

## APPENDIX.

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### The American Investigations of the Habits and Migrations of the Mackerel.

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SINCE its first foundation the United States Commission of Fish and Fisheries has paid great attention to the habits and movements of the migratory fishes, more especially of those of the mackerel and menhaden. In the early years of the Commission an endeavour was made to obtain information by the issue of circulars to fishermen and others, who were likely to be in a position to observe the movements of the fish. In this way a large amount of material was got together, and was embodied in two comprehensive memoirs, published in the Report of the Commissioner:—

- (1) "The Natural and Economical History of the American Menhaden," by G. Brown Goode. *Commissioner's Report*, 1877, pp. 1-529.
- (2) "Materials for a History of the Mackerel Fishery," by G. Brown Goode, Joseph W. Collins, R. E. Earle, and A. Howard Clark. *Commissioner's Report*, 1881, pp. 93-531.

The information, however, so obtained was not of an altogether satisfactory nature, and it was seen that if the various problems presented were to be satisfactorily solved, special investigations for that purpose would have to be made.

It was largely with a view to undertaking researches into these questions that the schooner *Grampus* was built for the Commission. This vessel was completed in 1886, and since that year she has been very largely employed in such work.

The *Grampus* is a two-masted, schooner-rigged vessel, 90 ft. long over all, 22 ft. 2 ins. beam, and 10 ft. depth of hold; her registered tonnage is 83·30 tons. She is supplied with all kinds of fishing appliances and scientific instruments suitable for the work she has to do.

The appended extracts from the *Commissioner's Reports*, issued since 1887, will show the various steps which have been taken to investigate

the subject. It is evident that a large amount of material, consisting of observations systematically taken for a number of years, must now be in the hands of the Commission; but up to the present neither the detailed observations made during the last few years, nor any general discussions of the habits and movements of the mackerel, based upon the recent work, have been published.

*Report for 1887*, p. 54.—"From the latter part of April until the last of May, 1887, while in command of Captain D. E. Collins, and with Dr. T. H. Bean as naturalist, she [the *Grampus*] was engaged in cruising on the early mackerel grounds between Cape Hatteras, North Carolina, and Cape Cod, Massachusetts, for the purpose of studying the schools of mackerel as they approach the coast, and their subsequent movements with relation to temperature, the abundance of food, etc. The schooner was well equipped with the necessary scientific and fishing appliances, and succeeded in obtaining many valuable observations, which have been published in the *Fish Commission Bulletin* for this year. A part of the time she kept company with the fishing fleet, and at others was cruising independently, with the view of ascertaining whether the mackerel could be found in advance of the fishing centres or in other directions. During the first part of the season the mackerel were scarce and small. Sea birds, cetaceans, and various other marine forms, which generally accompany the schools and indicate their position and size, were less abundant than usual. Bad weather also prevailed most of the time, and this undoubtedly interfered with the schooling of the fish at the surface. Most of the schools sighted, even during the latter part of the cruise, were too deep in the water to be reached by seining, and it is probable that a large proportion of the fish passed northward unobserved. They also appeared to move nearer the land than has generally been recorded.

"During the following summer, beginning the first part of July, the *Grampus* extended its researches respecting the distribution and abundance of mackerel along the coasts of the British Province as far north as Labrador. She was then in charge of Captain J. W. Collins. The principal object of the trip was to verify the recent reports concerning the appearance of mackerel off the north-east coast of Newfoundland. Following the coast of Nova Scotia as far as Canso, the *Grampus* entered the Gulf of St. Lawrence, and sailed as far north as the Magdalen Islands. Thence she proceeded to St. John's, Newfoundland, and along the outer side of Newfoundland to the Straits of Belle Isle. No mackerel were observed at this point; but many natural history specimens and physical observations were obtained. Mr. F. A. Lucas and Mr. William Palmer, of the U.S. National Museum, accompanied the schooner as naturalists, and in addition to the regular work of the cruise they were allowed to land and make shore collections at the different harbours visited.

"The work begun in the spring of 1887 was continued by the *Grampus* during April, May, and June, 1888, Captain D. E. Collins being again in command, and Dr. T. H. Bean acting as naturalist. The cruising ground was

the same as in the previous year. Only small schools of mackerel were encountered, and those not until late in May. Low water temperatures prevailed during the early part of the season, and the mackerel food was found to be abundant only in streaks or scattered patches. The experiment of carrying living mackerel in the schooner's well proved successful, and it will therefore be possible to undertake the reproduction of this species at one of the coast stations of the Commission."

During the winter of 1888-89 the *Grampus* was chiefly at work in the Gulf of Mexico, making general investigations into the fisheries.

*Commissioner's Report*, 1888, p. 15.—"Being impressed with the importance of a systematic study of the temperature, conditions, and the changes of conditions in our off-shore waters, I have instituted a systematic investigation to this end, and have assigned the Fish Commission schooner *Grampus* to this work. Prof. William Libbey, of Princeton College, has been selected to take charge of the investigation, and the vessel is now being fitted with the necessary apparatus and appliances for the work, and will enter upon it at the beginning of the next fiscal year."

*Commissioner's Report*, 1889-91, p. 5.—"The physical inquiries in the mackerel region off the southern New England coast, under the direction of Prof. William Libbey, jun., referred to in the last Annual Report, were conducted during a part of July and August, 1889, and again during the summer of 1890. The former season the work was performed by means of the schooner *Grampus* alone, but during the latter the Coast Survey steamer *Blake* was detailed to act in co-operation with the *Grampus*, and, through the courtesy of the Lighthouse Board, a party of observers was also stationed on the Nantucket New South Shoal Light-ship. Parallel lines of observing stations were carried seaward from the coast for distances of 130 to 150 miles, the lines being 10 minutes of longitude apart and the stations 10 miles apart. At each of these stations, which numbered several hundred in the course of the two seasons, the temperature of the water was taken at regular intervals between the surface and bottom, or down to depths of 300 to 500 fathoms, where the depth of water exceeded that amount, and at the same time a full set of meteorological observations was recorded. The result has been to furnish a large series of vertical temperature sections through the water, which show very clearly the relations of the Gulf Stream with the colder waters of the Arctic current; and the surface variations are accompanied by very complete meteorological data, with which, it is hoped, a correlation may ultimately be rendered possible. These observations will undoubtedly throw much light upon the habits of several species of pelagic fishes, of which the mackerel is most conspicuous, and even the movements of such bottom fishes as the tile-fish will probably find their explanation in a knowledge of these physical characteristics."

Ditto, p. 129.—"From May 5 to June 8, 1891, the schooner *Grampus* was engaged in making a series of observations over the mackerel grounds, from

Delaware northward to Massachusetts. This was in continuation of similar inquiries made in previous years to determine so far as possible the temperature and other physical phenomena connected directly with the northerly movement of the advance schools of mackerel along the coast.

"The principal object of the cruise was to locate the early schools of mackerel; to follow their movements northward, or in whatever direction they might take; and to learn everything possible regarding the conditions of the air and water in connection with their habits. As it was somewhat late in the season before the trip began, it was expected that the schools were already upon the grounds, and that it would not be necessary to proceed very far south before meeting them. Such was found to be the case; but the observations were carried southward from Woods Hole until the fish were encountered, and thence over a part of the area through which they had passed, in order to obtain the necessary data for comparing the conditions in advance of the first schools with those existing in their rear. Subsequently the *Grampus* followed the schools as far as Marthas Vineyard, taking ripe males the last of May and ripe females the first of June in that vicinity. The physical observations have not yet been reduced and compared."

*Commissioner's Report*, 1892, p. 91.—"The physical inquiries respecting the waters off the southern New England coast, begun in 1889 by the schooner *Grampus*, and conducted the next year by the same vessel in conjunction with the Coast Survey steamer *Blake*, were continued during the summer of 1891 by the *Grampus* alone. The work was carried on, as in previous years, under the direction of Professor William Libbey, jun., of Princeton College."

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

to inspect all arrivals of mackerel there from the purse-seine fleet, as well as from the shore apparatus tributary to that market.

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

"On May 23, the southern fishery having ended several days before that time, the *Grampus* left Woods Hole, where she had put in for supplies, and proceeded to Nova Scotia to continue the inquiries on the same plan as at the south. The entire fleet had assembled there, but no fish were taken on this coast, except in trap-nets on the shore, until after June 1. By June 5 some of the fleet had done fairly well, the others poorly. The *Grampus* returned to Woods Hole the latter part of June, bringing a large quantity of specimens bearing upon the breeding habits, food, size, etc., of the mackerel, together with very complete records of the daily observations.

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

Ditto, p. 57. *Division of Statistics*. "In May and June, 1893, the field force was placed in the New England States for the special purpose of making a detailed investigation of the commercial aspects of the mackerel fishery. This inquiry was in progress at the close of the fiscal year.

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

"For the vessel fishery the following information was obtained for each vessel: Name of vessel, hailing port, rig, net tonnage, present value; value

of outfit; number and value of each kind of fishing apparatus used; the number of crew, specified by nativity and nationality; the kinds, quantities, and value of bait caught by the vessel or purchased in America or British provincial ports; the number of entries of foreign ports, and the expenditures therein for each purpose; the lay of the crew; the quantity and value of each grade of mackerel taken in each region with each kind of apparatus; the fishing season in each region; the number of trips from each region and to each port; and the kinds, quantities, and value of other fish taken with mackerel.

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

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

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

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

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

"Record books of a similar character were placed among the pound-net and trap-net fishermen of the Massachusetts coast. The distribution was accomplished through Mr. F. F. Dimick, local agent at Boston, Mass.

Fishermen at a number of points on the Maine and Virginia coasts were also communicated with by mail, and asked to record their mackerel catch.

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

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

*Commissioner's Report, 1894, p. 91.*—"The investigations respecting the habits and abundance of the mackerel, and the fisheries to which this important species gives rise, were continued again this year upon the same general plan as in 1893, but on a more elaborate scale and during a greater part of the season. The schooner *Grampus* and the steamer *Fish Hawk* were both utilised in connection with this inquiry, and several land parties were employed to study the subject from the standpoint of the in-shore fisheries along the entire coast covered by the range of the species. The information sought to be obtained from this series of observations was desired for the use of the Joint International Commission, as elsewhere explained; and the practical importance to the American fishermen of reaching a more complete and definite understanding of all the circumstances connected with the natural history of the mackerel, in relation to the several methods employed for their capture, has long been acknowledged.

"Until this work was started by the Fish Commission a few years ago most of the facts at hand were such as had been obtained incidentally, and it is only within a year or two that the matter has been taken hold of in the systematic and comprehensive manner which it deserves. The mackerel fishery has long been the subject of a vigorous controversy, both domestic and international. Each year the same phases are repeated; the fish first appear off our coast above Cape Hatteras, whence they spread rather rapidly toward the north and east as far as Labrador, giving rise to one of the most active and persistent fisheries of the world. Their abundance, within the scope of observation of the fishermen, varies from year to year, and at times the fluctuations are very great; periods of plenty, of greater or less duration, being followed by others of scant supply, bringing consternation to those whose fortunes are mainly linked with this species.

"The improvement of methods for the capture of mackerel has kept pace with the steady development in other lines of industry, until it would appear as though the limit of perfection had practically been reached. One of the most important questions of the day is whether, as some affirm, the modern devices are proving too destructive and are causing a depletion, in view of the lessened catch during several years past. To those who are at all acquainted with the history and character of the mackerel fishery, it will be evident that this question cannot be answered off-hand, and that the published

observations respecting the natural history of the mackerel do not meet the requirements of a thorough consideration of the matter. To supply this *desideratum*, so far as possible, has been the object of the inquiries now in progress.

"These inquiries have been directed so as to cover at least the more essential features in the history of the mackerel during that part of each season when their presence along the coast becomes apparent through their surface distribution, the only period when they can be fished for. It has been attempted to trace their movements and all the principal circumstances connected therewith, from the time of their first appearance in the spring, until cold weather causes their return to winter quarters; to learn the extent and relations of the schools, the conditions which accelerate or retard their progress, and the factors which influence their swimming at different depths, whereby the great body of the fish may travel long distances unobserved; to settle definitely their spawning places and seasons, and their habits in that connection; to ascertain the effect upon the schools of the different fishing methods apart from the simple question of the quantity of fish so captured; and from the data thus secured, as well as from statistics of the catch, to determine, so far as possible, if the stock is being decimated, and the causes which may be directly responsible therefor.

"The schooner *Grampus* started south from Gloucester, Mass., on April 7, to repeat the customary examinations on the southern grounds during the early spring season; but heavy gales retarded her movements in the beginning, as well as interfered with the operations of the fishing vessels. Lewes, Del., was made the headquarters from April 20 to May 10; but the *Grampus* remained constantly with or in the neighbourhood of the fleet, as the best means of keeping track of the schools of fish, making a careful series of physical observations at hourly intervals, towing for mackerel food, and recording all facts obtainable from the fishing captains, or by personal observations, respecting the positions of the schools each day, their extent, movements, depth, the abundance, size, and condition of the fish, etc. From the extreme south the *Grampus* followed the main body of the fish to the region off New York, and thence proceeded eastward over Georges Bank to Cape Sable and the Nova Scotia coast. Here the mackerel were studied during their progress to the Gulf of St. Lawrence as far as Cape North, stops being made at Shelburne, Liverpool, Beaver Harbour, and North Sidney, in search of such information as could be gained from the local fisheries in the neighbourhood of those places.

"On June 13, the main part of the down run of mackerel having ended and the spring season closed on the cape shore, the *Grampus* left North Sidney and returned to Gloucester, first passing around the north side of Cape Breton and through the Gut of Canso in quest of further data. Gloucester was reached on June 25, and the remainder of the month was spent in preparations for a summer cruise on the mackerel grounds in the Gulf of Maine. This work was in charge of Mr. E. E. Hahn, master of the *Grampus*, with Mr. W. C. Kendall as naturalist.

"Mr. B. L. Hardin was stationed again this year at Fulton Market, New York City, from April 21 to the last of May, his observations being mainly supplemental to those conducted on board the schooner *Grampus*, and directed chiefly toward completing the records bearing upon the early off-shore fishery. Every fare landed by the purse-seiners from the southern grounds, as well as all specimens received from the shore fisheries tributary to New York, were inspected by Mr. Hardin, and everything that could be learned relating to their capture and conditions was fully noted. Convenient office and laboratory accommodations were supplied gratuitously by Hon. E. G. Blackford, through whom, and the other prominent fish-dealers of the city, Mr. Hardin was afforded the fullest opportunity for the successful prosecution of his inquiries.

"Mr. H. F. Moore, of the University of Pennsylvania, was detailed to the study of the shore fisheries from their southern limit at Virginia Beach, Va., to Rhode Island. His work was begun at the south at the commencement of the season, and was carried northward, all of the principal fishing centres being visited, the fishermen interrogated, specimens examined wherever possible, and blanks left to be filled in with daily records of the catch. In this manner a very complete account was secured of the shore relations of the mackerel during the period of their early movements, a subject which had not hitherto been given much attention.

"Dr. W. E. Wolhaupter was given the section of coast from Rhode Island to the outer side of Cape Cod, including the important spawning and hooking grounds between Block Island and Nomans Land, and the extensive trap-net fisheries of Vineyard and the Nantucket Sounds. The steamer *Fish Hawk* also assisted in the work here during a part of June. The region between Cape Cod and the Bay of Fundy, including the coast waters of Massachusetts, New Hampshire, and Maine, and the Gulf of Maine, was assigned to Captain A. C. Adams, formerly in command of the schooner *Grampus*, and having a long experience in connection with the mackerel fishery. His inquiries were started at Province Town on Cape Cod, about the middle of May, and were thence extended along the shores of Massachusetts Bay, Cape Ann, and the coast farther north to Portland, where he was joined by the steamer *Fish Hawk* and Dr. Wolhaupter in the latter part of June. By the close of the year the examination had been carried as far east as Boothbay Harbour."

*Commissioner's Report*, 1895, p. 80.—"The observations made in 1893-94, respecting the natural history of the mackerel and the fisheries to which it gives rise, were repeated during the past year in accordance with the same plan, and on practically the same basis. The capricious habits of the species, its fluctuating abundance as indicated by the size of the catch, its wide distribution and far-reaching movements, make it one of the most difficult of all the commercial fishes to study or to comprehend. It is thought, however, that the series of investigations, which has been in progress for several years, and which is still to be continued, will throw much new light upon the practical questions connected with its history, and will aid in determining to what

extent, if any, the supply may be affected by the several methods employed for its capture.

"At the beginning of the fiscal year the schooner *Grampus*, E. E. Hahn, master, and W. C. Kendall, naturalist, was investigating the off-shore mackerel fisheries in the Gulf of Maine, with headquarters at Gloucester, Mass. The latter part of July and the first half of August, 1894, were spent in cruising in the Gulf of St. Lawrence, the season's work terminating at Gloucester the last of August. In the spring of 1895 the *Grampus* was again detailed to the study of this species, and continued to be so employed until the end of the fiscal year. The inquiries were of the same character as in previous seasons, being designed to secure as complete a history as possible of the early movements of the mackerel as they approach and work up the coast on the way to their several spawning and summer-schooling grounds. The cruise began on April the 12th. Lewes, Del., was made the headquarters until May 10, when, the body of fish having left southern waters, the *Grampus* proceeded to the region off New York, and thence eastward over Georges and Browns Banks to the coast of Nova Scotia. Here the schools of fish were closely followed to Cape North, Cape Breton Island, and a short cruise made into the Gulf of St. Lawrence. The schooner returned the last of June to Gloucester, where preparations were made to continue the inquiries during the summer in the Gulf of Maine.

"Shore parties were at work at all seasons of the year during which the mackerel were present on the coast. During July and August, 1894, Captain A. C. Adams and Dr. W. E. Wolhaupter, with the assistance of the steamer *Fish Hawk*, were engaged on the coast of Maine, their investigations extending eastward from Portland as far as Jonesport. All important fishing localities were visited, the nets and catch inspected, and the fishermen interviewed. Subsequently, and until late in the fall, Captain Adams was occupied mainly with the study of the fishery from the ports of Gloucester, Boston, and Portland, while Dr. Wolhaupter returned to the southern coast of New England to complete his observations begun there the previous spring. Both of these assistants again took up the field work in April, 1895. Captain Adams' inquiries during the spring season were restricted to the coast of Massachusetts, north of and including the waters about Cape Cod. Dr. Wolhaupter began at Virginia Beach, Va., which is nearly as far south as the mackerel strike the shore, and proceeded thence northward along the coast as far as Cape Cod, visiting in succession nearly all localities where mackerel are taken in shore nets. For a short period in the course of his trip he was stationed in New York City, and then continued to the important spawning region off Rhode Island and south-eastern Massachusetts, where most of the month of June was spent.

"Mr. B. L. Hardin was detailed as heretofore to conduct the customary inquiries at Fulton Market, New York City, his observations being mainly supplemental to those made on board the schooner *Grampus*, and designed to complete the records bearing upon the off-shore fishery. Every fare landed by the purse-seiners, which were then at work exclusively on the southern

grounds, and also catches marketed there from the shore fisheries, were carefully inspected, and all information that could be obtained relating to the capture and condition of the fish, etc., was fully noted. Through the courtesy of Hon. E. G. Blackford convenient office and laboratory accommodations were provided; and to him, as well as to the other prominent fish-dealers of New York, Mr. Hardin was indebted for the means of carrying on his work successfully. Mr. Hardin reached New York about the middle of April, and continued there until the end of the first week in May, when he was replaced by Dr. Wolhaupter, who remained until the close of that month.

“Some of the observations made this year at Fulton Market relative to the spawning season and habits of the mackerel were especially interesting. The first fish received were two individuals caught in shad nets on the coast of North Carolina on April the 6th and 8th. The first fare brought in from the off-shore grounds consisted of 7700 mackerel taken in a purse-seine on April 17, about 65 miles south-east of Cape Henry. They measured from 10 to 17½ inches long. In some of the larger of these fish the reproductive organs were found to be spent, indicating that they had already spawned, and giving an earlier date for the beginning of the spawning season, at least in some years, than had previously been supposed. The location where the spawning had taken place could not, of course, be told; but that it was not situated close to the shore would seem to be shown by the fact that never more than small quantities of mackerel are ever taken so far south in the shore apparatus. In several subsequent purse-seine catches made off the Virginia coast up to the last of April, and even into May, the same conditions were observed, more or less, of the fish having apparently spawned, while in others the eggs were approaching maturity; but in no case did the fish seem actually to have been spawning at the time when taken. It should be explained in this connection, however, that only a relatively small number of the fish from each fare marketed could be obtained for examination, and are the basis for the facts above mentioned.

“About May 1st the shore nets on Long Island and along the southern coast of New England began to take their first mackerel, which appeared latest and continued longest at the eastern end. The fish which reached New York from this region were either in spawning condition or nearly ripe.”