with long seanes or basse nets, which stop in the fish; and the water ebbing from them they are left on the dry ground, sometimes two or three thousand at a set, which are salted up against winter, or distributed to such as have present occasion either to spend them in their homes or use them for their grounds.

He also describes [3] how "shoales of basse have driven up shoales of mackerel from one end of the sandie beach to the other," near Salem, and mentions them in the Merrimac. In the earliest record the chief centers of abundance for them within the Gulf were Cape Cod Bay and the shore of Cape Cod; the neighborhood of Boston Bay and harbor; the vicinity of the Merrimac River; the Kennebec River and vicinity, and the larger rivers that drain into the Bay of Fundy. Inexhaustible, however, though the supply seemed, a decrease was reported as early as the last half of the eighteenth century. At first this was apparent only locally. For example, fewer were seen in the Piscataqua after about 1792. And very few were reported there from about 1880 down to 1936 or 1937, when the young fish, that were hatched in southern waters in 1934, appeared in our Gulf in such numbers (p. 402).

They seem to have continued moderately plentiful in Massachusetts Bay and around Cape Cod during the first half of the nineteenth century, when bass were still being netted in abundance along the beaches between Boston and Cohasset; 300 good-sized fish were taken in one seine haul at the mouth of Barnstable Harbor in July 1829; while 700 were taken at Provincetown in a day in October 1859. Fishing for bass from the rocks with hook and line was a well recognized sport then around Massachusetts Bay. But Freeman wrote as long ago as 1862 (in his History of Cape Cod) that the bass were much less plentiful in Cape Cod waters then than they had been of old. And the catch for Cape Cod Bay and the outer shore of the Cape, combined, reached 2,000 pounds in only three of the years of record during the last quarter of the 19th century and the first quarter of the 20th.[4] Bass, in fact, had so nearly vanished soon thereafter from the Massachusetts coast north of Boston that no commercial catches were reported there for the period 1876 to 1883, though an occasional fish may have been caught.

There may have been a few more bass along the coast of northern Massachusetts during the next 17 years, for yearly catches ranging from none up to 441 fish (1892) were reported for Essex County between 1884 and 1900, while a number were seined in the Merrimac River in 1897. But this was again succeeded by a period of scarcity so extreme that no bass were reported for the Massachusetts coast north of Boston during the next 30 years.[5] And the capture of a single fish in the inner part of Massachusetts Bay by any method was so unusual an event then that one of 44¾ pounds, caught near Brant Rock on the southern shore of the Bay, in November 1930, was given wide publicity in the newspapers.

The bass of the coasts of Maine fared no better. They had practically gone from the Androscoggin by 1860; the reported catch for the entire coastline of Maine (already only about 27,000 pounds in 1880) had fallen to about 1,600 pounds in 1902, 4,200 pounds in 1905, to 600 pounds in 1919. And no commercial catches at all have been reported from Maine in any subsequent year,[6] except for 537 pounds in 1932.

It seems that the bass population of the St. John River system shared with those of Massachusetts and of Maine in the general decline in abundance during the first half of the nineteenth century, for they were reported as much less plentiful there by 1873 than they had been in the early 1800's when they were a familiar sight rolling and splashing at the surface in June.[7] But neither the St. John population, nor the population at the head of the Bay of Fundy, nor of the Annapolis River, seem ever to have fallen to as low an ebb as has happened along Maine and Massachusetts. In 1919, for example, when no bass were reported from the Massachusetts coastline of the Gulf (p. 401) and only 600 pounds for Maine, 2,700 pounds were reported from the Nova Scotian coastline of the Bay of Fundy,[8] 1,600 pounds for the St. John River system.

The year 1921 seems to have marked the "turning of the tide" for the bass in Cape Cod Bay waters, for 4,784 pounds were taken that year at

[3] Wood, New Englands Prospect, 1634, p. 47.

[4] 1878—4,974 pounds; 1897—4,820 pounds; 1900—6,450 pounds.

[5] Statistics have been published for 1903 to 1910, 1919, and 1928–1930.

[6] Statistics published for 1929–1933, and 1935–1947.

[7] See Adams (Field and Forest Rambles, 1873, pt. 3, Fishes, p. 248), who described the Indians of the Melicete Tribe as still spearing good-sized bass from their canoes in the St. John, in 1873.

[8] 2,000 pounds from the Cobequid–Shubenacadie region (Hants County), 700 pounds from Annapolis County.

Sandwich, near the Cape Cod Canal, through which they may have come, while some, that did not find their way into the official returns were taken in the inlets along the outer shore of Cape Cod during that summer or the summer before. And the commercial catches for Barnstable County rose to 8,060 pounds for 1928, to 18,665 pounds for 1929, and ran between about 27,000 pounds and about 34,000 pounds [9] for 1930, 1931 and 1932.

Surf fishermen, too, did better along the outer Cape shore from 1930 through the next couple of summers than they had for many years; (a 33-pounder was taken in the surf on Cape Cod, and one of 44¾ pounds on the south shore of Massachusetts Bay, p. 401). And it appears that the bass spread northward to the estuaries north of Cape Ann during these years (unless a small stock had persisted there through the poor period), for some were taken in the Parker River in the late 1920's while 8,700 pounds were reported thence in the winter of 1930, when net-fishing was allowed, temporarily.

This upswing was brief (the reported catches for the entire coastline of Massachusetts were only 4,500 and 5,100 pounds, respectively, for 1933 and for 1935).[10] But at least it gave a foretaste of what was to come, for the waters around Cape Cod were invaded during the summer of 1936 by countless schools of little bass, weighing about 2 to 3 pounds. These (as is now known) had been hatched in 1934 (i. e., 2 years previous) in the Chesapeake Bay–Delaware Bay region (p. 393), and it is interesting, not only that they came from so far away, but that this was the largest year's brood that has been produced in Chesapeake Bay for as far back as any record is available.[11] Unfortunately, there is no knowing in what numbers they reached the outer shore of Cape Cod and Cape Cod Bay in 1936, for no record seems to have been kept of commercial catches of them there in that year.

But they (chiefly) comprised the catches which were some 5 to 16 times as great in 1936 as in any of the 8 previous years [12] along the coast of Rhode Island. And considerable numbers of them were reported from as far north as the harbors and rivers along the southern part of the coast of Maine, where very few bass, large or small, had been caught for many years previous.

In 1937, having now grown to an average weight of about 3 to 5 pounds, they not only reappeared in such numbers that a commercial catch of something like 80,000 pounds was reported from the Gulf of Maine coast of Massachusetts,[13] but so many of them spread north past Cape Ann that the catch from the inner part of Massachusetts Bay to the New Hampshire line (about 55,000 pounds) was perhaps three times as great as that for the Cape Cod Bay–outer Cape region (in the neighborhood of 19,000 pounds). And more of these little bass were caught by anglers in the river mouths and estuaries of New Hampshire that summer, and of Maine as far as the Penobscot region, than had been the case the year before, but not enough to figure in the official statistics.

The fish of the 1934 year class averaged around 6 pounds by 1939 (many had reached 7–9 pounds); and the bass seemed so well established all along from Cape Cod to southern Maine that anglers had largely forgotten the preceding lean years. And the growth of the individual fish as they advanced in age, combined with fresh increments from the south seem to have more than balanced the death rate (natural or from fishing) for the next 5 or 6 years, for the coast of Massachusetts as a whole.[14] And a good part of the fish of the 1934 year class (still swimming in good numbers) grew meantime to 18 to 25 pounds, to the delight of the anglers.

Bass fishing improved so much in the Hampton region also, and in the Piscataqua River system that about 19,000 pounds were reported for 1943 in the commercial statistics for New Hampshire, where bass had not been mentioned in the fishery statistics for many years. But it is evident that depletion in numbers outran renewal along the coast of Maine during this same period, for there were many fewer fish there in the season 1940 then there had been in 1939 or 1938, though they ran larger, averaging about 8–10 pounds according to local reports.

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[9] To the nearest 1,000 pounds.

[10] No data for 1934.

[11] Tiller, Publ. 85, Chesapeake Biol. Lab., 1950, p. 24.

[12] For details, see Merriman, Fish. Bull. No. 35, U. S. Fish and Wildlife Service, vol. 50, 1941, p. 10, fig. 4; p. 13, fig. 8.

[13] Assuming that about two-thirds of the catch of 28,700 pounds for Barnstable County came from the outer shore of Cape Cod and from Cape Cod Bay, probably an under estimate.

[14] Reported catches for Massachusetts as a whole were about 62,500 pounds for 1939, about 75,700 pounds for 1940, about 99,500 pounds for 1943, no data available for 1941 or 1942.

Small bass (apparently spawned in southern waters in 1940, 1941, or 1942[15] and now large enough to be included in the commercial statistics) again entered the southern part of our Gulf in 1944 in such numbers that the commercial catch for Massachusetts as a whole was nearly twice as great for that year (about 191,000 pounds) as it had been the year before (about 99,500 pounds).[16]

But it seems that very few of the fish of the 1942 year class, if any, spread northward much beyond the Merrimac River, for the reported catch for New Hampshire fell from about 19,000 pounds in 1943 to between 10,000 and 11,000 pounds in 1944, and to about 9,000 pounds in 1945, though the proportion of large fish was greater, while occasional bass, only, were reported in Maine waters in these years, or in the later 1940's.

Anglers' reports in general, and our own observations, are to the effect that few young bass appeared in the Cape Cod Bay-outer Cape region during the four years 1946–1949, or farther north along the New England coast. While this prevailing scarcity of baby bass caused widespread fears that the striper might be facing another serious decline, anglers welcomed an accompanying increase in the numbers of bass weighing upwards of 20 to 25 pounds. Thus, a larger number of fish heavier than 25 to 35 pounds were landed along the outer shore of the Cape, in Cape Cod Bay and in northern Massachusetts waters in 1950 than for many years. We saw one of 45 pounds that was caught by an angling companion in the inner part of Massachusetts Bay that September, and one of 51½ pounds, caught in the surf, was reported from the outer shore of Cape Cod that August, while others, doubtless in the 50-pound class, were taken of which we did not chance to hear. A few very large fish were reported, that summer, in the surf at Old Orchard Beach, Maine. And hundreds of bass of 25 to 45 pounds, with a few running up to 52 or 53 pounds (few smaller than 25–30 pounds) were caught in the surf on the outer beach near the tip of Cape Cod during the summer of 1951, many up to 30–45 pounds in Cape Cod Bay that July; a few as large as 20 to 30 pounds in Duxbury Bay; at least two (to our knowledge) weighing a little more than 50 pounds in the inner part of Massachusetts Bay; a few in the 30 to 45 pound class on the northern Massachusetts coast.

It is almost certain that most of these large fish belong to the abundant year classes that were spawned in the early 1940's or even previously. Hopes for the future depend, therefore, on renewed replenishments of the stock. A year ago (in 1950), prospects seemed good in this respect, for great numbers of little bass (many smaller than the legal length in Massachusetts, 16 inches from snout to fork of tail) were reported that summer and autumn from various localities along southern New England, and northward as far as Plymouth and Duxbury Bays; from the North and South Rivers in Marshfield; from Boston Harbor; from the Parker River (Plum Island Sound region); from the lower Merrimac River; and from Hampton Harbor, N. H. Many "school" fish of 2 to 8 pounds seen (and some caught) in the Saco in July and August of 1950, and a few landed every day from the York and Mousam Rivers late that June, point similarly to a fresh influx of bass to southern Maine waters, either that year or the year before, for it is not likely that these fish had been spawned in the streams along that part of the coast.

And reports that Pleasant Bay, on Cape Cod, the Massachusetts Bay end of the Cape Cod Canal, and Duxbury Bay, have all been "loaded" with small bass at times during the present summer (1951) and also of many too small to keep, off Wollaston Beach in Boston Harbor, are promising at least; so is the fact that a good many fish in the 10 to 15-pound class have been caught at various places along the coast.

An interesting aspect of the bass situation is that the young bass that invaded the water of Massachusetts and of Maine in 1936 and 1937 seem not to have spread to the St. John River system for while commercial catches ran larger there during the 1930's than they had during the 1920's, the increase may not have been greater than can be accounted for by an increasing demand for bass. And, in any case, it had taken place by 1932, i. e., two years before the fish were spawned that re-

[15] The broods of 1940–1942 were large, in Chesapeake Bay, though not as large as the brood of 1934 (Tiller, Chesapeake Biol. Lab., Pub. 85, 1950, pp. 13, 24–25).

[16] The minimum legal length for bass (snout to fork of tail) having been set in Massachusetts at 16 inches (fish 3–4 years old).

plenished the Massachusetts stock in 1936 and 1937 (p. 402).[17]

Some of these that reached Massachusetts in 1944 may have spread to Nova Scotia, also, for the average catch was larger there from 1944 to 1946, than it had been for many years. But the increase was not great enough to suggest than any large recruitment had taken place from the south.[18]

Additional evidence that the bass of the Bay of Fundy region do not intermingle to any great extent with those of the western side of the Gulf of Maine is that the fish ran so small in the Nova Scotian streams in 1949 and 1950 (p. 397) when there were so many very large ones in Massachusetts waters (p. 403). And the fact that those caught in those years ran considerably larger in the Annapolis River than in the Shubenacadie River (p. 397) emboldens us to suggest that the populations in the several Nova Scotian streams are more or less separate; and separate also from the bass of the St. John.

It would, of course, be of the greatest interest, to commercial fishermen and to anglers alike, to know what determines that an abundant brood of bass, or a poor brood is to be reared in any given year. All we dare say is that the largest brood on record (that of 1934, in Chesapeake Bay) was produced when the parent stock was at a very low ebb, which may prove a general rule, and that studies by Merriman[19] and by Tiller[20] suggest that very large broods are raised only in years when the temperature of the water is lower than normal, both before the spawning season and after it.

Importance.—Striped bass have not been plentiful enough in the Gulf of Maine at any time during the past 100 years to support a commercial fishery of any great magnitude. Even in the good years 1944–1946 the reported value of the commercial catches for Massachusetts as a whole was less than $50,000 yearly.[21] But this does not take into account bass used for home consumption, or those sold in small lots. In the seasons of 1937 and 1938, when the yield of the year class of 1934 was at its peak, about 30–40 percent of the reported commercial catch was made by hook and line, about 40–45 percent in pound nets and traps. But with the development of increasingly efficient methods of trolling with hand lines from small craft, the hook and line catch increased in importance to about 63–65 percent for the seasons of 1939, 1940, and 1943,[22] and to about 89–91 percent for 1944, 1945, and 1946, while the pound net and trap catches decreasing correspondingly.[23]

The striper is the leading game fish in its periods of plenty all along our coast, from the outer shore of Cape Cod to New Hampshire waters. The number of anglers who cast for them in the surf along the beaches of Cape Cod and northward from Cape Ann to the mouth of the Merrimac and at scattered spots elsewhere certainly is in the thousands. Many party boats troll daily for bass in Cape Cod Bay, some also along the Plum Island shore and at the mouth of the Merrimac, while many are caught by trolling, by live line fishing, and even by still fishing in the various inlets.

So far as we know, Shubenacadie River and Lake, and the Annapolis River are the only waters on the Canadian shores of our Gulf where the striper attracts attention as a game fish (p. 397); anglers visiting the St. John are far more interested in salmon.

So much has been written about the techniques of surf casting, trolling, choice of lines, and baits, that we need not delay; but it is interesting, in comparison, to read, in Wood's New England's Prospect, published in 1634 (p. 37), that "the way to catch them is with hook and line, the fisherman taking a great cod line to which he fasteneth a peece of lobster and threwes it into the sea. The fish biting at it, he pulls her to him and knockes her on the head with a sticke".

We should point out in conclusion, that the recreational value of the striper is high; its money return to the seaside communities where bass are plentiful is much greater than the price the fish bring in the market, if the amounts spent for tackle and bait, boat hire, lodging, guide service, and the patronage of service garages, and gasoline filling stations are taken into account.

[17] Maximum reported catch for St. John River system for period 1922–1943, was 21,200 pounds in 1932.

[18] Average yearly catch, Nova Scotian rivers and coast of the Bay of Fundy was about 3,355 pounds for 1922–1930; about 12,600 pounds for 1932–1943; about 18,300 pounds for 1944–1946.

[19] Fish. Bull. 35, U. S. Fish and Wildlife Service, 1941, vol. 50, p. 14.

[20] Pub. 85, Chesapeake Biol. Lab., 1950, pp. 18, 28.

[21] 1944, $29,173; 1944, $34,643; 1945, $48,748; 1946, $34,643.

[22] No data are available for 1941 or 1942.

[23] About 15–35 percent for 1939, 1940, and 1943; about 5–11 percent for 1944, 1945, and 1946.

White perch *Morone americana*

(Gmelin) 1789

SEA PERCH

Jordan and Evermann, 1896–1900, p. 1134.

Description.—The white perch resembles its larger relative, the striped bass, in the number, outline, and arrangement of its fins, and in its deep caudal peduncle without longitudinal keels. But it is a deeper bodied fish, (only about 2⅓ to 3 times as long as deep, not counting the caudal fin); and it is more flattened sidewise (p. 390). The dorsal profile of its body is more convex than that of a bass, but its head is rather noticeably concave and its mouth is smaller. Furthermore, there is no free space between the two dorsal fins of the white perch, whereas they are separated by a short interspace in the striped bass. The perch has fewer rows of scales between gill cover and base of tail than the bass (about 48 in the white perch, 60 or more in the striped bass), and its anal spines are much stouter than those of the bass with the second and third about equal in length (graduated in the bass); also it usually has only one spine (sometimes two) at the margin of the gill cover. Finally, there is a constant difference in color.

The first dorsal fin (9 spines) of the perch is rounded in outline with its third and fourth spines longest, and although there is no free space between the two dorsal fins they are entirely separated by a deep notch. The second dorsal fin (1 spine and 12 rays) is rhomboid in outline and so short that it leaves a rather long caudal peduncle bare. The anal fin (8 to 10 rays preceded by 3 stout spines) originates under the middle of the second dorsal and is of the same shape as the latter. The ventrals originate a little way behind the pectorals and each ventral is armed with one stout spine at its forward margin. Both the pectorals and the ventrals of the perch are larger, in comparison with the size of the fish, than those of the striped bass.

Color.—The upper surface is variously olive, dark grayish green, or dark silvery gray, shading to paler olive or silvery green on the sides and to silvery white on the belly, while large fish often show a bluish luster on the head. The fins often are more or less dusky. The ventral fins and the anal fin are sometimes rose-colored at the base. The sides of young specimens are marked with pale longitudinal stripes but these usually fade out with growth.

Size.—White perch are occasionally as much as 15 inches long, 5 inches or more deep, and 2 pounds or a little more in weight; but the average is 8 to 10 inches long and 1 pound in weight, or less.

Habits.—The white perch is much more closely restricted in its seaward range than the bass, for while they are taken in undiluted sea water along southern New England, and at various other localities thence westward and southward, they are much more plentiful in ponds connected with the sea, in the brackish water of bays behind barrier

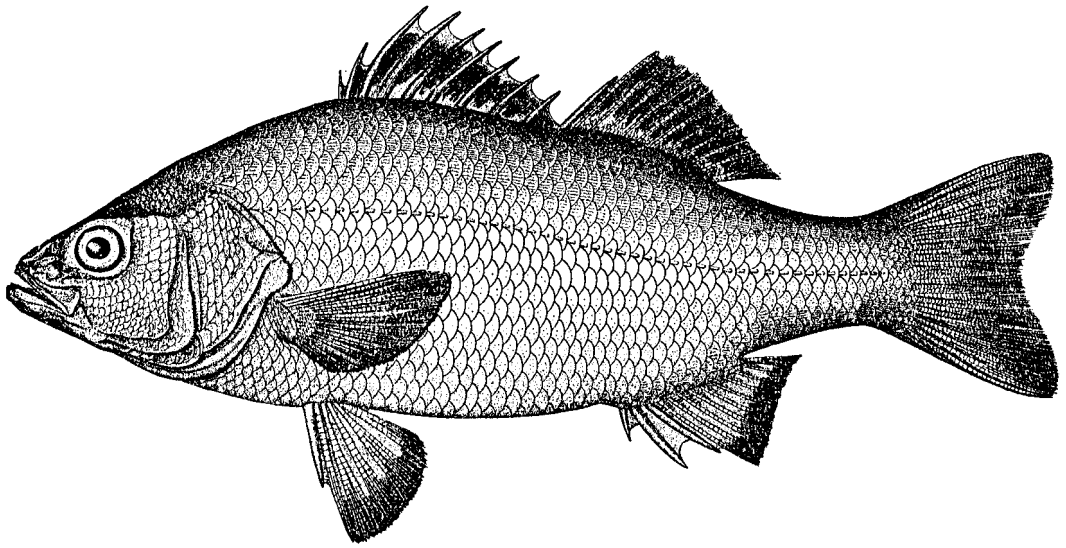

FIGURE 210.—White perch (*Morone americana*). From Goode. Drawing by H. L. Todd.

beaches, in estuaries, and in river mouths. White perch also occur landlocked in fresh-water ponds in many places.

They are ordinarily found in shallow water, usually not deeper than perhaps a fathom or two, but sometimes as deep as 10–21 fathoms in Chesapeake Bay.[24] However, they are not bottom fish (except in winter), but wander from place to place in small schools. Apart from this, they are resident throughout the year wherever found. In winter they congregate in the deeper parts of the bays and creeks, where they either hibernate, or at least pass the cold season in a sluggish condition.

When living in salt or brackish water white perch feed on small fish fry of all kinds, young squid, shrimps, crabs, and various other invertebrates, as well as on the spawn of other fish, of which they are very destructive. Swarms of young perch, for instance, have been seen following the alewives around the shores of ponds on Marthas Vineyard, eating their spawn as it was deposited. They bite freely on almost any bait, natural or artificial.

Breeding.—Along southern New England the white perch spawn in April, May, and June. Presumably the season commences a few weeks later around the Gulf of Maine, but definite data are lacking.[25] Those living in salt water run up into fresh or slightly brackish water to spawn. The eggs (about 0.73 mm. in diameter, with large oil globule) sink and stick together in masses, or to any object on which they chance to rest. Incubation occupies about 6 days at a temperature of 52°. The newly hatched larvae are about 2.3 mm. long with the vent some distance behind the yolk sac and with very little pigment. In five or six days after hatching the head begins to project forward, the yolk sac has been partly absorbed and branched pigment cells have appeared on the oil globule. The late larval and post larval stages have not been described.[26]

General range.—Atlantic coast of North America from the Gulf of St. Lawrence and Nova Scotia to South Carolina, breeding in fresh or brackish water and permanently landlocked in many fresh ponds and streams.

Occurrence in the Gulf of Maine.—The white perch inhabit salt, brackish, and fresh water indifferently along the shores of southern New England. But while this is a familiar fish in many ponds throughout northern New England, New Brunswick, and Nova Scotia, they are found regularly in only a few estuarine situations north of Cape Cod, and they hardly belong to the fish fauna of the open Gulf. Thus we have heard only vaguely of them in Duxbury Bay and in the North and South Rivers in Marshfield; and we had not been able to satisfy ourselves of their presence in the salt creeks about Cohasset, Mass. (localities apparently suited to it) until the summer of 1950, when white perch running-up stream to a pond were reported there.[27] Storer long ago described white perch as brought to Boston market from the mouths of neighboring rivers and from ponds to which the sea had access. And white perch run in salt and brackish reaches of the Parker River in northern Massachusetts, providing fishing for many small boat anglers in spring and summer.

Ordinarily white perch are so scarce along the open coast from Cape Cod northward that they did not figure in the statistics of the shore fisheries of any part of Massachusetts Bay from 1907 to 1928.[28] And ordinarily they are not common along the coast of Maine; none was reported from the shore fisheries of Maine in 1905 or 1919, and only 400 pounds in 1902; none at all of late years. But they appear locally, however, in unusual numbers on rare occasions. Thus it is probable that certain unfamiliar fish taken at Beverly on the north shore of Massachusetts Bay during the summer of 1950, and in Casco Bay, were white perch.[29] No less than 1,600 pounds of white perch were reported for the shore fisheries of the short coast line of New Hampshire in the year 1912: Casco Bay saw a run of them in the summer of 1901 when local fishermen, not knowing the fish, dubbed them "sea bass"; and they have been reported at Eastport, Maine. But apparently they do not occur around the shores of the Bay of Fundy, either in salt water or in brackish. And there is no reason to suppose that white perch were more regularly plentiful along the coast of the Gulf of Maine than they are today.

[24] Hildebrand and Schroeder (Bull. U. S. Bur. Fish., vol. 43, Pt. 1, 1928, p. 245) report ripe specimens as deep as 9½ to 21 fathoms in Chesapeake Bay.

[25] In Chesapeake Bay they spawn chiefly in April and May, but they are known to do so exceptionally in December (Hildebrand and Schroeder, Bull. U. S. Bur. Fish., vol. 43, Pt. 1, 1928, p. 245).

[26] Ryder (Rept. U. S. Comm. Fish., (1885) 1887, p. 518) describes the early development.

[27] Reported by Lenore Williams, Salt Water Sportsman for June 30, 1950.

[28] Only recent years from which detailed information is available.

[29] Moore, Boston Herald, for August 7, 1950.

In more eastern Nova Scotian waters, also, perch are "less often seen" in salt and brackish water than in fresh[30] and they appear to be restricted, in the eastern side of the Gulf of St. Lawrence, to the "estuarine transition" from salt water to fresh.[31]

Importance.—The white perch is of considerable commercial importance wherever it is abundant in tide waters. The commercial catch in Chesapeake Bay, for example, was 1,143,700 pounds for 1946, 1,851,000 pounds for 1947. And several millions of artificially hatched fry are released there yearly. It also affords good sport to many anglers wherever it is plentiful, both in brackish water or in fresh. But it is not important in the open Gulf of Maine in either of these respects.

Sea bass *Centropristes striatus* (Linnaeus) 1758

BLACK SEA BASS; BLACKFISH

Jordan and Evermann, 1896–1900, p. 1199.

Description.—The sea bass is easily distinguished from the striped bass and from the white perch by the fact that the spiny and soft-rayed portions of its dorsal fin are continuous, so that there is only one long fin instead of two short separate fins. It agrees with its nearer relative the wreck fish (p. 409) in this; also with the scup (p. 411), with the rosefish (p. 430), with the cunner (p. 473), and with the tautog (p. 478). But its general form, rounded caudal and pectoral fins, and its short but high anal fin are sufficient to separate it from the scup, its color prevents confusing it with the rosefish; and no one should take sea bass for tautog or cunner; its mouth and its pectoral fins are so much larger, its caudal of different outline (cf. fig. 211 with figs. 249, 250), and the soft portion of its dorsal as long as the spiny portion. It differs from the wreck fish (p. 409), in many respects, especially in its much larger scales; in the smoothness of its head and gill covers; and in the shape of its tail fin.

It is moderately stout-bodied, about three times as long (not counting the caudal fin) as it is deep, with rather high back but flat-topped head, moderately pointed snout, a large oblique mouth, eye set high up, and one sharp flat spine near the rear angle of each gill cover. The spiny (10 spines) and soft (11 rays) portions of its dorsal fin (which originates slightly in front of the rear corner of the gill covers) are separately rounded, the latter higher than long, with the characteristic outline shown in the illustration (fig. 211). The caudal fin is rounded. In large fish one of the upper rays is much the longest, and though the resulting outline is a trivial character and variable from fish to fish it is an extremely characteristic one that is shared by no other Gulf of Maine species except the kingfish (p. 423). The anal fin (3 short sharp spines followed by 7 soft rays) originates under or very slightly behind the origin of the soft portion of the dorsal fin, which it resembles in its rounded

[30] Vladykov and MacKenzie, Proc. Nova Scotia Inst. Sci., vol. 19, 1935, p. 91.

[31] Huntsman, Trans. Roy. Soc. Canada, Ser. 3, vol. 12, Sect. 4, 1918, p. 63.

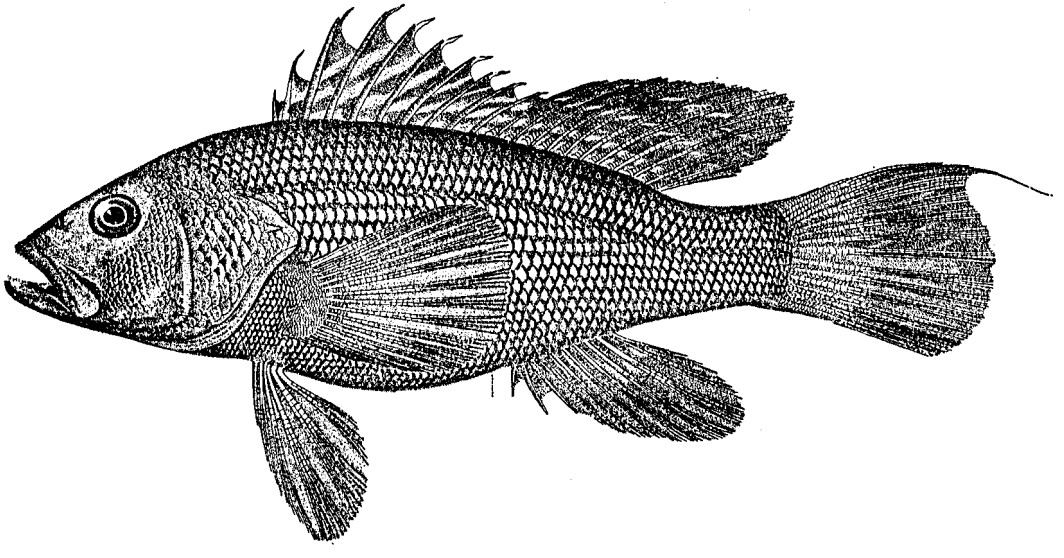

FIGURE 211.—Sea bass (*Centropristes striatus*), Connecticut. From Goode. Drawing by H. L. Todd.

outline and in being higher than long. Both the anal fin and the soft part of the dorsal are noticeably soft and flexible. The pectorals are so long that they reach back almost, if not quite to the anal, broad and round tipped; a good field mark. The ventrals, too, are larger than in any other fish with which the sea bass might be confused, and they originate in front of the pectorals, whereas they stand slightly behind the latter in scup, rosefish, cunner, and tautog. The scales are rather large, but the top of the head is naked. Adult males develop a fatty hump on the back in front of the dorsal fin.

Color.—Sea bass, like most fish that lie on rocky bottom, vary widely in color, the general ground tint ranging from smoky gray to dusky brown or blue black, usually more or less mottled. The belly is only slightly paler than the sides. On every sea bass we have seen the bases of the exposed parts of the scales are paler than their margins, giving the fish the appearance of being barred with longitudinal series of dots of a lighter tint of brown than the general hue on dark fish, but pearl gray on pale ones. The dorsal fin is marked with several series of whitish spots and bands; the other fins are mottled with dusky. Young fish 2 or 3 inches long are greenish or brownish with a dark side stripe passing from eye to caudal fin, and with dark cross bars on the sides.

Size.—Sea bass grow to a length of 2 feet or more and a few reach a weight of 7½ pounds; but northern specimens are seldom heavier than 5 pounds, and they average only about 1½ pounds. A fish a foot long weighs about one pound, one of 18 to 20 inches about 3 pounds.

Habits.—The sea bass contrasts with the striped bass in being strictly confined to salt water. Its inshore-offshore range extends from close in to the coast line, in depths of only a few feet, out about to the 70-fathom contour line, according to the season of the year. Off New Jersey, Long Island, and southern New England they appear inshore during the first or second week in May, withdrawing again late in October or early in November.

They winter offshore along the 30- to 70-fathom zone; the depth and the distance offshore being governed, it seems, by a preference for temperatures higher than about 46°–47°.[32]

It seems, too, that some of the population that summers off New Jersey and to the northward may combine this offshore movement with a southward migration, for sea bass form a considerable part of the catches that are made by the winter trawl fishery off Virginia and northern North Carolina from January to April,[33] whereas they have been taken in small numbers only (though widely dispersed) off southern New England at that time of year.[34]

During the part of the year when the sea bass are inshore they are most plentiful on hard bottom, in water less than 20 fathoms or so, often around submerged wrecks and the pilings of wharves. They are bottom feeders, subsisting chiefly on crabs, lobsters, shrimp, and various mollusks. They also eat small fish (e. g., launce and menhaden), and squid on occasion. And they take a hook readily.

The sea bass spawn in May along the North Carolina coast; from the middle of May to the end of June off New Jersey, off Long Island, and off southern New England. The eggs are buoyant.[35] The young fry are easily identifiable as sea bass by the time they have grown to a length of 2⅝ inches (60 mm.) or so.

General range.—Atlantic coastal waters of the United States, from northern Florida to Cape Cod, occasionally to Maine.

Occurrence in the Gulf of Maine.—The sea bass enters our Gulf only as a rare stray from the south, Pemaquid Point and Matinicus Island being its nothernmost known outposts. It has been taken in Casco Bay; near Gloucester (where a few have been caught in the traps); off Nahant, Salem, and Beverly in Massachusetts Bay; at North Truro and at Monomoy on Cape Cod; and 5 miles east of Pollock Rip Lightship, where a 5-pound fish was trawled in 24 fathoms, December 1930.[36] But it has never been found in any numbers north of the elbow of Cape Cod so far as we can learn. We have never seen it in the Massachusetts Bay region, nor are fishermen of whom we have inquired familiar with it there. Sea bass, it is true,

[32] Neville, Fishery Circular No. 18, U. S. Bur. Fish., 1935, p. 3–7.

[33] For quantities caught and other details, see Pearson, Investigational Report No. 10, U. S. Bur. Fish., 1932.

[34] We counted from 1 to 25 sea bass per haul in 31 out of 45 trawl hauls made by the dragger *Eugene H* off Rhode Island and off southern Massachusetts, in 46 to 67 fathoms, Jan. 27 to Feb. 3, 1950.

[35] The early development of the sea bass has been described by Wilson (Bull U. S. Fish Comm., vol. 9, 1891, p. 209).

[36] Reported by Firth, Bull. 61, Boston Soc. Nat. Hist., 1931, p. 12.

occasionally appear in the returns of the local pound nets and traps.[37]

But it is doubtful whether these records can be accepted, for when the name "sea bass" is used along the northern New England coast it usually is either striped bass (p. 389), white perch (p. 405), tautog (p. 478), or even rosefish (p. 430) that is meant.[38] No sooner do we round Cape Cod to the west, however, than we find the sea bass one of the important ground fish.

Judging from its season at Woods Hole, where it is to be caught from May to October (most abundantly in July, August, and September), sea bass are most likely to be taken in the Gulf of Maine in summer, if at all, though there is one record for December. There is no reason to suppose that they ever succeed in reproducing themselves in the Gulf or in establishing a temporary foothold even if the rare migrants should spawn there.

Importance.—Too scarce to be of any importance in the Gulf, the sea bass is a very valuable food and game fish in more southern waters.

[37] For example, 80 pounds at Provincetown for 1896; 146 pounds at Truro 1898; 101 pounds at the same locality for 1900; with occasional fish at Eastham, Barnstable, Sagamore, Manomet, and Gloucester.

[38] The 3,000 pounds of "sea bass" reported from Manchester, Mass., in 1911 certainly were not this fish.

Wreck fish *Polyprion americanus* (Bloch and Schneider) 1801

WRECK BASS

Jordan and Evermann, 1896–1900, p. 1139.

Description.—The combination of a sea-bass-like body with a very rough head having a prominent ridge and strong spines on each gill cover, and a bony protuberance over the eye and on the nape, give the wreck fish an aspect so different from that of any other Gulf of Maine fish (even from its close relative the sea bass) that it should be easily recognized if caught. It is strongly flattened sidewise, about 2½ to 3 times as long as deep (to origin of tail fin), with large mouth. And the lower jaw projects considerably beyond the upper. The scales are rough, much smaller relatively than in the sea bass, and they extend over the bases of the soft-rayed fins. The first part of the dorsal fin has 11 strong spines, the second part, 11 or 12 soft rays, and the spiny part of the dorsal is continuous with the soft-rayed part. The anal fin, with 3 spines and 8 or 9 rays, is similar to the soft-rayed part of the dorsal in outline. The caudal fin is gently rounded; the pec-

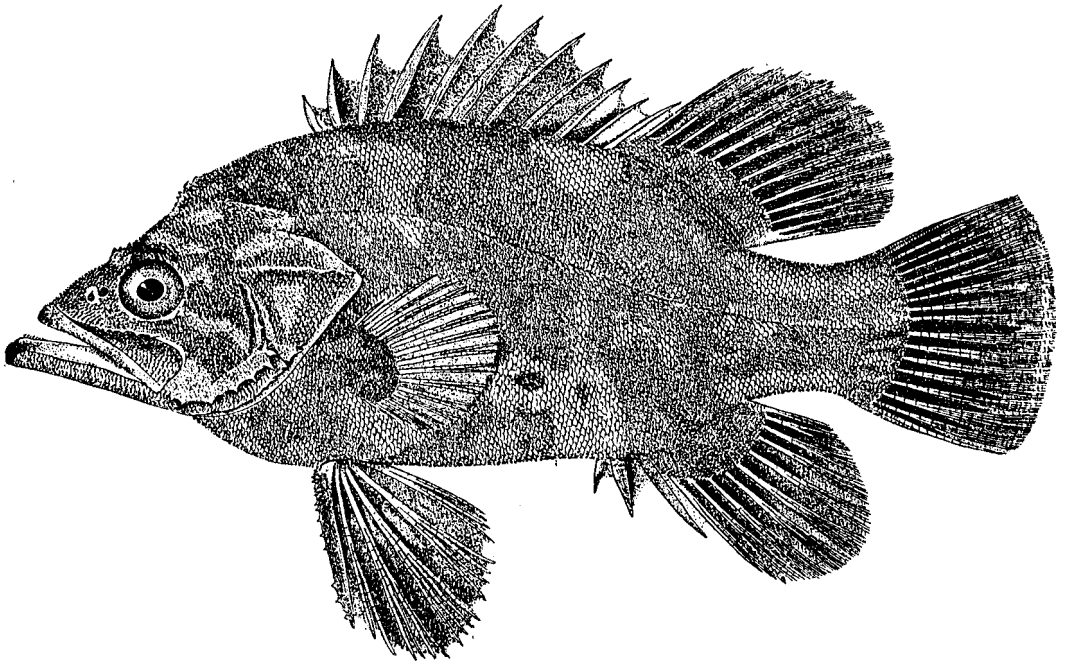

FIGURE 212.—Wreckfish (*Polyprion americanus*), Grand Bank. From Goode and Bean. Drawing by H. L. Todd.

torals (about half as long as the head) stand almost above the ventrals.

Color.—Grayish or blackish brown, the caudal fin edged with white. Young fish are mottled above with gray and cream on head and body.

Size.—Reaches a length of 4½ to 5 feet at least, and a weight of more than 100 pounds.

Habits.—Small wreck fish are most likely to be found under floating logs or wreckage, as the common name implies. When larger, they take to bottom; this, at least, is the case around Madeira and in the Mediterranean.

General range.—This is a fish of wide distribution. In the eastern Atlantic it is known as far north as Norway, as far south as the Canaries; also in the Mediterranean. It has been reported only occasionally in the western Atlantic, but its latitudinal range there extends from the Grand Banks of Newfoundland to the La Plata River. It is also known from the Cape of Good Hope and Indian Ocean.[39]

Occurrence in the Gulf of Maine.—The only report that has reached us of a wreck fish in any part of the Gulf of Maine is of one 24½ inches long, weighing 9 pounds 7 ounces (dressed), taken on the northern edge of Georges Bank, August 13, 1951, by the trawler *Winthrop*.[40] Another, 6 inches long, was caught on the surface off No Man's Land Island, near Martha's Vineyard, August 21, 1925; and two have been brought in from the Grand Banks, one of them many years ago,[41] the second in 1929.[42]

THE CATALUFAS OR BIG EYES. FAMILY PRIACANTHIDAE

The big eyes are very closely related to the sea basses (Serranidae), from which they differ chiefly by the fact that the entire head, including the snout and upper jaw, is clothed with rough scales.

Short big-eye *Pseudopriacanthus altus* (Gill) 1862

Jordan and Evermann, 1896–1900, p. 1239.

Description.—The most striking characters of this fish are its very large eyes and its brilliant red color. Apart from these, it is distinguishable from the seabass tribe by the fact that its whole head, as well as its body, is clothed with rough scales and that the anal fin is longer than the soft-rayed portion of its dorsal fin. Its sidewise flattened body, unusually stout dorsal fin spines, very large ventral fins, and small pectorals, are ready field marks to separate it from the rosefish, the only common Gulf of Maine species of similar appearance that rivals it in color. The big-eye is ovate in outline, very thin through, with rounded dorsal profile, large head, notably oblique mouth, and enormous eyes. The spiny (10 spines) and soft (11 rays) portions of its dorsal fin are continuous, and extend back from the nape nearly to the base of the caudal fin. The anal (3 stout spines and 9 or 10 rays) originates under the eighth or ninth dorsal spine and its soft portion is nearly of the same form as the soft portion of the dorsal, except that its outer angle is somewhat more rounded. The caudal is square-cornered and slightly convex. The ventrals, which originate a little in front of the pectorals, are much larger than the latter, round tipped, and each commences with a stiff spine.

Color.—Bright red in life, below and above; dorsal fin red, the spinous part edged with yellow, a few blackish dots on the soft rays; caudal fin pale, with blackish reticulations; anal red, edged with black; ventrals red at base, dusky on outer part; pectorals plain red. The iris is gold.

Size.—The largest specimen on record was 11 inches long.

General range.—Caribbean Sea, West Indies, and Gulf of Mexico in rather deep water, straying northward to the Woods Hole region and very rarely rounding Cape Cod.

Occurrence in the Gulf of Maine.—A big-eye found alive on Marblehead Beach, September 3, 1859; a second, found at Scituate, Mass., in 1932 or 1933;[43] and a third, about 1½ inches (38 mm.) long, picked up in a tide pool at Cohasset, Mass., by F. G. Bemis in September 1937,[44] are the only definite records for this southern fish within the Gulf. But since it occasionally appears in some numbers at Woods Hole in summer, it may round Cape Cod more often than this paucity of actual records suggests.

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[39] We have given a more detailed statement elsewhere (Copeia, 1930, No. 2, p. 46).

[40] This specimen, which we have examined, is in the collection of the U. S. Fish and Wildlife Service at Woods Hole.

[41] Goode and Bean, Smithsonian Contrib. Knowl., vol. 30, 1895, p. 238.

[42] Schroeder, Copeia, June 1930, p. 46.

[43] Reported by MacCoy, Bull. 67, Boston Soc. Nat. Hist., 1933, p. 9.

[44] This specimen, reported by Schroeder (Copeia, 1937, p. 238) is in the Museum of Comparative Zoology.

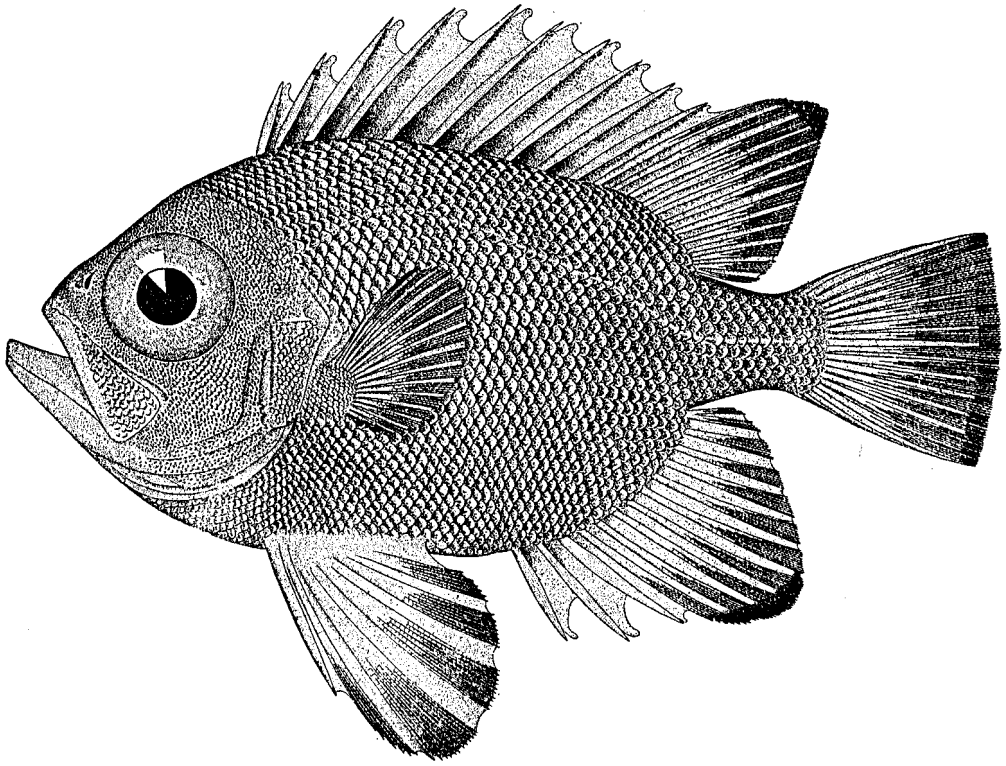

FIGURE 213.—Short big-eye (*Pseudopriacanthus altus*), Key West, Florida. From Jordan and Evermann. Drawing by H. L. Todd.

THE PORGIES. FAMILY SPARIDAE

The structure of the fins is essentially the same in this family as in the sea basses; both spiny and soft portions of the dorsal are well developed and the ventrals are situated below the pectorals. There are important anatomic differences, however, most obvious of which are that the edge of the gill cover does not end with a sharp spine in the porgies but is rounded or at most bluntly angular; and that the maxillary bone (the bone forming the margin of the upper jaw) is sheathed and hidden by the preorbital bone when the mouth is closed. Long, pointed pectoral fins are likewise characteristic of the family; the spiny and soft portions of the dorsal fin are continuous, and the soft rayed anal fin is about as long as the soft part of the dorsal.

KEY TO THE GULF OF MAINE PORGIES

1. Outline of caudal fin deeply lunate, with sharp corners ..... Scup, p. 411
   Outline of caudal fin only slightly concave, with rounded corners ..... Sheepshead, p. 416

Scup *Stenotomus versicolor* (Mitchill) 1815

PORGY

Jordan and Evermann, 1896–1900, p. 1346, as *Stenotomus chrysops* (Linnaeus), 1766.

Description.—Although the scup is not marked by any one outstanding character it is made easily recognizable by the fact that the spiny portion of its dorsal fin is considerably longer and higher than the soft-rayed portion, which, with its deeply lunate caudal fin, separates it from all other Gulf of Maine fishes of similarly deep and sidewise-flattened bodies. The scup is about one-half as deep as it is long (to the base of the tail fin) and very thin through, recalling a butterfish (p. 363). But the dorsal profile of its rather short head is slightly concave instead of convex, and its scales rather large, thick and firmly attached; not small, thin and easily detached as they are in the butterfish.

The mouth of the scup is small, its eyes are situated high up on the side of the head, and the margins of its gill covers are rounded. It has one

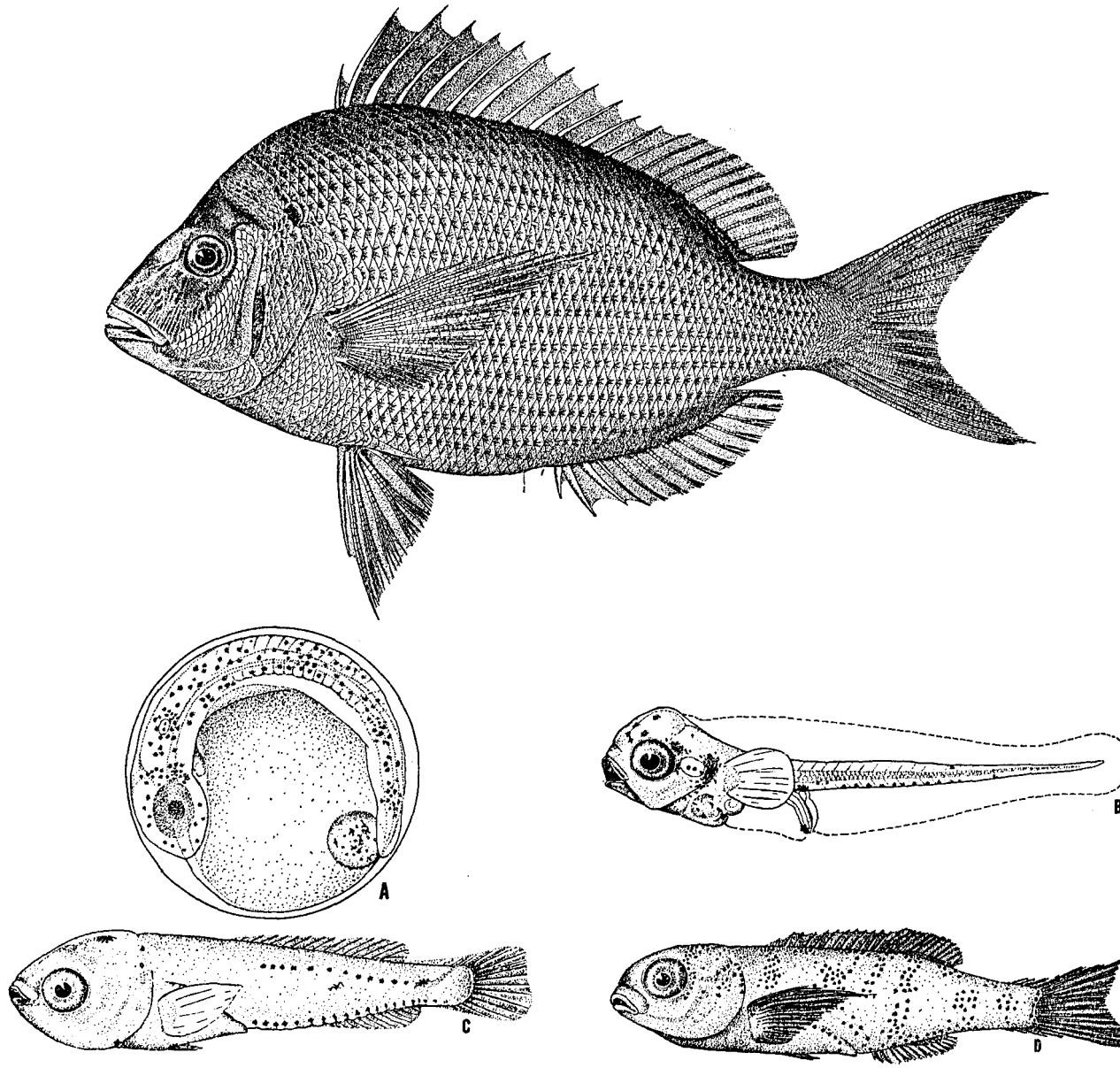

FIGURE 214.—Scup (*Stenotomus versicolor*). Adult, Woods Hole; from Goode, drawing by H. L. Todd; A, egg; B, larva, 3 days old, 2.8 mm.; C, larva, 10.5 mm.; D, larva, 25 mm. A–D, after Kuntz and Radcliffe.

long dorsal fin originating over the pectorals and preceded by a forward-pointing spine; the spiny (12 spines) and soft (12 rays) parts are continuous, forming a single fin. As a whole the dorsal fin is moderately high, its first spine much shorter than the others, its rear corner rounded, and it can be laid back in a groove along the mid line of the back. The anal (3 spines and 11 or 12 rays) is nearly as long as the soft part of the dorsal, under which it stands, and is almost even in height from front to rear, but with the first spine shorter than the others. The anal fin is depressible in a conspicuous groove, like the dorsal. The caudal is deeply concave with sharp corners. The pectorals are very long (reaching to even with the soft part of the dorsal), sharp pointed, and with slightly concave lower rear margins. The ventrals, situated below the pectorals, are of moderate size.

Color.—Dull silvery and iridescent, somewhat darker above than below; the sides and back with 12 to 15 indistinct longitudinal stripes, flecked with

light blue and with a light-blue streak following the base of the dorsal fin. The head is silvery, marked with irregular dusky blotches; the belly is white. The dorsal, caudal, and anal fins are dusky, flecked with blue; the pectoral fins of a brownish tinge; the ventrals white and bluish, and very slightly dusky; the iris silvery; the pupil black.

Size.—The scup is said to reach a length of 18 inches and a weight of 3 to 4 pounds, but adults usually run only up to about 12 to 14 inches, and weigh only 1 to 2 pounds.

Habits.—Scup are inshore from early April at the mouth of Chesapeake Bay, and from early May northward to southern Massachusetts. Most of them withdraw from the coast late in October, though some few linger through November, and an occasional fish into December even as far north as the vicinity of Woods Hole.

It has been known for the past 20 years or more that many scup winter off Virginia and off northern North Carolina, in depths of 20 to 50 fathoms, where large commercial catches are made yearly by otter trawlers from January to April,[45] with a few as deep as 90 fathoms or so. And marking experiments have proved that some of the scup that summer along southern Massachusetts migrate southward in autumn as far as to the offings of Chesapeake Bay and of northern North Carolina for the winter, at least in some years, and vice versa.[46]

Scup have, however, been taken during the past few winters in depths of 45 to 70 fathoms off southern New England, in numbers large enough to show that part of the northern contingent of the species simply moves offshore in autumn, to come inshore again in spring.[47]

Differences in the locations where the largest catches are made in cool winters and in warm make it likely that a preference for water at least as warm as about 45° F. is the factor that determines how far seaward the scup move off any part of the coast in any particular winter.[48] And they are so sensitive to low temperatures that large numbers have been known to perish (both large ones and small) in sudden cold spells in shallow water.

It appears that different bodies of scup move inshore successively in spring, for in 1950 the *Albatross III* took 2,700 scup in 15 hauls at 45 to 55 fathoms, in the Hudson Gorge, on May 11–18, which is one or two weeks after the earliest scup ordinarily appear inshore near New York. And the fact that scup are more plentiful in June and July than in May points in the same direction.

It has been said that the first fish to arrive in spring are the large adults, with the immature fish following later. But there is no definite rule in this regard.

During their summer stay inshore, the scup tend to hug the coast so closely that a line drawn 5 or 6 miles beyond the outermost headlands would probably enclose the great majority of the total population at that time of year.

Scup usually congregate in schools. The young fry come close in to the land in only a few feet of water. Large fish, however, are seldom caught in summer in water shallower than 1 or 2 fathoms (occasionally at the surface), or deeper than 15 to 20 fathoms. They prefer smooth to rocky bottom, which results in a distribution so local that one trap at Manchester, on the North Shore of Massachusetts Bay, took small numbers of scup in 1885, 1886, and 1887, while another trap close by did not yield as much as one fish. They are bottom feeders in the main, seldom rising far above the ground, the adults preying on crustaceans (particularly on amphipods) as well as on annelid worms, hydroids, sand-dollars, young squid, and in fact on whatever invertebrates the particular bottom over which they live may afford. They also eat fish fry to some extent, such free-floating forms as crustacean and molluscan larvae, appendicularians, and copepods. The young feed chiefly on the latter and on other small Crustacea. Adult scup, like most other fish, cease feeding during spawning time, for which

[45] Reported catches for 1930–1931 (the only winter for which statistics are readily available) were 9,684 pounds in December, 495,312 pounds in January, 637,595 pounds in February, 653,276 pounds in March, and 76,322 pounds in April (Pearson, Investigational Report, No. 10, U. S. Bur. Fish., 1932, p. 14, table 2). In February 1930 *Albatross II* trawled three off Chesapeake Bay in 93 fathoms.

[46] One scup, tagged in summer near Woods Hole, was recaptured in winter off northern Virginia; two off Chesapeake Bay; and one off northern North Carolina (Neville, Fishery Circular No. 18, U. S. Bur. Fish., 1935, p. 3, fig. 3). Three tagged in winter off Virginia were recaptured in summer along New Jersey.

[47] We counted from 1 to 40 scup per haul in 17 trawl hauls out of a total of 44 hauls, on the *Eugene H* off Rhode Island and southern Massachusetts, Jan. 27 to Feb. 3, 1950, at depths of 47 to 67 fathoms; a dragger that caught 7 to 30 bushels in 3 hauls nearby at the time reported catches of 2,000 to 5,000 pounds as sometimes made in the vicinity at that same season; and the *Priscilla V* reported taking 445 pounds on Jan. 12, also 1,230 pounds on Jan. 21, 1950, at 52 to 54 fathoms, some 75 to 82 miles south of No Mans Land off Marthas Vineyard. The *Eugene H* fishing near Hudson Gorge in about 62 fathoms, caught 30,000 pounds of scup on a trip April 1–6, 1953.

[48] For details, see Neville, Fishery Circular No. 18, U. S. Bur. Fish., 1935.

reason few are caught then, but they bite very greedily throughout the rest of the summer on clams, bits of crab, and sea worms (*Nereis*), as do the immature fish throughout their stay.

Along southern New England scup spawn from May to August, but chiefly in June. Probably spawning both commences later and continues later for the few fish that manage to summer in Massachusetts Bay, and it may be assumed that they spawn wherever they summer.

The eggs are buoyant, transparent, spherical, rather small (about 0.9 mm. in diameter), and have one oil globule. Incubation occupies only about 40 hours at 72° (probably two to three days in the June temperatures of Massachusetts Bay) and judging from the season of spawning at Woods Hole, it is not likely that development can proceed normally in water colder than about 50° F. At hatching the larvae are about 2 mm. long, the yolk is fully absorbed within 3 days when the larva is about 2.8 mm. long, and there is then a characteristic row of black pigment spots along the ventral margin of the trunk. At 25 mm. the pectorals have assumed their pointed outline and the caudal fin is slightly forked, but the ventrals are still so small, and the body so slender, that the little fish hardly suggest their parentage until they are somewhat larger.[49]

In southern New England waters fry of 2 to 3 inches, evidently the product of that season's spawning, have been taken in abundance as early as September; they are 2½ to 3¼ inches long in October, and they may be as long as 4 inches at Woods Hole in November. Apparently young scup grow very little during the winter, for many of 4 inches are seen in the spring, probably the crop of the preceding season. According to Neville's unpublished studies,[50] scup average about 4¼ inches (11 cm.) long at one year of age (from hatching), about 6¼ inches (16 cm.) at two years, about 7⅞ inches (20 cm.) at three years, about 9 inches (23 cm.) at four years, and about 9¾ inches (25 cm.) at five years. If this age schedule is correct, the ages of the large fish of 12 to 15 inches, weighing 1½ to 2½ pounds are considerably greater than the 3 to 5 years that have been credited to them, following Baird's [51] estimate.

General range.—East coast of the United States, from North Carolina to Cape Cod; casual in the Gulf of Maine as far as Eastport, Maine.[52]

Occurrence in the Gulf of Maine.—Although the scup is one of the most familiar of shore fishes right up to the elbow of Cape Cod, with the southern coast of Massachusetts and its off-lying islands yielding annual catches of 1 million to 2 million pounds in good years, very few find their way past Monomoy Point into the colder waters of the Gulf of Maine.

The first definite mention of scup caught north of Cape Cod is Storer's statement that one was taken at Nahant in 1835, and another in 1836, but that it was never seen there before. Possibly these and one picked up dead at Cohasset in 1833 [53] were the survivors of a smack load that had been liberated in Boston Harbor a year or two earlier, and a similar plant was made in Plymouth Bay in 1834 or 1835. There is no reason to suppose that these planted fish established themselves. But when the practice of setting mackerel nets outside Provincetown Harbor was first adopted (about 1842) a few scup were taken in them from year to year; odd fish were caught in Cape Cod Bay yearly and between Boston and Cape Ann during the period 1860 to 1867; and a number were taken in a weir on Milk Island near Gloucester in 1878. It has been learned since (mainly from the catches of the pound nets and traps) that there were a few scup in northern Massachusetts waters in most years (or terms of years) down to the first decade or so of the present century, alternating with other years, or terms of years, when only an occasional fish was taken, or none.

In most of the years for which information is available, and when there have been any scup north of Cape Cod, the combined catches of the various traps have run from less than 100 pounds to 1 to 2 thousand pounds at most, whether for Cape Cod Bay or for the northern side of Massachusetts Bay (Essex County).[54] But Cape Cod Bay seems to have seen what might almost be called peaks of abundance in 1879 (catch, about 7,000 fish); in 1882–1885 (yearly catches 2,372–

[49] Kuntz and Radcliffe (Bull. U. S. Bur. Fish., vol. 35, 1918, p. 106) describe the early development of the scup.

[50] Information from James A. Mason, of the U. S. Fish and Wildlife Service.

[51] Rept. U. S. Comm. Fish. (1871–1872) 1873, p. 228.

[52] The southern scup, *Stenotomus chrysops* (Linnaeus) 1766, which was first reported from Charleston, S. C., ranges northward about to Cape Hatteras.

[53] Goode, Fish. Ind. U. S., Sect. 1, 1884, p. 387.

[54] Statistics of the shore fisheries were published by the State of Massachusetts in the Annual Reports of the Commissioner of Fisheries and Game for 1879–1911 and 1917–1919; of the Division of Fisheries and Game for 1920 and 1921.

5,354 fish); in 1887,[55] in 1890 (1,890 fish); and in 1895–1896 (14,362 and 5,083 fish, respectively); also the northern side of Massachusetts Bay in 1909–1910 (8,417 pounds [56] and 4,181 pounds); both Cape Cod Bay (6,000 pounds) and the north shore of Massachusetts Bay (3,217 pounds) in 1917.

The cataclysmic shrinkage that took place in the stock of scup off southern Massachusetts between 1896 (prior to which the annual catch there had usually run from 1 to 3 million pounds) and 1902, when it fell to only about one-tenth as much (about 200,000 pounds) appears to have involved the scup in Cape Cod Bay also, for none at all were reported there from 1907 through 1911, or in 1918–1920,[57] except that there was an unusually large run there in 1917. But 1908, 1909, and 1919 were good scup years for the north shore of Massachusetts,[58] "good," that is, for those northerly waters, suggesting that when conditions favor, a small independent population may be present there. Perhaps the fact that larger catches than usual are not always registered in both these regions in the same year may point in this same direction.

No scup were reported from Essex County for 1919, 1928, or 1930; nor were enough taken in Cape Cod Bay in those years to cause any local comment.[59] Though the fisheries statistics do not throw any light on the status of the scup north of Cape Cod subsequently,[60] there cannot have been many of them in Cape Cod Bay regularly at any time during the past 15 years or so, for the only scup that were taken in a set of 8 traps at North Truro from 1935 down through 1950 were 125 pounds taken on June 28, 1938, evidently one small school of perhaps 100–125 individuals.[61] And 33 barrels (about 4,950 pounds) taken in a trap at Sandwich on the southern shore of Cape Cod Bay on Sept. 15 or 16, 1944, after a heavy gale, were the only scup caught in this set of traps from 1944 to 1950.[62] It would be interesting to know whether they came through the Cape Cod Canal or around the Cape.

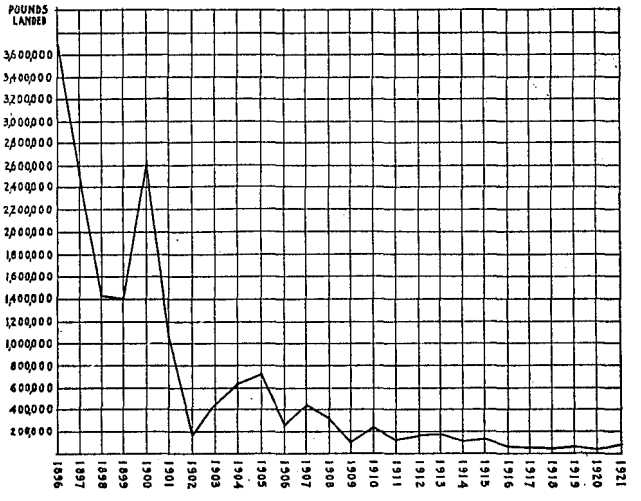

FIGURE 215.—Scup (*Stenotomus versicolor*). Annual catch of scup (pounds) in pound nets and traps in Massachusetts, from statistics published by the State Commissioner of Fisheries and Game.

Thus the presence of considerably greater numbers of scup on the southern coast of Massachusetts since about 1928 than had been there during the preceding decade [63] seems not to have been reflected in Cape Cod Bay except in sporadic cases. And we have not heard of any caught in the northern side of Massachusetts Bay during the past few summers.

In any case, Cape Ann is the northern boundary to the usual range of the scup. In 1896, a year of plenty not only in Massachusetts Bay but to the south in general, occasional specimens were taken daily in Casco Bay in the Small Point traps during the first half of July, and in July 1951, three were reported from Small Point, Maine, sporadic visits such as may be expected of any southern stray. In 1938 about 100 pounds of scup were landed in Lincoln County, Maine, probably from nearby,

[55] The reported catch for the town of Barnstable for that year was so large (69,168) as to suggest that it included scup from the south shore.

[56] If all these really were scup and not some other fish.

[57] No information is available for the years 1912–1916.

[58] Pound net catches for Essex County of 1,203 pounds, 8,417 pounds and 4,181 pounds, respectively.

[59] Catches reported for these years for Barnstable County include not only such scup as may have been taken in Cape Cod Bay, but the catches (doubtless far larger) for the southern coast, which does not fall within the limits of the Gulf of Maine.

[60] We are informed by William Royce of the U. S. Fish and Wildlife Service that catches since 1931 have been credited to the home ports of the vessels making them, wholly irrespective of where the fish were caught or landed. There is no reason to suppose that any significant part of the landings of scup reported for Essex County since then (which reached a maximum of 7,945,209 pounds for 1938) actually came from Massachusetts Bay, or from anywhere in Massachusetts waters, for that matter.

[61] Information from the Pond Village Cold Storage Co.

[62] Information from Benjamin Morrow, who operates these traps.

[63] The yearly landings of scup for Massachusetts rose from not more than 100,000 pounds for the decade 1912 to 1921 to about 1,100,000 pounds for the 5 years 1943–1947. But there is no way of knowing how large a part of the catches reported during the latter period were actually taken in Massachusetts waters and not farther west and south along the coast.

and they have been reported from Eastport.[64] But we suspect that porgies in St. Marys Bay, Nova Scotia, reported to Knight[65] were some other fish.

Probably such scup as spread north of Cape Cod in favorable summers withdraw southward again (if they survive) in autumn to the same offshore wintering grounds to which the much more numerous scup repair from the southern shores of Massachusetts. The fact that small scup, probably devoured on their way offshore, have been found in autumn in cod stomachs on Nantucket Shoals, where scup certainly are not common in summer, points in this direction. There is no reason to believe that any of these fish winter in the deep basin of the Gulf of Maine.

Importance.—Scup are never plentiful enough anywhere north of the elbow of Cape Cod to be of importance, whether commercially or to the angler. But this is an important food fish to the westward and southward where it is plentiful. Landings ran, for example, between about 3,300,000 pounds and 5,600,000 from the southern coast of New England and between about 3,300,000 and 4,300,000 pounds from New York, for the years 1945–47. The "porgy", as it is commonly called along that part of the coast, is also a favorite with anglers, for it bites greedily and is a good pan fish. Great numbers of them are caught on hook and line for home consumption.

[64] A specimen taken many years ago recorded by Kendall (Occ. Pap. Boston Soc. Nat. Hist., vol. 7, No. 8, 1908, p. 103).

[65] Descript. Cat. Fishes Nova Scotia 1866, p. 13.

Sheepshead *Archosargus probatocephalus* (Walbaum) 1792

Jordan and Evermann, 1896–1900, p. 1361.

Description.—The sheepshead resembles the scup so closely in its general organization that the family relations between the two are obvious. Like the scup it is deep bodied and much flattened sidewise, with similar profile. It has one long dorsal fin, scuplike in outline, the anterior two-thirds of which is spiny (11 or 12 spines) and the posterior one-third is soft (11 to 13 rays). Its anal fin (3 spines and 10 or 11 rays) is about as long as the soft portion of its dorsal, under which it stands, and both the dorsal fin and the anal can be depressed in a deep groove. The pectorals are long and pointed; the ventrals are situated a little behind the latter; the scales are large; and the eyes are located high on the sides of the head; in all of which the sheepshead agrees with the scup. It is readily recognized, however, by the fact that its caudal fin is not so deeply emarginate as that of the scup, and has rounded corners instead of pointed ones, while its dorsal spines are alternately stout and slender; its second anal spine is much stouter than

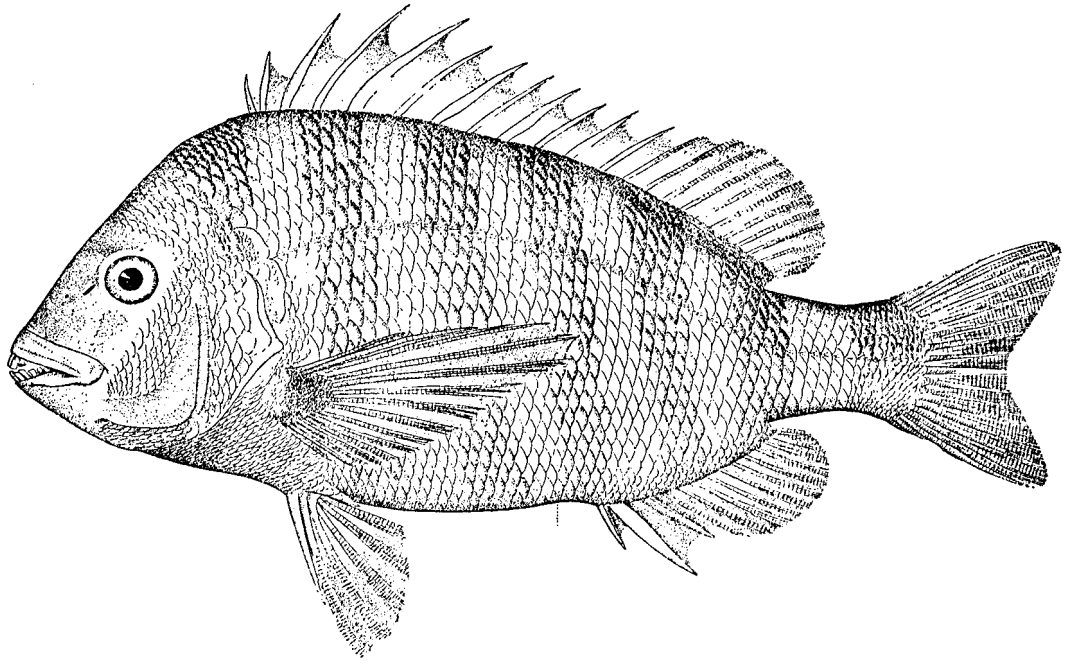

FIGURE 216.—Sheepshead (*Archosargus probatocephalus*), North Carolina. From Goode. Drawing by H. L. Todd.

that of the scup; the dorsal profile of its head is steeper; its nose is blunter; and its teeth are much broader. Furthermore, the body of the sheepshead is noticeably thicker, its back is rounded, and its sides show seven broad, dark brown or black crossbars on a gray or greenish yellow ground, instead of being plain colored like the sides of the scup.

Size.—The sheepshead grows to a length of about 30 inches and to a weight of 20 pounds.

General range.—Atlantic and Gulf of Mexico coasts of the United States from Texas to Cape Cod, and reported in the Bay of Fundy as a stray.

Occurrence in the Gulf of Maine.—The sheepshead was abundant as far north as New York formerly, and not uncommon about Woods Hole. It is common still to the southward. But it has been decidedly rare east of New York for many years past, although a number, about 6 inches long, were taken off Onset at the head of Buzzards Bay, in late August 1951.[66]

The only record of it north or east of the elbow of Cape Cod is Cox's[67] statement that it is occasional in St. John Harbor, New Brunswick. But no actual specimens are mentioned, and as it is not known ever to have strayed to Massachusetts Bay (a far more likely goal for any southern coast fish than the Bay of Fundy is), its claim to mention here is weak.

THE CROAKERS, DRUMS, AND WEAKFISHES. FAMILY SCIAENIDAE

The croakers have both the spiny portion and the soft portions of the dorsal fin well developed (either separate or as one continuous fin), and their ventrals are what is known as thoracic in position, i. e., about under the pectorals. They are readily separable from the sea basses (p. 389,) the porgies (p. 411), and the cunner tribe (p. 473) by the fact that their anal fin has only 1 or 2 spines instead of 3, and is much shorter than the soft portion of the dorsal; from the rockfishes and sculpins by their relatively smooth head; and from all the mackerels and the pompano tribe by their stout caudal peduncles and rounded or only slightly concave caudal fins. Most of them produce loud drumming sounds by rapid contractions of certain abdominal muscles against the gas-filled air bladder; hence the common names "croaker" and "drum." The kingfish (p. 423) is an exception to this rule.

KEY TO GULF OF MAINE CROAKERS AND WEAKFISHES

1. There is no barbel on the chin 2
   The chin bears one or more barbels 3
2. Body only about one-fourth as deep as it is long (to base of caudal fin); anterior profile of head sloping only moderately; snout pointed; no dark spot behind upper corner of gill opening ... Weakfish, p. 417.[68]
   Body at least one-third as deep as it is long to base of caudal fin; anterior profile of head sloping steeply; snout blunt; there is a dark spot close behind the upper corner of the gill opening ..... Spot, p. 423
3. Several barbels on chin; snout ends about even with front of lower jaw; cheek smooth ... Black drum, p. 425
   Only one barbel on chin; snout projects considerably beyond lower jaw; cheek with 2 short, tooth-like serrations ..... Kingfish, p. 423

Weakfish *Cynoscion regalis* (Bloch and Schneider) 1801

SQUETEAGUE; SEA TROUT; GRAY TROUT

Jordan and Evermann, 1896–1900, p. 1407.

Description.—The relative sizes and shapes of the fins of the weakfish, and its color, are such ready field marks that it is one of our most easily identified fishes. Among Gulf of Maine species with separate spiny and soft-rayed dorsal fins, it is distinguishable from the mullet by the considerable length of its dorsals as well as by many other characters; its slightly emarginate tail distinguishes it from any mackerel or pompano; this same character, combined with a short anal fin and a first dorsal fin higher than the second dorsal gives it an appearance quite different from a bluefish; and the fact that its second dorsal is much longer than the first, and that it has only 2 anal spines and a slender body obviate all possibility of confusing it with striped bass or white perch. The shape of its dorsal and caudal fins and of its head, and the absence of a chin barbel make it distinguishable at a glance from the kingfish (p.

[66] Information from Mrs. Harold Hatch.

[67] Bull. Nat. Hist. Soc. New Brunswick, No. 13, 1895, p. 71.

[68] Jordan (Stanford Univ. Publ., Univ. Series, Biol. Sci., vol. 3, No. 2, 1923, p. 202) placed the weakfish in his new family Otolithidae, which he separated from the Sciaenidae as having a different arrangement of vertebrae. But we think it preferable (following Smith, Sea Fishes Southern Africa, 1949, p. 223) to use Sciaenidae in the older and more inclusive sense, because the only family character marking Otolithidae off from it is internal, hence requires dissection for its recognition.

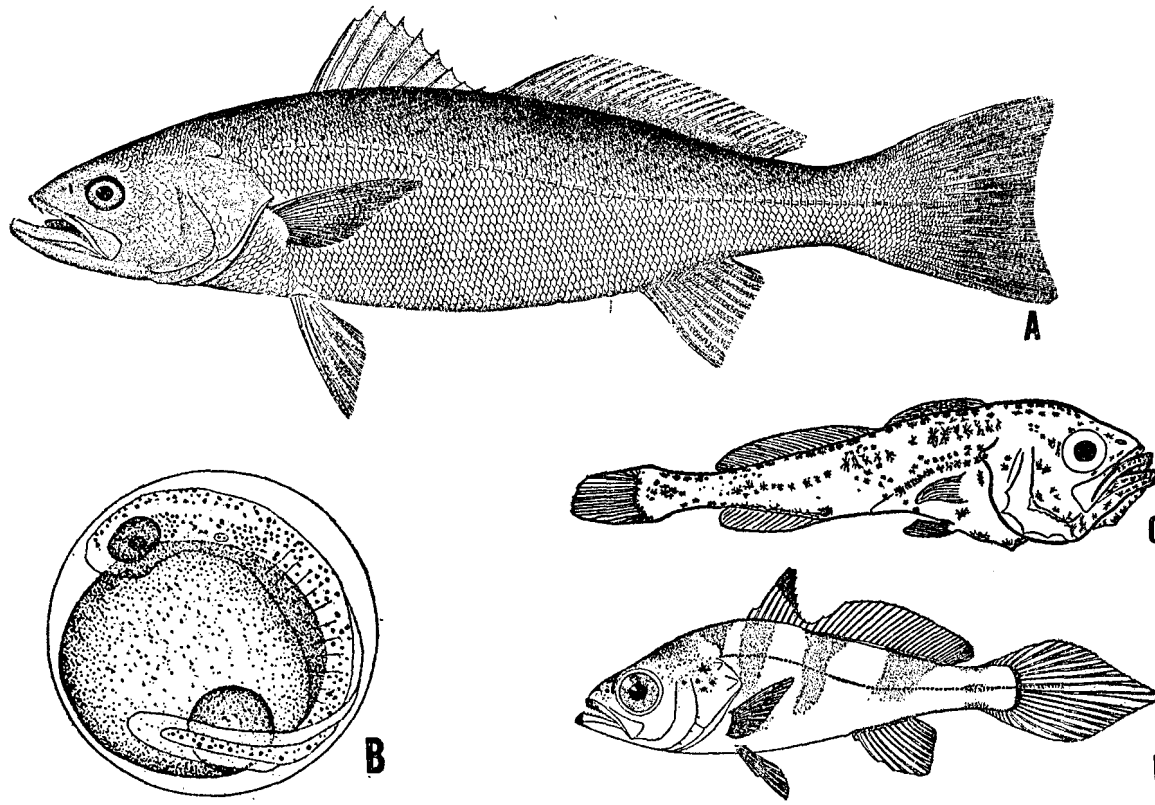

FIGURE 217.—Weakfish (*Cynoscion regalis*). A, adult; from Goode, drawing by H. L. Todd. B, egg; C, larva, 12.4 mm.; D, fry, 32 mm. B and D, from Welsh and Breder; C, after Tracy.

423), the absence of barbels on the chin separates it from a drum (p. 425); it has nothing in common with such bizarre fishes as the John Dory (p. 297), triggerfish (p. 520) or any member of the sculpin tribe.

The weakfish is a slim, shapely fish, about four times as long as deep (to the base of the caudal fin), only slightly flattened sidewise, with rather stout caudal peduncle; a head about one-third as long as body, moderately pointed snout, and large mouth. Its upper jaw is armed with two large canine teeth and its lower jaw projects beyond the upper. The first dorsal fin (10 spines), originating a little behind the pectorals, is triangular; the second dorsal (26 to 29 rays), originating close behind the first, is more than twice as long as the first and roughly rectangular. The caudal fin is moderately broad and only slightly concave in outline. The anal fin (2 very slender spines and 11 or 12 rays) is less than half as long as the second dorsal, under the rear part of which it stands. The ventrals are below the pectorals, which they resemble in their moderate size and pointed outline.

Color.—Dark olive green above with the back and sides variously burnished with purple, lavender, green, blue, golden, or coppery, and marked with a large number of small black, dark green, or bronze spots, vaguely outlined and running together more or less, especially on the back; thus forming irregular lines that run downward and forward. The spots are most numerous above the lateral line, and there are none on the lower part of the sides or on the belly. The lower surface, forward to the tip of the jaw, is white, either chalky or silvery. The dorsal fins are dusky, usually more or less tinged with yellow; the caudal is olive or dusky with its lower edge yellowish at the base; the ventrals and the anal are yellow; and the pectorals are olive on the outer side, but usually yellow on the inner side.

Size.—It is said that weakfish have been taken as heavy as 30 pounds, but the largest of which we can find authentic record in recent years was one of 17 pounds 8 ounces, taken on the New Jersey coast, on rod and reel, by A. Weisbecker, Jr., September 30, 1944. And a fish heavier than 12

pounds or longer than 3 feet is a rarity. Off southern Massachusetts the largest fish run 6 to 10 pounds in weight, while most of the larger ones taken there weigh from 1 to 6 pounds and are 14 to 26 inches long. An average of 5 pounds has been reported for Massachusetts Bay, but this is probably excessive. The average proportion between length and weight of weakfish is about as follows:

Length in inches	*Weight in pounds*
12 to 14	⅔ to 1
14 to 16	1 to 1½
16 to 18	1¼ to 1¾
18 to 20	1⅞ to 2½
22 to 23½	3½ to 4⅞
25½ to 27½	5 to 6
30 to 32	9½ to 11

The female members of a school usually run somewhat larger than the males.

Habits.—Although there are very few weakfish in the Gulf of Maine today, if any, they were for a time so plentiful in its southwestern waters (and may at any time reappear there in abundance) that their habits deserve more attention than the fish's present status would call for.

In the southern part of its range (e. g., along the Carolinas) this is said to be a resident species. But it is strictly seasonal to the northward, appearing in spring, spending the summer inshore, and withdrawing again in autumn. Within the mouth of Chesapeake Bay the fishing season usually is from the middle of April (commencing a week or two later up the bay) to the middle of November, with good catches occasionally made as late as the first of December. On the southern New England coast, as illustrated by Woods Hole, weakfish are caught from May (some years as early as April, other years not until June) until the middle of October. Probably they are not to be expected north of the elbow of Cape Cod until June (in the years when they come that far north), nor later than September or October at latest, for most of the weakfish disappear from the middle Atlantic coast before the end of October.

The lower limit to the temperature range preferred by the weakfish has not been determined. But it has long been known that they are sensitive to cold. And a case is on record (November 27, 1903) when many were benumbed by a sudden chilling of the water, near Beaufort, North Carolina.[69] Hence seasonal chilling is doubtless the event that drives them away from the middle Atlantic and New England coasts in late autumn.

The capture of weakfish in some numbers between the offings of Chesapeake Bay and of Cape Hatteras by otter trawlers during the winter months, during the past twenty-odd years,[70] has dispelled some of the mystery in which the winter home of this fish was previously shrouded. The fact that 5 small ones were picked up in the 50 to 55 fathom zone off Rhode Island by the dragger *Eugene H* in mid-January 1950, also 6 more south of Marthas Vineyard in about 55 fathoms,[71] and another 5 pounder on February 20 [72] is evidence that some of those that summer to the northward only move offshore to escape falling temperature. Others may move southward in winter for long distances, and offshore, as some of the northward-summering scup seem to do (p. 413).

Weakfish tend to hold close inshore during their summer stay on the coast; we have never heard of one on Nantucket Shoals, and only once of weakfish caught on Georges Bank.[73] They are usually found in shallow waters along open sandy shores and in the larger bays and estuaries, including salt marsh creeks. They even run up into river mouths, but never into fresh water, so far as we know.

Weakfish move in schools, often small but sometimes consisting of many thousands.[74] They have been described repeatedly as swimming near the surface, this being the general rule near New York and along the southern New England coast, where great numbers are caught on hook and line within a few feet of the top of the water. And their preference for shallow water is reflected in the large numbers caught in pound nets along the middle Atlantic coast. Probably few descend deeper than 5 to 6 fathoms during the summer, but the precise level at which they are to be caught at

[69] Smith, North Carolina Geol. and Economic Survey, vol. 2, 1907, p. 411.

[70] See Pearson, Investigational Report No. 10, U. S. Bureau of Fisheries, 1932, p. 14, table 2, for the catches for the winter of 1930–1931, by species and by months. The *Albatross III*, also, trawled 83 weakfish in 29 fathoms off Cape Hatteras, and 1 in 14 fathoms off Charleston, S. C., in late January 1950.

[71] Reported by Capt. Henry Klimm. We saw one of them.

[72] We saw this fish.

[73] Two fish were reported by an otter trawler from the offshore part of the Bank in the summer of 1950.

[74] A notable and oft-quoted instance was off Rockaway Beach, N. Y., July 1881, when a school was sighted so large that three menhaden steamers seined some 200,000 pounds of weakfish from it, averaging 1½ to 3 feet in length.

any given locality is governed by their food at the time. On open coasts they often feed on bottom right in the surf. They also feed on bottom in estuarine waters when dieting on bottom-living animals, but in the upper water layers when preying on small fish.

Weakfish feed on a wide variety of animals, including crabs, amphipods, mysid and decapod shrimps, squid, shelled mollusks, and annelid worms, but chiefly on smaller fish, such as menhaden, butterfish, herring, scup, anchovies, silversides, and mummichogs, of which they destroy vast quantities. The precise diet varies with the locality (that is, with what is most readily available), but small menhaden are probably the most important single item. The adult weakfish usually depend on fish, though occasionally they have been found feeding exclusively on crabs and shrimps. The young depend more on shrimp and on other small crustaceans than the adults.[75] Weakfish bite greedily on various kinds of bait, especially on shedder crabs, clams, shrimp, and mummichogs or other small fish. And they are often caught on artificial lures of one kind or another.

The females do not make any sounds, but the males have well-developed croaking muscles in the walls of the abdomen, with which they make a drumming noise.

Breeding habits.—On the middle Atlantic coast the weakfish spawn from May to October, with the chief production of eggs between mid-May and mid-June.[76] The eggs have been taken in tow nets at various localities in temperatures ranging from 60° to 70°, in salinities of 28.01 to 30.9 per mille. And it is probable that weakfish spawn locally around the shores of Cape Cod Bay in years when the fish are plentiful there, as they do regularly about Woods Hole, if the summer temperature of the surface is high enough. Spawning takes place chiefly in the larger estuaries or close to their mouths, usually at night. The eggs are buoyant, spherical, 0.74 to 1.1 mm. in diameter, usually with one, rarely with as many as four, oil globules that coalesce into one large one as development progresses. Incubation occupies 36 to 40 hours at a temperature of 68° to 70°, and the newly hatched larvae are 1.75 mm. long.

At 30 mm. the young weakfish have attained most of the structural characters of the adult. But they continue much deeper and more flattened sidewise until they are 6 to 8 inches long; the head and eyes are relatively larger; and their caudal fin is obtusely pointed with the center rays much the longest, instead of concave. The smaller fry (1½ to 3 inches) are marked with four dark, saddle-shaped patches extending downward on the sides to a little below the lateral line, which are not lost until a length of about 4½ inches is reached. As the young fish grow, other bands of pigment are interpolated below the lateral line, the adult coloration not being fully developed until they are 7 to 8 inches long.[77]

Rate of growth.—Weakfish fry grow at so variable a rate during the first summer that they may be anywhere between 4 inches and 6 inches long in the fall, when they are about 6 months old. The smallest fish seen in spring (no doubt yearlings) are 8 to 10 inches long. Thereafter the rate of annual growth is slower. But the variation in the length attained by the fry during their first summer and autumn, consequent on the protracted spawning season, combined with the fact that scale studies of this species have proved puzzling, make it difficult to group the older age classes by size. As far as known, a weakfish of 10 to 12 inches is likely to be about 2 years old; one of 13 inches, about 3 years; 15 inches, about 4 to 5 years; 18 inches, about 5 or 6 years; one of 22 inches about 6 to 7 years old;[78] 24 inches perhaps 9 years; and 30 inches perhaps as old as 12 years. Both males and females usually mature at 2 to 3 years of age, i. e., when 10 to 13 inches long.

General range.—Eastern coast of the United States from the east coast of Florida to Massachusetts Bay, straying northward to the Bay of Fundy, and perhaps to Nova Scotia.[79]

[75] For diet lists of weakfish of various sizes, see especially Welsh and Breder (Bull. U. S. Bur Fish. vol. 39, 1924, p. 159); also Peck (Bulletin U. S. Fish Comm., vol. 15, 1896, p. 352).

[76] The following account of the breeding and development of the weakfish is condensed from Welsh and Breder (Bull. U. S. Bur. Fish., vol. 39, 1924, p. 150).

[77] Tracy (Thirty-eighth Ann. Rept. Comm. Inland Fish., Rhode Island, 1908, pp. 85–91), Eigenmann (Bull. U. S. Fish Comm., vol. 21, 1902, p. 45), and Welsh and Breder (Bull. U. S. Bur. Fish., vol. 39, 1924, p. 154) describe the older larvae and fry.

[78] According to studies by Taylor (Bull. U. S. Bur. of Fish., vol. 34, 1916, p. 318); by Welsh and Breder (Bull. U. S. Bur. of Fish., vol. 39, 1924, p. 158); and by R. A. Nesbit, formerly U. S. Bur. Fish. (unpublished).

[79] It is credited indefinitely to "Maine" by Holmes (Fishes of Maine, 1862, p. 74); Goode (Fish. Ind. U. S. Sect. 1, 1884, p. 362), states that scattering individuals have been caught as far as the Bay of Fundy; and Halkett (Check List Fishes Canada, Newfoundland, 1913, p. 87) mentions one as probably caught off Nova Scotia.

Occurrence in the Gulf of Maine.—The center of abundance for the weakfish is along the coast of the middle Atlantic States from the Virginia Capes to New York. It also occurs regularly as far north and east as Cape Cod. But the stock of weakfish fluctuates widely on the southern New England coast, and it is only during periods of great abundance there that weakfish appear in any numbers in Cape Cod and Massachusetts Bays, which may be set as the extreme northern limit for its appearance except as a stray. In the years when it has passed Cape Cod in appreciable numbers it has always been far more plentiful along the inner side of the Cape and in Cape Cod Bay than north of Boston, as appears from the following statement of catches for 1906, a year of great abundance.

	Pounds
Cape Cod Bay:	
Provincetown	115, 789
Truro	202, 050
Brewster	137, 659
Sandwich	6, 221
North Shore of Massachusetts Bay:	
Nahant	[80] 369
Manchester	410

Only once, however, for a period of about 9 years, have there been many weakfish during the past century and a half, even in the Cape Cod Bay region.[81] Apparently they were plentiful off southern New England during the last part of the eighteenth century, and to judge from fishermen's reports weakfish were well known in Massachusetts Bay at that time. But they vanished so completely sometime prior to 1800 that when a stray specimen was taken at Provincetown in June 1838, it was sent to Boston for identification. And this disappearance evidently involved the whole northern part of the range of the species, for weakfish vanished similarly from the Nantucket-Marthas Vineyard region sometime between 1800 and 1837. They had reappeared, however, off southern Massachusetts by 1867; they were abundant there, once more, by 1870; and one or two were taken off Truro and Provincetown in 1884. From then on until 1895, a few were returned yearly from Truro, Provincetown, Plymouth, and even from as far north as Gloucester and Manchester, the annual catch ranging from an odd fish only (e. g., 1893 and 1894) to 700 or 800 pounds, at most, for Cape Cod Bay and for the northern part of Massachusetts Bay, combined.

The catch in the Cape Cod Bay-Massachusetts Bay region was larger for the next few years (4,892 pounds in 1896,[82] 1,006 pounds in 1897, 6,046 pounds in 1898, and 11,572 pounds in 1899), though with the catches localized chiefly on the outer side of Cape Cod and in Cape Cod Bay, as might be expected of a stray from the south. And they appeared in such numbers in Cape Cod Bay in 1900 that the catch there jumped to upward of 108,000 pounds for that year,[83] while a few were taken even as far north as Boston Harbor and Gloucester.

This marked the commencement of a period of local abundance, which was entirely unexpected (for nothing like it had been experienced since the settlement of the country), and which (with its equally sudden eclipse) is perhaps the most interesting event in the history of the local fisheries. Unfortunately definite statistics of the catches are not available for the crucial years, but weakfish were so plentiful in Cape Cod Bay in 1901 as to be a drug on the market; while in 1902 and 1903 the pound nets in Cape Cod Bay were often filled with schools of large weakfish, averaging about 5 pounds. So plentiful were they, indeed, during the summer of 1903 that the traps at North Truro alone reported 280,000 pounds.

This abundance continued through 1904, by which time it seems to have been accepted as the normal condition of affairs, and no longer worth comment. But it seems to have culminated in that summer or the next, for weakfish were reported as less plentiful in 1906. Nevertheless, the Cape Cod Bay traps (excluding Barnstable, Chatham, Yarmouth, and Dennis) reported almost half a million pounds of weakfish for that year; the North Shore of Massachusetts Bay, 20,779 pounds, which probably was not more than half or two-thirds of the actual total, for the returns were incomplete. This, however, was the last big year, for the catch north of the elbow of Cape Cod was less than one-third as great in 1907 as

[80] Twenty thousand pounds were also reported from Gloucester, but we have reason to believe that the fish were actually caught in Cape Cod Bay; and traps operated at Rockport and at Newburyport took no weakfish.

[81] There are intimations in the writings of the early historians of New England of similar disappearances and returns of the weakfish (Goode, Fish. Ind. U. S., Sect. 1, 1884, p. 363).

[82] Omitting the towns of Yarmouth, Dennis, Chatham, and Barnstable, where traps have been operated on the Vineyard Sound shore as well as on the Gulf of Maine shore line.

[83] Omitting the towns of Yarmouth, Dennis, Chatham, and Barnstable, where traps have been operated on the Vineyard Sound as well as on the Cape Cod Bay side.

it had been in 1906. And this was the beginning of the end, for only 8,249 pounds were reported there in 1908, 569 pounds in 1909, and 907 pounds in 1910.

We do not know of the capture of a single weakfish that can be credited with certainty to the outer shore of Cape Cod, to Cape Cod Bay, or to the northern shore of Massachusetts Bay from that time on, down to 1921 (most recent year for which the pound net catches were published in detail), when 21 pounds were reported for the town of Barnstable.[84] We should emphasize too that about the same number of pound nets and traps have been operated from year to year throughout this period and at about the same general localities, so that fluctuations in the catch did actually reflect similar fluctuations in the stock of fish.

There is no reason to suppose that weakfish have ever entered Cape Cod Bay in any numbers since that time. Only one, indeed (a 5-pounder), was recorded, from one set of 8 traps at North Truro during the 16 years 1935–1950;[85] another set of 2 traps at Barnstable, took only 3 weakfish during the summer of 1950;[86] and 3 other traps at Sandwich, Mass., took 2 weakfish in 1948, 1 in 1949, and none in 1950.[87]

We doubt whether any weakfish have reached the northern side of Massachusetts Bay since 1909, when 200 pounds were reported from a pound net at Gloucester. Large landings, it is true, have been reported as from the northern part of the Massachusetts coast (Essex County) in several recent years, ranging up to some 3,600,000 pounds in 1945. But there is no reason to suppose that any of them were caught north of Cape Cod for we are informed by William Royce of the Fish and Wildlife Service that all fish taken by vessels sailing out of Gloucester during these years were credited to that port, irrespective of where caught or where landed. The fish may have come from as far south as the North Carolina winter fishery. And this applies equally to a few that were credited to Maine in 1931 (45 pounds) and in 1932 (318 pounds).

We can offer no explanation for this unexpected invasion of weakfish north of Cape Cod about the turn of the present century, or for its equally sudden eclipse, the opportunity having passed long since for obtaining any information as to the sizes and ages of the fish, as to their movements, and as to the physical state of the water at the time. It was not a local event, however, but part of a corresponding fluctuation in the population as a whole existing east and north of New York. Thus the catch for the southern coast of New England was more than eight times as great in 1904 (upward of 7 million pounds) as it had been in 1889 (about 830,000 pounds), but thereafter declined so markedly that in 1908 both the commercial fishermen and the anglers of Rhode Island and of southern Massachusetts complained of the scarcity of weakfish. Less than 400,000 pounds were taken off southern New England in 1919, and the weakfish had so nearly vanished from the southern shores of Massachusetts by 1920 and 1921 that the reported catches for the pound nets of the State were only 785 and 691 pounds, respectively, for those years.[88] We should emphasize that the partial recovery that then took place off the southern Massachusetts coast, where the average catch was again nearly a quarter of a million pounds during the period 1931–1938, did not bring the weakfish back to Cape Cod Bay.

It has often been suggested that weakfish are plentiful when bluefish are scarce, and vice versa, and the argument has been advanced that the latter not only devour fry of the weakfish but its food also, and hence not only destroy many but drive others away. But no convincing evidence has been brought forward that the fluctuations of these two species of fish are mutually dependent in any way.

Importance.—At the present time the weakfish is of no importance in the Gulf of Maine, whether commercially or to the angler, though it was a very valuable addition to the shore fisheries of Cape Cod Bay during its one brief period of plenty there. However, it is one of the most important of food fishes along more southern coasts,[89] and a favorite

[84] No catch statistics are available for the years 1912–1916, and there is no knowing whether any of the weakfish reported for Barnstable Co., in 1919 (962 pounds) came from the northern (i. e., Cape Cod Bay) shore.

[85] Information from the Pond Village Cold Storage Co.

[86] Information from John E. Vetorino, who operates these traps. One hundred twenty-three pounds reported from Barnstable County in 1928, and 101 pounds in 1929, may likely have come from the Vineyard Sound shore, not from the Cape Cod Bay shore.

[87] Information from Benjamin Morrow, who operates these traps.

[88] No statistics are available for the years 1922–1929.

[89] In 1946, the reported catch of weakfish of this species was about 3,252,000 pounds for southern New England; 11,715,000 pounds for the Middle Atlantic States; 20,557,000 pounds for the Chesapeake Bay region; and 4,770,000 pounds for the South Atlantic States.

game fish which has been the subject of many accounts from the angler's standpoint.

Spot *Leiostomus xanthurus* Lacépède 1802

LAFAYETTE

Jordan and Evermann, 1896–1900, p. 1458.

Description.—The spot agrees closely with the weakfish in the arrangement and general shapes and relative sizes of its fins, and in lacking chin barbels. But it is a much deeper fish relatively (body about one-third as high as it is long, measured to base of tail fin), with blunt snout instead of pointed; it has no large canine teeth; its tail fin is more forked; and it is marked on either side with a conspicuous black spot close behind the upper corner of each gill opening.

The forward (spiny) subdivision of the dorsal fin, of 10 spines, is triangular, with rounded apex; the posterior part, of one short spine and 30–34 soft rays, is about one-half as high vertically as the spiny part. The caudal fin is moderately concave. The anal fin of two short spines and 12 or 13 soft rays, has a somewhat concave margin, and the pectorals are pointed.

Color.—Bluish gray above with golden reflections, silvery below. Medium-sized fish are marked on each side with 12–15 oblique yellowish cross bars [90] dipping obliquely forward, but these fade with age. And there is a conspicuous black spot close behind the upper corner of each gill opening. The fins are partly yellowish, partly dusky.

Size.—The spot grows to a length of about 13 to 14 inches and to a weight of 1 pound 6 ounces.[91] But adults average only about 10 to 10½ inches long, and few weigh more than three-quarters of a pound.

General range.—Inshore waters from Texas [92] to southern New England, and recorded from Massachusetts Bay as a stray.

Occurrence in the Gulf of Maine.—The spot is plentiful in some years as far north as New York, while young ones are described as common in autumn about Woods Hole. But its normal range is bounded so sharply by Cape Cod that it has been reported only once from the Gulf of Maine; a single specimen, taken in Massachusetts Bay, November 1936.[93]

Kingfish *Menticirrhus saxatilis*

(Bloch and Schneider) 1801

KING WHITING; MINKFISH; WHITING

Jordan and Evermann, 1896–1900, p. 1475.

[90] Dusky on preserved specimens.

[91] These were the longest of many measured in Chesapeake Bay by Hildebrand and Schroeder (Bull. U. S. Bureau of Fisheries, vol. 43, Part 1, 1928, p. 272). The maximum length previously recorded was 11¾ inches (Nichols and Breder, Zoologica, New York Zool. Soc., vol. 9, 1927, p. 95).

[92] Once reported doubtfully from Martinque.

[93] Reported by Goffin, Copeia, 1937, No. 4, p. 236.

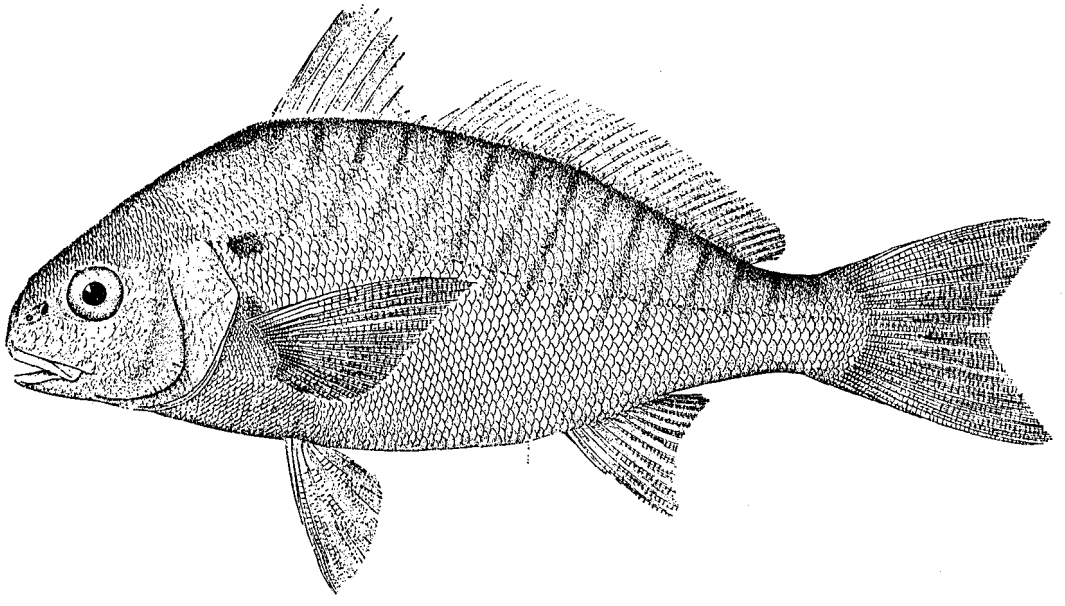

FIGURE 218.—Spot (*Leiostomus xanthurus*), Rhode Island. From Goode. Drawing by H. L. Todd.

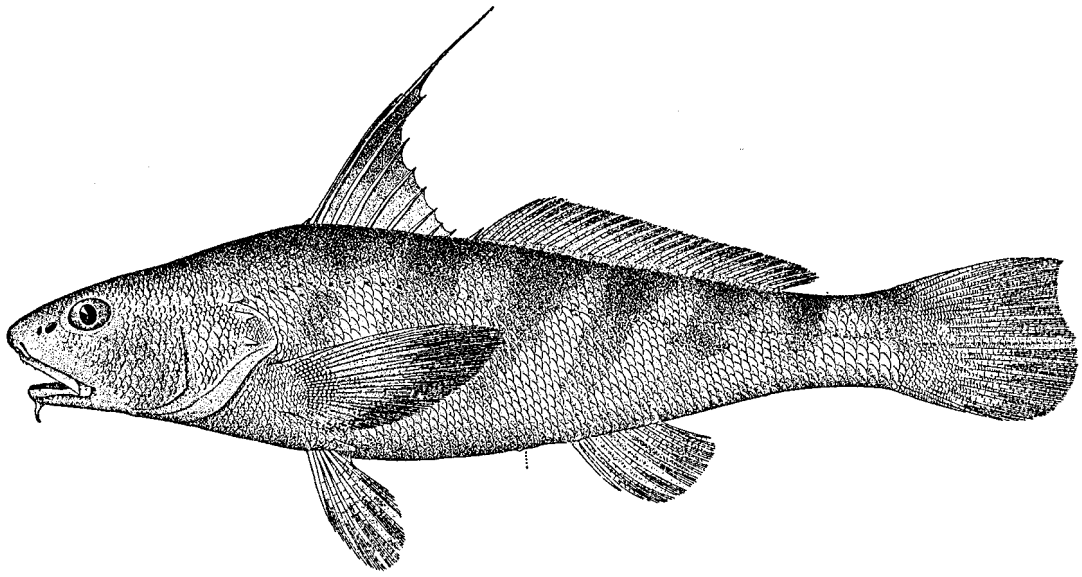

FIGURE 219.—Kingfish (*Menticirrhus saxatilis*), Pensacola, Florida. From Goode. Drawing by H. L. Todd.

Description.—The kingfish resembles the weakfish in the general arrangement and the relative sizes of its fins, the second dorsal being much longer than the first or than the anal. But its first dorsal (10 spines) is relatively much higher and more pointed than that of the weakfish, with the third spine not only much prolonged but filamentous at the tip in the adult (a noticeable character); the rather blunt nose, and snout overhanging the mouth, give the kingfish a very characteristic cast of countenance (fig. 219). Its upper jaw, furthermore, projects beyond the lower, whereas the reverse is the case in the squeteague. Its chin bears a barbel, which the weakfish lacks, its lips are fleshy, and it has no canine teeth. Its tail, too, is of very characteristic outline, with the lower half rounded but the upper half concave suggesting (though not exactly parallelling) the tail of the sea bass (p. 407). Its body is about as slender, proportionally, as that of a squeteague, but the kingfish carries its weight farther forward (it is deepest below the first dorsal fin), and it has a weak-tailed appearance remotely suggesting a hake (p. 222). We need merely note further that the filamentous spine of the first dorsal is longer in large fish than in small ones; that the second dorsal (one stout but short spine followed by 24 to 27 rays) occupies more than one-third of the length of the back and tapers slightly from front to rear; that the anal fin (one long spine and 8 rays) stands under the middle of the soft dorsal; and the pectorals are pointed and relatively much longer than those of the squeteague.

The Kingfish and its immediate relatives have no air bladder, hence makes no sounds, in which they differ from other members of their family.

Color.—Leaden or dusky gray above, (sometimes so dark as to be almost black) with silvery and metallic reflections; milky or yellowish-white below. The sides are cross marked irregularly with dark bars. These run obliquely forward and downward behind the spiny dorsal fin, but the foremost one or two bars run in the opposite direction, so that they form a V-shaped blotch or two dark V's below the fin. The pale belly is bounded above by a dark longitudinal streak on either side. The fins are dusky or blackish; the first dorsal fin anal, pectorals, and ventrals are tipped with dirty white.

Size.—Kingfish grow to a maximum length of 17 inches and a weight of about 3 pounds, but the general run are from 10 to 14 inches long, weighing ½ to 1½ pounds.

Habits.—Kingfish, like squeteague, are summer fish, appearing on the coast in May, to vanish in October. They are confined to the immediate vicinity of the coast during their stay, frequenting inclosed as well as open waters, even entering river mouths, and they are unknown on the offshore banks. They run in schools, keep close to the ground, prefer hard or sandy bottom, and feed

on various shrimps (perhaps their chief diet), crabs, and other crustaceans, small mollusks, worms, and on young fish.

Breeding habits.—Kingfish spawn in bays and sounds from June until August, but it is not likely that any young that might be hatched in the Gulf of Maine from eggs laid by the occasional visitors would survive its low temperature. Welsh and Breder [94] describe the spawning and early development of this species. Young fry of ¾ to 1-inch already show most of the structural characters of the adult, including the scales, and so are readily recognizable as kingfish though they vary widely in color, ranging from the pattern of the adult to almost uniform blackish brown. Welsh and Breder found from an examination of the scales, confirmed by a large series of measurements, that kingfish are 4 to 6 inches long by the first winter, average about 10 inches the second winter, and 13¾ the third. Many males ripen when 2 years old, but few females until 3 years old.

General range.—Atlantic coasts of the United States from Florida (Pensacola, Key West) northward regularly to Cape Cod; most numerous from Chesapeake Bay to New York; known as far north as Casco Bay, Maine, as a stray.

Occurrence in the Gulf of Maine.—This excellent food and game fish reaches the Gulf of Maine only as a stray from the south. So far as we can learn the only positive records of it within our limits are as follows, south to north: Monomoy and North Truro on Cape Cod in 1896 (collected by Dr. W. C. Kendall); one taken at Provincetown, July 1847, another there in November of that same year and many small ones, apparently chilled by the cold, that appeared in that harbor in 1879; one taken at the entrance of Boston Harbor in a lobster pot some time before 1833; one at Lynn in 1840; one 8 inches long off Marblehead on October 15, 1872; one of 6½ inches at Danvers, October 28, 1874; others at Nahant (one record),[95] and in Casco Bay.

Catch statistics, if taken at face value, would suggest that kingfish reached the northern shore of Massachusetts Bay (Essex County) in unprecedented numbers during the period 1931 to 1938,[96] but we are informed by William Royce of the U. S. Fish and Wildlife Service that all the fish taken by vessels sailing out of Gloucester during these years were credited to that port, irrespective of where caught or where they were landed. There is no reason to suppose that any of these kingfish or "king whiting" actually came from as far east or north as Cape Cod, or even from anywhere in southern New England waters for that matter. And this applies equally to 466 pounds reported in 1932 from Maine. It is, in short, an unusual event for a kingfish to round the elbow of Cape Cod, or for a small school of its fry, nor have we heard of any taken anywhere in the Gulf during recent years.

Importance.—The kingfish is not plentiful enough in the Gulf to interest either commercial fishermen or anglers. It is one of the better table fishes, and a favorite with surf anglers along the coasts of New York, New Jersey, and southward, as it bites readily and fights well. In the words of a well-known angler, "no fish that swims the sea makes a better dish. Certainly no bottom living fish plays such a game for the angler's real delight." [97]

Black drum [98] *Pogonias cromis* (Linnaeus) 1766

Jordan and Evermann, 1896–1900, p. 1482.

Description.—A short deep body (less than three times as long as it is deep to the base of the caudal fin) with high-arched back but flattish belly is characteristic of the drum. The profile of the face is even more diagnostic, for the mouth is horizontal and set very low, the eye high, and the chin bears several barbels. The arrangement and sizes of the fins are essentially the same as in the weakfish, except that the second (soft-rayed) dorsal is relatively shorter, and that the anal spine is much stouter. The jaw teeth are small and

[94] Bull. U. S. Bur. Fish., vol. 39, 1924, pp. 191–194.

[95] Small amounts of "kingfish" appear in the pound-net returns published by the State of Massachusetts at various localities in Massachusetts Bay, but fishermen inform us that these were not the true kingfish but some large species of the mackerel tribe.

[96] For Essex County, Mass., 2,029 pounds reported during 1931; 34,981 pounds for 1933; 5,100–10,600 pounds for 1933, 1935, 1937 and 1938.

[97] Rhead, Bait Angling for Common Fishes, 1907, p. 145.

[98] The channel bass or red drum *Sciaenops ocellatus* (Linnaeus) 1766, a southern sciaenid uncommon east or north of New York, is represented in the collection of the Boston Society of Natural History by a mounted specimen labeled "near Portland, Me.," but as this fish was probably purchased in the market, it is likely that it had been shipped from the south than that it was actually caught nearby. Should this drum ever be taken in the Gulf of Maine, its relationship to the weakfish, kingfish, and spot would be apparent from the arrangement of its fins, especially from the shortness of the anal fin relative to the soft (second) dorsal. But it is easily distinguished from the weakfish by the fact that its upper jaw extends beyond the lower instead of vice versa; from the spot, by the barbels on its chin; and from the kingfish by having several of these barbels instead of only one; by the shape of its tail fin; and by the presence of a conspicuous black blotch (sometimes as many as 4 or more blotches) on each side at the base of the caudal fin which affords a ready field mark for its identification.

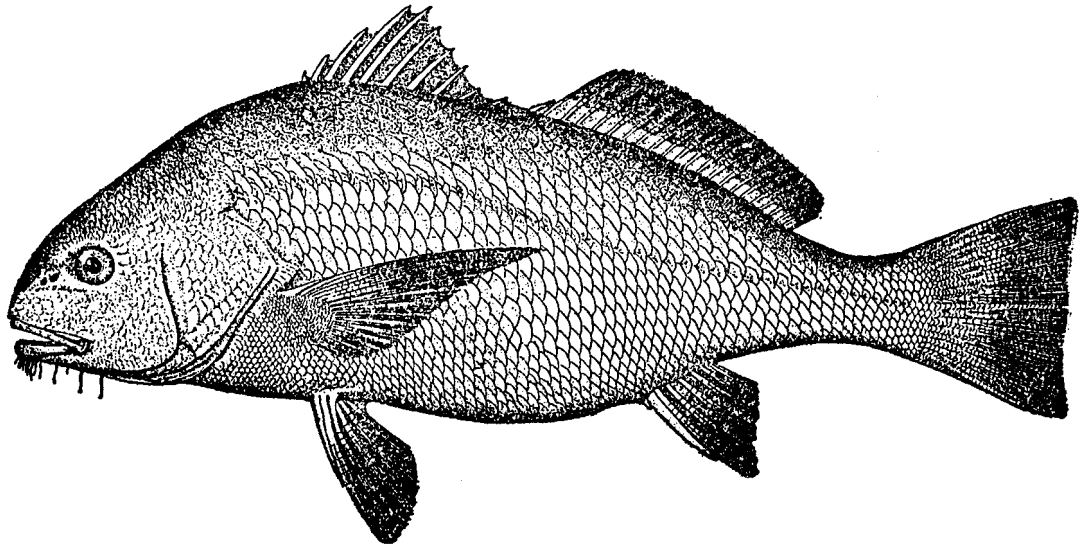

FIGURE 220.—Black drum (*Pogonias cromis*). From Goode. Drawing by H. L. Todd.

pointed, but the throat is armed with large, flat, pavement-like teeth with which the drum crushes shellfish for food, a character separating it from its allies the weakfish and the kingfish. The first dorsal fin (10 spines) is rounded-triangular; the second (1 short spine and 20 to 22 rays) oblong; the caudal is square-tipped with moderately high peduncle; the anal fin (2 spines, the first very short and the second long and stout, and 6 or 7 soft rays) is less than half as long as the soft dorsal; the pectorals are sharp pointed and relatively longer than those of the weakfish. The second anal spine is much stouter in young drums than in old ones. The eyes of the drum are comparatively small and its scales are large.

Color.—Silvery with a brassy lustre, turning to a dark gray after death. Young fish have 4 or 5 broad dark vertical bars that fade out with age. The fins are blackish. This drum occurs in two color phases, a grayish and a reddish.

Size.—Drums grow to a huge size. The largest we find positively recorded (caught in Florida) weighed 146 pounds; adults, as caught, run from 20 to 40 pounds, with 60 pounds not exceptional. The rod and reel record is 87 pounds 8 ounces, a fish 4 feet 4 inches long, caught at Cape Charles, Va., May 6, 1950, by Mrs. H. A. Bradley, Jr. A fish 40 inches long weighs about 40 pounds.

General range.—Atlantic and Gulf of Mexico coasts of America from Argentina to southern New England; common from New York southward and abundant from the Carolinas to the Rio Grande; a stray visitor as far north as Massachusetts Bay.

Occurrence in the Gulf of Maine.—This southern fish is decidedly uncommon east of New York; occasional specimens only have been reported from Woods Hole; and it is only a stray visitor to our Gulf, where 2 or 3 specimens have been taken at Provincetown, and 1 in the Mystic River, which empties into Boston Harbor.

THE TILEFISHES. FAMILY BRANCHIOSTEGIDAE

The tilefishes are sea-bass-like in appearance, but with the soft (rear) portion of the dorsal fin much longer that the spiny forward part, and the ventral fins are under the pectorals (thoracic). The only species that occurs off the northeastern United States is characterized by a large fleshy flap on the nape, suggesting (though not corresponding to) the adipose fin of salmons and smelts. But this adipose flap or fin is not shared by its relatives.

Tilefish *Lopholatilus chamaeleonticeps* Goode and Bean 1879

Jordan and Evermann, 1896–1900, p. 2278.

Description.—The presence of a thin, high, fleshy, finlike flap on the nape of the neck in front of the dorsal fin, close behind the eyes, suggesting the adipose fin of the salmon tribe in its appearance though not in its location, serves to identify the adult tilefish at a glance among Gulf of Maine

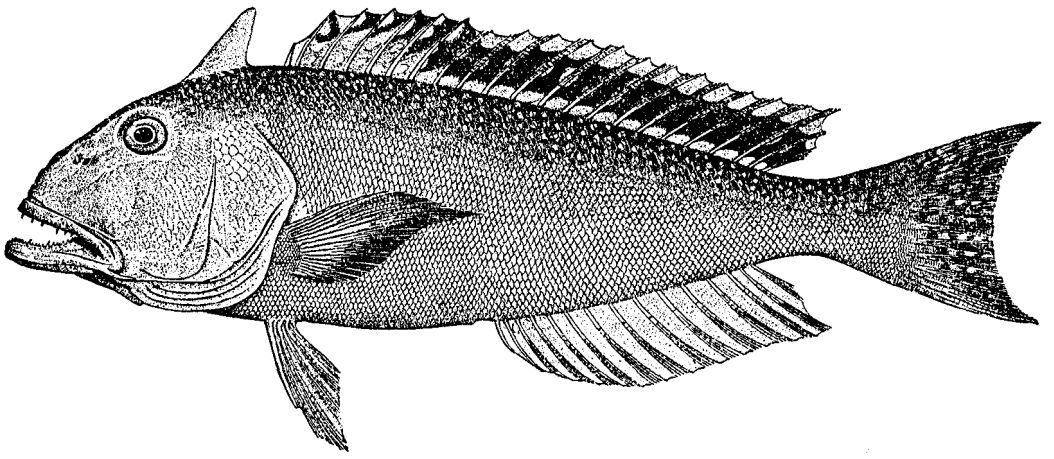

FIGURE 221.—Tilefish (*Lopholatilus chamaeleonticeps*), off Marthas Vineyard. From Goode. Drawing by H. L. Todd

fishes. In grown fish this flap is as high as the dorsal fin, higher than long, and rounded at the tip. In small fry it is relatively much lower. Equally distinctive, if less conspicuous, is a smaller fleshy flap situated on the side of the lower jaw close to the angle of the mouth, pointing backward (to be seen in the illustration, fig. 221). The large head is strongly convex in dorsal profile but nearly flat in ventral profile, with the eye high up, the mouth wide, and both the jaws are armed with an outer series of large conical teeth and inner rows of smaller teeth. The trunk (moderately flattened sidewise) is deepest close behind the head, tapering thence backward to the sidewise-flattened caudal peduncle. The spiny and soft portions of the dorsal fin are continuous, extending back from above the gill opening almost to the base of the caudal fin, as is the case in cunner, tautog, and rosefish. But the anal fin (14 or 15 rays) of the tilefish is about half as long as the dorsal fin, under the rear (soft-rayed) part of which it stands, and like the latter it is of nearly even height throughout most of its length except that its forward corner is rounded. The ventral fins are located below the pectorals, which are set low down on the sides, and both the pectorals and the ventrals are pointed. The gill covers, as well as the trunk, have moderately large scales.

Color.—This is a brilliant fish, bluish or olive green on the back and on the upper part of the sides, changing to yellow or rose lower down on the sides; its belly is of the latter tint with white midline. The head is tinged reddish on the sides; pure white below. The back and sides above the level of the pectorals are thickly dotted with small irregular yellow spots, which are particularly conspicuous below the adipose dorsal flap. The dorsal fin is dusky, marked with similar but larger yellow spots, its soft-rayed portion pale edged. The adipose flap is greenish yellow; the anal fin pale pinkish clouded with purple and with bluish iridescence; and the pectorals are pale sooty brown, with purplish reflections near their bases.

Size.—Tilefish have been reported up to 50 pounds in weight, but this is unusual. The largest fish we have seen (an unripe female) weighed 35½ pounds and was about 42 inches (108 cm.) long. Measurements taken by Bumpus[99] and more recently by us on the *Grampus* show that a 40-inch fish may be expected to weigh about 30 pounds; fish of 33 to 36 inches, 20 to 21 pounds; and 30- to 32-inch fish, 17 to 18 pounds.

Habits.—This is a bottom fish, and its depth range off our Atlantic coast is a very narrow one, none ever being taken shoaler than about 45 fathoms,[1] and very few much deeper than 100 fathoms. The deepest definite record with which we are acquainted is 170 fathoms (p. 428), and with the best fishing at 60–90 fathoms. In the Gulf of Mexico it has been caught at 90 fathoms. The thermal range to which the tilefish is exposed, normally, is very narrow also, for the temperature of the bottom water along the zone inhabited regularly by it varies only between about 47° and about 53°, in most years, summer or winter. And it appears to be very sensitive to chilling;

[99] Bull. U. S. Fish Comm., vol. 18, 1899, p. 329.

[1] The shoalest we have known any to be trawled was at 43–47 fathoms, by *Albatross III*, 35 miles southwest of Nantucket Lightship in mid-May 1950.

this having been the probable cause of a mass destruction of tilefish that took place in 1882 (for further discussion, see p. 429). It is not known whether the tilefish is equally sensitive to high temperatures, in any case it could escape such by descending to a greater depth.

Food.—A great variety of bottom-dwelling invertebrates have been taken from tilefish stomachs. Crabs, of which they are often packed full, are the most important article of diet. The list [2] also includes squid, shrimp, shelled mollusks, annelid worms, sea urchins, sea cucumbers, and sea anemones. Occasionally they catch other fish; two spiny dogfish, for instance, were found in one, and an eel (probably a conger or a slime eel) and unidentified fish bones in others.[3] The presence of pelagic amphipods (*Euthemisto*)[4] and of salpae in the stomachs of tilefish caught on long lines proves that they sometimes feed at higher levels, but they are never known to rise to the surface voluntarily, and when they are hauled up they are often "poke blown." Tilefish take any bait, perhaps menhaden best, salt herring not so readily.

Although they are strong active fish, it is probable that they suffer from the attacks of sharks, for fish caught on the long lines are often bitten in two. And we have seen numbers of sharks 7 to 8 feet long (species not determined) following them up to the surface, while the line was being hauled.

Ever since the tilefish was discovered it has been known to spawn in July, and eggs were running from 10 out of 11 females caught by the *Grampus* off New York on August 3, 1916, while the roe of the eleventh was still unripe. How early the spawning season may open is still to be learned, but August probably sees its close, for the majority of 18 females caught on the 26th of that month in 1914 were spent, only one or two still having running eggs. Among the fish that we have examined, the females have greatly predominated (only 1 male to 29 females in a total of 39 individuals).

Ripe eggs taken from a tilefish and preserved in formalin measured about 1.25 mm. in diameter.[5] As they had an oil globule of 0.2 mm., it is safe to say that they are buoyant, and tow nettings yielded eggs, indistinguishable from those stripped from the tilefish, at the station where we caught the ripe females just mentioned. But the larval stages have not been seen. The fact that a few tilefish of 2½ to 3⅛ inches were taken along the outer edge of the continental slope in April 1930, and others of 4 to 4⅛ inches in July, suggests that 4 to 5 inches is the usual length at one year of age.[6] Nothing is known of the subsequent rate of growth, nor at what age the tilefish matures sexually.

General range.—Outer part of the continental shelf and upper part of the continental edge off Nova Scotia and off the North and Middle Atlantic United States, from Banquereau Bank to the offing of Chesapeake Bay, in depths of 45 fathoms to perhaps 200 fathoms; also reported from southern Florida in more than 100 fathoms,[7] and from the Campeche Bank in the southern side of the Gulf of Mexico, whence the Museum of Comparative Zoology has received a specimen taken in 90 fathoms by the schooner *Seminole* on February 1, 1946,[8] and where local fishermen report that they have taken a number.

Occurrence off Nova Scotia and off the North and Middle United States.—The most easterly and northerly records for the tilefish are of a small one caught on Banquereau Bank (lat. 44°26′ N., long. 57°13′ W.) in 170 fathoms, December 15, 1902, from the schooner *Monitor* out of Gloucester,[9] and of another of 4½ pounds that was brought in to Boston in 1933.[10]

Its chief center of abundance is between the offings of Nantucket and of Delaware Bay. And there is some evidence that it ranges farther east in warm years than in cold. In 1908, for example, tilefish were caught off the South Channel (long. about 69°) in September, while in 1950 the *Albatross III* trawled a few at 50–80 fathoms nearly that far east (at longitudes 69°57′ to 69°35′ W.) in May, whereas the *Grampus* caught none off Martha's Vineyard (long. between 70° and 71° W.) in the very cold July of 1916, but made a fair catch off New York.

[2] Linton, Bull. U. S. Fish Comm., vol. 19, 1901, p. 47; Notes by Vinal Edwards; and our own observations.

[3] The menhaden credited to the diet of the tilefish by Sumner, Osburn, and Cole (Bull. U. S. Bur. Fish., vol. 31, Pt. 2, 1913, p. 767) were merely the pieces of bait on which the fish had been caught.

[4] Collins, Rept. U. S. Comm. Fish. (1882) 1884, p. 244.

[5] Eigenmann, Bull. U. S. Bur. Fish., vol. 21, 1902, p. 37.

[6] For details, see Schroeder, Bull. 58, Boston Soc. Nat. Hist., 1931, p. 7.

[7] One of 23 pounds, caught off Key West in more than 100 fathoms, is reported by Al Pfleuger, well-known fish taxidermist of Miami.

[8] Taken by the schooner *Seminole* on February 1, 1946. See Bigelow and Schroeder, Copeia, 1947, pp. 62–63, for details.

[9] Reported by Evermann, Rept. U. S. Comm. Fish. (1903), 1905, p. 85.

[10] Reported to us by J. Webster of the U. S. Bureau of Fisheries.

On the other hand, none have been reported alive off the Atlantic coast below lat. 37°29′ N., a few miles north, that is, of the mouth of Chesapeake Bay, which makes it likely that the tilefish of southern Florida and of the Gulf of Mexico are isolated populations.

The onshore-offshore range of the tilefish off our northern coasts, being limited in depth (p. 427), is confined to a bottom belt only some 15 to 25 miles wide—astonishingly narrow for so large a fish and one that is so plentiful. And presumably it is a year-round resident wherever it is found there, for its presence has been established northward to the offing of southern New England as early in the season as March, and as late as January, while there was no general falling off in the catches in autumn and early winter during the only year (1917–1918) for which monthly data are available.

Though the tilefish has been reported only once well within the limits of our Gulf, its history and its relationship to hydrographic factors are so interesting that it deserves more attention than its status as a Gulf of Maine fish would warrant otherwise.

It is astonishing that the very existence of so large a fish so close to our coast should have remained unsuspected until May 1879, when Captain Kirby, cod fishing in 150 fathoms of water south of Nantucket Shoals Lightship, caught the first specimens. Others were caught at 87 fathoms nearby by the schooner *Clara T. Friend* (Capt. William Dempsey) during the following July. And trips by the United States Fish Commission during the next two summers proved that the tilefish were plentiful enough to support an important new fishery. These early investigations likewise proved that it occupies a very definite environment, along the upper part of the continental slope and on the outer edge of the shelf where a narrow band of the sea floor is bathed with a belt of warm water (about 47° to 53°), varying by only a couple of degrees in temperature from season to season, and that it never ventures into the lower temperatures on the shoaling bottom nearer land, nor downward into the icy Atlantic abyss. The balance, in fact, between the physiological nature of the tilefish and its surroundings is so delicate that catastrophe overtook it within three years of its discovery. The first news of this disaster came in March 1882; throughout that month and the next vessel after vessel reported multitudes of dead tilefish floating on the surface throughout the entire zone inhabited by it north of Delaware Bay, and it has been estimated that at least a billion and a half dead tilefish were sighted.[11]

It has generally been believed that this destruction was caused by a temporary flooding of the bottom along the warm zone by abnormally cold water.[12] Consonant with this is the fact that other species of fish suffered too, and dredgings carried on during the following autumn proved that the peculiar invertebrate fauna that had been found in abundance along this warm zone in previous summers had likewise been exterminated.

The destruction of the tilefish was so nearly complete that fishing trials carried on off southern New England by the Fish Commission later in 1882; in 1883; 1884 (when a particularly careful search was made); 1885; 1886; and 1887 did not yield a single fish. But the species was not quite extinct, as the *Grampus* proved by catching 8 of them off Marthas Vineyard in 1892, and 53 in 1893. Tilefish were next heard of in 1897 when a fishing schooner caught 30 fish of 6 to 15 pounds, while long-lining for haddock south of Marthas Vineyard. And tilefish had become so numerous again by 1898 that the *Grampus* caught 363 fish, of ½ to 29 pounds, on three trips of only 1 to 3 days' duration each.

The length of the period which the fish required to reestablish itself after the mortality of 1882, together with the fact that in 1898 the catch included a considerable number of young fish, is evidence that the replenishment of the stock was chiefly the result of local reproduction, though it may have been been recruited to some extent by immigration from the southern part of the range, where destruction may not have been so complete as it was north of Delaware Bay.

The tilefish was kept in view during the next 17 years by occasional trips to the grounds by the Bureau's vessels. We caught 19, for example,

[11] Collins (Rept. U. S. Comm. Fish. [1882], 1884, pp. 237–294A) has described the event in detail, as have many subsequent authors. An account will also be found in Economic Circular No. 19 of the U. S. Bureau of Fisheries.

[12] No temperatures were taken on the tilefish ground at the season when the mortality occurred; and the bottom water was nearly as warm there by the end of the following August (48°–49°) as it usually is (about 50°–52°). The temperatures taken in this region during the early years of the Bureau of Fisheries are discussed elsewhere (Bigelow, Bull. Mus. Comp. Zool., vol. 59, 1915, pp. 238–241.)

weighing about 350 pounds, on the *Grampus* on August 26, 1914, in a set of one hour off Marthas Vineyard in 105 fathoms. In 1915, the Bureau undertook to popularize the tilefish in the market, believing it numerous enough to support an important fishery, and knowing it to be an excellent food fish. It proved so plentiful and so easily caught on long lines that the first trip stocked 38,383 pounds in 27 days. And the landings for the first 8 months after the inception of the fishery aggregated upward of 4,388,500 pounds, with a grand total of 11,641,500 pounds from July 1, 1916 to July 1, 1917. But for some reason the demand did not hold up; the catches diminished; and in 1947 (most recent year for which information is available) only 441,000 pounds were landed.[13] The tilefish continues, however, to offer a potential supply of perhaps two to three million pounds yearly, of fish that is good boiled or baked, and that is delicious for chowder. It also makes a good smoked fish, and its sounds are of value for isinglass.

THE ROCKFISHES. FAMILY SCORPAENIDAE

The rockfishes are perch-like or bass-like in general appearance. But they are related to the sculpins (p. 439) and to the sea robins (p. 467) by having a bony stay (an extension of one of the suborbital bones) stretching across the cheek, giving the latter a characteristic bony appearance. Furthermore their cheeks are spiny, and in most of the species the top of the head is marked by ridges that terminate in spines. Both the spiny portion and the soft portion of the dorsal are well developed, either as a continuous fin or subdivided by a deep notch. The ventral fins are on the chest ("thoracic"). In most of the rockfishes (including the rosefish) the eggs are retained within the mother until they hatch. There are many species, the temperate Pacific being especially rich in them. Only one, however, occurs regularly in the Gulf of Maine, though the range of another includes its offshore rim.

Key to Gulf of Maine Rockfishes

1. The lower rays of the pectoral fins, like the upper rays, are connected nearly to their tips by the fin membrane: There are 14 or 15 dorsal fin spines
Rosefish, p. 430

The lower 7–9 pectoral fin rays are free for the outer half of their length; there are only 12 dorsal fin spines.....Black-bellied rosefish, p. 437

Rosefish *Sebastes marinus* (Linnaeus) 1758

OCEAN PERCH; REDFISH; RED SEA PERCH; RED BREAM; NORWAY HADDOCK

Jordan and Evermann, 1896–1900, p. 1760.

Description.—The rosefish is perchlike in its general appearance, moderately flattened sidewise, about one-third as deep as it is long (to base of tail fin), with a large bony head; and its trunk tapers back from the shoulders to a moderately slender caudal peduncle. The dorsal profile of the head is concave, the mouth is large, very oblique, and gapes to below the eyes, the lower jaw projects beyond the upper, and there is a bony knob at its tip that fits into a corresponding notch in the upper jaw. Both of the jaws are armed with many small teeth. The eyes are very large and set high. The sides of the head are armed with spines, the most prominent of which are two near the rear angle of each gill cover, and a series of five confluent ones on each cheek. These, with a ridge behind and above each eye socket, give the head a bony appearance that is extremely characteristic.

The gill openings are very wide, with pointed gill covers. There is one continuous dorsal fin running from nape of neck to caudal peduncle; the spiny part (14 or 15 spines) is considerably longer than the soft part (13 to 15 rays), but the latter is higher than the former. The precise outline of the fin is easier illustrated (fig. 222) than described. The anal fin, consisting of three graduated spines and 7 or 8 longer rays, is shorter than the soft portion of the dorsal, under which it stands. The caudal fin is noticeably small, its rear edge moderately concave, and with angular corners. The pectoral fins are very large, and the smaller ventrals are situated below them. Both head and body are clad with scales of moderate size. There are about 60 to 70 oblique rows of scales from the gill opening to the origin of the caudal fin, just below the lateral line.

The rosefish agrees with the cunner, tautog, and sea bass in the union of the spiny and soft portions of its dorsal into a single long fin, and in its gen-

[13] 52,700 pounds in Massachusetts ports; 128,400 pounds in Rhode Island and Connecticut; 186,700 pounds in New York and 53,300 pounds in New Jersey.

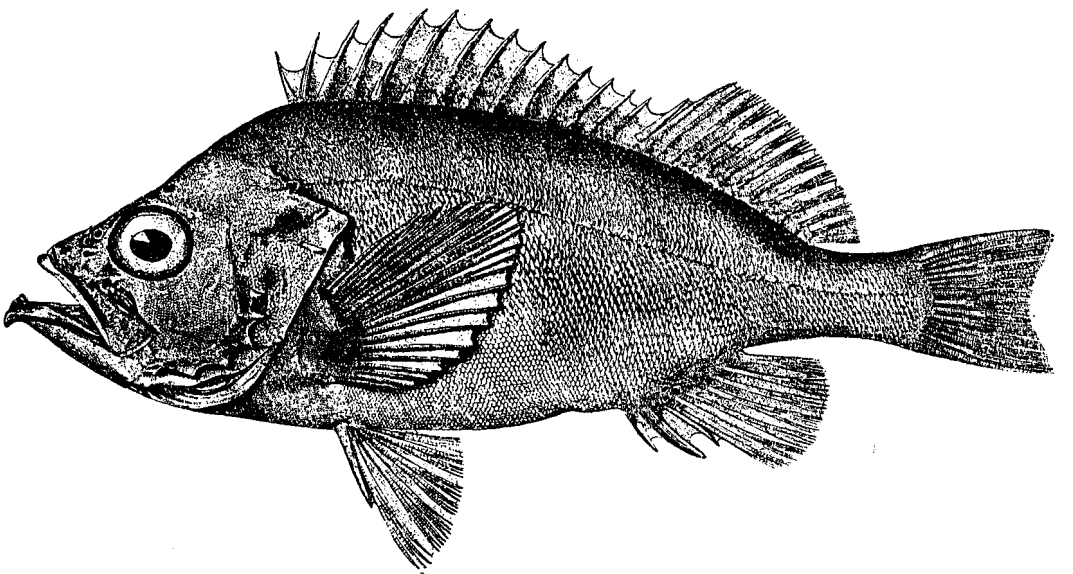

FIGURE 222.—Rosefish (*Sebastes marinus*), Eastport, Maine. From Goode. Drawing by H. L. Todd.

erally perch-like conformation. But it is separable from the first two by its much larger mouth, spiny head, large eyes, more slender caudal peduncle, and larger pectorals; and from the sea bass by its large spiny head, by the shape and small size of its caudal fin, and by the fact that its anal fin and the soft portion of its dorsal are relatively much lower. Its brilliant red color is a sufficient field mark.

Color.—Orange to flame red, occasionally grayish red or brownish red, with the belly a paler red that fades to white after death. The black eyes contrast vividly with the brightly colored body. Medium sized rosefish usually have a dusky blotch on each gill cover, and several irregularly broken dusky patches along the back. These dark markings are more conspicuous on small fish, and young fry up to 3–4 inches long are only faintly reddish, if at all so.

Size.—The rosefish matures sexually when 9 to 10 inches long, males when a little smaller than females. In the Gulf of Maine they are said to grow ordinarily to a maximum length of perhaps 2 feet. The largest measured specimen taken recently in the Gulf of Maine of which we have heard was 22 inches long, and weighed 5 pounds 11 ounces.[14] The largest we have seen measured 18¾ inches.[15] But Goode [16] reported one of about 24 inches, weighing about 14 pounds brought in to Gloucester; a 27½-inch specimen has been reported from the southern edge of the Newfoundland Bank, near the Whale Deep.[17] Another 27-inch fish, said to have weighed 13½ pounds was landed in Gloucester by the dragger *Estaela* on February 7, 1951, from somewhere off Newfoundland. And rosefish grow even larger (maximum about 31–32 inches) in the other side of the Atlantic and in Arctic Seas.[18]

The rosefish run smaller near the coast (usually 8 to 12 inches long) than on the offshore banks. In European waters, where a similar size-relationship obtains, the small inshore form represents a separate species (*Sebastes viviparus*) for it has many fewer scales than the larger, offshore form (*S. marinus*). But no racial distinctions have been found between the inshore populations and those offshore among the American rosefish.

The relationship between length and weight runs about as follows for Gulf of Maine rosefish: 9½ inches, ½ pound; 12 inches, 1 pound; 15 inches, 2 pounds; 17–18 inches, 2½–3 pounds; 20 inches, perhaps 4 pounds.

Habits.—The young rosefish drift in the upper and intermediate water layers (p. 435) until they are nearly an inch long. Fish upwards of a

[14] A fish landed in Gloucester, reported in Maine Coast Fisherman, January 1951, p. 9.

[15] One of 63 specimens trawled by *Albatross III* on the southeastern slope of Georges Bank at 175–195 fathoms, May 16, 1950.

[16] Fish. Ind. U. S. Sect. 1, 1884, p. 261.

[17] This specimen, reported by McKenzie. (Proc. Nova Scotian Inst. Sci., vol. 20, 1940, p. 44) was said to have weighed 7¼ pounds dressed, apparently an error, unless the fish was very thin.

[18] According to Saemundsson (Faune Ichthyol., Cons. Internat. Explor. Mer. 1932, plate). A length of 100 cm. (about 40 inches) has been stated, but we are inclined to doubt this.

couple of inches long tend to hold close enough to the bottom in our Gulf for great numbers of them to be caught in otter trawls. But some may also live pelagic over the deep basins as they are known to do in the Gulf of St. Lawrence; also, in the Norwegian Sea, where there is a population of all sizes living mostly at depths of about 50 to 100 fathoms, over much greater depths.[19] When they are on bottom the rosefish are chiefly on rocky or hard grounds or on mud, seldom on sand, if ever. Their depth range on the bottom is from within a few feet of tide line (p. 434) down to 350 fathoms at least; perhaps to 400 fathoms (p. 434) with the greater part of the commercial catch trawled at about 40 to 175 fathoms; and fry, living pelagic, have been taken as deep as 270 fathoms in north European waters.

Our rosefish inhabit a wide range of temperature. The maximum may be set at about 48° to 50° F., and probably it is the low temperature of parts of the Bay of Fundy, where the upper 10 fathoms or so may be as cool as 50°–52° even in midsummer that allows them to remain in shoal water there the year round (p. 435). At the other extreme they winter in Massachusetts Bay and in Passamaquoddy Bay in water as cold as 33° to 35°, and perhaps colder, though they could easily avoid these low temperatures by a short offshore migration. In fact, the rosefish has often been described as an Arctic species. But while this is true to the extent that its range extends to Arctic Seas, it is a misnomer if taken to mean that it is characteristic of Polar temperatures, for the records of its occurrence, horizontal and bathymetric, prove that the great majority of them inhabit waters warmer than 35°–36° over the greater part of their geographic range.

The distribution of the rosefish [20] in the Gulf of St. Lawrence is especially instructive in this respect, for it inhabits the comparatively warm water (39° to 42° F.) in the bottoms of the deep channels, and not the icy intermediate layer (about 32°) which, generally speaking, is so nearly an impassable barrier to its upward migration that it is seldom if ever taken on the shoal banks. And its vertical range in relation to temperature seems to be much the same as this off the southwest coast of Greenland, where rosefish are taken chiefly deeper than 90 fathoms, in water of about 37°–39°, not in the icy layer above, and where numbers of them (says Jensen) sometimes come to the surface dead in winter, apparently having succumbed to cold.[21] In the Norwegian Sea, however, rosefish of this species are caught only in the overlying layer of water of Atlantic influence at temperatures of 37°–39° or higher, never deeper in the icy cold Polar water.

Temperatures of 37°–39° are the lowest in which young rosefish are born in any numbers in our Gulf; there is no water there colder than this by the time production is well under way, say late June or early July. At the opposite extreme, practically the entire production of rosefish takes place in water colder than 46°–48°, this being the maximum to which the water warms at the 20-fathom level and deeper, except in regions of active vertical mixing where the temperature may rise a degree or two higher. In the Gulf of St. Lawrence, rosefish have been found breeding in 39°–42°. Cursory examination of station data might suggest that young are born in colder water on the Grand Banks as well as along the south and east coasts of Newfoundland, for they have been taken there in tow nets at many localities where the temperature was lower than 32°, either on the bottom or at some intermediate depth. But it is more likely that the parent fish, and the young fry also, were living above this icy layer, not in it; i. e., in water at least as warm as about 35° (1.5° C.), and warmer than about 36°–37° for the most part.

Thus the range of temperature within which American rosefish fry are produced in one place or another is from about 37° to 47° or 48°, which is about the same as for north European waters.[22] In fact it is not likely that rosefish breed successfully in temperatures lower than 35° anywhere in either side of the Atlantic.

The salinity in which rosefish breed in our Gulf is as definitely limited in one direction as is the temperature, if not in the other, for its young are produced for the most part in salinities upward of 32 per mille.

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[19] For studies of the pelagic occurrence of *S. marinus* in northeastern Atlantic waters, see Murray and Hjort (Depths of the Ocean, 1912, pp. 647–648) and especially Tåning (Journal du Conseil, Cons. Internat. Explor. Mer., Vol. 16, 1949, No. 1).

[20] Huntsman, Trans. Roy. Soc. Canada Ser. 3, vol. 12, Pt. 4, 1918, p. 63.

[21] See Jensen (Vid. Meddel. Dansk Naturhist. Foren. Copenhagen, vol. 74, 1922, pp. 89-109, for an interesting study of the occurrence of the rosefish in Greenland waters.

[22] See Tåning (Journal du Conseil, Cons. Internat. Explor. Mer, vol. 16, No. 1, 1949) for a recent discussion of the thermal relationships and breeding range of *S. marinus*.

Food.—The diet of the Gulf of Maine rosefish includes a great variety of crustaceans, especially mysid, euphausiid, and decapod shrimps; small mollusks; and various other invertebrates, and small fish.[23] It bites on almost any bait. In turn, it is the prey of all the larger predaceous fish, its fry being devoured in quantity by cod, by older rosefish, and by halibut.

It has long been known that the eggs of the rosefish develop and hatch within the oviduct of the mother, and the number produced by large females may run as high as 25,000–40,000 yearly. This is a small brood compared to the numbers produced by many of the marine egg-laying fishes. But the protection offered the eggs by being retained inside the mother's body during incubation gives the young a greater chance for survival.

The larvae are about 6 mm. long at birth (fig. 223B), with the yolk mostly absorbed, the mouth already formed, and the first traces of the caudal rays already visible. At a length of 12 mm. (fig. 223D) the dorsal and anal fin rays have appeared, the ventrals are visible, and the head spines are prominent. And though the red color is not developed until the little fishes are about to take to bottom, or later, all but the very youngest larvae are recognizable as rosefish by their large spiny heads, large eyes, short tapering bodies, very short digestive tract, and by the presence of two rows of post anal pigment cells, a dorsal and a ventral row.

This is a very slow-growing fish. Available information is to the effect that they average about 2½ inches when 1 year old.[24] Studies of the scales of rosefish of different sizes [25] indicate that 5-inch fish are likely to be 4 years old; 6-inch fish, 6 years old; 7-inch fish 7 or 8 years old; 8-inch fish 8 or 9 years old; 9-inch fish 9 or 10 years old, and that many of the largest fish of 18 inches and upward may be 20 years old, or older. Thus the mature fish are 8 to 9 years old and older, with the greater part of the commercial catch 10 years old and upward. And about as slow a growth rate has been reported for the immature rosefish of this same species of Barents Sea, on the other side of the Atlantic.[26]

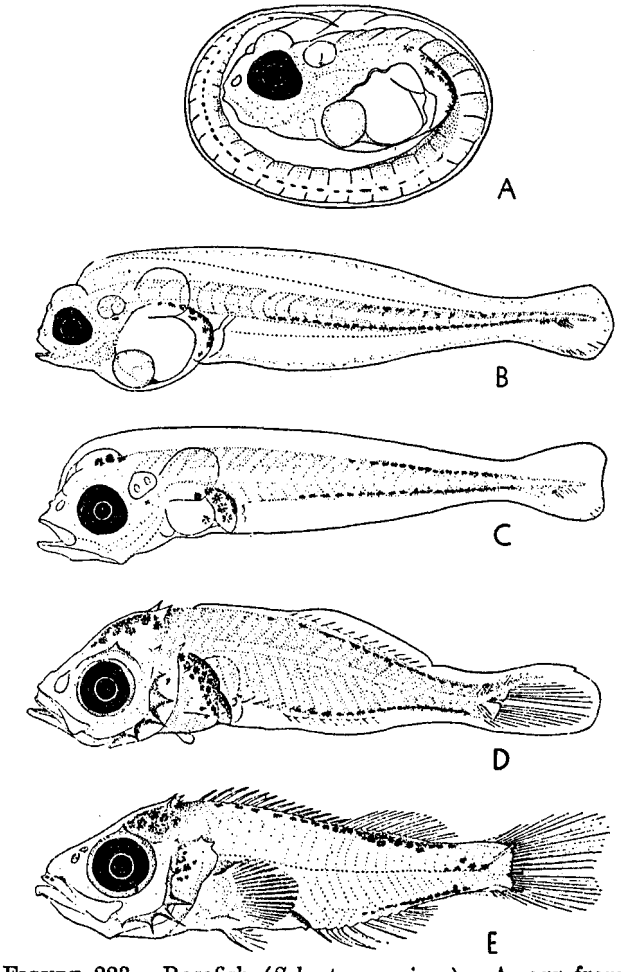

FIGURE 223.—Rosefish (*Sebastes marinus*). A, egg from the oviduct of a gravid female; B, larva, 6 mm.; C. larva, 9 mm.; D, larva, 12 mm.; E, fry, 20 mm. Specimens from Gulf of Maine. From Bigelow and Welsh.

General range.—Both sides of the North Atlantic; northward to Spitzbergen, Nova Zembla, Iceland, West Greenland, Davis Strait, southeastern Labrador, coasts and Banks of Newfoundland, and Gulf of St. Lawrence; southward to the offing of southern New England and as far as the offing of New Jersey in deep water along the American coast,[27] to the northern part

[23] Most of the rosefish that we have seen trawled had voided their stomach contents before they were brought on board.

[24] According to the sizes of young rosefish collected by us in the Gulf of Maine, May to August in various years.

[25] By Perlmutter and Clark, U. S. Fish and Wildlife Service, Fishery Bull. No. 45, 1949.

[26] By Veschezerov, in Knipovitch, Polar Sci. Inst. Sea Fisheries and Oceanogr., No. 8, 1941, pp. 236–270 (Russian).

[27] Tåning (Journal du Conseil Cons, Internat. Explor. Mer., vol. 16, 1949, p. 86) is of the opinion that the American rosefish does not belong to the same species as the European *S. marinus* hence he refers to it as *S. fasciatus*, Storer, 1854. But our own comparison of good-sized specimens from the two sides of the Atlantic has failed to show any differences that seem sufficient for specific separation, whether in number of scales, in the spines on the cheeks, in the fins, or in bodily proportions. We are much indebted to Dr. C. E. Lucas for sending us a series of rosefish of various sizes that had been landed in Aberdeen, Scotland.

of the North Sea and to the southwestern coast of Iceland along the European coast.

Occurrence in the Gulf of Maine.—This is one of the most plentiful of the commercially important fishes in all but the shoalest parts of the Gulf: on the offshore banks, in or over the deep central basin, and along shore. To list its known occurrences would be to mention practically every station where hook-and-line or otter-trawl fishing is carried on deeper than 20 fathoms. Thus considerable numbers are sometimes taken on lines or trawls in 20 to 35 fathoms or more in the Massachusetts Bay region both winter and summer, especially on or near rocky bottom, while many are caught on and near Jeffreys Ledge and at other spots between Cape Ann and Boon Island.

The fact that the *Grampus* took rosefish in 6 out of 7 hauls in 25 to 60 fathoms with a trawl only 8 feet across the mouth, between Cape Ann and Penobscot Bay in July 1912, and that *Atlantis* took 2,469 rosefish in 12 hauls with a 30-foot shrimp trawl in 66 to 96 fathoms in the mud-floored trough west of Jeffreys Ledge in August 1936, show how universal they are in the western coastal belt of the Gulf at appropriate depths; and the depth is not too great for them anywhere in the troughs of our gulf. The number of rosefish there seemed to be independent of the numbers of shrimp (*Pandalus*) on which we may assume they were feeding, the average catch per haul being almost the same (216 fish) for the group of stations where shrimp were scarce as for the group where they were plentiful.[28]

Rosefish are also caught in plenty all along the northern shores of the Gulf in depths of 25 fathoms or more; they are common in the Bay of Fundy, even in such enclosed waters as Passamaquoddy Bay; Huntsman found them in St. Mary Bay; and large commercial catches are made off the western coast of Nova Scotia (5,253,962 pounds reported in 1946).

Turning offshore, the vaguely outlined trough known as "South Channel" that separates the Cape Cod-Nantucket Shoals area from Georges Bank is one of the most productive and hardest fished of the rosefish grounds (19,016,052 pounds taken there in 1946); rosefish are generally distributed on and around Georges Bank itself, except perhaps on its shoalest parts; also on and around Browns Bank, and they range down to a depth of at least 260 fathoms on the southern slope of Georges Bank;[29] very likely down to 300 fathoms.

The relative yearly catches, from different areas, show that the inner and central parts of the Gulf in general are considerably more productive of rosefish than the offshore banks, for the poundage reported from off western Nova Scotia, from the Bay of Fundy, from the coasts of Maine and Massachusetts, and from the west-central part of the Gulf (including the Cashes Bank region and part of the deep basin) which is referred to as the "inshore grounds" in the statistical reports, were about three times as great as from the South Channel, Georges Bank, and Browns Bank combined in 1940; about 3⅛ times as great in 1946, and the regional contrast has been of this same order in other recent years of record. The South Channel in turn, has been many times as productive as the much more extensive area of Georges Bank,[30] though there were enough of them on Georges formerly for 22 successive trawl hauls to have yielded 3,887 rosefish there, September 26 to 30, 1913 (more than one-third as many as haddock).

During 1913, rosefish made up 1.8 percent of the total catch of fish of all kinds made by several trawlers operating on Georges Bank, June to December, and 5.9 percent in the South Channel.

This regional contrast between Bank and Channel emphasizes the very interesting fact that the rosefish of our Gulf, and those of outer Nova Scotian waters as well, are decidedly more plentiful in the deeper basins and depressions, and on soft bottom, than they are on the grounds that are the chief centers of abundance for cod and haddock, and for most of the commercially important flat fishes.

The statistics do not suggest any very great difference in the abundance of rosefish as between Georges Bank and the Nantucket Shoals-Nan-

[28] For further details, see Bigelow and Schroeder, Biol. Bull. vol. 76, 1939, p. 314.

[29] 63 large ones taken in one trawl haul, latitude 40°29′ N., longitude 67°10′ W., at 175-195 fathoms, by the *Albatross III*, May 16, 1950.

[30] The total reported catch for the period 1937-1946 (no report for 1942) was a little more than 158¼ million pounds for the South Channel, contrasted with a little less than 2 million pounds (1,876,000) for the whole of Georges Bank. The catches for individual years ranged between about 9½ million and about 30¼ million pounds for South Channel; between a little less than 29,000 pounds to a little more than 625,000 pounds for Georges Bank. For a chart showing the geographical limits of the statistical areas to which the catches are referred, see Fishery Statistics of the U. S., 1943, Stat. Digest, No. 18, U. S. Fish and Wildlife Service, 1943, p. 95.

tucket Lightship fishing grounds, for while the catch has averaged only about one-third as great for the latter as for the former, the statistical area in question is about one-third as extensive. But the catches of rosefish (1937–1946), made by United States vessels from southern Nova Scotia out across Browns Bank, are of the same general order of magnitude [31] as for the South Channel. And a catch of 1,400 rosefish in two sets of a line trawl on Browns Bank, April 4, 1913, will illustrate how plentiful they were there, before they were so hard-fished as they have been of late.

Large catches of rosefish are also made all along the outer Nova Scotian shelf to the eastward. There is an abundant population on the Newfoundland Banks still awaiting exploitation; some 7,000,000 pounds were taken in Hermitage Bay, on the south coast of Newfoundland from 1947 to 1950.[32] And fry have been taken along both coasts of Newfoundland; also northward from Flemish Cap, "where the Gulf Stream and the Labrador current struggle for mastery.[33] The most northerly record for the rosefish on the American coast is from the outer coast of Labrador (Camp Islands), a few miles north of the Strait of Belle Isle.[34]

It has been known for many years that there are rosefish in the deep waters of the Gulf of St. Lawrence. But we still await information as to how plentiful they may be there.

The upper limit to the vertical range of the rosefish in different parts of our Gulf is clearly correlated with temperature. Thus it is only deeper than 15 to 20 fathoms that rosefish are found during the warm half of the year in the southwestern part of the Gulf. But they have been known to run up into Gloucester Harbor in numbers in winter [35] (never in summer). Many have been taken near the surface in the spring in the drift-nets near the Isles of Shoals where it is only near bottom that they are reported in summer. We have taken them as shoal as 10 fathoms in summer off Mount Desert Island, Maine, where the water warms to about 52°–54° at that depth, and they occur in Pasamaquoddy Bay in water no deeper than 5 fathoms at that season, according to Huntsman. Verrill,[36] in fact, described them as round the wharves at Eastport, no doubt in late summer or early autumn, the season he studied the fauna there.

Apart from shifts in depth of the sort just mentioned, with the seasonal rise and fall of temperature, there is no evidence that the adult rosefish of our Gulf carry out any regular migration. But the larvae may journey for long distances while they drift helpless in the upper layers of the water (p. 436).

In 1930, we saw gravid females during the last half of April, with young nearly ready for birth, evidence that some rosefish may be born in the Gulf of Maine as early as the first part of May. Females also, with well-developed eggs, and males with well-developed milt, are taken commonly by mid-May, both within the Gulf and on Georges Bank,[37] while we have towed a few newborn fish (7 to 10 mm.) off Boothbay and off Mount Desert on May 31 and on June 14. But July 8 is the earliest that we have taken them in any numbers in our tow nets (57 larvae off Cape Cod on that date in 1913.)

Evidently the production of young continues right through July and August, for the *Albatross II* trawled many gravid females, 10 to 13½ inches long, in the central basin of the Gulf in July (1931), one of them containing about 20,000 young, 6–7 mm. long, practically ready for birth, while we have towed newly born larvae (6.5–7 mm.) in one part of the Gulf or another on July 24 and 29 and August 4, 7, 12, 14, 16, 22, and 31, and as small as 10 mm. on September 2.[38] But it is not likely that many young are produced after the first week in September.

Records for rosefish larvae and fry for late June, July, and August along the outer Nova Scotian shelf, and in the Gulf of St. Lawrence, as well as from May until into September around the Grand Banks and up the two coasts of Newfoundland, show that the season of production commences nearly as early in the season in these more northerly waters as it does in the Gulf of Maine and

[31] Yearly catches, from about 9½ million to about 27½ million pounds.

[32] Twentieth Rept. Dept. Fish. Canada (1949–50) 1951, p. 36.

[33] Tåning, Journal du Conseil, Cons. Internat. Explor. Mer., vol. 16, 1949, p. 90.

[34] See Frost, Newfoundland Dept. Nat. Resources, Res. Bull. 4, 1938, Ch. 7, for locality records of rosefish fry in Newfoundland and Labrador waters.

[35] Fish. Ind. U. S. Sect. 1, 1884, p. 262. We have not heard of them in any numbers in any other harbor south of Cape Elizabeth.

[36] American Naturalist, vol. 5, 1871, p. 400.

[37] In 1950 *Albatross III* trawled a number of large males with well-developed milt, and large females with young nearly or quite ready for birth, on the southern slope of Georges Bank on May 16, at 175–195 fathoms.

[38] For complete list, with station localities, numbers and sizes of larvae, and depths of the hauls, see Bigelow, Bull, Mus. Comp. Zool., vol. 58, 1914, p. 108; vol. 61, 1917, pp. 271–272.

that it continues equally late. In north European waters young rosefish are produced from mid-April through August, according to locality.

Seemingly the rosefish fry are ready to sink to near the bottom when they are about 25–30 mm. long, for we have not taken any larger than 27 mm. in our tow nets, while fry of 1½ inches and upwards are plentiful on bottom, both in the Bay of Fundy and in deep water off southern New England. And our failure to take any young rosefish in our tow nets off Massachusetts Bay in November or anywhere in the Gulf in winter is evidence that their descent to the bottom takes place early in their first autumn.

In north European waters such of the young rosefish as are fated to take to the bottom at all are described as continuing pelagic in the upper layers until they are 2–2½ inches (to 60 mm.) long.

Apparently rosefish never produce their young in less than 20 to 30 fathoms west or south of Penobscot Bay; and while they may perhaps do so in shoaler water about Mount Desert, and further east along the coast of Maine, Huntsman [39] reports that the spawning individuals move out into deep water. With this qualification, we have taken pelagic young in our tow nets at so many localities in the northern part of the Gulf including Southwest Harbor on Mount Desert Island, and so generally distributed, as to show that rosefish produce their young wherever they may chance to be, and do not gather on special grounds for the purpose. Rosefish (unlike most of the fishes producing buoyant eggs) also breed successfully in the Bay of Fundy, their larvae having been found both at the mouth of the bay and for some distance up the center, during the late summer.[40]

In the inner parts of the Gulf, our largest catches of its drifting young have all been located within a few miles, one side or the other, of the 50-fathom contour line. Examples are catches of several hundred off Cape Elizabeth on July 29, 1912; near Cape Sable on August 11, 1914; near Cashes Ledge on August 10, 1913, and on September 1, 1915; in the sink off Gloucester on August 9, 1913; on Platts Bank on August 7, 1912. And Goode and Bean [41] report the fry as caught "by the bushel" in the trawl by the *Fish Hawk* at 55 fathoms, presumably off Cape Cod, that being the only *Fish Hawk* station where the rosefish is listed by them. These last catches rival the swarms of young *Sebastes* that have been encountered between Iceland and the Faroes.[42]

On the other hand, most of our records for their pelagic young outside the 100-fathom contour line have been based on occasional specimens only. We have seldom taken young *Sebastes* in the western basin, though we have towed there frequently at all seasons, and never in the deep southeastern trough of the Gulf nor in the eastern channel between Georges Bank and Browns. All this suggests that the chief production of rosefish within the Gulf of Maine occurs at about 50 fathoms.

The presence of gravid females and ripe males on Georges bank (p. 435), together with the abundance of mature fish in the so-called "South Channel," shows that this general region is an important center of production. And the rosefish also breeds considerably farther west than this on the outer edge of the continental shelf, for young fry and adult females full of eggs were collected in 100 to 180 fathoms off the southern coast of New England during the early years of the United States Fish Commission.

The shelf along outer Nova Scotia (especially the depressions between the banks), the basin of the Gulf of St. Lawrence, and the waters around Newfoundland, must be productive nurseries, also, to judge from the abundance of young drifting stages that have been collected there.[43]

Importance and abundance.—The only measure of abundance of rosefish in our Gulf available before 1935 was the number taken in a few experimental trawl hauls, or on long lines (p. 434), for there was so little demand for them that nearly all of those caught incidentally were thrown back by the fishermen. Thus the reported catch for our Gulf was only 54,095 pounds in 1919, rising to a yearly average of about 209,000 pounds for the period 1931–1933. But the rosefish is a good table fish, excellent for quick freezing and filleting. The marketing of it as frozen fillets in 1935 so increased the demand that the landings from the Gulf of Maine, plus fish taken from southern Nova

[39] Contr. Canadian Biol. (1920-1921) 1922, p. 64.
[40] Huntsman, Contrib. Canadian Biol. (1920-1921), 1922, p. 64.
[41] Smithsonian Contrib. Knowl., vol. 30, 1895, pp. 260, 261.
[42] Schmidt, Skrifter, Kommiss, Havundersøgelser, No. 1, 1904, p. 9; Tåning, Journal du Conseil, Cons. Internat. Explor. Mer., vol. 16, 1949, p. 93–94.
[43] See Dannevig (Canadian Fish. Exped. (1914–1915) 1919, pp. 12–14, figs. 8–10), for records of young rosefish along outer Nova Scotia and in the Gulf of St. Lawrence; Frost (Newfoundland Dept. Nat. Resources, Res. Bull. 4, 1936, Ch. 7) for Newfoundland; also Reports, Newfoundland Fisheries Research Commission, vol. 1, No. 4, 1932; vol. 2, No. 1, 1933; vol. 2, No. 2, 1934, for details as to exact localities and dates.

Scotia out to Browns Bank rose to 17 million pounds in that year, to about 55 million pounds in 1936, about 66–89 million pounds in 1938 and in 1939, to about 106 million pounds in 1940, and to about 136 million pounds in 1941. The landings fell to about 100 million pounds in 1943, but rose again in 1945 to a peak of 151 million pounds. This corresponds to about an equal number of individual fish, a number larger than that for any other fish commercially important in our Gulf, except the herring.

It is now generally believed that this yearly drain was greater than a fish requiring 8 or 9 years to reach marketable size could withstand; the catch (Gulf of Maine and southwestern Nova Scotia) fell by about 30 percent the next year, and to only about one-fourth as much in 1949 as had been landed from these areas in 1945.[44] And this would have been calamitous for the fishery had the fleet not been able to draw on the rosefish to the eastward, along the Nova Scotian shelf, whence something like 133 million pounds were landed in New England ports in 1949, or between three and four times as much as from the Gulf of Maine.

We refer the reader to the table on page 333 for the monetary value of the catches of rosefish in recent years, as compared with cod, haddock, and mackerel.

George F. Kelly, writing in the Maine Coast Fisherman,[45] has recently emphasized the probability that the Nova Scotian catch may also be expected to decline from its present high level as soon as the accumulated stock of old fish is reduced there, as it has been in the Gulf of Maine. The fishery would then have had to depend on the annual increment of growth of a stock that has stabilized at a level considerably below its virgin state, unless operations had been extended to Newfoundland waters, where the same chain of events will eventually follow. And we must expect this increment to be far smaller for the slow-growing rosefish than it is for faster growing fishes, such as the cod or the haddock.

Finally, almost the entire commercial catch is taken in otter trawls; also while the rosefish is of such great importance to the commercial fishermen, it offers nothing to the angler; most of them live too deep to be within his reach, and any hooked would come in with very little resistance.

Black-bellied rosefish *Helicolenus dactylopterus* (De la Roche) 1809

RED BREAM; BLUE MOUTH

Jordan and Evermann, 1896–1900, p. 1837 as (*H. dactylopterus* (De la Roche) and *H. maderensis* Goode and Bean 1895).[46]

Description.—This species resembles the common rosefish closely in its general form and in the outline and arrangement of its fins. But the lower 7 to 9 rays of its pectoral fins are free from the fin membrane along the outer half to one-third of their length, and the upper margin of the pectorals is

[44] Landings of 108 million pounds for 1946; only about 36 million pounds for 1949.

[45] Vol. 5, No. 7, Jan. 1951, p. 9.

[46] We have examined some of Goode and Bean's specimens and agree with Holt and Byrne (Fisheries, Ireland, Sci. Inv. (1906), v. 1908) that the so-called *H. maderensis* is identical with *H. dactylopterus*.

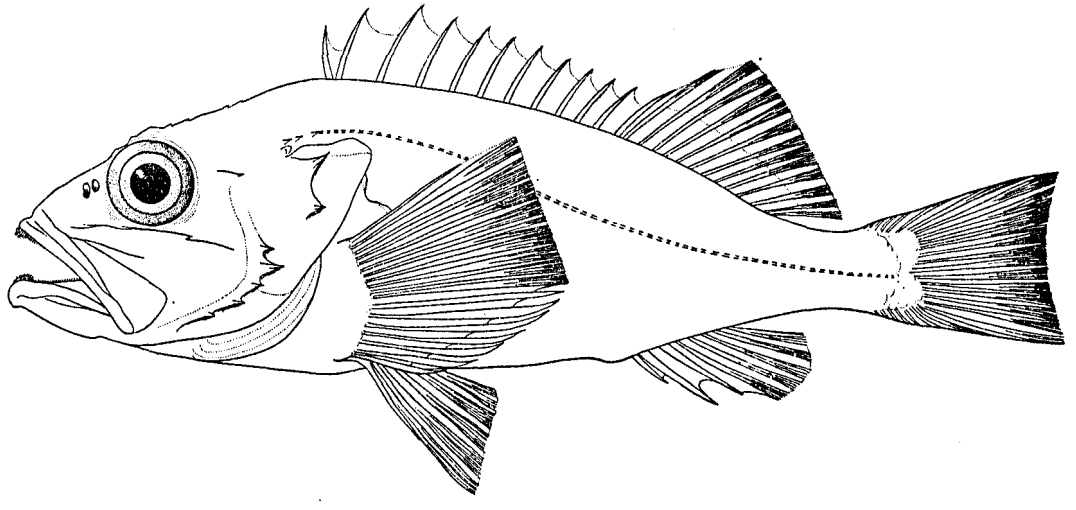

FIGURE 224.—Black-bellied rosefish (*Helicolenus dactylopterus*), off southern New England. Drawing by Louella E. Cable.

nearly straight, which gives the fins an aspect noticeably different from that of the rosefish. The space between the eyes (flat in the rosefish) is grooved in the black-bellied species; there are only 12 spines in the spiny portion of its dorsal fin (14 or 15 in the rosefish) and only 5 or 6 soft anal rays instead of 7 (in addition to 3 stiff spines).

Its caudal fin is relatively larger than that of the rosefish; its eyes closer together, the distance between them being less than one-half as great as the diameter of the eye (about two-thirds to three-quarters in the rosefish); the maximum depth of its body is somewhat less than the distance from tip of upper jaw to upper corner of gill cover; and its scales are larger relatively.[47] A more important difference anatomically is that the red bream has only 24 or 25 vertebrae, the rosefish 31.

Color.—More or less vivid reddish or pale pinkish, usually with some brown and green along the back and with irregular cross bands of darker or brighter scarlet on some specimens; the upper part of the sides marked with a sparse pattern of narrow, dusky vemiculations, roughly following the edges of the scales; and each gill cover generally has a leaden or dusky patch caused by the black inner surface shining through the bone. The lower surface is without dark markings. All the fins are pinkish, the spiny part of the dorsal mottled with white, and the soft portion of the dorsal, the ventrals, and the anal edged with white. The lining of the belly cavity is black, hence one of its common names.

Size.—Maximum length about 15 inches.

Habits.—Catch records show that the black-bellied rosefish sometimes are in the mid-depths, sometimes on bottom or close to it. Beyond this nothing is known of their daily life. Neither is it known definitely whether their eggs are hatched within the oviducts of the mother, as in the rosefish (p. 433), or whether they are set free in the water, like those of most fishes.[48]

General range.—Known from the eastern slope of Georges Bank westward and southward to Florida in depths of 68 to 373 fathoms in the western Atlantic; from Norway to the Canaries in the eastern; also in the Mediterranean.

Occurrence in the Gulf of Maine.—This fish must be generally distributed over the outer part of the continental shelf and along the upper part of the continental slope as far east as the general offing of Nantucket, for it has been reported from 27 stations between longitude 72° and a few miles east of longitude 70°,[49] including one catch of more than 100 of them, 4¾ to 11 inches long, in one haul, by the *Albatross III.*[50] One about 13 inches long was trawled on the eastern edge of Georges Bank, at 175 fathoms, October 6, 1929.[51] Subsequent records that fall within the limits set here for the Gulf of Maine, are of 24 fish, 4–10 inches long, trawled at 5 stations south of Nantucket, at 68–240 fathoms, by the *Albatross III*, May 11–18, 1950; of one brought in by the trawler *Red Jacket* from the northern slope of Georges Bank, from 120 fathoms, in 1949;[52] and of a catch of about 300 pounds of them, made in the southeastern part of the basin of the Gulf, at 120–140 fathoms, July 24, 1948.[53]

This last catch is especially interesting, for it shows that schools of black-bellied rosefish may occasionally come in via the deep channel between Georges and Browns Banks. But they have never been reported in the inner parts of the Gulf, nor are they to be expected there unless as strays from offshore.

BOAR FISHES. FAMILY CAPROIDAE

Boar fish *Antigonia capros* Lowe 1843

Jordan and Evermann, 1896–1900, p. 1665.

Description.—This Boar Fish[54] is set apart from all other Gulf of Maine fishes by the fact that its very thin body is deeper than it is long (longer than deep in all other species yet recorded from our Gulf). It resembles the John Dory (p. 297) in the general arrangement of its fins, both the spiny portion of the dorsal and the soft portion being well developed, with the latter much the longer of the two, but lower; the soft-rayed

[47] About 42–48 oblique rows of scales from upper corner of gill opening to base of caudal fin in *Helicolenus*, 60–70 in *Sebastes*.

[48] Ehrenbaum (Nordisches Plankton, Zool., vol. 1, 1905, p. 51) thought it probable that this is an egg-laying species, and Tåning (Journal du Conseil, Conseil Internat. Explor. de la Mer, vol. 16, 1949, p. 86) so characteristizes it. But its ripe eggs have not been seen, so far as we know.

[49] For list of stations, with depths, up to 1895, see Goode and Bean, Smithsonian Contrib. Knowl., vol. 30, 1895, pp. 251–252, as *Helicolenus maderensis*; *Albatross III*, also, trawled one or more specimens at nine stations off southern New England in May 1950.

[50] Latitude 39°42′ N., longitude 71°57′ W., 145–210 fathoms, May 12, 1950.

[51] This specimen, reported by Firth (Bull. 61, Boston Soc. Nat. Hist., 1931, p. 13) is in the Museum of Comparative Zoology.

[52] Specimen in Museum of Comparative Zoology.

[53] Taken by the schooner *Alice M. Doughty*, Capt. Manual Silva. Six of these specimens are in the Museum of Comparative Zoology.

[54] This is the only member of the family that has been reported from the western side of the North Atlantic.

anal is about as long as the soft dorsal and is preceded by 3 spines with fin membrane. The ventrals are placed a little behind the pectorals. It lacks the bony skin plates and the filamentous prolongations of the dorsal spines so conspicuous on the John Dory; and its mouth is very small (larger in the John Dory).

Color.—Color, in life, pink and pinkish white.

Size.—Maximum reported length about 1 foot.

General range.—Tropical and subtropical Atlantic, mostly offshore.[55]

Occurrence in the Gulf of Maine.—We mention this fish because we have seen 8 specimens [56] and heard of 6 others [57] that were trawled in 55–80 fathoms, south of Nantucket Lightship in May 1950. Other records of it near the American coast are one trawled by the *Albatross III* at 50 fathoms and a second at 22 fathoms off North Carolina, in January 1950. It has also been taken near Madeira, off the Barbados, and in Cuban waters.

[55] Reports of it from Japan, from the Kai Islands and from the Celebes Sea (Manado) may have been based on a closely allied fish. For descriptions of the species of this genus, with references, see Fraser-Brunner (Ann. Mag. Nat. Hist., Ser. 12, vol. 3, No. 32, 1950, pp. 721–724).

[56] Three trawled by *Albatross III*; five by the *Eugene H.*

[57] Reported by Capt. Henry Klimm, of the dragger *Eugene H.*

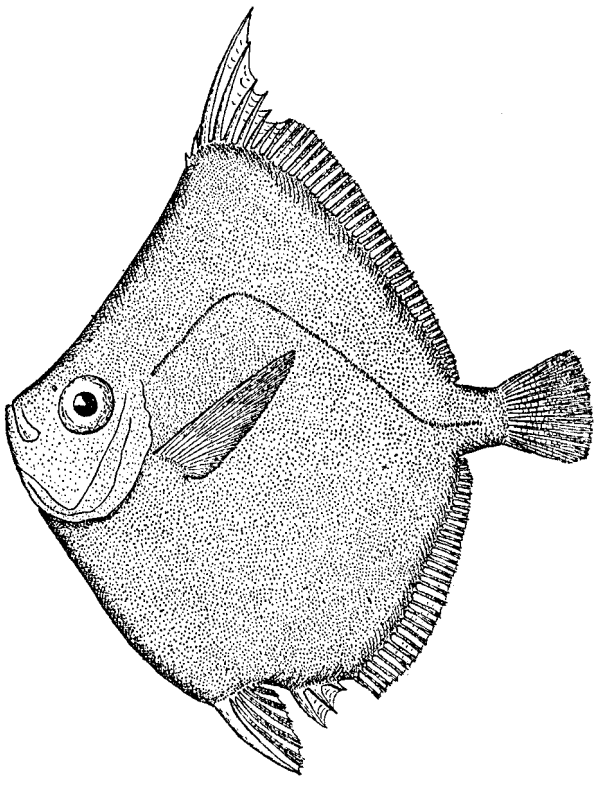

FIGURE 225.—Boarfish (*Antigonia capros*), 105 mm. specimen, south of Nantucket Lightship. Drawing by H. B. Bigelow.

THE SCULPINS AND SEA RAVENS. FAMILIES COTTIDAE AND HEMITRIPTERIDAE

The several members of the sculpin and sea-raven tribe that are known from the Gulf of Maine are a homogeneous group, characterized by large spiny heads; very wide gill openings; very broad mouths; slender bodies; separate spiny and soft-rayed dorsal fins (united in some rare species); large fanlike pectorals but small caudals; and by ventrals that are reduced to three long rays. All of them, too, have a fashion of spreading the gill covers and of flattening the head when taken in the hand. They likewise produce grunting sounds, and some of them have the power of inflating themselves with air or water when they are molested. The only other Gulf of Maine fishes that resemble them in general form, are the sea robins (p. 467), the toadfish (p. 518), and the goosefish (p. 537). But the entire head of the sea robin is armed with bony plates, different from the soft-skinned head of a sculpin; in the toadfish the soft portion of the dorsal fin is many times as long as the spiny part (at most twice as long as the spiny part in a sculpin); and not only are the fins of the goosefish small and weak as compared with the present family, but its lower jaw projects far beyond the upper, and its mouth is full of very large pointed teeth, whereas in the sculpins the teeth are small and the upper and lower jaws are of approximately equal length.

The sculpin tribe, as a group, are egg-laying fishes.[58] Among the Arctic members of the family, including the genera *Artediellus*, *Cottunculus*, *Gymnocanthus*, and *Icelus*, the males have a long anal papilla, through which the urinary duct and the sperm ducts both pass. The supposition is that this serves as a copulating organ, fertilization taking place within the female, and the fertilized eggs being laid soon after.[59]

[58] Eggs with embryos far advanced in development have been reported within the ovaries of female short horn sculpins (*Myoxocephalus scorpius*) from Finland (Nordquist, Svensk. Fiskeri Tidskr., year 6, 1899). But it is well established that this sculpin ordinarily lays eggs, as described below (p. 447).

[59] See Jensen and Volsøe (Danske Vidensk. Selskab. Biol. Meddel., vol. 21, No. 6, 1949, p. 18) for a detailed account of the anal papilla in *Icelus*.

KEY TO GULF OF MAINE SCULPINS AND SEA RAVENS

1. There is only one dorsal fin, the spiny and soft parts being continuous, one with the other ..... Arctic sculpin, p. 453
   There are two separate dorsal fins 2
2. The first dorsal fin is deeply notched between the spines; the lower jaw and the top of the head are adorned with fleshy tags ..... Sea raven, p. 454
   The first dorsal is not deeply notched between the spines; there are no fleshy tags about the head 3
3. The long spine on each cheek is branched at the tip ..... Staghorn sculpin, p. 452
   The long spine on each cheek is simple, not branched at the tip 4
4. The anal fin is long (25 rays); there is a series of bony plates along each side of the body ..... Mailed sculpin, p. 441
   The anal fin is short (14 rays or fewer): there are no bony plates along the sides of the body 5
5. The long spine on the cheek is hooked upward ..... Hook-eared sculpin, p. 440
   The long spine on the cheek is straight, not hooked 6
6. The longest (uppermost) cheek spine is four times as long as the one below it, and reaches back to the margin of the gill cover; all the head spines are very sharp ..... Longhorn sculpin, p, 449
   The uppermost cheek spine is not more than twice as long as the one below it, and does not reach more than about half way to the margin of the gill cover; the head spines are blunter 7
7. Total length more than 9 inches ..... Shorthorn sculpin, p. 445
   Total length less than 8 inches 8
8. Anal fin with 13 or 14 rays; the soft skin of each side of the throat is pierced by a minute pore close behind the lower part of the last gill arch ..... Shorthorn sculpin, young specimens, p. 446
   Anal fin with only 10 or 11 rays; sides of throat behind last gill arch have no pore ..... Grubby, p. 443

Hook-eared sculpin *Artediellus uncinatus* (Reinhardt) 1833

ARCTIC SCULPIN

Jordan and Evermann, 1896–1900, p. 1906, as *Artediellus atlanticus* Jordan and Evermann.

Description.—The most distinctive feature of this species among local sculpins is the long hooklike spine on each cheek, pointing backward and upward, plainly shown in the illustration (fig. 226). There is also a short backward-pointing spine covered by a flap of skin at the upper corner of each gill cover, two short spines on the top of the nose between the two pairs of nostrils, and a pair of blunt knobs above the eyes. Head, mouth, and tapering body are of the usual sculpin form. The skin is smooth and naked. The spiny dorsal fin is short (7 to 9 spines) and rounded in outline, the soft dorsal fin is about twice as long (13 rays), and the anal (11–12 rays) is a little shorter than the soft dorsal, which it resembles in outline and under which it stands. Each ventral fin consists of three long rays that reach back nearly to the vent; the pectorals, wide at the base and rounded in outline, reach beyond the beginning of the soft dorsal when they are laid back, and the caudal fin is narrower than it is in the commoner Gulf of Maine sculpins. The jaws and the roof of the mouth are armed with several series of small bristle-like teeth.

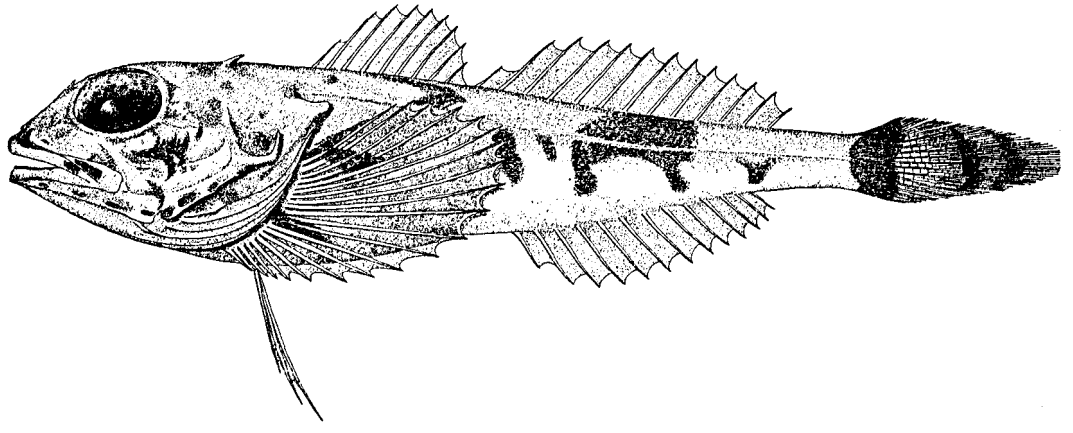

FIGURE 226.—Hook-eared sculpin (*Artediellus uncinatus*), Massachusetts Bay. From Jordan and Evermann. Drawing by H. L. Todd.

Color.—Preserved specimens are mottled with dark and pale brown, sometimes with a reddish tinge, and most of them have a blotch at the base of the caudal fin. All the fins are grayish or blackish, with oblique or vertical pale cross bands.

Size.—This is one of the smallest of sculpins, growing to a length of only about 4 inches.

General range.—This is a cold-water fish known from Labrador and the west coast of Greenland to Cape Cod in the western Atlantic; also in the littoral waters of arctic Europe, of Siberia, and of Greenland.[60]

Occurrence in the Gulf of Maine.—This sculpin, formerly thought to be rare in the Gulf of Maine, is now known to be generally distributed there in depths greater than 20 to 30 fathoms. It was dredged in numbers in the deeper parts of Massachusetts Bay many years ago. And we have since taken it repeatedly near Mount Desert; off Cape Elizabeth; in the trough between Jeffreys Ledge and the coast; around Cashes Ledge; along the northern slopes of Georges Bank; in the southeastern part of the basin of the Gulf; and at the entrance to the deep gully between Georges and Browns Banks, in depths ranging from 20 to 150 fathoms. Individual trawl hauls have yielded up to 6 or 8 specimens, both on hard bottom and on soft.

To the eastward and northward it has been taken off Cape Sable; at a number of places off the outer coast of Nova Scotia; and on the Newfoundland Banks, at depths of 50 to 190 fathoms.[61] It is common enough in the Gulf of St. Lawrence for Huntsman to have classed it as a characteristic inhabitant of the icy intermediate water layer on the Banks,[62] while Vladykov and Tremblay[63] have reported it from the estuary of the St. Lawrence River near Trois Pistoles; it has been reported from Hamilton Inlet on the outer coast of Labrador;[64] and doubtless it will be found farther north, when the fish fauna of the outer Labrador coast has been explored more thoroughly, for it is known from West Greenland.

Presumably, it is resident in small numbers wherever found, sculpins not being migratory, but nothing whatever is known of its way of life.

Mailed sculpin *Triglops ommatistius* Gilbert 1913

Jordan and Evermann, 1896–1900, p. 1923, *Triglops pingeli* (Reinhardt), 1832, in part.

Gilbert, Proceedings, U. S. National Museum, vol. 44, 1913, p. 465.

Description.—The most distinctive feature of this sculpin, apart from its very long anal fin, is that it has a row of about 45 broad plate-like scales along its lateral line on each side, with smaller spiny scales below the dorsal fins, while the skin of the sides lower down is gathered in obliquely transverse folds. The body, too, is more tapering than that of our other sculpins, the caudal peduncle more slender, and the tail fin is smaller. Furthermore, the head is smaller and smoother than in any of the sculpins that are common in the Gulf of Maine, with short spines and many prickles. The first dorsal fin (10 to 12 spines) originates over the

[60] After examining specimens from New England waters and comparing them with published drawings of European fish, we can find no significant differences between the hook-eared sculpins of the two sides of the Atlantic.

[61] For localities of record off outer Nova Scotia and on the Newfoundland Banks, see Goode and Bean, Smithson. Contrib. Knowl., vol. 30, 1895, p. 268; also Reports, Newfoundland Fishery Research Commission, Vol. 1, No. 4, 1932, p. 108; vol. 2, No. 1, 1933, p. 125.

[62] Trans. Roy. Soc. Canada, Ser. 3, vol. 12, Sect. 4, 1918, p. 63, as *Centridermichthys uncinatus*.

[63] Natural. Canad., vol. 62, 1935, p. 79.

[64] Kendall, Proc. Portland Soc. Nat. Hist., vol. 2, 1909, p. 217.

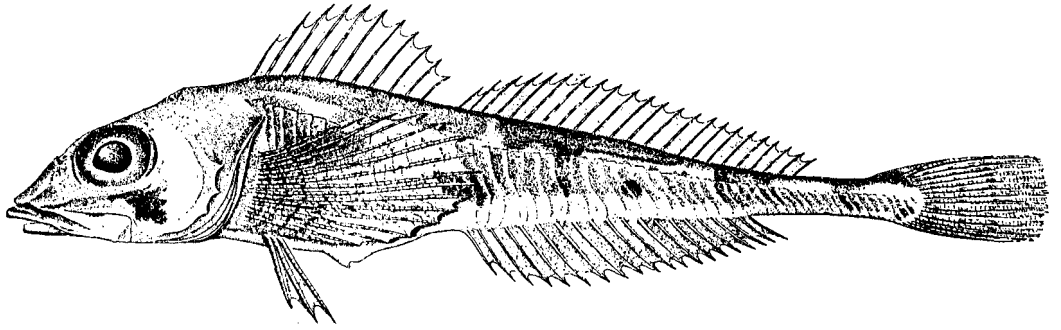

FIGURE 227.—Mailed sculpin (*Triglops ommatistius*), off Chebucto, Nova Scotia. From Jordan and Evermann. Drawing by H. L. Todd.

bases of the pectorals and is higher than the second dorsal, but only about half as long. The second dorsal has 20 to 25 rays. The anal fin is similar to the second dorsal in form and stands below it, but is a little shorter (20 to 22 rays). The ventral fins (each with 3 rays as is the rule among sculpins) reach about as far back as the rear end of the first dorsal, while the pectorals (17 rays) are of the fan-like shape usual among sculpins. The males have a very large and noticeable anal papilla.

Color.—Olive above; white, yellowish or orange below. There are four dusky blotches above the lateral line on each side, one on the caudal peduncle, one passing through the first dorsal fin, and two passing through the second dorsal fin. The fins are variously marked with yellowish and with gray-black. The first dorsal of the male has a dusky blotch between the first and second spines and another between the seventh and tenth spines; the second dorsal is marked with three horizontal olivaceous bars. Females lack the blotches on the first dorsal fin; and their second dorsal is marked with narrow lines of dots.

Size.—This is a small species, probably growing to about 8 inches, the maximum that is recorded for its European representative.[65] The largest yet recorded for the Gulf of Maine was 6 inches long.

Habits.—Little is known of its habits beyond the bare fact that it is a bottom fish, like other sculpins. Any that breed in the Gulf of Maine probably spawn in midsummer, Cox [66] having reported a ripe female at Cape Breton in July. Its eggs were pinkish, 2 mm. in diameter, with many oil globules. Presumably the eggs sink like those of other sculpins. The European mailed sculpin is known to eat worms and various crustaceans, and the diet of the American form is the same, probably.

General range.—Sculpins of this general type are circumpolar, ranging south to Cape Cod along the American coast and to the Baltic on the European side of the Atlantic, in rather deep water. But they show a tendency to split up into local races, the constancy of which is yet to be tested by a study of large series. Newfoundland specimens, for example, differ so much from typical *Triglops ommatistius* in the arrangement and number of folds of skin along the sides that Gilbert [67] has dignified them with a separate name (as the subspecies *terranovae* of species *ommatistius*); and both the eastern American forms are distinguished from the east Greenland and European mailed sculpins by the presence of the eyespot on the first dorsal fin of the male (which the European form lacks) and by slightly fewer fin rays. We do not feel convinced, however, that all these forms, together with the Bering Sea form (*Triglops beanii* Gilbert, 1895), will not finally prove to be local varieties of a single wide-ranging species.

Occurrence in the Gulf of Maine.—Judging from the scarcity of records this cold water fish is uncommon in the Gulf of Maine. Specimens have been recorded from the neighborhood of St. Andrews in the Bay of Fundy, in 15 fathoms (reported by Huntsman); a few from Massachusetts Bay and from off Race Point, Cape Cod (now or formerly in the collection of the Boston Society of Natural History); 11 others now in the United States National Museum were from Gloucester, Cape Cod, and Georges Bank; we have trawled them near Mount Desert; in Massachusetts Bay; off Cape Ann; off Cape Cod; and around the northern slope of Georges Bank, in depths of 20 to 140 fathoms in various months from spring to autumn; and two were trawled on the southeast slope of Georges [68] by the *Albatross III*, July 17, 1948, in 45 fathoms. Our most southerly record for it was about 10 miles east of Chatham, Mass.

The fact that Gilbert found differences between the Gulf of Maine and Newfoundland specimens, with others from Chebucto Head (Nova Scotia) and from Georges Bank intermediate between them, suggests that the mailed sculpin is a permanent resident of the inner parts of the Gulf, rather than that it appears there only as a wanderer, past Cape Sable, from the east and north.

Eastward and northward from our Gulf, this sculpin is described as being rather common to numerous on the outer Nova Scotian fishing grounds, and as one of the characteristic members of the fish fauna of the icy cold water on the Banks and in the Gulf of St. Lawrence.[69]

[65] Collett, Norske Nordhaus-Expedition, 1876–78, Zool., Fiske, 1880, p. 38.
[66] Contrib. Canad. Biol. (1918–1920) 1921, p. 111.
[67] Proc. U. S. Nat. Mus., vol. 44, 1913, p. 467.
[68] Latitute 40°48′ N., longitute 66°31′ W. (Arnold, Copeia 1949, p. 299).
[69] See Huntsman, Trans. Royal Soc. Canada, Ser. 3, vol. 12, Sect. 4, 1918, pp. 61–67, for a very interesting account of the fishes that are characteristic of the different water layers in the Gulf of St. Lawrence.

It is also reported off Bonne Bay on the west coast of Newfoundland, in the Strait of Belle Isle, and from the south coast of Newfoundland. It is so widespread on the eastern part of the Grand Banks that it was taken at 18 stations there on the cruises of the Newfoundland Fisheries Research Commission. It is also reported off the east coast of the Avalon Peninsula, and off Sandwich Bay on the outer coast of Labrador.

Grubby *Myoxocephalus aeneus* (Mitchill) 1815 [70]

LITTLE SCULPIN

Jordan and Evermann, 1896–1900, p. 1972.

Description.—The most distinctive features of the grubby, as compared with others of its tribe, are its short, simple head spines, combined with small size at maturity. It is of the typical sculpin form, though proportionately a stouter fish than either the shorthorned or the longhorned species, that is, about one-fourth as deep as it is long with smooth skin but showing the head ridges and spines typical of its genus. Most noticeable of these are a ridge with two spines running along the top of the head over each eye; a pair of spines between the nostrils; and six short spines on each side of the face between snout and gill opening. None of the cheek spines are long (p. 449). The spiny dorsal fin (9 spines), originating a little in front of the upper corner of the gill opening, is shorter (front to rear) than the second dorsal of 13 or 14 soft rays; its longest spines, measured from base to tip, are about the same length as the longest soft rays of the second dorsal; and the two fins are so close together that there is no free space between them. The anal fin (10 or 11 rays) is a little shorter than the second dorsal, under which it stands. The pectorals are of the fanlike outline characteristic of this family, while each ventral fin consists of one spine and three rays. There is no slit or pore behind the last gill arch (there is such a slit or pore in the shorthorn sculpin, at least in most specimens, p. 445).

Color.—Grubbies, like other sculpins, vary in color according to the bottoms on which they lie. All that we have seen, however (this confirms the published descriptions), have been light to dark gray or greenish-gray above, with darker shadings or irregular barrings that are most evident on the sides and on the fins. The sides of the head are usually mottled light and dark; the belly is pale gray or white. According to information supplied by Dr. A. G. Huntsman, the presence of an uninterrupted pale band of considerable length along the lower sides of the caudal peduncle is a useful field character. But we have seen some specimens intermediate in this respect between the extreme condition shown in figure 228 and the variable mottlings and cloudings of the shorthorn sculpin.

Size.—This is the smallest of our common sculpins, few growing to more than 5 or 6 inches in length, and perhaps none to more than 8 inches.

[70] Placed in the genus *Acanthocottus* Girard, 1849, by Jordan, Evermann, and Clark, Rept. U. S. Comm. Fish (1928), Pt. 2, 1930, p. 386.

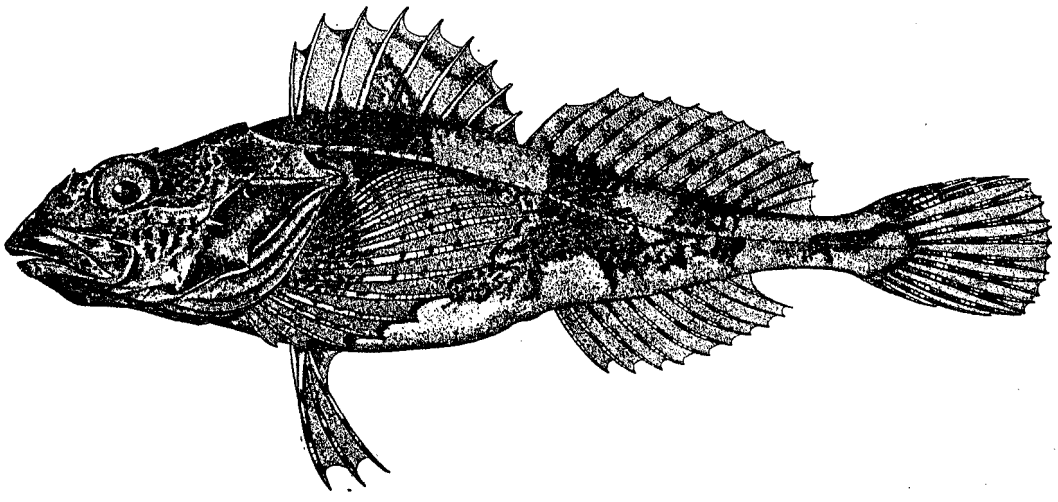

FIGURE 228.—Little sculpin (*Myoxocephalus aeneus*), Staten Island, New York. From Jordan and Evermann. Drawing by H. L. Todd.

Remarks.—The differences between the grubby and the shorthorn sculpin in number of anal rays, and in the presence or absence of a pore behind the last gill arch, seem sharp enough to forbid the possibility that the former may be a dwarf race of the latter. Determination, however, of these characters required such close examination, and grubbies resemble young shorthorns so closely in all other respects that it is not easy to tell the one from the other. We therefore suggest that any small sculpin that may prove difficult to name be forwarded for identification either to the laboratory of the U. S. Fish and Wildlife Service, Woods Hole, Mass.; to the Division of Fishes, U. S. National Museum, Washington, D. C.; or to the Department of Fishes, Museum of Comparative Zoology, Cambridge, Mass.

Habits.—On the southern shores of New England, where the grubby is not only more nearly universal than it is to the east and north of Cape Cod, but more plentiful, it is found from tide mark down to 15 fathoms or so. But we have taken it as deep as 28 fathoms in the Gulf of Maine, and Cox has reported it in the Gulf of St. Lawrence from the stomachs of cod caught in 60 to 70 fathoms. It is found on all sorts of bottoms, most abundantly among eel grass (*Zostera*) during the years when this plant was more plentiful than at present. And it is the only sculpin that summers in very shoal water along southern New England (Woods Hole and up Narragansett Bay) and near New York Harbor.

In the Gulf of St. Lawrence (e.g., around the Magdalen Islands) and on the Nova Scotian coast in general, it is found in estuaries, as in the southern part of its range, as well as outside. But it seems more restricted to the open coast in the Gulf of Maine, for Huntsman found it rare as far up Passamaquoddy Bay as St. Andrews, though common at the mouth, and more plentiful in St. Mary Bay and in Annapolis Basin than it is in Minas Basin on the Scotian side of the Bay of Fundy. Neither have we seen it in salt creeks about Massachusetts Bay.

The known distribution of the grubby in summer proves that it is certainly at home in water as warm as 69° F., and perhaps a degree or two warmer; these temperatures are several degrees higher than are preferred by its larger relative, the shorthorn. On the other hand, it survives temperatures as low as 32° in winter, if not lower, both in the Gulf of St. Lawrence, on the Nova Scotian coast, and about Woods Hole. Its presence in the inner parts of Narragansett Bay on the one hand and off open coasts on the other also proves it resistant to a wide range of salinity, but it never runs up into appreciably brackish water, as far as we can learn.

Probably the grubby breeds throughout its geographic range, certainly as far north as the southern part of the Gulf of St. Lawrence. And the Bay of Fundy appears to be the site of successful reproduction, for Huntsman found grubbies of all sizes there. The spawning season lasts all winter off southern New England and until June in the Gulf of St. Lawrence, Cox having reported a ripe female on the 18th of that month, at Amherst Island (Magdalen group). The eggs, which are described as of a beautiful green color and 1 mm. in diameter, sink like those of other sculpins and stick to seaweeds or to any other objects they chance to rest upon. Young sculpins (this species among them) have been caught in tow nets at Woods Hole from January to May.

This sculpin is omnivorous like its relatives, feeding on all sorts of small animals which it finds on the bottom, such as annelid worms, shrimps, crabs, copepods, snails, nudibranch mollusks, ascidians, and on small fish, including alewives, cunners, eels, mummichogs, launce, silversides, sticklebacks, and tomcod.[71] It also scavenges any kind of animal refuse.

General range.—North American coastal waters, from New Jersey to northern Nova Scotia and to the Gulf of St. Lawrence, both in the southern side, where it is common, and the Strait of Belle Isle.[72]

Occurrence in the Gulf of Maine.—It is probable that this little sculpin is to be found in suitable localities all around the shores of the Gulf of Maine, for it is reported as common along both shores of the Bay of Fundy (including St. Mary Bay) and at various localities in the Massachusetts Bay region, such as Cape Ann, Gloucester, Salem, Cohasset, and Provincetown, and the

[71] This list of fish fry eaten is from Vinal Edward's notes at Woods Hole.

[72] Maine has sometimes been given as its northern limit. But Doctor Huntsman writes us that in 1915 he obtained it in tide pools at Souris, Prince Edward Island; Needler (Proc. Nova Scotian Inst. Sci., vol. 20, 1940, p. 40) describes it as the common sculpin in Malpeque Bay, Prince Edward Island; Cox (Contrib. Canadian Biol. (1918-1920) 1921, p. 111) characterizes it similarly around the Magdalen Islands; Vladkykov and Tremblay (Nat. Canad., vol. 62, 1935, p. 80) report it from the estuary of the St. Lawrence, near Trois Pistoles; and Jeffers (Contrib. Canadian Biol. and Fish., N. Ser., vol. 7, No. 16, Ser. A; No. 13) (1932, p. 208) found two specimens on the beach at Raleigh, on the Newfoundland side of the Strait of Belle Isle.

Albatross II trawled 9 specimens 43–51 mm. long in 28 fathoms off the outer coast of Cape Cod abreast of Chatham, May 1, 1930. But it seems to be decidedly local in its distribution, for the only places where it has been definitely reported along the coast between Cape Ann and the Bay of Fundy is Casco Bay, nor have we caught it in any of the harbors of Maine where we have fished. In any case, it is far outnumbered in the Gulf of Maine by the two larger sculpins to be mentioned next.

Importance.—Because it is so small the grubby is of no commercial value. But wherever it is common it is something of a nuisance to anglers fishing for flounders and cunners, for it bites as greedily at any bait as do its larger relatives, and it serves as a source of food, no doubt, for more important fishes.

Shorthorn sculpin *Myoxocephalus scorpius* (Linnaeus) 1758 [73]

DADDY SCULPIN; BLACK SCULPIN; GREENLAND SCULPIN

Jordan and Evermann, 1896–1900, as *M. scorpius* and *M. groenlandicus*, p. 1974.

Description.—The shorthorn sculpin, with its large flat head, vast mouth, weak tapering body, bat-like pectorals, and insatiable appetite, typifies the sculpin race in northern seas. It has a longitudinal ridge with 3 knobs or spines running along each side of its crown; also about 6 (sometimes 5 or 7) short triangular bluntish spines on each side of the cheek between snout and gill opening, the uppermost of these less than twice as long as the one below it, and reaching not much more than halfway to the edge of the gill cover. And there is a short but sharp spine at the upper corner of each gill cover, pointing rearward and lying on a flap of skin, besides two thornlike spines on each shoulder close behind the upper corner of the gill cover.

There is a pore, or small slit, piercing the soft skin low down on each side of the throat close behind the last gill arch, easily seen on large specimens and detectable even on small ones on close examination.

The very large eyes are at least as wide as the space between them, set high up on the sides of the head with the upper edges close to the dorsal profile, and they are directed a little upward as well as outward. The two parts of the dorsal fin are entirely separated by a deep notch, but there is no gap between them. The forward part has 9 to 11 spines, the rear part about 16 or 17 (sometimes 15) soft rays, the longest of which are only a very little longer, if any, than the longest of the spines, each measured from base to tip. The anal fin, with 13 to 14 rays, is similar to the second dorsal in shape, but a little smaller; it originates about under the fourth or fifth soft

[73] Placed in the genus *Acanthocottus*, Girard, 1849, by Jordan, Evermann, and Clark, Rept. U. S. Comm. Fish. (1928), Pt. 2, 1930, p. 386.

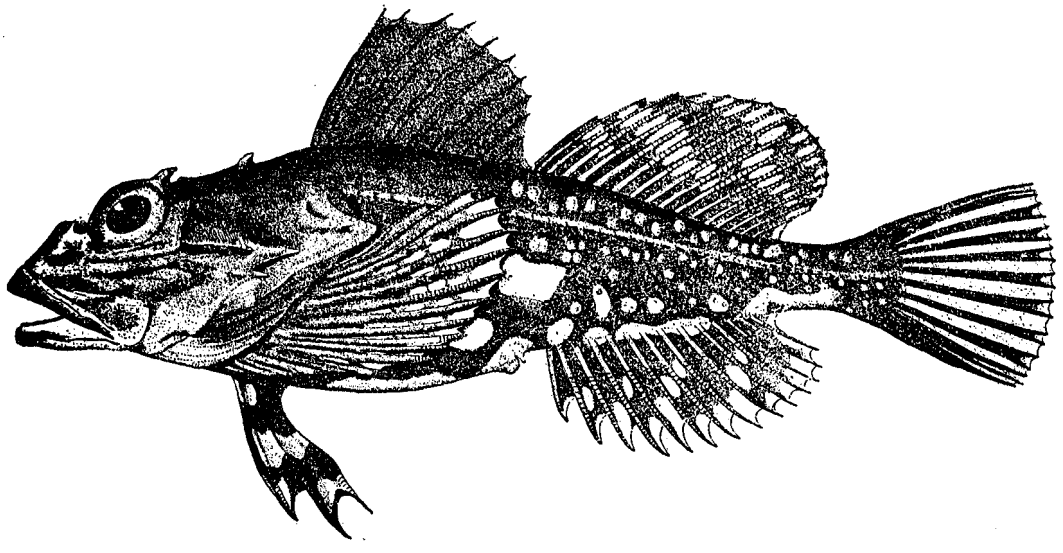

FIGURE 229.—Shorthorn sculpin (*Myoxocephalus scorpius*), Eastport, Maine. From Goode. Drawing by H. L. Todd

dorsal ray. The caudal fin is small, its rear margin weakly rounded; the fanlike pectorals, of 17 or 18 rays, reach back about as far as the vent. On large specimens the dorsal, anal, and pectoral fins are rather noticeably thick and fleshy. There are two series of prickly plate-like scales along each side of the body, one above the lateral line, the other below it.

Males and females differ in appearance, the former being the more slender, with higher fins, and the more brightly colored. Each of the scales, too, along the lateral line bears three or more prickles in males, but only one or two at the most in females, while some of the latter have no scales. Furthermore, the inner edges of the rays of the pectoral and ventral fins are armed with teeth or prickles on the males but not on the females.

Color.—The basic hue of the upper parts is usually of some shade of brown, ranging from a warm reddish tint to almost black, with the top and sides of the head marked with pale blotches and the back and sides of the body with broad dark bars on individuals on which the ground tint is pale. The lower parts of the sides are more or less spotted with yellow. The belly is whitish or yellowish in females, usually reddish orange with large round white spots in males, this being a good field mark for distinguishing the sexes. The dorsal fins are mottled dark and pale, the second dorsal often marked with 3 or 4 definite crossbars, and the caudal fin with various dark mottlings. The rays of the pectoral and anal fins are yellow with 2 or 3 irregular dark crossbars on many specimens, but they are uniformly dark in some. Males are more brightly colored than females in the breeding season, when their red and yellow tints become very brilliant, and when an intensification of the red or coppery ground color of the belly brings out the white spots more clearly than at other seasons.

Variability.—European studies have shown this to be a highly variable species, tending to break up into local races. Whether this is equally true of it on our side of the Atlantic is not known.[74]

Size.—This is the largest Gulf of Maine sculpin. It has been said to grow to a length of about 3 feet, but the average run of the adults taken in our Gulf is only about 8 to 14 inches, the longest not more than 2 feet. This species increases in size from south to north, Greenland fish averaging much larger than those taken off New England or off the Maritime Provinces.

Remarks.—Young shorthorns, up to 6 or 7 inches long, resemble the little grubby (p. 443) so closely that they are likely to be confused with it. Points of difference are that the shorthorn has at least 13 or 14 rays in its anal fin, and has a pore piercing each side of the throat close behind the last gill arch, the grubby only 10 or 11 anal rays, and no such pores.

Larger specimens of the shorthorn could hardly be mistaken for any other Gulf of Maine fish, unless perhaps for the longhorn sculpin. And even a cursory look is enough to separate one of these from the other, the upper cheek spine being less than twice as long as the one below it, and not reaching more than halfway to the edge of the gill cover in the shorthorn, but about four times as long as the one below it in the longhorn, and reaching back at least as far as the edge of the gill cover.

Habits.—Bays and the vicinity of ledges that rise from comparatively smooth bottom in shoal water are the chief haunts of the shorthorn sculpin. And it is found indifferently there, on mud, sand, or pebbles, on bare bottom or among weeds. Many are also caught off piers and along our rocky shores by cunner fishermen. Off our coasts, the great majority live shoaler than 10 fathoms. And while a day's fishing on any of the ledges northward and eastward from Cape Cod is likely to yield an occasional shorthorn among other fish, few are caught on long lines set deeper than 15–20 fathoms. The deepest records for it in American waters of which we know are 50 fathoms near Campobello Island, at the mouth of the Bay of Fundy (reported by Huntsman), and 57 fathoms in the northern part of the Gulf of St. Lawrence, just within the Strait of Belle Isle.[75]

This is a cold-water fish. Even in summer it is the most plentiful at localities and at depths where the temperature is lower than 55°–60° F. In winter it endures temperatures close to the freez-

[74] Most American ichthyologists recognize two subspecies of this fish the true "shorthorn" (*scorpius*) and the "Greenland sculpin" (*groenlandicus*) And with the prevailing tendency to call American and European fish by different names it is as the latter that our local sculpin has usually been recorded. But the differences between the two (size, relative breadth of the top of the head, and length of the dorsal fin spines) are so very slight and all of them have proved so variable, that we follow Huntsman (Contrib. Canadian Biol. (1921) 1922, p. 64) in uniting the two; the more willingly since both forms have been found on both sides of the Atlantic.

[75] Rept. Newfoundland Fish. Res. Comm., vol. 1, No. 4, 1932, p. 108, sta. 45.

ing point of salt water. We have never heard of one taken in brackish water, at least on our side of the Atlantic. It is a sluggish fish, often to be seen lying motionless, and as a rule, it hugs the bottom so closely that it is hard to tempt one to rise as much as a few feet by dangling a bait over it. Neither does it come to the surface voluntarily, though the surface may drop to the sculpin on the ebbing tide.

Sculpins usually swim slowly with undulating motion, spreading their great pectoral fins like bat's wings. As a rule, they move only a little way when disturbed, but on occasion they can dart ahead with folded "wings."

They are among the most voracious fishes, feeding chiefly on crustaceans, particularly on crabs, of which they are often full, on shrimps, sea urchins, and worms; on the fry of various other fishes; rarely on shellfish. And they are eager scavengers of any kind of refuse, congregating about fish wharves and lobster cars to feast on the debris. Like all sculpins they bite on any bait, and so greedily that we have caught one time and again, thrown it back, and seen it bite again almost as soon as fresh bait reached bottom.

The shorthorn has been described as hiding in dark crevices or among weeds by day, to emerge at night. This, however, has not been our experience, nor did Gill [76] find it doing so at Grand Manan.

This fish, like the longhorn sculpin, grunts or gurgles when drawn out of the water, particularly when handled, and it is also known to grunt in the water.

We must turn to European sources for the breeding habits of this sculpin, little attention having been paid to this phase of its life by American ichthyologists.[77] The spawning season is from November to February, both about Woods Hole and in north European waters, with the chief egg production in December, which no doubt applies equally to the Gulf of Maine. At this season the adult sculpins have been described as gathering in schools on sandy or weedy bottom, with the females greatly outnumbering the males.

Discussion has centered about the manner in which the eggs are fertilized, it being generally agreed that this takes place externally as a rule, but that they may be fertilized within the body of the mother in some parts of the Baltic Sea. In either case, the eggs sink [78] and stick together in irregular spongy masses through which the water circulates, and which retain considerable moisture even if they are left bare by the ebbing tide, as often happens. These egg masses are deposited on sandy bottoms, in pools in the rocks, among seaweeds, or in any crevice or hollow, in a tin can, for instance, or in an old shoe. Sometimes the male makes a nest of seaweed and pebbles, while he has been described as sometimes clasping the egg mass with his pectoral and ventral fins, and he has been photographed so employed.[79]

The eggs are of varying shades of red or yellow, 1.5 to 2 mm. in diameter. Incubation is so slow (occupying 4 to 12 weeks, according to temperature) that egg masses with advanced embryos have often been found as late in the spring as April or even May. Newly hatched larvae are about 7 to 8 mm. long. In a month they are 10 mm. long and the yolk sac has been absorbed. The young larvae soon rise to the surface, where quantities of them have been taken in tow nets in British waters in March, April, and May. By May and June some have grown to a length of 22 to 25 mm. They abandon their drifting life at about this size, or soon after, for the bottom, and they may be 38 mm. long by July, showing all the distinctive characters of the adult.[80] This timetable, compiled from European sources, probably applies equally to the Gulf of Maine, for larvae are found as early as February in the Bay of Fundy and thereafter throughout the spring.[81]

The subsequent rate of growth is not definitely known. But it is probable that this sculpin is 2 or 3 inches long by the end of its first summer, for we have taken a few 2-inch fish in late June on Nantucket Shoals, and 2- to 3¼-inch fish in late September off Boothbay Harbor, Maine. Most of them, it seems, do not mature sexually until they are at least 6 inches long.

General range.—One or another race of this wide ranging fish is known from Great Britain northward along the coasts of Europe; in Arctic seas

[76] Smithsonian Misc. Coll., vol. 47, 1905, p. 352.

[77] Gill (Smithsonian Misc. Coll., vol. 47, 1905, p. 352) gives a summary of its life history.

[78] Buoyant eggs taken in the tow net (Agassiz, Proc. Amer. Acad. Arts Sci., vol. 17, 1882, pl. 3) belonged to some other fish.

[79] Ehrenbaum, Wiss. Meeresuntersuchungen, Helgoland, Neue Folge, vol. 6, 1904, pl. 8.

[80] McIntosh and Masterman, Life-Histories of British Marine Food-Fishes, 1897, p. 129.

[81] Huntsman, Contrib. Canadian Biol. (1921) 1922, p. 64.

generally, including Spitzbergen, Nova Zembla, north Siberia, West Greenland, and northern Labrador; and southward along the American coast to southern New England; to New Jersey as a stray.

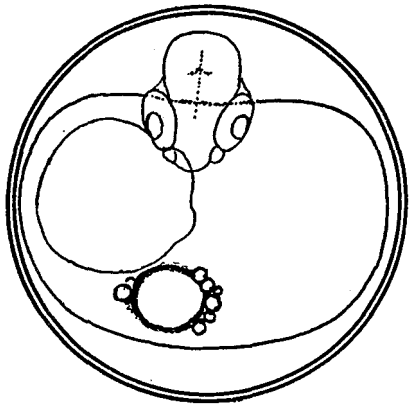

FIGURE 230.—Egg (European). After Ehrenbaum.

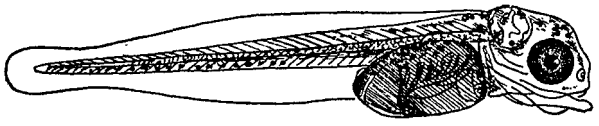

FIGURE 231.—Larva (European), 8.2 mm. After Ehrenbaum.

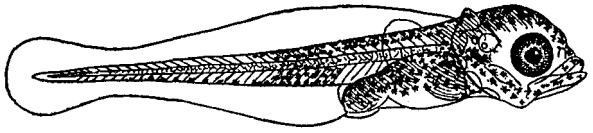

FIGURE 232.—Larva (European), 10 mm. After Ehrenbaum.

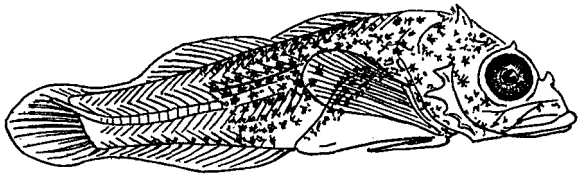

FIGURE 233.—Fry, 18 mm. After Ehrenbaum.

SHORTHORN SCULPIN (*Myoxocephalus scorpius*)

Occurrence in the Gulf of Maine.—This is one of the most familiar of our shore fishes, common all around the entire coast line of the Gulf of Maine; it is not so abundant as the longhorn sculpin (p. 449), but we doubt if there is a suitable situation, Cape Cod to Cape Sable, where some shorthorns are not to be found, except perhaps at the head of the Bay of Fundy.[82] But they do not run far up estuaries as a rule, and never into brackish water.

The shorthorn has not been reported positively either from Georges Bank or from Browns. Sculpins of some sort, it is true, are so common on the former that otter trawlers often catch from 20 to 100 per haul, and equally so on Browns Bank. But fishermen lump this and the next species together. Also the fact that the few positively identified on the banks have all proved to be longhorns, and the general predilection of the shorthorn for water shoaler than these offshore grounds, makes it doubtful whether it is to be found there in any numbers. Further evidence in this direction (if indirect) is that most of the shorthorns that were taken during the experimental trawlings of the Newfoundland Fisheries Research Commission were from hauls shoaler than 50 fathoms, only one from as deep as 57 fathoms.

Although it is more strictly confined to comparatively shoal water than the longhorn sculpin, the shorthorns are not often seen close to tide mark in summer, except in the Bay of Fundy where the temperature of even the uppermost few feet does not rise above 52°–54° in most summers, and where there are shorthorns of all sizes in very shallow water, in summer as well as at other times of the year.

On the other hand, the shorthorns living around the open shores of the Gulf show no tendency to avoid winter chilling by descending to greater depths in winter, In the Bay of Fundy, for example, where it is very common, Huntsman has characterized it as the only fish that remains near shore during the coldest part of the year; and it has been described as more plentiful along the shores of Massachusetts Bay in winter than in summer, as it certainly is south of Cape Cod. Certain shallow bays, it is true, such as Duxbury Harbor, where broad expanses of flats are exposed at low tide to heating by the sun in summer and to the formation of ice in winter, are an exception to this rule; i. e., the shorthorn sculpins tend to keep to the deeper channels through the coldest part of the winter as well as during the heat of midsummer. But we have found no evidence that they carry out any seasonal migrations more extensive than this. They are, indeed, among the most stationary of Gulf of Maine fishes.

[82] Huntsman found none there.

In Scandinavian waters this fish is said to vary widely in abundance from year to year, years of plenty alternating with longer periods of scarcity, but this does not seem to be the case to any noticeable extent in the Gulf of Maine where it is always common.

To the northward and eastward, the shorthorn is common all along the outer coast of Nova Scotia, in 10–30 fathoms, and it has been taken on Banquereau Bank. It has not been reported in the Magdalen and Prince Edward Island shallows in the southern side of the Gulf of St. Lawrence, where summer temperatures are high. But it is to be expected in that side of the Gulf in slightly deeper water, for it is known all along the northern shore of the Gulf, from Anticosti to the Strait of Belle Isle. We find no record of it on the Newfoundland Banks, probably because of the depth of water; neither is any definite information available as to its status along the south coast of Newfoundland. But it is recorded off the east coast, from the trawlings of the Newfoundland Fisheries Research Commission, and along the outer coast of Labrador, at Battle Harbor (just north of the Strait of Belle Isle);[83] at Rigolet in Hamilton Inlet;[84] in the vicinity of Nain;[85] at Fort Chimo, Ungava Bay, and it is widespread in the Hudson Bay region.[86]

[83] Specimen in Museum of Comparative Zoology.

[84] See Kendall (Proc. Portland Soc. Nat. Hist., vol. 2, Pt. 8, No. 13, 1909, pp. 213, 233) for records from outer Labrador.

[85] Kendall, Proc. U. S. Nat. Mus., vol. 38, 1910, p. 509.

[86] See Vladykov (Contrib. Canadian Biol., N. Ser., vol. 8, 1933, p. 30 [No. 2, p. 18], as *groenlandicus*) for localities where it has been taken in Hudson Bay, including James Bay.

Importance.—Although this is an edible fish and accounted a good one, its appearance and habits will probably close our markets to it as long as other fish are plentiful. Nevertheless, it once was of some commercial importance, being one of the best baits for lobster pots, for which purpose great numbers were speared formerly on the Massachusetts coast in spring, and were caught along the northern coast of the Gulf on hook and line. But very little use is made of them nowadays, if any.

Longhorn sculpin *Myoxocephalus octodecimspinosus* (Mitchill),[87] 1815

GRAY SCULPIN; HACKLEHEAD; TOADFISH

Jordan and Evermann, 1896–1900, p. 1976.

Description.—This fish resembles the shorthorn sculpin so closely that the description may be confined to the points in which it differs. Chief of these is the great length of its uppermost cheek spine, which usually is about four times as long as the spine just below, and which reaches at least as far back as the edge of the gill cover. This serves equally to distinguish the young longhorn from the grubby, which is short-horned. All the head spines, too, of the longhorn are so sharp that one must be cautious in grasping one of these fish, for it turns its spines rigidly outward by spreading its gill covers. Furthermore the long spines of the long horn are naked at the tip. The number and arrangement of the head spines

[87] Placed in the genus *Acanthocottus* Girard, 1849, by Jordan, Evermann, and Clark (Rept. U. S. Comm. Fish., (1928), Pt. 2, 1930, p. 386.

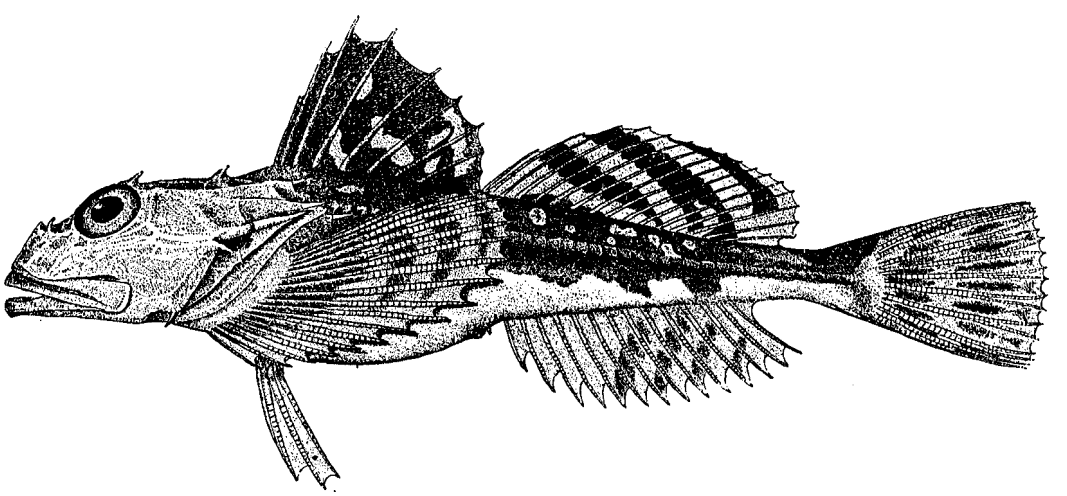

FIGURE 234.—Longhorn sculpin (*Myoxocephalus octodecimspinosus*), New Jersey. From Goode. Drawing by H. L. Todd.

is the same as in the shorthorn sculpin (p. 445), hence need not be described, and there are two thorns on each shoulder, with a larger one close above the origin of the pectoral fin. The first dorsal fin is higher than the second (in the shorthorn sculpin these two fins are of about equal heights), of rather different shape from that of the shorthorn (compare fig. 234 with fig. 229), and proportionately shorter than in the latter though with about the same number of spines (8 or 9).

The second dorsal fin and the anal have the same number of rays (15 or 16 dorsal and about 14 anal) as in the shorthorn; but the anal of the longhorn originates under the second or third ray of the second dorsal fin instead of under its fourth or fifth ray. The pectorals are of the fanlike form usual among sculpins. The lateral line of the longhorn sculpin is marked by a series of smooth cartilaginous plates instead of by prickly scales as it is in the shorthorn, a difference obvious to the touch; its body is more slender (about five and one-half times as long as it is deep); and its head is flatter.

Color.—The longhorn, like other sculpins, varies in color with its surroundings. The ground tint of the back and sides ranges from dark olive to pale greenish-yellow, greenish-brown, or pale mouse color, but is never red or black as the shorthorn so often is. As a rule it is marked with four irregular, obscure, dark crossbars, but these are often broken up into blotches and they may be indistinct. The coarseness of pattern often corresponds to that of the bottom, as does the degree of contrast between pale and dark. On mud and sand bottom this sculpin is often nearly plain colored, but when it is lying on pebbles with white corallines its back is often nearly white with dark-gray blotches, rendering it almost invisible. The first dorsal fin is pale sooty with pale and dark mottlings or spots; the second dorsal is paler olive with three irregular oblique dark crossbands; the caudal is pale gray; and the pectorals yellowish. Both caudal and pectorals are marked with 4 to 6 rather narrow but distinct dark crossbands. The anal is pale yellowish with dark mottlings; and there often is an obscure yellowish band along the lower part of the sides, marking the transition from the dark upper parts to the pure white belly.

Size.—This is a smaller fish than the shorthorn sculpin. It grows to a maximum length of about 18 inches, but only a few of them are more than 10 to 14 inches long. A 10-inch fish weighs about ½ pound, one 12 inches long about 1 pound.

Habits.[88]—Everyone who has fished along the shores of our Gulf is more or less familiar with this sculpin, for it is a nuisance to cunner and flounder fishermen. It often is bothersome to the angler to unhook when it spreads its needle-sharp spines and erects its spiny dorsal fin. It grunts when pulled out of the water and bites on any bait.

No doubt it is as omnivorous as the shorthorn. Specimens examined by Vinal Edwards at Woods Hole had fed chiefly on shrimps, crabs, amphipods, hydroids, annelid worms, mussels and sundry other mollusks, squids, ascidians, and on a considerable list of fish fry, including alewives, cunners, eels, mummichogs, herring, mackerel, menhaden, puffers, launce, scup, silversides, smelts, tomcod, silver hake, and small fry of other sculpins. Rock crabs (*Cancer irroratus*) and amphipod crustaceans (*Leptocheirus*) had been the dominant food of a large series of shorthorns in Block Island Sound, examined by Morrow; nearly all of them had eaten shrimps (*Crago*) but in small amount; a few contained small lobsters; and spider crabs (*Libinia*) were a regular article of diet in winter, but not in summer. It is interesting that these particular shorthorns had eaten only a few mollusks of any kind.[89]

The longhorn is as useful a scavenger as the shorthorn, and equally voracious, gathering about wharves, sardine factories, and under lobster cars, always keeping to the bottom. Its depth range is rather wider than that of the shorthorn. At the one extreme it is abundant in many shoal harbors and bays, where it comes up on the flats at high tide, to leave them at low; and it runs up into estuaries, salt creeks, and river mouths, though never into fresh water, so far as we know. At the other extreme it is caught in considerable numbers down to 50 fathoms or so, and it has been reported as deep as 105 fathoms.[90]

The longhorn evidently is at home in temperatures as high as about 65°–66°, for we have seen many of them in very shallow water that warm, or

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[88] Morrow (Bull. Bingham Oceanographic Coll., vol. 13, Art. 2, 1951) has recently published a detailed study of this sculpin, as found off southern New England.

[89] For more extensive diet lists see Morrow, Bull. Bingham Oceanographic Coll., vol. 13, Art. 2, 1951, pp. 60–61, 88–89.

[90] In Trinity Bay, east coast of Newfoundland, Rept. Newfoundland Fish. Res. Comm., vol. 1, No. 4, 1932, p. 108, Sta. 35.