I.—REPORT OF THE COMMISSIONER.

PRELIMINARIES OF THE INQUIRY.

The importance to the United States of the fisheries on its coasts can scarcely be exaggerated, whether we consider the amount of wholesome food which they yield, the pecuniary value of their products, the number of men and boys for whom they furnish profitable occupation, the stimulus to ship and boat building which they supply, and, not the least of all, their service as a school for seamen, from which the merchant-marine, as well as the Navy of the country, derive their most important recruits.

A few years ago, in view of the enormous abundance of fish originally existing in the sea, the suggestion of a possible failure would have been considered idle; and the fisheries themselves have been managed without reference to the possibility of a future exhaustion. The country has, however, been growing very rapidly; the construction of railroads and the use of ice for packing have furnished facilities for sending fish in good condition all over the country, and the demand for them has increased in proportion. The object of those engaged in the fisheries has been to obtain the largest supply in the shortest possible time, and this has involved more or less of waste, and, in some cases, reckless destruction of the fish.

The discovery, too, that fish can be made to supply a valuable oil by boiling and pressing, and that the residue, as well as the uncooked fish, furnish a valuable manure, to be applied either directly or after special preparation, has constituted an additional source of consumption on a very large scale.

As might have reasonably been inferred, the supply, which formerly greatly exceeded the demand, now, to a certain extent at least and in certain localities, has failed; and the impression has become prevalent that the fish themselves are diminishing, and that in time some kinds, at least, will be almost or quite exterminated. This assertion is made with reference to several species that formerly constituted an important part of the food supply; and the blame has been alternately laid upon one or another of the causes to which this result is ascribed, the fact of the decrease being generally considered as established.

The first official notice taken of this state of affairs, with the view of adopting measures for relief, was on the part of the States of Massachusetts and Rhode Island, both being especially interested in the question, as the greatest depreciation was alleged to have occurred on their southern border. The cause assigned by those who complained most

of the result was the multiplication of "traps" and "pounds," which captured fish of all kinds in great numbers, and, as was supposed, in greater quantity than the natural fecundity of the fish could make good year by year, especially in view of the fact that these catches were made during the spawning season, thereby destroying many of the fertile fish and preventing others from depositing their eggs.

Petitions were presented to the legislatures of both these States in the winter of 1869–'70, asking that a law be passed prohibiting the use of fixed apparatus for capturing fish; and the whole subject came before special committees of the legislatures, and was discussed in all its bearings. The Massachusetts committee, of which Captain Nathaniel Atwood, of Provincetown, was chairman, after considering the evidence adduced, decided that there was no reasonable ground for the complaint, and that any action on the part of the State was inexpedient. (See page 117 of the present report.)

On the other hand, the Rhode Island committee, after giving a much greater amount of personal attention to the matter, came to the conclusion that the prayer of the petitioners was well founded, and they reported in favor of a very stringent law, prohibiting the further use of "traps" or "pounds," excepting within a limited district. (Page 104.) So far from agreeing with the Massachusetts committee on this subject, they gave it as one result of their inquiry that the difference in abundance of food-fishes between the present time and that ten years ago involved an increase in expense of at least $100 per annum to one thousand persons, resident on or near the sea-coast; or, in other words, that one thousand families were taxed to the amount of $100 a year for the purchase of food which previously was readily taken by one or other of its members, at odd moments of time throughout the season. So totally different were the conclusions arrived at by the two committees.*

The report against the prayer of the petitioners, made by the committee of the Massachusetts State senate, settled the question for the time, and no further action was taken. The report of the Rhode Island committee, however, was presented to the legislature, but nothing definite was done. In this State it became a political question rather than an economical one, and shared with the regular issues in determining the result of elections. Rhode Island being strongly republican, the republican ticket was usually elected without any question; but the

* This remarkable contradiction in the results of the two commissions showed the necessity of a special scientific investigation on this subject, to be prosecuted in the way of direct experiment upon the fish themselves, their feeding and breeding grounds. It will be observed that the conclusions depended generally upon the evidence of fishermen alone. The same was the case with the British commission, of which Professor Huxley was a member, and which in the course of its researches visited eighty-six places on the coast of England, and had before them large numbers of persons engaged in the fisheries, some of them using nets and trawls, and others lines. These gentlemen reported that there was no proof adduced to show that the supply of fish in the British seas had decreased, and therefore they opposed any restrictions.

nominee of that party for lieutenant-governor, being looked upon as opposed to the abolition of the trapping of fish, was defeated by the popular vote, although subsequently elected by the legislature. The prevailing sentiment throughout the greater part of the State appeared to be in favor of the prohibition of traps, a measure which was confidently anticipated by all parties, although the propriety of such a course was contested by many persons whose judgment was entitled to consideration. Among these was Mr. Samuel Powel, a member of the State senate, who insisted that the question was too little understood to warrant such action, and that it should first be made the subject of inquiry on the part of scientific men before a proper decision could be reached.

In the accompanying foot-note I present a communication from Dr. Hudson, received as this report is going through the press, in regard to the action on the same subject taken by the State of Connecticut.* This has more particular reference to shad and salmon, but has a part in the general inquiry.

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*STATE OF CONNECTICUT, DEPARTMENT OF FISHERIES,
Hartford, Connecticut, January 2, 1873.

DEAR SIR: You ask for a short history of the efforts made to secure a law prohibiting pounds used for the taking of shad, or prospectively of salmon. In 1866 the Commissioners of fisheries of the New England States met at Boston to discuss measures for restoring salmon and increasing the number of shad in the different rivers of the States. The Connecticut River of our State was the only stream under special discussion, as four of the States, New Hampshire, Vermont, Massachusetts, and Connecticut were all equally interested. An agreement was finally made that the commissioners of Vermont and New Hampshire were to furnish all the salmon-fry necessary to restock the river, Massachusetts was to furnish fishways for all dams on the river in the State, and the Connecticut commissioners were to procure a law abolishing pounds at the mouth of the river. In accordance with this agreement, our commissioners succeeded in having a law passed in 1868, approved July 31, 1868, section 2 of which is as follows: "That from and after the year 1871 it shall be unlawful for any person to erect, construct, or continue in the waters along the northerly shore of Long Island Sound, in this State, any weir or pound for the taking of fish." You will notice that no penalty is provided in case of non-observance of the law. To remedy this defect a law (which I inclose) was passed in 1871, approved July 24, 1871, making a penalty of $400, but giving a majority of the commissioners authority to grant permits. As Massachusetts had built no fishways, and New Hampshire and Vermont did not pretend to live up to their promise in consequence, permits were granted under certain restrictions, and in 1872 the legislature passed a new law by which pounds may be allowed to fish except from sunrise on Saturday until sunrise on Monday, with a few hours' allowance for tides. All restrictions on fykes have been repealed.

Yours, very truly,

WM. M. HUDSON.

Prof. S. F. BAIRD, *Washington, D. C.*

AN ACT in addition to an act for encouraging and regulating fisheries.

Be it enacted by the senate and house of representatives, in general assembly convened:

SECTION. 1. That upon a written request of the fish commissioners, or a majority of them the selectmen of any town in the State shall appoint two or more such persons as shall be approved by such fish commissioners to be fish wardens, whose duty it shall be to assist the fish commissioners in detecting and prosecuting offenses against the fishery laws of the State, and who shall be paid a suitable compensation from the treasurer of

In view of such considerations as were adduced by Mr. Powel, and of the contrariety of opinion on the part of State committees, it was deemed desirable that the whole matter should be investigated by some scientific officer of the general Government presumed to be competent to the inquiry and entirely uninfluenced by local considerations. Indeed, as the alleged diminution of the fisheries was in tidal and navigable waters of the United States, and over which the Federal Government exercises jurisdiction in other matters, it was maintained by many that the State governments had no control, and that any enactments on the subject must be made by Congress; especially as, if left to the States, it would be impossible to secure that harmony and concurrence of action necessary for a successful result.

It will be observed that in all these cases the question turned upon the evidence of men who were interested in one way or another, and whose daily bread might depend largely upon the conclusions arrived at. Many of them had made large investments of money in nets and boats, while others who had no such interests acted upon the natural antipathy that seems to exist between those using the net and those fishing with the line. It was also shown, by some of the testimony, that in many instances persons were biased in their evidence by intimidation, either expressed or understood, on the part of the owners of nets. Ad-

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the town; and in addition thereto shall have one-half the penalty that may be recovered and paid into the treasury for any offense detected by them.

SEC. 2. Chapter 27 of the session laws of 1869, approved June 21, 1869, is hereby appealed.

SEC. 3. After the year 1871, any person who shall set, use, or continue, or shall assist in setting, or using any pound, weir, set-net, or other fixed or permanent contrivance for catching fish in any of the waters within the jurisdiction of the State without the written permission of the majority of the fish commissioners, shall forfeit and pay the sum of $400 to the treasury of the State.

SEC. 4. All the provisions of the third and fourth sections of the act entitled "An act in addition to an act for encouraging and regulating fisheries," passed May session, 1867, and approved July 26, 1867, are hereby extended and shall fully apply to this act; and all parts of acts heretofore passed which are inconsistent with this act are hereby repealed.

SEC. 5. In addition to the penalties provided in section three, any justice of the peace for the county in which such pound, weir, set-net, or other fixed or permanent contrivance has been so set up, used, or continued, or where any persons shall violate any of the laws of this State by fishing at such times as are prohibited by law, is hereby authorized and directed, upon the written request of any fish commissioner or fish warden, to issue his warrant commanding the sheriff, constable, or any other proper person or persons in such warrant named, to cause the same to be seized forthwith, together with all the parts thereof, and all nets, seines, boats, oars, sails, tackle, ropes, and other articles employed therewith, or used in violation of the laws of this State as aforesaid, and to be removed and sold at public auction to the highest bidder, and, after paying out of the proceeds of such sale all the expenses of such seizure, removal, and sale, to deposit what remains in the treasury of the State. The provisions of this act shall not apply to any pounds set for the purpose of catching white fish between the eastern boundary of the town of Clinton and Pond Point, in the town of Milford.

SEC. 6. All acts or parts of acts inconsistent herewith are hereby repealed.

Approved July 24, 1871.

mitting, however, that the use of nets of certain kinds has done a great part, or even the whole, of the mischief complained of, it was a matter worthy of serious inquiry whether so positive a measure as absolute prohibition was expedient or necessary, and whether by limiting the time during which the use of nets is allowed, the interests of both parties may not be reconciled, by giving to the fish the opportunity of spawning undisturbed, and also by regulating the size of the mesh, so as to catch only the oldest and largest fish. All this, however, was only to be ascertained by a careful study of the habits of the fish, so as to determine the nature of their food, the growth of their spawn, and other circumstances bearing upon the solution of the problem in question.

The following bill for this purpose was therefore introduced into the House of Representatives by the Hon. H. L. Dawes, and became a law on the 9th of February, 1871:

[RESOLUTION OF GENERAL NATURE—No. 8.]

JOINT RESOLUTION for the protection and preservation of the food-fishes of the coast of the United States.

Whereas it is asserted that the most valuable food-fishes of the coast and the lakes of the United States are rapidly diminishing in number, to the public injury, and so as materially to affect the interests of trade and commerce: Therefore,

Be it resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the President be, and he hereby is, authorized and required to appoint, by and with the advice and consent of the Senate, from among the civil officers or employés of the Government, one person of proved scientific and practical acquaintance with the fishes of the coast, to be commissioner of fish and fisheries, to serve without additional salary.

SEC. 2. *And be it further resolved,* That it shall be the duty of said commissioner to prosecute investigations and inquiries on the subject, with the view of ascertaining whether any and what diminution in the number of the food-fishes of the coast and the lakes of the United States has taken place; and, if so, to what causes the same is due; and also whether any and what protective, prohibitory, or precautionary measures should be adopted in the premises; and to report upon the same to Congress.

SEC. 3. *And be it further resolved,* That the heads of the Executive Departments be, and they are hereby, directed to cause to be rendered all necessary and practicable aid to the said commissioner in the prosecution of the investigations and inquiries aforesaid.

SEC. 4. *And be it further resolved,* That it shall be lawful for said commissioner to take, or cause to be taken, at all times, in the waters of the sea-coast of the United States, where the tide ebbs and flows, and also in the waters of the lakes, such fish or specimens thereof as may in his judgment, from time to time, be needful or proper for the conduct of his duties as aforesaid, any law, custom, or usage of any State to the contrary notwithstanding.

Approved February 9, 1871.

As passed, the resolution provided for the extension of the inquiry to the lakes, at the instance of some of the western members, who desired that the subject of the diminution in the supply of white-fish and other species in the western waters should be investigated.

To carry out the provisions of the law, an appropriation was made by Congress to meet the necessary expenses of the investigation, and the

position of commissioner (without salary) having been tendered by the President, I accepted it, with the determination of giving to the inquiry as much consideration as the time at my disposal would permit; and, receiving the necessary leave of absence from Professor Henry, the secretary of the Smithsonian Institution, I proceeded to Vineyard Sound early in June, 1871, as it was in that region that the alleged decrease was most clearly manifested, and established my headquarters at Wood's Hole, a village on the coast about eighteen miles from New Bedford, and directly opposite Holmes's Hole, (now Vineyard Haven.) From this center I could readily reach all such points on the adjacent coast, as were most likely to furnish important facts bearing on the question. About the same time Mr. J. W. Milner, of Waukegan, Illinois, a gentleman of scientific training and ability, proceeded to Lake Michigan and spent the entire summer and autumn in prosecuting his labors in reference to the fisheries of the lakes, the results of which will be presented hereafter.

The provision of the law directing the executive officers of the Government to render all the aid in their power to the required investigations was found to be of great value. By the direction of the Secretary of the Treasury, and through the courtesy of Mr. J. A. P. Allen, collector of customs at New Bedford, I was enabled to obtain the use of the small yacht Mazeppa, belonging to the New Bedford custom-house, as well as the services of the captain of the vessel, John B. Smith, esq., then janitor of the custom-house. A substitute in the way of a boat and captain was, however, furnished to the custom-house from the appropriation for the inquiry. The Treasury Department also instructed the collector of customs at Newport to detail the revenue-cutter Moccasin, belonging to that station, and in command of Captain J. G. Baker, for use in my investigation whenever her services were not required in any other direction. The Light-House Board granted the occupation of some vacant buildings and of the wharf connected with their buoy-station at Wood's Hole; and the Secretary of the Navy placed at my command for the summer a small steam-launch, belonging to the navy-yard at Boston, and gave me the use of a large number of condemned powder-tanks, which served an excellent purpose in the preservation of specimens. I am also indebted to Professor Henry for permission to use the extensive collection of apparatus belonging to the Smithsonian Institution in the way of nets, dredges, tanks, &c., and thus saving the considerable outlay which would otherwise have been necessary.

Due use was made, in the course of the summer, of all the facilities in question, and I beg leave here to express my acknowledgments to the Treasury and Navy Departments; as also, among many others, to Captain Macy, of the Newport custom-house; to Captain J. G. Baker and officers of the Moccasin; Mr. J. A. P. Allen, collector of customs, New Bedford; to Captain John B. Smith, of the Mazeppa; to Captain Edwards, of the light-house buoy establishment at Wood's Hole; as also to various other gentlemen whose names appear in the report.

CHARACTER AND PROGRESS OF THE INVESTIGATION.

The plan adopted for the inquiry was determined upon after careful deliberation. The great contrariety of opinion developed in the State investigations as to what should have been the best-known facts in the life-history of the fishes and their associates in the sea, made it necessary to study the natural history of these species as thoroughly as possible, so as to have a more complete knowledge of the facts, and consequently better means of arriving at satisfactory conclusions. Works already published upon American fishes proved to contain comparatively little of value as to the biography of the coast species; and the evidence of fishermen and others, whose judgment ought to be reliable, was found to be entirely contradictory and unserviceable. A systematic plan of inquiry was therefore drawn up, with the assistance of Professor Gill, embracing the points in the history of the fishes information relative to which was desirable, and a series of questions was devised, (see page 1,) answers to which, if satisfactory and complete, would leave little room for future inquiry. These were printed for the purpose of giving them a wide circulation, and include queries in reference to the local names of each kind of fish, its geographical distribution, its abundance at different periods of the year and in different seasons, its size, its migrations and movements, its relationship to its fellows or to other species, its food, and its peculiarities of reproduction; also questions relative to artificial culture, to protection, diseases, parasites, mode of capture, and economical value and application—eighty-eight questions in all, covering the entire ground.

As the history of the fishes themselves would not be complete without a thorough knowledge of their associates in the sea, especially such as prey upon them or in turn constitute their food, it was considered necessary to prosecute searching inquiries on these points, especially as one supposed cause of the diminution of the fishes was the alleged decrease or displacement of the objects upon which they subsist.

Furthermore, it was thought likely that peculiarities in the temperature of the water at different depths, its chemical constitution, the percentage of carbonic-acid gas and of ordinary air, its currents, &c., might all bear an important part in the general sum of influences upon the fisheries; and the inquiry, therefore, ultimately resolved itself into an investigation of the chemical and physical character of the water, and of the natural history of its inhabitants, whether animal or vegetable. It was considered expedient to omit nothing, however trivial or obscure, that might tend to throw light upon the subject of inquiry, especially as without such exhaustive investigation it would be impossible to determine what were the agencies which exercised the predominant influences upon the economy of the fisheries.

As already stated, the preliminary arrangements having been made, and the necessary leave of absence granted by Professor Henry, I left

Washington and established myself at Wood's Hole, where shortly after my arrival I was joined by Mr. S. J. Smith and by Professor A. E. Verrill, of Yale College, who had kindly undertaken to conduct the inquiries into the invertebrate fauna of the waters. With the facilities in the way of steamers and boats already referred to, I repeatedly visited in person the entire coast from Hyannis, Massachusetts, to Newport, Rhode Island, as well as the whole of Buzzard's Bay, Nantucket, Martha's Vineyard, &c., and in addition to making collections and investigations, I secured the testimony of a large number of persons who were interested in the inquiry; among whom were nearly all the leading fishermen, both line-men and trappers, as well as those who had been dealers in fish and engaged in supplying the markets of New York and Boston for many years. Many of these persons eagerly embraced the opportunity to tell their story of alleged wrongs, to urge various methods for their redress, or else to claim the possession of certain inherent rights which it were rank injustice to deprive them of. A verbatim report of this testimony was made by Mr. Henry E. Rockwell, an accomplished phonographer, and has been printed in part, beginning on page 7.

I also made the acquaintance of several gentlemen of literary ability and research, who had previously given much attention to the various questions connected with the fisheries, and who had in a measure become champions of the opposing sides, and obtained from them elaborate arguments on the subject. That of Mr. J. M. K. Southwick, of Newport, in behalf of the traps and pounds, will be found on page 76, and of Mr. George H. Palmer, of New Bedford, and Mr. J. Talbot Pitman, of Providence, as opposed to their continuance and in the interest of the line-fishermen, on pages 88 and 196.

Many important facts were thus elicited by means of the inquiries and testimony referred to, suggesting hints for personal examination to be subsequently prosecuted. Nearly all the fish pounds and traps along the coast, some thirty in number, were visited, and their location and character determined. These have been designated on a map of Massachusetts and Rhode Island, which accompanies the present report.

The large number of pounds in the vicinity of Wood's Hole rendered it an easy matter to obtain material for investigation; and the opportunity was embraced for determining more satisfactorily, from the contents of the stomachs of the different kinds of fish captured, the precise nature of their food. For the facilities in the way of specimens furnished by the proprietors of these pounds, always readily given, I beg to render my acknowledgments; especially to Captain Isaiah Spindel, at Wood's Hole; to Captain Rogers & Brothers, at Quissett; to Captain Peter Davis, at Ram's Head; to Captain Jason Luce & Co., at Menemsha Bight; to Captain Phinney, at Waquoit, and to others.

In addition to the material secured by thus sedulously visiting the pounds and other localities for the objects mentioned, seines and nets of different kinds were set or drawn almost every day, for the pur-

pose of ascertaining facts connected with the spawning of the fish, the rate of growth of the young, the localities preferred by them, &c. Professor Verrill and his parties wese engaged also throughout the summer in making collections along the shores at low tide, as also in the constant use of the dredge and the towing-net.

One important question connected with this investigation, in addition to determining the character of the food available for the fishes, was to ascertain its comparative abundance, a great diminution or failure of such food having been alleged as one cause of the decrease of the fisheries. Care was therefore taken to mark out the position and extent of different beds of mussels, worms, star-fishes, &c., at the sea-bottom, and by straining the water at various depths and at the surface, to ascertain the amount of animal life therein. Temperature observations were also repeatedly taken and recorded, especially from the revenue-cutter Moccasin, under command of Captain Baker.

Having ample facilities at hand for making zoological collections, the opportunity was embraced to secure large series, not only for the national museum at Washington, but also for other establishments; and a sufficient quantity was gathered to supply sets (as soon as they can be fully elaborated) to the various colleges and other public institutions throughout the country. Large numbers of fishes, especially of the more showy kinds, such as sharks, skates, rays, &c., in which the waters abound, were secured for a similar purpose, and a partial distribution to colleges and societies has already been made of the duplicates of this portion of the collections. The occasion was also embraced by several gentlemen to make special collections for establishments with which they were connected. Among them we may mention more particularly Professor Jenks, in behalf of Brown University; Professor Hyatt, for the Boston Society of Natural History; Professors Smith and Verrill, for Yale College; Professor Todd, for Tabor College, Iowa; Doctor Farlow, for the Botanic Garden at Cambridge, &c. Facilities for such enterprises were always gladly furnished.

With a view of exhibiting the character of the fishes of the region explored, and determining their rate of growth, an experienced photographer accompanied the party, who, in the course of the summer, made over two hundred large negatives of the species in their different stages of development, at successive intervals throughout the season. These constitute a series of illustrations of fishes entirely unequaled; forming an admirable basis for a systematic work upon the food-fishes of the United States, should authority be obtained to prepare and publish it.

Among gentlemen interested in science who visited Wood's Hole during the summer for a greater or less period of time, either with special reference to co-operation in the work of the commission, or on account of the interest experienced in such investigations, may be mentioned Professor L. Agassiz, of Cambridge; Professor J. W. P. Jenks, of Brown University; Professors Verrill, Smith, D. C. Eaton, William D. Whitney,

William H. Brewer, and Mr. Thatcher, of Yale College; Professor Hyatt and Dr. Thomas M. Brewer, of Boston; Dr. W. G. Farlow, of Cambridge; Professor Theodore Gill and Dr. Edward Palmer, of Washington; Colonel Theodore Lyman, Massachusetts commissioner of fisheries; Mr. Gwyn Jeffries, of England; Mr. J. Hammond Trumbull, of Hartford; Professor Todd, of Mount Tabor, Iowa; Professor O. C. Thompson, of the Technical Institute, Worcester, and several others.

As already mentioned, my own stay on the coast of Wood's Hole extended until the early part of October; and, on my departure, I commissioned Mr. Vinal N. Edwards, of that place, to continue the investigation as far as possible, by collecting facts in regard to the more important species, and especially as to the time of their leaving the shores. This he performed with great fidelity, besides securing valuable specimens of rare fishes and transmitting them to Washington.

An interesting result of the labors at Wood's Hole, during the summer of 1871, consisted in the great variety of fishes obtained through the pounds and otherwise, many of them of kinds previously unknown on the New England coast. The total number actually secured and photographed amounted to one hundred and six species, of which twenty or more are not included in the great work of Dr. Storer on the fishes of Massachusetts. Nine species are mentioned by various others as found in the waters of Vineyard Sound, but which were not secured; making one hundred and fifteen in all now known to belong to that fauna.

Among the more interesting novelties observed in the way of fishes was a species of tunny, a kind of small horse-mackerel, (the *Orcynus thunnina*,) a species weighing about twenty pounds, and which, although well known in the Mediterranean and in the warmer part of the Atlantic, had never been recorded as taken on the American coast. This fish proved to be quite common, not less than five hundred having been taken in the fish-pounds at Menemsha Bight alone. Two species of the sword-fish family, never noted before in the United States, were also captured. A complete list of the fishes taken, appended to this report, will elucidate more clearly the richness of the locality.

The variety of other marine animals secured was also unexpectedly large. Most of these will be referred to in the appendix, in the form of a paper by Professor Verrill. A list of the algæ, furnished by Dr. W. G. Farlow, of Cambridge, will also be found therein.

After completing my field labors for the season of 1871, I had a conference in Boston with Mr. Theodore Lyman, fish commissioner of Massachusetts, and Mr. Alfred Read, commissioner of Rhode Island, together with Mr. Samuel Powel, of Newport, when the results of the season were discussed, and the draught of a fishery bill presented, which was proposed for adoption by the States of Massachusetts and Rhode Island. The deliberations and discussions of this meeting will be found on page 125.

Simultaneously with the inquiries prosecuted during the summer of 1871, by myself and companions, a careful study was made of the food-fishes found off the coast of North Carolina, by Dr. H. C. Yarrow, acting assistant surgeon United States Army, stationed at Fort Macon. The value of the services of this gentleman in the collection of facts and statistics of the fisheries, and in adding to our knowledge of the natural history of the species, as well as in making collections of specimens, can scarcely be overestimated. The conclusions arrived at by this gentleman and his notes upon the specimens will be found embodied in the report.

During the summer and autumn of 1871, Mr. J. W. Milner, deputy commissioner for the great lakes, made the complete circuit of Lake Michigan, visiting every pound and gill-net station, and collecting a most important body of information and material. This will be made the subject of a special report, as soon as the data collected in 1872 can be properly arranged.

GENERAL RESULTS OF THE INVESTIGATION.

Having thus given an account of the circumstances which led to this inquiry, of the method of research adopted, and of the steps taken to carry out the programme, I now proceed to discuss, in a general way, the results obtained by the investigation, premising, however, that this is but the fruit of two seasons, and requires to be revised by a careful comparison of results for several successive years. Enough, however, has been determined to furnish a general indication in regard to habits of the fishes, and of the methods most likely to accomplish the object of their restoration to their original condition.

As already stated, the objects of the investigation, as authorized by Congress, were, first, to determine the facts as to the alleged decrease of the food-fishes; secondly, if such a decrease be capable of substantiation to ascertain the causes of the same; and, thirdly, to suggest methods for the restoration of the supply. A fourth object incidental to the rest was to work out the problems connected with the physical character of the seas adjacent to the fishing localities, and the natural history of the inhabitants of the water, whether vertebrate or invertebrate, and the associated vegetable life; as also to make copious and exhaustive collections of specimens, for the purpose of enriching the national museum at Washington, and of furnishing duplicates for distribution in series to such suitable collegiate and other cabinets as might be recommended for the purpose.

This research into the general natural history of the waters was considered legitimate, as, without a thorough knowledge of the subject, it would be impossible to determine, with precision, the causes affecting the abundance of animal life in the sea and the methods for regulating it; and the record of these facts, accompanied by proper illustrative figures, it was believed would be a very acceptable contribution to the

cause of popular education, and supply a want which has long been felt in this country.

As the direct operations of the commission required the use of extensive and complicated apparatus, the additional cost of securing specimens enough for the principal cabinets was found to be trifling, and the opportunity for enriching them with material usually so difficult of acquisition it was thought should by no means be lost.

Nearly all enlightened nations have devoted much time to the investigation of precisely such subjects, the German government, in particular, having now in progress, under the direction of the National Fishery Association, an exhaustive examination of all its shores and the adjacent waters, believing that, by a thorough investigation, *a priori* in this direction, the various problems in reference to the culture and protection of fish, oysters, lobsters, crabs, and the like, could be more readily settled.

I. DECREASE OF THE FISH.—Bearing in mind that the present report has more particular reference to the south side of New England, and especially to that portion of it extending from Point Judith on the west to Monomoy Point on the east, including Narragansett Bay, Vineyard Sound, Buzzard's Bay, Martha's Vineyard, and Nantucket, I have no hesitation in stating that the fact of an alarming decrease of the shore-fisheries has been thoroughly established by my own investigations, as well as by evidence of those whose testimony was taken upon the subject.

Comparatively a few years ago this region was perhaps the scene of the most important summer fishery on our coast, the number of southern or deep-sea species resorting to its shoal bays and inlets to deposit their eggs being almost incredible. The testimony of the earliest writers, as well as that given by witnesses examined, and set forth in the appendix to the present report, as to the abundance of the fish, is believed to be by no means exaggerated; and even within the memory of persons now living, the mass of animal life was exceedingly great. The most important of the fish referred to were the scup, the tautog or black-fish, the striped-bass, and the sea-bass, in addition to which there were species of less importance, although equally edible, such as the sheep's-head, the king-fish, the weak-fish, &c.

The appearance of these fish was very regular, and their arrival upon the shore could be calculated upon with almost the same precision as the return of migratory birds; varying only, year by year, with special conditions of temperature and oceanic currents. Other species, more capricious in their appearance, and belonging essentially to the division of outside fishes, were the mackerel, the blue-fish, the Spanish mackerel, the bonito, &c. The alewife, or gaspereaux, and the shad were also included; as likewise the salmon, at an earlier period, although this fish was exterminated at a comparatively early period. (See page 149 *et seq.*)

In view of the facts adduced in reference to the shore-fishes, there can be no hesitation in accepting the statement that there has been an enormous diminution in their number, although this had already occurred to a considerable degree with some species by the beginning of the present century. The evidence of the fishermen, however, and of others familiar with the subject, as published in the present report, goes to prove that the decrease has continued in an alarmingly rapid ratio during the last fifteen or twenty years, or even less; and I can state of my own personal observation that localities in Vineyard Sound where nine years ago an abundance of scup, tautog, sea-bass, &c., especially the former, could be caught, do not now yield one-tenth part of the weight of fish, in the same time and at the same season. As the decrease is most strongly marked in the case of the scup, I refer for the details to the chapter on that fish, (page 228.)

We may also refer to the testimony of the Rhode Island committee, on page 104, in reference to the increase of the cost of living on the coast of that State, in consequence of the diminution of the fisheries. "One very intelligent man thought it made $100 difference in the cost of living to those persons living on the shore and in the small towns on the bay, and, from his own experience, he had no doubt that there are one thousand persons living near the shore to whom it made this difference, amounting to a loss to them of $100,000 each year, that of the high price of fish in Providence market not being taken into account." (Page 105.)

The condition of things referred to is, perhaps, not felt uniformly over the entire coast, but in certain regions the complaint in regard to it is universal; and it will be our object to make inquiry hereafter as to the real causes of the evil.

Many persons are in the habit of considering that the fish supply of the sea is practically inexhaustible; and, therefore, that a scarcity of any particular location is to be referred rather to the movements of the fish, in changing their feeding-grounds capriciously, or else in following the migration, from place to place, of the food upon which they live. This may be true to a certain extent, as we shall hereafter show, but it is difficult to point out any locality where, near the shores in the New England States, at least, under the most favorable view of the case, the fish are quite as plentiful as they were some years ago; and still more so where, by their overlapping the original colonists of the sea-bottom, they tend to render the abundance appreciably greater than usual. And, furthermore, if the scarcity of the fish be due to their going off into the deep waters of the ocean, it is, of course, of very little moment to the fisherman that they are as abundant in the sea as ever, if they do not come upon such grounds as will permit their being taken by his lines or nets.

It is by no means to be inferred from our remarks as to the scarcity of fish that fewer are actually caught now than formerly at any time;

the contrary, perhaps, being the case, since by means of the improved methods of capture, in the way of pounds and nets, an immense supply is taken out at certain seasons of the year so as frequently to glut the markets. The scarcity referred to is better shown by the great difficulty experienced by line-fishermen in securing a proper supply throughout the year on grounds where they were formerly able to catch all they needed for their own use and for sale.*

The evil effects of the state of things here indicated, are felt in many ways. Primarily on the part of many fishermen, resident on the coast, who have been in the habit of making a living by the proceeds of their occupation, not only supplying themselves with food, fresh and salt, for the year, but also making a comfortable living by sales of their surplus. At the present time this resource is cut off to a great degree from this class of people in many places on the Massachusetts coast, where, as on Nantucket, Martha's Vineyard, and elsewhere, the deprivation from the loss of profits by fishing is being most seriously felt. The result, of course, of the inability to make a living in this manner is to drive the line-fishermen to other occupations, and especially to induce them to leave the State for other fields of industry. In consequence the population is reduced, and the community feels this drain of some of its best material in many ways. Furthermore, property depreciates in value, farms and houses are abandoned, the average of taxation is increased, and many other evils, readily suggesting themselves, are developed.

Again, an important stimulus to the building of ships and boats is lost in the decreasing demand for vessels of various grades; and, what is more important to the country at large, the training of skilled seamen with which to supply our national and our merchant marine generally is stopped, or more or less interfered with. It is well known that the line-fisheries, in their different manifestations, have always been looked upon as of the utmost importance in a politico-economical point of view, for which reason bounties were paid by the General Government; and, although these have been lately withheld, it may yet be necessary to restore them in order to regain our lost ground.

II. CAUSES OF THE DECREASE.—As the testimony and considerations already adduced may justly be considered as establishing the fact of the vast decrease in the extent and value of the summer shore-fisheries on the south side of Massachusetts and Rhode Island, the question recurs

*In the article on scup in the body of the report (p. 228) will be found a detailed account of the occurrence of the young fish, to an enormous extent, in the spring of 1871, and the speculations as to their origin. These reappeared in 1872, though in much less numbers, as two-year-old fish, and by autumn weighed from one-third to half a pound, and will doubtless be met with again in 1873 as marketable fish. There is, however, no evidence to show that a renewed supply of young fish, or at least in anything like the same numbers, was present in 1872; which tends to render the problem of their appearence still more difficult of solution.

as to the causes which have led to this result. These, as commonly given, are principally the following:

1. The decrease or disappearance of the food upon which the fish subsist, necessitating their departure to other localities.

2. A change of location, either entirely capricious or induced by the necessity of looking for food elsewhere, as just referred to.

3. Epidemic diseases, or peculiar atmospheric agencies, such as heat, cold, &c.

4. Destruction by other fishes.

5. The agency of man; this being manifested either in the pollution of the water by the discharge into it of the refuse of manufactories, &c., or by excessive overfishing, or the use of improper apparatus.

These we will now proceed to discuss briefly in their order, beginning with, first, *disappearance of the food.*

To this subject special attention was given in the course of the investigations of 1871 and 1872, as the suggestion was quite plausible, and by many was believed to be of great weight. The dredging operations under Professors Verrill and Smith, were admirably calculated to test this question, as the sea-bottom was raked in every direction by the dredges; and the towing and drifting nets revealed the extent and comparative abundance of animal life in the surface-water or throughout its depths.

Fortunately for the proper solution of this question, an extensive series of dredging operations had been conducted by myself in the waters in the vicinity of Wood's Hole, as long ago as 1863, when the diminution in the abundance of the fishes had not made itself so palpable. As a general result, it may be said that, so far from there being any scarcity of invertebrate life in the waters during the summer of 1871, as compared with earlier years, its actual amount was such as to strike with astonishment every one in our party engaged in the inquiry. The dredge was never brought up from scraping the bottom without being filled with worms, star-fishes, sea-urchins, shells, &c. The location of numerous mussel-beds, of acres in extent, was established; the towing-net would become almost filled, in a short time, with embryos of crabs, worms, ascidians, &c., and, on several occasions, in dredging off the coast, to a distance of twenty or thirty miles, the water was found to be so thick with animal life that a bucket of water drawn up would contain hundreds of specimens, the sea indeed appearing like a thick mush of organisms. If any difference were appreciable between the seasons of 1863 and that of 1871, it was in favor of the latter, possibly, indeed, because of the much less number of fishes calculated to reduce the mass. The validity, therefore, of the assumption of a diminution of food may be denied in the most positive terms.

The second alleged cause, *that of change of abode on the part of the fishes*, has also received proper consideration; but the most careful inquiry failed to reveal any locality or localities along the coast where

these fishes were to be found in an increased abundance, such as would result from the overlapping of the normal supply of any part of the coast by that from a different region. The fish were certainly not displaced in an easterly direction; and to the west of Narragansett Bay their numbers, though perhaps not diminished to the same extent as east of it, were decidedly less than formerly.

Thirdly, disease or atmospheric agencies.—The question of epidemic diseases among fishes is sometimes suggested by finding large numbers coming ashore, at times with and at others without any assignable cause. Occasionally this may be referred to volcanic exhalations, which charge the water with sulphuretted hydrogen gas or other noxious substances, and thus produce death. Where no positive cause can be indicated, the occurrence of some form of disease is frequently assigned as the reason. It is stated, for instance, that in the last century the blue-fish about Nantucket, then in great abundance and of enormous size, so large indeed that thirty of them would fill a flour-barrel, were attacked by a disease which destroyed them in large numbers; and that the Indians of the island were nearly exterminated at the same time, either by sharing in a common attack, or by eating the diseased fish. In the course of time the blue-fish again returned to the Nantucket waters, although of much smaller size than formerly represented; but the Indians never recovered their ground, their number being now extremely limited.

The agency of cold is also given as producing occasionally great mortality, especially among the tautog. A very cold spell, occurring at low tide some years ago, is said to have killed the tautog in such numbers that hundreds of tons were thrown ashore at Block Island and along the southern shores of Rhode Island and Massachusetts. This fact appears to be well attested, and, in all probability, may have had a decided influence, and similar facts, though on a much smaller scale, have been adduced in reference to the young scup in the late autumn, but this cannot have material influence on the number of old scup, as may be the case with the striped bass and tautog, both of which are known to be winter residents of these shores. Similar facts have been observed even as far south as the Gulf of Mexico, where the occurrence of a "norther" not unfrequently produces more or less mortality by chilling the water.

The *fourth* cause of decrease, as alleged, namely, *the ravages of predaceous fishes*, I am quite satisfied is one worthy of serious consideration, the principal offender in this respect being the blue-fish. No one who has spent a season on the coast, where this fish abounds, can fail to have been struck with its enormous voracity, and the amount of destructiveness which it causes among other kinds of fish. Wherever it appears in large numbers it is sure to produce a marked effect upon the supply of other fishes, either by driving them away from their accustomed haunts or by destroying them in large quantities in any

given locality. Ample evidence to this effect will be found in the testimony presented in the present report, as well as in the article on the blue-fish, (page 235.) As there stated, it is a pelagic or wandering fish, going in immense schools, and characterized by a voracity and blood-thirstiness which, perhaps, has no parallel in the animal kingdom.

The fish seems to live only to destroy, and is constantly employed in pursuing and chopping up whatever it can master. As some one has said, it is an animated chopping-machine. Sometimes among a school of herring or menhaden thousands of blue-fish will be seen, biting off the tail of one and then another, destroying ten times as many fish as they really need for food, and leaving in their track the surface of the water covered with the blood and fragments of the mangled fish.

The blue-fish range in size, when two years of age and over, from five to twelve pounds. I ascertained by a careful inquiry into the number shipped by the dealers along the shore that about a million and a quarter could be estimated as the number captured along through Vineyard Sound and on the coast from Monomoy Point through Long Island Sound and sent to market in 1871. Any one who has seen these fish will judge that not one in a hundred is taken. If, now, we admit the presence of 100,000,000 blue-fish in these waters referred to, we may form some estimate of the number of fish destroyed by them. To estimate twenty per day as the number destroyed, if not devoured, by each blue-fish, is by no means extravagant, when we bear in mind the result of my own examinations and the testimony of others.

We all know that fish-spawn and fish in different stages of growth constitute the principal source of food to other fishes in the sea, and that the great proportion of fishes devoured are of tender age. The blue-fish, however, will often attack species but little less than itself, and the 100,000,000 referred to probably destroy fishes of two or three ounces and upward; that is to say, those that have passed the ordinary perils of early life, and have a fair chance to reach maturity. Therefore, if 12,000,000,000 are eaten, the number destroyed off the New England coast in a season of one hundred and twenty to one hundred and fifty days can be easily estimated.

No other sea-coast than that of the Atlantic border of the United States can show, as far as our information extends, so destructive a scourge as the blue-fish, occurring in such numbers, of so large a size, and of so massive a frame; able to cope with and mutilate, if not devour, any other fish of less size. Indeed, I am quite inclined to assign to the blue-fish the very first position among the injurious influences that have affected the supply of fishes on the coast. Yet, with all this destruction by the blue-fish, it is probable that there would not have been so great a decrease of fish as at present but for the concurrent action of man, as we shall endeavor to show farther on.

Under the *fifth* head, that of *human agencies*, we may consider first the question of the pollution of the water by poisonous agencies.

These may consist, as already stated, of chemical substances, which exert a directly poisonous influence, or of mechanical objects, such as sawdust, which, it is said, gets into the gills of fishes, and ultimately causes their death, or, falling to the bottom, with edgings, bark, &c., covers up the gravel and destroys the natural spawning-beds, and thus prevents the development of the eggs.

These causes, however, apply essentially to rivers, and their injurious action in such cases has frequently been substantiated, and has invoked, in many instances, legislative interference. They exercise very little influence, however, in regard to the fishes of the sea. The testimony before the Rhode Island legislature would tend to show that, in the immediate vicinity of factories on the Narragansett Bay and its tributaries, many of the smaller varieties of fish were as abundant as ever, and that, even in the vicinity of gas-works, the discharge from which, as containing creosote and other substances, might be expected to produce a very injurious effect, the only result was the imparting of an unpleasant, tar-like taste to oysters and other mollusks that occurred in the neighborhood. It is by no means impossible that some fish might be driven away from the vicinity of the discharge of such an establishment; but that any marked effect could be produced on a large scale is not to be admitted.

Whatever the condition of things may be in Narragansett Bay, we know that none of the agencies alluded to exist, to any considerable extent, along other portions of the New England coast, where the fact of a similar scarcity of fish has been equally established.

We come, therefore, to the question of improper or excessive fishing. The capture of the sea-fishes by man is usually prosecuted either by the hook and line or by means of nets or weirs. Nets for the capture of fish may be divided into those which are movable and those which are fixed. Among the movable we may mention the seine, which incloses the fish in bodies, and either hauls them to the shore or gathers them in the open water, and the gill-net, in which the heads of the swimming fish pass partly through the meshes of the net, by which, in their effort to withdraw, they are held securely. These gill-nets may be either fixed or floating; if the latter, they are called "drifting nets."

The apparatus for capture by fixed nets have various names and modes of operation, as "traps," "pounds," "weirs," "fykes," &c. The trap is an apparatus peculiar to the Narragansett Bay, and consists of an oblong inclosure of netting on three sides and at the bottom, anchored securely by the side of a channel. Into this the fish enter, and the bottom of the net being lifted to the surface at the open end, the fish are penned in and driven into a lateral inclosure, where they are kept until needed. A net of this character requires constant attention, as the fish, after making the circuit of the trap, can readily pass out, unless prevented. On page 10, in Mr. Southwick's testimony, will be found a

figure and diagram illustrating the construction of these two forms of apparatus, as also in the special article on modes of capturing fish.

The pounds and weirs are adapted not only for taking, but many of them for retaining, the fish until it is convenient to remove them, needing no watching to prevent their escape. These are of various construction, depending upon the depth of the water, the tide, the nature of the shore, the kind of fish to be taken, &c. The most common form on the south side of New England consists of a fence of netting, extending from the shore, and nearly perpendicular to it, for a distance of 50 or 100 fathoms or more, as the circumstances may require. The outer end of this straight fence or wall is carried into a heart-shaped fence of netting, the apex of which is connected with a circular "bowl" of net-work, the bottom of which lies upon the ground, at a depth of 20 to 30 feet. The fish, in their movement along the coast, first strike against the fence of netting and are directed outward, following the fence or "leader" along until they reach the end, which, of course, brings them within the "heart." Here they wander around for a time, their only easy avenue for escape being through the apex into the "bowl," and in which when entered they continually circle about without ever finding the outlet. It is a peculiarity of fishes in their movements, especially when in schools, that they do not turn a sharp corner, but move around in curves; and the nets in question are so arranged that the curves they are likely to take never bring them toward an avenue of escape, but rather tend to conduct them farther within.

The "weirs" differ from the "pounds" principally in being constructed, in whole or in part, of brush or of narrow boards, with or without netting; and they are sometimes so arranged that at low tide a sand-bar cuts off the escape of the fish, leaving them in a basin inside, allowing them to be taken at any time before a certain stage of rise of the next tide. The variety of these modes of capture is very great, and I have given in the appendix a description of the forms best known, accompanied by the figures necessary for their illustration, and to these would refer for further information.*

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* On the map accompanying this report I have marked the traps and pounds in operation in 1871, on the south side of New England, east of Point Judith, as far as I was able to ascertain their existence. Information concerning those in Rhode Island was furnished by J. M. K. Southwick. Notices of those farther east were, for the most part, supplied by Captain Edwards, supplemented by my own observations. To Captain Prince Crowell I am indebted for a list of the weirs in Cape Cod Bay, represented on a separate map. I also give a separate sketch of Seaconnet Point, showing the peculiarities of arrangement of the traps in that region.

According to Mr. Southwick, there were in Narragansett Bay, in 1871, twenty pound or heart nets, of which the map represents eight on Conanicut Island, and eight on Rhode Island. There were sixteen traps—seven on Rhode Island and nine at Seaconnet Point. Seven of the latter indeed are double, each counting as two, making twenty-three, or a total of forty-three. But few of these were fished after the middle of June.

In Buzzard's Bay and on the Elizabeth Islands the pounds were as follows: One at

The propriety of authorizing the erection of weirs and pounds occupied the attention of the Canadian authorities a number of years ago, and, in consequence of the results of special inquiries, and the general impression on the part of the fishermen and others interested, the use of weirs and traps was forbidden in certain portions of the Dominion, as in the vicinity of Miramichi, and they were placed under close restriction in other localities. The amount of offal usually thrown into the water in the vicinity of the herring-weirs was supposed to have an injurious effect in driving away schools of herring; and a marked decrease in the shad-fishery of the Bay of Fundy and the Gulf of Saint Lawrence was ascribed to the action of the weirs in entrapping the young fish and causing them to perish in immense numbers. In the appendix to the present report I give the testimony of various English writers in regard to the necessity of protecting the fisheries by restricting the time of capture and the nature of the apparatus. Among these Bertram is very outspoken in his views, taking direct grounds against the report of the British commission, consisting of Professor Huxley and his associates.

As I have already remarked, the ordinary brush-weir arrangements, as used on the coast of Great Britain, are not calculated to produce very serious effects, owing to the fact that it is only species coming into comparatively shallow water that are captured in them; and there is abundant opportunity for the fish to escape from their toils, unless attended to immediately. I am, however, inclined to think that with the introduction of the improved American methods of traps and pounds

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Clark's Cove; three on Sconticut Neck; one at West Island, near New Bedford; one at Mattapoisett; one at West Falmouth; two at Quissett Harbor; two on Long Neck, near the guano-works of Wood's Hole; one at Hadley Harbor, two at Ram's Head, one at Robinson Hole, Naushon; five in Menemsha Bight; two at Tisbury, five at Lombard's Cove, two in Holmes's Hole, one west of West Chop, Martha's Vineyard; one at Falmouth; one at Waquoit, and one at Coltuit, on Vineyard Sound; or a total of thirty-five recorded, besides others probably omitted. Of these the greater number were kept down only to about the middle of June. Among those known to have been worked till late in the season were at least two near New Bedford; two at Quissett; one at Wood's Hole; two on Naushon; four on Martha's Vineyard, and one at West Falmouth; twelve or more.

I am informed that the number of pounds and traps in Narragansett Bay, in operation in 1872, was about the same as in 1871, but that there was a considerable increase to the eastward. Then there were four more at Menemsha Bight; one at Lombard's Cove; one at Paintville, Martha's Vineyard; two or more at Kettle Cove, Naushon, and one on the north side of Narhawena, an addition of at least nine to the thirty-five previously enumerated. More would doubtless have been erected if suitable locations could have been found.

According to the chart furnished by Captain Crowell there were fifteen weirs in Cape Cod Bay in 1871, extending from Barnstable to Wellfleet.

It is very probable that I have not learned the situation of all the traps and pounds in Massachusetts waters, as Mr. Bassett, of New Bedford, in his testimony in 1872, stated that there were seven between New Bedford and Mishaum Point, of which I have only enumerated four.

into Great Britain, a very different verdict would be given as the result of thirty years' trial.

While the seines ensnare enormous quantities of certain kinds of fish, under especially favorable circumstances, the pounds and traps take them in still larger numbers, because they act without the direct agency of their owners, who can remain on shore during stormy weather, assured that the very disturbance of the sea will conduce to the greater extent of the catch. Thousands of barrels of fishes are frequently taken at a time, and I am myself cognizant of the capture of no less than 20,000 blue-fish, representing a weight of at least 100,000 pounds, in one weir, in the course of a single night. In the appendix will be found an account of captures effected at various weirs and pounds.

With this general explanation of the character of these potent engines, we may perhaps realize their bearing upon the question of the fisheries. As set in the waters of Rhode Island and Massachusetts, they are usually put down in the early spring and kept at work for six weeks, or even longer; not unfrequently throughout the whole summer, but are taken up before the autumnal storms occur, in order to prevent their destruction. The expense of a net-pound is very considerable, amounting to two and even three thousand dollars, while four men at least are required throughout the season to attend to one. They are usually in operation by the 1st of May, sometimes being set a little earlier and sometimes later, and they take generally more or less in the order specified the following more important kinds of fish:

Alewives, (*Pomolobus pseudo-harengus*, Gill.)
Horned dog-fish, (*Squalus americanus*, Gill.)
Tautog, (*Tautoga onitis*, Gthr.)
Mackerel, (*Scomber vernalis*, Mitch.)
Menhaden, (*Brevoortia menhaden*, Gill.)
Scup, (*Stenotomus argyrops*, Gill.)
Sea-bass, (*Centropristes furvus*, Gill.)
Blue-fish, (*Pomatomus saltatrix*, Gill.)
Squeteague, (*Cynoscion regalis*, Gill.)

By the middle of June the supplies of some of these fish decrease to such an extent that the traps and pounds are generally taken up for the season. Some of the pounds, however, are kept down throughout the summer, especially with the object of securing menhaden, blue-fish, Spanish mackerel, and squeteague, other fish being captured occasionally, but in inconsiderable amount.

It is noteworthy in this connection that, with the exception of dog-fish, mackerel, alewives, and menhaden, the edible fish taken in the first part of the season consist of those species which constitute the great body of the summer-catch with the line, and which are known to find their spawning-ground along the south coast of New England. It is these fish to which the inquiries of the Rhode Island and Massachusetts legislatures have been particularly directed, and which, with the excep-

tion of blue-fish, make up the most important part of the summer fisheries. They are still taken in great numbers by the pounds and traps, although fewer than formerly, and consist in great proportion of adult males and females, ripe with milt and with spawn. We can, therefore, easily understand how a most injurious influence may be exercised upon the fisheries by the capture of so large numbers under the circumstances referred to.

In all discussions and considerations in regard to the sea-fisheries one important principle should be carefully borne in mind, and that is that every fish that spawns on or near the shores has a definite relationship to a particular area of sea-bottom; or, in other words, that, as far we can judge from experiment and observation, every fish returns as nearly as possible to its own birthplace to exercise the function of reproduction, and continues to do so, year by year, during the whole period of its existence. This principle underlies, as is well known, all effort looking toward restoring to our rivers their supply of salmon, shad, and alewives; since it is well known that it is not sufficient to merely remove restrictions that had for years prevented the upward run of these fish, but a colony of young fish must be established in the head-waters of these streams, which, running down to the sea at the proper time, and returning again when fully matured, shall fill the waters to the desired extent.

It is an established fact that salmon, alewives, and shad, both young and old, have been caught on certain spawning-beds, and after being properly marked and allowed to escape, have been found to re-appear in successive years in the same locality. The principle is rather more difficult to establish in regard to the purely marine fishes; but experiments have been made by competent men on our coast and elsewhere, which prove the existence of the same general principle in relation to them. Thus, I was informed by an intelligent fisherman living at Rockport, Massachusetts, that he had himself, on several occasions, marked young and old halibut, and during several seasons they had been retaken on about the same grounds.

A second law, equally positive, with a great variety of fish, is that they pass from their spawning-grounds to the sea by the shortest route that will take them out into the deeper waters, where they spend the winter; and that coming and going to and from a given locality, they follow a determinate and definite line of migration.

Having in mind these two propositions, we shall then better appreciate what takes place when fish are disturbed or caught up during the breeding-season. Should nets be set along their line of travel before they have spawned, so that when they strike the coast they are immediately arrested, first at one point and then at another, running a continued gauntlet of dangers in their course to their final destination; and should an appreciable proportion of them be caught before the eggs have been laid and fertilized, it is very easy to see why the stock should rapidly diminish. It is not a sufficient argument in reply to this to

point to the enormous number of eggs laid by a single fish in each season, amounting in some instances to perhaps from five thousand to hundreds of thousands, or even millions, since this immense fecundity is an absolute necessity to preserve the balance of life under the water. The eggs and the young fish furnish the appointed food to an immense variety of animals, many species of fish as well as crustaceans and other animals depending entirely upon them for their support. Among the particular enemies of the eggs and the young fry may be enumerated the small minnows or cyprinodonts, the atherinas, silver-sides or friars, the cunners or chogset, the young of many larger fish, the different kinds of minute crustaceans, including also the lobsters, &c. These are not interfered with to any material extent by any form of net, as they are too small to furnish profitable employment in their capture, and they pass readily through the meshes of any nets that would be set for other purposes. Although, therefore, the amount of spawn and of young fish may be materially less than a previous average, the predacious animals just referred to will probably still destroy as many as ever, since they have every opportunity for picking up their prey at all times; and whatever the scarcity at first, they are likely to get all they require. For this reason, we cannot count upon the increase of the fish that escape the perils of their journey to furnish a sufficient supply, since if half the young brood is lost by means of the capture of the parents through human agencies, before and during the spawning season, a very large percentage of the remainder is prevented from attaining maturity by other enemies.

As most fish require from three to five years of growth before they are capable of reproduction, and in many cases remain in the open sea until this period is reached, it will follow that for several years after the establishment of an exhausting fishery the supply may appear to be but little interfered with, since there are several successive crops of fish to come on at the annual intervals, and not until the entire round has been completed do these injurious agencies begin to present the evidence of their severity. It is easy, therefore, to understand why, after five or ten years' fishing, the supply of fish in a given bay, or along a certain stretch of the coast, will be reduced to a very considerable degree, and although it may be perfectly true that the sea is practically inexhaustible of its fish, yet if the fish of a particular region are cleaned out, there is no hope that others will come in from surrounding localities to take their places, since those already related to a given undisturbed area continue in that relationship, and have no inducement to change their ground. It should therefore be understood that the exhaustion of a local fishery is not like dipping water out of a bucket, where the vacancy is immediately filled from the surrounding body; but it is more like taking lard out of a keg, where there is a space left that does not become occupied by anything else.

These considerations also furnish a sufficient answer to the objection

against the necessity for any protection of the fisheries from disturbance during the spawning-season; namely, for instance, that should Massachusetts pass laws for their protection, it would be of no avail so long as Rhode Island and Connecticut failed to do the same. The practical result of protection on the one hand and of license on the other, probably would be, that after a few years' interval fish would be as abundant as ever on the Massachusetts coast, and would be almost exhausted on those of the adjacent States, and an important market would be furnished to the Massachusetts fishermen outside of the limits of their own State.

Another fallacy, which vitiates much otherwise sound argument on the question of protection, is in confounding regular shore-fish, that come in from the deep seas to the coast to spawn, with the outside fish that come and go with more or less irregularity, and usually feed and swim near the surface. In the one category we may enumerate the porgies or scup, tautog or black-fish, and the sea-bass; while the other includes such fish as the sea herring, blue-fish, mackerel, Spanish mackerel, and some others. The occurrence of the latter group is, to a large extent, determined by the presence of the former. Should the first mentioned be decreased materially in number, it becomes necessary for their pursuers to seek other waters for their proper supply of food. The case of the cod, that feeds largely upon ground-fish, as well as upon the more surface-loving herring, is another instance in which the scarcity or abundance of one fish is influenced by that of others.

It was formerly supposed that certain fish, as the herring, the shad, and the alewives, with others of like habits, prosecuted an extensive migration along the shores of the ocean, covering, sometimes, thousands of miles in the sweep of their travels; and much eloquent writing has been expended by such authors as Pennant and others in defining the starting-point and terminus, as well as the intermediate stages of the voyage. The shad, too, which, as is well known, occupies all the rivers of the Atlantic coast from Florida to the Gulf of Saint Lawrence, was thought to begin its course in the West Indies, and in an immense body, which, going northward, sent a detachment to occupy each fresh-water stream as it was reached, the last remnant of the band finally passing up the Saint Lawrence, and there closing the course. We now, however, have much reason to think that in the case of the herring, the shad, the alewife, and the salmon, the journey is simply from the mouths of the rivers by the nearest deep gully or trough to the outer sea, and that the appearance of the fish in the mouths of the rivers along the coast, at successive intervals, from early spring in the South to near midsummer in the North, is simply due to their taking up their line of march, at successive epochs, from the open sea to the river they had left during a previous season, induced by the stimulus of a definite temperature, which, of course, would be successively attained at later and later dates, as the distance northward increased.

The principle may safely be considered as established that line-fish-

ing, no matter how extensively prosecuted, will never materially affect the supply of the fish in the sea. As a general rule, fish, when engaged in the function of reproduction, will not take the hook, whatever be their abundance; but, as soon as the critical season has passed, they feed very voraciously, and then can be readily caught by skilled fishermen. It therefore would be no evil should every fully grown fish of three to five years old and upward be lifted from the sea after the close of the spawning season, in the course of a season, since the following year we may look for a new generation coming into exercise the function of reproduction; and ample provision will thus exist for a renewed supply from year to year. As already explained, the case is entirely different when these fish are caught before they spawn, all the evils that we have depicted following in the train of such thoughtless destruction, precisely equivalent to killing of all the mature hens in a farm-yard before they have laid their eggs, and then expecting to have the stock continued indefinitely. As well might the farmer expect to keep up his supply of wheat, year by year, while he consumed all his grain, reserving none for seed, and without the possibility of obtaining it from any other source.

Objections have been made to the use of what is called the trawl-line, trot-line, bultow, &c., in capturing fish of the cod family. This consists of a strong cord of 18 or 24 thread, sometimes of several hundred fathoms in length, to which are attached at intervals of about six feet short lines of nearly three feet in length, having hooks at the end. These, to the number of four or five hundred or more upon a single line, are baited and sunk to the bottom by anchors, and at regular distance, the ends of the main line being buoyed so as to show their locality. At intervals throughout the day these lines are examined, being taken up and carried across a boat, the fish captured removed and the empty hooks rebaited, and the whole again replaced. Immense numbers of fish are taken by this method, especially on the coast of England and on the banks of Newfoundland, as likewise along various parts of the New England coast.

Although this practice has excited the animadversions of some on account of its supposed destructive nature, it seems hardly possible that it can be really injurious, since it does not take the spawning fish, and merely represents the result of an increased number of hand-lines.

Our remarks have been hitherto directed toward the practice of the destruction of the parent fish before the function of spawning has been properly accomplished. It is equally reprehensible to interfere in any way with or destroy the spawn after they have been laid, or the young fry after they are hatched. This result is said to follow the use of the trawl-net, which, dragged carefully and sedulously, day by day, over that portion of the sea-bottom which constitutes the great nursery of fish, bruises the eggs and harrows up the sea-weed or grass to which the eggs have been attached, or among which the young fish are play-

ing, and gathers it inside of the net, involving the destruction of all life that may be inclosed. This evil has not manifested itself in America, owing to the almost entire absence of trawl-net fishing, as it has in Europe, where it is considered as doing much more mischief than all other modes of fishing put together. Should this engine of destruction come into general use on our coast and add its agency to those already referred to in connection with the pounds and weirs, the diminution of the supply may continue to go on in a vastly greater ratio than ever.

We have now considered at considerable length the influences separately exerted by the blue-fish and by human agencies upon the number of food-fishes on our coast; and we next proceed, as a *sixth* division of the subject, to discuss the result of their combined action, especially in view of the great destruction of the spawning fish.

While, perhaps, in view of the wonderful fecundity of fishes, the blue-fish alone, or the traps alone, might not produce any serious consequences upon the general supply, their combination in any locality cannot fail to have a very decided effect; as what the one spares the other destroys in large part; and in the enormous consumption in addition of the eggs and young fish by the minor inhabitants of the water, we can easily imagine how speedily an approximation toward extermination may be effected.

My explorations, as already referred to, have shown the existence in the waters, in addition to the larger kinds and their young, of immense numbers of small species of fish, such as the friar or atherina, the various species of cyprinodonts, &c., occurring in great numbers, and feeding almost exclusively upon the spawn and young of fish. These, it has been shown, are not affected by any modes of fishing, and in fact, if anything, are more abundant than ever, in consequence of the diminution of larger fish by which they are devoured in turn. Some are resident in particular places along the shore, while others move along the coast in large bodies. Being always on the grounds and congregating upon the spawning-beds, they are engaged in a continual work of destruction, and when the ordinary ratios have not been disturbed they simply tend to prevent an overproduction of the different species of fish; but if other causes of diminution co-operate when they have devoured their share, and the different crustaceans, star-fishes, &c., have been kept supplied, the percentage of eggs left for development and of young fish for attaining maturity becomes less year by year until practical extermination may follow.

As far as the blue-fish is concerned, however, if it were even possible to drive it off by any human agency, the fishermen of the south coast of New England would strenuously object, since, after its appearance on the coast, in May or June, it is the most important food-fish to be taken; and, as will be observed by the testimony presented, it was as much the diminution of the blue-fish as of any other species that excited the apprehension and alarm of the fishermen. It is, however, in all probability, the increasing scarcity of the shore-fishes that has in-

volved the reduction in addition of the blue-fish, since these require food in large amount and of easy access, and they would naturally leave for more favorable localities.

During the season of 1871, while blue-fish and Spanish mackerel were comparatively rare in Vineyard Sound and the adjacent waters, they abounded to an enormous extent in localities farther to the west, the coast of Long Island Sound and the coast of New Jersey being supplied with them to an unprecedented degree. It is not a little suggestive that while traps are scarcely known in the waters referred to, there has been no complaint in regard to the scarcity of the shore-fishes, nor but little of that of such species as the menhaden, blue-fish, &c.

MEASURES SUGGESTED FOR RELIEF.

In view of all these circumstances, therefore, the conclusion appears warranted that if measures can be taken to prevent the present great destruction of spawning-fish, the supply will again increase before long, and with the increasing abundance of the shore-fishes, the blue-fish will also increase in number. At the same time, I am not prepared to advocate the abolition of traps and pounds, as without them it would probably be extremely difficult to furnish fish in sufficient quantity to meet the present and increasing demand of the country. Nor is it probably desirable to suppress them during the whole of the spawning-season, as it is in consequence of the profits made during that time that the fishermen are enabled to meet their expenses, and very few would put down and maintain their traps for the summer-fishing alone. The traps and pounds also perform an important service in the capture of bait, especially of herring, alewives, and menhaden, for the spring mackerel-fisheries, without which it is alleged that this latter industry could not be successfully prosecuted. In this connection, however, it should be stated that the practice of carrying seines or gill-nets, and of catching herring and menhaden for themselves on the mackerel grounds, is rapidly increasing with the mackerel fishermen, who, consequently, do not depend to the same degree as formerly upon the pounds.

There is, however, no reason why there should not be occasional intermission during the six weeks when most of these fish deposit their eggs, of sufficient length of time to allow a certain percentage to pass through to their breeding-ground; and, after consultation with various persons interested, I have come to the conclusion that if the capture of fish in traps and pounds be absolutely prohibited, under suitable penalties, from 6 o'clock on Friday night until 6 o'clock on Monday morning, even during a season of six weeks only, (thus requiring a close time of three nights and two days, to enable the fish pass and perform their natural function of reproduction,) the interest of all parties would be subserved. Indeed, it would seem to be decidedly to the advantage of the owners of the pounds to enter heartily into such an arrangement, as it is well known that in the height of the season the supply of fish

thrown into the market is so great as very materially to reduce the price paid the fishermen. This, however, does not affect the consumer in the least, as the fish are all sold to middle-men, who keep up the retail price. Large numbers of fish, however, at this season become spoiled, and are either thrown overboard or converted into manure.

By intermitting the catch as suggested, there is a greater certainty that the entire supply will be put to its legitimate use as food; and it is probable that, while less money may be made by the middle-men referred to, the owners of the pounds and traps would receive quite as large an amount of money for less labor and for three-fourths the same weight of fish. This arrangement would also furnish an opportunity for persons connected with the fisheries to repair their apparatus, or attend to other duties. I have, indeed, been assured by many persons engaged in this business that they are fully aware that it would be for their interest, in every way, to have the close time specified, and that they will gladly welcome a law to that effect, if it be made universal in its application.

In view of all these considerations, I have draughted a bill, which has been presented to the consideration of the commissioners of several States, and to several eminent lawyers, well versed in the local laws of their respective States, and corrected to their satisfaction. A copy of this bill, as finally modified, is given on page 132. I sincerely trust that this, or a somewhat similar bill, may become a law in the States of Rhode Island, Massachusetts, Connecticut, and New York, as I am satisfied it would be for their benefit. Although there may be no serious question as to the right of the General Government to make enactments in regard to the common waters of the United States, it is possible that any attempt on its part, at the present time, to pass this law would meet with considerable opposition; and it would be extremely difficult for the United States to enforce any special requirement or penalty connected with a close season.

The plan of licensing the pounds, so as to give the State more efficient control, is considered one of great importance, and will, I believe, be acceptable to the owners of these establishments, as it would give them a security against interference from other parties that they do not at present possess.

The penalty attached to fishing without a license, and the ability of a State the more readily to punish an offender by depriving him of his permission to fish, will render parties careful how they offend; and by giving to the informer, in consequence of whose complaint the license is withdrawn, the first choice of taking the station forfeited, an intense vigilance will be induced on the part of those who may desire to secure a favorite location, and thus supersede the necessity of an expensive surveillance on the part of the State.

In the event, however, of the refusal of the States mentioned to establish the very limited close time suggested, I would recommend the

passage by the United States of a law absolutely prohibiting, until further notice, the erection of fixed apparatus for taking fish, after a period of one or two years, on the south side of New England and on the shores of Long Island, which constitute the spawning-grounds of the shore-fishes referred to. Although this would be a serious blow to the pound and trap interest, yet the grace allowed would permit the owners to use up their material in the way of nets, and render the enforcement of the law less onerous. The restoration of the fish to their original abundance would be thus accomplished in a much less time than by any merely palliative measures; and there is no reason to anticipate that there would be, in the mean time, any material decrease in the supply, or any rise in the price of fish to the consumer. There would still be open to the fishermen the use of seines, gill-nets, &c., which would capture fish in large quantity without overstocking the market; and the inducement to the use of the hook and line would furnish employment to large numbers of persons now needing it, while the markets would be more regularly and equally supplied. The wholesale cost of fish would probably be somewhat increased, but the competition being distributed among a large number of persons would prevent an excessive charge by the retail dealers; and the only difference would be that a few men would not make large fortunes in a short time, as they are now in the way of doing.

The erection of fixed apparatus requires a considerable amount of time, generally several days, and, once set, its presence along the coast could readily be determined by an occasional patrol by vessels of the Revenue Department, any violation of the law to be met by confiscation of all apparatus, including nets, piles, boats, &c. It would therefore be comparatively easy to prevent, at little or no expense to the Government, the infringement of the law of absolute prohibition, while it would be impossible to exercise a sufficient oversight as to the violation of the regulation in regard to close time, this requiring a multiplication of officers to be had only from among the regular authorities of the States themselves.

As already explained, the suggestions and reasonings here are restricted exclusively to the capture of fish by means of fixed apparatus in the waters on the south side of New England. Whether it is expedient to enact regulations in reference to taking menhaden and other fish in the waters of Long Island Sound, and elsewhere, by means of nets, or of herring, &c., on the eastern coast of New England, I hope to make the subject of a subsequent inquiry and report.

A potent objection to the abolition of pounds is the service they render during the spring in procuring bait (alewives, herring, mahaden, &c.) for mackerel-fishing. I am assured, however, that this can be done to a sufficient extent by seines or gill-nets, especially since the discovery that the true herring can be taken in the coast of Maine and in the Bay of Fundy in the spring, apparently to an unlimited extent. If,

however, the States will pass the regulation requiring a close time of two days and three nights, and for six weeks only, from the 20th of April to the 15th of June, as proposed in the bill, severer measures will, I trust, be unnecessary, and we shall probably find a gradually increasing supply of valuable food.

RESULT OF INQUIRIES IN 1872.

In consequence of an unavoidable delay in the publication of the present report, I have been enabled to include in it the results of inquiries respecting the fisheries on the south coast of New England during the season of 1872, having revisited many of the localities of the investigations of 1871, and sending an assistant to others.

I found what I had expected, that with the exception of the scup, fishes of all kinds in Vineyard Sound and Buzzard's Bay were as much scarcer in 1872, compared with 1871, as they had been in that year compared with the preceding one. (See pages 183–194 *et seq.*) The testimony everywhere, with scarcely an exception, both from line-men and trappers, was that the whole business of fishing was pretty nearly at an end, and that it would scarcely pay parties to attempt to continue the work on a large scale in 1873.

The pounds of Messrs. Jason Luce & Co., at Menemsha, took a larger number of fish, as shown by their statement of catch kindly furnished to me, (p. 173,) but only by increased exertion, and this during a very short period. The other pounds, according to testimony taken by Mr. Edwards, scarcely met their expenses in any single case.

At Nantucket most of the fishermen estimated the decrease at from one-half to three fourths, compared with last year.

Very few blue-fish were taken on the north side of the island with the line, the supply being furnished by means of gill-nets alone. According to some the supply was rather greater on the south side; but the difference between the two seasons was the greater, as the period for fishing was longer this year than the last, and was less obstructed by stormy weather.

Several of the fishermen at Nantucket (all, however, personally interested in gill-nets) contested the statements of others as to the decrease of fish, while many, both pound and line fishermen, stoutly maintained the fact.

At Edgartown and Hyannis the testimony was absolutely unanimous as to the fact of a woful diminution and the doubtful future of the entire fishery interest. At various places on Martha's Vineyard, as already remarked, the evidence was in the same direction from both net and line men.

Captain Hinckley, of Wood's Hole, testified that fish were never so scarce at his pound as this season, with the exception of menhaden, alewives, and dog-fish. These he found it difficult to dispose of on account of their numbers, and was obliged to turn many out of his nets unsold.

He considered the number of blue-fish scarcely one-fourth as great as usual, and these were of small size. Squeteague, also, were much scarcer.

At Newport the testimony was conflicting. Some persons, principally, however, fish dealers and trappers, maintained that fish were as plenty as last season, or even more so; this being based, however, upon the number of small scup and an unusual run of Spanish mackerel. Such assertions were, on the other hand, strongly denied by numerous line-men; and some of these testified that fish were never so scarce; and others admitted that they were no more plenty than last year, with the exception of the catch in the traps, which was quite equal to the usual average.

There was, however, no exception to the impression that blue-fish were much scarcer this year than last; this substantiating the opinion that they have been gradually diminishing for many years past. (See the article on blue-fish.)

Tautog and sea-bass were also scarcer. The scup were perhaps less numerous than last season, but made more show, as the small fish so plentiful in 1871 had attained a larger size, and were in a certain degree marketable. These, according to the testimony of some, were as plenty as ever they had been before; but this was certainly not the case in Vineyard Sound and Buzzard's Bay.

It is also noteworthy that whatever may have been the causes which produced so large a crop of young fish in 1871, they were not persistent, since comparatively few were taken in 1872 of the same dimensions as last year.

Upon the whole, the decrease in the fish appeared to be more marked in Vineyard Sound and Buzzard's Bay than about Newport; and this fact may be of much significance, when we remember that the pounds have multiplied much more rapidly in this locality than about Newport, where, indeed, as I am informed, the number was about the same in 1872 as in 1871. In 1871 the number was thirty-five. There were four new ones at Menemsha Bight, one at Lombard's Cove, and one at Paintville, on the north side of Martha's Vineyard; two or more in Kettle Cove, and one on the north side of Nashawena; making at least nine in all, in addition to the number there in previous seasons. The general result, as already stated, was that scarcely one made sufficient profit to pay for the outlay and labor.

The New York markets, as might be expected, were fully supplied with fish during the season of 1872, no appreciable difference being realized by the wholesale dealers. If anything, however, striped bass and blue-fish were scarcer, while the small scup, from the waters south of Massachusetts and Rhode Island, were shipped in large numbers, although scarcely of a size to render them marketable, their average weight being little more than from a quarter to half a pound.

In view, therefore, of all these facts I have no hesitation in saying that all the arguments presented in the earlier part of this report, in

favor of regulating the fisheries on the south side of New England by law, are enforced by the experience of the season of 1872, and that it is too evident that, unless some protective measures be adopted, the fisheries in these waters will be practically destroyed in a very short time.

This result will, of course, bring its own relief in time, since the cessation of trapping will permit the fish to recover their ground; but several years will be required for this, and doubtless as soon as there is any show of increase the traps will be again brought into use.

For several days during the present season Spanish mackerel were extremely abundant, so much so, in fact, that for a time they were sold in Newport at fifteen cents per pound. At Wood's hole pound five hundred and ninety-three were taken in one day, (August 23,) being a larger number than the entire catch of 1871. The total catch at this pound amounted to nine hundred and sixty-four.

Tautog, as already stated, were scarcer, and fewer striped bass were captured. A few salmon were taken at Seaconnet and at Menemsha. A marked increase in the abundance of shad and alewives was noticed, the shad especially being so plentiful about Newport that, according to Governor Stevens, they could not be sold in New York. When captured they appeared to be moving eastward. Alewives, too, were in unusually large numbers, this being the natural result of the operations of the fish-commissioners of New York, Connecticut, Rhode Island, and Massachusetts in protecting the alewives and opening the rivers for their entrance, while the abundance of shad was doubtless due to the enormous number hatched out under the direction of the Connecticut and New York commissioners and allowed to escape into the water. This certainly is a speedy realization of all the anticipations for the increase of shad, since fish, usually selling at a dollar a pair, became so abundant as not to be worth taking to market. This abundance, while rather unsatisfactory to the fishermen and dealers, is of great moment to the consumer.

Of mackerel none were taken off the south coast of New England, as in 1871. Messrs. Jason Luce & Co. secured a larger number of squeteague than in any previous year, and the testimony in regard to them elsewhere varied considerably, some maintaining that they were more abundant, others that they were scarcer.

GENERAL SUMMARY OF RESULTS.

The general conclusions at which I have arrived as the result of my investigations of the waters on the south side of New England during 1871 and 1872 may be briefly summed up as follows:

I. The alleged decrease in the number of food-fishes in these waters within the past few years has been fully substantiated.

II. The shore-fishes have been decreasing during the past twenty years, gradually at first, but much more abruptly from about the year 1865, the reduction by the year 1871 being so great as entirely to prevent any

successful summer-fishing with the hook and line, and leaving to the traps and pounds the burden of supplying the markets. This statement applies also, but perhaps to a certain extent, to the blue-fish. The decrease in their numbers first manifested itself about ten years ago, and is going on quite rapidly until now.

III. This period of decrease represents the time during which the traps and pounds have been well established, their operations increasing year by year, and their catch, especially in the early spring, being always very great.

IV. In 1871 and 1872 the decrease in the number of fish has been so great as to reduce very largely the profit formerly derived by the traps.

V. The appearance, in 1871, of an unusually large number of young fish spawned in 1870 is a phenomenon only to be explained by the probable escape of a larger number of breeding-fish than usual during the previous season, an abrupt decrease in the ravages of blue-fish and other species, or else by a spontaneous movement northward of newly-hatched fish that ordinarily would have remained on a more southern coast. While these fish will probably, for several years, constitute a marked feature in the fisheries, there is no evidence of the existence of a second crop of young fish corresponding to the one in question.

VI. The decrease of the fish may be considered as due to the combined action of the fish-pounds or weirs and the blue-fish, the former destroying a very large percentage of the spawning fish before they have deposited their eggs, and the latter devouring immense numbers of young fish after they have passed the ordinary perils of immaturity.

VII. There are no measures at our command for destroying the blue-fish, nor would it be desirable to do this, in view of their value as an article of food. The alternative is to regulate the action of the pounds so as to prevent the destruction of fish during the spawning-season.

VIII. The quickest remedy would be the absolute abolition of the traps and pounds. This, however, would be a harsh measure, and their proper regulation will probably answer the purpose of restoring the supply, although a greater number of years will be required. Such regulation may consist either in prohibiting the use of traps or pounds during the entire season of the spawning of the fish, or for a certain number of days in each week during that season.

IX. As the principal profit of the pounds is derived from the catch of fish during the spawning season, it will probably be sufficient to try the experiment of prohibition of the use of nets from Friday night until Monday morning of each week of the spawning-season, and after that no restriction need be imposed.

X. It is desirable that the regulation for a close time during each week be passed by the several States; and if this cannot be effected, then the General Government should enact absolute prohibition, or at least during the spawning-season, as it possesses no officers who could

exercise the supervision required to enforce the partial closure, or before whom complaints could be entered and the penalty exacted.

XI. Any marked increase in the number of the shore-fishes, resulting from their protection during the spawning-season, will probably tend to restore the blue-fish to their original numbers.

XII. As there is reason to believe that scup, and to a less degree other shore-fishes, as well as blue-fish, have several times disappeared at intervals to a greater or less extent, within the historic period of New England, we cannot be certain that the use of traps and pounds within the last ten years has actually produced the scarcity complained of. The fact, however, that these engines do destroy the spawning fish in so great numbers renders it very probable that they exercise a decided influence. No vested interest or right will suffer by the experiment of regulating the period of their use, as we have attempted to show that a better price will be obtained from a smaller number of fish, by preventing the glutting of the market, and the consequent waste of so perishable an article as fresh fish.

XIII. A feeling of bitterness entertained by the line-fishermen and the general public against traps and pounds, and those who own and profit by them, will in a measure be allayed if the experiment of regulation and restriction be tried, at least for a few years.

CONCLUSION.

In preparing the present report, my object has been to consider the subject of the New England shore-fisheries in a strictly dispassionate manner, not taking side with any of the different parties on the question as a special advocate, and attempting to draw such general conclusions only as the facts seemed to warrant. With the view, however, of enabling any one interested to review the ground for himself, I have given in detail the testimony (principally phonographic) collected during the inquiry in which I have been engaged, and added the special arguments of representative men on the opposing sides, prepared and furnished at my request, or else reprinted from official sources. To these I refer for the more local details and considerations of the subject, and especially in regard to the movements of scup in the Rhode Island waters.

As the entire questions at issue are most nearly related to the scup and the blue fish, I have given on pages 228 and 235 respectively as complete an account of their habits and peculiarities as the material at my command will allow.

For a detailed account of the principal methods in use for capturing fish in the United States by lines, nets, or otherwise, I refer to the article in the appendix. The subject is by no means exhausted, and I hope to refer to it again, and to include some important forms of such apparatus used in other countries and especially applicable to our own, to-

gether with some account of improved methods of curing fish for the market as yet unknown in the United States.

In addition to a list of the fishes found at Wood's Hole, amounting to the large number of 116 species, I give a complete list of all the fishes known to occur on the eastern coast of North America, as prepared and furnished by Professor Theodore Gill. I am collecting materials for full descriptions and biographies of these species, to be published hereafter, with appropriate figures, should such a work be called for.

The account of the natural history of the south shore of New England is rendered much more complete by the memoir of Professors Verrill and Smith on the marine invertebrates, with its excellent illustrations, all executed in relief by the method of Jewett & Co., of Buffalo. The list of the algæ, by Dr. Farlow, will also furnish an important indication in reference to the distribution of this group of plants.

An accompanying map of the south shore of Massachusetts and Rhode Island is intended to show more particularly the distribution of animal life—the fish-food—along the coast by indication of the results of soundings, dredgings, and temperature observations, made by Professor Verrill and myself during the season of 1871. On this same map is recorded likewise the position of all the traps and pounds in use in 1871, as far as I could ascertain their situation. There is also a separate diagram of the traps at Seaconnet, where are taken, as is said, nearly nine-tenths of all the fish caught by fixed apparatus in Rhode Island. I have also given a diagram of the weirs on Cape Cod Bay, as furnished by Captain Crowell.

SPENCER F. BAIRD,
Commissioner.

SMITHSONIAN INSTITUTION, *December* 2, 1872.