

spaces. But its dorsal fin (which extends from close behind the pectorals back to the caudal fin) is spiny (about 75 to 77 spines) for its entire length like that of its close relatives the blennies. But the absence of ventral fins separates it from all of our local blennies, and its peculiar profile is an equally useful field mark, the head being flat-topped, the eyes set high up in very prominent orbits, and the mouth strongly oblique with so heavy a lower jaw that it gives the face a bulldog-like expression when the mouth is closed. The wide gill openings, running forward under the throat, and the small size and rounded outline of the pectorals are distinctive, also, as is the fact that both the dorsal fin and the anal fin are low (less than half as high as the body is deep in large specimens, relatively higher in small), and of uniform heights throughout most of their lengths, with the anal about two-thirds as long as the dorsal. The caudal fin is oval.

*Color.*—Described (and the few preserved specimens we have seen correspond with this) as of varying shades of brown or reddish brown, with the upper part of the sides marked with two or three irregular rows of small darker brown spots that run from head to tail; the top of the head is thickly speckled; the dorsal and anal fins are spotted with similar but smaller dots, and the belly is grayish white. A few spotless specimens have been seen.

*Size.*—Maximum length about 3 feet.

*Habits.*—Very little was known of the habits of the wrymouth until recently, except that it is a bottom fish living from the intertidal zone down to considerable depths (where it is sometimes taken on line trawls in the Bay of Fundy). But in 1910 and again in 1920 Willey and Huntsman<sup>85</sup> found full-grown wrymouths living in burrows in the mud on the flats at the mouth of the Magaguadavic River, a tributary of Passamaquoddy Bay. These burrows, to quote from their account, "were found in very soft mud from the lower part of the *Fucus* zone downward; that is, as far up as 4 feet above low-water mark," and "each system of burrows, inhabited by only one fish, consisted of branching tunnels about 5 cm. in diameter and from 3 to 8 cm. below the surface" of the mud, originating from a more or less centrally placed mound, where the

main entrance was, with other smaller openings along the tunnels and at their terminations.

It seems that the burrowing instinct is strong, for one fish kept in a tank constantly inhabited a piece of hard rubber tubing. Hence it is probable that wrymouths in other parts of the Gulf likewise live in burrows or perhaps under stones. And they seem as likely to be inshore in shoal water in winter as in summer, for one was speared in Marblehead Harbor in December many years ago.<sup>86</sup> Within our Gulf wrymouths have been found from a little above low water mark, as just remarked, down to about 100 fathoms; and to somewhere between 245 and 325 fathoms off New Jersey (see footnote 89, p. 502).

Huntsman and Willey found "beach fleas" or "sand-hoppers" (*Gammarus*), shrimps (*Crango*) and fragments of winter flounders in several wrymouths which they opened, and the one kept in captivity ate sand-hoppers, hermit crabs, small herring, and mollusks such as limpets, periwinkles, whelks, clams, and mussels. Apparently it located food as much by sight as by smell.<sup>87</sup>

Ripe wrymouths are yet to be seen; but the presence of the larvae early in spring in Passamaquoddy Bay, as reported by Huntsman, with the seasonal occurrence of the fry mentioned below (p. 502), proves it a winter spawner in the Gulf of Maine. It may breed later in the Gulf of St. Lawrence, for Dannevig<sup>88</sup> records a young wrymouth only 38 mm. long that was taken there as late as June 10. The localities where the young fish have been taken (see p. 502) suggest that wrymouths spawn all around the coast of the Gulf of Maine and wherever they occur on the offshore banks.

Neither the eggs nor the early larval stages are known. But by the time the young have grown to a length of 21 to 22 mm. they show the long dorsal and anal fins, and the lack of ventral fins characteristic of their parents, though they are much less slender, relatively, their caudal fins are larger and square instead of rounded and their mouths are nearly horizontal. The pigmentation of the fry is likewise extremely characteristic, the upper sides from the eye back to the caudal fin

<sup>85</sup> Putnam, Bull. Essex Inst., vol. 6, 1874, pp. 11-13.

<sup>87</sup> Willey and Huntsman also give interesting data on its respiration and on its response to various stimuli.

<sup>88</sup> Canadian Fisheries Expedition, 1914-1915 (1919), p. 16. He gives an excellent figure of this specimen on pl. 2, fig. 10.

being thickly speckled with dark brown dots, which are sparser on the lower part of the sides.

*General Range.*—Atlantic Coast of North America, from southeastern Labrador, the coasts and banks of Newfoundland, and the Gulf of St. Lawrence to Long Island Sound and to the offing of central New Jersey.<sup>89</sup>

*Occurrence in the Gulf of Maine.*—Published records locate this fish in the Bay of Fundy; at Eastport; in Casco Bay; at Portland; in the mouth of the Piscataqua River; at Gloucester; in Marblehead Harbor; at Swampscott; Nahant; and Dorchester in Boston Harbor; and in the outer waters of Massachusetts Bay; there are specimens in the Museum of Comparative Zoology from Trenton, Maine; from outer Boston Harbor; and from near Provincetown. Two were taken in the central basin of the Gulf in July 1931 at a depth of 88–95 fathoms; one was trawled by the *Atlantis* in the deep trough west of Jeffreys Ledge at 72–78 fathoms, and another in the southwestern basin of the Gulf off Cape Cod at about 100 fathoms (183 meters), in August 1936; the *Albatross II* trawled one on the eastern slope of Nantucket Shoals<sup>90</sup> at 52 fathoms, in May 1950. And one of the crew of the dragger *Eugene H* reports the capture of 4 of them on the northeastern part of Georges Bank on October 12, 1951. We have also taken its late larvae and fry in tow nets (11 specimens 18 to 40 mm. long) in Massachusetts

Bay off Boston Harbor; over Jefferys Bank; in the trough near the Isles of Shoals; in the western basin a few miles west of Cashes Ledge; off Penobscot Bay; near Mount Desert Island; and in the deep basin off Machias, Maine, in May 1915, and in March and April 1920. These localities are sufficiently scattered to show that it is to be found, not only all around the coasts of the Gulf, but on the offshore grounds as well.

However, it seems to be rare or at least very local, for we have caught few adults ourselves, nor have we seen it brought in by fishing boats. In fact, few of the fishermen of whom we have inquired have been aware of its existence, a fact no doubt associated with its burrowing habit. And it has not been reported as yet from Browns Bank though it is to be expected there.

Following its range to the eastward and northward, we find it described as "rather common" all along Nova Scotia (taken at 60 fathoms on Western Bank off Halifax);<sup>91</sup> it has been reported from a number of stations on the eastern half of the Grand Banks region, from the southern and southeastern coasts of Newfoundland, and from the outer Labrador coast some 20 miles north of the Strait of Belle Isle (see footnote 89, p. 502); also within the Gulf of St. Lawrence from the Bay of Chaleur in the southwest,<sup>92</sup> and from the entrance to the Strait of Belle Isle in the northeast.<sup>93</sup>

## THE WOLFFISHES. FAMILY ANARHICHADIDAE

The wolffishes are closely allied to the blennies, and like the latter they have a single long spiny dorsal fin running the whole length of the back from the nape of the neck. But the presence of large molar teeth and canine tusks, with their total lack of ventral fins and the fact that all but the last 10 or 12 of their dorsal fin spines are soft and flexible at the tips, instead of stiff justify a separate family for them. They are much larger fish than any of our blenny tribe. Two species

occur in the Gulf of Maine, one, the wolffish, commonly; the other, the spotted wolffish, only as a stray from the north. Another cold water species, *Anarhichas latifrons*, has been recorded repeatedly from Nova Scotian waters, hence it is to be expected in our Gulf sooner or later though it has not been reported there definitely. It is included in the following Key.<sup>94</sup>

<sup>89</sup> The most northern locality-record which we have found is for its drifting larvae off the outer coast of Labrador, about 20 miles north of Belle Isle (Rept. Newfoundland Fish. Res. Lab., vol. 2, No. 3, 1935, p. 79, Sta. 422); the most southern are for one trawled by the *Albatross II* off northern New Jersey, lat. 40°04' N., long. 73°32' W., August 1936, at 35 fathoms; and of another dredged by the *Atlantis* 30 miles farther south (lat. 39°31' N., long. 72°16' W.) between 245 and 325 fathoms, that same year.

<sup>90</sup> Lat. 40°05' N., long. 69°22' W.

<sup>91</sup> Vladykov and McKenzie, Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 104.

<sup>92</sup> Halkett, Checklist Fishes Canada, 1913, p. 112, "Gaspé Bay."

<sup>93</sup> Rept. Newfoundland Fish. Res. Lab., vol. 2, No. 3, 1935, p. 79, Sta. 370.

<sup>94</sup> We think it likely that a specimen of *A. latifrons* credited by Bean (Proc. U. S. Nat. Mus., vol. 3, 1881, p. 82) to "east coast of United States" was actually brought in from Nova Scotian waters rather than that it was caught anywhere west of Cape Sable. See Bigelow and Schroeder (Proc. Boston Soc. Nat. Hist., vol. 41, No. 2, 1935, p. 15) for further remarks on this species.

## KEY TO GULF OF MAINE AND NOVA SCOTIAN WOLFFISHES

1. Back and sides definitely black spotted on a pale ground; the bands of molar teeth in the roof of the mouth are all of about equal lengths.

Spotted wolffish, p. 507

Back and sides plain colored or dark barred and blotched, but not definitely black-spotted; the central band of molar teeth in the roof of the mouth is longer than the bands that flank it..... 2

2. The central band of molar teeth originates at about the same level as the bands on either side of it, but it extends considerably farther rearward than they do; the canine teeth are very large and prominent; the flesh is firm..... Wolffish, p. 503

The central band of molar teeth originates considerably in advance of the bands on either side of it, but it terminates about even with them rearward; the canine teeth are small, not very prominent; the flesh is noticeably flabby when fresh-caught.

Arctic wolffish, *Anarhichas latifrons*,  
Steenstrup and Hallgrímsson.

### Wolffish *Anarhichas lupus* Linnaeus 1758

CATFISH; OCEAN WHITEFISH

Jordan and Evermann, 1896-1900, p. 2446.

*Description.*—The wolffish suggests a huge blenny in its general make-up, except that its dorsal fin spines are flexible at their tips instead of stiff; that it has no ventral fins; and that its mouth is armed with a set of teeth more formidable than those of any other Gulf of Maine fishes, except for its relative, the spotted wolffish (p. 507), and for some of the sharks. There is a row of about 6 very large, stout, conical canine tusks with a cluster of 5 or 6 smaller canines behind them in the upper jaw; and the roof of the mouth back of the latter is armed with three series of crushing teeth. The central series of these consists of a double row of about 4 pairs of large rounded molars that are

united into a solid plate; each of the outer series consists of two alternating rows of blunt conical teeth. In the common wolffish the central series, which is the longest of the three, originates a very little in advance of the outer series, and it extends rearward noticeably farther. The lower jaw has 4 to 6 large tusks in front, behind which are two longitudinal diverging rows of rounded molars. And the throat also is armed with small scattered teeth. The great projecting tusks, rounded nose, and small eyes give the wolf a singularly savage aspect.

The body is deepest close behind the head, tapering back to a slender caudal peduncle and to a small weak tail fin. The dorsal fin (69-77 spines) is about half as high as the head is long and uniform in height from end to end except for its rounded corners, and it extends from the nape of the neck to the base of the caudal fin. The anal fin (42-48 rays) is only about half as high as the dorsal, and a little more than half as long; its rear corner is angular. The pectoral fins are large and rounded, and the caudal fin is slightly convex in outline.

*Color.*—Wolffishes are dull-colored, but they vary widely in tint. The upper parts and the dorsal fins of those taken off the Massachusetts coast have been described as purplish brown and we have seen them of this tint. But fish caught on Georges Bank are invariably dull olive green, according to Mr. Clapp, while they are described as purplish, brownish, or bluish gray, or slate colored in other seas. No doubt the color of the wolf, like that of many other ground fish, varies with that of its surroundings, purplish and brown tints ruling among red seaweeds and olive gray on clean bottom. Whatever its tint, its sides are transversely barred with a variable number (usually 10 or more) of irregular and broken

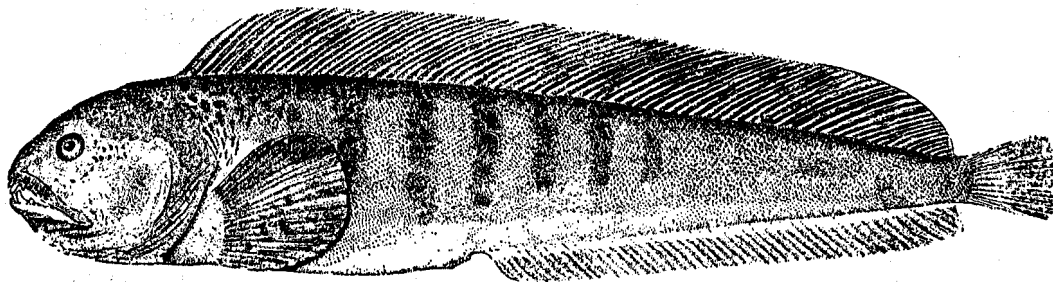


FIGURE 265.—Wolffish (*Anarhichas lupus*), Georges Bank. From Goode. Drawing by H. L. Todd.

darker bands or blotches, or scattered spots, that extend out on the dorsal fin. The throat and the belly back to the vent are dirty-white tinged with the general ground tint of the upper parts. Wolf-fish fade so soon after they are caught that those seen in the markets usually are much paler than they were in life.

*Size.*—A length of 5 feet seems about the maximum in Gulf of Maine waters; one more than 4 feet long is seldom seen, and the larger fish caught and brought in run less than 3 feet. European authors speak of wolffish of 6 feet and even longer, but they average only about 2 feet in Scandinavian waters,<sup>95</sup> i. e., scarcely so large as those in the Gulf of Maine. A fish 33 inches long weighs about 10 pounds, one of 37 inches between 16 and 17 pounds. The greatest weight reported for American waters so far is about 40 pounds.<sup>96</sup>

*Habits.*—The wolffish is solitary, living one here and one there, and it is not abundant anywhere, in the sense that this term can be applied to the cod, to the haddock, to the pollock, or others of our commercially important fishes. It holds close to the bottom; and it is always caught on hard ground, never on mud, a preference illustrated by the fact that our experimental trawlings on the soft bottom of the deep troughs within the Gulf did not catch one wolffish, though they did yield a variety of other fishes in plenty.<sup>97</sup> It is a weak swimmer, moving by sinuous side to side undulations like a blenny or an eel; and probably it spends most of its life hidden among seaweed or rocks, or nosing about such surroundings for food. There is no reason to suppose that it ever attacks other fish in its normal way of life, but when hauled out of the water it snaps like a bulldog and with good aim at anything in its way, the hands, an oar, or at other fish among which it is thrown, and it can inflict a serious bite. Goode<sup>98</sup> remarks that it has been known to make a furious attack on persons wading among the rock pools at Eastport, Maine.

The depth zone occupied by the wolffish at one time or another extends from a fathom or so below tide mark down to 85 fathoms at least, and very likely deeper. It has been reported in tide pools at Eastport, but we have never heard of it in such

situations or at low-water mark anywhere else in the Gulf, nor does it run up estuaries, and it is probable that most of the local stock lives in depths of 10 to 50 or 60 fathoms.

The wolffish is a cool- and cold-water fish, as might be assumed from the fact that its regular geographic range extends hardly farther west than Cape Cod and Nantucket shoals. Those living in the coastal belt of our Gulf, at depths of 25 fathoms or less, regularly experience temperatures as low as 34°–36° (locally even as low as 32°) at the end of the winter, or at some time during the spring, according to locality.<sup>99</sup> They are in temperatures equally low or even lower, fractionally, in late spring and early summer on the fishing grounds along outer Nova Scotia, while the grounds where they are caught in the Gulf of St. Lawrence are flooded every spring and early summer, with water as cold as 32°, which they can avoid only by descending deeper into the Laurentian Trough, a movement of which we have no direct evidence. And they have been caught, widespread, on the Newfoundland Banks (p. 507) in water as cold as 30°–31°. At the other extreme, the highest temperature in which wolffish occur in any numbers is about 50°–52°, at the end of summer (again for those living shoalest) in the coastal belt of our Gulf, and also on the Nantucket shoals grounds. They are never known to run up into brackish water.

The wolffish is resident wherever it is found, to be caught throughout the year. For example, about as many are brought in from Georges Bank in one month as in another, allowance being made for the difficulties and dangers of winter fishing. And as it passes through only a brief pelagic stage when it is young (p. 506), it is a comparatively stationary fish, with much less interchange from one locality to another than is the case with cod or with haddock.

The diet of the wolffish consists wholly of hard-shelled mollusks, crustaceans, and echinoderms. So far as we can learn fish have never been found in the stomach of a wolffish. Mr. Clapp found that the 50 or 60 fish that he opened on Georges Bank had all eaten large whelks (*Buccinum*), cockles (*Polynices*, *Chrysodomus* and *Sipho*), sea clams (*Macra*), and other shellfish, which it crushes easily in its viselike molars. Sometimes,

<sup>95</sup> Smitt, *Scandinavian Fishes*, vol. 1, 1892, p. 232.

<sup>96</sup> Goode, *Fish. Ind. U. S. Sect. 1*, 1884, p. 249.

<sup>97</sup> For list of species taken, see Bigelow and Schroeder, *Biol. Bull.* vol. 76, 1939, p. 309.

<sup>98</sup> *Fish. Ind. U. S. Sect. 1*, 1884, p. 249.

<sup>99</sup> For further details, see Bigelow, *Bull. U. S. Bur. Fish.*, vol. 40, part 2, 1927, p. 542.

however, mollusks even as large as these are swallowed whole, and we have seen many caught on hooks baited with clams. In north European waters wolffish are said to subsist largely on mussels, and one examined by Vinal Edwards at Woods Hole was full of these; none, however, were found in stomachs of the fish caught on Georges Bank, although mussels are plentiful there, which points to a definite preference for the other shellfish just mentioned. The wolffish is also known to feed on large hermit crabs, on ordinary crabs, and other crustaceans, on starfish, and on sea urchins, a quart of the latter having been taken from one caught at Eastport.<sup>1</sup> And Mr. Clapp's observations that every one he has opened contained food of some sort is good evidence of its constant search for anything edible. With such a diet it is not surprising that wolffish are more often caught on hand lines baited with cockles or clams than on long lines, which are usually baited with herring.

*Breeding habits.*—The breeding habits of the wolffish have not been followed on this side of the Atlantic. In north European waters it spawns chiefly from November until January,<sup>2</sup> and apparently the breeding season is about the same for it in Nova Scotian waters, and in the Gulf of Maine, for McKenzie and Homans<sup>3</sup> report a mass of eggs dragged up on February 19, in 1937, some of them just hatching, while we have taken larvae of 20 to 22 mm. (fig. 267), that is, 2 to 3 months old from the time the eggs were deposited, as early as January 30 in 1913, and as late as March 4 in 1920.

The eggs, 5.5 to 6 mm. in diameter (among the largest fish eggs known), yellowish, opaque, and with an oil globule of 1.75 mm., are laid on the bottom in shoal water where they stick together in large loose clumps among weeds and stones. The fish have been described as making an annual shoreward journey for spawning purposes, but there is little evidence of this. The precise duration of incubation is yet to be learned; probably it is long, as it is for most of the fishes that lay their eggs on the bottom.

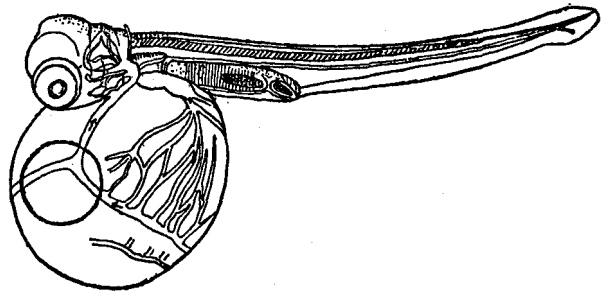


FIGURE 266.—Larva (European), just hatched. After Ehrenbaum.

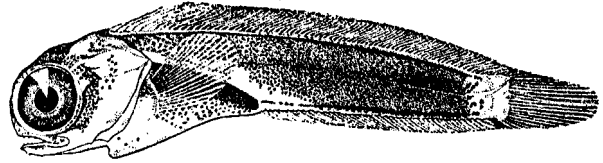


FIGURE 267.—Larva, 21.5 mm. Gulf of Maine.

WOLFFISH (*Anarhichas lupus*).

The slender transparent larvae of the wolffish of north Europe are described as about half an inch (12 mm.) long at hatching, but those that hatched from a mass of eggs dragged up off Nova Scotia were 17–18 mm. long.<sup>4</sup> They have an enormous baglike yolk sac enclosed in a net of highly developed blood vessels (see fig. 266, p. 505), and thus they suggest salmon or trout larvae remotely, in appearance. Wolffish hatched by McIntosh and Prince in the aquarium at St. Andrews, Scotland, did not absorb the yolk sac wholly until about 3½ months old and upward of 20 mm. long, but in natural surroundings larvae as small as 17 mm. have been found free of yolk, nor was any trace of it visible in the larvae of 21 mm. and upward which we have towed in the Gulf of Maine. Larvae of 20 to 22 mm. show the dorsal and anal fin rays in their final number, but the large head, enormous eyes, and tiny teeth, with the fact that there is no definite separation between the anal and dorsal fins and the caudal, give the young fishes an aspect very different from that of their parents until they are 1¼ to 1½ inches long. In life the wolffish is silvery on the sides at this stage, but this metallic hue fades after preservation, leaving only the dark brown pigment granules with which the sides are thickly dotted. The largest fry we have seen (44 mm. long) are similarly pigmented but somewhat paler.

<sup>1</sup> Verrill, Amer. Naturalist, vol. 5, 1871, p. 400.

<sup>2</sup> It was formerly thought to spawn in spring, but McIntosh and Prince (Trans. Roy. Soc. Edinburgh, vol. 35, Pt. 3, No. 10, 1890), to whom we owe all that is known of its early larval development, proved it an autumn and winter spawner both by examination of its ovaries and by the discovery of its eggs.

<sup>3</sup> Proc. Nova Scotian Inst. Sci., vol. 19, 1938, p. 279.

<sup>4</sup> McKenzie and Homans, Proc. Nova Scotian Inst. Sci., vol. 19, 1938, p. 279.

When first hatched, the larvae lie on bottom like young trout or salmon, resting on the yolk; it is not until the latter is considerably reduced in size (several weeks after hatching) that they swim much. And they do no more than dart upward for a few inches and then settle back again until a month old. Thus the wolffish spends the early part of its life close to bottom instead of drifting at the mercy of tide and current, as all fishes do that produce buoyant eggs. Some of the older larvae and the young fry adopt a drifting habit for a time after the yolk is absorbed (we took some 20 specimens of various lengths from 21 to 44 mm., in our tow nets during March and April 1920). But it seems that they seldom rise to the uppermost water layers, for only 2 of the 8 hauls that took them were made at the surface, the others were at depths of 30 to 60 fathoms. And as fry no larger than this have been trawled on bottom in European waters, it seems that some do not leave the ground. It follows, then that the wolffish probably is not subject to the long involuntary migrations that are carried out by most of the members of the cod and flatfish tribes, but that it passes through its entire larval stage near where it is hatched, hence localities where the young are taken are evidence of local spawning. The brevity of the pelagic stage, if any, also implies that the stock of wolffish in any given locality depends on local reproduction for its maintenance.

In Scottish waters wolffish fry have been taken as long as 5 to 6 inches in July, and up to 7 to 8 inches in August, pointing to a rapid rate of growth for the first summer. Nothing is known of the later growth.

*General range.*—Both sides of the North Atlantic; north to Davis Strait in American waters; south regularly to Cape Cod; less often to the westward along southern New England, and exceptionally to New Jersey;<sup>5</sup> also Greenland; Iceland; and northern Europe southward to northern France.

*Occurrence in the Gulf of Maine.*—Although the wolffish has been recorded at only a few stations

in the Gulf in scientific literature<sup>6</sup> it is a fairly common fish, to be caught on suitable bottom in all parts of the Gulf, though nowhere in any great numbers. Thus, something like 30,000 pounds were taken off western Nova Scotia yearly during the period 1944–1946;<sup>7</sup> scattering fish are caught at the mouth of the Bay of Fundy and around Grand Manan (stray fish only up the Bay, if any); on one occasion, in April 1930, we saw 35 of them, 2 to 3 feet long, caught on one set of a long line in 18 fathoms of water off Mount Desert Island; and enough are caught on the small grounds thence eastward to Eastport for 16,000 pounds to have been reported from this statistical area in 1945. The various small coastwise fishing grounds, westward from Mt. Desert, yield much greater numbers, as reflected in reported landings, for 1945, of 253,000 pounds for central Maine; about 1,400 pounds for Cashes Ledge and the neighboring patches of hard bottom, where we have caught them, as we have on Platts Bank also; about 26,000 pounds for western Maine; and about 118,000 pounds reported as taken by the vessel fishery off the coast of Massachusetts from the New Hampshire line to Cape Cod.

Recent statistical surveys have not been of a sort to localize the catches more precisely than this. But the small-boat fishermen, landed more than 37,000 pounds in Essex County, Mass., in 1905, mostly from Jeffreys Ledge, from Stellwagen Bank, and from the deeper rocky spots near Gloucester and Nahant, grounds where fishermen report them as fairly plentiful. And there is no reason to suppose that the situation in this respect has altered subsequently.

Considerable catches are also brought in from Cape Cod waters, as reflected in landings of 233,000 pounds reported for Barnstable County in 1945, about 224,000 pounds for Cape Cod in 1947.<sup>8</sup>

Wolffish are not taken in commercial quantities either to the westward of Nantucket Shoals, or

<sup>5</sup> Abbott (Geol. New Jersey, 1868, p. 818) characterized it as "not unfrequently met with" off the New Jersey coast, and Schnakenbeek (Fauna Ichth.; Cons. Perm. Internat. Explor. mer. Pl. not numbered, 1933) even outlined its range as extending southward to Cape Hatteras. But we have heard of none caught to the westward and southward of Vineyard Sound at any time during the past half-century.

<sup>6</sup> The deep channel between Georges Bank and Browns; off Cape Sable; in St. Mary Bay; at Grand Manan; at Campobello, at the mouth of the Bay of Fundy; Eastport; Mussel Ridge Channel; Casco Bay; Ipswich Bay; Annisquam; off Gloucester; Massachusetts Bay; North Truro; Nantucket Shoals, and Georges Bank.

<sup>7</sup> Canadian and United States catches combined.

<sup>8</sup> We cannot localize these any more precisely.

on the southwestern part of Georges Bank.<sup>9</sup> But the so-called "south channel" grounds from Cape Cod out to the northwestern part of Georges, with the northern and eastern parts of Georges, and Browns Bank to the eastward, support so large a population that these grounds, combined, yielded about 368,000 pounds in 1945, about 840,000 pounds in 1947.<sup>10</sup> And it is much more likely that the differences from year to year in the catch<sup>11</sup> are due to the fact that wolffish are taken only incidentally, so that the catch depends on the precise grounds fished, rather than on any periodic alterations in their abundance.

In 1946 (most recent year for which we have seen statistics for the Canadian as well as for the United States catches) something like 1,571,500 pounds of wolffish were reported as caught within the limits of our Gulf, or something like 260,000 to 270,000 fish, assuming an average weight of 5 to 7 pounds. But it is anyone's guess what proportion of the total population this may be.

Wolffish appear to be about as numerous on the various fishing grounds along outer Nova Scotia (reported catch for 1949, about 800,000 pounds) as they are on Georges and Browns Banks. (p. 507). But while they are reported at several localities in the southern side of the Gulf of St. Lawrence,<sup>12</sup> also off the west coast of Newfoundland, and at Anticosti, they are not plentiful enough anywhere in the Gulf to yield commercial catches.<sup>13</sup> And this applies equally to the Newfoundland Banks, though they have been taken widespread there; also along the south and southeast coast of Newfoundland, and as far north as the offing of Hamilton Inlet on the outer Labrador coast, during the experimental trawlings carried out by the Fishery Research Board of Newfoundland.

The fact that we have taken wolffish larvae in the channel between Browns Bank and Cape Sable; near Seal Island (Nova Scotia); on German Bank and off its slope; off Lurcher Shoal; off

Machias (Maine); on Jeffreys Bank (off Penobscot Bay); and in Massachusetts Bay a few miles off Gloucester, is evidence that the wolffish breeds in the Gulf wherever it is to be found, as might, indeed, be expected. And this applies, equally (it seems) to the more northern parts of the American range of the wolffish, for its pelagic young have been reported off northeastern Newfoundland; in the Strait of Belle Isle; and off Sandwich Bay on the Atlantic coast of Labrador, by the Newfoundland Fisheries Research Commission.

*Commercial importance.*—The market demand for wolffish is of comparatively recent growth. It is an excellent table fish, selling readily as "ocean catfish" or as "whitefish." In 1947 the average price to the fisherman was between 4 and 5 cents per pound, and the Gulf of Maine catch was worth about \$70,000 to \$80,000.

### Spotted wolffish *Anarhichas minor* Olafsen 1774<sup>14</sup>

#### SPOTTED CATFISH

Jordan and Evermann, 1896-1900, p. 2446.

*Description.*—This species resembles the common wolffish closely in its general form and in the arrangement of its fins. The chief difference is that while the central ("vomarine") band of teeth on the roof of the mouth is longer than the band on either side ("palatine") in the common wolffish, these bands are of about equal lengths in the spotted wolffish, and its teeth are described as red in life, not white. Furthermore, the rear end of its dorsal fin is abruptly indented close to the base of the tail, with its last 3 to 6 spines much shorter than those further forward, while the rear end of the dorsal is evenly rounded in the common wolffish.

Color is, however, the most convenient field mark for the spotted wolffish, its pale olive or chocolate<sup>15</sup> upper parts together with its dorsal and caudal fins, being thickly sprinkled with blackish brown spots, of different sizes and of irregular shapes.

*Size.*—Notwithstanding its Latin name this is fully as large a fish as the common wolffish, said to grow to a length of 6 feet. One 37 inches long weighed 13 pounds, eviscerated.

<sup>9</sup> Reported landings were about 6,000 pounds for Nantucket Shoals and about 13,000 pounds for the southwestern part of Georges Bank for 1945; about 9,000 pounds and 23,000 pounds respectively for these same grounds in 1947.

<sup>10</sup> Weight of dressed fish.

<sup>11</sup> For earlier examples, see Bigelow and Welsh, Bull. U. S. Bur. Fish., vol. 40, Pt. 1, 1925, p. 373.

<sup>12</sup> Cheticamp; Prince Edward Island; also Gaspé Bay.

<sup>13</sup> They are not mentioned in the catch statistics for the Gulf of St. Lawrence coast of Nova Scotia, for New Brunswick or for Quebec.

<sup>14</sup> Jordan, Evermann and Clark (Rept. U. S. Comm. Fish. (1928), Pt. 2, 1930, p. 472) place this species in the genus *Lycichthys* Gill 1876; but it seems preferable to follow the older usage here.

<sup>15</sup> The general ground tint has been variously described.



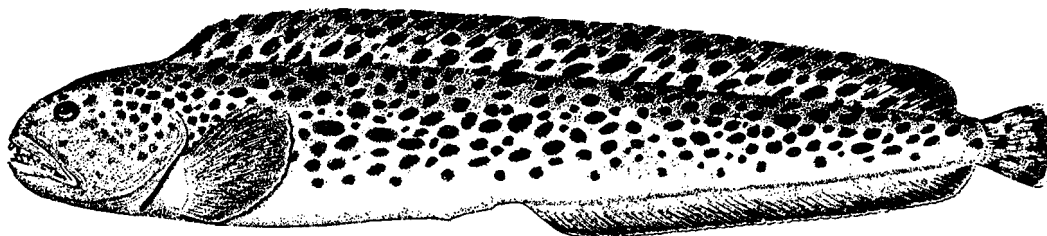


FIGURE 268.—Spotted wolffish (*Anarhichas minor*), off La Have Bank. From Goode. Drawing by H. L. Todd.

*Habits.*—Very little is known of its habits. Its diet is much the same as that of its more common relative. But it is said to keep to rather deeper waters, having been caught as deep as 200 to 240 fathoms off Banquereau Bank<sup>16</sup>, to 200 fathoms in the eastern Atlantic. And its geographic range (see below) shows that it is confined to colder water than is the common wolffish.

*General range.*—Chiefly north of the Arctic circle; north coast of Russia, White and Barents Seas, and Iceland, south to middle Norway (vicinity of Bergen) on the European coast; Greenland; and southward occasionally to the Gulf of Maine on the American coast.

*Occurrence in the Gulf of Maine.*—Goode and Bean's<sup>17</sup> statement that "the Fish Commission has specimens from off the mouth of Gloucester Harbor and from Eastport, Maine," long remained the only notice of this northern fish for the Gulf of Maine,<sup>18</sup> and fishermen of whom we have inquired have either never seen it there or they have failed to distinguish it from the common wolffish, which is unlikely, so striking is its color pattern. But the late Walter Rich, of the U. S. Bureau of Fisheries, obtained a specimen that had been taken in 35 fathoms off Cape Elizabeth (now in the collection of the Portland Society of Natural History); another, weighing 3¼ pounds

was caught on a long line off Portland lightship on April 23, 1927. Evidently this wolffish reaches our Gulf only as an accidental waif from its Arctic home, one to be watched for but hardly to be expected.

It appears to occur regularly off outer Nova Scotia however, though in small numbers. Thus 5 to 10 are usually landed at Boston each year from Sable Island Bank; we have records of 7 caught there in 1934;<sup>19</sup> one was brought in many years ago from 200 fathoms from the deep gully between Sable Island Bank and Banquereau; and one from 250 fathoms from the northeast slope of the latter bank.<sup>20</sup> Another was taken on Banquereau in 50 fathoms, in 1932;<sup>21</sup> three were taken on Western Bank in 1937;<sup>22</sup> five more were definitely reported from Banquereau in that same year; and McKenzie<sup>23</sup> writes that half a dozen are brought in from that general region yearly.

With so many records for Nova Scotian waters it is astonishing that the spotted wolffish has not been reported at all in the Gulf of St. Lawrence so far as we can learn, nor is it mentioned among the fishes listed in Newfoundland waters or off outer Labrador from the experimental trawlings by the Fishery Research Commission of Newfoundland.

#### THE OCEAN POUTS AND WOLF EELS. FAMILY ZOARCIDAE

The ocean pouts and wolf eels are slender eel-like fishes with the anal fin continuous with the caudal. In most of the members of the family the dorsal fin, also, joins the caudal equally, making one continuous fin extending around the tip of the tail, but in the only common Gulf of Maine species the rear portion of the dorsal is so

low that there seems to be a bare space between it and the caudal. All the members of the family, however, known definitely, either from the Gulf of Maine, or from the outer coast of Nova Scotia, are readily separable from the true eels by having ventral fins (small but unmistakable) situated<sup>24</sup>

<sup>16</sup> Bean, Proc. U. S. Nat. Mus., vol. 3, 1881, p. 82.

<sup>17</sup> Bull. Essex Inst., vol. 11, 1879, p. 11.

<sup>18</sup> Goode's (Fish. Ind. U. S., Sect. 1, 1884, p. 249) statement that it has been seen in the Bay of Fundy apparently refers to this Eastport record.

<sup>19</sup> Bigelow and Schroeder, Bull. U. S. Bur. Fish., vol. 48, 1936, p. 337.

<sup>20</sup> Bean, Proc. U. S. Nat. Mus., vol. 3, 1881, p. 82.

<sup>21</sup> Vladykov, Proc. Nova Scotian Inst. Sci., vol. 19, pt. 1, 1935, p. 3.

<sup>22</sup> McKenzie and Homans, Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 279.

<sup>23</sup> Proc. Nova Scotian Inst. Sci. vol. 20, pt. 1, 1939, p. 18.



little in advance of the pectorals. But the green ocean pout (*Gymnelis viridis* Goode and Bean) of arctic seas has no ventrals; it ranges southward as far as the estuary of the St. Lawrence River,<sup>24</sup> and perhaps as far as northern Nova Scotia.<sup>25</sup> The closest affinities of the ocean pouts, among Gulf of Maine fishes are with the blennies (p. 491), the wolffishes (p. 500), and the wrymouths (p. 502). But they are easily separable from the blennies and wrymouths by the fact that at least the major part of the dorsal fin is soft-rayed, not spiny; and from the wolffish by their more slender form and smaller teeth.

Only two species are known definitely from our Gulf, one, the common ocean pout (p. 510) very plentiful; the other, the wolf eel (p. 515), much less so. A third, the Arctic Ocean pout (p. 516) has been reported from shoal water to the west of our Gulf as well as from the Nova Scotian Banks to the east, though not from the Gulf itself. A fourth species (*Lycodes esmarkii* Collett 1875) has been credited to the Bay of Fundy.<sup>26</sup> But the specimen in question was trawled by the *Albatross I*, on the southern slope of the Grand Banks in 244

fathoms of water.<sup>27</sup> Two others that have been reported from the Nova Scotian Banks are also included in the following key, as they are likely to be found in our Gulf sooner or later.

Still another species, *Lycodes atlanticus* Jensen 1904, has been reported from a number of stations along the continental slope from the offing of southern Nova Scotia to the offing of northern North Carolina, in depths of 543 to 1,423 fathoms.<sup>28</sup> But being a deep-water form, it is not to be expected either within the limits of the Gulf of Maine, or on the Nova Scotian Banks.

The various species of the genus *Lycodes* resemble one another so closely that their identification is very difficult. If one should be taken in the Gulf that does not agree with either of these that are described on the following pages, we suggest that it be sent either to the laboratory of the U. S. Fish and Wildlife Service, Woods Hole, Mass.; the Division of Fishes, U. S. National Museum, Washington, D. C.; or to the Department of Fishes, Museum of Comparative Zoology, Cambridge, Mass., to be named.<sup>29</sup>

#### KEY TO GULF OF MAINE AND NOVA SCOTIAN OCEAN POUTS AND WOLF EELS

1. The dorsal fin seems to be separated from the caudal fin by a considerable gap..... Ocean pout, p. 510  
The dorsal, caudal and anal fins form one continuous fin..... 2
2. The trunk is extremely slender, at least 14-16 times as long as it is deep; the dorsal fin originates over the tips of the pectoral fins..... 3  
The trunk is stouter, less than 12 times as long as it is deep..... 4
3. Dorsal fin with only about 92 rays and anal fin with about 88 rays; lower surface of body with only a few scales..... Wolf eel, p. 515  
Dorsal fin with about 118 rays and anal fin with about 110 rays; lower surface of body uniformly scaly, like upper surface..... *Lycenchelys paxillus*, Goode and Bean 1879<sup>30</sup>
4. The lateral line runs along the middle of the sides; the vent is only a little nearer to the snout than to the tip of the tail; there are no scales on the belly or on the forward part of the back..... Arctic eelpout, p. 516  
The lateral lines (or their lower branch if double) run along the lower part of the sides; the vent is considerably nearer to the snout than it is to the tip of the tail; the body is covered with scales..... 5

<sup>24</sup> Vladykov and Tremblay, *Natural. Canad.*, vol. 62 (Ser. 3, vol. 6), 1935, p. 82.

<sup>25</sup> Goode and Bean (*Smithsonian Contrib. Knowl.*, vol. 30, 1895, p. 313) credit it to Nova Scotia but give no definite locality.

<sup>26</sup> By Vladykov and McKenzie, *Proc. Nova Scotian Inst. Sci.*, vol. 19, 1935, p. 109.

<sup>27</sup> Reported by Goode and Bean (*Smithsonian Contrib. Knowl.*, vol. 30, 1895, p. 305) as from lat. 44°47' N.; long. 66°33' W., *Albatross* Station 2470; but the actual position of this station was lat. 44°47' N.; long. 56°33' W. See Townsend, *Rept. U. S. Comm. Fish.*, (1900), 1901, p. 399.

<sup>28</sup> Reported by Goode and Bean (*Smithsonian Contrib. Knowl.*, vol. 30, 1895, pp. 305-306) as *L. frigidus* Collett 1875, with list of stations.

<sup>29</sup> Jensen's monograph of the Lycodids of Northern Europe and of Greenland (*Danish Ingolf Exped.*, vol. 2, Pt. 4, 1904) includes descriptions, and beautiful illustrations of all the species of *Lycodes* that have been reported from the Gulf of Maine, or from the Nova Scotian Banks. And Vladykov and Tremblay (sta. Biol. Saint Laurent. *Fauna and Flora Laurent*, No. 1, 1936) have given a revision of the genus in the western Atlantic with descriptions and photographs of several new species and subspecies from the Gulf of St. Lawrence and northward.

<sup>30</sup> Known from several stations on the continental slope abreast of our Gulf and off southern New England at depths of 365-904 fathoms; also from the deep gully between LaHave and Sable Island Banks at 200 fathoms (see Goode and Bean 1895, p. 311 for list).

5. Lateral line single, running along lower part of side of body; forward part of dorsal fin marked with one or more sooty patches.....*Lycodes vahlii* Reinhardt 1838<sup>31</sup>  
 Lateral line double, with the more distinct branch of the two running along the lower edge of the side of the body; the forward part of the dorsal fin is not marked with dark patches.....*Lycodes esmarkii*, Collett 1875<sup>32</sup>

**Ocean pout** *Macrozoarces americanus* (Bloch and Schneider) 1801

EELPOUT; CONGO EEL; MUTTONFISH

Jordan and Evermann, 1896-1900, p. 2457. *Zoarces anguillaris* (Peck) 1804.

*Description.*—The ocean pout is blenny-like or eel-like in form, its body about 8 times as long as it is deep (10 to 11 times in young fish up to about 8 inches long), moderately flattened sidewise, noticeably sway-bellied, and tapering backward from abreast of the pectorals, where it is deepest, to a pointed tail. It is very soft, its scales are very small, and its skin as slimy as an eel. Its ventral fins are small like those of the rock eel (p. 492), and they are situated well forward of the pectorals.

The most useful field mark for the identification of the ocean pout among the several eel-like fishes with which it might be confused are its vertical fins. Its anal fin is continuous with the caudal, there being no trace of any notch between the two, as is the case with the true eels. In reality, this is also true of the dorsal fin of the eelpout. But about 16 to 24 of the dorsal rays near the rear end of the fin are so short as to be hardly visible, so that there seems to be a considerable free gap between the dorsal fin and the caudal fin. Furthermore, these short rays are spiny instead of soft as all the other dorsal rays are. The dorsal fin runs from the nape back along the whole length of the

<sup>31</sup> Originally described from Greenland; reported from Banquereau Bank, at 130-190 fathoms by Goode and Bean (Smithsonian Contrib. Knowl., vol. 30, p. 308, as *Lycodes zoarchus*. See Vladykov and McKenzie, Proc. Nova Scotian Inst. Sci., vol. 19, pt. 1, 1935, p. 109.

<sup>32</sup> Spitzbergen and Northern Norway; Grand Banks; LaHave Bank, and southward along the continental slope in depths of 300-420 fathoms to the offing of Rhode Island.

trunk, and consists of first about 95-100 soft rays; next of the short spines, then of about 17 more soft rays. The anal fin (about 105-124 soft rays) originates a little in front of the mid length of the fish. Both the dorsal fin and the anal are of nearly even height from end to end except as just noted, but the dorsal is nearly twice as high as the anal. The pectoral fins are large and rounded like those of the wolffish. The very small ventrals are on the throat, in front of the pectorals. The upper jaw projects a little beyond the lower, the soft, fleshy upper lip somewhat farther still,<sup>33</sup> enclosing the tip of the lower lip when the mouth is closed.

The mouth is wide, gaping back beyond the small eyes, and it is set low with thick and fleshy lips that give the profile a distinctive aspect. Both jaws are armed with two series of strong, blunt conical teeth, largest in front, but the mouth lacks the crushing teeth that are so characteristic of the wolffish tribe (p. 502). There are 131-144 vertebrae.

*Color.*—Although this fish has usually been described as reddish brown mottled with olive, or as salmon colored, most of those we have seen caught have been of some shade of muddy yellow, paler or darker; some tinged with brownish, some with salmon, and some with orange; a few have been pure olive green. Fishermen usually describe them as yellow, and this is evidently the prevailing hue in the offshore parts of the Gulf. Other ocean pouts we have caught inshore along the coast of Maine, however, have shown yellow only on the margins of the fins, particularly the lower edge of the pectorals, with the general ground tint of sides

<sup>33</sup> The ocean pout has sometimes been described and pictured as with the upper lip and jaw projecting far beyond the lower; but this is contrary to our observations.

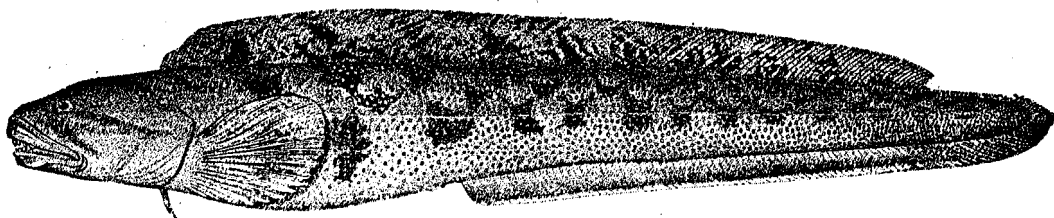


FIGURE 269.—Ocean pout (*Macrozoarces americanus*), Eastport, Maine, specimen. From Goode. Drawing by H. L. Todd.

and back ranging from pale gray (sometimes with purplish tinge) to dull brown or to dark dusky olive; the belly ranging from dirty white or yellowish or pinkish to the same dark shade as the back. One of a pair that were caught side by side in Northeast Harbor, Mount Desert, was pale grayish white below while the other was amethyst pink on the belly and on the lower side of the head. Whatever the ground tint, the sides are dotted with small dark spots clustered in irregular cross-bars, extending out on the dorsal fin. And there is a dark brown stripe running from eye to edge of gill cover.

Young fry, up to 3 or 4 inches long, are checkered along the sides and irregularly blotched on the back with light and dark brown, and they have a small but prominent black spot on the forward part of the dorsal fin until about 1 foot long, but this spot fades out with growth.

*Size.*—The ocean pout is said to reach a length of 3½ feet and to a weight of 12 pounds; Olsen and Merriman's largest, among some 2,500 specimens, was 38½ inches long, weighing 11¾ pounds, and we have seen one of about 3 feet among the many we have handled. But only a few grow longer than 30 inches, with 16 to 28 inches as a fair average for the general run of those that are caught.

The average weights of pouts of different sizes were about as follows for a large number taken in the southern side of the Gulf of St. Lawrence, in the Bay of Fundy, in the southwestern part of the Gulf of Maine, and off southern New England: 16 inches, ½ pound; 18 inches, 1–1½ pounds; 20 inches, 1½–1¾ pounds; 22 inches, 2–2¼ pounds; 24 inches, 2½–3 pounds; 26 inches, 3¼–3¾ pounds; 28 inches, 4½ pounds; 30 inches, 5½ pounds.<sup>34</sup>

*Remarks.*—The ocean pout of North Europe (*Zoarces viviparus* Linnaeus 1758), a very close relative, is distinguishable from the American eelpout, by having fewer fin rays (about 100 dorsal rays and 6 to 10 spines; 80 to 89 anal rays), fewer vertebrae (101–126), smaller head and mouth, and only a single row of teeth in the front of the jaw, while some specimens have no interruption between the dorsal fin and the caudal. Also, the European ocean pout is a smaller fish,

and its eggs are retained in the ovaries of the mother until after they have hatched, hence its specific name *viviparus*.

It is well known<sup>35</sup> that the European ocean pout tends to break up into genetic races that are partly correlated with environmental conditions. And recent studies by Olsen and Merriman<sup>36</sup> make it likely that there is a slower growing race of ocean pout in the Bay of Fundy and perhaps northward; a larger, faster growing race ranging from Cape Cod southward, with each of these including minor subpopulations. This interesting subject would repay further investigation.

*Habits.*<sup>37</sup>—The ocean pout is a ground fish, as might be expected from the fact that it has no swim-bladder, as well as from its food (see p. 512). And the habits of fish kept in aquaria, where they are described as remaining coiled up in the darkest parts suggests that they spend most of their lives hiding among sea weeds and stones. They are described as moving slowly backward and forward by undulations of the fanlike pectoral fins or of swimming more rapidly by undulating motions of the rear part of the trunk and tail, with the pectorals wide spread and held horizontal, and with the dorsal and anal fins close to the body.<sup>38</sup> They swim actively when disturbed. And it is almost unbelievable to what a hopeless tangle of cord, fish, and slime a few ocean pouts can reduce many fathoms of long line set for other fish.

The vertical range of the ocean pout in one place or another extends at least as deep as 105 fathoms.<sup>39</sup> At the opposite extreme Clemens and Clemens<sup>40</sup> report that young ones are sometimes found around rocks and in seaweed along the shore in the Bay of Fundy during the ebb tide. They are even known to run into rivers for some distance, though always holding to the bottom, i. e., to the undercurrent of water of

<sup>34</sup> Especially from investigations by Johannes Schmidt and by J. V. C. Smith (for list of references, see Olsen and Merriman, Bull. Bingham Oceanographic Collection, vol. 9, art. 4, 1946, p. 182).

<sup>35</sup> Bulletin, Bingham Oceanographic Coll., vol. 9, art. 4, 1946, p. 116–117.

<sup>36</sup> Olsen and Merriman (Bull. Bingham Oceanogr. Coll., vol. 9, art. 4, 1946) have recently published a detailed study of the life history of the ocean pout.

<sup>37</sup> Willey and Huntsman (Canadian Field Naturalist, vol. 35, 1921, p. 6), and Clemens and Clemens (Contrib. Canadian Biol. [1918–1920], 1921, p. 71) give some observations on the actions of ocean pouts kept in the aquarium at the St. Andrews Laboratory.

<sup>38</sup> *Albatross III* trawled 3 specimens from between 105 and 240 fathoms, on the southwestern slope of Georges Bank in May 1950.

<sup>39</sup> Contrib. Canadian Biol. (1918–1920) 1921, p. 72.

<sup>40</sup> According to graphs by Clemens and Clemens (Contrib. Canadian Biol. [1918–1920] 1921, fig. 5, p. 79), for the Gulf of St. Lawrence and Bay of Fundy; and by Olsen and Merriman (Bull. Bingham Oceanographic Coll., vol. 9, art. 4, 1946, fig. 4, p. 43) for the southwestern part of the Gulf of Maine and for southern New England.

high salinity that tends to move inward along the bottom from offshore. But most of them live between 8-10 fathoms and perhaps 45 fathoms in the waters with which we are most immediately concerned. During the years when ocean pouts were in demand (see below), good catches were made as shoal as 10 to 12 fathoms in the southwestern part of the Gulf, also off southern New England.<sup>41</sup> And we have seen large numbers caught from party boats, at 8-17 fathoms along the coast of New Jersey.

We have taken ocean pouts in the Gulf of Maine on sandy mud, on sticky sand, on broken bottom, also on pebbles and gravel. They are caught in large numbers on smooth hard bottom and we have seen many more of them taken from party boats off northern New Jersey on rocky bottom, along with sea bass (p. 407), tautog, cod, and other fishes, than were taken on soft bottom when we were fishing for hake (*Urophycis*).

There is no evidence that they carry out any extensive migrations. However, information has accumulated recently to the effect that the adults congregate through the summer, autumn, and early winter on rocky bottoms where the eggs are deposited and guarded, to disperse again in midwinter (after the eggs have hatched), over the smoother grounds in the vicinity where food is more plentiful.<sup>42</sup> And this spawning migration appears to be complicated by an autumnal shift offshore to deeper water, with a return movement in spring, in coastal regions where the bottom water chills in winter to a temperature too low for their comfort; in the Bay of Fundy, for example (p. 514), and perhaps in the Gulf of St. Lawrence.

The ocean pout can be classed as a cool-water fish, for the great majority of them, in whatever part of their geographic range, are in temperatures at least no higher than about 62°, throughout the year. At the other extreme, they have been taken in 32° in the Bay of Fundy (p. 514); in about 31° to 32° in Trinity and Conception Bays, Newfoundland.<sup>43</sup> And eelpouts are exposed to temperatures as low as this, in spring, in the Gulf of St. Lawrence, unless they descend deeper into the Laurentian Channel, which they may do.

*Food.*—The American ocean pout feeds on a wide variety of shelled mollusks, univalve and bivalve, on crustaceans large and small, on echinoderms and on other invertebrates. The Bay of Fundy fish opened by Clemens and Clemens had dieted chiefly on the two common mussels, *Mytilus* and *Modiolaria*, on whelks (*Buccinum*), periwinkles (*Littorina*), and on scallops (*Pecten*) as well as on various other bottom-living mollusks, on sea urchins, brittle stars, and barnacles. A large specimen caught in Massachusetts Bay, January 1924, was packed full of brittle stars (ophiurans), spider crabs, and small sea scallops (*Pecten magellanicus*); a number trawled by the *Albatross III* at 42 fathoms, near Nantucket Lightship, May 17, 1950, were full of small sea scallops (*Pecten magellanicus*), as many as 100-200 per fish. Olsen and Merriman<sup>44</sup> write that sand dollars (*Echinarrachnius*) were the chief items in the stomach contents of some 850 ocean pouts taken in the southwestern part of our Gulf and off southern New England, with crabs (*Cancer*) and isopod crustaceans (*Unicola*) as seconds; while some had eaten bivalve mollusks (*Yoldia* and *Pecten*) in large amounts; also the eggs of the longhorn sculpin (p. 451), which are often laid among the branches of the finger sponge (*Chalina*).

Ocean pouts bite on fish as greedily as they do on clams or cockles, and pouts kept in the aquarium at St. Andrews took fish as readily as clams;<sup>45</sup> while two of the fish opened by Clemens and Clemens,<sup>46</sup> and also Bay of Fundy fish examined by Olsen and Merriman,<sup>47</sup> contained remains of fish. But in all probability about the only fish they get are dead ones that have sunk to the bottom, or occasionally a small one that a pout may have the good luck to catch. The European representative of our ocean pout (*Zoarces viviparus*) is described<sup>48</sup> as taking in mouthfuls of weeds for the crustaceans and mollusks living among these, and as swallowing a considerable amount of the plant material with its animal prey. But American ocean pouts appear not to feed in

<sup>41</sup> Olsen and Merriman, Bull. Bingham Oceanographic Coll., vol. 9, art. 4, 1946, p. 37, 38, fig. 3.

<sup>42</sup> This shift of grounds has been demonstrated recently by Olsen and Merriman (Bull. Bingham Oceanog. Coll., vol. 9, art. 4, 1949, p. 40-42).

<sup>43</sup> Rept. Newfoundland Fish. Res. Comm., vol. 1, No. 4, 1932, p. 109.

<sup>44</sup> See Olsen and Merriman, (Bull. Bingham Oceanog. Coll., vol. 9, art. 4, 1946, p. 124-129) for a list of stomach contents, with discussion.

<sup>45</sup> As reported by Willey and Huntsman, Canadian Field Naturalist, vol. 35, 1921, pp. 6-7.

<sup>46</sup> Contrib. Canadian Biol. (1918-1920) 1921, p. 80, small fish, including 8 smelt.

<sup>47</sup> Bull. Bingham Oceanogr. Coll., vol. 9, art. 4, 1946, p. 129; probably herring.

<sup>48</sup> By Blegvad, Report Danish Biol. Stat. (1916), 1917, p. 42.

this way to any great extent, for only traces of plants have been found in their stomachs.

The eggs of the European ocean pout (*Zoarces viviparus*) are fertilized within the mother, and are retained within her oviducts until after they hatch. But the American eelpout lays eggs, as proved by the fact that the young were hatched from a mass of eggs brought up, with two eelpouts, in an old rubber boot,<sup>49</sup> in Blacks Harbor, Passamaquoddy Bay. And enough small specimens of 1½ inches and upward have been collected of late, between New Jersey and Maine, to show that the eelpout breeds successfully throughout this part of its range, at least; and probably as far north as northern Nova Scotia and the southern side of the Gulf of St. Lawrence.

Various lines of evidence<sup>50</sup> show that spawning takes place in September and October. And the fact that fish taken in summer differ widely in the stage of development of their sexual products suggested to Clemens and Clemens that they do not breed every year. But it seems more probable to us that this is evidence simply of a protracted breeding period, some individuals ripening early in autumn, others not until later.

Large females lay more eggs than small, the numbers of maturing eggs actually counted having ranged from 1,306 in a fish 21½ inches (55 cm.) long to 4,161 in one of about 34½ inches (87.5 cm.).

The eggs are yellow, 6–7 mm. in diameter, and are laid in masses held together by a gelatinous substance. The only egg mass so far brought in was in an old rubber boot, suggesting that they are normally deposited in crevices in rocks or among stones, which would explain the apparent tendency of the mature fish to congregate on rocky bottom as the spawning season approaches.

The fact that eggs brought up in the trawl in the Passamaquoddy region, where the spawning is supposed to take place from mid-September through October, hatched in early January, and that ocean-pout eggs taken off New York in mid-November<sup>51</sup> still were some weeks short of hatching, makes it likely that incubation occupies at least 2½ to 3 months. And the actions of a captive female that lay coiled around its mass of eggs, though

these had not been fertilized,<sup>52</sup> makes it likely that the eggs are guarded by one or the other parent during this period, perhaps by both of them.

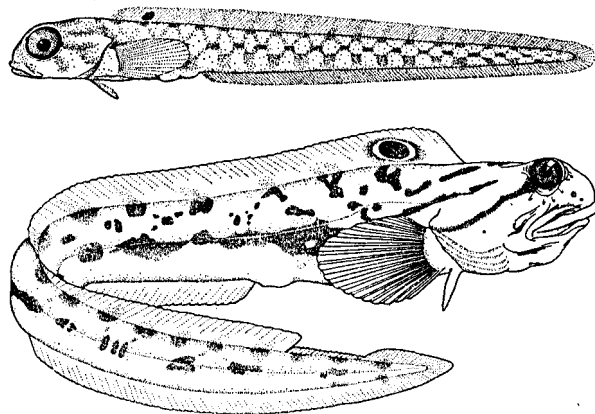


FIGURE 270.—Ocean pout (*Macrozoarces americanus*). Above, larva, 48 mm. Below, young fish, 387 mm. Drawings by Louella E. Cable.

The larvae are about 30 mm. long at hatching, i. e., much larger than those of most of our commercially important fishes, and they are so far advanced already in development that they are easily identified.<sup>53</sup> Being so nearly adult in form, it is probable that they hold to the bottom from the time they are hatched; all catches of immature fish recorded so far have, indeed, been on the bottom.

The sizes, of the fry in different months, show that ocean pouts reach a length of about 3 inches during their first summer, and that they are about 4 to 5 inches long when 1 year old. According to studies of otoliths by Olsen and Merriman,<sup>54</sup> ocean pouts in southern New England waters may be expected to reach 6 inches when between 1 and 2 years old; 12 inches at 3 years; and 24 inches when between 6 and 7 years, the very large fish of 36 inches and upward being 12 years to 16 years old. Estimates by the same method by Clemens and Clemens<sup>55</sup> point, however, to a considerably slower rate of growth in the colder water of the Bay of Fundy, where a 12-inch fish is likely to be nearly 5 years old, a 24-inch fish between 12 and 13 years old; and where the 8 oldest fish examined

<sup>49</sup> For account, see White, Jour. Fish. Res. Bd. Canada, vol. 4, pt. 5, 1939, pp. 337–338.

<sup>50</sup> Discussed in detail by Olsen and Merriman, Bull. Bingham Oceanogr. Coll., vol. 9, art. 4, 1946, pp. 69–77.

<sup>51</sup> From the stomach of a cod, see Olsen and Merriman, Bull. Bingham Oceanogr. Coll., vol. 9, art. 4, 1946, p. 76, fig. 9.

<sup>52</sup> See Olsen and Merriman (Bull. Bingham Oceanogr. Coll., vol. 9, art. 4, 1946, p. 75, fig. 8) for a photograph of a female so employed, in the Shedd Aquarium, Chicago.

<sup>53</sup> For further details, see White, Jour. Res. Board Canada, vol. 4, 1939, p. 338.

<sup>54</sup> Bull. Bingham Oceanogr. Coll., vol. 9, art. 4, 1946, pp. 85–93.

<sup>55</sup> Contributions to Canadian Biology, 1918–1920 (1921), p. 74.

(16-18 years) among 190 specimens, were only 26¼ to 28½ inches long.

In one commercial catch, probably representative, made off Provincetown and analyzed by Olsen and Merriman, most of the fish were 4 to 10 years old, with only scattered fish of 11 to 16 years.

Off southern New England, according to Olsen and Merriman, a few females mature sexually when they are about 18 inches long; about half at 22-23 inches, and all of them by the time they are 24-25 inches long; males mature earlier, most of them by the time they have reached 15-16 inches; a few not until larger. The smallest females with large eggs seen in the Bay of Fundy region by Clemens and Clemens were 16-18 inches long.

*General range.*—Coast of North America from the Strait of Belle Isle, Gulf of St. Lawrence, and southeastern Newfoundland south to Delaware;<sup>60</sup> common from the southern side of the Gulf of St. Lawrence and northern Nova Scotia to New Jersey.

*Occurrence in the Gulf of Maine.*—The ocean pout, known more familiarly as "conger", or "congo" eel along the coast of Maine,<sup>61</sup> is a familiar fish in the Gulf in moderate depths of water both near shore and on the offshore banks; abundant locally off western Nova Scotia; in the Bay of Fundy;<sup>62</sup> all along the coasts of Maine and Massachusetts; and on Georges Bank where considerable numbers are taken both by otter trawlers and by long-line fishermen.<sup>63</sup> Very small ones have been collected off Chatham, Cape Cod; on Stellwagen Bank at the mouth of Massachusetts Bay; and near Mount Desert Island, Maine, by us; also in the Bay of Fundy and in Passamaquoddy Bay by Clemens and Clemens,<sup>64</sup> evidence that it breeds successfully all around the Gulf.

There seems to be a wide difference in the depth zone frequented by the ocean pout in different parts of the Gulf. In the Bay of Fundy some of them run up into shoal water in summer and young ones are to be found under stones and among seaweed between tide marks. Similarly, one is always apt to catch several in a half day's flounder fishing in 1 to 3 fathoms in Penobscot Bay or in

Northeast Harbor, Maine, as we can bear witness. And this probably applies to bays and harbors all along the coast of Maine east of Cape Elizabeth. But we have never seen one taken in less than 10 fathoms of water in the Massachusetts Bay region, where most fishermen speak of it as a comparatively deep-water fish though it has been recorded from Gloucester Harbor. And the ocean pouts on the offshore grounds live mostly deeper than 20 to 30 fathoms. Thus *Albatross II* trawled a number in the basin of the Gulf down to 90 fathoms in July 1931, while a large number of them have been trawled on Georges Bank, at depths of 20-60 fathoms.<sup>60</sup> And in May 1950, the *Albatross III* trawled 3 at 105 fathoms or deeper<sup>61</sup> on the southwestern slope of Georges Bank.

Ocean pouts also frequent different types of bottom in different localities. In Massachusetts Bay they are seldom caught on the good fishing grounds on stony or gravelly bottoms, that is, or about ledges. But if the long line chances to run off these, the portion of it that is resting on the softer floor of the deeper parts of the bay often brings in eelpouts and nothing else except an odd hake. They are caught regularly on hard bottom, however, off Cape Cod and to the westward; we have trawled them on rather sticky sand in Ipswich Bay (22 fathoms) among good catches of hake and plaice; on broken bottom at the mouth of Casco Bay; on pebbles and mud in Penobscot Bay; they are commonly caught on stony ground farther eastward along the coast of Maine; and Huntsman describes them as taken on hard bottom in the Bay of Fundy.

In fact, the only type of bottom where we have not heard of them in our Gulf is the soft oozy mud with high organic content that floors certain of the deeper depressions, such as the trough to the west of Jeffreys Ledge.<sup>62</sup>

Information as to the seasonal movements of ocean pouts in different parts of the Gulf is not only scanty, but perplexing. In the open Bay of Fundy, Huntsman describes them as working inshore in spring but moving out again into deeper water in

<sup>60</sup> There is a doubtful record for North Carolina (Smith, North Carolina Geological and Economic Survey, vol. 2, 1907, p. 379).

<sup>61</sup> Years ago we heard them called "yowlers" by long-line fishermen, but we doubt that this name is still used for them anywhere.

<sup>62</sup> Clemens and Clemens (Contrib. Canadian Biol. (1918-1920) 1921, p. 69) give a general account of the ocean pout in the Bay of Fundy, and list the localities there whence it has been recorded.

<sup>63</sup> Contrib. Canadian Biol. (1918-1920), 1921, p. 77.

<sup>60</sup> *Albatross III*, for example, trawled 137 of them along the southern slope of Georges, at 31-80 fathoms, in May 1950; the dragger *Eugene H* trawled an average of 8 pouts per haul at 26-45 fathoms, and about 2 per haul at 46-76 fathoms on the south central part of Georges Bank, in late June 1951.

<sup>61</sup> The depth ranged from 105 fathoms to 240 fathoms along the strip of bottom on which the trawl was working.

<sup>62</sup> They were not represented among the considerable list of fishes trawled in such situations by the *Atlantis* in August 1936 (Bigelow and Schroeder, Biol. Bulletin, vol. 76, 1939, p. 309).

October or early November, which is corroborated by a report of Clemens and Clemens, that set lines made good catches in the Passamaquoddy region from early June through September, but caught none there from January to May. And their abundance in Penobscot Bay in midsummer suggests that some of them may perform a similar on and offshore migration there, too. But this may not apply to the coast south of Cape Elizabeth. Off southern New England, where they are plentiful on the commercial fishing grounds in winter and spring, only stray ocean pouts are taken there in summer and autumn. But it seems more likely that they shift, then, to regions of rockier bottom nearby, than that they move off-shore.<sup>63</sup>

It is not yet clear to what extent their movements depend on the local food supply, on seasonal changes in temperature, or on the habit the mature fish have of congregating on rocky grounds during the spawning season, and while guarding the eggs thereafter (p. 513). One must also bear in mind that failure to catch them on hook and line may simply mean that they are not biting at the time, not necessarily that they have moved away. This is likely to apply to the adult fish in particular during their spawning and egg-guarding season.

*Importance.*—Although the ocean pout has few bones and is said to be a sweet-meated fish, there was no regular market for it prior to the early 1930's; only a few, brought in by small boats, were sold on the streets of Boston, and nearly all of those that were caught incidentally by the larger vessels were thrown overboard. A small demand then developed for them resulting in landings for Massachusetts ranging between 45,600 pounds and

114,700 pounds yearly, for the period 1935 to 1942,<sup>64</sup> though none for Maine.

A concerted attempt was made in 1943 to market ocean pout as fillets, partly as a war measure. This was so successful that 3,943,300 pounds were reported as landed in Massachusetts ports in that year; 4,449,600 pounds in 1944, most of them caught from the tip of Cape Cod southward, and nearly all of them marketed through New York. But this popularity was short lived, for word soon spread that ocean pout are often afflicted with a protozoan parasite. Many shipments were condemned for this cause, and the demand fell off so rapidly that the landings for Massachusetts were less than one-fourth as great in 1945 (1,003,700 pounds) as they had been in 1944<sup>65</sup>; fell to 613,300 pounds in 1946; were 167,400 pounds in 1947; and dropped to 6,100 pounds in 1948, the most recent year for which statistics of the catch are available.

**Wolf eel** *Lycenchelys verrillii* (Goode and Bean)  
1877.

Jordan and Evermann, 1896-1900, p. 2470.

*Description.*—This fish is eel-like in form and resembles the ocean pout in most other respects as well, except that it is more slender (about 14 to 16 times as long as it is deep), and that there is no separation, apparent or real, between its dorsal, caudal, and anal fins, but the three form a single continuous vertical fin running along the back, around the tail, and forward on the lower surface to the vent. The dorsal fin not only originates

<sup>63</sup> Landings for 1933 to 1940 were listed as "conger eels"; no data are available for 1934 or 1936.

<sup>64</sup> For a detailed history of the event, see Olsen and Merriman, Bull. Bingham Oceanogr. Coll., vol. 9, art. 4, 1946, pp. 9-10.

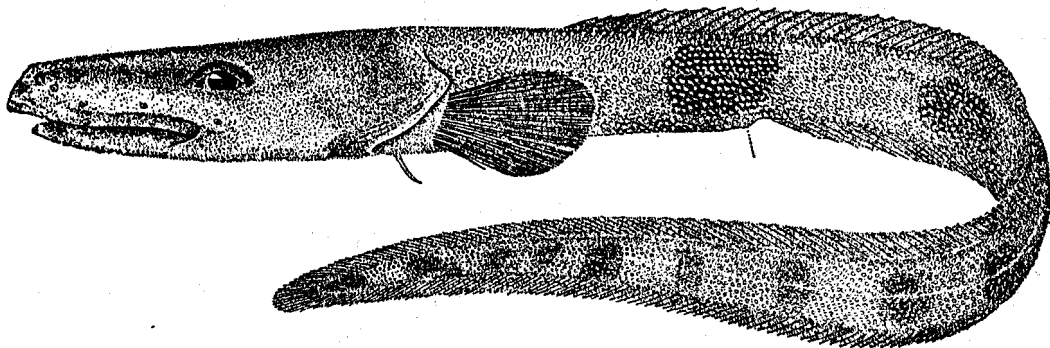


FIGURE 271.—Wolf eel (*Lycenchelys verrillii*), off Chebucto, Nova Scotia. From Jordan and Evermann. Drawing by H. L. Todd.



farther back than in the ocean pout (over the tip of the pectoral instead of in front of the base of the latter), but all the dorsal rays (about 92) are soft. Furthermore the anal fin (about 88 rays) extends relatively farther forward than in the ocean pout. The pectoral fins are rounded like those of the ocean pout, but smaller relatively, the small ventrals are similarly located well forward of the pectorals, and in small specimens the head resembles that of its relative in profile except for a somewhat wider mouth. Old males, however (fig. 271), "are transformed almost beyond specific recognition by an extraordinary development of the entire head in advance of the eyes. The snout becomes shovel-shaped, its length equal to two-fifths that of the head, while in the normal condition it is one-fourth".<sup>65</sup>

*Color.*—The sides are light brown above the lateral line, white below it, with a series of 8 to 10 irregular dark brown patches which the lateral line bisects. The belly is blue, its lining jet black.

*Size.*—Maximum length about 10 inches; usual length about 4 to 6 inches.

*Habits.*—This is a bottom fish, living on mud or sand and confined to considerable depths of water. Normally, 25 to 30 fathoms is its upper limit, but the fact that the *Grampus* specimen mentioned below was taken in a tow net, though close to bottom, proves that it sometimes rises from the ground. To the southward, on the continental slope, it has been trawled down to 603 fathoms.

Nothing is known of its way of life or of its breeding habits.

*General range.*—So far known only off the coasts of Nova Scotia and of New England, and southward along the continental slope to the offing of Beaufort, N. C., in rather deep water.

*Occurrence in the Gulf of Maine.*—The wolf eel has been trawled at many localities on the continental slope at 200 to 600 fathoms from the offing of Cape Fear, North Carolina (lat. 34°40' N., long. 75°15' W.) to abreast the western end of

<sup>65</sup> Goode and Bean, Smithsonian Contrib. Knowl., vol. 30, 1895, p. 310.

Georges Bank (long. 68°22' W.).<sup>67</sup> It was formerly regarded as very rare within the Gulf of Maine, the only records for it there up to 1925 having been of a few specimens trawled off the mouth of Passamaquoddy Bay in 35 to 50 fathoms; of one 4 inches long taken off Monhegan Island by the *Grampus* on August 2, 1912, in 60 fathoms; and of several that were collected by the U. S. Fish Commission many years ago off Cape Ann in 75 to 110 fathoms, in the Western Basin in 115 fathoms, and off Cape Cod. More recent captures, however, of a number of wolf eels at about 90 fathoms in the trough west of Jeffreys Ledge by the *Albatross II* in November 1927, in August 1928, and in September 1930 (a total of 61 specimens) show that they are more plentiful in the deeper parts of the Gulf than the previous record might have suggested.

The only definite records for the wolf eel eastward from Cape Sable are of 5 specimens taken by the U. S. Fish Commission steamer *Speedwell* 3 miles off Cape Negro, Nova Scotia, in 90 fathoms, in the summer of 1877<sup>68</sup>, and of one<sup>69</sup> taken 27 miles off the entrance to Halifax Harbor (Chebucto Head) in 101 fathoms.<sup>70</sup>

#### Arctic eelpout *Lycodes reticulatus* Reinhardt 1838

Jordan and Evermann, 1896–1900, p. 2465.

*Description.*—This fish resembles the ocean pout in its general appearance and in the arrangement of its fins. The readiest field marks for it are that the dorsal fin is not interrupted, but is continuous with the caudal fin, and that the dorsal originates behind the bases of the pectorals instead

<sup>67</sup> Goode and Bean (Smithsonian Contrib. Knowl., vol. 30, 1895, p. 310) give a long list of localities from the early cruises of the U. S. Coast Survey and of the U. S. Fish Commission. And Beebe (Zoologica, N. Y. Zool. Soc., vol. 12, 1929, p. 18) has reported a wolf eel from the Hudson Gorge, off New York, at 69 fathoms.

<sup>68</sup> Reported by Goode and Bean, American Jour. Science, ser. 3, vol. 14, 1877, p. 473.

<sup>69</sup> This is the specimen pictured here in fig. 271.

<sup>70</sup> Probably these specimens were the basis for Jones' (List Fishes Nova Scotia, 1879, p. 5; Proc. Nova Scotian Inst. Sci., vol. 5, 1882, p. 91) statement that the wolf eel occurs on the Nova Scotian fishing banks.

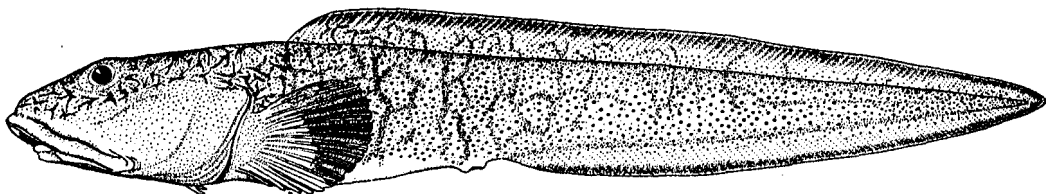


FIGURE 272.—Arctic eelpout (*Lycodes reticulatus*). Drawing by Louella E. Cable.

of in front of them, while the fanlike pectoral fins are even larger, relatively, than those of the ocean pout. Furthermore, its upper jaw projects far beyond the lower, giving it a distinctive cast of countenance (compare fig. 272 with fig. 269). The most obvious difference between this *Lycodes* and the wolf eel (p. 515) is that the former is much the stouter bodied of the two, being only about 8 times as long as it is deep (the wolf eel is 14–16 times as long as deep), and that the dorsal fin of *Lycodes reticulatus* originates farther forward, i. e., close behind the bases of the pectorals instead of over the tips of the latter.

*Color*.—Described as brownish, with a network of black lines on the head and with several groups of such lines or with solid dark bands on the body. The dorsal fin is dark edged. The young fry are marked with a series of large dark spots on the back and extending out on the dorsal fin.<sup>71</sup>

*Size*.—Specimens of which the measurements have been definitely recorded have ranged up to 15 inches (380 mm.) in length.

*Remarks*.—This lycodid tends to separate into local races; one such from northeast Greenland and Jan Mayen has, in fact, been dignified with a separate varietal name; var. *macrocephalus* by Jensen,<sup>72</sup> because seemingly separable from the West Greenland form. One subspecies, *hacheyi*, too, has been described subsequently from Hudson Bay by Vladykov;<sup>73</sup> also a second (*lavalei*) from

the Gulf of St. Lawrence by Vladykov and Tremblay<sup>74</sup> but none of these call for consideration here.

*Habits*.—Little is known of its habits except that it is a ground fish, usually living in moderately deep water, and that worms, crustaceans, and small fish have been found in the stomachs of European specimens. In its turn it falls a prey to larger fishes, and frequently to Greenland sharks.<sup>75</sup>

*General range*.—Both sides of the Arctic Atlantic; reported as far south as Vineyard Sound, southern Massachusetts.

*Occurrence along the Atlantic coast of North America*.—This particular *Lycodes* has been reported definitely off southeastern Labrador in the offing of Sandwich Bay; in the Strait of Belle Isle; in Conception Bay, Newfoundland; on the Grand Banks; off Placentia Bay, south coast of Newfoundland; also on the Newfoundland side of Cabot Strait;<sup>76</sup> and on the southwest slope of Banquereau Bank at 300 fathoms;<sup>77</sup> while Vladykov and McKenzie report it from Nova Scotian waters in general.<sup>78</sup>

It has not yet been recorded from the Gulf of Maine. But it is to be expected there sooner or later, for it has not only been taken to the east and north of our limits, as just stated, but also in Vineyard Sound to the westward,<sup>79</sup> if the specimen in question was identified correctly.

## THE CUSK EELS. FAMILY OPHIDIIDAE

The members of this family are eel-like in appearance, but they differ very obviously from the true eels in having well-developed ventral fins in the form of long forked barbel-like structures, situated on the throat. Their soft-rayed dorsal and anal fins are low but continuous around the tip of the tail; the gill openings are very wide, and the snout projects beyond the mouth. Many species are known, most of them from warm seas.

### Cusk eel *Lepophidium cervinum* (Goode and Bean) 1885<sup>80</sup>

Jordan and Evermann, 1896–1900, p. 2484.

*Description*.—The cusk eel is about 12 to 13 times as long as it is deep; all its fins are soft and eel-like; and there is no separation between the dorsal, caudal, and anal fins, but the three form one continuous fin running backward along the

<sup>71</sup> See Smitt (Scandinavian Fishes, vol. 1, 1892, p. 605) for the coloration of the genus *Lycodes* in general; Jensen (Danish *Ingolf* Exped., vol. 2, pt. 4, pl. 2, figs. 2, 3, and pl. 8) for beautiful illustrations of this species.

<sup>72</sup> Danish *Ingolf* Exped., vol. 2, pt. 4, 1904, p. 66, pl. 8.

<sup>73</sup> Contr. Canad. Biol., N. Ser., vol. 8, No. 2, 1933, p. 25.

<sup>74</sup> Fauna et Flora St. Laurent., Sta. Biol. St. Laurent., No. 1, 1936, p. 34.

<sup>75</sup> Smitt, Scandinavian Fishes, vol. 1, 1892, p. 613.

<sup>76</sup> For records of it in Labrador and Newfoundland waters, see Goode and Bean (Smithsonian Contrib. Knowl., vol. 30, 1895, p. 305); also the Annual Reports of the Newfoundland Fisheries Research Commission, vol. 1, No. 4; vol. 2, Nos. 1–3, 1932–35.

<sup>77</sup> See Goode and Bean, Smithsonian Contrib. Knowl., vol. 31, 1895, List of plates and figures, p. 17, figs. 273, 281.

<sup>78</sup> They do not mention any definite locality records but write of it (Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 100) as usually believed to be the most common *Lycodes* there.

<sup>79</sup> Goode and Bean (Smithsonian Contrib. Knowl., vol. 30, 1895, p. 305), *Fish-Hawk* Station 681; Sumner, Osburn, and Cole (Bull. U. S. Bur. Fish., vol. 31, Pt. 2, 1913, p. 768). Goode and Bean also report it from east of the Bahamas (*Albatross* Sta. 2652, lat. 24°13' N., long. 77°13' W., 140 fathoms). But this is so very far to the south of the normal range of this species that we suspect the record is an error.

<sup>80</sup> See Jordan and Evermann (Bull. 47, U. S. Nat. Mus., Pt. 3, 1898, p. 2482) for the nomenclatural history of the name *Lepophidium* Gill 1895.

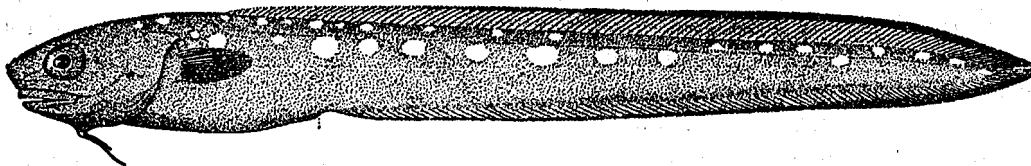


FIGURE 273.—Cusk eel (*Lepophidium cervinum*). After Goode and Bean. Drawing by H. L. Todd.

back, around the tip of the tail, and forward on the lower surface. But it is separated from all the true eels, by the presence of ventral fins, situated on the throat far in front of the pectorals, and reduced to forked barbel-like structures. The structure of the ventral fins and the uninterrupted dorsal fin separate the cusk eel from the ocean pout, its near relative among local fishes. And the presence of a short sharp spine on the top of the snout pointing forward and downward, which is easily felt if not seen (for it is nearly concealed in the skin), likewise differentiates it from such other Gulf of Maine species as it resembles in general appearance. The shape of the snout, too, is distinctive, as are its rather large scales, for the other genera of its family have naked heads, and the scales on their bodies are very small.

*Color*.—Brownish yellow, darker above than below, the upper part of each side marked with a row of 14 to 23 roundish white or pale brown spots.

The dorsal and anal fins have narrow black or dusky margins. It seems that the adult color pattern develops late, for neither the spots nor the edgings on the fins are visible in a young specimen of  $2\frac{3}{4}$  inches.

*Size*.—The type specimen was about  $10\frac{3}{8}$  inches (262 mm.) long.

*General range and occurrence in the Gulf of Maine*.—This fish has been taken at various localities along the outer part of the continental shelf from off Florida to eastward of Nantucket, in depths of 38 to 102 fathoms. It is mentioned here because one specimen has been taken in 76 fathoms off Nantucket Shoals,<sup>81</sup> while two others, about  $7\frac{1}{2}$  and  $8\frac{1}{2}$  inches long (newly swallowed) were found in the stomach of a white hake *Urophycis tenuis* that was trawled on the southwestern part of Georges Bank (lat.  $40^{\circ}31' N.$ , long.  $68^{\circ}55' W.$ ), at 39 fathoms, by the dragger *Eugene H.* on June 27, 1951.

## THE TOADFISHES. FAMILY BATRACHOIDIDAE

The toadfishes are somewhat sculpin-like in appearance, but the resemblance is superficial, for their ventral fins are situated on the throat well in front of the pectoral fins ("jugular"), and they have only three gills and three gill arches. Both the soft and the spiny portions of the dorsal fin are well developed as separate fins, the former much longer than the latter. Most of the species belong to warm seas, only one reaching the Gulf of Maine.<sup>82</sup>

### Toadfish *Opsanus tau* (Linnaeus) 1766

Jordan and Evermann, 1896-1900, p. 2315.

*Description*.—The toadfish, like the sculpins, has a large flat head, round nose, tremendous mouth, tapering body with plump belly, and fanlike pectoral fins. But it differs from all sculpins,

and indeed from all other spiny-finned fishes of the Gulf of Maine except the blennies (p. 491) in the location of its ventral fins, which are under the throat well in front of the pectorals ("jugular") instead of below the latter or behind them. And no one could confuse it with any blenny, for it is not only a totally different looking fish, but its dorsal fin is mostly soft rayed while that of the blennies is spiny throughout. The presence of fleshy flaps of irregular outline on the tip of the upper jaw and along the edge of the lower jaw, on the cheeks, and over each eye, gives its head a peculiar warty appearance. Distinctive, also, is the fleshy nature of all its fins and the outline of the dorsal, the soft part of which (26 to 28 rays) is five to six times as long as the spiny part (3 spines), from which it is entirely separated by a deep notch, the two together extending the whole length of the trunk from the nape of the neck nearly to the base of the caudal fin. The anal

<sup>81</sup> Goode and Bean, *Smithson. Contrib. Knowl.*, vol. 30, 1895, p. 847.

<sup>82</sup> See Schultz and Reid (*Copeia*, 1937, No. 4, p. 211) for a synopsis of the American-Atlantic species of the genus *Opsanus*.

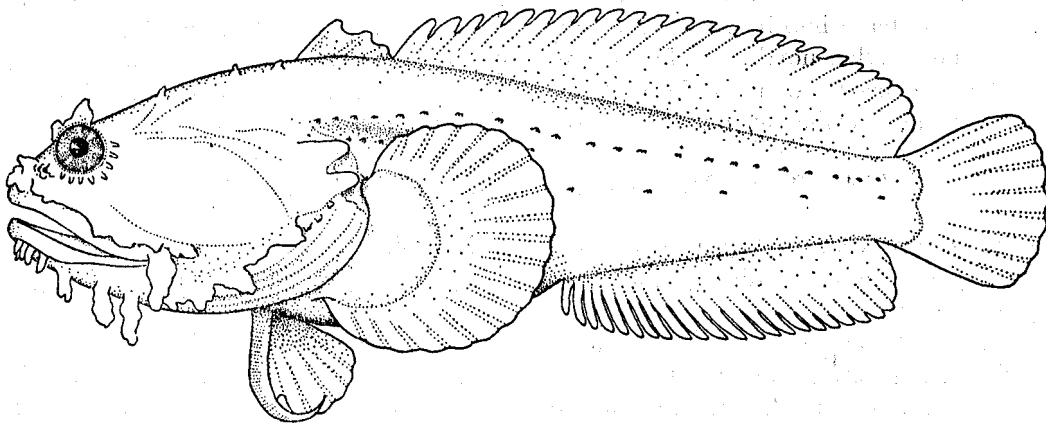


FIGURE 274.—Toadfish (*Opsanus tau*), Woods Hole. Drawing by Louella E. Cable.

fin (21 or 22 rays) is somewhat shorter than the second (soft) dorsal, originates under about the eighth ray of the latter, and is similar to it in outline except that its rays are more or less free at their outer ends, especially in its forward half. The caudal fin is rounded; the ventrals covered by thick fleshy skin, are jagged in outline, with the first ray stouter than the others. There is a large open pit of unknown function in the axil of each pectoral fin.

We need only remark, further, that the skin is covered with a thick layer of slimy mucus. The toadfish has no scales; its teeth are large and blunt; and it has two short spines at the upper angle of each gill cover, hidden however, in the thick skin.

*Color.*—The general ground tint ranges from dark muddy olive green to brown or yellow, darker on back and sides, paler below, and variously and irregularly marked with darker bars and marblings, which may be restricted to head and fins or may extend over the whole fish, belly as well as back. The toadfish, like many other bottom fishes, changes color to match the bottom on which it lies.

*Size.*—Exceptionally 15 inches long, but few are longer than 12 inches.

*Habits.*—The toadfish lives in shoal water, and it is resident the year around wherever found, probable becoming torpid in winter in the northern part of its range. It is commonest on sandy or muddy bottom, hiding among eelgrass or under stones where it hollows out dens in which it lies in wait for prey. It is voracious and omnivorous, Vinal Edwards's diet list for it at Woods Hole including sea worms (*Nereis*), amphipods, shrimps,

crabs, hermit crabs, a variety of mollusks both univalve and bivalve, ascidians, squid, and fish fry such as alewives, cunners, mummichogs, menhaden, puffers, sculpins, scup, silversides, smelt, and winter flounders. No doubt any small fish is acceptable.

Toadfish snap viciously when caught, and they often fight among themselves. Like some sculpins they grunt, especially at night or if handled. And despite their clumsy appearance, they can dart out of their hiding places and back again with considerable speed. They are very tenacious of life and can live out of water for an astonishingly long time.

In the northern part of its range the toadfish spawns in June and early July. The very large eggs (about 5 mm. in diameter) are laid in holes under stones, under large shells, in old tin cans, among sunken logs, or among eelgrass, where they adhere in a single layer to whatever serves as a nest, which the male guards during the 3 weeks or so that are occupied by incubation. Even after hatching the tadpole-shaped larvae remain attached to the nest by the yolk sac until the latter is absorbed at a length of 15 to 16 mm. when they break free.<sup>83</sup>

*General range.*—Shoal water along the east coast of North America from Cuba to Cape Cod, straying northward to Maine.

*Occurrence in the Gulf of Maine.*—The toadfish is common about Woods Hole and thence westward. But it ventures around Cape Cod so

<sup>83</sup> Ryder (Bull. U. S. Fish Comm., vol. 6, 1887, p. 8) and Gudger (Bull. U. S. Bur. Fish., vol. 28, 1910, pt. 2, pp. 1071-1109, pls. 107-113) describe the breeding habits, eggs, and larvae of the toadfish. For further accounts of its habits see Gill (Smithsonian Miscell. Coll., vol. 48, 1907, pp. 388-427).

seldom that none of the fishermen in Massachusetts Bay of whom we have inquired have seen or heard of it there, nor further north. In fact there are only two definite records of it in the Gulf of Maine: "Maine"<sup>84</sup> and Cohasset on the south

shore of Massachusetts Bay, where one (now or formerly in the collection of the Boston Society of Natural History) was caught by Dr. Owen Bryant. There is also one doubtful record for Kittery, Maine.<sup>85</sup>

### THE TRIGGERFISHES. FAMILY BALISTIDAE

The triggerfishes are very divergent from the ordinary spiny-rayed fishes anatomically, and their external appearance is so characteristic that they are not apt to be mistaken, unless for their close relatives, the filefishes (p. 521). Their most interesting external characteristics are that the first spine of the first dorsal fin is not only very much stouter than the others but it can be locked erect by the second dorsal spine, and that the large bony scales are so close set as to form a hard but flexible armor. Other distinctive features are mentioned below in the description of the Gulf of Maine species. Most of the many species of triggerfishes are purely tropical; it is only as a stray that any member of the family enters into the Gulf of Maine fauna. Most of the tropical species are more or less poisonous if eaten.

#### Triggerfish *Balistes carolinensis* Gmelin 1789<sup>86</sup>

Jordan and Evermann, 1896-1900, p. 1701.

*Description.*—The readiest field marks for the triggerfish are its deep, sidewise-flattened body with slender caudal peduncle; its small terminal mouth with both dorsal and ventral profiles of the nose nearly straight; its eye situated so high as to give its face a very peculiar aspect; its large projecting incisor teeth; its very short gill openings wholly above the insertions of the pectorals; the plate armor of thick scales with which its entire head and body are clad; and especially its unusually stout first dorsal spine.

The spiny dorsal fin is triangular, with three spines, the first so stout that it is more like a horn, situated close behind the eyes and with the second spine acting as a trigger to lock the first spine

<sup>84</sup> Storer, Mem. Amer. Acad., N. Ser., vol. 2, 1846, p. 384, gives no definite locality.

<sup>85</sup> Holmes (2nd Ann Rept. Nat. Hist. Geol. Maine, Pt. 1, 1862, p. 95), "noticed it while standing on the bridge which connects the Navy Yard at Kittery with one of the islands."

<sup>86</sup> Jordan, Evermann, and Clark (Rept. U. S. Fish Comm. (1928), Pt. 2, 1930, p. 491) prefer the name *capricus* Gmelin, and correctly so, from the strictly nomenclatural standpoint. But *carolinensis* is preferable both because it appeared on an earlier page of the same publication, and because the great majority of references to the species have been under that name.

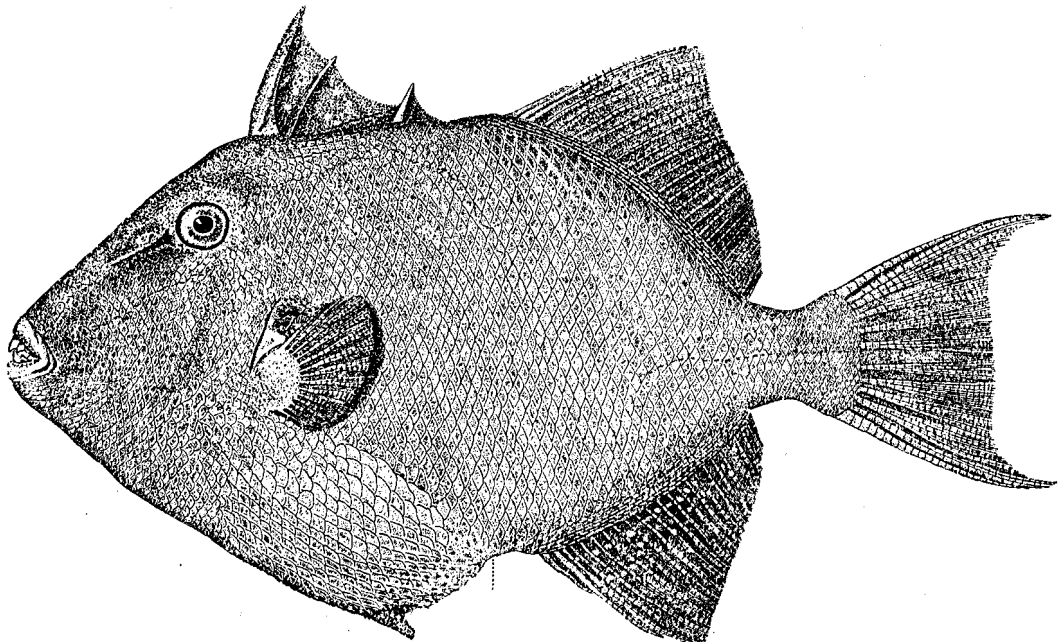


FIGURE 275.—Triggerfish (*Balistes carolinensis*), New York. From Goode. Drawing by H. L. Todd.

erect, whence the common name of the fish. The soft dorsal fin (27 rays) is separated from the first by a considerable interspace, is rhomboid in outline with the third or fourth ray longest, and tapers back to the base of the caudal peduncle. The anal fin (25 rays) corresponds to the soft dorsal in outline and in location. The caudal fin is of moderate size, its rear margin moderately concave, in a very characteristic curve, with sharp pointed, somewhat prolonged corners. The pectorals are short, rounded, and situated below the gill openings. The ventrals are reduced to one short, stout, blunt spine, mostly embedded in the skin and they are connected with the general outline of the abdomen by a sort of dewlap.

*Color.*—The colors of this triggerfish vary widely. A specimen 2 inches long recently taken on Georges Bank was yellowish, with many small blue-violet spots on the sides, dusky-blotched along the back, and with one broad, irregular dusky band extending from the base of the dorsal fin almost to the anal. The caudal fin was pale yellow. Other examples have been described as olive gray, marked with violet dots and with dark crossbars, the fins as variously tinted with yellow, blue, and olive.

*Size.*—Said to reach a weight of 4 pounds, but they average only about 1 pound.

*General range.*—Both sides of the tropical Atlantic, also the Mediterranean; straying north to Ireland on the European coast; to the outer coast of Nova Scotia, in the vicinity of Cape Canso<sup>87</sup> on the American side.

*Occurrence in the Gulf of Maine.*—Only one specimen of this tropical fish, taken in the Squam River at Annisquam, near Gloucester, Mass., many years ago,<sup>88</sup> had been reported from the Gulf of Maine previous to 1925. But it must drift in over the offshore rim of the Gulf more often than had been suspected, for two small fry of 2 to 3 inches were picked up on the northeast part of Georges Bank among Gulf weed (*Sargassum*) from the *Albatross II*, in mid-September 1927; a large one about 15 inches long was gaffed at the surface from the fishing schooner *Huntington Sanford* 14 miles southeasterly from Highland Light, Cape Cod, on July 19, 1929;<sup>89</sup> one, now in the Museum of Comparative Zoology, was picked up at Plymouth, Mass., on September 5, 1932, by the late C. L. Hauthaway, a well-known angler and a close observer.<sup>90</sup> One was reported from Casco Bay, (Small Point), Maine, in 1949, and one near Boothbay Harbor (Linekin Bay), also in 1949.<sup>91</sup>

### THE FILEFISHES. FAMILY MONACANTHIDAE

The filefishes recall the triggerfishes in their general form, being similarly deep and flattened sidewise, with the same peculiar profiles, small terminal mouths, projecting incisor teeth, eyes set high up, very stout dorsal spines, and short gill openings; also in the fact that the ventral fins are either lacking altogether or at least are reduced to a single short blunt movable spine at the end of the very long pelvic bone, forming a keel-like continuation of the general ventral profile of the head and connected with that of the belly by a dewlap of skin. The filefishes differ from triggerfishes in having only one dorsal spine instead of three, and in the fact that their scales are so minute that the skin is velvety to the touch although very

tough. Most of the species are tropical or subtropical, and none has any commercial or sporting value. Adults of the four species known from the Gulf of Maine are separable as follows:

<sup>87</sup> Nova Scotian records are from Halifax and from Queensport near Cape Canso (Vladykov, Proc. Nova Scotian Inst. Sci., vol. 19, 1935, p. 9; McKenzie Proc. Nova Scotian Inst. Sci., vol. 20, 1939, p. 18); also 24 miles southeasterly from Sable Island, where one was picked up by the schooner *Wanderer*, July 5, 1931 (Firth, Bull. 61, Boston Soc. Natural History, 1931, p. 13).

<sup>88</sup> This specimen is now in the Museum of Comparative Zoology.

<sup>89</sup> Reported by Firth, Bull. No. 61, Boston Soc. Nat. Hist., 1931, p. 12.

<sup>90</sup> Another species of trigger fish (*Ballistes vetula*) is more common than *carolinensis* at Woods Hole, and is recorded from Nantucket, but it has not been taken in the Gulf of Maine as yet. It is separable from *carolinensis* by the fact that the forward rays of its soft dorsal fin and the corners of its caudal fin are elongated and filamentous; also by the presence of two blue bars on each side of its head.

<sup>91</sup> These last two fish were reported by Scattergood, Trefethen, and Coffin, Copeia, 1951, No. 4, p. 298.

### KEY TO GULF OF MAINE FILEFISHES

- |                                                                                            |   |
|--------------------------------------------------------------------------------------------|---|
| 1. There is a prominent external ventral spine; the gill openings are nearly vertical..... | 2 |
| There is no external ventral spine; the gill openings are very oblique.....                | 3 |

2. Dorsal profile of head in front of the eyes is straight, or only very slightly concave; there are no thorns on the sides of the caudal peduncle..... Filefish (*Monacanthus hispidus*), p. 522  
 Dorsal profile of head in front of the eyes is conspicuously concave; there are about 6 stout thorns pointing forward on each side of the caudal peduncle..... Filefish (*Monacanthus ciliatus*), p. 523
3. Dorsal fin with about 34 to 38 soft rays; anal with 36 to 41 rays; also, in small specimens, the caudal fin is more than one-half as long as the body..... Orange filefish (*Alutera schoepfi*), p. 524  
 Dorsal fin with about 44 to 48 soft rays; anal with 47 to 52 rays; also, in small specimens, the caudal fin is less than one-half as long as the body..... Unicornfish (*Alutera scripta*), p. 525

**Filefish *Monacanthus hispidus* (Linnaeus) 1766**

Jordan and Evermann, 1896-1900, p. 1715.

*Description.*—In this species the rear edge of the dorsal spine, which is situated over the rear edge of the eye, is armed with a double series of barbs, but the sides of the rounded caudal peduncle do not bear any spines. The point of origin of the soft dorsal fin (32 to 34 rays) is behind the middle of the body, while the first soft dorsal ray often is much prolonged in adults and with a filamentous tip (young 1 to 2 inches long lack this filamentous ray.) Otherwise the fin is rounded in outline, narrowing from the front to the rear. The anal fin (31 to 34 rays) stands below the soft dorsal, and is of the same shape except that none of its rays are prolonged. The caudal fin is rounded. The pectorals are short, rounded, and situated lower than the gill openings, like those of triggerfishes.

*Color.*—Greenish, olive, or brownish. The back and sides of young fish are mottled with irregular darker blotches but adults are plain colored. The dorsal spine and the caudal fin are green. The soft dorsal fin and the anal fin are pale and translucent.

*Size.*—Maximum length about 10 inches.

*General range.*—This is a tropical species, common along the south Atlantic Coast of the United States and among the West Indies; also around the Canaries and Madeira in the eastern Atlantic, and represented in East Indian waters by a fish that does not seem to be distinguishable from it in any way. In the western side of the Atlantic it is known as far south as Brazil, has been taken from time to time as far north as Woods Hole, and has been recorded from St. Margaret Bay and from Halifax on the outer coast of Nova Scotia.<sup>92</sup>

<sup>92</sup> The only recent Nova Scotian record that has come to our notice is of one taken in Halifax Harbor in the autumn of 1923 (Leim, Proc. Nova Scotian Inst. Sci., vol. 17, Pt. 4, 1930, p. 46).

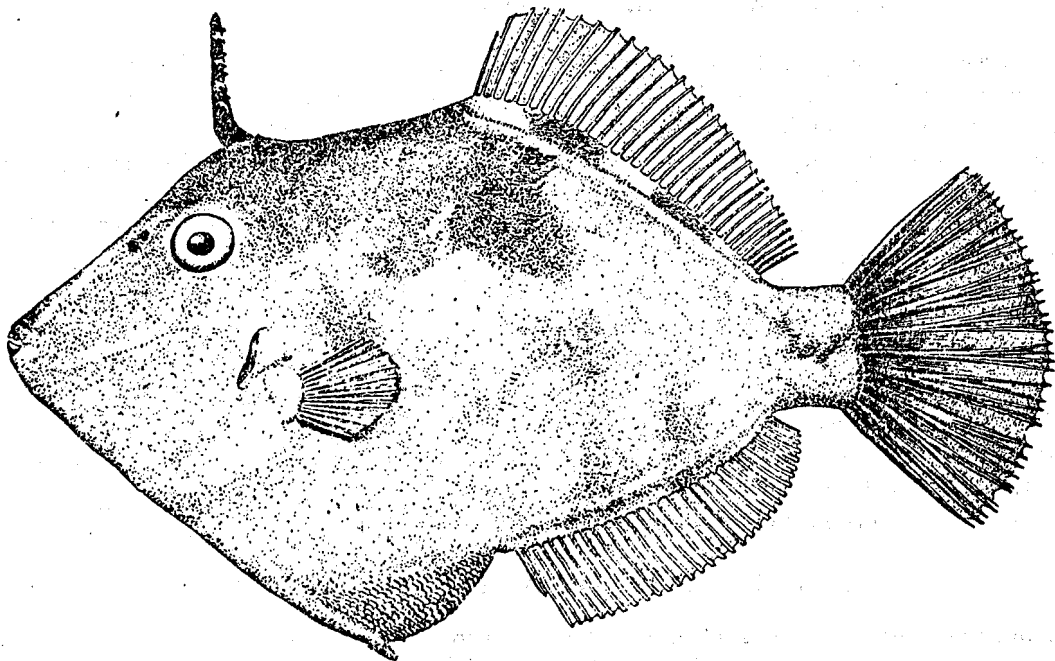


FIGURE 276.—Filefish (*Monacanthus hispidus*). From Jordan and Evermann. Drawing by W. S. Haines.



*Occurrence in the Gulf of Maine.*—Odd specimens of this filefish have been recorded from Hingham, Lynn, Nahant, and Boston Harbor in Massachusetts Bay; and from Cape Cod; all many years ago. More recent records of it in the Gulf are of 181 fry, 1–2 inches long, picked up from the *Albatross II* on the northeastern part of Georges Bank among floating Gulf weed (*Sargassum*), in September 1927; a larger one taken off Seguin Island, Maine, September 12, 1927;<sup>93</sup> one of 6 inches, at Provincetown, November 6, 1929; one picked up from the schooner *Old Glory* among floating rockweed (*Fucus* or *Ascophyllum*) and Gulf weed (*Sargassum*), on the western part of Georges Bank, September 15, 1930;<sup>94</sup> one taken off Portland Lightship, July 17, 1931; one taken in a trap at Provincetown, October 6, 1950; and two, about 6 inches long, taken off Wood End, Provincetown, in 17 fathoms, by the dragger *Mary Magdalyn* (Capt. Charles Santos), on October 30, 1951. It is also likely that a "filefish" taken at Beverly on the north shore of Massachusetts in 1933<sup>95</sup> was of this species. An occasional filefish

straying from the south is thus to be expected anywhere on Georges Bank, or in the western side of the Gulf. But we find no evidence that they ever enter its eastern side, or that they ever reach the Bay of Fundy.

**Filefish *Monacanthus ciliatus* (Mitchill) 1818**

Jordan and Evermann, 1896–1900, p. 1714.<sup>96</sup>

*Description.*—This filefish resembles the species *hispidus* (p. 522) very closely. But its first dorsal ray is never prolonged, the ventral dewlap extends somewhat farther behind the tip of the ventral spine, and the caudal peduncle in the adult is armed with 2 or 3 pairs of strong forward-curving hooks on either side.

*Color.*—Described as varying from olive gray, or grass green to yellowish brown, with darker blotches or crossbands. The dorsal and anal fins are pinkish and they usually have three dark spots at the base. The ventral dewlap is edged with scarlet, and the caudal fin is greenish, mottled dark and pale.

<sup>93</sup> Kendall, Bull. 58, Boston Soc. Nat. Hist., 1931, p. 11.

<sup>94</sup> Firth, Bull. 61, Boston Soc. Nat. Hist., 1931, p. 13.

<sup>95</sup> MacCoy, Bull. 67, Boston Soc. Nat. Hist., 1933, p. 9.

<sup>96</sup> The illustration labeled "*ciliatus*" by Jordan and Evermann (Bull. 47, U. S. Nat. Mus., Pt. 4, 1900, pl. 259, fig. 634) is actually of *hispidus*, as is their figure 635.

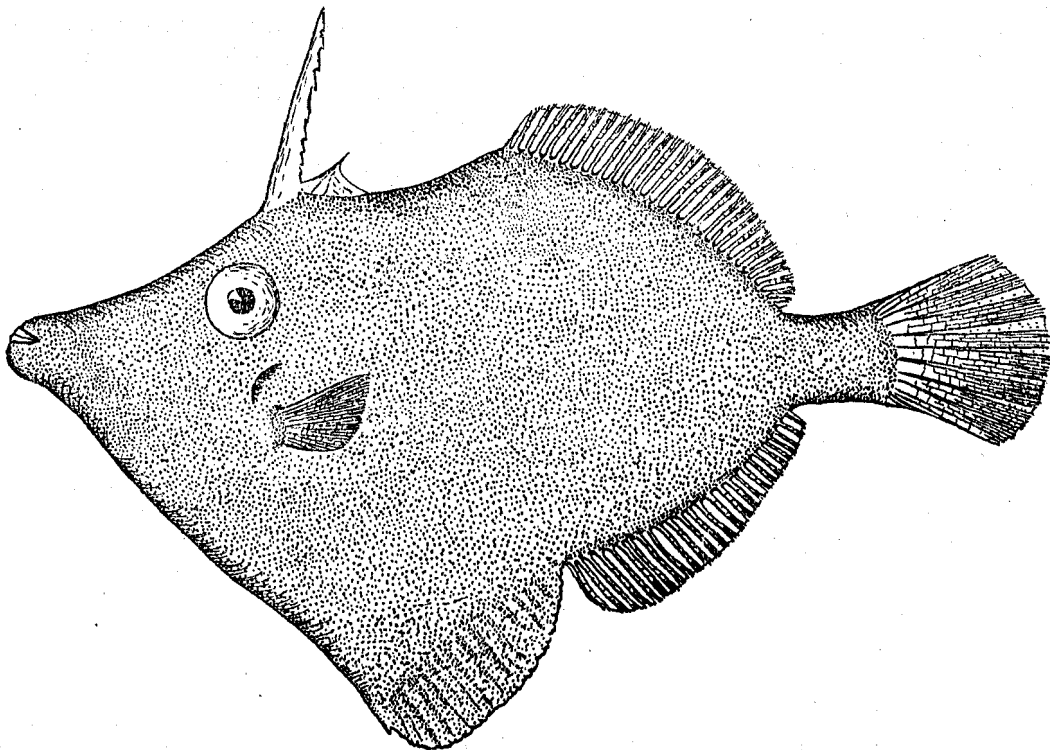


FIGURE 277.—Filefish (*Monacanthus ciliatus*), Bahamas specimen, 85 mm. long. Drawing by H. B. Bigelow.

*Size*.—Four to eight inches long.

*General range*.—Warmer parts of the Atlantic; from Brazil to Cape Cod on the American coast. A straggler has even been reported from Argentina, on the southern coast of Newfoundland, far to the north of its normal range.<sup>97</sup>

*Occurrence in the Gulf of Maine*.—The only recent report of this filefish from within the Gulf of Maine is of a 7-inch specimen taken in a trap at Provincetown, November 9, 1929.<sup>98</sup> We judge that earlier reports of it from Massachusetts Bay referred to in Storer's description and illustration<sup>99</sup> were actually based on a specimen of *hispidus*.

**Orange filefish *Alutera schoepfi* (Walbaum) 1792<sup>1</sup>**

FILEFISH; TURBOT; HOGFISH; SUNFISH;  
UNICORNFISH

Jordan and Evermann, 1896-1900, p. 1718.

*Description*.—This fish resembles its relatives of the genus *Monacanthus* in most respects (p. 521), but while it is equally flattened sidewise, it is relatively shallower, being not over half as deep as long. The pelvic bone is as prolonged as it is in the other filefishes, but it does not project ex-

<sup>97</sup> Newfoundland Fish. Res. Comm. Rept., vol. 1, No. 1, 1933, p. 126.

<sup>98</sup> Firth, Bull. Boston Soc. Nat. Hist., No. 61, 1931, p. 13.

<sup>99</sup> The illustration of his *Monacanthus massachusettsensis* shows the profile typical of *hispidus*, and neither his description nor his illustration suggests that there were any thorns on the caudal peduncle such as characterize *cillatus*. (See Storer Mem. Amer. Acad. Arts, Sci., N. Ser., vol. 8, 1863, p. 425, pl. 34, fig. 4; also Fishes of Massachusetts, 1867, p. 231, pl. 34, fig. 4.)

<sup>1</sup> Jordan, Evermann, and Clark (Rept. U. S. Comm. Fish. (1928), Pt. 2 1930, p. 495) place the species in the genus *Ceratocanthus* Gill 1801.

ternally, nor is there a ventral dewlap, which is the readiest field mark by which to distinguish *Alutera* from *Monacanthus*. The eyes, too, are set lower down on the sides of the head, and the gill openings are relatively longer and more oblique. The dorsal spine is relatively shorter than in *Monacanthus*, and the lower jaw projects considerably beyond the upper. The soft dorsal fin (34-38 rays) originates behind the middle of the trunk and is rounded in outline, and the anal fin (36-41 rays) corresponds to the soft dorsal fin in size, shape, and position. The short rounded pectorals are situated opposite the lower half of the oblique gill openings and the tail fin is relatively narrower than in the other filefishes or triggerfishes; its longest rays are more than  $\frac{1}{2}$  as long as the body in small specimens, but only one-fourth to one-fifth as long as the body in half-grown fish and larger.

*Color*.—Described as varying from uniform olive gray to rich orange yellow or to milky white above, mottled with darker hues of the same tints; bluish white beneath. The caudal fin usually is yellowish on adults but sometimes it is dusky, edged with white.

*Size*.—Maximum length about 2 feet.

*General range*.—Atlantic and Gulf of Mexico coasts of the United States; not uncommon in summer as far north as Cape Cod; reported to Portland, Maine, and perhaps to Halifax, Nova Scotia.<sup>2</sup>

<sup>2</sup> A specimen, found in Halifax Harbor, August 25, 1938, appears to have belonged to this species, but it was not in good enough condition for positive identification (McKenzie, Proc. Nova Scotian Inst. Sci., vol. 20, 1939, p. 19).

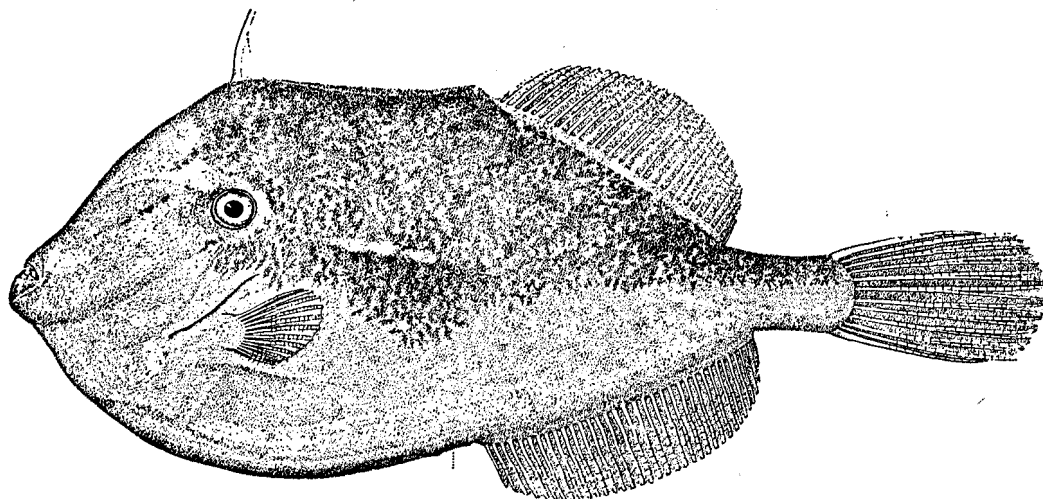


FIGURE 278.—Orange filefish (*Alutera schoepfi*), Key West, Florida. From Jordan and Evermann. Drawing by W. S. Haines.

*Occurrence in the Gulf of Maine.*—Although the orange filefish has been described as "rather common" at Woods Hole during the summer,<sup>3</sup> only 3 specimens have been reported within the limits of the Gulf of Maine: 1 from Portland, Maine, and 2 from Salem, Mass., all of them many years ago.<sup>4</sup> Evidently it reaches the Gulf of Maine only at long intervals, as a waif from the south.

**Unicornfish** *Alutera scripta* (Gmelin) 1789

Jordan and Evermann, 1896-1900, p. 1719.<sup>5</sup>

*Description.*—This species much resembles the orange filefish from which it differs chiefly in its somewhat more slender body (2 to 3 times as long as deep), longer dorsal fin (44 to 49 rays), longer anal fin (47 to 52 rays), shorter caudal fin (in small unicornfish the caudal is less than half as long as the body, while in young orange filefish

it is more than half as long), and in color. The dorsal spine may be serrated in young fish, but it is smooth in adults.

*Color.*—The unicornfish is olive on head and body with light blue reticulations extending from the snout to the tail; in grown fish there are numerous small round black spots on the sides of the body.

*Size.*—Reaches a length of 3 feet.

*General range.*—Tropical seas; northward to South Carolina on the Atlantic Coast of America, and to Georges Bank as a stray.

*Occurrence in the Gulf of Maine.*—Two specimens of this fish, 5 inches and 5½ inches long, caught on the western edge of Georges Bank Sept. 15, 1930, by the schooner *Old Glory*,<sup>6</sup> are the only ones that have been reported from the Gulf of Maine. A third, 5 inches long, was taken by *Atlantis*, south of Sable Island (lat. 40°55' N., long. 59°55' W.), August 18, 1941.

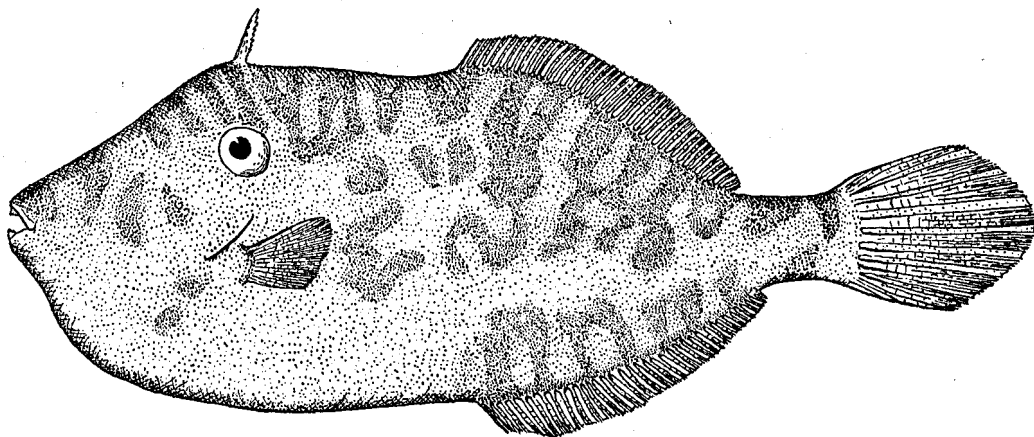


FIGURE 279.—Unicorn fish (*Alutera scripta*), Georges Bank specimen, 143 mm. long. Drawing by H. B. Bigelow.

THE PUFFERS AND PORCUPINE FISHES  
FAMILIES TETRAODONTIDAE AND DIODONTIDAE

The members of these two families are so closely allied one to the other, not only anatomically but in general appearance, that they may be described as a unit. They have only one dorsal fin (the soft-rayed), the spiny dorsal being obsolete, and they have no ventral fins. Their gill openings are reduced to short slits like those of their allies, the

triggerfishes and filefishes (pp. 520 and 521); their teeth are fused into cutting plates; and they have no scales. The two families are separable by the structure of the teeth, as described below in the accounts of the two species concerned, and by certain anatomical characters.

All of them are capable of inflating their bellies to balloonlike proportions with air or with water, if annoyed, and of deflating at will. And it is a matter of general interest (though not touching

<sup>3</sup> Sumner, Osburn, and Cole, Bull. U. S. Bur. Fish., vol. 31, Pt. 2, 1913 p. 762.

<sup>4</sup> There is no way to verify the identifications at this late date.

<sup>5</sup> Jordan and Evermann's (Bull. 47, U. S. Nat. Mus., Pt. 4, pl. 266, fig. 637) illustration labeled "*Scripta*" seems to have been based on a specimen of *choepfi*, in an intermediate stage of development.

<sup>6</sup> Reported by MacCoy, Bull. Boston Soc. Nat. Hist., No. 58, 1931 p. 16.

the Gulf of Maine directly) that the flesh of some of the species of puffers, and perhaps of all of the porcupine fishes, is poisonous.

Both groups are warm-water fishes. One species of puffer reaches the southwestern part of the Gulf rather commonly; and one porcupine fish has been reported there as a stray from the south.

### KEY TO GULF OF MAINE PUFFERS AND PORCUPINE FISHES

1. Skin set with large conical spines.....Burrfish, p. 527  
Skin merely prickly.....Puffer, p. 526

**Puffer** *Sphaeroides maculatus* (Bloch and Schneider) 1801

SWELLFISH; SWELL TOAD; BALLOONFISH;  
BELLOWSFISH; GLOBEFISH

Jordan and Evermann, 1896-1900, p. 1733.

*Description.*—When the puffer is not inflated it moderately slender (about three times as long as deep), about as thick as it is deep, and it tapers from abreast the gill opening to a rather slender caudal peduncle in one direction, to a rounded snout in the other. Its very small mouth is situated at the tip of the snout as it is in the triggerfishes and filefishes. It has no true teeth but the bones of its upper and lower jaws form cutting edges, each divided in the middle by a suture, giving the appearance of two large incisors above and two below. The gill openings are very small and set oblique, but their obliquity is the reverse of that of the filefishes (p. 521), i. e., backward and downward. The eyes are set very high and are horizontally oval in outline. The skin has

no scales, but the sides of both head and body, the back from snout to dorsal fin, and the belly as far back as the vent are rough with small, stiff, close-set prickles; those on the back are bluntish and nearly vertical while those on the sides and belly are rather sharp, pointing backward when the fish is not inflated, but erect when it is.

There is no spiny dorsal fin. The soft dorsal fin is very short (8 rays), rhomboid in outline, about twice as high as it is long, and set far back close to the caudal peduncle. The anal fin (7 rays) is similar to the dorsal in shape and size, and arises close behind it. The caudal fin is of moderate size, weakly rounded, with angular corners. The pectorals are fan-shaped, and are situated close behind the gill openings. There are no ventral fins.

The most interesting morphologic character of the puffer is its ability to inflate itself with air or with water if it is handled or at the slightest disturbance of any sort, until the skin of the belly is stretched tight as a football, and the fish is almost globular. In this condition, it floats at the surface, belly up, and apparently helpless. Leave it alone, however, and it soon deflates, discharging the air or water suddenly, and shrinks back to its normal dimensions.

*Color.*—Dark olive green above, sometimes ashy or dusky, the sides greenish yellow to orange, crossbarred with 6 to 8 rather indefinite dark bands or blotches. The belly is white.

*Size.*—The puffer is said to grow to a length of 14 inches, but few of them are more than 10 inches long. Females average larger than males.

*Habits.*—The puffer is an inshore fish, often coming in to the tide line. It runs up into slightly

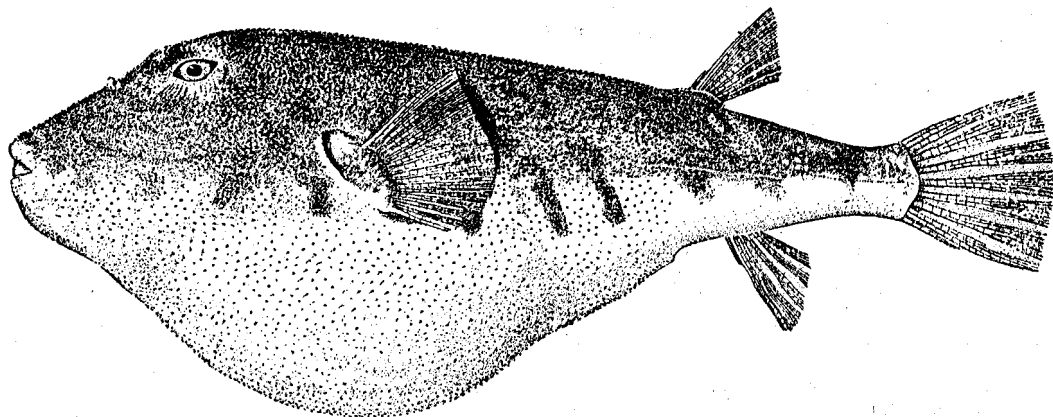


FIGURE 280.—Puffer (*Sphaeroides maculatus*), Connecticut. From Jordan and Evermann. Drawing by W. S. Haines.

brackish water in various estuaries, and seldom is caught more than a few fathoms deep, or more than a mile or two from land. Throughout the northern part of its range it belongs in the rather numerous and varied category of "summer" fishes, taken from April to November in Chesapeake Bay, from late May or early June to October or early November along southern New England. It is probable that when the puffers disappear from their usual summer haunts, with the onset of cold weather, they merely descend into somewhat deeper water nearby, to spend the winter on bottom in a more or less quiescent state.

Puffers feed on small crustaceans of all sorts, especially on crabs, shrimp, isopods and amphipods, as well as on small mollusks, worms, barnacles, sea urchins, and other invertebrates, which they find on bottom. Young fry of 7 to 10 mm., examined by Dr. Linton at Woods Hole, had eaten copepods as well as crustacean and molluscan larvae. And they are only too ready to take bait, if the hook is small enough. Where they are plentiful they may be nearly as much of a nuisance in this way as the cunners.

Puffers spawn in shoal water close to the shore, from mid-May, in Chesapeake Bay, and from early June through the summer off southern Massachusetts. And they are prolific. The ovaries of a Chesapeake Bay female, 10½ inches long contained (estimated) about 176,000 ova.<sup>7</sup> The eggs (about 0.9 mm. in diameter, with many small oil globules) sink and stick fast to each other or to whatever they chance to touch. Incubation occupies 3½ to 5 days at a temperature of about 67°–68° F. (20° C.). The larvae are about 2.4 mm. long at hatching, and are brilliantly pigmented with red, orange, yellow, and black. In 3 days the mouth functions, and when they are 7 mm. long the young fish show most of the diagnostic characters of the adults,<sup>8</sup> and can inflate themselves even more, in fact, until the bulging skin entirely hides the dorsal and anal fins.

*General range.*—Atlantic coast of the United States from Florida to Cape Cod in abundance; to Casco Bay in small numbers, and perhaps to the Bay of Fundy as a stray.

*Occurrence in the Gulf of Maine.*—Anglers find the puffer only too plentiful along the southern

shores of Massachusetts, but the elbow of Cape Cod marks the eastern and northern limit to their presence in any numbers. They have been reported at Monomoy, Truro, and Provincetown. Cape Cod Bay may perhaps support a small resident population, for Prof. A. E. Gross informs us that he has seen as many as four or five taken at one time in a pound net at Sandy Neck, Barnstable, at a tide, in the summer of 1920; besides others stranded there on the beach.<sup>9</sup> And we have heard of others there recently, or nearby. Storer described them as common at Nahant, a few miles northeast of Boston, but this seems to have been an error, for Wheatland (1852, p. 214) writing about the same period, not only spoke of them as seldom seen in Massachusetts Bay, but considered a single specimen taken in Salem Harbor in the summer of 1848 as worthy of a note. And this remained the only positive record for a puffer for Essex County until August 24, 1920, when one was caught at Gloucester.<sup>10</sup>

The only records of puffers north of Cape Ann that have come to our notice are of two taken in a trap in Casco Bay in 1896, and of one taken near Long Island, off Portland Harbor, Maine, on July 24, 1933. But there may be a small local population in Casco Bay, and in the vicinity of Boothbay Harbor, Maine, for L. W. Scattergood<sup>11</sup> writes us that the pound net fishermen have long been acquainted with them there and that he had received three specimens recently from Pemaquid Point where the fishermen report them as commonest in June. A skeleton, apparently of a puffer, has been found on the shore of Minas Basin, at the head of the Bay of Fundy on the Nova Scotian side.<sup>12</sup>

### Burrfish *Chilomycterus schoepfii* (Walbaum) 1792<sup>13</sup>

#### PORCUPINEFISH; RABBITFISH; OYSTERFISH

Jordan and Evermann, 1896–1900, p. 1748.

*Description.*—The burrfish resembles the puffer (p. 526) in the positions of its dorsal and anal fins, but its skin is armed with short, stout, triangular

<sup>7</sup> The Auk, vol. 40, 1923, p. 24.

<sup>8</sup> This specimen, reported by MacOoy (Bull. 67, Boston Soc. Nat. Hist., 1933, p. 9) is in the Museum of Comparative Zoology.

<sup>9</sup> Letter dated September 19, 1951, U. S. Fish and Wildlife Service.

<sup>10</sup> Reported to us (1951) by Dr. A. H. Leim of the Fisheries Research Board of Canada.

<sup>11</sup> Jordan, Evermann, and Clark place this species in the genus *Cyclichthys* Kaup 1855.

<sup>1</sup> Hildebrand and Schroeder, Bull. U. S. Bur. Fish., vol. 43, Pt. 1, 1923, p. 348.

<sup>2</sup> Welsh and Breder (Zoologica, New York Zool. Soc., vol. 2, No. 12, January 1922, N. Y.) describe the early stages in the life history of the puffer.

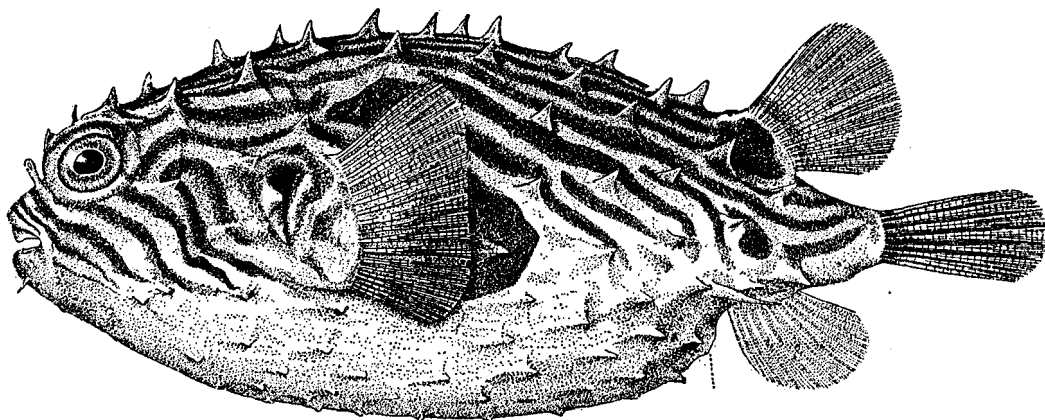


FIGURE 281.—Burrfish (*Chilomycterus schoepfii*), Connecticut. From Goode. Drawing by H. L. Todd.

spines instead of being merely prickly. These spines are sparsely scattered all over the trunk, with about 9 or 10 from nose to tail along any given line. Furthermore, the burrfish is oval in outline, not fusiform like the puffer; the openings of its nostrils are prolonged in a single tubular tentacle; its bony jaw plates are not divided by a median suture as they are in the puffer, hence each jaw apparently is armed with a single very broad incisor tooth instead of with two; the pectoral fins are not only much larger than in the puffer but their upper edge is level with the upper corner of the gill openings in the burrfish (considerable below it in the puffers); its eye is round, not oval; and its anal fin is below the dorsal, not behind the latter. We need only add that the soft dorsal and anal fins (it has no spiny dorsal) are both rounded, each has 10 to 12 rays; the caudal fin is very narrow and round-tipped; the pectorals are much broader than long, and there are no ventral fins.

*Color*.—The ground color varies from green to olive or brownish above, with pale belly, usually tinted with yellow or orange. The back and sides are irregularly striped with olive brown, dusky, or black lines, running downward and backward, roughly parallel one with another. There is a dark blotch on each side at the base of the dorsal fin, a smaller one between the latter and the anal fin, one above the base of each pectoral fin, and a fourth close behind the latter.

*Size*.—Length, to about 10 inches.

*General range*.—Coast of the United States, from Florida northward regularly about to New York, occasionally to Cape Cod, and straying as far as Massachusetts Bay; most plentiful from the Carolinas southward.

*Occurrence in the Gulf of Maine*.—The only record of this southern fish north of the elbow of Cape Cod is of one taken in Massachusetts Bay many years ago<sup>14</sup> and another caught at West Point, Maine, August 5, 1949.<sup>15</sup>

#### THE OCEAN SUNFISHES OR HEADFISHES. FAMILY MOLIDAE

Although the ocean sunfishes are allied anatomically to the puffers and porcupine fishes, with which they agree in the very small gill openings and in the fusion of the teeth into a sort of bony beak, they bear no resemblance whatever to them in general appearance, for they appear to consist of nothing but a "huge head to which the fins are attached," as Jordan and Evermann<sup>16</sup> aptly express it. They have no spiny dorsal fin; the soft dorsal and anal fins are short and very high, and they have no caudal peduncle. The caudal fin, so short that it is apparently nothing more than

a flap of skin, extends all around the rear outline of the trunk. Corresponding to their extraordinary conformation the sunfishes have only 16 or 17 vertebrae.

All known members of the family are oceanic in nature, and they are widely distributed in warm seas. One (*Mola mola*, p. 529) is a rather frequent

<sup>14</sup> This specimen, reported by Kendall (Oceas. Paper, Boston Soc. Nat. Hist., vol. 7, Pt. 8, 1908, p. 118) is (or was) in the collection of the Boston Society of Natural History.

<sup>15</sup> Taken in a fish trap and reported by Scattergood, Trefethen, and Coffin (Copeia, 1951, No. 4, p. 298).

<sup>16</sup> Bull. 47, U. S. Nat. Mus., Pt. 2, 1898, p. 1752.

visitor to our Gulf from the south; and a second (*Masturus lanceolatus*) has, perhaps, a claim to mention here, on the strength of one very young sunfish that was taken in Massachusetts Bay many years ago (p. 532).

### KEY TO GULF OF MAINE SUNFISHES

1. There is no evident caudal fin.....Sunfish, p. 529
2. There is an evident caudal fin, extending horizontally across the posterior edge of the trunk, with a triangular lobelike extension a little above the midlevel of the body.....Sharp-tailed sunfish, p. 531

#### Sunfish *Mola mola* (Linnaeus) 1758

Jordan and Evermann, 1896-1900, p. 1753.

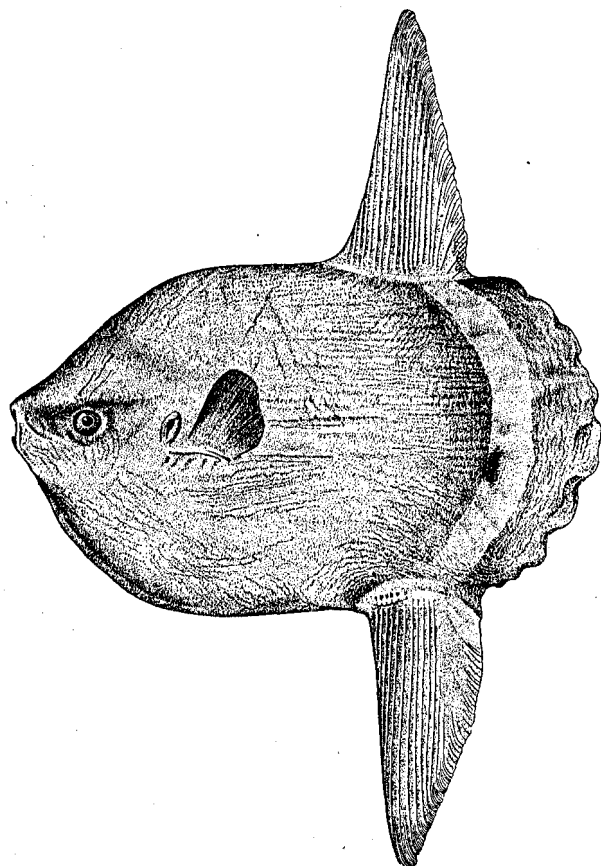


FIGURE 282.—Sunfish (*Mola mola*). From Goode. Drawing by H. L. Todd.

*Description.*—The oblong body of an adult sunfish (adults alone are seen regularly in the Gulf of Maine) suggests the head and fore trunk of some enormous fish cut off short, for it is truncate immediately back of the dorsal and anal fins, and has no caudal peduncle. But it tapers in front of the

fins toward the snout so that the forward half of the trunk is oval in profile. The fish is less than twice as long as deep, strongly flattened sidewise (about one-fourth as thick as deep), with a very small mouth at the tip of the snout; teeth completely united in each jaw; a very small eye in line with the mouth; remarkably short gill openings, and the nose overhangs the upper jaw as a kind of rough, mobile wart or pad. The soft dorsal fin (there is no spiny dorsal) stands over the anal fin, close behind the midlength of the fish. Both these fins are very much higher than long, triangular, with sharply rounded tips, and each has 15 to 18 rays, with the seventh ray the longest.

The fins cannot be laid back, as they can in most bony fishes; and the sunfish propels itself along by waving them from side to side. The caudal fin extends around the whole posterior margin of the body. Confluent with the dorsal and anal fins in the young and hardly separated from them in the adult, it is so short and its rays so hidden by the thick opaque skin that it looks more like a fold of skin than a typical fin. Its general outline is rounded, paralleling the rear outline of the body, but its margin is scalloped, with a rounded bony prominence or knob in line with each caudal ray (11-14) and with a notch between every two of these prominences. We have counted 11 such notches on a fish 3½ feet long, and have record of 8 on one of about 4 feet.<sup>17</sup> The pectoral fins are small, rounded, each with 12 or 13 rays, and are situated about halfway up the body close behind the tiny gill openings. There are no ventral fins. The skin is unusually thick (about 1½ inches thick in one 47 inches long which we harpooned near La Have Bank on August 7, 1914), very tough and elastic in texture; it is crisscrossed with low ridges, and fins as well as trunk are clothed with small bony tubercles, giving the appearance of shark skin.

The sunfish is described as glowing luminescent at night in the water. We cannot verify this first hand. But we can bear witness that it grunts or groans when hauled out of the water; that its skin is covered with a thick layer of tough slime, and it is the host of a great variety of parasites, external and internal, with copepods and trematodes clinging to its skin and infesting its gills, with its muscles harboring round worms and with various

<sup>17</sup> Taken near Boothbay, Maine, and reported to us by Dr. Austin F. Riggs.



round worms and flat worms inhabiting its intestines.

*Color.*—Dark gray above, the back with a brownish cast, the sides paler with silvery reflections, the belly dusky to dirty white. Some descriptions mention a broad blackish bar along the bases of the dorsal and anal fins, but nothing of the sort was to be seen in the only example we have handled fresh from the water.

*Size.*—The sunfish grows to a great size. Heilner<sup>18</sup> describes the capture of one 10 feet 11 inches long off Avalon (Calif.), while Jordan and Evermann record another Californian specimen 8 feet 2 inches long, weighing about 1,800 pounds.

One measuring 8 feet in length and 11 feet from tip of dorsal fin to tip of anal fin was exhibited in London in 1883,<sup>19</sup> and an 8-foot specimen was taken off Cape Lookout (N. C.) in 1904,<sup>20</sup> but large ones such as this are exceptional, the general run being from 3 to 5 feet (rarely 6 feet) long, and from 175 pounds to 500 pounds in weight. A fish 4½ feet long is about 31 inches across the body and 6½ feet from the tip of the dorsal fin to the tip of the anal. One, 5 feet 3 inches long, was 4 feet 2 inches wide and 14½ inches thick.<sup>21</sup> A fish 4 feet 1 inch long, caught off Boston Harbor, August 14, 1922, weighed 516 pounds.<sup>22</sup>

*Habits.*—The sunfish is a wanderer of the high seas, drifting at the mercy of the ocean currents; those that are seen are at the surface (see following for an exception); how deep they may descend is not known.

When these unlucky vagrants are sighted in our cool northern waters they have usually been chilled into partial insensibility. They float awash on the surface, feebly fanning with one or the other fin, the personification of helplessness. Usually they pay no attention to the approach of a boat, but we have seen one come to life with surprising suddenness and sound swiftly, sculling with strong fin strokes, just before we came within harpoon range. When one is struck it struggles and thrashes vigorously while the tackle is being slung to hoist it aboard, suggesting that they are far more active in their native haunts than their

feeble movements in fatally cold surroundings might suggest.

The sunfish lives on an unusual diet, for as a rule the contents of the stomach consists either of jellyfish, ctenophores, or salpae, or of a slimy liquid that probably represents the partially digested remains of these. This has been true of all the sunfish brought in to the Bureau of Fisheries at Woods Hole. But various crustacean, molluscan, hydroid, and serpent-star remains, even bits of algae and eelgrass (*Zostera*), have been found in sunfish stomachs in European waters, proving that at times they either feed on the bottom in shoal water, or among patches of floating weed. And their jaws certainly seem fit for harder fare than jellyfish.

The spawning habits are not known, nor have the eggs been seen; presumably these are buoyant, with many globules, as are those of the sharp-tailed sunfish *Masturus lanceolatus*. The young fry differ from their parents in being armed with 8 short stout spines on either side, and with a single median row of 4 spines along the back and 7 along the ventral margin of the body.<sup>23</sup>

*General range.*—Oceanic and cosmopolitan in tropical and temperate seas; known northward to northern Norway on the European side of the Atlantic, to the Newfoundland banks, the Gulf of St. Lawrence, and the outer coast of Nova Scotia on the American side.<sup>24</sup>

*Occurrence in the Gulf of Maine.*—The sunfish is only a stray visitor to our Gulf, which it enters now and then from the warmer and more congenial waters outside the continental slope. There are published records of its appearance in St. John Harbor, New Brunswick, near Birch Harbor; near Seguin Island; off Small Point; and off Cape Elizabeth (Maine), where it has been reported repeatedly; off Cape Ann; and from various localities in Massachusetts Bay. Sunfish have even been

<sup>18</sup> For a discussion of the young fry of the ocean sunfishes, with illustrations and references to earlier accounts, see Schmidt, Meddel. Kommission Havundersøgelser, Ser. Fiskeri, Denmark, vol. 6, 1921, No. 6.

<sup>24</sup> Localities where sunfish had been reported in the Gulf of St. Lawrence up to 1947 include north of Cape Breton; Bathurst, New Brunswick; Northumberland Straits; the north shore of the Gaspé Peninsula; the south shore of the Gulf opposite the Saguenay River; vicinity of Trois Pistoles; Anticosti; and Bay of Islands on the west coast of Newfoundland. See Medcoff and Schiffman (Acadian Naturalist, vol. 2, No. 7, 1947) for list with details. Dunbar (Canad. Field Naturalist, vol. 64, No. 3, 1950, p. 124) has recently reported one, 5 feet long, that was found on the beach at Metis on the southern shore of the Lower St. Lawrence River. A Gulf of St. Lawrence record that is especially interesting because so late in the season, is of one about 5 feet long that stranded late in October 1, 1926, at Curling, Bay of Islands, west coast of Newfoundland (reported in the Boston Traveler for Nov. 2, 1926).

<sup>19</sup> Bull. New York Zool. Soc., vol. 23, No. 6, November 1920, p. 126.

<sup>18</sup> Smitt, Scandanavian Fishes, vol. 1, 1892, p. 626.

<sup>20</sup> Smith, North Carolina Geological and Economic Survey, vol. 2, 1907, p. 353.

<sup>21</sup> As reported in the Boston American for June 24, 1930.

<sup>22</sup> Reported, with photograph, in the Boston Daily Post for August 14, 1922

seen in Boston Harbor, and on August 18, 1918, one 4½ feet long was killed in a narrow creek at Quincy, Mass. The *Grampus* sighted sunfish near the Isles of Shoals in 1896 (Dr. Kendall's field notes), in 1912, and in 1914, as well as one in the eastern basin of the Gulf in 1912. Seaside dwellers reported one or two near Cape Porpoise in 1921; one of 7 feet was caught off Boothbay, Maine, in August 1927; and one 5 feet 3 inches long in the northern side of Massachusetts Bay, off Bakers Island, Beverly, in 1940, an especially interesting case, for the fish in question was taken on a hand line in 20 fathoms of water.<sup>25</sup> And in 1950 several blundered into one of the traps at Barnstable on Cape Cod Bay.

An occasional sunfish is, in short, to be expected anywhere in the western side of the Gulf and along the coast of Maine. The only record, however, for a sunfish in the Bay of Fundy is from near its mouth at St. John Harbor.<sup>26</sup> Nor do we find any report of them along the Nova Scotian side of the open Gulf of Maine.

In most summers it is something of an event to see a sunfish anywhere in the inner part of the Gulf. During July and August of 1912, for example, we sighted only one from the *Grampus*, none at all in August 1913, and only one in the Gulf and another near La Have Bank during the mid and late summer of 1914. They vary, however, in numbers from year to year; 1928, for example, was a year of abundance all along the coast, while in 1950, a single trap at Barnstable on Cape Cod Bay took 26 sunfish, an astonishing number. Report also has it (we cannot verify this firsthand) that sunfish are more plentiful over and along the southern edge of Georges Bank than they are within our Gulf, as indeed might be expected from their oceanic origin.

In the inner parts of our Gulf sunfish are oftenest sighted in mid or late summer, or early in autumn. And one has been reported stranded in Bay of Islands on the west coast of Newfoundland as late as the end of October.<sup>27</sup> But it is not likely that any can survive the winter in our Gulf, or anywhere along the coast to the northward. Neither is there

any reason to suppose that the waifs that visit our Gulf ever spawn there.<sup>28</sup>

**Sharp-tailed sunfish *Masturus lanceolatus***  
(Liénard) 1840<sup>29</sup>

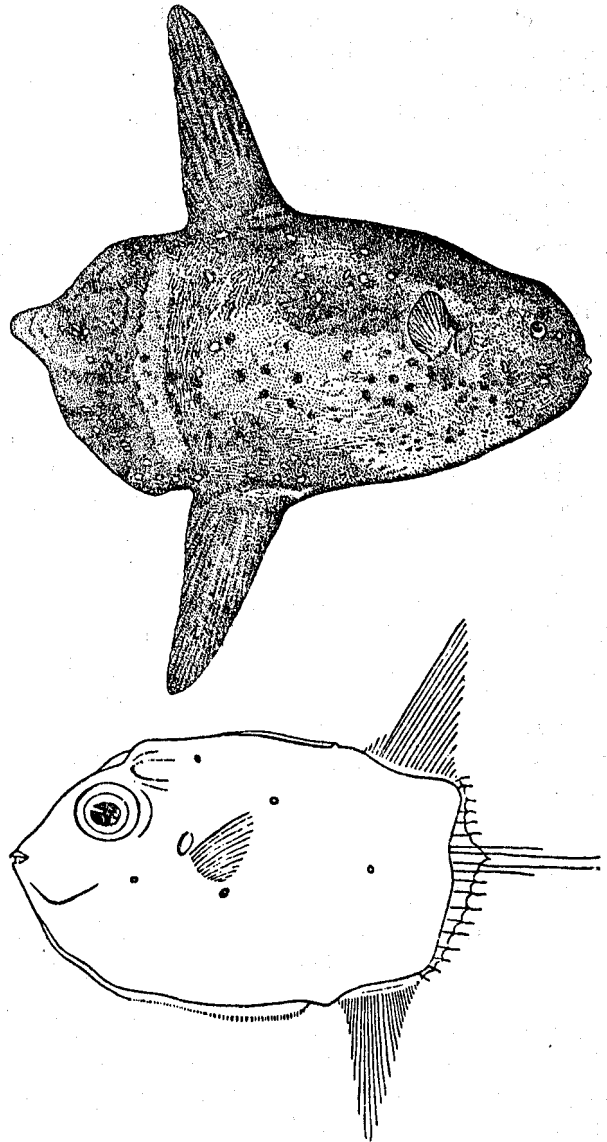


FIGURE 283.—Sharp-tailed sunfish (*Masturus lanceolatus*). Above, adult, Miami, Florida, after Gudger. Below, young, 54 mm., Massachusetts Bay, after Putnam.

<sup>25</sup> Sunfish fry, about 2 inches long, taken in Massachusetts Bay many years ago and reported by Putnam (Proc. Amer. Assoc. Advancement of Science, 19th Meeting (1870), 1871, pp. 255, 256, fig. 3) as this species, actually belonged to the closely allied sharptailed sunfish (p. 532), as shown by Schmidt (Meddel. Kommis. Havundersøgelser, Denmark, Ser. Fiskeri, vol. 6, 1921, Pt. 6, p. 6), and by Gudger (Proc. Zool. Soc. London, 1937, Ser. A, p. 382).

<sup>26</sup> It is an open question still, whether specimens with longer tail fins and others with shorter tail fins represent two separate species, or whether the differences between them are sexual ones. See Fraser-Brunner (Bull. British Mus. Nat. Hist., vol. 1, No. 6, 1951, p. 105) for a recent discussion of this subject.

<sup>27</sup> Reported in the Boston American, June 24, 1930.

<sup>28</sup> Cox, Bull. Nat. Hist. Soc. New Brunswick, No. 13, art. 2, 1896, p. 75.

<sup>29</sup> Reported in the Boston Traveler, November 2, 1926, from the Associated Press.

*Description.*—The sharp-tailed sunfish differs from the common sunfish (*Mola mola*) chiefly in the fact that the rear margin of its body is edged by a short but evident caudal fin of 18–20 soft rays, that extends around from close behind the dorsal fin to close behind the anal fin, with a triangular lobelike, blunt-tipped projection a little above the midlevel of the body. Its scales, too, are much finer and less evident to the touch than those of *Mola*, and its skin is less slimy. It resembles *Mola* very closely in all other respects.

*Color.*—Described as with the whole trunk more or less silvery, the upper parts of the sides grayish brown to blackish, the lower parts paler; the sides either plain or variously marked with ill-defined dark spots; the dorsal and anal fins as dark slaty, the caudal fin as sometimes with pale blotches.

*Size.*—This sunfish appears to grow as large as the more common *Mola*, perhaps even larger. In a Florida specimen, 88 inches long (after being dried somewhat) the tail fin occupied 21 inches, the body occupied 67 inches and was 38 inches high.<sup>30</sup> The dimensions of a North Carolina specimen 73½ inches long were: body 54½ inches long by 37 inches high and 11 inches thick, tail fin 19 inches long, dorsal fin 27 inches high, anal fin 25 inches high.<sup>31</sup>

*Habits.*—Nothing is known of its habits to differentiate it from its more common relative.

*General range.*—This sunfish, like *Mola*, appears to be cosmopolitan in tropical-warm temperate latitudes; oceanic in nature but coming close inshore on occasion, and even into estuarine situations. Adults have been reported from Japan, the Hawaiian Islands, Polynesia, Amboina, and Mauritius in the Indian and Pacific Oceans; from the Red Sea; from South Africa (Table Bay); from Madeira, from near the Azores; near Habana, Cuba (7 specimens); east coast of Florida (9 specimens), and North Carolina (4 specimens) in the Atlantic. Young fry have been taken off the Azores; in the Sargasso Sea; west of the Canaries; in the Caribbean; and in the Gulf of Mexico.<sup>32</sup>

*Occurrence in the Gulf of Maine.*—The only record for the sharp-tailed sunfish for our Gulf is for 4 young fry, about 2 inches long, that were taken many years ago in Massachusetts Bay. These were originally reported by Putnam<sup>33</sup> as the young of the common ocean sunfish, but Schmidt<sup>34</sup> and Gudger<sup>35</sup> have shown that they were the sharp-tailed species in reality, because with projecting caudal fins. The nearest locality record for an adult of the species (to date) is for Pamlico Sound, N. C. But it would not be astonishing if one were to drift farther northward any summer, as so many stray species do from the south.

## THE ANGLERS. FAMILY LOPHIIDAE

This family is the only familiar Gulf of Maine representative of the small but anatomically remarkable tribe of pediculate fishes, in which the base of the pectoral fin takes the form of an arm ("pseudo-brachium") formed by the elongation of the carpal bones ("actinosts"), which are so short in all other bony fishes that they are not noticeable externally. Coupled with this peculiar structure of the pectorals, the gill openings are reduced to small apertures in or near the axils ("armpits") of these fins. The anglers are characterized among their immediate relatives by a very large and very much flattened head; by an enormous mouth; and by the fact that they have only two bones in each pectoral "arm." The Gulf of Maine harbors one species.

**American goosefish** *Lophius americanus* Cuvier and Valenciennes 1837

MONKFISH; ANGLER; ALLMOUTH; MOLLIGUT;  
FISHING FROG

Jordan and Evermann, 1896–1900, *Lophius piscatorius* Linnaeus 1766 in part, p. 2713.

*Description.*—The goosefish is so unlike all other Gulf of Maine fishes that there is no danger of mistaking it for any other once it is seen. It is so much flattened, dorso-ventrally, and so soft in texture that when one is left stranded on the

<sup>30</sup> See Gudger (Proc. Zool. Soc. London, 1937, Ser. A, p. 353), for list of locality records up to 1937 with references; Brimley (Jour. Elisha Mitchell Sci. Soc., vol. 55, 1939, p. 295) for account of North Carolina specimens.

<sup>31</sup> Proc. Amer. Assoc. Advancement of Science, 10th meeting, Troy, N. Y. (1870) 1871, pp. 255–256.

<sup>32</sup> Meddel. Komm. Havundersøgelser, Denmark, Ser. Fiskeri, vol. 6, Pt. 6, 1921, p. 6.

<sup>33</sup> Proc. Zool. Soc. London, 1937, Ser. A, p. 382.

<sup>34</sup> Hubbs and Giovannelli, *Copels*, 1931, pp. 135–136.

<sup>35</sup> Brimley, Jour. Elisha Mitchell Sci. Soc., vol. 55, 1939, p. 295.

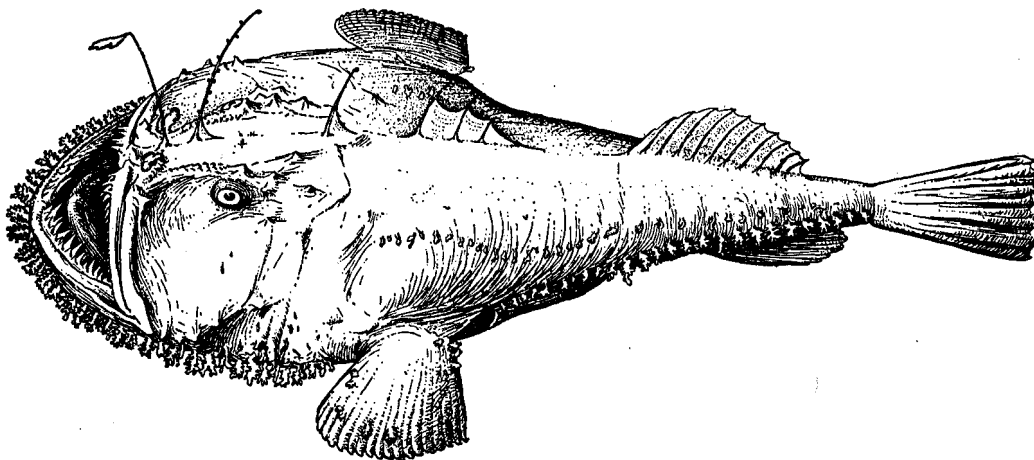


FIGURE 284.—Goosefish (*Lophius americanus*), oblique-dorsal view, Gulf of Maine specimen. From Bigelow and Welsh.

shore it collapses until it is hardly thicker than a skate. Its head is rounded as seen from above, about as broad as it is long, and enormous in comparison with the body, which is so narrow and tapering, back of the pectoral fins as to give the fish a tadpole-like appearance. The most noticeable feature is the enormous mouth, which is directed upward, with the lower jaw projecting so far beyond the upper jaw that most of the lower teeth are freely exposed even when the mouth is closed.

Both jaws are armed with long, slender, curved teeth, all alike in form but of various sizes, and very sharp, and all the teeth point inward toward the gullet. Some of them may be as much as an inch long in a large fish. The teeth in the lower jaw are in 1 to 3 rows, mostly large, while in the upper jaw the few teeth in the middle (there is a toothless space in the midline) are largest, with a single row of smaller ones flanking them. And there are several rows of thorn-like teeth on the roof of the mouth. The gill openings are behind the pectoral fins and they lack the gill covers that are to be seen in most of the bony fishes. The eyes are on the top of the head, and are directed upward.

The pectoral fins are exceedingly distinctive, for their bases have the form of thick fleshy arms as already described (p. 532) that bear the fins proper at their outer edge. The finlike parts are fanlike when spread, and so thick-skinned that the rays are hardly visible except in the scalloping of the margins.

The top of the head bears 3 stiff slender spines (representing the anterior part of the spiny dorsal

fin) hardly thicker than bristles, the first standing close behind the tip of the snout, the second a little in front of the eyes, the third on the nape of the neck. And while the first and second are movable from recumbent to erect, the third slopes backward with its basal half imbedded in the skin.<sup>36</sup> The relative lengths of these spines vary, but the first two have been about equal in length on most of the fish we have seen, or the second a little the longer, with the third much the shortest of the three. The first spine bears an irregular leaflike flap of skin at its tip, which plays an important role in the daily life of the goosefish as a lure for its prey (p. 536) while the second and third spines have small triangular membranes at their bases, and one or both of them may be fringed with short lobes of skin. Besides these spines there are two well-developed dorsal fins, the first (of 3 spines) situated over the pectorals and the second (10 to 11 rays) on the rear part of the trunk.

The single anal fin (9 to 10 rays) stands below the second dorsal fin, and the ventral fins (about 5 thick rays) are situated on the lower surface of the head, well in front of the pectorals. The caudal fin is small and broom shaped. The dorsal fins have thin delicate membranes. But the caudal, anal, and ventral fins are thick and fleshy, like the pectorals. The skin is scaleless, very smooth and slippery to the touch, and there is a row of fleshy flaps of irregular shape running around the margin of the head and around the edge of the lower jaw, besides smaller tags that

\* Sometimes more than one-half is so imbedded.

fringe the sides of the trunk as far back as the base of the caudal fin. Furthermore, the upper side of the head bears several low conical tubercles which vary in prominence from fish to fish.

*Color.*—The many goosefish we have seen (and this corroborates the published accounts) have been chocolate brown above, variously and finely mottled with pale and dark. The dorsal fins, the upper sides of the pectoral fins, and the caudal fin are of a darker shade of the same color as the back, except nearly black at the tips, while the whole lower surface of the fish is white or dirty white. Sometimes, it is said, the upper side is dotted with white spots but we have seen none that were marked in that way. Very small ones are described as mottled and speckled with green and brown. Wilson, who watched many in the aquarium at Plymouth, England,<sup>37</sup> writes that the European species is able to match both its color and its color pattern closely to the sand and gravel on which it lies.

*Size.*—Adults run from 2 to 4 feet long,<sup>38</sup> weighing up to 50 pounds, and heavier ones have been reported. One 38 inches long, caught at Woods Hole on July 25, 1923, weighed 32 pounds alive.

*Remarks.*—The goosefish of eastern North America has usually been thought identical with the widespread eastern Atlantic angler (*L. piscatorius* Linnaeus. But as Tåning<sup>39</sup> has pointed out, the late larval stages of our fish do not resemble those of *L. piscatorius* as closely as they do those of the angler of the Mediterranean and of neighboring parts of the Atlantic that various authors regard as a separate species, *L. budegassa*, Spinosa 1807.<sup>40</sup> This suggests that the goosefish of the western Atlantic is a distinct species, for which Berrill<sup>41</sup> has revived the old name *L. americanus* Cuvier and Valenciennes 1837.

The adults of the three forms in question certainly resemble one another so closely that we have not found any external differences that seem significant to separate Gulf of Maine fish from two specimens from northern Europe, and others

from the Mediterranean (all of about the same size) with which we have compared them. But it seems wisest to retain the separate name for our form until the larval differences can be investigated further (which we are not in a position to do), and until much larger series of grown fish have been compared.

*Habits.*—The depth range inhabited by the goosefish extends from tide line down to at least 365 fathoms on the continental slope off southern New England, and very likely deeper still. The adults appear, for the most part, to hold to the sea floor, where many are taken by the otter trawlers. And they are found indifferently on hard sand, on pebbly bottom, on the gravel, sand, and broken shells of the good fishing grounds, and on soft mud, where we have trawled them in the deep basin of our Gulf.

Specimens of the closely allied European goosefish kept in the aquarium at Plymouth, England, spent most of the time resting quietly.<sup>42</sup> When they swam they did so slowly, and they used their paired fins for walking on the bottom. Wilson describes one as digging a small hollow in the bottom when it settled down, using its pelvic fins to shovel the sand and pebbles forwards-outwards, and using its pectorals, almost like webbed hands, to push the sand away to either side until its back was almost flush with the surrounding bottom. But the fact that goosefish have been known to seize and swallow hooked fish as the latter were being hauled up, and even to capture sea birds sitting on the surface, proves that while they ordinarily snap up their prey from ambush, or by a sudden short rush, they may make considerable excursions for a meal on occasion.

The American goosefish is at home through a very wide range of temperature. They have been trawled on the Newfoundland banks in water as cold as 32°, and it is likely that those living shoalest in the Gulf of St. Lawrence are exposed to equally low temperatures, in late winter and in spring. But we doubt if they can survive much colder water, for many were seen floating dead in Narragansett Bay, and on the shore, during the

<sup>37</sup> Jour. Marine Biol. Assoc. United Kingdom, vol. 21, Pt. 2, 1937, p. 485.

<sup>38</sup> Rumor has it that goosefish grow to 6 feet, but we find none definitely recorded (and have seen none) longer than 4 feet.

<sup>39</sup> Rept. Danish Oceanogr. Expeds. (1908-1910), No. 7, vol. 2, Biol. A. 10., 1923, p. 7-16.

<sup>40</sup> See Regan, Ann. Mag. Nat. Hist. Ser. 7, vol. 11, 1903, p. 283 for descriptions of *L. piscatorius*, of *L. budegassa*, and of a new species, *callanti*, described by him from the Azores and from the Cape Verde Islands.

<sup>41</sup> Contrib. Canadian Biol. N. Ser., vol. 4, No. 12, 1929.

<sup>42</sup> Wilson (Jour. Mar. Biol. Assoc. United Kingdom, vol. 21, Pt. 2, 1937, pp. 486-490) has given a very interesting account of the habits of specimens in the aquarium at Plymouth, England, where some were kept for as long as 11 months.

<sup>43</sup> Rept., vol. 2, No. 1, Newfoundland Fish. Res. Comm., 1933, p. 123 sta. 97.

winter of 1904-1905, apparently killed by the unusually severe cold.<sup>44</sup>

At the other extreme, goosefish picked up by net fishermen near Cape Lookout, N. C., in shoal water (p. 540) are exposed to temperatures higher than 70° for part of the season, perhaps as high as 75°. But reports<sup>45</sup> that the inshore contingent of the goosefish population of Rhode Island waters works out (i. e., deeper) in July, to work inshore again in October suggest that they tend to avoid extreme summer heat, if they can do so by descending into deeper water.

They are tolerant to a wide range of salinity also, occurring as they do from estuarine situations out to the upper part of the continental slope. But we have never heard of one in brackish water.

The larvae of the goosefish, like those of most sea fishes, feed on various small pelagic animals such as copepods, crustacean larvae, and glass worms (*Sagitta*); and *Sagitta* is the chief diet of young goosefish in the Adriatic during the life of the latter near the surface, hence may serve this same purpose in the Gulf of Maine.

The goosefish becomes a fish eater in the main after it takes to the bottom, and the following Gulf of Maine species have been recorded from its stomach: spiny dogfish, skates of various kinds, eels, launce, herring, alewives, menhaden, smelts, mackerel, weakfish, cunners, tautog, sea bass, butterfish, puffers, various sculpins, sea ravens, sea robins, sea snails, silver hake, tomcod, cod, haddock, hake, witch flounders, American dab, yellowtail flounders, winter flounders, and various other species of flatfish unnamed, as well as its own kind. The goosefish often captures sea birds, as one of the vernacular names implies, cormorants, herring gulls, widgeons, scoters, loons, guillemots, and razor-billed auks are on its recorded dietary, while we have found grebes and other diving fowl, such as scaup ducks and mergansers, in goosefish in Pamlico Sound, N. C. It is questionable, however, whether even the largest of them would be able to master a live goose, as rumor has it, nor do the local fishermen believe it ever does so in Pamlico Sound, though the abundance of wild geese there in winter would afford it every op-

portunity. Goode,<sup>46</sup> however, tells of one which a fisherman saw struggling with a loon. Even a sea turtle has been found in one.<sup>47</sup>

Goosefish are also known to devour invertebrates such as lobsters, crabs of several species, hermit crabs, squids, annelid worms, shellfish, starfish, sand dollars, and even eelgrass. Linton's<sup>48</sup> report of one that was full of mud containing small shellfish, crustaceans, and worms is interesting. In short, nothing edible that strays within reach comes amiss to a goosefish. And examinations of stomachs have shown that the relative importance of various articles in its diet varies widely on different grounds, depending on what is available. Thus Field<sup>49</sup> found skates, flounders, and squid their chief dependence near Woods Hole. The 32-pounder from there, mentioned above, contained 2 menhaden, 1 spiny dogfish a foot long, and the vertebral columns of 6 others; while goosefish diet largely on hakes in the Bay of Fundy;<sup>50</sup> on haddock, flatfish, and on skates on Georges Bank.

The goosefish has often been cited for its remarkable appetite. We read, for instance, of one that had made a meal of 21 flounders and 1 dogfish, all of marketable size; of half a pailful of cunners, tomcod, and sea bass in another; of 75 herring in a third; and of one that had taken 7 wild ducks at one meal. In fact it is nothing unusual for one to contain at one time a mass of food half as heavy as the fish itself. And with its enormous mouth (one 3½ feet long gapes about 9 inches horizontally and 8 inches vertically) it is able to swallow fish of almost its own size. Fulton, for instance, found a codling 23 inches long in a British goosefish of only 26 inches, while Field took a winter flounder almost as big as its captor from an American specimen. One that we once gaffed at the surface, on Nantucket Shoals, contained a haddock 31 inches long, weighing 12 pounds, while Captain Atwood long ago described seeing one attempting to swallow another as large as itself. Wilson's observations, however, indicate that they are no more gluttonous than any other rapacious fish, for those that he watched in the aquarium usually refused food for 2 or 3 days

<sup>46</sup> Fish. Ind. U. S., Sect. 1, 1884, p. 174.

<sup>47</sup> Schroeder, *Copeia* 1947, p. 201.

<sup>48</sup> Bull. U. S. Bur. Fish., vol. 10, 1901, p. 487.

<sup>49</sup> Rept. U. S. Comm. Fish., (1906) 1907, Doc. No. 622, p. 39.

<sup>50</sup> Connelly, Bull. 3, Biol. Board Canada, 1920, p. 16.

<sup>44</sup> Reported by Tracy, 36th Rept. Comm. Inland Fish. Rhode Island, 1906, p. 92.

<sup>45</sup> Tracy, 36 Rept. Comm. Inland Fish., Rhode Island 1906, p. 92.

after a meal. His observation that they evidently preferred small fish is in line with their normal habits, for they feed mostly on small fish, not on large, and even the largest of them take very small fry on occasion.

In Scottish waters,<sup>51</sup> where the habits of the local goosfish are better known than in the Gulf of Maine, their local abundance depends on the supply of small fish. And despite their poor ability as swimmers goosfish have been found to congregate near particular shoals of herring.

Goosfish, like most fish of prey, often swallow indigestible objects. They have even been credited (on how good evidence we cannot say) with pouching lobster-pot buoys. And the story of one whose mouth made a holding ground for the anchor of a small boat has been related repeatedly.

The most interesting habit of the goosfish is that it actually does use the flap of skin at the tip of its first dorsal spine as a bait to lure small fishes within seizing distance, much as Aristotle described. W. F. Clapp (only observer who has watched the American goosfish feeding, to our knowledge) has described them to us, in Duxbury Harbor as lying motionless among the eelgrass, with the "bait" at the tip of the first dorsal ray swaying to and fro over the mouth. When a tomcod (the only fish he saw them take) chances to approach, it usually swims close up to the "bait," but never (in his observation) actually touches the latter, for the goosfish opens its vast mouth as soon as the victim comes within a few inches and closes it again, engulfing its prey instantaneously.

Further details added by observations on European anglers in aquaria at Port Erin, Isle of Man, by Chadwick,<sup>52</sup> and at Plymouth, England, by Wilson,<sup>53</sup> are that the first dorsal spine, with its terminal "bait" is held down along the top of the head, to be raised at the approach of a prospective victim; that the bait may be jerked to and fro quite actively in front of its owner's head; that the victim is usually taken in head first; that a fish swimming close enough may be snapped up without the bait being brought into play; and that some anglers use the bait often, others seldom.

Wilson also made the interesting observation that touching the "bait" does not cause a reflex snapping of the jaws, showing that the angler feeds by sight.<sup>54</sup>

Adult goosfish cannot have many enemies. But small ones are no doubt picked up by various predaceous fishes. And Lebour's observation<sup>55</sup> that goosfish larvae in aquarium jars at Plymouth, England, were devoured by the larvae of the spiny lobster (*Palinurus*), by large copepods, by ctenophores, and by hydroids when they came close enough to the walls of the jar to be seized by the latter, is an interesting illustration of the hazards that larval fishes meet during their free-drifting stages.

Goosfish spawn in spring, summer, and early autumn, according to the latitude, and through a long season. Eggs and larvae have been taken near Cape Lookout, N. C., in March and April,<sup>56</sup> in May off Cape Hatteras;<sup>57</sup> and as early as May at Woods Hole. But spawning may not commence until early summer in the Gulf of Maine, for June 24 (Passamaquoddy Bay<sup>58</sup>) is the earliest date when eggs have been seen north of Cape Cod. September 18 (off Seguin Island, Maine) is the latest recorded date for American waters.

The floating egg-veils of the European angler have been reported as early as February 18 in Scottish waters and as late as July 23,<sup>59</sup> while Tåning<sup>60</sup> concludes from the sizes of larvae taken at different dates that March-June is the season of chief production to the west and southwest of the British Isles in general. In the Mediterranean (with higher temperatures), anglers spawn from December and January on, as shown by the presence of larvae.<sup>61</sup>

The locality of spawning has been the subject of discussion, whether inshore in shoal water, or offshore in deeper. The egg veils reported from the Bay of Fundy by Connolly;<sup>62</sup> from Passama-

<sup>54</sup> Gudger (Amer. Naturalist, vol. 70, 1945, p. 542), has given an interesting and readable survey of observations, at various hands, on the use of the bait.

<sup>55</sup> Jour. Mar. Biol. Assoc. United Kingdom, vol. 13, 1925, p. 723.

<sup>56</sup> Information supplied by the late S. F. Hildebrand.

<sup>57</sup> Tåning, Rept. Danish Oceanogr. Expeds., 1908-1910, No. 7, vol. 2 (Biol.), A 10, 1923, p. 25.

<sup>58</sup> Connolly, Contrib. Canadian Biol. (1921) 1922, p. 116.

<sup>59</sup> See Bowman (Fish. Bd. Scotland, Sci. Invest. (1919, No. 2), 1920, p. 23) for records for angler eggs up to 1919.

<sup>60</sup> Danish Oceanogr. Expeds., 1908-1910, No. 7, vol. 2 (Biol.), A 10, 1923, p. 23.

<sup>61</sup> See Stiasny (Arbeits. Zool. Inst. Vienna, vol. 19, 1911, p. 70) for Mediterranean records, besides which an egg veil has been reported in January near Naples by Le Bianco (Mith. Zool. Stat. Neapel., vol. 19, pt. 4, 1909, p. 725).

<sup>62</sup> Contrib. Canadian Biol. (1921), No. 7, 1922, p. 116.

<sup>51</sup> Fulton (Ann. Report, Fish. Board Scotland, (1902) 1903, Pt. 3, p. 195) lists the stomach contents of 541 goosfish from various localities off Scotland).

<sup>52</sup> Nature, vol. 124, 1929, p. 337.

<sup>53</sup> Jour. Marine Biol. Assoc. United Kingdom, vol. 21, pt. 2, 1937, p. 479;



quoddy Bay by Berrill;<sup>63</sup> and from Frenchman Bay near Mount Desert by Procter and others,<sup>64</sup> were in such early stages of incubation that they must have been spawned close at hand. And this also applies to some isolated eggs that were collected at about the 20-fathom contour line off northern North Carolina,<sup>65</sup> by the *Dana*. Neither is there any reason to suppose that veils farther advanced in incubation, that have been taken in the inner parts of the Gulf of Maine (p. 541); at Woods Hole; and at Newport (p. 537), had come from any great distance. Furthermore, large adult fish are present in abundance inshore throughout the spawning season, which would hardly be the case if they moved offshore or into deep water to spawn. On the other hand, veils that could not have been spawned long before have also been met with near the 1,000 to 1,100 fathom (2,000-meter) contour line over the continental slope off North Carolina<sup>66</sup> and at about the same relative position over the slope south of the Newfoundland Banks.<sup>67</sup>

It appears, in short, that the American goosefish spawns indifferently in shoal water and in deep. It differs in this respect from its European relative, which moves offshore and down the slope for the purpose, to near the 1,000-fathom contour, to judge from the localities where the newly hatched larvae have been collected in the eastern North Atlantic.<sup>68</sup>

The presence of egg veils off North Carolina; near Newport<sup>69</sup> and near Woods Hole along southern New England; in the Gulf of Maine (p. 541); and over the continental slope south of the Newfoundland Bank; with the capture of a very small (4-inch) specimen on the Grand Bank (p. 540) shows that the American goosefish breeds throughout its geographic range.

The eggs are shed in remarkable ribband-like veils of mucus, each probably the product of a

single ovary, up to 25-36 feet long, and said sometimes to be as much as 2 to 3 feet broad, in which the eggs are arranged in a single layer, lying one to three or even four in separate hexagonal compartments, with the oil globule uppermost. In an egg veil found near St. Andrews, New Brunswick, between 32 and 36 feet long, about 8 inches wide, about  $\frac{1}{8}$  inch thick, and about 25 quarts (26 $\frac{1}{2}$  liters) in volume, about 5 percent of the eggs were single, about 80 percent were in pairs, and about 5 percent were in threes, per compartment. This veil was estimated to contain about 1,320,000 eggs,<sup>70</sup> and Fulton estimated about the same numbers (1,345,848 and 1,317,587) in the ovaries of two in Scottish waters.<sup>71</sup>

The veils are light violet gray or purplish brown, made more or less blackish by the embryonic pigment of the eggs according to the stage of development attained by the latter. And they are so conspicuous when floating at the surface that fishermen have long been familiar with them, though it was not until about 1871 that Alexander Agassiz demonstrated their true parentage.<sup>72</sup> The eggs occasionally become isolated, perhaps when a storm shreds the mucous veil to pieces, and they float like any ordinary buoyant fish eggs when this happens. We have not actually found them in this condition in the Gulf of Maine, but Agassiz and Whitman saw isolated eggs at Newport, and Tåning has reported others from North Carolina waters.

The eggs themselves, large numbers of which have now been examined, are 1.61 to 1.84 mm. in longest diameter in the case of the American species, as they lie in their mucous compartments.<sup>73</sup> The yolk is straw-colored, and they have either one copper-colored or pinkish oil globule of 0.4 to 0.56 mm., or several smaller ones. Incubation proceeds normally at temperatures from as low as 41° to as high as 63°-64°, and probably in higher temperatures. The larvae, which float with the yolk uppermost at first, have been re-

<sup>63</sup> Contrib. Canadian Biol. Fish., N. Ser., vol. 4, No. 12, 1929, p. 145.

<sup>64</sup> Biol. Surv. Mount Desert Region, Pt. 2, Fishes, 1928, p. 3.

<sup>65</sup> Tåning, Rept. Danish Oceanogr. Expeds., 1908-1910, No. 7, vol. 2 (Biol.) A 10, 1923, p. 25.

<sup>66</sup> Lat. 36°16' N., long. 74°33' W., see Tåning, Danish Oceanogr. Expeds., 1908-1910, vol. 2 (Biol.), A 10, 1923, p. 25.

<sup>67</sup> Murray and Hjort, Depths of the Ocean, 1912, p. 108.

<sup>68</sup> For further discussion, see Bowman (Fishery Bd. Scotland Sci. Invest. [1919], No. 2, 1920, p. 21) and Tåning (Rept. Danish Oceanogr. Expeds., 1908-1910, vol. 2 (Biol.) No. 7, A 10, 1923).

<sup>69</sup> It was at Newport that Agassiz, and Agassiz and Whitman, collected the veils and the larvae on which they based their accounts.

<sup>70</sup> Berrill, Contrib. Canad. Biol. and Fish., N. Ser., vol. 4, No. 12, 1929, pp. 145, 147.

<sup>71</sup> Sixteenth Annual Report, Fish. Bd. Scotland (1897) 1898, Pt. III, pp. 125-134, pls. 2-3.

<sup>72</sup> Baird, American Naturalist, vol. 5, 1871, pp. 785-786.

<sup>73</sup> The eggs of the European *L. piscatorius* are described as larger, averaging about 2.3 mm.

ported as from about 2.5 mm. to about 4.5 mm. long when they hatch.<sup>74</sup>

The first of the dorsal fin rays (which is to form the second head spine of the adult) appears within

<sup>74</sup> Larval goosefish from New England, from the Bay of Fundy, and from Nova Scotian waters have been described and pictured by Agassiz (Proc. Amer. Acad. Arts, Sci., N. Ser., vol. 9, 1882, p. 280); by Agassiz and Whitman (Mem. Mus. Comp. Zool., vol. 14, No. 1, Pt. 1, 1885, p. 16, pl. 6, figs. 1-10); by Connolly (Contrib. Canadian Biol. [1921], No. 7, 1922); by Procter and others (Biol. Surv. Mt. Desert region, Pt. 2, Fishes, 1928); and by Berrill (Contrib. Canadian Biol. and Fish., N. Ser., vol. 4, No. 12, 1929, pp. 145-149). For accounts and illustrations of North European and Mediterranean *Lophius* larvae, see especially Lebour (Jour. Marine Biol. Assoc. United Kingdom, vol. 13, No. 3, 1925, pp. 721-728) who reared them from the eggs at Plymouth, England; also Bowman (Fishery Board for Scotland, Sci. Invest. [1919] 1920, No. 11), Stiasny (Arbeit, Zool. Inst. Vienna, vol. 19, 1911, p. 71), and Tåning (Report, Danish Oceanogr. Expeds., 1908-1910, No. 7, vol. 2 (Biol.), A 10, 1923).

4 days or so after hatching, as a lobe at the margin of the embryonic finfold on the nape of the neck. The pectorals are formed at about 7 days, when the larva is 5.5 mm. long, the ventral fins have now appeared as two long conical processes below and behind the pectorals (fig. 285D); and the pigment has become congregated in 3 or 4 masses behind the vent, the last being a very conspicuous feature that the larvae of the European species *L. piscatorius* do not share. The yolk has been absorbed at a length of 6-8 mm., a second dorsal ray has formed behind the first, and the ventral fins have become 2-rayed. The third and fourth dorsal rays or filaments appear while there are still only two

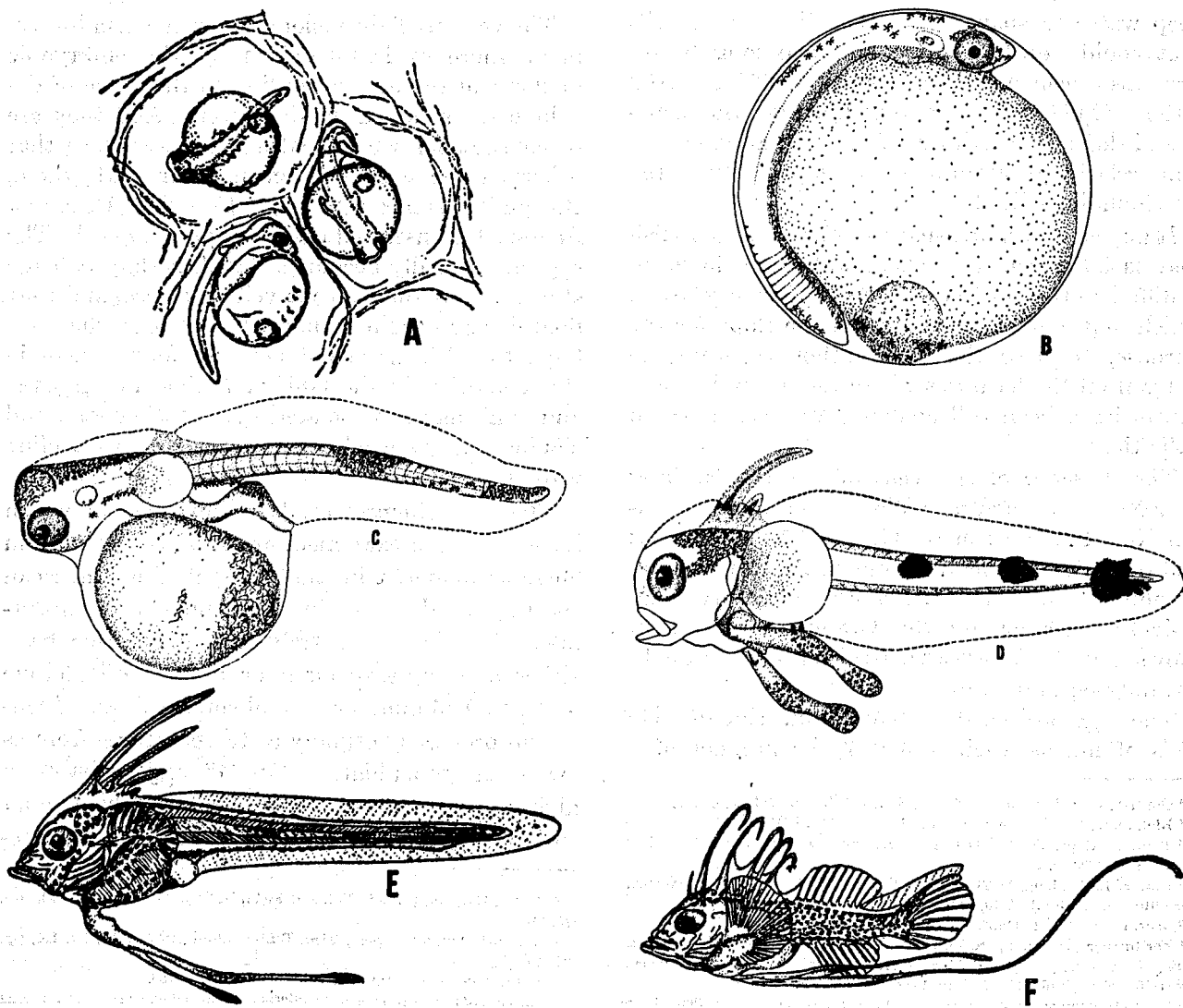


FIGURE 285.—Goosefish (*Lophius americanus*). A, eggs in veil; B, egg with advanced embryo; C, larva, about 5 days old; D, larva about 12 days old; E, older larva; F, larva, 30 mm. A, E, and F, after A. Agassiz. B, C, and D, from New England.

ventral rays in the American goosefish (fig. 285E), but they do not do so in the European species until the third rays have developed, in the ventral fins. The Mediterranean larvae so far described have agreed with the American in this respect, which makes the situation puzzling.

A fifth dorsal ray next appears behind those that have developed already, and a sixth in front of these, all of them being interconnected with membrane at their bases but free at their tips. The pectoral fins assume a great breadth and fanlike outline; the second dorsal, the anal, and the caudal fins take definite form; the ventral rays become filamentous at their tips, streaming far out behind the tail; and a complete row of teeth appears in the lower jaw, with a few in the upper. The goosefish pictured at this stage by Agassiz (fig. 285F) was 30 mm. long, and one much like it taken off Brazil Rock, described by Connolly, was 27 mm. long, but the larvae of the Mediterranean goosefish attain this stage when they are only 13 to 18 mm. long, according to Stiasny.

The older post-larval stages of the American goosefish have not been seen yet. But development no doubt follows the same course for them as it does for the Mediterranean form; i. e., the foremost dorsal ray becomes bristlelike with the flap appearing at its tip; the last three of the free rays on the nape of the neck join together as the future first dorsal fin; the lappets of skin appear around the margin of the lower jaw and along the cheeks; and the head broadens and flattens while the young fish are still living pelagic, with enormous pectoral fins and with threadlike ventrals (fig. 286).

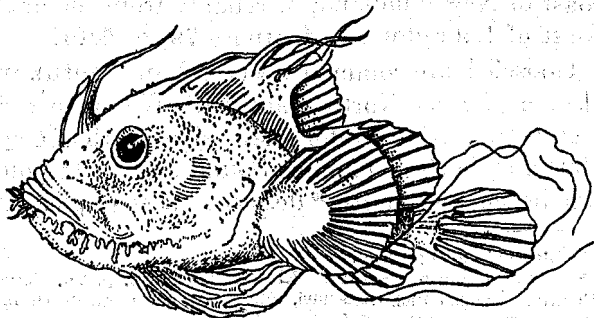


FIGURE 286.—Goosefish (*Lophius*). Larva, Mediterranean, 50 mm. After Stiasny.

The largest free-swimming Mediterranean larva seen by Stiasny was 2 inches (50 mm.) long. Probably the young take to the ground shortly

after this stage, for Bowman describes European goosefish fry of about 2½ inches (65 mm.) that were trawled on the bottom, off Scotland, as of adult form, except that their pectorals were proportionately larger. To attain this state entails growth on the part of the head out of proportion to the rest of the body; enlargement of the mouth; shrinkage of all the fins (of the ventrals most of all); alteration of the second and third free dorsal rays into spines (they are soft previously); and a general flattening of the whole fish. Young of 3 inches taken at Halifax, one of 4½ inches from Campobello (both pictured by Connolly), and others as small as 4–4½ inches that we have trawled, were at about this stage in their development.

The capture of a 2½-inch specimen in October (presumably), in Halifax Harbor, and of another of 3 inches there (date not recorded),<sup>75</sup> suggests that the goosefish may be expected to reach about that length by the onset of their first winter in our northern waters. One 4½ inches long from Halifax, studied by Connolly, seemed, from the thickness of its otoliths, to have been in its second summer or autumn, i. e., one full year old, which probably applies to three others of 4–4½ inches, trawled in August, that we have seen. But it is not clear whether 14 others of 7½ inches in May, and of 6¼–9 inches in July, were early hatched fry in their second season, or late hatched specimens in their third season.<sup>76</sup>

One of the larger fish studied by Connolly showed 4 concentric rings in its vertebrae; one 31 inches long seemed to have 9 rings; one of 37 inches seemed to have 10 rings; and one of 40 inches seemed to have 12 rings. But it is not certain whether these vertebral rings are laid down regularly, one per year, or not.

Fulton's observations<sup>77</sup> show that the fry of the North European angler may be 5–5½ inches long by November off Scotland, where spawning commences in March or earlier; which is as large as the fry of the American species are in their second summer in our northern waters, where the first growing season is at least 3 to 4 months shorter. Fulton's measurements also point to more rapid growth by the larger Scottish fish than by the

<sup>75</sup> Connolly (Contrib. Canadian Biol. (1921), No. 7, 1922, pp. 119–120).

<sup>76</sup> Equal uncertainty applies to two of 10 inches, one of which was trawled in February, the other in April.

<sup>77</sup> 21st Ann. Rept. Fish. Bd. Scotland, Pt. 3 (1902) 1903, pp. 190–194.

American goosefish in the Bay of Fundy, namely to 9–16 inches at a year and a half; to 14½–18½ inches when 2½ years old; and to about 21 inches at 3 years of age.

Few goosefish mature on either side of the Atlantic until they are 30 inches long, or longer.<sup>78</sup>

*General range.*—Coast of eastern North America from the southern and eastern parts of the Grand Banks of Newfoundland, and the northern side of the Gulf of St. Lawrence<sup>79</sup> southward to North Carolina, in shoal and moderately deep water; also reported (as *L. piscatorius*) off the Barbadoes at 209 fathoms, on the Yucatan Bank, southern part of the Gulf of Mexico, at 84 fathoms,<sup>80</sup> and off Cape Frio, Brazil, in lat. 22°56' S.,<sup>81</sup> if these southern specimens actually belonged to the same species.

*Occurrence in the Gulf of Maine.*—This is a familiar fish in the Gulf of Maine both along shore and on the outer fishing banks. It has been recorded in print from the west coast of Nova Scotia (St. Mary Bay) and from various localities in the Bay of Fundy, where, according to Huntsman, large ones are frequently taken on long lines, or found stranded on the beach. It is well known, if not abundant, all along the coast of Maine, and we once caught 8 (all large) in Ipswich Bay in one haul of a beam trawl only 8 feet wide. In Massachusetts Bay goosefish are the most common on the smooth bottom south of Boston; many enter Duxbury Bay (p. 546); and they are so numerous in Cape Cod Bay that one can hardly walk the beach for an afternoon without finding a jawbone bleaching on the sand, which applies equally all along the outer shores of Cape Cod. Fishermen speak of them as common on and about Stellwagen Bank, also. And we have trawled them in the deep basin of the Gulf.

Goosefish formed about 1 percent (in numbers of individuals) of the fishes of all kinds taken by certain otter trawlers in the South Channel and on Georges Bank in 1913. And most of the trawl hauls that we have seen made there subsequently

in depths of 60 to 100 fathoms have brought in from 1 to 40 of them.

They do not show any evident preference for any particular depth zone in the inner parts of the Gulf between tide mark and 100 fathoms or so, and the *Albatross III* found them generally distributed from 22–30 fathoms down to at least as deep as 150–160 fathoms both on Georges Bank and off southern New England to the westward, in May 1950.<sup>82</sup> Our failure to take any in the bowl between Jeffreys Ledge and the coast suggests that they may avoid the very softest mud bottoms. And it is likely that a rather definite concentration of them in depths of 26 to 45 fathoms on the southwestern part of Georges Bank in June 1951, when the *Eugene H* caught an average of about 5 per haul there, but only 1 per haul at 46–65 fathoms, was a matter of the food supply, not of the depth.

Goosefish are said to be as common on Browns Bank as they are on Georges, also along the outer Nova Scotian coast and banks as far as Banquereau, though they may not be as common inshore there as they are in the Gulf of Maine. They must be generally distributed in the southern side of the Gulf of St. Lawrence also, to judge from the localities of record there, and they have been reported from Anse des Dunes and from near Mingan on the north shore.<sup>83</sup> They have also been trawled at a few localities on the southern and eastern part of the Grand Banks.<sup>84</sup> And a 4-inch specimen was brought back from the Grand Bank in 1856.<sup>85</sup> But this seems to be its northern limit in our side of the open Atlantic, for they have not been reported from the east coast of Newfoundland, or reliably from the outer coast of Labrador (see footnote 79, p. 540).

Goosefish are common westward and southward also, as far as North Carolina. We have seen many stranded in winter a few miles north of Cape Hatteras, both in Pamlico Sound and on the outside beach, and Smith<sup>86</sup> described it as so plentiful

<sup>78</sup> The smallest ripe males of the North European species seen by Fulton were 26–27 inches long, the smallest ripe females 30 inches.

<sup>79</sup> Pennant's (Arch. Zool., vol. 1, 1784, p. cxcl) report of "the *Lophius piscatorius* or common angler" in Hudson Bay seems to have been based on a sculpin (for history of the case, see Connolly, Bull. 3, Biol. Bd. Canada, 1920, p. 7). And we think it likely that this applies also to the "*Lophius laevis*" reported by Weiz (Proc. Boston Soc. Nat. Hist., vol. 10, 1866, p. 289) from Okak, northern Labrador.

<sup>80</sup> Goode and Bean, Smithsonian Contrib. Knowl., vol. 30, 1895, p. 486.

<sup>81</sup> Regan, British Antarctic (*Terra Nova*) Exped. (1910), Zool., vol. 1, No. 1, 1914, p. 23.

<sup>82</sup> Catches of 1 to 34 per haul.

<sup>83</sup> See Cox (Contrib. Canadian Biol. [1902–1906], 1907, p. 90), Cornish (Contrib. Canadian Biol. [1906–1910], 1912, p. 81), and Connolly (Bull. 3, Biol. Bd. Canada, 1920, p. 7) for Nova Scotian and Gulf of St. Lawrence localities; the Annual Reports of the Newfoundland Fishery Research Commission, vol. 1, No. 4, 1932, p. 110, for additional records for the Nova Scotian Banks.

<sup>84</sup> Rept. Newfoundland Fish. Res. Comm., vol. 1, No. 4, 1932, p. 110, Sta. 17; vol. 2, No. 1, 1933, p. 127, Sta. 97; vol. 2, No. 2, 1935, p. 116, Sta. 204, 205, 274.

<sup>85</sup> Goode and Bean, Smithsonian Contrib. Knowl., vol. 30, 1895, p. 486.

<sup>86</sup> North Carolina Econ. Geol. Surv., vol. 2, 1907, p. 399.

near Cape Lookout that "as many as 20 large specimens are sometimes found in a sink net at one lift," though it has been seen less often of late years.<sup>87</sup>

Egg veils have been reported within the Gulf of Maine from Campobello Island at the entrance to the Bay of Fundy; from Passamaquoddy Bay (2 instances);<sup>88</sup> in Frenchman Bay, Maine;<sup>89</sup> about 15 miles off Seguin Island, Maine, September 18, 1925 (with eggs nearly ready to hatch, found by Capt. Greenleaf of the U. S. Bureau of Fisheries); and at Provincetown, where we found a veil within a few feet of the shore, on June 26, 1925. The captures of the pelagic larvae within the Gulf have been fewer, namely 3 taken near Brazil Rock off southwestern Nova Scotia, and two very small ones (5 and 6.5 mm. long) collected by us on the *Grampus* in Massachusetts Bay, one on July 12, 1912, the other September 29, 1915.

### THE SARGASSUM FISHES. FAMILY ANTENNARIIDAE

The sargassum fishes resemble their relatives the anglers (p. 532) in their peculiar armlike pectorals and in their large fleshy ventrals, as well as in the fact that the forward part of their dorsal fin is represented by a series of separate spines. But they are very different from the anglers in general appearance, for their bodies and heads are flattened sidewise instead of dorso-ventrally; their soft second dorsal fin is much longer than their anal fin; their second and third dorsal spines are clothed with fleshy skin so thick as to obscure their true nature; and their mouth is much smaller than that of the anglers.

These curious little tropical-oceanic fishes live chiefly among masses of floating seaweed, with which they sometimes drift far to the north of their normal homes.

**Sargassum fish, *Histrio pictus* (Cuvier and Valenciennes) 1837**

#### MOUSEFISH

Jordan and Evermann, 1896-1900, p. 2716, as *Pterophryste histrio* (Linnaeus) 1758.

**Description.**—The peculiar armlike pectoral fins; the rather long fleshy ventral fins situated on the

The question why the egg veils should have been encountered so seldom in our Gulf when they are so conspicuous in the water, and why so few larvae have been taken in our tow nets, when the parent fish are moderately plentiful and very generally distributed, is an intriguing one that we cannot answer from present information.

**Importance.**—No regular commercial use has been made of the goosefish in America up to the present time. But it is an excellent food fish, white-meated, free of bones, and of pleasant flavor, as Dr. Connolly assures us from personal experience. In 1948,<sup>90</sup> English and Scottish vessels landed about 7 million pounds of the European species, as "monk" which fetched nearly as high a price as haddock in English markets, though it brings only about one-half as high a price as haddock in Scotch ports.<sup>91</sup> And some were sold in retail stores during the last year.

throat; the soft flabby skin; and a body flattened sidewise (about  $2\frac{3}{4}$  times as long as it is deep) distinguish this fish from any other that is known from the Gulf of Maine, or that is ever likely to be found there. The goosefish (p. 532), the only one of its close relatives which normally inhabits the Gulf, is of such different appearance with its flattened body form, and enormous mouth, that it is not necessary to enumerate the smaller differences between the two.

The head and body of the sargassum fish appear as one, for each gill opening has the form of a pore on the lower margin of the pectoral near its base, so small that it is likely to be overlooked. There are three detached dorsal spines. The first, standing over the front margin of the eye, has the form of a slender tentacle, its tip bearing a bulbous swelling, known technically as an "illicium," which is fringed at the tip. The second spine (close behind the first) and the third are much larger than the first; they are enclosed in skin so thick that they suggest conical horns in their general appearance, and they bear several tags or streamers of skin. All the other fins are also fleshy. The second (soft-rayed) dorsal fin is more than twice as long as the anal fin; and the detached

<sup>87</sup> Information supplied by the late S. F. Hildebrand.

<sup>88</sup> Connolly, Contrib. Canadian Biol. (1921) 1922, No. 7, p. 116; Berrill Contrib. Canadian Biol. Fish. N. Ser., vol. 4, No. 12, 1920, p. 145.

<sup>89</sup> Procter and others, Biol. Surv. Mt. Desert, Pt. 2 Fishes, 1928, p. 8.

<sup>90</sup> Most recent year for which the international fisheries statistics are readily available.

<sup>91</sup> For catches and values, see Bull. Statist., Cons. Internat. Explor. Mer., vol. 33, 1951, pp. 14, 16-18.



FIGURE 287.—Sargassum fish (*Histrio pictus*). Drawing by Louella E. Cable.

tips of both the dorsal rays and the anal rays form short fringes. The margin of the caudal fin is almost straight. The skin feels smooth to the touch; actually it is finely studded with minute granulations, and it bears variously shaped fleshy tags, as appears in the illustration (fig. 287).

*Color*.—Creamy white, the fins as well as the head and body mottled with pale and dark brown. The fleshy tags are yellowish.

*General range*.—Tropical and subtropical, living at the surface among floating seaweed; sometimes drifting far northward with the Gulf Stream.

*Occurrence in the Gulf of Maine*.—A specimen about 4¼ inches (12 cm.) long, that was picked up

in a purse seine near the surface over the west central part of Georges Bank, by the Schooner *Old Glory* on September 15, 1930,<sup>92</sup> and a second of 2¼ inches, taken off the southeast slope of Georges Bank, by the sword fisherman *Leonora C*, on June 15, 1937, are the only records of this fish in the Gulf of Maine; the most northerly records, in fact, for it for continental waters in this side of the Atlantic. But it has been picked up from time to time near Woods Hole.<sup>93</sup> Living, as they usually do, among floating gulf weed (*Sargassum*), it is not astonishing that sargassum fish should drift in over the offshore banks, occasionally.

#### THE DEEP SEA ANGLERS. FAMILY CERATIIDAE

The members of this family fall with the anglers and sargassum fishes in the pediculate tribe. And the first dorsal spine bears a "bait" at its tip (known technically as an "illicium") as it does among the anglers. But the wristlike structure of the pectoral fins is not obvious in the deep sea anglers. And the members of this family, as well as those of several other families closely related

to them,<sup>94</sup> differ from the anglers and from the sargassum fishes in lacking ventral fins. Their bodies are somewhat flattened sidewise (not dorso-ventrally as in the anglers); their dorsal and anal fins are very short (3 to 5 rays); and their central four caudal rays are branched. Their

<sup>92</sup> For early records of it near Woods Hole, see Sumner, Osburn, and Cole, Bull. U. S. Bur. Fish., Vol. 31, Part 2, 1913, p. 774.

<sup>94</sup> For a synopsis of the ceratioid fishes, a numerous race, see Regan and Trewavas, Rept. 2, Danish *Dana* Exped. (1928-1930), 1932, p. 48.

<sup>93</sup> Reported by Firth, Bull. 61, Boston Soc. Nat. Hist., 1931, p. 14.

mouths are oblique when closed, or even vertical. Associated with their deep-water habitat their bodies are noticeably soft and flabby. Their eyes are very small; some appear to be blind. The ceratioids, too, are unique among the vertebrates in the fact that the males of many of them (including those of the Gulf of Maine species) are dwarfs in size as compared with the females, and live parasitic, attached to the females by their heads.

They are oceanic as a group, living in the mid depths, mostly from about 200 fathoms down to perhaps 750 fathoms. And they are blackish in color as are so many other pelagic fishes of that same depth zone. One species has been taken in the Gulf of Maine as a stray.

**Deep sea angler** *Ceratius h lbo lli* Kr yer 1844

Jordan and Evermann, 1896-1900, p. 2729 (young as *Mancalias uranoscopus* Murray); p. 2730 (young as *Mancalias shufeldti* [Gill]; Barbour and Bigelow, Proc. New England Zool. Club, vol. 23, 1944, p. 16 (adult, as *Reganichthys giganteus*, new genus and species); Clarke, Discovery Rept., vol. 26, 1950, p. 1 (adult).

*Description.*—This deep sea angler is so bizarre in its appearance that there is no danger of con-

fusing it with any other Gulf of Maine fish, unless it were with some other member of its own family. In the large female, the body is strongly flattened sidewise; the eyes are very small and set high on the head; and the mouth is nearly vertical when it is closed. Perhaps their most striking external feature is the very long and extremely slender bristlelike spine or "tentacle," that is borne on the top of the head. This is jointed about two-thirds the way out along its length, and it ends in a fleshy, pear-shaped swelling ("illicium"), the tip of which is described as pierced by a small pore.<sup>95</sup> The illicium is supposed to be luminous,<sup>96</sup> and it bears 2 to 4 short filaments.<sup>97</sup> This head-tentacle corresponds to the whiplike head spine of the goosefish, but is situated farther back, about abreast of the eyes. It is interpreted as representing a vestige of the first dorsal fin. The basal

<sup>95</sup> So described by Clarke (Discovery Rept., vol. 26, 1950, p. 9) for an Antarctic specimen; the pore is not visible on the specimen we have examined.

<sup>96</sup> Dahlgren (Science, vol. 68, 1928, p. 65) describes the tip of the illicium of an unnamed species of *Ceratius* as with an open gland in which light is produced by bacteria.

<sup>97</sup> Four in the Gulf of Maine specimen described by Barbour and Bigelow (Proc. New England zool. club, vol. 33, 1944, p. 9) as *Reganichthys giganteus*; two (each bifid) in an Antarctic specimen described by Clarke.

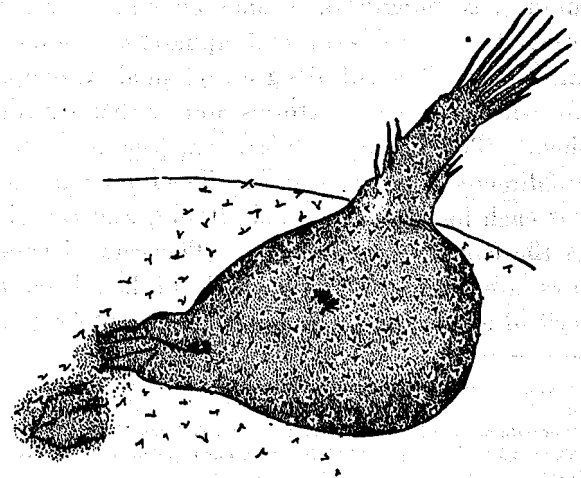
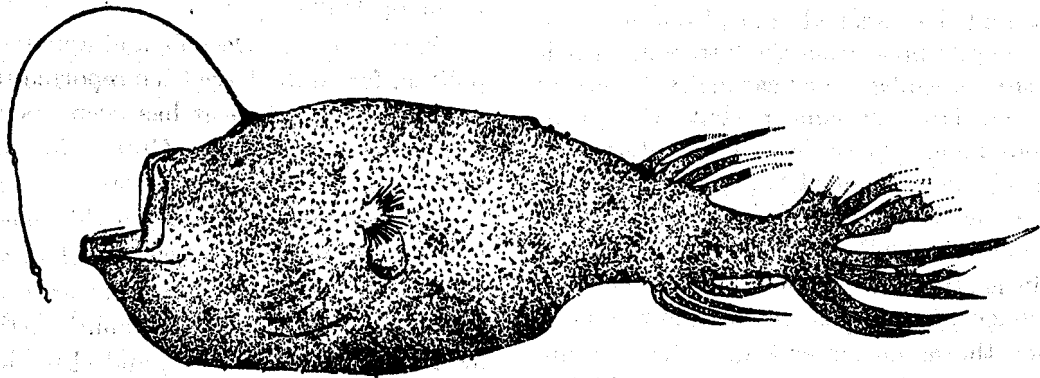


FIGURE 288.—Deep-sea angler (*Ceratius h lbo lli*), adult female (above) and parasitic male (right) that was attached to her, off Mount Desert Rock. From Barbour and Bigelow.



joint of the head tentacle is provided with retractor muscles by which it can be withdrawn rearward into a tunnel-like sheath along the head and back, bringing the "bait" close to the mouth.

Bertelsen<sup>98</sup> has found (from dissecting a West Greenland specimen) that when this happens, the rear part of the hard axis of the head tentacle, which is enclosed in the very elastic skin, emerges from the back of the fish, about midway between the caudal fin and the base of the pectoral fins, so as to form the axis of a slender, tapering "dorsal tentacle." Thus this extraordinary and unique structure, which has been the subject of much discussion, is actually the rear end of the head tentacle which protrudes when the latter is drawn rearward.

When the cephalic tentacle is moved forward by its protractor muscles, its protruding rear end is withdrawn into the tentacular sheath, either partially, when the so-called dorsal "tentacle" appears as a short fingerlike process, or wholly, leaving simply an indentation or pore in the midline of the back, as it is in the Gulf of Maine specimen pictured in figure 288.

Close behind the so-called "dorsal tentacle" (or behind the pore representing the latter) are a pair of low, fleshy appendages or "caruncles," scarcely noticeable on large specimens, but more conspicuous on small. These have been interpreted as vestiges of the first dorsal fin, for each of them encloses a spine that can be felt if not seen. Their function is not known.<sup>99</sup>

The skin is strewn with small prickles on very small specimens, but is close-set with low conical, broad-based thorns on larger fish. The eyes are minute, seemingly functional on small fish, but covered over by skin and apparently blind on large ones. The gill slits are very small, C-shaped; placed below the pectorals and a little behind them. The small, slender, sharp-pointed teeth are directed into the mouth. The dorsal and anal fins each have 4 rays, thick, fleshy, and tapering, as the caudal rays are also. The central caudal rays are forked. The caudal fin has been described as occupying as much as two-fifths of the

total length of the fish when it is intact.<sup>1</sup> But it has been much damaged in most of the specimens that have been seen, and the membranes of all the fins have been mostly torn away.

*Color.*—Small ones are jet black, but the dermal prickles, being colorless, show white against the black skin on large specimens, giving a granulated black and white appearance.

*Size.*—The largest specimen seen so far<sup>2</sup> was 26¼ inches (68 cm.) long to the base of the tail fin, and about 47 inches (119 cm.) long, counting the tail fin.<sup>3</sup>

The parasitic males are fastened to the ventral side of the female, by two outgrowths from the front of the head, that are fused at the tip. They have no teeth, no tentacle-like spine and no eyes, and the alimentary canal is vestigial; in fact, about the only important internal organ is a large testis. But their fins resemble those of their mates, as do the gill openings; their skins are prickly; and they are similarly black. Those that have been seen (1 or 2 per female) have ranged from about 3¾ inches (85 mm.) long to about 6 inches (150 mm.) long (Gulf of Maine specimen).

*General range.*—Oceanic and apparently cosmopolitan, for adults have been reported from Greenland; Iceland (where it has been taken the most often); off Nova Scotia; Gulf of Maine; near the Azores; and in the sub-Antarctic. Young specimens apparently referable to this species are reported off southern New England; from the Caribbean; near the Canaries; north of the Cape Verde Islands; from the South Atlantic (lat. 52°25' S., long. 9°50' E.); and also widespread in Indo-Pacific waters.<sup>4</sup>

*Occurrence in the Gulf of Maine.*—A female, about 32 inches long to the base of the caudal fin, and about 40 inches counting what remained of the latter (fig. 288), with one male attached, and showing the scar of attachment of another, was taken 12 miles south of Mount Desert rock, at 125

<sup>98</sup> Vid. Meddal. Dansk Naturh. Foren., vol. 107, 1943, pp. 190-193; see especially his fig. 4, p. 192.

<sup>99</sup> See Regan and Trewavas (Rept. 2, Danish *Dana* Exped. (1928-1930), 1932, pp. 23-24) for an account of the lateral line papillae in different families of deep sea anglers.

<sup>1</sup> This was the case in the specimen about 47 inches (119 cm.) long described by Krøyer (Naturhist. Tidsskr., Ser. 2, vol. 1, 1844, pp. 640-642); also in one pictured by Goode and Bean (Smithsonian Contrib. Knowl., vol. 31, 1895, pl. 117, fig. 399, after Galmard).

<sup>2</sup> Krøyer's original specimen from Greenland.

<sup>3</sup> See Clarke (*Discovery* Rept., Vol. 26, 1950, p. 14, table 1), for measurements of several specimens.

<sup>4</sup> For complete list of localities for adults and young, see Clarke, *Discovery* Rept., vol. 26, 1950, pp. 23, 30.

fathoms, in October 1943, by the schooner *Dorothy and Ethel II*, Capt. Harold Paulsen.<sup>5</sup> A second female, about 18 $\frac{3}{8}$  inches long to the base of the caudal fin, and about 24 $\frac{3}{8}$  inches counting what was left of the caudal fin, trawled on the southeast part of Georges Bank, between 150 and 200 fathoms, in February 1927, appears to belong to

this same species.<sup>6</sup> A third probable Gulf of Maine record is of a fish, about 3 feet long, and weighing about 20 pounds, that was taken by the trawler *Ebb*, in 140 fathoms, on Georges Bank, in June 1936. Photographs of it appeared in the *Boston Globe* and in the *Boston Post* for June 29 of that year.

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<sup>5</sup> This specimen, now in the Museum of Comparative Zoology, was described by Barbour and Bigelow (*Proc. New England Zool. Club*, vol. 23, 1944, p. 9) as "*Reganichthys giganteus*."

<sup>6</sup> This specimen, now in the Mus. Comp. Zool., and first described by Parr (*Bull. 63, Boston Soc. Nat. Hist.*, 1932, pp. 12-13) as *Mancalia wanoscopus*, was later made the basis of a new genus, *Typhlocerattus*, by Barbour (*Proc. New England Zool. Club*, vol. 21, 1940, p. 78). Its head and back have been so badly damaged that it has lost whatever tentacular structures it may have had originally.