# XIV.—NATURAL HISTORY OF SOME OF THE MORE IMPORTANT FOOD-FISHES OF THE SOUTH SHORE OF NEW ENGLAND.

## I.—THE SCUP.

*Stenotomus argyrops*, (Linn.,) Gill.

*Common names:* Porgy; porgee;[1] scup; scuppaug; mishcup.

This species has a lesser variety of names than most others belonging to our coast, it being known in the Southern States, and northward to New Jersey, as porgy; while in Long Island Sound, and on the south coast of New England, it is the familiar scup or scuppaug, from mishcùp-paûog of the Narragansett Indians.[2] In the time of Roger Williams its English appellation was bream, from the resemblance to the British fish of that name. Its southern range, as stated by Dr. Holbrook, extends to Cape Florida, and it occurs on the southern coast throughout the year, most abundantly, however, in June and July. It makes its appearance, at least in considerable quantity, on the coast of New England, about the middle of May, although the advance guard of very large fish arrive sometimes as early as the middle of April, and it is most abundant toward the 1st of June, and arrives in successive detachments or "runs," differing in size, the smallest fish coming last. The first run on the southern coast of New England, as stated, takes place about the beginning of May, and consists of large breeding fish, weighing from 2 to 4 pounds, and measuring up to 18 inches or more in length. The spawn is quite well developed at that time, and is said to be at first red, but gradually to become light yellow as it matures. The particular time and place, however, of laying the eggs, is not yet known, although it is probable that this occurs early in June, since the schools are said to break up about the middle of that month, and the fish to scatter. It is thought probable that the spawning takes place in the eel-grass which covers the shoal waters of Narragansett Bay and Vineyard Sound.

According to the fishermen generally, the scup, on first coming into the shores, do not take the hook readily, being apparently too much occupied in the business of reproduction, and two weeks usually elapse before they can be caught in this way. They present themselves in large schools of immense extent, and moving very slowly, at about the rate of three miles an hour. From the testimony presented before the committee of investigation of the Rhode Island legislature, they appear to come from the south and west, as when they enter Narragansett Bay they strike the western shore and move up along its edge. They are said, however, to drift slowly backward and forward with the tide, especially at the entrance of this bay. At this time they are very sluggish, and are said sometimes to appear as if blind, and can frequently be taken with the hand or a very short scoop-net.

[1] Not to be confounded with pogy or poagie, which is the menhaden.

[2] Roger Williams. Key to the Language of America, London, 1643. (Publications of Narragansett Club, I, page 138, 1866; J. H. Trumbull, editor.)

According to Captain Edwards, of Wood's Hole, in proceeding to their breeding-grounds, on the coast of New England, they are taken at Montauk Point three weeks earlier than at Wood's Hole, and a week earlier at Wood's Hole than at Hyannis, still farther east.

The scup feed upon a great variety of marine animals, such as worms, small crustaceans, mollusks, &c., and take the hook very freely during the greater part of their stay; in fact, the smaller ones become veritable nuisances to the fishermen, from the readiness with which they pounce upon the baited hook whenever thrown overboard.

The flesh of the scup is very much prized by most persons, as it is firm and flaky, and usually sweet, although occasionally a bitter flavor detracts from its palatability. Since the settlement of the coast by the whites, it has been by far the most important food-fish of Fisher and Vineyard Sounds, Narragansett Bay, and of Buzzard's Bay; and the rapid diminution in number has caused the greatest solicitude.

The scup is but little known, as far as accounts go, on the north side of Cape Cod; indeed, Dr. Storer states that they were introduced into Massachusetts Bay about 1833, and that they are taken only occasionally at the present date. Of their abundance on the south coast of New England in former times, almost incredible accounts are given. Thus, according to J. D. Swan, of Newport, at one place in Narragansett Bay, where the schools ran over a point where the water was 9 feet deep, they were so thick as to crowd each other out of the water. (See page 12 of the present report.) Mr. E. E. Taylor could catch five hundred fish in the morning and return in time to peddle them off in Newport, and then go out in the afternoon and get as many more. (Page 27.) Six hundred barrels have been taken at one haul of the seine at Tuckernuck, near Nantucket. (Page 40.) Captain Hallett has taken in one morning eight hundred scup, weighing 500 or 600 pounds, and eighteen boats have loaded a smack in a single day, (page 48.) Mr. Ryder, at the head of Buttermilk Bay, which opens out of Buzzard's Bay, twenty years ago could catch three boat-loads in a tide. In 1861, at Seconnet, 700 barrels were turned out of the traps because there was no sale for them. A subsequent capture netted only 18 cents a barrel.

The testimony of residents along the coast all tends to show that, until within not more than eight or ten years, scup, of large size, could be taken with a hook throughout the summer, at any point near the shore, from Point Judith to Cape Cod, almost as rapidly as a line with two baited hooks could be thrown over and hauled in.

The case, however, at the present date, is very different. Large numbers, it is true, are caught in traps and pounds for a few days in the spring, as the fish are on their way to their spawning-ground; after which only scattering individuals are taken in nets, and so few by lines as to remove them entirely out of the speculations of the fishermen, except, perhaps, on the coasts of New York and New Jersey.

In 1871 the diminution, even as compared with that of 1870, was very evident in most localities; Captain Hallett, of Hyannis, stating that not one-fourth as many were taken as in the previous year. (Page 48.)

The scup is a fish that grows with rapidity, and at two years is almost of sufficient size to be marketable. Throughout the summer young fish of the spring spawning are to be seen floating around in the eel-grass and over the sandy bottoms, having attained a length of from $2\frac{1}{2}$ to $3\frac{1}{4}$ inches by the 1st of October. When these fish re-appear the next season, thus completing one year of existence, they measure about 6 inches, six to eight or nine weighing a pound; and by the 1st of September attain an average length of 8 inches, including the tail, and a breadth of

3 inches. (Twelve individuals, measured on the 31st of August, measured from 7.75 to 9 inches in length, and from 2.75 to 3.25 inches in breadth, not including the dorsal and anal fins.) On the 8th of September twenty-five of this age weighed 4¾ pounds, or an average of little over 3 ounces each. In the third year of existence, or at the age of two years, they have increased considerably, though not so rapidly as was once supposed, measuring, on their re-appearance, about 10 inches, with an average weight of one-half pound. Six weighed in New Bedford, October 9, averaged but little over 5 ounces each, while the average of those on the stalls in New York, October 17, was a little over 8 ounces. After this they grow more quickly. One hundred and ninety-nine, presumed to be three years' fish, weighed on the 6th of September, averaged 1½ pounds each, and measured about 12 inches in length by 4½ inches in width, some individuals being larger and some smaller. The female fish of the second year not unfrequently contains mature eggs. It is in the fifth year, or after the lapse of four years from birth, that the scup presents its finest development; specimens believed to be of this age measured 14 or 15 inches by 5 to 6 inches or more, with a weight of 2½ to 3 pounds. They, however, still continue to grow, specimens being not unfrequently met with 18 inches long, and weighing 4 pounds and even more. The dimensions may belong to fish of six or more years of age; more probably, however, of five years. It is, of course, impossible to do more than give average estimates of the weight and size of fish of the same age, the differences probably depending on the fact whether they were spawned by old or young fish, and the period when the eggs were laid, this extending over a considerable length of time in each locality, although the great majority of fish undoubtedly spawn at nearly the same season.

Abundant as the scup has been during the greater part of the present century, there appears to be good evidence to show that prior to the year 1800 there was at least one period, if not more, when it was extremely rare. According to Mr. Southwick, (page 11,) there is a tradition that they first occurred at Newport about 1793, the sheep's-head disappearing about the same time. Mr. Lyman, in an article on the possible exhaustion of the sea fisheries, written in 1871, also quotes some negative evidence of the absence of this fish at Compton, Rhode Island, from 1794 to 1803, the "sheep's-head" (more probably the tautog is meant) being spoken of as common, and the scup not mentioned.

Mr. John C. Parker, an octogenarian of Falmouth, Massachusetts, states that the scup were observed there, according to his father's statement, sometime after 1790, and had become quite abundant by 1814. On the other hand, however, in 1621, again quoting from Mr. Lyman, Massasoit entertained his half-famished Puritan visitors with "fishes like bream, but three times so big, and better meat;" this fact, with the description, being applicable to no other fish than the scup. The European sea bream is very similar to the scup, and would readily be referred to the same species by the unobservant traveler.

Again, Roger Williams, in his "Key to the Language of the Indians," speaking of the scup says, "mushcup, the bream." "Of this fish there is abundance, which the natives dry in the sun and smoke, and some English begin to salt. Both ways they keep all the year, and it is hoped they may be as well accepted as cod at market, and better if once known." We find no reference to the occurrence of the fish from this date, 1642, up to 1794.

The time of the arrival of the scup on the coast varies with the locality. The young probably spend the winter in our southern waters or

out in the Gulf Stream, but in the spring commence their migration either along the coast or from the deep seas toward the waters on the south coast of New England. The latter supposition is the more probable, as no scup are taken on the southern coast of anything like the size of the breeders that visit New England, making their appearance at once in a huge body, extending, apparently, from Block Island to Martha's Vineyard.

The western division of this army appears to strike first at Watch Hill, to the west of Point Judith, and to make its way slowly along eastward, the smaller or eastern division moving through Vineyard Sound. According to Captain Luce, the Menemsha pounds take the scup three days or a week earlier than the pounds at Lombard's Cove, and nearly two weeks earlier than at the guano-works at Wood's Hole. The progress of this fish is at first very slow, scarcely exceeding a few miles a day, and their movements appear to be largely regulated by the flow of the tide, going forward with the flood, and partly retrograding with the ebb. According to Mr. Whalley, (page 24,) of Narragansett Pier, it occupies about four tides, or two days, in moving from Point Judith to Seaconnet Point.

The precise period of their reaching the coast varies with the season, although their abundance generally occurs from the 5th to the 12th of May. In 1871 the fish appeared much earlier than usual, and were on the shore before traps were down in readiness for their capture. Their occurrence was about the 15th to the 25th of April. Breeding scup were taken at Hyannis the same year on the 27th of April, at least two weeks earlier than usual. They were taken in the fish-pound at Wood's Hole on the 27th of April, but were most abundant on the 8th of May. In 1872 the season was late, and a few scattering scup were taken at Wood's Hole from the 10th to the 13th of May, but were most abundant at a later date. On the 17th of May 10 barrels were taken, and 150 barrels on the 9th of June. Some of those captured in the middle of May were of unusual size, weighing 4 pounds and over. At Newport they were most abundant on the 15th of May, or two days earlier than at Wood's Hole. Here, too, the number of mature fish was less than usual, but the average size greater. Over 1,000 barrels were taken in Luce's pound, at Menemsha Bight. It is mentioned as an unusual occurrence, that in the spring of 1872 large fish were caught in purse-nets five or ten miles off the shore of Newport, mostly with spawn, although very poor and thin.

As already remarked, the fishermen on the coast distinguish three runs of scup: the first, consisting of mature breeding fish, coming in from the 10th of April to the 20th of May, according to the season, varying in size from 1½ or 2 to 4 pounds; these represent the fish of three years old and upward. A second and separate run is said to be about ten days later, (sometimes nearly simultaneous,) and embraces fish of about a pound. This run is the largest in point of numbers, and, as already stated, has many spawning-fish in it, although not generally as many as the first run. Both these runs, according to Mr. Church, of Tiverton, are characterized by the presence of well-marked dark bars, something like those of the sheep's-head. The third run, according to the same authority, is without stripes. This comes in about ten days later, and embraces the scup weighing from one-fourth to one-half of a pound, evidently fish of the preceding year's hatching, and about twelve months old. These fish, according to Mr. Church, are not marketable, largely in consequence of their heating through and spoiling before they can be iced.

An apparently unusual occurrence in the history of the scup took

place in the spring of 1871, namely, the great number of young fish of the previous year, or those of the third run. These, however, besides their unusual abundance, were more mixed up with the first and second runs than usual. They swarmed in all the pounds, and, indeed, gave a great deal of trouble in the well-meant efforts of the fishermen to turn them out without injury. It is said that as many as 10,000 barrels were taken at one time in a single pound in Narragansett Bay in the middle of May, and a similar abundance was recorded by the fishermen along the entire coast, although in many localities the maximum was not seen until the end of June. The cause of this unexpected and unusual phenomenon is one that is difficult to explain. Although many fishermen insisted that these fish were hatched in 1871, it is quite certain that if so, they were not hatched in New England waters during that year. It has even been suggested that they may have been spawned in more southern waters very early in the season, subsequently moving forward to occupy the feeding-grounds of the New England coast. This hypothesis is, however, negatived by the statement of Thomas James, (page 185,) that late in the fall of 1870 his nets were filled with immense numbers of small scup of that season.

If these fish were really, as asserted, so much smaller than the supposed yearlings as to induce the impression that they were of the same year's spawning, it may be that they belonged to a late hatching of 1870. But as far as I could judge, from many observations, they were about the average represented by one year's growth. They grew very rapidly, so that by the end of September they measured nearly 6 inches in length. They continued along the coast in great abundance, and furnished capital sport for juvenile fishermen in taking them from the wharves; and when a seine was hauled in the small bays, bushels could be readily captured, although they were too small to be of any special service as food.

As expected, the small scup, to which reference was made as being very abundant in 1871, made their appearance again in 1872, of considerably larger size, weighing from a quarter to a half pound, and were marketed in large numbers. They were sent to New York, but were not very popular among the wholesale dealers. The persistence of this increase was more marked at Newport than elsewhere, where they were more plenty, according to the statements of several parties, than they had been for quite a number of years. As many as 10,000 barrels, according to Mr. Southwick, were turned out from the pounds outside of Narragansett Bay on the 21st of May. It is, however, not certain whether they were one or two years old. At Wood's Hole a similar increase of medium-sized fish was observed, but all agreed, as well at Newport as elsewhere, that there was nothing like the show of small scup which appeared in so marked a manner in 1871. The fish were evidently spawned in 1870, and were, of course, two years old in the summer of 1872. For this reason it is possible that after the present generation has reached maturity and been caught up, a scarcity of this particular species of fish may again be experienced. Both at Newport and farther east, scup of unusually large size were taken, some of them measuring 18 or 19 inches in length, with a weight of 4 pounds. But few of these, however, were captured with the hook, and they were taken during a few weeks only by the traps.

If the traps and pounds exercise so detrimental an influence upon the spawning fish as has been asserted, we could understand the appearance of yearling scup in unusual numbers in 1872, as it is well known that, owing to their unusually early appearance in 1871, they had been on their grounds some time before the nets were set for their capture. In

this way a large number would be able to discharge their spawn without any interruption, the result of which should have been seen in an increased number of young fish. This reasoning, however, would hardly explain the presence of so many young fish in 1871, since the traps were in position in 1870, before the spawning fish arrived.

According to Mr. Edwards, scup were still more scarce than usual at Wood's Hole in 1872 up to the 1st of July, a few small ones only being seen, and none of any size taken with the hook. After that date, however, the two-year fish made their appearance in considerable numbers.

In reference to the movement of the scup in Narragansett Bay, the testimony taken both by the Rhode Island commission, and by Mr. Theodore Lyman and myself, was quite contradictory, some maintaining that they enter by the west passage, and, passing round the north end, fall into the traps set for them in the eastern passage; others insisting that the fish enter both passages at the same time. The general impression, however, seemed to be that the army of old fish did not pass up into the bay, but that probably while the main body kept along the shore, from headland to headland, only those that were originally spawned up the bay turned off and proceeded up toward its head. The success of the traps at Seaconnet is probably due in large part to the peculiar funnel-shape of the river, by which the fish at flood-tide would be carried out of their course. The traps there being always set toward the north, it is likely that during the flood the fish pass up along the channel, and as the tide turns, losing their direction, they are scattered toward the shores, and in following down the ebb are taken in the traps.

According to Captain Thomas Hinckley, after passing Seaconnet Point and entering Buzzard's Bay, the scup keep along the northern shore and make almost the entire circuit of the bay before appearing at Quisset Harbor and Wood's Hole, their appearance being always later there than at the head of the bay or about New Bedford. Whether it is the fish alone that belong to Buzzard's Bay that enter it, or whether others pass directly between the Elizabeth Islands and Martha's Vineyard, is not yet satisfactorily ascertained. We know, however, that they reached Waquoit, the first pound on the north side of Vineyard Sound, in 1871 as early as April 25, but that the largest numbers were taken from the 10th to the 13th of May. This gives about a week's difference between this point and Newport.

On the south side of Vineyard Sound the fish are netted at Menemsha Bight, where there are several large and effective pounds, three days or a week earlier than at Lombard'sCove, and nearly two weeks earlier than at the Wood's Hole pound.

According to Mr. Luce, breeding-fish enter the tidal ponds on the north side of Martha's Vineyard (formerly in large numbers,) where they spawn, accomplishing this operation by the end of June, the ponds being filled with young in August. As soon as frost comes these fish leave for their winter abode.

As a general rule, in their movement along the coast the scup are not found in water shallower than a few fathoms; and it sometimes happens, in the course of heavy storms, that in consequence of the discoloration of the water near the shore, the fish move farther out to sea, and on such occasions measurably escape falling into the traps.

The scup is very largely a bottom-feeder, and depends very much upon mollusks or shell-fish for subsistence. I have been informed by the fishermen that they may frequently be seen feeding upon small bivalves of different species, rooting them out of the sand or mud. The stomachs of about two hundred 1½-pound scup were examined at one time in

the beginning of September. These almost exclusively, contained shells of various genera, with some worms, and a few amphipods.

Like all other small fish, they are devoured by their more rapacious fellows, and very largely by blue-fish, notwithstanding a general impression to the contrary. The extent to which this takes place will be considered under the head of the blue-fish. Halibut, cod, sharks, and other ground-feeders, likewise use them up in great numbers.

As already remarked, the breeding-fish do not appear to feed on their first arrival, being then too much occupied in carrying out the reproductive function. As, however, they can be taken with the hook about the 1st of June, we may infer that this is about the time they begin to feed for themselves. The younger fish probably feed as soon as they reach the shores. No remains of fish have hitherto been found in the stomachs of scup, and we may conclude that they are not piscivorous.

Although the period and the general region where the eggs are deposited has been pretty well ascertained, I regret that nothing is known of the peculiar method by which this is accomplished. I have been informed (page 47) that on hauling up of anchors of boats that have been lying over night in two fathoms of water, the rope is frequently found coated with spawn sticking upon it. The eggs are doubtless fertilized as discharged, and probably adhere to the gravel, grass, and other objects at the bottom; but as to the precise period of development, nothing is known.

The scup, like other shore-fish, not unfrequently suffer from changes of weather. Mr. Southwick informed me that he has evidence to show that in the early part of May in 1809, 1817, and 1838, after a cold spell in each of those years, large numbers were thrown on the shore. On the 29th of November, 1871, there was a fall of snow at Wood's Hole, and the next day scup and sea-bass came ashore in considerable numbers, generally, according to Mr. Edwards, about ten scup to every yard along the shore for a considerable distance. They were, however, all small fish. While scup were in greatest abundance, the other fish observed were sea-bass, butter-fish, mullet, &c. Similar facts have been observed in regard to tautog, which indeed seemed to suffer very much more than scup from this agency.

As may be inferred from what has already been said, the market at the present time is supplied with scup from the spring traps and pounds, the capture by these means having become almost entirely exclusive. Formerly, however, they could be taken with the hook from the latter end of May until the end of October, and in any desired abundance. There is no fish on the American coast that bites so freely when abundant, and which can be captured with so much ease.

I am informed by Mr. Dunham that in the deep holes of the pond at Nantucket, where he has been with his boat, he has sometimes thrown a stone overboard so as to give the scup a start toward the shore, and then following and throwing his dog overboard, he has driven the fish clear out of the water upon the beach, and has taken as many as five hundred in this way at one time. A similar mode of capture was reported to me as having taken place in the pond at Menemsha Bight.

The value of the scup as a marketable fish varies, of course, with the supply; and while they have been sold in early times as low as from 10 to 25 cents a barrel, and were used as a manure, they are now too scarce for any such purpose. They were worth in 1871 from 6 to 8 cents a pound at Newport and about 2 cents at Hyannis. At New Bedford they generally brought 10 cents as a maximum price.

On the coast of Carolina they are said to prefer deep, clear water,

with rocky bottom, although they may be taken in almost any locality in the region of their occurrence.

The scupremain along the northern coast until about the middle of October, when the larger ones at least, begin to leave the shores and moves out into deeper water. Mr. Vinal Edwards has, however, taken young fish at Wood's Hole as late as the 10th of December, and Captain John Rogers, of Noank, states that, in fishing for cod on Nantucket Shoals late in November, their stomachs are occasionally filled with small scup, which drop out of their mouths when hauled on deck, found to be to the extent of five or six at a time. It is quite possible that they, as well as other fish, seek in winter that portion of the Gulf Stream that corresponds in temperature to that of their summer abode; and as the mean summer temperature of the waters of Southern Massachusetts and Rhode Island amounts to about 63° Fahrenheit, they must go nearly to the latitude of Norfolk, Virginia, before they can find that same temperature in the winter season.

The European analogue of our American scup or porgy is the *Pagrus vulgaris*, the braize or becker, sometimes bream, of the fishermen. These come on to the European coast in the summer time, and are said to have much the same habits as the American species.

## II.—THE BLUE-FISH.

*Pomatomus saltatrix*, (Linn.,) Gill.

*Common names:* Blue-fish; horse-mackerel; skip-jack; snap-mackerel; green-fish; white-fish.

Among the various species of marine fishes belonging to the eastern coast of the United States there is no one more conspicuous, wherever found, than the blue-fish. This prominence is due not alone to its value as an article of food, and to the sport which it furnishes to its captors, but it has a very important bearing upon the condition of our coast-fishes generally, and one worthy, perhaps, of much more attention than it has hitherto received.

The blue-fish, like most of our other fishes, has received a great variety of names. From New York northward the adults generally bear the name of blue-fish, except at Newport, where as on part of the Jersey coast, it is called horse-mackerel. It is the skip-jack of South Carolina, the green-fish of Virginia, and the tailor of Maryland, &c. They oung bear the name of skip-mackerel about New York, and white-fish higher up the Hudson River.

Its geographical distribution, if we may rely upon the accounts of writers, is very extensive. Prince Maximilian gives it as found on the coast of Brazil and Schomburg or British Guana; Webb and Berthelot record it at the Canaries; and others mention it as found in the Mediterranean Sea, off Madagascar, about Amboyna, and on the shores of New Holland.[1] Professor Poey, however, has not met with it in the vicinity of Cuba, and I find no positive evidence of its occurrence in the West Indies. On our own coastit is known from Georgia, and probably Florida, as far north as New Hampshire and Maine, although it appears to diminish in numbers to the north of Cape Ann. I have been unable to detect

[1] Castlenan, (Proceedings of the Zoological and Acclimatisation Society of Victoria, I, 1872, p. 118,) says it is one of the most common market fish in Melbourne, where it is generally of small size, although he has seen a specimen 30 inches long. He adds, that at the Cape of Good Hope, it is very common and of large dimensions. Guichenot says it is abundant and esteemed at Algiers.

any evidence of its occurrence in the Bay of Fundy, although I have been informed that it has been taken well over toward the coast of Nova Scotia.

The blue-fish is pre-eminently a pelagic or wandering fish, and like many others, especially of the *Scombridæ*, is apparently capricious in its movements, varying in numbers at particular localities with the year, and sometimes disappearing from certain regions for a large fraction of a century, again to return as before. The cause of this variation it is impossible to explain, being due in some instances, probably, to the disappearance of its favorite food in consequence of its own voracity, or for other undetermined reasons.

They occur during the summer throughout the entire range indicated for the United States, but are much larger in size and in greatest abundance from the coast of New Jersey northward. From New Jersey osuthward, in the season mentioned, with the exception of an occasional wandering school, they are generally only about 8 to 12 inches in length, representing, therefore, in all probability, individuals of the second year's growth.

They appear to have a regular migration along our coast, presenting themselves later and later in the spring the farther they are found to the north, and disappearing in the inverse order from the same regions in the autumn. First noticed on the Carolina coast as early as March and April, immense schools of them, bound eastward, are seen off the coast of the Middle States, from the middle of May to the middle of June; and in October similar bodies, perhaps embracing fewer individuals, pass to the southward. It is possible, however, that in the autumn some schools move well out to sea, and are, therefore, less likely to be observed. They leave the northern coast about the middle of October, and about the middle of November appear in vast numbers off the coast of North Carolina, where, from Nag's Head, in Currituck County, to Cape Lookout, there is a very extensive fishery prosecuted, which furnishes blue-fish for the northern markets. It is estimated that at least one hundred and fifty crews are engaged in this fall fishing, which lasts generally until late in December. At this time individuals may be taken weighing 15 to 18 pounds, although their average size is about 10.

Their occurrence in autumn, off the coast of North Carolina, is preceded and first indicated by the vast schools of menhaden, which they follow in, several miles from the sea, and by the usual accompaniment of flocks of gulls attending them to take a share in the feast. Of the particular mode of fishing in this neighborhood we shall take occasion to speak hereafter.

According to Dr. Yarrow, the blue-fish are first seen in spring on the North Carolina coast, (the smaller ones first,) in March or April, when, however, they are much less in size than the specimens referred to as occurring in the fall. The precise time of their appearance at most of the points farther north has not yet been ascertained. Whether they actually migrate from south to north, and *vice versa*, or merely come in from the outer seas in regular order, as is believed to be the case with the shad, &c., has not been settled, although the former supposition appears the more probable. They reach the New Jersey coast some time in the early part of May, and usually appear at Newport and in Vineyard Sound (the time varying with the season) from the middle of May to the first week in June. They are expected at Edgartown from the 25th to the 30th of May; but I am informed that, on their first arrival, they feed at the bottom, and sometimes for a while are not seen at the surface at all, seldom being taken with the hook, but caught in large

numbers in pounds and with the gill-net, usually along the lower edge of the net. According to Dr. Yarrow, they are not taken with the hook about Beaufort until about the 1st of July. They do not bite, however, in Vineyard Sound until from the 10th to the 15th of June, when they appear on the surface and are caught in large numbers, in the usual manner.

Great interest attaches to this fish in consequence of the changes that have taken place in its abundance, and even its actual occurrence on our coast, within the historic period. The precise nature and extent of this variation has not been established, nor whether it extended along the entire coast or not. Its earliest mention for our waters is in the work of Josselyn, ("New England Rarities Displayed," 1672,) where, on page 96, he mentions the "blew-fish, or horse," as being common in New England, (his residence was on the New Hampshire coast, or near by in Maine,) and "esteemed the best sort of fish next to rock-cod." He says: "It is usually as big as the Salmon, and a better meat by far." He also, on page 24, catalogues two kinds of "Blew-fish" or "Houndfish;" the "Speckled Houndfish" and the "Blew Houndfish, called Horsefish." There appears to be no species to which this reference could apply, excepting the subject of our present article, this being the opinion of Mr. J. Hammond Trumbull, who has devoted much research to determining the modern equivalents of ancient Indian names of animals, and to whom I am indebted for the hint. Mr. Trumbull also remarks that in a manuscript vocabulary obtained by President Stiles, in 1762, from a Pequod Indian at Groton, Connecticut, there is mentioned the "Aquaundunt or blue-fish," clearly the same as what now bears that name, which shows that this fish was found in Fisher's Island Sound in 1762.

Again, according to Zaccheus Macy,[1] the blue-fish were very abundant about Nantucket, from the first settlement of the English on the island, in 1659 to 1763, and were taken in immense numbers from the 1st of June to the middle of September. They all disappeared, however, in 1764, a period of great mortality among the Indians of that island. (See page —.) It has been suggested that the disease which attacked the Indians may have been in consequence of an epidemic in the fish upon which they fed, or else that it invaded both fish and Indians simultaneously, resulting in almost their entire extermination.

According to Dr. Mitchell, this fish was entirely unknown about New York prior to 1810; but they began to be taken in small numbers about the wharves in 1817, and were abundant in 1825. Immense numbers were caught at the Highlands in 1841. The doctor remarks, as has been done repeatedly by others, that as the blue-fish increased, the squeteague or weak-fish diminished in about the same ratio.

According to Mr. Smith, of Newport, (page 20 of testimony,) his father used to catch blue-fish some time about the year 1800, when they were very abundant and of large size, weighing from 16 to 18 pounds.

Captain Francis Pease, of Edgartown, also testified that his father spoke of large blue-fish at the end of the preceding century, some of them weighing 40 pounds. This leaves an interval between 1764 and toward the end of the century, in which no mention is made of the blue-fish, and which may probably indicate its absence, as during that time there were many works published relating to the local history and domestic economy of New England, and which would doubtless have taken note of so conspicuous a fish had it been present.

Whether they existed uninterruptedly during the century intervening

[1] Collections Massachusetts Historical Society for 1794, vol. iii, 1810.

between Josselyn's time, 1672, (or even 1659, according to Macy,) and 1764, I am at present unable to say. According to Captain Pease, they were known about Edgartown at the end of the last century. As already stated, Dr. Mitchell speaks of their first making their appearance about New York in 1810. They are noted as having been seen in Vineyard Sound again as early as 1820. It would therefore appear that they were in such small numbers about New York in 1810 that the young only were noticed flocking about the wharves, and that in ten years they were observed as far east as Nantucket, where the specimens seen, from 1824 to 1826, were very small, not over 4 inches. The next year they measured 7, and the third year 10 inches, according to the testimony of one witness, although this does not represent, in all probability, the rate of growth.

According to Captain Burgess, of Monument, Massachusetts, they were caught about Nantucket in 1825, and were very abundant in 1830. Dr. Storer states the first blue-fish recorded as having been noticed in the present century, north of Cape Cod, was captured on the 25th of October, 1837. Captain Atwood remarks that in 1838 he saw blue-fish for the first time about Provincetown. These were very small, the largest weighing only 2 pounds. In a few years, however, they became larger and more numerous, and finally increased to such an extent as to exercise a very marked influence upon the fisheries. According to the captain, (Proceedings of Boston Society of Natural History, 1863, p. 189,) they arrive in Massachusetts Bay in a body, coming at once, so as to almost fill the harbor at Provincetown. On one year they came in on the 22d of June, and although the day before eight thousand mackerel were taken, the day after not one was seen or captured. He says that they leave about the last of September, with the first cold northeasterly storm, although stragglers are taken as late as December at Provincetown.

According to Messrs. Marchant and Peter Sinclair, of Gloucester, (October, 1872,) blue-fish made their first appearance in numbers about Cape Ann twenty-five years ago, coming in great force and driving out all other fish. They are now much scarcer than twenty years ago; about the same as tautog; some seasons scarcely noticed.

Mr. J. C. Parker, an aged gentleman of Falmouth, says the first blue-fish seen at Wood's Hole in this century was taken in July, 1831; but his father informed him that they were abundant in the preceding century, about 1780 or 1790, at which time they disappeared; and that when the blue-fish left, the scup first made their appearance.

They are also noted as having shown themselves at the head of Buzzard's Bay in 1830 and 1831, and although numerous, were of small size, measuring about a foot in length.

To sum up the evidence, therefore, in regard to the periodical appearance of the blue-fish, we find notice of its occurrence in 1672, or even 1659, and up to 1764. How long it existed in the waters prior to that date cannot now be determined. The oral testimony of Mr. Parker refers to its occurrence at Wood's Hole in 1780 or 1790; and it is mentioned as being at Newport in 1800, (Mr. Smith, p. 20,) and at Edgartown, Massachusetts, about the same time, (Captain Pease, p. 39), Mitchell testifies to its occurrence in New York, of very small size, in 1810; and it is recorded as existing again at Nantucket in 1820, and about Wood's Hole and Buzzard's Bay in 1830 to 1831; and a little later at Hyannis. In 1830 it had become abundant about Nantucket, and in the fall of 1837 it was first noticed in Massachusetts Bay; and then year by year it became more and more numerous, until now it is very abundant. Several

accounts agree in reference to the very large size (even to 40 or 50 pounds) of those taken in the last century.

Further research into ancient records may tend to throw more light on the early history of the blue-fish, and even materially to change the conclusions already reached. It will be observed that the references to its occurrence, from 1780 to 1800, are on the testimony of aged persons who have heard their fathers speak of it, although I find no printed records anywhere in reference to it between 1764 and 1810. The rate of progression to the north of Cape Cod I have at present no means of indicating, although they probably gradually extended farther and farther north, and may possibly occur much farther east than we have any mention of at present.

During the present century the maximum of abundance of these fish off the middle coast of the United States appears to have been reached from 1850 to 1860. The testimony elicited from various parties, as well as from printed records, indicates a decrease since that period much greater in some localities than others. About New York they are said to have been unusually plenty in the summer of 1871, but farther east the diminution which had been observed in previous years appeared to continue. The testimony taken at Newport varied somewhat, some persons thinking the fish were decidedly scarcer than in previous years, others finding no appreciable difference. (See pp. 8, 11, 18.) Mr. Harmon, of Pasque Island, Vineyard Sound, stated that the blue-fish, within a very few years, had diminished to such an extent that, when fishing from the stands, not more than two or three could be taken in a day.

At Nantucket, those fishing with gill-nets considered the blue-fish as plenty as before, and even more abundant; but the unanimous testimony of a large number of line-fishermen was to the effect that there had been a very decided reduction. This expression of opinion was also shared by the line-fishermen at Edgartown as well as at Hyannis. Indeed it was asserted that while the reduction, up to 1870, had been gradual, it became abruptly much greater in 1871. If this be true, it may have been caused by a more limited range of the fish; perhaps in consequence of remaining off the coast of New York and New Jersey, where the number is believed to have been greater than in previous years.

All parties, however, agreed that there were fewer fish on the north side of Nantucket than usual.

The testimony at Hyannis was very emphatic in reference to a positive and abrupt decrease, although this was less in the case of the blue-fish than had been observed in regard to the scup, sea-bass, and tautog.

According to some persons, the number taken in 1871 was not half that of 1870; thus, while a year or two before 1870 five hundred pounds a day was a fair average for a single fisherman, one hundred pounds was a liberal allowance for 1871. (Page 50.) Ten or fifteen years ago, eighteen men at Hyannis could load a vessel with blue-fish in a day, to do this requiring fifteen hundred fish weighing five or six pounds each. This is now said to be entirely impossible, even with twice the number of men.

According to Captain Edwards, the blue-fish in 1871 were not more than half or one-fourth as plenty as they were a few years ago; this either in consequence of their extending their cruising-grounds farther to the east, or the diminution of their food.

Captain Thomas Hinckley, also of Wood's Hole, believes the decrease to be very decided, and states that it commenced four or five years ago.

On the other hand, Dr. Yarrow learns that blue-fish have increased on the Carolina coast, as compared with their abundance before the war.

I have been unable to learn whether any appreciable difference has presented itself on the north side of Cape Cod, corresponding to that on the south side. Of the fact of the decrease in 1871, along the entire coast from Newport to Monomoy Point, there can, I think, be no question, as, although the number captured was perhaps absolutely greater than in the previous year, these were taken mainly in a greatly increased number of traps, pounds, and gill-nets, while the line-fishermen, as already stated, on ground where formerly they could readily capture from one hundred to one hundred and fifty fish in a day, now found twenty or thirty a very large allowance for the average catch. I have myself been able to appreciate a very great difference in the abundance of blue-fish in the vicinity of Wood's Hole from 1863 to 1871.

In 1872 a continued decrease in the number of blue-fish was again apparent, the number being much less everywhere than before. At Hyannis, Wood's Hole, and Edgartown, the estimated decrease compared with 1871, varied from one-half to three-fourths; and they the fish were also said to be smaller than usual. These statements are corroborated by parties in New Bedford. According to the wholesale dealers in Fulton Market, they were less plenty than heretofore. At Edgartown and Nantucket, and in Vineyard Sound, comparatively few were taken with the line, the gill-nets being depended upon for a supply.

The decrease at Hyannis is noticeably shown by the statements on page 178, where it will be seen that with nearly twice the number of boats in 1872, as compared with 1871, fewer fish were landed at Baxter's wharf. Captain Handy took less than half as many fish as in the previous year, and Timothy Crocker and J. G. Loring both referred to a corresponding decrease.

The question now arises as to the causes of this decrease in abundance on the part of the blue-fish on the south side of New England, while they appear to be as plentiful as ever off the coast of New Jersey and Long Island. It is of importance in this inquiry that this variation in the number of blue-fish has been accompanied by a similar change in the other fishes, and especially in the scup and menhaden. As, however, there is no marked indication of decrease elsewhere than from Watch Hill to Monomoy, we are entitled to look for some local cause as affecting the number; and it is a curious coincidence at least, if not a relation of cause and effect, that it is precisely in this area of diminished abundance of particular kinds of fish that we find the summer-fishing, by means of traps, pounds, and gill-nets, to have received its highest and most rapid development.

Although fixed apparatus for the capture of fish have been in use in Narragansett Bay for a considerable number of years, the introduction of such engines into more eastern waters has been comparatively slow, and usually limited to a short season in the spring of the year. Within the last five or ten years, however, the pounds have not only increased in number, but have greatly extended the time of their operation, so that instead of being taken up in June, they are now kept down much later, many of them even into October. It is, however, not to any direct action of the pounds upon the blue-fish that I attribute their scarcity. That the blue-fish themselves destroy other fish in immense numbers, there can be no question; and a reduction of their food, whether caused by themselves or supplemented by other influences, will tend to induce them to seek other fields of supply. That this latter is the case, seems to be shown by their temporary increase at least off the coast of New York and New Jersey. Indeed, in reference to the question of the fish-supply, it may be considered as established that the fecun-

dity of fishes is so great that any ordinary influences acting upon them will exercise no particular effect, but that while the capture of fish, in ordinary seasons, by the usual human agencies, will be of comparatively little account, any disturbance of such fish, while on their spawning-grounds, must have some influence, however slight. This will be exhibited not only in the number of breeding-fish actually destroyed before their reproductive function can be accomplished, but in the breaking up of the schools, and thus keeping them from suitable spawning-grounds, causing them to waste the spawn in the waters, where, for one cause or another, a proper combination of the sexes cannot be effected, or where the eggs do not find a suitable *nidus* for development; or, again, where the young fish cannot be properly protected from the destructive agencies surrounding them. If, now, in addition to these influences, which would act perhaps very slowly and almost unappreciably for a great number of years, we introduce a new disturbance, in the form of immense numbers of the most voracious fish on record, which, from its earliest age to its maximum development is in the habit of destroying its own weight or more in fish every day, we can easily imagine what an effect must be produced.

As far as I can learn, there is no parallel in point of destructiveness to the blue-fish among the marine species on our coast, whatever may be the case among some of the carnivorous fish of the South American waters. The blue-fish has been well likened to an animated chopping-machine, the business of which is to cut to pieces and otherwise destroy as many fish as possible in a given space of time. All writers are unanimous in regard to the destructiveness of the blue-fish. Going in large schools, in pursuit of fish not much inferior to themselves in size, they move along like a pack of hungry wolves, destroying everything before them. Their trail is marked by fragments of fish and by the stain of blood in the sea, as, where the fish is too large to be swallowed entire, the hinder portion will be bitten off and the anterior part allowed to float away or sink. It is even maintained, with great earnestness, that such is the gluttony of the fish, that when the stomach becomes full, the contents are disgorged, and then again filled. It is certain that it kills many more fish than it requires for its own support.

The youngest fish, equally with the older, perform this function of destruction, and although they occasionally devour crabs, worms, &c., the bulk of their sustenance throughout the greater part of the year is derived from other fish. Nothing is more common than to find a small blue-fish of 6 or 8 inches in length, under a school of minnows or of making continual dashes and captures among them. The stomachs of the blue-fish of all sizes, with rare exceptions, are found loaded with the other fish, sometimes to the number of thirty or forty, either entire or in fragments.

As already referred to, it must also be borne in mind that it is not merely the small fry that are thus devoured, and which it is expected will fall a prey to other animals, but that the food of the blue-fish consists very largely of individuals which have already passed a large percentage of the chances against their attaining maturity, many of them, indeed, having arrived at the period of spawning. To make the case more clear, let us realize for a moment the numbers of blue-fish that exist on our coast in the summer season. As far as I can ascertain by the statistics obtained at the fishing-stations on the New England coast, as also from the records of the New York markets, kindly furnished by Middleton & Carman, of the Fulton Market, the capture of blue-fish, from New Jersey to Monomoy, during the season, amounts to not less

than one million individuals, averaging 5 or 6 pounds each. Those, however, who have seen the blue-fish in its native waters, and realized the immense number there existing, will be quite willing to admit that probably not one fish in a thousand is ever taken by man. If, therefore, we have an actual capture of one million, we may allow one thousand millions as occurring in the extent of our coasts referred to, even neglecting the smaller ones, which, perhaps, should also be taken into the account.

An allowance of ten fish per day to each blue-fish is not excessive, according to the testimony elicited from the fishermen and substantiated by the stomachs of those examined; this gives ten thousand millions of fish destroyed per day. And as the period of the stay of the blue-fish on the New England coast is at least one hundred and twenty days, we have in round numbers twelve hundred million millions of fish devoured in the course of a season. Again, if each blue-fish, averaging 5 pounds, devours or destroys even half its own weight of other fish per day, (and I am not sure that the estimate of some witnesses of twice this weight is not more nearly correct,) we will have, during the same period, a daily loss of twenty-five hundred million pounds, equal to three hundred thousand millions for the season.

This estimate applies to three or four year-old fish, of at least three to five pounds in weight. We must, however, allow for those of smaller size, and a hundred fold or more in number, all engaged simultaneously in the butchery referred to.

We can scarcely conceive of a number so vast; and however much we may diminish, within reason, the estimate of the number of blue-fish and the average of their captures, there still remains an appalling aggregate of destruction. While the smallest blue-fish feed upon the diminutive fry, those of which we have taken account capture fish of large size, many of them, if not capable of reproduction, being within at least one or two years of that period.

It is estimated by very good authority, that of the spawn deposited by any fish at a given time, not more than 30 per cent. are hatched, and that less than 10 per cent. attain an age when they are able to take care of themselves. As their age increases, the chances of reaching maturity become greater and greater. It is among the small residuum of this class that the agency of the blue-fish is exercised, and whatever reasonable reduction may be made in our estimate, we cannot doubt that they exert a material influence.

The rate of growth of the blue-fish is also an evidence of the immense amount of food they must consume. The young fish, which first appear along the shores of Vineyard Sound, about the middle of August, are about five inches in length. By the beginning of September, however, they have reached six or seven inches, and on their re appearance in the second year, they measure about twelve or fifteen inches.[1]

After this they increase in a still more rapid ratio. A fish which passes eastward from Vineyard Sound in the spring, weighing 5 pounds, is represented, according to the general impression, by the 10 to 15 pound fish of the autumn. If this be the fact, the fish of 3 or 4 pounds, which pass along the coast of North Carolina in March, return to it in October, weighing 10 to 15 pounds. The only parallel to the voracity and rapacity of the blue-fish in our waters is, perhaps, to be met with in the case of the common pickerel; and an experiment quoted by Mr. Theodore

[1] According to Genio C. Scott, the blue-fish weighs 2 pounds when it appears on the coast in its second year, (aged twelve months,) and by autumn, or at eighteen months, they weigh from 3 to 5 pounds.

Lyman may serve as a measure for both, and their resulting rate of growth. He states that a friend of his, Dr. Sturtevant, introduced two young pickerel, about 5 inches long, into a horse-trough, minnows of about an inch in length being supplied to them daily. On the first day they devoured one hundred and twenty-eight; the second, one hundred and thirty-two; and the third, one hundred and fifty; and they themselves increased one inch in length in forty-eight hours, consuming an average of about sixty-six fishes each per day, a weight much greater than their own.

In view of this fact, and bearing in mind that the blue-fish, by its pertinacity and its strength and vigorous motions, can find no difficulty in overtaking the prey that it attacks, the estimate of ten fish per day is probably much below the mark.

We now proceed to consider the respective action of the pounds and the blue-fish upon the fish supply. No one will deny that most of the shore fishes are taken, as already explained, while on their way to their spawning-beds, the erection of traps and pounds, in the line of their regular migration, being especially adapted to their capture. It will also be admitted by every unprejudiced person that, in addition to the large percentage actually captured by the pounds, a decided influence is produced by their interference with the course of the remaining fish, and causing them to spawn at improper times or in unsuitable localities. Supposing, however, that the percentage already mentioned escape the perils to which they are exposed, and perform their appropriate functions in due season, their eggs will, of course, be greedily devoured by the small fry attracted by them. Apart from fish attaining a considerable size, the water abounds in various diminutive species of *cyprinodonts*, *atherinas*, &c., which are never taken in the pounds, and which, of course, hold their own year by year, and, indeed, may multiply in consequence of a diminution of the number of larger fish that would otherwise devour them. These act both upon the spawn and the young fish, as also do the other marine animals, the various crustaceans, some of the radiates, &c. As all of these are on the spot, they doubtless devour as many eggs and young one year as another, and what is left by them while growing up has finally to run the gauntlet of capture by man in various ways, and by the blue-fish and other species that devour them after they reach a considerable size.

Should it be a matter of astonishment, then, in view of this combination of agencies of destruction, if the supply of fish were to decrease appreciably on those portions of the coast where all are acting in concert, even though their number may not have diminished perceptibly, where only one or the other occurs.

In this connection, I have confined my examination to the blue-fish; but it may be stated that the squeteague is almost equally destructive, devouring as it does immense numbers of fish of considerable size. There is this difference, however, that the squeteague, from the weakness of its teeth, appears unable to mangle its prey, and confines itself to satifying its appetite by swallowing the fishes whole. Nor is there any evidence that the squeteague empties its stomach when once filled, for the purpose of loading it again. For this reason the effect produced upon other fishes by an equal number of these two kinds of fish, of the same weight, would be very dissimilar, although that of both is doubtless quite appreciable.

As already remarked, the size of this fish varies considerably with season and locality, those spending the summer on the southern coast, according to good authority, rarely exceeding two or three pounds in

weight, and being generally considerably less. The largest summer specimens are those found farther to the eastward, where they are not unfrequently met with weighing from ten to fifteen pounds, although this latter weight is quite unusual. Mr. Snow, however, (page 44,) mentions having seen one of twenty-two pounds, and others give, as their maximum, from fourteen to twenty. The average size of the schools in Vineyard Sound, during the early season, is from 5 to 7 pounds. The schools, however, that make their appearance in October, embrace many individuals of from 10 to 15 pounds. It is therefore not improbable that the difference between the first-mentioned average and the last represents the increase by their summer feeding. As already remarked, blue-fish in the last century sometimes attained a weight of 40 or 50 pounds in Vineyard Sound; according to Zaccheus Macy, thirty of them would fill a barrel.

On getting back to the Carolina coast in the early part of November, according to Dr. Yarrow's statement, they are from 3 to 5 feet in length and weigh from 10 to 20 pounds. What becomes of these large fish, that so few of them are seen in the early spring, it is impossible to say. If it be really true that they are much scarcer than in the fall, we may infer that their increased size makes them a more ready prey to the larger fish and cetaceans, or that they have accomplished their ordinary period of life; possibly that they have broken up into smaller parties, less conspicuous to observation, or that they have materially changed their locality. The average length of the fish that appear in the spring off the coast of Virginia and the southern part of New Jersey, according to Dr. Coues, Dr. Yarrow, and my own observations, is about one foot, being probably about one year old. As a general rule, those of the smaller size keep close to the shore, and canal ways be met with, while the larger ones go in schools, and remain farther outside.

I was unable to obtain any very young fish about Wood's Hole in 1871, the smallest found making their appearance quite suddenly along the coast, especially in the little bays, about the middle of August, and then measuring about 5 inches by 1.20. By the end of September, however, these had reached a length of 7 or 8 inches, and at the age of about a year they probably constitute the 12 or 14 inch fish referred to as occurring along the southern coast. The fish of the third year, or those two years old, are possibly the 3-pound fish, while the 5 to 7 pound fish may be considered a year older still. Accurate observations are wanting, however, to determine these facts; as also whether they require two years, or three or more, to attain sufficient maturity for breeding. As far as I know, there is no appreciable difference between the sexes in their rate of growth or weight, excepting that the female is likely to be a little deeper in the body.

I have already referred to the principal facts connected with the migrations and movements of the blue-fish, and especially their arrival and departure. As already suggested, they appear to start along the southern coast in April, and move northward, parallel with the coast, in very large bodies, and extending sometimes several miles outside of the shore-line. Their presence at the surface is usually indicated by their "breaking," apparently in pursuit of their prey, and by the flocks of gulls and terns which hover over them. The birds become exceedingly eager on the occasion, and may be seen crowding together and darting continually at their food upon the surface of the water. No surer evidence of the presence of a school of blue-fish or Spanish mackerel, off the middle coast of the United States, can be given, in the summer-time, than the sight of gulls and terns so occupied.

The blue-fish sometimes make their way up the rivers to a considerable distance, the adults, however, apparently never entering the perfectly fresh water. They are found in the Potomac as far north as Acquia Creek, and also far up the Hudson; indeed, the young of the year are taken as high as Sing Sing on the Hudson and other tidal rivers, where the water is entirely fresh.

As already explained, the relationship of these fish to the other inhabitants of the sea is that of an unmitigated butcher; and it is able to contend successfully with any other species not superior to itself in size. It is not known whether an entire school ever unite in an attack upon a particular object of prey, as is said to be the case with the ferocious fishes of the South American rivers; should they do so, no animal, however large, could withstand their onslaught.

They appear to eat anything that swims of suitable size, fish of all kinds, but perhaps more especially the menhaden, which they seem to follow along the coast, and which they attack with such ferocity as to drive them on the shore, where they are sometimes piled up in windrows to the depth of a foot or more.

The amount of food they destroy, even if the whole of it be not actually consumed, is almost incredible. Mr. Westgate (page 33) estimates it at twice the weight of the fish in a day, and this is perhaps quite reasonable. Captain Spindel goes so far as to say that it will destroy a thousand fish in a day. This gentleman is also of the opinion that they do much more harm to the fishes of the coast than is caused by the pounds. They will generally swallow a fish of a very large size in proportion to their own, sometimes taking it down bodily; at others, only the posterior half. The peculiar armor of certain fish prevents their being taken entire; and it is not uncommon to find the head of a sculpin or other fish, whose body has evidently been cut off by the blue-fish. In the summer-time the young are quite apt to establish themselves singly in a favorite locality, and, indeed, to accompany the fry of other fishes, usually playing below them, and every now and then darting upward and capturing an unlucky individual, while the rest dash away in every direction. In this manner they attend upon the young mullet, atherinas, &c. They are very fond of squid, which may very frequently be detected in their stomachs. In August, 1870, about Fire Island, Mr. S. J. Smith, found their stomachs filled with marine worms, a species of *Heteronereis*, which, though usually burrowing in the mud, at that season swims freely toward the surface, in connection with the operation of reproduction. This, like the squid, is a favorite bait for the blue-fish; and they appear to care for little else when these are to be had. This fact probably explains the reason why, at certain seasons, no matter how abundant the fish may be, they cannot be taken with the drail.

Their influence upon other marine animals is not always injurious. Thus, according to Captain Atwood, the lobsters have multiplied fourfold in Massachusetts Bay since the blue-fish have appeared there, in consequence of their driving away the mackerel, which were the greatest enemy of the young lobsters. *Per contra*, however, he remarks that the blue-fish actually destroy great numbers of mackerel of all sizes, and they have almost entirely broken up the mackerel fishery in the vicinity of Provincetown, making it necessary for the fishermen to resort to far distant waters, to which blue-fish have not yet penetrated. According to Dr. Storer, the mackerel fisheries of Massachusetts Bay have been entirely ruined since 1847.

The fondness of the blue-fish for squid, Captain Atwood thinks, has

had a material influence upon the abundance of flounders, which have a similar proclivity, and appear to depend upon these animals in greater part for food. Flounders have, therefore, greatly diminished in Massachusetts Bay, either from being starved out or obliged to resort to other localities.

The blue-fish are not unfrequently found with crabs and shell-fish in their stomachs, (page 42,) as also eels, (page 44,) which probably they obtain at night, as it is understood they feed at the bottom at that time, coming to the surface by day. This is proved by the fact that blue-fish taken in gill-nets are taken at night near the middle line; but if taken by day, then near the upper edge.

In the discussion of the question as to whether the decrease of fish on the south coast of New England has arisen from the multiplication of traps and pounds, it has been denied that scup form any part of the food of the blue-fish, it being asserted that the spinous nature of the fins effectually prevents such a performance. Apart, however, from the positive testimony of a great number of persons on this point, I am able to state in the most emphatic manner that of the large number of blue-fish examined at Wood's Hole during the summer of 1871,[1] nine-tenths of them had their stomachs filled with scup in greater or less number. Most of these fish were taken in pounds, in which scup were also caught; and it would be but the exercise of a natural instinct for the one to prey upon the other under these circumstances; and, nevertheless, it is very clear that the natural defenses of the scup did not prevent their being swallowed. Furthermore, however, the examination of many blue-fish taken in gill-nets also resulted in finding scup in their stomachs. We may, therefore, readily infer that, while, perhaps, preferring menhaden and mackerel, as being either more savory or more easily taken from their swimming near the surface of the water, blue-fish will feed upon any animal life to be found in the sea, going nearer the bottom at night, and coming to the surface by day, and that whatever fish the sea affords in greatest abundance at the time will suffer most severely from their ravages.

As already stated, the first blue-fish of the season are caught at the bottom, while fishing for scup; and the evidence shows that they are first taken in gill-nets sunk to the bottom, before they are taken with the line at the top, this being the evidence of their presence, and before any indication is seen by their "breaking" at the surface.

According to Dr. Yarrow, this fish, on the southern coast, comes in from the sea into the inlets on the flood tide, the larger ones returning on the ebb, feeding in preference in water of 4 to 5 feet in depth.

As already explained, they seem to know no particular time for taking their food, being equally voracious day and night.

I regret to say that but little definite is known in regard to the reproduction of the blue-fish. Dr. Yarrow does not give any facts in regard to this subject, at Fort Macon, except that spawn was seen to run out of a small female caught July 14. Dr. Holbrook is also silent on this head. Mr. Genio C. Scott says the spawning-beds are visited by the parent in June, and consist of quiet nooks or bays. Mr. R. B. Roosevelt states that very diminutive young occur in immense numbers

[1] Of seven hundred blue-fish the stomachs of which were examined by my assistant, Dr. Palmer, at Wood's Hole, between the 2d of August and the middle of September, six hundred and fifty-five contained scup, in numbers varying from two to ten or more, the average being four or five. Next in number to the scup came the butterfish, the squid, small mackerel, and the sand-smelt. Even young blue-fish of the season had entire scup of the year within them.

along the coast at the end of September or beginning of October. (Game Fish of America, 1862, 159.) I found the young fish at Carson's Inlet, Beasley's Point, New Jersey, in July, 1854, two or three inches in length, and more compressed than the adult; but farther east, on Vineyard Sound, although diligent search was conducted, between the middle of June and the first of October, with most efficient apparatus in the way of fine meshed nets, I met with nothing excepting fish that made their appearance all at once along the edge of the bay and harbor.

According to Captain Edwards, of Wood's Hole, a very accurate observer, they have no spawn in them when in Vineyard Sound. This statement is corroborated by Captain Hinckley; and Captain Hallett, of Hyannis, (page 48,) "does not know where they spawn." The only positive evidence on this subject is that of Captain Pease, (page 38,) who states it as the general impression about Edgartown, that they spawn about the last of July or the first of August. He has seen them when he thought they were spawning on the sand, having caught them a short time before, full of spawn, and finding them afterward for a time thin and weak. He thinks their spawning-ground is on the white sandy bottom to the eastward of Martha's Vineyard, toward Muskeeget. While not discrediting the statement of Mr. Pease, it seems a little remarkable that so few persons on the eastern coast have noticed the spawning in summer of the blue-fish; and although there may be exceptions to the fact, it is not impossible that the spawning-ground is in very early spring or even in winter off New Jersey and Long Island or farther south. It is not impossible that, at a suitable period after spawning the young, in obedience to their migratory instinct, many move northward along the coast, growing rapidly as they proceed. This explains the almost sudden appearance of fish of five inches about Wood's Hole.

We have the statement of Dr. Yarrow that vast schools of small blue-fish were met with in Beaufort Harbor during the last week in December, 1871. These were in company with small schools of young menhaden and yellow-tailed shad, and were apparently working their way toward the sea by the route of the inlet. When observed, they were coming from the southward through the sound, moving very slowly, at times nearly leaving it, and then returning. The largest were about 4 inches in length, and others were much smaller; and as many as twenty schools were observed from the wharf at Fort Macon, each of them occupying an area of from 60 to 80 feet square, and apparently from 4 to 6 feet in depth. I would not be much surprised if these fish should prove to have been spawned late in the year off the southern coast.

The mode of taking these fish varies with the locality, the more productive method being either with weirs, or pounds, or by means of the gill-net. In Massachusetts Bay immense numbers are sometimes taken in the brush-weirs, which are very common in that region. During the night of the 14th of September, 1870, I happened to be anchored off Billingsgate Shoal, where one weir took a school of blue-fish estimated at 20,000 in number, weighing probably six pounds each. Fifteen carts were occupied the entire morning in hauling these fish up from the beach.

At Hyannis, Nantucket, and Edgartown they are taken principally by the line, although a large number are caught about Nantucket in gill-nets. In 1872, owing to the increasing scarcity, comparatively few were taken at these places with the line, the supply being furnished mainly by net.

Farther west, in Vineyard Sound and in Buzzard's Bay, they are taken principally in the pounds; while still farther to the west and in

Long Island Sound, they are taken very largely in gill-nets as well as with the line. Wherever they occur, of course large numbers are taken with the hook and line by sportsmen and amateurs.

The fish taken on the south side of New England, and off the coast of New York and New Jersey, are for the most part shipped to New York for consumption as fresh fish. They are packed in ice, if near a railway communicating with the cities, and put up in sugar-boxes, about 300 pounds in a box. The fish taken at Nantucket, however, and to some extent those at Edgartown, are salted and packed in barrels for winter use. These contain about 200 pounds each, and are worth $10 per barrel in good seasons.

According to Captain Atwood, (Proceedings Boston Society of Natural History, IX, 1863, p. 189,) in addition to their capture in Massachusetts Bay in weirs, they are taken very largely outside by gilling. For this purpose two boats, each with 450 yards of netting meet, and unite the ends of their respective nets, and then, moving in opposite directions, pay out the nets, and then nearly meet with the outer ends, the net forming a semi-circle. Just before coming together, they turn inward so as to form a helicoid-curve toward the net. Then, moving outside, they endeavor to drive the schools of fish into the concavity of the net, and thereby cause them to become gilled.

Formerly, when they first appeared they were taken only in the bay, but of later years, according to Captain Atwood, they have become hardy, stay later in the season, and are more frequently found on the outer edge of the cape.

About Nantucket the gill-nets are usually set in a nearly straight line parallel with the shore; and the fish, according to Mr. Snow, are captured on the ebb tide. The nets are 25 to 50 fathoms long, and from 30 to 50 meshes wide, the meshes varying from 4¼ to 4½ inches, No. 15 or 16 thread. The gill-nets sometimes float at the surface of the water; sometimes are sunk nearly to the bottom, as already stated, the season, the time of day, and time of tide all requiring to be taken into account.

At Newport, according to Mr. Taylor, (page 27,) the nets used in that vicinity are 76 meshes deep, the mesh 4½ inches. In these they are taken about midway, the weight of the fish varying from 2½ pounds to 7 or 8.

The usual method of taking them with the line is by drailing or trolling, this consisting in fastening a hook to from 20 to 50 fathoms of line, the bait consisting simply of a bit of polished metal, which may be cast around the base of the hook, or of a bit of bone or ivory similarly placed. This is dragged rapidly through the water, under full sail. Sometimes the weighted hook is covered by a piece of inverted eel-skin, one end of which is tied down over the leaded portion, and extending nearly to the barb of the hook, with a small piece generally playing just beyond; the whole resembling a small shining fish, as it moves rapidly through the water. They are sometimes, indeed, taken with a bait of red flannel, or even a white rag; as, when ravenously inclined, they will snap at anything they see thus in rapid motion, especially if it has any resemblance to a moving fish. Menhaden or other shining fish may also be used to advantage; but it is seldom thought necessary to take this trouble. The shank of the hook, or metal fastening, must be sufficiently long to prevent the blue-fish, in their eager haste to seize their prey, from cutting the cord, as they would bite through it almost with the precision of a pair of nippers. Indeed, the end of the line is sometimes connected with the hook by means of a

small chain, or else coated with wire. This mode of taking the blue-fish is very exciting, as, when abundant, they usually bite at the drailing hook as rapidly as it is thrown out, several fish often being seen jumping at the same time to seize the coveted but delusive prize.

A mode recently introduced off the coast of New York and New Jersey consists in baiting certain fishing-grounds with chopped menhaden, and then anchoring the smack. Lines, with pewter squids, are then dropped overboard and hauled rapidly up. This proves to be very successful, much more so than trolling.

Although the sight of a school of fish playing in the water is generally the sign to thrown out the lines, it often happens that stragglers are picked up when their presence is not suspected, so that in regions where blue-fish are generally found, it is customary for fishermen to keep a line out at the stern while making their trips from point to point. Great care must be taken to keep the hook free from floating seaweed, which is very apt to become fastened around it, as this invariably prevents any further success.

Not unfrequently blue-fish are taken when fishing with deep-sea lines for scup or tautog, especially at night; although the surface fishing is most customary and most productive.

The fishermen of Edgartown and of some other localities on Vineyard Sound, keep their line, when fishing, well out by means of a stick of wood projecting from the side, although generally the line is held in the hand directly over the stern or side of the boat. By the use of a moderate degree of skill, at least three lines if not more can be managed well from a sail-boat, one from the stern and the others from either side.

Another method of taking them is in the surf, when they are near the shore, coming in either after menhaden or to lie in wait for the schools of young alewives, as they pass out from the ponds in which they have been bred. In this case the usual method consists in swinging a weighted hook several times around the head; then, by a dexterous fling, throwing it off as far as possible into the water, and then immediately hauling hand over hand very rapidly. If no fish is hooked, the same experiment is repeated. In this way many large fish are taken.

Sometimes also the fisherman turns, as soon as he sees the splash of the hook, and runs as rapidly as possible up the bank and from the shore; again to return and repeat the operation. Under favorable circumstances, this method of fishing is very productive, resulting in the capture of large numbers in a short time.

For fuller details of everything connected with the capture of blue-fish by means of lines, I must refer to the excellent works of Genio C. Scott, Mr. R. B. Roosevelt, Mr. Thaddeus Norris, and others, who have made such subjects a specialty.

Whether the numbers of the blue-fish can be considered as at all diminished by any or all these methods of fishing, it is impossible to state, although I am inclined to the opinion that, if any, it is very slight. As the fish are not taken when exclusively engaged in the operation of reproduction, there is no special interference with their spawning, and although there has been a variation in abundance, as already explained, this may be ascribed as well to some peculiar caprice on their part, or to their finding less food than they require; and consequently their going elsewhere in search of it.

The average catch with the hook of course varies with the abundance of the fish and their readiness to bite. According to Captain Pease, (page 40,) one man, a few years ago, could take about 1,500 pounds a day; while, as an illustration of their decrease in number, the largest

catch in one day in 1871 was 500 pounds, and the average at Edgartown and Hyannis not more than 100 pounds.

On the Carolina coast the best season for fishing is about at slack water, including the last of the ebb and young flood. At full tide the success is much less.

Reference has already been made to the number of blue-fish taken in Vineyard Sound during the season of 1871, these amounting to not far from a million of fish. At Hyannis alone, notwithstanding the decided diminution in number, as many as 100,000 fish, representing a weight of half a million pounds, were taken up to the 18th of September, and shipped by the cars to New York.

Of the winter fishing for blue-fish on the coast of North Carolina, the principal range, according to Dr. Yarrow, United States Army, extends from Nag's Head to Cape Lookout, the north bank near Nag's Head being a favorite locality. The fishing season there lasts about five or six weeks, from about the middle of November to the end of December; and in 1871 there were one hundred and fifty crews engaged. At this time the fish appear to come in direct from the sea, and, after spending some time there, they pass out again to sea in a southerly direction, this being possibly the time at which they come in to spawn, although Dr. Yarrow was unable to detect the presence of any spawn.

These fish are all large, some of them weighing 18 to 20 pounds, although their average, as already remarked, is about 10. They are captured by gill-nets made of No. 6 cotton-twine, 200 yards long and about 50 meshes deep, the mesh itself being 3 inches.

They are also captured, in less number, however, by means of the hook baited and thrown in the usual manner. Their first appearance is indicated by schools of menhaden, in pursuit of which they display so great eagerness as sometimes to run themselves upon the shore. When a school is seen to approach, the nets are let off from the boats about half a mile from the shore, so that the fish are gilled as they come in. The fish are generally of about the same size, and large, no young ones being found in their company.

A full outfit costs from seventy-five to one hundred dollars, and the boat's crew share the profits, which are sometimes very large; as in a good season the fish will bring about six cents per pound. As many as 4,000 fish have been taken out at a single haul, but this is unusual. A fair average is about 3,000 fish to a crew for a season. Allowing 2,000 as an average for the 150 crews, and we have 300,000 fish, which, at an average of ten pounds each, will give 3,000,000 pounds, amounting, at 5 cents per pound, to $150,000. These figures are believed to be fully within the mark.

Dr. Yarrow further states, in this connection, that no fish will swim in their company, large sharks even sometimes losing their fins by them. The only fish of the southern waters able to protect itself against them is the largest sized drum. They are, however, devoured in large numbers by the porpoises, which follow them to their grounds and make sad havoc among them. The same is the case farther north. Sharks, too, doubtless kill considerable numbers.

The economical value of the blue-fish as a food-fish is very great, constituting, as it does, a very large percentage of the food supply, during the summer, of the people of the coast from New Jersey to Massachusetts. It is to be met with in its season in all the markets, and is the principal reliance of summer boarding-places near the sea-coast, especially since the diminution in the number of the scup and other shore fishes. This is in strong contrast to the contempt manifested for them in the earlier part

of their occurrence during the present century. In one instance (page 183) a fisherman who caught two hundred could not induce people to steal them, although he left them out all night on a wharf for the express purpose. According to Dr. Storer, (Pr. Boston Soc. Nat. Hist., 1852, 289,) a bounty for its extermination was proposed, especially in view of its injury to the mackerel-fishing. The blue-fish is, however, very sweet and savory, but does not keep very well; and the difference in taste between a fish fresh from the water and one that has been out a few days, even though the latter be perfectly sweet, is very great. A great improvement in the flavor of the fish, as well as in the firmness and whiteness of its color, is effected by killing it as soon as caught and bleeding it, this operation being best performed by slashing the gills and cutting through the throat between them. The fish is well supplied with blood, as shown by its great muscular vigor, and bleeds very profusely; and persons accustomed to its taste when cooked, after being thus treated, are very unwilling to eat such as have been allowed to die in the ordinary manner.

As far as I could ascertain, very few blue-fish are used for the manufacture of manures or for oil, coming, as they do, when other kinds of food-fish are scarce. It is probable, however, that on the sea-coast, when a very large catch is made, the surplus is applied directly to the land, as is customary with the menhaden.

The wholesale value of the fresh blue-fish varies also with the season and the locality. At Edgartown the fish were sold in 1871 for about 1 cent a pound; and at Hyannis, Wood's Hole, and the pounds along the coast, at from 1½ to 2 cents a pound, the price varying with the immediate demand. At Beaufort, North Carolina, which is the principal market for the Carolina blue-fish, the wholesale value is 60 cents to $1 per hundred. The salted fish bring about $8 or $10 per barrel of 200 pounds. The retail price varies perhaps less than the wholesale, being generally, in the markets near the coast, about 8 cents a pound.

There appears to be no foreign commerce in this fish, the consumption being almost exclusively when fresh, and but to a limited extent when salted in barrels.

I have not learned whether the experiment has ever been made of salting and drying this fish, as is done with the cod family.

There appears to be no fish on the European coast presenting the same relationship to the other fishes as the blue-fish, which, as already remarked, exercises a terrorizing influence over other species, either destroying them bodily, or driving them away from their accustomed abode.

Captain Atwood refers to the influence they exert upon the shore-mackerel fisheries of New England. A similar effect is produced in Massachusetts Bay during the summer upon the fish of the cod family, the tautog, and other fish, it being understood that when the blue-fish appear all other fishing ceases for the time. Although such a result of the return of the blue-fish is not so marked on the south coast of New England, its exterminating qualities are evident, and need to be taken very seriously into account in considering the question as to the causes of the diminution of the food-fishes.

As already remarked, I feel quite assured that this combination of blue-fish, with the use of traps and pounds, has reduced the scup and tautog, sea-bass, &c., to their present scanty number on the south coast of New England. The two causes must be considered as working together, and deserving the accusations that have been brought against them. And possibly the effect is about equal, as, although the blue-fish

destroy the vastly greater number, yet these are the fish swimming in the open sea and taken after the operation of spawning has been accomplished, while the pounds secure particularly the spawning fish, and that, too, during the few weeks when they school near the shore for the purpose of depositing their eggs. Whether the British committee, which prosecuted the inquiry as to the influence of nets and traps upon the fishing, would have decided as they did, to the effect that they could observe no evil result therefrom, had the blue-fish been an inhabitant of their coast, is a very serious question.