643,564 | 464,873 | 543,233 | 991,005 | 1,266,426 | 1,348,801 | 5,803,674 |
| Total | 561,973 | 644,133 | 464,873 | 554,321 | 1,005,278 | 1,280,138 | 1,372,881 | 5,883,597 |
| King, or spring: | | | | | | | | |
| ½-pound flat | 14 | 62 | | 54 | 67 | 5,151 | 1,585 | 6,933 |
| 1 pound tall | 43,410 | 23,667 | 48,034 | 40,167 | 45,451 | 38,166 | 32,785 | 271,680 |
| Total | 43,424 | 23,729 | 48,034 | 40,221 | 45,518 | 43,317 | 34,370 | 278,613 |
| Red, or sockeye: | | | | | | | | |
| ½-pound flat | 22,692 | 10,909 | 8,193 | 22,320 | 13,601 | 28,024 | 29,041 | 134,780 |
| 1-pound flat | 29,821 | 26,950 | 85,193 | 39,941 | 4,967 | 16,242 | 11,735 | 214,849 |
| 1-pound tall | 1,242,600 | 1,613,911 | 1,611,916 | 1,388,006 | 1,296,750 | 1,856,089 | 1,924,461 | 10,933,733 |
| Total | 1,295,113 | 1,651,770 | 1,705,302 | 1,450,267 | 1,315,318 | 1,900,355 | 1,965,237 | 11,283,362 |
| Grand total | 2,169,872 | 2,606,973 | 2,395,477 | 2,413,053 | 2,823,817 | 4,054,641 | 3,739,185 | 20,203,018 |

[a] The ½-pound cans have been reduced one-half in number and treated as 1-pound cans.

AVERAGE ANNUAL PRICE PER CASE OF 48 1-POUND TALL CANS OF SALMON, 1905–1913.

| Product. | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 |
|---|---|---|---|---|---|---|---|---|---|
| Coho, or silver | $3.20 | $3.63 | $3.91 | $3.98 | $4.07 | $4.89 | $5.67 | $4.44 | $3.45 |
| Dog, or chum | 2.69 | 2.87 | 2.97 | 2.53 | 2.28 | 3.04 | 3.72 | 2.37 | 2.21 |
| Humpback, or pink | 2.95 | 3.00 | 3.16 | 2.69 | 2.40 | 3.15 | 3.94 | 2.55 | 2.58 |
| King, or spring | 3.28 | 3.78 | 4.18 | 4.20 | 4.32 | 5.34 | 6.48 | 5.37 | 4.04 |
| Red, or sockeye | 3.38 | 3.77 | 4.59 | 4.52 | 4.53 | 5.30 | 6.33 | 5.45 | 4.54 |

## MILD CURING.

### EXTENT AND METHODS.

In the salmon fisheries of Alaska, the process of mild curing takes rank second only to that of canning. As a result of the successful season in mild-cure operation during 1912, an unusual interest in this field was exhibited during the spring and early summer of 1913. Various new stations were built, and a greatly increased fleet of both power boats and hand trollers began operations in April.

As was the case last season, the Forrester Island grounds proved very attractive. This island is in a Federal bird reserve and is under the control of the Department of Agriculture. New regulations were promulgated by that Department in respect to fishing privileges within the reserved waters about the island, and Game Warden Cooper was stationed there to enforce the regulations. Also Dr. Harold Heath, of Stanford University, spent most of the season on the island making a study of its birds, fishes, and mammals.

The additional restrictions imposed this year as to fishing operations about Forrester Island limited the total number of power-boat permits in effect at one time to 25. Also no permits were issued for any boat not conforming absolutely with the navigational requirements of the Department of Commerce. And, in addition, no permit was to be continued in force in the case of a person not abiding by the rules of the fishing camp. Permits were also denied aliens who desired to fish near the island.

A total of 398 rowboat permits were issued, though the highest number in force at one time was 341. All told, 34 power-boat licenses were granted. A number of power boats defied the authority of the warden and fished in the restricted area without permission, disappearing before they could be apprehended. Another year an additional officer ought to be stationed at the island, and a seaworthy power boat should be provided for his use. This season several permits were revoked for various causes, and the former holders were forced to leave the island.

No lives were lost this season, though there were a number of narrow escapes. Several of the small boats were dashed to pieces upon the rocks or were carried away during heavy blows. On account of the exposed position of Forrester Island, and the heavy weather frequently experienced, it is not possible to fish more than four days a week on the average. A fund of about $600 was collected from the fishermen to construct a runway to facilitate the landing of the small boats. Prior to this many had been badly pounded on the rocky shore as they landed in the swell or through the surf.

Operations began May 3 and officially came to a close August 12, though a few hand boats remained several days longer. The low price obtained for mild-cured salmon shortened the season.

The best day's catch reported by any one hand troller was 52 king salmon, while the high boat for the season caught fish to the value of $650. The most successful power trolling boat caught $1,150 worth of salmon thoughout the season. The price paid the fishermen was $1 for red-meated and 30 cents each for white-meated fish. Five companies engaged in buying fish at the island; the fish were taken by run vessels to the shore stations on Prince of Wales and Dall Islands.

Various fishing camps were established this season at the newly developed trolling grounds north of Forrester Island, in the vicinity of Noyes, San Lorenzo, San Pedro, Anguilla, Baker, and other islands of the region. Also the older grounds on the inside reaches at Cape Fanshaw, Union Bay, Cape Camaano, Point Baker, and other places were fished extensively. But aside from the Forrester Island operations, the greatest activity in king salmon troll fishing centered at Port Conclusion and at Port Alexander, a few miles above Cape Ommaney. This is the first season that operations have been conducted here on an extensive scale. The development of this region is in line with the tendency of the last two seasons or so to get nearer to the sea to anticipate the incoming run of salmon.

Fishing operations began about April 15, and, aside from a few boats, the season ended the middle of July. The best catches were made during the latter half of May and through the month of June. There is also a fall season along in September and October, but the low price did not warrant fall fishing this season. The constant tendency of king salmon trollers to shift from place to place makes it difficult to get exact figures as to the number of boats operating. The best estimates for the Cape Ommaney region, however, are 300 power boats of all sizes and descriptions, and 400 hand trolling boats. So numerous were the fishermen that not infrequently salmon were snagged as the boats moved back and forth. As a matter of fact, the field was overworked, and but few had a profitable season.

The power trollers fish more with spoons than bait, hence nearer the surface. The result is that they take more small fish than do the hand boat trollers, who use herring for bait more frequently and catch most of their fish 10 or 12 fathoms below the surface. There is no definite rule in the form of lure, as some days spoons appear to be preferable while at other times bait does better. In taking a hook, it is said that the salmon do not strike directly from the rear as the lure moves slowly through the water, but instead they circle and take it head on as it moves toward them. Fishermen think that this supposed tendency results in the considerable number of snagged fish for which the power trollers are responsible. As a matter of fact, it is difficult to slow down the power boats as much as should be, and for this reason they are apt to snag fish. A speed of 2 miles an hour is fast enough. Drags are sometimes used to reduce speed.

Undoubtedly as a proper means of catching king salmon the power boat is less desirable than the hand trolling boat. In the case of the latter practically every fish hooked is landed, instead of the many that are torn from the hooks of the power-boat fishermen. Some of the larger power boats had as many as 10 lines out at one time—2 from the mast, 4 from outriggers, and 2 each from 2 skiffs towed behind.

The fishing gear for trolling usually consists of an Ewell-Stewart no. 7 spoon, with either a no. 10 or no. 11 hook. Above the spoon and swivel is a twisted wire snell about 3 feet long, and above this is placed the lead sinker. Ordinarily 100 feet of line is used. The favorite size is 48-thread hard-laid tanned line. Sinkers varying in weight from 1 to 7 pounds are used by the hand trollers, while sometimes the power boats use weights of as much as 12 or 15 pounds. As a rule the power boats do not fish with heavy enough sinkers, and this also applies in a measure to hand trollers. Tests show that the larger fish are caught 10 or 12 fathoms below the surface. They were notably small this year, the average in the Cape Ommaney region being approximately 17 pounds as taken from the water. One salmon weighing 66 pounds was noted, but many were taken weighing only 5 or 6 pounds, or even less.

Most of the buyers paid the fishermen $1 each for red meated kings and 30 cents for white meated, regardless of size. On the Taku the fishermen received 4½ cents a pound for red meated and 1½ cents a pound for white meated kings. One company in the Cape Ommaney region paid 4 cents a pound for reds and 30 cents each for whites; another concern part of the time paid 5 cents a pound for reds and 2 cents a pound for whites. Where the fishermen took out tierces and salt and packed the fish themselves, the prevailing price was 11 cents a pound for fletches weighing 8 pounds each or more; 7 cents a pound for the medium-sized sides of 6 to 8 pounds; and 3 cents a pound for the sides running under 6 pounds each. Fish caught by the hand trollers were regarded more highly by the buyers than those taken by the power boats. A better price was sometimes paid to the hand trollers.

There was a good run of kings in the Taku this year; also the traps in Icy Strait caught quite a few kings the early part of June. For a first-class mild-cure product it is necessary to handle the fish gently at all times. This rule was not observed faithfully in the case of some of the trap fish, and the result was that the sides or fletches showed broken or ruptured spots in the tissues of the flesh. The gill-net fish from the Taku did not show these ruptures. The red-meated kings from the Taku were mild-cured, while most of the white-meated kind were frozen. It is said by some that king salmon from the Taku command a better price in the German markets, to which much of the mild-cured product goes, as they seem to have a brighter appearance than those from other places. In the Taku region the percentage of whites is higher some seasons than others, but on the average it is about 15 per cent. The records of one company show that for a period of two weeks in 1910 nearly 48 per cent of the king salmon received were white-meated. Taking a fair average of southeast Alaska as a whole, the catch of white-meated kings runs about 18 per cent. The catch of whites is heaviest during the early part of the season.

In the general method of mild-curing king salmon at the shore stations, the fish are placed on a table with the heads projecting over the edge. One man then cuts off the heads and the fish are scored four or five times on each side so as to permit of better curing. The next step is the removal of the viscera, following which a longitudinal cut is made just above the backbone the entire length of the body, and a similar cut is made just below the backbone. This divides the fish into two sides or fletches, and the backbone and tail are thrown away. In order to command the best price it is necessary to have each side weigh 8 pounds or upwards. The medium grade as to size runs from 6 to 8 pounds, while the smalls are under 6 pounds. For each 800-pound tierce it takes on the average 70 sides or fletches of the larger size. In the case of the mediums the average is 120 sides per tierce, while the smalls run about 180 sides. Sometimes when the fish run extra small they are opened up but not split into two sides. The fletches are placed carefully in the tierces in layers of salt, and after being headed up, the tierces are turned on their sides, which causes the fletches to be on edge and thus allows the brine to get in more effectively between them. After about 12 days the tierces are opened and the fletches are sorted and repacked in fresh brine, ready for shipment. They must at all times be kept in a cool temperature.

It not infrequently happens that the so-called mild-cured king salmon of Alaska is in reality more of a hard-pickled product. On the Columbia River, where salting is light and the fish are kept at a temperature of about 35 degrees, a truly mild-cured product is the result, but in Alaska where tierces and salt are taken out by fishermen who have little knowledge of the process and have no cooling facilities, it is necessary to use about one-third more salt, and the resultant product almost passes from the mild-cure classification. This, of course, does not apply to the shore stations where fish are delivered in the round and are so packed as to insure a high-grade mild-cured product. The heavier production this season, together with the poorer quality of the rather carelessly prepared power-boat pack, resulted in so lowering the price that, taken as a whole, returns have not been satisfactory. Also, in this connection it must be noted that the cost of production was greater this year, since most of the fish were purchased at the flat rate of $1 each, irrespective of size, and it so happened that the average weight was considerably lower than in the past. Instead of the usual average of about 45 fish to a tierce, this season's general averages show that it took approximately 55 king salmon to fill a tierce.

*Principal mild-cure plants.*—With four plants in operation, Engelbr. Wiese (Inc.) was engaged more extensively in the mild-cure business than any other concern in Alaska this season. The station at Ketchikan was operated the same as last year, but the plant at Howkan was superseded by a new establishment at Waterfall on the west coast of Prince of Wales Island, which location is more convenient to the fishing grounds. This is a large plant with suitable cold-storage machinery and storage capacity for about 300 tierces. The Wiese company also built a new mild-cure station this season at Port Conclusion, a few miles north of the king salmon trolling ground about Cape Ommaney. A 2½-ton ice-plant and storage facilities for 200 tierces were provided. The fourth Wiese plant was at Hoonah, where a new building erected for the purpose was leased from the Hoonah Packing Co. King salmon from the Icy Strait traps were mild cured at this establishment.

Another concern operating extensively in the mild-cure field in Alaska was the Vendsyssal Packing Co., with headquarters at the former whaling station at Tyee. This company also engaged in mild-cure work at Sitka. The Columbia & Northern Fishing & Packing Co. engaged heavily in mild-cure operations, and in addition to the main plant at Wrangell a floating receiving station was utilized at Port Alexander near the lower end of Baranof Island, where fish were received for transfer to Wrangell. The Pacific Coast & Norway Packing Co. had a mild-cure station at Cape Fanshaw. Cold-room facilities for 200 tierces were provided. Ice from a near-by glacier was used for cooling purposes. Still another extensive operator in the mild-cure business was J. Lindenberger (Inc.), at Craig. Ample cold-storage and freezing facilities were afforded at this plant.

A new mild-cure station was built and operated in conjunction with the cannery of the North Pacific Trading & Packing Co. at Klawak. The facilities include cold-room capacity for 250 tierces and a 2-ton ice machine. The cannery operated last year at Warm Chuck by Swift, Arthur & Co., was used this year as a mild-cure station. The company was reorganized under the name of the Swift-Arthur-Crosby Co. (Inc.). A 2½-ton ice machine was put in, together with a refrigerating room of 250 tierces capacity.

Other more important operators in mild-cure work in southeast Alaska this season included the Diamond T Packing Co., of Ketchikan, with also a floating auxiliary plant at Dall Island, and the Taku Canning & Cold Storage Co., at Taku Harbor. The Sanborn-Cram Co. at Burnett Inlet also put up mild-cure salmon before the canning season opened, and the Kake Packing Co. was likewise engaged at Kake. M. E. Lane put up mild-cure salmon at Union Bay, as did also Gottfried Friedrichs at Wrangell. M. B. Dahl had a floating plant at Karheen and Port Alexander, and S. B. Reynolds, of Ketchikan, also operated a floating plant of considerable importance. A floating plant devoted chiefly to mild-cure and herring work was operated on the steamer *Neptune* in the Cape Fanshaw district by the recently organized Toledo Fish Co. Another company organized this year was the Alaska Cooperative Fishing & Packing Co., composed chiefly of business men and fishermen of Wrangell. A plant was erected at the latter place with storage facilities for 200 tierces of salmon. So far operations have been confined to the handling of mild-cure salmon, but later it is expected that other branches of the industry will be entered. In addition to those mentioned above, there were various other less extensive operators in the mild-cure business in southeast Alaska.

In the Dry Bay region, Capt. Malcolm Campbell, of Juneau, engaged in mild-cure operations on the schooner *Standard Fish Co. No. 2*. The fish were taken by means of gill nets, and it is notable that out of a pack of 77 tierces none of the white-meated variety was observed. The small steamer *Dolphin*, operated by John Berg, got a few tierces of kings and a few barrels of sockeyes in the vicinity of Dry Bay.

Central Alaska came into the mild-cure work this year to a more notable extent than heretofore. A few tierces of king salmon were mild cured by L. Mikkelson at Abercrombie, which place is 55 miles out from Cordova on the Copper River & Northwestern Railroad. His principal business was salting red salmon. The Alganik Fish Co. mild cured a few tierces of king salmon in the same region. This season is the first for mild-cure work on the Copper River. In the Cook Inlet country J. A. Herbert, of Seldovia, engaged for the first time this season in mild-cure operations. The fish came chiefly from two traps driven at favorable locations in Cook Inlet. The Puget

Sound & Alaska Fish Co., organized this year at Seattle, sent the schooner *Allie I. Algar* to Cook Inlet, where a successful season was spent mild curing king salmon.

The power schooner *Bender Bros.* was operated by J. E. Shields, of Seattle, in mild-curing operations on the Kuskokwim River in western Alaska. Although more than 150 tierces were packed, the undertaking was not considered a success. The fish did not have the much-desired bright silvery appearance; also, in order to keep the product from spoiling, it was necessary to salt too heavily for mild curing. In the central and western Alaska regions the lack of cold-storage facilities is a bar against effective mild-cure work. It either becomes necessary practically to hard-pickle the salmon or else run the risk of spoiling on account of a lack of proper means of cooling. As in Bering Sea and Cook Inlet waters practically all of the king salmon are red meated.

### STATISTICAL SUMMARY.

The investment in mild-cure work this year was $1,165,866, as compared with $326,152 in 1912. Although there was a very notable advance in mild-cure operations this year, part of the gain in investment is due to the inclusion of working capital, which item was not shown in the previous report. The number of fixed plants increased from 15 in 1912 to 20 in 1913. The number of persons engaged increased from 779 in 1912 to 2,644 in 1913. This gain was largely of white fishermen in southeast Alaska. The total product of mild-cured salmon increased from 5,245 tierces in 1912, valued at $399,852, to 7,443 tierces in 1913, valued at $543,362, a gain of 2,198 tierces and $144,510 in value.

INVESTMENT IN THE SALMON MILD-CURING INDUSTRY IN 1913.

| Items. | Southeast Alaska. | | Central Alaska. | | Western Alaska. | | Total. | |
|---|---|---|---|---|---|---|---|---|
| | *No.* | *Value.* | *No.* | *Value.* | *No.* | *Value.* | *No.* | *Value.* |
| Fixed plants | 20 | $147,335 | 1 | $500 | 1 | $3,000 | 22 | $150,835 |
| Operating capital | | 427,000 | | 17,500 | | 5,000 | | 449,500 |
| Vessels: | | | | | | | | |
| Power vessels over 5 tons | 41 | 143,600 | 2 | 9,500 | 1 | 12,000 | 44 | 165,100 |
| Net tonnage | 641 | | 114 | | 91 | | 846 | |
| Launches under 5 tons | 516 | 300,190 | | | 2 | 600 | 518 | 300,790 |
| Sailing | | | 1 | 4,500 | | | 1 | 4,500 |
| Net tonnage | | | 150 | | | | 150 | |
| Boats, sail and row | 1,490 | 46,967 | 6 | 460 | 7 | 245 | 1,503 | 47,672 |
| Lighters and scows | 11 | 8,350 | 2 | 1,500 | | | 13 | 9,850 |
| Pile drivers | | | 1 | 2,000 | | | 1 | 2,000 |
| Gear: | | | | | | | | |
| Haul seines | 4 | 375 | | | | | 4 | 375 |
| Fathoms | 350 | | | | | | 350 | |
| Purse seines | 6 | 2,100 | | | | | 6 | 2,100 |
| Fathoms | 690 | | | | | | 690 | |
| Gill nets | 268 | 20,850 | 4 | 400 | 22 | 750 | 294 | 22,000 |
| Fathoms | 28,630 | | 400 | | 650 | | 29,680 | |
| Hand lines | 5,511 | 11,144 | | | | | 5,511 | 11,144 |
| Total | | 1,107,911 | | 36,360 | | 21,595 | | 1,165,866 |

PERSONS ENGAGED IN THE SALMON MILD-CURING INDUSTRY IN 1913.

| Occupations and races. | Southeast Alaska. | Central Alaska. | Western Alaska. | Total. |
|---|---|---|---|---|
| Fishermen: | | | | |
| Whites | 2,087 | 21 | 5 | 2,113 |
| Indians | 272 | ........ | ........ | 272 |
| Shoresmen: | | | | |
| Whites | 134 | 2 | 7 | 143 |
| Indians | 10 | 5 | 40 | 55 |
| Chinese | ........ | ........ | 1 | 1 |
| Transporters: | | | | |
| Whites | 46 | 8 | 2 | 56 |
| Indians | ........ | 4 | ........ | 4 |
| Total | 2,549 | 40 | 55 | 2,644 |

PRODUCTS OF THE SALMON MILD-CURING INDUSTRY IN 1913.

| Species. | Number tierces. | Pounds. | Value. |
|---|---|---|---|
| Southeast Alaska: | | | |
| King salmon | 6,787 | 5,476,364 | $504,382 |
| Coho salmon | [a] 286 | 233,697 | 11,195 |
| Total | 7,073 | 5,710,061 | 515,577 |
| Central Alaska: King salmon | 219 | 177,850 | 17,785 |
| Western Alaska: King salmon | 151 | 124,575 | 10,000 |
| Total: | | | |
| King salmon | 7,157 | 5,778,789 | 532,167 |
| Coho salmon | 286 | 233,697 | 11,195 |
| Grand total | 7,443 | 6,012,486 | 543,362 |

[a] Includes 6 tierces chum salmon.

## PICKLED SALMON.

Early in the season prospects for a remunerative return on pickled salmon were so unalluring that interest in this field of endeavor was much lessened. This was particularly true of southeast Alaska, where mild-cure operations and the demands for canning diverted attention from the pickling of salmon. As a matter of fact, the only concern in southeast Alaska engaged in a strictly pickling venture this season was the Holbrook Fishing & Packing Co. In central Alaska there was considerable activity along this line, although the Cordova Fish Packers Association, which was organized in 1912 and put up a good sized pack of salt salmon, did not operate this year. Saltery operations were conducted near Katalla, at Abercrombie (on the Copper River), at Eshamy Bay, at Seward, and at two salteries in the Kodiak region. It was in western Alaska that the greatest activity in salt salmon occurred. The heavy run of reds, and the overtaxing of canning facilities stimulated salting operations very perceptibly.

The saltery doing business under the name of the Lagoon Salmon Co., at Nelson Lagoon in western Alaska, was operated again this season by Libby, McNeill & Libby under option of purchase. This company also acquired the saltery on the Igushik River formerly owned by the Alaska Fishermen's Packing Co.

The Port Heiden Packing Co. this year operated for the first time a salting station at Port Heiden, using the brigantine *Harriet G.* (188 tons) as a base of operations. Salting has been carried on at this place from time to time in a desultory manner, but never heretofore with any reputed degree of financial success.

This year Peter M. Nelson, whose former salting station on the Igushik River was absorbed by the Alaska Fishermen's Packing Co. in 1910, built and operated successfully a small plant of similar character near Kogiung. Some of the material for this plant was brought from the old Bear River saltery near Port Moller.

### SALMON BELLIES.

There has been more activity in putting up salmon bellies this year than for a season or so past. The supply has not been equal to the demand, and there has been resort to the plan of cutting bellies from pickled salmon. In southeast Alaska, where interest waned in the canning of chums this season, a profitable utilization of bellies might have been made. The chum belly is larger and better than the humpback belly. At one plant in southeast Alaska chum bellies were put up and the backs were dry salted for exportation to the Orient.

In view of the fact that during the past season the business of pickling salmon bellies has shown a marked increase, it seems proper again to invite attention to an order promulgated by the Commissioner of Fisheries on April 18, 1908, directing attention to the necessity of disposing of the remaining edible portion of the fish when bellies are pickled.

The order in question is as follows:

#### NOTICE TO PACKERS OF SALMON IN ALASKA.

It is desired to call the attention of all packers of salmon in Alaska to section 8 of the act for the protection of the fisheries of Alaska, approved June 26, 1906, which reads as follows:

"SEC. 8. That it shall be unlawful for any person, company, or corporation wantonly to waste or destroy salmon or other food fishes taken or caught in any of the waters of Alaska."

The present methods of preparing the bellies of salmon for the market involve the waste of a large part of the edible portion of the fish. It is believed that this waste is contrary to the spirit and letter of the above provision. The Secretary of Commerce and Labor, who is charged with the enforcement of the Alaska fisheries act, has notified this Bureau that the practice of curing and preserving the so-called belly of the salmon which results in the waste of a large proportion of the edible portion of the fish, is a wanton waste within the meaning of section 8 above, and that after January 1, 1909, those who engage in this practice will be reported for prosecution, as provided for in the act.

From the foregoing it will be noted that the law does not forbid the preparation of salmon bellies, but it forbids waste of good material, which has frequently occurred in the past.

Favorite methods of disposing of the remaining portion of the fish are dry-salting or use for dog food.

### Statistical Summary.

There were 24 salteries in operation this year as compared with 26 in 1912, and the number of persons employed was lessened from 538 to 478. The investment, however, shows an increase from $387,565 in 1912 to $445,377 in 1913. The production was larger this year, but brought a smaller price. In 1912 the production was 34,639 barrels, valued at $306,534, while in 1913 it was 38,332 barrels, valued at $279,249. Approximately 77 per cent of the product this year was prepared in the Bristol Bay region.

#### Investment in the Salmon Pickling Industry in 1913.

| Items. | Southeast Alaska. | | Central Alaska. | | Western Alaska. | | Total. | |
|---|---|---|---|---|---|---|---|---|
| | *No.* | *Value.* | *No.* | *Value.* | *No.* | *Value.* | *No.* | *Value.* |
| Salteries | 7 | $28,697 | 11 | $24,150 | 6 | $83,500 | 24 | $136,347 |
| Operating capital | | 17,600 | | 31,100 | | 129,000 | | 177,700 |
| Vessels: | | | | | | | | |
| Power vessels over 5 tons | 3 | 9,500 | 3 | 21,000 | 3 | 16,800 | 9 | 47,300 |
| Net tonnage | 61 | | 68 | | 34 | | 163 | |
| Launches under 5 tons | 2 | 2,000 | 2 | 1,000 | 2 | 3,650 | 6 | 6,650 |
| Sailing | | | | | 4 | 26,500 | 4 | 26,500 |
| Net tonnage | | | | | 1,287 | | 1,287 | |
| Boats, sail and row | 17 | 595 | 46 | 2,780 | 59 | 9,680 | 122 | 13,055 |
| Lighters and scows | 4 | 1,200 | 2 | 1,600 | 17 | 7,840 | 23 | 10,640 |
| Pile drivers | | | 1 | 800 | 3 | 5,000 | 4 | 5,800 |
| Gear: | | | | | | | | |
| Haul seines | 5 | 780 | 16 | 1,955 | 1 | 100 | 22 | 2,835 |
| Fathoms | 475 | | 1,400 | | 75 | | 1,950 | |
| Purse seines | 2 | 650 | | | 1 | 600 | 3 | 1,250 |
| Fathoms | 275 | | | | 175 | | 450 | |
| Gill nets | 9 | 415 | 40 | 2,443 | 65 | 6,410 | 114 | 9,268 |
| Fathoms | 535 | | 2,980 | | 8,640 | | 12,155 | |
| Traps, driven | | | 1 | 2,000 | 4 | 6,000 | 5 | 8,000 |
| Dip nets | 1 | 2 | 6 | 30 | | | 7 | 32 |
| Total | | 61,439 | | 88,858 | | 295,080 | | 445,377 |

#### Persons Engaged in the Salmon-Pickling Industry in 1913.

| Occupations and races. | Southeast Alaska. | Central Alaska. | Western Alaska. | Total. |
|---|---|---|---|---|
| Fishermen: | | | | |
| Whites | 16 | 43 | 90 | 149 |
| Natives | 12 | 64 | 21 | 97 |
| Total | 28 | 107 | 111 | 246 |
| Shoresmen: | | | | |
| Whites | 12 | 22 | 102 | 136 |
| Natives | 25 | 24 | 34 | 83 |
| Japanese | 2 | 1 | | 3 |
| Total | 39 | 47 | 136 | 222 |
| Transporters: | | | | |
| Whites | | 1 | 3 | 4 |
| Natives | | 5 | 1 | 6 |
| Total | | 6 | 4 | 10 |
| Grand total | 67 | 160 | 251 | 478 |

BARRELS[a] OF SALMON PICKLED IN 1913, BY SPECIES.

| Products. | Southeast Alaska. | | Central Alaska. | | Western Alaska. | | Total. | |
|---|---|---|---|---|---|---|---|---|
| | No. | Value. | No. | Value. | No. | Value. | No. | Value. |
| Coho, or silver | 476 | $2,980 | 88 | $734 | 442 | $2,738 | 1,006 | $6,452 |
| Coho bellies | ..... | ..... | 38 | 706 | 16 | 240 | 54 | 946 |
| Dog, or chum | 95 | 760 | ..... | ..... | 5 | 18 | 100 | 778 |
| Chum bellies | 59 | 775 | 1 | 16 | 7 | 150 | 67 | 941 |
| Humpback, or pink | 2,289 | 15,635 | 435 | 2,546 | ..... | ..... | 2,724 | 18,181 |
| Humpback bellies | 284 | 4,065 | 40 | 481 | ..... | ..... | 324 | 4,546 |
| King, or spring | ..... | ..... | 26 | 260 | 109 | 1,150 | 135 | 1,410 |
| Red, or sockeye | 69 | 598 | 5,091 | 36,610 | 28,756 | 208,697 | 33,916 | 245,905 |
| Red bellies | ..... | ..... | 6 | 90 | ..... | ..... | 6 | 90 |
| Total | 3,272 | 24,813 | 5,725 | 41,443 | 29,335 | 212,993 | 38,332 | 279,249 |

[a] Barrels holding 200 pounds of fish.

## FRESH SALMON.

### SHIPPED FROM ALASKA.

As for several years past, considerable attention was devoted during 1913 to the shipment of fresh salmon to Puget Sound from Petersburg, Wrangell, Juneau, and Ketchikan. The fish are packed in ice in boxes holding about 450 pounds and are handled by the regular steamship lines. This year shows a falling off in the quantity of salmon handled in a fresh state, which condition may be explained by the fact that other means of disposal have seemed to offer a more substantial return. The records show that during 1913 shipments of fresh salmon from Alaska aggregated 645,956 pounds, valued at $51,727. In 1912 shipments totaled 1,188,649 pounds, valued at $87,463.

### MARKETED LOCALLY IN ALASKA.

No definite figures are available as to the exact quantity of fresh fish distributed and consumed in Alaska through the local markets. With the increase of population, particularly in certain sections of southeast Alaska, this industry has grown to considerable proportions. Careful estimates place the total consumption of fresh fish purchased either at local markets or from fishermen at 500,000 pounds, valued at $40,000. Of this, 50 per cent is halibut, 35 per cent salmon, and 15 per cent is miscellaneous fishes, including black cod, herring, bass, and other species. Local prices vary from an average of 7 cents per pound for halibut to 10 or 12 cents for salmon.

## FROZEN SALMON.

The freezing of Alaska salmon was carried on in connection with other cold-storage business at several different plants in Alaska. These included the Taku Canning & Cold Storage Co. at Taku Harbor, J. Lindenberger (Inc.) at Craig, the New England Fish Co. at Ketchikan, and the Columbia & Northern Fishing & Packing Co. at Wrangell, which establishments operated prior to this year, and the new plants of the Juneau Cold Storage Co. at Juneau, the Booth Fisheries Co. at Sitka, and the floating cold-storage ship, *Glory of the Seas*, operated by the Glacier Fisheries Co. at Idaho Inlet. Another cold-storage plant is now in process of construction at Ketchikan. The Weiding & Independent Fisheries Co., which had the combined floating cannery and cold-storage ship *William H. Smith* at Saginaw Bay last season, was the only withdrawal from the frozen-fish field in Alaska this year.

In freezing salmon it is essential that they be sleek and smooth, as a bruised appearance makes them unprofitable to market. For this reason it is better to freeze salmon that are caught in traps, as they are less apt to be marred in handling than those taken in seines and other gear.

During 1913 salmon were frozen to the extent of 701,418 pounds, valued at $28,057. This is a gain of 250,359 pounds and $7,770 in value as compared with 1912.

SALMON FROZEN IN ALASKA IN 1913.

| Species. | Pounds. | Value. |
|---|---|---|
| Coho salmon | 340,908 | $16,425 |
| Dog salmon | 330,537 | 10,406 |
| King salmon | 29,973 | 1,226 |
| Total | 701,418 | 28,057 |

## MINOR PRESERVING PROCESSES.

### SPECIAL PRODUCTS.

Though there is a strong modern-day tendency to specialize in food products along the line of novelties put up in attractive and fancy ways, the field of special fishery products has not been developed proportionately with others. This is particularly true as regards combination products having fish as the chief constituent. The notable exception so far as Alaska is concerned, has been the work of the Revilla Fish Products Co. at Ketchikan, where, in 1912, several thousand cases of fish pudding, smoked salmon loaf, smoked fish loaf, deviled halibut, and canned halibut were put up. In addition to the salmon, cod, or halibut which formed the base of these preparations, cereals, oils, and spices were used. This company is the first to engage in the preparation of these products, and their high grade and attractive appearance warrant a hearty reception at the hands of the public. The chief difficulty to date has been a lack of proper advertising to acquaint the trade and market with the merits of the product. With a little more time and means to advertise and demonstrate these specialties, a good trade ought to be built up. The Revilla Fish Products Co. did not operate during the season of 1913.

Another special product that might be prepared is salmon caviare. The process involved consists of salting, screening, and packing the roe in glass jars with a tin top, or in other suitable containers. A wholesome product can be prepared profitably and at a price that will put it within common reach. A small quantity was prepared this year.

### Kippered Salmon.

A field which would seem susceptible of profitable and extensive expansion, particularly in southeast Alaska, is the smoking or kippering of salmon, perhaps largely the white-meated fish. Neither as a mild-cured nor as a canned product does the white king command a price commensurate with its real value as compared with its more favored kin of higher color. Therefore, in casting about for means of utilizing the white king to better advantage, consideration might well be given the plan of preparing a smoked or kippered product. A ready market is assured.

Last year William E. Lloyd, of Wrangell, prepared a limited amount of this very palatable salmon product, and this year the work was prosecuted somewhat more vigorously. Local demands are about all that have been taken account of so far. This season C. B. Ferguson, of Craig, smoked 5,900 pounds of salmon, valued at $498.

As a feature of its new plant at Juneau, the Juneau Cold Storage Co. has installed a large and substantial smokehouse, where it is intended to prepare various kippered products.

### Dry Salt Salmon.

At M. E. Lane's saltery at Union Bay, 100,000 pounds of pink and chum salmon backs were dry-salted for the oriental market. This work was incidental to the salting of bellies, and was adopted as a means of utilizing the backs. The Admiralty Trading Co. dry-salted 5,282 pounds of chum salmon, and at Metlakahtla 16,000 pounds of pink backs were similarly prepared by John Davis. The total value of the dry salt salmon products this year was $1,235.

### Salmon Fishing on the Yukon.

Salmon constitutes the principal diet of many of the natives of interior Alaska. Without the salmon run to depend upon, the lower Yukon natives could not exist, as there is but little other food obtainable. On the Yukon above Kokrines, and on the Tanana, the natives also live principally upon salmon, but they have in addition a variety of big game with which the salmon diet may be supplemented. During their long journey up the Yukon, as far as the Tanana and other tributary streams, the salmon as a rule become quite thin and the flesh loses its rich and oily characteristic. This is especially true during the latter part of the season. In consequence, the fish are not much esteemed by the white population for use in a fresh state except early in the season.

On the Tanana and Yukon as far down as Nulato small fish wheels are almost entirely used in the capture of salmon, but from Anvik down various rather primitive styles of traps are used. In either case they are usually placed near some rocky point or curve in the river. In the vicinity of Nome a few small seines are used by the Eskimos. The fish taken by the latter are consumed locally. Early in June, soon after the break-up of the rivers, nearly every family of natives starts for the site of its intended fish wheel or trap, as the case may be. The bucks put in the fishing apparatus, after which it is attended by the squaws, who also clean and smoke or otherwise prepare the fish. From June 10 to 15 the king salmon, the first fish of the season, begins to run. This run lasts about a month, and each Indian catches on the average anywhere from 60 to 125 fish. In July the runs of coho and dog salmon begin, and continue until well along in August. It is estimated that during the season an Indian will catch from 300 to 600 coho and from 1,200 to 1,500 dog salmon. A white man will catch several times as many fish as a native, but there are very few white fishermen engaged. They are mostly squaw-men who live and catch their fish near some white settlement where they can dispose of them for dog feed.

Practically all of the salmon caught in the interior of Alaska are smoked and dried, though early in the season a few are sold fresh. The Indians sell the best fish of their catch and eat the remainder or feed it to their dogs. The salmon as dried and sold for dog feed are handled by traders who retail this commodity at prices ranging from 10 to 12½ cents per pound. Most of the fish sold to whites for human consumption are lightly smoked.

## HALIBUT FISHERY.

### CONDITIONS AND PROSPECTS.

The commercial value of the halibut fishery of the Pacific now greatly exceeds that of the Atlantic, and in Alaska, as in British Columbia, it is second in importance only to the salmon fishery.

The great size of the halibut, the trifling loss of weight in dressing for market, and the generally remunerative price which it commands render its pursuit attractive to the fisherman, while its clean, white, firm-grained flesh and its capacity to withstand much handling and distant shipment, also its susceptibility of preservation in a fresh state for extended periods without serious loss in palatable flavor, find favor alike with dealer and consumer.

In food value the halibut has high rank. Compared with meat its low price and minimum of waste in preparing for the table combine to make it a favorite with an ever-increasing number of consumers. For some years a prejudice against cold-storage halibut from so distant a source as the North Pacific had a tendency to deter its extended use in the Eastern States, but, as a result primarliy of the care exercised in handling and transporting, this has been entirely overcome. The growth of the trade has since been remarkable, with every prospect of a steady continuance under the present methods of distribution.

Judged by statistics of shipments, the Pacific halibut shows no decline in abundance, yet the fact remains that for some years past larger vessels of increasing power and steaming radius have become necessary to supply the market requirements. The greater part of the halibut brought into Pacific ports formerly originated from that wonderful network of channels and fiords which cut into the coasts of British Columbia and southeast Alaska. Now, however, the most important supply is from grounds off the outer coasts, and these grounds are being steadily developed at points more and more remote from the home ports. Small power craft continue to deliver quantities of halibut yielded by the banks of the inner channels, but it is generally conceded that the maximum of their productivity has been reached if not, in some instances, actually passed. While Frederick Sound, Chatham Strait, and Icy Strait, in their wider reaches, continue to receive attention from a few of the larger craft, one of the present favorite grounds for the best-found vessels is that off Yakutat. During the past few months explorations have been carried on by practical fishermen in the Prince William Sound district, and their favorable reports lead to the belief that a considerable development of the industry may follow in that region.

It is a general belief that there is little waste in the halibut fishery, but this is not strictly true. Halibut are almost exclusively caught on trawl or ground lines, which, equipped with hundreds of hooks, are set out from dories in great lengths over the bottom. At intervals, as the weather permits, the lines are under-run, the catch removed, hooks rebaited, and the lines reset, this work also being done from dories. After careful inquiry among halibut fishermen themselves, it is believed to be a safe estimate that for every halibut caught at least one other fish of more or less value as food is taken from the hooks. With those rare exceptions when black cod are retained, all these fish are thrown back into the sea, either dead or soon to perish. Except in so far as they may become food for other species, they may be regarded as a total economic loss. The fishermen have so little space in their dories that they seldom give the cheaper fishes boat room, yet a great many of them have distinct market value. The most abundant are the red rockfishes and the black cod, with the former predominating in number when all grounds are considered. True cod are found in largest numbers where the depletion of halibut is most pronounced; and deep-sea soles, flounders, and skates are most numerous on a muddy bottom. It is certain that the total quantity of these fishes at present wasted is enormous in the aggregate; in weight it is probably at least one-half that of the halibut itself. That such a situation should not long be allowed to continue is obvious.

Stormy weather, during which it is too rough to work from dories, occurs very frequently during the winter months, and it often happens that a large quantity of gear set out is never recovered. In the meantime the baited hooks resting on the bottom continue to lure and capture fish which are never brought to the surface, and which inevitably come to a miserable end. How important a factor this condition is in the depletion of the grounds is problematical, but in those regions most subject to unfavorable weather it certainly must contribute in no little degree to the threatened future of the fishery. Fishermen freely admit heavy losses of gear, and do not deny that the results of such losses can not help being felt in time. The intervals of fair weather are so infrequent during the period in the region under discussion that every moment when dory fishing may be carried on is taken advantage of, and frequently lines are laid out on the mere chance that they may be recovered later, notwithstanding that all signs point to the contrary.

As a result of this, and probably due in part also to the establishment of cold-storage plants in close proximity to the more prolific fishing localities, another change in the type of vessels and their methods has been inaugurated. This latest development is toward a reduction in the size, power, and cost of maintenance of halibut cruisers. The idea is that they shall be sufficiently large to remain at sea in moderately heavy weather, such as when trawl-line work from dories would be unsafe, and at such times to set, under-run, and reset the lines from the main craft itself. To this end the power "gurdy," a sort of winch for lifting the ground line from the bottom, has been devised and may be expected to come more and more into general use. As the employment of power entails a greater strain on the gear handled, the tendency is toward the use of heavier ground lines, and one dealer in Seattle has already laid in a supply of 36-pound stuff to take the place of the 30 and 32 pound articles at present in vogue.

That a further development of the halibut fishing industry may be expected with the opening of the Panama Canal is not improbable. It is reported that agents of certain Atlantic steamship lines are already planning to equip vessels with cold-storage accommodations of several hundred tons capacity each, with a view to the transportation of choice fish from north Pacific ports to European markets. With so potential an expansion of market demands, it seems not unreasonable to suppose that the present waste of the food fishes taken incidentally with the halibut may be nullified if present tendencies to save them develop in the manner hoped for. Where the lines are lifted from the bottom by power and the catch is landed on the deck of the cruiser itself there is no reason why all food fishes should not be struck into the hold and carried to a cold-storage plant adjacent to the fishing ground, there to be cared for until shipment to the distributing centers.

In the matter of cold storage and freezing the halibut industry has made notable advances in southeast Alaska this year. The thoroughly wholesome condition and appetizing appearance of the frozen halibut, with its thin coating of clear ice which effects an absolute hermetical sealing, is bringing this fish to the popular attention it rightly deserves.

Three new companies have engaged in cold-storage halibut operations this year as the chief feature of their business. These are the Juneau Cold Storage Co. at Juneau; the Booth Fisheries Co. at Sitka; and the floating plant of the Glacier Fisheries Co. on the ship *Glory of the Seas,* located at Idaho Inlet. The Columbia & Northern Fishing & Packing Co. at Wrangell has also extended its business this year to include cold-storage facilities. Other concerns which engaged again this year in cold storage and other operations were the New England Fish Company at Ketchikan; Taku Canning & Cold Storage Co. at Taku Harbor; and J. Lindenberger (Inc.) at Craig. The combined cold-storage and canning plant operated last year by the Weiding & Independent Fisheries Co. on the ship *William H. Smith* was not sent north this season. The schooner *Metha Nelson,* which did cold-storage work in the vicinity of Kodiak last year, was not operated this season.

The new plant of the Booth Fisheries Co. at Sitka appears to be very favorably located as regards proximity to the halibut grounds. A modern plant has been erected with storage capacity of 500,000 pounds; two sharp freezers have been installed with a total daily capacity of 25,000 pounds. Announcement has been made that the plant will be enlarged soon.

In addition to other features of its business, the Juneau Cold Storage Co. has storage capacity of upwards of 300,000 pounds of frozen fish. A 14-ton ice plant has been installed and there is storage space for 150 tons of ice. Although the principal business of the Columbia & Northern Fishing & Packing Co. at Wrangell this season has been the mild curing of king salmon, a considerable quantity of halibut has been frozen. A sharp freezer of 10 tons capacity has been installed and there is storage room for 150,000 pounds of frozen fish.

A very complete cold-storage plant was installed by the Glacier Fisheries Co. on the ship *Glory of the Seas*, which vessel during the last two years has been operated as a floating cannery. The daily capacity of the sharp freezers is 60,000 pounds, while the total cold-storage facilities will enable the handling of approximately 3,000,000 pounds. The vessel was towed to Idaho Inlet in June and was brought back to Seattle in the fall with the season's product. The Taku Canning & Cold Storage Co. at Taku Harbor has storage capacity for approximately 450,000 pounds of fish. This concern utilized, in part, the barge *Dashing Wave* in connection with its cold-storage operations. The largest cold-storage plant in Alaska is that of the New England Fish Co. at Ketchikan, which now has facilities for handling 100,000 pounds daily and a total storage capacity of 6,000,000 pounds.

In connection with what has been said elsewhere concerning the utlization of those products of the fisheries now generally regarded as waste, it may not be out of place to call attention to the very considerable quantity of nutritive material which is a part of the head of the halibut. In northwestern Europe this is considered the choicest part of the fish and many delicacies are prepared from it. If the heads of the large numbers of halibut taken in Alaska could reach the hands of such establishments as the Revilla Fish Products Co., at Ketchikan, where various special fishery preparations have already been put on the market, it would appear that a further value might accrue to the halibut fishery.

While fresh and frozen herring continue to be the favorite bait for halibut on the offshore grounds, also on the inside banks during the winter months, it has been found that fresh salmon is a superior attraction in the regions adjacent to the canneries and salteries during the salmon-packing season. At this time the halibut are enticed from distant points, probably by the offal from the packing establishments, and as long as the canning season continues a hook baited with a liberal piece of salmon is said to surpass all other lures.

The serious strike of halibut fishermen operating chiefly from headquarters on Puget Sound, which began on November 14, 1912, was amicably terminated about the first of February of the present year. Since this time no further labor disturbances have occurred.

The only serious disaster to the halibut fleet during the season of 1913 was the loss of the steamer *Weiding*, formerly the *Weiding Bros.*, of Seattle (120 net tons), which was sunk off the Queen Charlotte Islands on July 23. No lives were lost. Weather conditions were remarkably favorable to halibut-fishing operations until early in September, subsequent to which an unusual series of storms succeeded each other to the close of the year.

While vague and unconfirmed reports of halibut poaching by Canadian fishermen in American waters have been heard from time to time, it is not believed that it has been indulged in to any considerable extent. On the other hand, complaint is made that American fishermen are not accorded the same measure of accommodation in transit that is granted to the Canadians. The most common demur is that while British vessels regularly take on fuel, bait, and other supplies in Alaskan ports, similar practices by Americans are discouraged by the Canadian authorities. It is understood that a bill permitting American fishing vessels to enter British Columbia ports to take on bait is now before the provincial parliament. It is to be hoped that the bill may become a law.

During December, 1913, one of the revenue cutters gave attention to the question of whether alien vessels were taking halibut within the 3-mile limit on the lately developed banks between Yakutat and Prince William Sound. It was found that most of the fish are taken in depths of from 40 fathoms to the 100-fathom curve, which in this region are at least 3 miles offshore.

### STATISTICAL SUMMARY.

On account of the entrance of four new companies in the halibut-freezing business and the construction of new vessels the investment in halibut operations increased from $2,036,050 in 1912 to $2,360,025 in 1913, a gain of $323,975. The number of persons engaged also increased from 1,038 in 1912 to 1,256 in 1913, a gain of 218 persons. More activity was displayed this year by small power boats operating on the inside reaches. These small boats fished chiefly for the cold-storage plants. Returns show that the weight of prepared halibut products credited to Alaska in 1913 is 13,437,784 pounds as compared with 16,896,743 pounds in 1912, a decrease of 3,458,959 pounds. The figures shown refer to all vessels fishing for plants operated in Alaska, as well as those vessels from Puget Sound fishing in Alaska waters, with the exception that catches from extra-territorial waters of Alaska landed directly at Puget Sound ports by the fishing vessels are not included.

INVESTMENT IN THE ALASKA HALIBUT FISHERIES IN 1913.

| Items. | Number. | Value. |
|---|---|---|
| Fishing vessels, steamer and power | 162 | $1,212,000 |
| Tonnage | 3,327 | |
| Outfit | | 582,225 |
| Boats: | | |
| Dories | 441 | 22,050 |
| Sail | 6 | 575 |
| Apparatus: Trawls and fishing gear | | 73,175 |
| Shore and fixed property | | 470,000 |
| Total | | 2,360,025 |

PERSONS ENGAGED IN THE ALASKA HALIBUT FISHERIES IN 1913.

| Races. | Number. |
|---|---|
| Whites | 1,216 |
| Natives | 40 |
| Total | 1,256 |

PRODUCTS OF THE ALASKA HALIBUT FISHERIES IN 1913.

| Products. | Pounds.[a] | Value. |
|---|---|---|
| Halibut: | | |
| Fresh | 3,642,163 | $114,277 |
| Frozen | 9,987,310 | 454,320 |
| Dry salted | 21,159 | 830 |
| Fletched | 37,152 | 1,887 |
| Total | 13,687,784 | 571,314 |

[a] Prepared weight.

## COD FISHERY.

The cod industry in Alaska waters has been in a flourishing condition this year. All vessels took full fares, and the shore stations did well. This may be accounted for largely by the fact that, taken as a whole, weather conditions for the inside operations at the shore stations, also in Bering Sea, were unusually favorable. The offshore vessel catch in the Pacific, however, was considerably lessened by heavy weather.

One man was lost from the schooner *Fanny Dutard*, of the Matheson Fisheries Co., and the Union Fish Co. lost a man from one of its shore stations.

### VESSEL FISHERY.

On the night of March 29, returning from the Alaska shore stations with a cargo of 145,000 codfish, the schooner *John D. Spreckels*, operated by the Alaska Codfish Co., was run down off the California coast by the steamship *Statesman* and lost. A heavy fog was responsible for the disaster. Two seamen on the schooner were crushed to death. The cargo also was lost.

The Pacific Coast Codfish Co. operated for the first time this season the 328-ton schooner *Charles R. Wilson*. This company also had the the schooner *John A.*, which has been in service for several seasons. Operations were confined to sea fishing. The Blom Codfish Co. did not send the schooner *Fortuna* north this year.

Early in the season the Union Fish Co. equipped the schooner *Vega* (233 tons) and the power schooner *Union Jack* (39 tons) with trawl lines designed on the general plan of halibut trawls. Virtually the entire catch of these vessels was made in this way. Each dory with two men used 14 ground lines to a set, each ground line being 50 fathoms long and having 75 hooks. The *Vega* fished outside in water as deep as 120 fathoms, while the *Union Jack* operated on the inside Shumagin banks in from 50 to 70 fathoms of water.

Later in the season an Atwood net lifter operated by a 4-horsepower gasoline engine was installed on the *Union Jack* and was found to operate very successfully in lifting the trawls. This type of lifter is much the same as that employed on the Great Lakes for handling gill nets in lake trout and whitefish operations. A marked advantage of using the lifter in Alaska for cod work is that since the entire operation is from the deck of the vessel, it can be continued when heavy weather makes dory fishing impossible.

In its cod operations the Union Fish Co. also experimented successfully with gill nets set on the bottom in from 50 to 70 fathoms. About 7½ inches appears to be the best size of mesh. Each net was 125 yards long and 15½ meshes deep and heavily leaded. Special cedar floats were used, but since they get waterlogged an aluminum float is better.

Plans are under way for the experimental use this winter of a small beam trawl in the central Alaska cod fishery.

The following vessels were operated in connection with the Alaska cod fishery this year:

ALASKA COD FLEET, 1913.

| Names. | Class. | Net tonnage. | Operators. |
|---|---|---|---|
| Fanny Dutard | Schooner | 252 | Matheson Fisheries Co., Anacortes, Wash. |
| Maid of Orleans | do | 171 | Do. |
| Alice | do | 220 | Robinson Fisheries Co., Anacortes, Wash. |
| John A | do | 235 | Pacific Coast Codfish Co., Seattle, Wash. |
| Charles R. Wilson | do | 328 | Do. |
| W. H. Dimond | do | 376 | Alaska Codfish Co., San Francisco, Cal. |
| John D. Spreckels [a] | do | 253 | Do. |
| City of Papeete | Barkentine | 370 | Do. |
| Nonpareil | Power schooner | 31 | Do. |
| Ottilie Fjord | Schooner | 247 | Pacific States Trading Co., San Francisco Cal. |
| Bertha Dolbeer [b] | do | 230 | Do. |
| Vega | do | 233 | Union Fish Co., San Francisco, Cal. |
| Galileo | do | 328 | Do. |
| Sequoia [b] | do | 324 | Do. |
| Golden State [b] | Power schooner | 223 | Do. |
| Union Jack | do | 39 | Do. |
| Volcano | Schooner | 17 | Do. |
| Martha | do | 14 | Do. |
| Union Flag | Power schooner | 7 | Do. |

[a] Wrecked Mar. 29, 1913. [b] Transporting vessels.

SHORE STATIONS.

Shore stations were situated as follows: Alaska Codfish Co.: Unga, Squaw Harbor, and Kellys Rock, on Unga Island; Companys Harbor and Murphys Cove, on Sannak Island; and Dora Harbor, on Unimak

Island. John H. Nelson: Squaw Harbor, Unga Island. R. H. Johnson: Hard Scratch, Unga Island. Pacific States Trading Co.: Northwest Harbor, Herendeen Island. Union Fish Co.: Pirate Cove, Popof Island; Northwest Harbor, Herendeen Island; Pavlof Harbor and Johnson Harbor on Sannak Island; Unga, on Unga Island; and Dora Harbor, on Unimak Island.

Summarizing the foregoing, the Alaska Codfish Co. and the Union Fish Co. each operated six shore stations, while the Pacific States Trading Co., John H. Nelson, and R. H. Johnson had one each. Of this total of 15 stations, 6 were on Unga Island, 4 on Sannak Island, 2 each on Herendeen and Unimak Islands, and 1 on Popof Island.

The business of R. H. Johnson and John H. Nelson, whose plants are on Unga Island, was largely the preparation of stockfish. This is a hard-dried form of cod, and is usually shipped in bales. In southeast Alaska the Kake Packing Co. experimented with the canning of cod. It is said that a very attractive product was prepared. The results bespeak further endeavor along this line.

The price of cod has been strong this season, owing chiefly to light catches on the east coast.

## STATISTICAL SUMMARY.

The statistics relating to the foregoing vessels are included in the tables. Up to last year figures for vessels have been in part omitted.

The total investment in the cod fishery in 1913, inclusive of both offshore vessel and shore station operations, was $581,107, as against $274,674 for 1912. The increase is due to the addition of vessels to the fleet, enlarged production, and the inclusion of approximately $150,000 more cash capital. The number of persons engaged was 531, including 5 natives and 1 Japanese. This is a gain of 46 persons over 1912. Figures for persons employed at the plants in the States are not included.

The catch totaled 11,916,500 pounds of prepared products, valued at $357,711. This shows a substantial gain over the 1912 production of 8,064,853 pounds, valued at $218,268.

INVESTMENT IN THE COD FISHERY IN ALASKA IN 1913.

| Items. | Number. | Value. | Items. | Number. | Value. |
|---|---|---|---|---|---|
| Vessels: | | | Apparatus: | | |
| Power vessels | 4 | $80,000 | Hand lines | 977 | 1,406 |
| Tonnage | 290 | | Trawl lines | | 700 |
| Launches under 5 tons | 3 | 3,200 | Gill nets | 100 | 1,500 |
| Sailing vessels | 15 | 142,100 | Cash capital | | 214,851 |
| Tonnage | 3,622 | | Value shore stations | | 122,020 |
| Boats, row | 400 | 14,730 | Total | | 581,107 |

PERSONS ENGAGED IN THE ALASKA COD FISHERIES IN 1913.

| Occupations and races. | Number. | Occupations and races. | Number. |
|---|---|---|---|
| Fishermen: | | Transporters: | |
| Whites | 424 | Whites | 53 |
| Natives | 5 | Japanese | 1 |
| Total | 429 | Total | 54 |
| Shoresmen: Whites | 48 | Grand total | 531 |

PRODUCTS OF ALASKA COD FISHERIES IN 1913.

| Products. | Prepared weight. | Value. |
|---|---|---|
| | *Pounds.* | |
| Salted | 11,885,500 | $355,992 |
| Pickled | 15,700 | 624 |
| Tongues, pickled | 8,000 | 720 |
| Stock fish | 7,700 | 375 |
| Total | 11,916,900 | 357,711 |

## HERRING FISHERY.

### GENERAL CONDITIONS.

It is the consensus of opinion that herring have been more numerous this season in the waters of Alaska, and especially in the southeast section aside from the Yes Bay region, than for a number of years past. At no time heretofore has there been anything like an alarming shortage, but as in the case of the herring fishery the world over, there are periodical lean and full years. It not infrequently happens that during the poorer years alarming reports arise to the effect that the supply of herring is being diminished through ruthless fishing operations. Particularly has this view been cited against the practice of utilizing herring in the manufacture of fertilizer and oil.

That this opinion is not borne out in fact has been clearly established by careful and impartial analysis of the situation. So far as Alaska is concerned, the destruction of countless millions of herring in embryo by the natives, who use large quantities of impregnated eggs for food purposes, is a more destructive agency than the use of the adult fish for fertilizer purposes. The natives place brush on the spawning grounds by means of which to remove the eggs. Measures should be taken to prohibit this.

The halibut fishermen are particularly interested in the herring situation, because of the dependence of their industry upon the supply of herring for bait. Much of the agitation as to the fertilizer and oil question has emanated from this source. Unless future developments show radically different conditions as compared with other parts of the world where time has been the infallible test, there will be not only enough herring in Alaska waters to meet present day needs, both for bait and fertilizer, but will also permit of an expansion along these lines as well as a growth of the food herring industry.

Herring of the sort desired are found at times in great numbers in the coves and estuaries of Frederick Sound and the lower part of Stephens Passage, and, to a lesser extent, are reported in Summer Strait and the southern part of Chatham Strait. They are best in September, October, and November, but by January have usually lost so much fat as to be unfit for the preparation of a high-grade product. In July and August also the southeast Alaska herring are in prime condition, but at that time it is a popular belief that they can not be cured in salt owing to the fact that their stomachs are then engorged with a small crustacean popularly known as "red feed." Much has been said about the impossibility of salting herring which have been subsisting upon red feed, and the statements of John E. Shields, who has had a large practical experience as a fish salter, are of particular interest in this connection. According to Mr. Shields all first-class pickled herring should have the viscera completely removed. If this is done he contends that it makes no difference what the stomach contents may have been—there is no remaining obstacle to a thorough salt cure. He states that it is possible to eviscerate herring in a commercially practical manner by using the nose of a knife, not too sharp, with which to pinch out a section of the throat.

Too much stress can not be laid upon the necessity for careful attention to detail in the preparation of all fishery products intended for use as food. This applies with particular force to salt herring. Too often there has been much carelessness in handling herring. Strictly fresh fish of uniform size, properly eviscerated and thoroughly cured are absolutely essential to a wholesome preserved product. Stale fish, irregular sizes, indifferent curing and packing, and short weights have been the causes for the poor demand hitherto prevailing for Alaska salt herring. With improved methods of preparation and handling now in vogue, a steadily increasing market should be the certain result.

There has been in recent years a growth of the herring industry in the Shumagin Islands and vicinity. The herring of this region, like those occurring in Chignik Bay and Shelikof Strait, are exceptionally large and at times very fat. In size some of these fish are extraordinary, running as large as 200 per barrel, although they will average more often 250. In many of the larger harbors of the eastern islands of the Aleutian chain, notably in Unalaska Bay and Akun Cove, very large and fat herring are known to occur at times in enormous schools, and in Goodnews Bay, near the mouth of the Kuskokwim River, immense numbers of fine fish of the same sort are reported as appearing regularly.

In the Shumagin Island region Ross Boye and others put up several hundred barrels of salted herring. At Craig, in southeast Alaska, C. B. Ferguson smoked several thousand pounds of herring. At various cold-storage plants large quantities have been frozen for halibut bait, the New England Fish Co., at Ketchikan, having engaged in this phase of the work more heavily than any other concern. The fish used by this company come chiefly from the north Behm Canal region. It is well recognized that frozen herring are in every way equal to fresh herring for halibut bait. Salted herring are, however, much inferior for this purpose.

The Griffiths Fish Co. operated extensively in the salt-herring industry during the fall and winter of the current season. The barges *America* (1,908 tons) and *Louisiana* (1,436 tons) were anchored at Convenient Cove and used as floating plants. Fishing operations were conducted in Yes Bay, Spacious Bay, and other near-by waters of the Behm Canal region. The work was carried on mainly by Japanese. Capt. A. W. Thomas and H. Sundsby were also engaged extensively in herring operations in this section.

Although the season was shorter, the catch of herring by the Killisnoo plant was very satisfactory this year. The price of both oil and fertilizer has improved somewhat because of the light take of menhaden on the east coast this season. Part of the fertilizer product has found ready market at San Francisco for use as the base of a very good form of chicken feed. For this purpose particular attention must be paid to reducing the content of oil as low as possible.

Last January at Klawak on the west coast of Prince of Wales Island there occurred an unusually enormous run of herring. So numerous were the fish as they crowded into the bay that hundreds of thousands or even millions were stranded and suffocated. When the tide receded they were left in a solid mass over the beach to a depth in places of several feet. This is an evidence of the abundance of herring in southeast Alaska during the current year.

In Norway a custom has long existed of setting a net across the mouth of a favorable arm of the sea or bay for the purpose of impounding schools of herring. The fish are thus kept alive and may be removed at leisure. There has been a recent tendency among fishermen familiar with this custom of northern Europe to apply it in the herring fishery of southeast Alaska. A specific case occurring in the vicinity of Petersburg last winter resulted in the arrest of a fisherman, Rasmus Enge, who was charged by another fisherman, Nels Husvig, with grand larceny on the ground that the said Enge seined up 2,000 barrels of herring within a lagoon where they had been impounded by the net stretched from shore to shore by Husvig. The matter was finally settled out of court.

The case is peculiar, in that it was Husvig, the complainant, who was guilty of violating the law, though probably through ignorance, for the fisheries law of Alaska prohibits the casting of a net or fishing appliance for more than one-third the distance across any body of water. The inhibitory distance clause appears in section 4 of the act of June 26, 1906, in reference to salmon fishing, but section 11 of the same act extends all of the limitations affecting salmon to other species, which, of course, includes herring. So long as the present law is in effect, any stretching of seines or other nets from shore to shore in the waters of Alaska for the purpose of impounding herring or other food fishes as herein described will in future result in prosecution of the person or persons involved.

Considerable agitation occurred near the close of the year at Craig, on the west coast of Prince of Wales Island, on account of alleged wasteful practices upon the part of nonresident fishermen engaged in herring operations. It was claimed that only the largest and best herring were retained, while the others were thrown away. An investigation of the matter by Deputy Warden Walker resulted in a fine of $200 being imposed December 22 upon Nels Husvig.

Under the chapter on whaling, elsewhere in the report, will be found a discussion of the erroneous popular impression that the killing of whales has an injurious effect upon fishing operations, especially in the case of herring.

### STATISTICAL SUMMARY.

The statistics show a decline in the herring fishery of 1913 as compared with 1912, which latter year was particularly good. The total investment for 1913 was $261,480, as compared with $338,890 in 1912, a falling off this year of $77,410. The number of persons engaged in 1913 was 200 as against 339 in 1912. The value of the products declined from $239,278 in 1912 to $191,105 in 1913, a reduction of $48,173.

INVESTMENT IN THE HERRING FISHERY IN ALASKA IN 1913.

| Items. | Southeast Alaska. | | Central Alaska. | | Total. | |
|---|---|---|---|---|---|---|
| | *Number.* | *Value.* | *Number.* | *Value.* | *Number.* | *Value.* |
| Fishing vessels: | | | | | | |
| Steamers and launches | 9 | $37,700 | | | 9 | $37,700 |
| Tonnage | 209 | | | | 209 | |
| Sailing | 2 | 26,000 | | | 2 | 26,000 |
| Tonnage | 3,251 | | | | 3,251 | |
| Launches under 5 tons | 5 | 5,700 | | | 5 | 5,700 |
| Boats, sail and row | 19 | 1,675 | 6 | $180 | 25 | 1,855 |
| Scows | 8 | 4,800 | | | 8 | 4,800 |
| Pile drivers | 2 | 1,000 | | | 2 | 1,000 |
| Apparatus: | | | | | | |
| Haul seines | 2 | 150 | | | 2 | 150 |
| Purse seines | 14 | 9,800 | | | 14 | 9,800 |
| Gill nets | 4 | 250 | 14 | 375 | 18 | 625 |
| Traps, stake | 2 | 1,400 | | | 2 | 1,400 |
| Cash capital | | 115,250 | | | | 115,250 |
| Shore and accessory property | | 56,000 | | 1,200 | | 57,200 |
| Total | | 259,725 | | 1,755 | | 261,480 |

PERSONS ENGAGED IN THE ALASKA HERRING FISHERIES IN 1913.

| Occupations and races. | Southeast Alaska. | Central Alaska. | Total. |
|---|---|---|---|
| Fishermen: | | | |
| Whites | 54 | 7 | 61 |
| Japanese | 18 | | 18 |
| Total | 72 | 7 | 79 |
| Shoresmen: | | | |
| Whites | 78 | | 78 |
| Japanese | 33 | | 33 |
| Chinese | 10 | | 10 |
| Total | 121 | | 121 |
| Grand total | 193 | 7 | 200 |

PRODUCTS OF ALASKA HERRING FISHERIES IN 1913.

| Products. | Southeast Alaska. | | Central Alaska. | | Total. | |
|---|---|---|---|---|---|---|
| | *Quantity.* | *Value.* | *Quantity.* | *Value.* | *Quantity.* | *Value.* |
| Herring: | | | | | | |
| Fresh, for bait ........pounds.. | 3,936,500 | $22,245 | | | 3,936,500 | $22,245 |
| Frozen, for bait..........do.... | 231,935 | 2,291 | | | 231,935 | 2,291 |
| Pickled, for food.......barrels.. | 3,036 | 23,223 | 426 | $3,609 | 3,462 | 26,832 |
| Pickled, for bait..........do.... | 1,381 | 3,297 | | | 1,381 | 3,297 |
| Dry-salted, for food...pounds.. | 5,259,520 | 50,183 | | | 5,259,520 | 50,183 |
| Fertilizer ..................do.... | 2,400,000 | 33,000 | | | 2,400,000 | 33,000 |
| Oil ....................gallons.. | 260,000 | 52,000 | | | 260,000 | 52,000 |
| Smoked, for food......pounds.. | 17,371 | 1,257 | | | 17,371 | 1,257 |
| Total | | 187,496 | | 3,609 | | 191,105 |

## WHALE FISHERY.

### SHORE STATION OPERATIONS.

On account of unprofitable returns in 1912, but one concern operated a shore whaling station in Alaska during the season of 1913. This was the United States Whaling Co., whose plant is located at Port Armstrong near the southern end of Baranof Island. The station built on Akutan Island in 1912 by the Alaska Whaling Co. was not operated this year. Likewise operations of the Tyee Co. were suspended. In fact this company has been dissolved, the shore station at Tyee having passed into the hands of the Vendsyssal Packing Co., which used it for mild-curing salmon this season.

Last year the United States Whaling Co. had the Norwegian steamer *Somerstadt* (2,777 tons) as a floating plant auxiliary to the shore station at Port Armstrong. This vessel put in part of the season at the Shumagin Islands. This year operations were confined solely to the Port Armstrong plant. The company operated the killing boats, *Star I*, 133 tons net burden, and the *Star II* and *Star III*, each of 97 net tons. Their normal cruising radius did not extend more than 60 miles from the station. It was observed that whales in this region almost always move in a general northerly direction.

The killing boats are of the modern type common to whale fishing. At the bow of each is mounted a muzzle-loading whale gun of 3¼-inch bore. These guns are now fitted with recoil cylinders, which is an improvement over the original form of Svend Foyn gun. The charge of black powder in a bag is first put in, then a bunch of waste, and next the harpoon, to which is attached the line leading back to the steam winches which are made to play a whale after it is struck, in manner similar to that of the angler who plays his catch. Outside the gun and made a part of the harpoon is the bomb, with expanding arms and so timed as to explode within the whale. The average shooting distance is about 120 feet. In rough weather it is difficult to hit a whale on account of motion both of the vessel and the animal, and this factor has much to do with the success or failure of whaling operations. Unfavorable weather was experienced, particularly during the early part of this season's operations.

Sperm whales generally run in schools. One day, July 24, the three killing boats got 11 sperms, which considerably overtaxed the station's capacity. Sperms are more indifferent to the approach of a vessel; hence are easiest to kill. Heretofore the trouble has been a scarcity of this species, which is exceeded in value only by the great bowhead of the Arctic.

In 1912, when the United States Whaling Co. established its station at Port Armstrong, arrangements were not made to dispose of any portion of the carcasses other than the blubber and gill bone. With the advent of the season of 1913 the plant was much enlarged and additional machinery was installed, so that all of each carcass could be utilized. This process includes the preparation of oil from the blubber, also from the meat and bones, and the reduction of the residue to fertilizer. In anticipation of the installation of fertilizer machinery in 1913, the carcasses of whales taken in 1912, after being stripped of their blubber, were cut up and piled out of doors near the plant. The material thus accumulated was worked up this season into fertilizer, though much of its value was lost through action of the elements.

The plant as it now stands is capable of handling 500 whales a season. The main building is 200 by 80 feet, in addition to which is a large warehouse for storage of fertilizer. There are also quarters for employees and various minor buildings.

When a whale is to be processed, it is hauled up by a winch on an inclined platform, and the blubber is torn off in strips, also by means of a winch, flensing knives having first been run along the body of the animal to cut the strips. The blubber is then cut up by revolving knives and is lifted in a conveyor to the blubber boilers, which are of open-top pattern, about 6 feet in diameter and 12 feet high. Steam is turned into these boilers or cookers for six or eight hours, after which the oil is drawn off and the mass is similarly cooked again. Sometimes even three cookings are required to obtain all of the oil. Blubber varies in this respect. The oil comes out at the lower end of the boilers and is pumped to the settling tanks, where it remains 24 hours or more and is then barreled for shipment.

After the blubber has been removed a winch hauls the carcass up a steep incline to the upper floor of the main building, which is level with the tops of the 15 meat boilers (each 8 by 10 feet), and the 4 bone boilers (each 10 by 12 feet), which stand on end. Armed with long flensing knives, a crew of Japanese cut up the meat into 30 or 40 pound chunks and it is put into the meat boilers. Tops are screwed fast to these boilers, and the mass is given one cooking for 8 or 10 hours at a pressure of 65 pounds. The oil is drawn off on one side at the bottom, while on the other side is a door through which the residue of solids is removed. It then goes to the drier for conversion into fertilizer.

After the carcass has been cut up, a process which takes 10 men 6 or 8 hours in the case of a good-sized whale, the bones are put into the bone boilers, where they are given a single cooking in steam lasting from 20 to 24 hours, also under a pressure of 65 pounds. The bones are rich in oil which grades as no. 2, whereas the oil from the meat is poorer in quality and grades as no. 3. The bones when taken from the boiler are light in weight and of porous appearance. They go to the bone crusher, then through the drier, and after cooling the material is ground and sacked ready for the market.

The residue from the meat boilers is also put through the drier, is allowed to cool, and is then pulverized and sacked. Each sack holds about 200 pounds. At present prices meat fertilizer is worth about $3 a sack, while bone fertilizer is worth $2.50. The latter is of a grayish color, while the meat fertilizer is a deep brown.

It has been found that the meat from the sulphur bottoms must be more thoroughly cooked in the boilers, since it is slower to dry than meat from other species of whales. When processing sperm whales the first step is to sever the head and remove the oil from the cavity therein. This is a very high-grade and valuable oil. Each sperm produces from 10 to 20 barrels. On account of this proceeding, it takes considerably longer to dispose of a sperm whale.

A deputy customs officer was stationed at Port Armstrong to enter and clear the whaling boats, as they operate chiefly outside the 3-mile limit.

The total catch for the season was 186 whales, of which 126 were males and 60 females. The first whale was killed April 6 and the last September 25. July was the best month, when 55 whales were taken, of which 23 were sperms. It is notable that out of 32 whales captured in April and May but 2 were females, thus indicating an advance run of males. The take of 73 sperms, nearly 40 per cent of the total catch for the season, is most remarkable. In 1912 all three companies got but 23 sperms out of a total kill of 685 whales.

### SAN FRANCISCO WHALING FLEET.

Operations of the San Francisco fleet in northern waters during 1913 amounted to comparatively little. The bark *Gay Head* (252 tons) cleared December 27, 1912, and returned August 30, 1913, with a take of 32,430 gallons of sperm oil, valued at $12,072. The *Gay Head* cleared again October 3, 1913, for a cruise to southern whaling grounds. The steamer *Belvedere* (339 tons) left March 11, 1913, on a whaling voyage to the Arctic. This vessel was frozen in near Griffen Point, and will be forced to winter in the north. The power schooner *Elvira* (60 tons) cleared from San Francisco May 26, on a cruise to the Arctic. On account of unfavorable conditions, this vessel was also seized in the ice, and late in September capsized and became a total loss. The crew escaped over the ice. This vessel was formerly a Japanese seal poacher captured by a revenue cutter and afterwards sold. So far as known at present, no whales were killed this season, either by the *Belvedere* or *Elvira*. The Eskimos succeeded in getting four bowheads near Point Barrow.

The steamer *Karluk*, for many years actively identified with the San Francisco whaling fleet, was acquired by the Stefansson Arctic expedition, and sailed north this spring.

The steamers *Herman* (229 tons), *Beluga* (409 tons), *Bowhead* (243 tons), *Narwhal* (389 tons), and *Thrasher* (502 tons), also the brigantine *Jeanette* (217 tons), did no whaling this year, but were laid up in Oakland Creek.

### STATISTICAL SUMMARY.

The total sum invested in shore-station whaling operations was $891,780. This is a decrease of $249,051 from the 1912 season. A total of 99 persons were engaged, of which 73 were whites and 26 Japanese. Last year 303 persons were employed in the industry. The value of the products declined from $311,307 in 1912 to $157,550 in 1913.

WHALES TAKEN IN SHORE OPERATIONS IN 1913.

| Species. | Number. | Species. | Number. |
|---|---|---|---|
| Sperm | 73 | California gray | 1 |
| Sulphur bottom | 58 | Bottlenose | 1 |
| Finback | 32 | | |
| Humpback | 21 | Total | 186 |

Included in the finbacks above are three whales designated by whalemen as "sei" whales. They are a species of finback, but never grow to a large size. In all characteristics except size they closely resemble the finback. They have been referred to as the "sharp-headed finner," which attains a length of about 27 feet.

INVESTMENT IN WHALE FISHERY IN ALASKA IN 1913.

| Items. | Number. | Value. | Items. | Number. | Value. |
|---|---|---|---|---|---|
| Vessels: | | | Value of plants | | $250,000 |
| Steamers | 3 | $180,000 | Cash capital | | 400,000 |
| Tonnage | 327 | | Wages paid | | 60,545 |
| Launches under 5 tons | 1 | 435 | | | |
| Boats, row | 5 | 150 | Total | | 891,780 |
| Lighters and scows | 2 | 300 | | | |
| Pile drivers | 1 | 350 | | | |

PERSONS ENGAGED IN WHALE FISHERY IN ALASKA IN 1913.

| Races. | Persons engaged. |
|---|---|
| Whites | 73 |
| Japanese | 26 |
| Total | 99 |

PRODUCTS OF ALASKA SHORE WHALING OPERATIONS IN 1913.

| Products. | Quantity. | Value. |
|---|---|---|
| Whale oil ... gallons | 466,500 | $139,950 |
| Fertilizer ... tons | 665 | 17,600 |
| Total | | 157,550 |

## EFFECT OF WHALING OPERATIONS ON FISHING.

Considerable agitation has developed of late in certain quarters because of the contention that the killing of whales off the Alaska coast has worked great harm to the halibut and herring fisheries, and also affected cod and salmon operations. It is claimed that whales drive the herring toward the shore, where they are followed by the halibut and other species. Thus it is said that if the whales are killed, fishing is bound to be poor.

This theory is open to much question. It is a recognized fact that pelagic fishes have well-defined migratory movements, particularly those general movements toward the shore and to shallower or even fresh water. This is primarily the call of the reproductive instinct. Under the circumstances it seems more reasonable to suppose that the whales follow the herring than to believe that they drive them.

The fact that there has been legislation in Norway prohibitive of whaling is often quoted as evidence that whaling is injurious to other fishing, and particularly to herring operations. In the light of present information on the subject, it would seem that the prohibition of whaling on the Norwegian coast was more or less involved with politics. In the first place, the decrease of the herring yield, at least during some years, was by the fishing population attributed to the supposition that the schools of herring came into the fiords because they were chased by the whales, and unless there were some whales to do the chasing there would be no herring near the coast; and secondly, whales had been hunted so persistently on the coast for so many years that the number had so decreased as to make whale fishing unprofitable, and those who owned the big establishments in that industry were only too anxious to have the Government stop whaling and remunerate the owners for the values of the plants which thereby became confiscated. Therefore they lent their efforts to the agitation of the fishing population. Men of science in Norway are agreed that the whale has nothing to do with the run of herring or any other fish in Norwegian waters. Any marked or prolonged diminution in the supply of herring could with much more reason be attributed to the energy with which the herring fishery has been prosecuted to meet the demands of a heavy export trade.

### FERTILIZER AND OILS.

Operations this season in the manufacture of fertilizer and oil from fishery products were not conducted as extensively as last year. This was due to the fact that two of the whaling establishments did not operate. The companies doing business were as follows: Alaska Oil & Guano Co., Killisnoo; United States Whaling Co., Port Armstrong; W. H. Royden, with a small floating plant; and the Union Fish Co., Shumagin Islands. The products of the first-named company are shown elsewhere under the report on the herring fishery, while the whaling station appears in the section devoted to whaling. Mr. W. H. Royden operated the scow *Elliott* with headquarters at Petersburg, and as a part of his work prepared 16 barrels of shark oil, valued at $200. The Union Fish Co. put up 210 gallons of cod-liver oil, valued at $60. This was merely a minor incident in the season's operations and does not represent any concerted effort in the preparation of oil. The present price is said to be too low for profitable work along this line.

As a phase of the fertilizer and oil situation, more attention ought to be given the manufacture of these products from cannery waste. In other words, put to use every portion of each fish handled, as do the meat-packing establishments their waste products. The meat packer would not long survive if he placed before the public only the choice edible portions of each steer handled and threw away 30 per cent of his raw material, as the salmon packer does. True, the discarded fish material is not proportionately equal in value at present to the animal material of the packing house, but nevertheless it offers a field in the production of fertilizer and oil, the manufacture of which might well be undertaken by the canning interests. The lack of small and economical units of machinery has heretofore stood in the way, but this situation is being improved.

As bearing upon the manufacture of fertilizer and oil, much interest centers in the plant put in at Klawak this season by the North Pacific Trading & Packing Co. The plant was located in a building convenient to the fish house. An endless conveyor took the gurry from the iron chink to a hopper or iron tank 12 by 12 feet and 4 feet deep. It was then taken by a bucket elevator to the two digestors or cookers, each of about 5 tons capacity. Here the material was cooked in steam for an hour. It was then placed in shallow trays wrapped in burlap and put in the hydraulic press operating at 1,200 pounds pressure. About 1,000 pounds of material could thus be handled at a single operation of the press. Fifteen minutes served to remove the oil and water, which passed to a pit and was then pumped to the settling tanks where the oil and water were separated, the oil being drawn off into barrels. These tanks are of wood, 12 feet long, 4 feet high, and 3 feet wide.

The residue of solids from the press was put in a vertical circular drier, with an agitator revolving about 25 times per minute. It was originally intended to put about 1,000 pounds of material in the drier for each charge, but here a difficulty arose, as it was found that only about 150 pounds could be treated successfully at one time. In other words, it developed that the capacity of the drier was not proportionate with other facilities, or with the requisites in treating the refuse from a cannery packing 1,200 cases a day. This was the principal difficulty experienced, and next year it is the intention to double the drier capacity. After coming from the drier the fertilizer was spread out in the air to aid the drying process. It was then run through a sieve and put up in 100-pound sacks ready for the market. The product commands a price of about $28 per ton delivered at San Francisco. As a result of the season's experimental operations approximately 6 tons of fertilizer and 500 gallons of fish oil were prepared.

Analysis has shown the fertilizer to be rich in ammonia—about 12 per cent—but the sample analyzed contained 16 per cent of oil, which is too much for a strictly high-grade product. It should be reduced to 10 per cent.

An agent of the Bureau of Soils of the Department of Agriculture made some preliminary investigations in Alaska during the summer to consider the matter of converting cannery waste into fertilizer. This was in conjunction with a study of the kelp fields in Alaska waters.

## MINOR FISHERIES.

### TROUT.

A few hundred cases of Dolly Varden trout were packed by the Midnight Sun Canning Co. at its cannery on Kotzebue Sound. Operations were confined chiefly to the month of August, though another year it is purposed to put the two traps in earlier. The catch was lessened this season because of unfavorable weather, also by schools of belugas which invaded the traps. A number of these were shot, and in the future watchmen will be stationed at the traps to guard against further disturbance from this source.

The plant, which is the most northerly in Alaska, is located on Kotzebue Sound, just outside the mouth of the Noatak River. Aside from two whites and one Japanese, all of the work was performed by Eskimos, both men and women. The plant was built in 1912 and additional buildings were erected this year. It is the intention of the company to specialize on the canning of Dolly Varden trout, which are rich in oils and are said to find a ready sale. The color is a pale pink, but the flesh is not quite as firm as that of salmon. The product is very palatable, however.

At a cannery on Bristol Bay a few cases of trout, chiefly Dolly Vardens, with an occasional small steelhead, were packed this season as a specialty. These fish were butchered and packed by hand and then processed the same as salmon. They were caught incidentally with the salmon, but it was noted that they occurred most plentifully near the beginning and close of the salmon run. For this reason if the canning of trout were developed more extensively it would not interfere so seriously with salmon operations. At any event, during the off years for salmon it would seem a profitable undertaking to pack trout. Under a fancy label it is said that distributors have had no difficulty in marketing at quite remunerative prices the comparatively small quantity packed.

Another phase of the situation is that the salmon will increase proportionately with the canning or destruction of trout, for it is generally conceded that the Dolly Varden and other species of trout are most destructive enemies to both eggs and young salmon. The canning of trout in Alaska should be encouraged and supported in every way.

At the Shumagin Islands this summer a few barrels of Dolly Varden trout were put up at a salmon saltery. The fish were taken incidentally in connection with seining operations for red salmon. In the salting process merely the gills and viscera were removed—the fish not being split open so as to lie flat. Curing was complete but the method of packing was bad, according to commercial standards, and it was difficult to dispose of the product. If the trout had been split open in the usual manner of preparing pickled salmon, it is said that there would have been no difficulty in marketing them at a profitable figure. Evidence of this may be had in the fact that a few barrels of trout prepared in the orthodox method at a cannery in central Alaska have commanded a price as high as $20 a barrel. A few barrels of pickled Dolly Varden trout were also packed at Eagle Harbor, on Kodiak Island, this season. On Cook Inlet 45 cases of Dolly Varden trout were canned.

As an experiment, a few cases of Dolly Varden trout were put up this season in southeast Alaska by the Kake Packing Co. The fish came from the traps and were put in half-pound flat cans. The experiment was considered a success and further efforts along this line are anticipated.

There has been some misapprehension upon the part of the public regarding the laws of Washington as to the sale of trout. Mr. L. H. Darwin, State fish commissioner and chief game warden, advises that the laws of the State prohibit the sale within the State of all varieties of trout save the Dolly Varden. These are not protected and may be handled commercially. The law also provides that no species of trout, the sale of which is prohibited in the State, may be had in possession, even though it be imported from another State. It will be seen, however, that there is no bar in the State of Washington to the commercial utilization of Dolly Varden trout from Alaska.

PRODUCTS OF THE ALASKA TROUT FISHERY IN 1913.

| Sections and species. | Fresh. | | Frozen. | | Canned. | | Pickled. | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds.* | *Value.* | *Pounds.* | *Value.* | *Cases.*[a] | *Value.* | *Barrels.* | *Value.* |
| Southeast Alaska: | | | | | | | | |
| Dolly Varden | 2,780 | $194 | | | | | | |
| Steelhead | | | 5,093 | $382 | | | | |
| Total | 2,780 | 194 | 5,093 | 382 | | | | |
| Central Alaska: Dolly Varden | | | | | 45 | $153 | 22 | $143 |
| Western Alaska: Dolly Varden | | | | | 775 | 2,788 | | |
| Grand total: | | | | | | | | |
| Dolly Varden | 2,780 | 194 | | | 820 | 2,941 | 22 | 143 |
| Steelhead | | | 5,093 | 382 | | | | |
| Total | 2,780 | 194 | 5,093 | 382 | 820 | 2,941 | 22 | 143 |

[a] Each case contains forty-eight 1-pound tall cans.

## EULACHON.

The eulachon, candle-fish, or "hooligan" as it is variously termed in Alaska, is a very toothsome member of the smelt family which has a wide distribution in the coastal waters of the territory. It is very rich in oil and possesses food values much in excess of the recognition generally given the species. It is a favorite fish of the natives, who utilize it for food, as well as for the extraction of oil.

In the Juneau markets there has been some call for eulachon, where it is held in high esteem by those acquainted with its merits. One dealer states that there has been some demand for euclahon as a breakfast fish. The Juneau local market has been supplied from the Chilkat River, where eulachon are found in great numbers each spring. Occasionally a supply is brought from Dry Bay, where the average size is better.

Experimentation in the Cook Inlet country by Mr. W. J. Erskine has developed the high value of eulachon for salting purposes, and a very attractive product has been the result. An enormous run of eulachon occurs in Cook Inlet, usually during the last two weeks in May or as soon as the ice goes out. They swarm into the Susitna River in such enormous numbers that they can be easily dipped up as required. No expensive fishing gear is needed. Thus eulachon could be salted at considerably less expense than herring, as the cost of getting the fish would be very little.

## BLACK COD.

A fish that has come into well-merited favor during recent years is the black cod (*Anoplopoma fimbria*), a species entirely distinct from the true cod, particularly as regards the rich and oily character of the flesh. Most all of the black cod are taken incidentally in halibut operations. However, in consequence of growing demands, definite sets were made this year, perhaps for the first time in Alaska, with a view primarily to the capture of black cod. These operations were conducted in Chatham and Icy Straits. The same gear and bait are used as in halibut fishing, but sets are made in 300 fathoms or more, as fishermen claim that black cod are found in considerable numbers only at these depths. So far as known at present, the species occurs rather scatteringly in the fiords of the northwestern coast of the continent, and has been found in greatest abundance in southeast Alaska.

Aside from what is consumed locally in Alaska, most of the black cod is handled by Puget Sound wholesalers. In the past they have taken the black cod more as an accommodation to their halibut fishermen than anything else. During the last two years, however, the black cod has been steadily increasing in popularity and is rapidly coming into its own. It is now featured by the leading hotels and restaurants of Seattle.

The principal demand in the Puget Sound market at present is for kippered backs. This usually appears on the menu as "barbecued Alaska black cod." The bellies, which are exceptionally rich and toothsome, are salted down separately. The black cod is said by salt-fish handlers to be one of the best fish for salting purposes found in Pacific waters.

Carelessness in the handling of the black cod has undoubtedly kept its price at a lower figure than so fine a fish ought to bring. Sometimes it comes to the dealers in a hard-salted condition which makes it necessary to soak thoroughly before the smoking or kippering process can be undertaken; again, it has been received in an iced or frozen state, rendering it necessary to thaw out before striking it in salt, which is essential in curing. Few fish can stand this, and while the resulting product is marketable, the practice is undesirable.

The best method of treatment is a mild-cure process, butchering and salting the fletches on the same day the fish is caught. It should then be held at a low temperature until it can be given the light smoking usual in the kippering process, the belly being better suited as a hard-salt article for breakfast consumption.

One of the Seattle brokers is of the opinion that the Puget Sound market will take care of three or four hundred barrels a month. At the present time, salt black cod is worth about $11 a barrel in the Seattle market, whereas formerly the price was not over $7.

Until quite recently practically the entire production of black cod was consumed locally in Alaska, but within the last two or three years shipments to Puget Sound have been of growing importance.

SHIPMENTS OF BLACK COD FROM ALASKA IN 1913.

| Products. | Pounds. | Value. |
|---|---|---|
| Black cod: | | |
| Fresh | 14,308 | $707 |
| Frozen | 5,436 | 327 |
| Pickled | 29,400 | 1,460 |
| Total | 49,144 | 2,494 |

# FUR-SEAL SERVICE.

By Walter I. Lembkey, *Agent in Charge.*

Complying with instructions dated May 17, 1913, Assistant Agents James Judge and Ezra W. Clark left Washington May 18 for San Francisco, for the purpose of purchasing the annual supplies for the Pribilof Islands. The steamer *Homer* had already been chartered to transport the supplies to the islands, the charter price being $150 per day, including wages of crew. Owing to the limited appropriation provided by Congress, it was necessary to restrict the purchases to the actual necessities, such as food, clothing, fuel, and medical supplies. The amount of the purchases, all told, was $24,877.01.

The steamer *Homer* sailed from San Francisco June 23, arrived at St. George Island July 10, after stops at Dutch Harbor and Unalaska to discharge freight and take on coal. After discharging passengers, mail, and freight at St. George, the vessel sailed for St. Paul July 12, arriving next day. The return voyage to San Francisco, with sealskins and fox skins of the season's catch on board, was begun on August 8, arrival at San Francisco being made August 24.

## AFFAIRS OF THE COMMUNITY.

### NATIVES' BANK ACCOUNTS.

Since the management of the practical affairs on the Pribilof Islands was assumed by the Government in 1910, the agent in charge, namely, W. I. Lembkey, has acted as trustee for such natives as had sums of money for deposit as savings accounts. These accounts were placed on deposit in the Union Trust Co. of San Francisco, bearing 3½ per cent interest, and the interest was drawn by the trustee each spring and in turn paid over to the several natives having accounts.

Congress having abolished the position of agent, however, to take effect June 30, 1913, the trusteeship of the natives' savings accounts was, with agreement of all the natives except one, transferred to F. M. Chamberlain, naturalist on the Pribilof Islands, who succeeded to the administrative charge of all affairs of the islands. Drafts covering principal and interest on all the natives' accounts, with the pass book for each, were accordingly delivered to Mr. Chamberlain, and at his request were taken to San Francisco and deposited with the Union Trust Co.

Detailed records of all transactions in the fiscal affairs of the natives are filed in the Bureau of Fisheries in Washington.

### CENSUS OF NATIVE INHABITANTS.

On St. Paul Island, the annual census taken June 30, 1913, showed 194 native residents, of which 94 were males and 100 females. During the year there were 7 births and 3 arrivals, also 1 departure and 9 deaths.

On St. George Island, the total native population June 30, 1913, was 110; 53 males and 57 females. During the year ending on the date mentioned, 5 births and 1 death occurred. There were no arrivals.

### SUPPORT OF NATIVES.

#### Problems in Communistic System.

The instructions of the Bureau provide that the natives shall be supplied, so far as funds will permit, with the necessaries of life to an amount sufficient to maintain them in comfort, due regard being paid to economy and thrift. To this end, various supplies to be used by the natives, as fuel, food, clothing, etc., were purchased in San Francisco at the best wholesale rates obtainable and transported to the islands on the Bureau's chartered steamer *Homer*. These supplies upon arrival at the islands were placed in the two general stores (one on each island), where they were marked for issue or sale at a price one-third above wholesale cost, including all discounts except for cash. They were then distributed after the methods hereafter detailed. The increase of one-third over the wholesale cost was made to cover cost of transportation and handling only.

The instructions of the Bureau further provided that from the supplies thus taken to the islands merchandise to the amount of $40,000 be furnished the native inhabitants for their support and maintenance during the fiscal year ending June 30, 1913. These supplies were not to be received by the natives as a gratuity but as a return for services rendered. Services such as might be performed in the taking of sealskins and in the management of the herd in general were considered the main labor for which the natives were to receive this support; but, as the killing of seals was to be greatly curtailed, the natives, in return for their support by the Government, were to be required to perform such other labor of a nature to benefit the community generally as might become necessary or desirable. Individual natives, however, who were willing to perform such labor of a skilled or unskilled nature as might be necessary to the upkeep of the Government property and the maintenance of the stations in general were to be compensated individually in cash from funds other than the $40,000 set apart for the community support at the rate of, for skilled labor 25 cents an hour, and for unskilled 15 cents an hour. The skilled labor embraced that of carpenters, engineers, painters, and ironworkers, etc.; the unskilled mere laboring work requiring no special aptitude.

The system involved in the foregoing arrangement for natives' support is one of almost pure communism. The main problem confronting those charged with its conduct was to support the people in such comfort and happiness as the resources would allow and at the same time to minimize those admitted evils of conmunal existence which, in this case, could easily result in reducing the island inhabitants to a mental condition of stolid apathy, and a physical condition of virtual peonage, if not slavery.

If no labor were required of these people, the problem would be simply to give gratuitously to each person supplies sufficient to insure his existence. It is necessary, however, at almost all times of the year to require some of them to perform services for which they receive no specific compensation, but merely a right to participate in the general fund. If all labor required of them were alike in character and amount and if all the natives could perform this labor with a like degree of proficiency, no special difficulty would be encountered. Some of the labor, however, requires aptitude and special training which some natives do not possess; also, some by reason of physical imperfections can perform less work even of a general nature than others, and some no work at all. To support the natives only to the extent that they perform service would be to allow some to suffer and others to starve because of inability to work and therefore to earn.

But if a helpless cripple and his family should not be allowed to starve, on the other hand a man of high efficiency should not be required to expend his best efforts for a compensation no greater than that which the cripple and his family receive for their bare maintenance in return for which they furnish no labor whatever, and which, too, the efficient would receive as a matter of course without rendering any service in return. Then, moreover, the fund for natives' support is not large enough to allow special compensation to some and general support to all, but sufficient only to prevent suffering no matter what labor may be required of them.

These and other questions, which perhaps appear trivial to the casual observer, become of vital importance to those managing the natives' affairs. It may be of interest to detail the methods which are used in the distribution of the fund for the support of the natives, all of which methods have been the subject of careful study.

The $40,000 fund was considered as belonging to the community and to be used for its support without regard to the question whether the person so supported was or was not able to perform service in return. It was therefore divided between the two islands on a strict per-capita basis; that is to say, the whole amount was divided into as many parts as there were natives on both islands, and each island was allotted as many of these parts as there were natives on that island. From this fund before distribution, however, coal enough for both islands was paid for. This coal was turned over to the native community, and the community, through its chief men, was allowed to make distribution of it without official interference. No cash was paid from this fund except $1 a piece to each native man on Christmas and Easter, for church purposes, and a payment to a midwife of $5 for each baby born.

From the amount remaining after the deduction for coal, a suit of clothes was given to each man and boy; each individual was provided with two pairs of shoes; each family with material enough to make underclothing for the children and women, and each person with a supply of rubber footwear. From the remainder an "emergency fund" of perhaps $1,500 was set apart. What was left was available for purchase of food and clothing on regular issues. This remainder was divided into 52 equal parts, representing weeks in the year, thus fixing the amount that might be spent weekly for support of the whole population.

The total number of persons to be supported was next ascertained from the census—two children being considered as one adult—and divided into the weekly allotment for the whole island, thus establishing a per-capita tentative allowance for each person per week.

The number of individuals in each family was then ascertained, and the per-capita amounts combined to give a basis for the expenditure for each family for the week.

It having been demonstrated that a large family under the same roof can live more cheaply per capita than a small one, a readjustment of amounts was made, deducting a certain sum from the large family allotments and adding it to those of small families. In this way a final adjustment of allotments was reached, giving about $5 weekly to a family of two, and about $7.50 weekly to a family of six or seven.

Having thus established the amount which each family may spend weekly, issues of food and such clothing as could be purchased out of the allowance were then made on Saturday of each week to the heads of families, each head being given an order for such supplies as he wished not exceeding his allowance, which order when taken to the store was filled, and the merchandise represented thereon given to the person presenting the order.

The emergency fund, already mentioned, was used to meet expenditures not contemplated in the regular allowance—such as occur in cases of death, sickness, marriage, childbirth, etc.

In this way the amount available for support of the natives is expended, not in cash, as stated, but in merchandise itself. The amount is just about enough to support the population without want. It reaches a little more than $100 per capita. Everything to eat, to wear, and to keep the fires burning has to be transported over 2,000 miles, and the food is mostly in tins. Nothing edible except seal flesh can be obtained locally. It can be realized, therefore, that if the fund for natives' support is barely enough to provide the actual necessities of each person, little can be done toward encouraging and compensating extra effort or otherwise alleviating the objectionable features of communistic life in general.

Where a number of persons share equally in the distribution of a general fund, as these natives do, the natural tendency of each is to take and use the whole of that share without regard to whether it is needed or not. There is no inducement for a native to strive through self-denial to exist upon less than his share from the general fund when such abstention would result simply in increasing the share of his less provident neighbor. The whole tendency of a scheme of this character is to produce an attitude of carelessness in the use of communal resources—in short, to create that attitude of mind which says: "As there is no reward for economy, let's get all we can. The other fellow will get it if we don't."

### Experimental Plan to Induce Thrift and Self-Reliance.

This tendency toward shiftlessness, which is an inevitable result of these peculiar circumstances, has long been recognized, and efforts have been made to palliate it at least. In 1911 a plan was put in operation designed to induce the natives to save at least a small portion of their earnings. It was based upon the general principle that by reducing weekly and other issues of supplies to a minimum an unexpended balance would be created, which balance at the year's end was to be distributed in cash among the earners according to their proficiency as workers. If even from a weekly allowance the native saved something, that saving was to be given him in cash at once. It was hoped he could be induced to open savings accounts with cash thus obtained, or at least to use it in purchasing some article not otherwise obtainable that would increase his happiness and comfort.

This scheme was placed in operation on St. George during the winter of 1911-12. The results from a careful following of the plan are interesting. At the end of the first month in which the native men were informed that such savings as they made from their weekly allowances for family supplies would be paid to them in cash, more than half the families in the village drew cash savings thus derived, the sums varying from $1 to as much as $8 or $9. They continued to do thus during each remaining month in the year, almost every family saving something out of the amount allowed for its support.

Careful inquiries into the motives governing the making of these savings developed several interesting points. It seemed, on the whole, that the main object of the native was not to hoard the cash thus obtained by saving, but on the other hand, to get possession of the cash itself, which in many instances he at once took to the store to expend for perhaps the very articles he had denied himself in order to make the saving. Some few, of course, used the cash to purchase in San Francisco articles which could not have been issued to them had they not the cash. No savings accounts were created. If any sums were saved they were secreted in the natives' houses.

Some of the natives who made the largest savings had previously complained that their allowances were too small; those who have always been thrifty, however, redoubled their efforts to save, increasing their hoards regularly every month. But it was found that to make these monthly savings, in some cases the children in the family were made to suffer through deprivation of proper clothing and sometimes food.

At the end of the year, the sum of $632.48 was unused from the natives' fund and remained for distribution. This amount was divided among the sealers, the first-class men receiving about $32 each, and the lower grades in proportion. This money was nearly all spent in the store for articles of general use. No portion of it, as stated, was used to create or to increase savings accounts in bank. It is reported, however, that the natives were greatly pleased with the plan as operated and under it many of them came into possession of more money than they ever owned before.

The net result of this one year's experiment is not large. It shows that the natives desire their earnings in cash rather than a mere credit. It shows also that if paid in cash for their labor in taking sealskins, etc., the greater portion, if not nearly all of their money, would be used for the same purpose for which the credit is used, namely, the purchase of the necessaries of life. It shows that under the present communal system the natives are not desirous of creating permanent savings funds because of their inability to profit greatly by the result of the self-denial necessary to create the fund.

It must be stated that conditions were not favorable for carrying the operation of this plan beyond the mere point of inducing the natives to curtail their use of the necessaries of life to a minimum. It was impossible to demonstrate to them that any particular benefit would follow this saving, because there was nothing they might obtain with their savings except the bare necessities of life, of which they had deprived themselves in order to create the savings fund. And, having saved, all they could buy was what they could have had without saving. Under the present system it is not permitted to purchase for island use anything but the barest necessaries of life. Articles from the use of which the average citizen finds enjoyment or benefit, and by means of which he is able to bring his life above the level of mere animal existence, are not allowed to be purchased for sale on the islands. Neither can the native improve his mind and broaden his education by travel, because no means of transportation are available. His clothing is of a certain fixed grade each year; if he desires a better suit or an unusual article of clothing, he can not purchase it because it is not in the store; nor can he order it unless through some cumbersome private arrangement almost impossible to make. In short, he is held down to the use of a greatly circumscribed class of merchandise, on an isolated spot of the universe, in which use he must live and die, practically without power to alter the condition.

Why, therefore, should the native save money? Money has no value unless it can be used as a medium of exchange. The mere hoarding of it induces no satisfaction or comfort to any normal person. The reward of self-denial exists in the possibilities for greater enjoyment and greater comfort created as the result of the self-discipline. If the native has no use for his money after saving it, he will not save it; neither will anyone. To carry out successfully any scheme of this character, it is necessary to broaden the possibilities of the natives' purchasing power. He must be able to buy desirable and attractive articles at least to the amount of his savings.

Everywhere, except to these people, a prize is offered for thrift. It should be held out to them, too. For example, it should be so arranged that the shiftless must wear poor clothing, but the provident may wear better. The provident, industrious man should be able to obtain better food than his careless and lazy neighbor. Under the present system, this is impossible. This situation could be adjusted readily by a private concern, and it should present no more difficulties to the Government.

### Need for Broadened Opportunity.

Since the killing of seals has been stopped on the islands, except a few for food, and because of the material reduction in the appropriation by Congress for the natives' support, the system of cash payments has, unfortunately, been discontinued after only one year of trial. The building up of the moral and intellectual fiber of a people is a matter of generations, not of years, even under ideal conditions. In the case of these natives, not only should precept and example be afforded, but an intelligent readjustment of conditions on the islands should be made to give point and object to mere academic advice.

It may seem from the foregoing that because no greater results were obtained from this experiment, it is useless to attempt to lead the natives to greater self-reliance and thrift. It is believed, however, that such object is not so near an impossibility as supposed. The cause should be sought in the system, not the native. The instinct of self-preservation is as highly developed in these natives as in the more effete races, and this instinct forms the basis of all desire to lay by something of what is in hand to insure against future want. Under the present system the native expects that his future will be provided for, and has, therefore, no incentive to deny himself and no self-reliance. While no one would be willing to make the existence of these people a matter of doubt, on the other hand, it is thought that it can be so managed that the native would have to depend more upon himself, through the removal of certain of the paternalistic offices performed in his behalf by the Government.

As the situation is at present, the native merely has to work and to draw his weekly rations. He might complain in order to get more, but beyond that he has no voice in the disposition of his earnings. All the managing of his resources is done in his behalf by the agent in charge, under departmental instructions, and the only open line of endeavor is to hoodwink the agent into giving him more than his share. This unnatural situation should be remedied by allowing the natives more voice in the management of their domestic financial arrangements. It is believed, contrary to general opinion, that nearly all the native men are capable of handling their earnings in a thrifty and judicious manner, once they understand that it is necessary for them to do so or starve. Under this hypothesis it would be better for the native to receive his earnings, or at least a large portion of them, in cash at the close of each season with the understanding that this sum must suffice to support him and family for a year; or monthly amounts could be given them with the same understanding.

A native supervisory body should be created, the duty of which should be the oversight of the methods used by the several native men in handling their resources with a view of preventing suffering on the part of those children whose fathers might neglect to provide properly for them. This board should be chosen by the natives themselves, to be changed annually or at most every two years. The resident government representative should have general supervision over the whole, with power to enforce the findings of the board. Should a native be grossly improvident, a stated sum from his earnings should be set apart for use of his children. The Government should arrange to deposit any savings the native might make, or to expend them for such articles as the native may request to be ordered. At present this latter privilege is denied.

In short, the strongly paternalistic attitude of the Government, together with the communal system of living, has robbed these people of all chance of self-improvement by destroying the incentive. Any effort along the lines indicated or others to increase this self-reliance will be salutary. It is conceived that a certain small percentage of receipts from the sale of skins taken by these people, set apart for them, either for their support or as a fund for the improvement of local conditions, or as a sheer bonus to increase efficiency and faithful cooperation, would be a paying investment.

### Cash Payments for Sundry Labor.

What has been said in the foregoing concerning natives' earnings relates wholly to the fund earned by the community in general, mainly from the taking of skins. Such work as the natives perform as laborers or skilled workmen in maintaining the station buildings, exclusive of their own residences, is paid in cash monthly. These sums, although small, are welcome as representing the only cash the natives receive, and because this desultory labor is the only means through which the native may get individual results from independent action. Cash thus obtained almost invariably is used to augment the regular allowance of supplies, and the work through which it is obtained is eagerly sought. Not to pay them individually for such work, which is not at all for their benefit, would be to destroy the feature which removes their system of existence from mere peonage.

Accounts showing the character and value of merchandise issued to each native during the year ended June 30, 1913, as well as the amounts of cash paid to each for labor, with proper receipts, are on file with the Bureau, together with invoices, inventories, ledger accounts, balance sheets, and a statement of condition of business on the date mentioned. Cash slips showing character and amount of all cash sales of merchandise are also filed.

## SANITATION AND HEALTH.

### Importance of Studying Local Conditions.

As has long been known, the chief diseases of the natives of the Pribilof Islands are tuberculosis and related pulmonary troubles.

The importance of a careful study of the general question of health and sanitation on the islands was early realized, and the matter received serious consideration in March, 1909, shortly after the transfer of the fur-seal service to the Bureau. In the general instructions issued on March 31 of that year to the agent in charge this matter was presented in the following words:

> There is probably no other locality in America where questions of health and sanitation can be studied under such favorable conditions as at the seal islands. These islands are almost completely isolated from the rest of the world. The population is

quite definitely fixed; there is practically no immigration, no emigration, and little visiting with other communities. The islands constitute a compact physical and biological unit, a compact health or sanitary unit. The conditions are so isolated and so bunched as to render their control and study comparatively easy. This is true not only as regards the native animals and plants of the islands, but it is true also of the people who have long been resident on the islands. The conditions for scientific study of many problems relating to the health and well-being of the various species of plants and animals (including man) found on the islands are therefore peculiarly favorable.

As Mr. Chichester has been studying medicine for several years, many of these problems will doubtless appeal to him as questions in which he would be especially interested and which would afford him a fine opportunity for doing some excellent and valuable original work. His knowledge of the nature of disease, of bacteriology, hygiene, and sanitation will enable him readily to appreciate the exceptional opportunity and to formulate the details of the methods to be employed.

The Bureau therefore desires Mr. Chichester to take up the whole question of health on the seal islands and submits the following suggestions as to the scope and nature of the investigations which it wishes to have made:

### HEALTH CONDITIONS ON THE SEAL ISLANDS.

*Natives.*—It is desired that a careful study be made of all the important conditions or factors bearing on the health of the natives. Many of the questions should be considered historically.

1. Housing: Character of houses as related to health; changes since first occupation, whether for the better or not; if present conditions are not what they should be, suggest improvements. Every house should be inspected with reference to sanitary conditions, including ventilation, light, heating, cleanliness, drainage, and general adaptability.

2. Clothing: In the past and now; whether suited to the climate, healthful, sanitary, adapted to the vocations of the people, etc.

3. Food: In the past and now; whether properly or adequately nutritious, and healthful; proper proportions of different kinds; properly prepared, etc.

4. Diseases: (*a*) Those brought to the islands by first colonists; which of these have disappeared and which have persisted; work out as fully as possible the history of each. (*b*) Diseases brought to the islands since the first colonization; when, whence, and by whom brought, and history of each since introduction. (*c*) Diseases induced by local conditions—i. e., originating on the islands or whose history can not be traced, if there be any such. (*d*) Diseases to which natives are peculiarly subject; the relative importance of the various diseases as shown by number of deaths from each and by frequency and duration. (*e*) History of therapeutics or methods of treatment of each disease by the resident physicians, together with consideration of results. If possible, compile mortality tables for all who have died on the islands since first occupation, giving name, sex, age, date of death, and cause. This bears upon (*d*). (*f*) Relation of climate and of habits and occupations of natives to disease. This should be carefully investigated. (*g*) A health card should be prepared for each person on the islands. This will supply the basis for thorough and continuous study of these questions.

5. Parasites: A special study should be made of the intestinal and other parasites affecting the natives, and ample study material should be preserved.

6. Use of intoxicants: The strong desire for intoxicants possessed by the natives is well known, and the necessity for protecting them against this desire is recognized.

The whole question should receive most thorough study and thoughtful consideration—the origin of the taste for intoxicants; whether this taste is growing stronger; whether the regulations now in force conduce to temperance among the natives and, if not, how they may be made more effective in that regard.

You are instructed to give this matter very careful consideration and to make such recommendations as will, in your opinion, be to the best interests of the natives and the service.

Dr. Harry D. Chichester, at that time one of the assistant fur-seal agents, and Dr. Walter L. Hahn, who was appointed naturalist in the fur-seal service in July, 1910, both heartily approved taking up this investigation and pursuing it in a comprehensive and thorough manner. They both believed it possible to free the islands completely of all infectious diseases and, through the maintenance of proper quarantine regulations, to maintain such freedom from disease.

As a preliminary requisite it was regarded as necessary to fill out a health card for each inhabitant of the islands, and, after conference with a number of able physicians and careful consideration, a suitable blank form was prepared by Dr. Chichester.

The matter was set forth again in definite instructions to the agent in charge July 27, 1910, from which the following extract may be made:

The betterment of the physical and moral condition of the natives is earnestly desired.

The service, for the study of these problems, is placed under the immediate direction of Dr. Chichester, who, under the general supervision of the naturalist, will organize the service with a view to securing the highest efficiency and speedy practical results. Attention is directed to office letter of March 31, 1909, in which is pointed out the exceptional opportunity which the islands offer for study of problems concerning public and individual health. The letter of March 31, 1909, is to be regarded as forming a part of these instructions.

All these problems should be taken up at once and their investigation pursued continuously and persistently to solution. With many of them important practical results should be easy of early attainment. Special and immediate attention should be given to those problems the study of which will lead promptly to results of real benefit to the natives. Among these may be mentioned the following:

Sanitary inspection of houses, water supply, etc.; directions and suggestions to natives regarding food, clothing, personal habits, etc.; physical examination and filling out of health card for each; determining and putting on record present conditions as a basis for future investigation. One problem which should be carefully studied is that of inbreeding. In small communities such as these, into which little new blood comes from the outside, there is sure to be too close inbreeding, with all the attendant evils. The blood relationship of the various natives should be made out as definitely as possible, particularly of man and wife. When close relationship is discovered, determine what evil effects, if any, on the children. Consider these questions in connection with the rules and practices of the church as to marriage. Consider also what can be done toward bringing new blood to the islands.

It is expected that the resident physicians will promptly and effectively cooperate in every way possible with Dr. Chichester and the naturalist in the study of these various problems.

It is desired that Dr. Chichester submit a full and detailed report to the Bureau next summer, showing what has been accomplished to date and indicating future work contemplated.

Both Dr. Hahn and Dr. Chichester died May 31, 1911, as a result of an accident on St. Paul Island, before they had been able to do much more than enter upon this important work. Since that date various unexpected untoward conditions have arisen which have prevented any marked progress from being made in the study of these problems.

HEALTH REPORTS.

The reports submitted by the physicians for the last year are brief; the more important matters contained therein are here given.

*St. Paul Island.*—During the fiscal year ended June 30, 1913, the resident physician treated 220 cases, not including subsequent treatments. These cases were varied in their nature, totaling about 46 different kinds. Several surgical operations were performed, including the removal of enlarged tubercular glands of the left axilla, setting fracture of the lower end of radius, incision of abscesses, etc.

Seven births took place during the year. There were 9 deaths, 6 of which were infants and 3 adults.

*St. George Island.*—The resident physician on St. George Island reports that there was very little sickness on that island during the year ending June 30, 1913, except an epidemic of influenza in the summer of 1912, when the whole population, including the whites, were attacked. Fortunately, with few exceptions, the cases were mild. During the winter the cases treated were chiefly gastro-intestinal and pulmonary affections.

Monthly inspections were made of the natives' houses and surroundings which, with few exceptions, were in excellent condition and creditable in every way. At the time of these inspections instructions were given to the natives on feeding and general care of infants and children, how to clean milk bottles, proper method of disposing of sputum and other excreta, the danger of expectorating on the floors, the value of fresh air, and the general principles of ventilation.

The records kept on this island show that there were 105 births and 94 deaths between January 1, 1891, and July 1, 1913. According to Dr. Mills, 70 per cent of the deaths have been from tubercular troubles, 25 per cent from gastro-intestinal disorders, and 5 per cent from other causes. At present about 25 per cent of the natives are suffering from tuberculosis in one form or another. The resident physician believes it possible to control this disease, with proper care and attention and the improved hygienic conditions of the last two or three years, together with an appreciation by the natives themselves of the necessity for properly disposing of sputum and other excreta.

The Bureau concurs in this view. It believes that a competent, resourceful physician in charge, ambitious to do something worth while, could in the course of a few years entirely free the island of tubercular and all other contagious and infectious diseases. This is a hope worthy of the ambition and best efforts of any physician. The

Bureau has on several occasions during the last three years, in its instructions to the agents and physicians, called attention to this matter. It is not without hope that this ambition may yet be realized.

### NATIVE DWELLINGS.

The dwellings provided by the Government for the natives are, in most cases, tight, warm, and in fairly good repair. In four instances on St. George Island the houses are entirely too small for the families that occupy them. One family consists of husband, wife, and 6 children; another, of husband, wife, and 10 children; and two others each of husband, wife, and 7 children. The houses occupied by these large families have been enlarged by the addition of bedrooms built on the outside, but they are still too small. A number of larger houses should be built. The new buildings should be one and one-half stories, so that the upper floor could be used as bedrooms. The regulation house is one story, 12 feet front by 20 deep, divided into two rooms, with a lean-to on one side for a kitchen and an entrance.

The house occupied by the family of 12 is one of the largest and has a kitchen and three rooms, all of which are used as sleeping rooms. The largest room is 11 by 12 feet, the next 9 by 11, and the other 7 by 11 feet. To enlarge this house would be more expensive than to build a new one. One house, No. 8, said to be the oldest dwelling on St. George Island, became uninhabitable some time ago and has been torn down. All the lumber in it possessing any value has been used in repairing other houses.

The houses on St. Paul Island are essentially of the same type as those on St. George. Most of them are in fairly good condition, but many of them need considerable repairs, and some larger houses are needed.

New shingle roofs were put on one side of each of six native dwellings. Extensions of existing lean-to kitchens were made to two houses. The tenants, assisted by other natives, did the work without compensation. The Government furnished the material, and the work was well done.

### UPKEEP OF RESERVATION.

It has been the policy of the agents to encourage the native men and boys in the use of common tools and the making of useful articles. On St. George Island during the past winter a number of such articles were made. Four pieces of office furniture were made by native workmen from plans or designs furnished them by the agent. These articles are a desk and cabinet, a typewriter desk, an office desk, and a cabinet around the safe, with card-index drawers.

For this work the natives received the usual wage of 25 cents an hour.

*Telephone to Garden Cove.*—The need of telephone connection with Garden Cove, on St. George, one of the three landing places on the island, about 2½ miles from the village, has long been felt. Last fall a small frame house 8 by 12 feet was set up there and telephone wire strung from it to the village. The lumber for the house was cut to length in the village shop and then carried on the backs of the men to Garden Cove and set up. Necessary telephone posts were obtained from the abandoned line to Staraya Artel. This work was done by the natives without compensation.

*Zapadni watch house.*—The watch house at Zapadni was originally a sod house; that is, a frame structure banked up to the eaves with sod. The house was greatly in need of repairs; the roof leaked and much of the planking was rotten. It gave very little protection to the native guards, who live in it from June until November of each year. This spring a new shingle roof was put on, new studding put in the wall, and the whole building double weatherboarded after removing the former sod walls. The house is now tight and warm. The lumber for this work was cut to length in the village and hauled on sleds the 5 miles from the village to Zapadni. This was also "community work," i. e., work without compensation.

*Wharf at village landing.*—The old wharf was a light frame structure lashed to the rocks, forming the side of the landing slip. It had to be taken up each fall. Last fall a heavy sea carried the structure away. Instead of putting in a landing like the old one it was determined to build a large permanent landing, the fronts on the water to be of concrete and the whole thing filled in with huge bowlders that were piled on the end and at the rear of the former wharf. In prosecuting this work 40 barrels of Portland cement were used and 2,000 feet of lumber of various kinds, much of which was saved from the old wharf. The wharf as it now stands has a frontage on the landing slip of 40 feet, and running at right angles is another sea front of 40 feet, the two forming the water frontage of the landing. Over 2,000 square feet of wharf surface is secured, on which the bidarrahs can be handled and cargo landed. The former wharf afforded less than 500 square feet of available surface.

Over three weeks were required to complete this work. It is a solid structure of rock, faced with walls of reinforced concrete and will withstand the ice and sea and always be ready for use. The only expense was for material, the work being done by the natives without compensation.

*Wharf derrick guys.*—The galvanized-wire derrick guys had not been renewed for a number of years and were very rusty and stranded in many places. New guys of five-eighths inch galvanized wire were put on the derrick and on the boat davits, and new running gear also was placed in the latter. The whole equipment was worked over and put in the best of condition.

*Wireless station.*—The wireless station established on St. George during the summer of 1912 proved of great value. From September 11, 1912, to June 30, 1913, something over 200 official messages were sent and received. Many of these messages were from the Bureau and of the greatest importance. Without the wireless communication it is hard to see how the business of the station could have been conducted.

The only fault that can be found is that the sending apparatus is strong enough to send as far as St. Paul Island only. Three times every 24 hours the St. Paul Island wireless set is "tuned down" to hear St. George. At other times this set is unable to make itself heard at St. Paul. A great many things might occur between the regular calling hours that would be of vital importance to have known. For instance, a fire might start and threaten the entire village. Before the regular calling time arrived the plant might be destroyed, and it would then be impossible to make the condition known. Of course, nothing of this sort has ever happened, and every precaution is taken to prevent such a thing. But it is possible, and attention is called to the possibility in support of what is believed to be a need for a wireless sending plant that would enable this station to communicate with Unalga, where an operator "listens in" during the entire 24 hours.

## WATER SUPPLY.

In the fall of 1912 a pumping system was installed jointly by the Bureau and the Navy Department for furnishing water for domestic purposes to St. Paul village as well as to the Navy wireless station. This proved of no service to the village, however, because the pipe supplied was of too small diameter to allow water to be pumped through it to the tanks. It was efficient only for the Navy wireless station, about halfway between the well and the village.

On October 9, 1912, or as soon as the 40,000-gallon reservoir tanks were installed on the village hill, an effort was made to pump water into them. After about one and one-fourth hours with a weak stream flowing into the tanks the pump, working at a pressure of nearly 200 pounds, smashed the teeth on two of its gear wheels and became useless. In response to a wireless message, the Navy authorities at Mare Island sent up to Nome additional gear wheels in time to have them there placed on the revenue cutter *Bear* and brought by her to St. Paul. Another attempt on November 12, at 180 pounds pressure, resulted in the breaking of a shaft in the pumping engine after an hour's work and further efforts to fill the tanks were abandoned. The pump broke because the strain necessary to force water through a pipe two-thirds of a mile long and 1¼ inch diameter to tanks with an elevation of 100 feet above sea level was too great for the pumping engine to withstand. In addition to breaking its various parts while attempting to do this work, the packing around the pump was forced out from between the joints by the pressure.

To pump to the wireless station, a distance of about half a mile on a level, required much less pressure, and the pump was able to perform this duty practically at all times during the winter. Arrangements were made, therefore, to allow the natives to secure water from the wireless tanks at certain times daily, namely, between 9 and 10 a. m. and 3 to 4 p. m., thereby saving two-thirds of the distance the natives would have to travel in hauling water from the well itself as formerly. This arrangement after a trial seemed unsatisfactory to the natives, and after November 14 none of them applied for water at the wireless station. They objected to the arrangement because the water coming from the wireless tanks was greasy and was also cloudy from discoloration by coming into contact with the new redwood tank. The main reason for their dislike, however, seemed to be that they did not wish to adhere strictly to the hours set for them to get the water, but desired it at any time it might suit them to go. When they were refused this they went on to the well, pumped their own water, and hauled it home in casks on wheelbarrows or sleds, thereafter paying no attention to the supply in the wireless tanks.

To furnish an abundance of water to the village for domestic purposes is a matter of vital importance for the health of the inhabitants. Without it the houses can not be kept clean. When unclean, the filth furnishes breeding places for disease germs of all descriptions. The infants die in numbers from gastric disturbances because of the uncleanness of the vessels used in feeding them. The bed clothing in the squalid houses becomes filthy. Tuberculosis patients mingle with the healthy. The native is prone to be dirty by nature, but the doctrine of cleanliness can not be preached successfully unless water is furnished with which to put the theory into actual practice. The native simply can not furnish water enough to keep his dwelling clean when he has to haul it in casks on a wheelbarrow or a sledge a distance of nearly a mile. To do so would require his entire time and energy.

A determined effort should be made to install an efficient water system on St. Paul, whereby to bring to the native houses a sufficient supply of water for all purposes. The present system has ample well and reservoir facilities. A new pipe line only is required to replace that now installed, which is of too small diameter to allow water to be pumped through it to the distance required. The present pipe line is 1¼ inches in diameter. The new pipe should be at least

3 inches. A redwood pipe can be purchased in San Francisco that is more desirable and cheaper than metal.

In addition to this a satisfactory pumping engine should be furnished by the Bureau. The engine now there, furnished by the Navy, is of the cheapest construction (costing only about $130) and is constantly out of order. Furthermore, it can be operated only at the pleasure of the Navy employees. A system should be put in which would be entirely free of any supervision of the Navy authorities and under the entire control of the Bureau.

The natives will perform the labor without charge. The new pipe suggested would cost about $1,000; the engine about $500. It is earnestly recommended that this material be supplied, and Congress should be requested to appropriate the sum mentioned.

The fresh-water supply for the village on St. George is obtained from wells sunk in a depression a few hundred feet in the rear of the village. There are no springs. Water from melting snow and from rains is caught in the various ponds and gradually filters through to the sea, filling the wells as it runs through the low ground. The supply is abundant during the summer and during thaws in winter, but water is scarce in freezing weather. There are times when snow has to be melted by the natives to get water for domestic use.

To insure an adequate supply of fresh water, one or more large tanks should be installed. These tanks should have a total capacity of not less than 30,000 gallons. This would be sufficient not only to supply water for the village but also for freshening salted fox food, if that sort of food must be used. These tanks could be connected with the well, from which the water could be pumped into the tanks either by windmill or gasoline engine.

The cost of such a water-storage system would not exceed $500, exclusive of the labor incident to installation.

## THE FUR-SEAL HERD.

The act of Congress approved August 24, 1912, provides, among other things, that "all killing of fur seals on the Pribilof Islands, or anywhere within the jurisdiction of the United States in Alaska, shall be suspended for a period of five years, and shall be, and is hereby, declared to be unlawful." The first sealing year under this law was that ending August 10, 1913. In strict compliance with this provision of law no seals were killed on either of the islands in the year ending August 10, 1913, except such as were necessary for food for the natives. The number was 2,298, of which 1,960 were taken on St. Paul and 338 on St. George. Two skins from St. George were not shipped, being too green to handle. This left 2,296 as the entire shipment from both islands.

## KILLING OF SEALS.

### St. Paul Island.

As the purpose of the killing this year was strictly for food for the native residents, no drives were made on St. Paul except from Reef Rookery, which is adjacent to the village, whither the animals could be driven and the flesh of the carcasses distributed to the various native families, or from Sea Lion Rock, whence the carcasses could be taken to the village in boats. During the year 125 seals were killed at North East Point to furnish fresh meat to sea-lion hunters, fox trappers, and guards at that place, but these were taken from isolated pods of bachelors without disturbing the large body on the hauling ground. The bachelors' hauling grounds at Zapadni, Tolstoi, and Halfway Point were not disturbed unless when visits were made to these rookeries for purposes of observation.

Details of the killings are shown in the following table:

Statistics of Killing on St. Paul in 1912–13.

| Date. | Rookery | Number killed. | Date. | Rookery. | Number killed. |
|---|---|---|---|---|---|
| 1912. | | | 1913. | | |
| Oct. 22 | Reef | 222 | June 3 | North East Point | 10 |
| Nov. 12 | .....do | 184 | 9 | Reef | 154 |
| Dec. 1 | North East Point | 58 | 23 | .....do | 335 |
| 10 | Sea Lion Rock | 67 | July 3 | .....do | 44 |
| 23 | .....do | 130 | 7 | .....do | 414 |
| | | | 8 | North East Point | 15 |
| 1913. | | | 22 | .....do | 3 |
| May 14 | North East Point | 12 | Aug. 1 | Reef | 153 |
| 21 | Sea Lion Rock | 132 | 6 | North East Point | 3 |
| 21 | Nort East Point | 5 | | | |
| 24 | .....do | 10 | | Total | 1,960 |

### St. George Island.

Within the sealing year ending August 10, 1913, 8 seal drives were made on St. George Island, from which a total of 326 seals were killed. Within the same period the native guards at Zapadni killed 12 seals for food, making a total of 338 for the year. Of this number, 336 skins were shipped on the *Homer* August 8, 1913. Two skins, taken August 5 by guards at Zapadni, being too green to bundle, were held over until next year.

Statistics of Killing on St. George in 1912–13.

| Date. | Rookery. | Number killed. | Date. | Rookery. | Number killed. |
|---|---|---|---|---|---|
| 1912. | | | 1913. | | |
| Oct. 23 | North Rookery | 40 | June 23 | North Rookery | 38 |
| 23 | Zapadni guards | 2 | 29 | Zapadni guards | 2 |
| 24 | .....do | 1 | July 3 | North Rookery | 44 |
| Nov. 5 | North Rookery | 18 | 5 | Zapadni guards | 1 |
| 11 | Staraya Artel | 5 | 9 | .....do | 2 |
| 22 | East Rookery | 37 | 20 | East Rookery | 85 |
| | | | Aug. 5 | Zapadni guards | 2 |
| 1913. | | | | | |
| June 10 | .....do | 59 | | Total | 338 |
| 17 | Zapadni guards | 2 | | | |

## RETURN OF YEARLING SEALS.

The determination exactly of the date of return of yearling seals to the islands after their first migration has been relatively unimportant until recently, when charges were made in Congress that the yearling seals have formed the bulk of the annual takes of skins, and that among these yearlings so claimed to have been taken were thousands of female yearlings the sex of which, because of their extreme youth, it was impossible to recognize until after death. All the natives and all the white people who have ever been engaged in the taking of sealskins have held that these yearlings never appear in any considerable numbers on the islands until after the 1st of August, after the annual catch has been secured, and that when so appearing they are so small that their skins are undesirable. This belief, however, has been based wholly on general observation and experience which, although thoroughly reliable as such, was not the result of such extended scientific investigation as would be regarded as a complete demonstration of the fact.

To obtain exact knowledge as to when the yearlings really arrive, and their size and weight at the time of arrival, has been the endeavor of the Bureau for the last two years. To this end, the Bureau's instructions in 1912 required that a large number of seal pups of that year be permanently marked with a hot iron brand on the head. When these animals so marked appeared the year following, no question as to their identity as yearlings could be raised, and observation of them would afford exact data as to their movements as well as to their weight and size.

Following the Bureau's instructions, 5,529 pups of both sexes were branded in 1912 with a permanent brand. As these pups of 1912 would be yearlings in 1913 a careful watch was kept for their return in the latter year. In all drives made in 1913, every pod of seals driven up was carefully scrutinized to determine whether any of these marked yearlings were present.

In the drive of June 9, on St. Paul Island, no branded yearlings were seen, nor any seal, in fact, small enough to approach the size of a yearling, according to the usual acceptation of its size. On June 23, no branded yearling was seen and only seven small seals that might be classed as yearlings, although their identification was in doubt.

On July 7, none of the branded yearlings appeared, and very few small seals.

On July 24, no branded yearlings having yet been found, the hauling ground on Reef rookery was driven, in order to discover how many if any, of these marked animals were present. The seals were separated into pods, of perhaps 50 animals each, and each pod was carefully examined in turn to ascertain how many of the marked yearlings might be in it.

Out of the entire drive of more than 1,200 seals, 6 marked yearlings were found, and all of them were males. Although only 6 of those marked were found, there were present a few other animals of similar size which might properly be classed as yearlings, but the whole number of this size present, including those not marked, would not equal 10 per cent of the whole number in the drive. None of the marked seals was killed.

A single yearling appeared in the drive of July 20 on St. George.

### ARRIVAL OF SEALS ON ST. GEORGE ISLAND.

The first bulls to haul out this season appeared May 8 on North and East rookeries. The first cow appeared on North rookery, June 12. Details of certain observations on the arrival of seals and harem counts are given in the following table:

COUNT OF BULLS, HAREMS, AND COWS, ST. GEORGE ISLAND, NORTH ROOKERY, SEASON 1913.

| Date. | Bulls. | Harems. | Cows. | Idle bulls. | Quitters. | Remarks. |
|---|---|---|---|---|---|---|
| May 8 | 4 | ... | ... | ... | 1 | |
| 18 | 30 | ... | ... | ... | 1 | |
| 21 | 47 | ... | ... | ... | 5 | |
| 24 | 58 | ... | ... | ... | 5 | |
| 29 | 60 | ... | ... | ... | 6 | 1 bull in water. |
| June 5 | 64 | ... | ... | ... | 3 | 15 bachelors. |
| 7 | 76 | ... | ... | ... | 2 | |
| 12 | 80 | 1 | 1 | 79 | 10 | 40 bachelors. |
| 16 | 82 | 1 | 1 | 81 | 5 | |
| 30 | 99 | 69 | 924 | 30 | 14 | |
| July 2 | 99 | 75 | 986 | 24 | 4 | |
| 3 | 99 | 77 | 1,016 | 22 | 10 | |
| 7 | 104 | 95 | 2,214 | 9 | 5 | |

After the early days of June, when the seals had hauled out in numbers, no complete counts of the nonbreeding seals were made by the agent. The full census of all classes was made by Mr. George A. Clark, special investigator, who will make a separate report.

### SEAL MEAT NECESSARY FOR NATIVES' FOOD.

The natives are almost entirely dependent on seals for fresh meat. For both islands at least 5,000 carcasses from seals of desirable ages should be provided to afford the natives an abundance of the food which has formed the basis of their diet.

In addition to the number of seals killed for natives' food, a sufficient number of carcasses should be put in the silos during the summer to provide fox food from September 15 to the following May. Between these dates birds are not sufficiently abundant to supply the

[a] A telegram dated March 16, 1914, from Mr. P. R. E. Hatton, in charge on St. Paul Island, reports a total return of 14 branded seals to that island in 1913 between July 14 and November 8. On St. George Island a total of 74 branded seals were seen, chiefly in drives between August 16 and November 25. This is a total of 88 for the two islands, out of the 5,529 branded pups of 1912. They were never seen in numbers, but appeared occasionally on a number of different rookeries.

foxes with enough food to keep them from starving. Previous to 1904, the number of seals killed each fall, whose carcasses were allowed to remain on the ground, provided ample food for the foxes, but as the killings decreased this food gradually became less and less, until it became necessary to preserve food in silos to carry the fox herd through the winter. At that time the lessee was required to furnish each year 12 tons of dried or salted fish, in addition to the seal carcasses preserved. Last year the fox herd on St. George alone consumed 12 tons of salted whale meat and 10½ tons of salt salmon, in addition to what they could get from the refuse parts of the carcasses left on the killing grounds and the birds, fish, and other food they could get by hunting and combing the beaches. The salted food was put out at the fox trap and none was wasted. In the absence of this food the foxes will starve to death.

## THE FOX HERD.

### ST. PAUL ISLAND.

Fox trapping was allowed on St. Paul Island for a period of six days, from December 2 to 7, 1912, as the result of which 143 blue and 30 white fox skins were secured. These were shipped in tight casks on the *Homer* to San Francisco and there consigned by freight to Funsten Bros. & Co., St. Louis, as directed by the Department.

The two localities on St. Paul in which foxes are most numerous are those in which the greatest number of seals have been killed. These are North East Point and the village. The fox-trapping locality next in importance is Southwest Bay, which contains the Zapadni rookeries and killing ground. Foxes are least numerous where seals are not present at all and where the foxes exist on birds, beach food, and various vegetable matter.

No reliable method of ascertaining the number of foxes remaining on St. Paul at the close of the trapping can be used. That many survived the trapping season, however, is known. From those actually observed and from the fox tracks seen in the snow it could almost be believed that the trapping made no appreciable impression upon the number in the whole herd. The following summer (1913) foxes, both young and old, could be seen anywhere in plenty and, if anything, more numerous than before.

The St. Paul foxes seemed to be in no lack of food during the past winter. With one exception all foxes taken at the village were well supplied with fat, and that animal was suffering from severe ulcers on the stomach—outside lining. Nearly all had full stomachs when captured. The winter, however, was unusually mild and open, with little snow, giving the foxes exceptional opportunity to forage, which they would not enjoy under usual winter conditions.

In the summer of 1912 a pit at the village was filled with seal viscera and the bodies of such few seals as were for any reason objectionable for natives' food. In February following this pit was opened and some of its contents strewn about. Thereafter the foxes frequented this hole, eating of the contents. No salt or other preservative was used on the contents of this pit.

A reindeer died at the village on February 2, and the body was consumed by foxes in several days. The two deer dying at North Shore were also eaten almost immediately. Those deer dying in the corral at the village were eaten by foxes almost before the bodies could be found by the herders. This consumption of fresh meat in such short time by the St. Paul foxes is unusual, and indicates not so much a scarcity of food as an unusually large number of foxes.

As the fall of 1912 was the first in which there was complete absence on the rookeries of the bodies of seal pups dead from starvation because of the mothers being killed at sea, it was a matter of interest to observe how the elimination of this accustomed food supply would affect the foxes. It could not be seen that foxes were suffering from lack of food at any time, but it is believed that the unusual openness of the winter compensated in great part for the absence of dead pups. Had the winter been severe and the beaches piled high with the usual ice barricade (which was wholly absent last winter) the foxes undoubtedly would have suffered from lack of food.

### ST. GEORGE ISLAND.

On St. George Island fox trapping began on the night of November 26 and ended on January 31. The village trap was used 21 nights and string traps were used in the village three days. At Zapadni trapping was carried on two days and only one fox was caught.

The first night of trapping at the village 247 foxes passed through the fox-house trap; the second night 76, the third, 85, and the fourth, 64. Thereafter the number varied from night to night, but never equaled the numbers of the first four nights. The total number of foxes killed was 268, of which only 1 was white. Five of these skins were mangy, and 15 other mangy skins were taken from foxes found dead, making 20 mangy skins in all, which were shipped to the Bureau for examination. The skins in good condition numbered 263, including 1 white.

Trapping can not be carried on successfully every night. Those branded and released will return to feed, but soon become "trap-shy" and will not reenter the trap, although all sorts of devices are resorted to to induce them to do so; there is always a number that will return and feed, but will not enter the trap.

*Selective breeding and the food question.*—The present foxing methods on St. George Island were put in practice about 1897. The method was based on the theory or belief that by killing the poorer foxes and reserving the better conditioned ones as breeders a superior strain or breed of foxes could be developed. Proceeding on this assumption, those to be reserved as breeders were branded and released. During recent years the number so branded and reserved has usually been about 200 pairs annually, and all inferior animals were killed. No discoverable improvement, however, has been noted. The catch of the winter of 1912–13 was of poorer quality than that of the two previous years, and more mangy foxes were killed last year than in any previous year.

The causes of the deterioration are evident. The natural food on St. George Island obtainable by the foxes is not sufficient for their needs. Until in recent years the numbers of seals killed on the island each year, the refuse parts of the carcasses of which were available for fox food, were sufficient, together with other obtainable kinds of natural food, to supply the foxes adequately and with wholesome food. But during the last few years the amount of seal meat has not been enough for their needs. Therefore, from about the first of October until in May the foxes, finding little or nothing else to eat, have been fed mainly on salted food freshened in sea water. Meat sufficiently impregnated with salt to preserve it, then freshened in sea water, can not come from the freshening vats with any less salt than is contained in the water in which it has been soaked. A diet carrying that much salt, fed to foxes year after year during seven months, can not be wholesome and must inevitably produce injurious results.

Furthermore, the trapping season extended over too long a period. It should be limited to a week or 10 days, as it was on St. Paul. The period during which the fur is at its best is very short.

A quantity of whale flesh (12 tons) was shipped last August from the whaling station at Akutan to St. George to be used for fox food, to compensate for the absence of the usual amount of seal meat saved and stored for that purpose. When this whale meat was fed to the animals during the winter they ate it with eagerness and seemed to enjoy it more than any other food that has been given to them heretofore, not excepting the dried salmon which the lessee used to furnish. In 1913, unfortunately, this whale meat could not be obtained, because the Akutan whaling station was closed. As the foxes had to be fed, attempts were made to induce natives of Unalaska to catch fish for this purpose, and one native responded by proposing to catch any amount of Attu mackerel or kelpfish, dried, up to 10 tons, at English Bay, Unalaska Island, at $20 a ton, the Government to furnish the sacks in which it was to be shipped. As no other offer was made, the proposition of the native was accepted. The live fish were there in quantity, but after catching about 5 tons and hanging the fish up to dry, most of it spoiled because the weather was too rainy to permit of drying. As the matter was urgent, Agent Lembkey visited the place, to induce the man to renew his efforts. He also procured a quantity of burlap for shipment of the fish and arranged with the Revenue Cutter Service to transport it from English Bay to St. George some time during the fall. It is not known what quantity of this fish was furnished.

On St. Paul, realizing that the St. George foxes would be in danger of starvation during the winter of 1913–14, on July 7 such pieces of seal meat as were left on the field by the natives and such few seal carcasses as were undesirable for natives' food because of the removal of the blubber, were hauled to the village and there cut up and barreled after being lightly salted. Twenty-four barrels were so filled and sent to St. George on the *Homer*. This quantity of seal meat would weigh about 2½ tons and will last only a short time.

## REINDEER HERD.

On the last day of August, 1911, 4 male and 21 female adult reindeer were placed on St. Paul Island, and on the next day 1 adult male, 12 adult females, and 2 young males were landed on St. George Island by the revenue cutter *Bear*. These reindeer had been supplied to the Department of Commerce by the Department of the Interior from its herd at Unalakleet, on the mainland.

Up to the spring of 1912, the losses had been but 3—1 male and 1 young cow on St. Paul and the adult bull on St. George. In the spring of 1912 there were produced 17 healthy fawns on St. Paul and 11 on St. George. At the end of August, 1912, there were on St. Paul 3 adult bulls, 20 adult cows, and 17 young, or a herd of 40. On St. George there were 2 adult bulls, 12 adult cows, and 11 young, or a herd of 25; a total of 65 on the two islands. The losses from these until September, 1913, on St. Paul were 1 adult bull, 1 adult cow, 1 yearling cow, and 2 yearling bulls; those on St. George, 1 adult bull, or a total of 6.

In the spring of 1913 there were produced 18 healthy fawns on St. Paul and 13 on St. George. At the end of September, 1913, the herds therefore consisted of 2 adult bulls, 18 adult cows, 7 yearling bulls, 7 yearling cows, and 18 fawns on St. Paul, or a herd of 52; and on St. George 2 adult bulls, 12 adult cows, 2 yearling bulls, 9 yearling cows, 8 male fawns, and 5 female fawns, or 36. The total for both islands at the end of September, 1913, is therefore 88. This is a net increase of 120 per cent in the two years.

The experience of the two years has demonstrated the practicability of maintaining a reindeer herd on each of the islands. The climatic conditions are favorable, or at least not unfavorable. There was no loss that could be attributed to the physical environment. The agent and others familiar with St. Paul Island believe that the reindeer moss and other suitable food are sufficiently abundant on that island to support a herd of at least 1,000. The moss on St. George Island is thin and short and will probably not support a herd of more than 150 to 200.

The herds appear to require no special care except in the spring, when the young are being dropped. Experience has shown that, unless cared for, the young are apt to wander away and into holes or crevices in the rocks from which they can not extricate themselves. It has been found advisable to corral the does and to give them constant attention during the period when the young are being dropped and until the fawns are well able to take care of themselves.

The St. Paul herd has been under the direction of two native herders, each receiving as compensation for his services the sum of $2.50 a month. These herders twice each week search for the herd, which wanders at large, and drive it slowly to a point near the village in order to accustom it to man's presence and to being handled.

On January 30 last a young male was found injured in the hind leg, which dragged inert as the animal walked. The deer was driven slowly to near the village and an examination made, which showed the knee and hip joints to be greatly swollen and stiffened. On the suggestion of Dr. McGovern the animal was placed on a sled and brought to the shop, where it was intended to place it in a sling and, after clipping the affected areas, to apply thereto an ichthyol and iodine dressing. While this was being done, however, the animal quietly died. An autopsy showed both the joints mentioned to have been torn asunder by some violent strain, conjecturably through fighting with an older male.

On March 15, 1912, a yearling female was seen to be somewhat disabled in a fore leg, but keeping well up with the herd. On the 22d, however, the body of this animal was found at North Shore nearly eaten by foxes, not enough being left to determine the cause of death.

On April 28 a doe was found to have died in giving birth to a stillborn fawn.

On May 5 two fawns were born dead. On the 18th a two days' old fawn was found dead in a small hole in the corral and almost entirely eaten by foxes. On the same night a female yearling died in giving birth to her fawn, and by morning both bodies were almost entirely eaten by foxes. On the 28th the body of an old male, of the original stock, was found at North Shore.

The herders reported the deaths, therefore, of 1 old female, 1 old male, 2 yearling females, 1 yearling male, and 5 fawns.

The herd habitually resorted to an area near North Shore almost 10 miles away from the village and nearly inaccessible in winter.

For this reason it was not possible to ascertain the date of the rutting season without a man's staying continuously with the herd, which was impossible, as no houses were in the vicinity. The season for dropping fawns, however, begins between April 1 and 15. The habit of the female when approaching delivery is to absent herself from the herd and seclude herself in some chosen spot where her young is born. To keep the females under observation during this period, and to prevent the new-born fawns from straying into holes from which they could not extricate themselves, the whole herd, was on March 22, driven into a corral about a mile from the village, where it could be visited daily. As the moss in this corral is sparse, it became necessary for the herders each day to drive the animals outside, allow them to graze for several hours, and then return them to the corral. When the first fawn was born the herders kept the animals inside the corral and gathered moss outside which they carried to the animals.

On April 17 the deer broke through the corral fence and escaped. When finally driven back four females were missing and remained at large until several months later, when each was found with a living fawn. Whether it is desirable to confine the animals in this restricted inclosure during the fawn-dropping period, or whether to allow the does to follow their desire to isolate themselves at this time, is conjectural. The does on St. George have not been confined in inclosures during the period of parturition, notwithstanding which no seeming increase in the death rate resulted.

There are not yet enough animals in the reindeer herd to allow of killing any for food or of training any to draw vehicles. Females should never be killed, of course. In the case of males, selective killing should be practiced; i. e., only the smaller and less vigorous males should be used for food. The Esquimo herders saw off the horns of the most belligerent bucks, that the latter may not injure the younger males. Observations show that the species has much less resistance than a wild animal would be supposed to have. Of the two adults found last winter with injured legs, both died, although the injury of itself was not fatal, and did not prevent the animal from obtaining as much food as it desired. Innumerable instances can be cited of cattle, horses, sheep, and foxes living for years after an injury that partially or wholly destroyed the use of a leg. From this it may be deduced that, as draft animals, the reindeer would be of much less utility than a horse or mule. If trained, however, it probably could travel with a light load over frozen surfaces with facility. Its greatest use to the Pribilofs will be that of furnishing fresh meat for human consumption, refuse meat for the foxes, and skins, which make superior sleeping bags.

No possible interference with seals or foxes can occur on the part of the reindeer. At best it is a timid creature, except perhaps in the rutting season. The herds invariably frequent the uplands in the interior of the islands, miles from the nearest seal rookery. When driven to the village and there released, the herd at once travels back rapidly to the interior. On St. Paul, the mules while grazing find sport in stampeding the herd, if it approaches, and chasing it until the mules tire. The reindeer and seals have never been seen together, but it is almost certain that the latter would be not in the least disturbed by the deer.

At present the reindeer in the herds on the Pribilofs are the property of the Government. Native herders are employed, two on each island at the nominal salary of $2.50 per month each, to look after the herds and give them such attention as they may need. No reindeer have yet been killed for food. It is the intention to begin killing whenever the number of males considerably exceeds the needs of the herd for breeding purposes. After reserving the number of bulls necessary as breeders, the useless males will be killed for food and their skins. The conditions under which this food will be furnished to the natives have not been definitely determined.

It has been suggested that a system of apprenticeships be established whereby the natives may acquire individual ownership in the deer. Such a system has a number of advantages. It would, it is believed, cause the natives to take a greater interest in the deer and be more active in their care.

The natives would acquire the stimulus that comes with personal ownership and the possibility of personal profit from the sale of meat and hides.

There is no reason why the reindeer may not be utilized to a considerable extent on the Pribilofs in connection with travel and transportation to and from the remoter parts of the islands. The natives should be taught reindeer driving, not only for utilitarian reasons but because of the pleasure to be derived from sleighing parties during the long seasons of snow.

The same danger of deterioration of stock as a result of inbreeding will be encountered here as with domestic stock anywhere. To avoid this danger and for the purpose of general improvement of the herds, it is recommended that reindeer from the Alaska peninsula be introduced from time to time.

## SEA LIONS.

The small herd of Steller's sea lions on St. Paul and the much smaller one on St. George seem to remain without either increase or decrease. These animals would not be disturbed at all by the islanders were it not for the fact that the skins of the surplus males have been and are still used for covering the native bidarras or large lighters essential for transporting cargo from the supply vessels to the beach. No other form of boat, carrying the same quantity of merchandise, is light enough to be handled by the force of workmen on the islands. It has been the practice, therefore, to secure on St. Paul skins enough to renew each year the cover of a bidarra on each island. The St. George herd rarely if ever furnishes a skin.

In late years it has not been possible to obtain such a number of skins. No drive of sea lions on St. Paul has been made since 1909. notwithstanding annual attempts to make such drive.

The driving of sea lions requires skill, patience, and courage that not all the native hunters seem to possess, and does actually call into use all the aboriginal skill in hunting that these men have fallen heir to.

The animals sought to be secured are the immature males and young male adults that have not been able to secure cows. These, as do the fur-seals of the same class, gather in one place usually, apart from the breeders. They are enormous beasts, 10 to 12 feet long, each weighing nearly or quite a ton. They are very wary and will rush for the water at sight, sound or scent of any disturbing element.

It is the object of the native hunters to place themselves between the sea lions and the beach and to induce them to run inland instead of into the water. Once started in an inland direction they may be driven slowly but with comparative ease to any place where it is desired to kill them.

To get between the animals and the sea is the difficult and dangerous task. The wind must be directly off shore or slightly quartering, or otherwise the scent of the approaching hunters would cause the creatures to rush into the sea before they could be intercepted. If the beach line is clear and the wind favorable, the men creep carefully along the rocky beach at low tide until they have reached a position favorable for turning the sleeping animals inland. Then rising suddenly with shouts, hand clapping, and gunshots the attempt is made.

If all goes well, some of the animals in their fright will rush inland; others will make for the water despite the noise. Then it is well if a luckless native is not in the line of a charging beast, as nothing can stop it until the sea is gained. Many narrow escapes from injury or death from trampling or a snatch from the enormous jaws has served to add zest to the enterprise.

If a drive is made, the animals are driven to a level stretch of ground where racks have been erected. There the beasts are shot, the skins removed and piled one over the other, where, covered with grass or turf, they are allowed to "sweat" until incipient putrefaction has so loosened the hair that it can be scraped off. The skins then are taken up, scraped clean of hair, and stretched on the racks until they become dry and stiff. In this condition they are stored until time to use them for a boat cover. Then they are soaked until soft, the edges trimmed until they fit each other, and are sewed together by the women with thread made of whale sinew, or better, as has been found, with stout linen thread. The cover while wet is stretched taut over the boat frame, lashed to the gunwale with heavy twine, and allowed to dry. When dry it is as tight as a drumhead and as stiff as sole leather. Since 1909 conditions have not been propitious for making a drive of these animals. While they have been present each year, either they haul out in places inaccessible for driving, or the weather conditions were not favorable for the men to approach without giving alarm. Attempts each year to make a drive have been without success.

This spring (1913) the usual report came from North East Point that about 50 sea-lion bachelors had hauled quite a distance back from the beach and that a drive probably could be made. Acting on this, on May 14, a team was sent with eight hunters and a cook. On May 20 these men were brought back after they had made several unsuccessful attempts to secure the drive. On May 23 the party again was sent out and remained until the 31st, when further attempts to make the drive were abandoned.

During this whole period the wind was favorable for driving on only two occasions, May 20 and 24. On the first date a drive was attempted. As the animals lay widely scattered, the driving gang was divided into two sections, each approaching along the beach from a different flank upon the center. While crawling along the water's edge, before they were in position to rise suddenly and startle the animals a fox in the driver's path ran off among the sea lions, barking at the men. This caused the drive to withdraw to the beach, and made the attempt a failure. On the 24th the sea lions were so widely scattered that none could be prevented from plunging into the water.

While it is necessary to have these boat covers made of some flexible material, it is believed that heavy canvas could be substituted for sea-lion skins and used to advantage. This could be sewed as are the skins, and covered with paint or oil. The dislike of the natives to use a bidarra covered with anything else than sea-lion hides would have to be overcome. Certainly the bidarras now on the islands will have to be covered with something soon, and, as no skins seem to be obtainable, something else will have to be used.

Sea lions are plentiful on Bogaslov Island, west of Unalaska. The natives of St. Paul found over 100 young males on Walrus Island June 14 of this year. The species is not in danger of extermination, but conditions seem to prevent any from being captured. It is not allowed to shoot them on their breeding grounds.

## WALRUS ISLAND BIRD RESERVATION.

Walrus Island, a low-lying islet about one-third of a mile long, lies about 8 miles east of St. Paul Island. It is barely above the wash of the surf at its highest point, and is composed mainly of lava layers breaking abruptly into the sea. Basaltic bowlders form a small portion of its north shore line. About 1,500 square feet of its surface is covered with loam; the remaining surface is flat, rain-washed rock or loosely strewn bowlders.

In previous years a few walrus hauled out here, and perhaps a few lived here, but from the small area and general topography of the place it can well be assumed that it must have served merely as a hauling or resting ground for young or surplus male walrus, the overflow from the main walrus rookery on North East Point on St. Paul. From the presence of these few walrus in former times, however, the islet got its name. None of this species has been seen to land here since about 1890.

This small island, however, has long been known as the breeding place of countless thousands of a few species of sea fowl. So great is the profusion of bird life there that this little rock is generally known as one of the few remaining places in the world where wild life may still be found in such superabundance as to be innumerable and startling.

Positive efforts to conserve this bird life have never been made. The inaccessibility of the locality has rendered it immune from disturbance by man, if we except the annual visits of the St. Paul natives to gather eggs. On these visits the native party would gather a boatload of eggs of the murre, which are laid on the flat bare rock without sign of a nest. If the weather is favorable, this trip may be followed up perhaps by a return visit a week afterwards, when the surface previously gathered over is again covered with eggs unmistakably fresh.

Walrus Island was made a special Government reservation in 1909, but the privilege of the natives of St. Paul to visit this island during the spring to collect eggs for food, as has been their custom for years, has been continued. Of such visits in the summer of 1913 it is purposed to report here.

On June 12, 1913, a rowboat manned by six natives left St. Paul village about 5.30 a. m. and visited Walrus Island, returning about 5 p. m. with about 1,000 murre or "arrie" eggs. These were gathered off the flat top of the island without necessity of selection, as all were fresh. The boat captain stated that only a small space on the island was cleared of eggs, as more could not be brought back in the boat with safety to the crew. He reported that many gulls were to be seen there, but the crew could not find over a dozen gulls' eggs. This is quite an unusual circumstance as the gulls usually lay their eggs before the murres. Bird life in general was reported to be as plentiful as heretofore.

An opportunity to visit the island again did not occur until June 30, when Mr. Kleinschmidt, charterer of the schooner *P. J. Abler* lying off St. Paul island, made the trip to Walrus Island in the schooner and kindly took Agent Lembkey along, together with five natives to gather some more eggs, if the condition of the latter would justify gathering for food. Several hours were spent there, and opportunity was afforded for a somewhat careful observation of conditions.

The area denuded of murre eggs by the native party on June 12 was found completely covered again with eggs, which however, were already incubated to a point rendering nearly all of them undesirable for food. Only about a bushel of eggs was taken by the natives, each egg having been tested in water and found to sink.

At this date no murre chicks had been hatched. Of the glaucous winged gulls, only three chicks were found, two perhaps a week old and one just out of the shell. The young cormorants, very few in number, had grown to over half the size of the parents, but were still in down and had scarcely any feathers. No puffin young were found, but many puffins were seen hatching in their burrows and several of their eggs when broken were found to be about one-third incubated.

No diminution in the numbers of birds frequenting Walrus Island seems to have occurred. As the boat containing the visitors approached the landing, all cliff edges were seen to be alive with murres, standing so close together as almost to be touching each other. They paid but little attention to the visitors even after the latter landed, and retreated only a few yards from the person coming toward them. Even within this, they constantly returned, each to straddle its particular egg lying precariously on the flat rocks without sign of nest, and sometimes rolling its own or other eggs about in a way that demonstrated the unusual thickness of the shell. With all this rough treatment and confusion very few eggs were broken. The murre eggs covered thickly all the flat space usually occupied by them and few if any more could find hatching space.

The glaucous-winged gulls arose in clouds as the party moved about the island, and were continually rising and alighting again, as were the murres. A few kittiwakes were seen nesting on the abrupt faces of the cliffs in the little shelving recesses which they frequent. With the exception of the small bowlder beach on the north side no areas were found that could have been used for breeding purposes, and here it is possible that in a storm the space might come within the reach of dashing spray and therefore be undesirable. It is fair from this to conclude that bird life on this island is probably at its greatest expansion. It certainly is as profuse to the eye as when it was visited by Agent Lembkey in 1899. During the time of the visit on June 30 last the air was so filled with flying birds that photographic plates with a very short exposure showed them as thick as flies over the whole sky space on the film. In short, the number of birds in the air was as remarkable as the very remarkable number of birds on shore. The impression that the whole scene creates upon an observer is that there are millions of birds inhabiting this little island. When it is considered, furthermore, that the islands of St. Paul and St. George, especially on those portions of shore line where abrupt cliffs are found inaccessible to man, contain breeding areas for these same species many times greater in extent than the whole of Walrus Island, some faint idea can be gathered of the boundless profusion of bird life about the islands.

It does not seem that the destruction of eggs by the egging expeditions of the St. Paul Island natives ever has had the effect of diminishing the birth rate. The eggs most sought and generally obtained are those of the murre. This species will lay and hatch but one egg if undisturbed, but experiments made on several occasions show that if the first be removed the bird will immediately lay another and a third if the second be removed. In some cases, even a fourth egg will be laid if the previous ones have been taken away, but the fourth usually is small and seems to mark the limit of the bird's endurance. The natives never remove eggs from any specific breeding area more than twice in one season, and all such eggs when removed appear to be immediately replaced by the birds. It would seem that this could have no effect upon the numbers of birds hatched but merely would make the date of hatching somewhat later, a matter which would work no particular loss of offspring.

It is likely that in a state of nature many murre eggs are destroyed and have to be replaced. The eggs are laid usually on flat sloping rocks, resting in a mere indentation that offers a precarious resting place. In a crowded breeding ground quarrels are incessant, and as a result the eggs are started rolling, and in spite of the extremely thick shells many are broken. Under the St. George cliffs the shells of murre eggs may be found in abundance.

The murres have also a constant and vicious enemy in the glaucous-winged gull, which in sheer wantonness, when hunger does not serve as a reason, attacks the eggs of the murre the moment the latter are left ungarded, and punctures them with a heavy blow of the beak. On Walrus Island clouds of the gulls could be seen to settle on the thickly strewn egg spaces just deserted by murres, and to begin, with every sign of pure maliciousness, to pick at them and to gulp of their contents, perhaps a single mouthful only from each egg. They also would start the eggs rolling down a rock to break at the bottom without any further attention from the gulls. These gulls also have been seen to sink their bills into murre eggs, and to fly away carrying the eggs so transfixed. On Walrus Island round balls of mashed murre eggshells could be seen everywhere, indicating that birds, probably these same gulls, had gorged their crops with the shells and ejected them afterwards. The murres themselves are not at all hesitant about tumbling each other's eggs off the rocks on which they were laid. Both sexes of the murres must alternate in guarding and hatching the egg, otherwise it would be destroyed by its natural enemies.

The glaucous-winged gull makes its nest on Walrus Island on the area covered by loam, constructed usually of green grass flat on the ground. The nests on June 30 contained two eggs usually, and in a number of cases one egg only. Nests with three eggs were very rare. In endeavoring to photograph the two young gulls just hatched that were found there, the photographer was dealt a vicious blow on the head by one of the parent birds swooping suddenly in its flight, and his hat was sent spinning.

The puffins lay their eggs in tunnels driven through the loam a few inches below the surface and were found sitting on one egg each. A puffin fights viciously when seized.

The red-faced cormorants on Walrus Island are very few in number. It is stated that this island is the only breeding place of this species on the American side of the Pacific, although many breed on the Siberian side.

# EXPERIMENTAL STUDY OF THE GROWTH AND MIGRATION OF FRESH-WATER MUSSELS

By Frederick B. Isely

*Professor of Biology, Central College, Fayette, Missouri*

Appendix III to the Report of the U. S. Commissioner of Fisheries for 1913

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# EXPERIMENTAL STUDY OF THE GROWTH AND MIGRATION OF FRESH-WATER MUSSELS.

By Frederick B. Isely,
*Professor of Biology, Central College, Fayette, Missouri.*

## INTRODUCTION.

The growth lines of the Unionidæ have long been considered by many observers as "annual rings," marking the yearly increase in the shell diameter. On the other hand, proof of the correctness of this assumption has been lacking, and not a few investigators have questioned its validity.

If the so-called annual rings do mark yearly additions, the rate of growth may readily be ascertained in many species by inspection; if, however, two or three of these lines appear in one season, or prominent lines appear only at irregular yearly intervals, the importance of "growth lines" as definite indicators of rate of growth loses much of its significance.

The economic importance of fresh-water mussels has added a new stimulus to the study of the growth problem. Investigations[a] under direction of the Bureau of Fisheries during the past five years concerning various phases of and questions related to the problem of artificial propagation of the species valuable for use in the manufacture of pearl buttons, knife handles, etc., has promoted inquiry concerning the time required for an economic species to reach marketable size.

Israel and Haas, among German investigators, have recently given the growth question some attention in connection with their extensive study of the fresh-water mussels of streams of Germany. In this country Lefevre, Curtis, and Coker[b] have gathered experimental data concerning growth.

In my study of the ecology of the Unionidæ during the past five years, one of the perplexing problems has been the rate of growth and

[a] Various papers by Lefevre, Curtis, Coker, and other workers, in Bureau of Fisheries publications, the Journal of Experimental Zoology, and the Biological Bulletin for 1909, 1910, 1911, and 1912.

[b] Through the kindness of Dr. Coker, I have been permitted to read in manuscript the results of his experiments and observations.

the age question. After carrying on experimental work for some time on my own initiative, I was given opportunity in 1910 to undertake the work on a larger scale under the direction of the Commissioner of Fisheries.

## PLAN OF INVESTIGATION.

In the experiments to be undertaken I proposed to ascertain the rate of growth, to inquire into the meaning of growth lines, to investigate the relation of age, maximum size, etc., and, as a secondary problem, to gather data concerning migration. The plan of work was, in brief, to collect a thousand specimens of as many species and sizes as could be secured in the region where the work was carried on; in some way mark them individually, weigh, measure, and make any other necessary records; and then return them to their usual habitat and at suitable intervals reclaim, weigh, and measure again.

To carry out this work, two questions of method had to be solved: (1) The marking of specimens and (2) the reclaiming of them.

### MARKING OF SPECIMENS.

In 1909 I experimented with two ways of marking: One was to scratch a symbol (pl. I, H), as a Roman numeral, on the shell, and in this way identify it for future records; the second method was to fasten a serial-numbered tag to the shell and keep records by these numbers. In the final work both methods were used, the former for light shells, the latter for heavy ones.

The method of marking a shell by scratching a number on it is simple enough, as a mark cut through the epidermis of a mussel valve will be carried indefinitely. To get a satisfactory series for a large number of specimens, however, is difficult.

The tagging with serial numbers seemed to me to be more exact. For this method I used brass tags about the size of a dime and fastened them to the specimens with a light copper wire passed through a small hole made in the posterior edge of the valve. The hole in the valve was made with a very fine button-eye drill about 2 millimeters from the posterior edge of the shell (pl. I, II, and III). To hold the button-eye drill, a geared hand drill was used, and only a few seconds were needed to drill a hole even in a thick shell. By making a little hook on the wire it could be passed through the hole and out between the valves, usually without much difficulty. In large specimens it was found that the work of tagging could be more readily accomplished by wedging the valves open slightly before inserting the wire. A slight injury to the animal often resulted from the fact that the mantle was not sufficiently drawn back to avoid the drill point. While the irritation at the moment was doubtless severe, the ultimate effect upon the animal's future growth and activity was insignificant (p. 19).

## FIELD RECORDS.

A tabular record was kept of all specimens tagged. The weights were taken in grams, a Harvard trip balance being used; the measurements, length, height, and breadth in millimeters with a steel caliper. The field record form, kept in duplicate, was ruled in columns with headings for number, weight, length, height, breadth, species, and remarks.

## PLANTING SITES.

In most cases, after tagging and taking records, the mussels were placed directly back in their original habitats, but in some instances transplanting from river to creek or from pond to river was practiced.

Four different sites were selected for planting: One on Shoofly Creek, on the Corn farm in the north end of Kay County, Okla.; two on the Chikaskia River, on the Brewer and Esch farms near Tonkawa, Okla.; and a pond site on the Browne farm near Autwine. As the pond dried up, due to the unusual drought of 1910, this series does not figure in the results.

The Chikaskia River is a small, clear-water, sandy stream. The sand is coarse, and frequently there are stretches of gravel and occasionally mud banks and small, mud-bottomed side channels. In certain portions of the Chikaskia, Unionidæ are abundant.

Shoofly Creek is a tributary of the Chikaskia. In very dry weather the water stops flowing over the shallow, gravelly stretches; but the ponded sections, often a mile in length and with water 2 to 6 feet deep, have a constant water supply. In certain of these ponded portions mussels are fairly abundant.

## PLANTING OF TAGGED SPECIMENS.

In all, about 900 specimens were tagged, weighed, measured, and listed for future observation. For convenience in further discussion these specimens may be grouped into seven lots.

### SHOOFLY CREEK.

*Shoofly, lot A, 140 specimens, and lot B, 80 specimens.*—Nearly all of these were *Quadrula undulata* (three-ridge) and were taken from the direct site where they were planted after tagging. All of the *Q. undulata* (three-ridge) secured in the Shoofly were large; out of some 500 specimens handled in two days, only 4 weighed under 200 grams.

*Shoofly, lot C.*—Twenty-two specimens of *Anodonta grandis* (floater) were planted in a mud bank similar to the environment selected by this species in this creek.

*Shoofly, lot D.*—As already indicated, the Shoofly species were mostly *undulata*, with a few *grandis*, and all were large. In order to get a larger number of species and smaller specimens, I collected 168 mussels in the Chikaskia and planted them in the Shoofly. In this lot, *Q. undulata* (three-ridge), *Q. lachrymosa* (maple-leaf), *Q. pustulosa* (warty-back, pimple-back), and *Q. rubiginosa* were represented by fairly good numbers, and nearly all of the specimens were under 200 grams in weight. It should be stated here that a few specimens of all of the Quadrulæ were found native of the Shoofly, and in addition to these, *Lampsilis gracilis* (paper-shell), *Lampsilis anodontoides* (yellow sand-shell), *Symphynota complanata* (heel-splitter), and *Anodonta imbecilis* were found. Not counting *grandis* (floater), the ratio would be 25 *undulata* (three-ridge) to one of another species. This, however, is not unusual in dominance of species in certain streams.

In planting specimens, the bottom was cleared of the original occupants and the tagged specimens were put in their places. For example, for lot D, an area of bottom about 12 feet in diameter was cleared and the Chikaskia specimens spread out on the cleared bottom. The Shoofly bottom, where the sites were located, is made up of a mixture of broken blue shale, coarse sand, and mud. The water is still and cloudy and from 2 to 5 feet deep. The specimens were planted in water about 3½ feet deep. Results that follow indicate that the above is a favorable type of habitat for the species used.

As already indicated, the specimens were free in the stream; no obstruction of any kind was placed in their way, nor any effort made to confine them. The planting operation consisted in turning them out of a sack and spreading them around on the stream floor. In 24 hours after planting it was noticed that most of the specimens had righted themselves and were stuck in the bottom, foot end down, but seldom was a *Quadrula* found with the foot extended.

The Shoofly specimens, lots A, B, C, and D, were tagged, weighed, etc., June 13 to 16, 1910; reclaimed and first checked over in part June 14 and 15, 1911; and a second time some were reclaimed and checked over September 19, 1911.

## CHIKASKIA RIVER.

In the Chikaskia two lots were planted. These were inclosed with a wire netting, as I was a little doubtful in regard to reclaiming free Unionidæ in the Chikaskia.

*Chikaskia, lot E.*—On the Brewer farm were planted 120 specimens of various sizes of Quadrulæ, and a few representatives of the other species mentioned for the Shoofly, with the addition of a few specimens of *Lampsilis purpuratus* and *Tritogonia tuberculata* (buckhorn, pistol-grip). The inclosure consisted of a triangular pen made of 3-foot, 1-inch mesh wire netting, run out from the bank and back again, 40 feet of netting being used in its construction. The bottom was a mud bank along the side and medium coarse sand farther out. The water was from 2 inches to 3 feet in depth, a portion of the main channel running across the lower end. The specimens were collected in part from the immediate vicinity of the inclosure, but, as they were by no means numerous in this portion of the river, about 90 of the 120 mussels were secured a mile farther down the stream. Lot E specimens were planted, weighed, etc., June 23 and 24, 1910, and checked over in part September 26, 1910, and June 22, 1911.

*Chikaskia, lot F.*—The second planting in the Chikaskia was on the Esch farm, and consisted of 330 specimens, collected mostly from the immediate vicinity, as the mussels in this portion of the river were abundant. The range of size was good, although really small specimens were rare in 1910. The species were about the same as noted under lot D, mostly Quadrulæ, as these are the only common species in this stream. Fifty specimens of *Unio tetralasmus*, a pond form never found in the Chikaskia, were placed in the Esch inclosure. This pen was made by fencing across a side channel formed by a long bar. The channel was 40 yards long and from 4 to 6 yards wide. The bottom was mostly coarse sand. At the time of its construction there was a regular flow of water through the channel, the depth of water varying from a few inches to 3 feet. Lot F mussels were planted June 23 to 28, 1910; examined and rechecked in part September 26, 1910, April 11, 1911, and June 20 and 21, 1911.

## GROWTH RESULTS.

In discussing experiments and results, we will first consider growth, and second, migration (p. 19).

The results have shown that much could have been learned from a smaller number of specimens. It was not known, however, that we should be able to reclaim so large a per cent of the specimens first planted. Then, too, it was necessary to guard against loss by accidents, such as changes in course of streams, drifting sand, drying up of water, and other possible environmental changes. The Shoofly specimens were absolutely unmolested; only three dead specimens were found in the whole lot, and these had all started to grow, showing that the tagging certainly had no bad effects. The Chikaskia specimens suffered somewhat from all of the hostile environmental factors mentioned above; and, further, some were lost to the small boy interested in collecting brass tags.

On the whole, however, the specimens were reclaimed in such large numbers that all of the material could not be worked over for records in the time available when the rechecking and reclaiming was done.

In rechecking material as many specimens were handled as time would permit. As small specimens were few in number, these were always rechecked and care was taken to include representatives of all species. Aside from these influences in selection, specimens were rechecked as found. The left-over material was returned to the stream when it could not be handled. Where a lot was checked over several times, as lot F, naturally the ones worked over the first time they were reclaimed, September 26, 1910, were again followed up in subsequent work.

Far more data were gathered than can be included in this paper. In the tables given below I have stated the reasons for selecting the data presented. Nearly all the material used is selected from lots D and F, as the latter was more available for frequent recheckings, and lot D of the Shoofly material represented a larger number of species and more range as to size.

TABLE 1.—A YEAR'S GROWTH IN YOUNG QUADRULÆ FROM LOT D.

[NOTE.—All starred numbers in tables represent specimens shown in plate figures.]

| Specimen No.[a] | Species. | Weight. | | Length. | | Height. | | Breadth. | |
|---|---|---|---|---|---|---|---|---|---|
| | | June, 1910. | June, 1911. | June, 1910. | June, 1911. | June, 1910. | June, 1911. | June, 1910. | June, 1911. |
| | | *Grams.* | *Grams.* | *Mm.* | *Mm.* | *Mm.* | *Mm.* | *Mm.* | *Mm.* |
| 323* | Q. undulata (three-ridge)... | 20 | 43 | 45 | 62 | 31 | 42 | 17 | 23 |
| 319 | .....do..................... | 49.5 | 77 | 64 | 75 | 42 | 50 | 24 | 27 |
| 341 | .....do..................... | 66 | 102 | 70 | 80.5 | 46 | 51 | 27 | 31 |
| 158* | Q. lachrymosa (maple-leaf). | 22.5 | 47 | 45 | 56 | 35 | 45 | 19 | 25 |
| 149* | .....do..................... | 26 | 53 | 45 | 59 | 36 | 46 | 20 | 25.5 |
| 159 | .....do..................... | 80 | 112 | 67 | 76 | 55 | 60 | 29 | 33.5 |
| 368 | Q. rubiginosa............... | 52 | 65 | 64 | 68.5 | 48 | 50 | 26 | 27 |
| 351 | .....do..................... | 60 | 76 | 64 | 69 | 50 | 52 | 26 | 28 |
| 353 | .....do..................... | 104 | 115 | 76 | 79 | 60 | 65 | 32 | 33.5 |
| 349* | Q. pustulosa (warty-back or pimple-back)............ | 10 | 20 | 30 | 37 | 25 | 30 | 15 | 20 |
| 375 | .....do..................... | 54 | 63 | 56 | 58 | 45 | 46 | 28 | 29 |
| 383 | .....do..................... | 67 | 77 | 64 | 65 | 52 | 53 | 29 | 30 |

AVERAGE GAIN AND PER CENT OF AGGREGATE GAIN FOR EACH SPECIES.

| Species. | Weight. | | Length. | | Height. | | Breadth. | |
|---|---|---|---|---|---|---|---|---|
| | *Grams.* | *Per ct.* | *Mm.* | *Per ct.* | *Mm.* | *Per ct.* | *Mm.* | *Per ct.* |
| Q. undulata........................ | 28.8 | 63 | 12.8 | 21 | 8 | 20 | 4.3 | 19 |
| Q. lachrymosa...................... | 27.8 | 64 | 11 | 21 | 8.3 | 19 | 5.3 | 23 |
| Q. rubiginosa...................... | 13.3 | 18 | 4.1 | 6.1 | 3 | 5.6 | 1.5 | 5.3 |
| Q. pustulosa....................... | 9.6 | 22 | 3.3 | 6 | 2.3 | 5.7 | 2 | 9.7 |

[a] Specimens listed in all tables according to size for each species.

The foregoing tables relate to Unionidæ from lot D (p. 8) that were planted June 15 and 16, 1910, and reclaimed June 15 and 16, 1911. In the figures given, the first series under each number is the initial record, the second series the record a year later. These specimens show manner and extent of growth in one year's time for four species. They were killed at the time of reclaiming, and are preserved for future study should anyone wish to examine them. It can be seen at a glance that *undulata* (three-ridge) and *lachrymosa* (maple-leaf) are rapid growers in comparison with *pustulosa* (warty-back, pimple-back) and *rubiginosa*. Further averages and percentages are worked out for each species listed in table 1 and later tables on page 8.

TABLE 2.—TWO PERIODS OF GROWTH, OF ONE YEAR AND OF THREE MONTHS, RESPECTIVELY, IN SPECIMENS TAKEN FROM LOT D.

[NOTE.—Starred numbers represent specimens shown in plate figures.]

| Specimen No. | Species. | Weight. | | | Length. | | | Height. | | | Breadth. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | June, 1910. | June, 1911. | Sept., 1911. | June, 1910. | June, 1911. | Sept., 1911. | June, 1910. | June, 1911. | Sept., 1911. | June, 1910. | June, 1911. | Sept., 1911. |
| | | *Gms.* | *Gms.* | *Gms.* | *Mm.* | *Mm.* | *Mm.* | *Mm.* | *Mm.* | *Mm.* | *Mm.* | *Mm.* | *Mm.* |
| 135 | Q. lachrymosa (maple-leaf) | 92.5 | 124 | 142 | 70 | 76 | 81 | 57 | 63 | 66.5 | 32 | 36 | 37.5 |
| 165 | ....do | 152 | 182 | 194 | 93 | 96 | 97 | 57 | 61 | 63 | 37 | 39 | 40 |
| 146 | ....do | 164 | 216 | 237 | 82 | 89 | 94 | 68 | 70 | 72 | 41 | 43.5 | 45 |
| 168 | ....do | 166 | 185 | 197 | 93 | 96 | 98 | 57 | 61 | 63 | 37 | 39 | 40 |
| 283 | Q. undulata (three-ridge) | 95 | 132 | 150 | 72 | 83 | 88 | 46 | 51 | 56 | 34 | 38 | 39 |
| 317 | ....do | 120 | 147 | 162 | 83 | 88 | 92 | 51 | 56 | 61 | 34 | 37 | 38 |
| 329 | ....do | 125 | 149 | 159 | 85 | 88 | 90 | 55 | 60 | 62 | 34 | 37 | 38 |
| 306 | ....do | 140 | 164 | 176 | 90 | 96 | 100 | 56 | 60 | 62 | 35 | 37 | 38 |
| 171 | ....do | 145 | 175 | 190 | 88 | 94 | 97 | 52 | 55 | 58 | 37 | 39 | 39.5 |
| 166 | ....do | 166 | 192 | 214 | 92 | 97 | 102 | 56 | ...... | ...... | 38 | 40 | 41 |
| 307 | ....do | 183 | 217 | 230 | 98 | 102 | 105 | 64 | 69 | 72 | 35 | 37 | 38 |
| 322 | ....do | 185.5 | 207 | 220 | 93 | 97 | 99 | 60 | 62 | 64 | 41 | 42 | 42.5 |
| 163 | ....do | 200 | 226 | 236 | 98 | 102 | 104.5 | 58 | ...... | ...... | 42 | 43 | 44 |
| 374 | Q. pustulosa (warty-back, pimple-back) | 35 | 45 | 50 | 51 | 55 | 57 | 43 | 45 | 47 | 24 | 25 | 27 |
| 363 | ....do | 60 | 73 | 80 | 55 | 57 | 59.5 | 49 | 51 | 52 | 29 | 31 | 32 |
| 384 | ....do | 87 | 102 | 112 | 63 | 65 | 66 | 55 | 57 | 57 | 34 | 36 | 36.5 |
| 377 | ....do | 90 | 107 | 114 | 79 | 82 | 85 | 57 | 59 | 60 | 31 | 32 | 33 |
| 358 | ....do | 135 | 145 | 152 | 88 | 89 | 90 | 65 | 66 | 67 | 33 | 35 | 35.5 |
| 355* | Q. rubiginosa[a] | 68 | 75 | 84 | 64 | 67 | 70 | 49 | 50 | 52 | 29 | 30 | 31 |
| 371 | ....do | 87 | 97 | 104 | 76 | 78 | 80 | 53 | 55 | 55 | 31 | 32 | 33 |

[a] It should be noted that five of the specimens for the two last species were more nearly mature for these species than the specimens of *undulata* (three-ridge) and *lachrymosa* (maple-leaf).

The specimens shown in the preceding table were planted June 15 and 16, 1910, and were reclaimed June 15 and 16, 1911, put back in the stream, and reclaimed September 9, 1911. All of the specimens of lot D that were reclaimed twice, measured, and weighed, are shown in table 2.

In the figures given above, the first is the initial record, the second the record one year later, and the third a three months' summer record (June 15 and 16 to Sept. 9, 1911).

Table 2 simply adds to the data of table 1 in regard to annual growth, growth of species, etc. It adds the fact of seasonal growth;

and gives data for comparison of yearly growth and summer months. The average yearly growth for 20 specimens shown in table 2, as well as the growth for three summer months (85 days) is shown below:

| | Weight. | | Length. | | Height. | Breadth. |
|---|---|---|---|---|---|---|
| | *Grams.* | *Per cent.*[a] | *Mm.* | *Per cent.*[a] | *Mm.* | *Mm.* |
| Average gain for one year, 1910–11. | 23.2 | 18 | 4.2 | 5.2 | 3 | 2 |
| Average gain for three months, 1911[b] | 12.1 | 8.2 | 2.9 | 3.4 | 2.4 | 1 |

[a] Per cent of aggregate gain.
[b] It should be noted in this comparison that the 1910 and 1911 summer months were different in weather conditions. During 1910 there were no rains heavy enough to raise the creek and wash out the food supply of micro-organisms, while in 1911 there were two periods of high water, one in July and one in August.

Per cent of gain gives a truer basis for this kind of comparison than the average net gain. The lack of conformity in the height averages, when compared with other measurements, is doubtless due to error on account of the great difficulty in getting this dimension in rapid field measurements because of the circular ventral margins of these species.

TABLE 3.—SEASONAL GROWTH.

| Specimen No. | Species. | Weight. | | | | Length. | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | June, 1910. | Sept., 1910. | Apr., 1911. | June, 1911. | June, 1910. | Sept., 1910. | Apr., 1911. | June, 1911. |
| | | *Grams.* | *Grams.* | *Grams.* | *Grams.* | *Mm.* | *Mm.* | *Mm.* | *Mm.* |
| 594 | Q. undulata (three-ridge) | 210 | 222 | 222 | 225 | 102 | 104 | 104 | 104 |
| 734 | .....do | 255 | 269 | 271 | 270 | 116 | 122 | 122 | 122+ |
| 678 | .....do | 261 | 273 | 272 | 277 | 110 | 112 | 112 | 112 |
| 573 | .....do | 290 | 305 | 305 | 305 | 118 | 125 | 125 | 125 |
| 644 | Q. lachrymosa (maple-leaf). | 104 | 116 | 114 | 116 | 76 | 76 | 76.5 | 77 |
| 753 | .....do | 105 | 115 | 117 | 123 | 66 | 67 | 68 | 70 |
| 665 | .....do | 154 | 167 | 167 | 172 | 84 | 86 | 86 | 86+ |
| 660 | .....do | 160 | 173 | 171 | 180 | 86 | 88 | 88 | 89 |
| 687 | .....do | 163.5 | 174 | 176 | 182 | 84 | 86 | 86 | 86.5 |
| 694 | .....do | 164 | 180 | 179 | 180 | 86 | 89 | 89 | 90 |
| 622 | .....do | 187 | 195 | 200 | 200 | 90 | 91.5 | 91.5 | 91.5 |
| 617 | Q. pustulosa (warty-back, pimple-back) | 91 | 98 | 98 | 99 | 64 | 64.5 | 64.5 | 64.5 |
| 689 | Q. rubiginosa | 141 | 146 | 146.5 | 147 | 84 | 86 | 86 | 86 |
| 721 | .....do | 148 | 154 | 156 | 156 | 84 | 86 | 86 | 86 |

While table 2 has given some good data concerning seasonal growth, table 3 gives more detail and permits a more exact location of the growth periods. Table 3 specimens are from lot F, Chikaskia River. These specimens were checked up, approximately, at the third, ninth, and twelfth months that they were under observation, and the results are shown by successive records. The initial records were taken June 23–28, 1910; second, September 26, 1910; third, April 11, 1911; and fourth, June 20, 1911. Only the weight[a] and length records appear in this table. The average gain for the different periods we find to be as follows:

[a] Some observers report weight measurements subject to a great deal of variation. In this investigation I have always kept the specimens out of water for short intervals and always under cover. Under these conditions I have found weight measures very satisfactory and stable under repeated reweighings.

| Time. | Weight. | Length. |
|---|---|---|
| | *Grams.* | *Mm.* |
| June 28 to Sept. 26, 1910 | 10.9 | 2.4 |
| Sept. 26 to Apr. 11, 1911 | .5 | .1 |
| Apr. 11 to June 20, 1911 | 2.5 | .3 |

For comparison with these averages we have the results from lot E, which I have not tabulated, for 14 specimens: 7 *lachrymosa* (maple-leaf); 4 *undulata* (three-ridge); and 3 *pustulosa* (warty-back, pimple-back). In this case the April reclaiming was not done.

| Time. | Weight. | Length. |
|---|---|---|
| | *Grams.* | *Mm.* |
| June 23 to Sept. 26, 1910 | 9.1 | 1.0 |
| Sept. 26 to June 23, 1911 | 5.4 | .55 |

The second period shows a gain in the growth for lot E over lot F. The explanation is one of food and possibly oxygen, and appears later (p. 24) under the discussion of migration.

The following four tables show proportional rate of growth, at different ages, of a single species, *Q. undulata* (three-ridge). The fact that lot D mussels were transplanted (p. 5) brings in an additional factor (footnote, p. 23), but I am not sure that this is material. In making these comparisons weight and length are used.

TABLE 4.—INCREASE IN ONE YEAR OF SPECIMENS FROM LOT D, WEIGHING LESS THAN 100 GRAMS.

| Specimen No. | Weight. | | Length. | | Specimen No. | Weight. | | Length. | |
|---|---|---|---|---|---|---|---|---|---|
| | June, 1910. | June, 1911. | June, 1910. | June, 1911. | | June, 1910. | June, 1911. | June, 1910. | June, 1911. |
| | *Grams.* | *Grams.* | *Mm.* | *Mm.* | | *Grams.* | *Grams.* | *Mm.* | *Mm.* |
| 323 | 20 | 43 | 45 | 62 | 313 | 70 | 101 | 74 | 83 |
| 319 | 49.5 | 77 | 64 | 75 | 287 | 85.4 | 107 | 79 | 85 |
| 299 | 50 | 70 | 67 | 76 | 283 | 95 | 132 | 72 | 83 |
| 341 | 66 | 102 | 70 | 80.5 | 282 | 100 | 124 | 82 | ....... |

TABLE 5.—INCREASE IN ONE YEAR OF SPECIMENS FROM LOT D, WEIGHING UNDER 200 GRAMS.

| Specimen No. | Weight. | | Length. | | Specimen No. | Weight. | | Length. | |
|---|---|---|---|---|---|---|---|---|---|
| | June, 1910. | June, 1911. | June, 1910. | June, 1911. | | June, 1910. | June, 1911. | June, 1910. | June, 1911. |
| | *Grams.* | *Grams.* | *Mm.* | *Mm.* | | *Grams.* | *Grams.* | *Mm.* | *Mm.* |
| 336 | 120 | 135 | 79 | (a) | 304 | 145 | 163 | 89 | 92 |
| 317 | 120 | 147 | 83 | 88 | 292 | 149 | 172 | 94 | ....... |
| 329 | 125 | 149 | 83 | 86 | 331 | 163 | 182 | 91 | ....... |
| 290 | 131 | 160 | 87 | 94 | 310 | 187 | 222 | 95 | ....... |
| 333 | 134.5 | 160 | 89 | (a) | 339 | 195 | 225 | 99 | 102 |

a No record.

TABLE 6.—INCREASE IN ONE YEAR OF SPECIMENS FROM LOT B, WEIGHING OVER 200 GRAMS, SELECTED AT RANDOM FROM 20 SPECIMENS ONE YEAR FROM DATE OF PLANTING.

| Specimen No. | Weight. | | Length. | | Specimen No. | Weight. | | Length. | |
|---|---|---|---|---|---|---|---|---|---|
| | June, 1910. | June, 1911. | June, 1910. | June, 1911. | | June, 1910. | June, 1911. | June, 1910. | June, 1911. |
| | *Grams.* | *Grams.* | *Mm.* | *Mm.* | | *Grams.* | *Grams.* | *Mm.* | *Mm.* |
| 216 | 193 | 215 | 110 | 111 | 244 | 282 | 300 | 114 | 115 |
| 239 | 226.5 | 246 | 101 | 101 | 201 | 291 | 302 | 119 | 120 |
| 211 | 240 | 263 | 115 | 116.5 | 242 | 308 | 322 | 114 | 114 |
| 251 | 250 | 265 | 110 | 111 | 205 | 323.5 | 335 | 115 | 116 |
| 219 | 258.5 | 270 | 110 | 111 | 249 | 378 | 394 | 119 | 120 |

TABLE 7.—INCREASE IN ONE YEAR OF SPECIMENS FROM LOT A, WEIGHING OVER 200 GRAMS, SELECTED AT RANDOM FROM 68 SPECIMENS RECLAIMED ONE YEAR FROM DATE OF PLANTING.

| Specimen No. | Weight. | | Length. | | Specimen No. | Weight. | | Length. | |
|---|---|---|---|---|---|---|---|---|---|
| | June, 1910. | June, 1911. | June, 1910. | June, 1911. | | June, 1910. | June, 1911. | June, 1910. | June, 1911. |
| | *Grams.* | *Grams.* | *Mm.* | *Mm.* | | *Grams.* | *Grams.* | *Mm.* | *Mm.* |
| 70 | 199.5 | 216 | 96 | 97 | 9 | 266.5 | 277 | 125 | 125.5 |
| 80 | 223.5 | 235 | 107 | 108 | 5 | 270 | 285 | 114 | 115 |
| 10 | 240 | 260 | 106 | 107 | 15 | 273.5 | 304 | 120 | 120.5 |
| 12 | 252 | 270 | 125 | 125.5 | 2 | 316 | 342 | 120 | 120+ |
| 1 | 256.5 | 274 | 106 | 107 | 23 | 328 | 340 | 125 | 125.5 |

AVERAGES FOR ONE YEAR.

| | Average increase in weight. | Average length. | Average increase in length. | Increase in length. |
|---|---|---|---|---|
| | *Grams.* | *Mm.* | *Mm.* | *Per cent.*[a] |
| Table 4 | 27.5 | 66.1 | 11.6 | 17.5 |
| Table 5 | 24.55 | 88.9 | 3.5 | 3.9 |
| Table 6 | 16.15 | 112.7 | .8 | .7 |
| Table 7 | 17.75 | 114.4 | .7 | .6 |

[a] Per cent of aggregate increase.

The specimens under 100 grams make the largest increase in weight and length; those under 200 grams, the second; and those over 200, or fully mature specimens, fall short. A point of special interest in connection with tables 6 and 7 lies in the fact that while per cent of gain in length is almost negligible, weight goes steadily forward in fairly good proportion. From averages in tables 4 and 5, an average yearly growth for a young *undulata* (three-ridge) might be put at 25 grams in weight and from 5 to 25 millimeters in length; at this rate it would take about eight years to reach the weight of 200 grams and a length of 90 to 100 millimeters; as later growth is slower, about 12 to 15 years would be a fair estimate for the age of a Shoofly Creek *undulata* (three-ridge) of 300 grams in weight and 110 to 120 millimeters in length.

TABLE 8.—RATE OF GROWTH BY SPECIES.

[NOTE.—This table shows species not mentioned in other tabulations, because the number of individuals was too small for comparative study. The records are useful as indicative of what may be expected from these species. The Quadrulæ here listed are given because of their use in plate figures.]

| Specimen No. | Species. | Time. | Weight. | Length. | Height. | Breadth. |
|---|---|---|---|---|---|---|
| | | | Grams. | Mm. | Mm. | Mm. |
| 109 | A. grandis (floater) | When planted | 143 | 120 | 63 | 41 |
| | | 1 year later | 193 | 127 | 66 | 45 |
| 113 | ....do | When planted | 144 | 120 | 62 | 41 |
| | | 1 year later | 192 | 124 | 65 | 45 |
| 111 | ....do | When planted | 211 | 132 | 72 | 48 |
| | | 1 year later | 269 | 139 | 74 | 52 |
| 114 | ....do | When planted | 281.5 | 140 | 82 | 53 |
| | | 1 year later | 320 | 142 | 82 | 54 |
| 281* | Q. undulata (three-ridge) | When planted | 16.5 | 40 | 27 | 16 |
| | | 1 year and 3 months later. | 51 | 65 | 41 | 25 |
| 564* | Q. lachrymosa (maple-leaf) | When planted | 5 | 22 | 17 | 10 |
| | | 1 year and 3 months later. | 20.5 | 41 | 32 | 20 |
| 413* | ....do | When planted | 8 | 27 | 22 | 13 |
| | | 1 year later | 18 | 42 | 35 | 19 |
| 430 | T. tuberculata (buckhorn, pistol-grip) | When planted | 128 | 87 | 56 | 31 |
| | | 1 year and 3 months later. | 138 | 90 | 58 | 32 |
| 431 | ....do | When planted | 470 | 136 | 76 | 50 |
| | | 1 year later | 489 | 136.5 | 76.5 | 50 |
| XI | L. gracilis (paper-shell) | When planted | 11 | 51 | 26 | 14 |
| | | 3 months later | 29 | 69 | 35 | 20.5 |
| X | ....do | When planted | 13 | 65 | 27 | 18 |
| | | 3 months later | 55 | 82 | 44 | 28 |
| II* | ....do | When planted | 22.5 | 63 | 32 | 19 |
| | | 1 year and 3 months later. | 84 | 97 | 50 | 33 |
| 566* | L. anodontoides (yellow sand-shell) | When planted | 97 | 93 | 46 | 34 |
| | | 3 months later | 116 | 97.5 | 49 | 35.5 |
| 650 | ....do | When planted | 125 | 103 | 48 | 37 |
| | | 1 year later | 138 | 106 | 49 | 37.5 |
| 495 | ....do | When planted | 180 | 110 | 51 | 43 |
| | | 1 year later | 186 | 111 | 51.5 | 43 |
| V | U. tetralasmus | When planted | 25 | 65 | 33 | 20 |
| | | 1 year later | 30 | 71 | 36 | 22 |
| LI | ....do | When planted | 31 | 70 | 35 | 22 |
| | | 1 year later | 43 | 72 | 37 | 23 |

## DISCUSSION OF DATA.

The results set forth in the tables given above speak for themselves and need no extensive explanation.

One striking fact is the cessation of growth during the winter months of the Chikaskia specimens, especially in table 3. There are a number of cases in my field records where a loss is shown in weight for the six months from late September to early April, although in general they hold their own. It has been my observation for several years that the Chikaskia mussels, in the shallow water at least, burrow down into the sand in late October and become abundant again in late April.

For *undulata* (three-ridge), I have given rather complete averages of weight, and comparisons of rate of growth according to size in tables 5–8. From tables 1 and 2 (all lot D), I find the averages given below for the four species named: *Undulata* (three-ridge), 12 specimens; *lachrymosa* (maple-leaf), 7 specimens; *pustulosa* (warty-back, pimple-back), 8 specimens; *rubiginosa*, 5 specimens. From table 8, *grandis* (floater), 4 specimens; *tetralasmus*, 2 specimens; *gracilis* (paper-shell), 2 specimens; *anodontoides* (yellow sand-shell), 1 specimen.

AVERAGE INCREASES IN WEIGHT AND LENGTH, BY SPECIES.

AVERAGES FOR ONE YEAR.

| Species. | Average weight. | Average increase in weight. | Average length. | Average increase in length. |
|---|---|---|---|---|
| | *Grams.* | *Grams.* | *Mm.* | *Mm.* |
| Lachrymosa (maple-leaf) | 100 | 30.8 | 70 | 7.5 |
| Undulata (three-ridge) | 124 | 28 | 82 | 7.2 |
| Rubiginosa | 74 | 11.4 | 68.8 | 3.4 |
| Pustulosa (warty-back or pimple-back) | 67 | 11.5 | 60 | 2.7 |
| Grandis[a] (floater) | 194 | 48.6 | 128 | 5 |
| Tetralasmus[b] | 28 | 8.5 | 67 | 4 |
| AVERAGES FOR THREE SUMMER MONTHS. | | | | |
| Gracilis (paper-shell) | 12 | 30 | 53 | 22.5 |
| Anodontoides (yellow sand-shell) | 97 | 19 | 93 | 4.5 |

[a] Large mature specimens, still the increase is good.
[b] In an unusual environment for this species (p. 9).

Juvenile Quadrulæ[a] of the above species double in size in a year, as shown by a number of examples (149, 158, 349, 323, in table 1; 281, 564, 413, in table 8). Averages here given and those taken from other sources indicate that a 100-gram, 75-millimeter *undulata* (three-ridge) (p. 14) or *lachrymosa* (maple-leaf) can develop in the Shoofly in about four years (averages for tables 1, 2, 4, and 5). A 300-gram specimen of *undulata* (three-ridge) or *lachrymosa* (maple-leaf) would doubtless be close to 15 years old. The largest *undulata* (three-ridge) rechecked weighed 407 grams in June, 1910, and 421 in June, 1911. This specimen was 123 millimeters long, and increased 1 millimeter in length. In *undulata* (three-ridge) and *lachrymosa* (maple-leaf), after the 100-millimeter length is reached, the increase in length is slow, and growth lines follow one another so closely that the differentiation of lines is difficult. *Pustulosa* (warty-back, pimple-back) and *rubiginosa* grow more slowly than the two preceding species. A 50-millimeter *pustulosa* (warty-back, pimple-back) has passed the age of rapid growth, and from this size on additions come slowly.

A light-shelled form, as *L. gracilis* (paper-shell) grows very rapidly; this would seem to indicate that the shell is built up at greater expense of food and energy than the soft parts of the mussel. In table 8, specimen X, during the three summer months, shows an increase of over four times in weight and 27 millimeters in length; 566, *L. anodontoides* (yellow sand-shell), in the same time, makes an increase of one-fifth its original weight, and 4.5 millimeters increase in length.

[a] Early juvenile forms grow even more rapidly as experimentally found (foot-note, p. 5) by Coker.

ARRESTED GROWTH RINGS.

"Growth lines," the conspicuous dark concentric rings of the shell, may be due to (1) thick epidermis, (2) double epidermis, and especially (3) to double epidermal and prismatic layers. It is well known that the epidermal and prismatic layers are formed by the

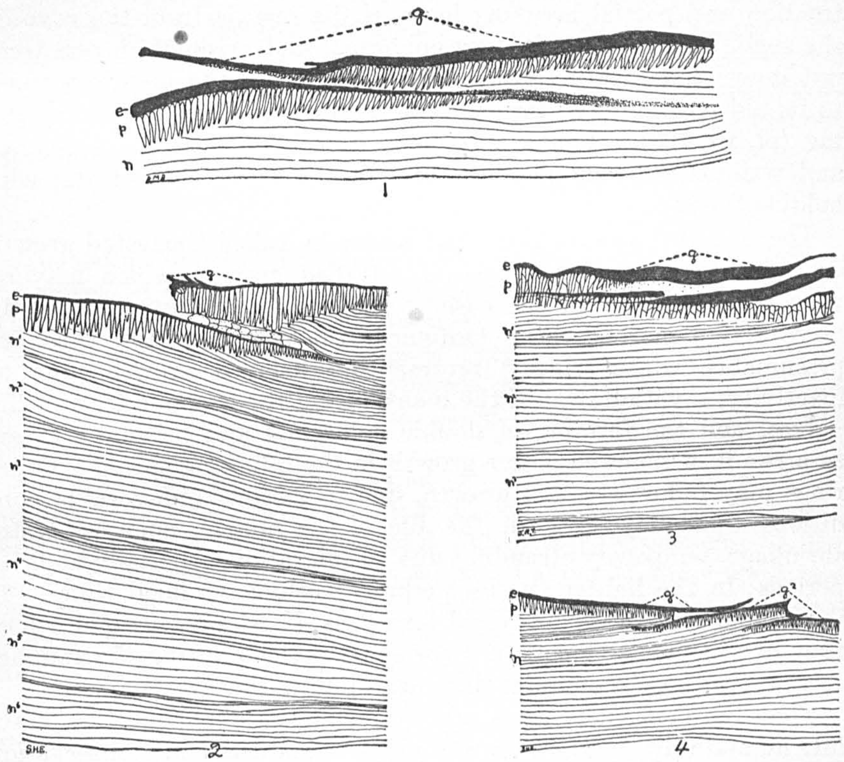

FIG. 1–4.—Cross-sections of shells of *Quadrula* showing structure in region of rest rings, all figures enlarged 20 times; *e*, epidermis; *p*, prismatic layer; *n*, nacreous layers; $n^1$, successive layers of nacreous structure; *g*, position and width of rest rings (growth lines).

FIG. 1.—Section from near edge of shell, showing double layers and long underlying tongue of epidermal and prismatic structure, which formed the dark wide rest ring of a young rapid-growing *Quadrula lachrymosa*. Rings $x^1$ or $x^2$, specimens 149 or 158, plate II, would give similar sections.

FIG. 2.—Section of shell of mature mussel, taken about the middle of the valve. Rest ring not so wide as in 1, tongue shorter, prismatic layer thicker, and thick successive layers of nacreous structure.

FIG. 3.—A rest ring due chiefly to unusually thick, double layers of epidermis.

FIG. 4.—Two successive rest rings near together, undoubtedly formed in the same season, and probably only a few weeks apart, as specimen was young and at the rapid-growing age. (See description of specimen 413, pl. II.)

edge of the mantle only. Thus increase in shell diameter begins with the formation of the epidermal, followed by the prismatic layer. However, if the mantle is withdrawn from the edge of the shell, it often puts down new layers of epidermal and prismatic material underneath older layers [a] of the same structure, and sometimes underneath older layers of nacre as well. This is well shown in figures 1–4, showing sections of shells made through the growth lines.

In watching the growth of tagged specimens it was noted that a distinct growth line was formed at the time of tagging; the work of tagging, i. e., the drilling of the hole through the shell and the placing of the wire, caused considerable irritation, probably a strong contraction and partial breaking loose of the mantle from the edge of the shell, and, as a result, new epidermal and prismatic layers were put down underneath those already formed, as the mantle worked to its old position, and formed new layers over the wire holding the tag (pl. III, 763). Young specimens, especially, show a conspicuous and well-defined ring passing through the outer side of the wire holding the tag.

The so-called annual rings had better be called "arrested growth or rest rings," as they represent retarded growth, which may be very temporary, as in the case of the tagged specimens, and still leave a very marked ring. Ordinarily the prominent rest rings are presumably winter rings,[b] representing delayed growth, due to inactivity, a withdrawal of the mantle from the extreme edge of the valves, and the forming of double epidermal and prismatic layers as a result of renewed active growth in the following spring. Other rings may follow arrested growth, due to various unfavorable conditions that may arise in the life of the mussel, such as water shrinkage, temporary stranding due to migration, especially at flood periods; in the lighter species perhaps washing at flood times. It is possible that in certain pond forms, as *U. tetralasmus* and others that live in ponds that go dry for short periods during the summer season, the more prominent rings are summer rings.[c]

That the concentric rings are by no means dependable as absolute annual rings is well shown in many specimens under observation in this investigation.

A few specimens shown photographically (pl. I, II, III) will clear up some points in regard to growth. Rest rings are not always brought out clearly by photographic methods on account of the unequal or convex surface of the shell. A slight ridge that may have no connection with a rest ring will show as a shadow line beyond the ridge. This is shown in photograph H, plate I, in the line marked "o." Additional explanations are given with the plate figures.

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[a] This explanation was first suggested to me by Dr. Coker, and later verified in connection with my study of shell sections through arrested growth lines.

[b] While in this paper we have emphasized the point that "annual rings" are not annual rings absolutely, the statement that the prominent rest rings are usually, under stable environmental conditions, winter rings is clearly within the evidence of this investigation.

[c] Live specimens of this species were plowed up in the Browne pond (p. 7) three months after the pond had gone dry.

## MIGRATION.

No end of speculation has been carried on as to the traveling ability of mussels. The long undulation tracks, often found upon the pond or stream floor, together with other field observations, and the active movements of specimens kept in aquaria have afforded data for discussion. While gathering information concerning growth, I have constantly kept in mind the migration question, as it was easy to carry on the two together.

As already indicated, the main reason for tagging a large number of mussels was the feeling that many would be lost through migration; and further to guard against this migration in the Chikaskia I inclosed the specimens in good-sized pens.

### SHOOFLY.

The extent of actual migration is best shown in considering definite plantings. Lot D (see p. 8) of the Shoofly is good for this purpose. The 168 Quadrulæ planted here were from the Chikaskia, where they were collected from the sand bars in shallow water. From track-mark evidence these specimens had been actively moving about on the sandy bottom, stimulated to activity by unfavorable environmental conditions.

The 164 specimens were spread out on a small portion of the bottom of the Shoofly (p. 8), June 16, 1910, and left free to move. June 14 and 15, 1911, I reclaimed 139 of these specimens, or 84.8 per cent, in about three hours' work. Twelve of these specimens were reserved for records. On September 11, 1911, a cold rainy day, I again checked over lot D, and this time I secured 93 specimens in about one hour's time; the water was so cold that collecting was exceedingly difficult. Three specimens not found in June were found on this date, bringing the total number reclaimed from the original planting up to 142. When we consider that the water was cloudy and from 3 to 4 feet deep the experienced field collector will know that specimens could not be recovered in these numbers unless they were on the very spot [a] where they were planted. Lots A and B in the Shoofly gave similar results, although I did not attempt to recover these as thoroughly as in the case of lot D.

Lot C in the Shoofly is of especial interest, as these specimens were all *A. grandis* (floater). Of this lot 12 specimens were found directly on the site where they were planted. While this is rather a small per cent in comparison with lot D, I was surprised to find 46 per cent of *A. grandis* (floater), as it is well known to be an active

[a] It has been suggested that since lot D specimens were transplanted the inactivity may have been due to the changed environment. The relatively rapid growth and like inactivity of lots A and B, Shoofly specimens, which might very well be considered as control lots, should quiet any apprehensions on this point.

form. In all my reclaiming work in the Shoofly, which amounted to about 10 hours' actual hunting and collecting on three different days, I secured only one specimen that may be said to be off the planting plot; this was no. 141, found 15 feet from plot D.

### CHIKASKIA.

In the Chikaskia lot E gave results similar to D. The Chikaskia River specimens were disturbed somewhat by curious people, and for this reason proportional figures can not be emphasized. The inclosure for lot E (p. 9) was rather small, but there was ample chance for movement. The results in this instance substantiate what I have often noticed in field work, namely, that the mussels, especially Quadrulæ and related species, are unable to help themselves if conditions become unfavorable, but, on the other hand, the power to endure these unfavorable conditions is remarkable.

Since the Chikaskia is a fairly swift stream, the lower end of the inclosure was undermined, making escape easy, while a sand bar was formed across the upper portion. Two-thirds of the mussels were caught in the drift bar and when I examined them on September 26, 1910, were helplessly stranded. Conditions of oxygen and food supply must have been unfavorable, and as a direct result the summer's growth was below the average for lot F.

These stranded specimens were now taken and put in the outer corner of the pen, where they could escape under the wire net through an opening 5 feet long. Six months later, June 22, 1911, I again examined lot E. A large number of the specimens were recovered, about half being along the wire net inside, and half along the net outside; not a specimen was found over 5 yards from the pen. Clear water and sandy bottom made the finding of specimens easy.

Lot F specimens of the Esch inclosure (p. 9) had a good opportunity for migration; in fact, the inclosure was not needed, as only two specimens reached either lower or upper cross fences. One of these was a *gracilis* (paper-shell), and the other a *grandis* (floater). The Quadrulæ did not come within 25 yards of the lower fence. If they were placed in water over 3 feet deep, the migration was slight in any case, as far as the Quadrulæ were concerned. Those placed in water as shallow as 1 foot moved to deeper water, which was easily reached in this case. The *Lampsiles* were more active, and the percentage recovered was small by comparison. Of the 50 *U. tetralasmus*, not a single specimen or shell was found at the first examination, September, 1910; but in the June, 1911, examination, three specimens were found. I am not able to explain the disappearance of the *tetralasmus*; however, they are great burrowers, and may have escaped my extensive digging for them.

### DISCUSSION OF MIGRATION DATA.

The migration results came as a surprise to me. The very fact that I was willing to risk specimens free in the Shoofly would indicate that I hoped to make some kind of recovery; but to go back and find specimens by the score—apparently in the exact spot where they were planted—was not to be expected. The Quadrulæ in these plantings show little migration; the Shoofly specimens may be said to be nearly stationary in water over 3 feet deep. Those placed in shallow water in the Chikaskia always moved until water 2 to 3 feet deep was found. Specimens found on shoals and bars in nature are there by chance distribution, not choice, although breeding reactions may cause migration in some species.

### ECONOMIC BEARING OF EXPERIMENTS—RELATED PROBLEMS.

While the scientific interest in the growth and migration problems was the real motive that prompted this investigation, it was the relation of the problem to the practical question of artificial propagation of mussels for commercial purposes that made funds available to carry on the work. That the results will be of service as preliminary to further investigation is a matter of satisfaction. The man interested in commercial propagation will continue to ask the question, How long will it take to grow a mussel to marketable size? Much more work will be needed to get at all the facts in the case of the various economic species; and where the work of propagation is to be conducted on a large scale, preliminary experiments will be of value in testing the fitness of a particular region for commercial operations. Some of the methods of procedure have been indicated by the series of experiments here outlined.

I wish to call the attention of the field students of the Unionidæ to the transplanting of adult mussels from the Chikaskia to the Shoofly, where young specimens were not to be found, yet these transplanted mussels averaged higher in rate of growth than the regular Chikaskia specimens. If the Shoofly is so favorable a habitat for mussels, why are young specimens absent from the beds?

Again, notice the transplanting of over a hundred specimens from the vicinity of lot F, where mussels are so abundant, to lot E: The transplanted specimens did as well in growth as the specimens that were near the region of abundant mussels in the Chikaskia. This difference in abundance was by no means slight. It is a fact that in the vicinity of lot F one could, in a few hours, collect a wagonload of mussels, while for a quarter of a mile above and below the Brewer inclosure two of us were able to get only 30 specimens in several hours' careful collecting.

The distribution of mussels within individual streams, and in the Chikaskia in particular, is not easy to explain. Little or negligible migration among the Quadrulæ, at least, has not cleared the situation.

## SUMMARY.

1. Rate of growth is exceedingly variable for individuals of a single species in the same stream and in different streams, depending, as in other invertebrates, upon season, food, oxygen supply, and other conditions. Juvenile mussels grow much more rapidly than adult or near-adult individuals. *Lampsilis* species grow very much faster than Quadrulæ. Specimens in stable conditions seem to have a fairly definite rate of growth from year to year. The rate, after sexual maturity, is slowed down, but growth goes on steadily, though the proportional increase in length is so slow as to make appreciable additions very slight, so that growth lines in Quadrulæ, after a size of 100 millimeters (4 inches) has been reached, can not be ascertained by inspection.

2. From April to September may be designated as growth months, most specimens showing very slight increase during winter.

3. Lines of arrested growth may be called rest rings, the conspicuous ones being usually winter rest rings; very often, however, the rings may be two or more years apart, or several equally prominent rings may be formed in one year. Prominent lines are generally due to double prismatic and double epidermal layers. Winter rings, especially where environmental conditions are stable, are usually sufficiently regular for use as indicators of age in estimating roughly the time required for a commercial species to reach marketable size.

4. Under favorable conditions there is little migration among the Quadrulæ. Some of the Lampsiles and other light-shelled species move about quite actively, but probably seldom migrate far from the point where they were dropped from the fish, although their total wanderings may be considerable. Water of sufficient depth is essential to optimum conditions. The minimum depth seems to be at least 2 feet; the range up to the maximum has not been studied. Quadrulæ prefer water over 2 feet deep. The reason they are found on the shoals in many of our streams may be explained as chance distribution, due probably to the fact that the particular individuals have never found optimum conditions after their parasitic development, and the reason they move about is that they do not find the right environment.

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[a] Dr. A. E. Ortmann and Dr. F. Haas have called my attention to Dr. Haas's monograph, "Die Unionidæ in Martini-Chemnitches Conchylliencabinet," 1910. I have not had access to this paper.

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## EXPLANATION OF PLATES.

All photographs are about natural size. For actual measurements see tables. As already explained (pp. 10, 11, and 15), tags were fastened on with a small copper wire passed through a small hole made about 2 mm. from the edge of the shell, usually along the edge of the posterior umboidal ridge. $x$ marks the tagging ring, i. e., the ring formed when the specimen was marked and measured. This ring was formed without exception in all specimens handled and thus marks the diameter of the mussel at the time of tagging and making initial records; $x^1$, rest rings formed by natural processes between tagging time and reclaiming of specimen; $o$, shadow line due to a ridge on the valve and in photographic cuts may be mistaken for a rest ring.

### PLATE I.

Specimen H, *Lampsilis gracilis* (table 8), shows 34 mm. growth in length in 15 months (June, 1910, to Sept., 1911); $x$ marks the rest ring formed when the specimen was marked and measured; $x^1$ is probably the 1910–11 winter rest ring; $o$, shadow line.

Specimen 323, *Quadrula undulata* (table 1), shows 17 mm. increase in one year's growth (June, 1910, to June, 1911). A new ring appears at $x^1$ near the margin. Notice the two rings, $y^1$ and $y^2$, near together, formed before the specimen was tagged.

Specimen 281, *Quadrula undulata* (table 8), shows 25 mm. growth in 15 months (June, 1910, to Sept., 1911); $x^1$ is probably the winter rest ring.

### PLATE II.

Specimen 355, *Quadrula rubiginosa* (table 2), shows 6 mm. increase in 15 months (June, 1910, to Sept., 1911) in a mature slow-growing species. No evidence of rest rings beyond $x$.

Specimen 349, *Quadrula pustulosa* (table 1), shows 10 mm. increase in one year (June, 1910, to June, 1911). A rest ring, not well brought out by the plate figure, shows very near the margin; $o$, on the anterior slope, is a shadow line.

Specimen 564, *Quadrula lachrymosa* (table 8), shows 19 mm. increase in length in 15 months (June, 1910, to Sept., 1911). Tag pulled off ($t$) after specimen was reclaimed.

Specimen 413 (table 8), shows 16 mm. increase in one year (June, 1910, to June, 1911). Two rest rings, $x^1$, $x^2$, in addition to the regular, $x$, formed at the time of tagging. If we count the one at the tagging line we have three rest rings for one year.

Specimens 149 and 158, *Quadrula lachrymosa* (table 1 and as shown here about two-thirds natural size). These specimens are from the Shoofly, the two *lachrymosa* above from the Chikaskia. The rest rings are about the same as 413 and the time (June, 1910, to June, 1911) is the same.

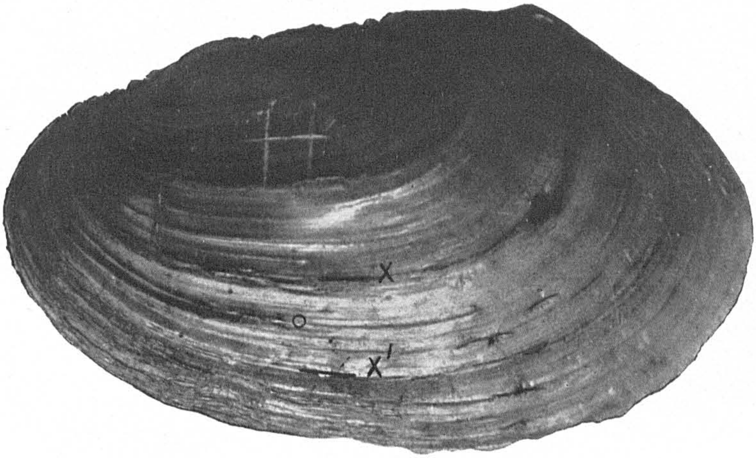
Specimen 158 is the left valve and so does not show the tag or mark.

PLATE III.

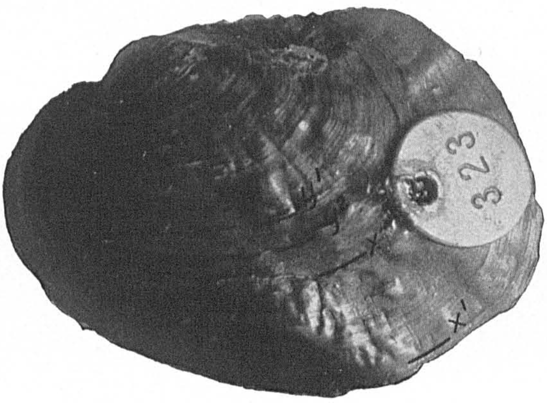
Specimen 566, *Lampsilis anodontoides* (table 8) ,shows 5 mm. increase in length in nearly three months (June 27, 1910, to Sept. 19, 1910). A mature Chikaskia specimen growing in rather unfavorable environment.

Specimen 763, *Quadrula lachrymosa*, shows how the tag wire is overlaid with nacre (*t*) nearly three months after tagging (June 27, 1910, to Sept. 19, 1910).

Specimen 200, *Quadrula undulata*. In the Shoofly (p. 7) no *Q. undulata* under 193 grams was found in June, 1910. In 1911 two specimens were secured that may be called young. No. 200 is one of these and is interesting on account of the regularity of rest rings, four in number. The specimen measures 80 mm. in length and, according to estimates worked out upon known growth of this species in the Shoofly, was 4 or 5 years old when taken (p. 14).



SPECIMEN H.

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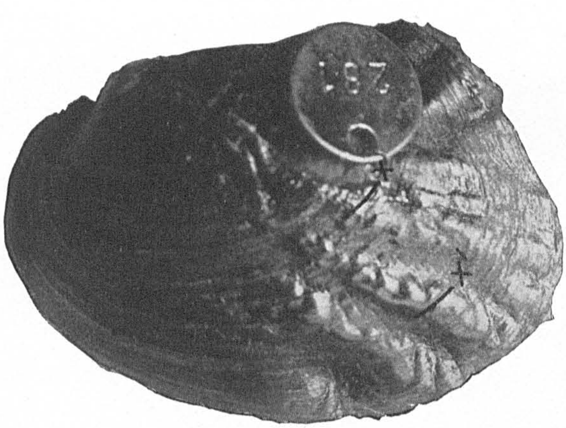


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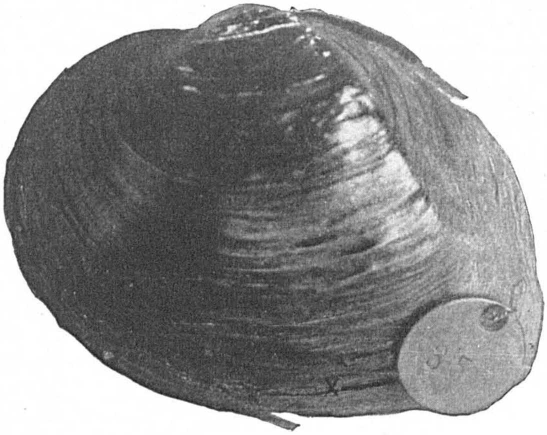

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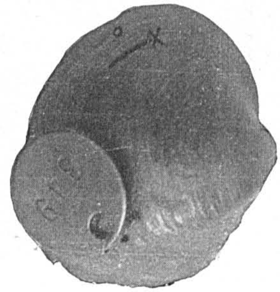

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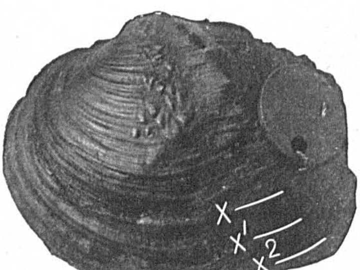


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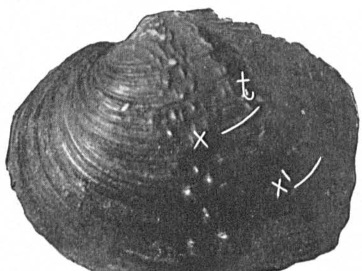


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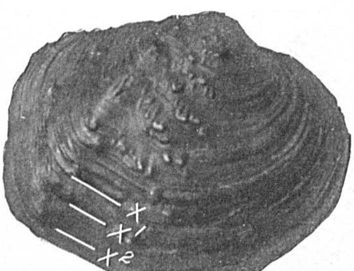


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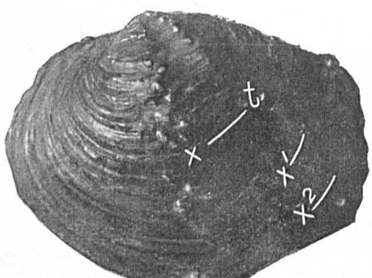
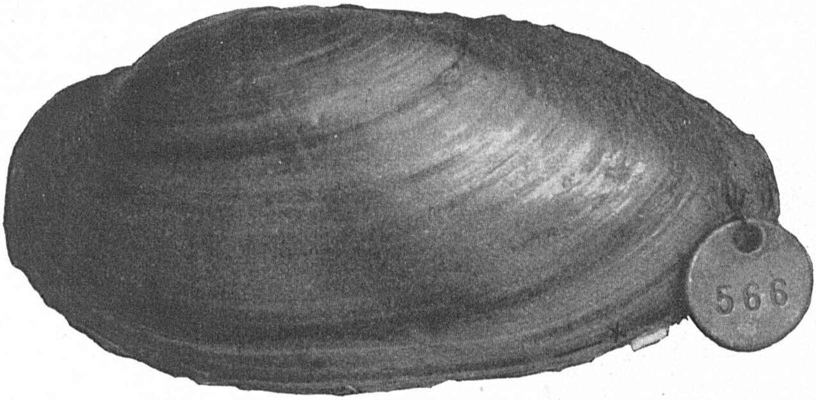
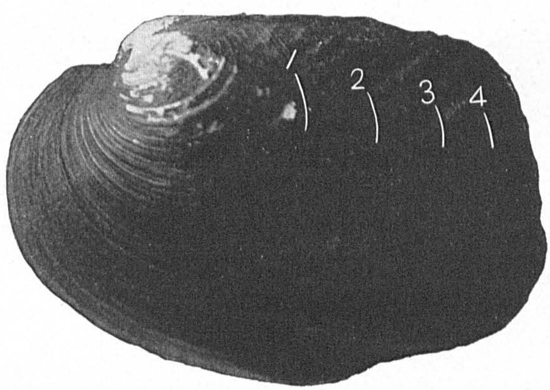



SPECIMEN 413.




SPECIMEN 566.


SPECIMEN 763.




SPECIMEN 200.

# EXPERIMENTS IN PROPAGATION OF FRESH-WATER MUSSELS OF THE QUADRULA GROUP

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By Arthur Day Howard

*Scientific Assistant, United States Bureau of Fisheries*

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**Appendix IV to the Report of the U. S. Commissioner of Fisheries for 1913**

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# EXPERIMENTS IN PROPAGATION OF FRESH-WATER MUSSELS OF THE QUADRULA GROUP.

By ARTHUR DAY HOWARD,
*Scientific Assistant, United States Bureau of Fisheries.*

## INTRODUCTION.

The fresh-water mussels of central North America with their heavy shells of beautiful pearl are a natural resource the value of which probably has not begun to be realized. The extensive development of the pearl-button industry in a brief period of 20 years is evidence of the wealth of the original natural supply; but a very evident decrease of readily obtainable shells, along with the increasing necessity for extension of clamming operations to more and more distant sources of supply, has made it evident that this resource is not unlimited.

Within the first 10 years of the growth of the industry, interested manufacturers requested an investigation of conditions by the United States Bureau of Fisheries. The purposes of this first investigation (Smith, 1899, Simpson, 1899) were to discover whether indiscriminate and wasteful methods were being employed that might be corrected by supervision or restrictive legislation. Later there were carried on for a number of years investigations to determine if methods could be found for artificially supplementing the natural production of young mussels, i. e., methods similar to those so successfully employed by the Bureau in the culture of oysters, trout, lobsters, and other water forms of economic importance.

The essential facts in the life history of the fresh-water pearl mussels (Unionidæ or Naiades) have been known since the discovery by Leydig in 1866 that at one stage they are parasitic upon fishes. An historical account of these discoveries and the life history of fresh-water mussels, together with methods which have been adopted for their propagation, have been described in publications by the Bureau of Fisheries (Simpson, 1899, Lefevre and Curtis, 1912). The work in propagation, however, has been limited to a few species of the *Lampsilis* group, chiefly *Lampsilis ligamentina* and *L. anodontoides*. With one possible exception, none of the *Quadrula* group of mussels, including some of the most valuable commercial shells, had been, up to the time of the present investigation, carried through the parasitic stage, though many experiments had been made on various species of fish and under varied conditions to determine a suitable method of propagation. The rarity of successful infections, along with other indications, suggests that, as in other cases of parasitism in the animal and vegetable kingdom, each mussel may have its appropriate host or hosts restricted to a species of fish, a genus or a family, as the case might be, and that the reason for failure was due to not finding the proper host.

Since the number of species of mussel for this locality (Fairport, Iowa) is 40 or more and the number of species of fairly common fish at least 60, the problem of determining the appropriate host for each mussel is obviously quite complex. To determine the hosts for each species of mussel by artificial infection, a "trial and error" method would be roundabout and difficult. Obviously a more direct solution of the problem, as I have shown in a previous paper (Howard, 1912), would be secured by a study of natural infections, i. e., fish taken at large are examined for glochidia and when present these are determined as to species, condition, etc. In the present investigation of some of the *Quadrula* group of mussels the above method was the one chiefly employed. Studies were begun in February, 1912, upon assignment of the problem by the director, Dr. R. E. Coker, at the Government biological laboratory at Fairport, Iowa.[a]

## METHODS AND TECHNIQUE OF EXPERIMENTS.

As stated above, the matter of first importance in determining how to propagate a given species of mussel seemed to be the finding of a suitable host. In making this search I have examined as many local species of fish as were obtainable, identifying, if possible, all glochidia found upon the gills or fins. Some glochidia, because of peculiarities of form or size, were readily determined, while others were less easily identified because of fewer apparent differences. In this study I have made identifications by comparison of the glochidium found in the natural infections with a series of preparations and drawings of glochidia (see Surber, 1912) obtained from gravid mussels.

Fishes were examined for natural infections wherever obtainable, but attention was also given to securing them in the vicinity of special mussel beds. Infected filaments of gills or portions of fins have been examined and drawn, first in the fresh state and then fixed

[a] Special acknowledgment is due Prof. Lefevre and Prof. Curtis, of the University of Missouri, for data of their experiments placed at our disposal.

in 10 per cent formalin or a one-third saturated solution of bichloride of mercury. The usual histological procedure for whole mounts was followed after fixation. Acid fixing fluids and acid stains have been avoided on account of the delicate calcareous shells of the glochidia. For the sake of accurate comparison in identifications it has seemed desirable to apply the same method of preparation for the natural infections that is used for the glochidia.

When evidence of the natural host was obtained by the above method, the kind or kinds of fish thus designated were tested by artificial infection to verify the results already secured and to determine the possibilities of artificial propagation.

The method of making artificial infections is as follows: Young mussels or glochidia, which are produced to the number of many thousands by each female mussel, are taken from the gill of the latter and placed in a receptacle with the fish to be infected. The myriads of glochidia thus distributed through the water, passing constantly through the gill openings of the fish, become attached to the filaments of the gills or in some cases fasten externally upon the fins. As soon as they become attached there is a reaction of the tissue in the nature of an hypertrophy of the external epithelium which produces a cyst enveloping the glochidium.

For a fuller discussion of infection methods I would refer to the paper by Lefevre and Curtis (1912). Some special difficulties encountered in dealing with the short-period breeding *Quadrulas* will be discussed in connection with the propagation of *Quadrula pustulosa* and artificial infection of *Quadrula ebena.*

Glochidia were obtained from gravid mussels collected with the "crowfoot" and mussel rake, the usual methods in vogue among clammers. The preparation of these was for the most part by the method described by Surber (1912). For differentiating the thread gland, Grenacher's borax carmine was employed as a stain. Examinations in alcohol covered to prevent evaporation gave better differentiation for some features than the stained and cleared material.

The collection of juveniles has been carried on chiefly by two methods—dredging and hand or shore collecting. The dredge employed was of the Chester rake pattern and of suitable dimensions for use with a gasoline launch. This method is adapted for deep water or for shallow water that is so muddy as to make it impossible to see the bottom. As the Mississippi has been almost constantly muddy during the warmer months this method has proved to be the chief reliance. The small shells are separated from sand and mud by means of a sieve or by washing in a fine-meshed bag. Hand collecting was about the only method applicable to very shallow water and stony bottom, and was employed during winter or on very rare occasions in summer when the water was sufficiently clear.

## DETAILS OF OBSERVATIONS.

In the following account, the experiments and observations have been described under the name of each species. This was done for the sake of clearness and convenience, and it will be readily seen that all have not received equal attention. I have followed chiefly the classification and nomenclature of Simpson (1900), in places employing Ortmann's system, in which case it is so indicated. The changes made by Ortmann, so far as they apply to the forms I have considered, seem justified. These are based, according to that author, upon a thorough study of the anatomical characters of the soft parts as well as of the shell. It seems evident enough that a continuance of this kind of revision is very desirable. In this I make no criticism of the herculean labors of Simpson, whose synopsis has removed the taxonomy of the Naiades from chaos.

I have described and figured some of the glochidia in order to bring out features not previously considered, while others previously published are reproduced in order to show all on the same scale. In the dimensions the "height" signifies the longest axis perpendicular to the hinge line, while the "length" is the longest axis parallel to the hinge line. The range given for each dimension is the extent of variation that I have observed. The greatest that I have measured was 12 per cent. If the measurements had been taken from several broods of glochidia from different localities, this variation would probably be larger.

Very little has been published regarding the juvenile stages of the *Quadrulas*. It is not my intention to go into details of description here, reserving such observations for a later paper; however, a few notes are given by way of calling attention to this little-known stage. I regard a knowledge of these as necessary for a proper consideration of the problems connected with the propagation of mussels. If the suggestion (Lefevre and Curtis, 1912, p. 192) that propagation be carried through this stage prove to be feasible, such information would be indispensable. Again, a knowledge of these is required for the maintenance of proper conditions for the natural development of mussel beds. From the few observations that have been published upon juveniles of North American Unionidæ (Isely, 1911; White, 1905; Sterki, 1891 a, b), it seems probable that, in some cases at least, they have a habitat quite different from the adult. For example, some species, such as the yellow sand-shell, *Lampsilis anodontoides*, and the butterfly, *Plagiola securis*, have been found in the shallow water of rapids or riffles attached to stones or gravel by a byssus, while the adult dwells in deep water on a mud or sand bottom. Differences so great between the habitat of the young and the adult would be important considerations in any attempt to raise mussels artificially through this stage.

THE WARTY-BACK, *Quadrula pustulosa* (Lea). [Pl. I, fig. 1, 2.]

This mussel, with allied species, is commonly called the warty-back and pimple-back because of the pustules on the shell. It is a shell of good luster and texture, and therefore is ranked high by manufacturers.

*Distribution.*—Its range is throughout the Mississippi drainage and into Michigan, extending east into the Alabama River system and west into central Texas.

*Habitat.*—It is found in streams of some size either in gravel or on mud bottom (Scammon, 1906).

*Juvenile.*—The juvenile, of 10 to 20 mm. in length, can be recognized by a broad triangular green ray upon the lateral slope. I have found it chiefly in fine gravel or sand in a strong current.

No byssus was observed in a considerable number of specimens taken and none has been reported for this species to my knowledge; apparently, however, there is a byssus gland present. In the very early stages (less than 1 mm. in length) a mucilaginous secretion is produced which serves to anchor the young mussel. I think it doubtful if this species at any stage produces the hard hyaline byssus threads which are found in some of the Lampsilinæ. Among the *Quadrulus* here described the only case of a true byssus observed was in that of a specimen of *Q. plicata* having a length of 4.5 mm.

*Glochidium* (pl. v, fig. 36).—The warty-back is a summer breeder, or tachytictic, the glochidia being found during the months of June, July, and August. The earliest record that I have for a season is June 12, and the latest August 23, when I found two gravid out of 46 examined. The glochidia occupy all four gills in the female, and are white in color. They are of the hookless type, and as seen flatwise, the usual position for examination under the microscope, have the form of an elongated purse (pl. v, fig. 36).

Dimensions: Height, 0.28 mm. to 0.3 mm.; length, 0.22 mm. to 0.23 mm.; length of hinge line, 0.08 mm., or 2.75 times in length. The difference in height observed (0.28 mm.-0.3 mm.) gives a variation of less than 8 per cent; more than 10 per cent seems to be uncommon in glochidia of one species, although I have seen 12 per cent. This species should not be confused with any others in the region investigated because of unique form and size. The only glochidia here at all resembling it are those of *Lampsilis luteola* and *Plagiola securis*. *L. luteola* can be distinguished by its relatively greater width (0.25 mm.) and hinge line (0.118 mm.), and *Plagiola securis* by its greater length (0.31 mm. to 0.33 mm.) and different proportions.

*Natural infection.*—The first record for a natural infection by this species was found upon a catfish obtained July 5. This was the channel cat, *Ictalurus punctatus*, and was the first record of infection found on catfishes. Previous to that time all examinations of catfishes had favored the belief that they were immune to all glochidial infection. Other records for this fish were obtained through July and August, the breeding period for the mussel. The fish were taken by seining over known shell beds in one instance, in others in wing nets and bait nets of commercial fishermen. In all, during 1912, 17 records of infection were obtained out of 39 fish examined, and 9 of these were determined as *Q. pustulosa.*

This glochidium is more readily identified in infections than some others, because of its large size and owing to its peculiar shape. None of the mussels of similar dimensions have the same form. The nearest approach to it is *Lampsilis luteola.* (See description of glochidium above.) The glochidia in infection were usually well encysted, and in many cases development was far advanced, even to the extent of some growth beyond the glochidial shell. (Pl. III, fig. 19, 23.) This development of an extra embryonic shell in the parasitic stage has been reported (Coker and Surber, 1911) for the *Proptera* (Ortmann, 1912) group, but not, I believe, among the *Quadrulas.* One record only was obtained of *Q. pustulosa* on another fish, the yellow cat, *Leptops olivaris,* but this was important, as it suggested a possible host for this mussel, and led to the discovery of many infections in *Ictalurus punctatus,* although one had been seen in that species before. In 9 other specimens of *L. olivaris* examined by me and 44 by Mr. T. Surber in August, no infections were found. From the standpoint of natural infections, *I. punctatus* is indicated as the natural host for *Q. pustulosa,* with a possible extension to other species of the *Siluridæ.* After August 28 and during the autumn no natural infections were obtained from a total of 98 fish examined. This date corresponds with the latest date for gravid mussels of the species. On August 23, 2 gravid shells were secured from a total of 48. After this date none were found in a total of 176 examined. This gives a space of five days after the last gravid mussels were found, during which the natural infections were obtained The indications from this are that the parasitic period is brief. If the parasitic period were a long one, say a month, this correspondence of dates would be lacking.

The character of the cysts and their position on the gill filament are features to which attention has been called as of importance, perhaps, in determining the possibilities of artificial infection. The cysts of *Q. pustulosa* on *Ictalurus punctatus* are of ordinary size. They are often set off by a slight furrow or indentation (see pl. III, fig. 23), which is quite characteristic. The position is chiefly on the edge of the filaments, often near the base, a rather unusual location. Lefevre and Curtis (1912) are of the opinion that those fish in which the glochidia are distributed on the tips of the filament are able to carry a much greater number. An attachment near the base of the filament giving a more intimate relation with the host may insure more certain survival to the glochidium. However, the cysts I have examined gave no evidence of serious interference with circulation in the filament, so it looks as if the position in the case of the catfish probably would not make much difference in the effect on the host.

The finding of glochidia on the catfishes is of interest, since this fish had been regarded as belonging to the immune class, this opinion being based largely on the results of artificial infection. The habits of the fish as a bottom feeder, and especially as a voracious eater of mussels, would make it seem surprising if it did not carry the glochidia of some species of mussel. Forbes and Richardson (1908), in examination of the food of these fish, say:

> Mollusks, about equally large water snails, and large, thin clams were a decidedly important element, being found in 15 of the 43 fishes. They amounted to 15 per cent of the food of the group, and several specimens had little or nothing else. Notwithstanding the number of bivalves eaten by this fish, no fragment of a shell was ever found in their stomachs, but the bodies of the mollusks seem to have been separated while yet living from the shells, as indicated by their fresh condition and by the fact that the shell muscles were scarcely ever present.

TABLE 1.—ARTIFICIAL INFECTIONS WITH QUADRULA PUSTULOSA.

| Date. | Experiments. | Species of fish. | Number of fish. | Number of glochidia attaching. | Date liberated. | Period on fish. | Development at latest observation. | Average temperature. |
|---|---|---|---|---|---|---|---|---|
| 1912. | | | | | | | | °F. |
| Aug. 21 | V-22 | Ameiurus melas | 6 | 88 | Aug. 27-29 | 6 to 8 days | Complete | 75.1 |
| 23 | V-26 | do | 2 | 230 | | More than 8 days. | do | 75.5 |
| 1913. | | | | | | | | |
| June 12 | VI-1 | Ameiurus {melas, nebulosus} | 7 | 500 | June 27-29 | 15 to 17 days. | do | 72.1 |
| 24 | VI-4 | L. olivaris (wt. ½ lb.) | 1 | Many | | 11 days | Advanced. | 78.3 |
| 24 | VI-4 | L. olivaris (wt. 2½ lbs.) | 1 | do | | 9 days or less. | do | |
| July 7 | VI-10 | Ictalurus punctatus | 8 | do | July 16-18 | 9 to 11 days | Complete | 78.1 |
| 10 | VI-12 | do | 10 | do.[a] | July 20-21 | 10 to 11 days. | do | 76.7 |
| 10 | VI-12 | Lepomis pallidus | 2 | Several | July 11 | 1 day | None | |
| 10 | VI-12 | Pomoxis sparoides | 2 | Very few | do | do | do | |
| 10 | VI-12 | Pomoxis annularis | 3 | do | do | do | do | |
| 29 | VI-19 | Ictalurus punctatus | 1 | Many | Aug. 8 | 10-12 days | Complete | 76.3 |
| 29 | VI-19 | Aplodinotus grunniens | 1 | Few | July 29-30 | 1 day | None | |
| 29 | VI-19 | Leptops olivaris | 1 | Several | Aug. 6-8 | 8 to 10 days | Complete | |
| 29 | VI-19 | Pomoxis sparoides | 2 | None | | | | |
| 29 | VI-19 | Micropterus salmoides | 1 | Many | July 31 | 1 day | None | |
| Aug. 4 | VI-20 | Ictalurus punctatus | 29 | do | Aug. 15-16 | 11 to 12 days. | Complete | 75.5 |
| 4 | VI-20 | Leptops olivaris | 3 | do | Before Aug. 9 | Less than 5 days. | ? | 76 |

[a] On gills and barbels. All other glochidia were attached to gills only.

As *Q. pustulosa* is a heavy-shelled species it may not supply the catfish with food by way of returning favors, unless the fish has some means of opening the heavy shells. However, as mussels of various species segregate in the same location, forming beds, the thinner-shelled species in furnishing food to the fish would favor the breeding of the heavier-shelled species. This attraction of the fish would serve to furnish the host and also increase the chances of the young mussels being shed there by the fish, thus partly accounting for the segregation of mussels. The fishermen on the Mississippi take advantage of this appetite in the catfish by baiting nets with the "meats" of the mussels which the clammers or mussel fishermen remove from the shells.

*Artificial infection.*—The finding of glochidia of *Q. pustulosa* on catfishes in natural infection suggested testing these fishes in experiments in artificial infection.

In these experiments four species of catfish were tried and five other kinds of fish. The results of some of these experiments are shown in table 1.

When exposed to infection in the same tank and thus under the same conditions, the difference in susceptibility between the catfish and the other species was very marked and the difference in implantation still more so. The catfish in general received them more quickly and retained the glochidia, while, though abundant on the gills of some of the other species, they disappeared before the end of the second day.

The results in the case of the different species of catfish were not uniform. The duration of the parasitic period seems to vary slightly in the different species and there is evidence of immunity in some individuals of *Leptops olivaris*. The greatest variation in duration of parasitism occurred in the case of the bullheads *Ameiurus melas* and *A. nebulosus*. (See table 1, experiments V–22 and VI–1.) The long period, 17 days, can be explained by the lower temperature (average 72.1° F.); but the temperature of 75.1° F. for the shorter period of 6 to 8 days is no higher than those in which the parasitism is of much longer duration.

The experiments with *Ictalurus punctatus* gave more definite and regular results than with any of the other species. The majority of the experiments were conducted between June 18 and August 14, during a season when the water temperatures were more uniform than usual. This probably accounts for the uniformity in the parasitic period, which was determined as 9 to 12 days. The minimum period on a fish is less readily determined than the maximum; taking this into account it is probable that the period may be less than 9 days for some. This seems a remarkably short period when we consider cases of winter-breeding mussels carried over six months by the fish.

The young mussels after dropping from the fish were secured and their structure and habits noted.[a]

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[a] During these early stages I observed cases of ingestion by a turbellarian very abundant in the aquarium This, with the number of empty shells found, indicates a high mortality among them.

The growth of shell, according to my observations, was quite rapid for the first few days; at two weeks it was nearly twice as long as the glochidium; at four weeks no increase was observed beyond that of the second week. This cessation of growth is rather surprising, but is in accord with many observations upon growth under laboratory conditions. Just what is the cause of this inhibition of growth I can only surmise. The young mussels were kept in aquaria having a constant stream of running water coming from the river, their natural habitat. It is quite likely that under these conditions the water contains too small an amount of suitable food material. A further discussion of this matter and a more detailed account of the early juvenile stages I will reserve for another paper.

The evidence of immunity in *Leptops olivaris* will be seen by a comparison of results (see table 1) in experiments VI–4 and VI–20. In the latter the glochidia were all shed in less than 5 days, and thus in all probability did not reach maturity. In experiment VI–4 the small individual carried a large number for 11 days, the usual period of parasitism, while the larger fish on the ninth day had one glochidium only.

This indication of occasional or even common immunity to these glochidia in *L. olivaris* is suggested in studies of natural infections, as I have already shown. The fish is rarely found infected in nature by any mussel, and I have only two records of infection by *Q. pustulosa.* In comparison with this, the abundant infection of *Ictalurus punctatus* (sometimes as high as 50 per cent in a catch) forms a marked contrast and with the foregoing experiments point conclusively to the channel cat as the usual host fish and the most suitable for artificial propagation.

Tests for optimum infection have been made which indicate that a smaller number of glochidia per fish is desirable than in the infections with the "mucket" mussel, *L. ligamentina.* The glochidia in the case of *Q. pustulosa* are considerably larger and the infection must necessarily be made at a season of the year when there is more danger of parallel infection with fungus (i. e., *Saprolegnia*). An infection of 800 to 1,000 glochidia is recommended for a fish of 1 pound weight, 1,500 to 2,000 for a fish of 2 pounds weight, and proportionate numbers for other sizes. Undoubtedly fish released in their natural waters would carry larger infections than those subjected to the more severe conditions of experimentation in captivity. In the foregoing estimates I have taken account of this.

The collection of gravid mussels of this species for artificial propagation requires the taking of some special precautions to prevent the premature discharge of the glochidia. The best results are secured in warm weather with mussels that have been collected the same day and a short time before the infections are to be made. If the edge of the mantle and shell are uninjured, the gravid mussel may be kept alive out of water several hours, and still longer when kept cool. Mussels caught by the "crowfoot" method are more difficult to keep because of breaks in the shell. It is difficult to prevent abortion of glochidia when a number of mussels are placed together in water even though running as from a tap or when the mussels are placed in crates in a river. On account of this habit of abortion in *Q. pustulosa* and most of the *Quadrulas*, their transportation and retention is more difficult than in the case of the "mucket," *Lampsilis ligamentina*, and the other members of the Lampsilinæ that have been propagated artificially. In the latter the portion of the gill differentiated for a marsupium is relatively so small that the breathing function of the gill is little interfered with by the presence of the embryos, while in the former the presence of glochidia in all four gills is probably responsible for this reaction when proper aeration is interfered with by crowding or otherwise.

*Propagation.*—This species of warty-back is one of the most valuable of the pearly mussels used in the button industry, so that any practical means of increasing the supply would be welcomed. The determination of the host fish furnishes the means of employing the method of propagation that has proved so successful in the case of *Lampsilis ligamentina* and others of that genus.

In the catfish we seem to have a fish almost ideal for the application of this method. It is abundant and hardy, thus meeting the conditions required by the method, i. e., the securing of many fish and the ability of the fish to withstand the handling and confinement incident to the process of infection with glochidia. The method as employed for the past three years has had some modifications. The fish, after seining, in one instance, were brought to a central station for infection; in the other they were infected in the field and immediately released. Some fish will not survive even the latter very limited amount of handling or confinement; for example, the herring, *Pomolobus chrysochloris*, which has been determined as the host for the niggerhead, *Q. ebena* (Surber, 1913). The power of catfish to survive removal from water is remarkable and this hardihood is an important feature, since the breeding period for these mussels is July and August, when the mortality is highest among fish in captivity.

A third modification of this method, the propagation of mussels in ponds or artificial streams after infection, may prove to be very practicable, as some mussels seem to prosper under these conditions. If, in the case of the commercial species, this method proves successful it will offer the advantage of greater certainty in results. By the method in use at present, the young mussel is released at a stage when it is quite at the mercy of its enemies and results are scarcely ascertainable. If protected until a few millimeters long, when a heavy shell has been formed, its chances of survival must be tremendously increased. The introduction of mussels into various streams when at this stage has been suggested (Lefevre and Curtis, 1912). This would have the advantage over the method of using the fish for distributing the mussel that transportation in the former case would be much easier and the fish can be used a second time. In this connection comes up the question whether a natural or an artificial distribution is better. It seems likely that conditions of introduction under control would be better then the probably haphazard distribution of young mussels in nature. When they drop off the gills of a fish their finding a favorable location is probably to a large extent a matter of chance. (See, however, discussion of segregation under head of natural infection, p. 11, 12.)

In the study of the juvenile mussels and their environment an attempt has been made to determine these conditions. For *Quadrula pustulosa* apparently a good current of water with proper food content and a bottom of fine gravel are demanded. The conditions of a pond are easier to meet, but the difficulties presented in producing the conditions of a flowing stream seem not to be insuperable.

The season of breeding is an important feature from the practical standpoint. The mussels of the short-breeding period are at some disadvantage because of the limited working season; this, however, is offset by the fact that during breeding months mussels and fish can more readily be obtained.

The number of glochidia per mussel is a feature of practical importance in propagation. As this species has an estimated average of about 200,000 or about one-fifth as many as the "mucket," *L. ligamentina*, it will be seen that a larger number of gravid mussels is necessary for a given number of fish to be infected. This small number as compared with some other species is somewhat offset by the abundance of the species.

THE PIMPLE-BACK, *Quadrula pustulata* (Lea). [Pl. VI, fig. 37, 38, 39.]

The quite similar *Q. pustulata* I have studied in the juvenile stage, finding it a habitant of sand bars, having 10 records for this location with only 2 for mud or gravel. The natural infections so far identified have been so few that little is known regarding this phase. I succeeded in artificially infecting the following fish with this species: *Pomoxis sparoides*, *Micropterus salmoides*, and *Lepomis pallidus*, but the death of the fish before the end of the experiment precluded the obtaining of any conclusive results. As the species is comparatively uncommon in this region its propagation would hardly be practicable here.

The glochidium has the following dimensions: Height, 0.25 mm.; length, 0.2 mm. (See Surber, 1912.)

THE PURPLE WARTY-BACK *Quadrula granifera* (Lea). [Pl. VI, fig. 40, 41.]

The shell of this species has purple nacre and is therefore not usually saved by clammers. The juveniles are very handsome because of the fine crenulations of the umbones. The glochidium is of large size having the following dimensions: Height, 0.355 mm.; length, 0.29 mm. (Surber, 1912.)

THE MAPLE-LEAF, *Quadrula lachrymosa* (Lea). [Pl. VI, fig. 43, 44.]

The odd sculpturing of this shell, with the coloring of the epidermis, makes it a handsome species. It seems not to be very common in the Mississippi in the region I have investigated, viz, between Hampton, Ill., and Muscatine, Iowa.

*Distribution.*—Western New York to Kansas and Minnesota, and south to Texas and Alabama. (Call.)

*Habitat.*—The larger lakes and rivers on a muddy or sandy bottom in somewhat shallow water. (Baker, 1898.)

*Juvenile.*—I have myself taken only a few juveniles of this species. These were found in shallow water in a rather swift current. The form is so much like the adult that it may be readily recognized.

*Glochidium* (pl. v, fig. 29).—Eggs were observed the middle of June; they were white in color and occupied all four gills. Early embryos of this species were found in four out of five specimens examined June 27. According to these observations, mature glochidia would be found during July in this region. Mature glochidia were obtained in August, 1912, from a tributary of Fall River, Glenwood County, Kans.,[a] and also June 12, 1913, at Fairport, Iowa. Form, of the purse-shaped type, similar to *Q. metanevra*.

Dimensions: Height, 0.085 mm.; length, 0.078 mm. This is the smallest glochidium of the *Quadrula* group that I have seen. Ortmann (1912) places *Tritogonia tuberculata* (Simpson) in the genus *Quadrula* on the basis of its anatomical structure. In its shell sculpture, though peculiar, he recognizes a relationship to the group of *Quadrula lachrymosa*. The extremely small size and similar form of the glochidia of these two species is another feature supporting this view.

*Propagation.*—No observations have been made upon natural infections. Experiments in propagation would be practicable in regions where the species is not uncommon. Scammon (1906) reports it abundant in Kansas and it is reported common in Indiana, and the closely allied species, *Q. fragosa* and *Q. nobilis*, are abundant in Arkansas.

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[a] I am indebted to Dr. Roy L. Moodie, of the University of Kansas, for this material.

THE MONKEY-FACE, *Quadrula metanevra* Rafinesque. [Pl. I, fig. 4, 5.]

An odd shell of good luster and texture, but not of uniform thickness.

*Habitat.*—Larger streams and rivers, common in almost all stations. In my experience on the Mississippi it is found more often in the channel than on muddy bottom in still water.

*Distribution.*—Mississippi drainage area except its southern portion, extending to the Tennessee and Arkansas Rivers. (Simpson, 1900.)

*Juvenile* (pl. I, fig. 6).—This stage was found on gravelly or sandy bottom in similar locations as the adult.

*Glochidium* (pl. V, fig. 31).—Form of the purse-shaped type with narrow hinge line. Dimensions: Height, 0.185 mm. to 0.2 mm.; length, 0.17 mm. to 0.176 mm. Breeding season, May, June, and July. This seems to be a short period and I suspect may be extended into August; however, examinations at the Fairport biological laboratory of some 89 specimens during August gave negative results.

*Natural infection.*—Infections with the glochidia of this mussel were found upon the gills of the sunfish, *Lepomis pallidus,* June 24, and of the sauger, *Stizostedion canadense,* July 26. The fish were taken at the edge of the river channel near mussel beds. Surber (1913) reports five infections on *Lepomis pallidus.* No decisive results in artificial infection with this species have been obtained, but the indications are that the sunfish, *L. pallidus,* may be infected successfully, and in the light of the information obtained regarding natural infections there should be no special difficulty in propagating this species.

THE NIGGERHEAD, *Quadrula ebena* (Lea). [Pl. I, fig. 7, 8.]

This is a much-prized species because of the excellent luster, color, and texture of the shell, as well as its uniformity in thickness. Its habitat is both in mud and among rocks. Shells from a swift current have a better quality than those from water of little flow.

*Distribution.*—Mississippi drainage generally, except its western portion; Alabama and Tombigbee Rivers; northeast Texas? (Simpson, 1900.)

*Juvenile* (pl. I, fig. 9).—The juvenile of this species I have taken only four times. Its scarcity in the collections is surprising when the abundance of the adult shell is considered. It seems probable that its habitat is on a pebbly bottom on which a dredge can scarcely pick up small material. Again, its color and shape are such as to make it difficult to find.

*Glochidium* (pl. v, fig. 30).—Gravid females with glochidia are reported from May until August. In 1912 the first found were 13 out of 85 examined on June 17, the latest 3 out of 66 examined on September 3. The spring of 1912 was late, which may have had the effect of delaying the breeding season.

All four gills are marsupial. The eggs are pink, giving this color to the gills. As development proceeds the embryos lose the color; but if, as is often the case, there are unfertilized eggs, the color remains until the eggs are discharged with the glochidia.

Form: Suborbicular; the outline as seen in side view is subsemicircular. (Pl. v, fig. 30.)

Dimensions: Height, 0.148 mm. to 0.15 mm.; length, 0.153 mm. to 0.16 mm. The dimensions of this shell are so near those of *Q. trigona* and *Q. solida* that one is obliged to rely chiefly on the form to distinguish them.

*Natural infection.*—In seeking the natural host for this species the investigation was begun early in the spring; although infections at this time seemed improbable, it was necessary to determine whether any infections could be carried over winter. The results, so far as this species of mussel is concerned, were negative; but a common infection by another species was found in the sturgeon, *Scaphorhynchus platorhyncus*, early in April soon after the ice broke up. Material was obtained by seining and trammel nets as well as by fyke or wing nets and lines. Many natural infections of various species were found during the spring, but the first evidence of any infection resembling the glochidium of *Q. ebena* was obtained June 21 on *Micropterus salmoides*. This was a single glochidium; similar single infections were found in June on *Pomoxis sparoides*, and one August 9 on *Pomoxis sparoides*, and four the same date on *Pomoxis annularis*.[a]

With this limited evidence as a guide, experiments in artificial infection were tried upon the three species named. The tests, although giving some results of interest, did not indicate that the natural host had been found. A discussion of the results will be found under the next topic.

On August 13, while out with the station seining crew engaged in mussel propagation, Mr. T. Surber secured a specimen of the blue herring, *Pomolobus chrysochloris*, heavily infected with glochidia. These, upon examination, were determined to be *Q. ebena*. This was the first specimen of this species of fish known to have been taken this season during the breeding period of the niggerhead. Earlier in the spring, May 16, a specimen was brought to me which proved to be heavily infected, but not with the niggerhead.

[a] The glochidia of *Q. ebena*, *Q. trigona*, and *Q. solida*, as will be seen by reference to the figures, do not differ greatly in appearance. This makes certain identifications difficult in some infections. (See *Q. plicata*, under natural infections, p. 27.)

Since finding this natural infection by the niggerhead, Mr. Surber has given special attention to the investigation of the infections by this mussel on the blue herring. (See Surber, 1913.)

The number of glochidia on a single fish is remarkable, some 3,700 being found on one, well encysted and giving evidence of maturing on the host. This, together with the relatively large number of infected fish taken, seems to fix this species as the natural host of the niggerhead.

The cases of infection observed on the black bass and crappies are probably either accidental infections which would not mature or they are the very similar glochidia of the pig-toe, *Q. trigona*, or the much less common *Q. solida*. In these three species the glochidia are so much alike that they can not easily be distinguished when embedded in the tissues of the host, especially when their number is limited. The implantation upon this fish may be at any point on the gill filaments, but shows a tendency to distribution on the tips. The filaments are so small that several are involved in a cyst, which is usually arge for the size of the glochidium, as observed in artificial infections with this glochidium on other species of fish. (See artificial infection, p. 20.)

Several glochidia occur in a common or compound cyst where they happen to attach closely. A peculiarity observable in many preparations is the presence of spaces in the cysts apparently once occupied by a glochidium. Adjacent to or near these may be glochidia. Surber (1913) has interpreted these as cases of migration of the glochidia. This, if the correct interpretation, is a condition not previously observed. I am not yet convinced that there is any migration except that necessary in escaping from the cysts, as examples may be seen where the glochidium has a well-defined sheath in what I understand Surber would consider the second position.

Infections on the blue herring during the remaining season were found most abundant in August, falling off in number in September, the latest being September 24 to 26, when 2 out of 9 were found infected. My latest record for gravid niggerheads is September 3, 3 gravid out of 63 examined. The difference of 23 days between September 3, the last record for the gravid mussel, and the 26th, the last for infected fish, as a rough indication of length of the parasitic period, would signify that in this case it is longer than in the case of the warty-back, *Q. pustulosa*.

Reference to a specimen of this fish taken on June 18, 1910, by H. W. Clark, revealed natural infection with the niggerhead. This is the earliest season date that I know for an infection, but corresponds with our records of 5 gravid mussels on May 31 and 13 on June 17.

In the carrying of mussels by the herring we have an interesting example of a fish reported from salt water and possibly anadromous acting as a host for fresh-water mussels. In this case it seems probable that the mussels are attached during the stay only of the fish in fresh water; however, it supports the opinion of Simpson (1899, p. 282) that the presence of fresh-water mussels of the same species in parallel coastal streams can be explained by their being distributed by fish which are free to pass from the mouth of one river in the ocean to the mouth of another. (See also White, 1905.)

The blue herring seems not commonly to have any commercial use, at least in this region, though it has been reported as being used for food in the South. Although it has no recognized commercial value in the North, its really great value becomes apparent as the host of the most sought-after fresh-water shell. I have found the herring infected by another species of mussel, which observation is of interest as it shows that this fish is not the individual host of the niggerhead. The range of the herring is reported (Jordan and Gilbert, 1882, p. 266) as the Gulf of Mexico and the Mississippi Valley, abundant and resident in all the larger streams and introduced through the canals into Lake Erie and Lake Michigan. Twenty-six years later, Forbes and Richardson (1908) report it not common in Illinois. As the fishermen on the Mississippi in this vicinity do not seem familiar with it and make rather few catches, and there are reports of its having been abundant, it looks as if the fish were much less common at this point than formerly. There is this consideration, however, which would account for its escaping attention: It is a gamey fish requiring special means for its capture, and not being sought after, it may be more common than is apparent. The distribution of the fish corresponds with that of the mussel and it would be interesting to find any extension of the range of the niggerhead through the reported access of *Pomolobus chrysochloris* to the waters of Lake Erie and Lake Michigan. It may be, however, that the niggerhead, because of its natural habitat in swiftly flowing streams, could not thrive under lake conditions.

*Artificial infection.*—Artificial infection was not undertaken until a systematic search had been made for the natural host. Up until the middle of August, as I have shown in the discussion of the natural host, the only evidence secured was the finding of four infections on the following species: Black bass, *Micropterus salmoides;* black crappie, *Pomoxis sparoides;* white crappie, *Pomoxis annularis.* There were only one to four glochidia in each infection, therefore they were not as conclusive as could be desired.

As experiments with the niggerhead had been tried by other workers upon these species of fish without success, I went to work on the assumption that success had not been attained in these cases because of unsuitable conditions in artificial infection. Some indication that this was the case was soon obtained. The glochidia would attach in some instances and not in others. It is of course necessary to imitate natural conditions as closely as possible as to temperature, aeration, light, etc. The results were more favorable when the sun was out than during cool, cloudy weather and apparently better in sunlight than in shade. It was found important to infect as soon as possible the same day after securing the gravid mussels, as this species will abort glochidia soon after capture. The cause is supposed to be that the lack of aeration due to confinement causes the animals to expel the glochidia which must tend to interfere with respiration. The small degree of special differentiation required to form a marsupium and the presence of the glochidia in all four gills of the *Quadrulas* undoubtedly contribute to this.

Infection and encystment of the glochidia were obtained. (Pl. III, fig. 24.) The latter was even observed under the microscope upon filaments severed from the gill and immersed in physiological salt solution. In one case observed the glochidium was completely covered by the encystment in four hours.

In the case of the fish left in tanks and aquaria the glochidia, although well encysted, were shed in from one to three days in all cases. The longest retention was found in the black bass. The cysts in these infections were exceedingly large, the excessive hypertrophy apparently being due to excessive stimulation. (See fig. 24.)

In one instance the fish were immersed in a salt bath (NaCl, 10 per cent) before introducing them to the container holding the glochidia. This resulted in more certain and rapid infection than usual in all species experimented upon, but the infection was no more persistent. The significance of the results in this experiment I will take up in the general discussion.

After the completion of a number of such experiments the discovery was made, as previously mentioned, of infections in large numbers on the blue herring, indicating it as the host fish for the niggerhead. This gave an explanation of the inconclusive results already attained, but, on the other hand, it did not offer ready means for the application of artificial infection. The host in this case is a fish which offers great difficulties to the methods at present employed in artificial propagation, in that it is rarely taken here and is difficult to retain in a living condition long enough to successfully subject it to infection. In order to find how to do this, it will probably be necessary to experiment in localities where both the fish and mussel are abundant. If possible to capture in pound nets or traps or by careful handling when seined, they could be infected without removal from the water. As the mussel is a species found in the larger rivers, inclosures would have to be made in a body of water having a current.

Since the fish is very active, suitable nets must be used to prevent injury. Trammel or gill nets, or seines of unsuitable mesh, would be fatal.

A satisfactory completion of the investigation of the parasitic stage in *Q. ebena* will probably be greatly aided by gaining more thorough knowledge of the fish's habits. This information will, of course, aid also in determining suitable measures for insuring the increase of the mussel.

Since some mussels, as the mucket, *Lampsilis ligamentina*, have been successfully carried through on more than one species of fish, the possibility of finding some more practical host in this case has been kept in mind. I am of the opinion that the experiments already conducted have been sufficiently thorough to demonstrate that the species so far tried are unsuitable. Chances for success would be looked for in closely related species. The only really common species in this locality answering these requirements is the gizzard shad, *Dorosoma cepedianum* (*Le Sueur*). Unfortunately this fish, like *Pomolobus*, is not readily kept alive; but the difficulties may not be insuperable. I have seen it kept alive several hours in the laboratory during the winter and have no doubt it could be kept in ponds, as it is found alive in bayous isolated from the river. As it has not yet, however, been found to carry mussels upon the gills, the probabilities of success are quite uncertain.

Three species of shad are found in the Mississippi. These are more closely related to *Pomolobus*, but they are not reported common north of St. Louis. Surber (1913) suggests the interesting experiment of infecting the species of herring to be found in the rivers of the Atlantic coast. This might be successful if tried in rivers containing considerable lime in solution, as is the case in the rivers in which the niggerhead thrives.

*Propagation.*—There is probably no shell for which there is a larger demand at present and its uses might be greatly increased. From the results already attained in the investigation of the life history of the niggerhead, propagation might be undertaken at once, provided it were done in a way that would permit of definitely ascertaining results. Whether the herring can be caught in sufficient numbers to make such operations practicable is a question, but reports would indicate that they can be in some localities. However, operations upon a large scale are hardly to be recommended before a demonstration of artificial infection and the completion of the parasitic period has been observed.

The remarkably full infection of this species in nature indicate that under natural conditions propagation of this mussel will take care of itself. Thus recommendations of measures for preventing the depletion of the niggerhead would be along the line of protection to the herring as the host fish. The cause for the increasing scarcity of the herring seems not to be due to capture in large numbers, as the fish is not commonly used for food throughout its range. It is more probable that it is due to artificial conditions, such as the obstruction of its natural migrations by dams and the introduction into the rivers of nonoxygenated sewage and the injurious wastes of manufacturing plants and the like.

*Quadrula solida* (Lea). [Pl. VI, fig. 46, 47.]

*Quadrula solida* closely resembles *Q. ebena*. I have investigated this species only so far as to make some observations upon its breeding. I found gravid females May 31 and July 23. In one specimen glochidia were present in both inner and outer gills; in the other cases only the outer gills were charged. Glochidia were found mature on both the dates mentioned. The glochidium (pl. V, fig. 34) has the subsemicircular form slightly more rounded than *Q. ebena*.

Dimensions: Height, 0.145 mm. to 0.16 mm.; length, 0.155 mm. to 0.160 mm. See also Surber (1912), to whom the material was referred for description. I have found no natural infections that could with certainty be ascribed to this species. Mr. Surber reported a single glochidium on a *Pomolobus* infected with many of *Q. ebena*. It would not be surprising if they are found to have the same fish for host.

THE PIG-TOE, *Quadrula trigona* (Lea). [Pl. I, fig. 10, 11.]

The brilliant orange-colored flesh of the pig-toe is characteristic, although occasionally it is found yellow or white. The nacre is a beautiful silvery white, more or less iridescent; rarely the nacre is pink. In the manufacture of buttons it is less desirable than the niggerhead because of less uniform thickness.

*Habitat.*—In the larger rivers, on a muddy bottom in rather deep water.

*Distribution.*—Western New York to Minnesota, and Iowa, and Kansas to Texas, east to Mississippi and Tennessee. (Call, from Baker, 1898.)

*Juvenile.*—The juveniles were the second most abundant of the 27 species I have collected and first in abundance among the *Quadrulas*. They were taken on both mud and sand bottoms. I have found this species in the artificial ponds at Fairport, Iowa, introduced in the parasitic stage on fishes—the second of the river-inhabiting *Quadrulas* to be found under such conditions.

*Glochidium* (pl. V, fig. 33).—The breeding records of the Fairport biological station for the past three years give June, July, and August as months in which the glochidia of this species have been taken. I found seven mussels with early embryos of this species August 27 and 28, 1913, and one with mature glochidia on September 10, thus extending the known breeding period well on into September. In July I took a gravid example only 30 mm. in length; this surprisingly small size for breeding indicates the early attainment of the adult stage. The glochidial shell of this species seems thin and more delicate than in *Q. ebena*. The eggs are a pinkish red, the glochidia colorless, filling moderately all four gills. Unfertilized eggs were found with glochidia, so that gravid mussels have gills varying in color from a deep to a light shade, according to the number of eggs remaining undeveloped. The number of undeveloped eggs is surprisingly high, sometimes more than 75 per cent. The form of the glochidium is of the subsemicircular type (fig. 33).

Dimensions: Height, 0.136 mm. to 0.149 mm.; length, 0.136 mm. to 0.153 mm. The smaller size and straighter lines of the anterior and posterior edges of the shell should distinguish this glochidium from the similar glochidia of *Q. ebena* and *Q. solida*.

*Natural infection.*—The natural host for *Q. trigona* has not to my knowledge been determined with any satisfactory degree of certainty. I secured infections on *Pomoxis sparoides* August 2 and *Pomoxis annularis* August 9, observing in the first 2 and the second 4 glochidia which answer to the dimensions of *Q. trigona;* but as unmistakable preparations of these were not obtained it is not at present possible to state whether they may not be either *Quadrula solida* or *Q. ebena*. Since the host-fish for the latter has been pretty definitely determined to be *Pomolobus*, it might be excluded as a possibility here if it were not known that accidental and sporadic infections are possible on other than the usual host. A single case is reported as *Q. trigona* on the black crappie, *P. Sparoides*, by Surber (1913); he also reports an infection upon *Pomoxis annularis*, but thinks both of these may be accidental infections. Some evidence as to the natural host was obtained in the finding of the juvenile of this species in an artificial pond in which sunfish, crappie, and gizzard shad, *Dorosoma cepedianum*, had been kept. Since gizzard shad have not been found with gill infections, the evidence favors the sunfish and crappie in this instance. Further evidence was obtained in the successful implantation of the glochidia on the gills of the sunfish in artificial infection; this will be taken up in the next topic.

The character of the distribution of the juveniles of *Q. trigona* must be of some significance; it was found to be the most generally distributed of all species in explorations of the river bottom, from which it is a safe presumption that the host must be a common fish. To summarize the results, the evidence, though not conclusive, points to the sunfish and crappie as the hosts.

*Artificial infection.*—In my experiments with this mussel five species of fish were tested, *Micropterus salmoides, Lepomis pallidus, Eupomotis gibbosus, Pomoxis sparoides,* and *P. annularis*. Examination the second day showed many glochidia encysted upon the gills of the sunfish, but only one or two on the bass and crappie. The third day they were still in good condition on the sunfish, but all gone on the others. By the seventh day all were shed by the sunfish. Whether the parasitic period in this instance was completed I unfortunately did not succeed in determining. If it were, the period is a brief one and needs further testing. Experiments were conducted by T. Surber with this mussel at the Fairport biological station in 1910. The following fishes were used: *Micropterus salmoides, Pomoxis annularis, Aplodinotus grunniens*, and *Lepomis* (sp. ?). No implantation at any point on or in the body was observed, but free (without encystment) glochidia were found in the intestine of *A. grunniens* 17½ hours after exposure. The results of my experiments point to gill infection as the normal method for this mussel and to good chances for success with *Lepomis pallidus*.

*Propagation.*—Propagation of this valuable mussel at present would probably have to be restricted to the introduction of the adult mussel in new territory. The success of this method can not be predicted with any degree of certainty until we know whether the host (presumably a fish) is found in the waters where introduction is attempted. A recent report of Wilson and Danglade (1912) recommends the introduction of this mussel into the rivers of Minnesota. Very practical work can undoubtedly be done along the line of extension of range of valuable species, but it would be obviously impractical to do this without a more certain knowledge than we have at present of the life history of this species. Take for example the case of the niggerhead mussel. So far as is known, it is dependent entirely upon the herring (*Pomolobus chrysochloris*) for propagation. Introduction into waters where this fish was absent would accordingly be certain of failure, as the mussels would be nonperpetuating. I have mentioned above the finding of many unfertilized eggs in the marsupia of these mussels. In the examination of hundreds of shells from various points in the region investigated I have found this state of things quite general. The result is that glochidia are difficult to obtain except in small numbers; under these circumstances artificial propagation would be quite impracticable.

THE BLUE-POINT, *Quadrula plicata* (Say). [Pl. II, fig. 17, 18.]

This form also bears the name of "three-ridge." It is at present one of the most-used shells in button manufacture.

*Distribution.*—Western New York to Arkansas and Iowa, Michigan to Alabama and Texas.

*Habitat.*—In the larger rivers, in rather deep water, generally on a muddy bottom (Baker, 1898).

*Juvenile.*—I have found this species with several others in the artificial ponds at the Fairport biological station. They have been introduced, for the most part, probably in the parasitic stage on fish retained in the ponds. As the first example of the *Quadrula* group raised in captivity, it has interest and is something of a demonstration that they may be raised under such conditions. This was the fourth most abundant species in my collections from the river.[a]

*Glochidium* (pl. v, fig. 32).—The breeding records indicate that mature glochidia are to be found during June, July, and August. On June 26 I observed the spawning of this species. The mussel was marooned on a sand bar and only partly in the water, and the loose white mass of glochidia were collecting in a depression in the sand behind it. I suspect this was not perfectly normal spawning, since the mussel was being left by the receding water, and cases of abortion of glochidia are commonly observed in the *Quadrulas* when placed under conditions unfavorable for oxygenation in the gills. The glochidium (pl. v, fig. 32) is of the hookless type, subsemicircular, elongate, and white in color. It possesses a thread gland and larval thread like *Q. heros*, and probably the same will be found in all the other members of the Crenodonta group as limited by Simpson (1900). The gland is somewhat different in appearance from that in *Q. heros*. The turns or loops of the spiral are of about the same number, but a small portion of what may be designated the distal end, becomes abruptly two to three times broader than the remainder. This larger portion begins at the posterior end of the hinge line and on reaching the anterior side of the adductor muscle curves in close to its ventral and posterior side. The contents of this enlarged portion is the coiled hyaline thread secreted by the gland, in a less condensed state than at the time of its emergence from the external pore, which lies on the posterior side of the adductor muscle.

The dimensions of the glochidium are: Height, 0.195 mm. to 0.215 mm.; length, 0.185 mm. to 0.200 mm.

*Natural infection.*—Five examples of natural infection with this species were obtained during June, July, and August. The fish were all crappies, both *Pomoxis annularis* and *sparoides* and were caught chiefly in the channel of the Mississippi on or near mussel beds where *Q. plicata* was abundant. Surber (1913) reports two cases, one on *S. canadense* and one on *P. annularis*, both for July 20. In determining natural infection of this species it is necessary to distinguish it from the glochidium of the "spike" mussel, *Unio gibbosus* (Barnes), as the latter has a similar form and dimensions, and it apparently infects some of the same species of fish. Typical glochidia differ in the following respects:

The dimensions in *U. gibbosus* are: Height, 0.208 mm. to 0.220 mm.; length, 0.190 mm. to 0.208 mm. The hinge line is proportionately

[a] I have received two juveniles of this species about 5 mm. in length, possessing a well-defined byssus. This material was collected in Lake Peppin by Mr. A. F. Shira.

longer and the thread gland curves in from the ventral edge of the right valve in *U. gibbosus*. In *Q. plicata* the ventral loops follow a peripheral course (see fig. 32). Unfortunately, this character is difficult to distinguish in glochidia which are imbedded in the tissues of a fish. Again, since the gland is an embryonic organ, it does not persist long after metamorphosis commences in tissues of the host. In natural infections it is not always possible to obtain an orientation of the specimens so as to obtain the most accurate measurements; especially is this the case when a fish carries only one or a few glochidia, when distinction between glochidia is made more difficult.

The number of infections determined as *U. gibbosus* were as follows: Black and white crappies, 5; yellow cat (*Leptops olivaris*), 1; Sauger (*Stizostedion canadense*), 1. In addition to these, I have records of three infections on the black bass (*Micropterus salmoides*) which belong to one of these species but which I am at present obliged to consider as doubtful.

Summarizing the results, the chief hosts for *Q. plicata* are indicated as the crappie, *Pomoxis annularis* and *Pomoxis sparoides*, with the sauger and black bass as occasional possible hosts. The reported (Lefevre and Curtis, 1912) successful artificial infection of *Micropterus salmoides* with *Q. plicata* would warrant the expectation of finding this fish infected in nature.

The presence of an embryonic thread suggests the possibility of fin infection from analogy with forms that possess that organ. The small size of the glochidium and lack of color would make them more difficult to detect than the fin-infecting glochidia of the *Anodontas*.

*Artificial infection.*—The artificial infection with this species which I have just mentioned as having been made by Lefevre and Curtis (1912) was the first reported and the only successful infection with *Quadrula* mussels so far as known to me. The fish, black bass, *Micropterus salmoides*, were infected August 5, 1908, exposed 30 minutes to infection, and young mussels liberated on August 17, giving a parasitic period of 12 days in water of 24.4° C. average temperature.

I have experimentally infected the following fish with this species: White crappie, *Pomoxis annularis;* black crappie, *P. sparoides;* yellow perch, *Perca flavescens;* sunfish, *Lepomis pallidus;* bullhead, *Ameiurus;* flathead catfish, *Leptops olivaris;* channel cat, *Ictalurus punctatus;* quillback, *Carpiodes velifer*. The first four named proved suitable as carriers of this species; the young mussels were carried through the metamorphosis in large numbers, and I was able to secure specimens of the young juveniles alive on the bottom of the aquaria in which the fish were retained. In the sunfish a large number were apparently shed prematurely, while a few were carried through to maturity. The bullheads carried a few for the full time, but on the fins and not the gills. The remaining species shed the glochidia in from one to two days.

In the successful cases the period of parasitism varied from 8 to 11 days, the water temperature averaging approximately 76° F. The last to mature seemed to be at the tips of the filaments, thus indicating that the position was an important factor in determining the parasitic period. The young mussels on leaving the fish show no appreciable development of shell; thus they are very minute at this stage and probably a prey to many enemies.[a]

*Propagation.*—Several factors favor the artificial propagation of this species upon a practical scale. It is common and at present one of the most used shells in the button industry. It seems to be a form not narrowly restricted as to hosts and these are indicated to be among the commonest and most readily obtainable fishes. Although a river form, its habit as a dweller in stiller water and on a mud bottom makes it susceptible to propagation or control under conditions readily imitable in artificial lakes or ponds. A continuous water supply is desirable; my observation has been, however, that it will survive rather adverse conditions in this respect. I have collected many live specimens from a slough which had gone dry to the extent that only mud remained. Under these conditions the majority of the pond mussels, *Anodonta corpulenta,* had died. I would cite also the finding of this species accidentally introduced in the parasitic stage into an artificial pond at Fairport, Iowa. The pond had gone dry and I found a specimen still alive buried in mud barely moist. It is evident, I think, from these observations that the species is hardy, at least as regards some of the more common vicissitudes to which mussels are naturally subjected.

THE WASHBOARD, *Quadrula heros* Say. [Pl. II, fig. 14, 15.]

This is the largest and one of the most handsome of American fresh-water mussels. Its unusual size adapts it to special uses, and in some localities it has the reputation of being one of the best of pearl-bearing species.

*Distribution.*—Mississippi River system generally; Red River of the North; Tombigbee River, Ala.; southwest to Nuevo Leon, Mexico (Simpson, 1900).

*Habitat.*—It is found in large rivers in deep water and on muddy bottoms.

*Juvenile* (pl. II, fig. 13).—The juveniles are very handsome because of their elaborate shell sculpture. They were taken in the same locations as the adult, viz, in deep water on a mud bottom.

*Glochidium* (pl. V, fig. 35).—I obtained mature glochidia of *Q. heros* September 24, having taken early embryos August 24 and immature glochidia as early as August 28. During October, in

[a] See p. 12, footnote, regarding observations of the destruction of young *Q. pustulosa.*

observations covering two successive seasons, the mature glochidia were readily obtained, as the majority of adult females examined were gravid. An examination on November 7 of 55 individuals from the same mussel bed yielded no gravid specimens at all, and some 50 mussels in March and April yielded 1 gravid specimen only; this was found April 14, and contained immature glochidia, still surrounded by the vitelline membrane. All the information available indicates that the regular breeding season is during the autumn, chiefly October, with an extension into the winter months in some localities, but that the glochidia are not carried a long period in the gills as in the Lampsilinæ. Since all four gills are used as marsupia and greatly distended, a long breeding period would seem to be too great an interference with the breathing function of the gill.

The productivity of this form is enormous, a single average-sized individual in which I estimated the number gave one and a third million young. A count was made of a definite fraction of a marsupial chamber in a gill and the total computed from a count of these chambers for the four gills, account being taken of difference in size in the gills. Simpson (1899) quotes Lea as giving the number of young produced as 6,000,000. I have not seen the original of this statement by Lea, but find another (Lea, 1857, p. 40) in which he gives an estimate of 3,000,000 or 4,000,000 as the number produced; as he says "probably to the number of 3,000,000 or 4,000,000," he may not have made an actual computation. A specimen twice the size of the one I considered, which would be unusually large, would hardly have more than 3,000,000. From this I suspect that Lea's estimate is too high. Lefevre and Curtis (1912, p. 144) say in regard to the breeding period of this species that, finding young embryos in May, their observations are not in accord with those of Frierson (1904), who found glochidia in January and so concludes that *heros* is an exception to the genus *Quadrula* and not a summer breeder. Conner (1909) gives an observation of breeding in November. Surber (1912) figures an immature glochidium, giving dimensions which correspond closely with the mature embryo, together with observations on the breeding season. Simpson (1900, p. 776) is of the opinion, since he has seen so few gravid specimens, that the breeding of these species is only at long intervals. It is apparent from the above references that the observations upon the breeding of this species have been quite limited and I know of no description of mature glochidia, with the exception of Lea's (1857, p. 46). In his description there is no reference to the time of breeding and he has omitted anatomical features that are distinctive. He says:

*Unio multiplicatus* (synonym for *Q. heros*) Lea, figure 3. Pouch shape; dorsal line long; side margins gently curved, basal margin slightly rounded; color clear white. Has no hooks.

The above is sufficiently accurate as to the features described but is not enough to identify the glochidium, since there are so many forms answering this description. I think the following will serve to distinguish it:

Dimensions: Height, 0.316 mm. to 0.340 mm.; length, 0.250 mm. to 0.260 mm. The right valve contains a large and conspicuous thread gland; this is in the form of a spiral rod (pl. 3, fig. 21) tapering at each end, and having about two turns about the adductor muscle. As compared with this gland in *Anodontas*, it is more conspicuous because of its greater width and its being possibly more highly refractive to light. The inconspicuous tapered extremities lie near the ventral side of the adductor muscle and one of them opens to the mantle cavity; from this opening the larval thread extends. The latter is of considerable length and lies coiled in the mantle chamber. It consists of a delicate hyaline thread which becomes readily extended when the glochidia are extruded from the parent gills. The presence of a thread gland has not been previously reported for the *Quadrula* group, I believe, and only in the *Anodontas* and the *Unios* (as listed by Ortmann, 1912). I find it present in *Pleurobema æsopa* and also in *Unio gibbosus*, for which, with the closely related forms, Ortmann has created the new genus *Elliptio*.

*Natural infection.*—When the investigation of the breeding of this mussel was undertaken very few data were available; in fact, the published accounts, as I have shown, indicated considerable uncertainty about the breeding period. I was fortunate in finding gravid mussels with active glochidia in considerable abundance and suitable for experimentation. This situation led me to accept the opportunity presented before I was able to investigate sufficiently the problem as to the natural host. I subjected a number of species of fish to infection, obtaining quite definite results. The following species carried the glochidia successfully on the gills or the fins: The sunfish, *Lepomis pallidus* (pl. IV, fig. 26*b*); the catfishes, *Ictalurus punctatus* and *Ameiurus melas;* and the drum, *Aplodinotus grunniens.* Some months after these experiments were made Mr. T. Surber, in examination of Arkansas fishes taken in January, reported several natural infections by this species on the fins of a sheepshead, *Aplodinotus grunniens*, but none on the gills. More recently I have had the opportunity of examining a number of fish taken in the Mississippi at three different stations. Among these I found infected by the larva of *Q. heros* five species of fish and the batrachian, *Necturus maculosus.* These observations are shown in detail in table 2.

The infections upon *Necturus* were none of them encysted, even after attachment for a known period of several days, which leads me to believe that the mussel is incapable of development upon this host.[a]

[a] Incidentally the observation may be of interest of a larval mussel of another species abundant upon *Necturus* completely encysted and passing through its metamorphosis on this animal.

TABLE 2.—NATURAL HOST OF FRESH-WATER MUSSEL QUADRULA HEROS.

| Name of host. | Date. | Locality. | Number of glochidia. | | Development. |
|---|---|---|---|---|---|
| | | | Gill. | Fin. | |
| Necturus maculosus | Oct. 20 | Moline, Ill | Few. | | Not encysted. |
| Do | ..do | ..do | Few. | | Do. |
| Do | Oct. 22 | ..do | Few. | | Do. |
| Dorosoma cepedianum | ..do | ..do | | 25 | Do. |
| Pomoxis annularis | ..do | ..do | | 22 | Do. |
| Dorosoma cepedianum | Oct. 24 | ..do | | 48 | Completely encysted. |
| Do | ..do | ..do | | 17 | Do. |
| Do | ..do | ..do | | 2 | Do. |
| Pomoxis annularis | ..do | ..do | | 1 | Undetermined. |
| Do | ..do | ..do | | 1 | Do. |
| Roccus chrysops | Oct. 25 | Fairport, Iowa | 3 | | Encysted. |
| Amia calva | Oct. 28 | Moline, Ill | 1 | | Do. |
| Necturus maculosus | ..do | ..do | Many. | | Not encysted. |
| Leptops olivaris | Nov. 7 | Hampton, Ill | 2 | | Deeply encysted. |

The results of the artificial infection experiments and the observations upon natural infections would indicate that this mussel may carry out its development upon both the gills and fins of a number of species of fish. In the natural infections it will be noted that the infection of the fins was more common.

This is an interesting case of a hookless glochidium adopting partially the fin-infection habit which is found in the *Anodontas*. It has other characters in common with this group in the large size of the glochidium, in the presence of the large thread gland, and in the winter (though probably not long period or bradytictic) breeding habit. The opinion of Simpson (1900, p. 766, footnotes) that this species breeds only at long intervals was based upon the absence of observations of gravid specimens. I think this scarcity of records may be ascribed partly to the following causes: The breeding season is at the time of year when less collecting is being carried on, as well as at a different season from that of related forms. Again, gravid mussels abort the glochidia so that the evidence is liable to be lost unless observed when the mussels are first removed from the water. I think the assumption that they breed annually is safe until more definite evidence to the contrary is found.

*Artificial infection.*—Mature glochidia suitable for infection were first obtained September 24, and subsequently other gravid mussels were obtained, apparently being not difficult to find. It was noticed that the glochidia had unusual vitality, it being possible to use the same lot day after day for more than a week. This is in marked contrast to the conditions I have encountered among other *Quadrulas*. It is possible that it may be associated with the lower temperatures at this season. Another feature of importance is the immense number of glochidia, which increases greatly the ease of manipulations.

Some 10 species of fish were subjected to infection in six different lots, according to the usual method. The results of these experiments are summarized in table 3.

TABLE 3.—ARTIFICIAL INFECTION OF QUADRULA HEROS SAY.

| Date. | Exper-iments. | Fish. | No. of fish. | Glochidium retained until— | Period on fish. | En-cysted. | Position. |
|---|---|---|---|---|---|---|---|
| Sept. 25 | 30–34 | P. annularis | 7 | Sept. 26 | 1 day | No | Gill. |
| 25 | 30–34 | P. sparoides | 9 | Oct. 1 | 6 days | Yes | Do. |
| Oct. 1 | 30–34 | R. chrysops | 4 | Oct. 6 | 5 days | Yes | Do. |
| Sept. 27 | 30–34 | M. salmoides | 4 | Oct. 8 | 11 days | Yes | Do. |
| 27 | 30–32 | I. punctatus | 7 | Feb. 7 | 4 months 11 days [a] | Yes | Fin. |
| 27 | 30–35 | A. melas | 2 | Feb. 11 | 4 months 15 days [a] | Yes | Gill and fin. |
| 27 | 30–35 | L. pallidus | 8 | Dec. 6<br>Feb. 5 | 2 months 9 days to 4 months 9 days. | Yes | Gill. |
| 25 | 30–34 | S. canadense | 5 | Oct. 5 | 10 days | Yes | Do. |
| 25<br>Oct. 7 | 30–35 | A. grunniens | 6 | Apr. 18 | 6 months 11 days [a] | Yes | Fin. |
| 1 | 34 | C. difformis | 1 | (Died.) | | Yes | Do. |

[a] Glochidia remained upon the fish after the date observed.

It will be noted that both gill and fin infection persisted more than four months on the catfishes, *Ictalurus punctatus* and *Ameiurus melas;* gill infections remained upon the sunfish over two months (pl. IV, fig. 26*b*). In these cases evidence of development was found, but not determined for the shorter periods of 11 days or less. In *Aplodinotus,* fin infections remained till April, more than six months, and showed considerable development at the time of examination.

The indications are that infection takes place chiefly during the autumn, possibly to some extent in winter and early spring, and that the young mussel leaves the host when the water becomes warmer in the later spring. The readiness with which the glochidia become attached to fish in the autumn would indicate that this is a natural time for infection, although for some long-period breeders (*Anodonta*) it is claimed that development proceeds during the winter before leaving the parent gill (Lillie, 1895). Lillie states that the glochidia are carried through the winter and are extruded finally in the spring; the species to which he refers is *Anodonta cataracta.* Lefevre and Curtis say that *Anodontas* have mature glochidia early in October. An experiment performed at the Fairport laboratory by Messrs. Clark and Surber September 26, 1910, with *A. corpulenta* resulted in attachment of glochidia upon fish, but temporarily only. From these citations it would seem that there is difference of observation as to the maturity of glochidia in the genus *Anodonta.* There may be a considerable difference as to date of maturity for different species of the genus, as is the case in the genus *Quadrula.*

The difference in duration of the period of attachment to fishes in the different hosts is to be noted. I am not at all certain of the explanation. If, as reported by Schierholz (1888) and Harms (1907–1909), the duration of the parasitic period varies inversely as the temperature of the water, that would not explain the liberation of glochidia from sunfish in midwinter. One must assume a difference of rate for different hosts or that development was incomplete in the case of the shorter periods.

The possibility of implantation upon both gills and fins of the host seems to be more liable to occur in this species than in any other of which I know having hookless glochidia. This habit might naturally be correlated with the large size, which would enable the glochidium to become attached more readily to the exterior of a fish, where places for attachment are coarser than on the gills. This character should be of advantage in artificial infection, through more diffuse distribution on the fish and on less vital parts, permitting a higher optimum infection. In the present experiments the largest number of glochidia carried through four months was 28;[a] this, however, should not be considered any criterion of possibilities, since the parasitic period in this case is probably an unusually long one. In general for the long-period breeders it is probably more economical, other things being equal, to infect in the spring, thus securing a shorter and more certain development.

The infection of the fins in the catfish calls attention to a difference in suitability to infection between such a fleshy fin and the membraneous type of the Centrarchidæ, which group has been found so favorable for gill infections.

The encystment of the glochidia of *Q. heros* (see pl. IV, fig. 26*b*) indicates a less vigorous reaction of the hosts tissues than, for example, in the niggerhead; in that the cysts are comparatively thin.

*Propagation.*—The very large size of *Q. heros* and the thickness of the shell give possibilities of use which are found in no other mussel. At the present time it is, according to manufacturers, with the mucket, *L. ligamentina*, and the three-ridge, *Q. plicata*, one of the three chief shells used in the button industry, possibly taking first place for large buttons; in quality it is considered second grade, but varies with locality. From the results of this investigation it is shown to be one of the most favorable among the *Quadrulas* for artificial propagation. The reasons for this are as follows: It is a fall or winter breeder, thus not being limited to a brief summer breeding period at a season when it is more difficult to deal with live fish and at a time when the other *Quadrulas* are breeding. It has at least three host fish and probably more upon which it can be propagated. The tremendous number of glochidia produced and their great vitality are features that increase the chances of success in artificial propagation. Its natural habitat is more easily imitated under artificial conditions than that of species which are restricted to river channels in that it is found in the more quiet waters of lagoons and lakes as well as in the open rivers. For a heavy shell it is a rapidly growing species.

[a] Through the winter of 1913-14 *Q. heros* was carried to maturity in large numbers (800 to 1,200 per fish) on the gills of the following: *Pomoxis annularis*, *P. sparoides*, *Lepomis pallidus*, *Apomotis cyanellus* and *Ameiurus* Sp., and in smaller numbers on the fins of the following: *A. grunniens*, *Ictalurus punctatus*, *Ameiurus* Sp.

*Natural hosts of mussels of Quadrula group.*—Natural infections of fish by mussels of the *Quadrula* group were found as follows, the figures representing the number of fish:

Warty-back (*Q. pustulosa*), on—
- Yellow catfish (*Leptops olivaris*), 1.
- Spotted catfish (*Ictalurus punctatus*), 9.
- Crappie (*P. annularis*), 1, reported by Surber, 1913.

Pimple-back (*Q. pustulata*), on—
- Crappie (*P. annularis*), 1, reported by Surber, 1913.

Monkey-face (*Q. metanevra*), on—
- Bluegill sunfish (*Lepomis pallidus*), 1; 5 reported by Surber, 1913.
- Blue sunfish (*Apomotis cyanellus*), 1, reported by Surber, 1913.
- Sauger (*S. canadense*), 1.

Niggerhead (*Q. ebena*), on—
- Large-mouth black bass (*M. salmoides*), 1(?).
- Skipjack (*Pomolobus chrysochloris*), 11, reported by Surber, 1913.

*Q. solida*, on—
- Bluegill sunfish (*L. pallidus*), 2, reported by Surber, 1913.

Pig-toe (*Q. trigona*), on—
- *Pomoxis* sp?, 1.
- Crappie (*P. annularis*), 1.
- Strawberry bass (*P. sparoides*), 1, 1(?) reported by Surber, 1913.

Blue-point (*Q. plicata*), on—
- Large-mouth black bass (*M. salmoides*), 3(?).
- *Pomoxis* sp.?, 2.
- Crappie (*P. annularis*), 2; 1 reported by Surber, 1913.
- Strawberry bass (*P. sparoides*), 1.
- Sauger (*S. canadense*), 1.

Washboard (*Q. heros*), on—
- Fresh-water drum (*A. grunniens*), 1, reported by Surber, 1913.
- Eel (*Anguilla chrysypa*), 1, reported by Surber, 1913.
- See also table 2.

TABLE 4.—COLLECTION OF JUVENILE QUADRULAS, SEASON OF 1912.

| No. of station. | Name. | Date. | Dredge hauls. | Depth. | Bottom. | Q. pustulosa. | Q. pustulata | Q. granifera. | Q. lachrymosa. | Q. metanevra. | Q. ebenus. | Q. solida. | Q. trigona. | Q. plicata. | Q. heros. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Iowa Shute | June 20 | 9 | 3–6 | Sand and gravel. | 3 | ... | ... | ... | ... | ... | ... | 3 | 1 | ... |
| 2 | Smiths Cove to Pine Creek. | June 22 | 15 | 4–8 | Varied (see hauls) | 2 | ... | ... | ... | 1 | ... | ... | ... | ... | ... |
| 3 | Sand bar above Smiths Creek. | June 25 | 0 | ........ | Sand silt | 0 | 8 | ... | ... | ... | ... | ... | 3 | 1 | ... |
| 4 | ....do | June 26, June 28 | 0 | 0–½ | ....do | 0 | 2 | ... | ... | ... | ... | ... | 3 | 2 | ... |
| 5 | Pine Creek | July 10 | 4 | 2–8 | 1, mud; 2, 3, and 4, mud and gravel. | 4 | ... | ... | ... | 1 | 1 | ... | 4 | 3 | ... |
| 6 | Pine Creek to Buffalo. | July 12 | 11 | 2+ | 1–6 gravel; 7–11, mud and gravel. | 5 | 1 | 2 | ... | 1 | 1 | ... | 17 | 15 | ... |
| 7 | Montpelier | July 15 | 5 | Varied. | Varied (see hauls) | 1 | ... | 1 | ... | ... | ... | ... | 2 | ... | ... |
| 8 | Barrs Landing | July 17 | 2 | 2–5 | Gravel and mud. | 11 | ... | ... | 1 | 2 | ... | ... | 16 | 6 | ... |
| 9 | Wagglers Landing | July 29 | 5 | 3–5 | Gravel and sand. | 12 | ... | 1 | ... | 8 | ... | ... | 7 | 5 | [a]1 |
| 10 | Moline | Sept. 24 | 4 | 2–4 | Sand and mud | 0 | ... | ... | ... | ... | 1 | ... | 1 | 5 | 1+ [a]3 |
| 11 | ....do | Sept. 26 | 5 | 2–4 | Mud | 1 | 1 | ... | ... | ... | 1 | ... | 3 | 10 | ... |
| 12 | Davis Point | Dec. 14, Dec. 23, Dec. 24 | 0 | ½–4 | Pebbles | 0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | | | | | 39 | 12 | 4 | 1 | 13 | 4 | 0 | 59 | 48 | 5 |

[a] Over 20 mm. and under 65 mm.

## GENERAL DISCUSSION.

In the investigation of the specific problem of propagating the *Quadrulas* some results have been attained which are of general application probably to all the Unionidæ. Also observations have been made incidentally upon other species which, as they have a bearing on the present problem, require discussion.

### REPRODUCTION AND EMBRYONIC STAGES.

As practical propagation of the Unionidæ is only indirectly concerned with the embryonic stages, I have not dealt with these in the body of this paper. My observations upon these stages have been very limited and incidental only to other studies, but as the *Quadrulas* have had little attention some of these may be worth mentioning. Reproduction among the *Quadrulas* seems to be essentially as reported in other Unionidæ (Rabl, 1876; Schierholz, 1888; Latter, 1891; Lillie, 1895). The sexes are separate so far as known. The gonads occupy a considerable portion of the visceral mass among the coils of the intestine. The eggs upon extrusion from the genital apertures pass into the suprabranchial chambers of the inner gills, passing from there to the cloaca and then back through the suprabranchial chambers to the gills. They are probably fertilized during transition to the gills by sperms introduced with the respiratory current. I have observed ovulation in *Quadrula ebena* and remarked the exceedingly fine stream of eggs issuing singly and covered by mucous envelope; the passage to the gills was not observed, but it would seem strange in these forms which carry embryos in all four gills that the eggs should not go directly into the inner gills, as they must pass the openings of the water tubes.

Contributions to a knowledge of the development from the eggs to the glochidial stage among Unionidæ have been made by Flemming (1875), Schierholz (1878, 1888), Goette (1891), and these stages have been completely described for *Unio complanata* and *Anodonta cataracta* by Lillie (1895).

While making examinations for breeding periods I was much astonished to note the slowness of division processes. The eggs of *Q. ebena* examined in the morning of May 31 seemed to be all in the one-celled stage; in the afternoon two-celled stages were present. The second day segmentation had advanced to the four- and eight-celled stages only, and the fourth day 16-celled stages predominated. Since making these observations I have read Lillie's (1895) paper and see that he has commented upon the phenomenally slow segmentation in the forms which he examined, *Unio complanata* and *Anodonta cataracta*, contrasting it with the rapid development in marine lamellibranchs.

## PARASITISM.

There are questions associated with the parasitism of fresh-water mussels which have previously had little discussion. Obviously the basis for a consideration of these must be upon observation of natural infections. I wish to discuss these under the following heads: Restricted infection, susceptibility and immunity, frequency of infection, extent of individual infection, conditions of infection in nature, etc.

*Restricted infection.*—The existence of specific or narrowly restricted parasitism in the case of some mussels I believe I have demonstrated in the case of *Q. pustulosa* upon the channel cat, *Ictalurus punctatus* (Howard, 1912). A similar case is that of the niggerhead upon *Pomolobus chrysochloris* (Surber, 1913). These are not surprising, since it is common, especially among animals, for a certain species of parasite to be restricted to a given species or genus of hosts, as *Goniodes stylifer,* the louse infesting the turkey, and *Trichodectes scalaris* upon the ox. If by accident they come in contact with some other animal they do not remain. Why? The supposition is that the reaction of the blood or something about the foreign hosts is unfavorable to them; in anthropomorphic language, "they do not like it."

To what extent this principle of limited parasitism extends among mussels is still to be determined. It seems obvious, however, that a solution of this question is logically to be sought from a study of natural infections.

The method of determining the host by artificial infection has proved practicable in the experiments reported by Lefevre and Curtis (1912), but in these cases the mussels were parasitic upon common and easily obtainable fish. The chief commercial species employed was the mucket, *Lampsilis ligamentina,* and the fish successfully infected were the sunfish, *Apomotis cyanellus,* and the black bass, *Micropterus salmoides.* In the experiments at the Fairport biological laboratory black bass, sunfish, and crappies were infected successfully; the pike, *Esox lucius,* and the perch, *Perca flavescens,* were reported doubtful. From these results it would seem that infection with the mucket is limited chiefly to the Centrarchidæ, a single family of fishes. The hooked glochidia of *Anodonta corpulenta* seem less restricted. I have seen these upon fish of the following families: Clupeidæ, Centrarchidæ, and Sciænidæ. A similar state of things is seen in the hookless external infecting glochidia of *Q. heros* successfully maintaining itself on the Sciænidæ, Siluridæ, and Centrarchidæ (the latter two observed in artificial infection).

*Susceptibility and immunity.*—The commonness of infections on some species of fish in nature might be called a sign of susceptibility in those species. The drum or sheepshead, *Aplodinotus grunniens*, is found infected commonly with the glochidia of *Lampsilis lævissima, L. gracilis, L. alata, Plagiola donaciformis*, and others. The drum is a mussel-eating fish (see Forbes and Richardson, 1908), so that we have an explanation of the presence of the larva of these thin-shelled and so readily eaten mussels upon its gills. In the above example we have several species of mussels parasitic upon one species of fish. From many examinations of the channel catfish, *Ictalurus punctatus*, I have found only one species of mussel, viz, *Q. pustulosa;* this seems to be the other extreme.

The failure to obtain gill infection with certain species has been mentioned (see introduction). I have observed a similar immunity in examinations for natural infections on the gills of the gar pike, *Lepidosteus platostomus*, the dogfish, *Amia calva* Linnæus, and the suckers, the Catostomidæ. Upon obtaining fuller data such cases may perhaps prove to have their parasitic species, at present unknown. It is to be noted that these reported cases of immunity refer to gill infection and that the absence of these possibly does not preclude infection of fins. We have not found infections on the gills of the gizzard shad, *Dorosoma cepedianum*, but Mr. A. F. Shira has found the fins of this species infected.[a]

Lefevre and Curtis, in seeking an explanation of immunity, raise the question as to whether the factors are chiefly mechanical or are an histological response of the fish's tissues. In my opinion both of these operate, and there is still another factor, viz, the failure of glochidia to fasten when the appropriate host is not found. The histological response begins with the hypertrophy resulting in the formation of the cyst; this occurs in most cases whether the parasite is retained or not. If not, the cyst is shed by a process of desquamation of the external epithelium. I have observed this in gill infections only. A stream of water of not great force will remove the outer layers of epithelium of an infected gill about to shed the glochidia. Such a catarrhal reaction is presumably the result of the irritation set up by the glochidium. The question arises as to what prevents such a reaction in cases of successful implantation. Is it merely absence of immunity in the host, or does the glochidium supply an active agent in the nature of an anæsthetic to prevent the irritation that would be expected? Mr. Thaddeus Surber once called my attention to an apparent case of acquired immunity in some sunfishes which received glochidia upon the first infection but not the second. This is a matter that should be investigated, as the existence of such a possibility would prevent the use of fish more than once successfully in artificial propagation.

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[a] Since writing this, I have found infections by *Q. heros* upon the fins of this species, also infections by other mussels upon the gills of the gar-pike and the dogfish. (See table 2.)

Some of the mechanical factors in immunity mentioned by Lefevre and Curtis were such as configuration of mouth parts, texture of gills, smallness of gill openings, and rapidity of fin movements. The third factor which I suggest, viz, failure of glochidia to react, was observed in experiments upon the niggerhead, *Q. ebena*, and the warty-back, *Q. pustulosa*. In the latter case the glochidia fastened readily upon the catfish, but not upon other species of fish upon which the glochidia of the mucket, *L. ligamentina*, will fasten readily. It is difficult to obtain any infection with the glochidia of the niggerhead upon the members of the Centrarchidæ; however, under certain circumstances (see the next topic) they will take hold so vigorously as to threaten overinfection. From such results it seems not improbable that the tissues or blood of the nonhost possess reactions in the nature of antibodies, precipitins, and other immunizing agents, such as those discovered in the higher vertebrates, while the glochidium is especially adapted to the reactions of the appropriate host.

*Induced susceptibility.*—I have already mentioned, in discussing the niggerhead, an experiment in which fish were immersed in a solution of common salt (10 per cent, by weight) before placing in the infecting tank, where it was shown that this treatment had the marked effect of causing rapid infection where previously it had been difficult to obtain. We have here possibly a suggestion that this reaction is related to the normal habit of the glochidium in responding to the presence of its natural host, the blue herring, a fish reported from salt water and possibly anadromous. However, one would assume that all perceptible traces of the more saline medium would be lost when the fish had passed through a few miles of fresh water. In my opinion, there is no causal connection here, since glochidia of many species show excitement in the presence of sodium chloride and other salts. This is due undoubtedly to the fact that their normal reaction is to chemical stimulation from the ions of protoplasmic salts diffused from the animal fluids of fishes' gills or bodies. As the glochidia did not remain upon the fish through the parasitic period, a probable explanation would be that the salt could have had only the effect of overcoming the inhibition of the glochidia to react.

The effects of the parasitism of the glochidium upon the host and the exact relations to the host at various stages in the developing mussel are matters the investigation of which should be productive of interesting results. Lefevre and Curtis (1912) record observations of the ingestion of portions of the host's tissues by the glochidium soon after implantation. It is a question whether the host continues to supply sustenance other than oxygen in forms like *Lampsilis ligamentina*, which show little or no increase in size. In forms like those of the *Proptera* (Ortmann) group, which increase to a considerable extent in the parasitic stage (see metamorphosis during the parasitic stage), the host must furnish the material. In these cases I have observed ocular evidence of absorptive processes whose exact nature I hope to investigate later.

*Frequency of infections.*—To know the proportion of infected fish in nature is a matter of considerable importance. The expectation would be that it must, from the nature of the case, vary according to species, locality, season, abundance of mussels, source of the fish, and the like. The results I have given for the channel cat, *Ictalurus punctatus,* give an idea of the variation that occurs. We see that for this fish during the months of July and August, the breeding season for the warty-back *Q. pustulosa,* there were 17 infected fish out of 39 examined. The entire absence of infections in September from an examination of 98 fish is explained by the season, which was after the close of the breeding period for the mussel. The figures given by Surber (1913) of no infections out of 21 fish of this species examined in August, I can hardly explain unless it is that the fish were not taken near mussel beds, or that owing to the position of the glochidia they might be easily overlooked in living fish.

The drum or sheepshead, *Aplodinotus grunniens,* on account of the fact that it is the host for a large number of species, runs the chance of more frequent infections.

In a region where artificial infection has been carried on upon a large scale, it would be difficult to determine satisfactorily anything of this nature regarding the species employed in the operations; this difficulty has arisen in investigations at the Fairport biological laboratory, fish having several times been captured which had been without doubt artificially infected.

*Extent of individual infections.*—Certain species of fish commonly in nature carry a remarkably large number of glochidia; for example, the drum, *Aplodinotus grunniens,* and the herring, *Pomolobus chrysochloris,* have been found with thousands; but a small number seems more common. Heavy infections are difficult to explain, except upon the supposition that they take place at the time of extrusion from the mussel, or as the result of oft-repeated infections. This brings up the subject of the following topic.

*Conditions of infection in nature.*—I know of no observations of the infection of fish in nature. Latter (1891) found that he could produce a discharge of glochidia by gently striking the water in which anodons were lying and made further observations upon the emission of glochidia which, he seems to conclude, argue against the necessity of the presence of fish. I believe, however, they support the probability that the approach of fish is the normal stimulus in eliciting the emission of glochidia. The cases of heavy individual infection of fish found in the species mentioned above suggest that the glochidia must be extruded when the fish are in close proximity, otherwise the glochidia would be too widely distributed to make heavy infection possible. We find the heaviest infections with glochidia of the niggerhead, which lives in swiftly flowing water. It would be quite reasonable to expect adaptations here comparable to those seen between insects and plants, not necessarily as elaborate as that between the rein-orchids *Habenaria* and fertilizing moths, but something of that nature would be equally advantageous to a species of mussel. The expected features in such a relation would be some attractive agent in the mussel, the perception by the latter of the fish's presence, and the reaction of extruding the glochidia. Mussel beds are known to offer attractions to fishes because of the associated life in their vicinity, such as worms, crustaceans, and the like. During the summer of 1912, Dr. W. P. Herrick called my attention to at least three instances of fish (sunfish in each case) being taken in his crates which contained live mussels. We have abundant evidence of attractions to some species of fish, e. g., catfish and sheepshead, in the food which the thin-shelled species of mussels supply (Forbes and Richardson, 1908, quoted above, and Kendall, 1910). This is a rather vicarious offering, and it is not known to be made by the heavier-shelled species among which we have found cases of narrowly restricted parasitism. It is among these that we would expect some special adaptations.

*Type of infection.*—In observations upon natural infections I have found that in general the hooked glochidia were to be found upon the fins and the hookless upon the gills, as has been reported by others, chiefly from artificial infection (Harms, 1909; Lefevre and Curtis, 1912). I find, however, there are some apparently constant exceptions. I have mentioned above the observations that the hookless glochidium of the washboard mussel, *Quadrula heros*, was found to be a fin-infecting species. Its considerable size apparently adapts it to this mode of infection. The presence of a larval thread also suggests a possible relation to this habit because of the presence of that organ in the fin-infecting hooked glochidia. In support of this is the recent discovery of fin infection in nature by the small hookless glochidium of *Unio gibbosus*, which has a larval thread.

I have rarely seen natural infections of gills by hooked glochidia; in two cases they were evidently unsuccessful, the glochidia having died, and were embedded in hypertrophied tissue at the base of the gills, apparently in process of shedding. The third and fourth instances were apparently successful infections of single glochidia, in one case on the heavy gills of a catfish, *Leptops olivarus*, and in the other on the sturgeon.

Another case was a heavy infection on the gills of *Pomolobus chrysochloris* by a glochidium which is hooked, but the hook is not of the ordinary type in the Anodontinæ (see pl. IV, fig. 27). The hook has the character of a straight thong inside the apex of each valve. The glochidium has been identified as that of *Unio crassidens*.

The absence of evidence of natural infections from certain species of mussels and failure to obtain infections with them according to known methods has led to the search for them as internal parasites of fishes. My examination of the alimentary tract of fishes has given negative results entirely. Mr. T. Surber, after infecting with *Quadrula trigona*, found their glochidia in the intestine 17 hours later, but they were not encysted, and the supposition was that they were not established in any way.

*Type of cysts.*--The type of cyst varies in different cases, and the question arises as to what are the factors that determine the form of a cyst. In artificial infections on several species of fish the cyst in each fish will vary in form as well as in distribution upon the gill in each species, and again infections with different species of mussel will vary in the same species of fish. That is, stimulus and reaction vary with the parasite and host. This is perhaps self-evident, and as a rule differences are not striking, but as there are occasional cases of marked peculiarity in cysts their consideration may be of interest. In the discussion of *Quadrula ebena* I have described the relatively large cysts. This holds for the natural host, *Pomolobus chrysochloris*, as well as for artificial infections on other species. The large glochidium of *Q. heros* has a relatively thin cyst in gill infections. In the case of *Q. pustulosa* the glochidium is usually quite deeply imbedded, but the cyst does not markedly change the contour of the gill filaments. This is due in part to the manner of implantation of the glochidium, it being usually attached to the edge of the broad filament in the catfish. There is commonly an inset of the cyst (pl. III, fig. 23) that seems peculiar to this form, but is not constant. Abnormal cysts of strange forms are occasionally found. I have figured one of these (pl. III, fig. 20), in which the hypertrophied tissue is more extensive than usual and prolonged into fingers or rays. In that shown in figure 20 the stimulation of the glochidia implanted at the base of the folds of the filament affected apparently the fundament of the folds, and thus we have a number of new folds produced. Studies of cyst formation, normal and abnormal, should have a practical value in determining the conditions governing retention of glochidia.

*Seasons of infection.*—The time of infection must of course be limited to the breeding season of the mussels, but as the period of breeding covers months in both the long and the short period types, the more exact fixing of the time of infection may be important. I have already discussed the question in connection with *Q. heros*, as to whether infection takes place in the autumn or spring. Lillie (1895) intimates that there is some development of the larvæ during the winter in the case of the long-period breeder *Anodonta cataracta.*

Lefevre and Curtis (1912) assume that development for anodontas is complete in the autumn. Harms (1909) suggests the probability of two broods in the short-period breeder, *M. margaritifera,* during July and August. Conner (1909, p. 112) gives the breeding period for this species as June and August. I have seen indications of two broods in the breeding of *Q. ebena,* and Lefevre and Curtis (1912, p. 114) mention similar observations. The settlement of this question would require the keeping of females under observation during the breeding period, but there is the difficulty that no one, so far as I know, has yet succeeded in getting these mussels to breed in captivity.

I have reported the absence of infections by *Q. pustulosa* after September 1. It is probable that September marks the limit of infections by short-period breeders. The finding of infections by long-period breeders early in the autumn and spring upon the sturgeon, *Scaphorhynchus platorhynchus,* and the wintering of *Q. heros* upon its host show that infections are not confined to late spring. It is to be expected that the period of infection would be adapted in large measure to the habits and seasonal migrations of fishes.

In general we may say that for most mussels in this climate the season of infection comes in the warmer months. In southern waters as much restriction would not be expected.

*Metamorphosis during the parasitic stage.*—The development of the young mussels in the post-embryonic or parasitic period has been systematically worked out in a number of forms (Brown, 1878a, 1878b, 1884, 1889; Schierholz, 1888; Harms, 1907a, 1907b, 1907c, 1908, 1909; Lefevre and Curtis, 1912). I wish here to call attention to some apparently decided differences in extent of development observed in natural infections. Differences in the amount of development of the larvæ at the end of the period of parasitism are very strikingly shown in a comparison of such species as *Lampsilis ligamentina* and *Lampsilis lævissima* (Coker and Surber, 1911). In the case of the former the juvenile mussel leaves its host with no shell beyond that of the glochidium (Lefevre and Curtis, 1912); in the latter there is a relatively enormous growth. This extra-glochidial growth I have observed in the following: *Lampsilis lævissima, L. alata, L. gracilis, Plagiola donaciformis, P. elegans* (Howard, 1912), and *Quadrula pustulosa.* The growth in the case of the large glochidia of *L. alata* (pl. IV, fig. 28) and *Q. pustulosa* (pl. III, fig. 19) is only sufficient to give the form of the shell of the adult mussel to the juvenile. In the others, which have very small glochidia, the great growth during the parasitic period would seem to be a compensatory provision giving them the size of other juveniles when taking up the post-parasitic life. It would not be surprising if in the case of the latter the metamorphosis were carried further than in those forms which have no growth beyond the glochidial shell.

*Duration of the parasitic period.*—Periods of parasitism have been reported (Lefevre and Curtis, 1912, p. 168) as short as 12 days, and I have observed a period as long as six months in the case of *Q. heros* carried through the winter. These cases were observed in artificial infections. In natural infections I have seen evidence of a long period in mussels carried by the sturgeon, *Scaphorhynchus platorhynchus;* matured larvæ were seen in late season catches, while none were seen in those taken through April and most of May or in October. Lefevre and Curtis have called attention to the lack of correspondence between their results and those of other observers (Harms, 1907, 1909; Schierholz, 1888) as to the effect of temperature on the length of parasitism. Considering the great variation in the period of metamorphosis for different species, I think it is obvious that the influence of temperature could be determined accurately only in a single species or in species having the same period. Individual variation in the length of period for mussels which were implanted at the same time on the same fish Lefevre and Curtis explain as due to differences in nutrition of the larvæ.

*Larval thread.*—The presence of a thread gland and larval thread in the mature glochidium I have reported and described under *Quadrula heros* and *Quadrula plicata.* Lefevre and Curtis (1912, p. 151, 152), in a thorough discussion of this interesting organ, in which they state that they have found it only among the Anodontas and Unios, agree with Lillie (1895) that it is an excretory organ and the thread is an excretion primarily. They do not agree with Schierholz (1888) in considering the thread an efficient organ for aiding in attachment to fishes. In this connection it is interesting to note that in this form, which is the only one of its kind known to take the habit of external or fin infection, we have an organ that is characteristic of fin-infecting groups, *Anodontas* and the European *Unios.* Since making this observation on *Q. heros* I have noted the thread gland in *Unio gibbosus* and also observed this glochidium in natural infection upon the fins.

From these observations it looks as if this habit might have some bearing on the function of the thread gland. Here we have among the hookless glochidia a form showing the thread gland and thread more highly developed apparently than in the Anodontas. The inference is natural that the thread has some function other than excretion alone. If a fundamental embryonic (Lillie, 1895) organ present at some time in the development of all glochidia, its persistence to the mature state in some cases and not in others would seem to indicate that its function later is not of a fundamental nature like excretion or it would persist in all. Lefevre and Curtis advance the argument that the threads are dissolved in a day or two and so are not effective during the greater part of the period in which the glochidia may be on the bottom. This would make no difference if infections take place at the time the glochidia leave the mussel, the evidence for which I have discussed above. (See conditions of infection in nature, p. 39.)

*Absence of parasitism.*—The interesting discovery of metamorphosis without parasitism as reported by Lefevre and Curtis (1912) for *Strophitus edentulus* (Say) suggests the possibility of some similar explanation for the absence of evidence of infection by some common species. This is especially to be looked for in species which have conglutinates similar in character to those of *S. edentulus*. I have in mind those of *Obliquaria reflexa* (Rafinesque). The fact that infections of this species have not been found lends support to the supposition that there is possibly something unusual in their life history.

Another species of mussel for which no natural infections have been reported is *Anodonta imbecillis*. While making measurements of the glochidia from a number of gravid individuals of this species collected during the month of November, I noticed that in many cases what I had supposed at first glance were mature glochidia were in fact juvenile mussels with organs developed to the stage usually seen in juveniles at the time they leave their host. These young mussels lie crowded in the marsupial gills of the parent without any conglutinate structure whatever. The outer gills, as in other anodontas, are marsupial, and these become well distended throughout their whole length when gravid.

In regard to the breeding of this species, Ortmann (1912) says it is gravid from September to May. My observations, which are rather limited, I give below:

Fairport, Iowa, July 16, 1910, 1 with glochidia.
Fairport, Iowa, May 13, 1912, 1 with glochidia.
Fairport, Iowa, May 27, 1912, 1 with early embryos.
Moline, Ill., September 24, 1912, 1 not gravid.
Moline, Ill., November 7, 1913, 2 with early embryos; 1 with both late embryos and glochidia, and 6 with juveniles.

In addition to these I have found numbers of free juveniles ranging from 5 to 30 millimeters not sexually mature. These stages are remarkable for the thinness of their shells and the flatness of the mussel as a whole. The term "floater" of the mussel fishermen for this type of mussel is well applied in its use for this species.

The presence of juveniles during November in the gills of a majority of the specimens examined seems to indicate that metamorphosis is probably completed in the fall. The time of discharge of the young mussels is yet to be determined, but the appearance of glochidia again in early spring would seem to indicate that the juveniles escape in the fall or early winter.

Among the six lots of marsupial juveniles that I collected, the degree of development varied slightly as to amount of shell growth, otherwise there seemed to be little difference. This growth consists of a narrow rim only around the edge of the glochidial shell. The hooks of the glochidium are still much in evidence but are much weaker than in parasitic forms. A noticeable feature is the large proportion of gaping shells as compared with a similar lot of glochidia. It would seem that with the loss of the powerful single adductor muscle the action of closing is less vigorous. Between the gaping valves can be seen the ciliated foot, on each side the gill papillæ, two adductor muscles, mantle, etc., indicating a development equal to that of other young Naiades at the end of parasitism.

I have tested the reaction of the glochidia in the presence of fish and obtained strong evidence that they do not respond as other known parasitic forms. Mature glochidia taken in March were employed. In an exposure to fish for an hour they failed to give the usual infection. A few glochidia lodged in the mouths of the fish, but no encystment could be detected. The fish showed no response. Following this test the fish were exposed for 10 minutes to the glochidia of *Symphynota complanata* (Barnes.) These rapidly became attached and the fish showed considerable uneasiness, in marked contrast to their indifference in the presence of the other glochidia.[a]

From these observations I think I am warranted in concluding that this mussel passes through its metamorphosis without parasitism. The absence of a conglutinate (Lefevre and Curtis, 1912) or placenta (Sterki, 1898) is of interest, as we have here a case of nonparasitic development independent of this type of structure found in Strophitus.

It is a question whether the development, following the escape of the glochidium from the egg, is aided by absorption of food or not. One would expect the former, as it is evident that this species has descended from parasitic ancestors which received extraneous nutrition during the parasitic period.

The discovery of the absence of parasitism in this species already possessing the distinction of being hermaphroditic certainly adds to its reputation as an eccentric among its relatives in the Unionidæ.

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[a] Observations made since the above was written indicate that juveniles may be found in the marsupium at almost any time during the year. I have also been able to secure infections and encystment on fishes with *Anodonta imbecillis* as well as *Strophitus edentulus*. In the latter complete metamorphosis was observed. Thus for *edentulus* we have indicated facultative parasitism, while in the other we have a persistence of the parasitic reaction at least when artificially brought in contact with a host. Metamorphosis on fishes was not secured in *A. imbecillis*. Abundant additional evidence is at hand that development in this (*imbecillis*) species normally proceeds without parasitism.

### JUVENILE STAGE.

The period in the life of the mussel following the parasitic stage has been given comparatively little attention by investigators. It is commonly stated that the mussel upon leaving the host assumes the adult form and manner of life. The investigations made upon this stage, however, indicate that the differences are probably of practical importance; that the adult form is not completely attained for some time (Schierholz, 1888), and that the manner of life may be quite different. According to Schierholz (1888, writing of the Unionidae):

> The following organs are acquired during this stage: The siphons, "Lippentaster," outer gills, and sexual glands. In *Anodonta* the outer gills are acquired the second summer, in *Unio* the third and fourth summer, while the sexual glands are developed in *Anodonta* the third summer and in *Unio* the fourth and fifth summer.

The acquirement of the sexual glands would mark the adult condition and the end of the juvenile period. The size upon first attaining the adult condition would, of course, vary considerably in individuals as well as in species. The smallest gravid mussels I have secured were 13 mm. in length. This was in the very small species *Plagiola donaciformis,* in which an example 50 mm. long would be exceptionally large.

The washboard (*Quadrula heros*), the largest of American mussels, has shell markings on the umbones that seem to be characteristic of the juvenile. These sculpturings mark the shell up to a size of 50 mm. to 60 mm., when they often cease abruptly. The size at maturity, according to the evidence I have, would be much greater, as the smallest breeding individual that I have collected was 91 mm. long. This showed a growth of three years beyond the juvenile shell and a total age estimated at 8 years.

In statistical estimates in ordinary sized species I have taken the arbitrary length of 20 mm. (Lefevre and Curtis, 1912) as a limit for the early juvenile stage. For large and small species it is evident this length would not be sufficiently accurate.

The sculpturings mentioned above for *Q. heros* are characteristic of the juveniles of most species, although they are absent in some. Commonly they are limited to the earlier portions of the shell.

The presence of a byssus in many species, as reported by Sterki (1891), Frierson (1903), White (1905), and Isely (1911) and the attachment of the young mussels to stones and gravel in shallow water I have been able to confirm in a number of cases, though, excepting *Q. plicata,* not among the *Quadrulas.* This habit of attachment in shallow water is found among the *Lampsilis* group, which in the adult stage are comparatively active mussels commonly in deep water. This is a noteworthy contrast between young and adult as to habits and habitat.

In my investigations upon the juveniles I have not found the early stages as uncommon as the literature led me to expect (Lefevre and Curtis, 1912, p. 177). The clammers of the Mississippi River seem to be familiar with them, reporting that they often bring them up with the "spider web attached," referring to the byssus threads. Their small size makes them less conspicuous, and special apparatus is required for collecting them. In 1912 I found about 400 juveniles under 20 mm., exclusive of *Plagiola donaciformis*, and comprising 25 species.

Among the *Quadrulas* I have not found so great a difference, as a rule, in the habitat of juvenile and adult as Isely (1911) has reported for the Lampsilinæ (Ortmann). However, in species which show marked differences between juvenile and adult it is quite evident that in any scheme of propagation which would carry the young through this stage special consideration must be given this period of the life history.

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## EXPLANATION OF FIGURES.

Photographs and drawings by the author, the drawings being made with the aid of a camera lucida.

### PLATE I.

Fig. 1. *Quadrula pustulosa* (Lea). Interior of right valve.
Fig. 2. Same individual. Exterior of left valve.
Fig. 3. Juvenile of same species.
Fig. 4. *Quadrula metanevra* Rafinesque. Interior of right valve.
Fig. 5. Same individual. Exterior of left valve.
Fig. 6. Juvenile of same species.
Fig. 7. *Quadrula ebena* (Lea). Interior of right valve.
Fig. 8. Same individual. Exterior of left valve.
Fig. 9. Juvenile of same species.
Fig. 10. *Quadrula trigona* (Lea). Interior of right valve.
Fig. 11. Same individual. Exterior of left valve.
Fig. 12. Juvenile of same species.

### PLATE II.

Fig. 13. Juvenile of *Quadrula heros* (Say).
Fig. 14. Adult of same species. Left valve.
Fig. 15. The same species. Interior of right valve.
Fig. 16. Juvenile of *Quadrula plicata* (Say).
Fig. 17. Adult of same species. Exterior of left valve.
Fig. 18. The same species. Interior of right valve.

### PLATE III.

Fig. 19. Glochidium of *Quadrula pustulosa* implanted upon the gill of *Ictalurus punctatus;* a natural infection taken August 26. Considerable development is evident from the growth of shell at the edge of the glochidial valves (*e. g. s.*) and two adductor muscles (*Ad. m.*) and foot (*fo.*) that are visible. The blood vessels (*B. V.*) of the fish's gills are seen to be inclosed by the valves of the glochidium. This is the same glochidium as that shown in figure 23.

Fig. 20. An abnormal cyst produced by the glochidium of *Quadrula pustulosa* upon the gill of *Ictalurus punctatus.*

Fig. 21. Glochidium of *Quadrula heros* showing the larval thread (*l. t.*) and larval thread gland (*lt. g.*) clearly differentiated by staining in borax carmine. The adductor muscle (*Ad. m.*) lies in the center.

Fig. 22. Glochidium of *Quadrula heros* with gaping valves seen from a side view. The larval thread (*l. t.*) is to be seen between the valves and its point of emergence ventral to the adductor muscle. Inner and outer sensory hair cells (*s. h. c.*) are visible on each valve.

Fig. 23. Filament of gill of *Ictalurus punctatus* naturally infected by the glochidium of *Quadrula pustulosa.* The cyst is set off on each side by incisions of the filament. This is somewhat characteristic of gill cysts in this species though not constant. The same glochidium is shown in figure 19.

Fig. 24. Encysted glochidium of *Quadrula ebena,* artificial infection upon *Micropterus salmoides.* The large size of the cyst is to be noted as characteristic of infections with this species of glochidium.

## Plate IV.

Fig. 25. A dorsal view of a juvenile of *Lampsilis alata*, 9 mm. long, showing the glochidial shell still visible. Magnification, 18 diameters.

Fig. 26a. A cluster of glochidia of *Quadrula heros* (Say), imbedded in the pectoral fin of a sheepshead, *Aplodinotus grunniens*. The fish was infected artificially October 7; these glochidia were removed by clipping off a small portion of the fin April 18. The soft parts are sufficiently distinct to permit the determination of the amount of metamorphosis which is nearly completed. Differences in appearance of the individuals are due chiefly to their varied orientation. The narrowest figure is an optical section taken in a transverse plane at right angles to the longitudinal axis. The preparation was stained by Mayer's hæmalum.

Fig. 26b. Gill filament of a sunfish, *Lepomis pallidus*, artificially infected by the glochidium of *Quadrula heros*. Age (Dec. 6), 69 days. The presence of two adductor muscles indicates that some metamorphosis has taken place. The cyst is seen to be thin as compared with some other species. Drawn in a living condition immediately after removal of the filament from the gill of the fish.

Fig. 27. Natural infection of the herring, *Pomolobus chrysochloris*, by the glochidia of *Unio crassidens*. This fish was captured May 16. The figure represents the tip of a filament shown chiefly in outline by dotted lines. The cyst includes a number of the finer subdivisions of the filament each with its afferrent blood vessel.

Fig. 28. A natural infection of the sheepshead, *Aplodinotus grunniens*, by *Lampsilis alata*. Considerable growth of shell is to be seen beyond the valves of the glochidium while still imbedded in the tissue of the host.

## Plate V.

Glochidia of species of *Quadrula*. All figures are magnified 275 diameters.

Fig. 29. *Quadrula lachrymosa* (Lea). A little immature; left valve, showing large mantle cells just beneath the very transparent shell and large adductor muscle.

Fig. 30. *Quadrula ebena* (Lea). Surface view of right valve, showing adductor muscle and pores of shell.

Fig. 31. *Quadrula metanevra* Rafinesque. Surface view of left valve.

Fig. 32. *Quadrula plicata* (Say). Right valve, showing thread gland passing around the adductor muscle and thread issuing posterior to the muscle.

Fig. 33. *Quadrula trigona* (Lea). A surface view of the right valve.

Fig. 34. *Quadrula solida* (Lea). A surface view of the left valve.

Fig. 35. *Quadrula heros* (Say). The left valve with the focus of the microscope slightly below the surface. The large light circle is the expanded portion of the thread gland. The shaded area represents an organ whose function has not been determined. A similar structure is visible in figs. 30 and 32; in the latter it appears to be continuous with the thread gland.

Fig. 36. *Quadrula pustulosa* (Lea). Left valve; surface view.

## Plate VI.

Fig. 37. *Quadrula pustulata* (Lea). Interior of the right valve.

Fig. 38. The same species. Left valve.

Fig. 39. Juvenile of the same species.

Fig. 40. *Quadrula granifera* (Lea). Interior of the right valve. The dark shade is due to the purple nacre of this shell.

Fig. 41. The same species. Left valve.

Fig. 42. Juvenile of the same species.

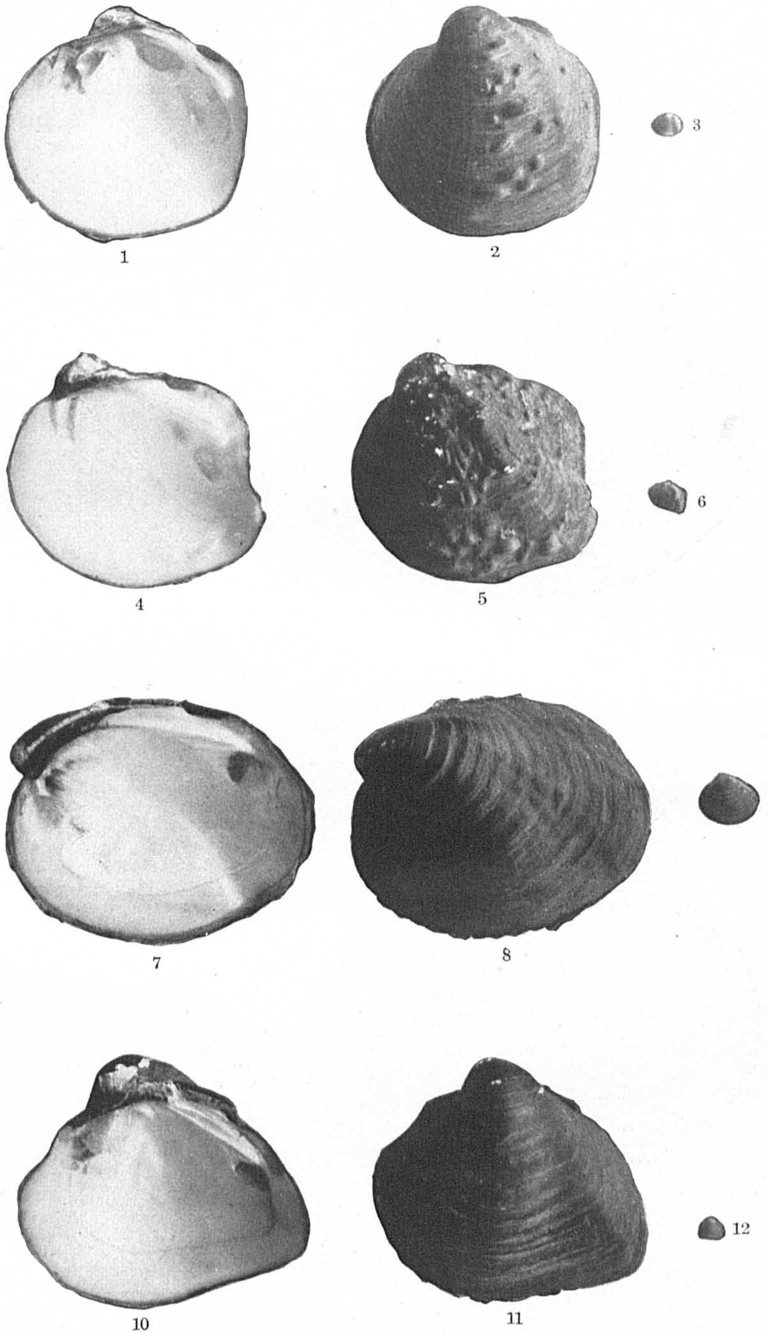
Fig. 43. *Quadrula lachrymosa* (Lea). Interior of the right valve.

Fig. 44. The same species. Left valve.

Fig. 45. Juvenile of the same species.

Fig. 46. *Quadrula solida* (Lea). Interior of the right valve.

Fig. 47. The same species. Left valve.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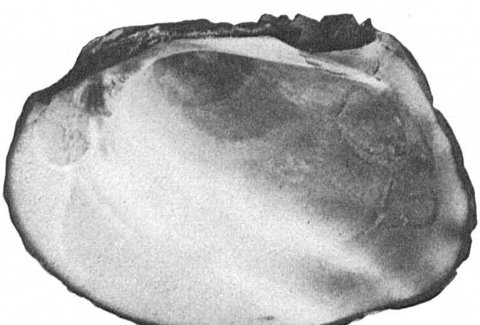

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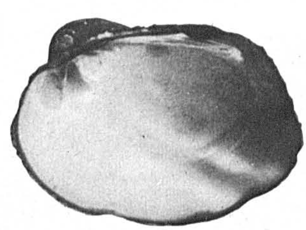

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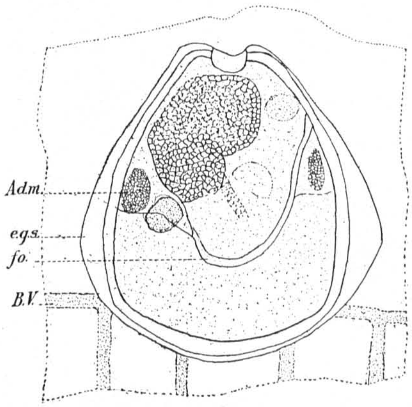


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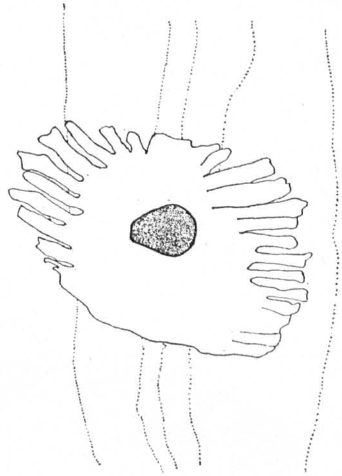

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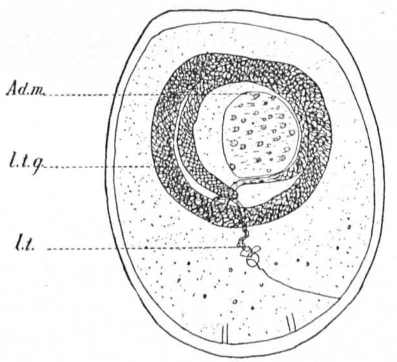


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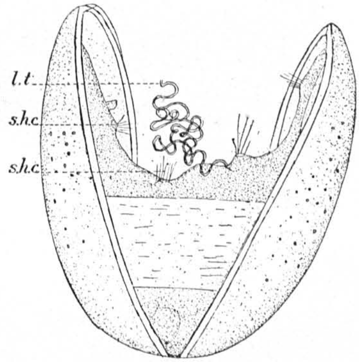


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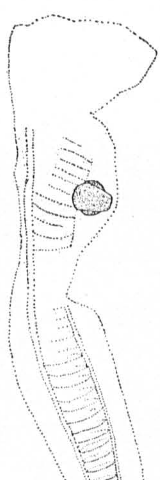

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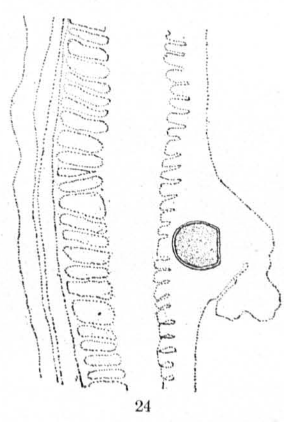

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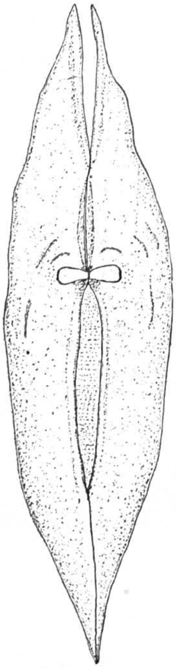

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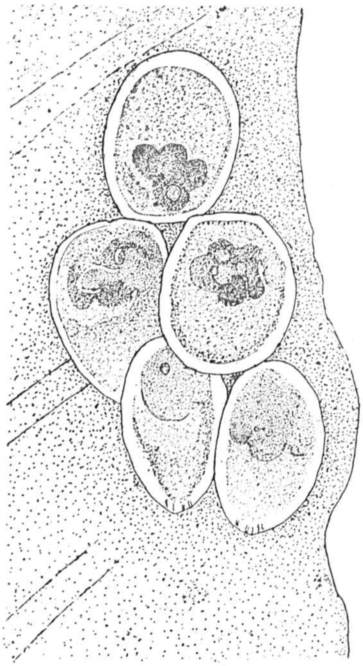

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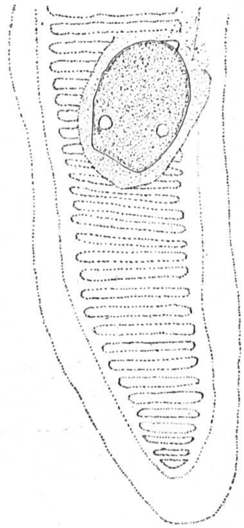

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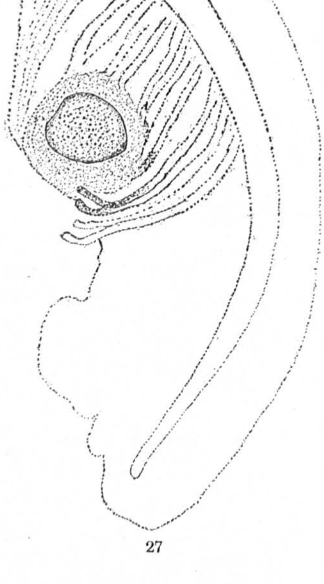

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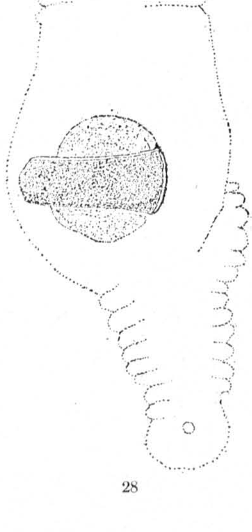

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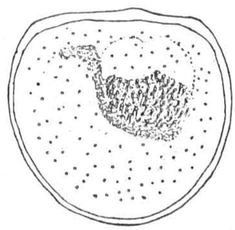

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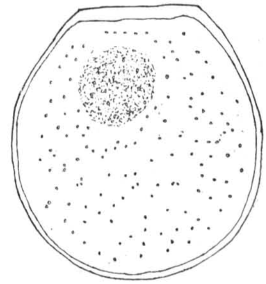

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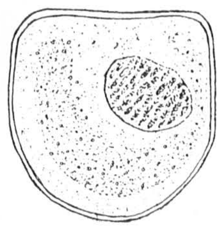

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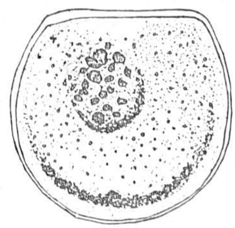

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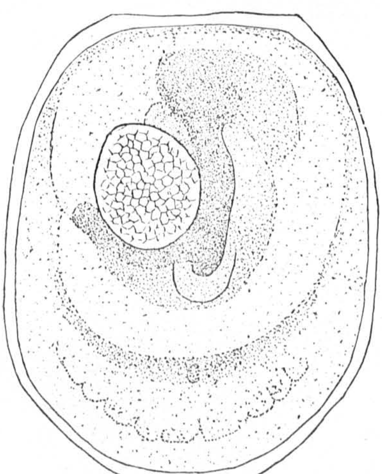

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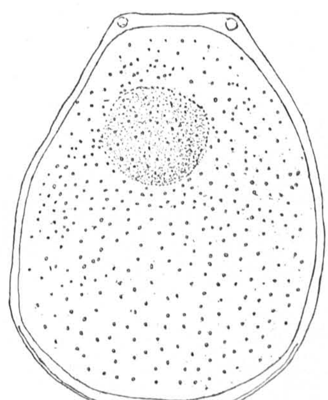

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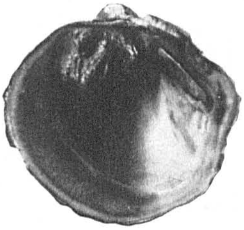
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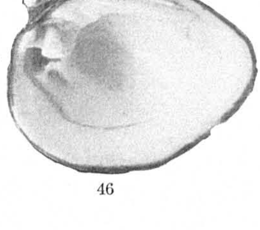
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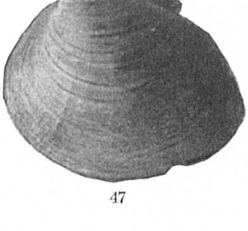
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# THE MUSSEL FAUNA OF CENTRAL AND NORTHERN MINNESOTA

By Charles B. Wilson and Ernest Danglade

Appendix V to the Report of the U. S. Commissioner
of Fisheries for 1913

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By Charles B. Wilson and Ernest Danglade.

## INTRODUCTION.

As a part of the fresh-water mussel investigations conducted by the Bureau of Fisheries, the central and northern portions of Minnesota were examined during the summer of 1912 with regard to the kinds and numbers of mussels to be found in the lakes and rivers. The mussel fauna of the Mississippi River in Minnesota below St. Paul and of the Minnesota River have been thoroughly investigated by representatives of the various pearl-button companies, and the quality and amount of shells which they produce have become fairly well known. The central and northern portions of the State had never been examined except by mussel fishermen. The shells obtained by some of these fishermen, however, and shipped to the button factories were of such exceptional quality as to attract the attention not only of the manufacturers but also of the Government experts at the biological laboratory at Fairport, Iowa. Since some of these shells were obtained from lakes and others from rivers, it was determined to make a preliminary survey of both lakes and rivers through the central and northern portions of the State.

This survey had a threefold object: First, to determine the geographic distribution of the various mussels in those portions of the State. Incidentally, of course, this would answer the question whether the exceptionally fine shells were locally or generally distributed, and where they were to be found.

Second, to make as careful a survey as possible of the various conditions, conducive or adverse to mussel development, in the different localities visited. This would not only throw some light on the presence of exceptional mussels in certain localities, but would also serve as a basis for the final object of the survey.

Third, to ascertain whether it would be profitable to introduce artificial propagation in any of the lakes or rivers, and if so, what species would be best adapted to the locality.

The investigating party consisted of the two authors, and in consequence of the large territory to be covered and the isolation of many of the localities visited it was necessary to travel entirely by railroad, stopping at convenient centers and driving to the lake or river. During this trip 45 lakes and 15 rivers were examined, with the results as herein given.

Samples of the shells obtained by the authors at the different localities herein mentioned have been identified by Mr. H. Walton Clark, of the biological station at Fairport, Iowa. Similar samples have been tested as to their mercantile value by Mr. John Southall, of the same station.

In order to understand the geographic distribution of the mussels, it is necessary to review so much of the glacial geology as will explain the present location of the lakes and rivers as well as their former relations.

## GLACIAL ORIGIN OF LAKES AND RIVERS.

Minnesota was formerly covered by a great glacier or ice sheet, which came down from the northeast and flowed across the State into Iowa. When the glacier melted, the gravel, sand, and clay which it carried was spread out over the surface of the underlying rocks and has remained there ever since. The only exception is a narrow strip bordering the Mississippi River from Lake Pepin southward, and thus outside of the present survey. North of Lake Superior this drift, as it is called, is thin in places, but elsewhere it averages from 100 to 150 feet in thickness and effectually conceals the bedrock.

Both glacier and drift have made the contour of the State more level and uniform than it was before. The glacier accomplished this by grinding off the ridges and elevations, while the drift assisted by filling in such hollows as were left by the glacier. In some places the material of the drift has been subsequently worked over and arranged in layers by the streams and rivers that flowed from beneath the glacier, but in most places it is still unstratified. During the melting of this great glacier there were successive periods of advancing, halting, and retreating, and at such times the drift accumulated in long hills or ridges called moraines, parallel with the edge of the glacier. Twelve of these moraines may be traced across the State in various directions, and while they are only from 25 to 75 feet in height, they are still sufficient to determine the general drainage of the State. They have the further effect of rendering any free drainage impossible, and thus they give rise to the remarkable number of lakes that are found in Douglas, Ottertail, Itasca, and other counties. Furthermore, the streams and rivers are very winding, and have a uniform current, and there are plenty of sand and gravel beds in the bottom of the lakes and rivers, and not very much mud. All these conditions are favorable for mussel growth and propagation and profoundly influence the mussel fauna.

When the melting ice sheet had receded beyond the moraine or watershed which separated the basin of the Minnesota River from that of the Red River of the North, a large lake, called Lake Agassiz, was formed along the edge of the ice. As the ice withdrew, this lake extended northward along the Red River Valley as far as what is now Lake Winnipeg. Lake Agassiz was 700 miles long and covered 110,000 square miles, and its duration is estimated to have been about a thousand years. Its outlet, known as the glacial river Warren, was along the valley now occupied by Lakes Traverse and Big Stone and the Minnesota River, into the Mississippi. At that period, therefore, the Mississippi River may be said to have had its origin in Lake Agassiz. And during the thousand years of its existence, this lake had abundant opportunity to become populated with fresh-water mussels ascending from the Mississippi. The lake disappeared, however, and the valley of the Minnesota River separated from that of the Red River. But the mussel faunas of the two rivers were derived from identically the same source, and the only differences would be the few minor changes that have crept in since then.

Many other glacial lakes were formed during the melting of the ice sheet, only to be subsequently obliterated. But while they existed they served as temporary channels for the migration of fish and mussels from the south. Two of these are of especial interest, in view of the results of our present investigation. Lake Upham once covered the region south of the Mesabi Iron Range, and drained southeast along the valley now occupied by the St. Louis and Cloquet Rivers. This lake was very shallow and temporary and, as far as can be determined, was not connected with the Mississippi River in any way. This fact accounts for the paucity of mussels in that portion of the State, as well as in all the Lake Superior drainage.

Lake Nicollet was formed around the headwaters of the Mississippi River and covered an area of 1,500 square miles. It drained southwest into the valley now occupied by the Crow Wing River and thence into the Mississippi. The Crow Wing River thus becomes the modern representative of the old headwaters of the Mississippi, and is older than that portion of the latter river which now extends from the mouth of the Crow Wing up to Lake Itasca. These facts explain the richness of the mussel fauna in the Crow Wing and its tributaries. At two places in the area covered by the present survey the bed rocks appear above the drift with sufficient prominence to materially affect the mussel distribution. At Carlton the St. Louis River plunges over a rocky ledge and through a gorge, which prevents the passage of either fish or mussels. Consequently that portion of the Lake Superior drainage which is tributary to the St. Louis River above Carlton is devoid of mussels.

The Falls of St. Anthony at Minneapolis have formed a similar barrier in the Mississippi River, but with this difference: Some fish have evidently been able to ascend these falls while others could not accomplish it. Accordingly, we find in the Mississippi above the falls, and in its tributaries an abundance of mussels belonging to the *Lampsilis* or mucket group, plenty of *Anodonta, Symphynota, Strophitus,* and the like, but not a solitary specimen was seen of the great *Quadrula* or pig-toe group. The falls have manifestly furnished in some way an effective barrier to the distribution of these mussels. On the other hand, the Minnesota River enters the Mississippi some distance below the falls, and it contains as many pig-toes as muckets.

The pig-toes also ascended the glacial river Warren into Lake Agassiz, and we find them to-day in the Red River of the North. They also ascended the St. Croix River, and in the St. Croix drainage they are even more numerous in species than the muckets.

For convenience we may divide the lakes and rivers which were examined into five groups, and designate them, respectively, the St. Croix group, the Minnesota River group, the Red River group, the Crow Wing group, the Mississippi River group, and the isolated lakes.

## MUSSELS OF THE ST. CROIX GROUP.

The lakes and rivers in this eastern central portion of Minnesota have been populated with mussels by way of the St. Croix River. This connection was established after the melting of the glacier and has not been materially changed since that period.

Joining the Mississippi some distance below St. Paul, and having no falls or other natural obstruction in its own course, the St. Croix River has afforded a constant and easy passage for all the Mississippi species of fish and mussels. Hence we find a goodly variety of both in the lakes and rivers belonging to the St. Croix drainage. The following table gives the geographic distribution of the various mussels found here during the present survey:

DISTRIBUTION OF MUSSELS IN ST. CROIX DRAINAGE.

| Species. | Pokegama Lake. | Snake River. | Cross Lake. | Rush Lake. | Bald Eagle Lake. | White Bear Lake. | Forest Lake. |
|---|---|---|---|---|---|---|---|
| Lampsilis luteola (fat mucket) | × | × | × | ...... | ...... | ...... | × |
| Lampsilis ventricosa (pocketbook) | × | × | × | ...... | ...... | ...... | ...... |
| Lampsilis recta (black sand-shell) | ...... | × | × | ...... | ...... | ...... | ...... |
| Lampsilis alata (pink heel-splitter) | ...... | × | × | ...... | ...... | ...... | ...... |
| Symphynota complanata (white heel-splitter) | ...... | ...... | × | ...... | ...... | ...... | ...... |
| Strophitus edentulus (squaw-foot) | × | ...... | ...... | ...... | ...... | ...... | ...... |
| Anodonta corpulenta (floater) | × | ...... | × | × | × | × | × |
| Quadrula undulata (blue-point) | × | × | ...... | ...... | ...... | ...... | ...... |
| Quadrula plicata (three-ridge) | ...... | × | × | ...... | ...... | ...... | ...... |
| Quadrula undata (pig-toe) | × | ...... | × | ...... | ...... | ...... | ...... |
| Quadrula lachrymosa (maple-leaf, stranger) | × | × | × | ...... | ...... | ...... | ...... |
| Quadrula pustulosa (warty-back) | × | × | ...... | ...... | ...... | ...... | ...... |

No comment upon the fauna of the last four lakes is needed save the single statement that the muckets in Forest Lake are all dwarfed and thin-shelled. The other two lakes and Snake River are parts of the same system, for the river flows through the entire length of Pokegama Lake and across Cross Lake nearly at its center. Both of the lakes and the river are shallow, and consequently the mussels are gathered with a rake or by wading. No crowfoot dredges were seen.

### QUALITY OF SHELLS.

The principal mussel here is the fat mucket, which is not dwarfed, as is usual in a lake, but retains its full size. Furthermore, the shell is exceptionally thick and heavy, and maintains this thickness to the extreme tips, making every portion of it available for buttons. The shells have a fine luster, show no discoloration, and will cut from 700 to 720 gross of blanks (20-line) to the ton. In Pokegama Lake these muckets form 75 to 85 per cent of the entire catch; in the Snake River between the two lakes, 60 per cent, and in Cross Lake from 40 to 50 per cent.

Of the other shells, the maple-leaves and blue-points are also exceptionally thick, of large size, unspotted, and in every way first-grade button shells. The three-ridges, on the contrary, are badly spotted, have a poor luster and are only second or third quality. The culls are nearly all heel-splitters and *Anodontas*. In Cross Lake the bottom is sandy next to the shore, and then becomes covered with mud, while in Pokegama Lake it is hard sand throughout. Hence there are more three-ridges, black sand-shells, blue-points, and floaters in Cross Lake, and the shells are not quite as thick as those in Pokegama Lake.

At the time these lakes were examined (July) there were fully two carloads of shells scattered along the shores of Cross Lake on the west side, and as many more at the upper end of Pokegama Lake, gathered within a space of 400 or 500 feet. The fishermen said they had been offered $23.50 per ton for these Pokegama shells.

### PEARLS.

The best pearl found in this vicinity was obtained from a fat mucket in Cross Lake several years ago, and was held for some time at $4,000. The price then gradually dropped to $3,000, and it was finally sold for $2,300. Of those found in 1912 one brought $1,800, another $1,200, a third $900, two were sold for $500 each, and six or eight reached $100 or over. In consequence of these exceptional finds everyone in the neighborhood caught the pearl fever, and they were all—men, women, and children—fishing for pearls at the time of our visit, the mucket being the favorite shell for them. But they showed far more wisdom than is common under such circumstances, for even the children had sense enough to save the valuable shells and turn them over to a local blank factory situated on the shore of Cross Lake in Pine City. At that time this factory was running entirely on such small job lots, which could be obtained at a considerable reduction in price.

### PROPAGATION.

Some of the mussel fishermen claimed that this locality was practically worked out, and in consequence they had left and gone to Rice Lake. But all of those who remained told us that they had no difficulty in gathering 500 or 600 pounds a day. The supply, however, is not inexhaustible, and unless measures are taken to replenish the more valuable species they will soon be gone.

Everything combines to make this an ideal location for such artificial propagation. Pine City, the county seat of Pine County, is conveniently reached by the Northern Pacific Railroad, 60 miles from St. Paul. It is located on the shores of Cross Lake and along the banks of Snake River, and the waterway is unobstructed up the river into Pokegama Lake. Hence propagation at a single point would supply both of the lakes and the river. And there is an abundance of the right kind of fish to serve as hosts for the glochidia.

### RECOMMENDATIONS.

1. The muckets and the maple-leaves that are found here are exceptionally fine shells, and in some way the local conditions are peculiarly suited to their development. They should be locally propagated, therefore, in sufficient numbers to keep up the supply. In all probability they will yield better returns than any other species that could be introduced.

2. A careful study of these mussels and of the local conditions should be undertaken in order to determine, if possible, what it is in the way of lime, food, or other things that renders these shells so exceptionally fine.

3. With a good local supply of these remarkable shells and a working knowledge of the conditions under which they flourish, it would be a simple matter to introduce them into other localities having a similar happy combination of river and lake. Among such possible localities may be mentioned Rice and Koronis Lakes near Paynesville in Stearns County, Clearwater Lake near Annandale in Wright County, Lost and West Lost Lakes near Fergus Falls, and Pine and Little Pine Lakes near Perham in Ottertail County.

4. A small local factory may often render efficient service by saving the odd lots of shells that are just as good in quality as any of

the others and perhaps even better, but are not sufficient in quantity to warrant shipping them for any distance. Such factories deserve the encouragement of both fishermen and manufacturers.

### MUSSELS OF THE MINNESOTA RIVER GROUP.

As has been already stated, the Minnesota River and its tributaries have been pretty thoroughly worked up by representatives of the button factories. Like the St. Croix, this river empties into the Mississippi below the Falls of St. Anthony, and so affords a free passage for all kinds of fish and mussels. Furthermore, it formed a part of the glacial River Warren, which was the outlet of Lake Agassiz, and thus there has been no break in its connection with the Mississippi.

The present investigation did not include the river itself, but only some of the lakes in Douglas County that eventually drain into it by way of the Chippewa River.

Within a radius of 6 miles from Alexandria, the county seat of Douglas County, there are 20 small lakes, several of which have become quite noted summer resorts.

Lakes Agnes, Henry, and Winona are close to the railroad station, small, shallow, and filled with water plants. The only mussels found in them were dwarfed and thin-shelled muckets (*L. luteola*), whose epidermis was highly polished and somewhat marly and whose nacre was a beautiful smoky brown.

Four miles north of the city there is a group of three larger and much deeper lakes, called, respectively, Darling, Carlos, and L'Homme Dieu. These lakes are comparatively free from water weeds, have sand and gravel bottoms, are very deep, and contain plenty of fish, but the only mussels that could be found in them were *Anodontoides freussacianus modestus* and *Anodonta pepiniana*.

A similar fauna was reported for the other 14 lakes, so that it does not appear as if any of the lakes in Douglas County contained commercial shells. Nor do any of them present conditions that would recommend the introduction of merchantable species by means of artificial propagation.

Some of the isolated lakes in this drainage, however, present entirely different conditions.

### MUSSELS OF THE RED RIVER GROUP.

The lakes and rivers belonging to this group were populated with mussels from the Mississippi River by way of the glacial river Warren and Lake Agassiz. Since the disappearance of this glacial river and lake the Minnesota River drainage and the Red River drainage have been separated, and each has acquired peculiarities of its own. The Red River turns northward along the western border of the

State and carries its mussel fauna across the line into Canada. It therefore becomes of great interest to the conchologist, as well as the mussel fisherman, since in it the mussels of the Mississippi Valley reach the point farthest north in their migrations. In consequence of the long continued glacial connection with the Mississippi, we are not surprised to find the rich mussel fauna indicated in the following table:

DISTRIBUTION OF MUSSELS IN RED RIVER GROUP.

| Species. | Little Pine Lake outlet. | Red River at Perham. | Ottertail Lake outlet. | West Lost Lake outlet. | Red River below Fergus Falls. |
|---|---|---|---|---|---|
| Anodonta pepiniana (paper-shell, floater) | × | × | × | × | .......... |
| Anodontoides ferussacianus subcylindraceus | .......... | .......... | × | .......... | .......... |
| Strophitus edentulus (squaw-foot) | .......... | × | × | × | .......... |
| Symphynota costata (fluted-shell) | × | × | × | .......... | .......... |
| Symphynota complanata katharinæ | × | × | .......... | × | .......... |
| Lampsilis luteola (fat mucket) | × | × | × | × | × |
| Lampsilis ventricosa (pocketbook) | × | × | × | .......... | × |
| Lampsilis recta (black sand-shell) | × | × | × | × | × |
| Quadrula coccinea (round pig toe) | .......... | .......... | × | .......... | .......... |
| Quadrula rubiginosa (Wabash pig toe) | .......... | .......... | .......... | .......... | × |

The only place in this entire drainage that has ever been worked is just north of Fergus Falls, where some of the country boys gathered and shipped a carload of shells to the button factories in Iowa in 1910. All of the lakes and the river are shallow and the shells must be gathered with rakes or forks, or picked up by hand; there is no chance for crowfoot dredges.

## QUALITY OF SHELLS.

The mucket, the pocketbook, and the fluted shell are the principal commercial mussels in the Red River. The black sand-shell is abundant and the best shell of them all in quality, but as it always has a dark purple nacre it can be used only for novelties. In many of these northern sand-shells, the hinge line, instead of being straight (*recta*), is strongly curved. But as it conforms in other particulars to a normal *recta*, it seems best to regard this merely as a local variation. The pocketbooks also are peculiar in being much flattened, somewhat elongated, and with short and stumpy teeth, very much like the variety designated by Lea as *Unio canadensis*. Many of the muckets have shells as thick and heavy as those of the St. Croix drainage, but there are others whose shells are thin and sometimes dwarfed like lake specimens.

The shells of nearly all the mussels which have a white nacre are badly stained. These stains vary from a light-gray or drab to a dark rusty brown in color. Sometimes there is but a small discoloration on each valve, at other times the whole interior of the shell is discolored. The stain usually affects only the interior layer or coat of nacre and when this is removed the rest of the shell is perfectly clean and uninjured. Such spotting of the shell, of course, injures their commercial value and reduces the material to the second or third grade. In other respects the shells have a fine luster and good texture, and would make excellent button material.

## PEARLS.

A few pearls and about the usual number of slugs were obtained from the carload of shells sent from Fergus Falls. At Little Pine Lake we also received reliable information that pearlers had worked the Red River above Mud Lake two years before, and that they obtained an abundance of mussels, with a fair amount of pearls. Further than this there has been no search for them in the Red River. If the discoloration noted above is due to some sort of parasite, it would very likely affect the pearls and slugs as well as the shells, but no data could be obtained. There is no reason other than this why the Red River should not be as prolific of pearls as the Mississippi.

## PROPAGATION.

The conditions at Ottertail Lake are very favorable for the propagation of certain species of mussels. The lake is 10 miles long by 4 miles wide, and is remarkably clean and free from weeds. It is surrounded also with fine sand and gravel beaches and contains many large sand bars. The Red River enters at the northeastern corner and flows the entire length of the lake. Similar conditions exist at Lost, West Lost, Pine, and Little Pine Lakes, but the lakes themselves are much smaller. At little Pine Lake the bottom was nearly covered with *Chara* and algæ, but wherever there was a bare spot the mussels were present in large numbers. As these lakes are full of just the kind of fish to serve as hosts the conditions are ideal for mussel propagation. On the river itself the conditions are less favorable. There are several dams in Fergus Falls, and a large power dam, 36 feet in height, 4 miles below the city. None of these dams are provided with suitable fishways, so that they form an effective barrier to the ascent of all fish.

## RECOMMENDATIONS.

1. Evidently the first thing to be done is to determine the cause of the stains which are so abundant. A satisfactory solution of this question would be of immense practical value, not merely here in the Red River drainage but wherever mussels are found. Different

regions show different degrees of discoloration but stain is present in some degree practically everywhere. How to check it, control it, and eventually eliminate it become exceedingly important questions. This Red River offers ideal opportunities for solving these questions.

2. Practical and efficient fishways should be provided for every dam across a river of the size and importance of the Red River. The blocking of the passage of the fish not only hurts the fishing in the waters above the dam but seriously affects every industry that is at all dependent upon fish. A dam or a natural fall, impassable for fish, may mean the entire absence of mussels in the river above.

3. Until there has been a solution of the cause of the numerous stains on the Red River shells and suitable means have been provided for the passage of the fish around the dams, there is little to be gained either by propagating the mussels already in evidence or by introducing new species.

4. Since the staining is the only character in which these shells are not first quality, since quite a percentage of the shells are free from stains, and since a goodly proportion (unstained part) of most of the stained shells can be utilized for buttons, it follows that a local blank factory, using the shells where they were found would obtain an abundance of material. The loss occasioned by the stained portions of the shell would be more than offset by the saving in freight.

## MUSSELS OF THE CROW WING GROUP.

The lakes connected with this group were once part of the great glacial lake Nicollet, which covered 1,500 square miles and drained southwest through the Crow Wing River into the Mississippi. This drainage, therefore, represents the original headwaters of the Mississippi River and was populated with mussels from that source. The center of the Crow Wing drainage is in Wadena County, from whence it extends north through the Fishhook River into Hubbard County and nearly up to the present headwaters of the Mississippi; west through Straight and Shell Rivers into Becker County; west also through Red Eye, Leaf, and Wing Rivers into Ottertail County, and south through Wing and Turtle Rivers into Todd County.

There are very few lakes in this drainage and they are close to the headwaters of the various tributary rivers. Both the lakes and the rivers are shallow, with sand or gravel bottoms; the mussels thus far secured have been obtained with forks and rakes; there was no opportunity to use a crowfoot dredge. The following table gives the distribution of the mussels in this group:

DISTRIBUTION OF MUSSELS IN CROW WING GROUP.

| Species. | Stations. | | | |
|---|---|---|---|---|
| | Shell River, Menahga. | Leaf River, Wadena. | Fish-Hook River, Park Rapids. | Crow Wing River, Motley. |
| Lampsilis ligamentina (mucket) | × | ........ | ........ | × |
| Lampsilis luteola (fat mucket) | × | × | × | × |
| Lampsilis ventricosa (pocketbook) | × | × | × | × |
| Lampsilis recta (black sand-shell) | × | ........ | ........ | × |
| Anodonta pepiniana | ........ | × | ........ | ........ |
| Anodonta grandis (floater) | × | × | × | ........ |
| Anodontoides ferussacianus subcylindraceus | ........ | × | × | × |
| Strophitus edentulus (squaw-foot) | ........ | × | × | ........ |
| Strophitus edentulus pavonius (squaw-foot) | ........ | × | × | ........ |

As can be seen from this table, the mussels are quite evenly as well as universally distributed, and it may be said that they were also fairly abundant at every place examined. Hitherto the mussel fishermen have worked at only one locality in this drainage, the Shell River at Menahga, but the shells obtained here were so exceptional in size and quality that they brought a high price, and many of them were exported to England and Germany.

### QUALITY OF SHELLS.

The principal mussel of this drainage is the pocketbook, which attains a large size and has an exceptionally thick shell. It also shows a good luster, has a fine texture, and is free from stains. Consequently it ranks as a first-grade shell and will cut 100 gross of 20-line and 1,000 gross of 16-line buttons to the ton.

The bottom of the river where these shells are obtained is covered with algæ and water weeds to the depth of 12 to 18 inches, and the thicker the vegetation the more plentiful the mussels beneath it. Two men were actively working the Shell River at Twin Lakes near Menahga at the time of our visit, and we watched them rake off the algæ and weeds and then dig into the underlying gravel and sand for the mussels. The latter are often buried to the depth of a foot or more. This is, at the least, a novel condition and one which, so far as is known, has not been reported from any other locality.

The Anodontas were also very thick shelled, so thick as to be easily mistaken for fat muckets, and to cut a poor quality of buttons, Quite a large percentage of the black sand-shells had white nacre. and of course these made first-quality button shells.

### PEARLS.

The slugs and small pearls from these shells run about 1½ ounces to the ton of shells, which equals that of the Illinois River, is twice the average for the Cumberland River, and three times that for the Ohio.

An ounce of these pearls and slugs was purchased and they have been carefully examined and compared with those from other localities. In luster and general character they are considerably better than those from the Illinois and Ohio Rivers, but are not equal to the Wabash River output.

One of the musselmen at Menahga showed us a large rosebud cluster of yellowish tint and the size of a small hickory nut, which was attached to the valve of a mucket near the posterior end. They also had several fine pearls, rather more than would be expected from the quantity of shells they had obtained.

While conditions in the Crow Wing and its tributaries are exceptionally fine, as is evidenced by the superior quality of the shells, and while there is an abundance of the right kinds of fish to serve as hosts, these advantages are more than offset by the very poor facilities for transportation.

The rivers run through those portions of Wadena County which are the farthest removed from railroads, and not until we reach Motley in Morrison County do we find good railroad facilities. Even at Menahga the shells must be carted 5 miles over a very sandy road in order to reach a shipping point. The Shell River, however, will furnish gravid pocketbooks of exceptional size and quality to stock other rivers that happen to be more conveniently located.

### RECOMMENDATIONS.

1. One of the musselmen at Menahga suggested a way to overcome the lack of transportation facilities. A "wannigan" as he called it—that is, a sort of house boat—could be built and equipped with machinery for sawing blanks at an expense not greatly, if at all, exceeding what it now costs ($300) to transport a single carload of shells from Menahga to the button factories. With this equipment it would be an easy thing to float down the Shell River into the Crow Wing, and down the latter into the Mississippi, using up the shells where they were found. The Crow Wing and its tributaries would supply enough material to keep such an outfit busy for several years. There would be no freight or transportation charges on the shells. Spotted shells, those with thin tips, and the white-nacred sand shells could be utilized along with the others, and when the work was finished the boat and its outfit would bring a very respectable portion of the original cost.

2. While the shipping facilities do not warrant artificial propagation in this drainage, such exceptional shells should not be allowed entirely to disappear before an earnest effort is made to introduce them in other localities. Here is a peculiarly fine parent stock which richly deserves protection and cultivation as a source from whence to derive propagation material.

## MUSSELS OF THE MISSISSIPPI GROUP.

As would be expected, this is much the largest of the groups here considered, and includes all of the Mississippi River above the mouth of the Crow Wing River, together with the lakes and tributaries connected with it. This portion of the Mississippi is entirely postglacial and has been formed since the disappearance of the glacial lake Nicollet.

It drains Crow Wing County, the northern portions of Aitkin, Cass, and Hubbard Counties, and the southern portions of Itasca, Beltrami, and Clearwater Counties. All of these regions, but especially Itasca County, contain a large number of lakes, some of which, like Leech, Winnibigoshish, and Cass Lakes, are among the largest in the State. This region, of course, has been in constant communication with the Mississippi since the very beginning and hence has been stocked with samples of all the mussels found in that river above the Falls of St. Anthony. The following table gives the geographic distribution of these mussels:

Distribution of Mussels in the Mississippi Group.

| Species. | Mississippi River, Brainerd. | Prairie River, Grand Rapids. | Prairie Lake, Grand Rapids. | Mississippi River, Wolf Lake. | Mississippi River, below Bemidji. | Mississippi River, Bemidji Lake. | Mississippi River, above Bemidji. |
|---|---|---|---|---|---|---|---|
| Lampsilis ligamentina (mucket) | .......... | .......... | .......... | × | × | × | .......... |
| Lampsilis luteola (fat mucket) | × | × | × | × | × | .......... | × |
| Lampsilis ventricosa (pocketbook) | .......... | .......... | .......... | × | × | × | × |
| Lampsilis recta (black sand shell) | .......... | × | .......... | × | × | × | × |
| Anodonta grandis (floater) | .......... | × | × | × | .......... | × | × |
| Anodonta corpulenta (floater) | .......... | × | × | .......... | .......... | .......... | .......... |
| Anodontoides ferussacianus subcylindracus | .......... | .......... | × | × | .......... | × | × |
| Symphynota compressa | .......... | .......... | .......... | .......... | .......... | × | × |
| Strophitus edentulus (squaw-foot) | .......... | .......... | .......... | .......... | .......... | × | .......... |
| Strophitus edentulus pavonius (squaw-foot) | .......... | .......... | .......... | × | .......... | .......... | × |

The poverty of specimens at Brainerd is explained by the fact that we could only examine the river for a short distance above and below the city, and in this interval we did not find any mussel bed. Doubtless there are as many mussels in this portion of the Mississippi as elsewhere.

## QUALITY OF SHELLS.

The *Lampsilis* or mucket group are the only mussels in this drainage that possess any commercial value. While the pocketbook does not attain the size or the quality of those found in the Shell River, and the fat mucket is not as thick at those found in Snake River and Pokegama Lake, yet on the whole the shells are of medium size and good quality. They are very plentiful in many places; at the outlet of Lake Bemidji 3 tons were obtained in one week from a space only a few rods in length. These mussels are like those in the Shell River, in that they are buried deep. The man who collected them told us that he dug down into the sandy bottom 2 and 3 feet for them and found them nearly as thick as they could lie.

The shells were remarkable for the small size of the cardinal teeth, indeed a few valves were found entirely destitute of teeth.

Another excellent locality is up the Mississippi above Lake Irving. The conditions here are excellent and several carloads of shells could easily be obtained. The Schoolcraft River comes into the Mississippi here from Lakes Marquette and Plantagenet and both the river and the lakes are reported to be full of good mussels.

The black sand-shells throughout this portion of the Mississippi have the hinge margin very strongly curved like those already described from the Red River and the Crow Wing drainage.

The fat muckets here are not thickened like the shells from Pokegama Lake, Pine County, and many of them are dwarfed after the manner of ordinary lake shells. In addition, those from Wolf Lake proved to be chalky and brittle when tested for button making, but those above Lake Bemidji were of medium size and furnished good button material.

The Anodontas form but a very small percentage of the mussel fauna, nearly all the shells seen being some form of *Lampsilis*. The mussels in this region would all be obtained with a fork or a rake; there is no locality where the water is deep enough to use a crowfoot dredge.

## PEARLS.

Quite a number of pearls and slugs have been obtained by professional pearlers, especially in the region about Bemidji. One beautifully colored pearl as large as a hazelnut had been purchased by a firm of jewelers in Bemidji just before our arrival there and was valued at $200. It weighed 21 grains, but had a slight blemish on one side. Some pearling has also been done in the Mississippi below the power dam, which is situated 11 miles down the river from Lake Bemidji. One pearl found here in July, 1912, was valued at $300. There was also a display of pearls and slugs and manufactured articles in the window of this jewelry store, all of which were stated to have been found in the vicinity. We saw several piles of shells that had been recently made by pearlers along the stretch of river above Bemidji, but did not find them anywhere else in this drainage. Evidently there has been very little search for pearls anywhere within this entire drainage.

PROPAGATION.

The conditions in most of the lakes and rivers of this group are excellent for propagation purposes. The water everywhere is clear and contains an abundance of lime; the bottom is almost universally composed of hard sand and gravel; there is nowhere any surfeit of algæ or aquatic vegetation, and there is apparently an abundance of food.

At Leech Lake, which, next to Red Lake, is the largest body of fresh water in the State, the outlet is muddy and full of weeds, and is reported to contain nothing but very thin-shelled floaters or paper shells. But the lake itself presents ideal conditions, and a small river which runs into it on the south shore out of Lake Linda is reported by a mussel fisherman to be full of thick shells for the mile of its course. The same fisherman said that Little Bay River, which enters the lake on the west shore, contains no commercial mussels from Leech Lake up to Laura Lake, but from there up to Little Bay Lake is full of them.

Lake Winnibigoshish was formerly a shallow mud lake, but its surface was raised 14 feet by a dam across the outlet. It would furnish a favorable locality for the introduction of the three-ridge, blue-point, washboard, and similar mud-loving species.

Cass Lake, Long Lake, and Wolf Lake are also very favorably situated, and all three, as well as the intervening portions of the Mississippi River which connects them, contain good bottom material. The conditions here are similar to those on the Snake River in the St. Croix drainage, and would be particularly well suited to the thick-shelled fat muckets.

The Mississippi flows through Lake Bemidji and Irving Lake to Beltrami County, and here again the conditions appear very propitious for the propagation of the fat muckets.

At Pokegama Lake in Itasca County there are long stretches of sandy beaches and numerous sand bars, which, combined with something of a current flowing through the lake, would favor the introduction of the yellow or slough sand-shells. This lake is 14 miles in length, but is quite narrow, and is made up of a succession of long arms and bays surrounded by fairly high land. A dam was placed across the outlet about 8 years ago, which raised the water in the lake 10 feet, and which effectually prevents any fish from entering the lake out of the Mississippi River.

At Prairie Lake, 6 miles north of Grand Rapids, the water is considerably discolored with iron brought down by the Prairie River from the Mesabi Iron Range. This iron does not appear to affect the mussel fauna at all, since they are neither stunted nor discolored. But thousands of logs are run down the Prairie River, and the bottom of both the river and much of the lake is covered so thickly with fragments of bark that no mussel can live in it.

It is hardly necessary to add that all these lakes, the Mississippi itself, and its tributaries are full of just the right kind of fish to serve as hosts. Furthermore, Walker, Cass Lake, Bemidji, and Grand Rapids are very conveniently situated for propagation work, and are in easy railroad communication with all other parts of the State.

### RECOMMENDATIONS.

1. As noted under the Red River group, suitable passage should be provided for fish around the dams at the outlet of Lakes Pokegama and Winnibigoshish, and the large power dam 11 miles below Lake Bemidji. These last two are across the Mississippi, and surely that river ought never to be closed to the passage of fish, to say nothing about the mussels.
2. The farther the source of supply is removed from the button factory the greater is the cost of transporting the shells. Therefore, in a city like Bemidji, forming a convenient center, the establishment of a local factory for sawing blanks can not be too strongly recommended.
3. This is not the best locality for trying the experiment of introducing commercial species of mussels into some of the Minnesota lakes. But after such an experiment has been made a thorough success, there are large and well adapted lakes here in which artificial propagation would undoubtedly yield profitable returns.

## MUSSELS OF THE ISOLATED LAKES.

### LAKE PEPIN.

This so-called lake is really a simple widening of the Mississippi River just below Red Wing. The bottom is of fairly coarse gravel mixed with some mud, there is very little current, and the water varies from 6 or 8 to 12 or 15 feet in depth. This locality has not been fished for mussels until within a few years, but at the time of our visit there were 100 clamming outfits along the east shore of the lake, and they were averaging more than 200 pounds apiece per day.

An examination of the piles of shells collected by these fishermen yielded examples of the following species: *Lampsilis luteola, recta, fallaciosa,* and *alata, Unio gibbosus, Strophitus edentulus, Obovaria reflexa,* and *Quadrula plicata, undulata,* and *pustulosa.*

The culls were mostly razorbacks, spikes, such of the black sand shells as have a pink nacre, and a few floaters. By count about half of the commercial shells obtained are fat muckets (*luteola*), while by weight they form only 40 per cent of the entire catch.

A large number of fine pearls have been found here, nearly all of which come from the *luteolas*. One of these found just before our visit sold for $300, and another for $150. The fishermen reported the pearls not as numerous as during the previous year. They also reported another curious fact, that shells with pearls run along certain ridges on the lake bottom and are not found in the hollows along either side of the ridge.

In view of these facts it would seem advisable to propagate artificially the local commercial species, especially these thick-shelled *luteolas*, and to use this locality as a source from which to introduce desirable species into other lakes and rivers.

Mr. Andy Noel, a shell buyer for the Wisconsin Button Co. at La Crosse, took us around the lake and showed us every courtesy in the way of obtaining samples and data. Our sincere thanks are hereby acknowledged for these kind attentions.

### PLEASANT AND CLEARWATER LAKES.

These lakes are situated near Annandale, in Wright County, and are connected by the Clearwater River with the Mississippi. Pleasant Lake, right in the edge of the town, is 2½ miles long and 1 mile wide, with a gravelly and sandy bottom, comparatively free from vegetation. Shells of the pocketbook (*ventricosa*) and *Anodonta pepiniana* were obtained here. The former proved to be excellent button material, but was very scarce. It was reported, however, to have been abundant during the previous year, but had been killed or driven into deeper water by the ice.

Clearwater Lake is 4 miles from town and is much larger than Pleasant Lake, being 7½ miles long and 1½ miles wide. The southeastern end of the lake is wider and deeper and has rocky shores; the northwestern half is narrower, shallower, and so lined with reeds and rushes that it is impossible to get anywhere near the shore in most places.

The fat mucket (*luteola*) was found here, in addition to the pocketbook and *A. pepiniana*. Both the mucket and the pocketbook are large and thick and make excellent button material.

The Clearwater River flows through the lake and was reported to be full of fine shells. This lake and river would yield a carload of first grade mussels, which could be readily floated down to the town of Clearwater, on the bank of the Mississippi, and shipped from there. Also the local species might well be propagated at the lower end of the lake and in the river, while in the muddier bottom at the upper end of the lake it is probable that some of the pig-toes (*Quadrula*) would thrive well.

It is very doubtful whether any recommendations can be made for Pleasant Lake.

PULASKI, BUFFALO, RICE, AND KORONIS LAKES.

These four lakes are connected with the Crow River, but the outlets are very small streams, and those of the first two are open only during spring freshets.

Lake Pulaski is nearly circular in outline, about 1½ miles in diameter, with a bottom composed of gravel and sand, covered with a heavy growth of *Chara*, *Potomageton*, and algæ.

Buffalo Lake is 2½ miles long and 1 mile wide, with a maximum depth of 50 to 60 feet. There are two shallow bars across the center of the lake which are covered with rushes, and the bottom is firm sand and gravel, with very little vegetation.

Rice Lake, 6 miles northeast of Paynesville in Stearns County, is 3 miles long by 2 miles wide. The bottom is composed of much coarser gravel than in Buffalo Lake, and there is a little more *Chara* and algæ. The north fork of the Crow River runs into the southwest corner of this lake and empties out again within a short distance.

Koronis Lake, 2 miles southeast of Paynesville, is 3½ miles long and 2 miles wide, with a very irregular and precipitous shore. The bottom contains much more sand than gravel and the vegetation is very limited except at the inlet and outlet.

The fat mucket (*luteola*) and *Anodonta pepiniana* were found in all four lakes, and in addition *Anodontoides ferussacianus modestus* was found in Buffalo and Koronis Lakes. Most of these muckets are dwarfed, as is usual in a lake, and thin-shelled, but those from Rice Lake are full size, of good thickness and have a fair luster, and were classed as first-grade shells.

The *Anodontas* were found in regular windrows 10 or 15 feet from shore, and outside of them were the *luteolas*, in water shallow enough to obtain them by wading. The epidermis of these *luteolas* was a dark straw-yellow, and was highly polished like that of the same species from Lake Henry (p. 11).

The comparative paucity of shells in these lakes is easily explained by the fact that fish can not run into them freely at the time of year when they are infested with glochidia. The conditions in Buffalo Lake are excellent for sand-shells and species which frequent shallow bars. The thick-shelled *luteolas* from Pokegama Lake (Pine County), or Lake Pepin would undoubtedly thrive in Rice and Koronis Lakes. Lake Pulaski is not worth stocking with any kind of shells.

Each of these lakes contains an abundance of perch, bass, sunfish, crappies, and wall-eyed pike, which could be seined with little trouble and would furnish sufficient hosts for the glochidia; therefore, in case the artificial stocking of lakes proves a success, three of these lakes present good opportunities for work on commercial species.

### SAUK LAKE AND SAUK RIVER.

Sauk Lake, 3 miles above Sauk Center in Stearns County, is 7 miles long and ¾ mile wide, and is thus little more than a widening of the river. It is partly natural and partly artificial, produced by a dam across the river at Sauk Center. The bottom is composed of sand and coarse gravel, covered with a profuse growth of algæ, *Chara*, *Potomageton*, and other aquatic vegetation. The only mussels found in the lake were the fat mucket (*luteola*), *Anodontoides ferussacianus modestus* and *Anodonta pepiniana*. The muckets are thin-shelled, dwarfed, and covered with a large amount of marl posteriorly. The epidermis is honey-yellow in color, highly polished, and faintly rayed. The two floaters, of course, possess no commercial value, and were found only in limited numbers.

The river was examined below the mill dam at Sauk Center, and again 3 miles above St. Cloud. The fat mucket (*luteola*), the pocketbook (*ventricosa*), and the black sand-shell (*recta*) were found in abundance at both places, and in addition near St. Cloud there were some ordinary muckets (*ligamentina*) and Anodontoides.

The fat muckets were of river size, and a small percentage were thick enough for buttons, the ordinary muckets were of large size and thick-shelled, but were somewhat spotted; the pocketbooks were exceptionally large, much flatter than usual, thick, and with a good luster, but they were also spotted, and on being tested proved to be brittle, thus rendering practically worthless material that to all appearance seemed to be as good as that from the Shell River at Menahga. The only thing worthy of comment here is the lack of a suitable fishway around the dam at Sauk Center. The effect of this is seen in the fact that although the pocketbook was common just below the dam, not one could be found in the 3 miles of river above the dam.

### LAKE MINNEWASKA, LAKE OSAKIS, AND BATTLE LAKE.

Lake Minnewaska, situated at Glenwood, near the center of Pope County, is 8 miles long and 2 miles wide. The bottom is of sand and rather fine gravel, with numerous shallow sand bars along the southwestern shore. The average depth of the water is from 12 to 15 feet, and while there is an interrupted fringe of rushes along the shore line the lake itself is exceptionally clear and free from aquatic vegetation. There is no outlet except during very high water, when a small stream overflows into the Chippewa River, which is a tributary of the Minnesota River.

The lake is fed by numerous large springs in addition to several inlet streams, which drain the surrounding country. The lake contains an abundance of sunfish, perch, crappies, wall-eyes, and bass. On the northwest shore of the lake, within the city limits of Glenwood, there is a State fish hatchery under the supervision of Supt. J. A. Pinkerton. The water for the hatchery comes from one of the large springs that feed the lake, while a series of fishponds or aquaria are built in the lake along the shore. The lake was found to contain a great many mussels, which, however, possess no commercial value. These include the fat mucket (*luteola*), which is much dwarfed and thin-shelled, with an epidermis which erodes easily and turns dead white on exposure, three species of *Anodonta, imbecillis, pepiniana,* and *benedictensis,* and *Anodontoides.* The profusion of these mussels and the rapidity of their development show that there is an abundance of food in the lake.

We find, therefore, that the temperature and depth of the water, the kind of bottom, the presence of numerous shallow sand bars, the freedom from aquatic vegetation, and the abundance of suitable food combine to make this lake an ideal one for the artificial propagation of mussels, particularly the *Lampsilis* group. And, as if to complete the requisites, here is a fish hatchery, in whose interests hundreds of bass and wall-eyes are seined out of the lake every spring. Along with the game fish which are used by the hatchery there are always taken in the seine a large number of sunfish and yellow perch which are simply thrown back into the lake. What could be simpler than to supply the hatchery with gravid mussels of some valuable commercial species and impregnate these sunfish and perch with the glochidia before they are returned to the lake? Manifestly this is a rare opportunity for testing the possibilities of mussel propagation with almost no additional expense. The importance of such practical experimentation under the direction of skilled workmen can hardly be overestimated.

While in Glenwood we were rendered great assistance and were shown many courtesies by the officials at the hatchery. One of them, Mr. John Dahl, took us around the lake, gave us many data, and explained the local conditions, with which he was thoroughly conversant. Our sincere thanks are hereby returned to him and to the superintendent for these and many other favors.

Lake Osakis, situated close to Osakis, in the southwestern corner of Todd County, is 10 miles long and 3 miles wide. The bottom, the depth of the water, the presence of sand bars, and the freedom from aquatic vegetation correspond exactly to those at Lake Minnewaska. This lake also has no outlet except at very high water, and is a typical shallow lake, such as are common in glaciated regions.

There were found here the fat mucket (*luteola*), *Anodonta pepiniana* and *Anodontoides*. Some of the muckets were dwarfed and thin-shelled, but a small percentage were full-size and had moderately thick shells.

Battle Lake is in the southern central portion of Ottertail County and empties into the Red River. It is 6 miles long by 3 miles wide. It has a bottom of sand and gravel sparsely covered with aquatic vegetation, and the water is very clear and cold. The fat muckets here were small and dwarfed and approached very closely the species known as *rosacea*. They were easily eroded, and the epidermis on exposed portions of the shell became absolutely snow-white.

In addition there were two species of *Anodonta*, viz, *pepiniana* and *kennicotti*, and *Anodontoides*. All of these shells, including the muckets, were worthless from a commercial standpoint.

Neither Battle Lake nor Lake Osakis has a fish hatchery, but otherwise they possess as favorable conditions as those at Lake Minnewaska, and are as conveniently situated. Consequently, if the experiments at Lake Minnewaska proved successful, it would be an easy matter to repeat them in these two lakes.

## SUMMARY.

1. Fat muckets (*Lampsilis luteola*) with exceptionally thick shells, and making first-grade button material, are plentiful in Pokegama and Cross Lakes, and in the Snake River, and also in Lake Pepin. They are not found in any of the other lakes or rivers which were examined.

2. Pocketbooks (*L. ventricosa*) of unusual size and luster are abundant in the Shell River and Twin Lakes near Menahga and elsewhere throughout the Crow Wing drainage and in the Sauk River. The Crow Wing shells are of superior quality and command a high price. Those from the Sauk River are so brittle as to render them worthless.

3. Muckets (*L. ligamentina*) are common in the Crow Wing and its tributaries and in the upper Mississippi. They are the ordinary good button material that is common in this species.

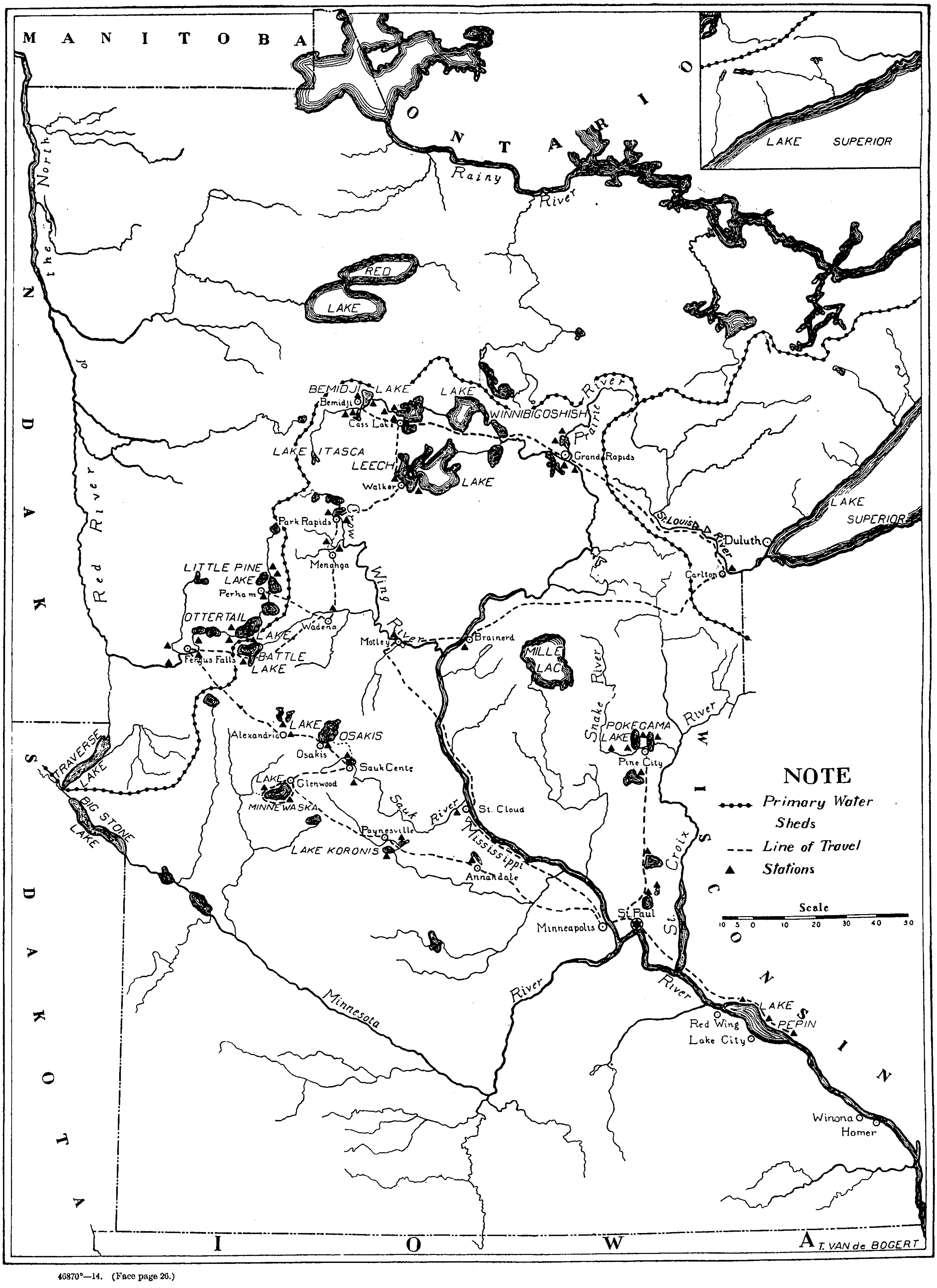
4. Black sand-shells (*L. recta*) are fairly abundant in all the rivers visited. Nearly all have purple nacre, are very thick, and make excellent material for novelties. The only exceptions are the white-nacred ones found at Menahga, which are excellent button shells.

5. Pig-toes (*Quadrula*) are found only in the St. Croix drainage and in the Red River. There are none in the Mississippi above the Falls of St. Anthony, nor in any of the other rivers and lakes visited. Some of the three-ridges were badly spotted, but all of the other pig-toes were of first quality and would make good button material.

6. Bemidji, in Beltrami County, is the best center from which to work the upper Mississippi. A blank factory situated there could

easily find material to keep it running for several years. Phelps, in Ottertail County, would make an equally good center for the Red River.

7. There are two of the recommendations which possess especial importance: First, to preserve by artificial propagation the types of shells shown in the muckets of Lake Pokegama and the pocketbooks of Menahga; second, to improve the opportunity so favorably offered at Lake Minnewaska and thoroughly try out by experiment the introduction of valuable commercial species into lakes that are specially suited to them.

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# THE MUSSEL RESOURCES OF THE ILLINOIS RIVER

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By Ernest Danglade
*Scientific Assistant, U. S. Bureau of Fisheries*

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Appendix VI to the Report of the U. S. Commissioner
of Fisheries for 1913

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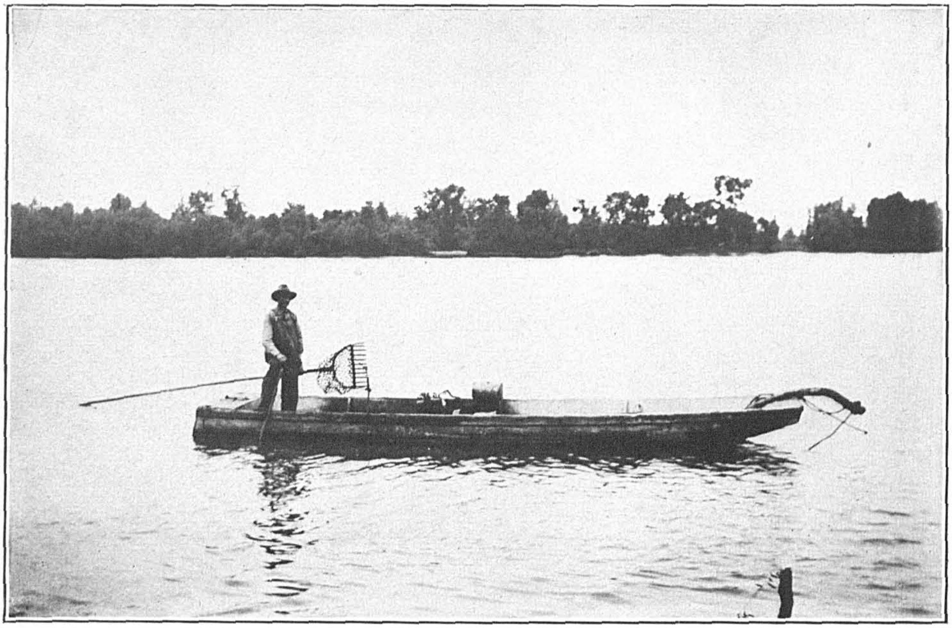

FIG. 1.—A MUSSEL FISHERMAN.

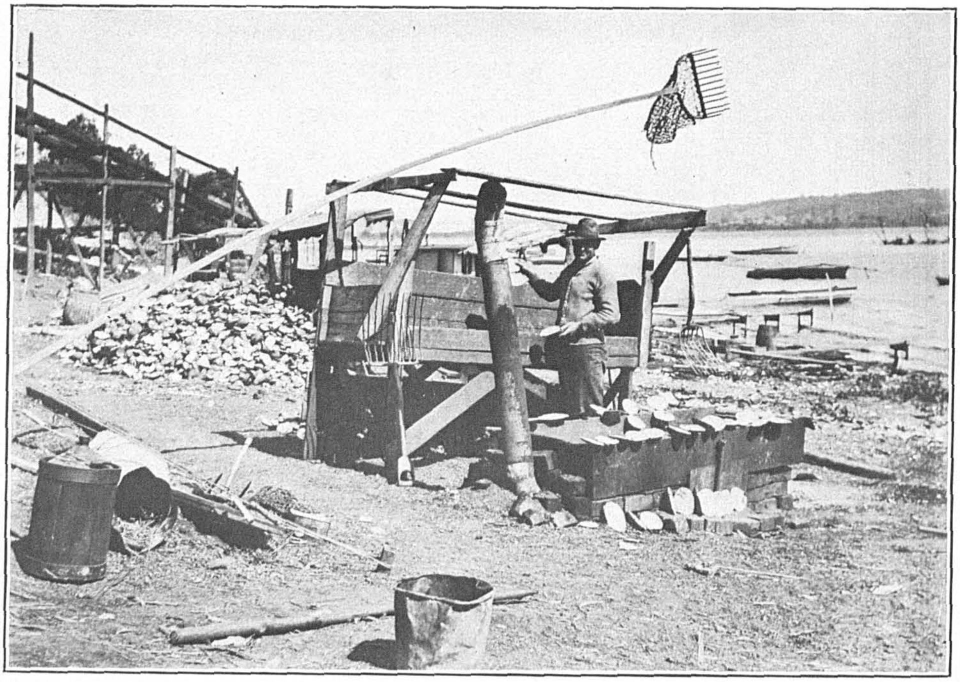

FIG. 2.—A PEARL GATHERER AND HIS CAMP OUTFIT.

# THE MUSSEL RESOURCES OF THE ILLINOIS RIVER.

By Ernest Danglade,
*Scientific Assistant, U. S. Bureau of Fisheries.*

## INTRODUCTION.

The Bureau of Fisheries conducted a series of investigations of the Illinois River, principally during the summer months of the period extending from 1907 to 1912. The work was carried on chiefly with regard to the mussel fishery; the kinds, the quality and quantity of shells, and also the general economic conditions of the river were the important points under consideration. From 1907 to 1909 the work was in charge of Harvey L. Freeland, and during 1912 the mussel investigation of the entire river was continued by the author and John A. Danglade. For several years the Illinois State Laboratory of Natural History, with some assistance from the United States Bureau of Fisheries, conducted biological and physical investigations of the river, under the direction of Prof. S. A. Forbes.

The principal shell-producing tributaries of the Illinois are the Kankakee,[a] which has been examined and reported upon; the Fox, the report of which by John A. Eldridge accompanies this paper; the Spoon and the Sangamon, brief accounts of which are given in the body of the present report.

The United States biological station, situated at Fairport, Iowa, in charge of Dr. Robert E. Coker, furnished valuable information and suggestions, which were of great assistance to the work. The table of the commercial appraisal of shells, made by the shell expert, given on page 11, shows the condition of shells as to luster, texture, and number of gross of blanks per ton, from various representative stations of the river. The map of the Illinois and Fox Rivers, at the end of this paper, gives the principal tributaries, towns, and cities along the course, and shows to some extent the islands, lakes, sloughs, bays, etc.

The following report of the river is intended principally for the benefit of those engaged in the pearl-button industry either as manufacturers or mussel fishermen, and for others interested in the development of the mussel resources of the country.

[a] Wilson, Charles B., and Clark, H. Walton: The mussel fauna of the Kankakee Basin. U. S. Bureau of Fisheries Document No. 758. 1912.

## PHYSICAL CONDITIONS.

The Illinois River is one of the most important tributaries of the upper Mississippi, not only on account of the volume of water it discharges and its excellent transportation facilities, but because of its extensive fisheries and large mussel resources. The Illinois, formed by the junction of the Kankakee and Des Plaines Rivers and emptying into the Mississippi at Grafton, Ill., is about 273 miles in length. Its drainage basin comprises about 29,000 square miles of fine farm land in Illinois, Indiana, and Wisconsin. Besides receiving many important natural tributaries, it is the outlet of the Chicago Drainage Canal, having a discharge of several thousand cubic feet per second of water from Lake Michigan, and with an equivalent drainage area of 6,000 square miles. The river consequently carries an enormous amount of sewage from Chicago, as well as from the various cities and manufacturing plants along its course.

The greater part of Illinois is covered by glacial drift of varying thickness, brought down from the Northeast during the ice age, and as a consequence many of the old river beds were filled with sand and gravel and the streams were forced to cut new channels, in some places completely changing the course for all or a part of the way. Such is the case with the Illinois River. In the upper part the river has cut its way through the Wisconsin drift down into solid rock, while in the lower portion, although still in its old course, it is often as much as 100 feet above solid rock.

The watershed of the Illinois River extends in a broad band, averaging 100 miles in width, in a northeast-southwest direction directly across the center of Illinois. The western side of the watershed is 20 to 40 miles in width, while the width of the eastern side is 60 to 80 miles. From the junction westward for 50 miles, being in a new course, its bed is usually on the rock and it has an average fall of about 1 foot per mile, but in the remainder of its course it is in a preglacial channel and has a very slight fall. From the junction to Utica, its course is independent of preglacial drainage lines. About midway of its westward course it crosses the Marseilles moraine. This, no doubt, for a considerable period held a lake in the basin at the head of the river (the Morris Basin), but was eventually cut down to the level of the low part of the basin. From the Marseilles moraine westward the channel found no prominent drift barriers to remove, but has been compelled to cut down 50 to 75 feet into the rock in opening an outlet from the Morris Basin into the valley of the lower Illinois. The lower Illinois seems to have been so imperfectly filled by glacial deposits that throughout nearly its entire length the stream is reestablished in the old course. The valley of the lower Illinois ranges in width from 2½ to fully 15 miles. The narrowest portions of the lower valley are a short section at Peoria, where it passes through the Shelbyville morainic system, and a section embracing the lower 60 miles, where it traverses the Eocarboniferous and Silurian limestones.[a]

[a] Leverett, Frank: The Illinois glacial lobe. U. S. Geological Survey, mon. XXXVIII.

From its origin to Utica, a distance of about 43 miles, the river is a series of rock rapids and pools, and is practically destitute of mussels.

From Utica to Meredosia, a distance of 159 miles, the river flows through a region of but slight fall and abounds in sloughs, bays, lakes, islands, and drowned timber. The principal tributaries between these cities are the Vermilion, Mackinaw, Spoon, and Sangamon Rivers, the last-named of which produced some excellent shells this year. The river bottom of this stretch, with but few exceptions, is composed of mud or of mud and sand, which is characteristic to the mouth. From the mussel fisherman's point of view, the most important part of this section, as well as of the entire river, is Peoria Lake, which, by the dip-net method, has yielded many tons of good shells.

From Meredosia to Grafton, a distance of 71 miles, the river flows almost due south and rather close to the high bluffs on the right, except near the mouth, where it bears to the east and to the hills on the left. In this stretch there are fewer sloughs, but more islands and bars. In the vicinity of Hardin there are many productive mussel beds, with a yield second only to that of Peoria Lake.

## POLLUTION OF THE ILLINOIS RIVER.

The effects of the sewage pollution of the Des Plaines River and the drainage canal upon the waters of the upper Illinois have been a subject for much discussion both to fishermen and the cities along the river. The analysis and general study of the physical conditions in the following data and tables were made under the direction of Prof. S. A. Forbes during the summer of 1911 and the spring of 1912:

During July the river between its origin and the Marseilles Dam is practically barren of fishes, bubbling with gases of decomposition, and full of floating organic matter, and the bottom is in many places deep with foul-smelling mud from which large bubbles of offensive gas escape when stirred. The character of the river changes greatly at this dam, black bass and carp coming up in some numbers to that point. During March, the organic matter of the sewage instead of being rapidly decomposed, with a nearly complete appropriation of the oxygen, as was the case last summer, is now being slowly decomposed, with a consequent gradual fall in dissolved oxygen, to Chillicothe, 93 miles down the river. At Morris there was 97 per cent of saturation in February, where last summer the average was less than 10 per cent, while at Chillicothe there is now 36 per cent where last summer there was an average of 44 per cent. Bottom conditions were similarly different. The gases of the bottom sediments at Morris last summer were largely methane, the product of organic decomposition in the absence of oxygen and the odor was that of a septic tank.

Table 1 shows the condition of the water during summer, Lake Michigan and the Kankakee River being high, while at the other places the percentage of saturation runs low. Table 2 shows the early spring conditions when the decomposition of organic matter is very slow. Table 3 shows the percentage of carbon dioxide ($CO_2$), oxygen (O), carbon monoxide (CO), methane or marsh gas ($CH_4$), and nitrogen (N) of the river and from septic tanks during the month of September.

TABLE 1.—FREE OXYGEN, ILLINOIS WATERS: PERCENTAGE OF SATURATION, JULY 18 TO SEPTEMBER 13, 1911.

| | |
|---|---|
| Lake Michigan | 95.5 |
| Kankakee River | 112.3 |
| Des Plaines River | 13.1 |
| Morris | 9.8 |
| Marseilles: | |
| Above dam | 7.5 |
| One-eighth mile below dam | 65.4 |
| Three-fourths mile below dam | 24.8 |
| Starved Rock | 37.1 |
| Peru | 37.1 |
| Depue | 30.3 |
| Hennepin | 35.7 |
| Chillicothe | 43.7 |

TABLE 2.—DISSOLVED OXYGEN, ILLINOIS RIVER, MARCH, 1912.

| Location. | Date. | Number of samples taken. | Temperature. | Dissolved oxygen, parts per million. | Per cent saturation. | Miles from mouth Chicago River (approx.). |
|---|---|---|---|---|---|---|
| Lockport: | | | ° C. | | | |
| Des Plaines River | Mar. 18 | 3 | 2.5 | 6.5 | 47.5 | 35 |
| Chicago Drainage Canal | ...do... | 3 | 3.0 | 6.3 | 46.7 | |
| Morris, Illinois River: | | | | | | |
| South shore | Mar. 19 | 2 | 1.5 | 10.4 | 73.8 | 65 |
| North shore | ...do... | 3 | 1.5 | 9.2 | 65.4 | |
| Marseilles: | | | | | | |
| Above dam | Mar. 21 | 3 | .0 | 8.8 | 59.8 | 80 |
| Below dam | ...do... | 3 | .0 | 10.0 | 68.0 | |
| Chillicothe | Mar. 22 | 6 | .0 | 7.2 | 49.0 | 145 |
| Peoria: | | | | | | |
| Above sewer outlet | Mar. 23 | 4 | .0 | 6.8 | 46.3 | 165 |
| Below sewer outlet | ...do... | 4 | .0 | 6.5 | 44.2 | |
| Havana | Mar. 25 | 4 | 2.0 | 6.2 | 44.6 | 205 |
| Beardstown | Mar. 26 | 3 | 1.5 | 7.7 | 54.7 | 240 |
| Pearl | Mar. 27 | 4 | 2.0 | 9.3 | 67.0 | 285 |
| Grafton: | | | | | | |
| Illinois River | Mar. 28 | 2 | 3.0 | 9.4 | 69.7 | 325 |
| Mississippi River | ...do... | 2 | 3.0 | 10.5 | 77.8 | |

TABLE 3.—GASES FROM BOTTOM SEDIMENTS, ILLINOIS RIVER, AND FROM SEPTIC TANKS OF SEWAGE SYSTEMS, SEPTEMBER, 1911.

| Location. | $CO_2$. | $O_2$. | CO. | $CH_4$. | $N_2$. |
|---|---|---|---|---|---|
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Morris, Illinois River | 19.45 | 0.00 | 0.69 | 79.30 | 0.56 |
| | 19.31 | .00 | .32 | 79.51 | .86 |
| | 18.12 | .09 | .68 | 78.97 | 2.14 |
| | 21.49 | .00 | .30 | 73.00 | 5.21 |
| Marseilles, Illinois River | 16.85 | .05 | .55 | 82.55 | .00 |
| | 18.74 | .00 | .00 | 81.28 | .00 |
| Septic: | | | | | |
| Collinsville | 17.98 | .23 | .34 | 81.26 | .00 |
| Naperville | 19.06 | .00 | .10 | 74.50 | 6.34 |
| Henry, Illinois River | 11.99 | .44 | .42 | 61.99 | 25.24 |
| | 17.76 | .00 | .52 | 80.83 | .89 |
| Averages: | | | | | |
| Morris | 19.59 | .02 | .49 | 77.69 | 2.19 |
| Marseilles | 17.79 | .03 | .27 | 81.91 | .00 |
| Septic tanks | 18.53 | .11 | .22 | 77.88 | 3.17 |
| Henry | 14.87 | .22 | .47 | 71.37 | 13.06 |
| Mazon Creek | .75 | .66 | .55 | 56.44 | 41.61 |

The following table, compiled from Water-Supply Paper 239, by W. D. Collins,[a] gives the mean of 36 mineral analyses of water from the Illinois, Fox, and Sangamon Rivers. The analyses were made from August 1, 1906, to July 31, 1907. While the Illinois River water is not so high in carbonates, it is higher in sulphates and chlorine than other waters of the State. The Fox has a high percentage of magnesium.

TABLE 4.—MINERAL ANALYSES OF WATER FROM ILLINOIS, FOX, AND SANGAMON RIVERS.

| | Illinois River, La Salle. | Illinois River, Peoria. | Illinois River, Kampsville. | Fox River, Ottawa. | Sangamon River, Springfield. |
|---|---|---|---|---|---|
| | Parts per million. | | | | |
| Turbidity | 159 | 43 | 188 | 94 | 74 |
| Suspended matter | 136 | 26 | 145 | 87 | 39 |
| Coefficient of fineness | .8 | .8 | .8 | 1.2 | .8 |
| Silica ($SiO_2$) | 12 | 12 | 12 | 11 | 16 |
| Iron (Fe) | .21 | .21 | .27 | .20 | .32 |
| Calcium (Ca) | 50 | 49 | 47 | 60 | 52 |
| Magnesium (Mg) | 22 | 21 | 20 | 32 | 24 |
| Sodium and potassium (Na and K) | 16 | 17 | 20 | 14 | 16 |
| Carbonate radicle ($CO_3$) | .0 | .0 | .0 | .0 | .0 |
| Bicarbonate radicle ($HCO_3$) | 203 | 198 | 202 | 275 | 247 |
| Sulphate radicle ($SO_4$) | 50 | 48 | 42 | 61 | 37 |
| Nitrate radicle ($NO_3$) | 6.6 | 7.8 | 4.3 | 4.9 | 3.4 |
| Chlorine (Cl) | 13 | 13 | 15 | 7.9 | 7.5 |
| Total solids | 278 | 271 | 267 | 335 | 276 |

Whether or not the great amount of sewage that is annually poured into the river is detrimental to the aquatic life in the lower stretches, the fact remains that from Chillicothe to near the mouth, with few exceptions, the Illinois is indeed a wonderfully productive stream in fishes and mussels, and far exceeds in these resources many rivers not having similar physical conditions.

## THE MUSSEL INDUSTRY.

It is of interest to note that probably the first American fresh-water shells taken for the purposes of button manufacture were derived from the Illinois River. As early as 1872 a couple of tons of mussel shells were collected from the river at Peoria, Ill., and exported to Europe. Again from the same river, at Beardstown, Ill., in 1876, a shipment of shells was made to a New York firm for manufacturing purposes. In both cases the returns were evidently insufficient to warrant a continuation of the work, due largely no doubt to the want of machinery adapted to river shells, together with the general inappreciation of the value of the material.

[a] Collins, W. D.: The quality of the surface waters of Illinois. U. S. Geological Survey, 1910.

With the exception of a few pearl hunters making their test hauls and drifting at random along the different stretches, nothing of consequence was done in the shelling industry until the spring of 1892, when work began in earnest on a fairly large scale and continued all summer, at Meredosia. However, at the close of the season, the industry was apparently dropped on this river and practically nothing was done until 1907. At that time the supply of shells was diminishing greatly on the Wabash and some other streams, and it was feared that unless new territory should be found many of the shellers were liable to be out of employment and the button factories considerably hampered thereby. As the Illinois had been previously tested and proved satisfactory, the mussel fishermen from various localities went to that river in large numbers for shells and pearls. Shelling began at once in the Beardstown district, reaching from above Grand Island, and as far down as Pearl, and during the next two years the industry extended over the greater part of the stream. The Illinois reached its maximum shell production during the season of 1909, when thousands of tons of good button shells were gathered and put in piles along the shore to await shipment.

This river has been the most productive stream per mile of any in the country, and it has been reliably stated that only two or three years ago more than 2,600 boats were engaged in the mussel fishery between Peru and Grafton. It appears that the total number now engaged would not exceed 400, and even this number is largely maintained by the new dip-net method in use at Peoria and the new field opened up in the lower district. For fishing to be profitable in a river like the Illinois, where the shells are not of the kind to command the highest prices, the yield must be relatively abundant. The price paid for the 1912 shells was from $12 to $13 per ton.

A button or blank factory was established on the Illinois at Beardstown in 1907, and the next year a second plant was located at Meredosia. At the present time (1912) along the river there are 15 factories with more than 250 machines, including 1 at Peoria, using about 4 tons of shells per week, 5 at Beardstown, 2 at Meredosia, 1 at Naples, 5 at Pearl, and 1 at Grafton.

Some of the earlier factories have changed hands a number of times; others have been dismantled and removed to other places. These factories are generally blank factories, sawing or cutting out the blanks which are sent elsewhere to be finished. The buildings are usually small frame structures, with inexpensive machinery.

## CHARACTER OF THE SHELLS.

The Illinois is distinctively a washboard, blue point, and wartyback (*Quadrula*) river. The condition of the bottom, the current, and the general character of the river are well suited to the growth and development of these species, although several other genera occur in small quantities. The principal commercial species (which are found in larger numbers than all the other kinds combined) are the blue point (*Q. undulata*), washboard (*Q. heros*), warty-back (*Q. pustulosa*), three-ridge (*Q. plicata*), pig-toe (*Q. undata*), and muckets (*L. ligamentina* and *luteola*).

The Illinois River shells are generally perfect specimens, and seldom eroded at the beaks; and, for the class, the product is exceptionally good button material. A peculiar feature, however, of the shells, particularly noticeable in the lower stretches, is their gradual reduction in size as we go down the river. From the upper limits of shell production to Beardstown, the shells are of the average size of similar species found in other rivers of the Mississippi Basin, but from Beardstown to Hardin, a distance of 70 miles, they become gradually smaller, thence slightly larger to near the mouth at Grafton. Even old shells taken from protected places show this character. What causes this condition is not very evident. It can hardly be due to the lesser quantity of food material coming down the river from the drainage canal, or to any particular change of bottom. The quality of these smaller shells is fully as good if not better than those of the upper districts.

## SCIENTIFIC AND COMMON NAMES.

The table of scientific and common names of the shells used in this report and given herewith is for the convenience of those who may desire to use the data for comparison. The nomenclature of Simpson,[a] with but few exceptions, is used, although many of the recent changes recommended by Dr. Ortmann and others will doubtless prove to be well founded.

### List of Common and Scientific Names.

| Common name. | Scientific name. |
|---|---|
| Purple warty-back | Quadrula granifera (Lea). |
| | Quadrula tuberculata (Raf.). |
| Niggerhead | Quadrula ebena (Lea). |
| | Quadrula pyramidata (Lea). |
| | Quadrula plena (Lea). |
| | Quadrula solida (Lea). |
| | Quadrula coccinea (Con.). |
| Ohio River pig-toe | Quadrula obliqua (Lam.). |
| Pig-toe | Quadrula trigona (Lea). |
| Wabash pig-toe | Quadrula rubiginosa (Lea). |
| Two-horned pocketbook | Quadrula pustulata (Lea). |
| Warty-back | Quadrula pustulosa (Lea). |
| | Quadrula fragosa (Con.). |

[a] Simpson, Charles T.: Synopsis of the Naiades, or pearly fresh-water mussels. Proceedings U. S. National Museum, vol. XXII, no. 1205, 1900, p. 501–1044.

| Common name. | Scientific name. |
|---|---|
| Maple-leaf, stranger | Quadrula lachrymosa (Lea). |
| Monkey-face | Quadrula metanevra (Raf.). |
| Washboard | Quadrula heros (Say). |
| Blue-point | Quadrula undulata (Barnes). |
| Three-ridge | Quadrula plicata (Say). |
| Bull-head | Pleurobema æsopus (Green). |
| Elephant ear | Unio crassidens (Lea). |
| Lady-finger, spike | Unio gibbosus (Barnes). |
| Spectacle-case | Margaritana monodonta (Say). |
| White heel-splitter | Symphynota complanata (Barnes). |
| Fluted shell | Symphynota costata (Raf.). |
| Rock-shell, bastard, queen | Arcidens confragosus (Say). |
| | Anodonta corpulenta (Cooper). |
| Floater | Anodonta grandis (Say). |
| | Anodonta suborbiculata (Say). |
| | Anodonta imbicillis (Say). |
| Squaw-foot | Strophitus edentulus (Say). |
| Three-horned shell | Obliquaria reflexa (Raf.). |
| Buck-horn, pistol-grip | Tritogonia tuberculata (Barnes). |
| Little pocketbook | Plagiola donaciformis (Lea). |
| Deer-toe | Plagiola elegans (Lea). |
| Butterfly | Plagiola securis (Lea). |
| Missouri niggerhead | Obovaria ellipsis (Lea). |
| Paper-shell | Lampsilis lævissima (Lea). |
| | Lampsilis gracilis (Barnes). |
| Pink hatchet-back | Lampsilis alata (Say). |
| | Lampsilis parva (Barnes). |
| Black sand-shell | Lampsilis recta (Lam.). |
| Slough sand-shell | Lampsilis fallaciosa (Smith). |
| Yellow sand-shell | Lampsilis anodontoides (Lea). |
| Higgins-eye | Lampsilis higginsii (Lea). |
| | Lampsilis orbiculata (Hildreth). |
| Mucket | Lampsilis ligamentina (Lam.). |
| Fat mucket | Lampsilis luteola (Lam.). |
| Pocketbook | Lampsilis capax (Green). |
| | Lampsilis ventricosa (Barnes). |

## COMMERCIAL APPRAISAL OF QUANTITY OF SHELLS.

The following table shows, in a general way, the number of shells to a given weight at four representative stations where the difference in size was very evident. The computation is based upon counts of 10 pounds of shells in each case, and the figures represent the number of pairs of shells. At Chillicothe the shells for the test were from a 65-ton pile; at Meredosia, from a 10-ton pile; at Florence, from a 16-ton pile; and at Hardin, from a 5-ton pile. The mixed shells were other commercial species taken from the same piles. The decrease in size between the shells from Chillicothe and those from Hardin is more than 50 per cent for the washboards and three-ridges, and slightly more than 25 per cent for the blue-points.

TABLE 5.—NUMBER OF SHELLS OF DIFFERENT SPECIES IN 1 TON AT FOUR REPRESENTATIVE STATIONS.

| Species. | Chillicothe. | Meredosia. | Florence. | Hardin. |
|---|---|---|---|---|
| Washboard (*Q. heros*) | 2,000 | 2,400 | 3,400 | 4,800 |
| Three-ridge (*Q. plicata*) | 3,000 | 4,800 | | 6,800 |
| Blue-point (*Q. undulata*) | 6,800 | 7,000 | 7,800 | 9,200 |
| Warty-back (*Q. pustulosa*) | | 14,200 | 17,200 | |
| Niggerhead (*Q. ebena*) | | | 7,400 | |
| Lady-finger (*Q. gibbosus*) | | 10,800 | | |
| Mixed shells | | 12,400 | | 21,200 |

The following table of the commercial appraisal of the most important shells found by the author between Peoria Lake and Beardstown was prepared by Mr. J. B. Southall, shell expert of the United States biological station, at Fairport, Iowa. Samples of the different species were weighed, and from these there were cut blanks of 16 to 30 lines diameter. The number of gross of blanks per ton of shells was then calculated. (L = line; 40 lines = an inch.)

TABLE 6.—COMMERCIAL APPRAISAL OF ILLINOIS RIVER SHELLS.

| Species. | Locality. | Discoloration. | Luster. | Texture. |
|---|---|---|---|---|
| Three-ridge (*Q. plicata*) | Peoria above bridge | A few stained | Good | 2d grade. |
| Blue point (*Q. undulata*) | Peoria Lake | do | do | 1st grade. |
| Fat mucket (*L. luteola*) | Peoria above bridge | None | do | Do. |
| Washboard (*Q. heros*) | Peoria to Havana | A few spots | do | 2d grade. |
| Pig-toe (*Q. trigona*) | Peoria above bridge | None | do | 1st grade. |
| Warty-back (*Q. pustulosa*) | do | do | do | Do. |
| Niggerhead (*Q. ebena*) | do | do | do | Do. |
| Mucket (*L. ligamentina*) | Havana | Pinkish | do | Do. |
| Buckhorn, pistol grip (*T. tuberculata*) | Beardstown | None | do | Do. |
| Pocketbook (*L. ventricosa*) | Havana | do | do | 2d grade. |
| Maple-leaf, stranger (*Q. lachrymosa*) | Peoria to Havana | do | do | 1st grade. |
| Higgins eye (*L. higginsii*) | Meredosia | do | do | Do. |
| Butterfly (*P. securis*) | Peoria to Havana | A few spots | do | Do. |
| Slough sand shell (*L. fallaciosa*) | Peoria to Beardstown | None | do | Do. |
| Rock shell, bastard, queen (*A. confragosa*). | Havana | A few spots | Fair | 2d grade. |
| Black sand shell (*L. recta*) | Peoria | | | |
| White heel splitter (*S. complanata*) | Peoria Lake | None | Good | 3d grade. |

| Species. | Gross blanks per ton shells. | | | | Remarks. |
|---|---|---|---|---|---|
| | 16 L. | 20 L. | 24 L. | 30 L. | |
| Three-ridge (*Q. plicata*) | | | 480 | | Medium to large, exterior not eroded. |
| Blue point (*Q. undulata*) | | 758 | | | Medium size, very good button shell. |
| Fat mucket (*L. luteola*) | | 851 | | | Medium to large, smooth exterior, good material. |
| Washboard (*Q. heros*) | 200 | | | 326 | Large, inclined to be a little chalky. |
| Pig-toe (*Q. trigona*) | | 424 | | | Medium to large and very thick beaks. |
| Warty-back (*Q. pustulosa*) | 845 | | | | Large size, very good button material. |
| Niggerhead (*Q. ebena*) | | 910 | | | Large, fine luster, very fine button material. |
| Mucket (*L. ligamentina*) | | 1,278 | | | Large, one of the best button shells. |
| Buckhorn, pistol grip (*T. tuberculata*) | 634 | | | | Very good button shell. |
| Pocketbook (*L. ventricosa*) | 700 | 874 | | | Large, inclined to be brittle. |
| Maple-leaf, stranger (*Q. lachrymosa*) | 535 | | | | Medium size, thick at beak, thin at tips. |
| Higgins eye (*L. higginsii*) | | 256 | | | Medium size, thick, good material. |
| Butterfly (*P. securis*) | | 251 | | | Large, heavy, good material. |
| Slough sand shell (*L. fallaciosa*) | | | | | Small, good for novelties, large shells good button material. |
| Rock shell, bastard, queen (*A. confragosa*). | | 428 | | | Large, heavy, fair button material. |
| Black sand shell (*L. recta*) | | | | | Some white, some purple; good for novelties. |
| White heel splitter (*S. complanata*) | | | | | About 30 per cent of shell good for buttons, remainder too thin. |

## PRICES OF SHELLS.

The price per ton of shells has varied to a considerable extent during the last few years on the Illinois, and also on different parts of the river, as well as on different rivers of the Mississippi Basin. The quality of the shells, transportation facilities, and the supply and demand are the principal determining factors. Only the very best grade of shells could find a market in 1902; all others were discarded, being left on shore and deemed entirely worthless. During the seasons of 1907 and 1908 the price ranged from $6 to $20, according to quality, and for the early season of the next year $9 was paid for all grades, excepting culls, but near the latter part of the year the price went as high as $25, which is about the maximum paid for the Illinois shells. The average price for 1912 was from $12 to $13 for the river run of marketable shells delivered on board the cars or on a barge at the river landing. There are so few niggerheads and yellow sand shells found on the Illinois that it is hardly profitable to sort them out, excepting in the lower stretch, where the percentage of the latter is large enough to do so. They then command a price from $50 to $60.

As shown by the following table taken from the United States Census Report for 1908, the mussel products of the Illinois River for that year constituted about one-sixth of the total value of the fishery products of this important stream; and, as stated on page 115 of the report, the yield of shells and pearls of this river was nearly 40 per cent of the total water product of the entire State.

| | |
|---|---|
| Shells and pearls | $139,000 |
| Carp | 412,000 |
| Other fishes | 309,000 |
| Total | 860,000 |

The report also furnishes the following information concerning the fisheries products of the Mississippi River and tributaries, 1908:

| | |
|---|---|
| Shells and pearls | $686,000 |
| Other fisheries | 2,365,000 |
| Total | 3,051,000 |
| Ratios of Illinois River to Mississippi and tributaries: | |
| Shells and pearls | 20 per cent. |
| Other fisheries | 30 per cent. |
| Fisheries products | 28 per cent. |
| Fisheries products, Illinois River, 1899 | 24,000,000 pounds. |
| Fisheries products, Illinois River, 1908 | 46,000,000 pounds. |

Increase, 92 per cent.

The yield of one-fifth of the total amount of shells and pearls of the Mississippi Basin is indeed a remarkable output for one river the size of the Illinois.

### PRINCIPAL MUSSEL BEDS.

For convenience in dealing with the mussel fauna of the Illinois, the river may be divided into three sections:

1. The upper river, from the origin to Chillicothe, a distance of 93 miles.
2. Peoria Lake, from Chillicothe to Peoria, a distance of 20 miles.
3. The lower river, from Peoria to Grafton, a distance of 160 miles.

*Upper river.*—From its origin to Utica, a distance of about 43 miles, the river flows over a sandstone bed covered with large blocks of sandstone and bowlders. The water has a very decided odor, though it has been stated that in the low water of summer, before the opening of the drainage canal, the odor was more pronounced and disagreeable than at present. The rocks at the water's edge are covered with a slimy ooze having the same odor as the water. This portion of the river is more directly affected by the drainage canal than are the lower stretches. In the process of decomposition the organic matter of the sewage abstracts the dissolved oxygen of the water and renders it unfit for aquatic life. It is practically destitute of mussels and forms an impassable barrier for fish, at least during the summer months.

From Utica to Chillicothe, a distance of 50 miles, the shells are rather scattering and but little work is carried on. Occasional camps have been located at three or four points along this stretch, but the output was small. The commercial shells are mostly the three-ridge type, washboards, warty-backs, and muckets.

At La Salle the river is about a mile from the city. The right bank is low and inclined to be swampy; the left bank opposite the bridge is a fairly high range of drift material. The shore line on both sides is composed of mud with patches of sand and gravel. A peculiar slimy, tanky odor is noticeable at this point. No musseling is done, although a young man stated that last year he had done some pearling. According to his report, both the shells and pearls were very scarce.

At Hennepin there is a fairly good mussel bed; at Henry there are two, one above and the other below the dam; there is also a small bed on the right bank a quarter of a mile below the dam, but no shelling was being done on this bed.

The following table represents the percentages of the commercial shells from a 3-ton pile at Henry:

| | Per cent. |
|---|---|
| Blue point | 40 |
| Mucket | 20 |
| Washboard | 15 |
| Three-ridge | 10 |
| Warty-back | 5 |
| Pig-toe | 5 |
| All others | 5 |

The washboards are large, but badly spotted; the muckets and blue points have good luster and are good button shells.

At the present time it is a hard day's work to get 500 pounds of shells, while but a few years ago a man could dig a ton per day.

The bed above the dam has a depth of water from 10 to 20 feet and rather high mud banks. The current is about 2 miles per hour. An hour's work with bars and hooks on this bed yielded 128 shells, as follows:

| | | | |
|---|---|---|---|
| Blue point | 60 | Pink hatchet-back | 2 |
| Mucket | 25 | Floater | 2 |
| Three-ridge | 10 | Buckhorn | 1 |
| Warty-back | 5 | Slough sand-shell | 1 |
| Pig-toe | 5 | Deer-toe | 1 |
| Washboard | 4 | Squaw-foot | 1 |
| Paper-shell | 4 | Lady-finger | 1 |
| Maple-leaf | 2 | Total | 128 |
| Rock-shell | 2 | | |
| White heel-splitter | 2 | | |

There are a few small beds, 2 to 3 acres in extent, between Lacon and Chillicothe, yielding mostly washboards and three-ridges.

*Peoria Lake.*—From Chillicothe to Peoria, a distance of 20 miles, the river broadens into a lakelike expanse, called Peoria Lake, having a varying width of from a few hundred yards to nearly 2 miles. The slow current, the large volume of water, the good average depth and soft mud bottom are suitable for mussel growth, and there are consequently many fine mussel beds and an enormous quantity of shells, making this at present probably one of the best mussel-producing districts in the United States. Although the bottom is covered with dead shells, there have been taken, during the latter part of 1911 and the season of 1912, many tons of good shells by the lately devised dip-net method. Just what has caused the mortality of so many shells at this point and elsewhere on the river is not known. When the dip-net is brought up and the catch is emptied into the boat, the shells are sorted, the dead ones being thrown back into the river, thus keeping the bottom continually covered with them.

It is difficult to state where the mussel beds are located in Peoria Lake; in fact, they appear to be pretty well distributed over the entire bottom. Certain localities, however, are much more productive, while they vary to a considerable extent in abundance of species.

At Chillicothe there was on shore a 65-ton pile of shells, taken from the local beds, with the following percentages: Blue points 50 per cent, washboards 25 per cent, mixed shells 25 per cent, the latter consisting mostly of three-ridges, muckets, warty-backs, pig-toes, slough sand-shells, and rock-shells. On the entire pile not more than two or three niggerheads were seen. The washboards were tolerably spotted, but hardly so much as at Henry; the blue points were rather small and thin posteriorly.

There is a good bed, extending from a mile above the railroad bridge to 300 yards below, having a width nearly that of the river. The current is about 2 miles per hour; the bottom clay and sand; the banks low on both sides, and the depth of the water 12 to 15 feet. The following is the result of a two-bar haul over the lower end of this bed:

| | | | |
|---|---|---|---|
| Blue point | 61 | Black sand-shell | 3 |
| Fat mucket | 25 | Slough sand-shell | 3 |
| Washboard | 24 | Rock-shell | 2 |
| Three-ridge | 22 | Niggerhead | 1 |
| Lady-finger | 22 | Maple-leaf | 1 |
| Warty-back | 17 | Purple warty-back | 1 |
| Pig-toe | 17 | Elephant-ear | 1 |
| Mucket | 12 | Paper-shell | 1 |
| Three-horned shell | 7 | | |
| Butterfly | 3 | Total | 223 |

Formerly niggerheads would average 10 to 12 per haul, but now only an occasional one is found. This bed does fairly well on rising water, yielding about 500 per day.

Opposite and extending below Chillicothe, there is a small bed, 100 yards by one-half mile, but it was not being worked much this year. During 1911 a $3,000 pearl was found at this place.

A mile above Rome there is a good mussel bed, but as it is full of hang-ups, little shelling was done. We lost our bar on the first haul and were compelled to abandon this place. Just below, another good bed, one-fourth by 1 mile, yields mostly washboards and blue points.

There is also a fine little bed, 25 feet by 300 yards, 1 mile below Rome, but since it has scarcely been touched, it is covered with trash and water plants. The yield is largely blue points and three-ridges.

At Sand Beach Bar, a mile above Spring Bay, there is a small bed, 200 yards by one-fourth mile. The bottom is composed of soft mud, with some sand and many dead shells. A series of dip-net hauls showed but a small percentage of shells, mostly blue points and pig-toes. On account of the dams and the excess of water from the drainage canal, this bar is covered by water the entire year. On many low points and banks there is considerable drowned timber, due to the same cause.

There is an excellent bed, one-fourth by 1½ miles, at the narrows below Spring Bay. The bottom is soft mud, clay, and dead shells; depth of water 8 to 10 feet; fair current. A comparison of two hauls, one made with an ordinary mussel bar of 98 hooks, distance 50 yards, and the other with an 18-inch dip net, 50-yard circle, is given in table 7.

The bar caught 136 shells of 11 species; with the dip net the result was 74 live shells of 18 species. The first, however, produced nearly twice the number of commercial shells, but it took more than twice the time to make the haul; also the shells had to be taken one by one from the hooks, while the dip net was dumped at once into the boat, and the trash and dead shells were thrown back.

Mr. Oscar Nash, who assisted in the work on this bed, stated that in 1909 he obtained here 14 tons in 17 days and sold them for $18 per ton.

TABLE 7.—COMPARISON OF HAULS MADE WITH THE DIP NET AND THE MUSSEL BARS.

| Species. | Number of shells. | | Species | Number of shells. | |
|---|---|---|---|---|---|
| | Dip net. | Bar. | | Dip net. | Bar. |
| Blue point | 44 | 102 | Paper shell | 1 | 1 |
| Three-ridge [a] | 3 | 15 | Rock shell | 2 | |
| Warty-back | 1 | 3 | Maple-leaf | 1 | |
| Washboard [a] | 1 | 1 | Black sand shell | 1 | |
| Pig-toe | 1 | 6 | Deer-toe | 2 | 1 |
| Lady finger | 4 | 2 | *Anodonta imbecillis* | 1 | |
| Mucket | | 2 | *Anodonta corpulenta* | 1 | |
| Fat mucket | 1 | | *Plagiola donaciformis* | 1 | |
| Three-horned shell | 6 | 2 | *Quadrula fragosa* | 1 | |
| White heel splitter | | 1 | | | |
| Pink hatchet back | 2 | | Total | 74 | 136 |

[a] The washboards and three-ridges are found mostly in the channel.

On the Mossville Flats, just below the narrows, there were four camps in operation, and about 30 tons of good shells, largely blue points, and muckets, with fewer washboards, and some pig-toes. The washboards are very good and but little spotted. In this vicinity one man with a dip net can dig 1,000 to 1,200 pounds in half a day. It is claimed that some beds here have not been even touched.

At the present time Peoria is a great center of shell production. During the mussel-fishing season men from various parts of the river go there fully equipped to work, as the dip net can be used advantageously and the yield is exceptionally good. There were many camps at Gatlin's landing and from 80 to 100 tons of shells on shore. A similar condition exists just above this place, at Averyville. One shell buyer stated that he had purchased 600 tons at these two places last year and would at least equal it this season.

The percentages of the different species of the different camps vary considerably according to the part of the lake fished. One camp of six to eight tons had the following percentages of shells:

| | Per cent. |
|---|---|
| Blue point | 65 |
| Three-ridge | 15 |
| Mucket | 7 |
| Washboard | 5 |
| Pig-toe | 3 |
| All others | 5 |

The shells grouped under "All others" include white heel splitters, slough sand shells, etc.

The bed just above the upper bridge at Peoria was examined On account of the bottom not being suitable for the dip net, the ordinary bars were used. Thirty species were found, the percentages of commercial shells of which are as follows:

| | Per cent. |
|---|---|
| Blue point | 50 |
| Three-ridge | 8 |
| Mucket | 10 |
| Fat mucket | 10 |
| Washboard | 10 |
| Pig-toe | 5 |
| All others | 7 |

A day's work, including cooking, will produce 700 pounds of shells from this bed. When the dip net and a good gasoline boat are used on favorable bottoms much better results are obtained.

*Lower river.*—That part of the Illinois from Peoria to Grafton may, for the purposes of this discussion, be designated as the lower river, which is conveniently divided into two sections, the first from Peoria to Kampsville and the second from the latter place to the mouth.

First section: Between Peoria and the Government Locks at Kampsville, a distance of 128 miles, the mussel supply is very poor as compared with the output of two or three years ago. Although many tons of good shells are still being taken, the river shows marks of depletion.

There are five tolerably well-established beds between Peoria and Pekin, but they were not worked to any extent during the present season, probably on account of the nearness of Peoria Lake and the better results obtained in that region, where the dip net is used to good advantage. In 1910 there were 25 shellers at work on these beds, 10 in 1911, and but 1 or 2 in 1912. The first bed below Peoria extends from Kickapoo Point to Wesley; the second from Willow Point to within one-half mile above Seven-Mile Island; the third from the foot of this island and extending down 1½ miles; the fourth from the river road to within three-quarters of a mile of the bridge at Pekin; and the fifth from the "day mark" to the bridge at Pekin, a distance of one-half mile.[a] During the early part of this season (1912), Mr. Lemm gathered from these beds about 10 tons of good shells, of which 60 per cent were blue points, 25 per cent washboards, 10 per cent three-ridges, and all others 5 per cent. The washboards were exceptionally good.

Although there are several good mussel beds between Pekin and Havana, but little shelling has been done. The bottom is composed

[a] Mr. Herman Lemm, of Pekin, Ill., furnished the information concerning the location of these beds.

of mud and sand, covered more or less with dead shells and trash. At the mouth of Mackinaw River the bottom was soft mud and practically without mussels. The water had a very bad odor, due to sewage pollution. In reference to the soft-mud bottoms, Mr. Freeland states: "I jumped from the front end of a launch near Copperas Creek Locks and sank into the mud almost to my hips. At the mouth of Old Crow Creek at Chillicothe, at the mouth of the Mackinaw River below Pekin, above Copperas Creek Locks and Dam at Liverpool, and in the narrow reach between Liverpool and Havana this condition exists, not only near the shore, but all the way across the river. At Liverpool the weight on the sounding line sank into the mud at the middle of the river when attempts were made to ascertain water depths." The percentages of shells of this stretch are about as follows:

| | Per cent. |
|---|---|
| Blue point and three-ridge | 36 |
| Warty-back | 30 |
| Washboard | 5 |
| Mucket | 4 |
| Others | 8 |
| Noncommercial | 17 |

At Havana there were five or six camps with about 30 tons of good shells, which were taken mostly from the beds below the city where the washboards predominate. The percentages of shells are about as follows:

| | Per cent. |
|---|---|
| Washboard | 50 |
| Blue point | 45 |
| Others | 5 |

The mixed shells were the black sand shells (some of which had a white nacre, others being deeply colored), yellow sand shells, warty-backs, pig-toes, buckhorns, rock shells, higgins eyes, deer-toes, and pocketbooks.

In company with Mr. Henry C. Allen we examined the beds in the vicinity of Havana with the dip net. Above the mouth of Spoon River a small bed 2 to 3 acres in extent is fairly productive. The bottom is mud, there is a 2-mile current, and the depth of the water is 8 feet. Several hauls were made, showing 75 per cent of blue points and 17 per cent of noncommercial shells. There were also many dead shells.

Another bed, with the same bottom conditions, but with many more dead shells—especially noticeable in the older washboards—and thousands of live snails, is located at the head of Cooks Island. The percentage of this bed is: Blue points, 35; three-ridges, 24; warty-backs, 12; rock shells, 8; maple leaves, 7; slough sand shells, 7; washboards, 4; and others, 3.

The bed at the mouth of Quiver Lake showed that fully 90 per cent of the shells were dead. The only live ones found were of the three-ridge type and small washboards, 2 to 2½ inches in length. It is difficult to state just what has killed the shells at this point, although the young washboards, 2 to 3 years old, were strong and vigorous, indicating that more favorable conditions exist at present. The east shore, especially on the lower course of the lake, is sandy, and on digging a few inches into the sand clear, cold water was found, coming from the uplands. The west shore is low, and since the building of the drainage canal all kinds of timber on overflowed lands—acres upon acres—have been killed, due to high water the entire year.

A small bed of the three-ridge and floater types extends from Cooks Island to the railroad piers. The depth of the water is 8 to 20 feet and there is a fair current. This bed, especially on the lower end, has a very poor output.

Formerly the mussel beds in the vicinity of Bath were perhaps the most productive ones of the entire river. Hundreds of tons of good shells were gathered and shipped from there. The industry, however, has dwindled to such an extent that at the present time there are only six camps in operation, with about 50 tons on shore.

The beds above Grand Island, though fairly productive, could be restored to a considerable extent by propagation. The bottom is of hard mud, the current is fair, and the shores are low mud banks covered more or less with timber. In testing these beds, as well as those down the right chute of the island, two bars of 90 hooks each, were used. These beds gave the following percentages of shells:

| | Per cent. |
|---|---|
| Warty-back | 31 |
| Blue point | 19 |
| Maple-leaf | 10 |
| Washboard | 9 |
| Others | 17 |
| Noncommercial | 14 |

In the right chute, the conditions are somewhat better, though there are more trash, hang-ups, and dead shells. About halfway down, the bottom for a short distance is mostly sand and as a consequence the epidermis of the shells is inclined to be yellowish. A washboard, conspicuous by having a pronounced ridge and valley running diagonally from the umbone toward the posterior end was taken in one of these hauls. On opening the shell, the mantle at the tip contained a 10-grain hightop pearl of good luster, but badly discolored on the base. These beds had warty-backs, 38 per cent; blue point, 16 per cent; washboards, 11 per cent; other commercial shells, 15 per cent; and noncommercial shells, 20 per cent.

Matanzas Bay, above Bath, is being worked with dip nets. Ninety per cent of the commercial shells are blue-points. There are, however, many paper-shells and *Anodontas*, and many dead shells.

The beds at Beardstown have been extensively worked, and though fairly productive, 500 pounds of shells per day of 10 hours' labor with a gasoline boat is considered a good catch. Fifteen to twenty boats were working there, and the five button factories use the shells of the locality. Although the output is not good, there are three reasons why these beds are being so heavily worked, namely, the fair amount of pearl finds, the nearness to home, and the ready market.

An estimation of percentages from a 25-ton pile of freshly dug shells shows washboards, 35 per cent; blue-points, 24 per cent; warty-backs, 18 per cent; three-ridges, 8 per cent; all others, 15 per cent. Though smaller than the same species above Beardstown, the washboards are exceptionally good in this pile.

A series of test hauls of 200 yards each were made with the mussel bar on the 5-mile bed at Beardstown, beginning above the railroad bridge and extending 1 mile below. The bottom is sand and mud; the depth in channel, 10 to 20 feet; there is a 2-mile current, and the banks are low. This bed has washboards, 25 per cent; warty-backs, 19 per cent; blue-points, 11 per cent; pig-toes, 10 per cent; others, 12 per cent; and noncommercial shells, 23 per cent.

On the right bank below the bridge the washboards are more abundant, but, owing to so many snags and hang-ups, it is deemed inadvisable to work at that point. The niggerheads are scarce, though they are reported to have been plentiful some years ago. The spikes or lady-fingers are abundant. The washboards are but little spotted and are good button shells.

In the bay above Beardstown the washboards are more spotted and not so desirable for commercial purposes.

Three miles above La Grange Locks there is a small bed, one-half mile in length and practically as wide as the river, excepting in the channel. The river conditions are as follows: Current, 1 mile; 8 to 12 feet deep; mud bottom. On this bed the washboards are nearer to the shore, while the smaller shells are farther out. This and the two beds just below yield about 200 pounds per day, with bar. Very few pearls and slugs are found. The percentages of commercial species of these beds were determined from camps situated 3, 2, and 1 miles respectively, above the locks: washboards, 50 per cent; blue points, 20 per cent; three-ridges, 10 per cent; warty-backs, 10 per cent; and others, 10 per cent. The washboards are very good.

A bed beginning a little below the locks and extending to Meredosia, although fairly productive, was being fished but very little. The shells are pretty well distributed, except in the channel. The river conditions at this point are: Slow current; 8 to 15 feet deep; and bottom of clay, mud, and sand. The pocketbooks, pig-toes, and purple warty-backs were somewhat more abundant than in the preceding beds. It was stated that some years ago the niggerheads, yellow sand shells, and muckets were plentiful. There is a large percentage of lady-fingers, which when caught are generally thrown back into the river.

At Meredosia the mussel fishermen were discouraged and stated that "the river is playing out." Several camps were considering the advisability of moving to more favorable localities, either on the Illinois or Mississippi. Although the output—200 to 300 pounds of shells per day—was small, the number of good pearl finds afforded considerable stimulation to the work. During 1909 there were 200 men at work between Meredosia and Naples, and they gathered 100 carloads, the price being $25 a ton,[a] while in 1912 there were but 25 to 35 men gathering 15 carloads at $13 per ton. There were about 400 tons in the hands of the buyers and 250 tons at the two button factories. In this stretch of the river the niggerheads and muckets are scarce, but there is an abundance of lady-fingers. The washboards here, being clear of spots, are the best button material, and the next best are the blue points and warty-backs. The few niggerheads found are thin.

At Valley City there were 10 to 12 men working on the local beds, the output not exceeding 300 pounds. It was stated that there were many boats employed here last summer. There is a small bed, 300 to 400 yards long, situated on the left bank, one-eighth mile above the railroad bridge. This bed is covered more or less with trash and hang-ups, thereby making it remarkably interesting, in that it is practically in its native state. It contains 18 species of commercial shells, including a fair percentage of niggerheads, pocketbooks, and muckets.

Although early in the season, 40 men were fishing on the mussel beds in the vicinity of Florence, while but 9 were engaged in July. Forty tons of 1912 shells had already been shipped and half that amount were on shore. The following percentages were determined from a number of hauls made at Florence, two bars of 100 hooks each being used; the bottom, sand and mud with brush and dead shells.

| | Per cent. |
|---|---|
| Blue point | 24 |
| Washboard | 20 |
| Warty-back | 18 |
| Pig-toe | 9 |
| Others | 21 |
| Noncommercial | 8 |

[a] Kappel Bros., Meredosia, Ill.

Only one each of elephant-ear and squaw-foot were found; the lady-fingers were smaller and much less abundant than at Meredosia and Valley City. This bed will yield 200 to 300 pounds per day per man.

There are good beds on both sides of the river practically all the way from Florence to Montezuma. At the latter place, 12 tons of shells had been shipped this year, and 5 tons remained on shore. There were two to four men working on the mussel beds, getting 200 to 300 pounds per day. It was stated that two years ago there were 30 to 40 boats in operation, and 200 tons were shipped. The percentages of the shells are about as at Florence.

From Bedford 15 to 20 tons had been shipped by the middle of July and 8 tons were on shore. There were 10 boats at work, the yield being 300 to 400 pounds. The shells are the usual run, however, some beds have as much as 5 per cent of muckets, while on others the lady-fingers appear to be associated with the washboards.

A few years ago Pearl, like Bath, was a great mussel center. Then there were 300 to 400 men working on the bed, beginning near Bedford and extending in zigzag lines for 15 miles down the channel of the river. At the present time (1912) there are 30 men engaged in the mussel fishery, and they have gathered 10 to 12 carloads of good commercial shells; but the conditions have so changed and the outlook is so unfavorable that some of the local button factories are anxious for new territory.

Near shore, in the left chute at the foot of Spar Island, 3 miles below Pearl, there is a good productive bed yielding mostly rather large washboards, a fair percentage of blue points, and a few muckets. This bed has a mud bottom somewhat covered with trash, and is best worked by wading and diving. Near the shore line fully 75 per cent of the shells were slough sand shells, burrowed in the mud and standing on end.

The camps at Gravel Point, Webbs Landing, and Woods Creek Landing had 15 boats in operation, with an output of 30 tons. The shells in this stretch are of the usual run, though there is a smaller percentage of culls, such as lady-fingers and paper shells. The washboards are exceptionally good.

TABLE 8.—PERCENTAGES OF DIFFERENT SPECIES OF MUSSELS AT SIX STATIONS IN THE LOWER STRETCHES OF THE RIVER.

| Species. | Above Grand Island. | Right Chute, Grand Island. | Beardstown. | Florence. | Hardin. | Grafton. |
|---|---|---|---|---|---|---|
| Niggerhead | 1 | × | × | × | 4 | 32 |
| Ohio River pig-toe | 1 | 1 | × | × | 2 | × |
| Pig-toe | 4 | 3 | 10 | 9 | 2 | 1 |
| Warty-back | 31 | 38 | 19 | 18 | 13 | 3 |
| Maple-leaf | 10 | 2 | 3 | 2 | × | 3 |
| Washboard | 9 | 11 | 25 | 20 | 23 | 15 |
| Blue-point | 19 | 16 | 11 | 24 | 20 | 20 |
| Three-ridge | 4 | 4 | 4 | 5 | 11 | × |
| Lady-finger | 5 | 15 | 20 | 5 | 13 | 1 |
| Three-horned shell | 4 | 2 | 1 | 7 | 3 | 1 |
| Buck-horn | × | 1 | 1 | × | × | 1 |
| Deer-toe | 1 | 2 | × | × | 1 | × |
| Butterfly | × | × | × | × | × | 3 |
| Paper shell | 5 | 1 | 1 | 1 | 1 | × |
| Yellow sand shell | × | × | × | × | 1 | 7 |
| Other shells | 5 | 3 | 4 | 7 | 5 | 11 |

NOTE.—× represents less than 1 per cent.

Second section: From Kampsville to the mouth of the Illinois at Grafton, a distance of 32 miles, the mussel conditions are much better, and the river is yielding greater quantities of shells than any other portion except the Peoria Lake region. There were about 150 boats at work in this stretch, with a daily yield of 500 to 700 pounds of shells per man.

Except in the last few miles of the lower course, the river bears closely to the right of the watershed and to the high bluffs and wooded hills, and consequently becomes very picturesque in appearance.

Above the Government locks at Kampsville 10 men were engaged in mussel fishing, each obtaining 300 to 500 pounds per day. There were 30 tons on shore. The last bed above the locks extends almost to the dam and is more productive on the lower end, probably due to the fact that but little work had been done there on account of the danger. The beds produce washboards, 45 per cent; blue points, 21 per cent; warty-backs, 20 per cent; while just below the dam the yield is not so large, yet the pearl finds will probably more than make up the difference.

Below the Kampsville locks (the last in the river) the water is swifter, and the stream is in its natural condition. The shells are about the same as above, but near the dam there are more pocketbooks (*L. ventricosa* and *capax*) and fat muckets. Some beds also have a large percentage of lady-fingers. On July 3 a sheller working the bed below the locks unguardedly ran his boat into the falls of the dam and was drowned.

From Willow Island to the foot of Hurricane Island there were 30 boats in operation, and very good results were obtained. Both sides of the latter island have good productive beds; the catch, especially in the channel, is: Washboards, 75 per cent; blue points, 10 per cent; and warty-backs, 10 per cent. A good 32-grain pearl was found in this stretch during the summer.

There were four camps and 26 tons of shells on shore in the dark or right chute of Diamond Island. This chute is deep, narrow, and has a number of hang-ups. No shelling is done here on Mondays on account of the large steamboat which makes a round trip then from St. Louis to Kampsville. In going through this chute the steamboat makes such large and dangerous waves that no small craft there could keep from sinking. Twenty-eight species in all were taken here, including the only spectacle-case (*M. monodonta*) taken during the entire trip. The shells are largely washboards of excellent quality, and but few lady-fingers. The bed affords 400 to 600 pounds per day per man. The left or light chute is much shallower and the beds have a good yield of commercial shells.

At Hardin there were from 60 to 100 gasoline boats at work on the mussel beds, the yield being from 400 to 700 pounds of good quality shells. Probably by the latter part of July as many as 1,000 tons had been shipped from there, about one-third of the amount going to Canadian factories. It appears that Hardin would be an excellent location for a button factory, the raw material being so abundant and near at hand. A number of good pearls were found this year, the most valuable one selling for $750.

A series of test hauls were made, beginning at the foot of Diamond Island and extending to Hardin. The mussel bar and crow-foot hooks were used. From this bed 34 species were taken, also a number of dead shells. The percentage was:

| | |
|---|---|
| Washboard | 23 |
| Blue-point | 20 |
| Warty-back | 13 |
| Three ridge | 11 |
| Niggerhead | 4 |
| Pig-toe | 2 |
| Others | 13 |
| Noncommercial | 14 |

In that part of the Illinois from Hardin to Grafton at the mouth, a distance of 20 miles, there are practically no places for accommodations in the way of lodging, and it was necessary to make the survey of the interesting district in one continuous run, from early morning until late at night. There are a number of good and productive mussel beds in this region, with the exception of the last few miles of the river.

In the left chute of Mortland Island the yield of shells is 400 to 600 pounds per man per day. There are 12 to 15 camps within 2 miles of each other, and 90 to 100 tons have been taken this year. The shells are of the usual run of those found in this stretch, though the washboards are very small and there are fewer culls, such as lady-fingers.

At Twelve-mile Island there were four camps in operation, two on each side of the island, the average daily yield being from 400 to 600 pounds per man. Early in the season the upper camp of the right chute took 1,200 to 1,800 pounds per day, which was very good work indeed with the mussel bar and crow-foot hooks. The lower camps, during the earlier part of the season were overflowed, and work accordingly could not be carried on; however, when the conditions became more favorable, two men gathered 30 tons of good marketable shells in eight weeks. The mussel beds in the vicinity of this island produce about 65 per cent of washboards, 20 per cent of the three-ridge type, a very small percentage of niggerheads, and a sufficient quantity of yellow sand-shells to be sorted out and sold separately at an advanced price of from $50 to $60 per ton. The lady-fingers and other noncommercial shells are not very plentiful in this district.

In the last productive stretch of the river there are 10 to 15 mussel camps in operation, the daily output being 500 to 600 pounds, which is somewhat less than the immediate shelling districts above. The shells of the three-ridge type are more abundant, though there are fewer warty-backs; the washboards have again become a trifle larger than at Hardin, but they are not quite so good from a commercial standpoint, as they are inclined to be spotted.

As a comparison of the Illinois River product with that of the Mississippi, the percentages given in the brief table below were made from a 2-ton pile of recently gathered shells taken in the Mississippi at Grafton, just below the mouth of the Illinois. It will be observed that the niggerheads are relatively abundant and that there is a fair amount of yellow sand-shells.

| | Per cent. |
|---|---|
| Niggerhead | 32 |
| Blue point | 20 |
| Washboard | 15 |
| Yellow sand-shell | 7 |
| Warty-back | 3 |
| Butterfly | 3 |
| Maple-leaf | 3 |
| Others, including culls, etc | 17 |

*Tributaries.*—The tributaries of the Illinois, as a rule, produce a superior grade of shells and a larger per cent of pearls and slugs than the main stream. A serious disadvantage, however, of the smaller rivers is that, especially during the low water of summer, the mussel beds are liable to be almost completely depleted by waders, either pearlers or shellers.

Spoon River.—No extended investigations were conducted on the Spoon River during the present survey; however, a short trip was made in the lower stretches, which did not reveal very satisfactory conditions for mussel beds. The banks are composed of drift or mud, and the low bottoms are subject to overflow in times of high water. The river is very crooked, with numerous large bends and a considerable number of cuts and corresponding fills and bars on the opposite side. It is practically a depleted stream, as relates to the mussel fishery, though the upper portions are more favorable for mussel beds, and it is a question whether it would be profitable to restock it or carry on propagation work to any extent, as it is so readily exhausted in a season or two by pearl hunters and others.

There have been recorded, 20 years ago, from the Spoon River, about 38 species of the Unionidæ.[a] The commercial species listed in the general table of species on page 37 were from a pearl hunter's pile of shells taken from the upper river during the present season. The shells were excellent in quality, and large in comparison with those of the Illinois. Some of the washboards (*Q. heros*) were so large that they would hardly fit into an ordinary hat.

Sangamon River.—The Sangamon River is about 170 miles in length and has a drainage basin of 5,670 square miles, which is the largest of the tributaries. The lower stretch, formerly very winding and overflowing the lowlands, has been straightened by means of a ditch. The general conditions of this river, with its many favorable places for beds, are good for mussel development, and the propagation of the better species could be easily carried on and the river made to yield a reasonable annual return, provided it were judiciously fished. A station was made near Springfield, Ill., and the commercial shells found there are listed on page 37. The shells are of a better grade than those of the main stream, and the muckets, niggerheads, and buckhorns are more abundant. About 100 tons of good shells have been gathered this year, with a daily output of 400 to 500 pounds. A number of fine pearls and slugs were found, and all were generally of a rather good grade. The river appears to be fairly well cleaned out.

## DEAD MUSSEL BEDS.

At several places on the Illinois, more particularly noticeable in the lower stretches, there are evidences here and there of old covered-up mussel beds which lie several feet below the surface. The keeper of the Government locks at La Grange stated that at the time of building the locks, when extensive excavation was done, a dead mussel bed of some extent and thickness was encountered at a short distance below the present surface, and that the shells were lying in their natural position.

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[a] Strode, W. S., M. D.: The Unionidæ of Spoon River, Fulton County, Ill. The American Naturalist, vol. XXVI, 1892, p. 495-501.

Near the head of Diamond Island, situated about 2 miles above Hardin, there is exposed at low stages of the river along the shore line from below the water's edge to a foot above, an extensive bed of dead shells, as shown at A in figure 1. A similar condition exists further down the river on the right bank, as shown at B in figure 1. This is probably a continuation of the same bed. Below Hardin two additional beds are exposed where the current has undermined and cut away the banks—one bed at the head of Mortland Island extending irregularly down the left chute of the island for half a mile, and the other at the head of Twelve-mile Island.

Here, no doubt, is a situation of the destruction of large mussel beds in comparatively recent times by means of a silting or filling in

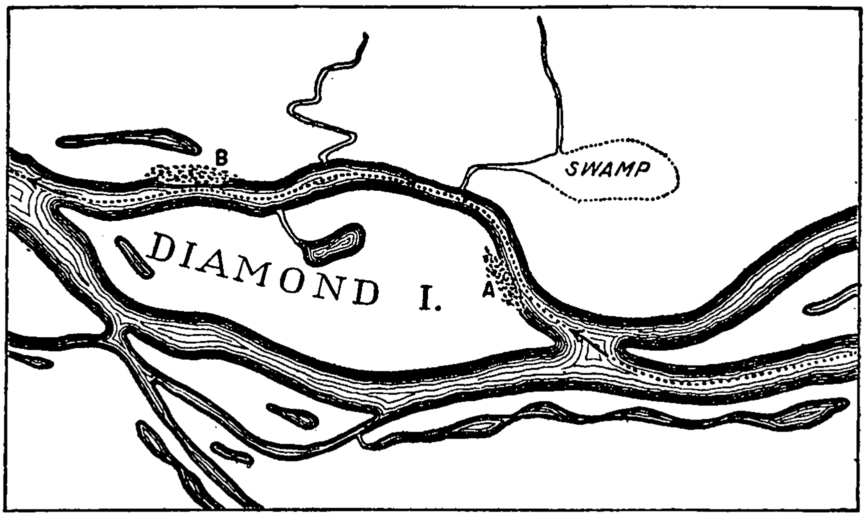


FIG. 1.

process of mud and sand. The mussels evidently could not keep pace with the settlings, as the deposit was rapidly forming, and were suffocated. The shells appear to be of the same species found in the river at those places, and are very fragile and limy white in color.

## METHODS OF THE ILLINOIS MUSSEL FISHERY.

The mussel fishermen of the Illinois are, as a rule, practical rivermen who are familiar with the conditions of the river, the general habits of the fishes and mussels, and the methods of taking them, although considerable misinformation is in evidence, as, for example, the structure of the mussel, methods of reproduction, the names of the shells, the character of pearls, etc. Mr. Freeland states that the men who were first attracted to the mussel fishery of this stream were largely an indolent lot, who expected to find an easy fortune in pearls, and in their haste to do so, generally discarded the shells as worthless, or at best only of secondary importance. During the summer of 1907 only two men were found who said that shells and not pearls were the chief object of their work. When the mussel industry reached a firm commercial basis, however, this type of men practically vanished, and was replaced by the regular fishermen, farmers who work at mussel fishing during dull seasons on the farm, the professional mussel fishermen, and by others who were attracted to the river for pleasure and profit during a summer's outing. The mussel fishermen, when at a distance from home, often live in tents or in rudely constructed houses situated at favorable places along the shore, and at times in substantial house-boats, which afford them shelter as well as an economical means of moving their outfit from place to place as the season changes or their inclination prompts.

Almost all of the shellers have gasoline boats with which to carry on their work. There are two types of boats in use—the launch, of which there are a variety of designs, and the john boat; the latter is very popular, as it is comparatively cheap, easily made, affords plenty of room, and is perhaps better adapted for handling the necessary appliances. It has a broad flat bottom, square ends, long rakes, especially forward, and is from 14 to 18 feet long. The gasoline engines are from 2 to 20 horsepower. The advantages of a power boat over the rowboat are very apparent, namely, the greater distance possible to travel in a day, the readiness with which the camps can be moved from one locality to another, and the greater quantity of shells taken.

*Crow-foot bar.*—The ordinary mussel bar or brail with crow-foot hooks, common on most of the commercial rivers, is the principal apparatus used on the lower two-thirds of the Illinois. The bar is usually of iron, from 12 to 16 feet in length, and from three-fourths to 1 inch in diameter. The strings carrying the hooks are placed 4 inches apart. There are two types of mules, or underwater sails, as they are sometimes called, the common solid frame type and the roll mule. The latter is generally used on this river, and has some advantages over the other, in that it can be rolled up and put out of the way when not needed, or used as a tent for protection against unfavorable weather, and it is claimed that it is better adapted to change the angle of the boat when desiring to cross the mussel bed diagonally or to avoid a known hang-up. On some parts of the river scissor forks or tongs are employed with fair success during part of the year, usually in low water. At those places where it is impossible to use any appliance on account of snags and other obstructions, and where the water is not too deep, the shells are often taken by wading or diving, but owing to the necessary exposure this method is not very popular with the mussel fishermen.

*Dip net.*—Since the time that the mussel fishery began on this river, it was known that Peoria Lake contained large beds of good commercial shells, but until 1911 no very successful method of taking them had been devised, scissor forks, oyster tongs, rakes, and the ordinary mussel bar with crow-foot hooks proving unsatisfactory. The dip net was introduced during the spring of that year and is now used there almost exclusively, as it is simple in construction, inexpensive, and especially suited to soft mud bottoms free from logs and hang-ups, and where there is but little or no current. Like the mussel bar, it gathers nearly everything in its path on the river bottom and even some little distance below. Besides the live and dead shells, and always plenty of mud, there are found at times in the net as the result of a haul some one or more of the following articles: Bottles, cinders, lanterns, old shoes and rubbers, folding anchors, spectacles, shotguns, pieces of musical instruments, shovels, watches and rings, jugs of gasoline, monkey wrenches, waterworks keys, tin cans, corncobs, snags, etc.

It is not known who invented this valuable apparatus, but probably the idea developed from the fish dip net, which it resembles, by gradually changing its form to the substantial tool now employed. There appear to be no two dip nets alike, as the blacksmiths make them according to orders and the material at hand. However, the various designs and patterns are very similar, the main difference being in size. The method of operation is the same for all of them. In a general way the dip net consists of a heavy, flattish iron hoop of one piece, bent somewhat triangular in form, with two of its sides curved outward and fastened firmly with bolts to a pole or handle 16 to 20 feet long. The third side or bottom is straight and from 18 to 36 inches in length, and is usually provided with coarse teeth along its edge, which is bent downward. A net of 2-inch mesh, made of small chain or no. 96 trot line with a capacity of a bushel or more, is fastened to the hoop by means of chain links and trails behind it. A short rope or bridle attached to the two curved sides of the hoop leads to a single rope secured to the bow of the boat. When the water is rather deep, the boats are fitted with a boom pole extending forward from the bow, and the rope from the bridle is fastened to its end, thus giving greater length of rope and convenience of manipulation. Driven by a gasoline engine of from 4 to 20 horsepower, according to the size and weight of the dip net, the boat draws the apparatus through the water along the bottom. The greater the power, of course, the better the results. The operator stands in the stern of the boat and steers with his foot or leg, and at the same time puts the net into the water, usually at his right side and bears down heavily on the handle. The teeth on the lower edge of the hoop dig up the mussels which roll into the net. Unless the appliance be placed at the stern and in the direct line of travel, there is a retardation on one side only, and the boat consequently makes a large circle over the mussel beds. When the tool is raised after making a haul, the mud and small shells are washed out by dipping the net a number of times into the river; the contents are then dumped into the bottom of the boat, to be sorted out, the trash and dead shells being thrown overboard. The partner usually attends to this matter as well as

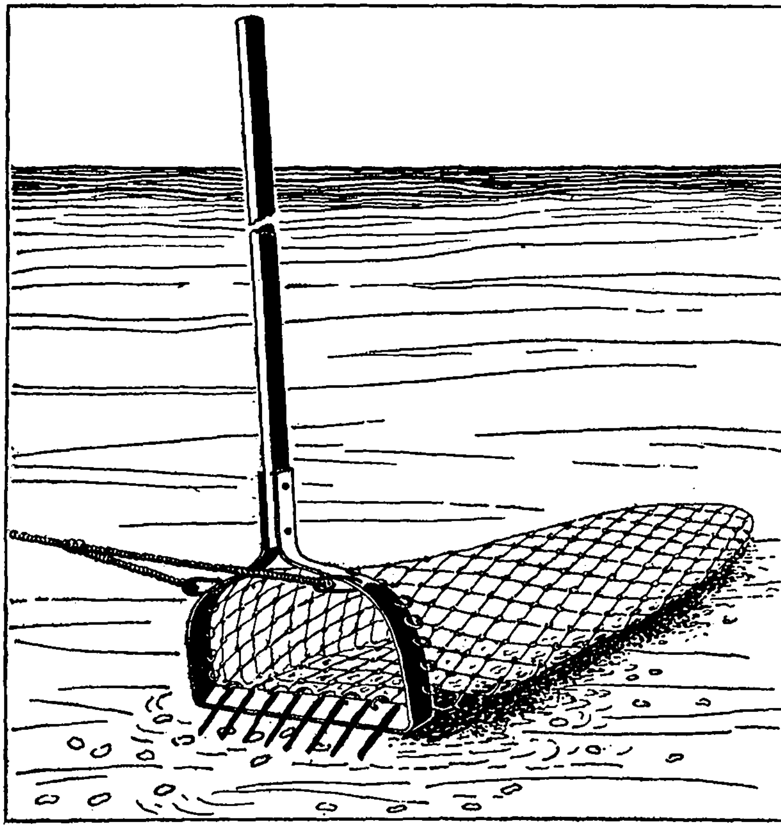

FIG. 2.

looking after the engine. By this method of mussel fishing, two men or a man and a boy can easily dig in a good locality 1,500 to 1,800 pounds of shells in half a day.

## LEGISLATION.

The legislature of Illinois has recently enacted a law looking toward the protection of mussels and the mussel fishery of the State. A closed season has been established for the navigable waters, extending from October 1 to April 1, inclusive. The boats are to be equipped with not more than two bars, which shall not exceed 16 feet in length, the hooks thereon to be at least 4 inches apart. Nonresidents must have a license costing $50 for each boat.

In view of the threatened depletion of the mussel beds on the Illinois, it has been suggested by mussel fishermen and others interested in the industry that there should be a closed season on all the mussel-bearing rivers or parts thereof, extending over a period of three to five years; the rivers or the parts to be so arranged in series that some (sufficient to maintain the button industry) would be left open during the ordinary shelling season. It may be that this view would prove satisfactory, provided there was a uniformity of laws in the various States, or that the mussel fishing was under Federal control.

## THE PEARLS OF THE ILLINOIS.

Very little pearling was done on the Illinois previous to 1892, although some years before this date occasional pearl hunters made frequent trips and extended investigations from time to time over the greater part of the river. During the earlier period pearls alone were the object of the search, there being no particular demand for the shells, and, besides, the pearler of that day had neither time nor inclination to save them; they were left after examination, usually in small piles along the shore as a waste product. If a locality in which he was working did not show immediate results he would move farther along, always hoping and expecting to find a mussel bed which would produce a pearl of considerable value, thus amply repaying him for his time and outfit. The pearl hunters are indeed the pioneers of the mussel industry, and in their extensive search for the elusive gems they have usually found not only the best mussel streams of the country but the best beds and the most productive portions of the rivers as well.

At the present time it might be said that the pearls and slugs are of secondary consideration and when found are regarded by the mussel fishermen as so much clear profit. The sale of slugs is generally sufficient to meet the actual running expenses of the camp and a pearl is considered as so much extra.

Beardstown, Ill., is a center for pearl buyers, and during the shelling season buyers are there from Paris, New York, and other places, besides the local dealers. One man claimed to have bought $20,000 worth of pearls and slugs along this river in 20 days.[a]

No particular work was done during the present survey toward the study of the origin of pearls; however, a number of distomids and cyst-forming parasites were observed in the meats of the mussels. The Illinois is a good river on which to carry on scientific pearl investigations, as it is rich in pearl mussels and affords many retired places

[a] The writer is indebted to Messrs. J. H. Carner and Otto H. Fischer, of Beardstown, who furnished much information concerning the pearls and slugs of Illinois.

and favorable mussel beds especially suited to pearl study. Among the most interesting localities for observing pearl formation and development may be mentioned Peoria Lake, Havana, Bath, Beardstown, Meredosia, Pearl, and Hardin, at which places, as well as at many others, excellent pearls have been found, and no doubt there are many more there yet to be taken.

### FINDING THE PEARLS.

The cooking-out process of the mussels is an interesting and important part of the work in the camps along the Illinois. The mussels are steamed for 15 or 20 minutes in a crudely constructed vat, until the shells have opened and the meats may be readily taken out. Shells and meats are then transferred from the cooker to the sorting table, and the parts there separated, the meats being put aside temporarily and the shells thrown into a near-by bin. The meats are then carefully examined one by one—a very tedious process, but well worth the trouble.

The slugs and other minor nacreous pieces when found are dropped into a glass of water on the sorting table and are afterwards cleaned, usually with soap or soap powder. A pearl, however, being much more valuable, receives an entirely different treatment in that it is "tempered" by being placed in the mouth for a while, then wrapped loosely in cotton, and put in a small tin box or other receptacle for safe-keeping. The pearlers and pearl buyers believe that this method of treating the gems prevents cracking.

"Does the boiling or cooking-out process of mussels injure the contained pearl?" is a question that is often asked and one that has led to considerable discussion. From personal observations and from the statements of mussel fishermen and pearl buyers it appears that moderate cooking or steaming of the mussels does not injure the pearls at all, provided they do not fall out of the shells or become disengaged from the meats and thus reach the bottom of the cooker and get scorched. Some mussel fishermen who have had practical experience along this line of work maintain that moderate cooking is beneficial rather than detrimental, inasmuch as the process "cures" the organic matter of the pearl and renders it less liable to crack or otherwise to deteriorate. However that may be, it is very evident that by far the greater percentage of the pearls and slugs are found after the mussels have been cooked, the exception being for those shells which show distortion or some other peculiarity, when they are generally opened with a knife as soon as found.

## CLASSIFICATION OF PEARLS.

There appears to be no definite standard or classification for the almost unlimited variety of shapes and kinds of pearls and slugs, and even on the different parts of the same river the irregular nacreous formations are variously named by the pearlers and buyers, according as fancy directs or to the resemblance to some familiar object. At times the classification is made under three heads—pearls, baroques, and slugs, each class with a number of subdivisions depending for names upon the particular shape of the pieces; and at other times there are but two heads—pearls and slugs. The following are the names and classifications generally used on the Illinois and includes most of the different kinds of pearls found there:

*Pearls:*

Ball or round pearls are those which are spherical in shape.

Pear pearls, including the drop, the egg, and the top pearls, depend for the name upon the resemblance in shape to a pear, egg, or top.

Button pearls, shaped somewhat like a button, biscuit, or saucer, have a more or less arched top and a flattish bottom.

Capsule pearls have a shape bearing a resemblance to a cylindrical medicine capsule such as is used for quinine.

Banded pearls are oblong in shape, with ridges and grooves around the middle portion which have the appearance of bands.

Cone pearls have a flattish bottom with the sides of the pearl running to an appex like a cone.

Baroque pearls include a great variety of forms which are irregular in shape without any particular pattern.

Rosebud pearls are of various shapes, usually having a flattish base; the upper portion is more or less covered with small protuberances, giving it at times a somewhat warty appearance.

Turtle-back pearls have a rather flat base and a low arched top, resembling somewhat the back of a turtle.

Besides these forms, there may be mentioned the dumb-bell, the cylinder, the twin pearls, etc., which are occasionally found.

*Slugs:*

Spikes or points, including wings, are usually placed under the head of slugs, although if they are of sufficient size they are sold as single pieces. Spikes or points are usually long, flat, and often pointed pearls found near the lateral hinge of the shell, while wings are broad, flattish pearls bearing a resemblance to the wings of a bird.

Nuggets and chunks are often classed together, with the difference that the chunks are much larger. They are irregular pearly formations resembling somewhat a gold nugget in shape.

Slugs include irregular pearls having no particular name and without much value and called "mixed;" also small or seed pearls, "chicken feed," etc. Slugs of this class are usually sold by troy weight, and are worth, according to quality, from $3 to $3.50 per ounce.

The ball, the pear, and the button pearls are the most valuable, although the capsule and some other forms often command a high price if they be symmetrical in shape and of fair size and good luster.

### POSITION OF PEARLS IN MUSSEL SHELL.

Pearls are usually found in the mantle near the tip or posterior end of the mussel, while slugs and other pieces may be found in various parts of the body, along the lateral hinge, at the cardinal teeth, in the adductor muscles, and in the shell itself, etc.

Sometimes a pearl becomes attached to the shell, after which it may be covered over by deposits or layers of nacre and is then said to be embedded. These pearls can be recovered by sawing the shell around the observed protuberance or by carefully removing the inclosing layers. Many shells have what are commonly called "blisters," which are successive pearly deposits over mud, muddy water, organic matter, or some foreign substance finding its way into the mussel. It illustrates a method the animal uses to remedy a disturbance within. Blisters, as found in the Unios, have no commercial value. There are found occasionally in the meats of the mussels cartilaginous formations which are denominated by the fishermen as "soft pearls undergoing the process of formation into true pearls." It is claimed that soft pearls are caused by a grain of sand or other foreign body.

### PEELING A PEARL.

As pearls are composed of thin concentric layers of nacre and conchiolin or animal substance, each separate and distinct, peeling or removing some of the outer layers of the various forms of pearls to improve the gems is often done successfully by one versed in this line of work. Pearls having a dark spot, stain, or chalky appearance over the entire surface, or even a part of it, are greatly diminished in value. When such is the case it is often worth while to try the experiment of peeling, as the result will probably be satisfactory and a good pearl obtained from within. However, it may be stated that fairly good pearls have been damaged rather than improved by peeling, as the inner layers were in a worse condition than those at the original surface. A fine, pink, high-button pearl of 40 grains and worth $800 was seen this summer. The pearl had a small spot on the side and might have been benefited by peeling, but the owner, considering its present value and the uncertainty of the result of peeling, would not take the risk.

### CRIPPLED SHELLS.

Occasionally the various mussel beds of the Illinois produce a few examples of distorted or injured mussels, commonly called "crippled shells." They are regarded by the pearler as excellent finds and are generally opened at once without waiting for the cooking-out process, with the hope that a piece of some value may be present.

Those shells which have received an external injury, however, and are distorted in consequence, seldom contain anything of value; but it does appear unquestionable that other distorted shells owe their peculiar condition to the presence of a pearl; the abnormal shape is the direct result of an accommodation to the disturbing nacreous growth within, which as it slowly develops maintains its position relative to the margin of the mantle and valves. Certain shells which have come to the writer's attention contained valuable pearls as well as showing clearly the abnormal condition. As viewed from the outside, such shells have a slight and gradually broadening ridge running diagonally down from near the beak or umbone to the tip or the posterior end on one valve and a corresponding valley or depression down the other. Within the shell the opposite condition of the ridge and valley is true. From this circumstance it is possible to estimate with some degree of accuracy the age of the pearl by the lines of growth on the external surface of the shell, noting where the disturbance begins and ends. In studying these distorted shells the peculiar fact is brought out that the pearl is always on that side of the shell whose valve shows, viewed externally, the valley or depression. In a large percentage of these distorted shells the pearls have been found on the left valve. The pearl, near the margin of the mantle, causes the abnormal action of the latter, which produces the slight inward curve of the nacreous deposit, so that it might be said that the pearl lies on or near a ridge. For the opposite valve the mantle condition is reversed, resulting in the outward deflection of the nacre, or the valley.

Some of these apparently valuable crippled mussels contain no pearl whatever, although the evidence is plainly written, both within and without, in the texture of the shell. When this condition is observed, the pearls are said to have been lost or "shed." If the pearl were lost some years before the mussel was taken, the shell often recovers in part its natural shape from that time on, as shown by the lines of growth and the posterior edge or lip, and it is hardly worth the time and trouble to try to find a pearl within.

Accompanying plates show some examples of distorted or otherwise injured mussels and will assist in understanding this interesting subject.

### QUALITY AND VALUE OF ILLINOIS PEARLS.

The quality of the Illinois River pearls and slugs, though very good, does not quite equal that of the pearls and slugs of the Wabash and some other tributaries of the Mississippi. Nearly all of the different species of mussels have produced pearls and slugs, but the washboard (*Quadrula heros*) is the principal pearl-bearing shell of the Illinois, and the blue-point and three-ridge (*Q. undulata* and *plicata*) are among the best slug producers, although the warty-backs (*Q. pustulosa*) occasionally have good specimens of the latter. Some of the paper shells and floaters were observed to have a number of attached pearls, appearing for the most part at the tips or posterior ends of the shells. These pearls, as a rule, are of no value except from the standpoint of the experimenter.

The average yield of slugs for the entire river will not exceed, perhaps, one-half ounce per ton of shells, while the percentage of good pearls is very small indeed. Many valuable gems, however, have been found in this river during its shelling history. It is difficult to determine the value of the Illinois River pearls and slugs for 1912 or for previous years, as there are many buyers traveling along the stream during the shelling season who make private purchases of them, paying for the slugs from \$3 to \$3.50 per troy ounce. Pearls ranging in value from \$5 to \$25 and upward were found in 1912 at nearly all the principal mussel beds from Hennepin to below Hardin. Among the best finds may be mentioned the following: Three fine pearls were found in Peoria Lake and sold for \$1,100 each, and one exceptionally fine pear pearl of beautiful luster, weighing 64 grains, sold for \$2,500. One at Pearl, Ill., sold for \$2,700, and one found at Hardin brought \$750. The news of such good finds spreads rapidly throughout the locality and is a great stimulus to the pearl and shell industry. The pearlers become expert in their line of business and can usually tell at a glance from what general class of shells the pearls and slugs are taken. For example, it is well known to them that the lower river beds produce "washboard stuff," which is very white, although some of the pieces may be stained similar to the spots in the shell, and the upper river stretches yield a large quantity of "bluepoint stuff," often having a tinge of pinkish color.

TABLE 9.—DISTRIBUTION OF MUSSELS AT THE PRINCIPAL STATIONS ALONG THE ILLINOIS RIVER.

| Mussel species. | Henry. | Chillicothe. | Peoria Lake. | Pekin. | Havana. | Bath. | Beardstown. | La Grange Locks. | Meredosia. | Naples. | Valley City. | Florence. | Bedford. | Pearl. | Spar Island. | Kampsville. | Diamond Island. | Hardin. | Twelve-mile Island. | Six-mile Island. | Grafton. | Spoon River. | Sangamon River. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Purple warty-back (*Quadrula granifera*) | | × | × | | × | × | | | | | | | | | | | | | | | | | |
| 2. Purple warty-back (*Quadrula tuberculata*) | | | | | | | | × | | | | | | | | | × | × | | | | | |
| 3. Niggerhead (*Quadrula ebena*) | | × | × | × | × | × | × | × | × | × | × | × | × | × | | × | × | × | × | × | × | | × |
| 4. Niggerhead (*Quadrula pyramidata*) | | | | | | | | | | | | | | | | | | × | × | | | | |
| 5. Niggerhead (*Quadrula plena*) | | | × | | | | | | | | | | | | | | | × | | | | | |
| 6. Niggerhead (*Quadrula solida*) | | | × | | | × | × | | × | | × | × | | × | | × | × | × | | | | | |
| 7. Thin niggerhead (*Quadrula coccinea*) | | | × | | | | | | | | | | | | | | | | | | | | |
| 8. Ohio River pig-toe (*Quadrula obliqua*) | | | × | | | × | × | × | × | | × | × | | × | | × | × | × | × | | | × | |
| 9. Pig-toe (*Quadrula trigona*) | × | × | × | × | × | × | × | × | × | × | × | × | × | × | | × | × | × | × | × | × | × | × |
| 10. Wabash pig-toe (*Quadrula rubiginosa*) | | | × | | | | | | | | | | | | | | | | | | | | |
| 11. Two-horned pocketbook (*Quadrula pustulata*) | | | | | × | × | × | × | × | | × | × | | × | | × | × | × | × | | × | | |
| 12. Warty-back (*Quadrula pustulosa*) | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| 13. Maple-leaf (*Quadrula fragosa*) | | | × | | | | | | | | | | | | | | | | | | | | |
| 14. Maple-leaf, stranger (*Quadrula lachrymosa*) | × | × | × | × | × | × | × | × | × | × | × | × | × | × | | × | × | × | × | × | × | × | × |
| 15. Monkey-face (*Quadrula metanevra*) | | | × | | | × | | × | × | | | | × | × | | | | | | | × | | |
| 16. Washboard (*Quadrula heros*) | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | |
| 17. Blue-point (*Quadrula undulata*) | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| 18. Three-ridge (*Quadrula plicata*) | × | × | × | × | × | × | × | × | × | | | × | | × | × | | × | × | × | × | × | × | |
| 19. Bullhead (*Pleurobema æsopus*) | | | | | | × | | | × | | | | | | | | | | | | | | |
| 20. Elephant ear (*Unio crassidens*) | | × | | | | × | | | × | | | × | | × | | × | × | × | × | | × | | |
| 21. Lady-finger, spike (*Unio gibbosus*) | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | |
| 22. Spectacle-case (*Margaritana monodonta*) | | | | | | | | | | | | | | | | | × | | | | | | |
| 23. White hatchet-back (*Symphynota complanata*) | × | | × | | × | × | × | × | × | × | | | | | | | | | | | | | |
| 24. Fluted shell (*Symphynota costata*) | | | | | | × | | | | | | | | | | | | | | | | | |
| 25. Rock-shell, queen (*Arcidens confragosus*) | × | × | × | | × | × | × | × | × | × | × | × | × | × | | × | × | × | × | × | × | | |
| 26. Rock-shell, queen (*Anodonta corpulenta*) | | | × | | × | × | | | | | | | | | | | | | × | | | | |
| 27. Floater (*Anodonta grandis*) | × | | | | × | × | | × | × | | | | × | × | × | | × | × | × | × | | | |
| 28. Floater (*Anodonta suborbiculata*) | | | × | | × | × | | | | | | | × | | | | | | | | | | |
| 29. Floater (*Anodonta imbecillis*) | | | × | | × | × | | | | | | | | | | | | | | | | | |
| 30. Squaw-foot (*Strophitus edentulus*) | | | × | × | | × | | | | | | × | | | | | | × | | | | | |
| 31. Three-horned shell (*Obliquaria reflexa*) | | × | × | | × | × | × | × | × | | × | × | | × | | × | × | × | × | × | × | | |
| 32. Pistol-grip, buckhorn (*Tritogonia tuberculata*) | × | | × | | × | × | × | × | × | × | | × | | × | × | × | × | × | | | × | × | × |
| 33. Pistol-grip, buckhorn (*Plagiola donaciformis*) | | | × | | × | × | × | × | × | | | | × | × | | | × | × | | | | | |
| 34. Deer-toe (*Plagiola elegans*) | × | | × | | × | × | × | × | × | × | × | × | × | × | | × | × | × | × | × | × | × | |
| 35. Butterfly (*Plagiola securis*) | | × | × | × | × | × | × | × | × | × | × | × | | × | | × | × | × | × | × | × | | |
| 36. Missouri niggerhead (*Obovaria ellipsis*) | | | × | | | | | | | | | × | × | × | | × | | × | × | | × | | |
| 37. Paper-shell (*Lampsilis lævissima*) | | | × | | × | × | × | | × | | | × | | × | | | | × | × | | | | |
| 38. Paper-shell (*Lampsilis gracilis*) | × | × | × | × | × | × | × | × | × | × | | × | | × | × | × | × | × | × | | × | | |
| 39. Pink hatchet-back (*Lampsilis alata*) | × | | × | × | × | × | × | × | | | | × | × | × | × | × | | × | | × | | × | × |
| 40. Pink hatchet-back (*Lampsilis parva*) | | | × | | | | | | | | | | | | | | | | | | | | |
| 41. Black sand-shell (*Lampsilis recta*) | | × | × | | × | × | × | × | × | × | × | | | × | | × | × | × | × | × | × | × | × |
| 42. Slough sand-shell (*Lampsilis fallaciosa*) | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × | | × |
| 43. Yellow sand-shell (*Lampsilis anodontoides*) | | | × | | × | × | × | × | × | | × | × | | × | × | × | × | × | × | × | × | | |
| 44. Higgins-eye (*Lampsilis higginsii*) | | × | × | | × | × | × | | × | | | × | | × | | × | | × | × | | | | |
| 45. Higgins-eye (*Lampsilis orbiculata*) | | × | × | | | | | | | | | | | | | | | | | | | | |
| 46. Mucket (*Lampsilis ligamentina*) | × | × | × | × | × | × | × | × | | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| 47. Fat mucket (*Lampsilis luteola*) | × | × | × | × | × | × | × | | × | | | × | | × | × | × | | × | | | | | × |
| 48. Pocketbook (*Lampsilis capax*) | | | | × | × | × | × | | | | × | × | | × | | × | | × | × | | × | | × |
| 49. Pocketbook (*Lampsilis ventricosa*) | | | × | | × | × | × | × | × | × | × | × | | × | | × | × | × | × | × | × | × | × |

## MUSSEL SPECIES.

There have been recorded about 63 species of Unionidæ from the Illinois River and its principal tributaries.[a] During the present investigation, however, the following 49 species were found in the main stream. About 20 of these are suitable for manufacturing purposes, although only 6 or 7 occur in sufficient quantities to be of practical worth.

[a] Baker, Frank Collins: A catalogue of the Mollusca of Illinois. Bulletin of the Illinois State Laboratory of Natural History, vol. VII, art. VI, September, 1906.

1. Purple Warty-back, *Quadrula granifera* (Lea).—This is a rather rare shell in the Illinois, although a few examples were found in the upper half of the shell-producing portion of the river at Chillicothe, Peoria, Havana, and Bath. It is an inflated shell, heavy anteriorly, and reaches a good size, but on account of its dull purple nacre it is not now used for the manufacture of buttons. After the cooking-out process, this shell is discarded by the mussel fishermen as worthless. The purple warty-backs, paper-shells, lady-fingers, and other culls are gathered along with the commercial species, and although they are known to be of no particular value, they are saved for the meats for fish bait, and also because they occasionally produce good pearls.

2. Purple Warty-back, *Quadrula tuberculata* (Rafinesque).—Rare; some examples of this mussel were found in the lower stretches of the river where the water is swifter, as below the Government locks at La Grange, at Diamond Island, and at Hardin. There appears to be a more or less gradual change from the inflated *granifera* of the upper stretches, where there is but little current and the bottom is composed largely of soft mud, to the much flatter *tuberculata* of the lower river where the bottom is harder and the current is stronger. This shell, like the *granifera*, has a dull purple nacre, and at the present time has no commercial value.

3. Niggerhead, *Quadrula ebena* (Lea).—On account of its good size, firm texture, and fine pearly luster this is the most valuable button shell of the United States. Near the tips it produces a few iridescent buttons. Although widely distributed throughout the entire river, this species is so rare in the upper stretches that often only one or two examples are found in a ton of shells. In the lower third of the river the conditions are better; the number may run as high as 2 or 3 per cent. It has been stated that eight or nine years ago the *ebena* and *ligamentina* (mucket) were fairly abundant in many beds of the Illinois, though the indications are that the former was never very plentiful.

Some mussel fishermen are of the opinion that the annual deposit of sediment, covering up the beds, is one reason for their diminution. Mr. J. F. Mayes, of Meredosia, Ill., has tried an experiment along this line, and states that if a washboard (*heros*), niggerhead (*ebena*), and a mucket (*ligamentina*) are put into a bucket and water and sand are added only the washboard will reach the surface; the others will be suffocated. This may explain the situation for some beds where the silting occurs rapidly at a time when the animals are more or less dormant, but does not appear satisfactory for the entire river.

Some examples of *ebena* taken at Peoria and Florence have the umbones wide apart, and are similar to Call's figures of this species, as illustrated in his paper on Mollusca, in the Indiana Geological Report, for 1899.

This species was found gravid, early embryo, all four gills, July 12.

4. *Quadrula pyramidata* (Lea).—Rare; a few samples were found in the last stretch of the river at Hardin and at Twelvemile Island. This shell is very heavy anteriorly and thin at the tips. Some examples have pink nacre. This and the two species following are usually classed with and generally called "pig-toes" by the mussel fishermen.

5. *Quadrula plena* (Lea).—Rare; an example or two were found at Peoria and Hardin.

6. *Quadrula solida* (Lea).—A comparatively rare species, although found in several mussel beds from Peoria to Hardin, more particularly at Peoria, Beardstown, Meredosia, and Valley City. The nacre varies from white to salmon. This shell furnishes good button material.

7. Thin Niggerhead, *Quadrula coccinea* (Conrad).—This is a very rare species in the Illinois. Some examples were found in Peoria Lake.

8. Ohio River Pig-toe, *Quadrula obliqua* (Lamarck).—This shell, while not a common one in the Illinois, is found generally distributed throughout the river. It furnishes good button material, but is hardly equal in size or quality to the species in the Ohio River beds.

9. Pig-toe, *Quadrula undata* [a] (Barnes).—Although this species in the Illinois is the most abundant of the "pig-toe" group, it forms but a small percentage of the mussel output. Some beds, depending upon the parts worked, gave the following percentages: Chillicothe, 7; Pekin, 3; Florence, 9; and Hardin, 2.

This is a good button shell, but has considerable waste on account of the heavy umbones. At Peoria small *undatas* just large enough to make one blank were taken and sold by some of the mussel fishermen. As an excuse for these small shells in their piles they said, "The pig-toes are running smaller now."

Some examples had orange flesh. Found gravid in all four gills June 20.

10. Wabash Pig-toe, *Quadrula rubiginosa* (Lea.).—This is a rare species in the Illinois. The only examples found were taken from Peoria Lake.

11. Two-horned Pocketbook, *Quadrula pustulata* (Lea).—Although this mussel is generally distributed throughout the river, it is found in very small numbers. It is usually classed with the *pustulosa*, or warty-backs, but is hardly as good material for manufacturing purposes.

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[a] According to Mr. Bryant Walker, Nautilus, vol. XXIV, p. 6, the name *undata* has precedence over the one (*trigona*, Lea) commonly used.

12. WARTY-BACK, *Quadrula pustulosa* (Lea).—The *pustulosa*, or warty-back, is a very common shell in the Illinois, certain very productive beds yielding a large per cent of the output. This mussel, though thin at the tips and in old specimens heavy at the beaks, is of good size, quality, and luster and often classed next to the niggerhead for manufacturing purposes. There are a number of variable forms of this species among our examples, one of which (no. F 6245), found at Henry, Ill., June 19, was referred to Mr. Bryant Walker, who states that it "is a young and very much inflated *dorfeuilleamus*, which Simpson calls a synonym of *pustulosa*. I think it quite likely that some day it may be given varietal rank." This mussel often contains a number of slugs; one of our examples had nearly 50 small nacreous pieces at the dorsal part of the body. Found gravid July 5.

13. MAPLE-LEAF, *Quadrula fragosa* (Conrad).—Rare; an example was found in Peoria Lake, but it does not agree exactly with *fragosa* as we found it in the Cumberland River, near Clarksville, Tenn.

14. MAPLE-LEAF, *Quadrula lachrymosa* (Lea).—*Lachrymosa*, while not common, occurs in small numbers in practically all the mussel beds of the river. Some examples of this shell found with projecting tubercules, appear to be the form described as *asperrima*, now a synonym. This shell has good luster and size in the Illinois and is usually classed as first-grade material. One example found in the Spoon River measured 4½ inches in length.

15. MONKEY-FACE, *Quadrula metanevra* (Rafinesque).—A rare species in the Illinois, but few specimens being found at the stations given in the general table on page 37.

The green triangular markings so prominent in well-defined species are faint in our specimens. Some examples vary considerably in shape and general appearance. One is heavily pustulose anteriorly, many of the pustules being elongate along the lines of growth, and is strongly suggestive of *Q. pustulosa*. Another of our examples has the markedly pinched posterior dorsal portion generally pronounced in this species in the lower Wabash. All of our shells are noticeably inflated.

16. WASHBOARD, *Quadrula heros* (Say).—*Heros* is the best button shell of the Illinois and produces the most blanks per ton, but in some localities is porous and does not do well for an engraved button. The three-ridge type makes a better finished button. In the upper stretches of the river the complete washboard shell averages about 1 pound in weight and is frequently spotted; but from below Beardstown to Twelvemile Island it is much smaller, flatter, freer from spots and stains, and of good luster. At Hardin this shell is no larger than the *undulata* or bluepoint of Peoria Lake, even old examples called "bald-pates" found in the channel are small.

In some localities, as at Quiver Lake, above Havana, the old *heros* are dead; not a single living example was taken, excepting the young, indicating that whatever the cause of the mortality had been, more favorable conditions exist at present.

Small shells 2 or 3 inches long are taken by the mussel fishermen; and while they make a few good blanks, to take them is very wasteful, as they should be thrown back into the river and allowed to mature.

In our collection there are three examples of this shell, which show very clearly the abnormal ridge and valley caused by the growth of pearls within. Two of the shells were found near Bath, Ill., and the other at Peoria.

Plate II represents a *heros* or washboard, measuring 4⅝ by 6½ inches. The nacre is remarkably clear. From the entire shell, 5 dozen 24-line blanks were cut at the button factory of Mr. J. H. Carner, Beardstown, Ill.

17. BLUE-POINT, *Quadrula undulata* (Barnes).—The *undulata* is a very abundant species and is regarded by the button men as a very desirable shell. It is rather flattish, particularly at Chillicothe, though lower down the river it is somewhat more inflated. It is rather thin and light in weight but of good size and luster.

The shell is commonly called the blue-point, but in some camps the name of "purple-tip" is applied to it on account of the slight purple tinge at the posterior end.

A few examples almost free from ridges were found in Peoria Lake and at Florence, Ill. Prof. Richardson, of the State biological station at Havana, had two similar specimens taken from the river at that place.

This mussel was found spawning July 12.

18. THREE-RIDGE, *Quadrula plicata* (Say).—The three-ridge is much less abundant and not so valuable a shell as the blue-point. Being usually more inflated, heavier at the beaks, and with larger ridges, it leaves more waste after the blanks are cut.

At Meredosia, it is claimed that the *plicata* has a tendency to crumble when cut. Found gravid July 8 and 15.

19. BULLHEAD, *Pleurobema æsopus* (Green).—Rare; examples were found only at Bath and Meredosia. It is brittle and not a good button shell; moreover, being so uncommon in the Illinois, it is disregarded altogether.

20. ELEPHANT-EAR, *Unio crassidens* (Lea).—Rare; although found in most of the beds, the percentage is so small that it is practically a negligible quantity. The nacre varies from pink to white. This shell is used for making novelties.

21. LADY-FINGER, SPIKE, *Unio gibbosus* (Barnes).—The lady-finger is not now a commercial shell unless it be white, which is seldom the

case. It is found in large quantities along the river, some beds, which the clammers avoid as much as possible, having a very large percentage. Above the upper bridge at Peoria there are two small beds of this species; one bed consists mostly of white nacred shells, while in the other the nacre is the ordinary dull purple color. At Meredosia a driveway leading from the river to the bank above is covered with about 60 tons of these shells. They had been purchased at a low price in the hope that there would be a demand for them. Button cutters claim that even the white *gibbosus* do not make good blanks on account of the shell being brittle.

In the Cumberland River, *crassidens* is much more abundant than *gibbosus*, which is the poposite condition in the Illinois.

22. SPECTACLE-CASE, *Margaritana monodonta* (Say).—Rare; only one example was found during the entire trip, at Diamond Island, above Hardin, although there were some specimens from this river at the biological laboratory at Havana, Ill. The shell is too thin and brittle to be of any commercial importance. Not so large as the Cumberland River species.

23. WHITE HEEL-SPLITTER, *Symphynota complanata* (Barnes).—When of sufficient thickness, this shell is used for buttons. It is fairly common in the Illinois, and from its flat shape and outline is often called the "elephant-ear" by the mussel fishermen. It is found in sloughs and in mud bottoms.

24. FLUTED-SHELL, *Symphynota costata* (Rafinesque).—Rare; only one example found, at Bath.

25. ROCK-SHELL, BASTARD, QUEEN, *Arcidens confragosus* (Say).—Found in small quantities on almost all of the mussel beds. It is not regarded as particularly good button material. This shell is sometimes called the black pocketbook, rock pocketbook, and bastard. An extra large and inflated example was found at Havana, June 28.

In young examples of *confragosus* the interior surface of the shell is indented or pitted to conform with the more pronounced pustules on the outside. This condition at the end of probably two years disappears, the shell becoming covered with subsequent layers of nacre.

26. *Anodonta corpulenta* (Cooper).—Four *Anodontas*, the *corpulenta, grandis, suborbiculata*, and *imbecillis*, were found during the present survey. They are thin, paperlike shells and have no commercial or economic value, excepting perhaps as they are used occasionally by the mussel fishermen for fish bait or hog feed. The *corpulenta* is found in sloughs, and on soft mud bottoms.

27. FLOATER, *Anodonta grandis* (Say).—Distributed as the preceding species. Shells which have recently been killed rise to the surface of the water on account of the gases of decomposition and

are seen floating along with the current; hence the common name of "floater." *Grandis* and *corpulenta* are often affected with parasites, particularly at the posterior end. Our examples were all of only moderate size as compared with shells seen in retired places along the Cumberland.

28. *Anodonta suborbiculata* (Say).—*Suborbiculata* is widely distributed and is generally found on mud bottoms and in slack water.

29. *Anodonta imbecillis* (Say).—This small, delicate shell is very abundantly distributed, especially in the more retired places of quiet waters. Found gravid June 27 and July 2.

30. Squaw-foot, *Strophitus edentulus* (Say).—Found rather scattering throughout the various stretches and mussel beds of the river. The nacre is usually of a yellowish color. This shell has no particular commercial value, although some examples are found which are of sufficient thickness and size for manufacturing purposes.

31. Three-horned Shell, *Obliquaria reflexa* (Rafinesque).—This mussel is widely distributed and is usually of small size. There are two or three forms of *reflexa* found in the Illinois. In the upper stretches of the river it is of the ordinary shape and size found in other streams, and although it can be used for manufacturing purposes it is not a particularly valuable shell to propagate. In the Peoria Lake region, however, where the current is slow and the bottom is composed of soft mud, the shell is often very heavy and rounded anteriorly, while posteriorly it is thin and much elongated, which no doubt is the result of accommodation to natural conditions. In the lower stretches the shell, though heavy and inflated, is considerably smaller than those in the upper portions of the river. A number of our examples have five tubercules on each valve. Found gravid June 27 and July 3.

32. Buckhorn, Pistol-grip, *Tritogonia tuberculata* (Barnes).—Although this interesting species is comparatively rare in the Illinois, it is widely distributed. The name of pistol-grip is applied to it in some localities, owing to the fact that it fits the hand like a pistol. The characteristic ridge of this shell gives it somewhat the appearance of the abnormal ridge found occasionally on the *heros* or washboard as the result of pearl growth. While this shell has a ridge on each valve, the abnormal washboard has but one valve ridged, the other having a corresponding valley.

The buckhorn furnishes good material for the manufacture of buttons and novelties.

33. Little Pocketbook, *Plagiola donaciformis* (Lea).—This small mussel, although of no commercial value, is very common in the Illinois. There are two types of this species found in many beds, differing in shape to a certain extent and particularly in color. On

account of its resemblance to *L. ventricosa* it is often called the "little pocketbook." Found gravid June 27 and July 4.

34. DEER-TOE, *Plagiola elegans* (Lea).—This beautiful species is found in small quantities throughout the entire river. It is hardly considered a commercial shell, but the larger and thicker examples are often seen in the mussel camps and piles along the shore. The length of the largest shell of this species found during the survey was 2¾ inches (70 mm.). Some examples, particularly from those portions of the river having soft mud bottoms, are greatly elongated posteriorly, and others bear a strong resemblance to *P. donaciformis*.

There are two forms of *elegans* found in several of the mussel beds of the Illinois, particularly noticeable at Peoria. The common form is the more abundant and compares favorably with the species in the collection of the Unionidæ at the Bureau of Fisheries and with those found in the Maumee and Wabash Rivers. The other form is proportionately more inflated, and has brownish epidermis, darker posteriorly, with dark capillary lines. The pseudocardinal teeth are heavy and curved; the laterals are broad and striate. The nacre is pink. The truncated shape gives it somewhat the appearance of *Truncilla triquetra* (Rafinesque). Some fine examples were found near the upper bridge, at Peoria, Ill., June 27.

35. BUTTERFLY, *Plagiola securis* (Lea).—The butterfly, or *securis*, is not a common species in this river, although many of the beds could be made to yield productively by propagation. On account of its flatter shape and proportionally lighter weight, the male shell is more valuable for commercial purposes than the female.

36. MISSOURI NIGGERHEAD, *Obovaria ellipsis* (Lea).—This species is comparatively rare in the Illinois Valley, but some examples were found from Peoria Lake to the mouth. This shell has a velvety epidermis and a good pearly nacre and furnishes good button material. The *ellipsis* appears to be closely related to *higginsii*.

37. PAPER-SHELL, *Lampsilis lævissima* (Lea).—This shell is fairly common in the river, and at the present time has no economic value. In nearly every example examined at Beardstown and a few other places, this mussel was more or less diseased at or near the tips or posterior end, due to parasitic infection.

38. PAPER-SHELL, *Lampsilis gracilis* (Barnes).—This mussel resembles the preceding species. The shell is thin and has no commercial value, though the meats or soft parts are used occasionally for fish bait. Found gravid June 27.

39. PINK HEEL-SPLITTER, *Lampsilis alata* (Say).—This species is fairly common and is found mostly on mud bottoms. It has no commercial value. One of our examples, taken at Hardin, is thick enough for manufacturing purposes and has a good white nacre.

40. *Lampsilis parva* (Barnes).—A rare species; one example found in Peoria Lake. This is a small, delicate shell of no economic value.

41. BLACK SAND-SHELL, *Lampsilis recta* (Lamarck).—The black sand-shell is a rather common one and reaches a very large size in this river. It is found in the lakelike places of the stream and in the swifter parts of the lower stretches. The nacre is generally pinkish or purple and, although the texture is good, the shells are discarded by the mussel fishermen and buyers, as there appears to be no particular demand at the present time for colored shells. The white-nacred ones, though much less abundant, are always saved. They are usually classed along with the yellow sand-shell, and are mad' use of in novelty factories. In the mussel camps this shell is often called "lady's slipper," on account of the appearance of the valves when opened out flat.

42. SLOUGH SAND-SHELL, *Lampsilis fallaciosa* (Smith).—Abundant; usually found standing on end burrowed in the mud of sloughs and bays or along the shore where there is but little current. When of sufficient size and thickness, they are classed with the yellow sand-shell. In Peoria Lake the *fallaciosa* are beautifully rayed.

Some doubt has arisen as to whether this species is identical with *anodontoides*, but it appears on the Illinois to be a distinct species. Our examples are markedly different from *anodontoides* of the same region. The *fallaciosa* vary greatly in distinctness and abundance of rays, some being but faintly rayed, others with many broad pronounced green rays. One example, a fine large male, is so heavily rayed as to be almost green, and approaches more nearly than any of the others the general form of *anodontoides*, but could not well be confused with that species. A well-rayed female of moderate size is noteworthy for a marked reddish-orange cast of the epidermis, the shell beneath having a rosy tinge. Another constant difference in our examples is the cardinal tooth of the right valve, which is compressed and almost lamelliform in *fallaciosa*, while in *anodontoides* it is more triangular.

It is quite possible that the convergence of the two species in the southern and southwestern portions of the United States is due to the different features of bottom and general abundance of silt and slough-like conditions in the lower courses of rivers, which would cause all to assume the characters of the slough-dwelling form.

43. YELLOW SAND-SHELL, *Lampsilis anodontoides* (Lea).—This species is found sparingly throughout the upper river, but is fairly abundant in the Hardin district, where it is in sufficient quantity to be sorted out and sold separately at an advanced price. This shell is the most valuable of the fresh-water mussels, and as it is easily propagated, many of the beds where the conditions are favorable could be restored. It prefers deep water and clean sandy bottoms.

Our examples have a rich yellow epidermis, and are appropriately called "banana shells" in some localities. This shell is valued at about $60 per ton.

44. Higgins-eye, *Lampsilis higginsii* (Lea).—Not common, though widely distributed, particularly over the lower half of the river. The males sometimes bear a strong resemblance to *Obovaria ellipsis*. There are four females in our collection and they present marked differences and peculiarities: One is normal and requires no comment; another flattened, flaring posteriorly, and suggests permanent sterility; another example has that portion covering the brood pouch strongly inflated, the portion of the shell immediately behind it underdeveloped and a trifle sulcate, forming a slight emargination; the general form suggests overdevelopment. The remaining example somewhat resembles this, but is flatter.

45. *Lampsilis orbiculata* (Hildreth).—This species has good luster and thickness. There are two examples in our collection, one from Chillicothe and the other from Peoria. The nacre of one is rather pinkish. This species is difficult to separate from *higginsii*, but is generally more southern in distribution.

46. Mucket, *Lampsilis ligamentina* (Lamarck).—The mucket occurs in small numbers throughout the entire river but is more plentiful in Peoria Lake than elsewhere. This mussel is usually smaller and thinner than those of the Kankakee, Fox, and Wabash Rivers, but nevertheless is regarded as a first-class commercial shell and is a very desirable species for propagation. Our examples and those seen in the shell piles along the shore have a pearly white nacre, while in some rivers—as, for example, the Mississippi—there are found a fair percentage with a pinkish color. The mucket was found gravid, late embryo, July 9.

47. Fat Mucket, *Lampsilis luteola* (Lamarck).—The fat mucket is widely distributed, though like the preceding species it is more plentiful in Peoria Lake. The male shells are much more desirable for button purposes than the female, the latter, especially in the older specimens, being more inflated and more troublesome to cut. This shell is often called the black mucket and pug-nose mucket. Found gravid June 27.

48. Pocketbook, *Lampsilis capax* (Green).—This is a rare species in the Illinois, and was found more frequently below locks and dams where the water was swifter. It is not a desirable shell to propagate.

49. Pocketbook, *Lampsilis ventricosa* (Barnes).—While this species is not a common one, it is more plentiful than the preceding mussel, and, like it, was more abundant in the swifter parts of the river, as below locks and dams. Some beautiful young examples, having a very delicate pink nacre and fine epidermal markings, were

taken, especially at Peoria and Meredosia; this is a remarkable condition for so muddy a river as the Illinois. This pocketbook, though inclined to be brittle, is usually good button material.

## SUMMARY AND CONCLUSIONS.

The Illinois river is 273 miles in length, and, from a mussel fisherman's point of view, it is one of the most important tributaries of the upper Mississippi.

Sewage pollution, with perhaps one or two exceptions, does not appear to have decreased the abundance or quality of the shells within the last 180 miles of the river.

The dip net is used almost exclusively in the Peoria Lake district and a few other places where similar lakelike conditions exist.

The price per ton of the river run of commercial shells during 1912 was $12 to $13.

Some excellent pearls have been found, ranging in value from a few dollars to $2,700. Slugs do not average more than one-half ounce per ton of shells.

The laws relating to mussel fishery have been generally observed.

There are 15 button or blank factories, with about 250 machines, along the river. The raw material is being better utilized than formerly.

The abundance of dead shells on many of the mussel beds may be due in part to the lack of erosion of the water and to the injurious effects of the crowfoot hooks.

The levees which have been heretofore and are now being constructed, particularly in the lower stretches of the river, reduce to a large extent the breeding grounds of the valuable species of fishes and incidentally affect the future supply of the mussels. During their early life mussels are parasites upon fishes for a period of from two to six weeks, and if the fish supply is greatly reduced it is readily seen that the mussel supply will also be materially reduced.

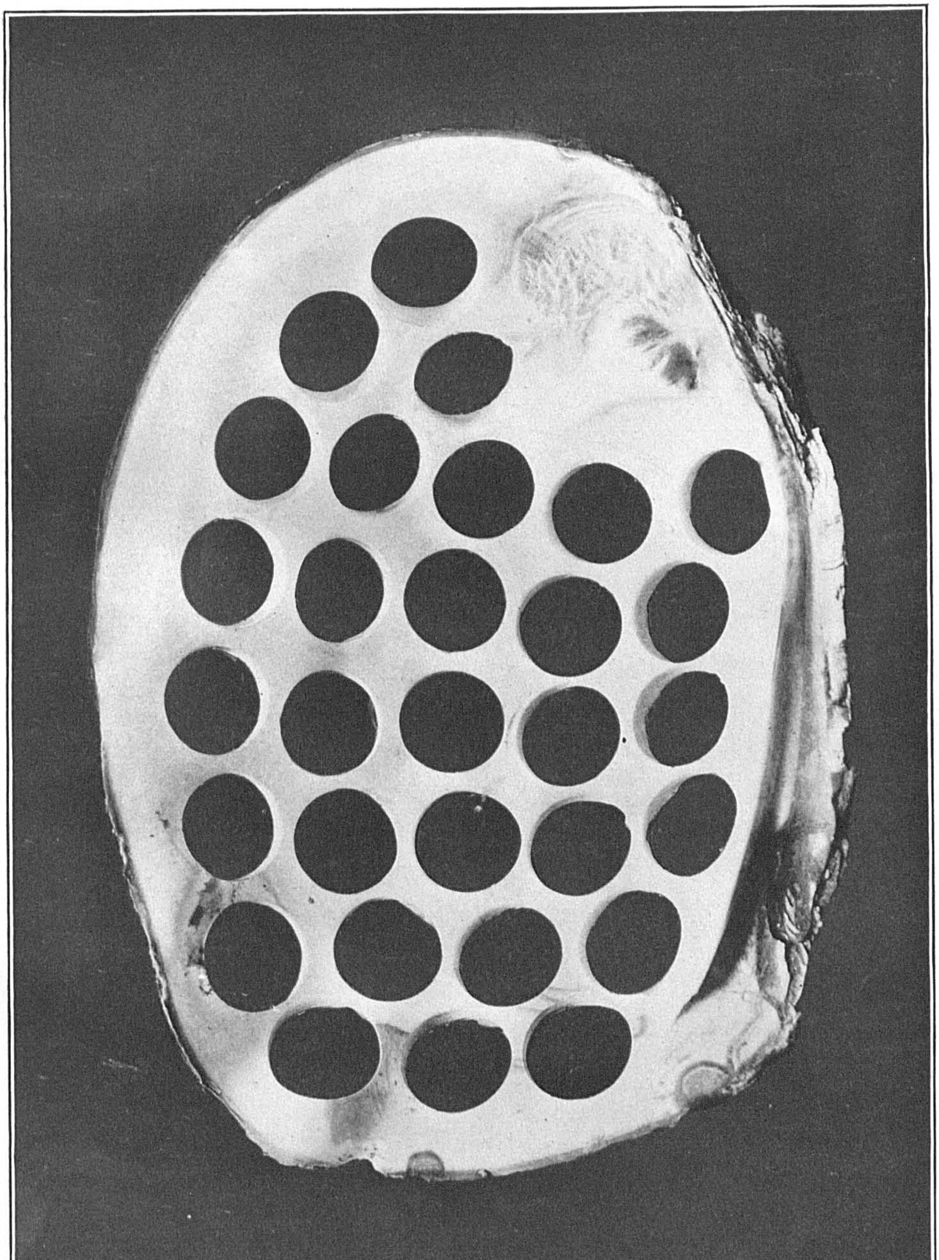
The washboard, or blue-point (*Quadrula*), group of mussels predominates in the Illinois. The slow current, mud bottoms, good average depth of water, and large fish resources all tend to make the river an ideal one for this group. The niggerheads (*ebena*), although apparently never very abundant, have become greatly reduced in numbers, from a cause not definitely determined. The old washboards (*heros*) in some places, as at Quiver Lake above Havana, have been killed, though the present conditions there appear to be more favorable.

The mucket (*Lampsilis*) group is found scattered in small quantities throughout the entire river, but more abundantly in Peoria Lake and the lower stretches.

The Illinois has been the most productive stream per mile of any in the country. There are but few places within the limits of shell production that do not support mussel beds, though certain stretches, as between Peoria and Kampsville, show marks of depletion.

The immediate future of the Illinois is good, but unless suitable mussel propagation is introduced and carried on under proper management, the river will become depleted within a few years and a valuable source of revenue thus be lost to the State.

There are several good localities where the propagation of mussels could be carried on successfully, as at Peoria, Havana, Bath, Beardstown, Meredosia, Pearl, Kampsville, and Hardin.



WASHBOARD (QUADRULA HEROS), SIZE 4$\frac{5}{8}$ BY 6$\frac{1}{2}$ INCHES.

Five dozen buttons were cut from the entire shell.

AN EXTERIOR VIEW OF A WASHBOARD (QUADRULA HEROS), SHOWING THE ABNORMAL RIDGE ON THE RIGHT VALVE AND THE VALLEY ON THE LEFT VALVE, WHICH ARE SIGNS OF THE PRESENCE OF A PEARL WITHIN.

In this example the pearl evidently began to form when the shell was about 1 year old. The age of the shell when taken was about 20 years. This shell was found at Bath, Ill., by Harry Lockwood.

AN INTERIOR VIEW OF THE SHELL REPRESENTED IN PLATE III.

It shows the reverse condition of the ridge and valley, and also the position of the pearl, which weighed 11 grains. The nacre of the shell, at the point where the pearl was found, is clear. A shell very similar to this one was found in the right chute of Grand Island, and contained a 10-grain high-button pearl, but was stained and contained mud. The shell was also stained at the point where the pearl was found.

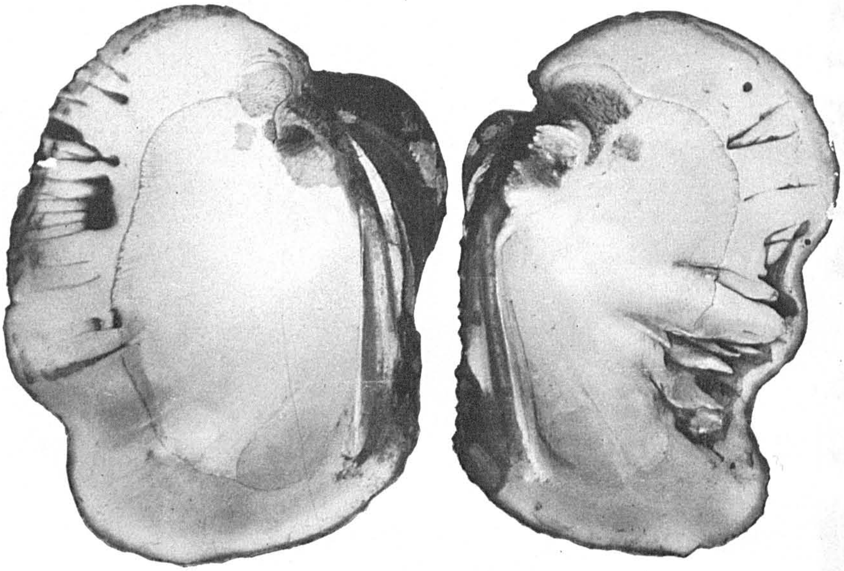


FIG. 1.—A THREE-RIDGE (QUADRULA PLICATA) WHICH WAS INJURED AND CONTAINED NO PEARLS.

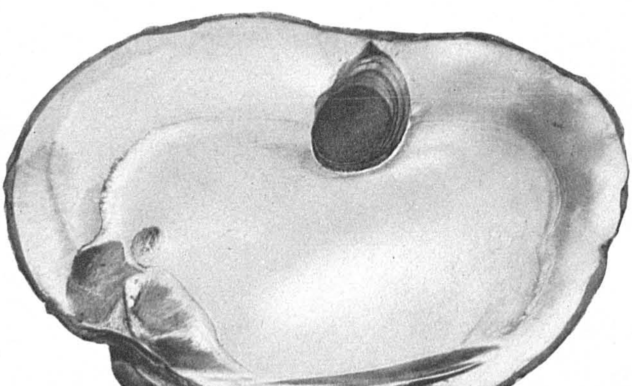
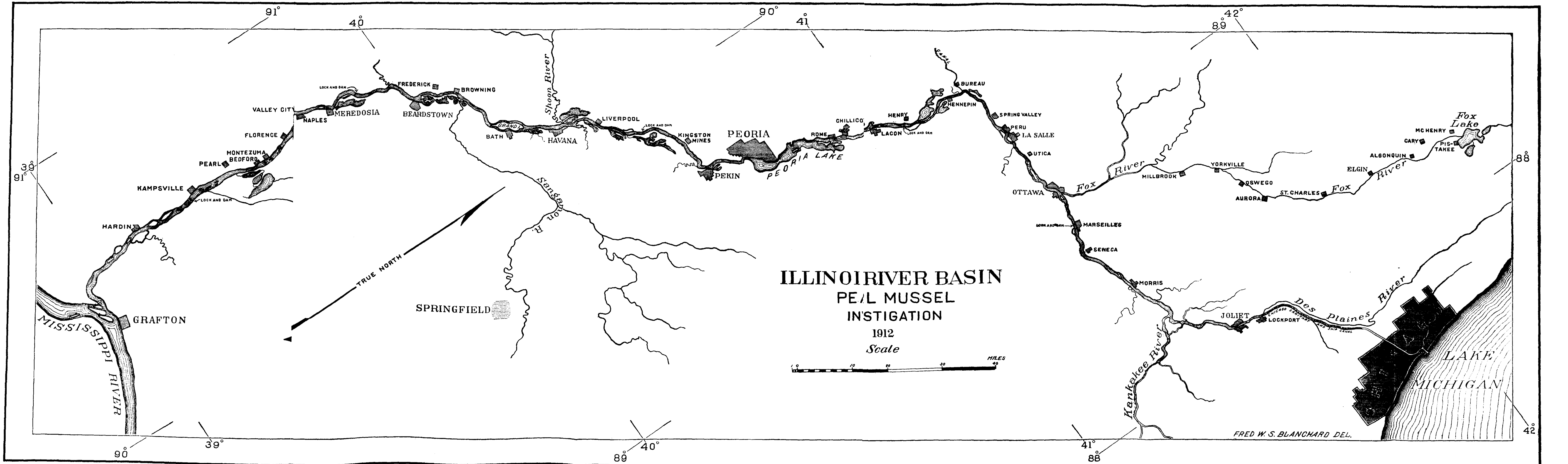


FIG. 2.—ONE VALVE OF A THREE-RIDGE (Q. PLICATA), SHOWING THE CAVITY FROM WHICH AN EMBEDDED 58-GRAIN TURTLEBACK PEARL WAS TAKEN, WHICH WHEN PEELED PRODUCED A FINE 20-GRAIN HIGH-BUTTON.

This shell, on account of the distortion caused by the pearly growth, is somewhat kidney-shaped.


ILLINOIRIVER BASIN
PE/L MUSSEL
INSTIGATION
1912
Scale
MILES
TRUE NORTH
GRAFTON
MISSISSIPPI RIVER
HARDIN
KAMPSVILLE
PEARL
MONTEZUMA
BEDFORD
FLORENCE
VALLEY CITY
NAPLES
MEREDOSIA
FREDERICK
BROWNING
BEARDSTOWN
Shoon River
BATH
HAVANA
LIVERPOOL
KINGSTON MINES
PEORIA
PEKIN
PEORIA LAKE
Sangamon R.
SPRINGFIELD
ROME
CHILLICO
HENRY
LACON
HENNEPIN
BUREAU
SPRING VALLEY
PERU
LA SALLE
UTICA
OTTAWA
MARSEILLES
SENECA
MORRIS
Fox River
MILLBROOK
YORKVILLE
OSWEGO
AURORA
ST. CHARLES
ELGIN
ALGONQUIN
CARY
MC HENRY
PISTAKEE
Fox Lake
JOLIET
LOCKPORT
Des Plaines River
Kankakee River
LAKE MICHIGAN
FRED W. S. BLANCHARD DEL.

# THE MUSSEL FISHERY OF THE FOX RIVER

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By John A. Eldridge

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Appendix VII to the Report of the U. S. Commissioner
of Fisheries for 1913

# CONTENTS.

# THE MUSSEL FISHERY OF THE FOX RIVER.

By John A. Eldridge.

The portion of the river embraced by the inquiry and dealt with in this report is that between Pistakee Bay, just south of the Wisconsin State line, and the mouth of the river at Ottawa, Ill., a distance of about 90 miles. The conditions of the stream were ascertained in part from observation and experiment, in part from questioning shellers, buyers, and manufacturers. The time of the inquiry proved unfortunate, as cold weather had stopped much of the work carried on during the summer. The brief time devoted to the inquiry prohibited as thorough an examination as was desired.

## GENERAL CHARACTERISTICS OF FOX RIVER.

This river, which is about 150 miles in length, rises in Waukesha County, Wis., a little northwest of Milwaukee. It flows south and southwest and enters the Illinois River at Ottawa. (See map, plate VI, preceding paper.)

As described by Forbes and Richardson in their pamphlet on the fishes of Illinois,[a] the drainage basin of the river is an undulating prairie region with more or less woodland and some swamps. For a distance of nearly 75 miles from its source the fall amounts to only a few inches to the mile. In its passage through Kane and Kendall Counties the fall per mile is about 3 feet, but in La Salle County it increases to about 5 feet per mile, making a descent of nearly 125 feet in the lower 25 miles of its course. Its channel even in its lower 75 miles has a breadth of only one-eighth of a mile.

Above Algonquin the river valley forms one of Chicago's foremost summer resorts; throughout this whole region its banks are lined with summer cottages. Its lower course is through fertile farming country, and several flourishing manufacturing cities lie on its banks. Many power dams have been constructed, which, with their influence on the depth, current, and character of the bottom, strongly affect the Mollusca above them. In most places the water is clear and apparently pure, but of late years the refuse of such places as Aurora

[a] Forbes, S. A., and Richardson, R. E.: The fishes of Illinois. Natural History Survey of Illinois, vol. III, p. XLIV-V, 1908.

and Elgin has contaminated it for considerable distances below those cities. This, however, does not seem to have harmed the mussels in these regions.

### PEARLS AND SHELLING ON THE FOX.

Pearls have been hunted on the Fox, as upon other mussel-bearing streams, for many years. During the last six years pearl hunting has increased in extent, but did not assume commercial importance until 1909, when hundreds of shellers were at work, chiefly between Millington and Sheridan. Several good finds were made which attracted others to the river, and by the middle of the summer the whole region from Yorkville to Serena swarmed with pearl hunters.

Certain portions of the river have received much notoriety from the newspapers on account of the pearl finds. These stories are often exaggerated, but, even at the prices named, the value of the finds seldom warrants the space given to them. This attention from the press has given the region near Elgin a reputation for pearl production which it does not deserve. The Fox has produced some extremely good pearls; its yield is much above the average; but most of the better finds have been made in the lower river in the neighborhood of Sheridan. From information gained from shellers and pearlers it is estimated that the average value of a season's pearl find for a constant sheller, between Geneva and Yorkville, would not exceed $100. On the mussel bed between Millington and Sheridan, however, extraordinary conditions seem to exist. The average value for finds here has been very high. Many extremely good pearls have been found in the last few years, ranging in price from $1,000 to $1,850. This region seems to have been one of the most fertile pearl producers in the country, though few valuable pieces were found in 1911. A few shellers still continue to work on this bed in spite of the extreme scarcity of shells, depending for compensation almost entirely upon "finds." Shells found in this district are opened by the knife to avoid injuring the pearls by cooking.

The shells in this locality are almost entirely muckets (*Lampsilis ligamentina*); the river bed is rock and gravel and the current is strong.

In 1909 shells were sold for the first time. The beds above Yorkville were tapped the following year and shellers were attracted to the work throughout the entire region between Cary and Sheridan. Two years of heavy shelling depleted the beds near the latter place. Further up, especially near Elgin, pearl hunters have increased in numbers, but the scarcity of shells and other conditions closed the season early. Apparently, shelling here as elsewhere along the river has seen its best days.

### CHARACTERISTICS OF THE SHELLERS.

The shellers and pearlers on the Fox are of a totally different type from those found on some of the larger streams. Although the river has been extensively worked for several years and its pearl finds have received much attention from newspapers, few outside shellers have come in. In some cases shellers from other States have been driven out by threatened prosecution under the State mussel law, which requires a license for nonresidents. As a consequence the nomadic class, found so frequently on some rivers, does not exist on this. Most of the shellers here are persons from the factory or the farm, who take an outing of perhaps several days or a few weeks every summer and try their luck on the river. With few exceptions, they are an intelligent, industrious, pleasant class of people.

The pearlers care little for the value of the shells and usually do not save them; they are left on the bank or thrown into the river to litter up the bed and thus are wasted. In some instances the shells are saved by regular shellers who gather them up along the bank or buy them from the pearlers at 5 to 10 cents a bucket, a rate of from $3 to $7 a ton.

The regular shellers who work day after day during the summer months depend chiefly on the shells for a living, and consider any pearls found as so much additional profit. Money from pearls may amount to more than from shells, but this can not be depended upon, for often nothing of value is found during the season and the general average for the year is not very high.

The number of regular shellers on the river during September, 1911, was about 70; in midseason there were probably as many as 100. The number of amateur pearlers on the river on some Sundays in the summer ranges perhaps between 400 and 500.

Many of the regular shellers begin work early in the spring and continue until the season closes October 1. During the season a sheller often gathers as many as 15 or 20 tons of shells, and the daily wages averages $3, exclusive of pearl finds.

### METHODS IN USE.

During the greater part of the season the shells are obtained by wading. The outfit consists simply of a pail or burlap bag to hold the mussels and a knife to open them. The regular sheller usually has a boat into which he throws the mussels and opens them by cooking. The mussel bar and mule are but little used, except in cold weather or high water. Some have a wheel at each end serving as a support from the river bottom. The mule which has given most success is a long and narrow one, about 8 feet long by 15 inches wide. In places where there is but little current a windlass is sometimes built upon the rear end of the boat carrying 500 feet of rope holding an anchor. The anchor is thrown out at the lower end of a bed, the boat rowed upstream to the extent of the rope, and the bar put into the water. Rewinding the windlass pulls both boat and bar downstream over the bed.

### FOX RIVER SHELLS.

The most characteristic mussel of the Fox is the mucket (*Lampsilis ligamentina*), which constitutes 90 per cent of the shells sent to market, and is of high grade, almost equaling the niggerhead as a button shell. Its luster is excellent, and its shape allows practically the whole shell to be made into buttons with very little waste. The muckets from the region between Oswego and Yorkville are considered the best; those lower down the river are thinner, and those above are slightly smaller.

On the upper river the mucket is of no importance. The shells saved here run 10 per cent blue-point (*Quadrula undulata*). They are of poor grade and no market has been found for them. Sixty tons of these shells were lying upon the bank above Cary awaiting a buyer at any price. Where there is little current and a muddy bottom the floater (*Anodonta grandis*) is chiefly found, while the fat mucket (*Lampsilis luteola*), the mucket (*Lampsilis ligamentina*), and the three-ridge (*Quadrula plicata*) or the blue-point (*undulata*) are rare. Going downstream, where a strong current and a rocky bottom are found, the mucket appears and increases in numbers until it forms a large percentage of the catch, the floater (*Anodonta grandis*), the fat mucket (*Lampsilis luteola*), and the blue-point (*Quadrula undulata*) decrease, and below Yorkville all are extremely scarce, the latter being seldom seen.

In places where dams check the current and bring about upstream conditions—still water and mud—the three ridges and other shells of the higher river are found in large numbers, while the muckets are scarce.

The fluted shell (*Symphynota costata*), and the squaw-foot (*Strophitus edentulus*), are found in larger numbers on the upper stream; the elk-toe (*Alasmidonta truncata*) more often on the rock bottom lower down; the lady-finger (*Unio gibbosus*), the Wabash pig-toe (*Quadrula rubiginosa*), the purple warty-back (*Quadrula tuberculata*), the pocketbook (*Lampsilis ventricosa*), and the black sand-shell (*Lampsilis recta*) are found in rather small numbers along all parts of the river. The warty-back (*Quadrula pustulosa*) is extremely rare, but two specimens of this species being seen during the investigation out of thousands of shells along the river. It is stated that it was once common.

While the small number of shells involved in some cases tends to render the figures inexact, the following table showing shells obtained at different points along the stream indicates in general the comparative numbers and distribution of the various species.

### ABUNDANCE AND VALUE OF THE SHELLS.

The price of shells paid by local buyers varies from $18 to $21 a ton; in some cases prices direct to factory were as high as $24.

Estimates for the last three years of the shipment of the Fox River shells are as follows: 1909, 10 to 12 carloads; 1910, 25 to 30 carloads; 1911, 22 carloads. The catch for next year is expected to be a bare third of that obtained in 1911. More than half of the shells were taken this year from the bed extending from Five Islands to Elgin; several carloads were caught above Elgin, and the rest on the lower river.

Most of the shells are shipped to Iowa factories, and some are sent to Germany every year. There are two blank factories along the river, one at Yorkville with 16 machines, and one at Samonauk with 10, which form the market for a few carloads each year.

Apparently at one time mussels were scattered quite evenly over the whole Fox River, at any rate as far down as Serena. There is no reason to doubt that shells were as plentiful near Sheridan several years ago as in other parts of the stream. The shelling of recent years, however, has in some places nearly exhausted the mussels, and there is a great difference in those remaining. On the river north of Carpentersville, where little shelling has been done previous to this year, 15 to 20 tons of shells were the usual catch per man in 1911; below Elgin on the Five Islands bed, which has been worked for two years, the catch averaged 10 to 12 tons per man; farther down below Yorkville, 7 tons per man were considered a good yield; on the Millington-Sheridan bed, which is the oldest and hardest worked in the river, but 4 tons a year per man could be caught. It was the general opinion that the shelling for 1911 was 50 per cent less than that of the previous year. The only cause for this is the ravages of man. As far as could be determined, but little loss is caused by animals or by natural conditions.

DISTRIBUTION OF MUSSELS IN FOX RIVER.

| Mussel species. | Pistakee Bay. | McHenry. | Cary. | Algonquin. | Two miles below Algonquin. | Elgin. | St. Charles. | Oswego. | Yorkville. | Millbrook. | Sheridan. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Purple warty-back (*Quadrula granifera*) | .... | .... | .... | .... | 1 | .... | .... | .... | .... | .... | .... |
| Wabash pig-toe (*Quadrula rubignosa*) | .... | .... | 3 | 15 | 10 | 2 | .... | 3 | 4 | 2 | 4 |
| Blue point (*Quadrula undulata*) | 2 | .... | 40 | 15 | 12 | 6 | 16 | .... | .... | 4 | .... |
| Three-ridge (*Quadrula plicata*) | 20 | 2 | .... | 2 | .... | .... | .... | .... | .... | .... | .... |
| Lady-finger, spike (*Unio gibbosus*) | .... | 39 | 9 | 34 | 13 | 6 | 4 | .... | .... | .... | .... |
| Elk-toe (*Alasmidonta truncata*) | .... | .... | .... | 2 | .... | 2 | 10 | .... | .... | .... | 2 |
| Fluted shell (*Symphynota costata*) | .... | 3 | 8 | 2 | 2 | .... | .... | .... | .... | .... | .... |
| Floater (*Anodonta grandis*) | 38 | 8 | 14 | .... | .... | .... | .... | .... | .... | .... | .... |
| Squaw-foot (*Strophitus edentulus*) | .... | .... | .... | .... | .... | .... | .... | .... | .... | 2 | 2 |
| Black sand-shell (*Lampsilis recta*) | .... | .... | 2 | .... | .... | .... | .... | .... | 2 | .... | .... |
| Mucket (*Lampsilis ligamentina*) | .... | .... | 6 | 25 | 47 | 78 | 68 | 90 | 94 | 90 | 92 |
| Fat mucket (*Lampsilis luteola*) | 40 | 48 | 14 | 5 | 14 | .... | 2 | 3 | .... | 2 | .... |
| Pocketbook (*Lampsilis ventricosa*) | .... | .... | 4 | .... | 1 | 6 | .... | 4 | .... | .... | .... |

## CONCLUSION.

The foremost fact concerning Fox River shelling is that the mussels are disappearing. The causes that have brought about this condition will probably continue until the beds are completely exhausted, since the unprofessional basis on which the work is conducted will allow its continuance after it has ceased to be profitable. There is but a small professional class which this exhaustion of mussels can influence seriously. This class for the most part will have left the river next year. Yet there are two blank factories near the Fox depending altogether upon it for raw material. Steps should be taken to preserve the mussel beds here for their own sake and because of their importance to the American button manufacturers. The grade of shell is for the most part very good, and the shells have been found in large numbers. The pearls, which have equaled the best in the country, have nearly disappeared.

The conditions observed in 1911 indicated that the industry on this river was doomed to disappear within a year or two unless preventive measures were taken.

# WATER-POWER DEVELOPMENT IN RELATION TO FISHES AND MUSSELS OF THE MISSISSIPPI

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Appendix VIII to the Report of the U. S. Commissioner of Fisheries for 1913

# CONTENTS.

# WATER-POWER DEVELOPMENT IN RELATION TO FISHES AND MUSSELS OF THE MISSISSIPPI.[a]

## INTRODUCTION.

Begun in January, 1911, and practically completed in June, 1913, the dam on the Mississippi between Keokuk, Iowa, and Hamilton, Ill., is not only an eminent feat of engineering and of efficient and expeditious construction, but it marks an epoch in man's utilization of the greatest North American river. Two hundred thousand horsepower are made available for commercial uses, 65 miles of water deep enough for unimpeded navigation is provided above the dam, and a single lock of the high lift of 40 feet replaces a navigation canal and chain of three locks formerly necessary for the passage of the Des Moines rapids of the Mississippi, now deeply submerged beneath the waters of Lake Cooper. Substantial public benefits are combined with the execution of such an enterprise.

This unique water-power development will have a great significance for the fisheries of the upper Mississippi, not only in the possible checking of the upstream movement of migratory fishes, but in the large area of lake waters it provides through the submerging of former dry land and the backing up of small tributary creeks. It is important to point out the significant advantage to fish and mussel life of the great additions to the feeding and breeding grounds covered by comparatively still water; it is also necessary to call attention to the probable deleterious effect of the dam as an obstruction to the free movement of fishes from the lower river to the upper, and vice versa. How advantage and disadvantage, as regards fish life, are to balance against each other in the future is not to be foretold. Time and observation alone will show, but it is the purpose of this report to present and to analyze the conditions offered by the dam, and to point out the opportunities and the importance of subsequent observations, as well as to offer certain suggestions for the minimizing of harm and the increase of benefit.

It is hoped, too, that the report may serve the broader purpose of pointing out the complexity of the problems involved in the effect of water-power development upon fisheries and of bringing out, even if inadequately, the opportunities and the fundamental necessity of

[a] The illustrations in thi paper are published by courtesy of the photographer, Mr. Anschutz.

a study, not only of fishways, but also of the migratory habits of fishes. There is no view that power development should be sacrificed to fisheries, but we are shortsighted, indeed, if we do not give thoughtful consideration to minimizing any possible sacrifice to fisheries that such developments may entail and to enhancing such advantages as they may afford. In all the active discussion of water-power problems there is almost a painful absence of reference to the fisheries aspects, notwithstanding that the food produced by the American fresh-water fisheries amounts to upward of 330,000,000 pounds, with a value to the fishermen alone of more than $12,000,000 and a value to the consumers far exceeding this amount.

## NEW CONDITIONS AND PROBABLE EFFECT UPON MOVEMENTS OF FISHES.

The writer approaches this inquiry with the conviction that the measure of importance of the fisheries of the Mississippi is not found in the existing state of the fishery.[a] The possibilities of the fisheries of the Mississippi and other great rivers will be realized only in the future, near or remote, when, under the pressure of economic conditions, and with the illumination of a more adequate knowledge of the needs of fish life, fish conservation will be more of an actuality than at present. We will then not only comprehend the essential importance of conditions favorable to the development of fish food and to the natural propagation of fishes, but we will know how to supply the necessary conditions. The further belief may be expressed that the future will show that Lake Cooper, as the large body of repressed water above the Keokuk dam is now known, will prove to be an important factor in supplying such conditions and possibly may rival Lake Pepin of the North by offering so large an acreage, or mileage, of comparatively still water provided with shoals and bays sure to be replete with vegetation, and practically free from the deleterious conditions incident to the excessive rise and fall characteristic of ordinary river conditions.

It is one of the tragedies of fish life, catastrophic in degree at times, that the spawning grounds may be found during spring floods far from the main course of the river, where an untimely recession will leave a generation of young fish isolated in some overflow pond, and marked for destruction unless reclaimed by the agency of Government or State. Such fish destruction is evident, and of common knowledge, but that which occurs when the flood stage comes late and after the fish have found nests in the originally shallow waters of the river banks at low stage, can only be guessed at. Accordingly, the significance of the interpolation in the course of a great river,

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[a] The fisheries of the Mississippi River and its tributaries yielded in 1908, as shown by the census report, food products of a value well upward of $2,000,000.

whether by natural or artificial means, of an immense pool, where practically fixed and dependable conditions can be found, is not to be lightly esteemed.

It becomes of greater importance that the possible disadvantages incident to such an interpolation should be eliminated as far as possible. Lake Pepin of the upper Mississippi, a virtual lake of natural origin, is a great natural fish reserve into and out of which fish may proceed at will at either end. Lake Cooper of the middle region of the Mississippi is an artificial lake into and out of which fish may pass unchecked in only one direction.

Any student of fisheries will at first glance make a further comparison of these two expansions of the Mississippi. The body of Lake Pepin has a comparatively straight shore line and in some places is bounded by steep bluffs; there is a relative absence of slues and shallows favorable for aquatic vegetation. Above and below Lake Pepin, however, there are many slues and bayous which offer favorable conditions for the breeding of fishes, and undoubtedly the fish life of the lake is continually replenished from these sources. Lake Cooper, on the other hand, has few bluff shores, and throughout its course, except very near Keokuk, there are many favorable bayous, creeks, and expansions over former agricultural or swampy flats. As regards the proportion of deeper waters preferred by some species of fish, the two lakes might compare more closely, except that the deep water in Lake Cooper is at one end and is less extensive.

The relation of such developments to mussel life may be briefly explained. The very young fresh-water mussels, with rare exception, when first liberated from the incubation pouches of the parent, must become parasitic upon fishes in order to pass through the next stage of their existence. To this end, if the chance offers after liberation, the young mussels, or glochidia, as they are called in this stage, attach themselves to the gills, fins, or scales of a fish. The mussels of economic importance attach themselves almost exclusively to the gills. In attaching or biting on the fish a very slight wound seems to be caused, which begins at once to heal over; but in the process of mending, the glochidium is overgrown and thus inclosed within the tissues of the fish. The mussel is now actually an internal parasite, in which condition it remains for a period of two weeks, more or less. It is thus conveyed wherever the fish goes, until, when the proper stage of development is reached, it frees itself from the host and falls to the bottom; if through a favorable fortune it finds suitable lodgment, it continues its growth to form an adult mussel. Owing to this fact of active transportation by the fish, a mussel born of parents in one part of the river may conclude its development in another region, even at points far upstream from the parent bed or perhaps in some tributary stream that the fish host may have entered.

Investigations carried on by the Bureau during recent years have shown that mussels do not necessarily attach to fish indiscriminately, but that a given species of mussel may make use of only certain species of fish, as the pimple-back mussel (*Q. pustulosa*) seems to be generally restricted in parasitism to certain species of catfishes, and, a more striking instance, the niggerhead mussel (*Q. ebena*) restricts itself so far as is known to the river herring, or blue herring, *Pomolobus chrysochloris*.[a] Conditions, therefore, which affect the movements of the river herring or the catfish may vitally affect the welfare of these important mussels.

It is not here simply a question of whether mussels will be transported from below the dam to the waters above, but, if the river herring is a truly migratory fish, going down the river in the fall and ascending again in the spring, and, if its course is so checked by the interposition of a dam that comparatively few find the way into the upper river, two results will follow: The fish will become a rare species in the upper river, and the future generations of niggerhead mussels will so generally fail of finding attachment to the only suitable fish, that successive broods will perish, until, with the ultimate death or capture of the old mussels, the species will become extinct in that portion of the river lying above Keokuk; that is to say, in practically the entire Mississippi, for the mussel resources of the Mississippi proper (tributaries excluded) are exceedingly limited south of Keokuk.

On the other hand, it is not to be lost sight of that the flood region of the repressed water will make available new bottoms for clam beds. The future condition is not to be predicted. None of the existing bottom of the new lake is definitive. Bottoms now covered with former land vegetation will acquire a new character in time as they are covered with silt or stream-washed sand. The old channel itself, no longer washed as before by active stream action, will undergo changes. The Des Moines Rapids was formerly the home of abundant niggerhead shells of particularly good quality, which could readily be taken from among the rocks. Deeply submerged as these beds now are, it will be scarcely possible to obtain the mussels. The gradual accumulation of silt over and among these rocks will probably make conditions unfavorable for this species, although other beds of different species may be expected to be formed

[a] In some publications the name "skipjack" is applied to this species. Except as derived indirectly from books, that common name does not seem to be applied to this species by local fishermen. The name "skipjack," in fact, seems generally to be appropriately applied to the gizzard shad, while the *Pomolobus* is generally and very appropriately designated as the "river herring," local fishermen having correctly recognized its close relationship to the true herrings. It has been learned, however, that the Ohio shad (*Alosa ohiensis*) is not regularly distinguished by fishermen from the river herring. To avoid further confusion the use of the term "skipjack" as applied to *Pomolobus* should be discouraged.

in other parts. A river-lake[a] fauna of mussels may replace a strictly river fauna. Should Lake Cooper eventually rival Lake Pepin—a condition scarcely to be hoped for—it will be one of the most important mussel regions of the country, supporting a mussel fishery exceeding anything known in this territory before.

In concluding this introduction, certain salient points which have been brought out or implied merit a particular emphasis.

(1) While the value of the dam will never be measured by its relation to the fishery, the effects, both direct and indirect, will be of exceptional interest and importance. There will be advantage not unmixed with disadvantage.

(2) There is a possibility worthy of serious inquiry that some provisions may be made to lessen the incidental injury to fish life.

(3) The dam will afford a unique opportunity for the study of the movement of fishes in the river, if systematic and continuous observations be undertaken in the early spring and continued through the summer.

(4) The new-formed lake offers an equally unique opportunity for the study of the development of the proper biological conditions for fish life. It would be not only a fascinating study, but one of most vital significance, to trace the development of this lake from a condition of infancy to one of maturity, were there available the means necessary for such an investigation.

(5) The opportunity afforded by this new body of water brings the responsibility of taking definite measures for stocking it with suitable fish and mussels; and scarcely less important is the introduction of suitable aquatic vegetation which otherwise, as our experience at Fairport indicates[b] will be slow to find a desirable development.

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[a] By "river-lake," I mean such a body of relatively still water as would ordinarily be called a lake, which is yet intimately connected with a river, either as interpolated in the course of the river, or as an arm of a river. The conditions in a body of this kind may be characteristic. With the opportunity for the internal circulation, plankton conditions and community life, corresponding in some degree to typical lakes, there are combined in a measure the features of circulation and regular renewal of water corresponding more nearly to usual river conditions. Illustrations are Cross and Pokegama Lakes in Minnesota, Lake Pepin and Lake St. Croix, and in a smaller way, Rice Lake at La Crosse, Wis., which is between the Mississippi and Black Rivers and connected with both. Lake and river faunas are generally quite distinct in character. In fact, it is rare for a lake to yield commercial mussels. In the instances just mentioned we find, however, characteristic river mussels, and, what is more striking, we find that a species such as the so-called fat mucket (*L. luteola*), which is generally abundant and worthless in true lakes, is in these river-lakes abundant and valuable—that is, it has a shell of such thickness and form as to be exceptionally useful for buttons. The adaptations of this species is an interesting chapter in itself. No other species of mussel is so generally worthless and, at the same time, so exceptionally valuable and abundant in particular regions. Are its good qualities attributable to the unusual combination of river and lake conditions, or are they characteristic of a geographic region? Will the same species attain importance in Lake Cooper? When the latter question is answered, as it will be in course of a few years, the answer to the former question will be supplied at the same time.

[b] The Bureau through the Fairport station has already made some plants of fish and mussels, and since this paper has gone to press has undertaken a preliminary study of the plankton of portions of the lake with a view of tracing in this and subsequent years the development of the content of fish food. Further observations are inserted in another portion of the paper.

(6) The lessons which can be learned at Keokuk, if the opportunity can be availed of, will be of far-reaching importance as supplying a basis of information for guidance in future developments upon the Mississippi or upon other rivers.

## PRELIMINARY OBSERVATIONS.

In June, 1913, it was brought to the writer's attention that the Keokuk dam was being filled with water and, therefore, that a portion of the river bottom below the dam might be exposed for observation. The idea immediately occurred that the practical stoppage of water during the process of filling might cause the congregation of large numbers of migratory fish below the dam, including the river herring which had for some time been sought without success both at New Boston and at Fairport. Mr. Thaddeus Surber, being then engaged upon the investigation of the river herring, was therefore advised to proceed to Keokuk in the hope of finding the desired fish and of securing needed mussels if beds were indeed exposed. The expectation in regard to the fish was fully realized. The fish which had been sought fruitlessly at Fairport and New Boston were found abundantly immediately below the dam.

After an inquiry from the Mississippi River Power Co. regarding the movement of fish, a second visit by Mr. Surber was made July 10 and 11. He reported almost incredible numbers of fish lying just below the dam, large numbers of which were being caught by local residents using hook and line, dipnets, hay forks, etc. During this visit the gates were closed on the Illinois end of the dam, thus leaving the new bed of the river fully exposed where previously there had been water 3 to 6 feet deep. Vast numbers of fish were left stranded and struggling about in the little pools among the large stones, and people from both sides of the river were reaping a harvest, some with gunny sacks filled, others with the larger fish slung on poles, while others still were contented with long strings of fiddlers, sheepshead, etc. He estimated that 1½ tons of fish were removed in the course of a couple of hours.

Below the dam on the 10th and 11th the following fish were observed, given in order of their abundance: Buffalo, carp, paddlefish, sturgeon, sheepshead, fiddlers, redhorse, bluefish (*Cycleptus*), toothed herring, and hickory shad. Very few bass and crappie were taken, though they were reported to be unusually abundant; no *Pomolobus* at all were secured, and, according to local informants, none had been taken for several days previously.

I visited the dam September 22 and 23 and again October 11–15, 1913. The administration of the company courteously granted passes for examination of the dam and its works and extended all information requested. The lock was also operated for purpose of demonstration.[a]

## DESCRIPTION OF THE KEOKUK DAM.

The figures and essential data regarding the construction plan are largely gleaned from a lucid description of the dam comprised in a booklet entitled "Electric Power from the Mississippi River" and issued by the Mississippi River Power Co., at Keokuk in 1912 and 1913.

The plant consists of the following principal elements (see pl. II): A dam proper, 53 feet high over all and four-fifths of a mile long, extending across the Mississippi from the Illinois shore at Hamilton and connecting at its western end with the power house, which is built in the river several hundred feet from the Iowa shore; the power house has its length almost parallel with the river shore, extending in a downstream direction from the terminus of the dam proper, and is practically one-third of a mile in length, over 132 feet wide, and with the great height of 177 feet 6 inches or from 25 feet below the surface of the limestone river bottom to nearly 110 feet above the surface of the lake at high water; the lower end of the power house (one-third of a mile below the dam) is joined to the Iowa shore by a series of constructions, including a section of dam about 100 feet long, which provides a narrow chute and houses the machinery for operation of the lock and dry dock, the lock 110 feet wide and 400 feet long, inside dimensions (618 feet over all), and the dry dock, 150 by 463 feet.

It thus appears that a bay or harbor of considerable size is formed between the power house and the Iowa shore, limited on the lower side by the lock and dry dock. This is called the fore bay and is protected on its upper side by a curved ice fender composed of concrete arches in a series 2,325 feet long and 300 feet of floating boom which may be opened back during the navigation season. It extends from the upper eastern or offshore corner of the power house (that is, from the western terminus of the dam) to the Iowa shore, the direction being somewhat curved, and the total length about half a mile.

The parts which are of immediate interest to us are the dam, the power house, and the lock.

### THE DAM STRUCTURE.

The dam proper is merely for the repression of water and the provision of spillways. It is 4,278 feet long, or, with its abutments, practically 1 mile. (Pl. II.)

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[a] I desire to acknowledge the courtesy of Maj. M. Meigs, United States engineer, who extended me the privilege of examination of the lock and facilitated my investigation in other ways.

The dam structure is composed of 119 spans, each consisting of two piers supporting an arch, which upholds a causeway. Between the piers is placed in each span a section of spillway, the part over which the water flows. This bridge-like structure, with the water flowing over the spillway sections, extends from the Illinois bluff, to which it is tied by an abutment, across the river to the upper outer corner of the power house on the Iowa side, to which it is tied by another abutment.

The piers are 6 feet thick, and the distance between piers—that is, the width of each of the 119 spillway sections—is 30 feet. The height of spillways is 32 feet. The upstream face of each spillway section is vertical, the downstream face having a curve designed to conform to the under surface of a body of water of this size and depth running over a vertical obstruction to the current; the spillway face is made to fit the under surface of the water to avoid friction as much as possible; the curve of the downstream face delivers the water in a horizontal direction down the river. (Pl. II.)

The stream over the spillway has a depth between 7 and 11 feet. We thus have at each spillway in use an unretarded waterfall of considerable volume with an abrupt drop of 32 to 40 feet, deflected only at the bottom, where it shoots out among the rocks with immense force in the form of a raging, foaming torrent, dashing against the rocks with indescribable commotion. For the protection of the base of the dam from the erosion due to back currents, a broad, low concrete apron is now being laid to flank the dam on its lower side. It would be impossible for a fish to ascend such a fall from below, or even, in all probability, to pass downward through it and escape alive. This is inevitable to the existence of such a dam, so that the opportunity for fish passage must be sought elsewhere.

Between the top of each spillway and the lower side of the overhanging causeway is an arched opening about 19 by 30 feet which will permit the passage of ice and drift with the water. These openings are partially closed by steel gates, 11 by 32 feet, which work in deep slots in the concrete and serve to control the head within certain limits, as well as to regulate the flow to conform with the minimum requirements for navigation as determined by the Government.

The dam proper is not at right angles to the course of the river below but has a slight downstream direction from east to west, so that the upstream end of the dam structure, as of the entire plant, is on the Illinois side. In ordinary times only a few of the spillways are in use simultaneously, so that the main stream of the river so far as it is determined by the flowage over the spillways—the waste water, so to speak—may be changed at any moment from one side of the river's course to the other through a distance of nearly a mile. (Pl. II.) In practice it is found necessary to be continually changing the gates in order that all may be in perfect order and no risk be run of any gate sticking or failing of operation at a critical time. The gates are raised or lowered by traveling cranes and require about 13 minutes to lower.

Accordingly, as regards those fishes which are seeking an upstream destination, so far as their course may be determined by the spillway current, they will be directed toward the foot of the dam or to the outskirts of a small sea of raging waters (at one side or the other, or midway of the river), where in any case they are confronted by an impassable barrier. If the stream is suddenly changed by the closure of gates at one place and opening of others in another part, the fish may be left in enormous quantities in the suddenly isolated pools among the rocks, where they are at the mercy of those who would capture them. Just this condition has occurred on some occasions when fish could be taken with clubs and hay forks or with any convenient tool. This condition is more or less inevitable, but its recognition may serve to suggest the necessity for care that the condition be not caused unnecessarily. In any case stringent measures should prohibit the slaughter of these fish and provide for their rescue and restoration to the river. It is probably within the province of the Government, in conjunction with the power company, to prevent the wanton destruction of the fish left suddenly helpless under an emergency condition.

## THE POWER HOUSE.

The power house is of great importance, not only as the actual seat of the machinery which converts water head into power in utilizable form, but as the place through which there will always be passing a considerable quantity of water. (Pl. III.) The spillways of the dam, it will be understood, serve only to supplement the flow of water through the power house, taking care of the elements of fluctuation in the volume of the river and of variability in the use of water for power.

The power house is not alongshore, but arises out of the body of the lake, as it were, forming the eastern boundary of the fore bay, for about one-third of a mile (pl. I.) Its exact length as designed is 1,718 feet, but only one section equal to one-half of this length is now completed. The foundation walls of the entire building are, of course, in place as an essential part of the dam as a whole. The outside wall of the building toward the Iowa shore is not built solid to the bottom, but is supported on a series of arches, so that the water from the fore bay has free access to an inner or head bay within the building and extending its entire length. The outer wall of the building, facing the Illinois shore, rises from the downstream bed of the river and is flanked by the tail-race or tail-bay, an important feature for our consideration. Between the head-bay and the tail-race intervene the turbines or power units, of which there are now 15 installed and 15 more in contemplation. These are arranged in a single linear series from the upper to the lower ends of the house.

The water from the head bay is admitted to each turbine through four gates, each 22 feet high by 7 feet 6 inches wide, the opening being protected by coarse screens or iron gratings, which exclude the passage of large drift, but are not fine enough to prevent the passage of any but the largest fish; the openings between bars of the gratings are 6 by 23 inches. The four intake passageways are of a special design and converge into a single large scroll chamber 39 feet in diameter around the turbine. Other gates or guide vanes at this place control the passage of water into the turbine chamber, whence, after setting the turbines in motion, the water passes down through the enlarging draft chamber out into the tail-bay below. The draft chamber is circular at its upper end just below the turbine, where it is 15 feet in diameter, or about 2 feet greater than the diameter of the water passage through the turbines. At once, however, it begins to enlarge in diameter and take a curved form by which it changes direction from the vertical to the horizontal and changes from a circular to an oblong shape in cross section. The outer openings of the draft tube below are 22 feet 8 inches in vertical diameter and 40 feet 2 inches in horizontal diameter. The bottom of these openings and the bottom of the tail-race is about 25 feet below the bottom of the Mississippi.

Between the head-bay and the tail-race there is normally a head of 32 feet. It is calculated that the velocity of the water at the top of the draft tube, immediately under the turbine, will normally be 14 feet per second, or 9 miles per hour, while at the point of discharge into the tail-race it will be 4 feet per second, or less than 3 miles per hour. The water in the tail-race itself may have a greater velocity.

It has been complained that many fish are destroyed by the turbines. It is possible that descent through the turbines would be fatal, but it is scarcely conceivable that fish in course of ascent would reach the turbines. It is to be remembered that the water passes the turbines in course of a vertical descent of 32 to 40 feet with greatest velocity where the turbines intervene. It is hardly possible that fish would successfully breast a vertical current of such force. It is not generally the swiftest fish that seek the darkest passageways. The blades or buckets of the turbines, of course, though revolving at high speed, are not slashing through the water as the uninitiated might suppose, but are driven before the water. Assuming, therefore, that a fish could make the tortuous passage from tail-race to head-bay against the velocity of the water, the turbine buckets would probably interfere less with its course than the solid walls that confine the water.

There are not infrequent reports of the finding of specimens of the spoonbill-cat or paddle-fish below the dam, with the spoonbill cut or broken clean off. Such injuries are attributed to the blades of the turbines, but the reports have not been as yet of such frequency as to indicate any serious degree of damage.[a]

The bottoms of the lower openings of the draft tubes are 25 feet below the natural bottom of the Mississippi. (See p. 14.) The tail-race is excavated to a corresponding depth from the upper end of the power house down to the region of the lock below. This is, for our purpose, one of the most significant features of the dam. The tail-race constitutes a narrow but deep channel, through which the water used in the power house is conveyed downstream to join the natural main channel of the river on the Iowa side near the bridge. The remainder of the river bed conveys, besides an overflow from this tail-race, only the spilled water from the dam, which may at various times be greater or less than the flow in the tail-race, according to the stage of the river above. It may be imagined that at the ultimate development of the plant the amount of water used regularly in the power house will be approximately equal to the minimum low-water volume of the river, since the storage capacity of the lake is not considerable as compared with the size of the plant.

Not all of the water from the draft tubes will follow the direct course, for the channel is not strictly confined, and a considerable surface current will always overflow from the tail-race toward the body of the river. At the time of this writing (October, 1913) the tail-race is to a considerable extent confined by the old cofferdam; but it is probable that this will be blasted out, permitting more extended lateral overflow. There will always be a strong flow of water in the tail-race corresponding at least to the volume of water required to supply the minimum demands of power. There will probably be little fluctuation of current from day to day at corresponding hours except with seasonal changes of lighting demands, but there will be a regular ebb and flow (considering the tail-race only) in the course of each 24 hours, since the use of electrical power is usually least during the early hours of the morning. This variation is very carefully watched by the company, so that it may be compensated by opening or closing gates over the spillways of the dam to minimize the effect on navigation in the river below.

The tail-race is the one perpetual passageway for water below the dam, and it is of interest to inquire in a later paragraph if the fish which may be attracted against this current may not be deflected by some simple means toward the only avenue of escape into the

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[a] Several cases have come under the writer's observation.

waters above. The tail-race will always be comparatively free from drift or ice, which must be screened out above for protection of the turbines. It will not be strictly free of drift below the power house on account of there being in the lower end of the power house a small spillway, or chute, through which drift that has entered the head-bay may be shunted to the tail-race below. Close to this chute, but just without the west power-house wall, is another small spillway for shunting the drift which may collect in the region of the lock.

### THE LOCK.

The lock was an essential requirement of the Government in order to provide for the necessities of navigation. It is of particular interest also since it is the only passageway by which it is supposed fish may pass from the lower river to the upper. The lock, built by the proprietors of the dam and deeded to the Government, is located below the power house and inshore from it, the upper eastern corner of the lock being connected with the lower western corner of the power house by a short section of dam provided with narrow spillways, as before mentioned. (Pl. I.) The lock is 110 feet wide and 400 feet long inside and has a maximum lift of 40 feet. The time required for locking a boat through is about 15 minutes. For such a great lift in so large a lock to be accomplished in so short a time requires a most efficient and special arrangement for filling and emptying the lock.

The bottom of the lock (which is 8 feet below the water level at the lowest stage of the river) is a gridiron of culverts, the mains being under the bottom of the walls running lengthwise of the lock, and the crossbars of the gridiron being culverts crossing the lock floor at intervals. The largest of these culverts are 13 feet in diameter and the smallest are 6 feet in diameter. The culverts are cast of concrete around steel lining. The angles in them are so sharp and the water pressure and velocity will be so great that the friction of the water against the concrete would wear the latter if it were not protected with steel. The outlet ends of the culverts discharge on the side of the lock at right angles to the course of the river.

By adjustment of a series of valves the water in the lock is permitted to run out into the river through the culverts. After the boat has entered and the gates are closed, the culvert valves of the filling system will be opened, the water from the higher level of the fore bay will rush through the culverts entering the lock chambers through fifty-seven 3-foot culvert openings until the level within the lock is the same as that of the fore bay, the boat being lifted 40 feet vertically within a few minutes. (Pl. VI.) As soon as the upper gate is submerged the boat may pass out and continue its course through the deep water of the bay and lake. In leaving the lock the boat passes over the front wall of the lock which is covered by 8 to 14 feet of water, according to the stage of the lake.

It should be remarked that the lower gates, which are of heavy steel truss construction, swing open, while the upper gate is of a new submerging type. This gate is a heavy steel truss containing air chambers below and works up and down in vertical slots of steel. There is also an emergency gate a short distance in front of the regular upper gate which may be used when necessary to repair the latter.

It will be inferred from the above description that the fish would not be likely to enter the lock from below during the process of emptying, since to do so would be to pass through the deeply submerged sharp-angle, culverts or tunnels out of which the water is discharging apparently at enormous velocity. Correspondingly it is not to be expected that they would gain the upper lake from the lock during the process of filling, since to do so entails passing down through the same tunnels against the rush of water under a 40-foot head. It is possible that a few might make their exit in this way after the lock is nearly filled.

It is also clear from the description of the working of the lock that the gate above is not submerged except when the lock is full, nor are the gates below opened except when the lock is empty. In other words, there is no ingress or egress through the gates for fish that are working upstream except when the water in the lock is stationary, which is to say, when ascending fish are least tempted to move in that direction.

Another feature of the lock construction is significant. The upper opening of the lock does not extend down to the bottom, but is largely closed from below by a solid concrete wall over 30 feet high. (Pl. VI). A fish entering the empty lock from below finds 8 feet of water at the lowest stage of the river; leaving the full lock above it finds 8 to 14 feet of water between the top of the submerged gate and the lake surface according to the stage of the lake. To find its way out, therefore, it must make a vertical rise of 25 to 35 feet, without the presence of any definite current to direct its movements, or else, as before mentioned, it may seek its way out through the deep tunnels beneath. How will this head wall affect the movements of bottom-loving fish?

Parenthetically, it may be said that the effect of the unwonted variation in pressure within the lock may have a real (but quite unknown) influence on the movement of fishes. The depth of water in the lock varies from 8 to 48 feet. The possible demoralization of the fish by the turbulence of waters suddenly boiling up from below under a 30 to 40 foot head is perhaps uncertain, though we may infer that its effect would not be the happiest.

As a matter of observation, fish are found in the lock. When the lock is emptied a few fish are often seen stranded on the broad top of the wall at the upper end of the lock. More often, perhaps invariably, some are caught between the rails on the top of the submerged gate when this is raised. The space between these rails is about 8 by 110 feet or 880 square feet. Only a few fish were thus taken under my observation, but I was informed that as many as 50 to 100 had been caught in this way at one time. We do not know whether these fish were going into or coming out of the lock. It is possible that the lock acts as a sort of fish trap into which fish of the immediate vicinity stray, and by means of which some of these fish are transferred infrequently from pool to river, or vice versa, without reference to migratory movement. The lock chamber is a little over an acre in extent (44,000 square feet) and such an area in nature will accommodate a large number of fish without indicating any special assemblage of fish seeking a passage in a definite direction. The actual fact, and the significance of the facts, may be determined only by systematic observations judiciously interpreted.

## THE QUESTION OF A PRACTICAL AND EFFECTIVE FISHWAY.

At the outset it may be stated that an ideal fishway is afforded only by the free channel of the river itself. We can not have water powers in the course of the stream, without some sacrifice of the free movements of fishes. Artificial fishways may, however, be practically effective, and locks are sometimes accepted as proper fishways, especially where occurring in the course of canals or narrow streams. It does not follow that a lock will be effective in all situations. Some features of the present case will first be recapitulated.

(1) The position of the lock is near the Iowa shore, from which it is separated only by the dry dock and the Government reservation on filled ground built out from the shore. (Pl. I.)

(2) The width of the lock opening is 110 feet, as compared with the approximately three-fourths of a mile breadth of the river. Its opening is perhaps one-thirtieth of the width of the river.

(3) The location of the lock is out of the principal currents, though not far removed from the important tail-race. It is not certain, therefore, that even a proportion of the fish equal to the ratio of the width of the lock to the width of the river would find entrance to the lake through this chamber. That a considerable number of fish should be found in the lock is not inconsistent with this statement.

(4) The filling and emptying of the lock is accomplished by methods which do not encourage the entrance or exit of migratory fishes during these processes. Fish may freely enter from below when the lower gates are open and, by rising toward the surface, may leave for the lake when the gate at the head is opened; but at these times the

water in the lock chamber is practically stationary. It has been suggested that this defect might be remedied by providing in some way that a slow but practically continuous flow of water might prevail through the lock.

(5) There are factors of pressure and of serious disturbance or turbulence of the water which may have significant effect upon the moving tendencies of fish in the locks.

(6) The lock is operated on an average about nine times a day, during the season of navigation, and requires from 15 to 30 minutes for the passage of one or more boats.[a]

(7) The movements of fishes can not be subjected to rules, nor even accurately defined, except after such patient and systematic observations as have not yet been made.

Any fishway to be effective, must receive the fish at some point of convergence and give them practically uninterrupted opportunity for ascent. The fishway should be in operation at least as early as the ice goes out in spring, and preferably sooner, and it should be so attended and cared for as to be always in unobstructed condition. The lock can not be said to meet these conditions.

The engineering difficulties of providing an effective fishway over a dam 40 feet high and a mile wide are not to be underestimated, and must be given careful consideration. Were it an impossibility to have a fishway under these circumstances, we should simply have to fall back upon the law of compensation and accept a great loss in exchange for a greater benefit. The stakes to be lost are, however, perhaps greater than may at first be supposed. The reduction of important fisheries in the entire upper Mississippi and the possible extinction of one of the most valuable mussels of the same portion of the stream are not to be lightly considered.

It is not impossible to suppose that practically all fish that approach the lower end of the tail-race could be made to converge toward the position of the lock or its juncture with the power house. It is possible that an open weir of coarse-meshed wire netting stretched out as a wing from the foot of the lock entirely across the stream below the tail-race would accomplish this purpose. The feasibility of this is suggested by the fact that the tail-race is so largely free from dangerous drift materials. A decided downstream angle to the wing net would not only increase its efficiency but would facilitate the passage around the end of the weir of the drift not screened out above, even if some attention were required to insure such clearance.

The desirability of a fishway at any point depends upon determination by experiment as to whether a large proportion of the fish could be

[a] Records from the lockmaster's book for a period of 46 days show 224 lockings "down" and 191 lockings "up," or a total of 415 operations.

concentrated at this place. Some simple experimentation is worth while, if only for guidance in case of future constructions. Were there installed a floating boom directed from the lower offshore angle of the lock structure downward and outward across the main flow from the power house, it would be practicable for experimental purposes to supplement this by suspending a weir of coarse-meshed wire netting below the boom. The object would be to determine whether fish in large numbers could be deflected in the direction of the lock. The possibility of a fishway near the Illinois end of the dam, which, as has been brought out, is the point farthest upstream, is also worthy of consideration; although the difficulties are here greater, on account of the exposure to floating ice and other drift, and because of the changes of flow from one part of the dam to another. It is possible that, after the period of construction is entirely passed, it will not be necessary to make entire changes of flow during the season of active migration of the fishes. It may be borne in mind that, on account of the tremendous disturbance resulting at the foot of the spillways, most fish will find their direct approach checked at several hundred feet from the base of the dam, although they may, and do, pass around the region of disturbance to reach the very foot of the dam. Accordingly a fishway having its foot at some distance from the dam might be in position to receive the fish at the uppermost point of direct approach.

Reverting again to the tailrace as a region of unceasing current, one may look down from the platform along the outside wall of the power house upon the upper part of the tailrace, where the big draft tubes are discharging columns of water 25 by 40 feet, directed with great force against the opposite face of the tail-bay some 75 feet from the power house. Meeting this obstruction, the waters are thrown into terrific commotion before they can be turned downstream to follow the direction of the excavated raceway. In this raging, whirling, ebullient current, no fish could find a rest or pursue a definite course. But the water is always overflowing now between the piers of the abandoned cofferdam flanking the tail-bay, and will, after the cofferdam is entirely removed, overflow in a continuous sheet toward the center of the river. This is of interest as a tolerably fixed condition, as opposed to the variable conditions characteristic of the spillway portion of the dam.[a] It appears plausible that fish will work up along this line of overflow, finding ultimately a terminus at the foot of the dam. If it be possible to provide a fishway on the dam at a point near the upper end of the tail-race, it is probable that the opportunity for concentration of fish would be more uniform here than at any other point on the dam proper, and likewise that the problem of preventing damage from floating ice and drift would be simplified

[a] Note the later observations inserted on page 25.

by the proximity of the head of the fishway to the power house and the present ice fender.

The possibility of a dipnet and hoist operated at the angle of power-house and dam, or elsewhere, is suggested by the congregation of fish in such places. None of the suggestions mentioned in this section is offered as a practical solution of the problem; rather as indicating some possible lines of preliminary experiment.

Finally, the question is sometimes asked if fish in migration are working along the bottom or near the surface. The answer is that there are bottom-loving fishes and surface fishes. The essential fact is that a fishway is intended for the use of fish working upstream, or those engaged upon the return journey. Consequently it must be located at a point that fish naturally approach in fighting a current. Needless to say, it should operate continuously, and not intermittently, unless the fish were prevented in some way from seeking another place while waiting for the opening of the way.

It is much easier to proclaim the desirability of a fishway than to say what sort of a fishway and what location for it would be practically effective. The problem which is raised is simply this: To determine by continued observation under varying conditions at what points the fish naturally converge or may, by artificial means, be made to converge; then to inquire what sort of passageway would be practicable and effective to permit and encourage ascending fishes to rise from the river to the lake. When these questions are given a definite answer, intelligent action can follow. If the end is necessary, and practicable of attainment, it is worth expense; if it is not found feasible to converge and give reasonably free passage to migratory fish, it is useless to waste relatively large sums for the name of "fishway." The whole matter at this stage may be expressed as a biological problem, definitive answer to which should not and can not be given except on the basis of further experience.

## LAKE COOPER.

It is indeed desirable that ascending fish should have access to the great breeding grounds of Lake Cooper. Regarding the lake, it is not pertinent in this connection to add much to the references made in the introduction concerning its relation to fish and mussel life.

As a region of repressed and relatively slack water, Lake Cooper extends above Burlington, Iowa, with a length of 65 miles and a width of 1 to 3 miles. It will not here be discussed except to remark that it has caused the submergence of many islands and low-lying shoreland and formed numerous deep coves and bays. Much of the submerged farming lands of high value are to be reclaimed by systems of levees and drainage. The growth of trees upon many of the flooded islands and shores has been removed by the company that there might be no danger to navigation. The maximum lake level is not yet attained; there may be a rise of 3 or 4 feet in the course of the next few years, to be made gradually in accordance with arrangements between the company and the property owners affected. The greatest depth in ordinary times will be about 40 feet, but the general depth will be much less.

There will ensue a good deal of decomposition of old land vegetation under water, but the effect of waves and surface wind currents, in connection with the circulation resulting from the regular flow of the river, will do much to reoxygenate the water. In course of time a proper growth of vegetation will be found in the bays, and this will form a most significant feature in the bionomics of the mature lake.

Experience at Fairport with new ponds supplied with Mississippi River water shows that the development of a proper degree of aquatic vegetation is greatly hastened by artificial introduction of suitable plants, and we have found it difficult to obtain these in any variety from the local overflow ponds and slues of the Mississippi. It would be most desirable, therefore, if the Government or State authorities should make such introductions in the various coves and bayous, so that the maturity of the pond as a fish environment might be expedited. Plants of fish and mussels can readily be made. It is understood that several hundred young bass were introduced by the Iowa State fishery department, and the United States Bureau of Fisheries, through the Fairport Biological Station, made a plant in October, 1913, of 2,343 large-mouth black bass and 425 crappie infected with Lake Pepin muckets and local Mississippi River muckets, in about equal proportions (1,380,000 glochidia in all).

## OPPORTUNITY AND RESPONSIBILITY FOR INVESTIGATIONS.

The problem presented by the Keokuk Dam may well serve to point out the inadequacy of our preparation to deal with situations of the kind—situations which may vitally affect the future food supply of our people. It is not alone an insufficiency of knowledge and experience which confronts us, but a real negligence. In connection with water-power developments everywhere, streams are obstructed with the bare and indefinite requirement for installation of fishways, which, in a large number of cases, become inoperative soon after they are put in. It is not the proprietors of the power developments who are at fault, so much as the public at large who expect the owners to provide and maintain fishways though robbed of incentive and guidance.[a]

The subject of fishways is one of live importance, and one requiring thorough experimentation. It is not the method of laboratory experiment that is needed, so much as that of field experiment and

[a] There are very few sorts of fishways that accomplish the purpose for which they are designed.

continued observation of the movements of fishes and their utilization of fishways. It is unfortunate that more practical experience has not been gained by a strict enforcement of the provisions requiring fishways and subsequent precise observation of their efficient working. In this way would the best of experience be gained.

Passing this subject, there are rare opportunities presented by the situation at Keokuk, to take advantage of which would be of the highest value.

We are deficient in our knowledge of the movements of fishes. What fishes migrate, at exactly what season does the migration occur with the several species of fish, and what is the extent of the movement with the several species? These are questions that we can not now answer with a satisfactory degree of definiteness. The existence of a practical obstruction in the Mississippi at Keokuk offers an unprecedented chance for exact observations, supplemented as they may be by the series of observations made by the biological station at Fairport, in the upper Mississippi at Lake Pepin, and elsewhere. The full realization of this opportunity can not be accomplished by a cursory examination, but demands a systematic and long-continued investigation undertaken before the movement of ice in the spring.[a]

Observations made by the staff of the Fairport station during the summer and fall of 1913 have revealed the fact that the river herring (*Pomolobus chrysochloris*) has been present just below the dam during practically the entire period and in large numbers. Nevertheless, it would be impossible to say at the present time if this is because the fish are blocked in the effort to proceed up the river, or if we have to do only with the assemblage of an exceptional number of individuals of this species due to peculiarly favorable conditions found in the swift waters below the dam.

The peculiar habits of eels are of particular interest in connection with any effective obstruction of the course of a stream. It is known of some species of eels, and believed to be true of all, that they do not breed in the rivers at all, but only in the depths of the ocean. The young eels, after hatching from the egg and passing through an interesting stage called the leptocephalus, during which they are strictly marine, ascend the rivers to grow to maturity, when they in turn will pass down the rivers to start a new generation upon the first stage of life in the sea. Supposing that few of the new generation of eels should succeed in passing above the dam, we would expect a gradual

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[a] Anadromous fishes are those which ascend rivers to spawn; the only fish of the Mississippi assumed to be anadromous is the Ohio shad, *Alosa ohiensis*. Catadromous fishes are those that go down to the sea to spawn; such are the eels of the Mississippi River. Other fishes are merely migratory having seasonal runs, from upper to lower portions of the river and return. In this class are generally included practically every important food fish, as the basses, wall-eyed pike, suckers, buffaloes, spoon-bill cat, lake sturgeon, shovel nose sturgeon, river herring, and all the larger catfishes. Very few fishes, among which would be the bullheads, would be left in the nonmigratory or permanent resident class. However, it must be said that the beliefs regarding the movements of fishes require to be submitted to the test of more exact observation.

extinction of the eel in the upper river and its tributaries, while we would look for a relative abundance of young eels below the dam, particularly during the next few years. This is a problem that may lend itself to concrete observation.

A question that raises itself in regard to purely migratory fishes, that is, those that move down the river in the fall and up in the spring, is, to what extent will the presence of the large body of deep water above the dam remove the necessity, or inhibit the tendency, of the fishes to proceed farther in their downstream course?

The destiny of the fish that are interrupted in their upward journey upon reaching Keokuk introduces a new problem. What becomes of these fish? Will they remain there all the summer? Will they turn back and work down the river or find tributary streams? To answer such questions would require close and continuous attention during the spring, and, since the fish can not be watched by the eye, a good deal of systematic trapping and seining at various points. In this connection it may be mentioned that reports were current to the effect that the Keokuk dam had turned innumerable fishes up the Des Moines River, which discharges into the Mississippi only 3 miles below the dam. It was said that more fish were being taken at Ottumwa than could be disposed of. Both Ottumwa and Eldon were visited by the writer in September, and the most careful inquiries made. It was found that the reports had no foundation, other than the hope and belief that the dam would deflect the fish into the Des Moines River as the first opening below Keokuk. Some local persons who did not fish offered some supposed confirmation of the reports, but every one of a considerable number of persons interviewed who fished either as a profession or for sport, agreed in stating that the fishing had been unusually poor during this season, and this condition was attributed to the fact that the river had been too low all the season for fish to ascend. There was some testimony that there had been an unusual run of very small channel cats and carp of 6 or 7 inch length—almost too small to use—but it did not appear that this had been unprecedented; also there was complaint of an increasing number of gars.

The sudden creation of a large lake intervening in the course of a great river with the submergence of islands and shore land, thousands of acres in extent, offers an unrivaled opportunity for investigations of material value. Upon this subject we are at liberty to some extent to draw conclusions a priori, as has been done, but there is none the less the privilege and the responsibility for more detailed inquiry and exact survey which, if completed, would furnish invaluable data for interpretation of the conditions of fish life and the determination of the ultimate requirements for the maximum development of fishery resources.

The problems here outlined are too extensive in scope to be solved in their entirety within the available resources of the Bureau, but the hope may be expressed that the lesson of this occasion may make so wide an impression that, should the fortune of time offer another situation of like significance, the possibilities of the Bureau's service may have been so anticipated that a condition of preparedness shall have been created. The effective conservation and development of the fishery resources is a not unimportant phase of the provision for the future welfare of the country.

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## Appendix.—The Problem of the Migration of River Herring.

The following brief account of observations made chiefly during the year 1914 are of interest in this connection. While it was not found feasible to detail anyone for continuous study of the succession and movements of fishes, as would have been desirable, some occasional visits could be made, which were not without value.

The writer visited Keokuk April 15, 1914, when the water was still cool, and practically no movement of fishes had occurred. It was learned that the river immediately below the dam had remained open all the winter, although as a whole below the bridge at Keokuk and above the dam it had been frozen over with thick ice. In the exposed water the wall-eye or "jack salmon" had been present all the winter and fished abundantly with hook and line. Practically the only fish then in evidence were perch and crappie in the slues. A few perch were noted in the lock, and the lock master stated that a large number had been taken at the first locking, about April 10.

A local informant, Mr. Joe MacAdams, was requested to write me of the first appearance of the herring. After a card from him, I visited Keokuk again April 29. He stated that the herring first appeared April 20, and that they became enormously abundant within a few days; on the 27th, according to several informants, during a warm day, one could at any moment see hundreds of them breaking the water in every part of the river below the plant.

The day of my arrival, April 29, was cold, windy, and cloudy, and at first view very few herring were observable. After closer observation, however, they were seen to be present in immense numbers, and congregated in certain locations exactly as had been predicted. (See p. 20 above.) A large number were seen just below the short section of dam between the upper end of the lock and the lower end of the power house; many were observed along the outer wall of the tail-race, but in the angle between the power house and the dam and from this point to the nearest open spillway, a short distance away, the herring were fairly massed. Such a close aggregation of fish can rarely be seen in fresh water. They had evidently followed up along the outer edge of the tail-race until they could go no farther. Again, on the outer side of the last spillway in use, which was about 700 feet from the power house, there were considerable numbers of herring. From this point to the Illinois shore, a distance of about two-thirds of a mile, not a single herring was in evidence. It was evident, therefore, that the herring had been guided by the moving water, so that they had in consequence assembled in such remarkable numbers on each flank of the stream below the open spillways, many more being guided to the eastward side by the strong current from the turbines.

Opportunity to observe whether they could breast the strong current was favored by the fact that there were three closed spillways between three open on the east and nine open on the west; thus there was a triangle of relatively slack water between two strong currents which met a short distance below. To the west of the westward current fish were abundant; to the east of the eastward current they were still more abundant; but in the triangle between not one fish could be seen. It was evident, therefore, that the power of the currents below the spillways proved an effective barrier to the lateral movements of the fish for some distance below the dam; otherwise not all of the fish would have been on the right side of one current and on the left side of the other.

The powerful currents caused slight eddies on each side, so that the dead water at the foot of the dam on either side was continually being drawn into the spillway streams. The fish were also drawn in, and it was easily observed that the velocity of the streams made them perfectly helpless. As soon as they passed into this stream they were thrown up in the foam and spray and often hurled 20 feet or more, back, sides, or under parts up, to be carried off as soon as they fell. Presumably no injuries were received, as no dead or injured fish were observed in the river below. No fish, as previously indicated, were drawn in from the slack water between the easterly spillways and the westerly, although similar eddies prevailed here.

It was observed that the roe of the herring was large, and it was thought that they would ripen within a few weeks. A visit was made by Superintendent Canfield May 29, and a number of herring were examined, but they were found to be not quite ready for spawning. A later visit was made by Mr. W. B. Gorham, June 11 and 12, when it was found that the herring had disappeared. This disappearance had not been noticed by the local fishermen for the reason that there were present in large numbers the Ohio shad, *Alosa ohiensis*, which is not generally, if ever, distinguished by fishermen from the herring. There was no clue, therefore, as to what had become of the herring.[a] Later observations at Lake Pepin are mentioned below.

The gathering of herring in such enormous numbers at Keokuk is of particular interest from the fact that this fish has never been gen-

[a] Later observations (in August) indicate that the disappearance was only temporary.

erally regarded as abundant in the river. Fishermen generally speak of it as uncommon, and yet informants sometimes refer to occasions when they were taken plentifully about the ends of wing dams. It has been supposed, therefore, that the fish is more abundant than common observations indicate, but that it migrates rapidly, keeping in the current where fishermen work least, and tarrying where the water runs swiftly around such obstructions as the wing dams. This supposition seemed to receive confirmation from the observations at Keokuk in 1913.

The question still occurred: Would the herring be found in the upper river after the dam was constructed? On the occasion of a visit by the writer to Lake Pepin in Minnesota on July 19, 1913, a single specimen was taken in a seine haul of our propagation crew. Several fishermen were positive that this was the first specimen seen in Lake Pepin in that season. The foreman of the crew, Mr. William Teachout, was requested to report each subsequent catch, and following is a record of his reports. To check the field identifications, specimens were sent to the Fairport laboratory from time to time, and in each case the identification was confirmed. The seining operations were discontinued in Lake Pepin after September 11, though pursued in the river below the lake. Later hauls in Lake Pepin were made October 17, 18, and 23, without further catch of herring.

BLUE HERRING TAKEN IN LAKE PEPIN DURING 1913.

| | | | | | |
|---|---|---|---|---|---|
| July | 29 | 8 | Aug. | 27 | 8 |
| Aug. | 3 | 53 | Sept. | 3 | 3 |
| | 9 | 1 | | 5 | 25 |
| | 12 | 5 | | 6 | 5 |
| | 23 | 8 | | 11 | 26 |
| | 26 | 12 | | | |

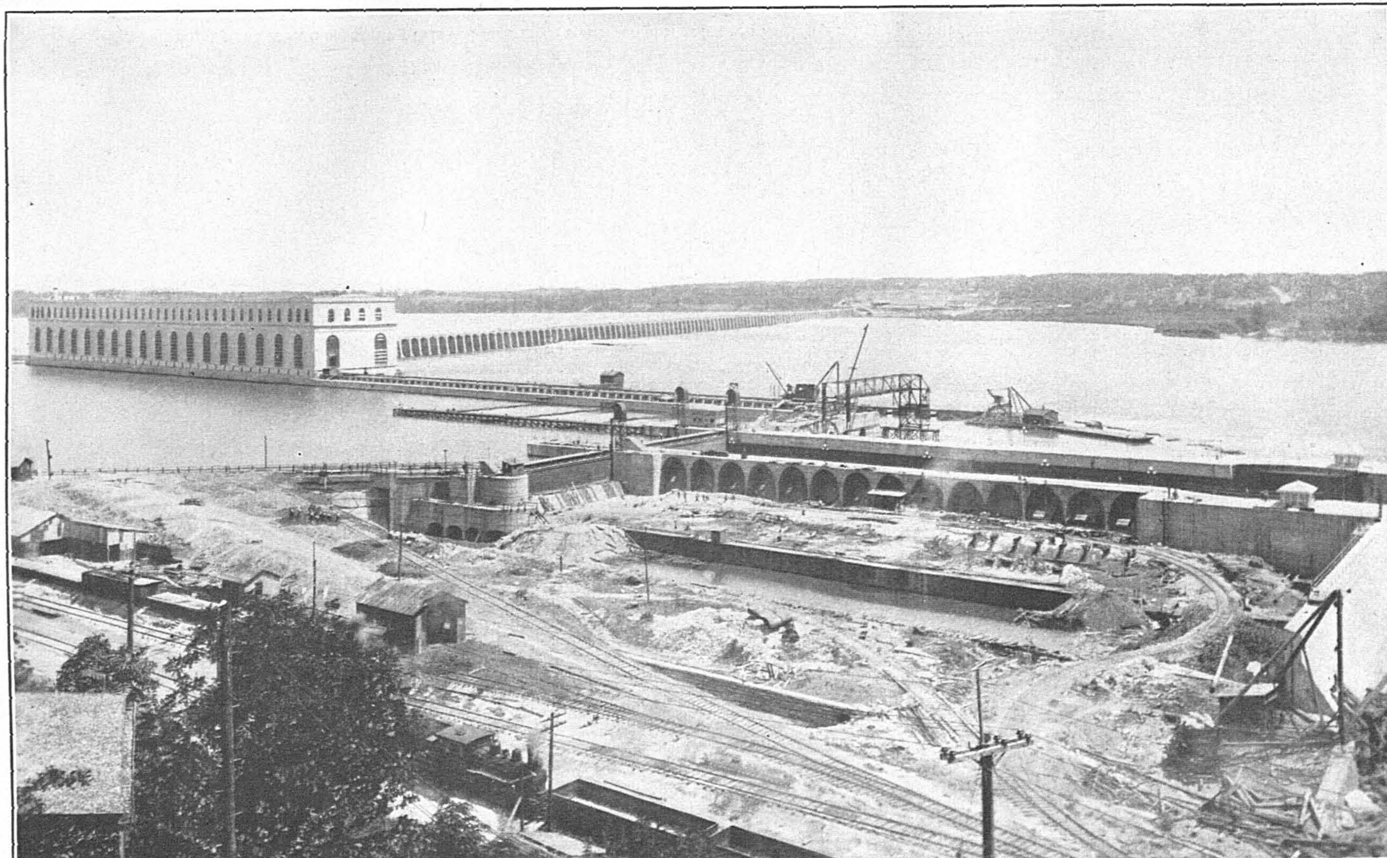
The observations at Lake Pepin were continued after the seining operations began in Lake Pepin in 1914. A single specimen was taken May 12, a few about the middle of June, after which they were taken more plentifully, especially in July, as shown by the records which follow, covering observations to the date of August 8:

BLUE HERRING TAKEN IN LAKE PEPIN DURING 1914.

| | | | | | |
|---|---|---|---|---|---|
| May | 12 | 1 | July | 9 | 1 |
| June | 15 | 1 | | 10 | 40 |
| | 17 | 1 | | 11 | 168 |
| | 19 | 3 | | 20 | 135 |
| | 22 | 28 | | 21 | 3 |
| | 23 | 8 | | 22 | 120 |
| | 24 | 14 | | 23 | 29 |
| | 25 | 3 | | 24 | 92 |
| | 26 | 1 | Aug. | 3 | 57 |
| | 27 | 12 | | 7 | 75 |
| July | 1 | 5 | | 8 | 1 |

The fact that the herring became abundant at Lake Pepin shortly after they ceased to be observable at Keokuk suggested that they might have passed through the lock. However, the examples received from Lake Pepin were noticeably smaller than the examples taken at Keokuk. This fact suggested the inference that the Lake Pepin herring might not have come from the river below Keokuk, but might represent younger fish that had wintered at intermediate points or possibly in Lake Cooper. Here the matter must rest pending further and more adequate studies. It is noteworthy that the herring seem to have appeared in Lake Pepin earlier in 1914 than in 1913, and that they appeared to be more numerous in the later year, notwithstanding that the river was obstructed at Keokuk throughout 1914 but not in the earlier part of 1913.

In August, 1914, a number of very young herring were collected by Mr. Teachout. In one shipment, August 26, 1914, 21 specimens were received of fingerlings or yearling herring, the lengths ranging from 122 to 165 millimeters (5 to 6½ inches). On September 5, six somewhat smaller specimens were sent us, having lengths of 107 to 128 millimeters, the smallest being scarcely over 4 inches. Such specimens are of particular interest as the first young herring observed at our laboratory and as indicating that Lake Pepin is a place where the herring breed. Mr. H. W. Clark, who has examined these specimens, reports that even many of these small herring are infected with glochidia of mussels.



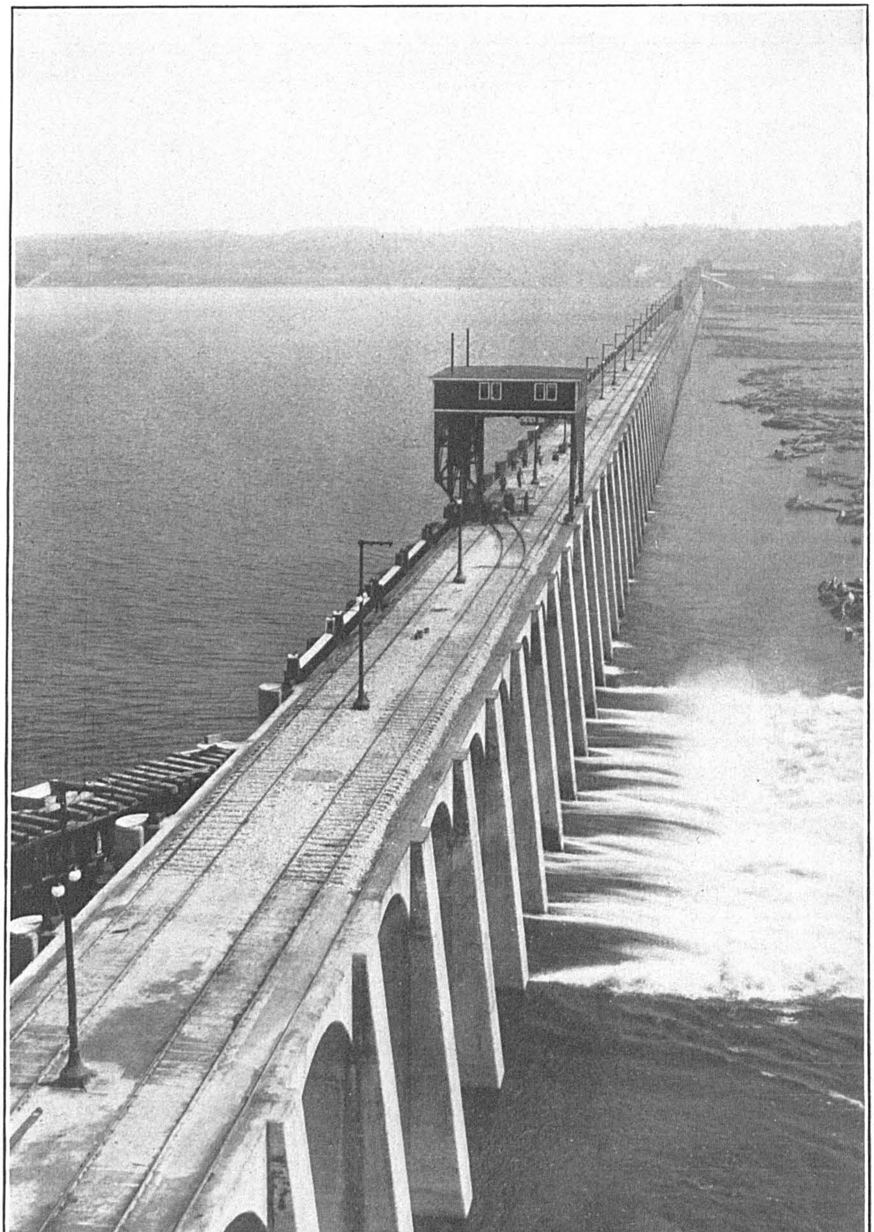
GENERAL VIEW OF THE WORKS OF THE KEOKUK-HAMILTON DAM FROM THE IOWA SHORE.

Hamilton, Ill., in the distant background, showing the dam structure, completed half of the power house, foundation of half of power house not completed, the lock, and the region of dry-dock and Government shops where excavation and fill is in progress. On the left in background is the lower portion of Lake Cooper above the dam, and the forebay between power house and foreground. A portion of the ice fender near the power house is barely seen on the extreme left.

VIEW OF THE DAM STRUCTURE SHOWING THE ARRANGEMENT OF SPILLWAYS; ALSO THE TAIL-RACE FROM THE POWER HOUSE ON THE LEFT.

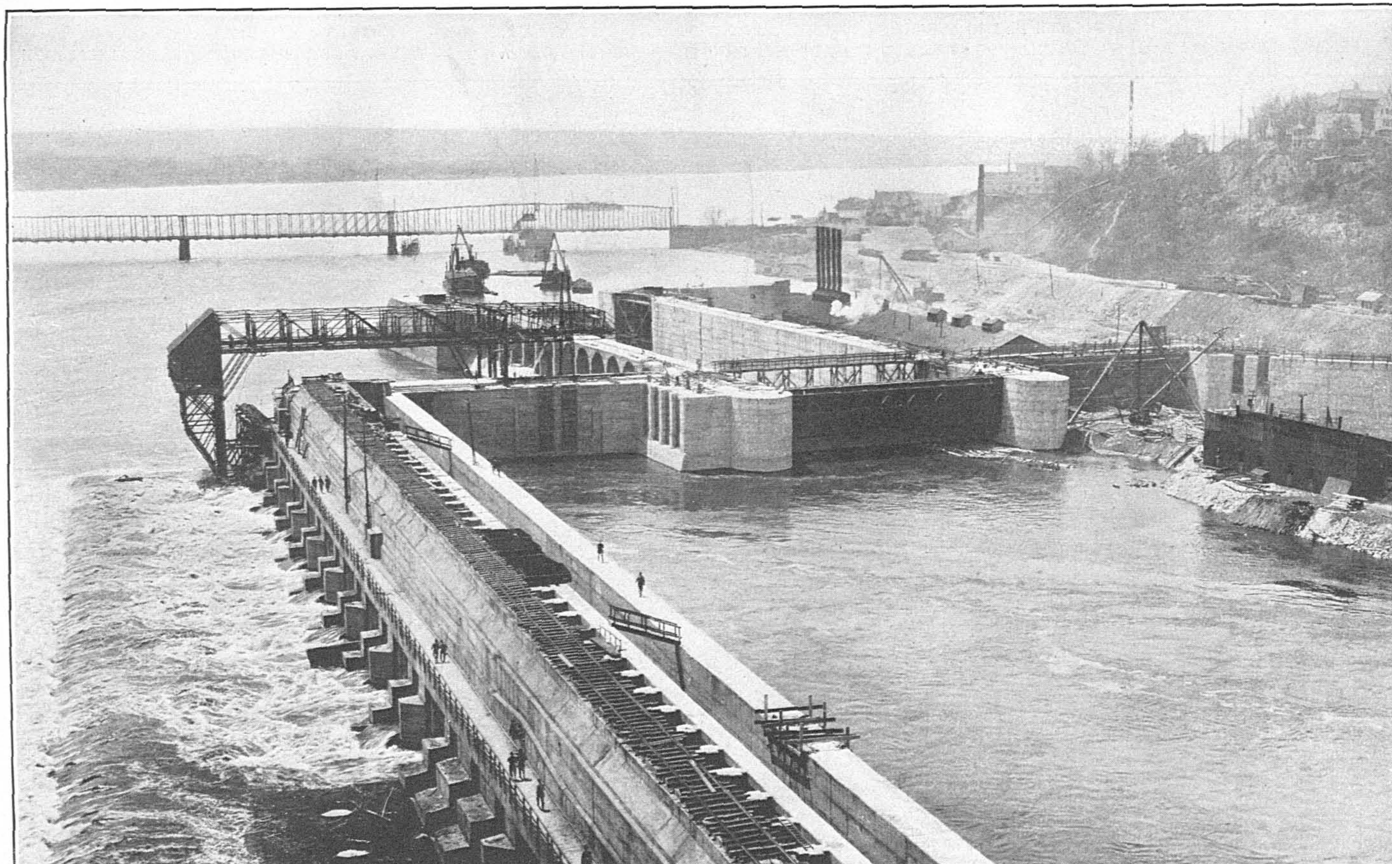
A temporary cofferdam separating this tail-race from the river proper is seen in this photograph, but it was subsequently largely removed.

SWIFT, TURBULENT WATER DASHING AGAINST OLD ROCKS BELOW THE SPILLWAYS.



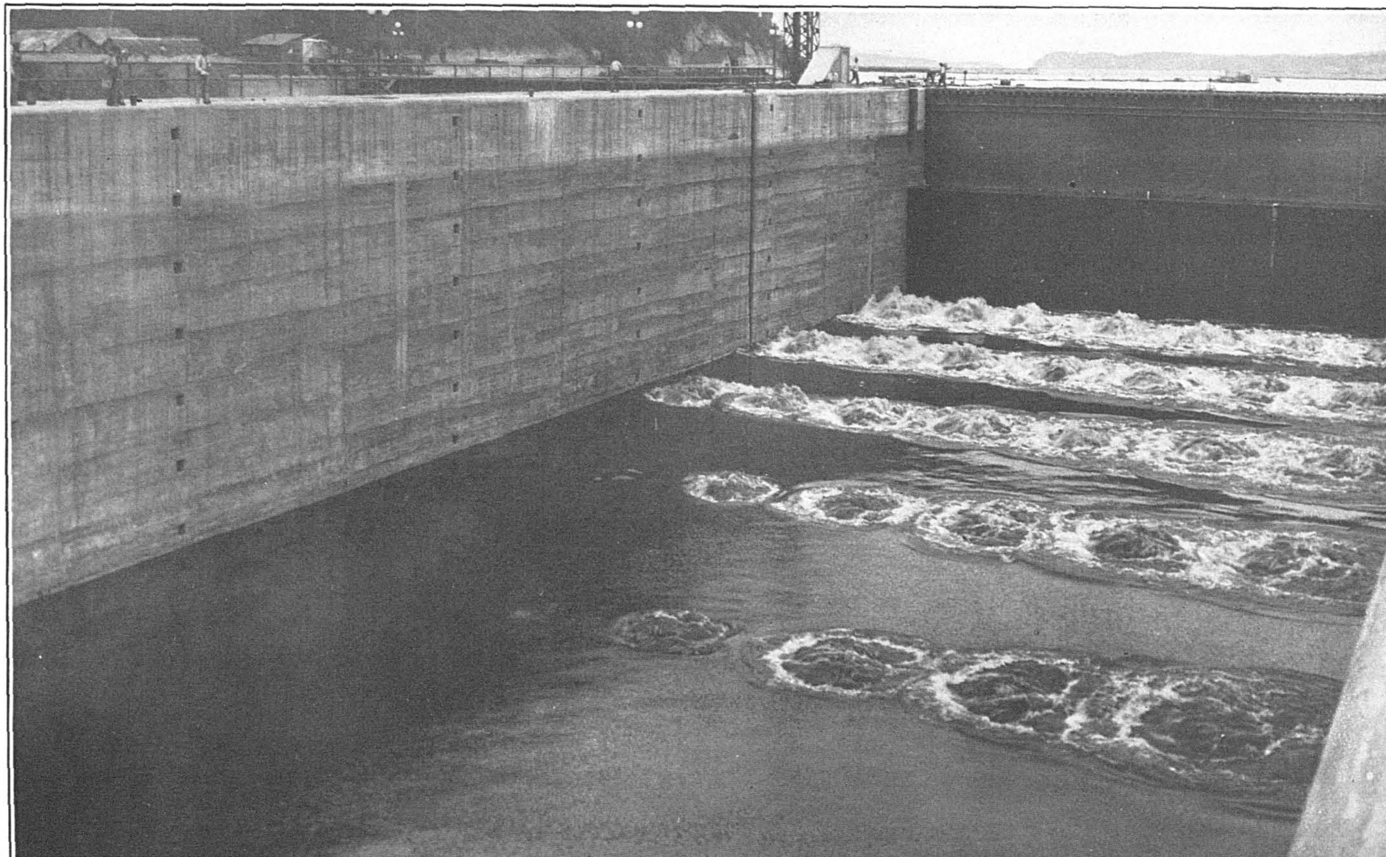
CONDITION BELOW THE DAM WITH SIX SPILLWAYS OPEN. NORMALLY A MUCH GREATER NUMBER OF SPILLWAYS ARE IN USE.

On the outer side of the first and last spillways of such a group an eddy draws into the spillway streams a portion of the slack water at base of dam. (See observations described in Appendix, p. 26.)



POSITION OF THE LOCK WITH REFERENCE TO THE LOWER END OF THE POWER HOUSE.

From left to right: (1) lower end of power house; (2) short section of dam between power-house foundation and lock; (3) the lock with forward emergency gate raised; (4) the dry-dock in construction with gate raised; (5) filling for Government shops in progress; (6) Keokuk bluffs at extreme left. Water is being passed through the gates of the lower unfinished portion of the power house.



HOW THE LOCK IS FILLED THROUGH A SERIES OF CULVERTS WITH OPENINGS INTO THE BOTTOM OF THE LOCK. THE VALVES HAVE FIRST BEEN OPENED, SO THAT THE LOCATIONS OF ONLY ABOUT 30 OF THESE 3-FOOT OPENINGS APPEAR IN THE ILLUSTRATION.