Many specimens of this common species, ranging in length from 30 to 460 millimeters (1¼ to 18 inches), were preserved. The young are proportionately deeper and more strongly compressed than the adult. The caudal fin is round or even pointed, and the very young are largely pale in color, with more or less definite dark bars on the back. This species is most readily distinguished from related species by the greenish color of the back, bearing darker markings, which form mostly oblique wavy lines.

The sexes in the adults of this species may be separated externally by feeling the abdominal wall. In the female the wall is uniformly thin. The male, however, has the walls thickened on each side along the lower ventral edge, due to the croaking or drumming muscles that are situated there. The female has no croaking muscles and can not make a croaking sound. The air bladder, which is used in making the sounds, is present in both sexes. Special muscles, however, as in the male, are required to produce croaking or drumming. The process is described in part by Smith (1907, p. 307) as follows: "The muscle, with the aponeurosis, is in close relation with the large air bladder and by its rapid contraction produces a drumming sound with the aid of the tense air bladder, which acts as a resonator." The value, or the purpose served, to the fish by croaking or drumming is not known. The females within a school usually average a somewhat larger size than the males.

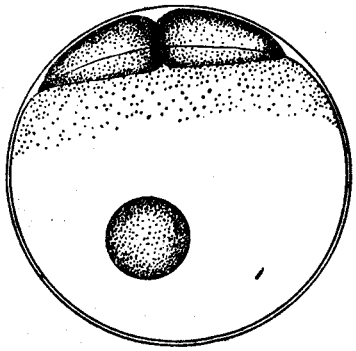

FIG. 177.—*Cynoscion regalis*. Egg in two-cell stage

The food of this fish, as indicated by the contents of 85 stomachs taken from specimens collected in Chesapeake Bay, consists of the following: Small fish (mostly anchovies and silversides) and small crustaceans (largely Mysis). Large individuals had fed almost exclusively on fish and the young mainly on small to minute crustaceans. The food of the squeteague is discussed at considerable length by Welsh and Breder (1923, pp. 159 to 164). These authors show that the food varies somewhat with the locality. Fish and crustaceans, however, are everywhere the principal foods, although mollusks and annelids also are eaten at times. It is noted also by Welsh and Breder that "small invertebrates" constitute the principal food of small-sized fish.

The reader is referred to the work of Welsh and Breder (1923, pp. 150–158) for an extended account of the spawning, embryology, and growth of the squeteague. These authors state that spawning takes place in the larger bays and possibly in the ocean. The season is a protracted one,

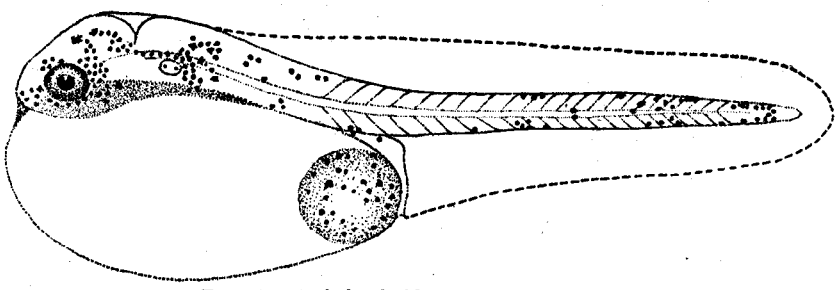

FIG. 178.—Newly hatched larva, 1.75 millimeters long

commencing in May and continuing until September. The great majority of the fish, however, are reported to spawn between the middle of May and the middle of June, the season appearing to be little affected by latitude, spawning occurring at approximately the same time from the Carolinas to Cape Cod.

The account of the development of the eggs and larvæ given by the same authors in their account of this weakfish was taken from the field notes of Lewis Radcliffe, who took the eggs upon which the account is based in the lower part of Chesapeake Bay. The work was done aboard the *Fish Hawk* and constitutes a part of the present investigation. The eggs are described as being pelagic, spherical, about 1 millimeter in diameter, buoyant, and transparent. Hatching occurred

in from 12 to 14 hours after fertilization at temperatures of from 68° to 70° F. It seems probable, from the examination of the condition of the reproductive organs, that virtually all spawning takes place in Chesapeake Bay and vicinity during May, June, and July. The fish examined in May were nearly ripe, and no spent fish were seen. In June most of the fish examined still contained roe, but some spent fish also were seen, and as late as July 9 many of the fish examined had not yet spawned.

No ripe squeteagues were observed in Chesapeake Bay, but as spawning is known to occur in Delaware Bay (Welsh and Breder, 1923, p. 150), it is probable that it also occurs around the entrance of the Chesapeake. Most of the spawning in this region is accomplished during May,

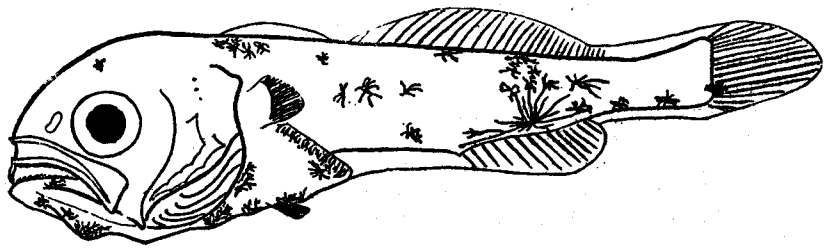

FIG. 179.—Larva, 6.5 millimeters long

June, and July. On May 21 we caught (with hook and line off Cape Charles city) 14 females and 4 males, 14 to 18 inches in length, having nearly mature gonads. On May 24 many of the Norfolk market fish were distended with eggs or milt. On June 11 many fish had large roe, and some had already spawned. On June 27, at Buckroe Beach, 1,000 pounds of squeteagues just landed from near-by pound nets (mostly females, 10 to 13 inches in length) were full of spawn, which protruded through the thin wall of the abdomen. As late as July 9 many fish caught in the lower York River had not yet spawned. A large series of fish, both males and females, examined during October, 1922, at Ocean View, Va., showed that individuals of 200 to 286 millimeters (about 8 to 11¼ inches) would probably spawn for the first time the following spring.

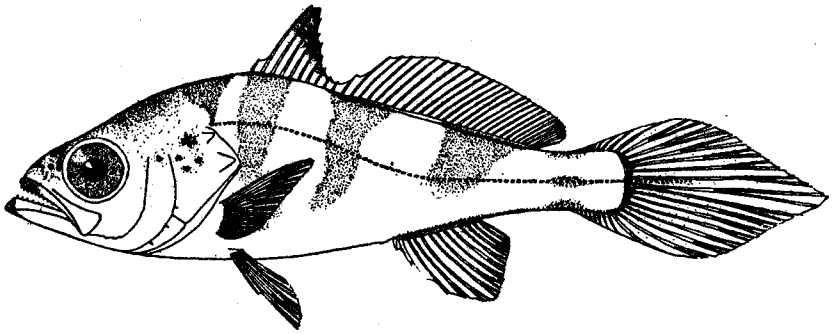

FIG. 180.—Young, 32 millimeters long

The young are reported to grow rapidly. However, observers do not agree with respect to the rapidity of their growth, and before it can be stated what the usual or average rate of growth is, further and more exhaustive studies must be made. Eigenmann (1902, p. 47) states that this fish reaches a "marketable size" in one year. However, it is not clear at which length this author considered the fish to have attained a marketable size. Welsh and Breder (1923) produce very limited data intended to show that a fish 30 millimeters long on July 1 may reach a length of 180 millimeters by November 1. One of us (Hildebrand), working at Beaufort, N. C., found (unpublished), for example, that on about August 1 two definite size groups of young squeteague could be taken. The fish composing the group of youngest fish ranged from 50 to 120 millimeters in length. These fish were thought to be the young of the same season. The fish of the other group, representing

older fish yet sexually immature, averaged about 220 millimeters in length and were thought to be fish 1 or a little over 1 year old.

Only two catches of very young squeteagues were made in Chesapeake Bay. The earliest catch consisted of 10 fish, 30 to 38 millimeters (1¼ to 1½ inches) long, seined at Buckroe Beach, Va., on June 28, 1921; and the other one was taken on July 27, 1916, when several young squeteagues, 36 to 49 millimeters (1⅜ to 2 inches) in length, were trawled off Windmill Point, lower Rappahannock River. No young were caught during August, but many were taken during the fall. Although the difficulty encountered by other investigators in separating squeteagues into age groups was met, some success in this respect was obtained by measuring entire catches taken in various types of fishing gear. Most of these fish were caught during September, October, and November in the lower parts of the bay, particularly at Ocean View, but catches made in other parts of the bay (that is, as far north as Solomons) agreed with these in every respect. As a result of consolidating the total number of young squeteagues taken in various seine and beam-trawl hauls from September 25 to October 31, 1921 and 1922, the distribution of sizes given in Figure 182 was found. It will be seen from this graph that the predominating size of the young during October, 1921 and 1922, in the lower parts of Chesapeake Bay was from 3½ to 5 inches in length. Late in October, 1915, of 107 squeteagues trawled by the *Fish Hawk* in the lower Chesapeake, 103 were 90 to 155 millimeters (3½ to 6⅛ inches) in length, three were 185 to 190 millimeters (about 7½ inches), and one was 225 milli-

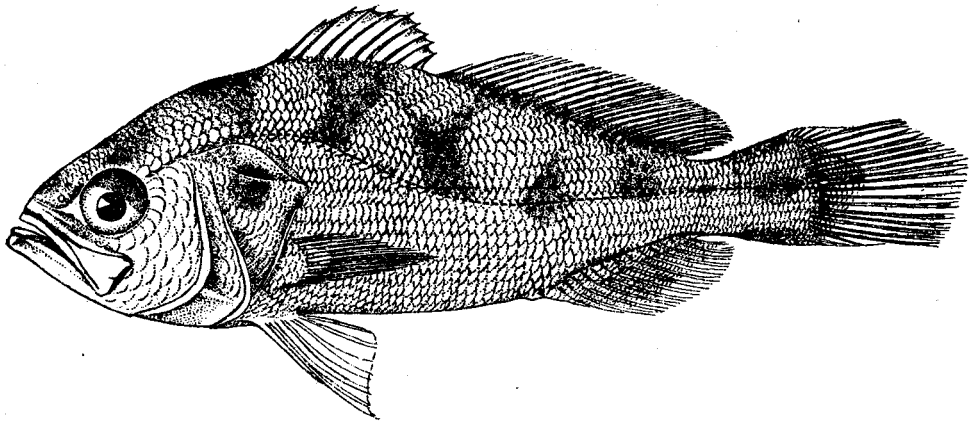

FIG. 181.—Young, probably about 45 millimeters long

meters (about 9 inches). The only squeteague taken (trawled) in December, 1915, was 90 millimeters (3½ inches) in length, and a single fish trawled in December, 1920, was 75 millimeters (3 inches) in length. The predominating sizes of the next group of fish, taken in the fall of 1921 and 1922, were 200 to 263 millimeters (about 8 to 10½ inches). A pronounced scarcity of fish between 160 and 190 millimeters (6¼ to 7½ inches) was found at this time. It is evident, therefore, that in the fall, at the age of about ½ year, the Chesapeake Bay squeteague has attained a length of from 3½ to 5 or even 6 inches, and that the usual size at 1½ years is 8 to 10½ inches. The size of older fish is difficult to determine unless scales are utilized for study.

The squeteague is one of the most valuable food fishes taken in Chesapeake Bay. During 1920 it ranked fourth, both in quantity and value, the catch being 7,918,713 pounds, worth $390,101.

In Maryland it ranked fifth in quantity and fourth in value, the catch being 678,470 pounds, worth $44,143. Of this amount 70 per cent were caught with pound nets, 16 per cent with haul seines, 8 per cent with purse nets, 3 per cent with lines, 2 per cent with gill nets, and 1 per cent with fyke nets. Kent County is credited with the greatest catch, namely, 255,600 pounds, followed by Somerset with 121,123 and Anne Arundel with 78,825 pounds.

In Virginia it ranked fourth in quantity and third in value, the catch being 7,240,243 pounds, worth $345,985. Of this amount, 96 per cent were caught in pound nets, 2 per cent with lines, and 2 per cent with other apparatus. Elizabeth City County is credited with the greatest catch namely, 2,034,840 pounds, followed by Mathews with 1,338,462 and Gloucester with 1,292,970 pounds.

The fishing season extends from about April 15 until November 15. The first appearance of the fish varies from year to year and is one or two weeks later in the upper part of the bay than near the entrance. Records obtained from a set of two pound nets at Lynnhaven Roads, Va., give the first appearance of the squeteague as follows: April 1, 1910; April 5, 1912; April 12, 1916; April 16, 1917; April 2, 1918; April 11, 1919; April 28, 1920; April 5, 1921; and April 1, 1922. The catch during April is usually small, but during May, June, July, and October large numbers are taken with pound nets. In the lower part of the bay some of the best pound-net catches of this species are made during November. It is taken with haul seines from May until October. Hook and line fishing is most productive from June until the end of October. In the vicinity of Norfolk, Va., good catches are sometimes made with pound nets as late as December 1, but in the upper sections of the bay fishing operations usually have ceased by November 1. The squeteague is caught in large numbers in all parts of the bay, from Baltimore southward. North of Baltimore the water freshens rapidly and the catch of squeteagues diminishes perceptibly, until at Turkey Point a scattering few are caught only in the fall, at which time the water usually is slightly brackish.

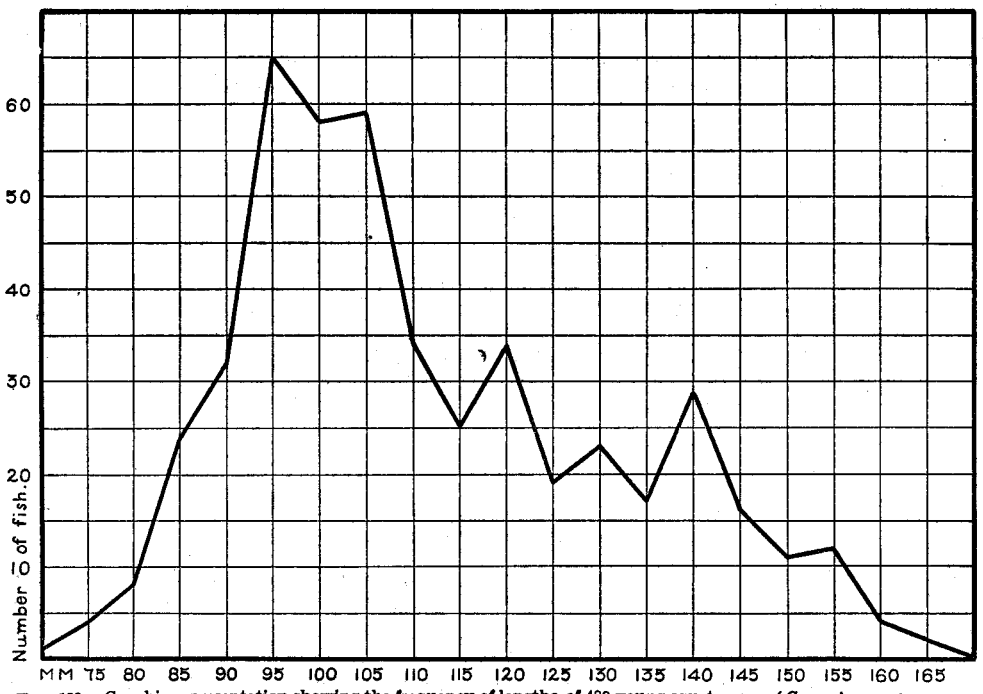

FIG. 182.—Graphic representation showing the frequency of lengths of 480 young squeteagues (*Cynoscion regalis*) taken from September 25 to October 31, 1921 and 1922, in the lower part of Chesapeake Bay

A large part of the Chesapeake catch of squeteague is shipped to outside markets. The best prices are obtained early in the spring and late in the fall, when the species is scarce along the upper Atlantic coast. Sometimes during May and June the price drops to the extent that it is scarcely profitable to ship the fish to market, and at such times the smaller sizes often are discarded by the fishermen. The markets are seldom glutted, for the fish is well known and it is shipped to all cities in the East. The highest price received by the fishermen during 1921 and 1922 was about 20 cents, the lowest 2 cents, and the average for the season about 5 cents per pound.

The squeteague is known throughout the Chesapeake region as "trout" or "gray trout," and is the weakfish of New York. The species bears no relationship to the true trouts and salmons, and the name "trout" tends to lead to confusion; but it is so firmly established in the Chesapeake and southward that a change of name would be very difficult.

In many markets the squeteague is the principal fish sold. Its fine appearance, good flavor, and the long season during which it may be caught contribute to its favor with both the consumer

and the marketman. The majority of the Chesapeake catches consist of fish weighing from ½ to 3 pounds. Larger fish are often taken and are particularly common during the spring and late fall. For example, on May 26, 1921, 500 pounds of unusually large fish were taken from a pound net in Lynnhaven Roads. The 29 largest fish weighed 210 pounds, averaging about 7 pounds each, and the largest one weighed 11 pounds 14 ounces. The largest fish observed by us weighed 16 pounds and was taken in a pound net at Ocean View, Va., on May 27, 1921. Fish weighing 12 to 15 pounds are seen occasionally, and a weight of 6 to 10 pounds is not uncommon. The maximum size recorded is 30 pounds. (See Welsh and Breder, 1923, p. 158.)

Habitat.—Massachusetts to the east coast of Florida; especially abundant from North Carolina northward.

Chesapeake localities.—(*a*) Previous records: "Chesapeake Bay, near the ocean" (Uhler and Lugger, 1876); Cape Charles city and Norfolk, Va. (*b*) Specimens in collection: From many localities, from Annapolis, Md., southward to Cape Charles and Cape Henry.

Comparison of lengths and weights of squeteagues

Number of fish weighed and measured	Length	Weight	Number of fish weighed and measured	Length	Weight
	Inches	*Ounces*		*Inches*	*Lbs. Ozs.*
3	3	0.2	7	13	11.0
7	3½	.3	6	13½	11.9
6	4	.4	10	14	13.5
9	4½	.6	5	14½	15.7
16	5½	.8	2	15	1 .7
11	6	1.1	4	15½	1 2.3
12	6½	1.4	2	16	1 3.0
17	7½	2.3	3	16½	1 7.2
37	8	2.8	4	17	1 8.3
6	8½	3.2	4	17½	1 9.4
10	9	4.0	2	18	1 11.4
12	9½	4.6	4	18½	1 13.0
33	10	5.2	1	20	2
6	10½	5.9	2	28	9
10	11	6.7	1	30	9 10.0
16	11½	8.1	1	31	10
10	12	9.0	1	33	11 14.0
6	12½	10.0			

Family LXXI.—BRANCHIOSTEGIDÆ. The tilefishes

Body elongate, more or less compressed; anterior profile strongly convex; preopercle denticulate; vomer and palatines toothless; scales rather small; nape with a large fleshy appendage; labial folds with somewhat similar appendages at sides; soft dorsal and anal fins rather short, composed of about 13 to 15 rays; ventral fins thoracic, composed of I, 5 rays.

129. Genus LOPHOLATILUS Goode and Bean. Tilefishes

Body stout, somewhat compressed; mouth moderate; maxillary reaching eye; each jaw with an outer series of canines and an inner band of villiform teeth; vomer and palatines toothless; nape with a high, fleshy appendage, resembling an adipose fin; lower jaw at sides with fleshy prolongations, extending backward beyond angle of mouth.

166. Lopholatilus chamæleonticeps Goode and Bean. Tilefish.

Lopholatilus chamæleonticeps Goode and Bean, Proc., U. S. Nat. Mus., II, 1879, p. 205; Nantucket Shoals. Jordan and Evermann, 1896-1900, p 2278.

Head, 3; depth 3.5; D. VII, 14 or 15; A. 14 or 15; scales about 93. Body robust, somewhat compressed; head rather large, its upper profile strongly convex; snout rather blunt; eye small, placed high, 6.5 in head; mouth moderate; maxillary reaching eye; upper jaw with an outer series of strong canines and an inner band of villiform teeth; lower jaw with a series of large canines; dorsal fin continuous, the spines scarcely shorter than the soft rays; caudal fin rather deeply concave; anal fin about half as long as the dorsal; ventral fins inserted below the pectorals; pectoral fins pointed, notably shorter than head; nape with a finlike fleshy flap in front of dorsal; a similar but smaller fleshy flap on side of lower jaw, near angle of mouth.

Color brilliant; the back and upper part of sides bluish or olive-green; this color changing to yellow or rose on lower part of sides; belly rosy with a median white line; head tinged with red on sides, white underneath; back and sides, above the level of pectorals, thickly dotted with small, irregular, yellowish spots, these spots most conspicuous at the nape; dorsal dusky, with yellow spots, the soft part with a pale margin; anal pale pinkish, clouded with purple and bluish iridescence; pectorals pale sooty brown, with purplish near bases; fleshy flap at nape greenish yellow.

This fish does not occur in the Chesapeake collection. The foregoing description is compiled from published accounts of the species. The brilliant colors and the fleshy flap at nape readily identify this fish.

The food (Bigelow and Welsh, 1925, p. 356) consists mainly of bottom-dwelling invertebrates including crabs, squid, shrimp, shelled mollusks, annelids, sea urchins, sea cucumbers, and anemones. Occasionally fish are included in the diet. The tilefish evidently is distinctly a ground fish, seldom, if ever, rising to the surface.

Spawning of the tilefish takes place in July. The eggs are reported to be buoyant and about 1.35 millimeters in diameter. Nothing is known about the larval stages nor the rate of growth.

The tilefish is reported to reach a weight of 50 pounds, but the usual size probably does not exceed 35 pounds. This fish is of no commercial importance as far south as off the mouth of Chesapeake Bay. Off New York and the southern New England coast it is of considerable importance.

Habitat.—Along the outer edge of the continental shelf, off the coast of New England, to opposite the mouth of Chesapeake Bay, usually in water varying from 50 to 200 fathoms in depth.

Chesapeake localities.—(*a*) Previous records: None. (*b*) Specimens in collection: None. The species is included because a specimen was observed in the market in Cape Charles city, Va., by Dr. Paul Bartsch, curator, division of mollusks, United States National Museum, in July, 1913. The exact locality where this fish was taken is not known to the writers. It is probable, however, that the fish was taken off the mouth of the bay and that the species does not properly belong to the fauna of the Chesapeake. Doctor Bartsch reports that the fish was the attraction of the entire fishing community.

Family LXXII.—EPHIPPIDÆ. The spadefishes

Body much compressed, very deep; back high, strongly arched; ventral outline less so; mouth small, terminal; jaws with bands of slender, sharp, movable teeth; premaxillary slightly protractile; nostrils double; gill rakers short; gill membranes broadly united to the isthmus; scales ctenoid, of small or moderate size; lateral line strongly arched; dorsal fins 2, the first with 8 to 11 spines, the second longer, with anterior rays produced; caudal fin broad, either square or concave; anal with 3 or 4 spines, the soft rays similar to those of dorsal; ventrals thoracic; pectoral fins short. A single genus and species of this family is found on the Atlantic coast of the Americas.

130. Genus CHÆTODIPTERUS Lacépède. The spadefishes

Body much compressed, nearly as deep as long; the back greatly elevated; snout short and blunt; vomer and palatines toothless; preopercle finely serrate; branchiostegals 6; lateral line concurrent with the back; scales small, about 60 to 70 in a lateral series; dorsal fins slightly disconnected, the first consisting of about eight spines, the third spine longest; anal fin with three spines, the second longest. A single species of this genus occurs on the Atlantic coast of the Americas.

167. Chætodipterus faber (Broussonet). Porgy; Spadefish; Moonfish; Angelfish.

Chætodon faber Broussonet, Ichth. Sistens, Pisc., 1782, p. 17, Pl. VI; Jamaica.

Parephippus faber Uhler and Lugger, 1876, ed. I, p. 107; ed. II, p. 89.

Chætodipterus faber Bean, 1891, p. 86; Jordan and Evermann, 1896-1900, p. 1668, pl. CCXLVII, fig. 619; Smith and Bean, 1899, p. 187; Evermann and Hildebrand, 1910, p. 162.

Head 2.9 to 3.2; depth 1.15 to 1.2; D. VIII–I, 23; A. III, 18 to 20; scales about 65 to 75. Body very deep, strongly compressed; the back greatly elevated; head short; snout very blunt, 2.3 to 2.58 in head; eye 2.7 to 3.25; interorbital 2.65 to 3; mouth small, nearly terminal; maxillary reaching eye in young, not as far back in adult, 3 to 3.35 in head; teeth in brushlike bands in each jaw, the outer series somewhat enlarged; gill rakers very short, 10 to 13 on lower limb of first arch; lateral

line arched like the back; scales small, ctenoid; dorsal fins contiguous, the third spine somewhat produced, equal to or longer than head in adult, proportionately shorter in young; the soft part of fin anteriorly somewhat elevated; caudal fin with concave margin in adult, round in young; anal fin with three short spines, the soft part similar to that of dorsal; ventral fin inserted under base of pectorals, one or more of the outer rays sometimes produced, reaching to or beyond origin of anal; pectoral fins very short, 1.45 to 1.6 in head.

Color variable, from grayish to greenish and yellowish; sides with four to six black, vertical bands, the first on head and passing through the eye, the last on caudal peduncle; these bars sometimes becoming obscure in large examples; fins mostly grayish green to dusky, the membranes attached to the produced spine of dorsal and the ventrals often black; caudal fin with a blackish bar at base, the remainder of the fin being plain translucent in small specimens.

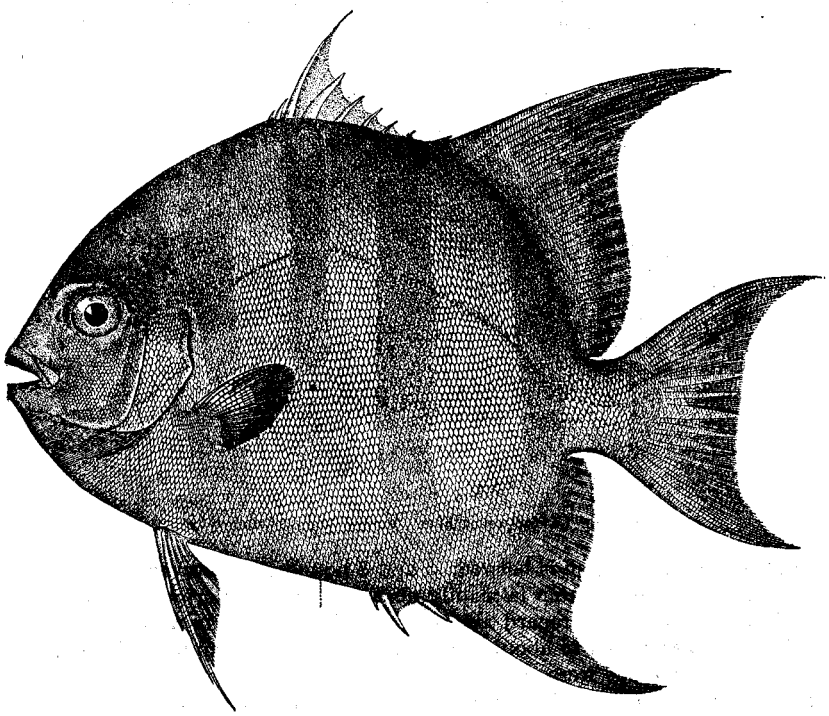

FIG. 183.—*Chætodipterus faber*. From a specimen 7½ inches long

Thirteen small specimens, ranging in length from 55 to 120 millimeters (2⅙ to 4¾ inches) were preserved, and adult fish frequently were observed in the Norfolk markets. This fish is readily recognized by the very deep and strongly compressed body, which is nearly as deep as long. The sides bear from four to six broad, black bands.

The food contained in four stomachs of small specimens (68 to 82 millimeters) consisted chiefly of vegetable débris with a few minute crustaceans intermixed. Smith (1907, p. 335) says: "It frequents rocky patches, wrecks, and piling in search of food, which consists of small crustaceans, worms, etc."

Spawning takes place during the summer. Fish with well-developed roe were taken at Crisfield, Md., on May 26, 1916. Smith (1907, p. 335) says: "At Beaufort (N. C.) ripe male and female fish have been found early in June. The eggs are quite small, being less than 1 millimeter in diameter."

The same author believes that fish about 3 inches long, which may be seined in August, are the young of the year. Young fish, probably the product of the same year's hatch, were seined in the Chesapeake at Ocean View, Va., during 1922, as follows: September 18, 1 fish, length 55 millimeters

(2⅛ inches); October 2, 8 fish, 69 to 83 millimeters (2⅝ to 3¼ inches); October 7, 1 fish, 78 millimeters (3 inches); October 11, 1 fish, 100 millimeters (4 inches); and October 13, 1 fish, 80 millimeters (3¼ inches). From October 23 to 25, 1915, the *Fish Hawk* trawled 12 spadefish, 65 to 85 millimeters (2½ to 3⅜ inches) long, in 7½ to 22 fathoms of water off the mouths of the Potomac and Rappahannock Rivers. Nothing definite is known beyond this concerning the rate of growth or when maturity is reached.

The spadefish is of minor commercial importance in the lower part of Chesapeake Bay. During 1922 the catch was about 1,000 pounds, worth $80, all taken in pound nets.

The season extends from May to October, during which time fish occasionally are caught by the pound nets in the lower York River, Cape Charles, Buckroe Beach, Ocean View, and Lynnhaven Roads, Va.

The name "porgie" is given this fish in the lower Chesapeake, where it is well known to most of the fishermen because of its occasional yet persistent appearance and its comparatively large

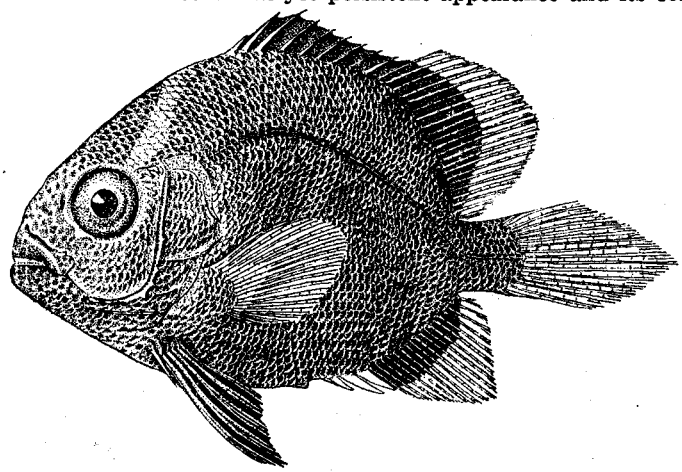

FIG. 184.—*Chætodipterus faber*. Young, 17.5 millimeters long

size. The usual size of market fish is between 3 and 5 pounds. However, fish of 10 or 12 pounds are not uncommon. The small catch is readily absorbed by the Norfolk markets. The porgy is a good food fish and held in high regard almost everywhere along its range. In North Carolina, during 1918, the catch amounted to about 9,000 pounds. In the vicinity of Key West, during the same year, about 1,000 pounds were caught.

This fish is reported to reach a length of 3 feet, but the average is probably less than 1 foot.

Habitat.—Cape Cod to Rio Janeiro, Brazil; rare north of Chesapeake Bay.

Chesapeake localities.—(*a*) Previous records: Gunston wharf, Cape Charles city, Hampton Roads, Norfolk, and Ocean View, Va. (*b*) Specimens in collection: Off Point No Point, off mouth of Potomac River, and Crisfield, Md.; mouth of Rappahannock River; Mobjack Bay, Lower York River, Buckroe Beach, Ocean View, Lynnhaven Roads, and Lynnhaven Inlet, Va.

Family LXXIII.—CHÆTODONTIDÆ. The butterfly fishes

Body short and deep, usually strongly compressed; head short; mouth small, with numerous bristlelike teeth on the jaws, none on vomer or palatines; gill membranes attached to the isthmus; pseudobranchiæ large; scales small to moderate, ctenoid; dorsal fin single, continuous, the soft part frequently elevated anteriorly, densely scaled; anal fin with three or four spines, the soft part similar to that of the dorsal; ventral fins thoracic, consisting of I, 5 rays. Color usually brilliant.

131. Genus CHÆTODON Linnæus. The butterfly fishes

Body short, deep, much compressed; head short; snout pointed; mouth small, terminal; teeth in the jaws in bands, numerous, slender, and flexible; scales firm, ctenoid; dorsal fin long, continuous, with about 12 or 13 spines; caudal fin straight or round; anal fin with three spines, the soft part similar to that of the dorsal; ventral fins thoracic, with a strong spine. A single species of this genus of tropical fishes comes within the scope of the present work.

168. Chætodon ocellatus Bloch. Butterfly fish.

Chætodon ocellatus Bloch, Ichthyol., 1787, p. 11, Pl. 210, fig. 2; Jordan and Evermann, 1896–1900, p. 1674, Pl. CCXLIX, fig. 621.

Head 2.55; depth 1.55; D. XII, 21; A. III, 17; scales 36. Body very deep, strongly compressed; anterior profile nearly straight (notably concave in adult); head short and deep; snout pointed, 2.95 in head; eye 2.3; interorbital 2.9; mouth very small, terminal; teeth in the jaws flexible, in bands; gill membranes attached to the isthmus; lateral line running high and ending under posterior part of dorsal fin; scales ctenoid, rather large on sides, reduced on head and caudal peduncle, the rows running obliquely upward and backward on upper portion of side; dorsal and anal both scaled; the dorsal long, its origin over upper angle of gill opening, the spines strong; caudal fin nearly straight; anal fin with three strong spines, the soft part similar to that of the dorsal; ventral fins inserted under base of pectorals; pectoral fins rather broad, 1.3 in head.

Color grayish to yellowish; a jet black bar, about two-thirds the width of eye, extending from the origin of the dorsal, through eye, to the lower margin of preopercle; a second indefinite bar running from middle of anal to middle of soft part of dorsal (this band is present only in the young); fins all more or less orange, middle of soft part of dorsal with a large black blotch.

A single specimen, 35 millimeters in length, was secured. Its short, deep form, pointed snout, and the black band extending from the nape, through the eye, to the lower margin of the head serve well to distinguish the butterfly fish from all other fish of Chesapeake Bay.

Nothing is known of the spawning and feeding habits of this showy little fish, which probably rarely exceeds a length of 6 inches. It has no commercial value.

Habitat.—Woods Hole, Mass., to the Isthmus of Panama; probably more common in the West Indies than elsewhere within its range.

Chesapeake localities.—(*a*) Previous records: None. (*b*) Specimen in collection: From end of Cape Charles, Va., caught September 20, 1921. Apparently very rare within the bay, as only this single specimen was seen.

Order CATAPHRACTI

Family LXXIV.—HEMITRIPTERIDÆ. The sea ravens

Body elongate, robust anteriorly; head large, bony; eyes large, placed high, in anterior half of head; interorbital space concave; mouth large; teeth in jaws in bands; preopercle with spinous processes; suborbital connected with preopercle by a bony stay; gill membranes united, free from the isthmus; gill arches 4, the slit behind the last obsolete; gill rakers rudimentary; body largely covered with prickles and dermal appendages; lateral line present; vent situated in anterior half of body; dorsal fins 2, separate, the first one with about 16 weak spines; anal fin with about 13 soft rays and no spines; caudal fin round; ventral fins thoracic, with one spine and three unbranched soft rays; pectoral fins moderate, with broad bases. Vertebræ 16+23; myodome much contracted behind.

132. Genus HEMITRIPTERUS Cuvier. Sea ravens

Body moderately elongate; head large, with numerous bony humps, ridges, and fleshy flaps; orbital rim much elevated; interorbital space deeply concave, followed by two blunt spines on each side; mouth large; teeth in broad bands on the jaws, vomer, and palatines; no slit behind the last gill; gill membranes broadly united, free from the isthmus; preopercle with stout, blunt spines; suborbital stay forming a sharp ridge; scales wanting; the skin covered with prickles and bony protuberances; spinous dorsal much longer than the soft part, with 16 to 18 spines; ventral fins with I, 3 rays; pectoral fins very broad.

169. Hemitripterus americanus (Gmelin). Sea raven; Red sculpin.

Scorpæna americana Gmelin, Syst. Nat., 1788, p. 1220; no definite type locality given.
Hemitripterus acadianus Uhler and Lugger, 1876, ed. I, p. 105; ed. II, p. 88.
Hemitripterus americanus Jordan and Evermann, 1896–1900, p. 2023; Evermann and Hildebrand, 1910, p. 163.

Head 2.65; depth 3.75; D. XVI–I, 12; A. 13; scales 40. Body rather stout; head very large and bony; mouth large; maxillary reaching beyond posterior margin of eye, about 2 in head; both jaws with several rows of sharply pointed teeth; body largely covered with prickles, these enlarged along the back and lateral line; nasal spines strong; supraocular ridge much elevated, with dermal flaps and two blunt spines; three pairs of fleshy flaps on nasal bones and two on supraocular ridges; smaller cirri on maxillary, on preorbital, and several on lower jaw; interorbital space deeply concave; two blunt, occipital spines on each side, and two or three others on the outside of these; opercle small, with a bony ridge; preopercle with two blunt spines and one or two more below these; the first two or three dorsal spines longest, the fourth and fifth spines shorter than those farther back; caudal fin rounded; anal fin somewhat similar to the second dorsal and about opposite it; ventral fins fleshy, with three rays; pectorals broad, nearly reaching origin of anal.

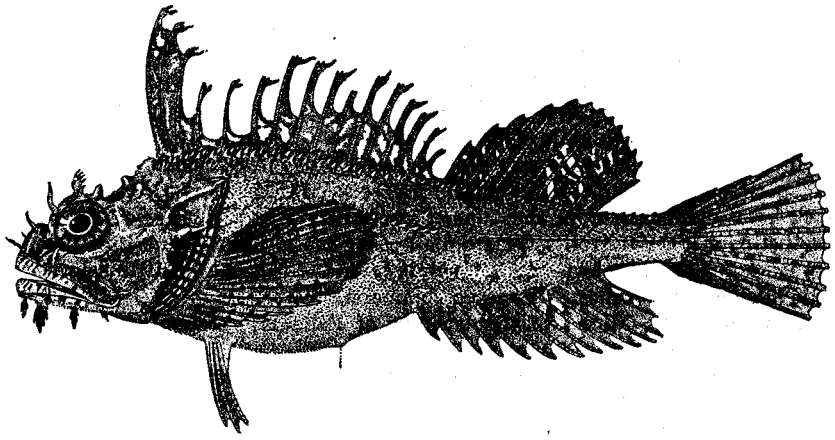

FIG. 185.—*Hemitripterus americanus*. From a specimen 4½ inches long

Color variable, reddish, reddish-purple, or yellowish-brown; always paler below; belly usually yellow; some individuals are variously marbled, others are of uniform coloration; fins variously barred with light and dark; anal and pectorals often with yellow rays.

This species was not taken during the present investigation. It is included here because of published records of its occurrence in Chesapeake Bay. The sea raven is the only sculpin known from Chesapeake Bay, and it is readily recognized by its rough, prickly skin and its bony head, with high ridges, numerous spines, and fleshy flaps.

The food of the sea raven is reported (Bigelow and Welsh, 1925, p. 332) to consist of invertebrates living on the bottom, such as mollusks, various crustaceans, sea urchins, and worms. It is said also to feed on fish. Bean (1903, p. 647) reports as follows relative to the eggs and spawning: "The sea raven spawns in November. Eggs observed on November 29, 1897, were in masses adhering tightly together. The egg at that date was five thirty-seconds of an inch (approximately 4 millimeters) in diameter and showed the form of the fish distinctly. Its color, when first deposited, is yellow, but soon changes to salmon and then to amber before hatching."

Maximum length, 25 inches; a fish 22½ inches long weighed 7 pounds 2 ounces. Fish 18 to 20 inches long and weighing 2 or 3 pounds are reported to be not uncommon in the Gulf of Maine. The species is nowhere of much commercial value, and of none whatsoever in the Chesapeake.

Habitat.—Labrador and Newfoundland, south to Chesapeake Bay; not abundant south of New Jersey.

Chesapeake localities.—(*a*) Previous records: Near the entrance of Chesapeake Bay (Uhler and Lugger, 1876), Cape Charles city, and Old Point Comfort, Va. (*b*) Specimens in collection: None. The species evidently is very rare in Chesapeake Bay.

Family LXXV.—CYCLOPTERIDÆ. The lump suckers

Body short and thick; back more or less elevated; head short and thick; suborbital stay present, thin and flattish; mouth small, terminal; teeth in the jaws simple, in bands; none on palatines or vomer; gill openings narrow, restricted to the sides; gill membranes broadly joined to the isthmus and to the shoulder girdle; gills 3½; pseudobranchiæ present; branchiostegals 6; skin smooth, tubercular, or spinous; dorsal fins 2, the anterior one sometimes hidden by the skin; soft dorsal and anal similar, without spines; caudal fin narrow, round, with few rays; ventrals thoracic, forming the bony center of a sucking disk; pectoral fins rather short, with very broad bases.

133. Genus CYCLOPTERUS Linnæus. Lumpfishes

Body more or less compressed toward the back, somewhat triangular in cross section; head short, thick, more or less quadrate in cross section; snout blunt, round; mouth terminal, turned slightly upward; skin covered with rough, bony tubercles; dorsal fins 2, the first visible only in the very young, completely hidden in the skin in the adult; ventral disk moderately large.

170. Cyclopterus lumpus Linnæus. Lumpfish; Lump sucker.

Cyclopterus lumpus Linnæus, Syst. Nat., ed. X, 1758, p. 260; Baltic and North Seas. Jordan and Evermann, 1896-1900, p. 2096, Pl. CCCXIII, fig, 757; Bean, 1907, p. 178; Kendall, 1914, p. [1].

Head 5 (in entire length); depth 2; D. VI to VIII–9 to 11 (the first dorsal visible only in very young); A. 9 to 11. Body massive, with the dorsal profile much more strongly arched than the ventral and concave over the head; body more or less triangular in cross section and with seven longitudinal ridges, one of these on the median line of the back as a cartilaginous flap inclosing the first dorsal in the adult and dividing into two ridges between the dorsal fins; another ridge on each side over the eye; another ridge paralleling it and extending from somewhat below posterior point of opercle to lower edge of caudal peduncle; and another marking the boundary from side to belly; each ridge with large pointed tubercles; the skin between the ridges thickly studded with small knobs; snout short; eye small, as long as snout, 4 in head; mouth broad, terminal; teeth small, in bands; gill opening moderately wide; second dorsal and anal similar and placed opposite each other; caudal fin square to slightly rounded posteriorly; ventral fins modified into six pairs of fleshy knobs in the center of the sucking disk, surrounded by a roughly circular flap of skin, the entire disk about as wide as head and situated close behind the throat; pectoral fins large, very broad at base, nearly meeting at throat.

Color variable, yellowish to greenish in young; adult males reddish; females bluish to brownish; spots, blotches, cloudings, and other marks not infrequent. The young often take on the color of their surroundings very closely.

This species was not taken during the present investigation. The foregoing description is compiled from published accounts. The peculiar shape, the body ridges with their bony tubercles, and the rough skin readily separate the lumpfish from all other fishes of Chesapeake Bay.

The food of the lumpfish appears to be quite varied, consisting of crustaceans, mollusks, worms, jellyfish, and various other invertebrates. Fish also are eaten.

The spawning period of this fish evidently is a protracted one, occuring in general during late winter and spring. The only two specimens recorded from Chesapeake Bay were ripe females; one was taken on April 14, 1907, and the other on April 29, 1914. An inshore migration is said to take place during the spawning season, and the eggs are deposited in comparatively shallow water. A large number of eggs are produced by a single female; they are about 2.2 to 2.6 millimeters in diameter and they stick together in masses and sink.

The pelagic habits of the young, described by Bigelow and Welsh (1925, pp. 336–337) were observed by one of us (Schroeder) in the Gulf of Maine during the summer of 1925, when many fry about 1 inch long were found among floating masses of rockweed.

The maximum length attained by the lumpfish appears to be 20 inches, but few exceed 14 to 16 inches. (Bigelow and Welsh, 1925, p. 336.) This fish is not eaten in the United States and is of no commercial value.

Habitat.—Both sides of the North Atlantic; on the American side from Western Greenland south to Chesapeake Bay; rare south of New Jersey.

Chesapeake localities.—(*a*) Previous records: Buckroe Beach and Wolf Trap Light, near Old Point Comfort, Va. (*b*) Specimens in collection: None. The species evidently is very rare in Chesapeake Bay.

Family LXXVI.—TRIGLIDÆ. The sea robins or gurnards

Body elongate, fusiform, deepest at nape; head large, completely inclosed in bony plates bearing spines, granules, and striations; mouth large, terminal; teeth small, in bands on jaws, vomer, and palatines; maxillary slipping under preorbital; premaxillaries protractile; no supplemental maxillary; gill arches 4; gill membranes not attached to isthmus; lateral line present; scales or bony plates on body; air bladder and pyloric cæca usually present; dorsal fins 2, the spines short; caudal fin rather long; anal fin without spines, similar to second dorsal; ventral fins thoracic, wide apart, I, 5 rays; pectorals long, winglike, the three lowermost rays detached, free from each other, developed as feelers.

134. Genus PRIONOTUS Lacépède. Sea robins

The characters of the genus are included in the family description. The species are mostly rather small, and as they are not eaten in this country they have no commercial value here.

KEY TO THE SPECIES

a. Mouth large, the maxillary reaching nearly opposite anterior margin of eye; no cross groove on top of head; gill rakers rather numerous, 15 to 20 on lower limb of first arch; lateral line in a black streak ..... *evolans*, p. 312

aa. Mouth smaller, the maxillary not nearly reaching eye; a shallow cross groove present on top of head; gill rakers less numerous, 10 to 13 developed on lower limb of first arch; lateral line not in a black streak.

b. Body moderately robust, the depth 4.15 to 5.15 in the length; mouth rather large, the maxillary 1.2 to 1.3 in snout; cross groove on top of head arched backward ... *carolinus*, p. 314

bb. Body less robust, the depth 5.55 to 5.65 in the length; mouth somewhat smaller, the maxillary 1.4 to 1.55 in snout; cross groove on head straight, not noticeably arched backward ..... *affinis* sp. nov., p. 315

171. Prionotus evolans (Linnæus). Sea robin; Flying fish.

Trigla evolans Linnæus, Syst. Nat., ed. XII, 1766, p. 498; Carolina.

Prionotus strigatus Cuvier and Valenciennes, Hist. Nat. Poiss., IV, 1829, p. 86; Bean, 1891, p. 86; Jordan and Evermann, 1896–1900, p. 2167.

Prionotus lineatus Uhler and Lugger, 1876, ed. I, p. 102; ed. II, p. 85.

Prionotus evolans Jordan and Evermann, 1896–1900, p. 2168, Pl. CCCXX, fig. 772.

Head 2.2 to 2.6; depth 3.65 to 5.1; D. X–11 or 12; A. I–9 or 10; scales 73 to 86. Body moderately robust, about as broad as deep at nape, compressed posteriorly; head large, depressed, broader than deep; snout broad, its length 2.05 to 2.4 in head; eye 4.15 to 5.8; interorbital concave, 5.1 to 6.45; mouth large, horizontal; lower jaw included; maxillary reaching nearly opposite anterior margin of eye, 2 to 2.35 in head; teeth in the jaws in broad villiform bands; gill rakers longer and more numerous in young than in adult, the stumps, however, usually remaining, 15 to 20 somewhat developed on lower limb of first arch; scales rather small, ctenoid; spines on head and about snout not very large; no spine at center of radiations on check; no cross groove on top of head; dorsal fins separate, the first consisting of rather short, stiff spines, the third spine the longest, 2.4 to 2.9 in head; the longest rays of the second dorsal scarcely as long as the longest spines; caudal fin with slightly concave margin, sometimes truncate; anal fin similar to second dorsal; ventral fins well developed, inserted under and somewhat behind the base of pectorals; pectoral fins large, the free rays tapering, greatest length of fin 1.79 to 2.15 in body.

Color grayish above; pale underneath; the largest specimen spotted with pale markings; back usually with three or four longitudinal stripes, not visible in large examples; lateral line in a black streak; dorsal and caudal fins brownish, the first dorsal with a black blotch between the fourth and sixth rays, more or less ocellated in young; anal and ventrals pale; pectorals largely bluish black, usually with the uppermost ray white, the fin being crossed in the largest individuals at hand by wavy black lines. Color in life (based on 12 specimens, 9 to 15 inches in length, observed in the aquarium at Woods Hole, Mass.) pale green or light brown above, white below; four or five prominent to obscure, regularly-placed, dark, saddlelike blotches on back (these generally more prominent than in *carolinus*), the first blotch under first dorsal, the second between dorsal fins, the third and fourth under second dorsal, the fifth on caudal peduncle; a prominent dark brown stripe, usually broken posteriorly, along lower part of side; brown markings on head, forming bars and concentric lines (no orange markings on head, no dusky markings on branchiostegals and throat, and no brownish streaks on dorsal, as in *carolinus*); first dorsal yellowish brown, with large black blotch usually extending from the fourth to the sixth spines, occasionally only from the fourth to the fifth spines; caudal and anal pale brown or yellowish brown, with pale edges; ventrals yellowish or pale; pectorals orange to brown, with pale edges, center of fin washed with dusky (this area not divided into two bars, as in *carolinus*), prominent dark brown or black wavy cross lines present; filaments of pectorals white, with pale brown or orange, marked with narrow brown bars (the bars absent in *carolinus*).

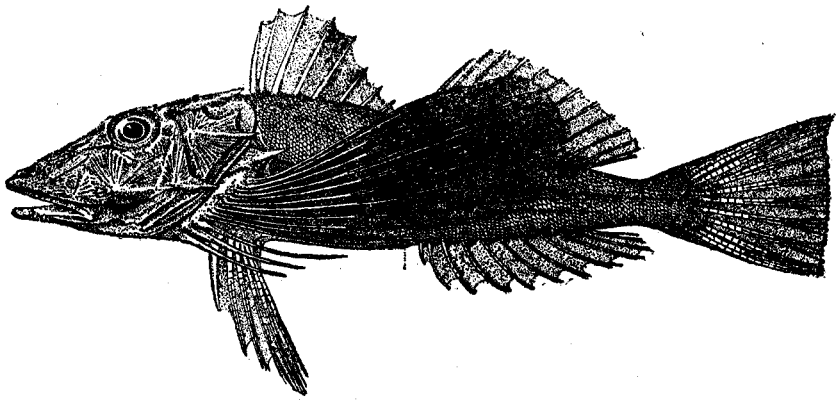

FIG. 186.—*Prionotus evolans*

This species, as here understood, is represented by 18 specimens, ranging from 60 to 340 millimeters (2⅜ to 13½ inches) in length. This species is distinguished from its relatives largely by the rather weak spines and weak striations on the head, by the rather numerous gill rakers, and by the color. The largest specimens in the collection appear to belong to the nominal species, *P. strigatus*. *P. strigatus*, as described, apparently differs from *P. evolans* chiefly in color. The specimens at hand indicate that the color pattern, namely the black-striped pectoral fins, develop with age. The largest specimen, 340 millimeters, has the pectoral fins very distinctly cross-striped; another, 300 millimeters, is somewhat less distinctly striped, and one of 245 millimeters has them obscurely cross-striped. The specimens at hand quite certainly are all of one species and here are referred to *P. evolans*.

Five stomachs of this sea robin were examined for food and found to contain only small crustaceans, principally Mysis. The spawning habits and the rate of growth are as yet unknown.

This species grows somewhat larger and is less common than *P. carolinus* in Chesapeake Bay. A maximum length of 18 inches has been recorded. It is not eaten and has no commercial value.

Habitat.—Massachusetts Bay to South Carolina.

Chesapeake localities.—(*a*) Previous records: "Lower part of Chesapeake Bay" (Uhler and Lugger, 1876) and Cape Charles city, Va. (*b*) Specimens in collection: Mobjack Bay, Cape Charles, off Fortress Monroe, Buckroe Beach, Lynnhaven Roads, and Ocean View, Va.

172. Prionotus carolinus (Linnæus). Sea robin; Gurnard; Flying fish.

Trigla carolina Linnæus, Mantissa Plantarum, Part II, 1771, p. 528; Carolina.

Prionotus carolinus Uhler and Lugger, 1876, ed. I, p. 103; ed. II, p. 86; Jordan and Evermann, 1896–1900, p. 2156, Pl. CCCXVIII, fig. 768; Smith and Bean, 1899, p. 187; Evermann and Hildebrand, 1910, p. 163.

Head 2.8 to 3.1; depth 4.15 to 5.15; D. X–13; A. I, 11; scales 100 to 107. Body rather robust, a little broader than deep under spinous dorsal, round or slightly compressed posteriorly; head moderately large, depressed; snout broad, its length 2 to 2.3 in head; eye 3 to 5; interorbital deeply concave, 7 to 9.3; mouth rather small, horizontal; lower jaw included; maxillary failing notably to reach eye, 1.75 to 2.6 in head, 1.2 to 1.3 in snout; teeth small, in villiform bands in each jaw; gill rakers slender, 10 to 13 on lower limb of first arch; scales small, ctenoid; striations and spines on head moderately developed; no spine at center of radiations on cheek; preopercular spine scarcely reaching base of humeral spine; serrations on margin of snout small; a shallow furrow with a backward curve across cranium, just posterior to the eyes; dorsal fins separate, the first composed of rather short slender spines, the third one the longest, 2 to 2.45 in head, scarcely longer than the longest rays of the second dorsal, not reaching past the tips of the posterior spines nor to origin of second dorsal when deflexed; caudal fin with rather deeply concave margin in adult, nearly straight in young; anal fin similar to second dorsal; ventral fins moderately developed, inserted under and posterior to bases of pectorals, reaching a little past origin of anal; pectoral fins rather short, reaching opposite base of sixth anal ray, 2.35 to 3.55 in body, the detached rays expanded at tips.

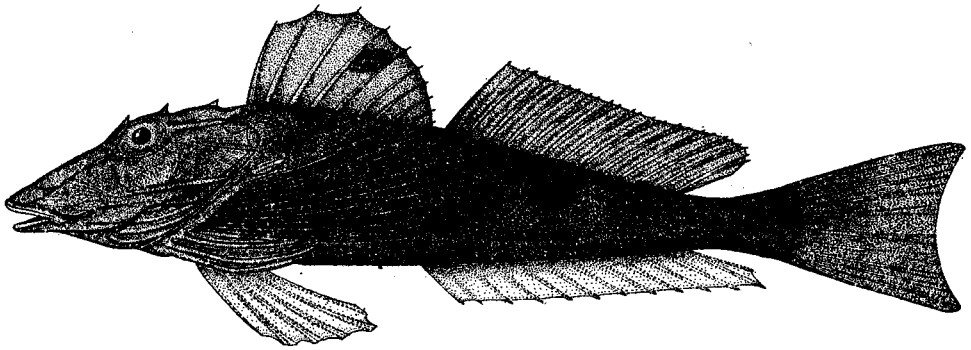

FIG. 187.—*Prionotus carolinus*. From a specimen 6 inches long

Color variable, usually grayish or reddish brown above, pale underneath; back with about five dark saddlelike blotches; young usually with small dark spots in addition to the large saddlelike blotches; dorsal fins more or less grayish, marked with pale spots and stripes, spinous dorsal with a black spot between the fourth and fifth spines; caudal fin uniform, grayish or brownish; anal and ventrals pale; pectorals brownish to blackish, sometimes spotted with darker markings. Color in life (based on eight fish, 8 to 12 inches long, observed in the aquarium at Woods Hole, Mass.) greenish to brownish above; white underneath; 3, 4, or 5 obscure, dark, irregularly-spaced, saddlelike blotches on back; head marked with orange; branchiostegals and throat with prominent dusky markings; dorsal fins pale to grayish, with irregular, brownish, longitudinal streaks; a prominent black spot on first dorsal on the membrane between the fourth and fifth spines; caudal brown, margin not pale; anal pale brown, without pale margin; ventrals pale yellow to brown; pectorals yellow or orange, with two broad dusky bars, one crossing middle of fin and the other on outer third, fin without brown wavy lines; pectoral filaments orange.

Many specimens of this species, ranging in length from 40 to 170 millimeters (1⅝ to 6¾ inches), were preserved. This species is recognized by its rather small mouth, robust body, short and blunt spines about the head, margin of caudal concave, and the dark saddlelike blotches on the back.

The food of this sea robin, as shown by 18 specimens taken in Chesapeake Bay, consists principally of crustaceans, which may be named in the order of their apparent importance, as follows: Mysis, amphipods, isopods, shrimp, and small crabs. One individual had fed on annelids and another on a small fish.

The spawning season at Beaufort, N. C., according to Smith (1907, p. 362), takes place in the spring. Welsh and Breder (field notes) found ripe fish at Atlantic City, N. J., from August 19 to 25, 1920. Kuntz and Radcliffe (1918, pp. 105 to 109), who give an account of the embryology and larval stages, state that the species spawns (presumably at Woods Hole, Mass., for that is where these authors worked) in June, July, and August. The egg is described as being 1 to 1.15 millimeters in diameter, lighter than sea water, slightly yellowish in color, but highly transparent. The incubation period at a temperature of 22° C. is given as approximately 60 hours. The newly hatched larvæ are stated to be about 2.8 millimeters long, and to have grown to a length of 3.1 to 3.4 millimeters in five days. In young fish, 8 to 10 millimeters long, the dorsal, anal, and caudal fins had become well differentiated, and the free rays of the pectoral fins, characteristic of the genus, were already present. Young fish 25 to 30 millimeters in length have all the fins well formed, the head shows the bony structure characteristic of the adult, and the fish are gradually acquiring the diagnostic characters of the species.

The following catches of young fish were made in the Chesapeake: December, 2 fish, 48 and 50 millimeters (2 inches); March, 2 fish, 46 and 53 millimeters (2 inches); April, 48 fish, 33 to 82 millimeters (1⅓ to 3¼ inches); May, 10 fish, 45 to 68 millimeters (1¾ to 2½ inches).

This species is reported to reach a maximum length of 15 or 16 inches; rarely, however, exceeding a length of 1 foot. No individuals among the numerous ones taken in Chesapeake Bay exceed a length of 11¾ inches. The species is very common in Chesapeake Bay, occupying both shallow and deep water, apparently being more numerous in deep than in shallow water. It was taken in considerable numbers throughout the year in the beam trawl, which usually was hauled in the deeper waters of the bay. The greatest depth recorded in the log for this species is 23 fathoms. This sea robin is not used for food and has no commercial value.

Habitat.—Bay of Fundy to South Carolina; common from Cape Cod to Cape Lookout.

Chesapeake localities.—(*a*) Previous records: Mouth of the Potomac River, Md., Gunston Wharf, Old Point Comfort, Hampton Roads, Norfolk, Ocean View, and off Cape Henry, Va. (*b*) Specimens in collection: Many localities, from Love Point, Md., to the mouth of the bay.

173. Prionotus affinis sp. nov. Sea robin.

Type No. 87654, U. S. National Museum; length 203 millimeters; off Kent Island, Md.

Head 2.95 to 3; depth 5.55 to 5.65; D. X–13; A. 12; scales about 108. Body quite slender, the depth under spinous dorsal nearly equal to the width, somewhat compressed posteriorly; head moderately large, quite strongly depressed; snout rather long, depressed, its length 1.95 to 2.05 in head; eye 5.2; interorbital deeply concave, 6.15 to 6.9; mouth rather small, horizontal; lower jaw included; maxillary not nearly reaching eye, 2.9 to 3 in head, 1.4 to 1.55 in snout; teeth as in *P. carolinus;* gill rakers rather short, 11 or 12 somewhat developed on lower limb of first arch; scales small, ctenoid, somewhat reduced in size on chest; spines and striations on head somewhat more prominent; otherwise as in *P. carolinus,* the preopercular spine reaching well beyond base of humeral spine; serrations on margin of snout quite prominent; a straight, shallow furrow across the cranium just posterior to the eyes; dorsal fins separate, the first composed of rather strong, stiff spines, the third and fourth of about equal length, 2 to 2.1 in head, somewhat longer than the longest soft rays, not reaching beyond the tips of the posterior spines when deflexed nor to origin of second dorsal; caudal fin with rather deeply concave margin, the rays of upper lobe slightly the longest; anal fin similar to second dorsal but not quite as high, its origin slightly behind that of the second dorsal; ventral fins moderately developed, inserted under and somewhat posterior to bases of pectorals, reaching somewhat past origin of anal; pectoral fins of moderate length, reaching about opposite base of the sixth anal ray, 2.4 to 2.45 in length of body, the free rays distally with membranous expansions.

Color in alcohol brownish above, with small darker brownish markings, but no large blotches; pale underneath; gill membranes dusky; dorsal fins brownish, with pale to white spots or longitudinal markings; a black spot between the fourth and fifth dorsal spines; caudal fin uniform brownish; anal fin pale, with a dark band across middle; ventral fins pale; pectorals dusky, the lower free rays pale.

Two specimens, 203 and 325 millimeters (8 and 12¾ inches) in length, occur in the collection, which are closely related to *P. carolinus,* differing, however, in the more slender and more elongate body, slightly smaller mouth, somewhat larger and more prominent sculpture of the head, and in color. The furrow on head just posterior to the eyes is straight and not bent backward as in *P.*

carolinus. No indications of dark saddlelike blotches are present on the back. These specimens differ from *P. scitulus*, a related species, known from North Carolina southward, principally in having a broader interorbital, shorter dorsal spines, none of them reaching beyond the tips of the posterior spines when deflexed and not to origin of second dorsal, whereas in *P. scitulus* the longest spines reach well beyond the tips of the posterior spines and to origin of second dorsal. The caudal fin in the present species is rather deeply concave posteriorly. In *P. scitulus* the margin is nearly straight. We are unable to identify the specimens in hand with any known species and, although very closely related to *P. carolinus*, they differ slightly in so many characters that we are convinced they represent a distinct species. We therefore are obliged to propose a new name. The genus, however, is in need of a critical study, and until such a study is made the true relationships of the species will not be known. We have reviewed the literature pertaining to the Atlantic coast species and had specimens of other species for comparison and for study only from Chesapeake Bay and Beaufort, N. C.

The species probably is rare in Chesapeake Bay. It was taken only in the beam trawl; one specimen was obtained at a depth of 14½ fathoms and the other at 10 fathoms.

Chesapeake localities.—Off Kent Island, Md., and off Old Point Comfort, Va.

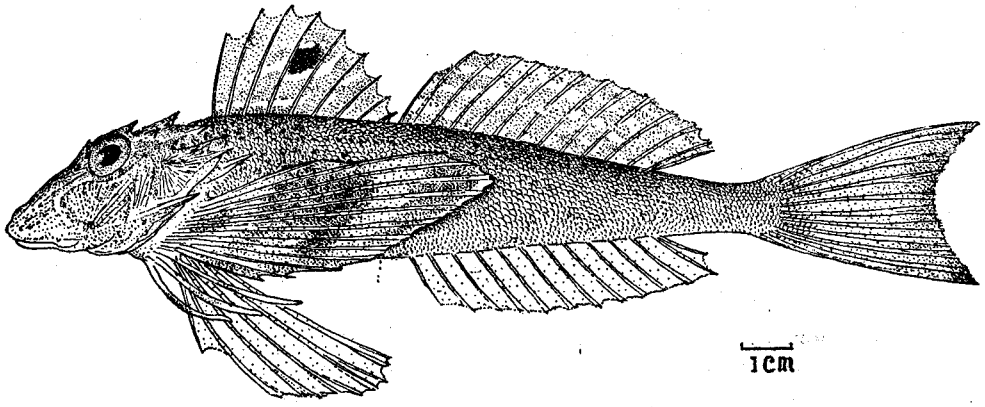

FIG. 188.—*Prionotus affinis* sp. nov. From the type, 8 inches long

Family LXXVII.—CEPHALACANTHIDÆ. The flying gurnards

Body elongate, rather broad, sides rather vertical; head blunt, quadrangular, nearly the entire surface bony, the bones about the eye united into a shield; a long, bony process ending in a sharp spine, extending backward from nape to beyond origin of dorsal; preorbital projecting beyond the jaws; preopercle extending backward as a long round spine, reaching beyond the base of ventrals; mouth small, inferior; teeth granular, present only on the jaws; gill openings restricted to the sides; pseudobranchiæ large; scales small, keeled; dorsal fin consisting of slender spines and rays; pectoral fins greatly enlarged, divided into two sections, the inner section much the longer. This family contains one genus, with a single representative in American waters.

135. Genus CEPHALACANTHUS Lacépède

The characters of the genus are included in the description of the family. The flying gurnards possess the power of flight, but to a much less degree than the true flying fishes.

174. Cephalacanthus volitans (Linnæus). Flying fish; Flying robin.

Trigla volitans Linnæus, Syst. Nat., ed. X, 1758, p. 302; Mediterranean Sea and oceans within the Tropics.
Dactylopterus volitans Uhler and Lugger, 1876, ed. I, p. 101; ed. II, p. 85.
Cephalacanthus volitans Jordan and Evermann, 1896-1900, p. 2183, Pl. CCCXXIII, fig. 778.

Head 3.95; depth 5.5; D. VI–I, 8; A. 6; scales 59. Body elongate, depressed, somewhat broader than deep; head depressed; snout short, blunt, its length 2.65 in head; eye 3; interorbital broad, concave, 1.85; mouth moderate; upper jaw projecting; maxillary reaching nearly to pupil, 2.6 in head; teeth in the jaws blunt, in bands; preopercle with a very large long spine, its free portion

exceeding somewhat the width of interorbital, not quite reaching the tip of the nuchal spine; scales on back and sides with prominent keels; first two spines of the dorsal separate; second dorsal and anal similar in shape; caudal fin deeply concave; ventral fins inserted under posterior part of pectorals, rather narrow, pointed; pectoral fins in two sections, the upper short and with six rays, the lower section long and broad, reaching base of caudal, 1.35 in body.

Color in life more or less variegated; the back and sides brownish green, with shades of red; white underneath; spinous dorsal barred and spotted with purple, brown, and yellow; membranes of soft dorsal plain, the rays alternately spotted with yellow and red; caudal fin with two or three irregular, vertical, wine-colored bars, with yellowish interspaces; anal with three pale reddish bars, its outer edge yellowish; ventrals deep orange; pectorals mostly black, the outer third of fin with bright blue bars and spots and a margin of the same color, inner third of fin with five or six bright blue streaks, fin everywhere with obscure reddish blotches. In preserved specimens the bright colors fade, but most of the markings remain either as light or dark spots and bars.

A single specimen 170 millimeters (6¾ inches) in length was seen and preserved. This specimen forms the basis for the foregoing description. The flying fish is readily recognized by its broad, depressed head and body, very large preopercular and nuchal spines, long pectorals, and the absence of "feelers."

This flying fish is reported to feed on various small crustaceans. Nothing has come to our notice in the literature concerning the spawning habits of this fish, and it is probable that these are largely unknown. The species is said to be able to maintain itself for considerable distances in the air by means of its flat body and large, winglike pectoral fins. A maximum length of 1 foot is reported.

Habitat.—Both coasts of the Atlantic Ocean; on the American coast from Cape Cod, Mass., to Brazil; common southward; rare north of North Carolina, only occasionally straying northward to Cape Cod.

Chesapeake localities.—(*a*) Previous records: Lower part of Chesapeake Bay (Uhler and Lugger, 1876). (*b*) Specimen in collection: From Ocean View, Va., taken in an 1,800-foot haul seine on October 2, 1922. Very rare in Chesapeake Bay.

Order PHARYNGOGNATHI

Family LXXVIII.—LABRIDÆ. The labrid or lipped fishes

Body moderately elongate, greatly compressed in some species; mouth terminal, usually of small or moderate size; lips usually thick, with longitudinal folds; premaxillaries protractile; maxillary without a supplemental bone; teeth in the jaws strong, prominent, separate or more or less fused at the base; lower pharyngeal bones united and bearing strong conical or tubercular teeth; nostrils double, without flaps; branchiostegals 5 or 6; gill arches 3½; dorsal fin continuous, usually long, the spines varying from 3 to 20; anal with two to six spines; ventrals thoracic, with one weak spine and five soft rays. This family contains about 20 American genera, only two of which are known to occur in Chesapeake Bay.

KEY TO THE GENERA

a. Anterior profile high and strongly convex; preopercular margin entire; about 70 scales in a lateral series; cheeks and opercles largely naked ..... Tautoga, p. 317

aa. Anterior profile not greatly elevated and only gently convex; preopercular margin serrate; about 40 scales in a lateral series; cheeks and opercles mostly covered with scales ..... Tautogolabrus, p. 320

136. Genus TAUTOGA Mitchill. Tautogs

Body elongate, moderately deep and compressed; anterior profile rather strongly arched head nearly as deep as long; eye small, placed high; mouth rather small; lips quite broad and thick; teeth in the jaws strong, the anterior ones more or less incisorlike; scales rather small, about 70 in a lateral series; cheeks and opercles largely naked; dorsal fin long, continuous, the soft part short; caudal fin short, round to slightly truncate; anal fin with three stout spines, the soft part similar to that of the dorsal. This genus consists of a single species.

175. Tautoga onitis (Linnæus). Tautog; Blackfish; Black porgy; Chub; Salt-water chub.

Labrus onitis Linnæus, Syst. Nat., ed. X, 1758, p. 286. (No type locality given.)

Tautoga onitis Uhler and Lugger, 1876, ed. I, p. 106; ed. II, p. 89; Jordan and Evermann, 1896-1900, p. 1578, Pl. CCXXXVII, fig. 596; Evermann and Hildebrand, 1910, p. 162; Fowler, 1912, p. 56.

Hiatula onitis Bean, 1891, p. 86.

Head 3.25 to 3.56; depth 2.55 to 2.95; D. XVI or XVII, 10; A. III, 7 or 8; scales 69 to 73. Body rather deep, compressed; the back rather strongly elevated; caudal peduncle short and deep, its depth equal to or a little greater than distance from tip of snout to margin of preopercle; head rather short; snout blunt, 2.25 to 3.25 in head; eye small, 3.05 to 6; interorbital 3.85 to 5.1; preopercular margin smooth; mouth moderate, slightly subinferior; lips rather broad and thick; maxillary reaching nearly opposite anterior margin of eye in young, not nearly as far back in adult, 3 to 3.55 in head; teeth in the jaws strong, the anterior ones in young more or less compressed, incisorlike becoming more rounded and caninelike in large examples; gill membranes broadly united, free from the isthmus; gill rakers short, about nine on lower limb of first arch; lateral line complete and continuous; scales rather small, thin, with smooth edges, reduced in size on belly and chest, largely absent on cheeks and opercles; dorsal fin continuous, the spines stiff, not quite as high as the soft part of fin; caudal fin broadly rounded; anal fin with three rather short strong spines, the soft part similar to that of the dorsal; ventral fins moderate, inserted about an eye's diameter behind base of pectorals; pectoral fins broad, their length 1.15 to 1.5 in head.

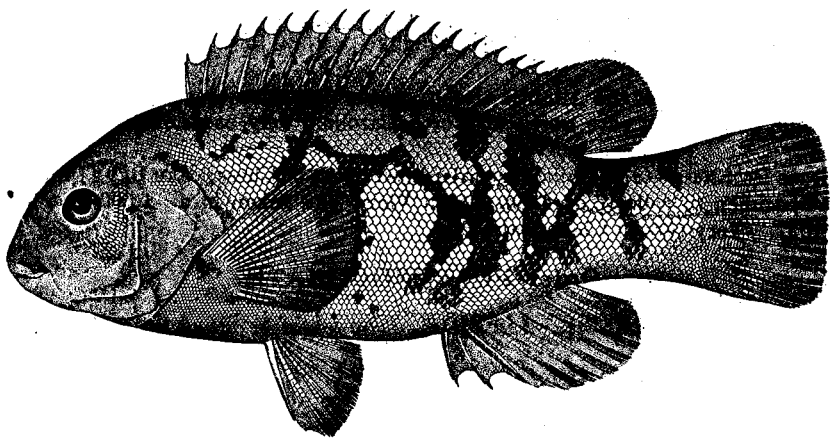

FIG. 189.—*Tautoga onitis*. From a specimen 6¾ inches long

Color dull black to greenish black or brownish above, with more or less distinct, irregular, blackish bars or blotches; the bars and blotches most distinct in young; fins plain, mostly like the ground color of body.

In regions off the Atlantic coast where this species is abundant two color patterns are recognized, one being plain blackish and the other having irregular blackish or brownish bars on a pale ground. Both varieties are found even among the largest fish, but very small fish nearly always are marked with blotches and irregular bars.

Many specimens of this species, ranging in length from 55 to 320 millimeters, were preserved. It is most readily recognized by its strongly convex anterior profile; thick lips; large incisorlike teeth, and very deep caudal peduncle.

The food of the tautog is varied, consisting largely of various small mollusks and crustaceans of suitable size. It is most numerous among rocks, old wrecks, piling, etc., were it feeds on barnacles, crabs, and other animals common in such places. The food of the tautog and the sheepshead are practically identical, and they occupy the same feeding grounds within the region where their ranges overlap. The tautog takes the hook readily and is of some importance as a "game" fish. Large numbers are caught with hook and line by sportsmen as well as commercial fishermen, particularly off the coasts of Long Island and New Jersey.

The tautog spawns principally during June at Woods Hole and probably somewhat earlier in Chesapeake Bay. The eggs are buoyant, have no oil globule, and are from 0.9 to 1 millimeter in diameter.[24] They hatch in 42 to 45 hours at a temperature of 68° to 72° F. The young at hatching are 2.2 millimeters long. The yolk sac is absorbed when the fish reaches a length of 3.3 millimeters. At this time the mouth is fully formed. At a length of 10 millimeters many of the characters of the adult fish are already evident. It has been suggested that fish seined along shores, measuring from 3 to 6 inches in length, are a year old. Nothing definite is known concerning the rate of growth, however, nor as to the age at which they mature.

Not one specimen had been collected in Chesapeake Bay during 1921 until September 23, when 208 were seined in six hauls of a 250-foot bag seine along Cape Charles beach. Excepting three adult fish, all these ranged from 55 to 115 millimeters (2¼ to 4½ inches) in length. Seining in the same locality on November 23, 1921, only three tautogs were taken, 3½ to 4 inches in length, indicating that the young had left the immediate shores. One fish, 150 millimeters (6 inches) in length, was seined on October 12, and on December 4 one specimen of the same length was taken

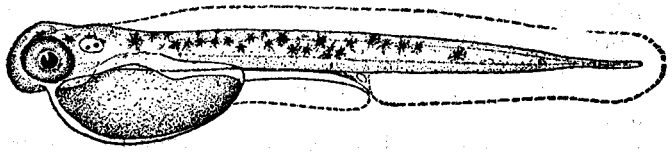

FIG. 191.—Recently hatched larva, 2.9 millimeters long

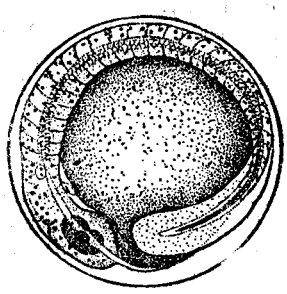

FIG. 190.—Egg with large embryo

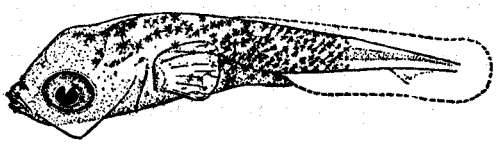

FIG. 192.—Larva, 5 millimeters long

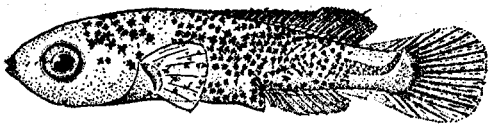

FIG. 193.—Young fish, 10 millimeters long

in the beam trawl. Whether the latter are a year older than the 2¼ to 4½ inch fish caught in October and November can not be determined from the meager data at hand. On April 13 one tautog 158 millimeters (6¼ inches) in length, was seined.

During 1922 the total catch of tautog in Chesapeake Bay is estimated to have been 2,000 pounds, worth about $80 to the fishermen. Almost all of this catch was taken in Virginia with hook and line and with pound nets.

The tautog may be caught throughout the year but is most common during the spring and fall. This fish usually frequents the vicinity of rock piles and old wrecks and is not considered a pound-net fish. However, stragglers are caught throughout the fishing season by the many pound nets in the Chesapeake, and the combined catch made with the apparatus is worthy of note.

The tautog is caught in the bay principally from the York River to the capes. It is rare above the Rappahannock. The combined daily catch of 120 pound nets in the vicinity of Buckroe beach, during April, 1922, was 10 to 40 tautog. Buckroe Beach, Ocean View, and Cape Charles are the chief fishing grounds. During September, 1922, as many as 60 rowboats, each with one to three persons, were fishing for spots off Ocean View; the average catch of tautogs was 1 to every 4 boats per day. However, the bottom was sandy and therefore not favorable to tautog fishing. It is

[24] For details relative to the embryology and development of the young refer to Kuntz and Radcliffe, 1918, pp. 92 to 99, figs. 1 to 17.

said that during the late fall tautogs are commonly caught off the large stone breakwater at Cape Charles city, and that fish of 8 or 9 pounds are sometimes taken. One fish about 13 inches in length was taken from a pound net at Chesapeake Beach, Md., on April 29, 1922, establishing the most northerly record for the bay.

The small annual catch is utilized in the Chesapeake markets; principally in Norfolk and Baltimore. The fishermen include this species among the mixed or miscellaneous fish, as it is rarely taken in sufficient numbers at one time to pack in separate boxes. During 1921 and 1922 the retail price ranged from 10 to 15 cents a pound. The tautog is a food fish of good flavor and is much esteemed along the North Atlantic coast, where it assumes considerable importance.

In Chesapeake Bay the tautog is usually called "salt-water chub" or "chub"; at Oxford, Md., fishermen call it "black porgy"; and at Solomons, where it is rare, it is called "blackfish." The last name is in common use at New York.

The maximum weight reported for the tautog is 22½ pounds. This fish was caught off New York in 1876 and was 36½ inches long. Fishermen reported individuals from Cape Charles city weighing 8 or 9 pounds. The largest from Chesapeake Bay seen during the present investigation weighed 4 pounds. Larger ones evidently are comparatively rare in the vicinity. The weight of adult fish varies widely, some being much deeper, and therefore heavier, than others. One Chesapeake specimen, 13 inches long, weighed 1 pound and 7 ounces, while a fish 14 inches long weighed only 13½ ounces.

Habitat.—Bay of Fundy to South Carolina; not taken in commercial numbers south of Chesapeake Bay.

Chesapeake localities.—(*a*) Previous records: Southern part of the bay, Cape Charles city, Old Point Comfort, and Norfolk. (*b*) Specimens in collection: Chesapeake Beach and Solomons, Md.; Tangier Island, Lewisetta, Lower York River, Cape Charles, Old Point Comfort, Buckroe Beach, and Ocean View, Va. Rather rare north of Cape Charles city and the mouth of the York River, and most common in the vicinity of Cape Charles.

137. Genus TAUTOGOLABRUS Günther. Cunners

This genus differs from Tautoga principally in the more elongate body; lower head, with a more gently convex upper profile; serrate preopercular margin; larger scales, about 40 in a lateral series; and in having the cheeks and opercles more nearly fully scaled. This genus, like Tautoga, consists of a single species.

176. Tautogolabrus adspersus (Walbaum). Cunner.

Labrus adspersus Walbaum, Artedi Piscium, 1792, p. 254; New York.

Tautogolabrus adspersus Lugger, 1877, p. 71; Jordan and Evermann, 1896–1900, p. 1577, Pl. CCXXXVI, fig. 595; Bigelow and Welsh, 1925, p. 281, fig. 131.

Head 3.45; depth 3.45; D. XVIII, 9; A. III, 8; scales 41. Body moderately deep, compressed; caudal peduncle deep, its depth about equal to postorbital part of head; head rather low, moderately long; snout pointed, 3.5 in head; eye 2.8; interorbital 4.7; mouth moderate, terminal; lips thin; maxillary scarcely reaching anterior margin of eye, 3.5 in head; teeth in bands on anterior part of jaws, becoming uniserial laterally, the outer ones anteriorly enlarged, caninelike; gill membranes united but free from the isthmus; preopercular margin serrate; lateral line complete and continuous, running high anteriorly but becoming median on caudal peduncle; scales moderate, thin, with smooth membranous edges, reduced on chest, present on cheeks and opercles; dorsal fin long, continuous, the spines stiff, pungent, not quite as high as the soft rays, caudal fin round; anal fin with three rather strong spines, the soft part similar to that of dorsal; ventral fins moderate, inserted slightly behind base of pectorals; pectoral fins moderately broad, round, their length 1.45 in head.

Color in alcohol uniform brownish yellow; dorsal fin with a black spot on base of anterior soft rays. Bigelow and Welsh (1925, p. 282) make the following observation concerning the color of this fish: "To describe the color of the cunner is to list all the colors of the bottoms on which it lives, it being one of the most variable of fishes."

A single small specimen of this species, 60 millimeters in length, was obtained. This cunner is most readily distinguished from its nearest relative, the tautog, by the scaly gill covers, the pointed snout, and the gently convex profile.

The cunner is reported to be virtually omnivorous in its feeding habits, feeding on almost all animals of suitable size that occur in the waters that it inhabits; often eel grass also is found in the stomach. Furthermore, it is reported to be a scavenger.

Spawning takes place in June, July, and August. The eggs are buoyant, transparent, and only 0.75 to 0.85 millimeter in diameter and without an oil globule. In temperatures of 70° to 72° they hatch in about 40 hours. At hatching the larvæ are about 2 to 2.22 millimeters in length.[25] According to Bigelow and Welsh (1925, p. 285), the young in the Gulf of Maine may reach a length of 2½ to 3½ inches by the autumn of the season during which they were hatched.

The cunner is found in abundance from New Jersey to Maine. Along the New England coast it lives chiefly close to shore, particularly in bays and sounds, and is one of the chief fish caught by youthful anglers. It prefers rocky bottom covered with marine growths. Along the northern New Jersey coast the cunner is present in large numbers throughout the year. In this region it is found chiefly offshore, on the rocky ledges frequented by tautog, sea bass, and other species. The usual size of New Jersey fish taken within several miles of shore is 5 to 8 inches, but about 8 miles offshore, on the 17-fathom bank, large cunners, 10 to 12 inches or more in length, are commonly taken. The cunner's habit of stealing bait from the hooks of fishermen is well known, and New York bank fishermen know that more bait is required to feed the cunner (or bergall, as it is called there) than all other species for which he may be fishing combined.

The cunner reaches a maximum length of about 15 inches. It is a food fish of good flavor and of some commercial importance.

Habitat.—Labrador to Virginia. Rare south of New Jersey. This fish was recorded from the Atlantic coast of Worcester and adjoining counties, Maryland, by Lugger (1877, p. 71). This record appears to have been overlooked, as the southernmost range given by recent authors is New Jersey. The capture of the small specimen in hand extends the known range to the mouth of Chesapeake Bay.

Chesapeake localities.—(*a*) Previous records: None. (*b*) Specimen in collection: Sixty millimeters long, taken by seining, Cape Charles, Va., September 20, 1921.

Family LXXIX.—SCARIDÆ. The parrot fishes

Body oblong, moderately compressed; mouth moderate, terminal; teeth in the jaws coalesced, at least at base, often forming continuous plates; frequently with one or more canines above the cutting edge; no teeth on vomer or palatines; scales large, cycloid, 23 to 26 in a lateral series; dorsal fin continuous, its rays constantly IX, 10, the spines weak and flexible or stiff and pungent; anal constantly III, 9. A single genus and species of this family of tropical fishes comes within the scope of the present work.

138. Genus SCARUS Forskål. Parrot fishes

Body rather robust, compressed; head moderately short and deep; snout blunt; upper lip laterally double, the inner fold becoming very narrow or disappearing anteriorly; teeth in the jaws fully coalesced, forming continuous plates, with a single median suture; gill membranes scarcely united to the isthmus; scales large, 22 to 26 in a lateral series; dorsal fin constantly with 9 flexible spines and 10 soft rays; anal fin with three flexible spines (the first one very small and often hidden in the skin) and 9 soft rays. This is a rather large genus, the members being of the warm and tropical seas.

[25] For details concerning the embryology and the larval development of the cunner, see Agassiz (1882, p. 290, Pls. XIII to XV); Agassiz and Whitman (1885, p. 18, Pls. VII to XIX); and Kuntz and Radcliffe (1918, p. 99, figs. 18 to 29).

177. Scarus cæruleus (Bloch). Blue parrot fish.

Coryphæna cæruleus, Bloch, Auslandische Fish., II, 1786, p. 120, pl. 176; Bahamas.
Scarus cæruleus Jordan and Evermann, 1896-1900, p. 1652, Pl. COXLIV, fig. 613; Smith and Kendall, 1898, p. 170.

Head 3.15 to 3.6; depth 2.85 to 3.2; D. IX, 10; A. III, 9; scales 24 to 26. Body elongate, moderately compressed; head not much longer than deep; snout very blunt, with a well-developed fleshy pad on its upper surface in adults, its length 2.35 to 2.7 in head; eye 5.15 to 6.4; mouth small, reaching about halfway to eye; lower jaw included; teeth fully coalesced, forming continuous plates; each plate with an evident median suture; no free canines; gill membranes slightly connected; scales large, not much reduced on chest, five in advance of ventrals; most of head scaly; two rows of six scales each and a third row consisting of two scales on cheek, scales of upper row much larger than those of second row; lateral line interrupted under posterior rays of dorsal, beginning again lower down on caudal peduncle, the pores more or less branched; dorsal with nine flexible spines, each one with a fleshy tip; caudal fin notably concave, with the angles produced in adult fish; anal with three flexible spines, the first one very small; ventrals a little shorter than the pectorals; pectorals 1.3 to 1.55 in head.

Color dark green to slightly grayish green above, becoming a lighter shade on sides and underneath; no stripes or bars present on preserved specimens; lips deep blue-green; dorsal and anal deep blue-green, almost black, each with a bright green margin; caudal slightly paler than the dorsal and anal, the outer rays bright green; ventrals and pectorals mostly greenish; axillary spot absent; teeth white.

This fish was not seen during the present investigation. The record is taken from Jordan and Evermann (1896–1900, p. 1652) and Smith and Kendall (1898, p. 170). These records are both based on an identification made from the jaws of one specimen taken in 1894 in a pound net set in the Potomac River off St. George Island. After the receipt of this jaw, an illustration was sent by Smith and Kendall to a J. E. N. Sterling, at Cape Charles city, Va., with an inquiry whether this fish had been caught in the vicinity. The reply was that from 6 to 10 fish resembling the figure and corresponding to the description that had been supplied were obtained in pound nets between Cape Charles and Hunger Creek.

This fish, being the only one of the family known from Chesapeake Bay, may be recognized readily by the coalesced teeth, which have a continuous cutting edge and resemble somewhat the beak of a bird.

Nothing definite is known concerning its food, breeding habits, or rate of growth. It is reported to reach a length of 2 to 3 feet.

Habitat.—Maryland to Panama; apparently rare on the coast of the United States; probably most common in the West Indies.

Chesapeake localities.—(*a*) Previous record: St. George Island, Md. (*b*) Specimens in collection: None.

Order GOBIOIDEA

Family LXXX.—GOBIIDÆ. The gobies

Body oblong or elongate, compressed or not; scales present or wanting; skin of head continuous with the covering of the eyes; premaxillaries protractile; opercle unarmed; preopercle unarmed or with a short spine; gill openings largely restricted to the sides, the membranes united to the isthmus; gills 4, a slit behind the fourth; no lateral line; teeth various, usually small; dorsal fins separate or connected, the spinous dorsal with two to eight flexible spines, rarely wanting; anal usually with a single weak spine, similar to soft dorsal; ventral fins close together, separate or united, each composed of I, 5 rays (rarely I, 4); the ventral fins, when united, forming a sucking disk, a cross fold between their bases completing the cup; caudal fin convex or pointed. Most of the members of this family are of small size. Some of them live in fresh water, others in salt water, and many of them occupy brackish water or live indiscriminately in salt or fresh water.

KEY TO THE GENERA

a. Body entirely naked; mouth nearly horizontal; second dorsal and anal short, each with 10 to 14 rays ..... Gobiosoma, p. 323

aa. Scales present on at least most of body; mouth oblique to nearly vertical.

b. Teeth in the jaws in bands, immovable; lower jaw rather strong, round anteriorly; second dorsal and anal rather long, each with 15 to 18 rays ..... Microgobius, p. 325

bb. Teeth in the jaws in a single series, movable; lower jaw very thin and angular anteriorly; second dorsal and anal short, each with about 11 or 12 rays.. Mugilostoma gen. nov., p. 327

139. Genus GOBIOSOMA Girard. Naked gobies

Body rather slender; mouth moderate, nearly horizontal; teeth pointed, in several series or in a band, the outer ones enlarged; no canines; skin entirely naked; no barbels or dermal flaps; spinous dorsal normally with 7 spines, rarely 5 or 6; second dorsal and anal short, with 10 to 14 rays; ventral fins united, forming a sucking disk.

KEY TO THE SPECIES

a. Body moderately robust, its depth 3.95 to 4.8 in its length; second dorsal normally with 13 rays, infrequently with 12 or 14; ventral disk short, reaching about half the distance from its base to the vent ..... *bosci*, p. 323

aa. Body slender, its depth 6 to 7.15 in its length; second dorsal normally with 12 rays, infrequently with 11 or 13; ventral disk long, reaching two-thirds the distance from its base to the vent ..... *ginsburgi* sp. nov., p. 324

178. Gobiosoma bosci (Lacépède). Clinging goby; Variegated goby; Naked goby.

Gobius bosci Lacépède, Hist. Nat. Poiss., II, 1798, p. 555, Pl. XVI, fig. 1; Charleston, S. C.

Gobiosoma bosci Bean, 1891, p. 86; Jordan and Evermann, 1896–1900, p. 2259; Smith and Bean, 1899, p. 187; Evermann and Hildebrand, 1910, p. 163.

Head 3.15 to 3.5; depth 3.95 to 4.8; D. VII or VIII–13 (infrequently 12 or 14); A. 11 (rarely 10). Body robust; head depressed, broader than deep; snout short, tapering, 3.45 to 4.25 in head; eye 3.25 to 4.67; interorbital bone about the width of pupil; mouth moderate, terminal; maxillary reaching about opposite middle of eye, 2.25 to 2.4 in head; teeth in the jaws pointed, in bands in each jaw, with some of the outer teeth enlarged; gill openings mostly lateral, the membranes joined to the isthmus; pores usually present on the cheeks; dorsal fins close together, the first consisting of very slender spines, the margin convex; second dorsal and anal similar and opposite each other, the rays of the dorsal reaching to or beyond the base of the upper short rays of the caudal; caudal fins short, round, shorter than head; ventral fins short, forming a disk, the disk scarcely reaching more than half the distance from its base to the vent, its length 1.65 to 2.45 in head; pectoral fins broad, a little shorter than head, 3.25 to 4.7 in the length of body.

Color in life greenish to dusky above; pale underneath; nape and sides with very narrow pale crossbars; pectoral fins mostly greenish; other fins mostly blackish; the caudal of a somewhat lighter shade than the dorsals. Considerable variation in color among individuals has been noted, some specimens being notably darker than others, and the males in general appear to be darker than females, with the pale crossbars showing less distinctly.

Many specimens, ranging from 25 to 60 millimeters (1 to 2⅜ inches) in length, were preserved. This goby is entirely naked. Its body is quite robust, the head is depressed, and the ventral disk is very short, scarcely reaching more than halfway to vent.

In a series of 37 specimens examined for the food contents of the stomachs, 12 had fed on small crustaceans (mainly Gammarus), 14 had eaten annelids (Chætopods), 2 had fed on fish, and 2 on ova of unknown origin. Two individuals had fed on both Gammarus and annelids, and 9 stomachs were empty.

Spawning apparently takes place from June to October. The gonads in many of the specimens taken in July are in an advanced stage of development, and it seems probable that most of the spawning takes place during this month. However, a few specimens taken during the early

part of October were not entirely spent. Kuntz (1916, pp. 423–426), who took the eggs and described their development, found that at Beaufort, N. C., ripe fish were comparatively scarce during August, and he states that the height of the spawning season evidently was past. This author states that the mature, unfertilized eggs are approximately spherical in form and about 0.5 millimeter in diameter, yellow in color, and opaque. They are heavier than sea water, and when stripped from the female they aggregate in a compact clump. As soon as fertilized, the egg begins to expand and becomes elliptical. The incubation period at ordinary summer temperature in the laboratory was approximately five days. The newly hatched larvæ are approximately 2 millimeters in length and almost transparent. Young fish 10 millimeters in length show many of the diagonostic characters of the adult. The head already has the characteristic shape of the species, the fins are well differentiated, and the sucking disk formed by the ventral fins is well developed.

This goby is an abundant species in Chesapeake Bay, inhabiting shallow grassy flats off the immediate shores. During April and May it was found in comparatively small numbers along the shores, but from June to October it was present in abundance. The largest catch made during our collecting consisted of 511 fish taken in 8 hauls of a 30-foot seine in the lower York River on October 11. In November it was found to be comparatively scarce in localities where it had been

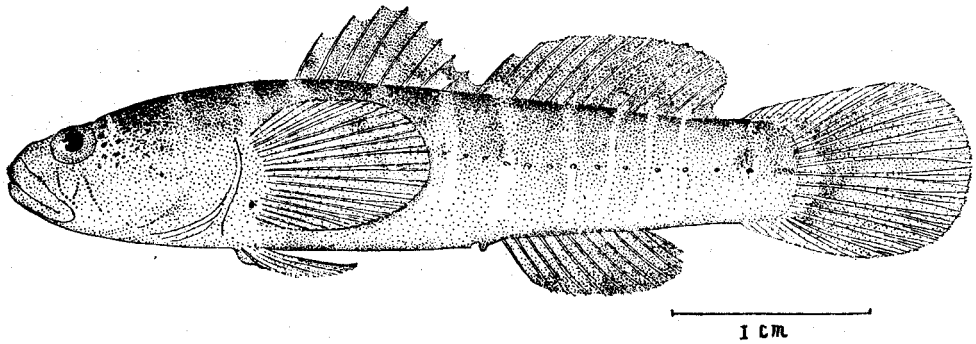

FIG. 194.—*Gobiosoma bosci*. Adult 50 millimeters long

abundant the previous month. This goby was found chiefly from the York River to Annapolis and Love Point. Only a few specimens were taken in the Patapsco River below Baltimore and in the vicinity of Havre de Grace. From the capes to Buckroe Beach it was not as common as from the York River northward. It was not infrequently taken in water only slightly brackish, and several specimens seined at Havre de Grace were from fresh water. The maximum size is about 2½ inches.

Habitat.—Massachusetts to Florida.

Chesapeake localities.—(*a*) Previous records: Gunston Wharf, Cape Charles city, Gloucester Point, and Hampton, Va. (*b*) Specimens in collection: From numerous localities, taken in fresh, brackish, and salt water from Havre de Grace, Md., to the mouth of the bay.

179. Gobiosoma ginsburgi sp. nov.

Type No. 87655, U. S. National Museum; length 45 millimeters; Cape Charles, Va.

Head 3.45 to 3.8; depth 6 to 7.15; D. VII–12 (infrequently VII–11 or 13); A. 11. Body rather slender; head somewhat depressed, broader than deep; snout short, tapering, 3.8 to 4.2 in head; eye 3.8 to 4.6; interorbital bone about the width of pupil; mouth terminal, slightly oblique; maxillary reaching somewhat beyond middle of eye, 2.05 to 2.35 in head; teeth in the jaws pointed, in bands, some of the outer teeth enlarged; gill openings mostly lateral, the membranes joined to the isthmus; pores evident and in series on cheeks; dorsal fins separate, the first with rather short, very slender spines and convex margin; second dorsal and anal similar and opposite each other, the rays of the dorsal scarcely reaching the base of upper rays of caudal; caudal fin moderate, round, about as long as head; ventral disk long, reaching about two-thirds the distance from its base to the vent, its length 1.25 to 1.45 in head; pectoral fins moderately broad, equal to or very slightly shorter than head, 3.65 to 4.2 in length of body.

Color of preserved specimens, brownish; body with about six or seven rather ill-defined, whitish crossbars; lateral line usually with longitudinally elongated dark spots; a few similar spots on median line of back in advance of dorsal; lower surface of head spotted with black; a black bar on mandible; ventral disk dusky, at least at base; other fins pale to slightly dusky; the dorsal fins and the caudal sometimes with indications of dark spots or bars; anal fin with a dark margin.

This species is represented by 26 specimens ranging in length from 37 to 52 millimeters (1½ to 2 inches). This goby is named for our colleague, Isaac Ginsburg, who made many of the preliminary identifications of the present collection and first called our attention to the fact that apparently two species were included in the genus Gobiosoma. This led to a detailed study and finally to the description of this new species. This naked goby differs from its relative, *G. bosci*, the only other naked goby recognized from the Atlantic coast of the United States, principally in having a more slender body, generally higher fins, somewhat shorter second dorsal, and in color. The difference in the height of the fins is most noticeable in the ventrals composing the sucking disk. In *G. bosci* the disk extends only about half the distance from its base to the vent, whereas in the present species it reaches fully two-thirds the distance to the vent. In counting the rays of the second dorsal in *G. bosci*, in 49 specimens, 4 had 12 rays, 41 had 13, and 4 had 14. In 26 specimens of the present species, 1 had 11 rays, 21 had 12, and 4 had 13. In making these enumerations the first simple ray was included and the last two, which apparently are united at the base, were counted as one.

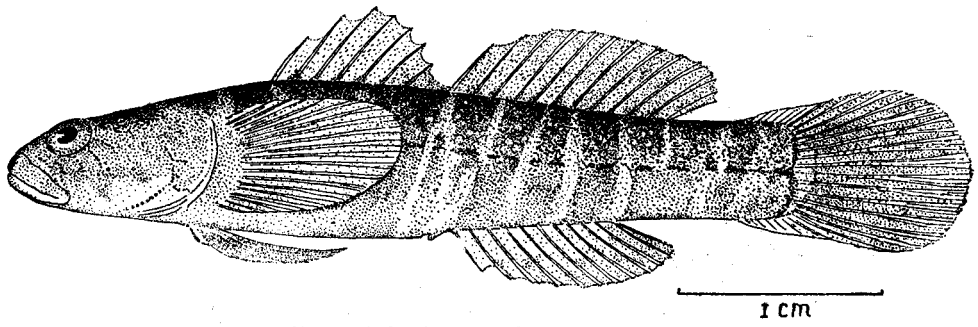

FIG. 195.—*Gobiosoma ginsburgi* sp. nov. From the type, 45 millimeters long

Three specimens were examined for food. In one the stomach was empty; the other two had fed on small crustaceans, chiefly Gammarus. A ripe or nearly ripe female occurs in a lot of specimens taken from May 21 to 23, 1922.

The size attained, judging from the specimens in hand, may be somewhat smaller than in *G. bosci*, and it evidently is much less numerous. *G. bosci* was taken only in shallow water, whereas the present species, although found in shallow water, was taken principally in deeper water, reaching upward of 25 fathoms. Most of the deep-water catches were made with the beam trawl from October to March.

Chesapeake localities.—Solomons, off Barren Island, and Crisfield, Md.; Cape Charles, lower York River, off Old Point Comfort, off Thimble Shoals Light, and Buckroe Beach, Va.

140. Genus MICROGOBIUS Poey. Gobies

Body elongate, more or less compressed; mouth quite large and very oblique to nearly vertical; outer teeth in the jaws enlarged, rather strong; scales cycloid or weakly ctenoid, present on most of the body; first dorsal with 7 or 8 spines; second dorsal and anal with 15 to 18 rays. The species are small and confined chiefly to the shores.

KEY TO THE SPECIES

a. Body rather deep, quite strongly compressed, the depth 4.7 to 5.4 in the length of body; mouth only moderately oblique; ventral disk long, reaching to or a little beyond origin of anal ---------- *holmesi*, p. 326