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

By Hugh M. Smith, *Acting Assistant in Charge.*

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

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

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

INVESTIGATIONS OF THE COMMERCIAL FISHERIES.

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

THE MIDDLE ATLANTIC STATES.

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

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

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

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

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

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

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

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

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

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

Persons employed.

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

Vessels, boats, apparatus, and capital employed.

Designation.	New York.		New Jersey.		Pennsylvania.		Delaware.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels	659	$991,640	607	$785,358	49	$107,295	26	$25,490	1,341	$1,909,783
Tonnage	9,292		9,320		1,220		310		20,142	
Boats	6,227	373,670	5,742	412,373	454	24,685	898	28,573	13,321	839,301
Apparatus:										
Seines	327	75,640	372	38,022	93	16,080	197	9,813	989	139,555
Pound nets, trap nets, and weirs	263	71,340	185	55,370			3	150	451	126,860
Gill nets	6,402	88,450	3,083	129,832	209	21,450	1,454	33,251	12,048	272,933
Fyke nets	6,246	55,465	1,692	18,881	2,476	4,914	522	1,109	10,936	80,369
Lines		11,745		5,178		451		20		17,394
Pots	15,898	17,391	4,755	5,339			1,815	884	22,468	23,614
Spears	3,489	3,728	216	404			170	85	3,875	4,217
Dredges, rakes, and tongs	13,719	119,912	6,690	68,210	164	5,035	353	2,632	20,926	195,789
Minor apparatus		250		487				113		850
Shore and accessory property		1,794,969		409,561		448,205		28,300		2,681,035
Cash capital		1,679,000		538,850		303,750		25,900		2,547,500
Total		5,283,200		2,467,865		931,865		156,320		8,839,250

Products.

Species.	New York.		New Jersey.		Pennsylvania.		Delaware.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives	2,194,560	$23,526	2,066,820	$14,260	2,331,775	$13,449	776,660	$11,017
Black bass			9,250	1,166	6,385	718		
Bluefish	5,506,575	237,010	7,227,926	264,163				
Butter-fish	837,246	12,988	230,802	6,582				
Carp			2,000	160	300	24		
Catfish	117,180	5,144	133,824	8,265	127,968	5,999	67,260	3,778
Codfish	2,277,458	89,921	841,011	26,001				
Drum			124,240	980			30,000	380
Eels	1,616,213	97,993	623,280	38,594	27,225	1,416	223,500	8,967
Flounders	1,561,696	45,231	987,895	33,620			5,000	108
Haddock	147,730	3,890	17,940	675				
Kingfish	157,541	10,792	33,697	2,208			960	48
Mackerel			25,117	2,316				
Menhaden	104,860,114	295,605	20,670,542	56,974			67,000	420
Mullet	160,060	7,878	88,350	4,902			38,900	1,125
Perch	88,125	6,320	693,062	40,758	10,845	625	235,070	15,211
Pike	8,215	740	19,485	1,904	975	97	23,400	1,455
Scup	350,858	7,016	25,682	855				
Sea bass	679,180	35,350	3,731,538	147,693	947,500	33,805		
Shad	3,044,956	161,209	10,225,455	443,438	2,491,775	114,854	1,442,663	61,513
Sheepshead	19,523	3,500	26,290	4,013				
Skate	101,897	2,022	7,050	353				
Spanish mackerel	74,836	7,255	78,391	12,629				
Spots and croakers	17,501	700	106,680	4,521			42,460	2,280
Squeteague	2,852,653	111,301	6,002,563	201,515			1,164,730	17,524
Striped bass	205,449	21,389	298,164	43,296	10,415	1,128	94,760	12,743
Sturgeon	30,261	929	452,630	10,619	52,700	640	1,304,200	30,448
Suckers	25,378	1,545	56,680	4,008	35,850	1,948	11,050	501
Tautog	171,172	7,618	99,437	3,894			8,000	320
Tomcod	278,400	10,468	1,400	42				
Other fish	238,741	8,178	317,953	13,541	64,430	3,324	2,080	44
Refuse fish	1,118,913	2,733						
Crabs, hard	435,566	7,589	230,111	9,499				
Crabs, soft	93,500	3,450	289,500	35,380			86,250	4,713
Crabs, king			2,798,980	7,534			740,000	647
Shrimp			1,200	600				
Lobsters	105,093	15,655	105,664	12,463			8,200	410
Mussels	21,000	900	6,000	200				
Oysters	18,277,434	2,748,509	16,114,567	1,639,648	1,183,700	124,420	1,097,040	70,134
Quahogs	1,505,500	105,891	827,000	47,700				
Scallops	4,524,520	650,621	3,454,024	371,933			21,920	2,094
Squid	313,042	48,340						
Shells	40,836	1,633						
Terrapins	16,766,100	15,950						
Turtles			3,280	1,074			11,088	2,190
							18,000	1,260
Total	170,885,022	4,817,369	79,116,380	3,520,057	7,291,843	302,447	7,521,691	250,290

Products—Summary.

Species.	Pounds.	Value.	Species.	Pounds.	Value.
Alewives	7,369,815	$63,152	Squeteague	10,019,946	$330,340
Black bass	15,635	1,884	Striped bass	608,788	78,556
Bluefish	12,734,501	501,173	Sturgeon	1,840,391	42,636
Butter-fish	1,068,048	19,570	Suckers	128,958	8,002
Carp	2,300	184	Tautog	278,609	11,832
Catfish	446,232	23,186	Tomcod	279,800	10,510
Cod	3,118,469	115,922	Other fish	623,204	25,087
Drum	154,240	1,360	Refuse fish	1,118,913	2,733
Eels	2,490,218	146,976	Crabs, hard	665,677	17,088
Flounders	2,554,591	79,019	Crabs, soft	469,250	43,543
Haddock	165,670	4,565	Crabs, king	3,538,980	8,181
Kingfish	192,198	13,138	Shrimp	1,200	600
Mackerel	25,117	2,316	Lobsters	338,957	28,528
Menhaden	125,597,656	352,999	Mussels	27,000	1,100
Mullet	287,310	13,905	Oysters	36,672,741	4,582,711
Perch	1,028,002	62,923	Clams	2,332,500	153,591
Pike	52,075	4,196	Quahogs	8,000,464	1,024,648
Scup	376,540	7,871	Scallops	313,042	48,340
Sea bass	5,358,218	217,413	Squid	40,836	1,633
Shad	17,204,849	781,014	Shells	16,766,100	15,950
Sheepshead	45,813	7,513	Terrapins	15,268	3,264
Skate	108,947	2,375	Turtles	18,000	1,260
Spanish mackerel	153,227	19,875			
Spots and croakers	166,641	7,501	Total	264,814,936	8,890,163

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

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

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

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

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

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

THE MACKEREL FISHERY.

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

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

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

In the case of the shore and boat fisheries the information secured for each proprietor-fisherman included the number and value of each form of apparatus employed, the number and value of boats, the fishing season, the number, nativity, and nationality of the fishermen, the wages

received, the kind, quantity, and value of bait utilized, and the quantity and value of each grade of mackerel taken with each appliance.

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

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

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

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

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

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

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

THE NEW ENGLAND STATES.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

THE PACIFIC STATES.

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

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

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

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

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

Persons employed.

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

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

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

Products.

Species.	California.		Oregon.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Anchovies	150,175	$1,502					150,175	$1,502
Barracuda	326,804	12,530					326,804	12,530
Bonito	249,332	9,400					249,332	9,400
Carp	65,662	2,191					65,662	2,191
Cod	2,274,565	56,864			539,000	$21,560	2,813,565	78,424
Cultus-cod	230,670	7,070	26,304	$1,315	359,000	6,875	615,974	15,260
Flounders	4,225,885	94,180	10,000	400	184,560	3,191	4,420,445	97,771
Halibut			18,870	1,787	1,410,500	29,140	1,429,370	30,927
Herring	4,486,887	55,796			617,112	6,817	5,103,999	62,613
Mackerel	350,399	14,159					350,399	14,159
Perch	335,117	10,927			65,140	1,303	400,257	12,230
Rockfish	1,829,657	51,765	86,115	4,255	163,000	4,515	2,078,772	60,535
Salmon	4,862,408	179,031	25,536,701	781,000	21,684,211	551,546	52,083,320	1,511,577
Sardines	752,994	15,237					752,994	15,237
Sea bass	257,712	9,795					257,712	9,795
Shad	526,494	14,372	109,000	3,270	103,350	3,183	738,844	20,825
Smelt	1,919,894	53,469			321,720	6,158	2,241,620	59,627
Striped bass	56,209	6,488					56,209	6,488
Sturgeon	718,017	21,854	2,513,490	28,001	543,623	5,757	3,775,130	55,612
Yellow-tail	354,434	13,682					354,434	13,682
Other fish	2,257,410	47,360			55,000	4,650	2,312,410	52,010
Abalone meats and shells	404,547	9,351					404,547	9,351
Octopus and squid	374,622	29,039					374,622	29,039
Clams	2,496,700	26,882	49,500	825	684,000	5,700	3,230,200	33,407
Oysters	15,098,700	698,257	147,000	3,062	9,895,440	147,995	25,141,140	849,314
Mussels	2,880,000	12,000					2,880,000	12,000
Crabs	2,862,320	102,900	4,125	495	79,000	3,550	2,945,445	106,945
Crawfish			20,000	3,000			20,000	3,000
Shrimp and prawn	5,313,345	241,817			2,000	500	5,315,345	242,317
Spiny lobster	303,275	8,486					303,275	8,486
Terrapins and frogs	45,625	8,050			13,125	5,250	58,750	13,300
Hair-seal and sea-lion pelts		2,267						2,267
Fur-seal pelts		167,526		43,266		121,528		332,320
Sea-otter pelts		36,150		1,729				37,879
Whale oil	1,574,843	62,123					1,574,843	62,123
Whalebone	197,339	937,371					197,339	937,371
Algæ	28,325	1,133					28,325	1,133
All other products	28,100	1,967			37,500	2,350	65,600	4,317
Total	57,838,466	3,022,991	28,521,105	872,405	36,757,287	931,568	123,116,858	4,826,964

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

Items.		California.	Oregon.	Washington.	Total.
Clams	bushels	40,470	825	11,400	52,695
Oysters	do	178,645	2,450	164,924	346,019
Mussels	do	48,000			48,000
Crabs	number	954,107	1,375	26,333	981,815
Hair-seal and sea-lion pelts	do	*a* 535			535
Fur-seal pelts	do	14,710	2,945	9,143	26,798
Sea-otter pelts	do	235	13		248
Whale oil	gallons	209,979			209,979

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

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

INQUIRIES AT GLOUCESTER AND BOSTON, MASS.

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

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

MINOR FIELD INQUIRIES.

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

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

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

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

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

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

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

THE INTERNATIONAL FISHERIES COMMISSION.

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

Mr. Richard Rathbun, assistant in charge of the Division of Scientific Inquiry, having been appointed by the President as the representative of this Government in the matter of conducting certain investigations in the waters contiguous to Canada and the United States, as called for by the agreement of December 6, 1892, between the United States and Great Britain, this work to be carried on conjointly by the United States Fish Commission and the Department of Fisheries of Canada, you are hereby detailed, at the request of Mr. Rathbun, to cooperate with and assist him in the prosecution of these inquiries. The plans for the work will be duly prepared by Mr. Rathbun, and you will follow out such parts of them as he may desire. You are

hereby authorized to make such trips as may be necessary in connection with this detail, but will at the same time maintain a close supervision over the office of your division, returning to Washington from time to time, as occasion may require.

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

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

REPORTS ON THE FISHERIES.

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

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

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

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

for the entire State are: 6,457 Americans, 2,227 British Provincials, and 2,076 other foreigners. The attention which the subject of the personnel of the United States fishing marine has from time to time received makes it advisable to give prominence to this error and correction.

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

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

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

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

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

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

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

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

As in previous years, a considerable amount of statistical and descriptive matter has been specially prepared for State authorities and other persons. In October a statistical and descriptive report on the fisheries of North Carolina, based on the field work of the division, was

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

NOTES ON COMMERCIAL FISH AND FISHERIES.

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

POMPANO AND SPANISH MACKEREL IN CHESAPEAKE BAY.

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

The lower Chesapeake is now the most important fishing-ground for Spanish mackerel, although its productiveness is much less than formerly, owing, it is supposed, to the capture of large quantities of fish prior to or during the spawning season. The principal part of the

catch is taken with pound nets set on the two sides of the bay near its mouth. According to the statements of Mr. Sterling, the yield in 1892 was but little more than half that of the previous season. The fish were probably twice as large, however, as in 1891. As was the case with the pompano, there appeared to be large schools of mackerel out in the bay, but they did not come within reach of the nets. Mr. Sterling states that nearly all the fish taken in the first part of the season, or up to July 4 or 5, were fully ripe; and sometimes several hundred would be brought in during a single day, all of which would contain ripe spawn.

SNAPPER FISHING ON CAMPECHE BANK.

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

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

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

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

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

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

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

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

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

a Includes 415 pounds of "rock perch."

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

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

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

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

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

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

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

TERRAPIN CULTURE.

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

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

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

THE WHALE FISHERY.

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

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

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

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

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

SOME RESULTS OF ACCLIMATIZATION.

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

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

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

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

FISH ACCLIMATIZATION ON THE PACIFIC COAST.

Few experiments in fish-culture have been economically more important and successful than those which have been conducted by the United States Fish Commission with reference to the Pacific Coast. Coincident with the propagation of native fishes, the introduction of non-indigenous species has been undertaken, with results that

have been extremely gratifying to fish-culturists, and perhaps more striking than any previously obtained in this or any other country.

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

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

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

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

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

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

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

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

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

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

The history of the striped bass is similar to that of the shad. It has attained considerable commercial importance, has increased steadily and rapidly, and is generally regarded as one of the best food-fishes of the coast. It has not yet attained anything like the abundance of the shad, nor was this to have been expected from the

meager plants, but there seems to be no reason to doubt that it is only a question of time when it will become one of the most prominent economic fishery products of the region, as well as a favorite object of capture by sportsmen.

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

THE MACKEREL FISHERY.

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

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

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

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

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

mackerel caught with hook and line from boats, and landed in said boats, or in traps and weirs connected with the shore.

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

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

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

Approved, February 28, 1887.

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

THE NEW ENGLAND GROUND-FISH FISHERIES.

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

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

numbers. While during the past three years there was a slight tendency toward an increase in numbers, the fish are much scarcer than they were eight or ten years ago.

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

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