
BIOLOGICAL NOTES.

No. 2. Issued August, 1901.

NOTES ON THE MIGRATION, SPAWNING, ABUNDANCE, ETC., OF CERTAIN
FISHES IN 1900.

By GEORGE H. SHERWOOD and VINAL N. EDWARDS.

Observations on the habits, abundance, spawning, migrations, and on the influence of physical changes on these phenomena, are here presented for a number of fishes of the Woods Hole region during the season of 1900:

Tarpon atlanticus, *Tarpon*.

Mr. H. M. Knowles, of Wakefield, R. I., is authority for the statement that a tarpon 5 feet long, and so slender that it weighed only 30 pounds, was caught in a fish trap near Dutch Island Harbor, Narragansett Bay. Another weighing 80 pounds was taken at Marthas Vineyard, and a smaller one in the Fish Commission trap at Woods Hole. The northern limit of range of this species is southern New England, but it probably does not breed north of Cuba.

Brevoortia tyrannus, *Menhaden*.

Although the menhaden season of 1900 was regarded as the most successful in three years, the fish were exceedingly scarce in this vicinity, particularly during the last of August, at which time it was impossible to procure any, either in Boston or Newport; and on this account a contemplated trip to the tile-fish grounds had to be postponed. In Buzzards Bay, however, where all net fishing is prohibited by law, large schools were present all summer.

Hippocampus hudsonius, *Sea-horse*.

In August a fine specimen of *Hippocampus* was dredged by the U. S. Fish Commission steamer *Fish Hawk*, outside of Devils Bridge, Gay Head. It was taken to the laboratory and lived for several days in the aquarium. This is the only one caught for several years.

Scomber scombrus, *Mackerel*.

Notwithstanding the catch of mackerel along the Atlantic coast was phenomenal, very few were taken in inshore waters. Even the traps far from the shore off Seaconnet and Newport took scarcely any. The failure of the mackerel to enter Buzzards Bay and Vineyard Sound is to be attributed in all probability to the remarkable scarcity of small fish of all kinds. Indeed, seining has never resulted in the capture of fewer small and young fish than in 1900.

The first mackerel reached Chatham April 29, and on the following day were taken at Cuttyhunk and Menemsha. The temperature of the water at Woods Hole at this time was 46° F., although 50° F. is apparently more favorable for them. The presence of so many spawning fish near the coast in 1900 led one to expect that young mackerel would be numerous, but this was not the case. On July 9 a few young mackerel 2.5 to 3 inches in length were seen in a trap at Woods Hole, but in a few days they disappeared and no more were recorded in the vicinity until late in the fall, and even then only in small numbers.

As throwing some light on the question of the equatorial migration of the mackerel, it is of interest that in 1898 they appeared at Seaconnet, R. I., Chatham, Mass., and Yarmouth, Nova Scotia, on the same day, May 3.

***Sarda sarda*, Bonito.**

Seventy-five bonito from a trap at Cedar Tree Neck on June 18, 1900, were reported to be the first arrivals of the season, and throughout the summer on almost every clear day the schools were breaking at the surface from Gay Head to Woods Hole. On account of the peculiar flavor of its flesh the bonito has not found a ready market, but it is growing in favor. In 1900 there was a considerable demand for it, and it brought even better prices than the squeteague. The indications are that the bonito may largely supplant the latter as an article of food.

***Scomberomorus maculatus*, Spanish Mackerel.**

This delicious food-fish, once quite abundant in Buzzards Bay, is now very scarce. One was taken in the Fish Commission trap in 1898, and three were caught at different times during the summer of 1900 in the trap in Vineyard Sound. These were all small fish, weighing 1.5 to 2 pounds.

***Trichiurus lepturus*, Cutlas-fish.**

A specimen 3 feet 8 inches in length was caught in a trap off Newport. Several smaller specimens, which were also caught in Narragansett Bay, were sent to the Rhode Island Fish Commission. In October one was taken in a trap at Menemsha.

***Pomatomus saltatrix*, Blue-fish.**

In a note on the abundance of the squeteague reference is made to the gradual decrease in the numbers of blue-fish which enter the waters of Buzzards Bay and Vineyard Sound. Simultaneously with this change there has occurred another, equally difficult to explain, in the time of their arrival. Some twenty years ago the fish were sure to be taken in the traps the first or second week in May, while recently they may be as late as the middle of June. The presence of large schools of blue-fish off Nantucket and No Mans Land all summer makes it evident that they have not completely deserted our coast; but just why so few come inshore and why they are so much later in their arrival is not apparent. In spite of the scarcity of mature fish the young have been very abundant everywhere, and particularly at Katama Bay, where undoubtedly they have destroyed many of the rare bright-colored southern forms referred to in Biological Notes No. 1. The rate of growth of the young, as found in Katama Bay in 1900, is as follows: July 27th, 3 inches; August 8th, 3 to 5 inches; August 29th, 5 to 7 inches; September 24th, 7 to 9 inches; October 3d, 8 to 11 inches.

***Centropristes striatus*, Sea Bass.**

It is to be regretted that this gamy fish is decreasing so rapidly in numbers. In a short time it will probably become a rare species in this locality. Hand-lining, even on the spawning-grounds off Hyannis, was remarkably poor this season, and the abundance of the young does not give promise for the coming year. As a rule the first adults appear in their seasonal migration during the first or second week in May, when the water has reached a temperature of 48° to 50° F. However, in spite of the cold of 1900, they appeared at Cuttyhunk and Menemsha Bight on April 28—with one exception the earliest arrival recorded in twenty-five years. Formerly the young were abundant everywhere, but at present they are restricted to a few localities—Katama Bay, Quisset Harbor, and Wareham River. The first fry were seined July 31 and measured three-fourths of an inch in length. On the 20th of October young fish 2 to 3 inches long were very plentiful in Katama Bay.

***Lobotes surinamensis*, Flasher, Triple-tail.**

The Rhode Island Fish Commission has in its possession a specimen of *Lobotes* weighing 6 pounds and measuring 22 inches in length, caught on September 10 in a trap off Prudence Island, Narragansett Bay. This inhabitant of all tropical seas is a very rare visitor in the waters of southern New England. Not more than six specimens have been recorded from this vicinity in the last twenty years.

***Stenotomus chrysops*, Scup.**

The catch of scup this year has been good, but not extraordinary. The first arrivals were taken off Newport April 21, at Cuttyhunk April 26, and five days later at Woods Hole. This was an average arrival, although the water was 2° to 3° F. below the average. The adult fish usually leave in October, while the young may remain a month or more longer. Hundreds of the latter are killed every year by the sudden changes of temperature.

The growth of fry as observed at Woods Hole is as follows: July 3d, 0.5 to 1.5 inches; August 2d, 1.5 to 2 inches; September 6th, 2 to 3 inches; September 29th, 3 to 4 inches; November 1st, 4 inches.

Roccus lineatus, Striped Bass.

Three specimens of striped bass were caught in the Fish Commission trap on July 21, 1900. The largest weighed 20 pounds. Several others were taken by the summer sportsmen with hook and line, and at Cuttyhunk they were reported as large and more plentiful than usual.

Cynoscion regalis, Squeteague.

The first squeteague of the season were taken at Cuttyhunk on May 5, 1900, and nine days later they reached Woods Hole. The water temperature at this time was 50° F. Compared with previous years, the arrival was a little later than usual; but since the temperature of the water during the spring was below the average, this was to be expected. As a rule, the first run of squeteague, like that of other migratory species, is composed of large adult fish, while the yearlings appear about two weeks later. During the spring of 1900, however, the reverse was true, small fish, weighing from 2 to 3 pounds, coming first. Toward the last of May, during the run of large fish, one was caught at Cuttyhunk which weighed 14 pounds. The abundance of the squeteague was remarkable. In the Menemsha traps alone 10,000 were taken in a single day (July 31); and, in fact, they were so plenty throughout the season that they ruined their own market and did not bring enough to pay the shipping bills. Many of the Vineyard fishermen retained the fish in the pockets, waiting for better prices, but a heavy northeast storm tore up the nets in the fall, and most of the summer's catch was lost.

Observations on the first appearance of the fry, their growth, and their abundance have been continued. The results are given in the following table, although much more complete data have been collected by Professor Eigenmann. The rate of growth corresponded with that of the blue-fish:

Date.	Locality.	Length.	
		<i>Inches.</i>	
July 25.	Wareham River.....	1.25 to 2.25	Very scarce.
Aug. 2	do.....	2 3	Do.
Aug. 5	Red Bridge, Providence River	1.25 2.25	Abundant.
Aug. 22	Wareham River (farther up)	3.75 5	Very scarce.
Oct. 5	Acushnet River.....	6 7.25	Do.

When, a few years ago, a bill to prohibit all net fishing in Buzzards Bay was presented to the Massachusetts legislature, one of the strongest arguments of its supporters was that the bay was the natural spawning-ground of the food-fishes, and therefore their decrease was attributed to excessive trap fishing. A careful study of the records of the movements of the squeteague for the last thirty years has revealed some striking facts which have an important bearing on this question. Notwithstanding protective legislation, it is very evident that breeding squeteague have ceased to enter Buzzards Bay in any considerable numbers; for while twenty years ago the young could be seined almost anywhere in the vicinity of Woods Hole (at Great Harbor, Hadley Harbor, Nobska Beach, and Quisset), there are now only two localities in Buzzards Bay and Vineyard Sound where they are found—at Wareham, near the head of the bay, and in Acushnet River, on the New Bedford side. Even in these places their numbers are greatly reduced.

The former abundance of the young was due in all probability to the fact that the adults spawned in the open bay or outside waters, and since the buoyant eggs were subject to the influence of winds and currents, they were carried hither and thither until finally lodged in the protected harbors and inlets. Such conditions would tend to distribute the eggs more or less uniformly along the shores of the bay, and the fry would not be restricted to the present areas. On the other hand, with the remarkable increase of the adults, if they still continued to spawn in the same places, there would have been a correspondingly large increase of the young.

It may be argued that the spawn is deposited in the same places as formerly, but that the eggs merely drift into the estuaries—Wareham River and Acushnet River. But this does not seem at all probable, since the outward current in these rivers is stronger and longer continued than the inward. A more plausible explanation is that the few adults entering these rivers find conditions favorable, and therefore spawn, while the great majority of the fish seek other localities. The Rhode Island fishermen who control the sea traps off Seaconnet and Newport say that whereas years ago they used to catch plenty of squeteague at the mouth of the bay, very few are ever seen there now. They believe that the fish no longer run in *offshore waters*, but enter the bays and inlets. Substantiating

this is the extraordinary abundance of the fry during the past few years in Narragansett Bay, particularly in its upper part, near Red Bridge and India Point. Even here great numbers of them were killed in 1900 by *Peridinium*. For two weeks or more in September this small protozoan infested the waters of the upper bay in such numbers that the water was almost a blood-red color, and as a result young squeteague, together with fish of several other species, were piled in windrows on the shore. There is but one conclusion to be drawn from the foregoing facts—the squeteague has changed its spawning-grounds within a few years, and, judging from the abundance of the young, Narragansett Bay is the more favorable locality at the present time.

The study of the yearly records has also shown that a definite relation exists between the abundance of squeteague and blue-fish. Twenty years ago 100 squeteague were considered a remarkable catch, but now it is not uncommon to take 4,000 at a single draft of a trap. On the other hand, twenty years ago blue-fish were so plentiful that barrels of them were shipped daily, while in 1900 not over 50 were recorded from the bay or sound. There can be but little doubt that the marvelous increase of the squeteague has been made possible by the disappearance of one of its most dangerous enemies—the savage blue-fish.

Tautogolabrus adspersus, Cunner.

Barrels of cunners were killed by the extreme cold of February, 1901, and were seen floating on the surface with the tautog.

Tautoga onitis, Tautog.

Fewer tautog were caught in the vicinity of Woods Hole than last year. In fact, many hook-and-line fishermen were compelled to seek other employment, but just the reverse obtained in Narragansett Bay. According to the report of the Rhode Island Fish Commission for 1900, the tautog in Narragansett Bay were very abundant and of large size, some weighing 13 pounds. Capt. Isaac L. Church, of Tiverton, R. I., who has followed tautog fishing for many years; says that they are as abundant now as they ever were. Young tautog were numerous along all shores during the summer, but more particularly at Katama Bay, where they actually occurred in shoals. For several days in February, 1901, tautog were found floating on the surface, evidently killed by the anchor ice, which formed nearly all the month. The outlook for next season's fishing is less promising than ever.

Lagocephalus lævigatus, Smooth Puffer.

During 1900 several specimens of this occasional visitor were taken in the vicinity of Woods Hole. In the fall two adults were caught in a trap at Cedar Tree Neck. The Rhode Island Fish Commission reports three specimens from Narragansett Bay; the largest, taken October 4 at Tiverton, R. I., weighed 10 pounds; the other two were caught the week before at the mouth of the bay. The smooth puffers are common in the South, but very rare north of Cape Hatteras. Their average length is 2 feet. The young from 2.5 to 4 inches long were found by the U. S. Fish Commission in the waters of Porto Rico.

Pollachius virens, Pollock.

During the spring of 1900 the young appeared as usual with the small cod. Years ago the adults were plenty in the sound, but now only a few stragglers are seen.

Microgadus tomcod, Tomcod.

The tomcod during the winter of 1900–1901 were entirely free from parasites (*Lernæonema radiata*). Some seasons nearly all the fish are infected.

Gadus callarias, Cod.

The number of cod taken in Vineyard Sound during the fall of 1900 was unprecedented. Off Bowbell Ledge the fishermen gave up fishing for tautog and made cod fishing their business. The cod were all plump and in good condition, weighing from 4 to 20 pounds. In Great Harbor, where the cod seldom enter, they were so plenty that 10 specimens were taken in the fyke nets in October, 15 were taken in November, and 45 in December. With one exception these were good marketable fish, weighing from 4 to 16 pounds, and were quite different from the thin, flabby specimens occasionally taken here. Five were spawners.

That the cod have not decreased off Nantucket is evidenced by the remarkable catch made by the *Grampus* in this locality during November and December, 1900. More than 3,000 brood cod were brought back to the station for the hatching season. The cod were equally abundant around No Man's

Land, but the fisheries were a failure because of the scarcity of bait. Herring were **not running** and quahogs could not be obtained in sufficient numbers.

On January 30, 1901, 500 to 600 cod, of which 48 had been **stripped** and the remainder were barren fish, were left in the cars to be **tagged**. On the following day there was a fall of snow and the temperature of the water began to fall from 31° F. and for the greater part of February remained at 28° F. Ice was formed in the harbor and all the cod **died**. This would go to show that the cod adapt themselves to abrupt changes in temperature by migrating to deeper water.

Rhinonemus cimbrius, *Four-bearded Rockling*.

Young rockling were taken in the surface tows at the Fish Commission wharf from June 27 to July 6, 1900. They formed in schools in the eddies around the wall and were mixed with young sticklebacks (*Gasterosteus bispinosus*). Their length was 0.5 to 1.375 inches. The rockling is found in all North Atlantic waters, and although it is said to be abundant in Massachusetts Bay, only two specimens have been reported from Woods Hole. One measuring 10 inches in length was speared in the Eel Pond January 5, 1889; the second was caught in Little Harbor also in the winter, but there is no record of the exact date. The young have never before been taken here.

Hippoglossus hippoglossus, *Halibut*.

On April 16, 1900, there was brought into Newport a halibut weighing 100 pounds, which with others was caught off Block Island by cod-fishermen. Halibut were formerly abundant in this locality and in Vineyard Sound, but none have been taken for several years. This catch leads one to hope that this valuable food-fish may return to its old grounds.

Pseudopleuronectes americanus, *Flat-fish*.

An illustration of the effect of a sudden fall of temperature on the behavior of fish was given in February and March, 1900. The flat-fish had been plentiful both at Great Harbor and Waquoit Bay throughout February up to the 23d, when they entirely disappeared, and none were taken again until March 6. The records show that after the 23d the temperature of the water dropped from 35° F. to 29° F., and that on March 6 it rose again to 32° F.

The normal breeding season of flat-fish is from February to May, and it is very unusual to find them with mature sexual products before January; but in 1900 seven specimens of the hatch of 1898, caught in Eel Pond on November 20, had ripe milt. Again, on November 27, three out of four flat-fish caught in a fyke net set in Great Harbor were ripe milts, and on the following day, at the same place, two females were taken, swollen with eggs, and in such condition that had they been taken in February they probably would have spawned within two days. Never before have flat-fish with ripe sperm been taken so early, and it is possible that the unusually warm water of October and November, 1900, may have caused this premature development of eggs and milt. The last flat-fish with ripe eggs for the season of 1899-1900 was taken April 25. Although it is generally believed that flat-fish extrude their eggs only at night, on March 14, 1901, a large fish, which had been in the fish-boxes at the hatchery a day or two, spawned in the middle of the afternoon.

In regard to the "black-bellied" fish, the report of the Rhode Island Fish Commission for 1900 states: "It is an extremely interesting fact that the dark-bellied variety, which gradually came into notice several years ago and attained the maximum of its abundance in 1898, is on the decline. Last season, according to a trustworthy estimate, only about 4 per cent were colored on the under surface, while three years ago at least 33 per cent were so colored." Among 300 flat-fish from Waquoit Bay this season (1900-1901) there was not a single specimen of the black-bellied variety, although last year Dr. Bumpus reported several. This variation seems to have completely disappeared.

A young flat-fish, 1.5 inches long, was seined at Katama Bay August 15, 1900; the posterior two-thirds of its upper surface was devoid of pigment, and a distinct line separated the two areas. The scales were different in structure from the normal, and the presence of a deep notch on the dorsal side of the tail suggested that the lack of pigment may have been produced through injury or disease, although the surface was apparently free from any lesion. This is the first time that this variation has been observed, although Mr. Edwards has seined in the vicinity of Woods Hole for thirty years.

Lophius piscatorius, *Goose-fish*.

During the fall of 1900, goose-fish were very abundant in Great Harbor, and late in the fall several large ones were washed ashore. This is of considerable interest, because the fish is not often seen near Woods Hole, although numerous at Menemsha and Cuttyhunk, where the shores are frequently lined with their bleached skeletons.

ADDITIONS TO THE FISH FAUNA IN 1900.

By HUGH M. SMITH.

The already surprisingly large fish fauna of the Woods Hole region was augmented by four southern species during the fall of 1900. These bring the total number of species known from the vicinity to 243. Following are the species new to the region:

Exocoetus rondeletii (Cuvier & Valenciennes). *Flying-fish*.

This common species of the West Indies and the Mediterranean has been recorded from United States waters only in Florida. A specimen 7.25 inches long was caught in a trap at Menemsha Bight, October 13.

Ocyurus chrysurus (Bloch). *Yellow-tail*.

The normal range of this species is southern Florida to South America. It is an abundant food-fish at Key West. On October 4, an example 5.5 inches long was seined in Katama Bay.

Scarus croicensis (Bloch). *Parrot-fish*.

This is a common West Indian species, the northern limit of whose known range heretofore has been Key West. Two specimens 3 inches long were taken in Katama Bay, October 20, the water temperature being 57° F.

Sparisoma flavescens (Bloch & Schneider). *Mud Parrot-fish*.

This, the commonest species of the genus, is abundant at Key West and throughout the West Indies. It was not known north of Florida until a specimen 6 inches long was found at Woods Hole on November 13; it had been benumbed by the cold and was picked up on the shore of Buzzards Bay.

NOTES ON THE SUBTROPICAL FISHES OBSERVED IN 1900.

By HUGH M. SMITH.

The season as a whole was unfavorable, and compared with 1899 there was a scarcity of tropical species. No gulf weed was seen in any of the inshore waters, and there was little wind from the direction of the Gulf Stream. Nevertheless, some rare fishes were found, and a number of species which until 1899 had been considered very uncommon were taken in abundance. Most of the collecting was done in Katama Bay, which the previous season's experience had shown to be the most favorable locality in the vicinity of Woods Hole, and only in this body of water were any of the typical southern fishes found. Large blue-fish and flounders were abundant at the inlet of the bay through the summer, and may have picked up many of the small gaily-colored stragglers from the south.

Clupanodon pseudohispanicus (Poey). *Spanish Sardine*.

There was a sudden fall of temperature on November 16, and a number of these fish, 5 to 6 inches long, were picked up on the shore in a benumbed condition; these were the first specimens observed in four or five years.

Holocentrus sp. *Squirrel-fish*.

One very small specimen, apparently representing the same species as the one taken in 1899, was obtained August 28.

Epinephelus niveatus (Cuvier & Valenciennes). *Snowy Grouper*.

Thirty-five small specimens were seined in Katama Bay on nine occasions between August 15 and October 26. The largest number taken during one day was 12, on September 8.

Epinephelus morio (Cuvier & Valenciennes). *Red Grouper*.

A small specimen, similar in size and appearance to those obtained in the same locality in 1899, was taken September 26.

Mycteroperca bonaci (Poey). *Marbled Rock-fish.*

One specimen, 3 inches long, was taken August 15.

Mycteroperca venenosa (Linnaeus). *Yellow-finned Grouper.*

Eight small specimens were secured on four different days (August 8 and 28, September 8, and October 20).

Pseudopriacanthus altus Gill. *Short Big-eye.*

Comparatively rare, only 9 being observed between August 15 and September 8, whereas in the previous year over 100 were taken.

Neomænis griseus (Linnaeus). *Gray Snapper.*

Five specimens, the largest 1.875 inches long, were seined in Katama Bay on August 29. The general color is pale, with 6 or 8 narrow, dark, longitudinal stripes; spinous dorsal fin dark, with a sharply defined blackish bar involving the distal part of the fin, the extreme edge being white. Only two specimens, taken in September, 1897, were previously obtained in this region. The species appears to range normally as far north as Chesapeake Bay.

Neomænis apodus (Walbaum). *Schoolmaster.*

There has been only one previous record of the occurrence of this snapper north of Florida—namely, September 20, 1888, when an example 5.5 inches long was taken at Woods Hole. On August 29 and September 11, 1900, two specimens, 1 inch and 1.5 inches long, respectively, were caught in Katama Bay. The general color of the body is pale yellow, with 6 to 8 dark crossbands; a dark line extends from snout through eye to upper end of gill opening; several narrow dark lines run on head posterior to eye; anal fin red.

Neomænis blackfordi (Goode & Bean). *Red Snapper.*

Nine specimens, the largest under 2 inches long, were seined September 7, September 11, and October 20. Their colors in life were as follows: General color, red like the adult fish; body marked by about 7 double dark crossbands; in the crossband nearest the junction of the two parts of the dorsal fin is a large jet-black blotch extending from the fin to below the lateral line; spinous dorsal dusky; soft dorsal with a dusky median zone and a dark edge; caudal pale, with a dark narrow border. The only other red snapper recorded for this region is a specimen weighing 8.5 pounds, taken in October, 1890.

Neomænis analis (Cuvier & Valenciennes). *Mutton-fish.*

Twenty specimens of this snapper were taken, between August 28 and October 12, the largest being 2 inches long. These resemble the young red snapper in being banded and having a black lateral spot; the bands, however, are rather broader and more sharply defined, and the spot is smaller, less distinct, and does not extend to the median line of the back. This species was regarded as very rare until 1899, when more than 20 small examples were observed.

Chaetodon ocellatus Bloch. *Butterfly-fish.*

This species, formerly a rare straggler, must now be regarded as common, in the light of the experience of the past few years. In 1900 123 specimens were taken, the fish being found in Katama Bay on 13 different occasions between August 15 and October 26; 26 were seined on September 8, and 21 on October 3.

Chaetodon bricei Smith. *Butterfly-fish.*

About 35 were observed on ten different days, in company with the preceding species.

Teuthis cœruleus (Bloch & Schneider). *Blue Tang.***Teuthis hepatus** Linnæus. *Tang.***Teuthis bahianus** (Castlenau). *Tang.*

A few specimens of each of these species were taken in August, September, and October. They were last observed on October 3, when one of each was secured.

Lactophrys tricornis (Linnaeus). *Cow-fish.*

Two specimens only 0.25 of an inch long were taken October 4.

Scorpaena plumieri Bloch. *Scorpion-fish.*

Two small specimens were obtained October 20 and 26.