

FIGURE 186.—Cutlassfish (*Trichiurus lepturus*), Florida. From Goode. Drawing by H. L. Todd.

South Atlantic coast of the United States, occasionally straying north as far as Massachusetts Bay.

Occurrence in the Gulf of Maine.—The cutlassfish is only an accidental straggler north of Cape

Cod. One was taken at Wellfleet in the summer of 1845, and one in Salem Harbor also many years ago, and it is recorded from Lynn by Kendall.⁴⁸ There is no report of it farther north in the Gulf of Maine, or for Canadian waters.

THE SWORDFISHES. FAMILY XIPHIIDAE

The upper jaw and snout of the swordfish (there is only one species) is greatly prolonged, forming a flat, sharp-edged sword. It has a very high first-dorsal fin and a very small second dorsal, both of them soft rayed; a broad lunate tail; two separate anal fins, the second very small; and a strong longitudinal keel on either side of the caudal peduncle. It has no ventral fins, and the adults have neither teeth nor scales. The spearfish family (p. 357) is the only other group represented in the Gulf of Maine fauna which at all resembles the swordfish, but spearfish have ventral fins and minute teeth; their swords are round edged, and either there is one long continuous dorsal fin or, if there are two, the first is several times as long, relatively, as it is in the swordfish.

Swordfish *Xiphias gladius* Linnaeus 1758

BROADBILL

Jordan and Evermann, 1896-1900, p. 894.

Description.—The salient feature of the swordfish is the prolongation of its upper jaw into a long, flattened, sharp-edged⁴⁹ and pointed "sword" occupying nearly one-third the total length of the fish. This sword is of itself enough to identify

⁴⁸ The Massachusetts Bay and Provincetown records listed by Kendall (Oce. Pap. Boston Soc. Nat. Hist., vol. 7, No. 8, 1908, p. 76) are based on the Wellfleet specimen. He also credits it to Monhegan I., Maine, quoting Storer as his authority, but Storer stated in his latest mention of the species that only two had come to his notice; the Wellfleet specimen just mentioned, and one taken at the head of Buzzards Bay.

⁴⁹ In its tropical relatives, the sailfish and spearfish, the sword is round edged, spearlike, and relatively shorter.

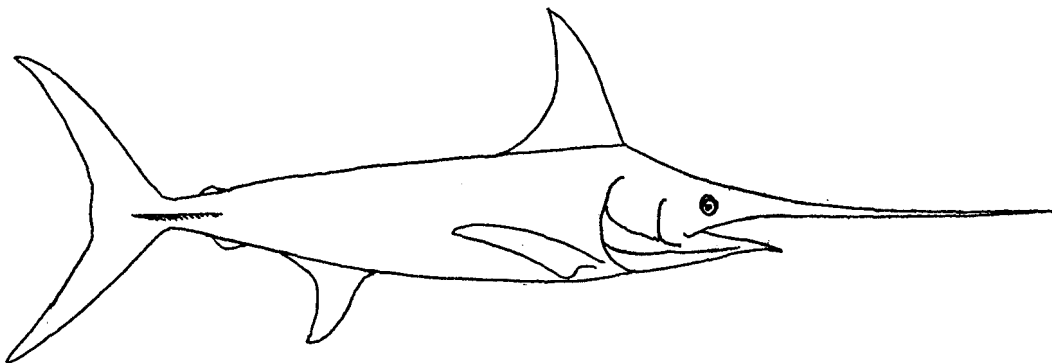


FIGURE 187.—Swordfish (*Xiphias gladius*). After California Fish and Game Commission.

the fish at a glance among all our northern fishes. On a fish 10 feet 10 inches long, which we harpooned on Georges Bank on the *Grampus* in July 1916, the sword was 42 inches long from its tip to the eyes.

The swordfish is moderately stout of body, only slightly flattened sidewise, deepest just behind the gill openings, and tapering rearward to a slender caudal peduncle, which bears a single strong longitudinal keel on either side. Apart from the sword the head is short; the lower jaw is pointed, and the mouth so wide that it gapes far back of the very large eyes, which are set close to the base of the sword. Swordfish (except young fry) are both toothless and scaleless. The first dorsal fin originates over the upper angle of the gill openings and is much higher than long (about 39 to 40 rays), with deeply concave rear margin. The second dorsal is very small and set far back on the caudal peduncle. There are two anals likewise. The second is as small as the second dorsal and located below the latter, while the first is similar to the first dorsal in outline but shorter, and located well behind it, close to the second anal. The pectorals are narrow, very long, scythe-shaped, and set very low down on the sides below the first dorsal. The caudal fin is short, but as broad as half the length of the fish from top of lower jaw to base of caudal fin, with deeply lunate margin and pointed tips. There are no ventral fins.⁵⁰

Color.—While all swordfish are dark above and whitish with silvery sheen below, the upper surface varies from purplish to a dull leaden blue or even to black. The eye has been described as blue. Very young swordfish, like very young tuna, are transversely barred, but none small enough to show this pattern has ever been found within the limits of the Gulf. The colors fade soon after death.

Size.—Swordfish grow to a great size. The heaviest definitely recorded from the Gulf of Maine was one caught on Georges Bank in the summer of 1921 by Capt. Irving King and landed at the Boston Fish Pier, that weighed 915 pounds dressed, hence, upwards of 1,100 pounds alive.⁵¹ This specimen was not measured, but the sword

was more than 5 feet long, so that the total length of the fish must have approximated 15 feet, and 16 feet seems to be about the maximum length, though fish as long as this are very unusual. The heaviest landed in Massachusetts during 1922 weighed 637 pounds dressed; that is, upward of 750 pounds live weight,⁵² while the largest taken in 1931 weighed 644 pounds dressed and was 13 feet long including its sword, which measured 44 inches. One that weighed 925 pounds before it was dressed was landed in 1932; also one weighing 650 pounds dressed, which must have weighed 800 pounds alive; while one of 850 pounds (dressed?), brought in to Halifax, Nova Scotia, was said to have been the largest ever landed in that port. And several, weighing more than 500 pounds, dressed, are reported almost every year.⁵³

But the general run are much smaller. Thus the average dressed weights of sundry fares of fish landed in Portland, Boston, and Gloucester in the years 1883–1884, and 1893–1895 were between 200 pounds and 310 pounds, falling to 114–186 pounds for the years 1917, 1919, 1926, and 1929–1930. And general report has it that Block Island fish run smaller than Georges Bank and Cape Breton fish. A 7-foot fish weighs about 120 pounds; 10- to 11-foot fish about 250 pounds; fish of 13 to 13½ feet, about 600 to 700 pounds, as taken from the water.

The rod and reel record is 860 pounds, for one 13 feet 9 inches long caught off Tocapila, Chile, April 28, 1940, by W. E. S. Toker.

Swordfish fry are quite different in appearance from their parents, having only one long dorsal fin and one long anal fin, a rounded tail, both jaws equally prolonged and toothed, and the skin covered with rough spiny plates and scales. But fish of half a pound weight such as are caught in abundance in the Mediterranean already resemble the adults, except that they have minute scales until 30 inches long.

*Habits.*⁵⁴—The swordfish is oceanic, not dependent in any way either on the coast (except as this offers a supply of food), or on the bottom; and it is a warm-water fish, most plentiful in localities and at depths where the temperature is higher than about 60°. But occasional captures

⁵⁰ In the sailfishes and spearfishes the body is scaly, the jaws are toothed, ventral fins are present, and the first dorsal fin is much longer than that of the swordfish.

⁵¹ Fishing Gazette for September 1921, p. 13.

⁵² Gloucester Times, April 26, 1923.

⁵³ See Rich (Proc. Portland Soc. Nat. Hist., vol. 4, Pt. 2, 1947, pp. 34–37) for these and other large fish landed from year to year.

⁵⁴ Rich (Proc. Portland Soc. Nat. Hist., vol. 4, pt. 2, 1947) has recently given an extended account of the occurrence and habits of our swordfish.

of swordfish on halibut lines set near bottom as deep as 200 fathoms, together with the fact that swordfish are by no means rare on the Newfoundland Banks, whence several fish were brought back by the American cod fleet in 1920, proves that temperatures as low as 50° to 55° do not bar it, at least for a brief stay.

Although swordfish may gather in certain localities they do not school, but are always seen scattered, either singly or at most two fish swimming together. Earlier published accounts, statements by fishermen, and our own rather limited experience all agree on this point. On calm days they often lie quiet on the surface, or loaf along with both the high first dorsal fin and the tip of the caudal fin above water, and they are easily harpooned while so employed, often allowing a vessel to approach until the pulpit projecting from her bow comes directly above the fish. When a swordfish is swimming at the surface, its first dorsal fin and the upper part of its tail fin both show above the water whereas a marlin shows its caudal only. One can tell a surfacing swordfish from a shark by its sharp-pointed dorsal (that of a shark is more broadly triangular) and by the fact that its tail fin seems to cut the water in a direct line, not wobbling from side to side as the tips of the tails of most sharks do (other than the mackerel shark tribe), if they show above the water at all.

When swordfish are at the surface, they jump a good deal, perhaps in vain attempts to shake off the remoras that so often cling to them. We saw one leap clear of the water four or five times in rapid succession close to the *Grampus*, off Shelburne, Nova Scotia, on July 28, 1914. Reports by fishermen, and our own experience, are to the effect that they surface only during the hours of daylight.

The swordfish is a fish-eater. During its stay in American waters it feeds on mackerel, menhaden, bluefish, silver hake, butterfish, herring, argentines, rattails (*Macrourus bairdii*), and indeed on any smaller fish, buckets of which have been taken from swordfish stomachs. Squid, too, are often found in them and may be their chief diet at times. And the jaws of one of the giant squids (genus perhaps *Architeuthis*), taken from the stomach of a swordfish harpooned on the northern edge of Georges Bank,⁵⁵ was an especially interesting find. One that we examined on Georges Bank,

July 24, 1916, was full of silver hake, one taken there in August 1929 contained 5 large haddock (p. 199), while another harpooned off Halifax contained a squid (*Ilex*) and fragments of silver hake. They have often been described as rising through schools of mackerel, menhaden, and other fishes, striking right and left with their swords, then turning to gobble the dead or mangled fish. And we have seen them so employed on more than one occasion, to judge from the commotion.

It is not unusual for swordfish taken on the offshore banks to contain deep-sea fishes of one kind or another in their stomachs; many such instances have been recorded,⁵⁶ sometimes swallowed so recently that they are still in good condition when the swordfish is opened.⁵⁷ And since these so-called "black fishes" live outside the edge of the continent, mostly below 150 fathoms, this is good evidence that the swordfish found on the banks that front our Gulf do some of their foraging at considerable depths farther out at sea. It also seems that they sometimes strip lines set for halibut and tilefish of the fish already caught, for they are sometimes brought up tangled in the line.

It was not out of the ordinary for swordfish to be hooked on long lines set for halibut in the days when this fishery flourished (p. 255). Goode⁵⁸ cites a number of cases, including one when 13 swordfish were caught in this way on one halibut trip. And fishermen have told us of more recent instances. Swordfish have often been hooked and landed on hand lines, also. A case is on record of 7 taken in this way on one trip, in the South Channel, in 15 to 25 fathoms of water, the bait being whole mackerel; evidence that swordfish seemingly do not insist on live food. We also read that of old, fishermen from Marthas Vineyard and Nantucket sometimes took them while trolling with some sort of silvery fish as bait, forecasting the big game anglers of today.

Many tales are current of swordfish attacking slow moving vessels without any provocation, and driving their swords through the planking, either

⁵⁵ The late Walter H. Rich of the U. S. Bureau of Fisheries reports the following genera as taken from swordfish on Georges and Browns Banks: *Alepisaurus*, *Chauliodus*, *Chiasmodon*, *Lampadena*, *Macrostoma*, *Myctophum*, *Notoscopelus*, and *Stomias*.

⁵⁷ Kingsley (Science, N. Ser., vol. 50, 1922, pp. 225-226) reports two freshly swallowed stomiatids (*Echistostoma barbatum*) being taken from the stomach of a swordfish harpooned on the offshore slope of Georges Bank.

⁵⁸ Rept. U. S. Comm. Fish., (1880) 1883, pp. 353-354.

in "fits of temporary insanity," as Goode⁵⁹ expressed it, or more likely, while pursuing dolphins or other fish. Most of the attacks of this sort reported from tropical seas seem actually to have been by spearfishes (p. 357) but some in northern waters seem almost certainly to have been by the broadbill. A case in point is that of the schooner *Volunteer*, out of Gloucester, which received a strong blow near Block Island, August 7, 1887, apparently from a 300-pound swordfish that was seen swimming alongside, and which proved to have lost its entire sword when it was harpooned and brought on board.⁶⁰ We can only add that we have never heard of a swordfish making an unprovoked attack on any of the fishing vessels that pursue them every summer, or on any of the other craft, large or small, that cruise off our coasts. But fish that have been harpooned often turn on their pursuers, and it is a common event for one to pierce the thin bottom of a dory. We have, indeed, known several fishermen of our acquaintance to be wounded in the leg in this way, but always after the fish had been struck with the harpoon. Under these circumstances swordfish have been known to drive their swords right through the planking of a fishing vessel.⁶¹

Stories of swordfish attacking whales are time-honored traditions of the sea, mostly with no more foundation than the myth that they ally themselves with the harmless thresher shark for the purpose. As a matter of fact swordfish are easily frightened, and they will not often allow a small boat to come within striking range, which made harpooning from dories difficult in the old days.⁶² But for some occult reason they will allow themselves to be almost run down by a larger vessel without paying the least attention to its approach until aroused by its shadow, or by the swirl of water under its forefoot. But we have never heard of a swordfish actually being struck by a vessel; they always sound or turn aside in time.

Swordfish fight gamely on the surface or below when harpooned. Storer long ago wrote that they sometimes sound with such speed and force as to

drive the sword into the bottom, which fishermen say is by no means uncommon; and we saw this off Halifax in August 1914, when a fish more than 10 feet long, which we had harpooned from the *Grampus*, plunged with such force that it buried itself in the mud beyond its eyes in 56 fathoms of water. When finally hauled alongside it brought up enough mud plastered to its head to yield a good sample of the bottom.

Full-grown swordfish are so active, so powerful, and so well armed that they have few enemies. Sperm and killer whales and the larger sharks alone could menace them. And while we can find no evidence that swordfish ever fall prey to the first two, Captain Atwood found a good-sized swordfish in the stomach of a Mako shark. A swordfisherman described seeing two large sharks bite or tear off the tail of a 350-pound swordfish, which he afterwards harpooned. A 120-pound swordfish, nearly intact with sword still attached, was found in the stomach of a 730-pound Mako taken near Bimini, Bahamas, while another Mako of about 800 pounds, harpooned off Montauk, Long Island, was seen attacking a swordfish, and was found to have about 150 pounds of the flesh of the latter in its stomach when it was landed (p. 24). And Rich⁶³ mentions that other like cases have been reported. Young swordfish would, of course, be preyed upon by any of the larger predaceous fishes.

Swordfish are infested with many parasites besides the remoras, several of which are often found clinging to one fish. No less than 12 species of worms and 6 of copepods have been identified from fish taken off Woods Hole.

The eggs of the swordfish have not been seen, or have not been identified if seen; probably they are buoyant. Neither is anything definitely known of the rate of growth of the swordfish. It has been supposed that the young fish of half a pound to 12 pounds that are taken in winter in the Mediterranean are the product of the past spring's spawning, which would call for unusually rapid growth. But the very large size to which swordfish grow may equally be the result of long life, as it is in the case of the tuna (p. 342).

General range.—Both sides of the Atlantic Ocean; north to northern Norway, southern and

⁵⁹ Fish. Ind. U. S., Sect. 1, 1884, p. 345.

⁶⁰ Related by Rich (Proc. Portland Soc. Nat. Hist., vol. 4, Pt. 2, 1947, pp. 48-49).

⁶¹ Many cases of this sort are mentioned in the rather extensive literature dealing with the swordfish.

⁶² Rich (Proc. Portland Soc. Nat. Hist., vol. 4, Pt. 2, 1947, p. 71) so informs us.

⁶³ See Farrington (Field and Stream magazine, vol. 47, February 1943) and Rich (Proc. Portland Soc. Nat. Hist., vol. 4, Pt. 2, 1947, p. 44) for more detailed accounts.

western parts of the Gulf of St. Lawrence, south coast of Newfoundland and Grand Banks, south to latitude about 35° south. Also in the Mediterranean and Red Seas; about the Cape of Good Hope; and widespread in the Indian Ocean and in the Pacific Ocean, both north and south of the equator.

Occurrence in the Gulf of Maine.—The swordfish seems to have attracted little attention in the Gulf in colonial days, and though it has long supported a lucrative fishery off New England, we know little more of its life there today than in 1883 when Goode⁶⁴ published his *Materials for the History of the Swordfish*. The outer half of the continental shelf off Block Island and southern Massachusetts; the offshore parts of the Nantucket Shoals region; Georges Bank; the deep channel between Georges and Browns; Browns Bank and La Have; and the banks off the outer coast of Cape Breton are its chief centers of abundance off our coasts.

On these grounds 25 or more are often sighted in a day, sometimes that many are in view at one time; in fact, "one skipper reports counting 47 fish in sight at one time, after a week-long breeze had died out to a flat calm,"⁶⁵ and some 10 to 20 thousand of them are harpooned every summer off the New England coast, with as many more off eastern Nova Scotia.⁶⁶ An occasional swordfish is seen off Massachusetts Bay also, and along the Maine coast nearly every year. During some summers, of which 1884 was one, numbers of them appear there, and on such occasions some are taken in the Gulf from Cape Cod to Browns Bank, with Jeffreys Ledge and a zone about 10 to 12 miles off the coast from Boon Island to Cape Elizabeth perhaps their favorite inshore resort. But the great majority keep strictly to the offshore banks during most years, and they are seldom seen in the Bay of Fundy. Thus we find only 2,500 pounds (10 or 12 fish) brought in by the shore fishermen of Cumberland County, and 3 or 4 fish (800 lbs.) landed in York County in 1919, while none was reported as caught off the coast of Maine in 1945, though 193,000 pounds were landed on the Nova Scotian side of the Gulf (Yarmouth Co.) in that year and the offshore catch was considerable.

Swordfish seem to be less plentiful along the outer Nova Scotian coast from Cape Sable to the Gut of Canso than on Georges Bank or on Browns, though a few are brought in from the various fishing banks every summer (p. 357). But the amounts reported from the outer (Atlantic) coasts of Cape Breton are so large as to show that they are likely to be as numerous there as they are anywhere abreast of the Gulf of Maine, or off southern New England, and perhaps more concentrated. These regional variations may be illustrated by the landings for 1945, which were as follows for United States and Canadian vessels combined: offing of southern New England, westward from Nantucket Shoals, about 242,000 pounds;⁶⁷ near coast of eastern Massachusetts, probably one fish;⁶⁸ coast of Maine, 400 pounds; Bay of Fundy (including both shores), 0; Nantucket grounds and Georges Bank region (including South Channel grounds), about 800,000 pounds; off west coast of Nova Scotia and on western part of Browns Bank, about 671,000 pounds; Nova Scotian coast and banks from eastern part of Browns to offing of Cape Canso, at the entrance to the Gut of Canso, about 219,000 pounds; outer (Atlantic) coast of Cape Breton,⁶⁹ about 2,059,000 pounds.

A few are harpooned on the Gulf of St. Lawrence shore of Cape Breton also; 600 pounds were reported there in 1936, 200 pounds (one fish?) in 1943, and 1,000 pounds (4 or 5 fish) in 1946. The only other definite report of swordfish in the Gulf of St. Lawrence that has come to our notice is from Bonne Bay, on the west coast of Newfoundland, where Wulff⁷⁰ saw one, and had a strike from it (he did not hook the fish). But some few are seen and harpooned on the Grand Banks, and also along the south coast of Newfoundland, most often along the stretch between Port au Basque, on Cabot Strait, and Hermitage Bay. Here, writes Wulff, they sometimes come so close inshore that they "have been harpooned from the small wharfs, from shore, and from dories in the almost landlocked harbors," which we have never known to happen in the Gulf of Maine.

⁶⁴ Rept. U. S. Comm. Fish. (1880) 1883, pp. 298-304, pls. 1-24.

⁶⁵ Rich, Proc. Portland Soc. Nat. Hist., vol. 4, Pt. 2, 1947, p. 71.

⁶⁶ See Rich (Proc. Portland Soc. Nat. Hist., vol. 4, Pt. 2, 1947, pp. 55-62) for a more detailed survey of the distribution of swordfish on Georges, Browns, and the Nova Scotian Banks.

⁶⁷ Forty pounds reported, but this probably is an error, for it is not likely that a swordfish that small was taken there.

⁶⁸ Victoria, Cape Breton and Richmond Counties, Nova Scotia.

⁷⁰ Internat. Game Fish Assoc. Yearbook, 1943, p. 66.

Swordfish are summer fish on the North American coast like the tuna, and their presence (often reported) in the blue water⁷² between the outer edge of the continent and the inner edge of the Gulf Stream proper, off southern New England and the Gulf of Maine, added to the fact that few are seen along the coast south of New York, makes it likely that they come in from offshore, direct.

They appear about simultaneously off New York, off Block Island, on Nantucket Shoals, and on Georges Bank, sometime between the 25th of May and the 20th of June, but seldom on the Scotian Banks until somewhat later, or in the inner parts of the Gulf of Maine before July. They are most numerous in July and August, and they vanish at the approach of cold weather. None have ever been reported east of Cape Cod after the first half of November, so far as we can learn (in 1875 one was taken on Georges in November in a snowstorm)⁷³ and most of them are gone by the last week in October, though some fish have been taken off New York and New Jersey in December and even in January. A case in point is that 13 were entangled in long lines set for tilefish in 95 to 125 fathoms off Long Island between December 20, 1921, and January 1, 1922.⁷⁴

General report has it that the fish caught early in the season average not only thinner but considerably smaller than those caught later, a phenomenon still awaiting satisfactory explanation.⁷⁵

Nearly all the swordfish that visit us weigh upwards of 50 to 60 pounds. One of 6 pounds 7 ounces, taken by the schooner *Anna* on Georges Bank, August 9, 1922 (now or formerly to be seen at the Boston Fish Bureau); a second of 7 pounds, taken by the schooner *Courtney* on a long line, on Browns Bank in 1931; a third of 7½ pounds, taken on a long line by the *Dacia* on Western Bank, early in September 1931; and a fourth 28¼ inches long to tip of lower jaw (its sword was broken off short), weighing 5¼ pounds, caught by the trawler *Winchester*, August 15, 1951, on the southeast part of Georges Bank in a haul which fished at 46 fathoms⁷⁶ are the smallest Gulf of Maine

and Nova Scotian specimens of which we have heard. Goode⁷⁷ also reported a sword, only 3½ inches long, found sticking in the nostril of a mackerel shark caught at Gloucester, probably picked up somewhere off southern New England for this particular shark does not ordinarily range farther south than that.⁷⁸ In the Mediterranean, however, young fry as small as half a pound are often brought to market.

It is generally believed that swordfish come directly in from the open seas when they appear on the offshore banks in spring; a few to enter the Gulf of Maine, but the majority to work slowly eastward along the outer part of the continental shelf. When they depart in autumn it is to return to the open Atlantic, but they are never seen on their journey offshore, or southward; they simply drop out of sight as the tuna do.

No ripe fish, male or female, have ever been seen off our coast. The ovaries and spermaries of most of those examined⁷⁹ have shown no signs of approaching maturity; most of the fishermen, too, of whom we have inquired have assured us that they have never seen "spawn" in swordfish, though they had dressed hundreds. And while the captures of 3 fish with ovaries containing eggs in early stages of development have been reported, one brought into Provincetown in September 1909, a second with ovaries weighing 15 pounds, brought to New Bedford on June 25, 1922,⁸⁰ and a third of about 150 pounds killed off Marthas Vineyard in July 1924, events of this sort are so unusual that they cause wide comment.

Evidently the swordfish that summer off our coasts spawn during the part of the year when they are elsewhere; probably in the subtropical parts of the Atlantic basin, for Lütken⁸¹ found swordfish fry as small as 10 mm. (evidently hatched only a short time previous) between the latitudes of 20° and 39° N. The fact that the fish are thin when they return to us in spring, but fatten during the summer stay, is further evidence that they are spent before they appear off our coasts.

Abundance.—Our only clue to the numbers of swordfish that visit our waters is the poundage

⁷² This is often spoken of as the "Gulf Stream"; its more accurate name is the "slope water."

⁷³ Rich, Proc. Portland Soc. Nat. Hist., vol. 4, Part 2, 1947, p. 58.

⁷⁴ Townsend, Science, N. Ser., vol. 56, 1922, pp. 18-19.

⁷⁵ Rich (Proc. Portland Soc. Nat. Hist., vol. 4, Pt. 2, 1947, p. 43) is "inclined to think" that there are two or more "distinct year-schools" in our waters.

⁷⁶ Reported to us by George Kelley of the U. S. Fish and Wildlife Service. The specimen is in its collection in Woods Hole.

⁷⁷ Fish. Ind. U. S., Sect. 1, 1884, p. 348.

⁷⁸ See Rich (Proc. Portland Soc. Nat. Hist., vol. 4, Pt. 2, 1947, pp. 37-39) for additional records of small Gulf of Maine swordfish.

⁷⁹ Many have been opened with this point in mind; some by us.

⁸⁰ Townsend, Science, N. Ser., vol. 56, 1922, pp. 18-19.

⁸¹ Spolla Atlantica, in Kong. Danske Vidensk. Selsk. Skrift, Ser. 5, Nat. Math. Sect., vol. 12, No. 6, 1880, pp. 444-445.

landed yearly. The smallest year's catch reported as landed at Portland, Gloucester, and Boston, within the period 1904 to 1929 was 883,000 pounds (in 1919), the largest 4,593,000 pounds (in 1929), the average about 2,000,000 pounds, or anywhere between 4,000 and 18,000 fish per year. And the landings in New England ports ran from 1,715,000 to 5,070,000 pounds during the decade 1930 to 1939 for southern New England and the Gulf of Maine. The interruption of swordfishing by German submarines and by the diversion of manpower was reflected in much lower landings during the first two years of the war, as was to be expected.⁸² But swordfishing picked up again after the war, to landings of about 1,250,000 pounds for southern New England and the Gulf of Maine, including western Browns Bank, in 1944 (New England and Canadian landings combined), to about 2,850,000 pounds in 1945, to about 2,500,000 pounds in 1946,⁸³ and to something like 2,000,000 pounds in 1947.⁸⁴

A catch of somewhere between 2 million and 3 million pounds would be a reasonable expectation for southern New England and the Gulf of Maine combined in average years. The catch off Cape Breton, eastern Nova Scotia, has run between 1½ and 3 million pounds of late years (1939-1946), averaging a little more than 2 million until in 1947, when it fell to about 770,000 pounds.⁸⁵ The Nova Scotian catches were not lessened by the submarine menace during the war years.

THE SPEARFISHES OR MARLINS AND THE SAILFISHES. FAMILY ISTIOPHORIDAE

The spearfishes and sailfishes, like the swordfish, have a sword formed by the prolongation of the snout and upper jaw. But their sword is rounded toward the tip, not flattened, and narrower than that of the swordfish. Their bodies, too, are closely clothed with narrow lanceolate scales, pointing rearward in general and embedded in the skin, either wholly or with their sharp tips projecting slightly (fig. 188), and their first dorsal fin is much longer, occupying the greater part of the back behind the nape, and it can be depressed

It is not known what percentage of the total number of swordfish off our coasts is represented by the catches. But, at least, they do not suggest that any extreme ups and downs took place prior to 1947.

Importance.—Appreciation of the swordfish as a food fish is of rather recent growth. Down to the middle of the past century it was unsalable in Boston and brought a very low price in New York, but of late years the demand would have taken care of a much greater supply than has been brought in. In 1919, the price to the fishermen averaged about 24 cents; in 1928, 22 cents; and 18 cents per pound in 1929 when a large catch was made. In 1945 it brought between 40 and 42 cents; and it rose to about 60 cents in 1946, but fell again to about 40 cents in 1947.

Practically all the swordfish brought in to market are harpooned; we have never heard of one caught in net or seine, nor is it likely that any net now in use would hold a large one. Swordfish have also been taken from time to time on hand lines and on long lines baited for cod or halibut with mackerel or other fish (p. 353). But the numbers caught in these ways have never been large enough to figure to any extent in the total catches, and are not likely to be.⁸⁶ Occasional swordfish have been caught by anglers of late years, on rod and reel, and sport fishermen would agree that a good-sized broadbill is the premier prize of the sea.

into a groove along the back. They fall in two groups, sailfishes with very large, sail-like dorsal fin, and spearfishes or marlins with lower dorsal.

The sailfish (*Istiophorus americanus* Cuvier and Valenciennes 1831), so common in the warmer parts of the Atlantic, is included in the following Key because it has been taken at Woods Hole on several occasions, though not yet recorded from the Gulf of Maine. It is readily recognizable by the fact that the first dorsal fin is much higher than that of the marlins while the ventral fins of the sailfish are 2- or 3-rayed instead of being reduced to a single spine, as in the marlins. The two dorsal fins of the sailfish have usually been described as connected even in the adult. This,

⁸² Landings were only about 545,000 pounds in Massachusetts and 7,000 pounds in Yarmouth County, Nova Scotia in 1942; about 479,000 pounds in Massachusetts and about 17,300 pounds in Yarmouth County in 1943.

⁸³ Most recent year for which the landings have been published for the Canadian coast of the Gulf of Maine and for the ports in New England.

⁸⁴ The Canadian catch statistics for 1947 have not reached us yet.

⁸⁵ Information from Dr. A. H. Leim of the Fisheries Research Board of Canada.

⁸⁶ Rich (Proc. Portland Soc. Nat. Hist., vol. 4, Pt. 2, 1947, pp. 67-82) gives an interesting account of the methods of the New England swordfishery.

in fact, is given as the chief distinction between it and the marlins by Goode⁸⁷ by Jordan and Evermann,⁸⁸ and by Boulenger.⁸⁹ But there is actually a considerable gap between the two fins in large specimens as Bean⁹⁰ remarks and as appears on Goode's own illustrations of a sailfish taken at Newport, and of a skeleton.

Two species of marlins, the blue and the white are known off the middle and north Atlantic Coasts of the United States. But it is not yet clear whether the enormous marlins, with violet cross-stripes on the sides, that are caught off the North Coast of Cuba⁹¹ are simply very large blue marlin, a separate subspecies, or even a species. And the marlins of more southern waters still await critical study.

KEY TO SPEARFISHES OR MARLINS, AND SAILFISHES

Middle Atlantic and North Atlantic Coast of United States

1. First dorsal fin much higher than the body is deep and sail-like; ventrals of 3 rays each. Sailfish, p. 357
The first dorsal fin is not higher than the body is deep; ventrals reduced to one spine each.----- 2
2. Apex of first dorsal fin and tips of pectorals pointed.
Blue marlin, p. 358
Apex of first dorsal and tips of pectorals rounded.----
White marlin, p. 360

Blue marlin *Makaira ampla* (Poey) 1860.

SKILLIGALEE

Jordan and Evermann, 1896-1900, p. 892, *Tetrapterus amplus*.⁹²

Description.—The marlin parallels the swordfish in the prolongation of the bones of the upper jaw to form a sword. But that of the marlin is slender and rounded above, not broad and flattened as in the swordfish, also only about half as long relatively. The two fish differ widely, too, in the

⁸⁷ Rept. U. S. Comm. Fish., 1880, p. 296.

⁸⁸ Bull. 47, U. S. Nat. Mus., Pt. 1, 1896, p. 890.

⁸⁹ Cambridge Natural History, vol. 7, 1904, p. 680.

⁹⁰ Bull. New York State Mus., 60, Zool. 9, 1903, p. 404.

⁹¹ Hemmingway (in Vesey-Fitzgerald and Lamonte, Game Fishes of the World, 1949, p. 158) reports these striped marlins weighing up to 1,250 pounds off northern Cuba.

⁹² Jordan and Evermann in their general review of the giant mackerel-like fishes, tunnies, spearfishes, and swordfishes (Occ. Papers, Calif. Acad. of Sci., XII, p. 28, 1926) separate the spearfishes into two genera *Tetrapterus* with the front of the first dorsal fin little if any higher than the median part of the fin and *Makaira*, with the front part of the first dorsal higher than the median part of the dorsal.

relative sizes of the first dorsal fin,⁹³ which extends along fully two-thirds of the length of the trunk from the nape backward in the marlin and is, futhermore, of characteristic falcate outline. But more important systematically, if less apparent, is the fact that the adult marlin has ventral fins which the swordfish lacks, though they are reduced, it is true, to one long spine each (actually 5 spines fused together).

Futhermore, the second dorsal fin and the second anal fin of the marlin are relatively larger, and the pectorals smaller than those of the swordfish, while there are two small longitudinal keels on either side of its caudal peduncle instead of one broad one; its body is more slender; and its head is relatively shorter. Careful examination would show that the spearfish is not naked but has small scales imbedded in the skin and that there are small teeth in its jaws and on the roof of its mouth.

The blue marlin differs from its close relative the white marlin in the shape of the apex of its first dorsal fin and of the tips of its pectorals, both of which are pointed; also in the much darker color of its sides and belly; and in the fact that it grows much larger.

The blue marlin is deepest abreast the pectorals, (about 6¼ times as long, not counting the caudal fin, as it is deep), tapering evenly to the caudal peduncle, and its upper jaw in front of the eye (including the sword) is about twice as long as the length of its head behind the eye.⁹⁴

The first dorsal fin, with 47 to 48 stiff rays is separated from the second dorsal by a space about as long as the latter in one fish seen by us; by a shorter space in another. The first anal fin (2 spines and about 12 or 13 rays), situated below the rear part of the first dorsal, is triangular, its long first rays forming a sharp angle. The short second anal is similar to the second dorsal fin and originates a little in front of the latter. The ventrals stand below the pectorals; the caudal resembles that of the swordfish in its lunate outline.

Color.—Dark dull blue on the back and on the sides down about to the level of the eyes, washed with coppery reflections, also on the bill, with

⁹³ Very young marlins have only one continuous dorsal fin, but this separates later into two.

⁹⁴ See Shapiro (Amer. Mus. Novitat., No. 995, 1938) for a study of the changes in proportional dimensions that take place with growth, in the blue marlin.

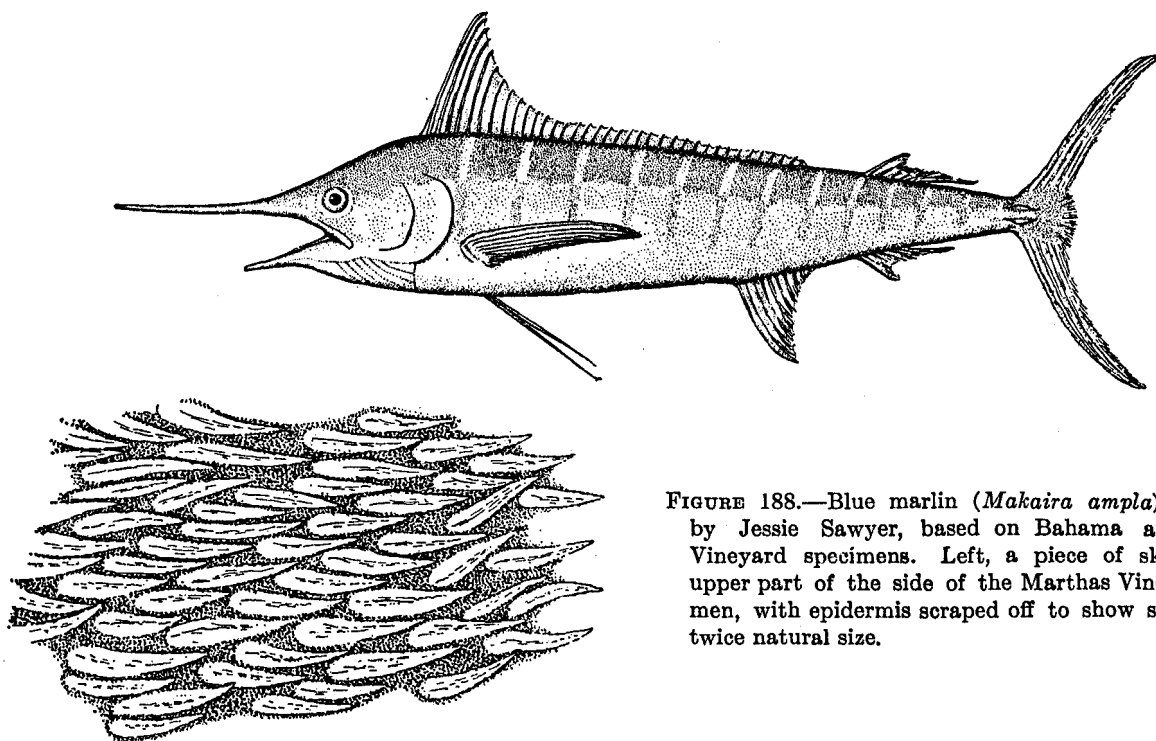


FIGURE 188.—Blue marlin (*Makaira ampla*). Drawing by Jessie Sawyer, based on Bahama and Marthas Vineyard specimens. Left, a piece of skin from the upper part of the side of the Marthas Vineyard specimen, with epidermis scraped off to show scales, about twice natural size.

rather abrupt transition to much paler gray-blue lower down the sides and on the lower surface, the belly being as dark as the lower part of the sides; the sides cross-marked with about 13 indistinct violet-blue stripes, about 1 to 1½ inches wide on a fish 8 feet long, showing pale against the dark blue of the upper parts of the body, but dark against the paler blue of the lower part of the sides. First and second dorsal fins, pectoral and ventral fins, and first anal fin dark rather vivid blue. Caudal fin of about the same color as upper part of trunk; second anal fin of same pale gray-blue as the belly.⁹⁵

Size.—Blue marlins run fully as large as swordfish. Reports are current of fish of 1,000 pounds being harpooned; the rod and reel record is 742 pounds.⁹⁶ Many weighing more than 500 pounds are caught off the north coast of Cuba and on the Bahamas side of the Straits of Florida every year,⁹⁷ and one taken on the southern part of Browns Bank, weighed 575 pounds dressed, when landed,

or about 700 pounds alive. A very large one may measure as much as 15 feet,⁹⁸ but the rod and reel record fish, mentioned above, was only 12 feet 10½ inches long. Another fish caught in the Bahamas weighed 650 pounds (not dressed), and measured 12 feet 1 inch; a third, of 621 pounds was 12 feet 3 inches long.⁹⁹

General range.—Warm parts of the northwestern Atlantic, straying northward to the Gulf of Maine. It has been reported near Sable Island, but the very small specimen in question may have been a white marlin (p. 360).

Occurrence in the Gulf of Maine.—This southern warm-water fish was reported from the South Channel, between Georges Bank and Nantucket Shoals, between 1877 and 1880, by the fishing schooner *Phoenix*. No other marlins that we can be sure were blues were reported within the limits of the Gulf of Maine until September 5, 1930, when a small one 6 feet 10 inches long,¹ was harpooned on the southern part of Browns Bank. And a very large one was caught in that same vicinity by the *Col. Lindbergh* the following July,

⁹⁵ Description based on a "blue" about 8 feet long from tip of bill to fork of tail, and weighing 169 pounds, fish taken near Bimini, Bahamas, June 1941, by R. W. Foster, mounted by the well-known fish taxidermist, H. Pfeuger of Miami, Fla., and now in the Museum of Comparative Zoology.

⁹⁶ Caught at Bimini, Bahamas, June 19, 1949, by Aksel Wichfeld.

⁹⁷ See Farrington (in Vesey-Fitzgerald and Lamonte, *Game Fish of the World*, 1949, p. 154) for a readable account of the blue marlin of Bahaman waters as a game fish.

⁹⁸ The blue marlin is said to reach 26 feet, but we think this much exaggerated.

⁹⁹ Reported to us by Frank Mather, of the Woods Hole Oceanographic Institution.

¹ This specimen is in the Museum of Comparative Zoology.

and brought into the Boston Fish Pier. A marlin about 5 feet long was taken on Georges Bank by the schooner *Ethel Merriam*, on August 5, 1925, but this may have been a white (p. 359).

Blue marlins are sighted at long intervals off Marthas Vineyard. And fishermen report them now and then along the southern edge of Georges (any very large marlin is a blue) but do not harpoon them, for they have no market value. They are game fish par excellence, and much sought after off Cuba and in the Bahaman side of the Straits of Florida. They also support a considerable commercial fishery off the north coast of Cuba.²

White marlin *Makaira albida* (Poey) 1860

Jordan and Evermann, 1896-1900, p. 892. *Tetrapterus imperator* (Bloch and Schneider) 1801, in part.

Description.—The white marlin differs from its larger relative the blue marlin in its rounded first dorsal and pectoral fins, in the pale color of the lower part of its sides, and in its white belly (p. 359); and in its smaller size. Few grow larger than 125 pounds; the rod and reel record stands at 161 pounds.³ This fish was 8 feet 8 inches long.

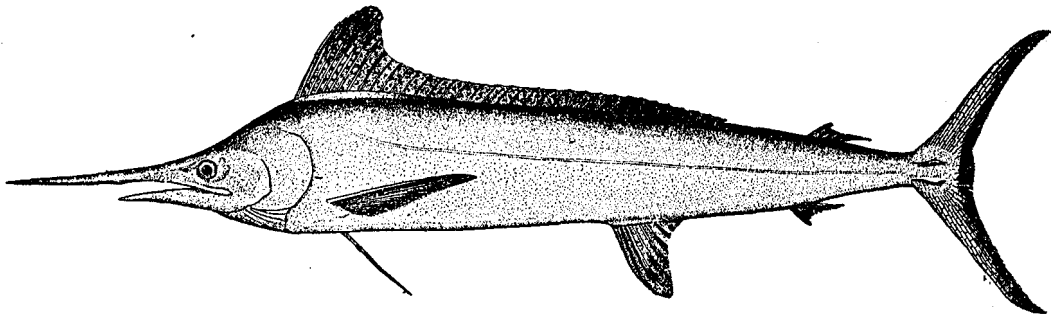


FIGURE 189.—White marlin (*Makaira albida*). From Goode.

THE DOLPHINS. FAMILY CORYPHAENIDAE

The dolphins (two species are known) are moderately slender and flattened sidewise, with slightly projecting lower jaw, a massive blunt head, a long, rather high dorsal fin without spines, extending from close behind the head to near the base of the caudal fin, an anal similar to the dorsal in shape but shorter, and a widely forked tail. They have small comb-like teeth in the jaws and on the roof of the mouth.

³ Farrington (in Vesey-Fitzgerald and Lamonte, Game Fishes of the World, 1949, p. 153) gives an interesting account of this fishery.

² One caught off Miami, Fla., Mar. 20, 1938, by L. F. Hooper.

General range.—Western North Atlantic; common in Cuban and Bahaman waters, and off southern Florida; north regularly in summer to the offing of Delaware Bay in abundance, and to southern New England waters in lesser numbers.

Occurrence in the Gulf of Maine.—So many white marlin come northward, as far as New York waters that about 500 were taken off Montauk, Long Island, on rod and reel during the 11 years 1925-1936, and more than 150 in 1935 alone.⁴ And a few are caught off the southern Massachusetts Islands in most summers.

But their usual turning point is west of Nantucket. True, Farrington⁵ speaks of "great quantities" of them as seen on Georges Bank; but we cannot find that any marlin caught there has been identified positively as a white, though one about 5 feet long taken on August 5, 1925 (p. 359) may perhaps have been one. The meager record suggests that they may stray oftener to outer Nova Scotian waters, for a 5-foot fish weighing 21 pounds, caught on Sable Island Bank, August 18, 1931, probably was a white marlin, while Farrington reports one harpooned off Glace Bay near Sidney, in 1945, and others sighted off Halifax that same year.

Common dolphin *Coryphaena hippurus* Linnaeus 1758

Jordan and Evermann, 1896-1900, p. 952.

Description.—The dolphin differs from related fishes in that its long tapering body is most massive and deepest close behind the head, and that its dorsal fin, originating over the gill cover, extends back nearly to the base of its deeply

⁴ Information supplied by Frank Mather of the Woods Hole Oceanographic Institution.

⁵ In Vesey-Fitzgerald and Lamonte, Game Fish of the World, 1949, p. 155.

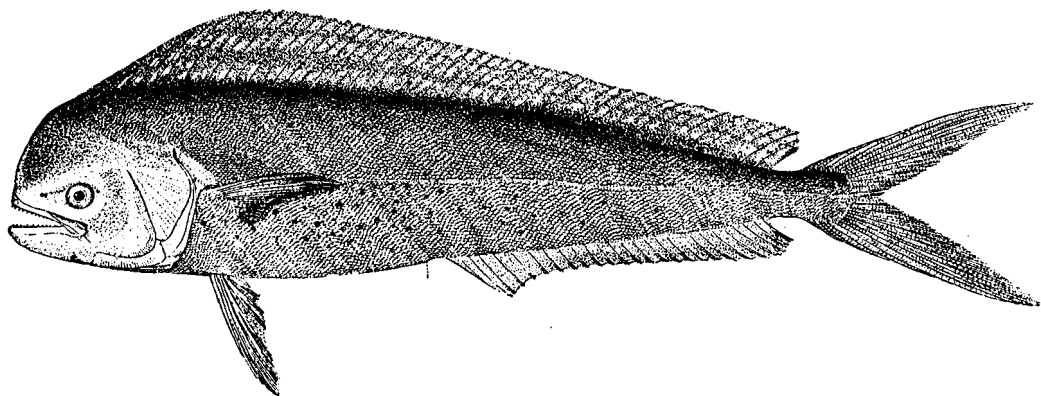


FIGURE 190.—Dolphin (*Coryphaena hippurus*). From Goode. Drawing by H. L. Todd.

forked tail fin. These characters, with its side-wise flattened form, notably steep forehead, deeply forked tail, and large ventral fins, separate it at a glance from the few other Gulf of Maine fishes which have long dorsal fins with bodies that are deepest forward. Its anal fin, 26 to 30 rays, originating about midway of its body, is about half as long and half as high as the dorsal which has 55 to 65 rays. The lobes of its deeply forked tail are long and slender. Its moderately long ventrals and pectorals are situated the one below the other.

Color.—The dolphin is famous for its brilliant hues and for the vivid waves of color that flash across it when first taken from the water. Alive, in the sea, its sides are largely vivid blue, variously mottled and washed with gold; its tail largely golden yellow.

Size.—Maximum length about 6 feet.

Habits.—The dolphin, despite its blunt snout, is one of the swiftest of fishes. Voyagers on tropic seas often see them leaping in pursuit of small fry, or when pursued themselves by larger fishes. In

sailing ship days dolphins were often caught by trolling from the stern. Offshore, they feed largely on flying fish; the Sandwich specimen mentioned later had some silversides in its stomach.

General range.—Cosmopolitan in warm seas; northward along our Atlantic Coast to southern New England, where it is rare inshore, occasionally straying as far as the outer coast of Nova Scotia.

Occurrence in the Gulf of Maine.—A dolphin about 3½ feet long (now in the collection of the Boston Society of Natural History) and weighing 23 pounds, taken 60 miles south-southwest of Cape Sable, in the deep gully between Browns and Georges Banks by the trawler *Natalie Hammond*, August 15, 1930, was the first record for the Gulf of Maine; a second was taken in a trap at North Truro on Cape Cod Bay, in August 1949⁶ (a season when many were taken off Marthas Vineyard); a third at Sandwich, on the southern shore of Cape Cod Bay in mid-July 1951.⁷

THE SEA BREAMS OR POMFRETS. FAMILY BRAMIDAE

The sea breams are usually considered the most nearly related to the dolphins. But they rather suggest the butterfishes (Family Stomateidae, p. 363) in general appearance, with single, long, falcate soft-rayed dorsal fin; anal similar to the dorsal; lunate tails, very small ventrals; and deep, sidewise flattened bodies. They are to be expected only as strays in the Gulf of Maine.

Johnson's Sea Bream *Taractes princeps* (Johnson) 1863

Johnson, Proc. Zool. Soc. London, 1863, p. 36.

Description.—This sea bream is unique among Gulf of Maine fishes in its general appearance.

⁶ Reported by Schuck, Copeia 1951, p. 171.

⁷ We saw this specimen in the collection of the U. S. Fish and Wildlife Service at Woods Hole.

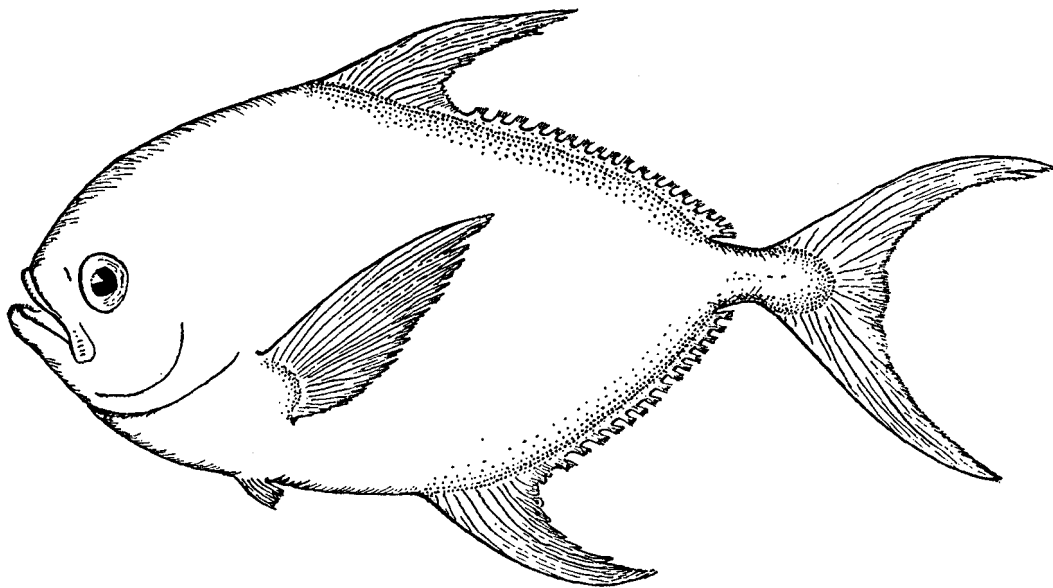


FIGURE 191.—Johnsons sea bream (*Taractes princeps*), Browns Bank. After Bigelow and Schroeder.

In the adult the body is massive, flattened side-wise, about half as deep as it is long to the base of the tail fin. The dorsal and anal fins are long, scythe-shaped in front, each followed by a row of low rays that are detached along their outer parts, but are joined by scaly skin along their bases, giving the fins the outline shown in figure 191. The tail fin is deeply lunate; the long pectorals originate a little in advance of the dorsal, and the very small ventral fins a little in front of the pectorals. The eyes are large, oval, with vertical diameter longer than the horizontal diameter. There is no lateral line. A striking character is that the scales which clothe the vertical fins and the body (about 43 scales along the median longitudinal row) vary greatly in size, being largest along the sides, smallest on the back, breast, and fins. They vary also in shape, their exposed margins being either concave, convex, notched, or straight.

This species is separated from *Brama raii* Bloch 1781,⁸ the only one of its relatives yet recorded from our North Atlantic coast, by its larger scales (*Brama raii* has 80 or more in the median longitudinal row) and by the fact that its ventral fins originate slightly, but distinctly, in front of the pectorals.

Color.—The body and head of a specimen, three days after death, were blackish, tinged with salmon on the gill covers and along the sides; the dorsal and anal fins were dusky, with the free ends of the short rays pale; the caudal was black but with its concave margin white; the pectorals were gray.

Size.—Maximum length about 3 feet.

General range.—Known only from Madeira in the eastern Atlantic, and from Browns Bank in the western.

Occurrence in the Gulf of Maine.—This fish is mentioned here on the basis of one specimen, about 33 inches long, caught on a long line on Browns Bank, off Cape Sable, in January 1928, by the schooner *Wanderer*. A detailed account and comparison with allied species is given by Bigelow and Schroeder.⁹

It seems certain that *Taractes* is very rare in American waters, at least in the depths in which commercial fishermen operate, for so conspicuous a fish would almost certainly be reported, if caught. Nothing is known of its habits except that it seems to be common around Madeira in deep water.

⁸ *Brama raii* has been taken at Woods Hole and on the Grand Banks.

⁹ Bull. Mus. Comp. Zool., vol. 69, 1929, pp. 39-50, 1 pl.

THE BUTTERFISHES. FAMILY STROMATEIDAE

The members of this family are deep bodied and very much flattened sidewise, with one long dorsal fin that is soft rayed except for a few short weak spines at its forward end, an anal fin of corresponding size and shape, a deeply forked caudal fin, a blunt nose, and a small mouth. The two species that occur on the east coast of North America lack ventral fins, but the extremity of the pelvic bone projects through the skin as a spine but this is so short that it is likely to be overlooked unless felt for.

Two species occur in the Gulf of Maine: one (the butterfish) a common summer visitor, the other (the harvestfish) a rare stray from the south.

KEY TO GULF OF MAINE BUTTERFISHES

1. The forward one-fourth of the anal fin is only about 2 or 3 times as high as the rear portion of the fin. The margins of the anal and dorsal fins are only slightly concave in outline.....Butterfish, p. 363
The forward one-fourth of the anal fin is at least seven times as high as the rear portion of the fin. The anal and dorsal fins are both very deeply concave in outline.....Harvestfish, p. 368

Butterfish *Poronotus triacanthus* (Peck) 1800

DOLLARFISH; SHINER; SKIPJACK; SHEEPSHEAD;
HARVESTFISH

Jordan and Evermann, 1896-1900, p. 967, as
Rhombus triacanthus.

Description.—The most distinctive characters of the butterfish are its very thin deep body, like a flounder on edge; the fish is only about twice as long as it is deep to the base of its tail fin (the only common Gulf of Maine species of this shape), combined with a single, long, soft-rayed dorsal fin, an anal fin almost equally long, and a deeply forked tail, but no ventral fins. The absence of ventral fins separates it from the pompanos; the dorsal without obvious spines from the scup (p. 411) and John Dory (p. 297); the lack of detached dorsal spines from the triggerfishes, which are, furthermore, very different in general aspect (p. 520). And it is easily distinguishable from its relative, the harvestfish (p. 194), which is rare in northern waters, by its much lower dorsal and anal fin (compare fig. 192 with fig. 194). The dorsal fin

(about 45 rays) originates close behind the axils of the pectorals and tapers at first abruptly and then gradually backward, while the anal (about 40 rays) narrows evenly from front to rear. There is a forward-pointing spine close in front of the dorsal fin, so short as hardly to be visible though it can be felt; also 3 very short spines in front of the anal, almost wholly embedded in the skin, the first of which points forward. Both the dorsal fin and the anal extend rearward almost to the base of the caudal fin.

Distinctive, also, are the long pointed pectoral fins, short head, blunt snout, small mouth, weak teeth, and the short and slender caudal peduncle, which does not have longitudinal keels. The scales are very small, and are easily detached when the fish is handled, and there is a row of very conspicuous mucous pores below the forward half of the dorsal fin.

Color.—Leaden bluish above, pale on the sides, with numerous irregular dark spots which fade after death. The belly is silvery.

Size.—The largest are about 12 inches long; the general run are about 6 to 9 inches long. The weight runs about 1¼ ounces at 6 inches, 4 to 4½ ounces at 8 inches; about 1 pound at 11 inches (if fat). The largest weigh about 1¼ pounds.

Habits.—Astonishingly little is known of the manner of life of the butterfish considering how familiar and valuable it is. As a rule they travel in small bands or loose schools; and draggers report catching several times as many by night as by day, suggesting that they are active enough to dodge a trawl, except during the hours of darkness. They often come close inshore, into sheltered bays and estuaries, hence their frequent capture in pound nets. And it shows so decided a preference for sandy bottoms rather than for rocky or muddy, that few are taken in traps on muddy ground while other traps along the sandy beach nearby may yield considerable numbers. General experience is that the butterfish keeps chiefly near the surface during its stay near the coast, and schools are often to be seen. At Cohasset (on the south side of Massachusetts Bay), for instance, schools of butterfish, fifty to a few hundred, are often to be seen where the flats are covered by only 4 or 5 feet

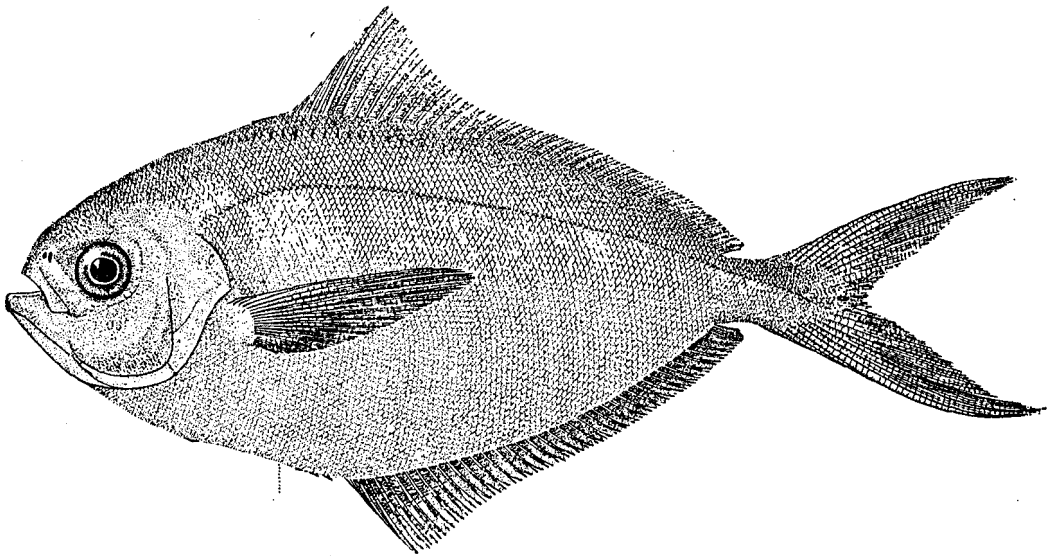


FIGURE 192.—Butterfish (*Poronotus triacanthus*), New Jersey. From Goode. Drawing by H. L. Todd.

of water. Though definite evidence is lacking, we believe butterfish seldom descend deeper than 15 to 30 fathoms during the summer, and that most of the fish caught by the otter trawlers on the Nantucket grounds and on Georges Bank in summer are picked up by the trawl on its way up or down, not while dragging on bottom. In fact, mackerel fishermen often take a few butterfish on Georges in their purse seines. But such evidence as is at hand is to the effect that they spend the winter and early spring near bottom, and in depths down to 100–115 fathoms (p. 367).

Food.—The butterfish feeds on small fish, squid, Crustacea such as amphipods and shrimp, and annelid worms. And ctenophores have been found in butterfish stomachs at Woods Hole, though these watery objects are not a regular item in its diet.

Breeding habits.—Butterfish begin spawning in the Gulf of Maine in June, soon after their arrival. The height of the reproductive season is in July and their eggs have been taken throughout August. Observations at Woods Hole suggest that butterfish spawn some few miles out at sea, returning to the coastwise waters when they are spent.¹⁰ We have taken its eggs in our tow nets at several stations in Massachusetts Bay, and it would not be astonishing to find them anywhere off the New England and western Nova Scotian coasts or on the Scotian side of the Bay of Fundy, Huntsman

having found large spawning individuals in St. Mary Bay in July. But despite the considerable number of butterfish eggs that are produced in the Gulf of Maine, we doubt whether the latter is a favorable nursery for this fish, for we have taken its larvae only twice there (off Cape Cod on August 16 and on Georges Bank on July 23, 1916) a total of only 3 specimens, 5 to 30 mm. long, although we have made hundreds of hauls widely distributed inshore as well as offshore at the season when they might be expected. Neither have young butterfish been reported from the Bay of Fundy. Butterfish fry are very plentiful, however, along the shores of southern New England.

The eggs are buoyant, transparent, spherical, 0.7 to 0.8 mm. in diameter, usually with a single oil globule of about 0.17 to 0.2 mm. In newly spawned eggs, however, there may be two globules, which coalesce as development advances.¹¹ At a temperature of 65° F. (about the summer state of the surface of Massachusetts Bay) incubation occupies less than 48 hours. And it is probable that development can only proceed in comparatively warm water, though the lower temperature limit to successful reproduction is not known. The larvae are about 2 mm. long at hatching and they are characterized shortly after by their short deep form, by their 30 muscle-segments, and by the row of black spots along the ventral edge in the

¹¹ A large series of butterfish eggs artificially fertilized at the Gloucester hatchery have been available for comparison with the pelagic eggs taken in the tow nets.

¹⁰ Kuntz and Radcliffe, Bull. U. S. Bur. Fish., vol. 35, 1918, p. 112.

post anal region.¹² The dorsal, anal, and caudal fin rays are visible in larvae of 6 mm., when the body has already begun to assume the deep thin form so characteristic of the adult butterfish. At a length of 15 mm. the caudal fin is deeply forked, the dorsal and anal fins are formed, and the little fish resembles the adults sufficiently for ready identification.

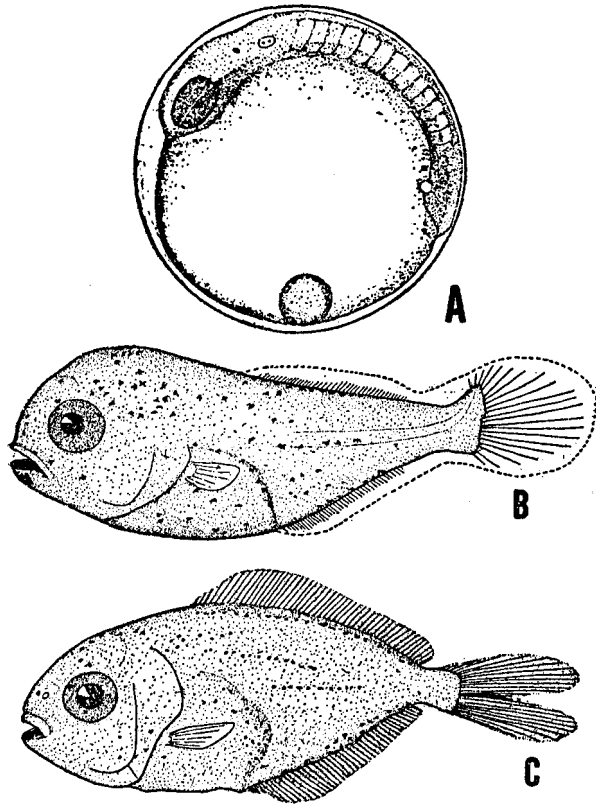


FIGURE 193.—Butterfish (*Poronotus triacanthus*). A, egg; B, larva, 6 mm.; C, fry, 15 mm. After Kuntz and Radcliffe.

During the first summer young butterfish often live in the shelter of the large jellyfishes as young haddock do, and Goode¹³ graphically described the fry of 2 to 2½ inches as swimming among the tentacles of the red jellyfish (*Cyanea*), sometimes 10 or 15 little fish under one jellyfish, where they find protection from larger fish, but to which they sometimes fall prey. This association, however,

is not essential to their welfare, for fry are often seen living independently at the surface, particularly in sheltered bays west and south of Cape Cod. On one occasion in late August 1925, on Nantucket Shoals, we observed numbers of young butterfish 1–1½ inches (26 to 39 mm.) long swimming free in the upper stratum of water. And we have seldom found young butterfish with the many *Cyanea* that we have captured in the Gulf of Maine.

It seems that the fry hatched earliest in the season grow to a length of 3 to 4 inches by autumn, great numbers of that size having been taken in Rhode Island waters in October. But late-hatched fish probably are not more than 2 to 3 inches long at the beginning of winter, and they can grow little during the cold season, for little fish of 3 to 5 inches are seen again in the spring. A series of measurements made by Welsh at Atlantic City, N. J., in August 1921, throws some light on the subsequent rate of growth. The fish fell into two groups: one ranging from 4 to 5¼ inches (averaging about 4¾) and the other from 7½ to 10½ inches. Very likely those of the first group (which were much the more numerous) were in their second summer, for Hildebrand and Schroeder¹⁴ record a growth of from 4 inches to 5¼ inches from May to October in Chesapeake Bay; those of the second size group were in their third summer, some perhaps in their fourth. It is probable that the butterfish matures when 2 years old, and upward of 7 inches long.

General range.—Atlantic coast of North America from the offing of South Carolina and from coastal North Carolina waters to the outer coast of Nova Scotia and Cape Breton; northward as a stray to the Gulf of St. Lawrence¹⁵ and to the south and east coasts of Newfoundland;¹⁶ southward to Florida in deep water.

Occurrence in the Gulf of Maine.—This is a regular summer visitor to the Gulf of Maine, locally abundant along the shores of Massachusetts, less common along the coast of Maine. Butterfish are common also in some years along the Nova Scotian coast of the Gulf; great numbers were caught in

¹² Information furnished by O. E. Sette. The illustrations of larvae 2.1 mm. and 3.4 mm. long credited by Kuntz and Radcliffe (Bull. U. S. Bur. Fish., vol. 35, 1918, figs. 63 and 64) to the butterfish and reproduced in the previous edition of this book (Bigelow and Welsh, Bull. U. S. Bur. Fish. vol. 40, Pt. 1, 1925, fig. 116, c and d) have since been proved to belong to one of the hakes (*Urophycis*).

¹³ American Fishes, 1888, p. 222.

¹⁴ Bull. U. S. Bur. Fish. vol. 43, Pt. 1, 1928, p. 214.

¹⁵ Hoar (Copela, 1937, p. 238) records two large ones from Margaree Harbor on the Gulf of St. Lawrence shore of Cape Breton, and cites an earlier record for the coast of Quebec.

¹⁶ It is reported from Rose Blanche on the south coast of Newfoundland, and from Bulls Bay and Ferryland on the east coast of the Avalon Peninsula (Rep. Newfoundland Fish. Res. Commission, vol. 1, No. 4, 1932, p. 108, and vol. 2, No. 1, 1933, p. 125).

St. Mary's Bay, for example, in 1910-1913 and again in 1938, though few were taken during the intervening years.¹⁷ But they appear only irregularly and in small numbers on the New Brunswick shore of the Bay of Fundy, though they have been taken repeatedly in Passamaquoddy Bay.

The diminution in the numbers of butterfish, following from south and west to east and north around the coast line of the Gulf may be illustrated by catches for 1938 a fairly representative year¹⁸ when catches in pound nets and floating traps around the shores of Barnstable, Plymouth, and Essex Counties, plus those landed in Boston and Gloucester by seiners and trawlers fishing offshore, amounted to 943,500 pounds, whereas only about 18,000 pounds were reported from the entire coast from the Massachusetts line to and including the region of Casco Bay, and none at all from farther east than that along the coast of Maine.

Butterfish also appear in the Nantucket Shoals region and on Georges Bank in summer, often in good numbers. About 1,000 fish, for example, were caught on Georges during one trawling trip in 1913; and otter trawlers accounted for nearly two-thirds of the total landings for Massachusetts in 1938, about one-half of those for 1945, most of which probably came from these offshore grounds. We have heard no rumor of them on Browns Bank but doubtless they occur there, for "fair quantities" usually visit Halifax Harbor in summer and autumn, according to McKenzie,¹⁹ in fact, he cites one instance when about 1,500 of them were taken from two traps there in one day. And they are said to be common eastward as far as Canso.²⁰ But this appears to be the normal limit to their range, for strays, only, have been taken in the Gulf of St. Lawrence (p. 365), or on the Newfoundland coast (p. 365).

Season.—Butterfish are warm season fish along our coasts; we refer of course to the temperature of the water, not to that of the air. They may appear off Rhode Island by the last half of April and about Woods Hole by the middle of May, though they are not plentiful in the Woods Hole region until in June. And it is likely that these early comers move in across the shelf from offshore, rather than that they have followed along

the coast, for from April 8 to 12, 1953, the *Eugene H* trawled 22,000 pounds of butterfish, close to bottom, in 85 fathoms south to Martha's Vineyard, and in 1950 the *Albatross III* trawled 10 to 723 butterfish per haul, May 11 to 18, along the 40-80 fathom zone off southern New England, where small commercial catches were also being made at the time. During the season of 1913²¹ the first butterfish were reported on Georges Bank June 5 to 8. But it is not until the end of that month or early in July that they are plentiful anywhere north of the elbow of Cape Cod. The earliest catches, for example, in one set of traps off North Truro, on Cape Cod Bay, were not made until June 26-28th in 1947, or until July 29th in 1948, but on May 29, 1951. From that time on there are butterfish in the inner parts of the Gulf throughout the late summer and autumn, also on Georges Bank.

The following tabulation of the catches made in one set of 8 traps at North Truro, on the eastern shore of Cape Cod Bay,²² suggests that butterfish are likely to be the most numerous there in August, at least in good years, and rather more numerous in September and in October than in July. But they are exceedingly irregular and unpredictable in their appearances and their disappearances. Thus the traps just mentioned yielded butterfish on only one day in July, 2 days in August, 3 days in September, and 3 days in October in the years 1948 and 1949 combined, though catches as great as 2,856 to 7,490 pounds were made on three of these occasions. The approximate catches, in pounds, for the years 1946 through 1950 follow:

| | Maximum | Minimum | Average | Total |
|----------------|---------|---------|---------|--------|
| July----- | 5,900 | 0 | 1,760 | 8,810 |
| August----- | 53,101 | 0 | 11,450 | 57,260 |
| September----- | 15,100 | 90 | 5,850 | 29,250 |
| October----- | 26,440 | 120 | 8,425 | 42,130 |

In some years the peak for this locality may not come until October, as in 1947, when the catch by this set of traps was between five times and six times as great during that month (about 14,500 pounds) as during the next most productive month (July, about 2,300 pounds; August, about 2,500 pounds). Similarly, in 1950 the October catch

¹⁷ McKenzie, Proc. Nova Scotian Inst. Sci., vol. 20, 1939, p. 14.

¹⁸ This is the most recent year for which butterfish have been mentioned in the statistical breakdown by counties for Maine.

¹⁹ Proc. Nova Scotian Inst. Sci., vol. 20, 1939, p. 17.

²⁰ Cornish, Contributions to Canadian Biology (1902-5) 1907, p. 85.

²¹ This is the only year for which lists are available of the number of fish of all species taken on Georges Bank by certain trawlers.

²² Information supplied by the Pond Village Cold Storage Co. of North Truro, Mass.

of these traps was about 26,400 pounds following a peak in August (about 53,000 pounds). And they linger in numbers until well into November in the Cape Cod Bay region in some years; also on Georges Bank. Thus four or five traps at Provincetown yielded some 30,000 pounds during that month in 1915, while 2 traps at Barnstable, on the southern shore of Cape Cod Bay took 4,275 pounds of butterfish on November 17, in 1950.²³

They may linger equally late into the season along the outer Nova Scotian coast in some years, as in 1938, when two traps at Halifax yielded about 1,500 fish on November 12th.²⁴ They have been caught on Georges Bank until the end of that month; and in 1928 several hundred pounds were reported from Nantucket Shoals as late as the last week in December.²⁵ But they all vanish from the coast by the end of December at latest, and usually earlier than that, not only from our Gulf but along the more southerly part of their range as well.

It seems that the southern contingents simply move out to the outer edge of the continent into deeper and warmer water to winter, as the mackerel do also, for they are often caught by otter trawlers working out on the shelf between the latitudes of Chesapeake Bay and of Cape Hatteras in winter. The *Albatross III* trawled from 1 to 202 butterfish at a number of localities at depths of about 20 fathoms to at least 115 fathoms, between the offings of Charleston, S. C., and of Cape Hatteras in January and February of 1950.

The case is not so clear for those that summer off southern New England and farther north and east. Butterfish, it is true, have been trawled in February near the 90-fathom line abreast of the eastern part of Long Island, N. Y.;²⁶ also late in March on the southwestern slope of Georges Bank (where the dragger *Eugene H* had the unusually large catch of about 15,000 pounds in 1951 in the last week of that month) and in April and in May off southern New England (p. 366). These, however, may not have wintered in the vicinity, but may have been following along the outer part of the shelf northward, before turning shoreward toward their summer homes.

Abundance.—During the period 1928 to 1947²⁷ the reported catch of butterfish for Massachusetts ranged between 279,000 pounds and 2,250,000 pounds. Low points were in 1928 (about 580,000 pounds) and in 1946 (about 279,000 pounds); high, in 1932 (about 1,479,000 pounds), and during the period 1937–1940 (from about 1,226,000 pounds to about 2,250,000 pounds). And while this includes landings for the southern shore of the State as well as for the Gulf of Maine shore, the fluctuations that are indicated from year to year probably were paralleled north of Cape Cod. But the catch may be poor at any particular locality even in a good year, or vice versa. Thus the North Truro traps mentioned (p. 366) took only 1,230 pounds of butterfish in 1948, though this was a better-than average year for the Massachusetts coast as a whole.²⁸

If the fish caught average about one-half pound each, the Massachusetts fishery may thus be expected to take somewhere between 560,000 and 4½ million individual fish. But it is not known what proportion this may be of the total population of butterfish in the Gulf of Maine.

Importance.—This is one of our best table fish, fat, oily, and of delicious flavor. Experience with many fresh from the net as well as on the table proves the old tale to be a myth that butterfish have a peculiar odor. However, they were often used to enrich land in planting during the first half of the past century, and appreciation of the fact that they are too good for this use is of recent growth. Even today the demand for butterfish in Boston is uncertain and the price widely variable. As late as 1938, 1,500 fish taken in traps at Halifax, Nova Scotia, were dumped for want of a market.²⁹

The commercial catch is made mostly in pound nets, floating traps, purse seines, and otter trawls, and it was thought of old that they would never take a hook. But anglers have recently discovered that butterfish will sometimes bite a very small hook greedily, if baited with a bit of clam or with a small piece of a sea worm (*Nereis*). And 1,100 pounds were reported in 1945 as caught along the Massachusetts coast on hand lines.

²³ Information from John E. Vettorino, who operates these traps.

²⁴ McKenzie, Proc. Nova Scotian Inst. Sci., vol. 20, 1939, p. 17.

²⁵ See Hildebrand and Schroeder, Bull. U. S. Bur. Fish., vol. 43, 1928, p. 215, for details as to their seasonal occurrence in Chesapeake Bay.

²⁶ Three fish taken by *Albatross II*, February 27, 1929.

²⁷ Statistics are not available for 1929, 1934, 1936, or 1941.

²⁸ Massachusetts catch, about 676,000 pounds.

²⁹ McKenzie, Proc. Nova Scotian Inst. Sci., vol. 20, 1939, p. 17.

Harvestfish *Peprilus alepidotus* (Linnaeus) 1766

STARFISH

Jordan and Evermann, 1896-1900, p. 996, as *Rhombus paru* (Linnaeus) in part.

Description.—The body of the harvestfish (not including the caudal peduncle) is almost as deep as it is long, and ovate in outline; its nose is rounded, mouth very small, and head very short. The outlines of its dorsal and anal fins afford the readiest field mark to separate it from its relative, the butterfish; both of these being very high and falcate in front, and continuing nearly straight, thence rearward (compare fig. 194 with fig. 192). The mucous pores, conspicuous in the butterfish, are lacking in the harvestfish. There is also a color difference between the two, the harvestfish being greenish silvery above, silvery sometimes tinged with yellow on its sides and belly, while the fins of some specimens are slightly dusky or yellowish. In all other respects (including size) it closely resembles the butterfish.

General range.—From Florida northward along the middle Atlantic Coast of North America; rarely straying north to Cape Cod, Mass., and to Cape Elizabeth, Maine; represented by a close ally (*Peprilus paru* Linnaeus 1758) in West Indian-Brazilian waters.³⁰

Occurrence in the Gulf of Maine.—This fish, although abundant to the southward, rarely strays as far north as the outer Cape Cod coast. A specimen taken at Monomoy Point by Dr. W. C. Kendall in 1896; 5 or 6 caught in floating traps at Richmond Island, off Cape Elizabeth, Maine, in July 1929;³¹ one from the Damariscotta River, Maine, in August 1933;³² and one taken at Race Point at the tip of Cape Cod, in October 1949,³³ are the only Gulf of Maine records of which we know.

³⁰ See Meek and Hildebrand (Field Mus. Nat. Hist., Zool. series, vol. 15, Pt. 2, p. 411, 1926) for discussion.

³¹ Reported to us by the late Walter H. Rich of the U. S. Bur. Fish.

³² MacCoy, Bull. 69, Boston Soc. Nat. Hist., 1933, p. 9.

³³ Reported to us by Edgar Arnold.

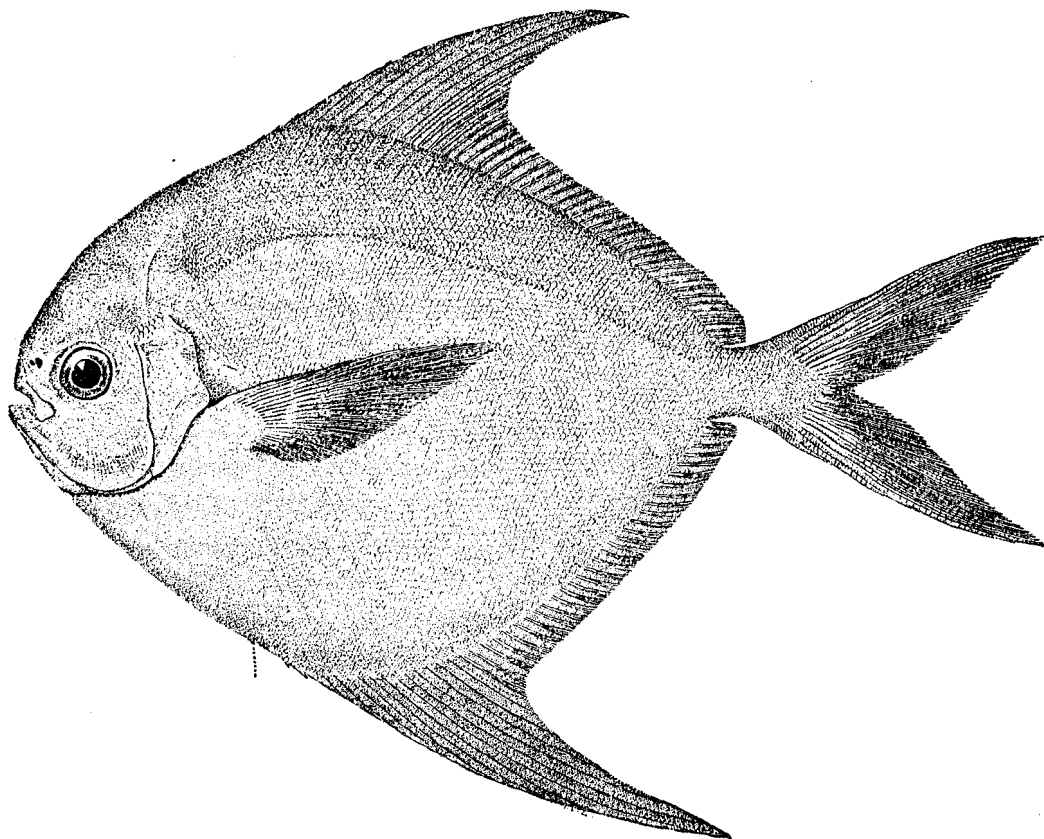


FIGURE 194.—Harvestfish (*Peprilus alepidotus*), New York. From Goode. Drawing by H. L. Todd.

THE RUDDERFISHES. FAMILY CENTROLOPHIDAE

The closest affinities of the rudderfishes are with the mackerel-like fishes. They have moderately stout bodies, short blunt snouts with convex profiles, and a moderately deep caudal peduncle without longitudinal keels. The single dorsal fin extends from over the pectorals to the caudal peduncle; the front part of the dorsal is spiny, either reduced to a few flexible spines covered over by the skin so that it is hard to find them, or represented by several detached spines so short that they might be overlooked, and preceding the much longer soft-rayed part of the dorsal. The tail fin is only slightly emarginate; the anal fin is similar to the dorsal in shape but much shorter; the ventrals are below the pectorals, and are smaller than the latter. The mouth is small, with small teeth in the jaws. Only two species are known off the Atlantic coast of the United States.

KEY TO GULF OF MAINE SPECIES

1. The single dorsal fin is preceded by 6-8 short detached spines; the sides of the head are scaly.....Barrelfish, p. 369
2. The dorsal fin is not preceded by any detached spines; there are no scales on the sides of the head.....Black ruff, p. 370

Barrelfish *Palinurichthys perciformis*
(Mitchill) 1818

LOGFISH; RUDDERFISH; BLACK PILOT

Jordan and Evermann, 1896-1900, p. 964.

Description.—The reduction of the spiny portion of the dorsal fin of the barrelfish to 6 to 8 short detached spines, with very small triangular fin membranes, closely followed by a long soft-rayed dorsal fin, marks the barrelfish from all other Gulf of Maine fishes, except for certain of the pompano tribe. The caudal fin of the barrelfish is only slightly emarginate instead of deeply forked and its caudal peduncle moderately stout and without keels instead of very slender. It suggests a tautog remotely in general appearance, especially in its rather stout body (about two-fifths as deep as long, not including the caudal fin), very bluntly rounded nose, convex forehead, and small mouth. But its rudimentary spiny dorsal fin and forked caudal fin are ready field marks to distinguish it. The soft dorsal fin (20 to 22 rays) arises about mid-way from tip of snout toward base of caudal fin; the anal (16 or 17 rays) somewhat farther back. Both these fins are moderately high and they taper slightly from front to rear. The anal is preceded by three short spines so nearly imbedded in the skin as to be hardly visible. Both the ventrals and the pectorals are large with rounded tips. The top of the head is scaleless but the sides of its head and the body are clothed with small rounded scales.

The presence of the dorsal fin-spines and the scaliness of the sides of its head distinguish it from its close relative the black ruff (fig. 196).

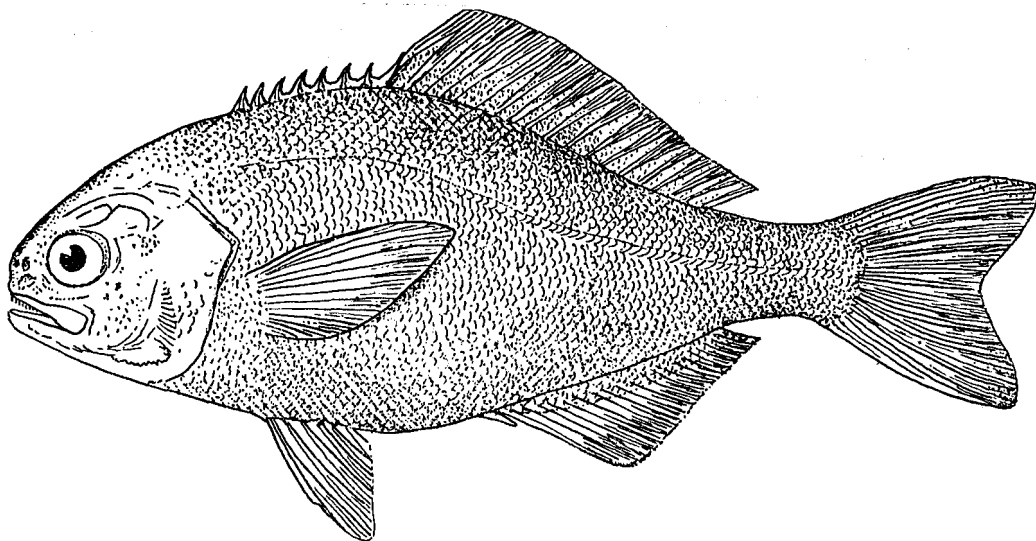


FIGURE 195.—Barrelfish (*Palinurichthys perciformis*). After DeKay.

Color.—Described as varying from blackish to green in life, and as either as dark below as above, or paling to bluish white on the belly, the latter variously mottled with darker dots and bars. It is said to change color to accord with its surroundings.

Size.—Maximum length 12 to 14 inches and about 1¼ pounds in weight, but most of those seen are smaller.

Habits.—The barrelfish owes its common name to its habit of congregating about floating spars and planks or any drifting wreckage, or inside of barrels or boxes, where it is easy to catch one in a dip net. Off southern New England they are often found under gulfweed, or under any other raft of drifting seaweed or eel grass (*Zostera*). And they sometimes gather about slow-moving vessels. Merriman³⁴ thinks its proper home is in the mid-depths offshore, but this is a question for the future.

It feeds on the sundry small crustaceans, barnacles, hydroids, young squids, small mollusks, and salpae, which it finds near or attached to its floating homes; on ctenophores; likewise on fish fry, the diet lists of specimens taken at Woods Hole including herring, mackerel, menhaden, launce, scup, and silversides.³⁵ Sometimes they contain seaweed, but we suspect that this is eaten for the animals attached to it, and not from a vegetarian taste.

Nothing is known of its breeding habits.

General range.—Atlantic Coast of North America, Cape Hatteras to outer Nova Scotia;³⁶ most plentiful south of Cape Cod. Probably it is

oceanic, as Merriman³⁷ suggests, and more widely distributed than the foregoing would suggest, for one was found in a drifting packing case off Penzance Harbor, Cornwall.

Occurrence in the Gulf of Maine.—The barrelfish is caught in some numbers in the traps near Woods Hole and to the westward, or is found drifting under mats of seaweed. They were unusually plentiful in Vineyard Sound, for example, in 1920.³⁸ But it is so rare a fish within the Gulf of Maine that we have never seen it there,³⁹ nor did Doctor Kendall find it on his various collecting trips along the Maine coast. In fact, the only published Gulf of Maine records for it that we have been able to find are one from Boston Harbor; one from Salem; one from Annisquam; one from Gloucester;⁴⁰ and one vaguely described as brought in from the fishing banks off the coast of Maine. We can now add one taken on the northern edge of Georges Bank by the trawler *Squall* on September 10, 1947.⁴¹

Black Ruff *Centrolophus niger* (Gmelin) 1789

Jordan and Evermann, 1896–1900, p. 963.

Description.—The black ruff resembles the pilot fish (p. 372) in its general body form more than it does its closer relative the barrel fish (p. 369), being moderately slender (a little more than ¼ as deep as it is long to base of tail fin), with very blunt snout, strongly convex forehead, and small mouth. But its body (about 2½ times as

³⁴ Trans. Connecticut Acad. Arts Sci., vol. 36, 1945, pp. 842–843.

³⁵ Notes by Vinal Edwards.

³⁶ According to Vladykov and McKenzie (Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 87) occasional specimens are caught off outer Nova Scotia in most summers. Recent records there are of one at Halifax, October 1924, and of another there September 1927 (Vladykov, Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 6).

³⁷ Trans. Connecticut Acad. Arts Sci., vol. 36, 1945, pp. 842–843.

³⁸ Smith, Copela, 1921, No. 91, pp. 9–10.

³⁹ Our own experience with this fish is limited to a single occasion, south of Nantucket, when several were seen about a drifting box.

⁴⁰ Reported by MacCoy, Bull. 67, Boston Soc. Nat. Hist., 1933, p. 9.

⁴¹ This specimen now in the Museum of Comparative Zoology, and was received through the kindness of J. Miggins of the U. S. Fish and Wildlife Service.

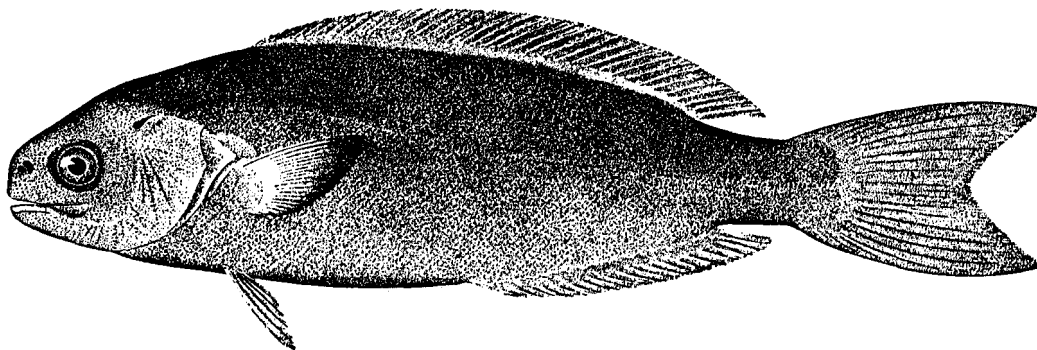


FIGURE 196.—Black ruff (*Centrolophus niger*), Dennis, Mass. From Goode and Bean. Drawing by S. F. Denton.

high as it is thick) is more flattened sidewise than that of the pilot fish; its caudal peduncle is much deeper, and has no lateral keels; its dorsal fin is considerably longer than that of the pilot fish, and there are no detached spines in front of its dorsal fin. The single dorsal fin of 3 flexible spines entirely covered over by skin and 35-38 soft rays reaches from over the pectoral fin to the caudal peduncle; the anal (3 spines concealed by skin and 20-22 soft rays) originates about under the midpoint of the dorsal and runs equally far back; both dorsal and anal fins are evenly graduated in outline from front to rear; and both are fleshy and scaly along their bases. Its ventral fins are about under the pectorals; pectorals and anals are both small; and the caudal is moderately forked.

Color.—Those we have seen (after a few weeks preservation in alcohol) are dark leaden-brown on back and sides, with the margins of the scales darkest, in so fine a pattern (because of the small size of the scales) that the general effect is sooty; the fins are darker, even, than the back; and the belly only a little paler. Other specimens have been described⁴² as brownish pink all over, or

brown, darkest above, some with irregular and obscure markings, either yellowish or dark blue.

Size.—Grows to about 2 feet in length.

General range.—Oceanic, and widespread in low and mid latitudes in the eastern North Atlantic; Madeira, the Azores, and the coasts of Spain north to the entrance to the English Channel, the Celtic Sea and southern Norway; also in the Mediterranean; and reported as a stray from Massachusetts and from Georges Bank.

Occurrence in the Gulf of Maine.—One specimen of this wanderer from Europe, about 12¼ inches long, was taken in a trap at North Truro, on Cape Cod Bay, September 6, 1890;⁴³ a second of 21½ inches was brought in from the northern edge of Georges Bank by the trawler *Thomas Whalen* in September 1936;⁴⁴ and a third of about 13 inches (330 mm.) to the fork of the tail was taken in a trap at North Truro June 23, 1951.⁴⁵

Another about 9 inches long was taken in 1888⁴⁶ at Dennis, Mass. But it is not known whether this record should be credited to our Gulf or to the southern coast of Massachusetts, since that township fronts both on Cape Cod Bay and on Nantucket Sound.

THE POMPANOS AND JACKS. FAMILY CARANGIDAE

The pompanos are allied to the mackerels; both have deeply forked tails, very slender caudal peduncles, and ventrals situated below the pectorals. And, mackerel-like, most of them have two dorsal fins, the first hard-spined, the second soft-rayed. But they are readily separable from the mackerels by the fact that their first (spiny) dorsal, if they have one, is much shorter than the second (soft rayed) while it may be reduced to a series of very short spines, or even lost altogether in old age. And, except for the leather jacket, they either lack the dorsal and anal finlets so characteristic

of the mackerel tribe, or have only one of each at most. They differ further from the mackerels in the number of vertebrae (only 24 as against upward of 30), and in that their premaxillary bones (fixed in the mackerels) are protractile (except in adult *Oligoplites*), while their anal fin is preceded by two free spines that may either take the form of a permanent finlet or may be lost in old age. Warm seas support a host of species, but none of them is more than an accidental stray to the Gulf of Maine.

KEY TO GULF OF MAINE POMPANOS

1. Rear parts of soft dorsal fin, from 7th ray backward, and of anal fin from 6th ray backward are so deeply indented between every two rays as to form a series of 12 to 14 nearly separate low finlets..... Leather jacket, p. 380
Rear parts of soft dorsal and of anal fins even-edged, not as series of finlets..... 2
2. Body very much flattened, sidewise; nearly or quite half as deep as it is long to base of caudal fin..... 3
Body moderately stout, less than two-fifths as deep as it is long to base of caudal fin..... 6
3. Back and belly rounded; pectoral fins reach not more than one-third the way back toward the base of the caudal fin..... True pompanos (genus *Trachinotus*)⁴⁷
Back and belly sharp-edged; pectoral fins reach at least half-way back toward the base of the caudal fin..... 4

⁴² Day, Fishes Great Britain, 1880-1884, vol. 1, p. 110.

⁴³ Reported by Bean, Proc. U. S. Nat. Mus., vol. 21, 1898, p. 639 and now in the U. S. National Museum.

⁴⁴ Reported by Bigelow and Schroeder, Copeia, 1937, p. 61.

⁴⁵ Received through the kindness of John Worthington of the Pond Village Cold Storage Co.

⁴⁶ Goode and Bean, Smithsonian Contrib. Knowl., vol. 30, 1895, p. 214.

⁴⁷ None of these southern fish have yet been reported within our Gulf.

4. Second dorsal and anal fins are conspicuously falcate in shape, very high in front, tapering abruptly toward the rear; there are no enlarged bony plates along the lateral line on the caudal peduncle..... Lookdown, p. 379
- Second dorsal and anal fins only moderately high in front, tapering rearward gradually; caudal peduncle with weak bony plates along the lateral line..... 5
5. Upper anterior profile of head concave; ventral fins very small; anterior rays of soft dorsal and of anal not elongate..... Moonfish, p. 378
- Upper anterior profile of head convex; ventral fins as long as head or longer; anterior rays of soft dorsal and anal fins elongate, threadlike..... Thread fin (probably the young of the Cuban jack), p. 381
6. There is only one well-developed dorsal fin (the soft rayed), the first (spiny) dorsal being reduced to a few short spines, without separate fin membranes..... Pilot fish, p. 372
- There are two well-developed dorsal fins though the first (spiny) is smaller than the second..... 7
7. There is a detached finlet behind the dorsal fin and one behind the anal fin..... Mackerel scad, p. 374
- There are no finlets behind the dorsal and anal fins..... 8
8. There is no finlet in front of the anal fin; and the anal is only about one-half as long as the soft dorsal..... Rudderfish, p. 373
- There is a finlet of 2 short spines in front of the anal fin, and the anal fin is nearly or quite as long as the soft dorsal..... 9
9. The forward part of the lateral line is scarcely arched..... Goggle-eyed scad, p. 377
- The forward part of the lateral line is strongly arched..... 10
10. The breast is naked, except for a small patch of scales in front of the ventral fins..... Crevalle, p. 375
- The breast is covered with scales..... 11
11. The body (to base of tail) is not more than 3 times as long as it is deep; the soft dorsal fin has only 23 to 25 rays..... Hardtail, p. 376
- The body to base of tail is more than 3 times as long as it is deep; the soft dorsal fin has 30 to 35 rays..... Saurel, p. 377

Pilotfish *Naucrates ductor* (Linnaeus) 1758

RUDDERFISH; SHARK PILOT

Jordan and Evermann, 1896-1900, p. 900.

Description.—The pilotfish is one of the more slender carangids (body about one-fourth as deep as it is long), round-sided, about two-thirds as thick as it is deep, and somewhat mackerel-like in appearance though with a blunter, more rounded nose and smaller mouth, while its caudal peduncle is conspicuously keeled on either side like that of a bonito. But its long second dorsal fin separates it from all the mackerel tribe. The first dorsal

fin is reduced to three or four short inconspicuous spines, which are connected by a membrane in young fish but this membrane is lost with growth. The second dorsal (26 or 27 soft rays) is weakly concave in outline and originates midway between tip of snout and base of caudal fin. The anal fin is similar to the second dorsal in form, but is only about half as long (16 or 17 rays), and is preceded by two very short spines. It resembles the rudderfish in this but the first dorsal of the latter is well developed and has 7 spines instead of only 3 or 4. The ventrals, situated far forward under the pectorals, are about as large as the latter. The caudal is large and deeply forked. The edge of

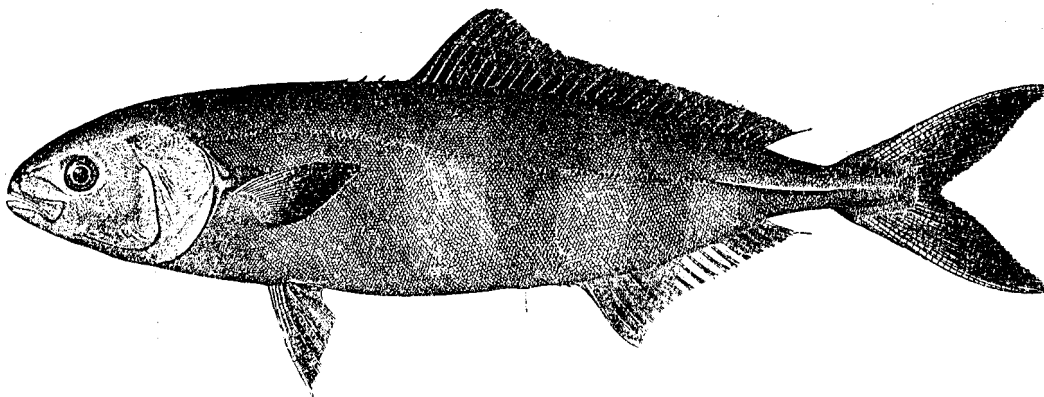


FIGURE 197.—Pilotfish (*Naucrates ductor*), about 13 inches long, New Bedford, Mass. After Goode. Drawing by H. L. Todd.

the gill cover is rounded in the adult but it bears a spine in young fry.

Color.—Bluish, cross-banded with 5 to 7 dark bands, 2 or 3 of which run up on the dorsal fin and down on the anal. The outer margins of caudal, ventral, and pectoral fins are nearly black. The caudal is white-tipped.

Size.—Maximum length about 2 feet.

General range.—A tropical fish of the high seas, rarely straying as far north as outer Nova Scotia.⁴⁸

Occurrence in the Gulf of Maine.—The only records of this species from within the Gulf are of one taken in a mackerel net in Provincetown Harbor in October 1858, the fish probably having followed a whale ship that arrived a few days previous; one caught near Seguin Island in 1906; one off Portland in September 1921; one taken from a mackerel net at Provincetown in August 1924; three in 1929; one of them from the northern edge of Georges Bank in October, the other two from the South Channel to the southeast of Cape Cod (one in August, one in November); one off Portland, July 1931; and one picked up in a trawl on the northern slope of Georges Bank (lat. 42°10' N., long. 66°32' W.) October 10, 1933.⁴⁹ We need only add that this is the fish that so commonly attends sharks in tropic seas, either picking up a living from the scraps left by the latter, or feeding on the parasites with which their protectors are infested. They often follow sailing vessels, also.

⁴⁸ Vladykov (Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 6), reports two specimens taken on Sable Island Bank, and one from Sambro near Halifax, during the period 1932-34.

⁴⁹ Reported to us by W. C. Neville of the U. S. Bur. Fish.

Rudderfish *Seriola zonata* (Mitchill) 1815.⁵⁰

AMBERJACK; PILOTFISH

Jordan and Evermann, 1896-1900, p. 902.

Description.—The rudderfish is deeper bodied, relatively, than the pilotfish (body about three and one-half times as long as deep), so much flattened sidewise that it is almost as thin as a butterfish (p. 363), and with a pointed nose. Its first (spiny) dorsal fin is well developed, with 7 spines. There are 36 to 38 rays in the second dorsal fin (only 26 or 27 in the pilotfish) and the ventrals are relatively much longer than in the pilot. In young fry of 2 to 3 inches the second dorsal originates a little in front of the tips of the pectorals, but it originates slightly behind the tips of the pectorals by the time the fish has grown to 8 or 9 inches, and still farther back in larger specimens.⁵¹

The anal fin (20 or 21 rays) is a little more than half as long as the second dorsal in the rudderfish, as it is in the pilotfish also. And in young fish it is preceded by one or two short spines which adults lack.

The ventrals are a little longer than the pectorals, and more pointed in large fish than in small; the caudal is deeply forked, its slender peduncle with a longitudinal keel on each side; the mouth gapes back to the forward margin of the eye and is armed with broad bands of hairlike teeth. The body is clad with small scales.

⁵⁰ The interrelationships of the several *Seriolas* that have been described from our South Atlantic coast still remain in doubt.

⁵¹ We have examined specimens ranging from 3 to 9 inches in length taken in Cape Cod Bay, at Woods Hole, New Bedford, and other localities. Storer's illustration, reproduced here, was of a 2-inch fish.

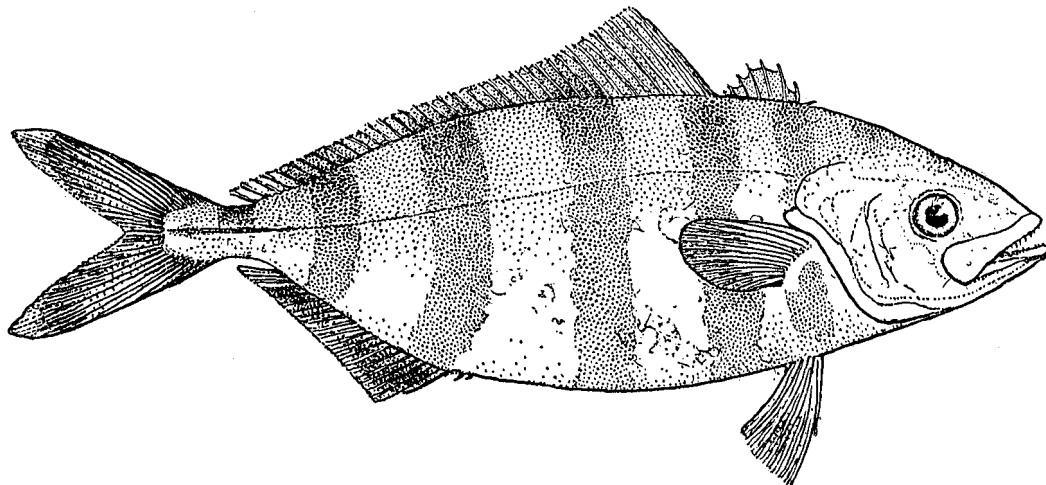


FIGURE 198.—Rudderfish (*Seriola zonata*), young, in striped stage, Wellfleet, Mass. After Storer.

Color.—Bluish or silvery brown above, paler on the sides, and white below. In young fish (no large ones have been reported from within our limits) the sides are conspicuously crossbarred with 5 or 6 broad dark blue or brown bands, the last 4 run up on the dorsal fin and the last 2 or 3 down on the anal fin. There also is a dark band running obliquely from the first dorsal to the eye in some cases. All of these bands fade with growth, however, to disappear in large fish. The first dorsal is black, the anal white at the base, the ventrals black above, pale below, and the caudal dusky green, with white tips.⁵²

Size.—Maximum length about 3 feet.

General range.—Atlantic Coast of America, Halifax, Nova Scotia,⁵³ to Gulf of Mexico.

Occurrence in the Gulf of Maine.—The rudderfish is ordinarily a rare visitor to the Gulf of Maine, and most of those that have been seen there have been small, made conspicuous by their crossbarred pattern. Two were taken at Wellfleet in 1844 and 1849 (mentioned by Storer); another at Beverly in May 1866; one five inches long at Provincetown in 1870; and one at Salem sometime prior to 1879. A gap then follows in the record until September 1921, when one was caught by an angler fishing for smelt at a wharf in Portland Harbor.⁵⁴ Another, of 5½ inches was caught on September 22, 1929, also by an angler fishing for smelt; one of 6¼ inches was taken on Nantucket Shoals August 1, 1930;⁵⁵ several were reported in 1949 at Boothbay Harbor, the Sheepscot River, and at Gloucester.⁵⁶ However, in the

summer and fall of the years 1949–51 large numbers of them were caught or observed in and around the traps at Barnstable, Cape Cod Bay, and one day's record catch by one set of pound nets, within this period, amounted to two barrels⁵⁷ indicating that, in some years, large schools of rudderfish are sometimes present in the latter region.

Small fry 1½ to 7 inches long are regular summer visitors at Woods Hole.

Mackerel scad *Decapterus macarellus* (Cuvier and Valenciennes) 1833

Jordan and Evermann, 1896–1900, p. 909.

Description.—This scad is easily recognized among such of its tribe as are known from our Gulf by the presence of a small detached finlet between the second dorsal and the base of the caudal fin with another similar to it behind the anal.⁵⁸ Furthermore, it is more slender than most of the other pompanos; its body is only about one-fifth as deep as it is long, and fusiform like the mackerel. But the great length of the second dorsal fin and the fact that there is only one dorsal finlet and one anal finlet would separate a mackerel scad from a mackerel at a glance. The mouth of the scad is smaller, and its premaxillary bones are protractile. Its triangular first dorsal fin (8 spines) originates over the middle of the pectorals. Its second dorsal (about 34 rays) is

⁵² Information supplied by Frank Mather who was informed of the 1949–1951 catches at Barnstable by Capt. John Vettorino in whose traps many of these rudderfish were caught.

⁵³ A second scad, the round robin (*Decapterus punctatus*), similarly characterized, is known as far north as the Woods Hole region. It has 40 or more scutes or shieldlike scales along the lateral line, instead of only about 30 or 31; its jaws are toothed, and it is spotted along the lateral line, characters that separate it from the mackerel scad.

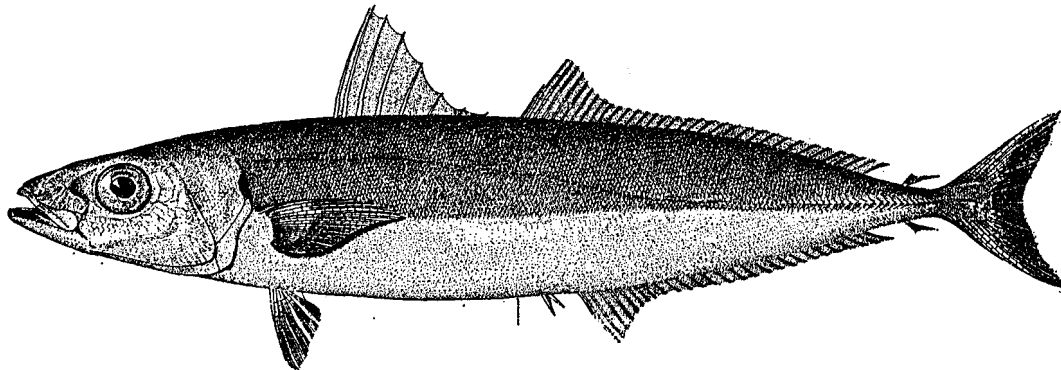


FIGURE 199.—Mackerel scad (*Decapterus macarellus*), Woods Hole. After Goode. Drawing by H. L. Todd.

⁵⁴ We have no color notes from life.

⁵⁵ Reported by Leim, Proc. Nova Scotian Inst. Sci., vol. 17, 1930, No. IV, p. xlv1, as *S. dumerili*.

⁵⁶ Reported to us by Walter H. Rich.

⁵⁷ Reported by Firth, Bull. 61, Boston Soc. Nat. Hist.; 1931, p. 12.

⁵⁸ Reported by Scattergood, Trefethen, and Coffin, Copela, 1951, p. 298.

separated from the first dorsal only by a very short space and extends back nearly to the base of the caudal. Its anal fin is similar to its second dorsal in shape but is shorter (about 28 rays), originates about under the seventh or eighth ray of the second dorsal, and is preceded by 2 short stout spines. The ventrals are shorter than the pectorals and situated under them.

The tail of the scad is less deeply forked than in most of the pompanos. In place of fleshy keels on the caudal peduncle, the rear half of its lateral line is armed with a series of 31 keeled shields, largest on the peduncle, and all of them much larger than the ordinary scales, a very noticeable character.

Color.—Described as slate blue or leaden above, silvery below, with a small black spot on the margin of the gill cover and with the axil of the pectoral black. We have not seen it alive.

Size.—Maximum length about 1 foot.

General range.—Warm parts of the Atlantic, rarely straying northward to the Gulf of Maine and to Nova Scotia.

Occurrence in the Gulf of Maine.—A specimen caught with smelt in Casco Bay, Maine, in October 1920, and another, 7 inches long, taken in a trap at Richmond Island, off Cape Elizabeth in September 1931, are the only Gulf of Maine records, though it has been taken at Canso and at Port Mouton Bay, Nova Scotia.⁶³ But being common in the autumn about Woods Hole, where as many as 10 barrels have been taken from one

trap haul, it would not be surprising to find it north of Cape Cod any summer.

Crevalle *Caranx hippos* (Linnaeus) 1766.

JACK

Jordan and Evermann, 1896-1900, p. 920

Description.—The presence of a well-developed first dorsal fin (8 spines) combined with an anal (about 17 rays, preceded by 2 short detached spines) nearly as long as the second dorsal (about 20 rays), but no detached finlets, separates this particular jack from all other pompanos known from the Gulf, except the goggle-eyed scad (p. 377), hardtail (p. 376), and the saurel (p. 377). Its arched lateral line and the presence of (usually) two pairs of small but plainly visible canine teeth in the lower jaw distinguish it from the goggle eye; its naked breast and its canine teeth from the hardtail and saurel. The dorsal profile, too, of the head of the crevalle (fig. 200) is characteristic, and the long scimitar-shaped pectoral fins are a convenient field mark to separate it and other members of its immediate tribe,⁶⁴ from the pilot-fish, rudderfish, and mackerel scad, in which the pectorals are short and blunter. We need only call attention further to its deeply forked tail; to the row of keeled shields along either side of its caudal peduncle; to its flattened oblong form (body

⁶⁴ The yellow tail (*Chloroscombrus chrysurus*), another species in this group straggles northward at times and, sometime, may be taken within the Gulf of Maine. It may be distinguished from the crevalle, hardtail, saurel, and big-eyed scad by the fact that its lateral line is wholly unarmed, whereas in these species it is armed with bony plates, along part of its length at least.

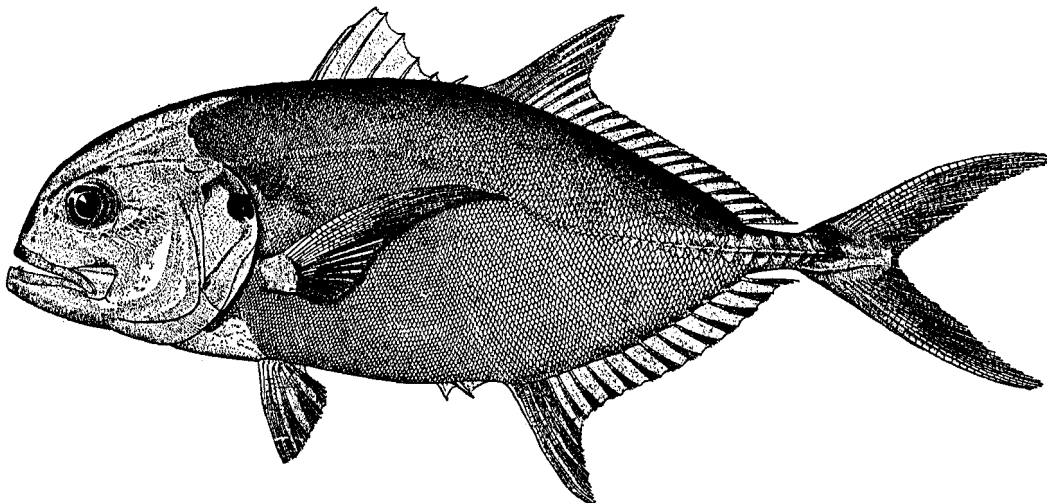


FIGURE 200.—Crevalle, or Jack (*Caranx hippos*), Woods Hole, Mass. From Goode. Drawing by H. L. Todd.

⁶³ This last fish, a 2½-inch specimen, caught October 10, 1928, was recorded by Leim (Proc. Nova Scotian Inst. Sci., vol. 17, No. 4, 1930, p. xlvi).

only about two and one-half times as long as deep, but with caudal peduncle as slender as that of a mackerel), and to its blunt head.

Color.—Greenish or greenish bronze above with golden sides; silvery below, sometimes with yellow blotches. There is a large black blotch on the gill cover, a fainter dark spot on the lower rays of the pectorals (in adults), and a black blotch in their axils. The fins are more or less yellowish; the edge of the dorsals is black. Very young fish have 5 or 6 dark cross-bars.

Size.—Maximum recorded weight 36 pounds.

General range.—Warm seas; abundant on both coasts of America; northward as a stray to the outer coast of Nova Scotia;⁶⁵ also among the East Indies.

Occurrence in the Gulf of Maine.—We know of only two records of this southern fish from our Gulf, one specimen picked up on Lynn Beach on the shore of Massachusetts Bay during the summer of 1847, and a second taken at Provincetown in 1933.⁶⁶ But it is a regular summer visitor at Woods Hole though it is not common there.

Commercial importance.—A famous game fish, but of minor commercial importance.

Hardtail *Caranx crysos* (Mitchill) 1815

YELLOW JACK; RUNNER; YELLOW MACKEREL

Jordan and Evermann, 1896-1900, p. 921.

Description.—The hardtail resembles the crevalle, saurel, and goggle-eyed scad in the rel-

⁶⁵ Reported near Halifax, Nova Scotia, by Vladykov (Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 4).

⁶⁶ Reported by MacCoy, Bull. 70, Boston Soc. Nat. History, 1934, p. 6.

ative sizes and arrangement of its fins, in its deeply forked tail, in its slender caudal peduncle and in the presence of a row of bony shields along at least the rear part of its lateral line. But its scaly breast, the lack of canine teeth in its lower jaw, and the lack of a black spot on the pectoral fin separates it from the first of these; the fact that the bony plates increase in size, passing rearward along the lateral line, marks it off from the saurel, and its strongly arched lateral line from the goggle eye. Its first dorsal fin has 8 spines, its second, one spine followed by 23 to 25 rays, while its anal consists of a finlet of 2 short spines followed, after a distinct gap, by the soft portion with 19 to 21 rays.

Color.—Greenish bronze above, golden or silvery below. The fins may show dusky cloudings, and there usually is a dark spot on the gill cover, near the margin, but none on the pectoral fin. Young fry are more or less distinctly cross-banded on the sides, but these bars disappear with growth.

Size.—Maximum weight about 4 pounds and length about 22 inches. Northern examples are seldom more than a foot long.

General range.—Atlantic coast of America, Brazil to Rhode Island and to Nantucket Sound regularly, and as far northward as outer Nova Scotia as a stray; represented by a closely allied species in the Pacific.

Occurrence in the Gulf of Maine.—The fact that this fish has been reported at Chatham on Cape Cod in 1933,⁶⁷ at Provincetown, in Boston Harbor,

⁶⁷ MacCoy, Bull. 70, Boston Soc. Nat. History, 1934, p. 6.

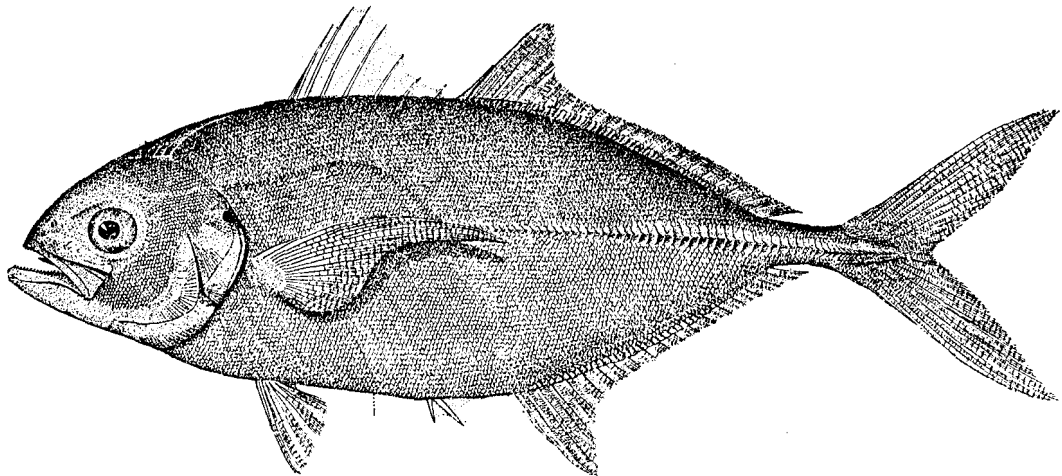


FIGURE 201.—Hardtail (*Caranx crysos*). Woods Hole. From Goode. Drawing by H. L. Todd.

off Gloucester,⁶⁸ and in Ipswich Bay,⁶⁹ and that 11 specimens, about 6 to 8 inches long, were taken in a fish trap at Barnstable on the shore of Cape Cod Bay on September 6, 1950, shows that it is more likely to round Cape Cod than is the crevalle. It is also reported from outer Nova Scotia.⁷⁰ Young fish are not rare about Woods Hole and thence westward from July to November.

Saurel *Trachurus trachurus* (Linnaeus) 1758

ROUGH SCAD

Jordan and Evermann, 1899-1900, p. 910.⁷¹

Description.—The saurel is distinguishable from all allied species yet known from New England waters by having about 75 bony plates along its lateral lines, as contrasted with about 30 or fewer in other Gulf of Maine carangids. It is a somewhat deeper fish than the mackerel scad but more slender than the hardtail or the crevalle, its body (to the base of tail) being about 3½ times as long as it is deep. Its first dorsal fin, of 8 spines, is closely followed by the long second dorsal of 25 to 30 soft rays. Its soft anal, opposite the second dorsal, has 24 to 26 rays, and is preceded by two small detached spines. The tail is deeply forked

⁶⁸ One netted September 18, 1878.

⁶⁹ Specimen now in the collection of the Boston Society of Natural History.

⁷⁰ A 5-inch specimen is reported from Port Mouton by Leim (Proc. Nova Scotian Inst. Sci., vol. 17, 1930, No. 4, p. xlvii), and small ones from Pubnico, and near Halifax, by Vladykov (Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 4).

⁷¹ Nichols (Bull. Amer. Mus. Nat. Hist., vol. 42, 1920, p. 479) considers the western Atlantic saurel distinct from the eastern Atlantic saurel and has proposed the name *lathamii* for it. But this separation has not been adopted generally.

Color.—Described as bluish green above, silvery below, with a black spot on the edge of the gill cover above its rear angle.

Size.—Length about one foot.

General range.—Known from nearly all warm and temperate seas, sometimes common off the Florida Keys. A few have been recorded from the vicinity of New York, one from Newport, R. I., and three from the Gulf of Maine.

Occurrence in the Gulf of Maine.—One specimen of this rare fish was taken in Casco Bay on August 12, a second at Castine, Maine, on October 15, 1930,⁷² and a third at Sandwich, Mass., on Cape Cod Bay in the summer of 1950.⁷³

Goggle-eyed scad *Trachurops crumenophthalmus* (Bloch) 1793

GOGGLER; GOGGLE EYE JACK

Jordan and Evermann, 1896-1900, p. 911.

Description.—This scad resembles the mackerel scad (p. 374) in general appearance, but it has larger eyes and lacks the detached finlets behind the dorsal and anal fins. Its high first dorsal fin separates it readily from the pilotfish (p. 372), while the fact that the forward half of its lateral line is only slightly arched instead of strongly so obviates any danger of confusing it with the crevalle (p. 375), the hardtail (p. 376), or the saurel (p. 377). Its first dorsal fin has 8 spines, its second dorsal is of 1 spine followed by 23 to 26 soft rays;

⁷² Kendall, Bull. No. 58, Boston Soc. of Nat. Hist., 1931, p. 11.

⁷³ We received this specimen from Capt. Benjamin Morrow and it is now in the Museum of Comparative Zoology.

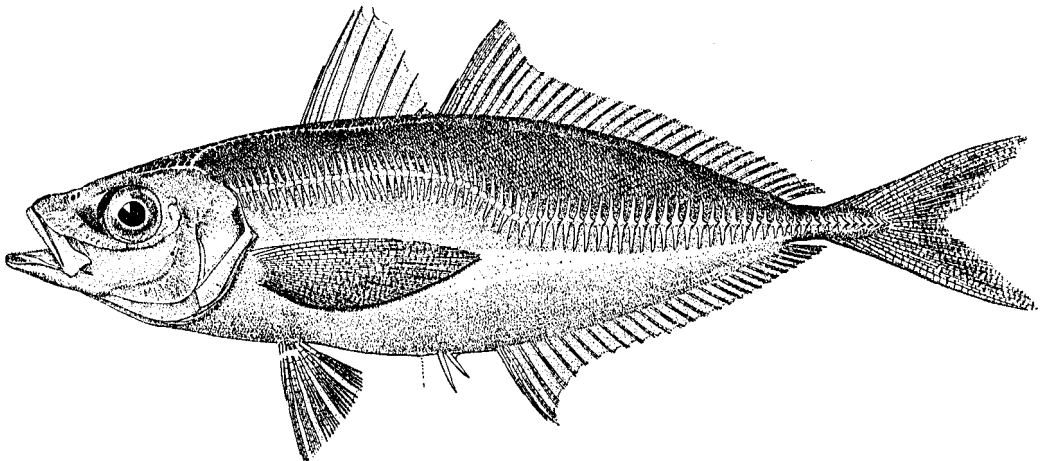


FIGURE 202.—Saurel (*Trachurus trachurus*), Rhode Island. From Goode. Drawing by H. L. Todd.

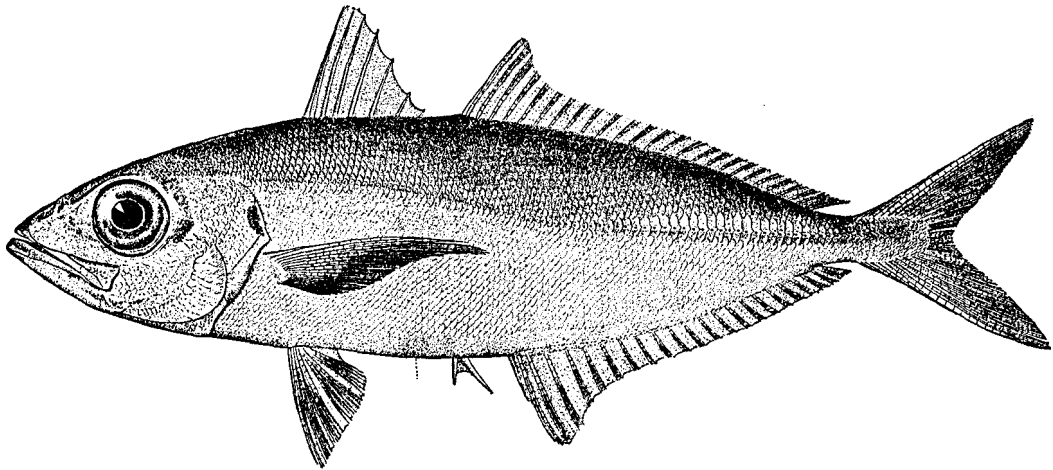


FIGURE 203.—Goggle-eyed scad (*Trachurops crumenophthalmus*), Woods Hole. From Goode. Drawing by H. L. Todd.

its anal fin has 1 spine and 20 to 23 rays, and is preceded by 2 stout detached spines. Its caudal is forked. Its ventrals originate a little behind the pectorals which reach nearly or quite as far back as its vent. Its entire breast is scaly, as are parts of its head.

Color.—Bluish above, silvery below. The fins, snout, and tip of the lower jaw have dusky markings.

Size.—Grows to a length of about 2 feet.

General range.—Cosmopolitan in warm seas, straying as far northward on our Atlantic Coast as Cape Breton, Nova Scotia.⁷⁴

Occurrence in the Gulf of Maine.—The only positive records of this species in our Gulf are of one 5¾ inches long taken in a trap at Provincetown on August 27, 1930;⁷⁵ a second 8 miles off Chatham, Cape Cod;⁷⁶ and a third from Sandwich, on Cape Cod Bay, in the summer of 1950.⁷⁷ It may be expected to round Cape Cod from time to time, for it is taken in summer and fall as far northward and eastward as Woods Hole.

Moonfish *Vomer setapinnis* (Mitchill) 1815

SHINER; HORSEFISH; BLUNTNOSE; DOLLARFISH

Jordan and Evermann, 1896–1900, p. 934.

Description.—The very deep, thin, sharp-edged body of the moonfish (adults are scarcely twice as

long as deep, and young fry even deeper, relatively), tapering to a slender caudal peduncle, and the concave upper anterior profile of its head, are enough to separate it at a glance from pilotfish, scad, crevalle, hardtail, saurel, or goggle eye; its very low dorsal and anal fins distinguish it from the lookdown (p. 379), which is of something the same shape (cf. fig. 204 with fig. 205). Its minute ventral fins, soft dorsal fin and anal fin which are nearly even in height from end to end, separate it from the threadfin (p. 381), and from the Cuban jack (*Hynnix cubensis*), now thought to be the adult of the threadfin (p. 381).

The first dorsal of the adult moonfish is reduced to 8 very short, inconspicuous, detached spines, but the first two of these are prolonged and filamentous in young fry. Its second dorsal fin (21 to 23 rays) and its anal fin (17 to 19 rays) are about equal in length, both of them low and tapering very slightly from front to rear. In very small fish the second to fourth rays of the second dorsal fin are more or less prolonged, and the anal fin is preceded by 3 or 4 short detached spines which are not to be seen in the adult. The ventrals are so small that they are likely to be overlooked except in young fry, in which the ventral rays are more or less filamentous as are the dorsal spines. The pectorals are scythe shaped. The scales along the lateral line are not large enough to be conspicuous, and the teeth are very small. There are no detached finlets, dorsal or anal.

Color.—Bluish green above, bright silvery on the sides. The second dorsal fin is plain pale greyish, sometimes light yellow at its base; the

⁷⁴ Reported from Canso by Cornish, *Contrib. Canadian Biol.* (1903–1905) 1907, p. 85. A. H. Leim advises us that a specimen 145 mm. long was taken off Centre East Pubnico, Nova Scotia, September 12, 1951.

⁷⁵ Firth, *Bull.* 61 *Boston Soc. Nat. Hist.*, 1931, p. 11.

⁷⁶ MacCoy, *Bull.* 70, *Boston Soc. Nat. Hist.*, 1934, p. 6.

⁷⁷ This specimen was received from Capt. Benjamin Morrow and is now in the Museum of Comparative Zoology.

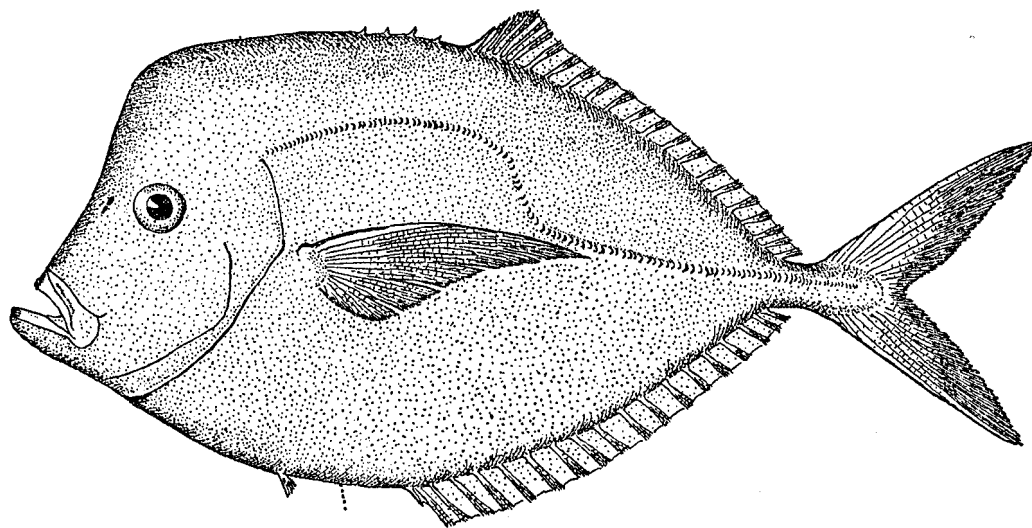


FIGURE 204.—Moonfish (*Vomer setapinnis*). After Goode. Original drawing by H. L. Todd.

caudal is greenish yellow; the pectorals light yellow or dusky greenish.

Size.—Said to reach 1 foot in length, but most of them are less than 9 inches long.

General range.—Warm seas off the east coast of America from Uruguay to Cape Cod, straying to Nova Scotia; common from Chesapeake Bay southward.

Occurrence in the Gulf of Maine.—This waif from warmer waters has been recorded from the South Channel off Cape Cod (one specimen 1¼ inches long); off Cape Cod (60 miles south by east from Highland Light), where one was taken in a mackerel seine, August 23, 1929;⁷⁸ from Gloucester (several specimens); from Magnolia, Danvers, Salem, and South Boston (a specimen 2 inches long) around Massachusetts Bay; from Saco Beach (fry of about 1 to 3 inches); and from Casco Bay in Maine. It has even been reported once or twice as far east as Liverpool and Halifax, Nova Scotia.⁷⁹ Thus it appears to reach our Gulf rather more often than any of its relatives do; not often enough, however, for most of the fishermen of whom we have inquired to know it north of Cape Cod. It appears more often (if irregularly) at Woods Hole, where young fish are sometimes common in August and September.

Lookdown *Selene vomer* (Linnaeus) 1758

HORSEHEAD; MOONFISH

Jordan and Evermann, 1895–1900, p. 935.

Description.—The very high second dorsal (about 22 rays) and anal fins (about 20 rays) of the lookdown, and their peculiar falcate outline with the second ray much the longest and the next 4 or 5 rays successively shorter make distinction easy between it and the moonfish. And its peculiar form is hardly less characteristic, for it shares with the moonfish a deep, rhomboid, but very thin flat body (the trunk is only about one and one-quarter times as long as deep), abruptly truncate in front, with slightly concave upper anterior profile, and tapering rearward to a slender caudal peduncle. The mouth is set so low and the eye so high that the expression of its face is very characteristic. When adult the first dorsal is reduced to 7 or 8 short inconspicuous spines, only the first 3 of which are connected by a membrane, and the ventrals are very small; but some of the spines of the first dorsal are very long in fry up to 4 or 5 inches in length, the ventrals are much longer than in the adults, and the anal fin is preceded by two short detached spines that disappear with growth. The caudal fin is deeply forked like that of other pompanos, and the pectorals are sharp pointed and falciform, reaching back behind the middle of the second dorsal fin.

Color.—Small specimens, and northern strays usually are small, are silvery above as well as

⁷⁸ Reported by Firth, Bull. 61, Boston Society Natural History, 1931, p. 12.

⁷⁹ Leim (Proc. Nova Scotian Inst. Sci., vol. 17, No. 4, 1950, p. xlv); Vladikov (Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 8).

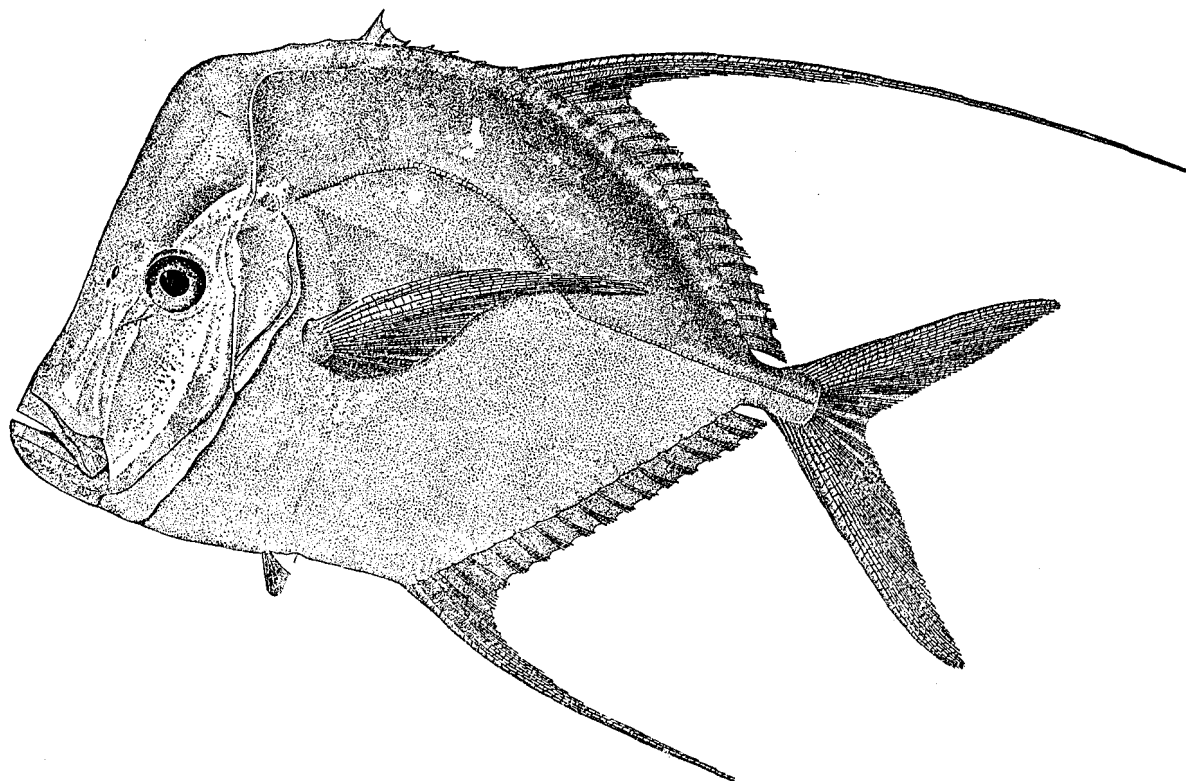


FIGURE 205.—Lookdown (*Selene vomer*). From Goode. Drawing by H. L. Todd.

below, with the ground tint of the back leaden; the sides are barred with several crossbands, variously described as dark or golden. But these bands fade out with growth.

Size.—Reaches a weight of about 2 pounds.

General range.—Warm waters on the east and west coasts of America, north rarely to Cape Cod, straying to the Gulf of Maine and to Nova Scotia;⁸⁰ common from Chesapeake Bay southward.

Occurrence in the Gulf of Maine.—There were only three records for the lookdown in our Gulf up to 1933; two of them for Casco Bay, the third for Boston Harbor (Dorchester). But many small ones were reported from the traps at the mouth of Casco Bay during that autumn, one from Beverly on the north shore of Massachusetts Bay, and one from North Truro on Cape Cod. Evidently this was an unusual incursion, for no one would be apt to overlook so bizarre a straggler from the south.

⁸⁰ Jones (Proc. and Trans. Nova Scotian Inst. Sci., vol. 5, App., 1879, p. 89) and Honeyman (Trans. Nova Scotian Inst. Sci., vol. 6, 1886, p. 328) report young fry as occasionally found in the shore waters of Nova Scotia, presumably along the outer coast, for tropical fishes are taken oftener there than along the Gulf of Maine shore of the Province.

Leatherjacket *Oligoplites saurus* (Bloch and Schneider) 1801

Jordan and Evermann, 1896–1900, p. 898.

Description.—The most interesting character of the leather jacket, and one which places it at a glance, is that the rear part of its soft dorsal fin back from the 7th ray, and also its anal fin back from the 5th ray, is broken, as it were, into a series of 12 low nearly separate finlets, the ray in each of which is subdivided at the tip like the hairs of a little brush. We need only note further that its body is about $3\frac{1}{2}$ times as long as it is deep, very strongly flattened sidewise, and thin, being only about one-third as thick as it is deep; its upper jaw bone reaches back about as far as the rear edge of the eye; its snout is moderately pointed; its caudal peduncle very slender, with a low, inconspicuous keel on either side. Its first dorsal fin is reduced to about 5 separate spines, each with small fin membrane and its second dorsal has about 20 rays; its soft anal fin, also of about 20 rays, is preceded by two stout and conspicuous spines, forming, together, a separate finlet. Its lateral line is nearly straight, and its

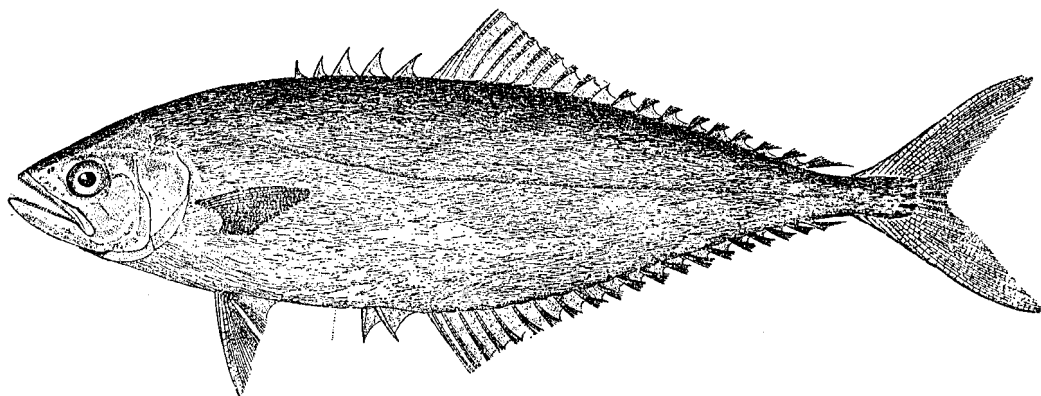


FIGURE 206.—Leatherjacket (*Oligoplites saurus*), Marthas Vineyard. From Jordan and Evermann. Drawing by H. L. Todd.

scales are very small, and imbedded in the skin, which is corrugated with a great number of short, fine, longitudinal ridges, giving it a leathery appearance, hence its common name.

Color.—Bluish above, silvery below, with yellow fins.

Size.—The largest are about 12 inches long.

General range.—Common on both coasts of tropical America; northward to New York and southern Massachusetts (Woods Hole), reaching the southwestern part of the Gulf of Maine as a stray.

Occurrence in the Gulf of Maine.—The only record of this southern fish within the Gulf is of one taken in a trap off the outer beach at Chatham, Cape Cod.

Threadfin *Alectis crinitus* (Mitchill) 1826 ⁸¹

Jordan and Evermann, 1896–1900, p. 931, as *Alectis ciliaris* (Bloch 1788).

Description.—The combination of a head strongly convex in dorsal profile, with the fact that the first few rays of its soft dorsal fin, and of its anal fin also, are extremely long, and threadlike, places the threadfin at a glance among the carangoids of our northeastern coast. On small fish these threadlike rays are considerably longer than trunk and tail combined, but they shorten with age, probably to be entirely lost. The trunk of the threadfin is nearly as high as it is long (to the caudal peduncle), the dorsal profile of its head is strongly convex and it is strongly flattened side-

wise. It has one dorsal fin of 1 stiff ray and about 19 soft rays, preceded by 6 short, separate, inconspicuous spines; the anal has 1 stiff ray and 16 soft rays, and is preceded by 2 spines so short that they are likely to be overlooked. Its lateral line is strongly arched over the pectoral; and the rear part armed with a series of bony platelike scales; the tail fin is deeply forked and the ventrals are larger than in most other carangoids. The pectorals are about as long as the head.

Color.—Upper surface bluish, the sides silvery, with traces of darker bars and blotches that tend to disappear with age; the prolonged parts of the dorsal and anal fins are bluish black; ventral fins mostly black; the fins otherwise more or less yellowish.

Size.—Specimens with the long threadlike fin rays have been reported up to about 7 inches long, in West Indian and Atlantic United States waters. But it now seems very probable that these are the young of the Cuban Jack (*Hynnys cubensis* Poey 1860). Their transformation consists chiefly in losing the filamentous fin rays; in a decrease in the depth of the body relative to its length; in a very considerable decrease in the relative size of the ventral fins; and in the assumption of a more falcate shape by the pectorals.

General range.—The threadfin (or threadfin stage of the Cuban Jack), is known on both coasts of tropical America; it strays northward on the Atlantic coast to southern Massachusetts, and it has been reported once from the Gulf of Maine. The adult Cuban Jack has not been reported north of southern Florida. ⁸²

⁸¹ We follow Smith (Copela, 1938, p. 146) in using the name *crinitus* Mitchill 1826, proposed for a specimen taken near Block Island, R. I., rather than *ciliaris* Bloch 1788 (type locality East Indies), awaiting final decision as to the true relationship between the threadfins of different oceans.

⁸² We have seen one taken at Key West, and there is one from the east coast of Florida in the Museum of Comparative Zoology.

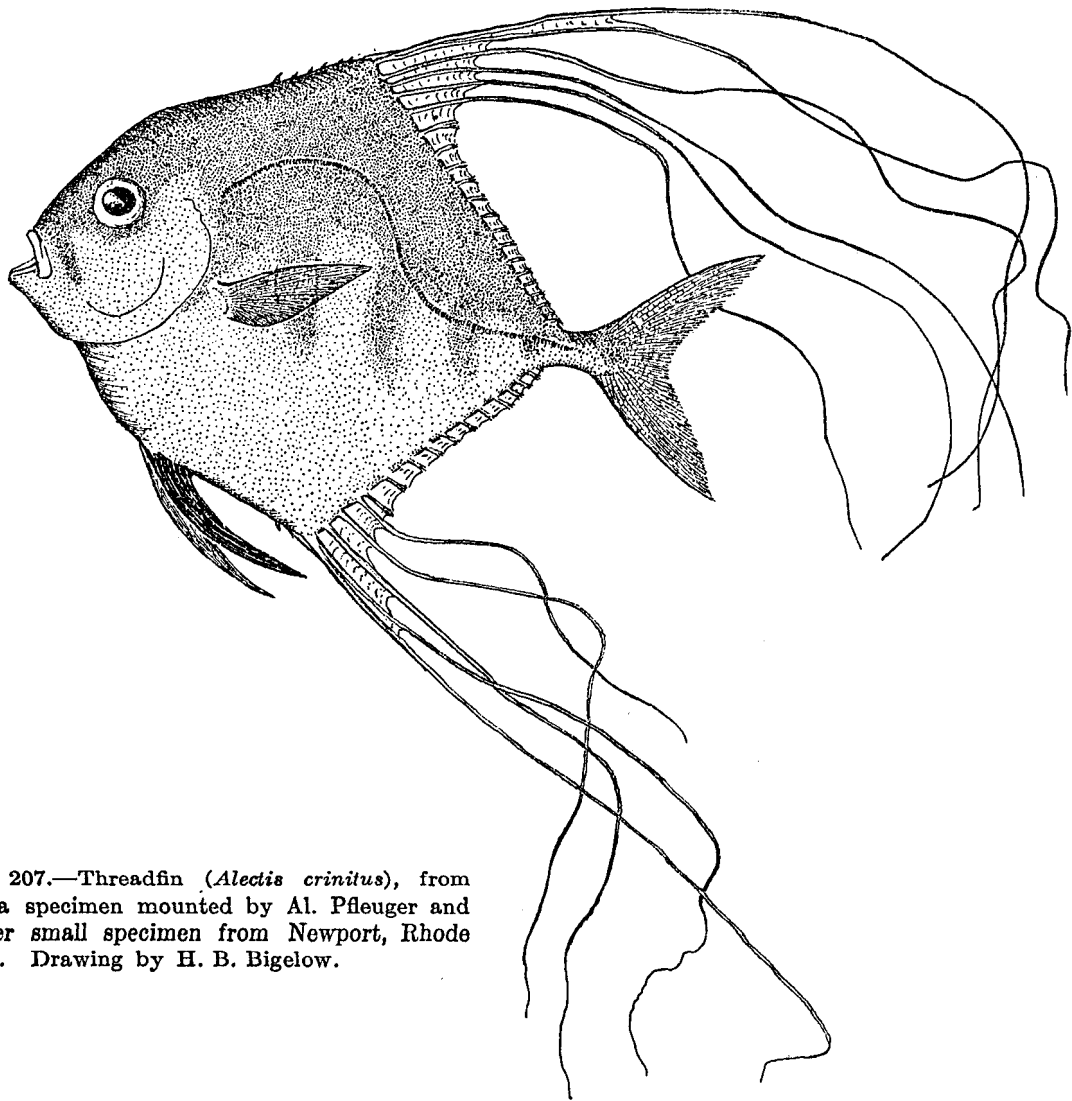


FIGURE 207.—Threadfin (*Alectis crinitus*), from Florida specimen mounted by Al. Pfeuger and another small specimen from Newport, Rhode Island. Drawing by H. B. Bigelow.

Occurrence in the Gulf of Maine.—The only records of this tropical fish for the Gulf of Maine are of one about $3\frac{1}{4}$ inches (85 mm.) long taken in a trap at Sagamore, on the southern shore of Cape

Cod Bay, September 1, 1937, and another taken in a trap at North Truro, Mass., August 16, 1951. They may have come through the Cape Cod Canal as suggested by Smith.⁸³

THE BLUEFISHES. FAMILY POMATOMIDAE

The bluefish (the only member of its family) resembles the pompano family in the general structure and arrangement of its fins, there being two dorsals, the first spiny and the second soft, with the ventrals well forward under the pectorals. But it lacks the free spines in front of the anal fin which are characteristic of most pompanos; its caudal peduncle is deeper; its tail is less deeply forked; and its teeth are much larger. It bears a superficial resemblance to certain of the weak-

fish family (p. 417) in its general body form and in the arrangement of its fins. But it is readily separable from any of the latter by the fact that its anal fin is nearly as long as its soft (second) dorsal, and from the sea-bass family in that its first (spiny) dorsal is much lower than the second. Most American ichthyologists look upon the bluefish family as closely allied to the pompanos, but

⁸³ Copela, 1938, p. 146.

it should be grouped with the sea-bass tribe according to another view because of skeletal characters.

Bluefish *Pomatomus saltatrix* (Linnaeus) 1758⁸⁴

SNAPPER (YOUNG)

Jordan and Evermann, 1896-1900, p. 946.

Description.—According to Jordan and Evermann, and to most of their successors, the bluefish is separable from its closest allies, the pompanos (Carangidae), by a tail “not deeply forked” and by larger scales, statements that may easily be misleading, for while the bluefish certainly has a less deeply forked tail than the pompanos, anyone, we think, would describe it as deeply forked as compared with any square-tailed fish. And while its scales are larger than those of most pompanos there is not much difference in this respect between a bluefish and a large crevalle (p. 375). There is, however, one positive point of difference. The jaws of the bluefish, upper as well as lower, are armed all around with a single series of stout, conical, canine teeth (one-eighth to one-fourth of an inch long in a fish of about 10 pounds), whereas the crevalle alone of northern pompanos has canines, and only two of them. Furthermore, the caudal peduncle of the bluefish is stouter than that of any pompano. It is sharply differentiated from all mackerels by the absence of dorsal or ventral finlets.

The bluefish is moderately stout bodied (large ones are about one-fourth as deep as long); its belly is flat-sided but blunt-edged below; its caudal peduncle moderately stout (slimmer, however,

than in many other fish, e. g., striped bass); its head deep; its nose moderately pointed; and its mouth large and oblique, with projecting lower jaw, and with prominent canines. “Snappers,” as small bluefish are called, are relatively deeper and more flattened sidewise than larger fish. The first dorsal fin (7 or 8 stout spines), originating over the middle of the pectorals, is low, rounded, depressible in a groove. It is separated by only a very short interval from the second dorsal, which is more than twice as long as the first (about 23 to 26 soft rays) and about twice as high, tapering backward with slightly concave margin. The anal fin (25 to 27 rays) is similar in form to the second dorsal though with a somewhat less concave outer margin; it originates somewhat farther back and is preceded by two very short detached spines that are often hidden in the skin. The caudal is broad and forked, moderately or deeply according to the other fish with which it is compared. The ventrals and pectorals are both of moderate size. The body, most of the head, and also the second dorsal and anal fins are clothed with medium-sized scales. There are no shields or keeled scales along the lateral line nor is the caudal peduncle keeled.

Color.—Sea-green above; silvery below. The second dorsal, caudal, and pectoral fins are of the general body tint, the latter with a black blotch at the base.

Size.—Maximum length about 3½ feet. The heaviest American fish of which we find definite record within recent years was 3 feet 9 inches long, weighing 27 pounds,⁸⁵ caught off Nantucket in 1903. One of 20 pounds was taken off Montauk, N. Y., in August 1951.⁸⁶ It is said that fish of 30 or even 50 pounds were not unheard of during the

⁸⁴ This fish has been known by various vernacular names along the middle and southern coasts of the United States. But it is the “bluefish” in the Gulf of Maine.

⁸⁵ Smith, *Forest and Stream*, vol. 61, October 10, 1903, p. 283.

⁸⁶ Reported in *Salt Water Sportsman*, August 17, 1951.

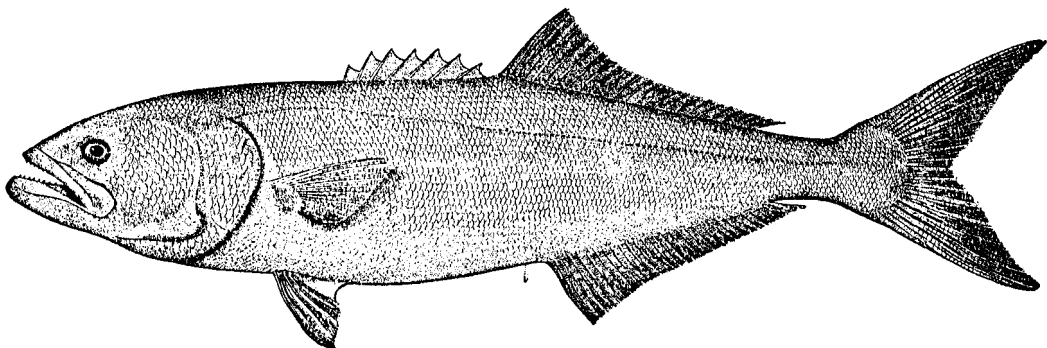


FIGURE 208.—Bluefish (*Pomatomus saltatrix*). From Jordan and Evermann. Drawing by H. L. Todd, from a cast.

last half of the eighteenth century, but these huge fish may not have been weighed. And the general run of the largest fish that are caught off the American coast is only 10 to 15 pounds. But they run larger off the African coast where 20-pounders are not unusual and where one of 45 pounds has been reported.⁸⁷ A 1-pound fish is about 14 inches long; a 2-pounder about 17 inches; a 3-pounder about 20 to 21 inches; a 4-pounder, about 2 feet; and an 8-pounder about 28 to 29 inches long. Fish weighing from 10 to 12 pounds are about 30 inches long.⁸⁸

Habits.—The bluefish is oceanic in nature, found indifferently inshore, offshore, and in many parts of the ocean (p. 385). It usually travels in schools, sometimes including many thousands; in 1901, for example, a school 4 or 5 miles long was reported as seen in Narragansett Bay. And it is perhaps the most ferocious and bloodthirsty fish in the sea, leaving in its wake a trail of dead and mangled mackerel, menhaden, herring, alewives, and other species on which it preys. Goode⁸⁹ wrote long ago, the bluefish, "not content with what they eat, which is itself of enormous quantity, rush ravenously through the closely crowded schools, cutting and tearing the living fish as they go, and leaving in their wake the mangled fragments." It is not only the schooling fish that fall prey to them, but scup, squeteague, hake, butterfish, cunners, and small fish of all kinds, besides squid. Baird writing in the 1870's, when bluefish were at the height of their abundance, estimated that they annually destroyed at least twelve hundred million millions of fish during the four summer months off southern New England; and while this calculation surely was wildly exaggerated it will help give the reader a graphic realization of the havoc that they wreak during their periods of plenty. They are also known to eat various Crustacea and even marine worms on occasion. And the young "snappers," 6 to 8 inches long, feed largely on copepods, or crustacean and on molluscan larvae, as well as on fish fry smaller than themselves.

Bluefish are creatures of warm water, never found in any numbers in temperatures lower than about 58° to 60° (at least in summer); and they appear along the United States coast as warm-

season migrants only. "Bluefish," writes Lyman,⁹⁰ "appear off the southern coast of Florida in midwinter," and by "late March anglers take them off the Florida coast in good quantities." "Large schools pass the Carolinas during March and April, appear off Delaware during April, and are first taken off New Jersey and Long Island, N. Y., during April and May," by commercial fishermen working well offshore. The earliest commercial catches are reported off southern Massachusetts in late May. But it is not until about a month later that they work inshore in numbers.

When they do come inshore, multitudes of little ones, known as snappers, run up into harbors and estuaries all along the coast, from Delaware Bay to Cape Cod. The larger ones, arriving somewhat later, also often come close enough in to the beach, west and south of Cape Cod, for many to be caught by anglers casting in the surf. But it is only in good years that this last holds true in our Gulf, even in the southern part.⁹¹ When they "first appear offshore, in any locality, almost always they will be feeding deep, at or near the bottom. This means that surface lines and baits are practically worthless."⁹² Later in the season schools are often seen at the surface, harrying other fish; and if they are deep, they can often be lured to the surface by throwing out ground bait.

Except for an occasional belated fish (p. 388), the bluefish disappear wholly from the entire coast northward from the Carolinas by early November. The winter home of this northern contingent has long been the subject of speculation. But the fact that we saw one trawled in 55 fathoms off Marthas Vineyard in mid-January in 1950 by the *Eugene H.*, and that several hauls of 175 to 1,400 pounds per trip were brought in from the region of the Hudson Gorge by otter trawlers early that same February, makes it probable that most of the members of the northern contingent merely move offshore on bottom, to the warm zone along the outer edge of the continent, to pass the winter there. It is certain, however, that some migrate far southward (as has often been suggested for the stock as a whole) for one that was tagged off New York in August 1936 was recaptured off Matanzas,

⁸⁷ By Lt. Commander Henry Lyman (Bluefishing, 1950, p. 9) who also saw a 22-pounder weighed off northwest Africa, with still larger ones that were not weighed.

⁸⁸ Goode, Fish. Ind. U. S., Sect. 1, 1884, p. 442.

⁸⁹ Fish. Ind. U. S., Sect. 1, 1884, p. 544.

⁹⁰ Bluefishing, 1950, pp. 10, 11.

⁹¹ We refer the reader to Lt. Comdr. Lyman's recent book (Bluefishing, 1950, pp. 34-49) for an interesting survey of the more-productive bluefishing grounds, Gulf of Mexico and Florida to Cape Cod.

⁹² Quoted from Lyman, Bluefishing, 1950, p. 11.

Cuba, in January 1939.⁹³ Whether wanderers such as this ever return to the north is unknown.

A few bluefish are caught in winter on both coasts of Florida, southward from Cape Canaveral in the east, from Tampa Bay on the west; and enough are taken near Key West between December 15 and February 15, to yield commercial catches of 10,000 to 15,000 pounds in most years.⁹⁴ Some, also, are caught around Cuba by commercial fishermen in January and February. But these Florida fish, presumably the Cuban also, vanish at the end of the winter, not to reappear until early the next. What their relationship may be to the northern stock is not known. There are bluefish, too, off the northern coast of the Gulf of Mexico and off Texas, but nothing definite is known about their seasonal movements.

It is not likely that any interchange ordinarily takes place between the bluefish populations of the two sides of the Atlantic.

Females with large ova approaching ripeness are taken off North Carolina in spring, and off various parts of the coast farther north in summer; ⁹⁵ ripe males have even been taken inside Chesapeake Bay in June and July, ⁹⁶ from which it appears that they spawn from late spring through July and perhaps into August. But bluefish have never been reported actually spawning, though watch has been kept for them, which makes it likely either that they interrupt their inshore visit to move offshore for the purpose, perhaps sinking deep, or that most of them have spawned out before they appear along our northern coasts. In either case, the regular presence of "snappers" in numbers inshore, and the occasional captures of smaller fry in Chesapeake Bay ⁹⁷ and in the Gulf of Maine (p. 388) make it likely that the spawning grounds of our northern bluefish are not far distant.

The eggs have not been identified with certainty. But the possibility is still open that the buoyant eggs with segmented yolk and large oil globule from Newport, R. I., provisionally referred to the

bluefish by Agassiz and Whitman⁹⁸ were actually those of this species. And while the identity of their "bluefish" larvae has likewise been questioned, we believe that their identification of the oldest (9 mm. long⁹⁹) was correct, though the younger ones may have belonged to some one of the mackerel tribe.

At this stage the second dorsal fin is formed, the first, however, still represented by the rudiments of the future spines. The anal fin is visible, also, and the tail is slightly forked. These larvae, like those of the mackerel (which they much resemble), have large blue eyes and large projecting teeth, but they are as far advanced in development as mackerel twice as large, and as ferocious in proportion to their size as the adult bluefish, devouring all other small animals in the tank with them.

The bluefish fry of three-fourths of an inch to 3 inches long, which have often been taken along shore in summer not only south of Cape Cod but even in the Gulf of Maine in some years (p. 388), are presumably the product of that season's spawning. And it seems that they grow to a length of 4 to 9 inches by autumn, fish of that size being common in October, while general experience suggests a length of 8 to 12 inches by the following spring. Nothing definite is known of the rate of growth of the older fish,¹ except that one that weighed about 1 pound when it was tagged off the coast of New York on August 10, 1936, was reported as weighing about 9 pounds when it was recaptured off Matanzas, Cuba, two years and five months later (January 15, 1939), which (if not exaggerated)² points to unexpectedly rapid growth.

The age at which the bluefish matures sexually is not known.

General range.—Widely but irregularly distributed in the warmer seas, its known range including the eastern coast of the Americas, northward regularly to Cape Cod, occasionally to outer Nova Scotia, south to Brazil and Argentina;³ Bermuda;⁴ eastern Atlantic off northwestern

⁹³ Reported by Lyman (Bluefishing, 1950, p. 10.)

⁹⁴ Schroeder, App. 12, Rept. U. S. Commissioner of Fisheries (1923) 1924, p. 12.

⁹⁵ Old statements to this effect are corroborated by Lyman (Bluefishing, 1950, p. 10), who reports females with roe and males with milt off North Carolina and near Nantucket early in summer.

⁹⁶ Hildebrand and Schroeder, Bull. U. S. Bur. Fish. vol. 43, Pt. 1, 1928, p. 232.

⁹⁷ Hildebrand and Schroeder (Bull. U. S. Bur. Fish., vol. 43, Pt. 1, 1928, p. 232) report fry as small as 2¾ inches in Chesapeake Bay.

⁹⁸ Mem. Mus. Comp. Zool., vol. 14, No. 1, Pt. 1, 1885, p. 13, pl. 4, figs 1-6.

⁹⁹ Mem. Mus. Comp. Zool., vol. 14, No. 1, Pt. 1, 1885, pl. 5, fig. 15.

¹ No growth studies based on the scales or on other exact methods have been undertaken for the bluefish, to our knowledge.

² Lyman (Bluefishing, 1950, p. 10), who reports the case, suggests that the fisherman who re-caught the fish "may have been stretching things a bit."

³ Frozen bluefish have recently been imported from northern Argentina.

⁴ See Lyman, Bluefishing, 1950, p. 12, for photo from the Bermuda News Bureau of a 15-pound bluefish caught at Bermuda, February 1949.

Africa; also Mediterranean; both coasts of southern Africa; Madagascar; eastern Indian Ocean and Malay Peninsula; southern Australia and New Zealand.

Occurrence in the Gulf of Maine.—Bluefish have been taken at one time or another wherever any information is available as to the local fishes around the western side of the Gulf. But they have seldom been seen east of Penobscot Bay (reported at Mount Desert in 1889); we have heard of only one taken in the Bay of Fundy, a fish caught in Minas Basin in July 1951,⁵ and we have found no record of bluefish off the Nova Scotian coast of the open Gulf of Maine. But one was caught off Halifax in 1925, another more recently near Liverpool on the outer coast of Nova Scotia,⁶ and they were reported "common" near Port Medway, Nova Scotia, in the summer of 1951.⁷

In our Gulf, too, they seem to be confined to the vicinity of the coast (they are unknown in the central basin or on Georges Bank), the small ones ("snappers") running up into brackish water, as in the Parker River, but the larger sizes (3 pounds or more) keeping to the outside waters.

The geographic distribution of the places where they have been recorded would suggest at first glance that bluefish are practically universal in the western side of the Gulf. But this is true only for brief terms of years and at long intervals, for while they have been known to swarm there for several summers in succession, they may then be so rare over periods of many years that the capture of a single fish causes remark.

Bluefish must have been common at the time of the first settlement, at least as far north as what is now southern Maine, for Josselyn, writing in 1672, referred to them as better meat than the salmon.

Bluefish were plentiful off southern New England and also about Nantucket in colonial times, but they seem to have disappeared thence about 1764, not to reappear there until about 1810. From that time on they increased in abundance west and south of Cape Cod, but none were reported north of the Cape until 1837. And since a fish as ubiquitous as the bluefish would

certainly have attracted attention and its presence found its way into print, had it been abundant in the Massachusetts Bay region, it is safe to say that very few, if any, visited the Gulf of Maine during the late eighteenth century, or the first quarter of the nineteenth.

According to Storer, the first bluefish seen north of Cape Cod after their long period of absence, was one caught on October 25, 1837; Captain Atwood⁸ saw them for the first time at Provincetown in 1838. According again to Storer, bluefish were taken yearly from the wharves at Boston after 1844. And by 1850 they were so plentiful about Cape Ann that fishermen complained of them as driving away most of the other schooling fish, while in 1863, which seems to have marked the culmination of this flood of bluefish, they were extremely abundant in the Massachusetts Bay region and especially at Provincetown.⁹ They remained plentiful in the southern part of the Gulf of Maine for several summers after 1863, but by 1872 they were reported as much less so, and there have not been enough bluefish anywhere in the Gulf since the late 1870's to menace the local mackerel fishery.

The yearly catch for the Cape Cod Bay region had fallen to about 22,000 pounds by 1888 (93 pounds for Essex County), to only about 3,000 pounds for 1889. But some bluefish were seen as far north and east as Mount Desert in that year, and evidently more of them rounded the Cape during the next 9 seasons, for the catches for the years 1890-1898 were between about 26,000 pounds and 80,000 pounds for Cape Cod Bay; with a few hundred pounds for the Massachusetts coast north of Boston. But this period of moderate plenty was followed by a period of scarcity¹⁰ so extreme (detailed statistics are wanting) that no catch as large as 5,000 pounds was reported again as made anywhere in our Gulf in any year for which statistics are available from 1900¹¹ down to the early 1920's. In 1906, in fact, in 1910 and again in 1919, only an occasional school can have

⁸ Proc. Boston Soc. Nat. Hist., vol. 9, 1833, p. 189.

⁹ Baird (Rept. U. S. Comm. Fish (1871-1872) 1873, p. 237-240), and Goode, (Fish. Ind. U. S.; Sect. 1, 1884, p. 435-437) have collected much information about the early history of the bluefish.

¹⁰ Reported catches for the Cape Cod Bay region by all methods were only about 3,600 pounds in 1899 and 7,659 pounds in 1900.

¹¹ Statistics of the pound net catches, by towns, were published in the Annual Report of the Commissioners on Fisheries and Game of Massachusetts for the years 1906, 1908, 1909, 1910, 1918, and 1919.

⁵ Reported to us by Dr. A. H. Leim.

⁶ Leim, Proc. Nova Scotian Inst. Sci., vol. 17, Part IV, 1930, p. XLVI.

⁷ Information from Dr. A. H. Leim, from report by L. R. Day, Fisheries Research Board of Canada.

rounded Cape Cod,¹² while bluefish must have been practically nonexistent north of the Cape in 1918, for the entire reported catch there was only 34 pounds for that year.

We should also point out (we cannot explain this) that a larger proportion of the bluefish than usual that did round Cape Cod seem to have continued on to the northern shore of Massachusetts Bay during this period of general scarcity. Thus about as many (300 lb.) were reported for Essex County in 1906 as for the Cape Cod Bay region; about one-fourth as many in 1908, about one-half to one-third times as many in 1908, 1909, and 1910.¹³

Bluefish must have come north in greater numbers in 1927, for they were reported here and there from Cape Ann northward during that summer with small catches in the Casco Bay region,¹⁴ and there seem to have been still more of them in the Gulf during the next two summers, as reflected in reported catches of 4,825 pounds for Essex County, Mass., and 140 pounds for the Casco Bay region, Maine, in 1928; 7,888 pounds for Essex County and 495 pounds for Casco Bay, Maine, in 1929. And so many blues invaded the southwestern part of the Gulf during the next three years that about 68,000 pounds were reported for Essex County, and 200 pounds for Casco Bay in 1930; 60,000 pounds for Essex County and 500 pounds for Casco Bay in 1931; and 1,414 pounds for the coast of Maine as a whole in 1932.¹⁵

Eighty pounds of bluefish were taken in a set of traps at North Truro on Cape Cod Bay on September 9 in 1936;¹⁶ we heard of some large ones caught in the surf on the outer shore of Cape Cod that same year; we know of one caught at Cohasset on the south shore of Massachusetts Bay in 1937, and enough came north again in 1938 to provide a commercial catch of about 1,800 pounds for Essex County. But this slight upsurge was followed by 6 years, or more, of scarcity so extreme that only small catches were reported from Maine (200 pounds in 1944), or

from northern Massachusetts (200 pounds for Essex County in 1945). The year 1946 was perhaps the low point for our Gulf, when the total catch including the southern coast of Massachusetts, was only about 1,200 pounds.

In 1947, however, when the total reported catch for Massachusetts was only 2,300 pounds (none reported for Maine)¹⁷, schools of small bluefish, of a pound or so, appeared along the inner shores of Cape Cod, near Wellfleet, in August. They are said to have been more widespread in Cape Cod during the two next summers, and in 1950 bluefish of $\frac{3}{4}$ pound to 1½ pounds, with a few up to 4 or 5 pounds, rounded Cape Cod in such numbers that Cape Cod Bay was described by anglers as "loaded" with them during that August.

Many catches of 60 to 100 pounds were made from party boats, both in the Wellfleet side of the Bay and along the Sandwich shore; a set of 8 traps at North Truro made small catches (10 to 160 pounds) at intervals between July 18 and October 7 of that year, while other traps around Cape Cod Bay from Provincetown and Sandwich made various catches between June and October. Some also worked north across Massachusetts Bay; witness captures of about 6 bushels of 1 to 1½-pound bluefish in a trap off Marblehead on the north shore of Massachusetts Bay, July 21.¹⁸ We heard of at least one taken at Hampton, N. H., also a few at Kennebunkport, Maine, early that September,¹⁹ and, at least, one from the lower Kennebec River. They continued plentiful also in Cape Cod Bay until the first week of that September. And while few, if any, were seen there after the severe northeast gale of mid-September, some were caught along the outer shore of Cape Cod as late as the first week of that October, and perhaps until later still.

All we can say, as to the catch in 1951 up to this writing (August 15) is that the earliest report of a bluefish in Cape Cod Bay was for June 19; a small one was taken at Plum Island, northern Massachusetts, on July 6; good catches (presumably of small fish) were reported in Cape Cod Bay by the last week of July (2,545 pounds taken in one set of traps at North Truro, July 7-28); a tremendous run of small bluefish were reported

¹² The catches north of Cape Cod ran only between about 300 pounds and 600 pounds for those years.

¹³ Pound net catches of 1,015 pounds reported for Essex County, 4,623 pounds for the Cape Cod Bay region in 1908; 600 pounds and 1,342 pounds, respectively, in 1909; 182 pounds and 419 pounds, respectively, in 1910.

¹⁴ The Boston Post for July 24, 1927, reported 65 taken near Bald Head one day, and 35 the next by Capt. Charles F. Pye.

¹⁵ No regional breakdown is available for Massachusetts for that year.

¹⁶ Information contributed by the Pond Village Cold Storage Co.

¹⁷ This is the most recent year for which catch statistics have been published.

¹⁸ Reported in the Boston Herald for July 31, 1950.

¹⁹ Reported in the Saltwater Sportsman for September 15, and October 6, 1950.

near Provincetown during the first part of August,²⁰ and a few large fish, among great numbers of small ones were being taken off the south shore of Massachusetts, and even in the Cape Cod Canal; some also were being caught in the rips and in the surf at the tip of Monomoy Point.

It remains to be seen whether this increasing run of bluefish in our Gulf is comparable to that of the 1860's. However this may prove, history will no doubt repeat itself sooner or later, and these sea pirates will again invade the Gulf in abundance, probably for several summers in succession.

The disappearance of the bluefish from the Gulf of Maine following the run of the 1860's was part of a general shrinkage in the bluefish population that visits the coast east of New York, and was to be expected, for the bluefish that reach our Gulf are only the northernmost fringe of the northern contingent. The increase in the numbers caught north of Cape Cod in the period 1928-31 was associated, similarly, with a corresponding rise in the yearly catches made off southern New England from about 55,000 pounds in 1928 to about 650,000-920,000 pounds for 1930-33.

The scarcity of bluefish north of Cape Cod from the early 1930's down to the early 1940's (interrupted in 1938 as noted) was clearly the result of the general decrease that took place in the abundance of bluefish over the northern part of their range as a whole, reflected in the southern New England catch which fell from nearly a million pounds in 1933²¹ to an all-time low of only 12,500 pounds in 1945. And there can be no doubt that the small bluefish that have reappeared in the Cape Cod Bay region and northward in increasing numbers during the past 2 or 3 years have been the overflow so to speak, from an increasing population to the southward, great numbers of which (mostly small) were being caught from New Jersey to Nantucket in 1950, and are being caught there with some large ones, at this writing (August 15, 1951).

We ought perhaps to add that it is only in the northern part of its range that the American bluefish falls periodically to a very low level; in 1945, for example, when the total catch for New England was only about 26,000 pounds, 223,000 pounds were taken in Chesapeake Bay and about

2½ million pounds along the Atlantic and Gulf coasts. This, again, was to be expected, for it is near the boreal boundary of its range that any warm-water fish is subject to the greatest vicissitudes.

An interesting phase of the fluctuations of the bluefish is that large numbers of very small ones have visited the southern coast of New England even in the poorest summers; some have been reported within the Gulf of Maine. Thus fry so small as evidently to have been the product of that season's hatch were taken in Casco Bay, Maine, in August 1899; slightly larger ones of 4 to 5 inches were caught off Plymouth in the summer of 1921, and "snappers" are sometimes reported at Provincetown, at Plymouth, and in the Parker River in northern Massachusetts. Almost all the fish, furthermore, that have been taken within the Gulf of Maine, and the majority of the larger catches that have been taken off southern New England during the past few years have been fish so small (mostly 1 to 2 pounds) that it is not likely they had reached sexual maturity. It is only in good bluefish years that many of the mature fish (weighing upwards of 4 or 5 pounds) appear that far north. In poor years large fish are caught in numbers only to the southward of Long Island, N. Y. Prior to August 15, 1951 a number of fish up to 7 pounds had been caught in southern New England waters, which may indicate better things to come.

In the years when bluefish pass Cape Cod in any numbers they usually appear in Cape Cod and Massachusetts Bays about the middle of June,²² sometimes as early as the first of that month, and they are seen off and on all summer. Most of them depart late in September, but an occasional fish lingers into late autumn. Bluefish have even been caught about Provincetown as late as December.

Importance.—The bluefish is an excellent table fish, but it never has been plentiful enough to support a fishery of any magnitude in the Gulf of Maine. Nevertheless, its presence or absence there may be a matter of direct importance to the fishing interests, for it may drive away the mackerel when it swarms, if not the herring and menhaden as well. Being a favorite game fish, many

²⁰ Reported in Salt Water Sportsman for August 10.

²¹ 920,065 pounds reported in 1933, to be exact.

²² Along southern New England the first blues are expected during the last half of May (p. 384).

anglers troll for them in Cape Cod Bay in seasons when there are enough of them to be worth following; also many are caught in the surf in good

years by anglers casting from the beach, as far northward along the coast as the outer shore of Cape Cod.²³

THE SEA BASSES. FAMILY SERRANIDAE

The sea basses are an extremely numerous tribe of perchlike fishes, with both the spiny portion and the soft rayed portion of the dorsal fin well developed, either as separate fins, or at least divided by a deep notch. The ventral fins are under the pectorals, technically thoracic, in position. The anal fin is nearly or quite as long as the soft part of the dorsal; the caudal peduncle is deep and the tail is broad. In most of the species the anal fin is preceded by 3 stout spines; the margin of the gill cover bears one or two sharp

conical spines in most, and the maxillary bone is not sheathed nor hidden by the preorbital bone when the mouth is closed. Smoother cheeks are a ready field mark to distinguish any of the sea basses from the rockfish family (p. 430); the 3 anal fin spines distinguish them from the croaker family (p. 417) which have 1 or 2 anal spines only; the spiny gill cover from the porgy family (p. 411); and the large mouth from the cunner and tautog tribe (p. 473).

KEY TO GULF OF MAINE SEA BASSES

- 1. There is one continuous dorsal fin, its front part spiny, its rear part soft rayed..... 3
 There are two separate dorsal fins, the first spiny, the second soft-rayed..... 2
- 2. The two dorsal fins are separated by a distinct inter-space; the sides are distinctly striped.... Striped bass, p. 389
 The two dorsal fins are joined at their bases; the sides are not distinctly striped..... White perch, p. 405
- 3. The scales are large; the space between the eyes is naked; no bony ridge on the gill covers..... Sea bass, p. 407
 The scales are small; the space between the eyes is scaly; there is a bony ridge on the gill covers... Wreckfish, p. 409

Striped bass *Roccus saxatilis* (Walbaum) 1792

STRIPER; ROCKFISH; ROCK; LINESIDES

Jordan and Evermann, 1896-1900, p. 1132, as *Roccus lineatus* (Bloch).

Description.—No one character alone characterizes the striped bass, but rather the combination of fin structure and arrangement with general outline and structure of the jaw. Its rather deep

and keelless caudal peduncle, stout body, the presence of two well-developed dorsal fins (spiny and soft rayed, and the one about as long as the other), its lack of dorsal or anal finlets, and a tail only moderately forked, separate it from all the mackerel tribe, from the bluefish, and from the pompanos. The fact that its anal fin has 3 spines

²³ We refer the reader to Lyman (Bluefishing, 1950) for an excellent account of bluefishing methods and localities, also of the natural history of the bluefish.

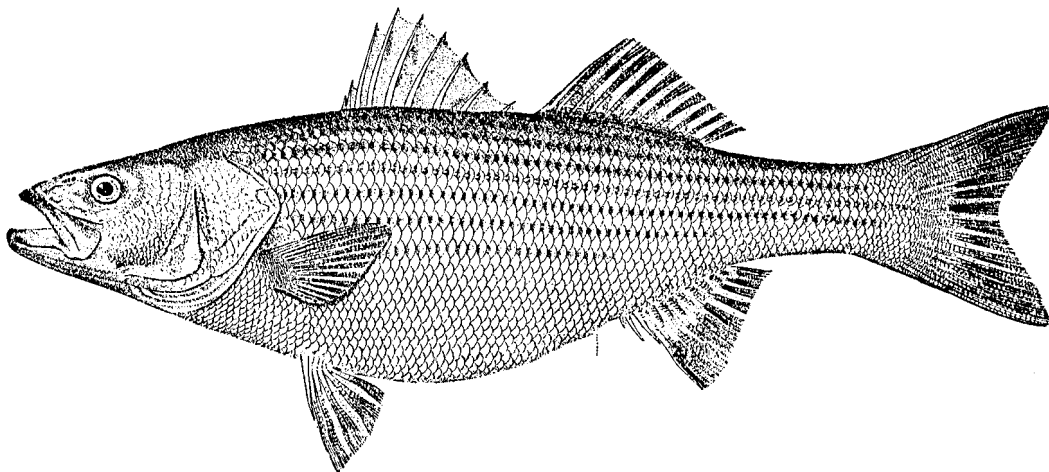


FIGURE 209.—Striped bass (*Roccus saxatilis*), Chesapeake Bay region. From Goode. Drawing by H. L. Todd.

and is almost as long as the second dorsal, also (less obvious) that its maxillary (upper jaw) bones are not sheathed by the preorbital bone, separate it from all the weakfish tribe (p. 417). Nor is there any danger of confusing it with the sea bass, cunner, tautog, or rosefish, for its two dorsal fins are entirely separate whereas in all these the spiny and soft-rayed parts are continuous, as a single fin. The white perch comes closest to it in general appearance but the two dorsal fins of the perch have no free space between them (p. 405), and its fin spines are stiffer.

The trunk of the striped bass is $3\frac{1}{2}$ to 4 times as long (to base of caudal fin) as it is deep, thick through, its back hardly arched. It has a moderately stout caudal peduncle, a long head (almost as long as the fish is deep), two spines on the margin of each gill cover, an oblique mouth gaping back to the eye, a moderately pointed nose, and a projecting lower jaw. Young fish are more slender than old. The two dorsal fins are of about equal lengths; the first (9 or 10 stiff spines) triangular in outline, originating over the middle of the pectorals; the second (12 or 13 soft rays) regularly graduated in height from front to rear, and separated from the first by a distinct (though short) space. The anal (about 11 rays preceded by 3 spines) is of about the same size and form as the second dorsal, and originates below the middle of the latter. The caudal is moderately wide and only slightly forked. The pectorals and ventrals are of moderate size, the latter somewhat behind the former.

Color.—Dark olive green varying to bluish above, paling on the sides, and silvery on the belly, sometimes with brassy reflections. The sides are barred with 7 or 8 narrow, sooty, longitudinal stripes, which follow as many rows of scales and which may be variously interrupted. The highest stripe is the most distinct, and all of them but the lowest are above the level of the pectoral fins. The dorsal, caudal, and anal fins are somewhat dusky.

Size.—The bass grows to a great size, the heaviest of which we have found definite record being several of about 125 pounds that were taken at Edenton, N. C., in April 1891.²⁴ One of 112 pounds, which must have been at least 6 feet long, was caught at Orleans, Mass., many years ago.

One of 100½ pounds is said to have been taken in Casco Bay, Maine,²⁵ and fish of 50 to 60 pounds are not exceptional. Usually bass, as caught, weigh from 3 to 35 or 40 pounds; the average weight of ones recorded in the register of the former Glades Hotel²⁶ at Scituate, Mass., during the period 1854 to 1858, was about 27 pounds.

Bass weigh about $\frac{3}{4}$ pound when 12 to 13 inches long; about $2\frac{3}{4}$ to 3 pounds at 18 to 20 inches; about 5 pounds at 24 inches; about 10–15 pounds at 30–32 inches; and about 18–20 pounds at 33–36 inches. Twenty-pound bass average about 36 inches in length; 30 pounders about 43 inches; 40 pounders about 47 to 48 inches.²⁷ On the Pacific coast 50 pounders run about 50 to 51 inches,²⁸ and the relationship between weight and length runs about the same for very large fish on the Atlantic coast. The record fish caught on rod and reel was one of 73 pounds, taken in Vineyard Sound in August 1913 by C. B. Church.

Females grow larger than males; probably most bass of 30 pounds and heavier are females.²⁹ Thus the common use of the term "bulls" for the very large ones might better be replaced by "cows."

*Habits.*³⁰—Stripers are powerful fish; so strong in fact, that they appear to have no difficulty in handling themselves in the surf, where one is sometimes seen actually in the translucent crest of a comber just before the latter breaks. But this is not a very swift fish as compared with the mackerel tribe. Bass often swirl conspicuously at the surface or splash in pursuit of bait fish. They sometimes roll as the little northern porpoise or puffing pig (*Phocaena*) does. And we have heard of them finning (i. e., with dorsal and tail fins showing).³¹ But we have never seen or heard of one leaping clear of the water as tuna and bonito so often do unless hooked in shoal water.

During the first two years they live mostly in small groups. Later they are likely to congregate in larger schools; this applies especially to those up

²⁴ Atkins, Fish. Ind. U. S., Sect. 5, vol. 1, 1887, p. 694.

²⁵ Kindly lent by John Adams.

²⁷ For a detailed tabulation of the length-weight relationship for bass from $\frac{1}{4}$ pound to 47¾ pounds, see Merriman, Fish. Bull. No. 35, 1941, U. S. Fish and Wildlife Service, p. 7, vol. 50, 1950, pp. 1-77.

²⁸ As scaled from a graph given by Scofield, California Fish and Game, vol. 18, 1932, pp. 168-170, fig. 38.

²⁹ Definite information in this regard is scant.

³⁰ Interesting recent studies of the striped bass are by Pearson (Bull. U. S. Bur. Fish., vol. 49, 1938, pp. 825-861) and by Merriman (Fishery Bull. 35, U. S. Fish and Wildlife Service, 1941, 77 pp.).

³¹ Frank Mather of the Woods Hole Oceanographic Institution reports an instance of this.

to 10 pounds or so, which are often spoken of as "school fish." The larger ones often school, but the very largest, of 30 to 40 pounds and upward, are more often found single or a few together. They are most likely to be in schools while migrating, but more scattered while feeding in one general locality.

Small fish (2 and 3 years old) in particular, tend to school densely; also they travel considerable distances without scattering but, as Merriman emphasizes,³² it is not likely that a given school holds together for any long period, for fish of various sizes (i. e., ages) up to the very large ones often school together, showing that different ages intermingle more or less. Mixed schools running from 8 or 10 pounds to 30 or 40 pounds were reported repeatedly in 1950, for example.

The bass is very voracious, feeding on smaller fishes of whatever kind may be available, and on a wide variety of invertebrates. Lists of its stomach contents for one locality or another include alewife, anchovy, croakers, channel bass, eels, flounders, herring, menhaden, mummichogs, mullet, rock eels (*Pholis gunnellus*), lance, sculpins, shad, silver hake, silversides, smelt, tomcod, weakfish, white perch, lobsters, crabs of various kinds, shrimps, isopods, gammarid crustaceans, various worms, squid, soft clams (*Myra*) and small mussels. In our Gulf the larger bass prey chiefly on herring, smelt, sand lance, eels, and silver hake, on squid (on which they gorge when they have the opportunity), on crabs large and small, on lobsters, and on sea worms (*Nereis*); while small ones are said to feed to a considerable extent on gammarid crustaceans and on shrimps.

When bass are gorging on any one particular prey it is common knowledge among fishermen that they are likely to ignore food of other sorts for the time being. It seems also that when prey is plentiful, bass are likely to gorge, then cease feeding to digest, then to gorge again; also that all the members of a given school are likely to do this in unison, with consequent annoyance to the angler.

Bass, too, seem on the whole to be more active, and especially to feed more actively, between sunset and sunrise than while the sun is high. In estuarine situations this fits with the habits of their prey, for it is by night that the sea worms (*Nereis*) that are the chief item in their diet there

emerge from their burrows to swim about. And bass fishing is often much more productive by night than by day off the open coast also, though schools of bait fish are seen at all hours (else the terns would starve), while the time when crabs, etc., are most likely to be stirred up by the surf, and are most easily caught around the rocks, depends on the stage of the tide, not on the hour of the day. So most fishermen (ourselves included) believe that it is inherent in the nature of the larger sized bass to avoid strong sunlight by sinking to the bottom. A familiar instance is the regularity with which they desert the surface soon after sunrise on bright summer days at places where large numbers are caught by trolling during the hour or two after daybreak; the eastern side of Cape Cod Bay is a local example.

It has been discovered recently that trolling deep with wire lines is often productive, irrespective of the time of day, at times and places where bass "show" only during the early morning hours. This habit, however, is not so deeply engrained but that schools of bass often rise to the surface in pursuit of bait fish at any time of day, or come within easy casting distance of the beach. We recall seeing several schools of good-sized fish (those that we landed ran up to 23 pounds) suddenly splashing all around our boat about midday, on one occasion off Wellfleet, in Cape Cod Bay, though it was only for a few hours after sunrise that the several boats fishing regularly there had taken any by top-water trolling for some time previous.

The best advice we can give the surf-caster, in this regard, is to go fishing whatever time of the day he is free to do so.

The striper is so strictly an inshore fish that we have never heard of large catches being made, or schools seen, more than 4 or 5 miles from the nearest point of land,³³ though the migrating schools doubtless pass much farther out in crossing the mouths of the larger indentations of the coast, such as Delaware Bay and Long Island Sound. And a few fish may stray far offshore in winter, for one about 18 inches long was taken in an otter trawl about 60 miles south of Marthas Vineyard, in 70 fathoms of water, in February 1949 (p. 400).³⁴

³² Henry Lyman informs us that bass are caught in numbers late in the autumn in the rips east of Nantucket about 4 miles out, but that verbal reports of some taken during the summer of 1950 on the offshore part of Georges Bank were actually based on two weakfish (p. 419).

³⁴ Reported to us by Capt. Henry W. Klimm of the dragger *Eugene H.*

³³ Fish, Bull. 35, U. S. Fish and Wildlife Service, 1941, vol. 60, p. 43.

On the landward side, many bass come within easy casting range of the shore; we have had a fair sized one strike our plug not 4 feet from the rock from which we were casting on the Cohasset shore. Many (especially the smaller sizes, but large ones also) run up into estuaries and into river mouths. In some rivers, good numbers (large as well as small) are caught so far upstream as to make it likely that they remain there the year round. This is notably the case in the Alabama River system where (we hear) 250 to 300 bass ranging from 5 to 40 pounds were caught near Tallasseem some 30 miles above Montgomery, which is at least 300 miles from salt water, following the river.³⁵ They are also known to spawn some 250 miles up the Sacramento River in California. It would be interesting to know what proportion of the bass that spawn at Weldon, N. C., 100 miles or so up the Roanoke, and that run 60 to 90 miles up the St. John, in New Brunswick,³⁶ ever see salt water. Bass also run up the Hudson for about 160 miles to Albany.

The great majority of the total population of bass frequent the coast line, except at breeding season. Among these, the smaller sizes, up to 15 pounds or so, are found indifferently within enclosed bays, in small marsh estuaries, in the mouths of rivers and off the open coast. But we do not often hear of fish heavier than 20 to 25 pounds caught in situations of these sorts. And the great majority of the large bass, of 30 pounds or more, hold to the open coast, except at spawning time (p. 394), and perhaps in winter (p. 400). But this is not an invariable rule; we are familiar with one narrow inlet where tides run strong, and where some lucky angler catches a very large bass now and then (p. 396).

Bass off the open coast are most likely to be found along sandy beaches, in shallow bays, along rocky stretches, over and among submerged or partially submerged rocks and boulders, and at the mouths of estuaries, the precise situations that they occupy being governed by the availability of food. Off the outer beaches they may be anywhere right to the breakers. When they are close in they frequent the troughs that are

hollowed out by the surf behind off-lying bars, also the gullies through which the water rushes in and out across the bars as the rollers break, for it is in such situations that bait fish are easiest caught, and that crabs, worms, and clams are most likely to be tossed about in the wash of the breakers. When the tide is high, bass often lie on a bar, or even in the white water along the beach if there is a good surf running. When the tide falls they drop down into the troughs or move farther out, according to the precise topography. In either case, every surf fisherman knows that his chances are much better when the sea is breaking at least moderately heavy so that he can cast into white water, than when it is smooth.

They also lie under rafts of floating rockweed at times, probably to prey on the small animals they find among the weeds.

The best spots along rocky shores are in the surf generally, and in the wash of breaking waves behind offlying boulders and among them, or where a tidal current flows most swiftly past some jutting point. In the mouths of estuaries they are apt to hold to the side where the current is the strongest, and in the breakers out along the bar on that side. In shallow bays, they often pursue small fry among the submerged sedge grass when the tide is high, dropping back into the deeper channels on the ebb. And they frequent mussel beds, both in enclosed waters and on shoal grounds outside, probably because these are likely to harbor an abundance of sea worms (*Nereis*).

When bass are schooling outside they are likely to be moving along the coast in the one direction or in the other. But they may remain in the same general locality for weeks, or through the summer. Thus a body of very large fish, of 25 to 50 pounds, stayed close in to the outer beach near the tip of Cape Cod, through most of July of 1951 and into that August, yielding consistent catches to the more skillful surf-fishermen.

Bass are active over a temperature range from perhaps 70° down to about 43°-46° F. Present indications are that if the temperature falls lower they either withdraw to somewhat warmer water if off the outer coast, or lie on the bottom in a more or less sluggish state if they are in some estuary. On the other hand it is not likely that they can long survive temperatures higher than about 77°-80°, for many were found dead in

³⁵ Information from Henry Lyman, from an angling correspondent in Alabama. They have long been known up the Alabama as far as Montgomery (Pearson, Bull. U. S. Bur. Fish., vol. 49, 1938, p. 826).

³⁶ According to Adams (Field and Forest Rambles, 1873, Pt. 3, Fishes, pp. 248-249), who has given an interesting and readable account of the bass in the river.

shallow estuaries in Connecticut and in Massachusetts during the abnormally hot August of 1937.³⁷ They are equally at home in fresh or slightly brackish water, and in coastal salinities of 3.1 to 3.3 percent. But their usual wanderings do not take them out into waters of full oceanic salinities (3.5 percent or higher).

Migrations.—No phase of the life history of the bass arouses as much discussion among fishermen as their migrations. And the picture still remains so puzzling that we dare not attempt anything more than a brief summary of what has been learned to date.

It seems certain that stripers do not ordinarily travel far until they are 2 years old. Thus the young fish from the enormous year classes of 1934 and 1942—apparently produced in the Chesapeake Bay-Delaware Bay region chiefly—did not appear in New England waters until 2 years later. But the fact that they did appear there and in the Gulf of Maine in hordes in the summers of 1936 and 1944 shows that a bass is capable of very extensive journeys, once it has reached its third year.

It has long been known, too, that the pound nets on Long Island and along southern New England ordinarily make large catches only in the spring (peak in May), and again from early October into November;³⁸ also that large spring catches are made progressively later in the season, proceeding from south to north, the reverse being true in the autumn. This, of course, suggests that part at least of the bass population follows the shore line northward and eastward as far as southern New England in spring, to return westward and southward in autumn. And this is verified for bass 2 and 3 years old by the returns from tagging experiments by Merriman at the eastern end of Long Island and in Connecticut during the years 1936 to 1938,³⁹ for recaptures of fish that had been tagged there in May came mostly from farther east along southern New England, one from Cape Cod Bay, and another from Cohasset on the southern shore of

the inner part of Massachusetts Bay. But the recaptures from fish tagged in summer were mostly from nearby (evidence of a stationary population), while those for autumn-tagged fish were scattered along the coast from the eastern end of Long Island to Chesapeake Bay, with one from Croatan Sound, one from Albemarle Sound (Stumpy Point), and one from Pamlico Sound in North Carolina.

But the picture is by no means so simple as the foregoing might suggest. To begin with, no evidence is available as to the movements of large bass, other than the successive dates when they appear or disappear off different parts of the coast.⁴⁰ And it is no less true of bass than it is of mackerel (p. 330), that successive appearances and disappearances from place to place are not conclusive evidence of along shore migration. Yet it is now certain that while some bodies of bass carry out extensive migrations north and east in spring, west and south in autumn, other bodies do not. Thus, as Merriman points out,⁴¹ the bass of the northeastern shore of the Gulf of Mexico are completely isolated, while those of the Atlantic coast south of Cape Hatteras form another separate population, few of which (if any) ever spread farther north. The bass of the Gulf of St. Lawrence and of the lower St. Lawrence River appear to be wholly isolated also. And while some interchange may take place between the populations found in various bays and rivers around the outer coast of Nova Scotia, it is doubtful whether these have any regularly migratory association, either with the Gulf of St. Lawrence fish or with those of more southern waters, except in occasional years (p. 398).

Chesapeake Bay, however, harbors both migratory bass,⁴² as proved by tagging experiments (p. 393) and other evidence (p. 393), and nonmigratory as proved by the fact that fish of all sizes are taken there both in summer and in winter, though not so many of them as in spring and fall. Similarly, some bass winter in northern waters though most of the fish appear to be migrants there; and perhaps a considerable percentage do so in the lower reaches of the Hudson River estuary.

³⁷ Merriman, Fishery Bulletin No. 35, U. S. Fish and Wildlife Service, 1941, vol. 50, p. 43.

³⁸ See Merriman, Fish. Bull. No. 35, U. S. Fish and Wildlife Service, 1941, vol. 50, pp. 33, 34, fig. 24, for details.

³⁹ For details we refer the reader to Merriman's original account (Fish. Bull. No. 35, Fish and Wildlife Service, 1941, vol. 50, pp. 36-42, figs. 26-29; also pp. 71-73, tables 17-20), which is the most authoritative discussion of the subject that has appeared yet.

⁴⁰ The few returns so far from bass of 5 pounds and upward that have been tagged have been from nearby, and soon after they were released.

⁴¹ Fish. Bull. No. 35, U. S. Fish and Wildlife Service, 1941, vol. 50, p. 42.

⁴² Using this term to mean extensive seasonal journeys.

Merriman⁴³ has suggested that these northern wintering fish may be "of two types—the individuals that form the resident more or less isolated population" and others "that may have had their origin farther south but spend an occasional winter in northern waters." It may prove that a good proportion of these bass that come from the south when they are 3–4 years old may remain in the north for the rest of their lives. And there is no way for the fisherman to tell in which of these categories the bass belong, that he lands. The reader will find some further discussion of migrations in connection with the status of the bass in the Gulf of Maine (p. 395). We need only add that the existence of these nonmigratory populations and the fact that the Pacific coast bass are similarly stationary, are sufficient proof that seasonal migration is not an essential incident in the life of the striper.

Bass spawn either in brackish water at the heads of estuaries⁴⁴ (the Hudson, for example) or in fresh rivers, never off the open coast in salt water so far as is known. Those that enter fresh rivers may deposit their eggs only a short distance above the head of tide as they do in the Potomac, or they may run much farther upstream. But we have yet to learn how large a percentage of the bass that are known to spawn 100 miles up the Roanoke, near Weldon, N. C. (a major spawning ground), or still farther up the Alabama,⁴⁵ and up the Sacramento River in California, have come from salt water (p. 392).

The chief requirement for successful spawning is (it seems) a current turbulent enough to prevent the eggs from settling on bottom where they would be in danger of being silted over and smothered.

The spawning season is from late April to early May in North Carolina; in May, chiefly, in the Chesapeake Bay region; perhaps equally early in the waters of New York.⁴⁶ Any bass that may spawn in the rivers of Massachusetts, of Maine, and of the Bay of Fundy, probably do so in June; those of the southern shore of the Gulf of St.

Lawrence and of the lower St. Lawrence River in June and July.

A large female during spawning may be surrounded by many small males, and the latter are described as fighting fiercely⁴⁷ with one another.

Females stripped at the Weldon, N. C. Hatchery yielded from 11,000 to 1,215,000 eggs each, during the period 1928 to 1938, with one of 4½ pounds yielding 265,000. Thus the oft-quoted estimate of 10 million fish for a really large one is within reason.⁴⁸

The eggs average 1.1–1.35 mm. in diameter when they are deposited in the water, but the perivitelline membrane swells during the first hours after fertilization to an average diameter of about 3.6 mm. They have a large oil globule and are semi-buoyant; that is, they sink in quiet water, but are swept up from the bottom by the slightest disturbance, so that they tend to drift downstream with the current. Consequently the eggs that are produced far upstream may not hatch until they have reached tidewater. The eggs are reported as hatching in about 70 to 74 hours at a temperature of 58–60°; in about 48 hours at 67°; in about 30 hours at 71–72°.

In Chesapeake Bay, the young fry of the year are about 1½ inches (30 mm.) long by June; 1¾ to 2½ inches (45–53 mm.) long in July; 2 to 2½ inches (50–70 mm.) in August; and 3¾ to 8½ inches by the following April and May; i. e., at the end of their first year.⁴⁹ According to Merriman,⁵⁰ most of the fry of the year taken in the Hudson River during their first summer are between about 1¾ inches (40 mm.) and about 3½ inches (90 mm.) long; a few seined in the Parker River, Newbury, Mass., were from about 2¾ inches (71 mm.) to about 3¾ inches (85 mm.) long. And this last is perhaps representative for whatever bass may now be produced in Gulf of Maine rivers, for we read that great numbers of fry of 2 to 3 inches were taken of old in winter in the rivers of Maine in bagnets set for smelt and tomcod.⁵¹

Two-year-old bass taken in Connecticut averaged 11 to 11½ inches (28 or 29 cm.) long in spring,

⁴³ Fish. Bull. No. 35, U. S. Fish and Wildlife Service, 1941, vol. 50, p. 42.

⁴⁴ See Merriman, Fishery Bulletin No. 35, U. S. Fish and Wildlife Service, 1941, vol. 50, p. 17, for precise salinities in which bass in their first summer have been taken in the Hudson River, and in the Parker River, Massachusetts. See Tresselt (Bull. Bingham Oceanogr. Coll., vol. 14, art. 1, pp. 98–110, 1952) for a survey of spawning grounds tributary to Chesapeake Bay.

⁴⁵ Pearson (Bull. U. S. Bur. Fish., vol. 49, 1938, p. 829) records a female with eggs from the Alabama River near Montgomery.

⁴⁶ Greeley (New York Conserv. Dept., Biol. Surv. Lower Hudson Watershed, 1937, p. 100) concludes that the spawning season in the Hudson "includes May."

⁴⁷ See Smith, North Carolina Geol. Econ. Survey, vol. 2, 1907, p. 272, for an eyewitness account by S. G. Worth.

⁴⁸ Merriman (Fish. Bull. No. 35, U. S. Fish and Wildlife Service, 1941, vol. 50, p. 19) gives an excellent summary of information available as to spawning, characteristics of the eggs, and period of incubation.

⁴⁹ Hildebrand and Schroeder, Bull. U. S. Bur. Fish., vol. 43, Pt. 1, 1923, pp. 248–249.

⁵⁰ Fish. Bull. No. 35, U. S. Fish and Wildlife Service, 1941, vol. 50, p. 17, fig. 10.

⁵¹ Atkins, Fish. Ind. U. S., Sect. 5, vol. 1, 1887, p. 693.

about 12 inches (30 cm.) in June, and about 14½ inches (37 cm.) in October; the 3-year-olds about 15¼ inches (40 cm.) in spring and about 18 inches (46 cm.) in October, while 4-year-olds increased in length from about 18¼ inches (48 cm.) to about 20¼ inches (53 cm.) between spring and autumn, on the average.⁵² And the average rate of growth was about the same for Hudson River fish examined by Greeley.⁵³ But the rate at which they grow is governed largely by the food supply. Bass in captivity have been known to grow from 6 inches long to 20 inches in 11 months, while some that were kept in a certain pond in Rhode Island are described as having gained weight from 1 pound in June to 6 pounds in October.⁵⁴

The later growth rate has not been traced for our Atlantic bass. But it is generally believed that the 35-50-pounders that were caught in considerable numbers in 1950, and are being taken in 1951, were members of the very successful year classes of 1940-1942, which fits well with the growth rate of bass on the Pacific coast, where the average age is about 7 years for 20-pound fish, 10-11 years for 30-pounders, about 14 years for 40 pounders, and 17 to 18 years for 50-pounders.⁵⁵

On the Pacific coast females grow faster than males after the third year, which is probably true of the Atlantic bass also.⁵⁶ This certainly is a long-lived fish for one kept in the New York Aquarium lived to be 23 years old.⁵⁷

Merriman⁵⁸ found that "approximately 25 percent of the female striped bass first spawn just as they are becoming 4 years old, that about 75 percent are mature as they reach 5 years of age, and that 95 percent have attained maturity by the time they are 6 years old," among Connecticut fish. But a large percentage of the males had matured at 2 years, probably nearly all of them by the time they were 3 years old. And it is probable that this applies equally to the Maine bass. Merriman has also made the interesting discovery that only about one-tenth of the bass of northern waters are males, but that males

are nearly as numerous as females, southward from Delaware Bay.

It has been suggested that the striper may not be a regularly yearly spawner,⁵⁹ but no positive evidence is at hand as to this.

General range.—Atlantic coast of eastern North America, from the lower St. Lawrence River and the southern side of the Gulf of St. Lawrence to northern Florida; also along the northern shore of the Gulf of St. Lawrence to Alabama and Louisiana; running up into brackish or fresh water to breed.⁶⁰ In the last quarter of the 19th century it was introduced on the Pacific coast, where its range extends now from Grays Harbor, Wash.,⁶¹ to Los Angeles County, Calif. It is now a favorite game fish there, and the yearly commercial catch since World War I ran between 500,000 and about 1,000,000 pounds there, until 1935, when commercial fishing for stripers was prohibited by the State of California.

Occurrence in the Gulf of Maine.—The range of the striper includes the coastline of our Gulf from Cape Cod to western Nova Scotia. But its distribution there in detail is determined by its very evident preference for surf-swept beaches and for particular stretches of rocky or bouldery shoreline; also for shallow bays, inlets, and estuaries. The geographic status of bass in our Gulf also depends on whether it be a good bass year (or run of years) or a poor one.

When bass are reasonably plentiful, as they have been during the past 15 years, and with a good representation of fish of different ages, the outer shore of Cape Cod provides the most productive surf casting, with Monomoy Island, the general vicinity of Nauset Inlet, and the tip of the Cape northward from Highland Light perhaps the warmest stretches, in most years. But the topography of a beach may be altered to such an extent during severe storms that a stretch that is good bass water one summer may be poor the next. Nauset beach is an example, for very few bass have been caught or seen there during the present summer (1951), though this has been one of the most productive localities on the Cape during the past few summers. Considerable numbers, mostly

⁵² Merriman, Copela, 1937, p. 23.

⁵³ New York Conserv. Dept., Biol. Surv. Lower Hudson Watershed, 1937, p. 62.

⁵⁴ Bean, Bull. New York State Mus., 60, Zool. 9, 1903, p. 527.

⁵⁵ Scaled from Scofield's graph (California Fish and Game, vol. 18, 1932, pp. 168-170, fig. 38).

⁵⁶ See Scofield, Fish Bull. No. 29, Div. of Fish and Game, California, 1931 for growth of bass in California.

⁵⁷ Bull. New York Zool. Soc., vol. 16, No. 60, November 1913, p. 1049.

⁵⁸ Fish. Bull. No. 35, U. S. Fish and Wildlife Service, 1941, vol. 50, p. 22.

⁵⁹ Merriman, Fish. Bull. No. 35, U. S. Fish and Wildlife Service, 1941, vol. 50, p. 16.

⁶⁰ Pearson (Bull. U. S. Bur. Fish., vol. 49, 1938, p. 827, fig. 1) charts its United States range, but does not include its Canadian range.

⁶¹ Gerlach (Contrib. 14, Oregon Fish. Comm., 1950) gives an interesting account of the life history and distribution of the striper in Oregon waters.

of the smaller sizes, are caught in Pleasant Bay too, within Nauset Marsh, and in Town Cove, Orleans.

Considerable catches are made by boats trolling outside the surf, also, or by casting in toward the breakers along the outer Cape Cod shore, when the weather permits. But the most productive and reliable trolling grounds are along the eastern and southern sides of Cape Cod Bay in most summers, especially off the Eastham shore a few miles southward from Wellfleet, and off the mouth of Scorton Creek, Barnstable and the Sandwich shore.⁶² The shores of Cape Cod and Cape Cod Bay have, in fact, been the chief center of abundance for bass within the Gulf from as far back as the record runs. Few bass are reported along the rocky stretch from the Cape Cod Canal to the entrance to Plymouth Harbor, though this would seem to be very good bass water, and schools must pass by. But many are caught in Plymouth Harbor, especially off Eel Creek, also up Duxbury Bay to the salt marsh creeks that open into its head.

Surf casters account for some along Duxbury Beach on the outside, for a few also in the boulder-strewn area at the western end of Humarock Beach.⁶³ The North and South Rivers in Marshfield yield considerable numbers in good years; we have seen and taken good fish there. Anglers, casting from the shore, take a few (never any great number) on boulder-strewn stretches along the Scituate shore, while Glades Point was famous for large bass in earlier periods of abundance (p. 390), when it was common practice to chum the fish by throwing out chopped lobsters, a method never likely to be revived because lobsters are far too costly nowadays. The Cohasset shoreline (with which we are familiar) yields a few yearly (mostly caught between sunset and sunrise), occasionally a very large one. In seasons when there is a good run of the smaller sizes, considerable numbers are taken at various places within the limits of Boston Harbor; Hull Gut, Weir River in Hingham, and Wollaston Beach are well known localities. And in years when there is a run of little fish, many of them are caught from

the docks and from the bridges, to the head of Boston Harbor.

The north shore of Massachusetts Bay seems not to be as attractive for bass as its succession of inlets, beaches, and rocky headlands might suggest, for catches reported are small and scattering in most summers. But the beaches and enclosed waters from a few miles north of Cape Ann to and including the mouth of the Merrimac River are productive enough to rank second to the Cape Cod-Cape Cod Bay region. Bass are taken in the surf from Ipswich Beach, Cranes Beach, and along the entire length of Plum Island Beach; many more are caught by boat fishermen over the flats within the mouth of the Merrimac, as well as about the jetties at its entrance. Schools are often reported in Plum Island Sound. And the Parker River, emptying into the latter, is not only well known water for bass, especially small fish, but it holds some bass over the winter (p. 400), and it is one of the few streams along the New England shores of our Gulf where very young bass have been taken within recent years (p. 398).

Some are caught in Hampton Harbor, N. H. But the next important bass waters (moving northward) are the lower reaches of the Piscataqua River system, marking the boundary between Maine and New Hampshire; a good number, large and small, are now caught there yearly. In good years bass are to be caught in several of the streams that drain the southern part of the Maine coast, especially in the York, the Mousam, and in the Saco which is the most productive. Schools are sighted and a few are caught along the intervening beaches and some in the shallows of Biddeford Pool.

Information as to the status of bass for the coastline and streams of northern and eastern Maine, past or present, is scant, and we have come to suspect that bass may never have been as plentiful there as was supposed. A few are caught here and there around Casco Bay in good years, product perhaps of the Kennebec. But the estimated catch in the Kennebec was only about 12,760 pounds as far back as 1880;⁶⁴ and there have been far fewer bass there of late years. Our most recent information is that schools of large fish were seen in the lower Kennebec, off Popham and Reed Beaches in early October 1950 with some

⁶² Many are caught by anglers casting in the Cape Cod Canal, but this is not properly a part of the Gulf of Maine.

⁶³ The bouldery area at the eastern end at the North River inlet is now within the limits of the military reservation; hence the only way to fish it is from a boat by casting in, toward the rocks.

⁶⁴ Atkins, Fish. Ind. U. S., Sect. 5, vol. 1, 1887, p. 675.

caught up to 26 pounds, and that a few were being taken daily, in late June 1951.⁶⁵ Nearly as many were taken in the Sheepscot, formerly, as in the Kennebec; the present condition is not known.⁶⁶ There were bass in the St. George during the period 1936-1940; doubtless there are some there still, for we heard of some in the surf near Georgetown, Maine, in August 1951.

Bass are seen in most years in Bangor Pool at the head of the estuary of the Penobscot, where some are caught by anglers casting especially for them, also by salmon fishermen. And many in the 2- to 4-pound class were reported and caught in the Belfast River and in Searsport Harbor farther down Penobscot Bay in 1938. But there have not been enough of them there during the past few years to have caused special comment. Stripers were seen in the tide rips in the narrows ~~between Mount Desert Island and the mainland~~ (near the Hancock-Sullivan Bridge) in August 1951, and others were reported driving squid ashore near Winter Harbor, Maine, a few miles farther east. Salmon fishermen sometimes "rise" bass in the Narraguagus, and Atkins⁶⁷ speaks of "a very few" in the St. Croix, though Huntsman found no recent record of bass in the Passamaquoddy region.

There may be an occasional bass in Maine rivers other than those we have mentioned, but there is nothing in the past record to suggest that there ever were many. In 1880, for example, the reported catch was nearly as great for the Kennebec (about 13,000 pounds) as for all the other rivers and coast of Maine combined (about 15,000 pounds). And there is no reason to suppose that the regional contrast has altered subsequently in this respect.⁶⁸ In the Bay of Fundy region, bass, as Huntsman has pointed out,⁶⁹ are confined to the large warm estuaries and the neighboring fresh water; i. e., to those of the St. John, Minas Basin-Cobequid Bay and Shubenacadie River systems, and of the Annapolis.

Available information suggests that bass always were more plentiful in St. John River waters than

anywhere along the eastern part of the coast of Maine, and that they are still. Bass are occasionally caught in St. John Harbor, mostly between April and June.⁷⁰ And while they were reported as already much less numerous in St. John waters by 1884 than they had been in earlier times,⁷¹ there still are enough of them in the St. John and its tributaries to have yielded commercial catches of 12,200 pounds in 1944, and 7,400 pounds in 1946. The most recent news that has reached us from the St. John is that salmon fishermen saw a school at the surface and caught some that weighed 3 to 11 pounds in late June or early July of 1951.⁷²

Bass are well known in the Minas Basin-Cobequid region. According to local fishermen,⁷³ as many as 80 fish are sometimes taken in weirs there in a day, most of them in the 8- to 10-pound category, but with occasional fish reported up to 33 pounds.

The status of the bass is especially interesting in the Shubenacadie River, for they are not only caught in fresh water there and in Shubenacadie Lake where they are known to spawn, but some large fish remain throughout the year in the lake; i. e., they behave like a land-locked population.⁷⁴ A thousand or so, in fact, are caught yearly by anglers in the Lake and in the Shubenacadie River;⁷⁵ and it is said that fish as large as 50 pounds have been taken,⁷⁶ though most of them run small there.

We are informed⁷⁷ that the catch by anglers was about 620 bass (average about 4½ pounds) in the Bass River, tributary to Cobequid Bay in 1950, and that the catches for 1949 and 1950 combined were about 1,350 fish (average about 2½ pounds) in the Gaspereau, tributary to Minas basin; 4,650 fish (average about 5¼ pounds) in the Annapolis River; and about 125 fish (average 6 pounds) in the Bear River, tributary to Digby basin, in 1950. It is interesting, that these fish ran so small, for the bass caught in Cape Cod and northern Massachusetts waters during these same

⁶⁵ Information from Dr. A. H. Leim.

⁶⁶ Goode, Fish. Ind. U. S., Sect. 1, 1884, p. 425.

⁶⁷ Saltwater Sportsman for July 6, 1951.

⁶⁸ According to Moore, Boston Herald, August 28, 1950.

⁶⁹ Information from Dr. A. H. Leim.

⁷⁰ According to Huntsman, Ann. Rept. Fishery Board Canada, (1949) 1950, p. 41.

⁷¹ Vladikov and McKenzie, Proc. Nova Scotia Inst. Sci., vol. 19, 1935, p. 91.

⁷² Information from Maj. Howard Scott of the Fishery Division of the Nova Scotian Department of Trade and Industry, received through Henry Lyman.

⁶⁵ Reported in Saltwater Sportsman for October 6, 1950.

⁶⁶ Yearly catch about 1880, some 8,000 pounds in the Sheepscot according to Atkins, Fish. Ind. U. S., Sect. 5, vol. 1, 1887, p. 716.

⁶⁷ Atkins (Fish. Ind. U. S., Sect. 5, vol. 1, 1887, p. 700) reports one of 20 pounds, taken in the St. Croix in a weir in 1880.

⁶⁸ What few bass were reported from Maine in 1919 were from the Kennebec (692 pounds) and from Penobscot waters (57 pounds); bass have not been included in the fisheries statistics for Maine for any subsequent years.

⁶⁹ Contrib. Canadian Biol. (1921) 1922, p. 63.

years included a good number of very large fish (p. 403).

Anglers have also come to realize recently that bass are to be caught in various bays and river mouths along the western shoreline of Nova Scotia. But no definite information has reached us as to how plentiful they are there, or how large.

The regional contrasts in the abundance of bass along different sectors of the coastline of our Gulf may be illustrated more concretely by the commercial landings for 1945.⁷⁸

Outer Cape Cod and Cape Cod Bay⁷⁹—

| | |
|---|-------------------------------|
| | perhaps about 57,000 lbs. |
| Cape Cod Canal to New Hampshire line | --- 51,100 lbs. ⁸⁰ |
| New Hampshire..... | 9,000 lbs. |
| Maine..... | None reported. |
| St. John River system, New Brunswick..... | 2,400 lbs. |
| Minas Basin, Cobequid Bay and Shubenacadie River region, Nova Scotia..... | 13,800 lbs. |
| Annapolis County, Nova Scotia..... | 3,100 lbs. |
| West coast of Nova Scotia | |

800 pounds in 1944; none reported in 1946.

A regional contrast of another sort, of interest to anglers, is that really large bass of (say) 30 pounds and upwards, are far more plentiful along the Massachusetts coast (especially in Cape Cod waters) than they are anywhere farther north and east in our Gulf.

Localities along the outer coast of Nova Scotia where we have heard (or read) of stripers are the head of Mahone Bay; head of Chedabucto Bay; and Mira Bay and other harbors of Cape Breton. The numbers caught there are so small that they are not included in the published statistics of the commercial catches for the counties in question. The shoal estuaries, however, of the Richibucto Bay region and also the estuary of the Miramichi River (on the southern shore of the Gulf of St. Lawrence) harbor isolated populations of bass plentiful enough to have yielded commercial catches of about 3,800 pounds and 9,000 pounds, respectively, in 1929, 4,100 and 3,000 pounds in 1931.⁸¹ And there is also a population (or populations) below Quebec in the lower St. Lawrence River, of bass that winter in that same general region, as proved by marking experiments recently

carried out by Vladykov.⁸² There are enough of them, in fact, around Isle d'Orleans for bass fishing to be a favorite sport there. But the commercial catches are so small as to suggest that the stock of bass is not very large.⁸³

It has been known for many years that bass spawn in the St. John River,⁸⁴ and it is probable that they also spawn in the small streams tributary to Minas Basin and Cobequid Bay at the head of the Bay of Fundy; in Grand Lake at the head of the Shubenacadie River, and probably in the Annapolis River. It is generally believed, also, that some bass spawned of old in all the larger rivers from the Penobscot westward. Great numbers, so small (2-3 inches) as evidently to be fry of the year, were caught, for example, in winter in the 1880's in the Kennebec, where ripe fish also have been reported⁸⁵ from the end of June into July. But the only Maine or Massachusetts streams where we find evidence of spawning bass in recent years are the Mousam, in Maine, where fishermen have reported taking females with ripe eggs on several occasions;⁸⁶ and the Parker, in Massachusetts, where Merriman⁸⁷ took three fry of the year 2¾ to 3¼ inches (7.1-8.5 cm. long) on August 4, 1937. Thus it seems sufficiently established that a great majority of the bass that summer in the western side of our Gulf come from spawning grounds to the west and south.

Merriman's⁸⁸ painstaking investigations show beyond reasonable doubt that most of the little bass of 2 to 5 pounds that appeared in great numbers along southern New England and to the northward in 1936 (p. 402), following a period of great scarcity of bass there, had been hatched two years previously (1934) in the region of Chesapeake Bay, perhaps some of them in the Delaware Bay region. Some of the abundant year classes of 1940 and 1942, which appeared in our Gulf in 1942, and 1944, also may have come

⁷⁸ Rapp. Gen. Ministr. Chasse et Pêch., Quebec, Pêcheries (1946-1947) 1947, p. 50.

⁷⁹ The reported catch for 1948-1949 was only about 1,800-1,900 pounds (17 quintals; See Rapp. Gen. Ministr. Chasse et Pêch., Quebec, Pêcheries (1948-1949) 1949, p. 94).

⁸⁰ Adams, Field and Forest Rambles, 1873, Pt. 3, Fishes, p. 248.

⁸¹ Atkins, Fish. Ind. U. S., vol. 5, Sect. 1, 1887, p. 693.

⁸² Towne, State of Maine Striped Bass Survey, Maine Devel. Comm. and Dept. Sea and Shore Fisheries, 1941 [approx. date], p. 14.

⁸³ Fishery Bulletin No. 35, U. S. Fish and Wildlife Service, 1941, vol. 50, p. 17.

⁸⁴ Fish. Bull. No. 35, U. S. Fish and Wildlife Service, 1941, pp. 46-52

⁷⁸ The most recent year for which detailed statistics are readily available.

⁷⁹ Assuming that about ¾ of the Barnstable County catch of 86,200 pounds was taken along the outer shore of Cape Cod and in Cape Cod Bay (probably an underestimate).

⁸⁰ Assuming that about ¼ of the Plymouth County catch of 75,000 pounds was taken on the Massachusetts Bay side.

⁸¹ This is the most recent year for which information is available for Northumberland and Kent Counties.

from equally far away; others perhaps from intermediate spawning areas.

Since the mature bass that visit the coasts of Cape Cod and northern Massachusetts in such plenty in good years almost certainly do not spawn in any numbers in any of the Gulf of Maine rivers, we can only suppose that they repair to more southerly rivers to spawn, perhaps to the Hudson, in particular. But many of them reach northern Massachusetts so early in the season, and so little information is available as to the condition of their sexual organs when they arrive, that we still face something of a mystery, here.

In the salt estuaries and open waters of our Gulf bass are taken only from late spring, through the summer, and until late in the autumn. In years when they are plentiful enough to attract attention, they are likely to be reported about equally early in the season all along from Cape Cod to the Merrimac River. In 1950,⁸⁹ for example, bass had been reported from the outer shore of the Cape (Pleasant Bay and Orleans) by mid-May, from the North and South Rivers, at Marshfield on the southern side of Massachusetts Bay, and from the Merrimac at Amesbury by mid-May; we heard of one caught in Duxbury Bay as early as May 1 that same year; and in normally early years they are generally distributed along the Massachusetts Coast of the Gulf in May or by the first days of June. The first bass were reported in and off Hampton Harbor and in the Piscataqua River about the beginning of the second week in June (1950), and in Casco Bay about the middle of the month.

Bass are said to appear as early as the end of May in Bangor Pool at the head of the estuary of the Penobscot in some years.⁹⁰ In 1950 they were scattered all along Penobscot Bay before the end of June. And it is probable that the seasonal schedule is about the same for the bass at the head of the Bay of Fundy, but information is scant.⁹¹

Once the bass have appeared, they continue in evidence until well into the autumn (p. 399). During this part of the year, the bass of the coasts of Massachusetts and most of those in Maine are in salt water and in brackish, except for such as enter fresh water to spawn (p. 398). But they are

caught all summer in fresh water far above the head of tide in the Shubenacadie in Nova Scotia (p. 397),⁹² also in the Annapolis, and part of the stock may have here a similar habit in various of the rivers of Maine, as in the Kennebec, where they ran up as far as Waterville until they were prevented by the construction of the dam at Augusta.⁹³

In rivers where bass winter, they may, of course, be taken in any month from late autumn into the spring (p. 400). As autumn approaches the bass vanish however from the open coast. What little information we have suggests that most of them have disappeared along the outer coasts of Maine by mid-October or the end of that month in most years. But they may be in evidence in Maine rivers until later in the autumn, as they were of old in the Kennebec, where Atkins⁹⁴ described them as continuing "feeding in weedy coves until November"; and in the Mousam River in southern Maine, where fishing is said to have been good until November during the period 1938-1940, when our Gulf had a spectacular run of young fish (p. 402).

Farther southward in our Gulf, they may linger equally late off the open beaches. In 1949, for example, a set of traps⁹⁵ located near Provincetown Harbor in 35-45 feet of water, took 3,705 pounds (the only large catch of the year) on November 3.

In 1950, a late season, Cape Cod Bay eastward from the Cape Cod Canal was described to us as "loaded" with bass until the third week in October, fair numbers were still being caught along the outer shore of Cape Cod at the end of the month, schools of small fish were reported on November 9, and half a dozen were landed from the surf on November 18, and one, on December 3.⁹⁶ Surf casting is likely to be much more productive along the outer Cape Cod beaches during 2 weeks or even 3 weeks of November than it is in July or August, especially for the smaller fish, and during the hours of daylight (p. 391).

And the bass in salt water may be in evidence until equally late in the season in the Minas-

⁸⁹ Huntsman, Ann. Rept. Fisheries Res. Board Canada, (1949) 1950, App. 2, pp. 41-42.

⁹⁰ Atkins, Fish. Ind. U. S., Sect. 5, vol. 1, 1887, p. 603.

⁹¹ Fish. Ind. U. S., Sect. 5, vol. 1, 1887, p. 603.

⁹² Property of the Pond Village Cold Storage Co., of North Truro, to whom we are indebted for much information.

⁹³ Reported by Henry Moore, Boston Herald for Dec. 7, 1950.

⁸⁹ This is the only year for which we have detailed information.

⁹⁰ Weston, Field and Stream, March 1932, p. 60.

⁹¹ Moore (Boston Herald, Aug. 28, 1950) reports that bass are taken in traps from July on, in the Cobequid Bay region.

Cobequid Bay region, at the head of the Bay of Fundy for fishermen report taking them there through October and into November.⁹⁷

The question where the bass that visit the different parts of the coast of the Gulf of Maine spend their winters still awaits a comprehensive answer. It has long been known that the Chesapeake Bay bass winter in the deeper channels near the head, of the bay as well as in its estuaries, and in the lower reaches of the rivers, in a more or less inactive state; also those of the New Jersey coast run up into rivers to remain until the following spring, as described more than a century ago by Mease.⁹⁸

Knight⁹⁹ writes too, that as the weather becomes colder, the bass of the southern side of the Gulf of St. Lawrence "penetrate into the bays and arms of the sea and ascend the rivers at some distance, where they spend the winter resting on the mud in a half torpid state." The bass also, in Maine "pass the winter in quiet bays and coves of fresh water in the rivers," according to Atkins.¹ We see no reason to doubt that the Bay of Fundy bass, and also those that still frequent the Maine rivers from the Penobscot westward, still follow this habit.

It has been known, also, for many years that some bass winter in the Parker River, in northern Massachusetts. In fact, some 8,700 pounds were taken there during the financial depression of 1930 (p. 402). Local fishermen tell us also that a few bass winter in the deeper parts of the North and South Rivers in Marshfield, Mass., on the southern side of Massachusetts Bay, apparently in salt water. But these and other small streams do not seem extensive enough to provide wintering grounds for all the schools of bass that appear in summer between southern Maine and Boston Harbor in reasonably good years. Neither is there anything in the available record to suggest that the Merrimac ever was an important wintering ground. And it is hardly conceivable that the multitude of bass that sometimes frequent Cape Cod Bay and the outer shore of the Cape in good bass years can winter nearby (unless they do so offshore), there being no large rivers along this section of the coast, and no local report of bass in winter in the shallow, partially enclosed bays there, or in the salt marshes.

It was generally believed until recently that the great majority of bass that frequent the Massachusetts coasts of the Gulf (and the Cape Cod region in particular), and also those that summer off southern Massachusetts and around the off-lying islands, move westward along the shore in autumn: some to contribute to the bodies of fish that are known to winter in the rivers of Connecticut and in the lower Hudson, and some to journey perhaps as far as Chesapeake Bay; i. e., to the region where many of them are hatched. The capture, however, in 1949, of an 18-inch bass some 60 miles south of Marthas Vineyard in 70 fathoms of water in February (p. 391) seems to favor the view, now gaining favor among observant anglers, that at least a part of the bass of the Cape Cod region may only move offshore to winter on bottom well out on the continental shelf in localities where the otter trawlers do not ordinarily operate, as has been found of late to be true of the summer flounder (p. 268).

If true, this would mean that some of the Chesapeake-hatched bass that spread northward to Massachusetts and Maine when 2 or 3 years old may never return to their home waters. More definite information in this regard is to be expected from tagging experiments now in progress.

Periodic fluctuations in abundance.—Nothing regarding bass is of greater interest to commercial fishermen and to anglers than the great fluctuations in its numbers that have taken place in our Gulf within historic times.

The bass was a familiar fish when New England and the Maritime Provinces were first colonized, all along the coast from Cape Cod to the Bay of Fundy; plentiful and easy to capture, because of its large size and its habit of coming into the mouths of streams and creeks; it was also an important food supply for the early settlers.

Wood,² for example, tells us that in what is now a part of Boston Harbor:

The basse is one of the best fishes in the country, and though men are soon wearied with other fish, yet are they never with basse. It is a delicate, fine, fat, fast fish, having a bone in his head which contains a saucerfull of marrow sweet and good, pleasant to the pallet and wholesome to the stomach . . . Of these fishes some be three and four foote long, some bigger, some lesser; at some tides a man may catch a dozen or twenty of these in three hours . . . When they use to tide in and out of the rivers and creekes the English at the top of an high water do crosse the creekes

⁹⁷ Report by Henry Moore, Boston Herald for Aug. 28, 1950.

⁹⁸ Trans. Litt. Phil. Soc. New York, vol. 1, 1816, pp. 502-504.

⁹⁹ The River Fisheries of Nova Scotia, 1867, p. 12.

¹ Fish. Ind. U. S., Sect. 5, vol. 1, 1887, p. 693.

² New Englands Prospect, 1634, p. 37.