

Fishery Publications of the United States.

By

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IN recent years the Bulletin of the United States Fish Commission has outgrown its older brother, the Report of the Commissioner, and in some respects supplanted it. The last volume of the Report, part xvii, bears the date of publication 1893, but it was only received by us in the present month of June, 1894, and it refers to operations carried out in the two years 1889-91,—in other words, from three to five years ago. The volume consists of three general reports and six appendices. The former are the Report of the Commissioner, that of Mr. Richard Rathbun on the Inquiry respecting Food-fishes and the Fishing-grounds, and that of Mr. Hugh M. Smith on the Inquiry regarding the Methods and Statistics of the Fisheries. The Appendices comprise three special reports, a Review of Sparoid Fishes, by David Starr Jordan and Bert Fesler, an article on Fish Entozoa, and a translation of Haeckel's well-known pamphlet, Plankton-Studien.

The first thing of interest which we note in the Report of the Commissioner is a statement of the amount of the appropriation of public revenue to the work of the Commission. In the year 1889-90 the total amount was \$278,900, in the following year \$298,900, in English money about £55,780 and £59,780 respectively. In the second of the two years mentioned the division of this money among the various departments of the work was as follows :

Commissioner's "Compensation"	.	.	£1,000
Propagation of food-fishes	.	.	30,000
Distribution of food-fishes	.	.	10,000
Maintenance of vessels	.	.	10,780
Inquiry respecting food-fishes	.	.	4000
Statistical inquiry	.	.	4000
			<hr/>
			£59,780

During the two years the Commission steamer "Albatross" was engaged in surveying the fishing-grounds off the Pacific coast of the United States, her work extending along the coasts of Washington, Oregon, and California, and over the shallow water area in the eastern part of the Behring Sea. In the early part of 1891 the "Albatross" was lent to Professor Alexander Agassiz for the purpose of a biological and physical exploration of the ocean and continental slope between the Galapagos Islands on the south and the Gulf of California to the north, a region which had previously been but little examined. This expedition was very successful, important and extensive information having been obtained by its means. The results of the ordinary work of the "Albatross" on the Pacific coast are described in Lieut.-Commander Tanner's special report among the appendices in this volume.

On the Atlantic coast the chief operations were conducted in the interest of the oyster industry. A complete survey was made of the coast waters of South Carolina, where the oysters were found to be all of the raccoon type, forming narrow ledges along the borders of the bays and the winding tidal channels between high and low water. It is suggested that the absence of oysters from the bottom below low water mark is due to the high specific gravity of the water, which prevents the spat from sinking below the surface. The raccoon oysters are useful as seed, improving in shape and flavour when transplanted. The investigation to which the Commissioner here refers has been fully described in two elaborate papers by John D. Battle and Bashford Dean, published in the Bulletin, vol. x, in 1892. Mr. Battle's paper contains the results of the hydrographic survey, and is illustrated by a number of charts showing the details of the observations made; while Mr. Dean describes the physical and biological conditions affecting the life of the oyster. The Commissioner next mentions an investigation in the "Fishhawk" of the oyster beds of Maryland and Virginia in Chesapeake Bay, and of the beds in Long Island Sound. He refers to the journey of Mr. Bashford Dean to Europe, undertaken for the purpose of studying the oyster industry in European countries. Many in this country who are interested in oyster-culture are well acquainted with the lucid and valuable papers in which Mr. Dean has published his observations, namely, *The Present Methods of Oyster Culture in France*, published in the Bulletin, vol. x, 1892, illustrated with ten plates of figures more or less satisfactorily reproduced from photographs of actual scenes; and *Report on the European Methods of Oyster-culture* in vol. xi, 1893, of the Bulletin, still more completely illustrated. These two papers form the best account extant of the methods now practised and the present condition of oyster-culture in Europe. Mr. Dean was sent

at the expense of the United States Fish Commission for the benefit of American oyster growers, but European and especially English people interested in the oyster industry are likely to obtain still more advantage and benefit from his careful work than Mr. Dean's own countrymen, and we owe a debt of gratitude to the Commission for thus providing us with reliable and important information without any cost or trouble to ourselves.

In reference to the Wood's Holl station the Commissioner reports that Dr. H. V. Wilson was appointed resident naturalist on behalf of the Commission in 1889, and served in that capacity in the two following years. His researches related chiefly to the development of the sea-bass, cod, and Atlantic salmon. An elaborate paper on the *Embryology of the Sea-bass* by Dr. Wilson is contained in the Bulletin, vol. ix, 1891. The study of the lobster was taken up at Wood's Holl by Prof. F. H. Herrick, and experiments in artificial propagation were conducted by Mr. V. N. Edwards. We are told that the investigations of the latter have furnished conclusive proof that the hatching work of the Fish Commission has been exceptionally successful in increasing the supply of cod on the southern New England coast, and shows that the larger fish resulting from these plantings will to some extent enter more shallow waters than are generally frequented by the cod, shoals of this species now often making their appearance in places where they were never seen before. The evidence for this would be interesting, and we shall see whether it is forthcoming among the documents published by the Commission.

The Report next mentions the investigations of the interior waters of several of the States, which were extensively and systematically carried out, and reports on which have appeared. A brief notice is then given of the inquiry into the methods and statistics of the fisheries, on which a special report is included in the volume. The rest of the Commissioner's Report is on the Department of Fish Culture which is under the chief's immediate direction. Twenty-two stations were in operation in 1890 and 1891. Sea fish were only manipulated at two stations, namely, Gloucester, Mass., and Wood's Holl, Mass., but in addition a few eggs of Spanish mackerel were hatched on the "Fishhawk" in 1891. The eggs of the cod were hatched in the largest numbers, namely, in round numbers 19 millions at Gloucester, 36 millions at Wood's Holl in 1891; at the same station in that year were hatched 3 million flat-fish fry and 3 million lobsters. The shad was still the fish most extensively treated in the operations of the Commission, nearly 70 million fry having been furnished for distribution in 1891. Altogether the number of different kinds of fish artificially propagated was thirty-eight, of which ten were marine, the rest fresh-water or anadromous.

On the interesting question of the benefits produced by the practice the Commissioner says that the results obtained have been difficult of exact determination; that good has followed is shown by the continued increase in the value of the fisheries demonstrated by carefully collected statistics. He urges that in cases where species have been introduced into waters from which they were naturally absent it is clearly shown what is possible of accomplishment, referring to the results of the importation of shad and striped bass to the Pacific coast, and of trout and white fish into streams and lakes of the Yellowstone National Park, formerly barren of food-fish.

We may turn at this point from the Report of the Commissioner to the Report on Statistics by Hugh M. Smith, M.D., in order to ascertain if we can obtain a more quantitative estimate of the results of the piscicultural operations. Concerning the shad we find it stated that this fish has become distributed along the entire Pacific coast north of Monterey Bay, California, and occurs in special abundance in the Sacramento River. Notwithstanding the fact that the fishermen have provided themselves with no apparatus especially adapted to the capture of shad, 101,071 pounds were taken in 1888, and 170,500 pounds in 1889. We are told that the quantity caught affords no idea of the abundance of the fish, and it is thought that the use of suitable apparatus will demonstrate the existence of large bodies of these fish in all the coast waters between Southern California and Puget Sound. But nevertheless it naturally occurs to the reader to wonder what proportion the amount captured on the Pacific coast bears to that taken on the Atlantic. This curiosity cannot be satisfied out of this Report. After some search we discover the statement that \$482,403 was the value of the shad taken on the South Atlantic division of the coast of the United States in 1890, but this is not enough to enable one to make a comparison. There is, however, a lengthy and detailed paper on the Fisheries of the Pacific Coast in the Commissioner's Report for 1888, published 1892, and in this we find that the value of the shad captured on that coast in 1888 was \$7063, which shows that although the shad has certainly been successfully introduced, the value of the yield on the Pacific side was only $\frac{1}{69}$ of that of the South Atlantic States. Planting of shad on the Pacific slope was apparently commenced in the Sacramento River in 1880. The striped bass (*Roccus lineatus*), though introduced some years before the shad, is stated to be less abundant and less widely distributed than the latter. It was chiefly found in San Francisco Bay, where specimens as much as 40 lbs. in weight have been taken, although the average weight is only 8 or 10 lbs. In 1888 only about 1000 lbs. reached the San Francisco market, but in 1889 they were more plentiful. This is all the statistica]

information supplied. It is evident enough that these two species have been introduced to the Pacific coast by transporting the fry in railroad cars from the Atlantic side, and the fact is impressive as an illustration of the magnitude of the operations carried on by the Commission. Whatever its imperfections, it has made itself a piscicultural organisation which connects together the two greatest oceans of the globe. The transport of useful animals or plants from one continent to another across the ocean is a practice of considerable antiquity; the transportation of valuable fish from one ocean to another across a whole continent had never been accomplished before.

But the question still remains, is there any good evidence by which to estimate the practical results of the piscicultural operations in connection with long-established fisheries? We naturally here examine first the case of the shad fishery on the Atlantic side, since we know that artificial propagation of the shad (*Clupea sapidissima*) has been more extensively and more successfully carried out by the Commission than that of any other fish. We look to see what the Commission has to say of the condition of the fishery. We know that the United States administration does not attempt to supply annual statistics of the fisheries as our own Fisheries Department does. The Commissioner remarks that the limited appropriation and consequent smallness of the force available for statistical inquiry preclude the possibility of an annual investigation; and that even if this were attempted it is open to question whether the variations in the fisheries from year to year are generally sufficiently marked, or whether at this time the results would be of sufficient importance to warrant the largely increased expenditure that would be required to conduct the work. He thinks that comparative statistics are more valuable when they relate to definite intervals of time than when they cover successive years. He asserts that the researches of the Commission furnish data for the comparison of conditions at intervals of three or four years, and for the determination of the influences of the methods and means employed upon the prosperity of the fisheries.

In the Statistical Report the total produce of the shad fisheries in different periods is not definitely presented, but there is a very interesting account of the fishery in the Potomac River, of which the following are the most important points. In 1890, 731,453 fish were taken, weighing 2,571,002 lbs., and realising to the fishermen \$75,935, or about £15,200. In 1889, 868,900 fish were taken, valued at \$85,378. These figures are compared with those corresponding for the end of the previous decade, namely, less than 200,000 fish in 1878, increasing till 1880, when 600,000 was the number of

the season's catch. It will be seen that the increase since 1880, though important, is not enormous, though presumably the Commission claims that the maintenance of the fishery in a prosperous condition is due to artificial propagation. The total value of the shad caught on the South Atlantic coast is given as \$482,403 in 1890, but no means of comparing this with any other time are afforded. However, we are informed in the volume that the work of this department was directed by Captain J. W. Collins, while the preparation of the report devolved upon Dr. Hugh M. Smith, in consequence of the fact that Captain Collins was called upon to do special work at the Chicago Exhibition. In the preceding volume of the series, the Commissioner's Report for 1888, there is a much more complete and detailed statistical review, prepared under the direction of Captain Collins, and covering the years 1887 and 1888. This paper contains a large number of very instructive and ably arranged tables, giving the kind of information we have been seeking.

One of these tables give a comparative statement of the catch of shad in all the United States in the years 1880 and 1888. The total catch in pounds in 1880 was 18,074,534, valued at \$995,790; while in 1888 it was 35,736,385 pounds, valued at \$1,672,192. Thus the amount of the catch had nearly doubled, while the value had not increased in proportion,—that is to say, the price had fallen. The total value in English money is £334,438, which is a little more than the total value of the mackerel landed on the English and Welsh coasts in 1893 (£302,516), but not half the total value of the plaice landed on the same coasts in the same year. The comparison, however, is scarcely just, because the shad is not a true sea fish, but anadromous. It is a curious thing that in another table, showing the comparison by sections, it is shown that the shad fishery in the New England States has decreased from 2,117,392 lbs. in 1880 to 1,412,945 lbs. in 1888. I can find no discussion of this decrease, but it is pointed out in the text of the paper that the total catch of alewives (*Clupea vernalis*) has not increased nearly so much as that of the shad, and that the alewife is not artificially propagated.

It has frequently been supposed that complete statistics of the fisheries of the United States have not been prepared or published. It is true, as we have already seen, that complete annual returns are not supplied; but statistics were compiled for the year 1880, and we have a complete estimate in this paper for 1888. The total value of the coast fisheries is computed to be \$35,222,929, or in English money £7,338,110. This is somewhat more than the total value of the products of the fisheries of the United Kingdom in the year 1888 as computed at the Board of Trade, the sum given being £6,418,000. But it must be noted that the American total includes

over a million dollars for the whale and porpoise fisheries, and nearly two millions for the seal, walrus, and sea-otter fisheries, as well as \$167,000 for reptilian fisheries, while the English returns include no air-breathing animals. Thus it is evident that if we compare the yield of fish, molluscs, and crustacea only in the two countries the fisheries of the United Kingdom are nearly equal in value to those of the United States. Comparing the number of the population employed in the fisheries in the two countries, we find the total in the United Kingdom in 1888 to be 122,526, and that in the United States 137,446; but the latter includes 28,867 shoresmen and factory hands, which ought to be deducted, leaving 108,579. A comparison of the vessels and boats employed in the industry in the two countries seems not to be possible without further explanation of the methods in which the computations are made. According to the United States return, there were in that country in 1888, 6099 fishing vessels, of a net tonnage of 170,126, and in addition 47,195 boats. The number of boats alone, apart from the vessels, is therefore greatly in excess of the total number of fishing vessels and boats of all classes registered under the Act of 1868 in the United Kingdom, namely, 27,812.

We may next pursue our inquiries concerning the results of the operations of the Commission, and ascertain whether evidence as complete as in the case of the shad is supplied with regard to other species, and whether it supports conclusions of the same favorable nature concerning the influence of artificial propagation. At the end of Dr. Smith's report on statistics in the volume for 1889 to 1891 it is stated that the fishermen of the southern New England coast have been much surprised, as well as pecuniarily benefited, by the appearance of young cod in great abundance on grounds where the fish have been scarce or absent for years. The fishery began in 1889, when a few small vessels made good fares, one schooner landing 300,000 lbs. of the fish. Inquiries conducted by the Commission showed that in 1890 by the last of July about 4,000,000 lbs. of small and medium-sized cod were taken in the inshore waters of southern New England, which even the most sceptical fishermen were willing to acknowledge were fish that had been artificially propagated at the Government hatcheries at Wood's Holl and Gloucester. As a result of this single fishery over \$100,000 was added to the income of the fishermen, and there was reason to believe that a permanent summer fishery had been inaugurated that promised good returns.

It would, of course, be desirable to have the complete statistics of the New England cod fishery in order to critically examine this statement about the increased abundance of cod. Acknowledgments

by the most sceptical fishermen are not in themselves conclusive. We find that the cod is the most important single species in the New England fisheries, the total catch in 1889 amounting to 97 million pounds, valued at $2\frac{1}{2}$ million dollars. But it appears that this fishery is carried on chiefly on the banks east of 65° W. long. It might be suggested that the inshore cod in question migrated in from the banks, but on the whole the probability seems to be on the side of the Commission, which regards these cod as its own production. It is interesting to ascertain the extent of the propagation of cod in the years preceding 1890. The number of fry produced were—

		Totals.
1889.	Gloucester . . .	11,000,000
	Wood's Holl . . .	8,000,000
		19,000,000.
1888.	Gloucester . . .	627,040
	Wood's Holl . . .	8,843,600
		9,470,640.
1887. } 1886. }	Wood's Holl . . .	20,000,000
		20,000,000.

The number of cod eggs hatched increased in 1890 and 1891; in the former year it was 21 millions, in the latter 55 millions. The pelagic eggs of marine fishes are still hatched by the officers of the Commission in the Chester tidal boxes and the improved McDonald tidal boxes. No mention is made of any attempt to test the efficiency of apparatus which has been found so much more satisfactory in Europe,—for instance, the Dannevig hatching box, or the hatching jars arranged on the plan used in our Laboratory at Plymouth. At Wood's Holl lobster eggs were stripped from the berried females, and also treated in the Chester and McDonald apparatus and in the universal hatching jar, the total number taken being 8,317,600, and the production of fry 54 per cent. The fry were released when two to four days old, except a few which were kept in the jars for six weeks. A fuller account of this experiment is contained in Mr. Rathbun's report on Food-fishes and Fishing Grounds, from which it appears that the Americans have found the problem of rearing lobster larvæ as difficult as we at Plymouth. It is stated that in none of the trials did more than a small percentage survive for any considerable length of time. Specimens about one month old were taken at the surface in Wood's Holl Harbour, how many or how frequently is not stated; in England the capture of pelagic lobsters is very rare. The stomachs of these specimens contained fragments of Copepods and of the larval stages of crabs, so that their natural food appeared to be other pelagic crustacea. As at Plymouth, it was

found that they would eat almost any animal food, from hard-boiled eggs to their own fellows, and rapidly gorged themselves, after which the majority soon died.

Among special observations and experiments described in Mr. Rathburn's report we have it stated that Mr. V. N. Edwards has studied the spawning and hatching of *Pseudo pleuronectes americanus*, the flat-fish or winter flounder, and has discovered that the eggs of this species are adhesive and sink in sea water. The best method of handling them was found to be to spread them thinly on panes of glass and place them in a current of water in the hatching boxes! It seems scarcely credible that any species of the Pleuronectidæ should not have buoyant pelagic ova. But the statements seem to leave no room for doubt, as Mr. Edwards is represented as squeezing the eggs from the fish and hatching them with facility; it is even stated that occasionally adhesion occurs among the eggs in the ovary, which when pressure is applied come out in a solid mass. It was an unexpected fact that the eggs of the sprat and pilchard are pelagic, while those of the herring are adhesive; and now we have a surprise in the opposite direction in the discovery of adhesive eggs in a flat-fish. The mere statement, however, requires to be supplemented, as doubtless it will be in time, by a description with figures by the original observer. Alex. Agassiz and Whitman in 1885 attributed a certain pelagic egg to this species, but apparently they were mistaken. The eggs of *Pleuronectes maculatus* and *Paralichthys oblongus* were obtained at Wood's Holl by Mr. Edwards, and were buoyant.

It had generally been believed that the American oyster, *Ostrea virginica*, did not reproduce itself in San Francisco Bay, where large numbers of seed or yearling oysters brought over from the Atlantic coast are reared for the market. Mr. Townsend, naturalist of the steamer "Albatross," has, however, found in several parts of the bay, Atlantic oysters naturally spat and derived from parents on the planted beds in such conditions—*e. g.* attached to rocks and piles—as left no doubt that they had developed from free spat *in situ*. Mr. Rathbun's report gives a fuller account of the oyster investigations referred to by the Commissioner himself. It is to be hoped that the efforts of the Commission will succeed in improving the condition of the oyster industry on the Atlantic coast, for the statistical review in the Report for 1888, already frequently referred to, shows that a serious deterioration had taken place between 1880 and 1888. The total decrease in bushels was from 22,195,915 to 21,765,640, made up as follows. The production in the New England States had increased enormously—more than doubled, in fact; in the Gulf States it was nearly four times as great in 1888 as in 1880, and there was also an increase in the Pacific States and in the South Atlantic

States. But a large proportion of the total production was derived from the Middle Atlantic States, which may be regarded as the chief original source of American oysters, and this quantity had decreased from 20 million to 17 million bushels.

In conclusion we may refer to the account in the Commissioner's particular report of an investigation, by the United States Senate, of certain charges brought against the administration of the Commission,—charges of want of discipline, inefficiency, and corruption. A committee of the Senate thoroughly inquired into the charges, and found none of them to be established, but decided from the evidence that the Commission was properly administered, and was performing valuable work worthy of its cost to the State. On this result all who know anything of the Commission will heartily congratulate it and its energetic chief, Colonel McDonald.

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