even a little warmer, in summer in the southern side of Massachusetts Bay. But in localities where the temperature of the upper few feet rises much higher than this they withdraw to somewhat deeper (i. e., cooler) water for the summer (p. 452), working inshore again in the autumn.

At the other extreme, it is subjected for the coldest part of the year to water as cold as 32°–33°, both in our Gulf, along the Nova Scotian shelf, and in the Gulf of St. Lawrence, while it has been reported from water of 31°–32° F. (−0.3° C.) in the bottom of Trinity Bay, Newfoundland. And it seems that even exposure to freezing temperature may not be fatal to it, if not too prolonged, for we find no evidence that these sculpins are ever killed by cold when they are overtaken on the flats in severe freezes, a fate that occasionally overtakes cunners and tautog (pp. 475, 480). But the fact that the geographic range of the longhorn does not reach as far north as that of the shorthorn suggests that it is not so well suited as the latter is to very low temperatures continuing throughout the year.

Off the southern New England coast the shorthorn deposits its eggs from late November through January, and perhaps into February, i. e., at the coldest time of the year, with the chief production in late December and January.[91] Presumably the spawning season is the same in the Gulf of Maine. Apparently one locality serves as well as another, nor is there any evidence that any particular depth is sought.

Ripe eggs are about 0.85 mm. in diameter before being laid, but they swell when they come in contact with the water; they are described as varying in color, from coppery green to reddish brown, orange, or purple. A 12¾-inch female, which we examined, taken near Woods Hole on November 18, 1951, contained about 8,000 chocolate brown eggs. They sink and they are so sticky when first laid that they cling together in clumps, or to anything that they may touch; and they continue to adhere during the period of incubation, but the surfaces of the eggs that are exposed to the water lose their stickiness after about 24 hours. The egg masses have been found free on the bottom, in empty clamshells or other cavities, or among the branches of the finger sponge (*Chalina*) like the eggs of the sea raven (p. 456) [92] and they are sometimes found thrown up on the beach.

The young fry have been taken in February and March off southern New England, in April on the eastern part of Georges Bank and in the channel between the latter and Browns Bank. These young stages [93] have longer cheek spines than the corresponding stages of the shorthorn sculpin (p. 447) they are more slender, and they differ further in the outline of the dorsal fin, for in the longhorns (if our identifications be correct) this is continuous from end to end, only the largest of them showing a shallow notch between spiny and soft portions, whereas in the shorthorn the two sections are separate from the time the fin first takes definite form.

Captures of many young fry 1½ to 2 inches long in September, and 3 to 3½ inches long in February suggest that the longhorn is about 2 to 2½ inches long at one year of age. According to Morrow's studies (based on the otoliths)[94] longhorns off southern New England average about 6½ to 7 inches long at 2 years of age; about 10 inches at 4 years; and 11 to 12 inches at 6 years. They are mature sexually at 3 years or older.

General range.—Coastal waters of eastern North America from eastern Newfoundland,[95] and the north shore of the Gulf of St. Lawrence,[96] south regularly to New Jersey, and reported to the Atlantic coast of Virginia.[97]

Occurrence in the Gulf of Maine.—This is our commonest sculpin, to be caught anywhere and everywhere along the entire coast line of the Gulf of Maine. We dare venture that there is not a bay, harbor, estuary, or a fishing station from Cape Sable to Cape Cod where it is not to be found. Not only is it more plentiful in most places than its short-horned relative, but it occupies a wider depth zone. It is very abundant in many shoal harbors where it comes up on the flats; it is caught

[91] For the most detailed study yet made of the breeding habits of the shorthorn, see Morrow, Bull. Bingham Oceanographic Coll., vol. 13, art. 2, 1951, p. 30-36.

[92] Warfel and Merriman (Copeia, 1944, p. 198) were the first to report this interesting habit.

[93] The smallest larva we have seen was 13 mm. long, from Georges Bank.

[94] Bull. Bingham Oceanographic Coll., vol. 13, art. 2, 1951, p. 47, table 6.

[95] Trinity Bay, Newfoundland; Rept. Newfoundland Fishery Research Commission, vol. 1, No. 4, 1932, p. 108, sta. 35.

[96] Repeated characterizations of this sculpin as ranging to "Labrador" are based on Storer's (Boston Jour. Nat. Hist., vol. 6, 1852, p. 250) report of 2 young specimens from some point not specified on the northern shore of the Gulf of St. Lawrence.

[97] *Albatross II* trawled them in small numbers at 9 stations scattered along the midbelt of the shelf, from the offing of southern Massachusetts to the offing of Delaware Bay, in the months of February, April, July, and September, at depths ranging from 11 to 50 fathoms.

also in considerable numbers down to 50 fathoms or so (p. 450). We have trawled it at 27 to 33 fathoms in Massachusetts Bay, and at 50 fathoms off Cape Elizabeth. But it has not been reported from the basin at greater depths.

It also occurs plentifully on Georges Bank, and while the composition of the sculpin population of Georges Bank is yet to be determined, the facts that this was the only sculpin (except the sea raven which it greatly outnumbered) taken there on otter trawling trips in June 1912, or in September 1929, and that the dragger *Eugene H* took 1,030 of them in 35 trawl hauls on the southwestern part of Georges, at 25–35 fathoms (but none in deeper hauls) in late June 1951, are evidence that it is the commonest member of its tribe on shoal parts of the bank. It is fair, also, to assume that this applies equally to Browns Bank, where fishermen report sculpins of one sort or another as plentiful. It is described, also, as very common along the Nova Scotian coast and banks eastward from Cape Sable, in suitable depths, and as widely but irregularly distributed around the southern shores and islands of the Gulf of St. Lawrence.[98]

The longhorn is a year-round resident, in the sense that its only periodic movements are off and on shore, and of short extent, combined with movements to and from particular grounds. Near New York it is commonest near shore from September to May, and is seen only occasionally in summer. In Long Island Sound they appear to carry out east-west journeys about which little is known; in Block Island Sound (off the mouth of Long Island Sound) they are plentiful on the productive fishing grounds from November throughApril, but mostly withdraw thence during May (either offshore, or onto more rocky grounds nearby), not to return in force until the next October.[99] These shifts do not appear to be connected with temperature.

All that is known of its movements in the Gulf of Maine is that in partially enclosed and very shallow situations where the water on the flats heats to 68°–70° in the warmest part of the season, but where ice forms in the winter (Duxbury Bay, for example), the shorthorns seek slightly deeper (i. e., cooler) water for the summer, work up again onto the flats in early autumn; move deeper again in late autumn; then work back on the flats again in early spring. They continue common, however, right up to low tide line all summer in localities where the surface does not become so warm in summer or so cold in winter. This is the general rule northward and eastward around the coast of Maine, including the Passamaquoddy region.

The presence of longhorn sculpins of all sizes, from very young fry to adult, proves that they breed all along the coasts of Massachusetts and of Maine, probably along western Nova Scotia as well. But it seems to be restricted as a breeder in the Bay of Fundy to the Scotian side. Thus it appears that the half-grown and adult fish that are plentiful along the New Brunswick shore are migrants, either from the Nova Scotian side across the bay, or from the open Gulf outside.

Importance.—The only commercial value this sculpin has had in our Gulf was as bait for lobster pots, for which they were speared formerly in some localities, and caught on hook and line in others. But very few of them are now used in this way.

Staghorn sculpin *Gymnocanthus tricuspis*

(Reinhardt) 1832

Jordan and Evermann, 1896–1900, p. 2008.

Description.—This sculpin is easily distinguishable from its more common relatives by the shape of the uppermost of its three cheek spines, which is broad, flat, and with three short, sharp branches at its tip [1] instead of cylindrical and single pointed; also its anal fin (16 to 18 rays) originates well in front of its second dorsal fin instead of behind the latter, and its two dorsal fins are separated by a distinct space instead of being practically continuous at the bottom of the notch that separates them. Furthermore, the spines characteristic of the top of the head and shoulders of our other sculpins are either lacking on the staghorn or are very short, and the corners of its gill covers are rounded instead of sharp. Distinctive also, if less obvious, is the fact that the top of its head is more or less prickly or warty.

The 3-rayed ventral fins reach only about to the vent on young fry of 1¾ to 2 inches, but they

[98] Cox, Contrib. Canadian Biol. (1918–1920) 1921, p. 111; Leim, Proc. Nova Scotian Inst. Sci., vol. 20, 1940, p. 40.

[99] For further details see Morrow, Bull, Bingham Oceanographic Coll., vol. 13, art. 2, 1951, p. 54.

[1] These branches are only faintly indicated at the tips of the spatulate spines on young fry that we have seen, 1¾ to 2 inches long.

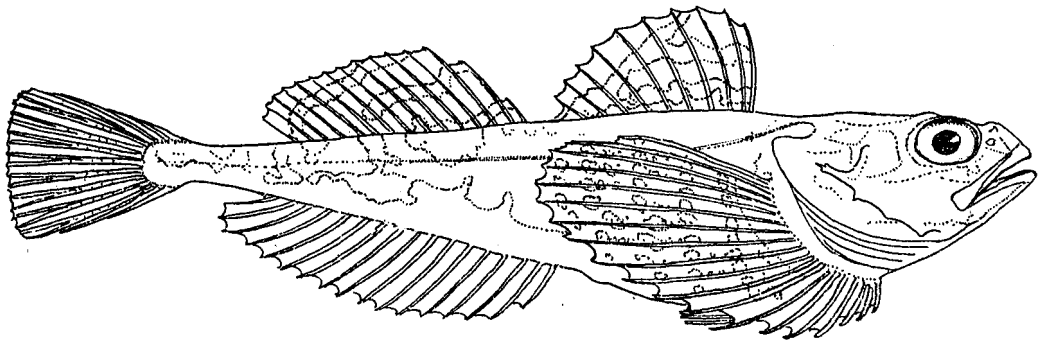

FIGURE 235.—Staghorn sculpin (*Gymnocanthus tricuspis*). After Smitt.

become relatively longer with growth until at maturity they reach considerably beyond the point of origin of the anal fin, farther in males of breeding age than in females.[2] The first dorsal fin has 11 or 12 spines; the second dorsal 15 to 17 soft rays. The caudal and pectoral fins and the general shape of the fish are of the usual sculpin type.

Color.—Described as dark brownish or gray above, the sides as marked with dark crossbands or with alternate light and dark greenish spots; the lower surface as white or yellowish with an irregular line of demarkation between dark sides and pale belly. The dorsal and pectoral fins are pale, the former with 3, and the latter with 4 or 5 irregular dark brown or black crossbands. The ventral and anal fins are yellow rayed, with membranes of the same color as the belly.

Size.—Up to about 10 inches long.

General range.—Arctic Ocean and North Atlantic, south to northern Norway on the European coast; on the American coast it ranges southward along the outer coast of Labrador[3] to the Gulf of St. Lawrence, where it is generally distributed along the north shore[4] and is characteristic of the icy water on the banks in the southern side, according to Huntsman, and it has been reported as far as Eastport, Maine, as a stray.

Occurrence in the Gulf of Maine.—The most southerly record for this Arctic sculpin, and the only one for the Gulf of Maine, is of a specimen caught at Eastport, Maine, in 1872, and now in the United States National Museum. It is only as a very rare stray from colder waters to the north that it ever reaches our Gulf.

Arctic sculpin *Cottunculus microps* Collett 1875

Jordan and Evermann, 1896–1900, p. 1992.

Description.—The head spines so characteristic of most sculpins, are reduced in this species to bony knobs, of which there are four on the top of the head and several on its sides. The two portions of the dorsal fin (spiny and soft) are united into one continuous fin, a feature that marks it off from all other local sculpins, while the spiny part (only 6 to 8 spines) is shorter and lower than the soft part (13 to 15 rays). But the very large bony head, wide mouth, slender tapering body, large fan-shaped pectorals, and the location of the ventrals below the pectorals, give the fish the typical sculpin aspect. The anal fin (about 10 rays) is a little shorter than the soft portion of the dorsal fin, and the caudal fin is small and rounded. The skin is roughened with small warts.

Color.—Described as pale with dusky crossbars, one on the head, two on the body and fins, and one at the base of the caudal fin. Scandinavian specimens have been reported as having still an other band across the tip of the caudal, and as with the anal and pectoral fins dark mottled.[5]

Size.—Up to about 8 inches long.

General range and occurrence in the Gulf of Maine.—This is an Arctic deep-water species, known off east Greenland and about Spitzbergen in the Arctic Ocean, and from both sides of the northern Atlantic. On the eastern side it has been reported from northern Iceland, from Norwegian waters southward to the Channel, and doubtfully from the Skagerak. Off the American coast it

[2] Small fry that we have examined from Saeglek Bay on the northeastern coast of Labrador, and an adult male from the estuary of the St. Lawrence River, agree with Smitt's (Scandinavian Fishes, vol. 1, 1892, p. 160 as *G. centralis*) account of a specimen from Spitzbergen.

[3] Presumably it also occurs all around the coasts of Newfoundland; but it is not included among the species listed as taken during the trawling cruises of the Newfoundland Fisheries Research Commission.

[4] Stearns, Proc. U. S. Nat. Mus., vol. 6, 1884, p. 125; Kendall, Proc. Portland Soc. Nat. Hist., vol. 2, No. 13, 1909, p. 213–214.

[5] Smitt, Scandinavian Fishes, vol. 1, 1892, p. 158.

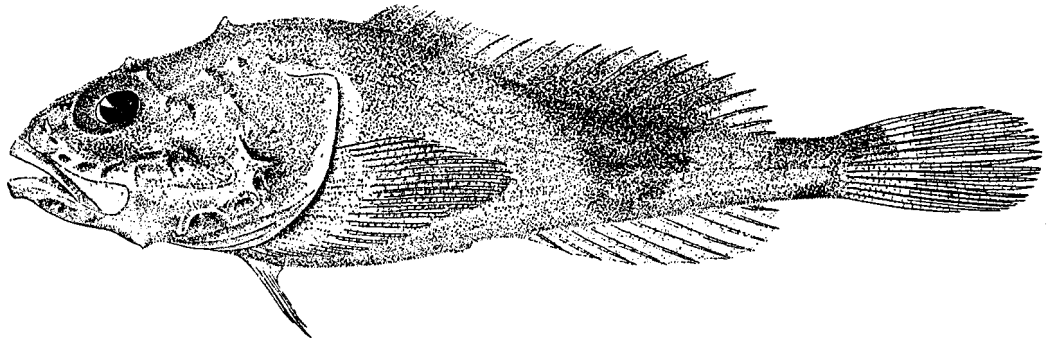

FIGURE 236.—Arctic sculpin (*Cottunculus microps*), continental slope off southern New England. From Goode and Bean. Drawing by H. L. Todd.

has been taken at numerous localities on the continental shelf and slope to abreast of New Jersey in depths of 122 to 487 fathoms. Only two of the earlier published records fall within the geographic limits covered by this report, one in the extreme southeast corner of the basin of the Gulf (latitude 42°23′, longitude 66°23′) in 141 fathoms, the other in the eastern channel between Browns and Georges Banks (latitude 42°15′, longitude 65°48′) in 122 fathoms. But we trawled one about 2 inches long, on the northern slope of Georges Bank, in 120 fathoms of water, on July 24, 1931, which (with earlier captures) shows that it is to be expected anywhere in the deep basin of our Gulf, at depths greater than 100 fathoms.[6] Nothing is known of its habits.

[6] Goode and Bean, Smithsonian Contrib. Knowl; vol. 30, 1895, p. 270, list the earlier American records.

Sea raven *Hemitripterus americanus* (Gmelin) 1789

RED SCULPIN; SEA SCULPIN; RAVEN; KING O'NORWAY

Jordan and Evermann, 1896–1900, p. 2023.

Description.—No one would be likely to confuse a sea raven with any other sculpin, for it is a "most remarkable looking fish," as Jordan and Evermann remarked.[7] It is stouter bodied than our other common sculpins, about three and three-fourths times as long as it is deep (counting caudal fin), with a very large head. Both the jaws of its wide mouth are armed with several rows of sharp teeth that are noticeably longer and stouter

[7] Bull. 47, U. S. Nat. Mus., Pt. 2, 1898, p. 2023.

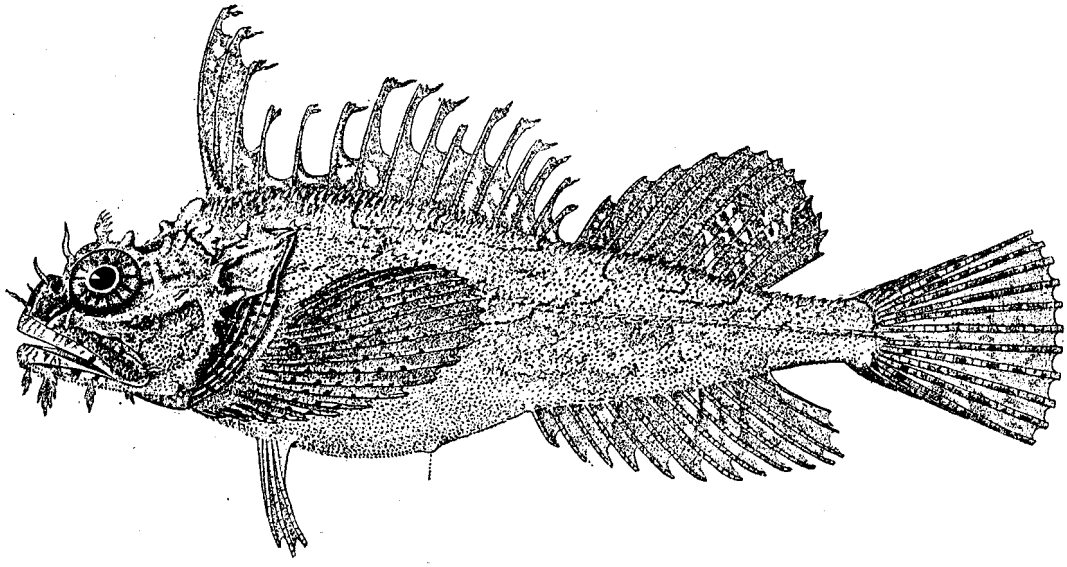

FIGURE 237.—Sea raven (*Hemitripterus americanus*), Halifax, Nova Scotia. From Goode. Drawing by H. L. Todd.

than the teeth of either the long-horned sculpin or of the short-horned sculpin. Its most distinctive features, however, which identify it at a glance, are the fleshy tabs, simple and branched, on its head; the curiously ragged outline of its first dorsal fin; and the prickly texture of its skin. There is a series of 4 to 8 of these tabs along each side of the lower jaw, three pairs on the top of the snout, and others, variable in number and size, above and in front of the eyes and along the upper jaw. There is also a short but high keel on the top of the snout with a deep hollow behind it, another high ridge above each eye, and a lower one below the eye. These ridges, with about 12 rounded knobs on the crown and several low bosses, and 2 short spines on each cheek, give the head a peculiarly bony appearance.

The first two or three spines of the first dorsal fin are the longest, and the fourth and fifth spines are shorter than those farther back, giving the fin an outline quite unlike that of any other sculpin. And the fin membrane is deeply emarginate between every two spines from the third spine backward, but expanded at the tip of each spine as an irregular flap of skin. The margin of the anal fin is similarly, but less deeply scalloped between the rays. Furthermore, the first dorsal fin originates further forward than in any other Gulf of Maine sculpin, i. e., well in front of the gill opening, and it is much longer (16 spines) than the second dorsal (1 spine and 12 rays), whereas in our other sculpins the second dorsal is longer than the first dorsal. The pectorals are fanlike, and the caudal brush-shaped, much as in other sculpins. The ventral fins are fleshy, each with 1 spine and 3 soft rays, with the first 2 rays so close that there seems to be only 1 soft ray.

The entire skin of the sea raven is prickly, belly as well as back, with the prickles largest on the back and along the lateral line; smallest, but still obvious to the touch, on the lower parts of the sides and on the belly. In all other Gulf of Maine sculpins the belly is smooth.

Color.—The sea raven varies in color from blood red to reddish purple, chocolate, or to yellowish brown, but it is invariably paler below than above, and it usually has a yellow belly. Many are plain colored. For instance, one 18 inches long, which we caught off Mount Desert recently, was uniform red chocolate on back and sides. But others are variously mottled with a paler or darker cast of the general ground tint, or even with white. The fins are variously barred with light and dark, and the pectorals and anal often are yellow-rayed.

Size.—One of the largest on record, of 25 inches and 5 pounds, is mentioned by Storer. But this specimen seems to have been in poor condition for we have caught one 22½ inches long that weighed 7 pounds. Warfel and Merriman [8] mention one about 19½ inches long that weighed 5.8 pounds inflated with water and 5.3 pounds when emptied. And many sea ravens are 18 to 20 inches long.

Habits.—The sea raven alone, among Gulf of Maine sculpins has the power of inflating its belly with water, like a bladder. If released in this condition it drifts helplessly, feebly waving its tail to and fro, and we cannot say whether it can empty itself again at will like a puffer (which, however, inflates with either air or with water, p. 526) or whether it must await the gradual escape of the water it has swallowed. Another way in which the raven differs from our other sculpins is that it can bite sharply, having larger teeth.

The raven is quite as voracious as its relatives; it takes any bait and is said to eat whatever invertebrates it finds on the bottom, such as mollusks (both bivalve and univalve), various crustaceans, sea urchins, and worms. Sea ravens also eat fish. Vinal Edwards found herring, launce, sculpins, tautog, silver hake, and both sculpin and sea-raven eggs in sea ravens taken at Woods Hole.

Our own experience, confirmed by our various inquiries, is that ravens are to be caught only on rocky ground (which is their chief haunt from Massachusetts Bay northward), pebbles, hard sand, or clay (which they frequent off Cape Cod and on the offshore Banks), never on soft sticky mud. There is no definite upper limit to their vertical wanderings other than the surface. But they are seldom caught within the smaller estuaries, perhaps never on the tidal flats at any time of year; at least we have never seen them in such situations in Massachusetts Bay, though they are not uncommon there about the off-lying ledges. The majority of them live deeper than a couple of fathoms at all times. On the other hand their usual range extends down only to about 50

[8] Copeia, 1944, p. 204.

fathoms, although one has been taken as deep as 105 fathoms.[9]

The geographic and vertical ranges of the sea raven suggest that the upper limit to its preferred temperature is about 58°–60°. At the other extreme their wide dispersal over the Magdalen Shallows in the southern side of the Gulf of St. Lawrence shows that they can winter in temperature close to the freezing point of salt water, unless they descend then into considerably deeper water, a possible shift in depth on their part of which there is no direct evidence.

Presumably the sea raven breeds throughout its geographic range. Off southern New England the eggs are deposited from early October (earliest date, October 2) on until late December; probably in autumn and early winter in the more northern part of its range as well.[10] Warfel and Merriman, who made a special study of the breeding of the sea raven, have made the very interesting discovery that it deposits its eggs chiefly at the bases of the finger-like branches of the finger sponge (*Chalina*); less often on the smaller sponge *Halichondria*, where they stick together in clusters and to the sponge. Since the eggs average only about 242 per cluster (minimum 141, maximum 478, among many clusters counted), whereas adult females contain something like 15,000 maturing eggs on the average, and occasionally as many as 40,000, it appears that a female does not lay all her eggs at one time, but deposits many clusters during each spawning season.

The eggs are large, averaging 3.9 to 4 mm. in diameter, with tough egg membrane, yellow when first spawned, but soon changing to an amber hue; so heavy that they sink; and very sticky and resistant to injury.[11] Eggs brought in to the laboratory by Warfel and Merriman hatched a few at a time, and some of those of a cluster collected on January 23 and left thereafter in a bottle fastened to a buoy (i. e., in the normal winter temperature of Long Island Sound) did not hatch until March 12.

The sizes of the few young sea ravens that have been taken in the Gulf of Maine suggest that they reach a length of 2 to 4 inches by the middle of their first summer, when 6 to 8 months old, and about 6 inches by the following April, at an age of 1½ years. Their subsequent rate of growth has not been followed.

General range.—Atlantic Coast of North America, southward to Chesapeake Bay; north to Anticosti in the northern side of the Gulf of St. Lawrence, to the Strait of Belle Isle on the Newfoundland side [12] and to the Grand Banks.[13]

Occurrence in the Gulf of Maine.—Sea ravens are to be caught all around the coastal belt of the Gulf, from a fathom or two down to about 50 fathoms, including the passages among the islands that fringe the coasts of Maine and of Nova Scotia, as well as the larger estuaries such as St. Mary, Passamaquoddy, Machias, Penobscot (it runs up the latter to the head at Bucksport), and Casco Bays; also in the deeper harbors, for example Boston, Salem, Eastport, and St. Johns. Fishermen also report them on Cashes Ledge, while the otter trawlers and long liners pick them up in small numbers over the shoaler parts of Georges Bank; likewise on Browns. But they are not known to occur on the soft mud bottoms of the deep troughs and basin of the Gulf.

Presumably the sea raven breeds in the Gulf wherever it occurs, young fry having been taken from the Bay of Fundy to Cape Cod.

Off the southern shores of New England sea ravens work inshore in autumn and out again into slightly deeper water in spring, but no seasonal movement of this sort (which means merely that shoal water is too warm for their comfort in summer) has been reported for them in the cooler waters of the Gulf of Maine.

Although they are distributed so generally in the Gulf, sea ravens are not so numerous as the shorthorn sculpins and longhorn sculpins; this is as true in the Bay of Fundy as it is in Massachusetts Bay, where one expects to catch a few ravens around any of the fishing ledges, but where it would be unusual for one person to land any considerable number in a day. Similarly, the schedules of the catches made by certain otter

[9] A specimen about 14 inches (360 mm.) long was trawled by the U. S. Fish and Wildlife vessel *Delaware* August 24, 1951, in 105 fathoms, latitude 42°06′ N., longitude 67°50′ W.

[10] Warfel and Merriman (Copeia, 1944, p. 202) probably were correct in their suggestion that a 20-inch female, containing ova of 2 sizes, caught by us off Boothbay, Maine, in April, was simply one that had failed to spawn at the proper time during the preceding winter.

[11] Described by Bean (Bull. 60, New York State Mus., Zool. 9, 1903, p. 647). The buoyant eggs referred to this species by Agassiz and Whitman (Mem. Mus. Comp. Zool., vol. 14, No. 1, 1885, p. 10) belonged to some other fish.

[12] Jeffers (Contrib. Canadian Biol. N. Ser., vol. 7, No. 16, (Ser. A, No. 13,) 1932, p. 208).

[13] Bean (Proc. U. S. Nat. Mus., vol. 3, 1881, p. 86) lists a specimen from the Grand Banks.

trawlers in 1913 and subsequently, added to our trawling experiences, show that sea ravens are much less numerous on Georges Bank than the longhorn sculpin; it is seldom that as many as a dozen are taken in a haul of the otter trawl. Thus the dragger *Eugene H* took only 46 sea ravens in 38 hawls on the southwestern part of Georges, at 26–55 fathoms in late June 1951, and none in her deeper hauls.

To the eastward and northward sea ravens are described as common all along outer Nova Scotia to Canso; they have been reported on Sable Island Bank and on Banquereau Bank in depths of about 20–30 fathoms; and they are taken here and there on the Gulf of St. Lawrence coast of Cape Breton. They are also reported from Anticosti and in the Strait of Belle Isle (footnote 12, p. 456); but there cannot be many of them in the southern side of the Gulf, for they are not mentioned in the published lists of Fishes for Prince Edward Island, or around the Magdalens. And there is only one report of a sea raven on the Grand Banks (see footnote 13, p. 456); and one for the Atlantic coast of Newfoundland, i. e., from Trinity Bay.[14]

To the westward and southward the sea raven is reported as rather common as far as New York and New Jersey; and it has been reported from Chesapeake Bay.[15]

Commercial importance.—Although the sea raven is said to be a good table fish there is no more market for it than for other sculpins in New England or Canada. But it is generally considered excellent bait for lobster pots, hence shore fishermen are likely to save what ravens they catch for this purpose.

ALLIGATORFISHES. FAMILY AGONIDAE[16]

These curious little fishes are related to the sculpins anatomically, though their general appearance gives no hint of the fact. Their most striking external feature is that the body is armed with several rows of overlapping plates. The only Gulf of Maine species somewhat suggests a pipefish in this and in its slender form, but there is no danger of confusing one with a pipefish, for its mouth is of the ordinary form; and it has ventral fins. Some agonids have a spiny dorsal fin which others lack, while the ventral fins are situated far forward (only a little rearward of the pectorals) in all of them. Twenty-six of the many species included in the family are known from the western coast of North America from Bering Sea to southern California; two are known from the eastern coast of North America.

One of the eastern American species (*Leptagonus decagonus*, Bloch and Schneider 1801), with two dorsal fins, is Arctic, ranging southward only to northern Nova Scotia;[17] the other, with only one dorsal fin (*Aspidophoroides monopterygius*) is a regular member of the Gulf of Maine fish fauna (p. 457).

Alligatorfish *Aspidophoroides monopterygius* (Bloch) 1786

SEA POACHER

Jordan and Evermann, 1896–1900, p. 2091.

Description.—The readiest field marks for the identification of this curious little fish (so odd in appearance that it is not likely to be mistaken for any other) are that its entire head and body are clad with bony plates; that it has only one dorsal fin (the soft rayed); and that it is very slender (about 12 to 13 times as long as it is deep, not counting the caudal fin), rather broader than deep, and tapering rearward from the head to a very slender caudal peduncle. The plates are smooth, arranged in longitudinal rows. There is a double row along the back running from close behind the head to close behind the dorsal fin where it unites into a single mid-dorsal row (altogether 45 to 50 double and single plates along the back); three rows on the forward part of each side, but only two rows along the rear part; and two rows along the lower surface to just behind the anal fin, where they unite in one row. Thus the trunk is octagonal in front of the unpaired fins, but hexagonal behind

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

[15] Jordan, Evermann and Clark's (Rept. U. S. Comm. Fish. 1928 part 2, 1930, p. 393) reference of it to the Tortugas seems to have been an error.

[16] Some recent authors separate this group into two families, Agonidae or Sea Poachers for those with two dorsal fins, Aspidophoroididae or Alligatorfishes for those with only one dorsal fin. But it seems preferable, for the purposes of the present volume, to follow the older custom of uniting them in the one family Agonidae.

[17] A young specimen has been reported from Banquereau Bank (Rept. Newfoundland Fish. Res. Comm., vol. 2, No. 1, 1933, p. 127) as *Agonus decagonus*.

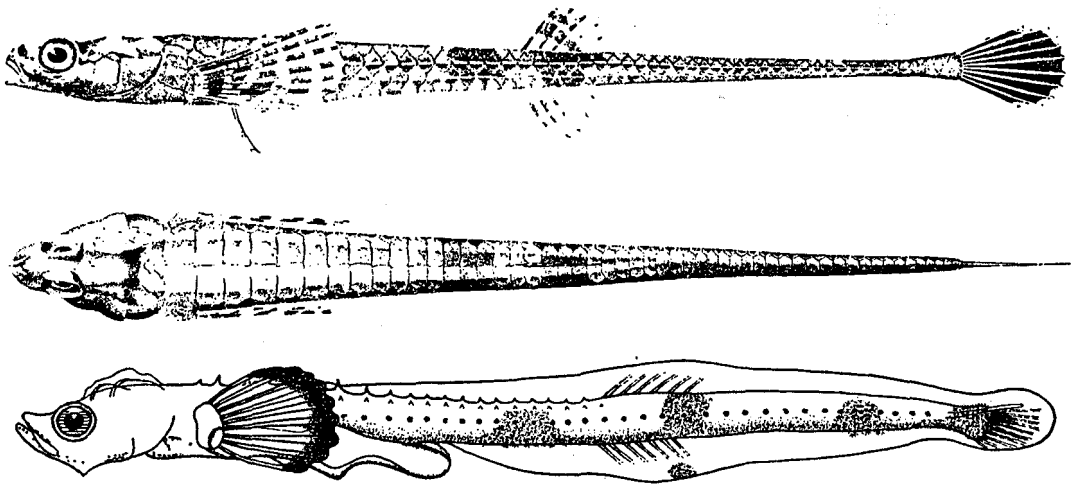

FIGURE 238.—Alligator fish (*Aspidophoroides monopterygius*). Top and center, adult, side and dorsal views, Halifax, Nova Scotia; from Jordan and Evermann, drawing by H. L. Todd. Below, larva, 11 mm. long, Gloucester, Mass.

them. There are likewise two large plates and several small ones in front of each pectoral fin. The eyes are very large, with prominent ridges above them, and there are two sharp recurved spines on the top of the nose. The mouth is small with minute teeth. The dorsal and anal fins (each of five or six rays) are fanshaped, one over the other, and are situated about midway of the trunk. The caudal fin is small and rounded, the pectorals are larger than the anal, dorsal, or caudal fins, and the ventral fins are reduced to one spine and two rays each.

Color.—The many specimens we have seen have been dark brown above, lighter brown below, with two darker cross bands between the pectoral fins and the dorsal fin; one cross band under the dorsal, and two or three cross bands between the dorsal and caudal fins. The dorsal and pectoral fins are more or less barred; the caudal is dusky.

Size.—Five to seven inches long when full grown.

Habits.—Nothing whatever is known of the life of the alligatorfish except that it is a bottom fish and that it has been repeatedly found in the stomachs of cod, haddock, and halibut although it is not "much thicker or softer than an iron spike." [18] The *Grampus* and the *Albatross II* have trawled it both on pebbly bottom, on sand and broken shells, and on soft mud. So far as known adults never stray into water shoaler than 10 to 15 fathoms, and the deepest record for it, with which we are acquainted, is from 104 fathoms.[19] Its range shows that it is a cold water fish. Its upper temperature limit is about 50°–52°; its lower limit close to the freezing point of salt water. Its breeding habits are unknown. Probably its eggs sink like those of sculpins.

The presence of its larvae in Passamaquoddy Bay, off Boothbay, and near Seal Island, Nova Scotia, from April to June, points to late autumn and early winter as the spawning season. It does not take to the bottom until of considerable size, for we have taken young ones as long as 29 mm. in our towings.[20]

General range.—From west Greenland and the east coast of Labrador southward to Cape Cod, and to northern New Jersey as a stray.

Occurrence in the Gulf of Maine.—Being of no interest to fishermen, and living too deep to strand on the beach, this fish is seldom reported. It has been taken in the Bay of Fundy in 15 to 100 fathoms; in the inner part of Passamaquoddy Bay; near Eastport; off Mount Desert in 60 fathoms; off Monhegan; near Portland; in 30 fathoms off Casco Bay; on Cashes Ledge; in Ipswich Bay; off Gloucester, Nahant, and Boston in Massachusetts Bay; off Provincetown; off Chatham; and in the South Channel to the eastward of Cape Cod. Evidently it may be expected anywhere in the Gulf in depths of 10 to 100 fathoms, and perhaps deeper.

Goode and Bean [21] described it as "abundant" in the deeper parts of Massachusetts Bay, but our

[18] Goode, Fish. Ind. U. S., Sect. 1, 1884, p. 258.

[19] Southeastern slope of Browns Bank, latitude 42°20′ N; longitude 65°08′ W; Goode and Bean Smithsonian, Contrib. Knowl., vol. 30, 1895, p. 284.

[20] Bigelow, Bull. Mus. Comp. Zool., vol. 61, 1917, p. 272.

[21] Bull. Essex Inst., vol. 11, 1879, p. 13.

experience on the *Grampus* suggests "not uncommon" as a better description, for our largest catches were 8 specimens from 32 fathoms in Ipswich Bay; 6 specimens from 27 fathoms in the inner part of Massachusetts Bay; and 14 specimens off Chatham, in May 1930, from 28 fathoms.

Other recent catches in various parts of the Gulf have been of 1 or 2 fish each. And the fact that we found it at only 4 out of our 10 trawling stations of 1912 (all in the western part of the Gulf) is in line with Huntsman's statement that it is found only occasionally in the Bay of Fundy.

It is perhaps more plentiful along the Nova Scotian shelf eastward and northward from Cape Sable.[22] It is numerous enough in the southern part of the Gulf of St. Lawrence for Huntsman [23] to describe it as "characteristic" of the ice-cold Banks water there; it has been reported in the estuary of the St. Lawrence River near Trois Pistoles; [24] and at several localities along the west coast of Newfoundland. It is so widespread over the eastern half of the Grand Banks, along eastern Newfoundland, and off southeastern Labrador that it is listed at 14 stations there from the experimental trawlings of the Newfoundland Fisheries Research Commission,[25] and is reported from Hamlton Inlet.[26]

The only records of it to the westward of Cape Cod are of the head of one that was dredged off Watch Hill, N. J., in 1874; [27] and of one that was taken off Sandy Hook, N. J., in 1864.[28]

THE LUMPFISHES. FAMILY CYCLOPTERIDAE

The lumps are characterized among Gulf of Maine fishes by their short, thick, high-arched bodies; by having a bony sucking disc on the chest with the very much reduced ventral fins at its center; and by the fact that the skin is set with tubercles.

KEY TO GULF OF MAINE LUMPFISHES

1. The body is roughly triangular in end view; the large tubercles on each side are in widely separated rows; the lower end of each gill opening is below the level of the upper edge of the base of the corresponding pectoral fin; the head (measured to the upper edge of the bases of the pectoral fins) occupies only about one-fourth of the length of the trunk; the first dorsal fin is entirely concealed within the skin after the fish is 2–3 inches long_____ Common Lump Fish, p. 459
2. The body is nearly round in end view; the large tubercles on each side are close set, in irregular pattern; the lower end of each gill opening is considerably above the level of the upper edge of the base of the corresponding pectoral fin; the head (measured to the upper edge of the bases of the pectoral fins) occupies about one-third of the length of the trunk; the first dorsal fin (though more or less fleshy) continues exposed throughout life_____ Spiny Lumpfish, p. 463

Lumpfish *Cyclopterus lumpus* Linnaeus 1758

LUMP; LUMP SUCKER

Jordan and Evermann, 1896–1900, p. 2096.

Description.—The lumpfish is about twice as long (counting its caudal fin) as it is deep, with a short head, and the dorsal profile of its trunk is much more arched than the ventral. There are 7 longitudinal ridges on its body. One of these ridges runs along the back as a cartilaginous flap that incloses the first dorsal fin in adults and that continues rearward as 2 ridges from the first dorsal fin to the second dorsal fin. There also are 3 ridges along each side, one of them over the eye, one close above the level of the pectoral fin, and one marking the line of transition between side and belly. Each of these ridges is marked by a line of large pointed tubercles, and the entire skin between the ridges is thickly studded with small knobs. The presence of these ridges makes the trunk of the lumpfish roughly triangular in end view, with flat belly (except when swollen by milt or roe) and sharp back, but the caudal peduncle is rounded. The profile of the head is characteristic, being concave above, convex below, with mouth at the tip of the snout. The teeth are small and the eyes and gill openings of moderate size.

The first dorsal fin (visible only on very small specimens) is of 6 to 8 spines. The second dorsal fin and the anal fin below it are alike in outline, both of them of 9 to 11 rays. The caudal is broad

[22] Vladykov and MacKenzie (Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 97) describe it as "very common" there.
[23] Trans. Roy. Soc. Canada Ser. 3, vol. 5, sect. 4, 1918, p. 63.
[24] Vladykov and Tremblay, Natural. Canad., vol. 62, 1935, p. 80.
[25] Annual Reports, Newfoundland Fisheries Research Commission, vol. 1, No. 4, 1932, p. 108; vol. 2, No. 1, 1933, p. 126; vol. 2, No. 2, 1934, p. 115.
[26] Kendall, Proc. Portland Soc. Nat. Hist., vol. 2, No. 13, 1909, p. 214.
[27] Goode and Bean, Smithsonian Contrib. Knowl., vol. 30, 1895, p. 284.
[28] Abbot, Geology of New Jersey, 1868, p. 816.

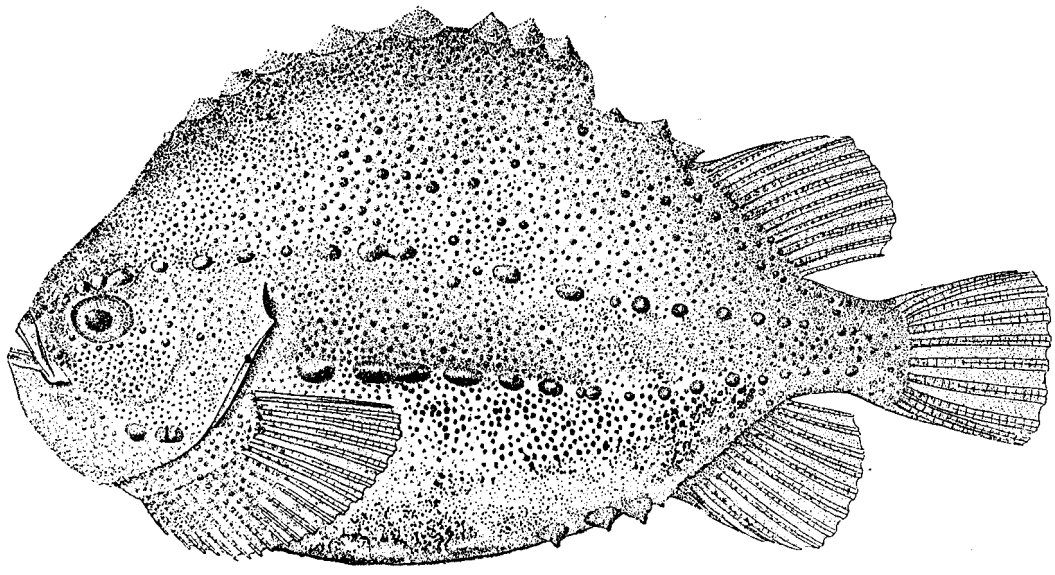

FIGURE 239.—Lumpfish (*Cyclopterus lumpus*), Eastport, Maine. From Goode. Drawing by H. L. Todd.

based and square tipped or slightly convex; the pectorals are large, rounded, and so broad based that they nearly meet on the throat, and they are larger on males than on females. The ventral fins are not visible as such, being altered into 6 pairs of fleshy knobs, surrounded by a roughly circular flap of skin. The entire disk, so formed, (sucking disk) is about as wide as the width of the head, and is situated close behind the throat.

Color.—Descriptions of this fish credit it with a great variety of tints, which we can corroborate. On adults the ground tint may be bluish gray, olive, brownish or yellow green, chocolate or kelp brown, or slaty blue, the belly usually being of a paler or more yellowish cast of the same hue, but sometimes whitish. On some specimens the back and sides are marked with dark blotches and more or less dotted with black. Others, however, are plain colored or nearly so, except that the tubercles are usually dark tipped. Young lumpfish (and it is with such that we are most familiar) often match their surroundings very closely in color, usually being mottled olive green and ochre yellow with silvery dots and stripings. Males, when mature, are more vividly colored than females, and their bellies turn red (brightest near the sucking disk) during the breeding season.

Size.—The longest lumpfish so far recorded from the American coast measured 23 inches, and weighed 13¼ pounds; the heaviest weighed 20 pounds but measured only 21½ inches (both from Orient, N. Y.), and the proportion of weight to length varies similarly in smaller fish. Few are longer than 14 to 16 inches, or heavier than 3 to 6 pounds while the largest we ourselves have seen was about 15 inches long.[29] Females average larger than males. Fulton, for example,[30] writes that 39 females taken in the Bay of Nigg (Scotland) averaged about 16 inches and 6 pounds, 30 males only 11 inches and a little less than 2 pounds.

Habits.—Although the lumpfish is ungainly, it can swim more rapidly for a short distance by vigorous tail strokes than its shape might suggest, and its young pelagic fry are very active. The adult lump is primarily a bottom fish, but is also made semipelagic by its habit of hiding in floating masses of rockweed. In European seas it ranges from tide mark down to 150–200 fathoms, but we have never heard of one taken in more than a few fathoms in the Gulf of Maine. Perhaps it is the nature of the bottom that restricts them there for the soft sticky mud that floors the deeper basins, at least in the western side,[31] can hardly be a favorable environment for them. Large lumpfish are often found hiding among rockweed or holding fast by the sucker to stones or other

[29] Smitt (Scandinavian Fishes, vol. 1, 1892, p. 294) gives 24 inches as the maximum for Scandinavian and European waters generally, apparently not accepting the enormous size (to 48 inches) credited to it by Möbius and Heincke (Vierter Bericht, Komm. wiss. Untersuch. deutschen Meere, Kiel, 1883, p. 226).

[30] Twenty-fourth Ann. Report, Fisheries Board Scotland, (1905) 1906, Pt. 3, p. 171.

[31] The eastern trough of the Gulf has a harder bottom.

objects. About Massachusetts Bay, lobster pots are favorite resorts for them when set on stony bottom. For instance, W. F. Clapp tells us that one pot in every 8 or 10 will yield a lumpfish on the broken ground off the entrance to Duxbury Harbor, and they often hold to the lower sides of lobster cars, probably for shade. Occasionally one is found clinging to one of the poles of a trap or weir, though this is a much less common event in the Gulf of Maine than it is in Scottish waters, where they are frequently caught in salmon nets set along shore. Welsh notes one entangled in a gill net set off Great Boars Head in April 1913; they have (rarely) been found clinging to floating logs or inside a floating box or barrel; sometimes they strand on the beach; and there is at least one record of a lumpfish clinging to a mackerel.

So far as known the only regular migrations carried out by the lumpfish are the involuntary drifts of its young fry at the surface, and a general movement of the adults into shoal water at spawning time followed by an offshore movement afterward.

The young fry swim at the surface, and we have taken them so often in our tow nets that we have learned to expect them wherever there are floating masses of rockweed (a refuge in which all but the smallest regularly hide, or to the fronds of which they cling).

Most of the lumpfish taken in tow nets or dipped up are less than 2 inches long, but large adults are sometimes seen at the surface; more often, perhaps, in the Bay of Fundy than elsewhere in the Gulf, their presence at the surface being determined less by the age of the individual fish than by the presence or absence of floating seaweed. However, most of the young lumpfish have left the surface by winter; indeed very few have been taken at any depth in the Gulf of Maine during the cold months,[32] but we picked up one on the surface off Lurcher Shoal on April 12, 1920, and another off Yarmouth, Nova Scotia, on January 4, 1921.

Food.—We have no first-hand information to offer as to the diet of the lumpfish. In British waters this has been found to consist chiefly of isopods, amphipods, and other small crustaceans, with various other invertebrates, including worms and soft-bodied mollusks. And its diet is much the same in the Gulf of Maine for Cox and Anderson[33] report euphausiid shrimps (*Meganyctiphanes*), fragments of jellyfish (*Aurelia*), amphipod crustaceans (*Hyperia*), caprellid crustaceans, with the remains of small fish in the stomachs of lumps from Passamaquoddy Bay. And large numbers of young clupeids have occasionally been found in their stomachs. This, too, is one of the few fish that regularly feed on ctenophores and on Medusae. Thus 25 specimens examined at Woods Hole by Vinal Edwards contained nothing but ctenophores. But lumps, like most other fishes, cease feeding during the spawning season. The lumpfish, in its turn, is said to be a favorite food of seals. Certainly it is so weak a swimmer that it would fall an easy prey to them.

In Scottish waters, where many observations have been made on the life of the lumpfish[34] spawning (and the corresponding inshore migration) takes place from February until near the end of May. And the evidence afforded by our tow nettings suggests an equally protracted spawning season in the Gulf of Maine, for while we have taken larvae 27 mm. long as early as May 10, we have taken newly hatched larvae (6 to 7 mm.) as late as June 19 in the inner parts of the Gulf and as late as July 23 on the northeast part of Georges Bank, with one only 10.5 mm. long on August 22 off Seguin Island. In the Gulf of St. Lawrence, however, where vernal warming is later than in the Gulf of Maine, lumpfish probably do not commence spawning until the middle of April, for Cox and Anderson found no larvae there until late in June, with their observations pointing to late May as the height of the breeding season and to mid-June as about its termination.[35] Presumably its period of incubation is about as long with us as it is in European waters of like temperature, i. e., 6 weeks to 2 months.

On the other side of the Atlantic the lumpfish spawns in very shallow water, chiefly close to low-tide mark. But the fact that the egg masses (more or less familiar objects on European shores)

[32] Cox and Anderson (Contrib. Canadian Biol., N. Ser., vol. 1, 1922, p. 5) state that the Canadian Research steamer *Prince* has taken only two lumpfish in the Bay of Fundy in winter, both of them small.

[33] Contrib. Canadian Biol. N. Ser., vol. 1, 1922, p. 9.

[34] McIntosh, 14th Ann. Rept., Fishery Board Scotland, (1895) 1896, Pt. 3, pp. 173-178, and Fulton, 24th Ann. Rept., Fishery Board Scotland, (1905) 1906, Pt. 3, pp. 169-178.

[35] The lumpfish spawns from late May through June on the coast of Greenland; in April and May in the Baltic; and early in the spring in Norwegian waters.

seem never to have been reported along the coast of the Gulf of Maine, although the local presence of larvae is proof that lumpfish breed all around its coast line, suggests that the eggs are deposited at least a fathom or two down with us. And our capture of recently hatched larvae over Georges Bank is evidence that the latter also serves as a spawning ground in 15 to 25 fathoms or deeper. But the lower depth limit to spawning is yet to be determined.

Large females of 18 inches may produce up to 136,000 eggs which sink and stick together in large spongy masses through which the water circulates freely. Off the coasts of northern Europe these egg masses are often found adhering to rocks or other objects, or in crannies near low-water mark, and watch should be kept for them along the rocky coast line of the Gulf of Maine.

The male lumpfish guards the eggs until they hatch; his courage and devotion has often been described.[36] Throughout the period of guardianship, which he performs fasting, he fans the egg mass constantly, keeping it free of silt and bathed in flowing water, never leaving it except to drive off some intruder. But his vigil ends as soon as the eggs are hatched, leaving him thin and exhausted. The females take no part in guarding the eggs, but are said to move out into deeper water once they have finished spawning.

The eggs are 2.2 to 2.6 mm. in diameter, pink when first laid but soon change to pale green or yellow, and deepen in tint as development progresses. The larvae are about 4 to 7.4 mm. long at hatching, shaped like a tadpole with a large head and slender tail, swimming actively, and soon able to cling to any bit of weed. At 34 mm. the tubercles begin to appear, and the fry then show most of the characters of the adult, except for the large first dorsal fin and slender form.

Lumpfish larvae and fry of all sizes are to be taken throughout the summer; the smaller ones undoubtedly are from that season's hatch, but the larger ones may be either those hatched earliest that spring, or late in the preceding summer, for the varying stage of development reached by different individuals at various sizes proves that the rate of growth varies widely. Thus Cox and Anderson describe one Cape Breton specimen that was only 33 mm. long in July, but that was so mature in outline and in its dermal armature that it must have been at least a year old, whereas they found that in the Bay of Fundy the fry of the year grow to 40 or 50 mm. by December with the yearlings averaging about 58 mm. in July and August. As they remark, the rate of growth is apparently about the same in the Bay of Fundy (probably in the Gulf of Maine as a whole) as it is in Scottish waters, while Gulf of St. Lawrence lumpfish correspond to those about Helgoland, in their slower growth.

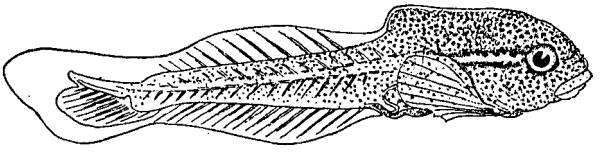

FIGURE 240.—Larva, 4–5 mm. After Garman.

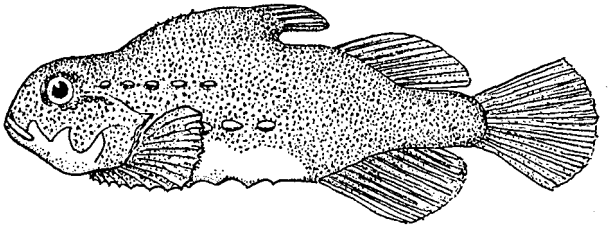

FIGURE 241.—Fry, 34 mm. After Garman.

LUMPFISH (*Cyclopterus lumpus*)

Presumably all Gulf of Maine lumpfish upward of 2½ inches long are in their second year. According to Cox and Anderson lumpfish 3¾ to 4¼ inches long are in their third year, those of about 10 inches in their fifth year.[37] But lumpfish grow much faster if fed to capacity than on the rations ordinarily available to them; one kept in the aquarium at St. Andrews increased in length from about 3.8 inches to about 12 inches in a little more than 12 months, which is as much as is to expected in 2 or 3 years under natural conditions.[38] Probably maturity is attained in the third year.

General range.—Both sides of the North Atlantic; White Sea, northern Norway and Iceland to the Bay of Biscay and occasionally to Portugal in the east (including the Baltic); northward in the west to the Gulf of St. Lawrence, Newfoundland, outer coast of Labrador, Hudson Bay, Davis Strait, and Disko (latitude about 70° N.)

[36] Fulton (24th Ann. Report, Fishery Board Scotland, (1905) 1906, Pt. 3, p. 169) gives an interesting eyewitness account of spawning and of the guardianship by the male parent over the eggs.

[37] As estimated from the structure of their vertebrae.

[38] According to McKenzie (Proc. Nova Scotian Inst. Sci., vol. 20, 1939, p. 17) this fish was kept well-fed on chopped clams and herring, but perhaps not to capacity for its appetite seemed insatiable.

in west Greenland; southward to New Jersey, and to Chesapeake Bay as a stray.

Occurrence in the Gulf of Maine.—The lumpfish is common along the outer coast of Nova Scotia and is to be found all around the shores of the Gulf of Maine. It has been reported at Yarmouth and in St. Mary Bay on the Nova Scotian side, and is abundant in all stages at various localities in the Bay of Fundy. There are many records for it along the Maine coast, including Eastport, Penobscot Bay, vicinity of Boothbay, the offing of Seguin Island, and Casco Bay; also in Massachusetts waters where it has been reported repeatedly, as at Nahant, Swampscott, Cohasset, Plymouth, Truro, along Cape Cod, and at Monomoy while we once picked up a lumpfish in the deep bowl between Jeffreys Ledge and the coast, probably as the trawl neared the surface.[39] It even enters river mouths, but it is never found where the water is appreciably brackish, so far as we can learn. According to fishermen large lumpfish are seldom seen on the offshore banks.

Importance.—The lumpfish is never eaten in the United States, but it sometimes finds its way to market as a curiosity. At one time a few were consumed locally in parts of the British Isles, and may still be.

Spiny lumpfish *Eumicrotremus spinosus* (Müller) 1777

Jordan and Evermann, 1896–1900, p. 2098.

Description.—The spiny lumpfish is easily distinguishable from its commoner relative by the fact that its skin tubercles are not only much larger relatively, and studded from the base to the tip with rough prickles, but are irregularly and closely scattered over the body and head. Furthermore, its gill openings are much shorter, while its body is not so high-arched, and is nearly round in cross section, instead of triangular. Also, its first dorsal (though fleshy in some of them) retains its fin-like appearance through life, instead of becoming entirely concealed by the skin.

Color.—Described as olivaceous to brownish.

General Range.—Arctic and northern parts of the Atlantic Ocean, south to the Gulf of Maine as a stray.

Occurrence in the Gulf of Maine.—Stray specimens of this northern fish have been reported from Eastport, Maine; from off Cape Ann; and from Salem, in the north side of Massachusetts Bay. We have also seen three small specimens, 1–1¼ inches long that were collected about 15 miles southeast of Cape Ann in 23 and 29 fathoms, by the U. S. Fish Commission in 1878 (now in the U. S. National Museum.) [40]

[39] Bigelow and Schroeder, Biol. Bull., vol. 76, 1939, p. 309.

[40] Myers and Bohlke (Stanford Ichth. Bull., vol. 3, No. 4, 1950, p. 199) have described a new species of spiny lumpfish (*E. terrae-novae*) from Newfoundland. But the specimens from off Salem and from off Eastport pictured by Goode and Bean (Smithsonian Contrib. Knowl., vol. 31, 1895, pl. 70, fig. 250) and by Garman (Mem. Mus. Comp. Zool., vol. 14, 1892, p. 71, figs. 1-3) were typical *spinosus*, as are the three small ones, from about 15 miles southeast of Cape Ann, that are mentioned above.

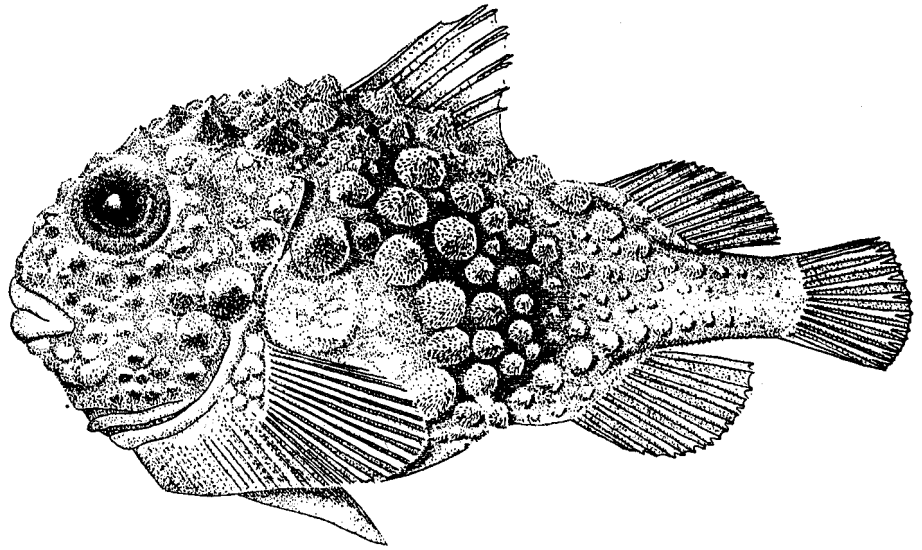

FIGURE 242.—Spiny lumpfish (*Eumicrotremus spinosus*), Massachusetts Bay specimen. From Goode and Bean. Drawing by H. L. Todd.

THE SEA SNAILS. FAMILY LIPARIDAE

The sea snails are tadpole-shaped, soft-bodied little fishes; and like the lumpfish (p. 459) most of them have a sucking disk on the chest, supported by the vestigial rays of the ventral fins.[41] But the skin is smooth, and without tubercles, and the spiny and soft parts of the dorsal fin are continuous as a single fin. The more than 115 species that are known are widely distributed in Arctic, North Temperate, and Antarctic Seas, and from the intertidal zone down to 2,000 fathoms or so.[42] The Gulf of Maine harbors two species. A third (*Careproctus ranulus* Goode and Beane, 1879) is known only from the vicinity of Halifax, Nova Scotia; from Middleground off eastern Nova Scotia,[43] from the Grand Banks, and off southeastern Newfoundland; perhaps from the estuary of the St. Lawrence River, also.[44]

We include it in the following Key, on the chance that it may be encountered in the deeper parts of our Gulf, sooner or later.

KEY TO GULF OF MAINE SEA SNAILS

1. The spiny (front) and soft (rear) portions of the dorsal fin are separated by a notch..... Sea snail, p. 464
   There is no notch between the spiny portion and the soft portion of the dorsal fin..... 2
2. The anal fin has only about as many rays (26–29) as the pectoral fin (28–33); there are two separate nostrils; the body is opaque, variously striped or spotted..... Striped Sea Snail, p. 466
   The anal fin has many more rays (at least 48) than the pectoral (27–28); there is only a single nostril; the body is translucent in life and colorless..... *Careproctus ranulus*[45]

Sea snail *Neoliparis atlanticus* Jordan and Evermann, 1898

Jordan and Evermann, 1896–1900, p. 2107.

Description.—Perhaps the most noticeable character of this and of the striped sea snail (p. 466) is that it is shaped more like a tadpole than like the conventional fish, thanks to the cylindrical fore part of the trunk, together with the broad rounded snout and fat soft belly, and the abrupt flattening (sidewise) of the body close behind the vent. It is also provided with a sucking disk similar to that of the lumpfish (p. 459). In side view the body is deepest abreast the pectoral fins (about four times as long as it is deep, not counting the caudal fin), tapering evenly to a moderate caudal peduncle. The head is flat above, the mouth is at the tip of the snout and moderately wide, and the jaws are armed with many small teeth arranged in bands.

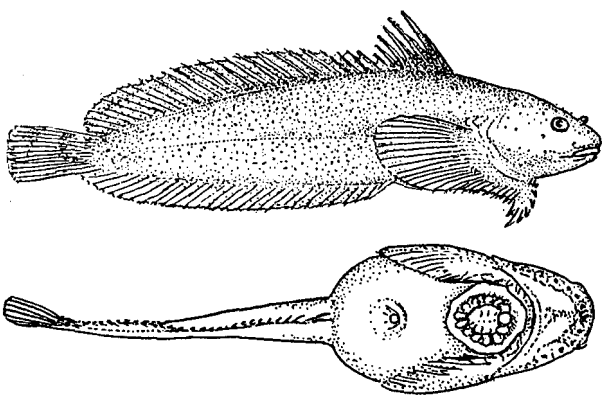

FIGURE 243.—Sea snail (*Neoliparis atlanticus*), side view (above) and ventral view (below) of adult male. After Garman.

The dorsal fin (6 spines and 26 soft rays) originates close behind the pectorals and runs continuously to the base of the caudal though it is separate from the latter. The dorsal spines are longer in males than in females, and project further beyond the membrane, giving the fin a fringed appearance. The anal fin (23 to 27 rays) originates under or a little behind the origin of the soft portion of the dorsal fin to which it corresponds in size and outline. The pectoral fins are not only very large and fanlike, but their bases run forward under the throat, where they expand into secondary lobes or wings with fringed edges. The ventral fins appear only as a circle of low knobs in the center of the sucking disk, which is situated on the throat between the pectoral fins. The skin is scaleless, and it is smooth except at spawning time, when the male becomes rough with small prickles.

[41] Some species of the genera *Paraliparis* and *Amitra* have lost the sucking disk.

[42] See V. Burke (Bull. 150, U. S. Nat. Mus., 1930) for a study of the family as a whole, giving descriptions and geographic ranges of all known species.

[43] McKenzie and Homans, Proc. Nova Scotian Inst. Sci., vol. 19, 1938, p. 278.

[44] We cannot judge whether the *Careproctus* reported by Vladykov and Tremblay (Natural. Canad., vol. 62 (ser. 3, vol. 6), 1935, p. 81) from the estuary of the St. Lawrence River as *C. longipinnis* was indeed identical with the fish from north of the Faroe Islands that was described under that name by C. V. Burke (Ann. Mag. Nat. Hist. Ser. 8, vol. 9, 1912, p. 510), or whether it is referable to *ranulus;* as seems the more likely on geographic grounds.

[45] For a detailed description, with illustrations, see Goode and Bean, Smithson. Contrib. Knowl., vol. 30, 1895, p. 275, vol. 31, pl. 70, figs. 251–251a, 251b.

Color.—Olive to reddish brown with lighter and darker cloudings and dots, the dorsal and anal fins often with crossbars. Its tints vary widely, also its markings and the strength of coloration, whether pale or dark, as is the case with so many fishes that live on the bottom.

Size.—Maximum length about 5 inches.

Remarks.—This sea snail resembles the following species (p. 466) so closely that the two are likely to be confused. The most evident difference between them is that the spiny portion of the dorsal (6 spines hardly stiffer than the soft rays) is marked off from the much longer soft part (22 to 27 rays) by a slight notch in the present species, whereas there is no such separation in the striped sea snail.

Habits.—Sea snails are inconspicuous little fish, usually found coiled up (tail to head) under stones, or attached by the sucker to some kelp stalk or other seaweed. But sometimes they swim to the upper water layers: thus the *Halcyon* specimens, for instance, mentioned below, were taken in a tow net at 8 fathoms, where the water was about 22 fathoms deep. And they seem to be indifferent to depth within moderate limits, for while they have been dredged as deep as 50 fathoms at various localities in our Gulf, they are often found clinging to lobster pots in the Bay of Fundy, (p. 465), while they have been taken in only a few feet of water in Massachusetts Bay. One was even found in a tide pool near St. Andrews, in Passamaquoddy Bay[46] so it would not be astonishing to find sea snails left in rock pools elsewhere, or on pebbly beaches by the ebbing tide, as often happens with its European representative. Young ones have been found living within the shells of the giant scallop (*Pecten magellanicus*), a curious habit that they share with the striped sea snail (p. 466) and with the hakes of the genus *Urophycis* (p. 224). Little else is known of the life of this sea snail, except that it is supposed to work inshore in winter to spawn. Presumably it feeds chiefly on small crustaceans and on small shellfish as its European relative does.

The spawning of this species has not been observed, but probably it takes place from March until midsummer in our Gulf, for Huntsman found larvae in Passamaquoddy Bay as early as April, while we towed one only 7 mm. long on German Bank as late as September 2 (1915).

The developmental stages of our sea snail have not been seen. The eggs of the European sea snail, which are about 1.1 mm. in diameter, and pale straw color to light salmon pink, sink and stick together, also to hydroids, seaweeds, and to debris of any kind. The little clusters are often brought up on long lines from 4 to 30 fathoms, but are sometimes found close below tide mark. There is no reason to suppose that the males care for the eggs, and the latter are so hardy that they do not suffer from exposure to the air for hours. Judging from the dates when newly hatched larvae have been seen, incubation of the European species occupies a month, perhaps longer in the case of the eggs that are spawned earliest in the season, at winter temperatures. The larvae are about 3.3 to 4.5 mm. long at hatching, with a small rose-red yolk sac that contains a large oil globule and that is inclosed in a net of blood vessels. Most of the characters of the adult are apparent at 11 to 12 mm. length, but the pectoral fins are brilliantly pigmented with yellow and black throughout the larval stage.[47]

General range.—Rocky shores along the North American Coast from northeastern Newfoundland, the northern part of the Gulf of St. Lawrence and the Grand Banks to southern New England.[48] It is rare west and south of Cape Cod, but has been taken at Woods Hole, on the coast of Connecticut, and off New Jersey.[49]

Occurrence in the Gulf of Maine.—This sea snail is generally distributed around the shore line of the Gulf. Thus the *Halcyon* trawled it off Yarmouth, Nova Scotia, in January 1921; it is rather common (according to Huntsman) in the Bay of Fundy and in Passamaquoddy Bay; and it has been definitely reported at Grand Manan; Eastport; Seguin Island; off Portland (where many have been collected); off Cape Elizabeth; at Kittery; and at various localities about Massachusetts Bay. It

[46] McKenzie and Homans, Proc. Nova Scotian Inst. Sci., vol. 19, Pt. 3, 1938, p. 278.

[47] McIntosh and Mastermann (Life histories of the British Marine Food-fishes, 1897 p. 191, pl. 2. fig. 9, 10) and Ehrenbaum (Nordisches Plankton, vol. 1, 1905-1909, p. 109) give descriptions of the eggs and larvae of the European sea snail *N. montagui* (as *Cyclogaster montagui*) from which the preceding is condensed.

[48] This fish is so closely allied to the north European sea snail, *N. montagui* (from which, however, it is quite distinct) that it passed under that name prior to 1898.

[49] A specimen was taken by *Albatross II*, off Atlantic City, lat. 39°24′ N., long. 74°05′ W., in 11 fathoms, in April 1930.

has been taken on Georges Bank also, and on Browns, living in scallop shells (p. 465).

Vladykov and McKenzie characterize it as "not uncommon" all around Nova Scotia;[50] it is classed by Huntsman as characteristic of the icy cold water on the banks in the southern part of the Gulf of St. Lawrence; and it has been reported from the estuary of the St. Lawrence River; from the northeastern part of the Gulf of St. Lawrence; off the south coast of Newfoundland; on the Grand Banks, and as far north on the Atlantic coast as the entrance to the Strait of Belle Isle.[51]

Striped sea snail *Liparis liparis* (Linnaeus) 1766

SEA SNAIL

Jordan and Evermann, 1896–1900, p. 2116.

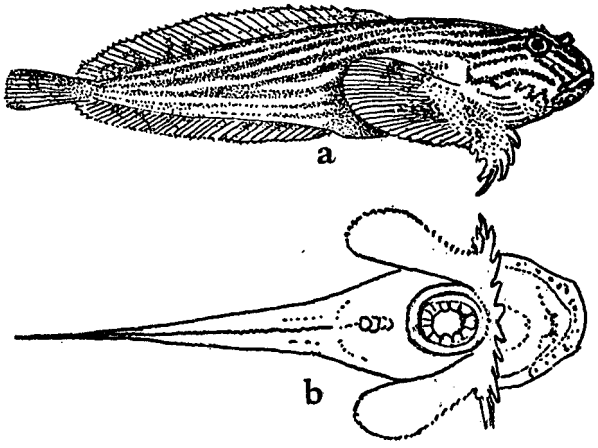

FIGURE 244.—Striped sea snail (*Liparis liparis*), side view (above) and ventral view (below) of adult. After Garman.

Description.—This little fish resembles the sea snail (p. 464) so closely, especially in its tadpole-like form, in the presence of a sucking disk on its chest, in which the rays of the ventrals (reduced to mere knobs) serve as a central support, and in the peculiar outline of the pectoral fins with secondary frilled basal lobes, that it is difficult to distinguish one from the other. The most obvious difference between the two species is that there is no indentation between the spiny and the soft parts of the dorsal fin in the striped sea snail. Furthermore, it usually has 33–35 rays in the soft portion of its dorsal fin and 26–29 rays in its anal fin, as against a maximum of 32 dorsal rays and of 27 anal rays in the other sea snail (p. 404). And the separation between the dorsal and anal fins and its caudal fin is not as definite in the striped sea snail as it is in the preceding species; in fact it is sometimes difficult to draw a sharp line between the fins. A minor character, which gives the head a rather different aspect, is that the dorsal profile is more arched in the striped sea snail.

Color.—Many color varieties of this fish have been described and named. As a rule the ground tint is of a shade of olive green, gray, or brown, variously tinged with reddish, with yellowish, or with lilac, and but little paler below than above. Red ones with pale and dark stripes have been seen among kelp in New England waters. And they are dark and pale in endless variety in varying situations, some nearly plain, some definitely striped with few or many narrow longitudinal bands, others spotted. In fact no two are alike. Usually the fins are darkly blotched or barred.

Size.—This fish grows to a length of 10 inches in Arctic seas but very few of them are more than 5 inches long in temperate latitudes.

Habits.—All that is known of its habits in our Gulf is that it lives on rocky or stony bottom, usually among the stalks and roots of kelp to which it sometimes clings fast, a habit which European writers describe as common. In British waters it is often to be found hiding in the tiny pools of water that are left under pebbles by the ebbing tide, and probably a search of the beaches would reveal it in similar situations in the Gulf of Maine also. Small ones often live inside the shells of the giant scallop (*Pecten magellanicus*), and it is our impression (though not backed by any definite evidence) that this is a more usual habit with the striped sea snail than with the preceding one (p. 465). At any rate, W. F. Clapp informs us that it is the rule to find at least one or two striped sea snails in a bushel or so of sea scallops, and fishermen have told us that sea snails of one species or the other (probably of both species) are found in scallop shells on Georges Bank.

Small crustaceans, chiefly amphipods and shrimps of various kinds, have been found in the stomachs of striped sea snails on both sides of the Atlantic; they also feed on small shellfish, and they were described by Fabricius [52] as eating small fish fry and algae.

[50] Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 99.

[51] From the trawlings of the Newfoundland Fisheries Research Commission.

[52] Fauna Groenlandica, 1780, p. 137.

This is a winter-spring spawner; females are full of roe at Woods Hole in December and January, and the collection of the Museum of Comparative Zoology contains a female distended with eggs that was taken on April 1 many years ago. Larvae only 5.5 mm. long, which we towed near the Isles of Shoals on July 22 and in Massachusetts Bay on August 31 in 1912, must have been hatched from eggs spawned at least as late as May, if not in June.

The eggs,[53] about 1.5 mm. (0.06-inch) in diameter, sink and stick together in bunches, to hydroids, seaweeds, or other objects, like those of *Neoliparis atlanticus*, and it seems that incubation is about as long as it is with the latter, i. e., at least a month. The larvae are about 5.5 mm. long at hatching and they live adrift until they are upward of 16 mm. long, when the sucking disk is well developed.

General range.—Arctic and North Temperate Atlantic; north to the White Sea, Spitzbergen, Greenland, Davis Strait, and northern Labrador, and reported from the Kara Sea and from the Arctic Ocean north of Siberia; south to northern France and to Delaware Bay and Virginia.[54]

Occurrence in the Gulf of Maine.—The distribution of this sea snail parallels that of the preceding species in our Gulf. Thus it has been dredged not uncommonly in the Bay of Fundy region in from 5 to 100 fathoms and has been recorded from Grand Manan: from Eastport, as well as from other localities on the Maine coast; here and there about Massachusetts Bay; and on Georges Bank; also at Woods Hole.

In Nova Scotian waters it has been characterized variously as "common" [55] and as "uncommon." [56]

It has been described as "common" in the southern part of the Gulf of St. Lawrence;[57] has been reported in the estuary of the St. Lawrence River; at Anticosti; and in the northeastern part of the Gulf; also off the south coast of Newfoundland; in Conception Bay; off the eastern end of the Strait of Belle Isle; off the southeastern Labrador coast,[58] and from Fort Chimo, on Ungava Bay, in northern Labrador,[59] as well as from West Greenland.

It is of no commercial importance.

THE SEA ROBINS OR GURNARDS AND THE ARMORED SEA ROBINS

FAMILIES TRIGLIDAE AND PERISTEDIIDAE

The sea robins and their European relatives, the gurnards, suggest sculpins in their broad heads, slender bodies, large fanlike pectoral fins, in having two separate dorsal fins (a spiny and a soft rayed), and in the location of their ventral fins under the pectorals. But their entire heads are armored with rough bony and spiny plates. The Gulf of Maine is the northern limit for the family on the Atlantic Coast of America.

The armored sea robins are close relatives to the sea robins but they differ from them in four very noticeable ways: (1) the entire body is enclosed in an armor of bony plates, each plate with a spine; (2) it is only the two lower rays of the pectorals that form separate feelers; (3) each side of the front of the skull projects forward as a long flat process, so that the snout appears to be double; (4) they have 2 long barbels on the chin. They live on bottom in fairly deep water, and they are widespread in tropical to boreal seas. One species is a member of the Gulf of Maine fish fauna.

KEY TO GULF OF MAINE SEA ROBINS AND ARMORED SEA ROBINS

1. Front of snout only slightly concave as seen from above; no barbels on chin 2
   Front of snout so deeply concave that it seems to be double when seen from above (fig. 247); two long barbels on chin ..... Armored Sea Robin p. 471
2. Pectoral fin with 2 broad dusky blotches; there is no prominent longitudinal stripe on the side of the body ..... Common Sea Robin p. 467
   Pectoral fin with only 1 broad dusky blotch; there is a prominent longitudinal dark brown stripe on each side of the body ..... Striped Sea Robin p. 470

Common sea robin *Prionotus carolinus* (Linnaeus) 1771 [60]

SEA ROBIN; ROBIN, GREEN-EYE

Jordan and Evermann, 1896–1900, p. 2156.

[53] The following lines are condensed from Ehrenbaum's (Nordisches Plankton, vol. 1, 1905–1909, p. 112) account of its eggs and larvae in European waters.

[54] This sea snail, formerly known only as far south as New York, has been taken off Delaware Bay by *Albatross II*, and off Assateague, Virginia, by the *Grampus* (Welsh, Copeia, No. 18, 1915, p. 2).

[55] Jones, Proc. Nova Scotian Inst. Sci., vol. 5, pt. 1, 1882, p. 89.

[56] Vladykov and McKenzie, Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 99.

[57] Cox, Contrib. Canadian Biol. (1918-1920) 1921, p. 112.

[58] From the cruises of the Newfoundland Research Commission.

[59] Packard Proc. Portland Soc. Nat. Hist., vol. 2, No. 13, 1909, p. 112.

[60] Jordan, Evermann, and Clark (Rept. U. S. Comm. Fish. (1928) Pt. 2, 1930, p. 407, place this species in the Genus *Merulinus* which was proposed by Jordan and Evermann in 1898 as a subgenus.

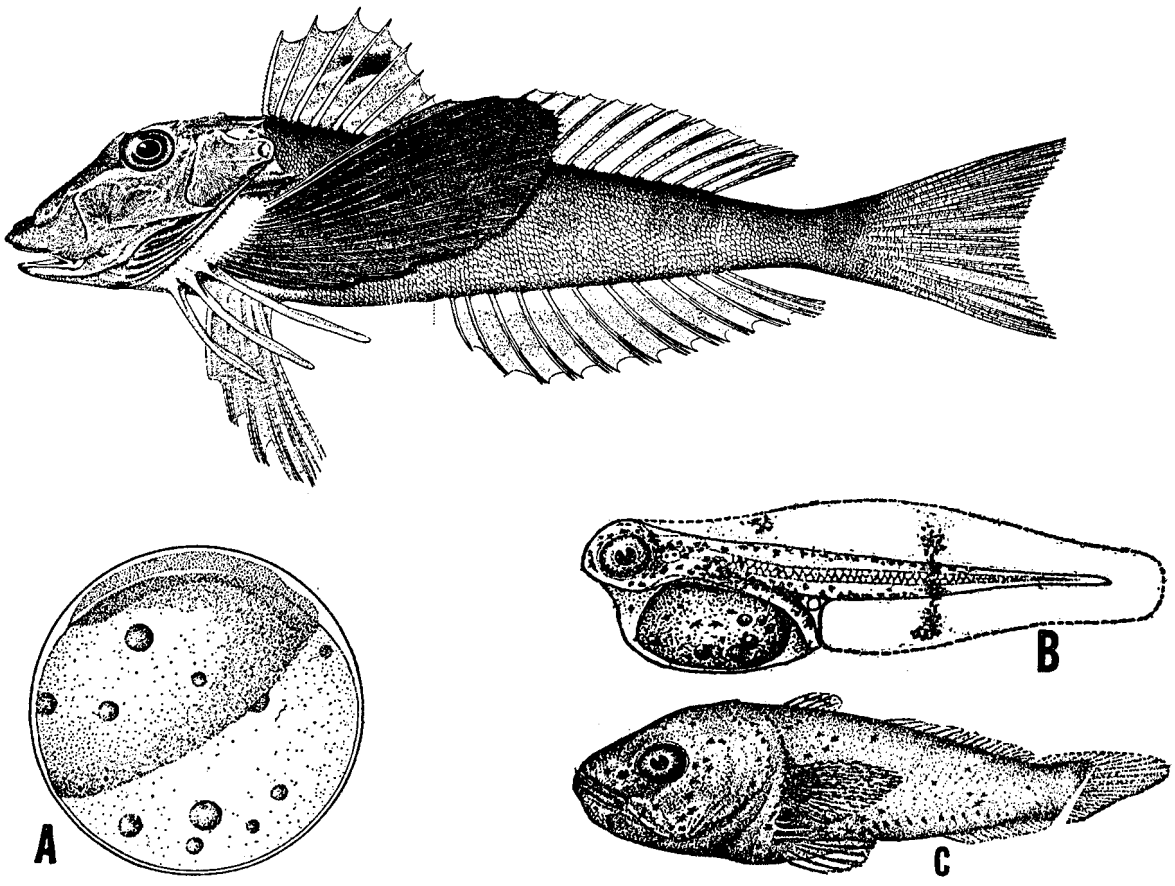

FIGURE 245.—Common sea robin (*Prionotus carolinus*). Adult, New Jersey; from Goode, drawing by H. L. Todd. A, egg; B, larva, just hatched, 2.8 mm.; C, young, 9 mm. A–C, after Kuntz and Radcliffe.

Description.—The large head, tapering body, and fanlike pectoral fins of the sea robin somewhat suggest a sculpin. But the robin is distinguished from all the sculpins by the incasement of its entire head in bony plates; by its smaller mouth; by the flat depressed dorsal profile of its snout; by its large ventral fins; and by the fact that the three lower rays of each of its pectoral fins are separate from the rest of the fin and modified into three independent feelers with slightly dilated tips, a very noticeable and distinctive feature. Furthermore, the front margin of the upper jaw is concave in outline when viewed from above, not convex as it is in most other fishes, which gives the nose of the robin a characteristic aspect. The head plates are rough and there is one sharp spine on each cheek at the angle of the gill cover; two short spines over each eye pointing backward; a spine on either side of the neck; and one on each shoulder above the base of the pectoral fin. The spiny and soft-rayed portions of the dorsal fin are separate, but they are so close together at their bases that they are almost in contact. The spiny dorsal has 10 spines, is rounded in outline, and higher than the soft dorsal (13 rays); but the soft dorsal is considerably longer than the spiny dorsal.

The caudal fin is of moderate size, its margin slightly concave. The anal fin (1 spine and 11 rays) is similar in outline to the soft dorsal, under which it stands. The pectorals (their 3 lower rays as just noted) are rounded in outline and are so large that they overlap the anal and the second (soft) dorsal when they are laid back. The ventral fins (each of 1 stiff spine and 5 rays) stand close behind the pectorals.

Color.—Usually the body is grayish or reddish brown above, with about five dark saddlelike blotches along the back, and is dirty white or pale yellow below. The dorsal fins are grayish, marked with pale spots and stripes, with a black spot between the fourth and fifth spines. The

caudal fin is uniform grayish or brownish; the anal plain brown; the ventrals plain yellow to brown. The pectorals are yellow or orange, strikingly marked with two broad dusky bars, one of them crossing the middle of the fin, and the other crossing its outer third. The pectoral filaments are orange.

Size.—The maximum length is 15 to 16 inches, but few of them grow to be more than a foot long.

Habits.—Sea robins, like the sculpins, tend to keep to the bottom. But they swim actively, usually with the pectorals closed against the body. They are often hooked close to the surface; we have caught them when trolling for mackerel, and many anglers have told us of similar experiences. When on the bottom they often lie with the fanlike pectorals spread. If disturbed they bury themselves in the sand, all but the top of the head and eyes, and they are said to employ the feeler-like rays of the pectorals in stirring up the weeds and sand to rout out the small animals upon which they feed. They are usually found on smooth hard grounds, less often on mud or about rocks.

Along southern New England, where robins are far more plentiful than they are farther north, a large part of the population appear inshore in May or June, to pass the summer there; some close to tide line, but others remaining in depths of 5 to 30 or 40 fathoms, or deeper. Like many warm-water fishes, they disappear from the coast in October, to pass the cold season well out on the shelf, as recently proved by catches made at 50 to 55 fathoms off southern Massachusetts by the dragger *Eugene H* in late January,[61] in 1950, also at 21 to 93 fathoms off North Carolina, in that same month and the next, by the *Albatross III*.[62]

The fact that the *Albatross III* trawled up to 83 sea robins per haul off New York and off southern New England at 22–61 fathoms as late in the season as mid-May of that same year suggests that some of them may remain well offshore until into the summer, if not all summer.

Notwithstanding this inshore and offshore migration, some at least of the sea robins experience a temperature range of nearly 30° F. with the change of the seasons, for those that come closest inshore are in water as warm as 68°–70° at the end of the summer, while some that were trawled along the 30- to 40-fathom zone in May were in water as cold as 40.2° to 41.4°.

The sea robin is a voracious fish, feeding indifferently on shrimps, crabs of various kinds, amphipods (crustaceans are its chief diet), squids, bivalve mollusks, annelid worms, and on small fish, such as herring, menhaden, and small winter flounders. Seaweed has also been found in sea robin stomachs. They bite greedily on any bait, and are often taken with a spinner, or other artificial lure.

About Woods Hole the common sea robin spawns from June to September with July and August as the peak of the season.[63] But some may spawn earlier, for we have examined females taken at 50–55 fathoms off southern New England at the end of January with eggs so large as to suggest that they would be spawned by April or May. Unlike the sculpin tribe, the robin produces buoyant eggs, which are 0.94 to 1.15 mm. in diameter, slightly yellowish, with a variable number (10 to 25) of oil globules of various sizes, usually arranged in a more or less definite ring. Incubation occupies about 60 hours at a temperature of 72°, but any eggs that might be spawned in the cooler water of our Gulf would be slower in hatching. The newly hatched larvae are 2.5 to 2.8 mm. long, with two transverse yellow cross bands, one of these close behind the pectoral fins, the other midway between vent and tail. The yolk is absorbed, the mouth formed, and the yellow markings no longer prominent in 5 days, at a length of 3 to 3.4 mm. The dorsal and anal fin rays are visible and the lower pectoral rays have separated from the remainder of the fin at about 9 mm., and young fish of 25 to 30 mm. are darker, with transverse bands, and already show most of the distinctive characters of the adult.

General range.—Coastal waters of eastern North America from the Bay of Fundy to South Carolina; chiefly west and south from Cape Cod.

Occurrence in the Gulf of Maine.—Plentiful though the sea robin is off southern New England,[64] only a few are taken north of Cape Cod.

[61] We saw these catches which ranged from 0 up to 5,000 fish per haul, in 54 trawl hauls.

[62] One to one hundred and thirty sea robins per haul.

[63] Kuntz and Radcliffe (Bull. U. S. Bur. Fish., vol. 35, 1918, p. 105–109) give an account of its embryology and larval stages, subsequently confirmed and supplemented by Welsh.

[64] A catch of 1,000, in a day, in one trap, is recorded for Vineyard Sound, and of as many as 3,000 to 5,000, per trawl haul, at 50 to 55 fathoms off southern Massachusetts in winter. See footnote 61, p. 469.

Following the coast we find them reported at Truro, Cape Cod; Prof. A. E. Gross has informed us that he often saw as many as a dozen sea robins taken in the trap at the entrance to Barnstable Harbor in a single tide in the early summer of 1920; [65] one now in the Museum of Comparative Zoology was trawled 12 to 15 miles off Plymouth, at 30 fathoms, on November 20, 1943; the sea robin has been reported off Lynn and Salem; and in 1913 Welsh saw several in a trap at Manchester, on the North Shore of Massachusetts Bay on June 29. North of Cape Ann it has been taken at Anisquam; at Newburyport at the mouth of the Merrimac River, whence one about 1 foot long was brought in to the Museum of Comparative Zoology on August 14, 1949; also at the mouth of the Saco River. And Dr. W. C. Kendall saw more than 25 taken from the traps near Small Point, Casco Bay, between July 4 and 14 in 1896.

The only records for it for the coast east of Small Point are, however, for a single specimen caught at Campobello Island in the mouth of the Bay of Fundy in August 1911, and another in August 1949,[66] one taken in a weir in Passamaquoddy Bay at St. Andrews, October 2, 1935,[67] and of another taken in the Bay of Fundy, near Minas Channel, during the late summer or early autumn of 1951.[68]

Enough sea robins also range eastward across the South Channel for trawlers to have picked up a few (never more than a dozen or two on a trip) on Georges Bank during the summer of 1913. But it is probable that the deep channel between Georges and Browns Banks form its easterly limit, for sea robins are not known on Browns Bank or off the west coast of Nova Scotia.

It is not likely that the sea robin ever succeeds in reproducing itself in the Gulf, unless in restricted localities such as Casco Bay, where summer temperatures may be high enough. We have never taken its rather characteristic eggs in our tow nets anywhere in the Gulf, nor have its young fry ever been reported there. But when wandering fish do find their way around Cape Cod from the south, they may remain there, wintering offshore in deeper water, as they do farther south.

Importance.—The sea robin is edible, and its near relatives, the gurnards, are table fish in Europe, but it is too scarce in the Gulf of Maine to be of any potential commercial importance there. Off southern New England, where it is abundant, it is a nuisance to anglers, taking bait planned for other fishes.

Striped sea robin *Prionotus evolans* (Linnaeus) 1766

Jordan and Evermann, 1896–1900, p. 2167, as *Prionotus strigatus* Cuvier and Valenciennes, 1829 [69]

[65] Briefly mentioned in The Auk, vol. 40, No. 1, January 1923, p. 24.

[66] This latter fish was reported by Scattergood, Trefethen, and Coffin (Copeia, 1951, No. 4, p. 298).

[67] McGonigle and Smith, Proc. Nova Scotian Inst. Sci., vol. 19, 1936, p. 160.

[68] Reported to us by letter by Dr. Huntsman.

[69] Ginsberg (Texas Jour. Sci., vol. 2, No. 4, 1950, p. 519, 520-522) has shown that the *P. strigatus* of Cuvier and Valenciennes is not separable from the *evolans* of Linnaeus.

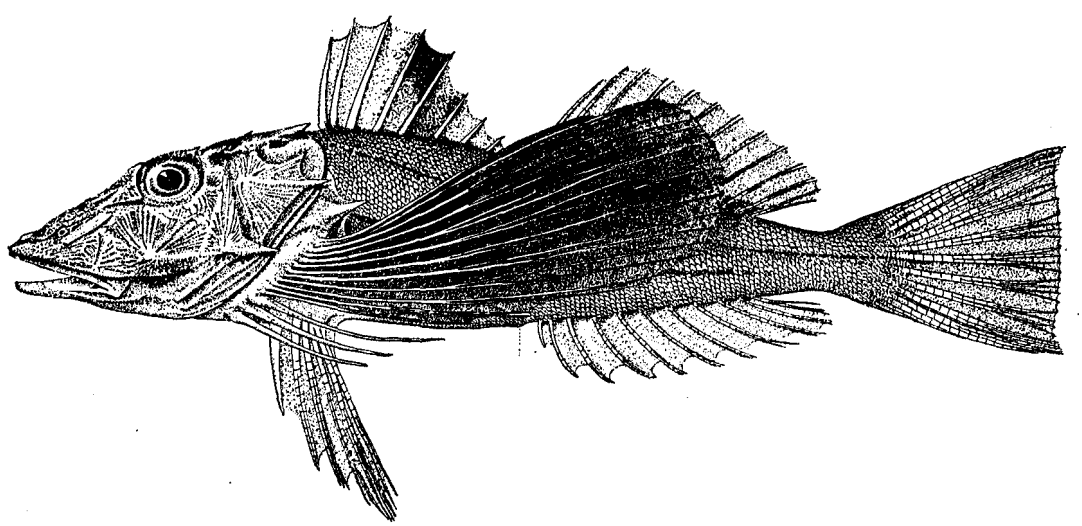

FIGURE 246.—Striped sea robin *(Prionotus evolans)*, Woods Hole, Mass. From Goode. Drawing by H. L. Todd.

Description.—The striped sea robin resembles the common sea robin so closely that one might easily be taken for the other. But its mouth is wider and gapes back almost opposite the front of the eye, with the maxillary bone more than one-third as long as the head. Its head is flatter (compare fig. 246 with fig. 245); its pectoral fins are longer relatively (reaching back to the ninth or tenth ray of the soft dorsal fin instead of only to the fifth or sixth ray); its pectoral feelers are more slender and tapering; its caudal fin is square-ended instead of concave in rear outline; and its reddish or olive-brown sides (the general ground tint varies) are marked longitudinally with a dusky or bronze-brown stripe below the lateral line. The first dorsal fin shows the same black or dusky blotch betweeen the fourth and fifth spines, so characteristic of the common robin. The pectorals are orange to brown with pale edges, their centers washed with dusky, but without the definite crossbars characteristic of the common sea robin. The pectoral filaments are pale brown or orange, marked with narrow brown bars. (The common sea robin does not show these bars.)

Size.—This is a larger fish than the common sea robin, growing to a maximum length of about 18 inches.

General range.—Shoal water along the Atlantic coast of North America from South Carolina to Cape Cod, reaching the Gulf of Maine as a stray from the south.

Occurrence in the Gulf of Maine.—This southern fish rounds Cape Cod so seldom that there are only 6 definite records for it from the Gulf of Maine: Monomoy; North Truro; Salem; Gloucester; Monhegan Island, Maine (its most northerly outpost) where one was taken in an otter trawl at 40 fathoms, November 19, 1933; and the eastern part of Georges Bank, whence one was brought in to the U. S. Fish Commission sometime between 1877 and 1880. We have never seen it north or east of the elbow of Cape Cod.

Armored sea robin *Peristedion miniatum* Goode 1880

Jordan and Evermann, 1896–1900, p. 2178.

Description.—The armored robin resembles the sea robins in general body form, and in the ar-

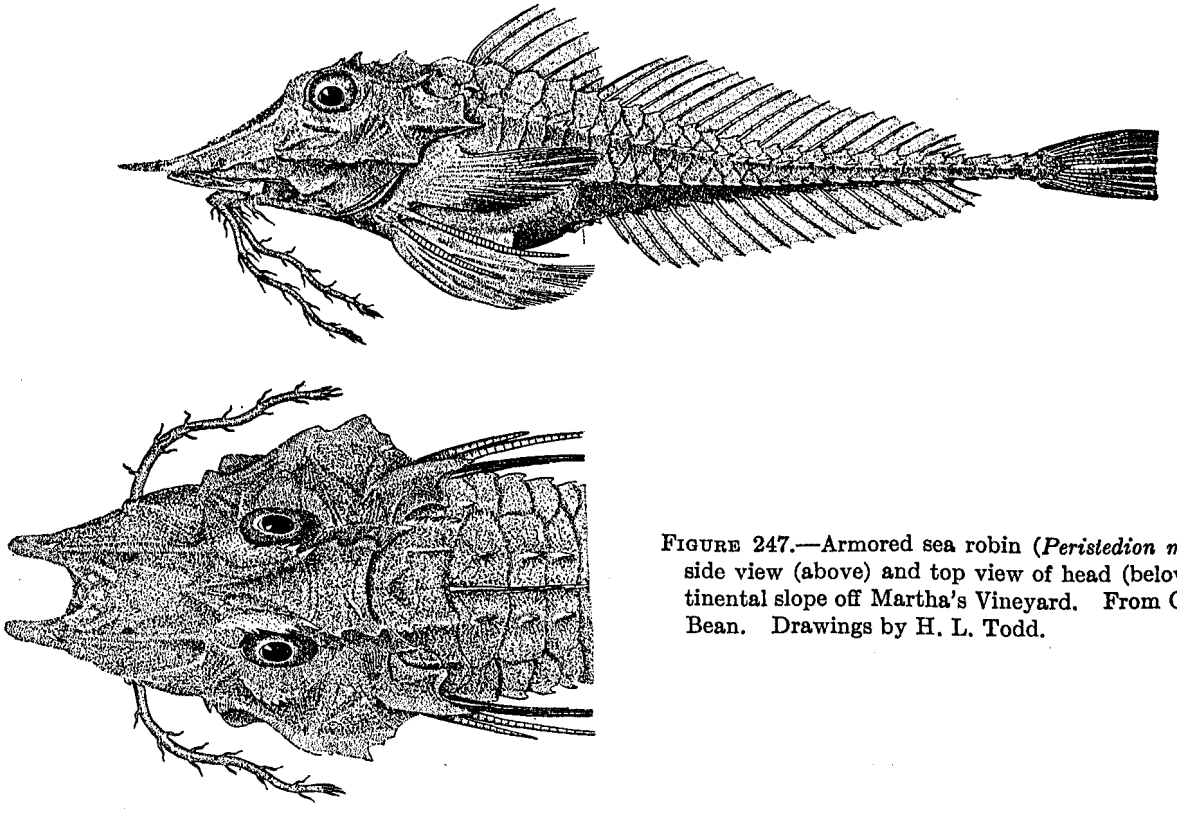

FIGURE 247.—Armored sea robin (*Peristedion miniatum*), side view (above) and top view of head (below). Continental slope off Martha's Vineyard. From Goode and Bean. Drawings by H. L. Todd.

rangement of its fins, including the fact that the two lower rays of each pectoral form separate feelers. But its body is entirely clothed with bony plates of considerable size. There are 4 rows of these on each side, from the vent rearward, with an equal number of rows of thornlike spines, the latter close set and directed rearward. The plates on the abdomen have no spines. Thanks to this armor, the trunk is very stiff. The lower jaw bears a number of short fleshy barbels; there is one long barbel with short side branches at each corner of the mouth (the sea robins have no barbels); and the front of its head is given so peculiar an appearance by the two projections from the skull (p. 467) that the armored robin could hardly be mistaken for any other fish, except for one of its own tribe.

Color.—Bright crimson, below and above.

Size.—Maximum recorded length between 13 and 14 inches (330–355 mm.).

Habits.—This is a ground fish, recorded from depths ranging from 50 fathoms down to somewhere between 200 and 235 fathoms. And it seems to be confined to the zone of warm water along the outer part of the continental shelf and upper part of the continental slope for the lowest temperature in which it has been recorded is between 44° and 45°.[70] The stomachs of those we have opened contained shrimps, stomatopods, and other small crustaceans.

General range.—Outer part of the continental shelf and upper part of the continental slope; from the southwestern face of Georges Bank to the offing of Charleston, S. C. (lat. 32°24′ N., long. 78°44′ W.).[71]

Occurrence in the Gulf of Maine.—Trawlers tell us they sometimes take these brilliant crimson fishes on the southwestern part of Georges Bank. And they must be rather common outside the 60-fathom contour, for we saw 89 specimens trawled there and south of Nantucket at depths of 66 to more than 185 fathoms, by the *Albatross III* in May 1950. But it is probable that they are barred from the more easterly parts of the bank and from the inner parts of the Gulf of Maine by low temperature.

THE FLYING GURNARDS. FAMILY DACTYLOPTERIDAE

Flying Gurnard *Dactylopterus volitans* (Linnaeus) 1758

Jordan and Evermann, 1896–1900, p. 2183, as *Cephalacanthus volitans* (Linnaeus)

Description.—The flying gurnard (only known representative of its family), built, in general, on the "sea robin" plan, is remarkable for its enormous pectorals. When it is about half grown or older, these reach nearly to the base of the caudal fin if laid back. When spread, they have the form of enormous rounded fanlike wings. Other con-

[70] We have seen it trawled off southern New England in water as shoal as 50 fathoms, and as cold as 44.4°.

[71] For list of early localities, see Goode and Bean, Smithsonian Contrib. Knowl., vol. 30, 1895, p. 471.

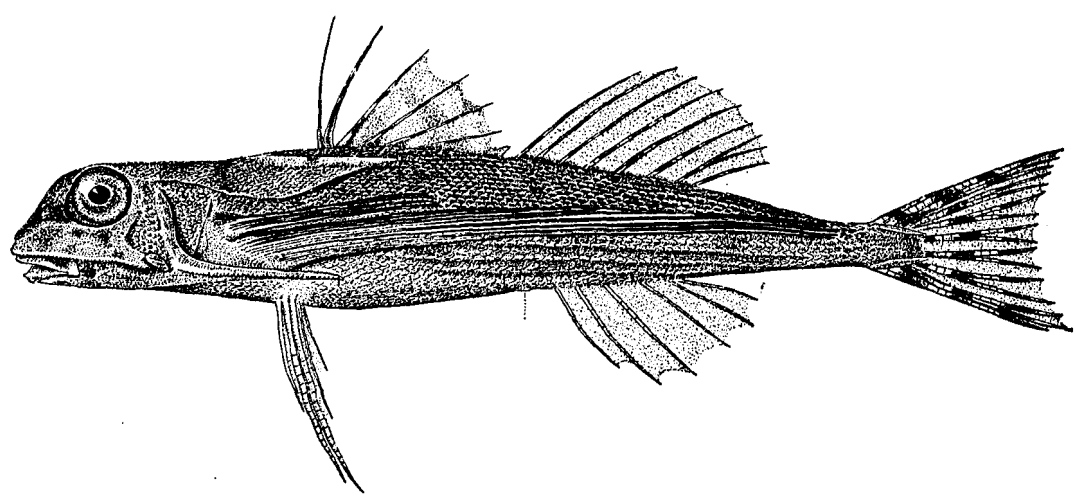

FIGURE 248.—Flying gurnard (*Dactylopterus volitans*), Key West, Florida. From Jordan and Evermann. Drawing by H. L. Todd.

spicuous respects in which the flying gurnard differs noticeably from its relatives, the sea robins, are that the first five or six rays of each pectoral, with their interconnecting membrane, form a separate fin, having no connection with the remainder of the pectoral except at the base; that the few lowermost rays of each pectoral fin are not separate, in the form of feelers, but are continuous with the remainder of the fin; that the first two spines of the dorsal fin are separate, that the bony armor covering the front and top of the head reaches rearward considerably beyond the origin of the dorsal fin on either side to end in a stout spine, that each gill cover [72] is extended rearward as a stout spine about as far as the axil of the pectoral fin, and that the scales are much larger and each armed with a short stout spine.

Color.—This is a very brilliant fish, varying widely in color; most of them are of some shade of brownish to greenish olive above, with the lower side paler, but marked irregularly with reddish salmon or salmon yellow. The winglike pectorals are variously marked with bright blue streaks near their bases, with blue spots and bars toward their tips. The caudal fin usually has about three brownish-red cross bars.

Size.—To about 12 inches.

General range.—Tropical to warm temperate latitudes of both coasts of the Atlantic; south to Brazil and north rather commonly to North Carolina on the American coast; a few to New York and the southern coast of Massachusetts in most years (in autumn [73]); recorded as a stray from Massachusetts Bay. A dried and hardened specimen that was found on the shore near Country Harbor, Nova Scotia, in September 1939, by Stanley McKinley, among the kelp and eel grass that had been washed ashore during the night, was thought by him (no doubt correctly) to have been carried north on the deck of some steamer from the south.[74]

Occurrence in the Gulf of Maine.—The only report of this warm-water fish from north or east of Cape Cod is of one said to have been taken in Massachusetts Bay.[75]

THE CUNNER TRIBE, OR WRASSES. FAMILY LABRIDAE

Members of the cunner family have a single long dorsal fin, its forward part spiny, its rear part soft rayed, with no evident demarkation between the two. The ventral fins are located under the pectorals, and the caudal peduncle is very deep. The structure of the dorsal fin is sufficient of itself to distinguish them from all Gulf of Maine fishes except the scup, sea bass, rosefish, tilefish, or certain sculpins. And there is no danger of confusing a cunner or tautog with any of these, for their rounded tails and pectorals, and their general body-forms separate them at a glance from the thin-bodied, fork-tailed scup; their small mouths and the relative sizes of their fins are obvious distinctions between them and the sea bass tribe; their smooth cheeks and broad caudal fins separate them from the spiny-headed, narrow-tailed rosefish or from any sculpin; and they do not in the least resemble the tilefish with its broad mouth, adipose "fin" on the nape of its neck, concave tail fin, and pointed pectorals. Both the roof of the mouth and the floor of the throat (pharynx) is armed with a patch of conical or knoblike teeth in the cunner tribe. It is with these that they grind the hard-shelled mollusks and crustaceans on which they feed.

KEY TO GULF OF MAINE CUNNERS

1. Gill covers scaly, snout somewhat pointed, dorsal profile of head rather flat.....Cunner, p. 473

   Gill covers largely naked, snout blunt, dorsal profile of head high-arched.....Tautog, p. 478

Cunner *Tautogolabrus adspersus* (Walbaum) 1792

Perch; Sea perch; Blue perch; Bergall; Chogset

Jordan and Evermann, 1896–1900, p. 1577.

Description.—The readiest field marks by which the cunner may be distinguished from its close relative, the tautog, are mentioned on page 479. It is moderately deep in body, moderately flattened sidewise, with a very deep caudal peduncle,

[72] Actually the preopercular bone.

[73] The most recent record from Woods Hole, of which we have heard, is of two taken there on November 24, 1948, from the deck of *Albatross III* while she was moored at the dock (Arnold, Copeia, 1949, p. 300).

[74] McKenzie, Proc. Nova Scotian Inst. Sci., vol. 20, 1940, p. 44.

[75] This specimen is now in the Museum of Comparative Zoology, to which it was transferred from the Boston Society of Natural History. There is no clue to its origin, except that it was taken many years ago.

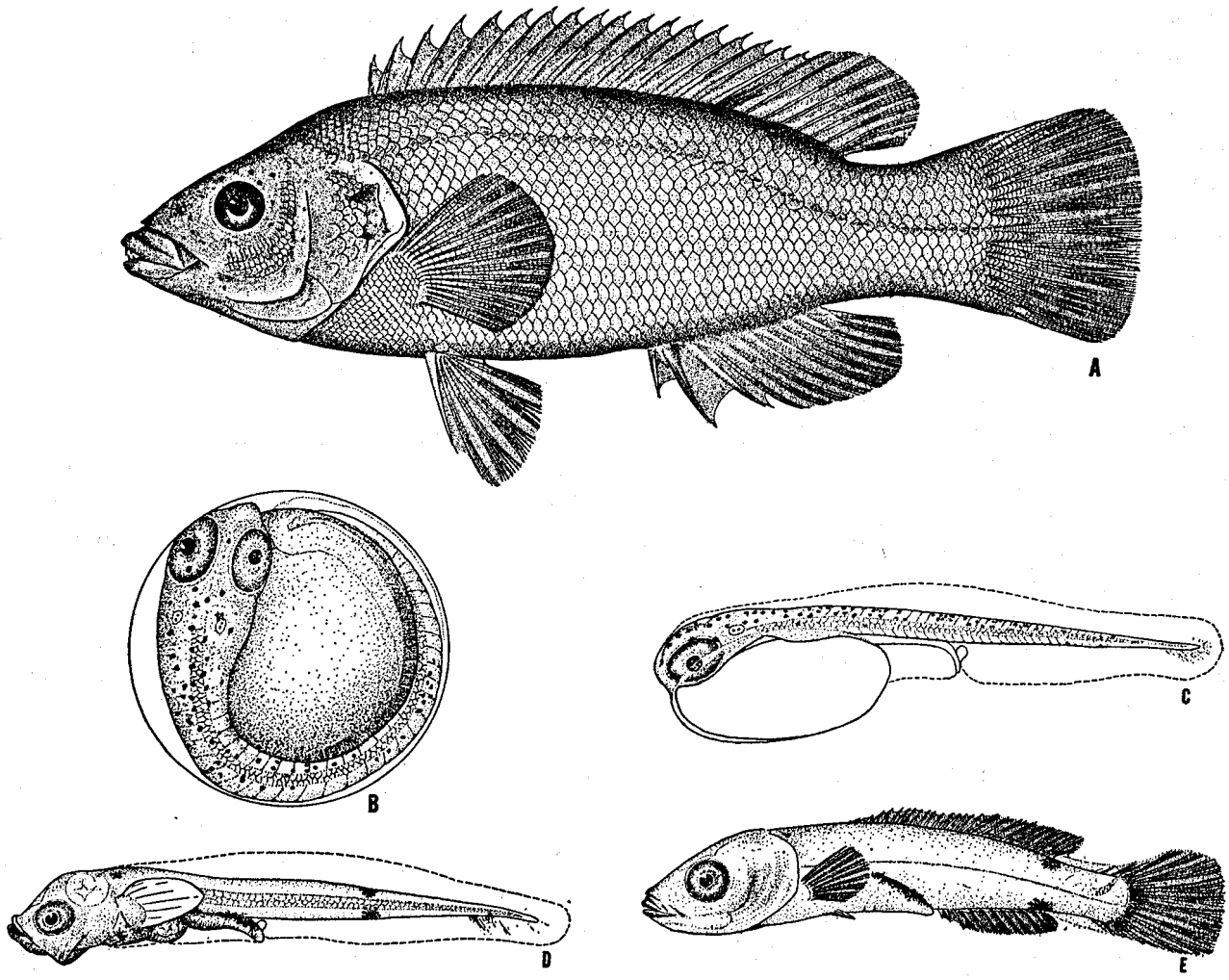

FIGURE 249.—Cunner (*Tautogolabrus adspersus*). A, adult, Woods Hole, Mass.; from Goode, drawing by H. L. Todd. B, egg; C, larva, newly hatched, 2.2 mm.; D, larva, 4.2 mm.; E, young, 8 mm. B–E, after Kuntz and Radcliffe.

flat-topped head (in the tautog the dorsal profile is high arched), small mouth at the tip of the snout, rather pointed nose, and protractile premaxillary bones. Its lips, too, are thinner than those of the tautog. It has several rows of conical teeth of various sizes in each jaw, the outer ones very stout. Its body and gill covers are covered with large scales (in the tautog there is a naked area in front of each gill opening), and its skin is so tough that the fish must be skinned before marketing. Its dorsal fin (about 18 spines and 9 or 10 soft rays) originates over the upper corner of the gill cover, i. e., a little in front of the pectoral fins, and runs back to the caudal peduncle. The first 4 or 5 rays of the dorsal fin are graduated, the others are of about equal lengths. The soft part is only a little more than one-third as long as the spiny part, and is rounded in outline. The rear margin of the caudal fin is slightly convex with rounded corners. The anal fin (3 stout spines and about 9 rays) originates under or behind the middle of the dorsal and corresponds to the soft part of the latter in outline. The ventrals stand under or a little behind the pectorals; both the ventrals and the pectorals are of moderate size, and the pectorals are rounded.

Color.—To describe the color of the cunner is to list all the colors of the bottoms on which it lives, for it is one of the most variable of fishes. As a rule the upper parts range from reddish brown (darker or paler) of a bluish cast to blue with brownish tinge, variously mottled with blue, brown, and reddish. Some fish, however, are uniform brown, while fish caught over mud bot-

tom are often very deep sepia. In some situations they may be dull olive green mingled with blue, brown, or rust color. Some cunners are slaty, but reddish or rust tones are apt to prevail when they are living among red seaweeds about rocks. Cunners caught in deep water are often almost as red as the rosefish; on the other hand we have seen very pale ones, more or less speckled all over with blackish dots, over sandy bottom. The belly is invariably of a bluish cast, more or less vivid, sometimes whitish, sometimes dusky, sometimes little paler than the sides. Some cunners have the lips and lining of the mouth bright yellow. Young fry are more or less dark-barred and blotched.

Size.—In the Gulf of Maine adult cunners measure about 6 to 10 inches in length and weigh less than half a pound, and one a foot long is very large. But a few are caught up to 15 inches long, and as heavy as 2½ pounds.

Habits.—The cunner is chiefly a coastwise fish. In our northern waters they are the most plentiful from just below tide mark downward. They swarm among eel grass (*Zostera*) and about the piling of wharves and under floats in harbors. They also run up into the deeper salt creeks, small fish farther than larger ones, though we have never heard of one in water that is appreciably brackish; and young cunners are often found among eel grass and in rock pools. Southward, however, from New York or thereabouts, most of them keep to water at least 15 to 20 feet deep, hence somewhat farther out, depending on the topography of the coast line and of the bottom.

At the other extreme, they are common enough at 10 to 15 fathoms in the inner parts of Massachusetts Bay, and not rare as deep as 25 to 35 fathoms on the offshore ledges and banks, and we have taken them as deep as 70 fathoms on Georges Bank. But the great majority live within 5 or 6 miles of the shore. And while there are some on the offshore grounds, such as Stellwagen Bank, Jeffreys and Cashes Ledges, and even on Georges and Browns Banks where the otter trawls frequently pick up a few, we have never heard of a large catch of them made far out at sea, whether along southern New England or to the northward. Most of the cunners that are caught the deepest and the farthest offshore are large ones that have probably strayed thither, and finding good feeding, have remained.

As far as we know adult cunners never depart far from the bottom, or from the rocks about which they make their homes, nor do they school. Many, it is true, may live together, but they act quite independently of one another, simply congregating because the surroundings are attractive. Cunners, like other rockfish, spend much of the time resting quietly or swimming slowly among the bunches of Irish moss (*Chondrus*) and fronds of kelp, or in the open spaces among the eel grass (*Zostera*), wherever the latter has reestablished itself, always on the lookout for food.

Cunners are year-round residents, broadly speaking, wherever they are found. At the most, they may descend into slightly deeper water to pass the coldest months,[75] or they may desert the shoalest parts of certain enclosed bays in midsummer to escape the very high temperatures produced there as the sun strikes the flats at low tide. They have been described as hibernating in the mud during the winter, or at least as lying among eel grass or rocks in a more or less torpid state. But we find no positive evidence of this; on the contrary, practical fishermen, among them Capt. L. B. Goodspeed, to whom we are indebted for many notes, inform us that cunners are to be caught in abundance on precisely the same spots in winter as in summer. In fact a few are landed in Boston during the cold months, and the only reason more are not brought in then is that there is so little demand for them.

It has long been known that the cunner is vulnerable to very low temperatures. Hazards of this sort are more frequent south of Cape Cod, where the fish are more likely to be caught in very shoal water in a sudden freeze, than in the Gulf of Maine, where active mixing by the tide usually prevents the water from chilling to the danger point, except at the surface. However, this did take place in Massachusetts Bay in the winter of 1835, when cunners came ashore in quantities between Marblehead and Gloucester. And the failure of the cunners to produce young within the Bay of Fundy (p. 478) suggest that the lower thermal limit to their successful reproduction is about 55°–56°, though the young fry as well as the adults are at home in temperatures close to the freezing point of salt water. The upper

[75] Ambrose (Proc. and Trans., Nova Scotian Inst. Nat. Sci., vol. 2, No. 2, 1870, p. 93) describes the cunners as moving out of Saint Margaret Bay, Nova Scotia, in autumn, to return early in May.

thermal limit, for the well being of the cunner, is something like 70°–72°, to judge from the distribution of the species.

Cunners are omnivorous. As a rule they find their livelihood browsing among seaweeds, stones, or dock piles, biting off barnacles and small blue mussels, with the fragments of which they are often packed full. They devour enormous numbers of amphipods, shrimps, young lobsters, small crabs, and other small crustaceans of all kinds; also univalve mollusks and the smaller bivalves, hydroids, and annelid worms. They sometimes eat small sea urchins, bryozoans, and ascidians, and they occasionally capture small fish such as silversides, sticklebacks, pipefish, mummichogs, and the fry of larger species. Finally, eel grass is often found in cunner stomachs besides the animal food. Small cunner fry taken at Woods Hole were found by Dr. Linton to have fed chiefly on minute crustacea such as copepods, amphipods, and isopods.

The cunner is a busy scavenger in harbors, congregating about any animal refuse, to feed on the latter as well as on the amphipods and other crustaceans attracted by the same morsels. They are also said to eat fish eggs, and no doubt feed to some extent on herring spawn. Our own belief is that cunners are always hungry, no matter what the stage of the tide.

The cunner spawns chiefly from late spring through early summer. The eggs are buoyant, transparent, 0.75 to 0.85 mm. in diameter, and they do not have an oil globule. Incubation occupies about 40 hours at temperatures of 70° to 72°, but it is probable that about 3 days are required for hatching in the cooler waters of the Gulf of Maine (55° to 65°). At hatching the larvae are about 2 to 2.2 mm. long, and at 15 mm. the young cunner is of practically adult form. On newly hatched larvae the pigment cells are scattered uniformly over head and trunk, but by the 3-mm. stage they have gathered into a pair of black spots, dorsal and ventral, about halfway between the vent and the base of the caudal rays, which are characteristic of the species. And these spots persist to about the 10- to 20-mm. stage. By the time the fry have grown to about 25 mm. they are as variable in color as their parents (it is on record that Louis Agassiz had 60 colored sketches of small cunners 3 to 4 inches long, of different hues, prepared at Nahant during a single summer).[76]

Fry of 1 to 1.2 inches have often been taken in August, and young fish up to 2 inches long in September in southern New England waters. Hence we may assume that Gulf of Maine cunners (probably hatched somewhat later) may average about 2 to 2½ inches by their first autumn, and 2½ to 2¾ inches by the following June when they are one year old, which Johansen [77] found true also of the earliest hatched fry in the southern side of the Gulf of St. Lawrence. The subsequent rate of growth has not been studied for the cunners of our Gulf. But Johansen's [78] age determinations for cunners of the Gulf of St. Lawrence make it likely that Gulf of Maine cunners 3 to 4 inches long are 2 years old; those of 4 to 5 inches 2 or 3 years old; those of 5 to 6 inches 3 years old; those of 6 to 7 inches 3 or 4 years old; those of 7 to 8 inches 4 or 5 years old; those of 8 to 9 inches 5 or 6 years old; those of 9 to 10 inches about 6 years old; and those of 10 to 11 inches 6 or 7 years old. But the relationship is complicated by the fact that female cunners run larger than males, so that males may be a year older than females of the same size.

Most of the cunners mature in their third summer (i. e., when 2 full years old) when 2¾ to 3½ inches long.

General range.—Atlantic coast of North America and the offshore banks, from Conception Bay, east coast of Newfoundland, and the western and southern parts of the Gulf of St. Lawrence,[79] southward in abundance to New Jersey, and occasionally as far as the mouth of Chesapeake Bay.

Occurrence in the Gulf of Maine.—The cunner is one of our most familiar fish, to be found all around the shore line of the Gulf. The Massachusetts Bay region is perhaps their chief center of abundance, and they are so numerous there in

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[76] The embryology and larval development and fry of the cunner have been described by Agassiz (Proc. Amer. Acad. Arts, Sci., N. Ser., vol. 9, 1882, p. 290, pls. 13 to 15); Agassiz and Whitman (Mem. Mus. Comp. Zool., vol. 14, No. 1, Pt. 1, 1885, p. 18, pls. 7–19, and Mem. Mus. Comp. Zool., vol. 40, No. 9, 1915, pls. 32–39); Kuntz and Radcliffe (Bull. U. S. Bur. Fish., vol. 35, 1918, p. 99, figs. 18–29); and more recently by Johansen (Contr. Canad. Biol., N. Ser., vol. 2, No. 17, 1925, pp. 440–450).

[77] Contrib. Canadian Biol., N. Ser., vol. 2, No. 17, 1925, p. 451.

[78] Johansen (Contrib. Canadian Biol., N. Ser., vol. 2, No. 17, 1925, pp. 451-455) worked out the age-length relationship for a large series of Gulf of St. Lawrence cunners by a study of their scales and otoliths.

[79] See Johansen, Contrib. Canadian Biol., Ser. 2, vol. 2, No. 17, 1925, pp. 5-6 [427–428]), for the distribution of the cunner in Canadian waters.

good years, along the rocky shores and around and over ledges, that no amount of fishing seems to have any effect on their numbers. Generally speaking, they are less numerous east of Casco Bay, and our experience has been that they are progressively less and less so eastward along the shore from Penobscot Bay toward the Bay of Fundy, but average larger. On the outer coast of Mount Desert, for example, it is unusual to catch one in the enclosed harbors (precisely the localities they frequent farther west and south), and most of those caught outside are very large. Thus we took many of 12 to 13 inches, averaging about 1½ pounds, near Baker's Island, off Northeast Harbor, in August 1922, and no small ones. But young fish in plenty, as well as adults, have been reported from Bluehill Bay, nearby,[80] where the water is warmer in summer.

Cunners are also taken, here and there, along the coast, eastward to the Grand Manan Channel, sometimes in numbers as in 1928, when so many were caught "about the rocks and in the coves to the south of West Quoddy," that they were reported in the press.[81] But they are so scarce ordinarily around Grand Manan and within Passamaquoddy Bay that only half a dozen large specimens had been taken there from the founding of the Biological Station at St. Andrews in 1906 down to the early 1920's.[82] And while the cunner is reported from Black River east of St. John, New Brunswick, it seems to be unknown farther in along the New Brunswick shore of the Bay of Fundy or in Chignecto Bay and Minas Basin at the head. But Annapolis Basin on the Nova Scotian side of the bay, harbors a few, while cunners of all sizes are so numerous in St. Mary Bay that this must be an important centre of reproduction and the source of the few large (i.e., old) ones that are caught farther up the Bay of Fundy. And they are reported along the western shore of Nova Scotia, as at Pubnico for example.

There are large cunners in small numbers on the offshore fishing grounds in our Gulf also, Stellwagen at the mouth of Massachusetts Bay, Cashes Ledge, and Georges and Browns Banks, as mentioned above (p. 475) in depths down to 50 fathoms or so. But it is not likely that they ever descend into the deep basins of the Gulf. Certainly our experimental trawlings have not yielded any there, 42 fathoms being the greatest depth at which we have known of a cunner taken anywhere in the inner parts of the Gulf.[83]

Extending our survey farther east and north, we find cunners reported as numerous all along the outer coast of Nova Scotia, including the many bays and inlets, also in the southern side of the Gulf of St. Lawrence from Cape Breton to the Gaspé Peninsula, including the shallow bays of Prince Edward Island and the shores of the Magdalen Islands, also up the west coast of Newfoundland as far as Bay of Islands. And they are to be expected at the heads of the bays along the south coast of Newfoundland for they have been taken in Conception Bay on the east coast. But this last is their most northerly known outpost on the Atlantic coast, and they have never been reported either from the estuary of the St. Lawrence or anywhere along the north shore of the Gulf of St. Lawrence.[84]

Cunners near Newport, Rhode Island, commence spawning by mid-May and June sees the chief production of eggs there and near Woods Hole, where most of the fish are spent after the first days of July, though eggs have been taken in abundance there until July 15, a few as late as August 15.[85] Probably spawning does not commence until June in the colder waters of our Gulf, but continues there through the later summer, for our towings have yielded many eggs, apparently of the cunner, in July and August. And the chief spawning season is about the same as this in the southern side of the Gulf of St. Lawrence, according to Johansen [86] and to Reid.[87]

Cunner eggs have been taken at our tow net stations along outer Cape Cod; near Race Point at the tip of the Cape; in Massachusetts Bay (where we have often towed them in great numbers in the tideways between the offlying ledges); and at the mouth of Penobscot Bay, as well as in sundry harbors. Blue Hill Bay inland from Mount Desert may be a breeding center, for small fry are reported there.[88] And eggs taken off

[80] Reported to us by Rear Adm. S. E. Morrison, U. S. Navy.
[81] Boston Transcript for August 29, 1928.
[82] Johansen, Contrib. Canadian Biol. N. Ser., vol. 2, No. 17, 1925, p. 5 [427].
[83] One was trawled at this depth at the mouth of Massachusetts Bay (lat. 42°28′ N., long. 70°13′ W.) by the *Albatross II*, July 28, 1931.
[84] See Johansen, Contrib. Canadian Biol., N. Ser. 2, vol. 2, No. 17, 1925, pp. 5-6 [427-428] for an account of the status of the cunner in the Gulf of St. Lawrence, and around Newfoundland.
[85] Agassiz and Whitman, Mem. Mus. Comp. Zool., vol. 14, No. 1, 1885, p. 18, Kuntz and Radcliffe, Bull. U. S. Bur. Fish., vol. 35, 1918, p. 99.
[86] Contrib. Canadian Biol., N. Ser., vol. 2, No. 17, 1925, p. 17 [439].
[87] Contrib. Canadian Biol. and Fish., N. Ser., vol. 4, No. 27, 1929.
[88] By Rear Admiral S. E. Morrison, U. S. N.

Libbey Island prove that cunners spawn in diminishing numbers eastward along the Maine coast nearly to the mouth of the Bay of Fundy. It is doubtful, however, whether eggs produced along the coast east of Mount Desert yield more than a very small proportion of fry, nor do cunners breed successfully in the cold water of the Bay of Fundy, where no small ones are ever seen. However, the Bay is simply a gap in the breeding range, for St. Mary Bay is a productive nursery. Both eggs and larvae were taken at various localities along the outer coast of Nova Scotia by the Canadian Fisheries Expedition during the summer; and the shoal inshore waters in the southern side of the Gulf of St. Lawrence are a productive spawning area.[89]

Larval cunners and small specimens generally, like their eggs, are so closely confined to the coast line that it is impossible to represent the localities where we have taken them on a general chart of the Gulf; in fact, all our catches of 100 or more have been made either in harbors or at most not a couple of miles from land.[90] There may be some successful reproduction on Casbes and Jeffreys Ledges. But we have found no evidence, whether of eggs or of young fry, that the few large cunners that wander offshore to Georges Bank produce any young there.

Variations in abundance.—No evidence is available as to how much the cunners may vary in abundance from year to year, along the coasts of our Gulf as a whole. But they may do so widely at a given locality. Thus we found very few of them in 1950 along the Cohasset shore, on the southern side of Massachusetts Bay, where they are plentiful ordinarily. And they were so scarce there during the summer of 1951, that persons raking Irish Moss (*Chondrus*) reported seeing hardly a cunner around the rocks where many are to be seen in most summers, and another acquaintance who usually baits a lobster pot or two with cunners taken in a cunner trap caught only one occasionally in that way.

Importance.—The cunner was a favorite pan fish once. During the 1870's the annual catch of the small boats fishing out of Boston was estimated as not much short of 300,000 pounds, while the fact that 104,100 pounds of cunners were reported for Maine in 1889, 148,300 pounds in 1898, and 281,500 pounds in 1905, shows that the annual harvest was still considerable to that time. But the reported catch had fallen to 30,695 pounds for Maine by 1919, and to about 10,000 pounds for the entire coast line of Massachusetts, south as well as north of Cape Cod. And Maine reported only 10,000 pounds for 1928 and 1,735 pounds for 1929, while the only cunners reported for Massachusetts were 30 pounds and 45 pounds for those 2 years, respectively. From that time down to 1947, commercial catches of cunners have been reported for Maine in only 3 years out of the 14.[91]

The landings reported for Massachusetts during this period suggests ups and downs so erratic and so extreme [92] that we hesitate to place any dependence upon them further than that landings ranging from 3,100 pounds to 18,700 pounds (average 7,450 pounds) for the years 1944–1947 show that a small demand continues for cunners. And we can witness that sizeable ones are very good pan fish.

Although not regarded as a game fish, the cunner affords amusement to thousands of vacationists near our seaside resorts. And the number caught, of which no record is kept, is so considerable that this must be classed as a useful little fish from the recreational standpoint.

Probably more cunners are caught on bits of clam than on any other bait. But they will take snails broken from their shells, bits of crab, lobster, or pieces of sea worms (*Nereis*) almost as freely. And we have even caught a few while trolling near rocks, for mackerel, with a small spinner tipped with a bit of white fish skin. The little ones are a great nuisance, often stealing the bait as fast as it is offered, and because it is a small-mouthed fish, very small hooks are best.

Tautog *Tautoga onitis* (Linnaeus) 1758

BLACKFISH; WHITE CHIN

Jordan and Evermann, 1896–1900, p. 1578.

[89] See Johansan (Contrib. Canadian Biol., New Ser., vol. 2, No. 17, 1925, p. 18 [440]; also Reid, Contrib. Canadian Biol. and Fish. N. Ser., vol. 4, No. 27, 1929.

[90] The precise records have been published elsewhere (Bull. Mus. Comp. Zool., vol. 58. 1914, p. 108, and vol. 61, 1917, p. 271).

[91] One hundred and seventy five pounds for 1933, 200 pounds for 1935, 45,300 pounds for 1938, an amount so large that we question its accuracy, especially since the entire catch was reported as made on "lines, trawl." No catch statistics are available for 1934, 1936, 1941, or 1942.

[92] Reported catches for Massachusetts jumped from 45 pounds for 1929 to 349,251 pounds for 1931, dropped to 0 for 1932, 152 pounds for 1933 and 0 again for 1935; rose to 27,800 pounds for 1937; were 0 again in 1938; but 53,500 pounds in 1940.

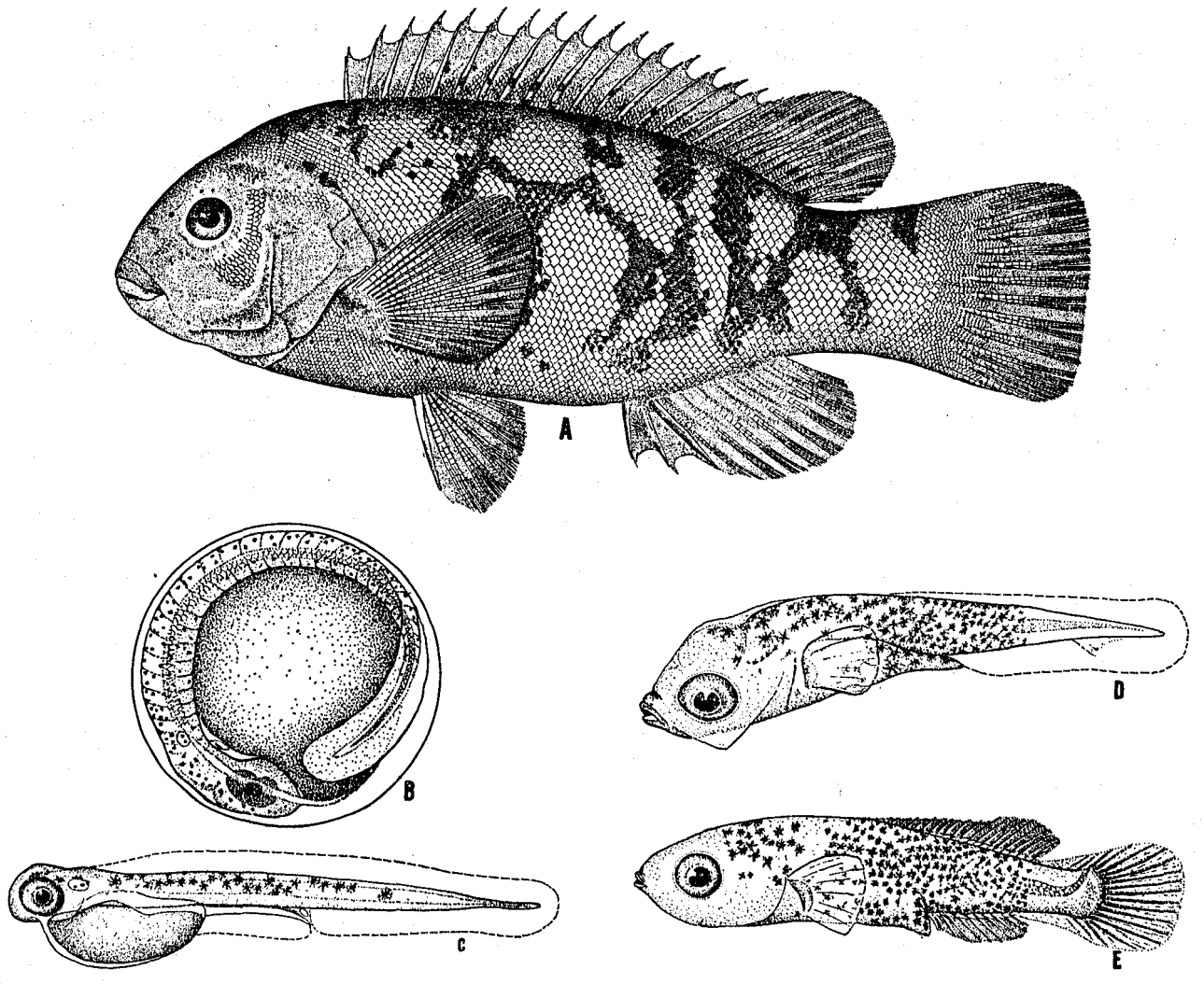

FIGURE 250.—Tautog. *Tautoga onitis*. A, adult, Woods Hole, Mass.; from Goode, drawing by H. L. Todd. B, egg; C, larva, one day old, 2.9 mm.; D, larva, 5 mm.; E, young fry, 10 mm. B–E, after Kuntz and Radcliffe.

Description.—The tautog suggests an overgrown cunner, but it is a heavier, stouter fish (about three times as long as deep, not counting the caudal fin) with caudal peduncle so broad and caudal fin so little wider than the peduncle that it is hard to hold a heavy one by the tail. The most obvious differences between the two fish are that the dorsal profile of the head of the tautog is high-arched, its nose is very blunt, and its lips are much thicker, giving it a facial aspect quite different from that of a cunner. A more precise if less obvious character is that the cheek region close in front of the gill opening (scaly in the cunner) is naked in the tautog and velvety to the touch. The fins of the tautog practically reproduce those of the cunner in relative size and location. The dorsal fin (16 to 17 spines and 10 soft rays) originates over the upper corner of the gill openings and runs back the whole length of the trunk; the anal (3 stout spines and 7 or 8 soft rays) corresponds in outline to the soft portion of the dorsal, under which it stands. The caudal fin is slightly rounded at the corners, the pectorals are large and rounded, and each of the ventrals has one stout spine. The jaw teeth of the tautog (in two series) are stout, conical, with the two or three in the front of each jaw larger than the others. The tautog has, besides, two groups of flat, rounded, crushing teeth in the rear of the mouth, as the cunner has also.

Color.—The tautog is a rather dark fish, generally mouse color, chocolate gray, deep dusky

green, or dull blackish, with the sides irregularly mottled or blotched with darker. These mottlings are more evident in the young than in adults and usually they are grouped as three pairs of more or less continuous bars. Large fish are often almost plain blackish. The belly is only slightly paler than the sides, but the chin usually is white on large ones, a very conspicuous character. Tautogs, like cunners, vary greatly in color on different bottoms, and also in their markings.

Size.—Maximum length about 3 feet. The 22½ pounder, 36½ inches long, mentioned by Goode[93] as caught off New York in 1876 and preserved in the United States National Museum, still remains the heaviest fish recorded definitely. Fish of more than 14 pounds are very rare, with 12-pounders unusual. Tautog average about 2 to 4 pounds as they come to market.

Habits.—The tautog is even more strictly a coastwise fish than the cunner. Northward from Cape Cod it is unusual to catch one more than 3 or 4 miles from the land, or deeper than, say 30–60 feet; we have never heard of one caught on a long line set for cod or haddock, and they are unknown on the offshore fishing banks. But they range farther out and deeper to the southward, being one of the commoner fishes caught in 10–13 fathoms on the Cholera Bank, 10–12 sea miles offshore from Long Island, and on Seventeen Fathom Bank, 8 miles off northern New Jersey. At the other extreme, they follow the flood tide up above low-water level around ledges, to prey on the abundant supply of blue mussels along the intertidal zone, dropping back into deeper water during the ebb. We have helped to seine many small ones close along the shore in only a few feet of water, at Provincetown as well as southward, and it is not unusual for tautog to run up into brackish water, but we have never heard of them entering fresh water.

Their favorite haunts are along steep, rocky shores; around breakwaters, offlying ledges and submerged wrecks; around the piers and docks; over boulder strewn bottoms; and on mussel beds. In some places, however, good numbers are caught on smooth bottom, far from any rocks (the eastern side of Cape Cod Bay is an example, see p. 482). And young fry, 2 to 4 inches long, are often seined on sandy beaches.[94]

When tautog are not feeding they are likely to gather in some hole or cleft among the rocks, where they lie inert, on their sides, often several crowded together, until the rising tide stirs them to activity again.[95] And they are extremely local fish, perhaps more so than any other Gulf of Maine species that is interesting either to the angler or to the commercial fisherman.

While tautog are seldom seen before well into April in any part of their geographic range, or after November, they do not carry out any extensive migrations with the seasons. At most, those that find themselves in shoal water in autumn may drop off into slightly deeper water, to spend the cold season lying among eelgrass (*Zostera*), where this has reestablished itself; in crevices among rocks; or (in the case of the young ones) in empty oyster and clam shells. They move and feed little then, though they have been caught in lobster pots there and on hook and line off Rhode Island.[96]

Tautog, like cunners (p. 475), are sometimes chilled and killed if they are caught in shoal water by a sudden cold snap, as happened along Rhode Island and southern Massachusetts in 1841, 1857, 1875, 1901, and no doubt on many other occasions that have not found their way into print or into the records of the Bureau of Fisheries.

Food.—Tautog feed on invertebrates, chiefly on mollusks (both univalves and bivalves), especially on mussels which are the chief diet of the tautog living about ledges, and on barnacles that they pick off the rocks. Crabs and hermit crabs are favorite morsels. They also eat sand dollars, scallops, amphipods, shrimps, isopods, and lobsters, swallowing the smaller ones whole, but cracking the larger with their crushing teeth (p. 479). A tautog of about 2 pounds that we once caught off Cohasset, Mass., had made a meal of gammarid amphipods (sand fleas) gleaned from among the rockweed with which the ledge was clothed, though cunners caught at the same time and place were full of barnacles. We think it likely that tautog living in shallow bays (Duxbury, for example) prey

[93] American Fishes. 1888, p. 292.

[94] We have seined tautog fry in such situations in localities as far apart as Provincetown Harbor; Woods Hole, Cape Poge Bay, Marthas Vineyard, and Cape Charles Beach, Va. And good numbers of larger tautog have been reported as caught occasionally in nets in the vicinity of Provincetown; 8,700 pounds for example in 1898, and 5,800 pounds in 1899.

[95] We have often observed this habit of theirs in the large live tank at the Woods Hole Oceanographic Institution.

[96] Tautog have been described as burying in the mud, but we cannot vouch for this. And we put no credence whatever in the old myth that the vent of the tautog closes over in winter.

to a considerable extent on sea worms (*Nereis*); certainly they take these freely as bait.

Breeding habits.—About Woods Hole the tautog spawn chiefly in June, and the season for such of them as breed north of Cape Cod is probably early and midsummer. The eggs are buoyant, without oil globule and resemble those of the cunner, except that they are a little larger (0.9 to 1 mm. in diameter). At a temperature of 68° to 72° incubation occupies 42 to 45 hours, and probably 10 to 12 hours longer in the cooler water of Massachusetts Bay. The larvae [97] are about 2.2 mm. long at hatching. When 4 days old (temperature of 68°–72°) they have grown to 3.3 mm., the yolk has been absorbed, and the mouth is fully formed. Larvae of 5 mm. show the first traces of the caudal fin rays; the dorsal and anal fins are differentiated at 10 mm. and by the time the little fish are about 30 mm. long they show the fins, form, deep caudal peduncle, and blunt nose of the adult tautog. The larvae and youngest fry of the tautog and of the cunner resemble each other closely in general form, but the arrangement of the pigment offers a ready means of identification at all but the very earliest stages, for the black pigment cells remain more or less uniformly scattered over the whole trunk in the tautog, whereas they soon cluster in two definite patches in the cunner as is described elsewhere (p. 476).

Probably Tracy [98] is correct in assuming that the young tautogs of 3 to 8 inches, which may be seined in abundance along the shores of southern New England in summer, are 1 year old. Nothing definite is known of the rate of growth of older tautog, nor at what age they mature. But we suspect that large ones of 8 pounds and more may be 8 to 10 years old.

General range.—Atlantic coast of North America from the outer coast of Nova Scotia to South Carolina, chiefly south of Cape Ann; most abundant between Cape Cod and the Delaware Capes, and restricted to the immediate vicinity of the coast.

Occurrence in the Gulf of Maine.—The center of abundance of the tautog lies to the south of Cape Cod. Most of the authors, in fact, who have written of it have accepted Mitchill's [99] statement that it was not native north of Cape Cod and was introduced there shortly prior to 1814, there being no definite record of them in the Gulf of Maine prior to that date. But it seems far more likely that the anonymous writer who stated in the Gloucester Telegraph of May 5, 1860, that tautog had been plentiful there many years before, and had merely reappeared after a period of scarcity, was correct; also that this reappearance would have taken place in any event, even if none had been liberated north of Cape Cod.

Apart from Mitchill's statement that by 1814 the Boston market had a full supply (which may have come from south and not north of Cape Cod), the first positive record of any in Massachusetts Bay is of several that were caught along the Cohasset rocks in 1824,[1] which the local fishermen said was a species new to them. Tautog, however, were being caught in numbers in the inner parts of Massachusetts Bay (e. g., Lynn, Nahant, Boston Harbor) by 1839; they were more abundant then around Manomet Headland in Plymouth; and they already supported a considerable hook-and-line fishery at Wellfleet. A few years later their presence was established for the coast of Maine, and in 1851 tautog were reported as common (according to Perley) in St. John Harbor, New Brunswick, though these Bay of Fundy fish were introduced (not native). In 1876 the weirs north of Cape Cod took 2,274 pounds of tautog, and in 1879 Goode and Bean described them as abundant in many localities about Cape Ann.

At present (or within the last few years, for this fish fluctuates in abundance from year to year), the regular range of the tautog includes the whole coast line from Cape Cod around to Cape Ann, in suitable localities.

Tautog are less regular northward from Cape Ann, less abundant, and more local. But there are some tautog grounds about the Isles of Shoals, off Cape Porpoise, and about Casco Bay, where Kendall wrote of them in 1931 as having been "locally numerous" for some time previous.[2] We have also heard of tautog along the ledges near Boothbay Harbor and in Penobscot Bay. East of the latter tautog certainly are not common.

[97] Kuntz and Radcliffe (Bull. U. S. Bur. Fish., vol. 35, 1918, p. 92) describe the eggs, larvae, and fry.

[98] 40th Ann. Rept. Inland. Fish. Rhode Island, 1910, p. 137.

[99] Trans. Lit. Philos. Soc., New York, vol. 1, 1815, p. 400.

[1] Goode, Fish. Ind., U. S., Sect. 1, 1884 p. 269.

[2] According to Kendall (Bull. 58, Boston Soc. Nat. Hist., 1931, p. 10–11) the green crabs (*Carcinides maenas*) found in Casco Bay were not native there but had been introduced as tautog bait.

And it is so scarce a fish in the Passamaquoddy region (it has long since vanished from St. John Harbor) that three specimens, only, are known to have been taken there within recent years.[3]

One has been taken near the head of the Bay of Fundy on the Nova Scotian side (Scotts Bay, Kings County) one on the Nova Scotian shore of the open Gulf of Maine (Cranberry Head, Yarmouth County), and one on the outer coast of Nova Scotia near Halifax (Petpeswick Harbor, Halifax County), this last being the most northerly record for the tautog.[4]

The more productive tautog grounds north of the elbow of Cape Cod of which we chance to know are the Cape Cod Bay shore southward from Wellfleet; the Sandwich-Sagamore shore with the jetties at the mouth of the Cape Cod Canal; the bouldery ground around Manomet headland and nearby; Gurnet Point at Duxbury; the ledges off Scituate and Cohasset and especially those off Swampscott; the Nahant, Marblehead, and Magnolia Rocks; and here along the rocky shore from Gloucester Harbor around Cape Ann. The Cape Cod Bay grounds are exceptional, for the tautog caught there are on smooth bottom, not among ledges which are the usual haunts. We have also known of good-sized tautog taken inside of Nauset Inlet (where there are scattered boulders only), one in a lobster pot during the summer of 1949. And quite a number, large and small, are caught within Duxbury Bay, especially around the pilings of Powder Point Bridge.

Although tautog tend to gather in certain choice spots, they move around enough so that some idea of their relative importance along different parts of the coast line can be determined from the catches made in pound nets. Thus the average yield per pound net or trap has run from twice to 20 times as great for Cape Cod Bay as for the north shore of Massachusetts Bay in reasonably good years [5] during the periods between 1890 and 1921, when the catches for Massachusetts were reported by towns, hence can be localized.[6]

The regional discrepancy has not always been so wide in seasons when the Cape Cod Bay catch has been smaller; in 1909, for instance, when the total catch reported for Cape Cod Bay was only 635 pounds of tautog (with 27 pound nets in operation) the average catch per pound net or set of pound nets was nearly as great for the coast from Boston Harbor to Gloucester (total catch 203 pounds with 12 nets or sets of nets in operation). But the pound nets take a few tautog in Cape Cod Bay, even in years when they are so scarce north of Boston that none at all have been reported for Essex County, despite the fact that the bottom seems more suited to tautog there because rockier. The slightly lower temperature along the north shore of Massachusetts Bay may have been the contributing factor.

During the peak period 1895–1899, the chief center of abundance for tautog for Cape Cod Bay seems to have been along the Sagamore shore, where the yearly catch, per pound net, then averaged about 2¼ times as great as for the eastern shore of the Bay,[7] Brewster to Provincetown. And catches of 18,100 pounds of tautog by 2 pound nets at Sandwich in 1895 and 36,010 pounds of tautog in 12 nets in Brewster in 1898 suggest concentrations of tautog quite out of the ordinary. But the best tautog fishing has been reported from the Wellfleet region in recent years.

Catch statistics suggest, also, that not much interchange takes place between the populations of tautog of the Cape Cod Bay region, and of the the rocky coasts along the north shore of Massachusetts Bay, for the peaks of abundance (as judged from the reported landings) have fallen in different years in these two regions.

April 29 (1949) and May 1 (1950) are the earliest dates at which we have heard of tautog caught either in Massachusetts Bay or in Cape Cod Bay (Duxbury in both instances).[8] In 1950, which appears to have been an "early" season, they were reported as biting well in Cape Cod Bay by May 25 and at Duxbury by the last days of the month;

[3] One in Passamaquoddy Bay in 1909 or 1910 (Reported by Huntsman Contrib. Canadian Biol. (1920–1921) 1922, p. 64); a second in a tidal tributary of the St. Croix River in the summer of 1934, and another there in August 1935 (reported by McGonigle and Smith, Proc. Nova Scotian Inst. Sci., vol. 19, 1936, p. 160); all of these were taken in herring weirs.

[4] These Nova Scotian specimens are in the Provincial Museum at Halifax; see Vladykov and McKenzie (Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 100), and Fowler (Proc. Acad. Nat. Science, Philadelphia, vol. 67, 1916, p. 517) for further details.

[5] The reported catches for 1895, 1897-1900, and 1910 were 5 to 43 times as great for Cape Cod Bay as for Essex County, made in 1.5 to 2.3 times as many pound nets or sets of pound nets.

[6] 1890–1900; 1906–1911; 1917–1921, in particular. Data are also available for earlier years.

[7] Total catch, Sagamore and Sandwich, 41,053 pounds, with 2 to 5 pound nets or sets of nets working in the different years; Brewster to Provincetown, 18,549 pounds with 14 to 24 pound nets or sets of pound nets in operation yearly.

[8] As reported in Salt Water Sportsman for May 25, 1950.

further up the Bay, however, as at Cohasset and Swampscott, very few are caught before July. In most years the best catches are made in August, September, and into October, and we have not heard of a tautog taken anywhere in the Gulf after early November at latest.

The tautog that frequent any particular ground in the Massachusetts Bay-Cape Cod region may be expected to pass the winter in a more or less inactive state close at hand, as they do farther south (p. 480). But we have no first-hand information in this respect.

Presumably the tautog spawn chiefly in June in Cape Cod and Massachusetts Bays, as they do along southern Massachusetts; perhaps into July.[9] But we have found no tautog eggs nor larvae in our towings in the Gulf of Maine, nor have any tautog less than 2 or 3 inches long been credibly reported in Cape Cod Bay or to the northward (we may have missed them as tautog spawn close in to the coast). And we have yet to learn whether the fluctuating stock north of Cape Cod is maintained wholly by local reproduction, or is reinforced from time to time by immigrants from the south. It would be especially interesting to know how many tautogs find their way from Buzzards Bay to Cape Cod Bay through the Cape Cod canal.

Fluctuations in abundance.—The pound net catches of tautog (averaged for 3-year periods) suggest that a moderate and irregular rise in abundance took place in the northern side of Massachusetts Bay from 1890–1892 (yearly average, 140 pounds) to 1899–1901 (yearly average, 1,049 pounds), followed by a corresponding decrease so extreme that none at all were reported from the pound nets of Essex County for 1917 to 1919, in the Massachusetts statistics,[10] only 42 pounds for 1920, and none for 1921. The local stock seems next to have built up again about to its former level, to continue so during the period 1928–1938.[11] Our angler-correspondents report that some tautog are caught along the Essex County rocks every summer, since then. But the fisheries statistics have not afforded information as to the tautog situation there for the past few years.

In the Cape Cod Bay region (again according to statistics of the landings) tautog seem to have been scarce for some years through 1890; then to have increased in numbers to a rather pronounced peak of abundance in 1895–1900, when the reported catch averaged about 13,190 pounds yearly (the maximum 22,264 pounds in 1895), an increase that came 5 or 6 years earlier than the upswing recorded for the north shore of Massachusetts Bay. There appear to have been fewer in 1899 (6,282 pounds recorded); perhaps not more than half as many in 1906 or in 1907 (3,168 pounds and 2,934 pounds reported) when the publication of the catches by towns was resumed, and apparently rather fewer still during the 4-year period 1908–1911.[12]

The Cape Cod Bay population seems to have been at about this same level in 1917, and tautog seem to have been more plentiful again in 1918, when the very large catch of 36,000 pounds was reported from the pound nets along the shore line of Brewster. But they fell, then, to so low an ebb that the reported yearly catches for 1919 and 1920 were only 801 and 877 pounds, respectively, and 44 pounds in 1921. Catch records tell nothing as to the status of the tautog in Cape Cod Bay since 1921.[13]

The disappearance of the eel grass (*Zostera*) about 1930–1931, must have altered their local habitat for the worse. But the stock seems to have built up again with the reappearance of eel grass here and there. And tautog have been plentiful enough around Cape Cod Bay during recent summers for party boats, hand-lining, to have made good catches there day after day. The traps at Barnstable continue to take some even though they are set on sand bottom, with their best catches in autumn when a single lift of 4 traps sometimes yields as much as 400 pounds.

According to local report, 1950 was a very good tautog season in Cape Cod waters. But the commercial fishermen took few or none smaller than one-half pound that year.[14] What this presages for the future remains to be seen.

Importance.—Tautog are not plentiful enough anywhere north of the elbow of Cape Cod to be of any great commerical importance, and never have

[9] In 1950 the "spawning run" was reported as about over in Cape Cod Bay by the end of the first week in June (Salt Water Sportsman for June 9, 1950).

[10] One hundred and fifty-eight pounds were reported for that year in the statistics of the U. S. Bureau of Fisheries.

[11] Landings, Essex County, 1928–1931, 1933, 1935, 1938, 0–803 pounds, average about 300 pounds. There is no reason to suppose that the 10,700 pounds reported for 1937 came from the Gulf of Maine. See footnotes p. 415; and p. 422.

[12] Maximum, about 3,900 pounds in 1910; minimum, 635 pounds in 1909; yearly average, about 1,400 pounds.

[13] There is no way of knowing how great a part of the catches reported in subsequent years from "Barnstable County" came from the Cape Cod Bay shore; i. e., from the Gulf of Maine.

[14] Information supplied by Henry Lyman.

been, but there is a ready sale for all that are brought to market, most people thinking this a very good table fish. And with so few fishes in the Gulf of Maine that can be classed as "game" (that is, affording sport on rod and reel), we may well wish the tautog were more plentiful there, for they put up so strong a resistance that tautog fishing is very good sport indeed.

Along the stretch from Manomet Headland, Plymouth, to Cape Ann, tautog are caught either from a boat at anchor over submerged ledges or bouldery bottom, or by casting with a long rod from dry ledges or from the rocky coast line. In either case, the fish are so local and irregular in distribution (depending on the food supply and also on the contour of the rocks) and so stationary that it is worth fishing for them only in certain spots. Even so, a few feet one way or the other may mean the difference between success and failure. In Cape Cod Bay, however, where the tautog are on smooth bottom, they lie in little openings among eel grass (whenever there is any), "with just their snouts sticking out" as an angler friend writes us,[15] "and, by lowering a fiddler or hermit crab in the clear spot in front of them, they will be caught in very shallow water."

Fishing the Cohasset rocks, we have found green crabs (*Carcinides*) the most attractive bait, whole if small enough, cut if larger; rock crabs (*Cancer*), or hermit crabs second best; large snails or cockles (*Polynices*) fairly good; lobster would perhaps be best of all, were it not so expensive. Mussels are often successful. And small whole clams are good, hooked through the "neck", (actually the siphon) with the shell cracked so as to let the juices escape, but they are next to worthless if shelled because they are stolen almost at once by the swarms of cunners. Anglers tell us that the same baits are used along the north shore of Massachusetts Bay. In Cape Cod Bay, where tautog are caught on smooth bottom (p. 480), the baits most used are hermit crabs and fiddler crabs.[16] We once had a good-sized tautog strike a sea worm (*Nereis*), behind our boat, while trolling for striped bass.

When a tautog bites, it passes the bait back to the pharyngeal teeth, to crush the shell before swallowing; in doing so he gives several distinctive jerks or twitches. This is the time to hook him; many are missed by being struck too soon by anglers not experienced in the ways of the tautog.

THE REMORAS OR SHARK SUCKERS. FAMILY ECHENEIDAE

The several remoras are easily distinguished from all other fishes by the fact that the spiny part of the dorsal fin is modified into a flat oval sucking plate, composed of a double series of cartilaginous crossplates with serrated free edges, and situated on the top of the head and neck. All the remoras, too, are slender of form with the lower jaw projecting well beyond the upper. Their mouths are armed with many small pointed teeth; their soft dorsal and anal fins are about the same in form and size, the one above the other; and their pectoral fins are set high up on the sides. The lower surface of the head is convex, the upper flat (a very conspicuous feature) with the lower surface of the body nearly as deeply colored as the upper so that the back is often mistaken for the belly. The members of this family all attach themselves to other fishes, or to sea turtles, by their sucking disk, usually clinging to the sides of their hosts, but often within the mouth or gill cavities of the larger sharks and of the giant rays.[17] They are carried about in this way, and they feed on the scraps from the meals of their transporters. All the remoras are tropical; they appear only as strays in boreal seas, usually fast to sharks or to swordfish.

We follow Sumner, Osburn, and Cole[18] in uniting under one species the shark sucker (*naucrates*), with more than 21 plates but a sucking disk less than one-fourth as long as the body, and the pilot sucker (*naucrateoides*), with only 20 or 21 plates but longer, fishes that are otherwise indistinguishable one from the other.

[15] Quoted from a letter from Henry Lyman.

[16] Not having fished there for tautog, we welcome this information from Henry Lyman.

[17] Gudger (Natural History, vol. 22, No. 3, May-June 1922, pp. 243-249) gives an interesting account of this habit.

[18] Bull. U. S. Bur. Fish. vol. 31, Pt. 2, 1913, p. 766.

KEY TO GULF OF MAINE REMORAS

1. Pectoral fins pointed; ventral fins attached to the belly for less than one-third of their length.. Shark sucker, p. 485
   Pectoral fins rounded; ventral fins attached to the belly for more than half of their length..... 2
2. Dorsal fin of 29 rays or more; at most 17 plates in the sucker..... Swordfish sucker, p. 486
   Dorsal fin of only about 23 rays; about 18 plates in the sucker..... Remora, p. 487

Shark sucker *Echeneis naucrates* Linnaeus 1758

PILOT SUCKER; WHITE-TAILED SUCKER

Jordan and Evermann, 1896–1900, pp. 2269–2270, as *Echeneis naucrates* Linnaeus 1758 and *E. naucrateoides*, Zuiew, 1789.

Description.—The most distinctive characters of the shark sucker are mentioned above. It is a very slim fish, 11 or 12 times as long as it is deep, nearly round in cross section, and tapering to a very slender caudal peduncle. The sucking plate, reaching from close behind the tip of the snout back over the nape of the neck even with the middle of the pectoral fin, is about as broad as the head, flat, oval, and with 20 or more very conspicuous transverse plates. The soft dorsal fin (32 to 41 rays) and the anal fin (31 to 38 rays) both originate about the mid length of the body, and they both extend nearly to the base of the caudal fin. Both of them taper, too, from front to rear, but the anal is more concave in form than the dorsal. The caudal fin is slightly concave in old fish but in young ones its central rays are the longest. The ventral fins are pointed like the pectorals below which they stand, and their inner rays are attached to the skin of the abdomen for only a short distance. The broad-based pectoral fins are set so high up on the sides that their upper margins are close below the overlapping edge of the sucking plate.

Color.—The general ground tint is slaty or dark brownish gray, with the belly nearly as dark as the back. Each side is marked by a broad darker brown or sooty stripe with white edges, that runs from the angle of the jaw to the base of the caudal fin but is interrupted by the eye and by the pectoral fin. The caudal fin is velvety black with white corners, a character noticeable enough to give rise to a vernacular name. The dorsal and anal fins are dark slate color or black, more or less margined with white. The pectorals and ventrals are black, either plain or more or less pale edged.

Size.—Reaches about 38 inches.

General range.—Cosmopolitan in warm seas, north as a stray to Halifax, Nova Scotia,[19] on the Atlantic Coast of North America.

Occurrence in the Gulf of Maine.—So far as we can learn no shark sucker of this species has been reported from the Gulf for many years; in fact, the only positive records of it there are for one taken from the bottom of a fishing boat in Boston Bay some time prior to 1839; [20] for a second reported by Wheatland [21] from Salem Harbor (reidentified by

[19] Leim Proc. Nova Scotian Inst. Sci., vol. 17, Pt. 4, 1930, p. XLIV.

[20] Described and illustrated by Storer (Fishes of Mass., 1867, p. 210, pl. 32. fig. 3).

[21] Jour. Essex Co., Nat. Hist. Soc., vol. 1, No. 3, 1852, p. 125.

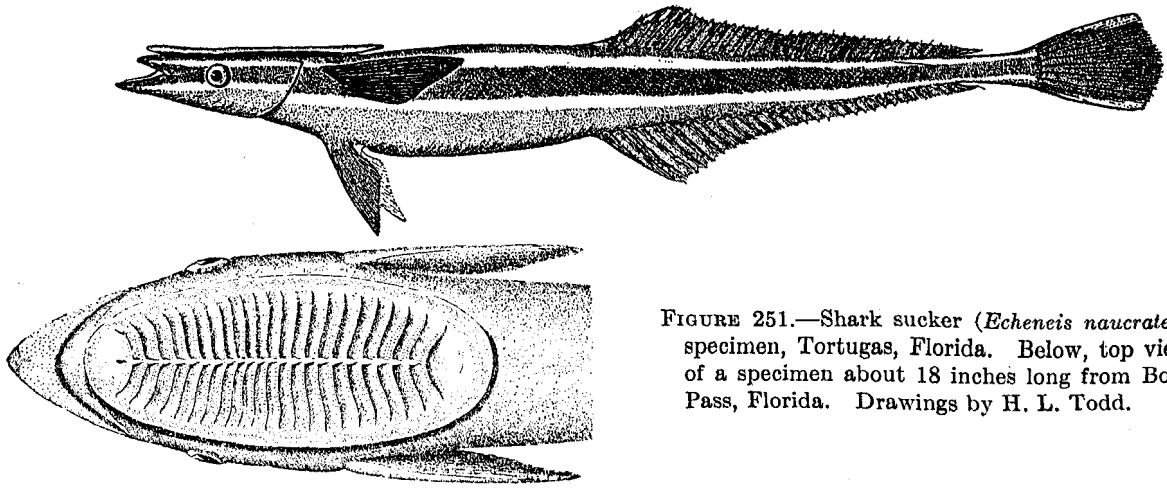

FIGURE 251.—Shark sucker (*Echeneis naucrates*), 11-inch specimen, Tortugas, Florida. Below, top view of head of a specimen about 18 inches long from Boca Grande Pass, Florida. Drawings by H. L. Todd.

Goode and Bean as *naucrateoides*); and for a third reported by Goode and Bean [22] as taken at the mouth of the Merrimac River in June 1870. And Leim [23] reports one from Halifax Harbor, Nova Scotia, during the fall of 1928. It is only as the rarest of strays that it ever wanders north of Cape Cod, clinging to some ship (for such is a common habit in its tropical home) or to some shark.

Swordfish sucker *Remora brachyptera* (Lowe) 1839 [24]

Jordan and Evermann, 1896–1900, p. 2272

Description.—This is a stouter fish than the shark sucker (p. 485), being only about seven times as long as it is deep (counting the caudal fin) and about as thick through the shoulders as it is deep, with a thicker caudal peduncle. And although the sucking plate is as long, relatively, it consists of only 14 to 17 ridges. Furthermore, the pectoral fins of the swordfish sucker are relatively shorter than those of the shark sucker, softer, and rounded instead of pointed, while the upper margins of these fins are not so close to the edge of the sucking plate. The ventral fins, too, are attached to the skin of the abdomen along their inner margins for at least one-half their length, as noted above (p. 485). The long dorsal fin (29 to 32 rays) of the swordfish sucker serves to separate it from the remora (p. 487).

Color.—Described as light reddish brown above and as darker below, with paler dorsal and anal fins. A distinctive feature is that it lacks the side stripes and white fin edgings so characteristic of the shark sucker.

Size.—A length of 12 inches is the maximum so far recorded.

General range.—Warm and warm-temperate seas generally, probably paralleling that of the swordfish.

Occurrence in the Gulf of Maine.—Goode and Bean's [25] description of this sucker as not infrequently accompanying swordfish into Massachusetts Bay probably applies to the whole Gulf except the Bay of Fundy, for specimens have been brought in from near Matinicus Rock and near the Isles of Shoals; fishermen occasionally speak of seeing "suckers" clinging to the swordfish they harpoon on the offshore Banks; sometimes several fastened to a single swordfish. But they also report far more swordfish lacking these uninvited guests than carrying them, and this has been the case with the few fish harpooned by the *Grampus* during our cruises in the Gulf. Suckers are described by eyewitnesses as usually fast to the shoulder of the swordfish, nor have we heard of one actually within the gill cover of the latter, though very likely they refuge there, for one has been

[22] Bull. Essex Inst., vol. 11, 1879, p. 20.
[23] Proc. Nova Scotian Inst. Sci., vol. 17, No. 4, 1930, p, XLVI.
[24] Jordan, Evermann, and Clark (Rept. U. S. Comm. Fish. (1928), Pt. 2, 1930, p. 449) place this species in the genus *Remoropsis* Gill, 1864.
[25] Bull. Esesex Inst., vol. 11, 1879, p. 21.

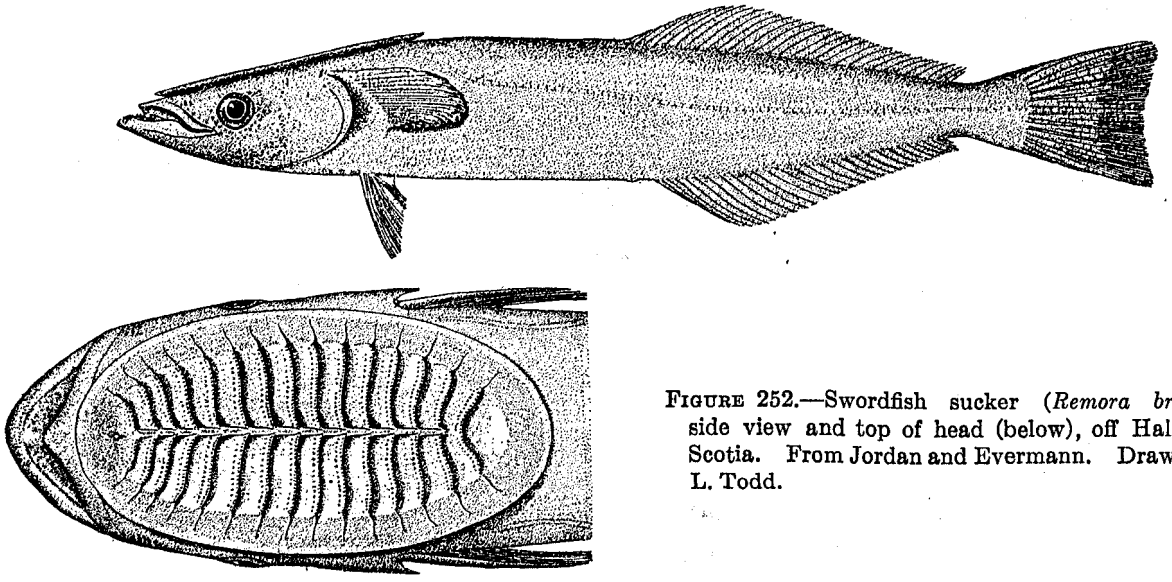

FIGURE 252.—Swordfish sucker (*Remora brachyptera*), side view and top of head (below), off Halifax, Nova Scotia. From Jordan and Evermann. Drawings by H. L. Todd.

taken from the gill cavity of a sunfish (*Mola mola*); others have been found in the mouths and gill cavities of large sharks.

Nothing beyond this is known of its way of life. Presumably it feeds on fragments of the fish killed by its host, as the shark sucker does whose actions are better known. Presumably, too, it is an active a swimmer as are its relatives. Nothing is known of its breeding habits.

Remora *Remora remora* (Linnaeus) 1758

Jordan and Evermann, 1896–1900, p. 2271.

Description.—The chief distinctions between the remora and the swordfish sucker is that it has a larger number of ridges in its sucking plate on the average (16 to 20, as against 14 to 17), and that there are only 22 to 25 rays in its dorsal fin, whereas the swordfish sucker has 29 to 32. Like the latter, it is a stouter fish than the shark sucker (p. 485), and its ventral fins are similarly attached to the skin of the abdomen along their inner edges.

Color.—Uniform brownish, blackish, or sooty, both above and below.

Size.—Maximum length about 18 inches.

Habits.—Very little is known of the life history of the remoras. The young fry of this, and of other species of *Remora* have been taken in the open Atlantic, usually in June or July which suggests a sharply limited spawning period. A remora may join a shark, or other host, when only about 1½ inches (3 to 4 cm.) long.[26] But we have yet to learn how long or how constantly one may accompany a single shark, or how often it may transfer from one host to another.

General range.—Tropical seas generally; very common in the West Indies, occasionally north to New York and to Woods Hole, and only a stray north of Cape Cod. It is usually attached to large sharks or to sea turtles.

Occurrence in the Gulf of Maine.—The only Gulf of Maine records for the remora, up to 1925, were of one taken many years ago in Salem Harbor, no doubt brought thither clinging to the bottom of some ship in from a southern voyage, as Goode and Bean [27] remarked; and of one in the Museum of Comparative Zoology that was taken at Provincetown long past. More recent records are of one found clinging to the bottom of a lobster trap in Portland Harbor in 1931, probably brought in by some West Indian schooner, several of which had recently been in the harbor;[28] of a second found sucking to the gills of a blue shark *Prionace glauca* caught on the northeast edge of Georges Bank, August 1 of that same year; and of a third fastened to a shark of the genus *Carcharhinus* that was caught at the surface over the southeast slope of Georges Bank in July 1939.[29]

Records from farther east and north along the American coast are of one taken from a blue shark, 10 miles off Cape Sable, June 1, 1933; [30] of another (also from a blue shark) west of Sable Island, September 9, 1934; and of two taken from sharks on St. Pierre Bank, south of Newfoundland, one of them on August 13, 1936,[31] the other on October 7, 1937.[32]

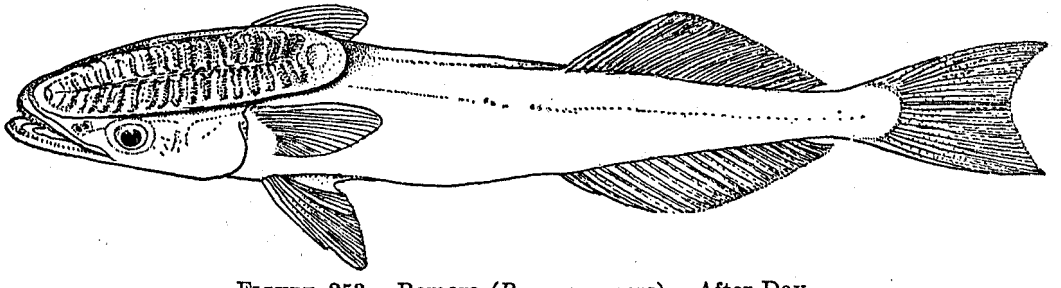

FIGURE 253.—Remora (*Remora remora*). After Day.

THE SAND LAUNCES. FAMILY AMMODYTIDAE

The slender, round-bodied sand launces suggest small eels in general appearance. Eel-like, too, they lack ventral fins, and they swim with eel-like undulations from side to side. But they are not even remote relatives of the true eels, from

[26] Tåning, Nature, vol. 20, 1927, p. 224.
[27] Bull. Essex Inst., vol. 11, 1879, p. 21.
[28] Reported to us by the late Walter H. Rich, of the U. S. Bureau of Fisheries.
[29] The last 2 are in the collection of the Museum of Comparative Zoology.
[30] Vladykov, Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 7.
[31] McKenzie and Homans, Proc. Nova Scotian Inst. Sci., vol. 19, 1938, p. 279.
[32] McKenzie, Proc. Nova Scotian Inst. Sci., vol. 20, 1939, p. 18.

which they are distinguishable at a glance by their forked caudal fin, separated by an appreciable space from both dorsal and anal fins; by their wide gill openings; and by the presence of a large bony gill cover, not to mention other anatomic characteristics equally important if less obvious. Only one species inhabits our Gulf.[33] The larger North European launce (*A. lanceolatus*), which grows to 12 inches and has 2 stout teeth on the roof of its mouth, has no representative in our side of the Atlantic.

Sand launce *Ammodytes americanus* De Kay 1842 [34]

SAND EEL; LAUNCE; LANT

Jordan and Evermann, 1896–1900, p. 833.

Description.—The sand eel is a slender fish, its body about one-tenth as deep as it is long (not counting caudal fin), with long head and sharply pointed nose, wide gill openings, and large mouth with the lower jaw projecting far beyond the upper. The jaws are toothless, and there are no teeth on the roof of the mouth. There is one long low dorsal fin, soft-rayed (59 to 64 rays; no spines), rising somewhat in front of the tips of the pectorals and running back along the whole length of the body nearly to the base of the caudal fin. The anal (28 to 32 rays), similar in outline and equally lacking spines, originates slightly behind the middle of the dorsal and runs equally far back. The tail is forked. The pointed pectorals are set very low down on the body, and there are no ventral fins. The scales are small, lying in cross series on the sides of the body between numerous skin folds that run obliquely downward and backward, and there is a low ridge of skin on either side along the belly.

The readiest field marks for the sand eel among Gulf of Maine fishes are its slender form and sharply pointed snout, coupled with long dorsal fin (separated from the caudal) and the absence of ventral fins. The only fishes with which one would be apt to confuse it are young eels, but in these the dorsal, caudal, and ventral fins are confluent, not separate, and the tail is rounded, not forked.

Color.—Authors differ in their accounts of the colors of the sand eel, probably because its iridescent luster fades at death and because it varies in shade on different bottoms. The many we have handled have been olive, brownish or bluish green above, with silvery lower sides and a duller white belly. Some have a longitudinal stripe of steel-blue iridescence [35] along each side, but others lack this.

Size.—Mature sand eels run from about 4 inches to about 6 inches in length as a rule, with a few as long as 7 inches.[36]

Habits.—Sand eels are found chiefly along sandy foreshores, also over the shoaler parts of the offshore fishing banks; they are seldom seen off rocky parts of the coast, or over muddy bottoms in deep water. They usually congregate in dense schools, often of thousands of individuals, and they swim as an eel does, by sidewise undulations that run along the body from front to rear, which makes them easy to recognize in the water.

The most interesting habit of the sand eel is the custom it has of digging itself several (4 to 6) inches deep in the sand, into which it burrows

[33] A second species of launce (the Arctic *Ammodytes dubius* Reinhardt 1838), thought to be characterized by having more fin rays (65–67 dorsals, 33–36 anals), has been reported from Boston by Günther (Catalogue Fishes British Mus., vol. 4, 1862, p. 387), and from Woods Hole by Smith (Bull. U. S. Fish. Comm., vol. 17, 1898, p. 95), but it is probable that the specimens in question were merely large *Ammodytes americanus*. In fact it is doubtful whether there is any sound distinction between the *A. dubius* of Greenland and the European *A. tobianus* on the one hand, and the American *A. americanus* on the other.

[34] Our sand eel is so closely allied to the common European launce (*Ammodytes tobianus*) that we doubt whether the distinction between the two (more slender form and longer head of *americanus*) will stand the test of time.

[35] In the European sand launce (*Ammodytes tobianus*), the sides are described as with lines of tiny brown dots and the tip of the snout as blackish, especially in the young fish.

[36] According to Bean (Bull. New York State Mus. 60, Zool. 9, 1903, p. 376) the majority are from 4⅞ to 7 inches; and the largest we measured was about 7 inches long. Storer (Fishes of Mass., 1867, p. 217) credits them with a maximum length of 12 inches; seemingly this was an error.

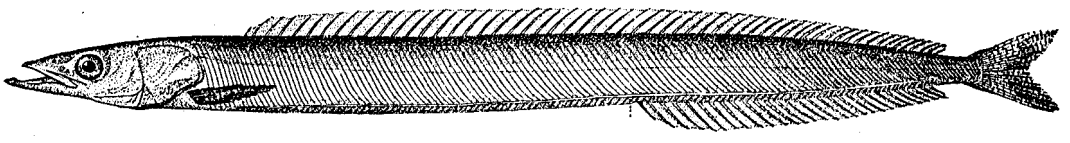

FIGURE 254.—Sand launce (*Ammodytes americanus*), Nantucket. From Goode. Drawing by H. L. Todd.

with great speed, opening the way with its sharp-pointed snout. It often does this above low-water mark at high tide to await the return of the tide. We have often seen them vanish with surprising rapidity when alarmed by clam diggers, and we cannot improve on Goode's [37] account of seeing "a great section of the beach" in Provincetown harbor become "alive with dancing forms of dozens of these agile fishes" when he stuck his clam-hoe into the sand. It has been suggested that they spend a large part of the time so buried, and that their sudden appearances and disappearances are to be explained thus, rather than as evidence of their wanderings or migrations. It is not known whether they follow this habit only in shoal water where they come under direct observation, or whether they also burrow into deeper bottoms. If the burrowing habit is for refuge, it is not always successful, for, as Smitt [38] remarks, porpoises have been seen rooting them out of the sand.

In Scandinavian waters sand eels feed on all sorts of small marine animals, but chiefly on small Crustacea, especially on copepods, and on fish fry, including their own kind. Worms have also been found commonly in the stomachs of sand eels, but it is not likely that they catch these while burrowing, as some writers have suggested.

The sand eel plays a very important role in the economy of northern seas as food for larger animals. Finback whales devour them greedily when they find them in abundance, as happened in Cape Cod Bay in June 1880, when launce appeared in swarms early in the month followed by finbacks a few days later. Porpoises, too, find them a staple article of food, and sundry predaceous fish such as cod, haddock, halibut, silver hake, salmon, mackerel, striped bass, and bluefish. When sand eels are fleeing from their pursuers especially from the silver hake, which does not hesitate to follow them up on the sand, they often strand in such numbers as to cover the flats.

Sand eels' noses are so sharp that when they are swallowed by cod, and perhaps by other fish, they sometimes work right through the stomachs and into the body cavities of their captors, to become encysted in the body wall.

The spawning of the American sand eel has not been observed so far as we can learn.[39]

Ripe specimens of the European species (*tobianus*), both male and female, have been taken throughout the year, a phenomenon that has given rise to widely differing views as to its spawning season. But the chief production of its eggs takes place in autumn and early winter, at least in the southern part of the North Sea, as Ehrenbaum [40] demonstrated, both by dredging them in large numbers, and by the fact that its larvae are extremely abundant there from January to March, but have seldom been taken at other seasons.

The occurrence of larvae suggests that the season is about the same for the American form in the Gulf of Maine. Thus the *Fish Hawk* towed numbers of larval launce (identified by R. A. Goffin of the Bureau of Fisheries and by Mrs. C. J. Fish) near Provincetown and in Cape Cod Bay, during December, January, and February, 1924–1925, evidence both that this part of the Gulf of Maine (where adults are abundant) is the site of considerable reproduction, and that spawning commences as early as November there. Fry have been taken in March at Woods Hole while the *Albatross* towed a number of larvae of 11 to 17 mm. on the western part of Georges Bank on February 22, 1920. It seems that the spawning season is progressively later, however, to the northward, for we took larvae only a few days old (7 to 8 mm. long), with the yolk still showing, off Newburyport, Mass., on March 4 in 1921, while the Canadian Fisheries Expedition of 1915 obtained an abundance of slightly older stages (7 to 15 mm. long) off the southeast coast of Nova Scotia in May.

Evidently the sand eel breeds successfully throughout the more northern part of its range, for its larvae have been found, widespread, over the Nova Scotian Banks, in the Gulf of St. Lawrence northward nearly to the Strait of Belle Isle, throughout the Grand Bank region, off the east coast of Newfoundland and off the outer coast

[37] Fish. Ind. U. S.; Sect. 1, 1884, p. 244.

[38] Scandinavian Fishes, vol. 2, 1895, p. 579.

[39] Hind (Fish. Comm. Halifax, 1877, Pt. 2, p. 7) describes the launce in the Gulf of St. Lawrence as "depositing their large reddish-colored ova on the sand between high and low water." This account, however, is widely at variance with the spawning habits of their European representative (*Ammodytes tobianus*) and with the seasonal occurrence of their larvae; and was probably borrowed from the larger European sand eel (*Ammodytes lanceolatus*).

[40] Wissenschaftliche Meeresuntersuchungen, Helgoland, Neue Folge, vol. 6, 1904, p. 184.

of Labrador, north to Sandwich Bay.[41] How far south it may do so is not known.

Sand eels were formerly thought to spawn on sandy beaches above low-water mark while burrowing in the sand, but their eggs have never been found in such a situation, and Ehrenbaum proved, by dredging them in large numbers, that those of the European species (*Ammodytes tobianus*) are actually deposited in depths of 10 fathoms or so, on sandy bottom where they stick fast to the grains of sand. His experience also suggests that they resort to very definite grounds for spawning, all of which probably applies as well to the American form as it does to the European.

The eggs of the American launce have not been seen. Those of the European *tobianus* are oval, 0.72 to 0.97 mm. in greatest diameter, with a yellow oil globule of 0.25 to 0.31 mm., and they are described as of an orange tint. The larvae are very slender, and about 7 mm. long by the time the yolk is absorbed. The dorsal and anal fin rays are visible when the larva is about 18 mm. long, but it is not until the little fish is upward of 25 mm. long that the tail begins to assume its forked outline; this is a convenient field mark for distinguishing between the launce and the herring, in which the tail is deeply forked from a much earlier stage. The early larval stages are easily recognizable by their slender form combined with the fact that the vent opens at one side, just as among the cod tribe, not at the margin of the larval fin fold, so that it apparently ends blind.

FIGURE 255.—Larva of European *A. tobianus* 6.6 mm. After Ehrenbaum and Strodtman.

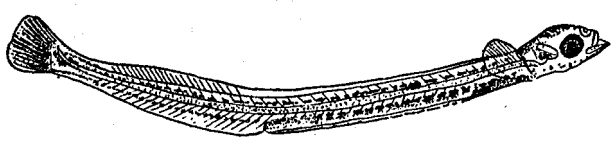

FIGURE 256.—Larva of European *A. tobianus*, 20.5 mm. After Ehrenbaum and Strodtman.

SAND LAUNCE (*Ammodytes*).

The older larvae resemble the corresponding stages of the rock eel (p. 493) in their slim form, and in the location of the vent slightly behind the middle of the trunk (it is located farther back in the similarly slender larvae of the herring tribe), but may be recognized by the row of black pigment cells along the *dorsal* side of the intestine instead of along the *ventral* side, and by their pointed noses.

The rate of growth of our launce has not been studied. But it is probable that the small ones of 3 to 4 inches, which are plentiful from July until September, are yearlings; those of 4 inches and upward probably are 2 years old, or more.

General range.—Atlantic coast of North America from Cape Hatteras to the Gulf of St. Lawrence, northern Newfoundland and northern Labrador, perhaps to Hudson Bay (p. 491). Its European relative, *A. tobianus*, occurs from Greenland, Iceland, northern Scandinavia and the White Sea south to Spain.

Occurrence in the Gulf of Maine.—The sand eel is very plentiful along the coast from Cape Cod to Cape Sable wherever there are sandy shores, but it is seldom seen off the rocky parts of the coast line. Thus it is rather scarce in the Bay of Fundy except locally, but is common on the sandy beaches that break the bold northern shores of the Gulf here and there. They swarm on the strands of Cape Cod Bay, a phase of their distribution associated with their burrowing habit. Here one may see schools of them throughout the summer in shoal water close in to tide mark, swimming with the curious undulating motion so characteristic of them; and they continue plentiful there in some years during the winter, when great numbers are sometimes cast on the beach in stormy weather. Sand eels are to be taken in shallow water on sandy flats throughout the year about Woods Hole also, but they are never so plentiful there in winter as they are in fall and spring. And since a general decrease in their numbers close inshore seems to take place during the cold months in the more northern part of their range as well, it is probable that a considerable proportion of the local stock moves out into deeper water for the winter, to return in spring, as most of the launce do in north European seas.

In Scandinavian waters this vernal inshore movement takes place in May as the coast waters warm up, and it is probable that the seasonal schedule is much the same in the Gulf of Maine, judging from its temperature. The sand eels may also be expected to leave some of the shallow-

[41] Dannevig, Canadian Fish. Exped. (1914–1915) 1919, p. 29; Frost, Res. Bull. 4, Newfoundland Dept. Nat. Res., 1938, Chart 8.

est bays of our Gulf in midsummer, when the water is at its warmest, to work in again in early autumn, such being their custom near Woods Hole.

There is no reason to suppose that they inhabit the central deeps of the Gulf of Maine regularly unless some of them repair thither in winter, though it would not be astonishing to find an odd sand eel in deep water at any time; in fact, we towed a young one about 1¼ inches long over the deep basin southeast of Grand Manan on June 10, 1915. But they must be plentiful on Nantucket Shoals, for they were found in the stomachs of cod caught there by the *Halcyon* and by the *Albatross II*, from time to time throughout the springs and summers of 1928–1930. There are also sand eels over the shallows of Georges and Browns Banks, whence they have been brought to the Bureau of Fisheries by fishermen on several occasions.[42]

Further northward, fishermen are familiar with them all along the outer coast of Nova Scotia and on the Scotian Banks; they are so common near Canso that a seine, dragged on a sandy beach there "captured hundreds in a short time";[43] they are reported from Prince Edward Island [44] and from the Magdalens in abundance,[45] here and there along the north shore of the Gulf; from the Strait of Belle Isle; also from Sandwich Bay and Sloop Harbor in southeastern Labrador; and they are to be expected all along the outer Labrador coast, for we have seen one taken at Eclipse Harbor, near Cape Chidley.[46] Sand eels have also been found on the southern side of Hudson Strait, and in the southern and western parts of Hudson Bay.[47] But these northern specimens may represent a distinct race for they have more fin rays (63–67 dorsal, 28–33 anal); Vladykov, in fact, has classed them as a new subspecies (*hudsonicus*) of the Greenland launce (*A. dubius*).

Sand eels are locally plentiful southward as far as northern New Jersey where we have seen squirrel hake gorged with them; they are reported as "common" as far as Cape May at the entrance to Delaware Bay,[48] and have been reported as far south as Cape Hatteras.[49]

Importance.—It is only for bait that sand eels are of any commercial value in our Gulf, for which purpose 67,800 pounds were landed from the traps in Massachusetts in 1919, 20,000 pounds in 1946.

BLENNY-LIKE FISHES. FAMILIES LUMPENIDAE, PHOLIDAE, AND STICHAEIDAE

The blenny tribes are characterized among Gulf of Maine fishes by the position of their ventral fins, which are under or in front of the pectorals, combined with a single dorsal fin that is spiny throughout its length and extends the whole length of the trunk, and with a slender form, eel-like in some of them. The only other Gulf of Maine fishes that resemble them are the wolffishes (p. 502) and the wrymouth (p. 500), but both of these lack ventral fins, which are present in all our blennies, though they may be very small. Furthermore, the tremendous canine tusks and molar teeth of the wolffish (p. 503) have no counterpart among the blennies, and the peculiar face of the wrymouth is equally distinctive for it (p. 501). The eelpout (*Macrozoarces*) also is somewhat blennylike in appearance, but the greater part of its dorsal fin is soft rayed, not spiny; and its anal fin is continuous with its caudal fin.

The blennies are a numerous tribe of small carnivorous shore fishes, widely distributed both in northern and in tropical seas. Five species are known in the Gulf of Maine.

KEY TO GULF OF MAINE BLENNY FISHES

1. Body very slender, about 18–20 times as long as it is high ..... Snake blenny, p. 494
   Body only moderately slender, not more than 8 to 10 times as long as it is high 2
2. There is a row of conspicuous roundish black or dusky spots along the dorsal fin 3
   There is only one large and conspicuous dark spot on the dorsal fin, or none 4

[42] Rept. U. S. Comm. Fish. (1879) 1882, pp. 808, 812, 814, 817.

[43] Cornish (Contrib. Canadian Biol. [1902–1905] 1907, p. 84.)

[44] Leim, Proc. Nova Scotian Inst. Sci.; vol. 20, Pt. 2, 1940, p. 39.

[45] Cox, Contrib. Canadian Biol. (1918–1920) 1921, p. 111.

[46] This specimen about 3 inches long, collected by C. O. Iselin, now in the Museum of Comparative Zoology, appears to be a typical *americanus*, for it has 30 anal fin rays, and only 59 dorsal rays.

[47] Vladykov, Contrib. Canadian Biol., N. Ser., vol. 8, No. 2, 1933, pp. 23–25.

[48] Fowler, Rept. New Jersey State Mus. (1905) 1906, p. 411.

[49] Jordan and Evermann, Bull. 47, U. S. Nat. Mus., Pt. 1, 1896, p. 833.

3. The pectoral fins are about as long as the body is high; the ventral fins are well developed, without noticeable spines, and about as long as one-half the height of the body ..... Arctic shanny, p. 497
   The pectoral fins are only about one-half as long as the body is high; the ventral fins are minute (likely to be overlooked) ..... Rock eel, p. 492
4. Pectoral fins evenly rounded, their middle rays the longest; dorsal fin marked on its forward part with one large and conspicuous dark blotch; only 43 or 44 dorsal fin spines ..... Radiated shanny, p. 498
   Pectoral fins with the lower rays longer than the upper rays and free at their tips; 58 to 61 dorsal fin spines ..... Shanny, p. 497

Rock eel *Pholis gunnellus* (Linnaeus) 1758

GUNNEL

Jordan and Evermann, 1896–1900, p. 2419.

Description.—The slender flexible trunk (only about one-tenth as deep as it is long and about one-half as thick as it is deep), short head, and rounded nose of this little blenny suggest an eel, but the spiny nature of its dorsal fin betrays its true relationship. The dorsal fin (73 to 86 spines) extends from the nape of the neck back along the whole length of the trunk to the base of the caudal fin, from which it is marked off by a shallow notch only; and it is of uniform height from end to end. The anal fin (2 very short spines and 37 to 44 rays) originates opposite the mid-length of the dorsal, to which it corresponds in height and outline, and runs back similarly to meet the caudal fin, from which it is marked off by a distinct notch, though there is no free space between the two fins. The caudal fin is small and rounded. The tiny ventrals, set near together close in front of or under the pectorals, are reduced to one very short spine and one rudimentary ray each. The pectoral fins, smaller than in our other blennies, are a little longer than one-half the length of the head. The skin of the trunk is clothed with very small scales, hardly visible, however, through the thick layer of slimy mucus with which the rock eel is covered. The head is naked; the mouth is small and oblique; the upper jaw is armed with several rows of conical teeth, but the lower jaw has a single row only.

Color.—A row of about 10 to 14 round, black-centered and pale-edged spots, spaced at equal distances along the middle of the back and spreading out onto the dorsal fin, are the most characteristic feature of the color pattern of this fish. The ground tint of the upper part is yellowish, olive brown, reddish, or light red, matching the seaweed or the bottom, with pale, irregularly rounded cloudings on the sides, and with an oblique streak from the eye to the angle of the jaw. The belly varies from pale gray to yellowish white. The pectoral, caudal, and anal fins are yellowish. We have seen a specimen (at Boothbay) that was brick red above and below, light and dark mottled, flecked also with tiny black dots, and with the spots on the dorsal fin dark red instead of black.

Size.—The maximum length is about 12 inches but few of those found are more than 6 to 8 inches long.

Habits.—Rock eels are often found along low tide mark, left by the ebb in little pools of water under stones, or among seaweed, where they await the return of the tide. But they are not confined to very shoal water as formerly supposed, for we have also collected them in considerable numbers both within the Gulf and on the offshore banks down to 40 fathoms, and one has been taken as deep as 100 fathoms (p. 494).

They are rather local throughout their range. In some places one is to be found under almost every stone; on others you may turn rocks in vain; their presence or absence along any particular stretch of shore probably depends on the character of the bottom immediately outside, for this fish prefers pebbly, gravelly, or stony ground, or shell beds, and not mud or eelgrass. Neither have we found them about the steep ledges so

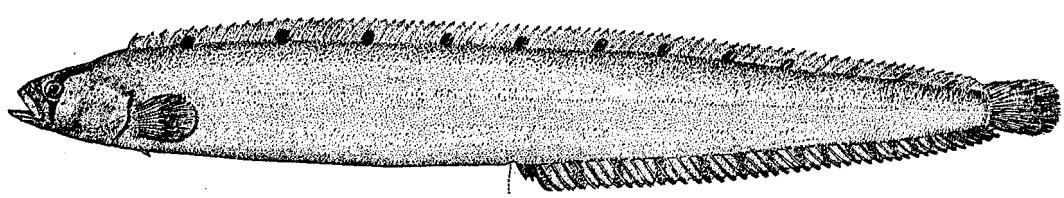

FIGURE 257.—Rock eel (*Pholis gunnellus*), Gloucester, Mass. From Jordan and Evermann. Drawing by H. L. Todd.

numerous along the rockbound coasts in the Gulf of Maine. In Scandinavian waters according to Smitt [50] they often take refuge inside large empty mussel shells. But as he remarks, there is no ground for the accusation that rock eels enter live bivalves of any sort to devour them. Whether they seek such places of concealment in deeper waters is not known.

When disturbed they squirm like eels. Eel-like, they swim by sidewise undulations, and they are so active and so slippery (hence the name "butterfish") that it calls for quick work to catch one by hand, even in a very small puddle.

Very little is known of the diet of the rock eel, except that it is carnivorous and that various molluscan and crustacean fragments have been found in their stomachs. Vinal Edwards records small amphipods, shrimps, and worms in the few that he examined at Woods Hole, but we have no first-hand information to offer on this point. In turn, rock eels have been found in the stomachs of various larger fishes, especially of cod, in New England waters.

So far as known the rock eel is resident throughout the year wherever it is found; at most it may move out from the beach into slightly deeper water in winter to escape chilling.

Breeding habits.—It is necessary to turn to European sources for information about its breeding habits, for its spawning has not been seen in American waters. In the eastern Atlantic and in the North Sea [51] it spawns from between tide marks down to 12 fathoms or more, from November to February or March. And its spawning season probably is the same in our Gulf, for eggs apparently belonging to the rock eel have been found off Rhode Island late in December.[52] A female from Peconic Bay, N. Y., contained 686 eggs.[53] These, by European accounts, are about 2 mm. in diameter, opaque, whitish, but iridescent on the surface, with a single globule of about 0.6 mm., and they are laid in holes or crannies. In British waters the rock eel usually chooses empty oyster shells, or the holes that are made in the limestone rocks by the boring bivalve *Pholas* for the purpose, but there are no oysters in the Gulf of Maine, except in Cape Cod Bay, and the local *Pholas* is unable to bore into the hard granite rocks of our coast line, so the rock eels must seek other nesting sites. Perhaps large mussel shells may serve them, or any crevice. The eggs are adhesive, and both the parents have been observed rolling them, by coiling around them, into balls or clumps an inch or so across, in which they stick together.

In European waters incubation occupies from 8 to 10 weeks, during which period the parent fish of both sexes have been seen lying close beside the egg clumps. But since Ehrenbaum [54] described the parent as "very negligent" in the aquarium, it seems that they merely seek the nesting holes as convenient shelters, and not that they actually guard the eggs.

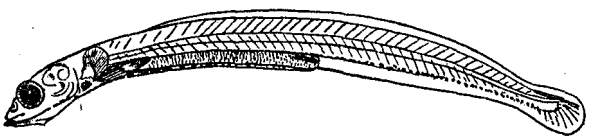

FIGURE 258.—Larva (European), 18 mm. After Ehrenbaum.

FIGURE 259.—Larva (European), 20 mm. After Ehrenbaum.

ROCK EEL (*Pholis gunnellus*).

The larvae are much larger at hatching (about 9 mm.) and further advanced in development than those of most of the fishes that lay buoyant eggs. Older larvae of the rock eel resemble corresponding stages of the launce and of the snake blenny in their extremely slender form. But they are easily distinguishable from both these species by the presence of a row of small black pigment spots below the intestine, instead of above it, and from the herring (the only other very slender larvae apt to be met in any numbers in the Gulf at the same season) by the location of the vent about midway of the body (fig. 259), and by the fact that their tails are rounded, not forked. The 12 black dorsal fin spots so characteristic of the adult are first noticeable against the transparent trunk in young fry of 25 to 30 mm. The

[50] Scandinavian Fishes, vol. 1, 1892, p. 223.

[51] MacIntosh and Masterman (Life Histories of British Marine Food-Fishes, 1897, p. 210) and Ehrenbaum (Wissenschaftliche Meeresunters., Helgoland, N. Ser., vol. 6, 1904, p. 160) give accounts of its spawning and of its larval development.

[52] Tracy, 40th Rept. Comm. Inland Fish., Rhode Island, 1910, p. 151.

[53] Nichols and Breder, Zoologica, New York Zool. Soc., vol. 9, 1927, p. 159.

[54] Wissenschaftliche Meeresuntersuchungen, Helgoland, N. Ser. vol. 6, 1904, p. 161

young fish (previously drifting near the surface) sink to the bottom when 30–40 mm. long, an event that takes place in late summer or early autumn in the Gulf of Maine. Nothing definite is known of the rate of growth of the rock eel after its first autumn.

General range.—Shoal waters on both sides of the North Atlantic; from Hudson Strait to the offing of Delaware Bay on the American coast [55] and south to France on the European coast; most numerous north of Cape Cod and north of the English Channel.

Occurrence in the Gulf of Maine.—This little fish is to be found all around the shores of the Gulf from Nova Scotia to Cape Cod. Thus it is definitely recorded at Yarmouth (Nova Scotia); at various localities on both sides of the Bay of Fundy where it occurs nearly everywhere (writes Dr. Huntsman); at half a dozen points along the Maine coast; on Cashes Ledge; at Portsmouth (N. H.), where A. H. Clark of the U. S. National Museum reports it plentiful; at Hampton (reported to us by W. F. Clapp); in Ipswich Bay; here and there along the northern shore of Massachusetts Bay; at Cohasset, on the southern shore, where we have seen them; among the stones and boulders of the Gurnet, off Plymouth, where W. F. Clapp informs us that he has found many while shore-collecting for mollusks; also at Provincetown. And doubtless it is more universal than these records indicate, for being of no consequence to the fisherman or to the angler, it comes to notice only when scientific collections are made.

We have taken its pelagic fry (20–39 mm. long) in our tow nets off Seal Island (Nova Scotia); on German Bank; near Mount Desert Island; off Matinicus Island; and off Ipswich Bay, in April, May, June, and August (a total, however, of only 6 stations), while Huntsman states that they are caught in early summer in the Bay of Fundy, evidence that it breeds all around the Gulf from early spring on into the summer.

Recent records show that rock eels also occur in considerable numbers on Nantucket Shoals, as well as on Georges and Browns Banks, where we have trawled a number, down to 40 fathoms, one as deep, even, as 100 fathoms,[56] where many of them have been found in the stomachs of cod and pollock.[57] They are described as common inshore along outer Nova Scotian waters, eastward from our limits; [58] and as "rather common" in the southern side of the Gulf of St. Lawrence,[59] where Huntsman [60] classes them as characteristic of the warm inshore waters, but where they are exposed to temperatures close to the freezing point of salt water in late winter and in spring.

They are reported from the southwest coast of Newfoundland; from the estuary of the St. Lawrence near Trois Pistoles,[61] from Anticosti; from the north shore of the Gulf of St. Lawrence; from both shores of the Strait of Belle Isle; from the southern and eastern parts of the Grand Banks; [62] from Bay Bulls, Conception Bay, and Trinity Bay on the east coast of Newfoundland; from Hamilton Inlet on the Atlantic Coast of Labrador, and from Fort Chimo, Ungava Bay, northern Labrador.

Importance.—This little fish is of no commercial interest. But it appears to be of some importance on the offshore banks as food for larger fishes.

Snake blenny *Lumpenus lumpretaeformis* (Walbaum) 1792

SERPENT BLENNY

Jordan and Evermann, 1896–1900, p. 2438, as *Lumpenus lampetraeformis.*[63]

Description.—This is a very slender little fish as its name implies, being only about one-twentieth as deep as it is long, slightly flattened sidewise, with head about one-eighth as long as body to base of caudal fin, large eyes, wide mouth, and blunt snout. It somewhat suggests a launce (p. 488) in general form, but is much more slender and eel-like. Also, its rounded tail (that of the launce is forked), its large pectoral fins, spiny dorsal fin (the launce has a soft dorsal only), and

[55] In February 1930 *Albatross II* trawled 2 rock eels, 80 and 84 mm. long, in 23 fathoms and 38 fathoms, at lat. 38°32′ N., long. 74°24′ W., and lat. 38°18 N., long. 73°51′ W.

[56] One was caught at this depth on the northeastern part of Georges Bank August 5, 1932 (Schroeder, Bull. 66, Boston Soc. Nat. Hist., 1933, pp. 5–6).

[57] We once found one alive in the mouth of a pollock caught at 34 fathoms on Browns Bank.

[58] Vladykov and McKenzie, Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 103.

[59] Cox, Contrib. to Canadian Biol. (1918–1920) 1921, p. 112.

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

[61] Vladykov and Tremblay, Natural. Canad., vol. 62 (Ser. 3, vol. 6), 1935, p. 81).

[62] The pelagic larvae.

[63] The original spelling of this name by Walbaum (*P. Artedi* Genera piscium, Ichth., Pt. 3, 1792, p. 184) was *lumpretae-formis.*

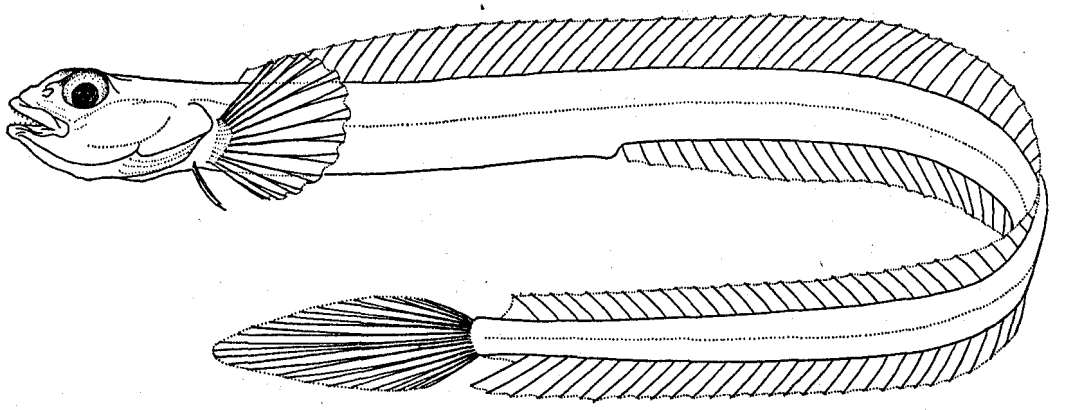

FIGURE 260.—Snake blenny (*Lumpenus lumpretaeformis*). Drawing by Louella E. Cable.

the fact that its lower jaw does not project beyond the upper, together with its color, serve to separate it from the launce at a glance.

The chief anatomic feature (apart from its slenderness) distinguishing it from the rock eel (p. 492) is that the ventral fins (each of one short spine and three longer rays) are well developed and one-third to one-half as long as the pectorals, slightly in advance of which they stand. The pectorals, too, are much larger than those of the rock eel, and its dorsal fin, with 68 to 85 spines and its anal with 49 to 62 rays are fully twice as high, relative to the depth of the body, while its anal fin originates farther forward; the separation of dorsal and anal fins from the caudal is more evident; and its eyes are noticeably larger.

The very slender body is the most obvious difference between this species and its allies the shanny (p. 497), the Arctic shanny (p. 497), and the radiated shanny (p. 498), which are rather robust. The outline of the caudal fin, which is oval (more pointed in large fish than in small), with the central rays much longer than the outer ones, is diagnostic, too.

Color.—Whitish or pale brown on the back and sides, with darker brown markings. On a 12-inch fish taken off the coast of Maine the head was pale brown, the sides of the body blotched with brown, the dorsal fin marked obliquely with 18 pale bars, the caudal marked transversely with 8 bars, the anal rays pale brown against a colorless membrane, the ventrals white, and the pectorals tinged with brown.

Size.—The largest one so far measured was 19 inches long.[64]

Remarks.—Vladykov's [65] discovery that Newfoundland specimens have a larger number of dorsal fin-spines (85) and anal fin rays (62) and a longer caudal fin (longer than the head) than others from the St. Lawrence estuary (75–79 dorsal spines, 52–56 anal rays) shows that the snake blenny tends to break up into local races. Vladykov has made the St. Lawrence race the basis of one new subspecies, *americanus*, and the Newfoundland race the basis of another, *terrae novae;* both of which have more spines and rays than have been recorded for some eastern Atlantic specimens. Gulf of Maine specimens, with 77–83 dorsal spines, and 56–59 anal rays, are intermediate between the Newfoundland and Gulf of St. Lawrence races in this respect.

Habits.—Little is known of the habits of the snake blenny on either side of the Atlantic. Although it is not found along the littoral zone, it is a fish of comparatively shoal water, never taken as deep as 100 fathoms (so far as we have been able to learn) and apparently the most common from a fathom or so below tide mark down to 40 or 50 fathoms. And as most of the specimens that have been caught in Scottish waters were picked up by the foot rope of the trawl, Sim's [66] suggestion that it burrows in mud

[64] In the Museum of Comparative Zoology, trawled about 17 miles off Cape Ann, lat. 42°28′ N., long. 70°13′ W., at 42 fathoms, in July 1931.
[65] Rept. Newfoundland Fish. Res. Comm., vol. 2, No. 3, 1935, p. 75–78.
[66] Jour. Linnaean Soc., London, Zoology, vol. 20, 1890, p. 38.

or clay bottom probably is correct. The *Albatross II* has taken it both on mud bottom and on hard.

Food.—Amphipods, copepods, and other tiny crustacea, with very small starfish, small bivalves, and holothurians have all been found in snake-blenny stomachs in British seas. These blennies are eaten in their turn by large fish, by cod and halibut, for example, in Massachusetts Bay,[67] by pollock in the Bay of Fundy; and by cod in Northumberland Strait, Gulf of St. Lawrence, as Capt. Thor Iversen informed Dr. Hunstman from his experience during the Canadian Fisheries Expedition of 1915.

The spawning season has been stated as autumn or winter in north Scandinavian seas, and it may commence by late summer there, or by early autumn, for Sim found its roe well advanced in development as early in the season as the end of April. Its drifting larvae have been taken in tow nets from February to March in the Baltic, and from March to May in the Gulf of Maine.

The eggs of this species have not been seen, but they probably sink and stick together like those of the rock eel. Apparently the larvae are of considerable size at hatching, for the smallest we have taken (the smallest on record) were about 11 mm. long, though they still lacked any trace of the dorsal- and anal-fin rays. Snake blenny larvae are very slender, resembling the corresponding stages of the rock eel and of the launce in general appearance, but they are distinguishable from both of these by the fact that the vent is situated considerably in front of the midlength of the trunk. There is no danger of confusing them with the young of the herring, the only other very slender pelagic fish larva (besides rock eel and launce) that is apt to be found in any numbers in the Gulf of Maine in spring, for the tail of the herring is forked from a very early stage and its vent is situated much farther back than that of the blenny (p. 91). Another distinctive feature of the snake blenny larvae is the presence of a large black pigment dot at the base of each pectoral fin, and of a double row of 6 to 9 black dots along the dorsal surface of the intestine with several about the vent, which are very conspicuous by contrast with the colorless body. Our largest pelagic larva (41 mm. long) showed most of the characters of the adult, although it was transparent and had the arrangement of pigment characteristic of the earlier larval stages.

General range.—Arctic and northern Atlantic Ocean; south to Scotland, the Baltic, and the southern part of the North Sea in the eastern side; to the offing of southern New England in the western side.

Occurrence in the Gulf of Maine.—It is probable that this northern fish occurs in small numbers around the coastline of the Gulf at some little depth. Thus Hunstman reports it from St. Mary Bay, Nova Scotia, in August and September; from Passamaquoddy Bay from April to August; and in the open waters of the Bay of Fundy from January on. It was recorded off Eastport in 1872; *Albatross II* trawled one specimen (about 12 inches long) 3 miles south of Great Duck Island, near Mount Desert, Maine, in 28 to 33 fathoms, April 1927; two others (8 and 8¼ inches long) 13 miles east of Boone Island, in 88 fathoms in August 1928; one off the Isles of Shoals at 72–78 fathoms in August 1926; one at 42 fathoms on the eastern slope of Stellwagen Bank, about 17 miles off Cape Ann in July 1931. And Goode and Bean [68] described it long ago as a common resident in the deeper parts of Massachusetts Bay.

Our tow nettings, also, of 1920 yielded its drifting larvae off Seguin Island; near Cape Elizabeth; over Platts Bank; near the Isles of Shoals; off Ipswich Bay; off Cape Ann; off Boston Harbor; and in the southwest basin of the Gulf off Cape Cod during March, April, and May—evidence that it breeds successfully throughout the southern part of its range. While it has not been reported on Browns or Georges banks, it is to be expected there.

It has never been reported from the banks along the outer coast of Nova Scotia, so far as we know. But it is so slender and active a fish that it can easily pass through the meshes of any of the nets that are used in our Gulf by commercial fishermen, hence is not likely to be brought in unless it is sought for especially. And the experimental trawlings by the Newfoundland Fishery Research Laboratory did take it at several stations on the Newfoundland Banks, as well as in the Gulf of St. Lawrence, and also off the southeastern coast of Labrador, while it has long been known from

[67] Goode and Bean, Bull. Essex Inst., vol. 11, 1879, p. 10.

[68] Bull. Essex Inst., vol. 11, 1879, p. 10.

as far north on the Labrador coast as Ungava Bay.[69]

Shanny *Leptoclinus maculatus* (Fries) 1837

LANGBARN

Jordan and Evermann, 1896–1900, p. 2433.

Description.—The shanny resembles the snake blenny somewhat in general appearance and in the location and shape of its dorsal and anal fins, but is not so slender (only 10 to 12 times as long as it is deep instead of about 20 times). The most important points of difference (aside from its more robust form) are that the tail of the shanny is about straight in outline instead of narrowly oval or pointed as it is in the snake blenny; that the lower rays of its pectoral are the longest and are separate at their tips; and that the shanny has only 58 to 61 dorsal fin spines, and 35 to 38 anal fin rays.

Color.—Dirty-yellowish, paler below, the back and sides marked with indistinct yellowish-brown blotches of various sizes. The dorsal fin is described as barred obliquely with about 10 rows of brownish dots and the pectorals as cross-barred with about 5 rows. These fins show no distinct markings on the several preserved specimens we have examined; the caudal fin, however, shows one or two dark crossbars, even after preservation.

Size.—Maximum length about 7 inches.

Habits and food.—In Scandinavian waters the shanny spends most of the year in deep water, probably coming up to the shallows to spawn. In the aquarium it keeps close to the bottom, with the body extended and the pectoral fins expanded, and apparently supports itself on the free lower rays of those fins.[70] Annelid worms and pelagic amphipods have been found in shanny stomachs; this is all that is known of their mode of life. The shanny is supposed to spawn in winter, but neither its eggs nor its larvae have ever been seen.

General range.—An Arctic fish, known south to Norway and Sweden in the eastern side of the Atlantic, and to Cape Cod in the western side.

Occurrence in the Gulf of Maine.—Definite records of this Arctic fish for the Gulf of Maine are of several specimens that were collected in 40 to 90 fathoms in Massachusetts Bay by the U. S. Fish Commission in 1887;[71] one that we took in a tow net near Boone Island on March 4, 1920; one from the northeast part of Georges Bank, August 1926, and four (4 to 4½ inches long) that were trawled off Chatham, Cape Cod, in 28 fathoms, May 1, 1930, by the *Albatross II*. This paucity of captures suggests that it enters the Gulf only as a chance straggler from the north, perhaps maintaining itself in small numbers in the bottoms of the deep isolated troughs where the water is coldest.

The nearest records of it to the eastward and northward are of fish taken off the Atlantic Coast of Cape Breton,[72] from the estuary of the St. Lawrence River near Trois Pistoles;[73] from St. Mary's Bay on the south coast of Newfoundland, from the eastern part of the Grand Banks, and off the east coast of the Avalon Peninsula, Newfoundland.

Arctic shanny *Stichaeus punctatus* (Fabricius) 1780

Jordan and Evermann, 1896–1900, p. 2439.

Description.—This shanny suggests the rock eel in its color pattern. But it is easily distinguished from it by having well developed ventral fins and considerably larger pectorals, but fewer dorsal fin

[69] Kendall, Proc. Portland Soc. Nat. Hist., vol. 2, No. 13, 1909, p. 224.
[70] Smitt, Scandinavian Fishes, vol. 1, 1892, p. 230.
[71] Presumably the Gulf of Maine specimens reported by Kendall (Proc. Portland Soc. Nat. Hist., vol. 3, 1914, p. 62), now in the United States National Museum, are this lot.
[72] By the Newfoundland Fisheries Research Commission; also it is listed from Nova Scotia without locality, see Vladykov and McKenzie (Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 104).
[73] Vladykov and Tremblay, Natural. Canad. vol. 62 (Ser. 3, vol. 6), 1935, p. 81.

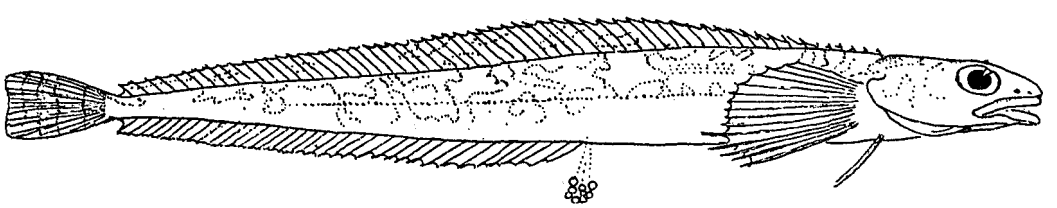

FIGURE 261.—Shanny (*Leptoclinus maculatus*). After Collett.

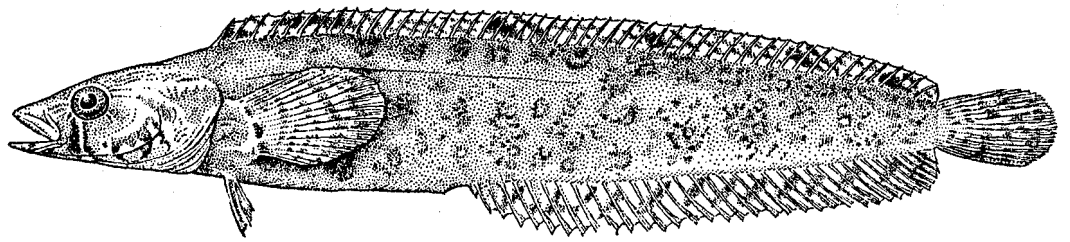

FIGURE 262.—Arctic shanny (*Stichaeus punctatus*), about 7¼ inches, Halifax, Nova Scotia, redrawn by E. N. Fischer from U. S. Fish Commission wash drawing.

spines (only 48 or 49). The presence of a series of large roundish spots on the dorsal fin separates it at a glance from the radiated shanny, which is similar to it in form, but which has only a single large blotch on its dorsal; its spotted dorsal and its evenly rounded pectorals mark it off from the shanny; and its much less slender body (only about one-seventh as deep as it is long) from the snake blenny.

The single long dorsal fin originates directly over the edge of the gill cover, and is of uniform height throughout its length, except that the first 2 or 3 spines, and the last 2 or 3, are shorter than the others. It extends backward nearly to the caudal, but the fins are separated by a conspicuous notch. The anal fin (one short spine, closely followed by about 35 rays) is about two-thirds as long as the dorsal fin, is of approximately the same height as the latter, and bears a similar relation to the caudal. The caudal fin is gently rounded in outline. The pectorals are broadly rounded, a little longer than the depth of the body; the ventral fins are somewhat less than half as long as the pectorals. The straight dorsal profile of the head, from tip of snout to origin of dorsal fin, is an outstanding feature, and the lateral line is single (double in the radiated shanny, p. 499), conspicuous, and ends at about the mid-length of the body.

Size.—Grows to a length of at least 7 inches.

Color.—The single row of 5 to 9 round black spots with pale margins on the dorsal fin, and irregular dark bars on the cheeks and chin are the most conspicuous markings of this shanny. The ground color of the body of an Alaskan specimen is described as bright scarlet,[74] but is brownish (after preservation) on a Gulf of Maine specimen, with darker cloudings extending from close behind the head to the base of the caudal fin. The lower surface of the body (except the head) is plain whitish. The anal fin is dusky, edged with white; the pectorals and caudal are crossed by pale bars, and the ventrals are plain yellow.

General range.—Arctic and circumpolar, from Greenland to northern Siberia and the Arctic Coast of America;[75] southward to Bristol Bay and Prince of Wales Island, Alaska, in the Pacific, and to Mount Desert, Maine on the Atlantic coast of America.

Occurrence in the Gulf of Maine.—A specimen 4⅓ inches (109 mm.) long, of this Arctic species, taken one-half mile off Little Duck Island near Mount Desert, Maine, from the stomach of a cod, on April 30, 1930, was in such good condition that it unquestionably had been living in the immediate vicinity.

The next most southerly records are of two specimens from Chedabucto Bay, Nova Scotia, near the Atlantic entrance to the Strait of Canso;[76] and of one taken off Cheticamp,[77] on the Nova Scotian shore, within the Gulf of St. Lawrence, where Huntsman [78] classes it as a characteristic of the icy-cold water on the banks; and of one from Battle Harbor, on the outer coast of Labrador, a few miles north of the eastern entrance to the Strait of Belle Isle.

Radiated shanny *Ulvaria subbifurcata* (Storer) 1839

Jordan and Evermann, 1896–1900, p. 2440.

Description.[79]—The most conspicuous feature of this little fish, and one that sets it apart from all the other blennies of our Gulf, is that the forward part of its dorsal fin is marked with a

[74] Jordan and Evermann, Bull. 47, U. S. Nat. Mus., Pt. III, 1898, p. 2439.

[75] Reported from Hudson Bay by Vladykov, Contrib. Canadian Biol., N. Ser., vol. 8, No. 3, 1933, p. 35.

[76] Cornish, Contrib. Canadian Biol. (1902–1905) 1907, p. 87.

[77] Cox, Contrib. Canadian Biol. (1918–1920) 1921, p. 112.

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

[79] Based on 3 specimens from Grand Manan, the largest 5⅜ inches long.

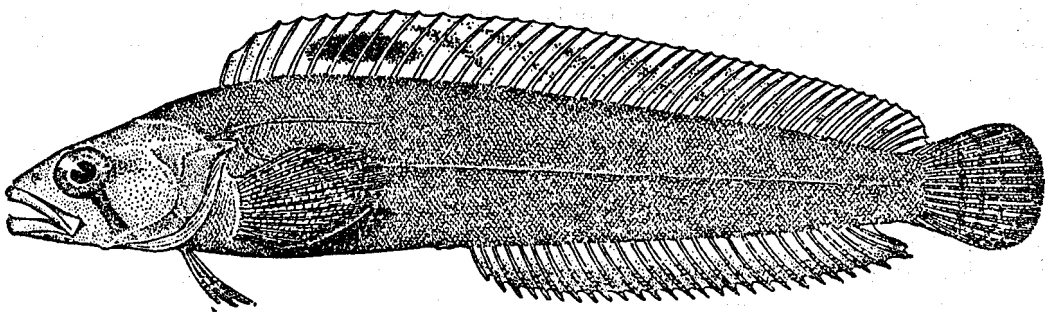

FIGURE 263.—Radiated shanny (*Ulvaria subbifurcata*). From Jordan and Evermann. Drawing by H. L. Todd.

single large dark blotch. More significant morphological characters are that it is much stouter of body (about one-sixth to one-seventh as deep as it is long) than the snake blenny; that its pectoral fins and especially its ventrals are considerably larger, relatively, than those of the rock eel (p. 492), while its ventrals are situated farther in advance of the pectorals; and that its gill openings are much wider and extend forward under the throat (confined to the sides of the neck in the rock eel). The evenly rounded outline of its pectorals distinguishes it from the shanny, in which the lower rays are the longest, and are separate at their tips. It is a stouter fish than the Arctic shanny (p. 497), and its lateral line is double, with an upper branch and a lower, whereas the lateral line of the Arctic shanny is single. The outline of the edge of its gill covers, with the upper corner terminating in a rounded fleshy flap concealing a sharp angle, is diagnostic also, for they are rounded in all the other Gulf of Maine blennies.

The dorsal profile of the head is more convex than the ventral; the lower branch of the lateral line runs the whole length of the body, but the upper branch (the more obvious of the two) reaches only about as far back as the tips of the pectoral fins. The dorsal fin, of 43 or 44 spines, is higher, relatively, than that of the rock eel, and is practically continuous with the caudal fin. The anal fin, of about 30 rays, is about half as long as the dorsal, and it is separated from the caudal by a short but definite interspace, made obvious by the abrupt rear angle of the anal. The pectoral fins, evenly rounded in outline, reach back about as far as the eighth dorsal-fin spine. The rear margin of the caudal fin is evenly rounded.

Color.—The most distinctive feature of the color pattern, one which marks this species among local blennies, is the presence of a large oval dusky blotch on the dorsal fin extending from the fifth or sixth spine to the eighth or tenth spine. The back and the upper parts of the sides are dull brown, obscurely barred or blotched alternately with paler and darker; the sides of the head are marked with a dark bar running obliquely downward and backward from the eye; and the belly is pale brownish (described also as yellowish white). The caudal fin is crossbarred with 3 or 4 series of dark dots, and the dorsal fin is marked with many tiny dark dots, besides the blotch just mentioned.

Size.—The largest one we have seen or read of is 6½ inches long, but the maximum size may well be larger.

Habits.—Nothing is known of the mode of life of this shanny except that it is a bottom fish like other blennies, living among seaweed and stones from low-tide mark down at least to 30 fathoms, and very likely much deeper. Dr. Huntsman writes in his notes, "It is found under stones near low tide mark" with the rock eel but far less abundantly than the latter and only on the more exposed shores. Cornish[80] likewise describes it as taken under stones on the beach, as well as in the dredge and trawl in 6 to 30 fathoms at Canso, Nova Scotia.

The eggs have not been seen, but the fact that we have taken larvae as small as 8 to 11 mm. in our tow nets in June, July, and October[81] points to a spawning season lasting from late spring throughout the summer (if our identification is correct).

[80] Contrib. Canad. Biol. (1902-1905) 1907, p. 87.

[81] These are listed in Bull. Mus. of Comp. Zool., vol. 58, No. 2, 1914, p. 109; and vol. 59, 1917, p. 273.

General range.—So far this fish is known only off the boreal coasts of eastern North America, from eastern Newfoundland, the north shore of the Gulf of St. Lawrence,[82] and from northern Nova Scotia to Nantucket Shoals and southern Massachusetts.[83]

Occurrence in the Gulf of Maine.—This shanny, first described by Storer from a specimen found at an unusually low tide among the seaweed at Nahant on the north shore of Massachusetts Bay in 1838, was long supposed to be rare. But it has proved to be common in the Bay of Fundy [84] among seaweed on rocky shores, a number having been taken both at Campobello Island and at Grand Manan, and one in the mouth of the St. Croix River, while the Museum of Comparative Zoology has a specimen from Grand Manan, collected by Verrill many years ago. Huntsman also reports it from St. Mary Bay on the Nova Scotia shore, and we have found several in the tide pools at Nahant, on the northern shore of Massachusetts Bay. Offshore, we have trawled it near Seguin Island; in Massachusetts Bay; also on the eastern part of Georges Bank. And we have found so many in the stomachs of cod caught on Nantucket Shoals, on Cashes Ledge, and on other offshore grounds as to show that it is widespread in the Gulf on hard bottom, from the shore down to at least 30 fathoms, while we have had one from as deep as 45 fathoms. Our tow nets also have taken its pelagic larvae near Seal Island (Nova Scotia); in the Grand Manan Channel; at the mouth of Casco Bay; near Cape Porpoise; off the Isles of Shoals; near Cape Ann; and in Massachusetts Bay.

The only importance of this little fish in the natural economy of our Gulf is that many of them are eaten by cod and by other fishes.

THE WRYMOUTHS. FAMILY CRYPTACANTHODIDAE

The wrymouths are slender, eel-like fishes, close relatives of the blennies but much larger. Like the blennies they have a long dorsal fin that is spiny throughout its length, but the demarcation between dorsal, caudal, and anal fins is so vague that they can be described as practically continuous. They have no ventral fins, and their mouth is so strongly oblique that it is nearly vertical. Only three species are known, all North American, of which the Gulf of Maine harbors one.

Wrymouth *Cryptacanthodes maculatus* Storer 1839

CONGO EEL; BASTARD CUSK; GHOSTFISH

Jordan and Evermann, 1896–1900, p. 2443.

Description.—The wrymouth is eel-like in form, about thirteen times as long as it is deep but much flattened sidewise, and (eel-like) it lacks ventral fins. And (as in the eel) there is no definite demarcation between dorsal fin and the caudal fin or between the anal fin (about 47 to 50 rays) and the caudal, the one merging into the other to form a continuous fin around the tail, with no inter-

[82] Reparted from Trinity Bay, Newfoundland (Rept. Newfoundland Fishery Research Comm., vol. 1, No. 4, 1932, p. 109, Sta. 39), and from Canso, Nova Scotia, by Cornish (Contrib. Canadian Biol. (1902–1905) 1907, p. 87. And Dr. Vladykov writes us that he has collected a specimen at Pointe du Maurier on the north shore of the Gulf of St. Lawrence.

[83] Sumner, Osburn, and Cole (Bull. U. S. Bur. Fish., vol. 31, Pt. 2, 1913, p. 768) record 4 living specimens from Vineyard Sound and others found in the stomach of a sheldrake (*Merganser*) that was shot near Robinson Hole in the Woods Hole region.

[84] Huntsman, Contrib. Canadian Biol. (1921) 1922, p. 66, and unpublished notes.

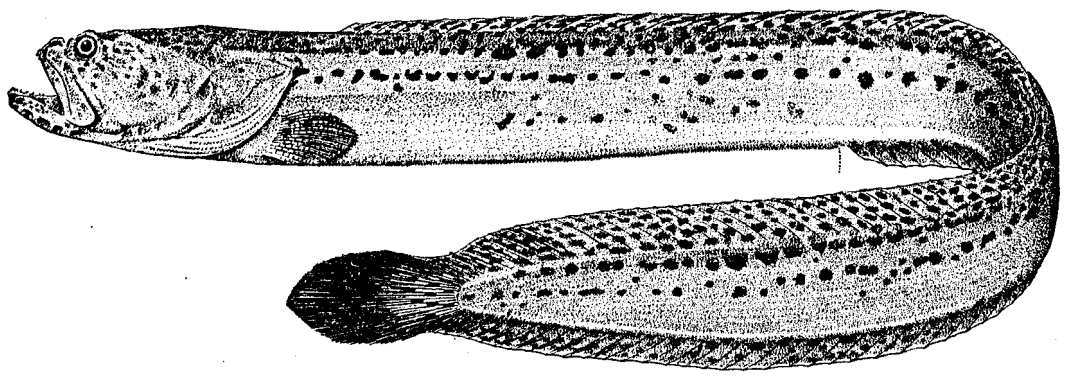

FIGURE 264.—Wrymouth (*Cryptacanthodes maculatus*). From Jordan and Evermann. Drawing by H. L. Todd.