The food of the hog choker, as shown by the stomach contents of 47 specimens examined, consists chiefly of annelids. A few specimens had fed on small crustaceans, also, and few others contained strands of algæ.

Spawning apparently takes places during late spring and summer. Specimens taken in April have the gonads somewhat developed, but no advanced development was observed until June. Ripe or nearly ripe fish were collected in June, July, and August. The eggs evidently are small and numerous. A female 165 millimeters long, taken June 14, 1921, with free eggs in the ovaries, contained approximately 54,000 eggs. The eggs were about 0.33 millimeter in diameter after preservation in alcohol. Sexual maturity at a small size is indicated by the well developed ovaries of a specimen only 4¼ inches in length taken on May 16, which undoubtedly would have spawned within a month or two. The following table is based on young that quite probably were in their second summer.

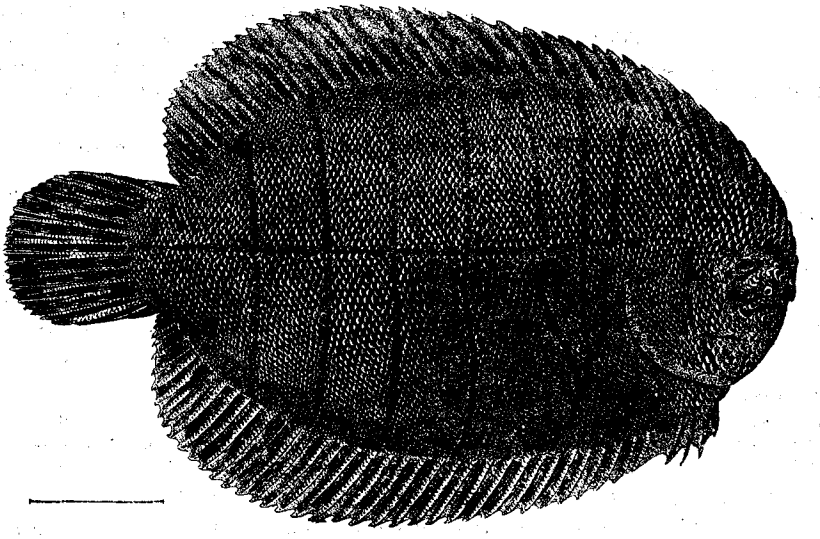

FIG. 90.—*Achirus fasciatus*

Date	Locality	Number of specimens	Inches
Apr. 17	Rappahannock River	31	1.3–3.0
Apr. 24	Potomac River	5	1.4–3.0
Apr. 29	Chesapeake Beach	7	2.7–4.0
May 8	Sassafras River	27	1.8–4.2
June 25	Back River	4	2.2–4.0
July 1	do	40	2.1–3.5
July 10	York River	2	2.3–4.1
Aug. 16	Chesapeake Beach	12	2.3–4.0
Oct. 29	Solomons	4	3.7–4.8
Nov. 22	Cape Charles	1	4.6

The maximum size attained by the hog choker, as given in published accounts, is 5 to 7 inches. However, we have a specimen at hand measuring 8 inches in length. The hog choker frequents shallow water during the summer and often ascends streams and is taken in fresh water. Smith and Bean, in their account of the fishes of the District of Columbia and vicinity (1899, p. 187), state: "Young specimens have been taken in Eastern Branch, Four-mile Run, and Little River. Adults are common in spring on the fishing shores below Washington but have not been observed in the immediate vicinity of the city." During the colder months of the year it is one of the commonest species, as shown by beam-trawl hauls made by the *Fish Hawk* in the deeper waters of the bay.

This sole, although common, has no commercial value and is discarded by the fishermen of Chesapeake Bay. The flesh is said to be well flavored. Apparently, however, because of the small size attained, this fish is seldom eaten. The name "hog choker" is reported to have originated from the fact that hogs, which in some sections feed on the fish discarded on the beaches, have great difficulty in swallowing this sole, because of the extremely hard, rough scales, and are said to choke on them.

Habitat.—Massachusetts to the Atlantic coast of Panama.

Chesapeake localities.—(*a*) Previous records: Havre de Grace, Md., Potomac River and several tributaries, Cape Charles city and Norfolk, Va. (*b*) Specimens in collection: From numerous localities from Havre de Grace, Md., to the capes; taken along the shores in the summer and in deeper waters during the winter.

Family XLI.—CYNOGLOSSIDÆ. The tongue fishes

Body elongate; eyes and color sinistral (i. e., on the left side); caudal fin joined to the dorsal and anal; ventral fins, if present, free from the anal; pectoral fins wanting.

65. Genus SYMPHURUS Rafinesque. Tongue fishes

Body quite elongate; eyes and color on the left side; eyes small, very close together, without a distinct interorbital ridge; mouth rather small, twisted toward the blind side; teeth minute, in

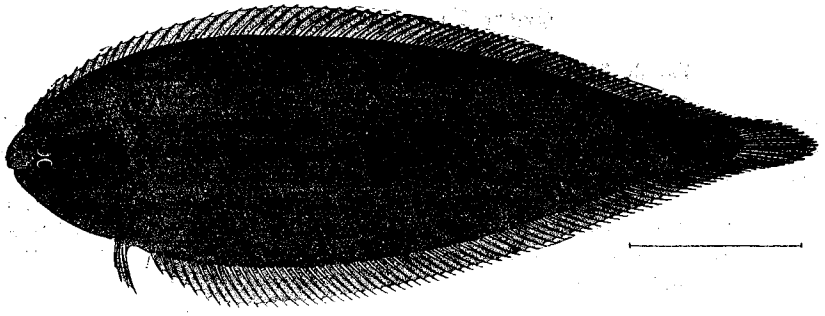

FIG. 91.—*Symphurus plagiusa*

villiform bands; gill openings rather small; the membranes joined below, free from the isthmus; scales ctenoid; lateral line wanting; vertical fins confluent; a single ventral fin present, situated on the ridge of the abdomen; pectoral fins wanting, at least in the adult. A single species of this genus comes within the scope of the present work.

85. Symphurus plagiusa (Linnæus). Sole; Tongue fish.

Pleuronectes plagiusa Linnæus, Syst. Nat., ed. XII, 1766, p. 455; probably Charleston, S. C.
Aphoristia plagiusa Bean, 1891, p. 84.
Symphurus plagiusa Jordan and Evermann, 1896–1900, p. 2710, Pl. CCCLXXXVIII, fig. 950.

Head 5.15 to 5.95; depth 2.9 to 3.3; D. 85 to 91; A. 69 to 75; scales 74 to 79. Body quite elongate; dorsal and ventral outlines about evenly convex; tail tapering; head short; snout blunt, 3.95 to 4.9 in head; eye small, 5.8 to 7.6; interorbital very narrow; mouth small, nearly horizontal; maxillary weakly developed, extending under lower eye, 3.25 to 4.6 in head; teeth in jaws small, in villiform bands, present principally on blind side; gill membranes broadly united; lateral line wanting; scales small, ctenoid; origin of dorsal slightly in advance of upper eye; dorsal and anal fin continuous with the pointed caudal; origin of anal slightly behind margin of gill opening; a single ventral fin present, situated on ventral ridge; pectoral fins wanting.

Color in life of a specimen 7¾ inches long: Brownish above, with 6 or 7 broad, dark crossbars extending from halfway to entirely across back; fins spotted with dusky markings. In some preserved specimens the crossbars have disappeared and the fins are plain.

This species is represented in the present collection by 8 specimens, ranging in length from 60 to 195 millimeters (2⅜ to 7¾ inches). The tongue fish is readily distinguished from the hog choker, the only other sole known from Chesapeake Bay, by the much more elongate body, the depth being contained about three times in the length. It also differs from its relative in having the eyes and color on the left side instead of the right; it has no fringed scales on the head, and the dorsal and anal fins are continuous with the caudal.

Little is known of the feeding habits of this species. Two examples examined had fed on annelids, small crustaceans, minute bivalve mollusks, and apparently on plants.

Nothing at all appears to be known concerning the spawning habits of the tongue fish.

This species reaches a length of only 7¾ inches, the size of our largest specimen, and it has no commercial value. It is a rare fish in Chesapeake Bay and unknown to most of the fishermen.

Habitat.—Chesapeake Bay to the northern part of the Gulf coast of Florida; rare north of Beaufort, N. C.

Chesapeake localities.—(*a*) Previous records: Cape Charles city, Va. (*b*) Specimens in collection: Off Hooper Island, off Point No Point, Md., and off Cape Charles city, Cape Charles, Old Point Comfort, and Ocean View, Va. One specimen (Ocean View) was taken in a haul seine on October 15, 1922. All the others were taken by the *Fish Hawk* in the deeper waters of the bay during January and March, 1914.

Superorder ACANTHOPTERYGII

Order THORACOSTEI

Family XLII.—GASTEROSTEIDÆ. The sticklebacks

Body elongate, somewhat compressed, tapering both anteriorly and posteriorly; caudal peduncle long and slender; mouth moderate, more or less oblique; premaxillaries protractile; skin naked or with vertically oblong plates on sides; middle or sides of abdomen shielded by the produced innominate bones; dorsal fin preceded by two or more free spines; caudal fin narrow, usually lunate; anal fin similar to soft dorsal, preceded by a single spine; ventral fins subthoracic, consisting of a strong spine and one or two rudimentary soft rays; pectorals rather short, inserted not far behind gill opening; air bladder simple; vertebræ 30 to 35.

KEY TO THE GENERA

a. Sides provided with vertically elongated bony shields; innominate bones united, forming a lanceolate plate on the middle of the abdomen ..... Gasterosteus, p. 178

aa. Sides entirely naked; innominate bones not joined, forming a ridge on each side of abdomen ..... Apeltes, p. 180

66. Genus GASTEROSTEUS Linnæus. Sticklebacks

Body elongate, compressed; tail long and slender; sides with few or many bony plates, various; innominate bones coalesced, forming a triangular or lanceolate plate on median line of abdomen; gill membranes united to the isthmus; dorsal fin with two free, nondivergent spines and a third one partly connected with the soft dorsal. A single species of this genus comes within the scope of the present work.

86. Gasterosteus aculeatus Linnæus. Common eastern stickleback; Three-spined stickleback; "New York stickleback"; European stickleback.

Gasterosteus aculeatus Linnæus, Syst. Nat., ed. X, 1758, p. 489; Europe.
Gasterosteus bispinosus Jordan and Evermann, 1896–1900, p. 748.

Head 3.3 to 3.4; depth 4 to 4.2; D. II–I, 12 or 13, A. I, 8; lateral plates 32 or 33. Body elongate, notably compressed; caudal peduncle very slender, with a prominent keel on sides, its depth less than diameter of eye, about 6 in head; head rather long, compressed; snout pointed, 3.25 to 3.5 in head; eye 2.9 to 2.5; interorbital 3.7 to 4; mouth rather small, oblique, slightly superior; maxillary

failing to reach eye, shorter than diameter of eye; sides with deep, well-developed, bony scutes; opercle finely striate; a large naked area in front of pectorals; innominate bones united, forming a narrow spinelike plate on the abdomen, somewhat shorter than the ventral spines; free dorsal spines strong, the first inserted over base of pectorals, the second the longest, nearly equal to length

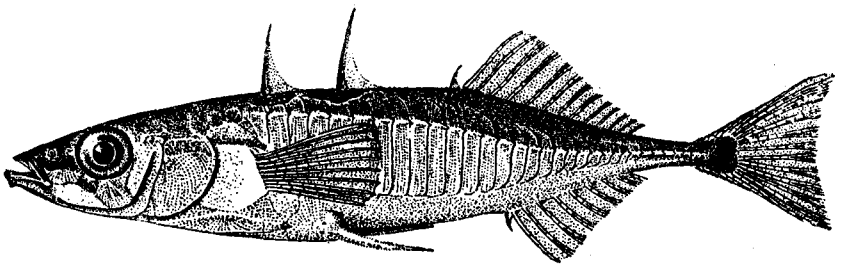

FIG. 92.—*Gasterosteus aculeatus*. From a specimen 2⅛ inches long

of snout and eye, the spine connected with soft dorsal short, the soft rays very low; caudal fin apparently slightly emarginate; anal fin similar to soft dorsal, the spine preceding it very short; ventral fins with large serrated spines, directed sidewise when set, reaching origin of anal when deflexed; pectoral fins moderate, inserted in advance of ventrals, 1.45 to 1.75 in head.

Color dark greenish above, lower parts silvery; back and upper parts of sides with indistinct dark bars, the last one of these on base of caudal.

Only two specimens, a male and female, respectively, 25 and 26 millimeters (1 inch) in length, were secured. This species is readily distinguished from the common four-spined stickleback of Chesapeake Bay by the bony plates on the sides. Published accounts give number of side plates as 28 to 33 and the number of dorsal spines as occasionally 3, rarely 4, in advance of the small spine at the base of the soft fin.

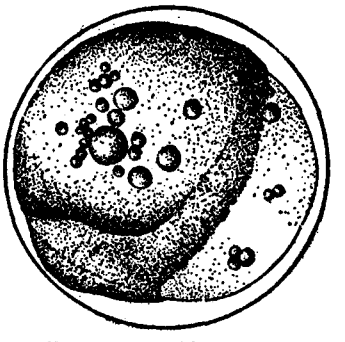

FIG. 93.—Egg with embryo

Much individual variation appears to exist among the group of mailed or partly mailed sticklebacks. Dr. W. C. Kendall, who has made an extensive study of these sticklebacks (unpublished), informs the writers that the American two-spined stickleback is doubtfully distinct from the European stickleback, and that, in any event, the name *bispinosus*, used by Jordan and Evermann (1896–1900, p. 748), is not available for this species. We therefore tentatively refer our specimens to the European species *aculeatus*.

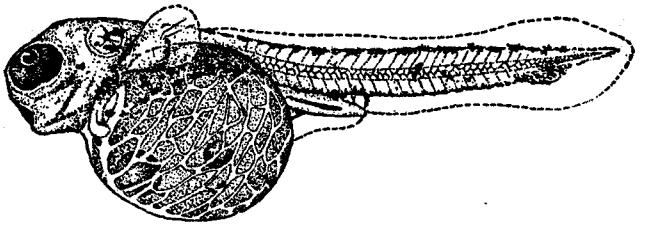

FIG. 94.—Newly hatched larva, 4.3 millimeters long

The stomachs of the two specimens at hand contained as food principally copepods; also small eggs (probably of insect origin) and fragments of alga.

Spawning apparently takes place in the spring at Woods Hole, the time being from June to July. This species, like the four-spined stickleback, is reported to build nests, in which the eggs are fanned and guarded by the male. For an account of the eggs, embryology, and larval development the reader is referred to Kuntz and Radcliffe (1918, pp. 130 to 132, figs. 113 to 121).

The species is said to reach a length of 4 inches. It is principally of northern distribution, occurring, according to Jordan and Evermann (1896–1900, p. 748), only as far south as New Jersey. Lugger (1878, p. 118), however, recorded it under the name *Gasterosteus noveboracensis*, from Sinepuxent Bay, on the Atlantic coast of Maryland. The present record appears to be the first from Chesapeake Bay, where it undoubtedly is rare.

Habitat.—Northern Europe and in America from Labrador to Virginia.

Chesapeake localities.—(*a*) Previous records: None. (*b*) Specimens in collection: Cape Charles city, Va., May 21, 1922. According to field notes by Dr. W. C. Kendall, two or three specimens were taken in the vicinity of Hampton, Va., on May 15, 1894.

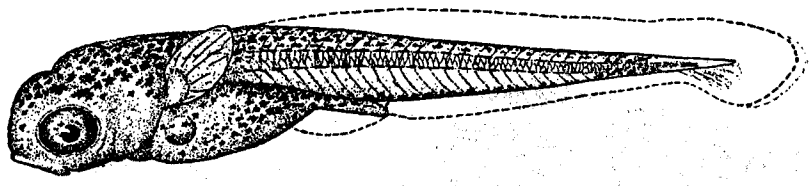

FIG. 95.—Larva 6.3 millimeters long

67. Genus APELTES De Kay. The four-spined stickleback

Body moderately elongate, somewhat compressed; tail very slender, not keeled; skin naked, no bony plates on sides; innominate bones not joined on the median line, forming a ridge on each side of abdomen; gill membranes attached to the isthmus, without free edge; two to four free spines in the dorsal; attached spine of dorsal and of anal strong; spines of ventrals strong, serrate; a bony ridge on each side of spinous dorsal. A single species is known.

87. Apeltes quadracus (Mitchill). Four-spined stickleback.

Gasterosteus quadracus Mitchill, Trans., Lit. and Philos. Soc., I, 1814, p. 430; New York.

Apeltes quadracus Uhler and Lugger, 1876, ed. I, p. 141; ed. II, p. 120; Jordan and Evermann, 1896–1900, p. 752, Pl. CXX, fig. 322; Smith and Kendall, 1898, p. 175; Evermann and Hildebrand, 1910, p. 160; Fowler, 1912, p. 55.

Head 3.6 to 4.2; depth 3.6 to 5.3; D. II to IV–I, 10 to 13 (commonly III or IV–I, 11 or 12); A. I, 8 or 9 (commonly I, 9). Body elongate, compressed, tapering anteriorly and posteriorly; caudal peduncle long and slender, not much deeper than broad, its depth less than diameter of eye, 6.6 to 10 in head; head rather long; snout pointed, its length 3 to 4.6 in head; eye 3.35 to 5.7; interorbital 4.7 to 6.8; mouth small, slightly oblique, nearly terminal; maxillary failing to reach the eye, scarcely as long as diameter of eye; teeth in the jaws small, pointed, in a single series; gill openings mostly restricted to the sides, the membranes united to the isthmus; body naked; innominate bones extending back to the vent, bounding the lower lateral edges of the abdomen; dorsal

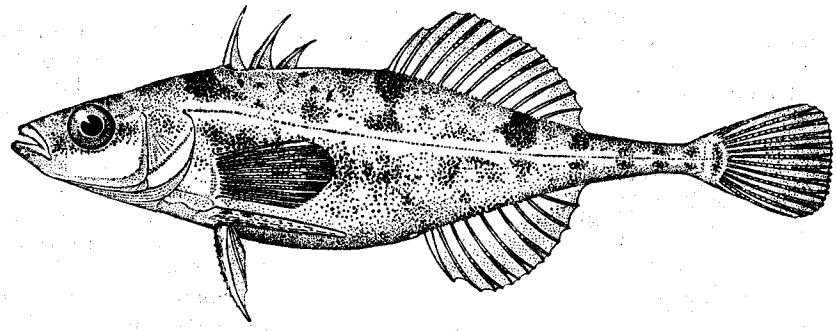

FIG. 96.—*Apeltes quadracus*

fin preceded by two to four free spines and another one largely free immediately in front of the soft rays, the free spines when deflexed fitting into a groove, strongly divergent when erect; the soft dorsal low, higher anteriorly than posteriorly; caudal fin broadly rounded; anal fin with a single nearly free spine, the soft part similar (although a little shorter) to that of dorsal; ventral fins with a strong serrated spine, pointing nearly sidewise when erect, lying on inside of innominate bone when deflexed; pectoral fins moderate, inserted almost exactly over the base of ventrals, 1.5 to 2.3 in head.

Color brownish above, mottled with darker; pale or silvery below; often an indefinite pale streak along side, with a broken dark band, extending through eye, below it; membrane of ventrals red, other fins mostly plain translucent.

This species is represented by many specimens, ranging from 25 to 65 millimeters in length. It is readily recognized by the naked body and the large stiff spines in the dorsal, anal, and ventral fins.

The food of this stickleback, according to the contents of 13 stomachs taken from specimens collected from early spring to late fall, consists almost wholly of small crustaceans, mainly amphipods.

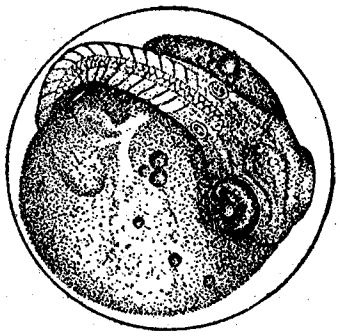

FIG. 97.—Egg with large embryo

Spawning in Chesapeake Bay takes place in the spring, apparently mainly during the last half of April and the early part of May, during which period we took many gravid fish. The sticklebacks build nests, which are guarded by the males after the eggs have been deposited.[14] The size attained is little in excess of 2½ inches.

This fish was taken in rivers and creeks and in nearly all parts of the bay along the immediate shores among vegetation. It commonly was found in company with pipefishes. It was especially abundant in quiet, brackish, grassy bays and was rarely taken along open sandy shores. On the flats of the lower Rappahannock River as many as 200 were secured in a single haul with a 30-foot seine. It is abundant as far north in the bay as Baltimore but not so common around Havre de Grace. On February 18, 1922, this stickleback was caught at three beam-trawl stations, 5 fish at a depth of 30 feet, 1 fish at 89 feet, and 1 fish at 102 feet, indicating that some of them, at least, spend the winter in the deeper waters of the bay.

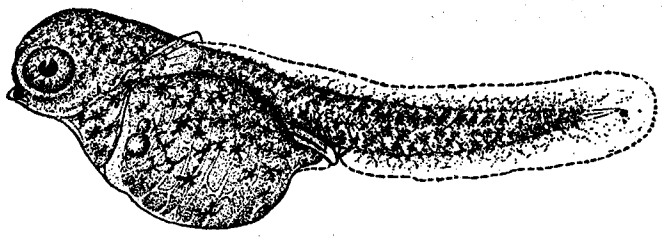

FIG. 98.—Newly hatched larva

This species is of importance only in the food that it furnishes for larger predatory fishes. It may not be easy to swallow by other fishes, however, because of its large, diverging, pungent spines.

Habitat.—Maine to Virginia, apparently reaching the southernmost limits of its distribution in Chesapeake Bay.

Chesapeake localities.—(*a*) Previous records: Fishing Creek, Big Bohemia River, Gunpowder River, Patapsco River, St. Georges Island, mouth of Windmill Creek, and Hampton. (*b*) Specimens in collection: From many points from Havre de Grace, Md., to Cape Charles and Lynnhaven Bay, Va.

Family XLIII.—SYNGNATHIDÆ. The pipefishes and seahorses

Body elongate, covered with bony rings; snout long, shaped like a tube, bearing a small mouth at the tip; jaws toothless; gill opening reduced to a small aperture near upper angle of opercle; tail long, sometimes prehensile; males with an egg pouch placed on the ventral side of the tail or under the abdomen, commonly formed by two folds of skin, meeting on the median line; dorsal fin simple, composed of soft rays only; caudal fin, if present, small; anal usually present, minute; ventrals wanting; pectorals small, occasionally missing.

[14] The eggs, embryology, and larval development of the four-spined stickleback are described by Kuntz and Radcliffe, 1918, pp. 132 to 134, figs. 122 to 126.

KEY TO THE GENERA

a. Tail not prehensile; head not shaped like that of a horse, usually in line with the axis of the body; egg pouch under the tail.....Syngnathus, p. 182

aa. Tail prehensile; head shaped like that of a horse, placed nearly at a right angle to the axis of the body.....Hippocampus, p. 185

68. Genus SYNGNATHUS Linnæus. Pipefishes

Body very elongate, 6 or 7 angled, not compressed, tapering into a long straight tail; snout long, tubelike, with a small toothless mouth at its tip; humeral bones firmly united to the "breast ring"; dorsal fin distinct; anal fin, if present, minute, placed close behind vent; pectorals present, short and rather broad. Male fishes with the egg pouch along the under side of tail.

KEY TO THE SPECIES

a. Snout rather short, 2 to 2.5 in head; dorsal fin with 35 to 41 rays, placed over 4 or 5 (rarely 3) body and 4 or 5 caudal rings; abdomen convex.....*fuscus*, p. 182

aa. Snout much longer, 1.6 to 1.85 in head.

b. Dorsal fin short, with 28 to 30 rays, placed over 1 to 1.5 body and 5.5 to 6 caudal rings; body rings 16 to 18; abdomen more or less convex.....*floridæ*, p. 183

bb. Dorsal fin rather long, with 32 to 37 rays, placed over 3 body and 5 caudal rings; body rings 20 or 21; abdomen flat.....*louisianæ*, p. 184

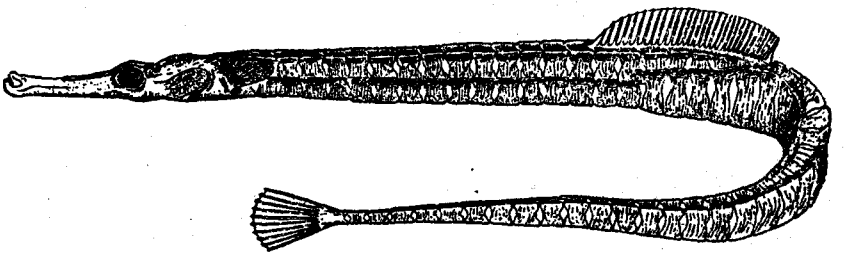

FIG. 99.—*Syngnathus fuscus*, adult

88. Syngnathus fuscus Storer. Common pipefish; "Banded pipefish."

Syngnathus fuscus Storer, Report, Fish., Mass., 1839, p. 162; Nahant, Mass.

Syngnathus peckianus Uhler and Lugger, 1876, ed. I, p. 91; ed. II, p. 76.

Siphostoma fuscum Bean, 1891, p. 84; Jordan and Evermann, 1896–1900, p. 770; Smith and Bean, 1899, p. 185; Evermann and Hildebrand, 1910, p. 160.

Head 6.5 to 8.1; D. 35 to 41; body rings 17 to 19; caudal rings 35 to 40. Body somewhat broader below than above; caudal portion quadrangular, longer than rest of body, 1.6 to 1.7 in length; abdomen convex; snout rather short, 2 to 2.5 in head; eye 5.4 to 7.6; egg pouch on 13 to 16 rings; dorsal fin long, the end of its base equidistant from tip of snout and base of caudal or more usually somewhat nearer the former, normally occupying 4 or 5 body rings and 4 or 5 caudal rings (several specimens occur in the collection in which the dorsal occupies 3+5 rings); caudal fin rather long, rounded; pectoral fins short, broad, 4 to 6.4 in head.

Color in spirits brownish above, somewhat paler below; sides more or less mottled, variable; snout usually with a dark bar on sides, passing through eye; dorsal fin sometimes more or less blotched with black; caudal fin usually dark, with a pale margin.

Numerous specimens ranging from 15 to 205 millimeters in length were preserved. The species differs notably from *S. floridæ* (the only other common species in Chesapeake Bay) in the shorter snout, the much longer dorsal fin, and in its position with respect to the number of body and caudal rings which it occupies. It apparently is distinguished from *S. louisianæ* with some difficulty.

The food, according to the contents of 18 stomachs that were examined, consists largely of small crustaceans, including principally copepods and amphipods. One individual had fed on fish fry only, another had fed on an insect, and a few stomachs contained strands of alga in addition to small crustaceans. It seems probable that the plants were taken by accident when the animals in the food were captured.

The sexes, among adults, may be distinguished by the presence in the male of a membranous pouch—a marsupium—on the ventral surface of the tail just posterior to the vent. The eggs are deposited by the female in this pouch and are retained there until they are hatched. The young are carried for some time after hatching. One preserved specimen, for example, contained young 7 millimeters (about one-third inch) in length in the pouch. Young of this length still contained a yolk sac. Another specimen had young 10 millimeters (about three-eighths inch) in length within the pouch. In larvæ of this length the yolk sac was almost completely dissolved, and it is probable that at about this size an independent existence is begun.

Spawing takes place from April to October. The height of the spawning season, judging from the number of males having pouches filled with eggs, extends from April through July. Eggs in several stages of development may be present in the marsupium at one time, although occasionally they are all of uniform development. The largest number of eggs found in the pouch of a single specimen was 570. The fish carrying these eggs was 190 millimeters (about 7½ inches) in length. The smallest number of eggs found in a pouch was 104, carried by a specimen 120 millimeters (4¾ inches) in length. The largest number of ova of uniform size and apparently nearly ripe was 860, which were removed from the ovary of a specimen 190 millimeters (about 7½ inches) in length.

This fish is common in all sections of the bay from Baltimore southward, wherever vegetation occurs; it also ascends streams to fresh water. As many as 305 were taken in eight hauls of a 30-foot seine in the lower York River. It was seined in comparatively large numbers from the time collecting began in April until October. Even as late as November 23 we found it plentiful alongshore in a few feet of water at Cape Charles. None were trawled in deep water during the summer, but as early as October 22 several were taken in 24 feet, and on the 23rd one was taken in 54 feet of water, indicating that a migration from the shore already had begun. The next trawling record occurs on November 22, when one was taken at a depth of 30 feet and two at 125 feet. On a cruise in December a number were taken from the 6th to the 10th at depths of 84 to 126 feet; from January 17 to 21 at depths of 114 to 120 feet; from February 14 to 19, 23 specimens in 11 localities at depths of 48 to 162 feet, and on March 6 seven were trawled at 66 feet. These winter catches were made in localities ranging from Baltimore to Cape Charles and Old Point. The latest spring catch made with the trawl was April 29. It is apparent from these records that the pipefish spends the winter in the deep waters of the bay and the remaining time along the immediate shores, most of the inshore migration occurring late in March and early in April and the offshore migration in November. This fish and the common four-spined stickleback, *Apeltes quadracus*, are common associates. This species is also common northward, where it is the only species of pipefish.

Habitat.—Nova Scotia to North Carolina.

Chesapeake localities.—(*a*) Previous records: St. Marys River and Riverside, Md.; Gunston, Hampton Creek, and Cape Charles city, Va. (*b*) Specimens in collection: From 96 localities lying between Baltimore, Md., and Cape Charles and Norfolk, Va.

89. Syngnathus floridæ (Jordan and Gilbert). Pipefish.

Siphostoma floridæ Jordan and Gilbert, Proc., U. S. Nat. Mus., 1884, p. 239; Key West, Fla.; Jordan and Evermann, 1896–1900, p. 766; Evermann and Hildebrand, 1910, p. 160.

Head 4.75 to 6.2; D. 28 to 30; body rings 16 to 18; caudal rings 32 or 33. Body slender, much more so in the young than in the adult; caudal portion quadrangular, usually somewhat longer than the rest of body, proportionately longer in males than in females, 1.7 to 1.95 in length; abdomen more or less convex; snout long, 1.65 to 1.85 in head; eye 6 to 11; egg pouch on 18 to 20 rings; dorsal fin rather short, the end of its base notably nearer the base of caudal than tip of snout, occupying 1 to 1.5 dorsal rings and 5.5 to 6 caudal rings; caudal fin moderate, rounded; pectoral fins short and broad, 8 to 10.2 in head.

Color in spirits dark brown above, lighter underneath; sides with gray specks; dorsal and pectorals plain translucent, the former sometimes with dark spots on the base; caudal fin usually

dark brown. Some specimens are much darker than others, the color varying according to the environment in which they were taken, as "color protection" is measurably developed in the species.

This species is represented by 120 specimens, ranging from 30 to 190 millimeters (1¼ to 7½ inches) in length. This pipefish is readily recognized by the long snout, which is notably longer than the rest of the head, and by the short dorsal, which occupies only 1 or 1.5 body and 5.5 or 6 caudal rings.

A thorough and comprehensive study of the spawning habits, as well as the embryology of this species, was made at the United States Fisheries Biological Station at Beaufort, N. C., by Gudger (1905, pp. 447 to 500, Pls. V to XI). The act of spawning—that is, transferring the eggs from the female to the marsupium of the male—was observed by Gudger in fish confined in the aquarium. Spawning apparently took place only at night and a well lighted room did not seem to interfere with the process. The fish intertwined their bodies like two letter S's, the one reversed upon the other, the bodies coming in contact at three points, including the vicinity of the vent. Quoting Gudger directly from this point, he says:

> The anal papilla, or the protruding oviduct of the female, is, at the moment of contact of their bodies, thrust into the button-hole-shaped opening at the anterior end of the marsupium. Some eggs, in number a dozen or more, now pass into the pouch and are presumably fertilized at this moment.
>
> The eggs are now in the anterior end of the pouch, and no more can be received until these have been gotten into the posterior end. To bring this about, the male performs some very curious movements. He stands nearly vertically, and, resting his caudal fin and a small part of the tail on the floor of the aquarium, bends backward and forward and twists his body spirally from above downward. This is repeated until the eggs have been moved into the posterior end of the pouch. * * * Then a short period of rest was observed to take place, which was followed by a repetition of the described process. Four alternate periods of spawning and resting were observed in one pair of fish between 10.15 and 11.06 p. m.

Gudger further says that it is not likely that the eggs are all transferred at one time: First, because of the means used in moving the eggs backward in the pouch; second, because males are frequently found with the pouch only partially filled; and third, because males with eggs at two or three stages of development are not infrequent. The ripe egg at spawning, according to Gudger, is about 1 millimeter in diameter, and the incubation period is given as about 10 days. In Chesapeake Bay male fish with eggs in the pouch were taken from May to October, indicating a protracted spawning season.

The food, according to the contents of 13 stomachs examined, consists largely of small crustaceans, including schizopods, isopods, and copepods. Two specimens also had fed on ova of unknown origin.

This pipefish was found only in the southern part of Chesapeake Bay, and it was not taken during the winter, when it probably leaves the bay for warmer waters. This species reaches the northernmost range of its distribution in Chesapeake Bay, from which it has been recorded only once previously. The maximum length attained by this species is about 9 inches.

Habitat.—Chesapeake Bay to Texas.

Chesapeake localities.—(*a*) Previous record: Hampton Creek and Cape Charles city, Va. (*b*) Specimens in collection: Crisfield, Md.; and Lewisetta, lower Rappahannock River, lower York River, Cape Charles, creek tributary to Lynnhaven Bay, and Cape Henry, Va.

90. Syngnathus louisianæ Günther. Pipefish.

Syngnathus louisianæ Günther, Cat. Fish., Brit. Mus., VIII, 1870, p. 160; New Orleans.
Siphostoma louisianæ Bean, 1891, p. 84; Jordan and Evermann, 1896–1900, p. 770; Smith and Kendall, 1898, p. 176.

This species has twice been recorded from Chesapeake Bay, but it does not occur in the present collection unless we are in error in assigning to *S. fuscus* certain specimens in which the dorsal occupies 3 dorsal and 5 body rings. The position of the dorsal in these specimens is correct for *S. louisianæ*, but the dorsal rays and body rings come within the range of *fuscus*. The specimens, furthermore, have the short snout of *fuscus*. The distinguishing characters of these forms are given in the key to the species. This pipefish undoubtedly is very rare in Chesapeake Bay.

Habitat.—Virginia to Texas.

Chesapeake localities.—(*a*) Previous record: Cape Charles city, Va. (*b*) Specimens in collection: None.

69. Genus HIPPOCAMPUS Rafinesque. Seahorses

Body compressed, tapering abruptly into a long, quadrangular, prehensile tail; head placed nearly at a right angle to the body, shaped remarkably like that of a horse; top of head with a star-shaped coronet; egg pouch of males placed at base of tail, immediately posterior to vent; dorsal fin moderate, usually placed over vent; anal fin usually present, small; pectoral fins short and broad.

91. Hippocampus hudsonius De Kay. Common American seahorse.

Hippocampus hudsonius De Kay, Fauna of New York, Fishes, 1842, p. 322, Pl. LIII, fig. 171; New York. Uhler and Lugger, 1876, ed. I, p. 90; ed. II, p. 75; Jordan and Evermann, 1896–1900, p. 777, Pl. CXXI, fig. 327; Evermann and Hildebrand, 1910, p. 160.

Head in trunk, measured over back from gill opening to end of dorsal base, 1.6 to 2.3; D. 18 or 19; A. 4; body rings 12; caudal rings 33 to 36. Body with 7 angles; the tail with 4 angles; all angles provided with blunt spines; head also with spines; snout slender, 2.3 to 2.9 in head; eye 4 to 6.2; mouth very oblique; dorsal fin over 3.5 or 4 body rings, its base 1.7 to 2.5 in head; pectoral fins about as broad as long, 3.25 to 4.5 in head.

Color in preserved specimens uniform grayish brown or with dark lines and spots on sides, the lines most prominent on sides of head; dorsal fin spotted with black, the upper part of the anterior rays of the dorsal frequently black, forming a more or less definite black spot.

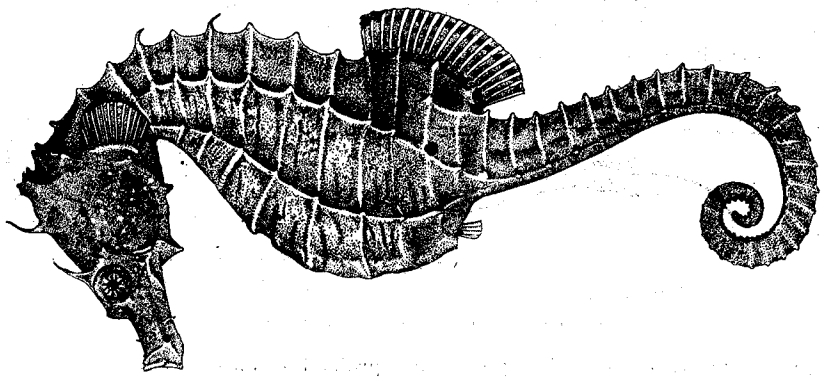

FIG. 100.—*Hippocampus hudsonius*, adult

This species is represented in the present collection by 11 specimens, varying in total length from about 40 to 150 millimeters. It is the only seahorse known from Chesapeake Bay. The southern allied species, *H. punctatus*, was once recorded from Ocean City and Somers Point, N. J., by Bean (1887, p. 134), which would indicate that stragglers may be expected, at least in the lower sections of the bay. *H. punctatus* does not have the dorsal placed wholly over body rings, the usual formula given for that species being 1½ or 2+1 or 2. The dorsal fin usually has somewhat fewer rays, although overlapping with *H. hudsonius*, the range being 16 to 18. *H. punctatus* is often profusely spotted with white or light blue, colors not occurring on *H. hudsonius*.

The food of this fish, as in the pipefishes discussed in this report, appears to consist mainly of small crustaceans. The egg pouch of the male is situated immediately posterior to the vent and it is rather short and slitlike when closed, but round when the young are about to be extruded. (Smith, 1907, p. 173.)[15]

This seahorse is not very common in Chesapeake Bay, and it was taken only from Cedar Point southward, about half of the specimens at hand having been taken in the vicinity of Cape Charles. A few specimens were taken in March with the beam trawl by the *Fish Hawk* at a depth of 150 feet. Other specimens were seined during September, October, and November. The usual length is about 6 inches; rarely a length of 7 inches is attained.

Habitat.—Massachusetts south to South Carolina, rarely straying northward to Nova Scotia.

Chesapeake localities.—(*a*) Previous records: St. Marys River, Md., and Cape Charles city, Va. (*b*) Specimens in collection: From the vicinity of Cedar Point, Md., and vicinity of Tangier Island, Yorktown, Cape Charles, and Lynnhaven Roads, Va.

[15] For an account of the early development of the seahorse see Ryder, 1882, pp. 191–190.

Order AULOSTOMI

Family XLIV.—FISTULARIIDÆ. The cornet fishes

Body very elongate, much depressed, always broader than deep; head very long, the anterior bones much produced, forming a long tube, terminating in a small mouth; both jaws and usually the vomer and palatines with small teeth; branchiostegals 5 to 7; gills 4, a slit behind the fourth; scales wanting; bony plates on various parts of the body, mostly covered by skin; a single dorsal, placed posteriorly; caudal fin forked, the middle ray produced into a long filament; anal fin similar to dorsal and opposite it; ventral fins abdominal, far in advance of dorsal, with I, 4 rays; pectoral fins small, preceded by a smooth area.

70. Genus FISTULARIA Linnæus. Trumpet fishes

The characters of the genus are included in the family description.

92. **Fistularia tabacaria** Linnæus. Trumpet fish; "Tobacco trumpet fish."

Fistularia tabacaria Linnæus, Syst. Nat., ed. X, 1758, p. 312; "Tropical America." Jordan and Evermann, 1896-1900, p. 757.

Head 2.7 to 2.8; depth 28 to 37 (10 to 13 in head); D. 14 or 15; A. 13 to 15. Body very elongate, strongly compressed; head in the vicinity of the eye quadrate, slightly broader than deep; snout very long, depressed, its length 1.35 to 1.4 in head; eye 9.8 to 11.5; interorbital (bone) 4.7 to 5.5 in

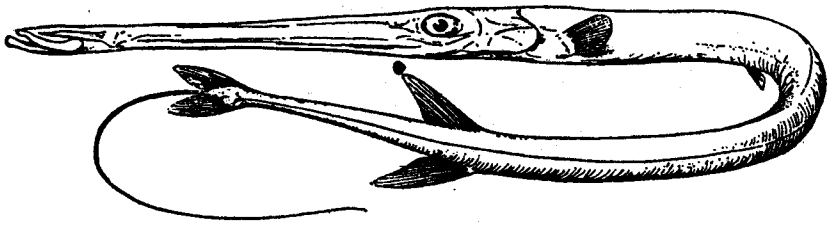

FIG. 101.—*Fistularia tabacaria*, adult

postorbital part of head; mouth oblique; lower jaw projecting; maxillary broad posteriorly, about 10 in head; skin slightly rough; lateral line posteriorly armed with bony scutes, these not evident in young; dorsal and anal fins similar, opposite each other, both somewhat elevated; caudal fin forked, the middle ray produced into a long filament; ventral fins small, inserted nearer base of caudal than tip of snout; pectoral fins rather small, 9 to 10 in head.

Color in life greenish brown above; pale below; sides with a row of blue spots close to vertebral line on back; sides and back with about 10 dark crossbars; caudal filament deep blue; the spots and bars disappearing in preserved specimens, leaving the back uniform brown.

This species is represented by four specimens ranging, without the caudal filament, from 190 to 285 millimeters (7½ to 11¼ inches) in length. This fish is peculiar in the greatly prolonged snout, which is somewhat similar to that of the pipefishes. The skin, however, is mostly naked, and the caudal fin is provided with a long filament.

The four specimens at hand had all fed on fish and one of them had also fed on shrimp and the ova probably of a fish. Its life history is virtually unknown.

The trumpet fish is interesting because of its peculiar structure, but it is without economic value. It is typically a tropical fish, said to be common in the West Indies and neighboring seas, but occasionally straying north in late summer as far as Woods Hole, Mass. Only one specimen has been recorded north of Nantucket, taken at Rockport, Mass., in September, 1865. (Goode and Bean, 1879, p. 4.) In the Chesapeake, where it is very rare, it probably enters the bay only late in the summer or early in the fall, when the water outside the capes is at its maximum temperature. The four specimens taken in this investigation were all caught on September 23, 1921, at the very end of Cape Charles in six hauls of a 250-foot bag seine. The maximum length attained is said to be about 6 feet.

Habitat.—Cape Cod to Rio Janeiro.

Chesapeake localities.—(*a*) Previous records: None. (*b*) Specimens in collection: From Cape Charles, Va. Another specimen was taken by Capt. L. G. Harron in Hampton Roads, Va., on September 18, 1899.

Order PERCOMORPHI

Family XLV.—ATHERINIDÆ. The silversides

Body rather elongate, more or less compressed; cleft of mouth moderate or rather small; teeth small, present on jaws, sometimes on vomer and palatines, rarely wanting; gill membranes separate, free from the isthmus; gills 4, a slit behind the fourth; branchiostegal 5 or 6; pseudobranchiæ present; scales moderate or small, cycloid or not; no pyloric cœca; air bladder present; dorsal fins two, the first with three to nine flexible spines, the second with one weak spine and with soft rays; anal fin similar to and usually longer than second dorsal; ventrals abdominal, with one small spine and five soft rays; sides with a silvery lateral stripe. The silversides are small fishes living in salt or fresh water.

KEY TO THE GENERA

a. Scales with smooth margins; base of dorsal and anal without scales ..... Menidia, p. 187
aa. Scales rough, with strongly lacinate margins; base of dorsal and anal each with a sheath of large decidious scales ..... Membras, p. 191

71. Genus MENIDIA Bonaparte. Smooth-scaled silversides

Margins of scales entire; no scales on base of dorsal and anal. Two species of this genus are common in Chesapeake Bay.

KEY TO THE SPECIES

a. Scales in lateral series 44 to 50 (15 to 18 oblique rows on side from upper angle of gill opening to origin of spinous dorsal); anal with I, 20 to 26 (usually 22 to 25) rays; peritoneum black ..... *menidia*, p. 187
aa. Scales in lateral series 37 to 41 (12 to 14 oblique rows on sides between upper angle of gill opening and origin of spinous dorsal); anal with I, 14 to 20 (usually 15 to 18) rays; peritoneum silvery, with or without dark punctulations ..... *beryllina*, p. 189

93. Menidia menidia (Linnæus). Silverside; "Dotted silverside."

Atherina menidia Linnæus, Syst. Nat., ed. XII, 1766, p. 519; Charleston, S. C.
Chirostoma notata Uhler and Lugger, 1876, ed. I, p. 139; ed. II, p. 119. (Probably two or more species confused.)
Menidia notata, Bean, 1891, p. 92; Smith, 1892, p. 69; Jordan and Evermann, 1896–1900, p. 800; Evermann and Hildebrand, 1910, p. 160.
Menidia menidia Kendall, 1902, pp. 262 to 264; Jordan and Hubbs, 1919, p. 52.
Menidia menidia notata Kendall, 1902, pp. 262 to 264; Fowler, 1912, p. 54.

Head, 4.15 to 4.7; depth, 4.3 to 6.95; D. III to VII—I, 7 to 10 (usual formula IV to VI—I, 8 or 9); A. I, 20 to 26 (usual formula I, 22 to 25); scales, 44 to 50 (15 to 18 oblique rows on sides between upper angle of gill opening and origin of spinous dorsal). Body variable, very slender to moderately deep and compressed; caudal peduncle rather long, its depth 2.2 to 3 in head; head depressed above, narrower below; snout moderately long, pointed, its length 2.7 to 3.75 in head; eye, 2.75 to 3.75; interorbital, 3.35 to 3.8; mouth small, moderately oblique, nearly terminal, the lower jaw being slightly included; teeth in the jaws pointed, in narrow bands, with the outer series somewhat enlarged; scales firm, with margins entire, extending somewhat on the base of caudal but not on the soft dorsal and anal; origin of spinous dorsal rather variable, sometimes about equidistant from tip of snout and base of caudal, more usually nearer the latter, the predorsal distance 1.75 to 2 in length to base of caudal; second dorsal situated over middle of anal base; caudal fin moderately forked; anal fin long, its base about an eye's diameter longer than head; ventral fins small, inserted equidistant from tip of snout and end of anal base, or more usually somewhat nearer the former; pectoral fins moderate, pointed, 1 to 1.3 in head.

Color greenish above; more or less silvery, with metallic luster in life below; sides with a bright silvery, well-defined band, about half diameter of eye, bounded above by a dark line; scales on

upper part of sides and back with numerous brownish dots; fins plain translucent; peritoneum black.

Many specimens, ranging from very small (8 millimeters) to 130 millimeters (5⅛ inches) in length, are at hand. Two subspecies are recognized from Chesapeake Bay by Kendall (1902, pp. 262 to 267). We, too, find these forms, the extremes of which differ quite markedly. Intermediate specimens, however, are at hand, and the two varieties (subspecies) intergrade perfectly. In general, the subspecies *notata*, which is greatly in the minority in the collection at hand, has a more slender body, rather more numerous scales in a lateral series, with a more forward position of the dorsal fins. The intergradations, however, are complete, and there are numerous specimens at hand that can not be said to belong to either typical form. Furthermore, the extremes as well as intermediates sometimes occur in a single lot collected in one locality within a few hours.

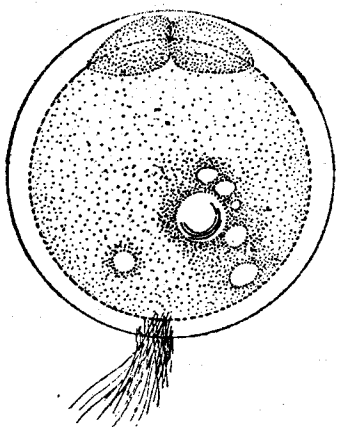

FIG. 102.—*Menidia menidia*, egg, two-cell stage

This species is recognized by the rather large size, long anal fin, rather small scales, and the black peritoneum. It is shown under *M. beryllina* that there is a slight overlapping with respect to the number of anal rays. In the present species, in 68 specimens, the following results were obtained: One specimen had 20 rays, 4 had 21, 7 had 22, 19 had 23, 17 had 24, 17 had 25, and 3 had 26 rays.

The food of this fish, according to the contents of 27 stomachs, consists largely of small crustaceans. Other foods are worms, insects, minute ova of unknown origin, and algæ.

Spawning takes place from early spring to late summer. The largest number of ripe fish, however, were taken in April and May. In 1894, Kendall (unpublished notes) stated that many ripe fish were seined from March 15 to 20 in the vicinity of Hampton and Cape Charles, Va. The eggs (Hildebrand, 1922, p. 114) are deposited in shallow water, in "grassy" areas, where the fish collect in large schools. The eggs are provided with numerous gelatinous threads of considerable length, by means of which they become attached to vegetation and other objects in the water. In this species, as in *M. beryllina*, eggs of several sizes are present in the ovary at one time, and when one size is ripe and spawned the next is already large enough to be seen clearly with the unaided eye. The protracted spawning season, together with the fact noted relative to the various sizes of eggs in the ovary, suggests that the fish may spawn more than once during a season. The eggs are spherical in form, about 1.25 millimeters in diameter, and slightly heavier than sea water. The period of incubation was about 16 days in water varying in temperature from 40° to 60° F. The newly hatched larvæ are about 5 millimeters in length and highly transparent, only a few yellowish green pigment spots being present. The fish assumes virtually all the characters of the adult when it has reached a length of 13 millimeters, and it is then readily recognized.

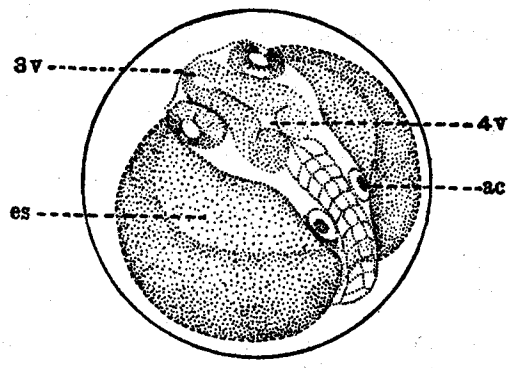

FIG. 103.—Surface view of egg of *Menidia menidia* 2 days after fertilization, water temperature 82° F. es, embryonic shield 3v, third ventricle of the brain; 4v, fourth ventricle; ac, auditory canal

This is the commonest and most abundant of the silversides, being found in all parts of the bay in both salt and brackish water. It is more salt-water in its habits than *beryllina*, rarely entering fresh water; and although the two species frequently associate in most sections of the bay, *M. menidia* is largely replaced by *M. beryllina* in the northern sections, and wholly so above the mouths of the rivers. It is among the most abundant of fishes in Chesapeake Bay and is present throughout the year. It was collected in large numbers along the shores from the time seining operations began, early in April, until late No-

vember. It probably remains near shore during most of the winter, but part of them at least retire to deeper water during the period of low temperatures, as shown by the following beam-trawl catches made in various parts of the bay: December 9 and 10, 1915, depths 108 to 126 feet; January 15 to 20, 1914, depths 33 to 162 feet; February 14 to 19, 1922, depths 46 to 162 feet; February 18 to 22, 1914, depths 33 to 150 feet; March 7 to 10, 1915, depths 50 to 63 feet; and March 21 to 23, 1914, depths 39 to 120 feet. Silversides were caught in many beam-trawl hauls during these winter months, but the aggregate catch was so small in comparison with the known abundance of the fish along shore during most of the year that it is doubtful if the deeper waters of the

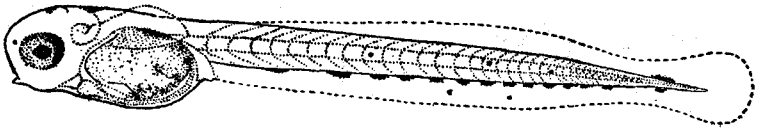

FIG. 104.—*Menidia menidia*. Recently hatched larva, 4 millimeters long

bay can be considered a wintering ground. The silverside is gregarious, usually traveling in schools of a few dozen to several hundred fish.

The largest silverside among many thousands taken in Chesapeake Bay was 5⅛ inches in length. However, it rarely exceeds a length of 4½ to 5 inches. Fish of this size could be utilized as food, but this is not done in the Chesapeake. It is of great economic importance as food for larger predatory fishes, however, notably of the striped bass.

Habitat.—Nova Scotia to the east coast of northern Florida. The variety *notata* predominates north of Chesapeake Bay and *menidia* from the Chesapeake Bay southward.

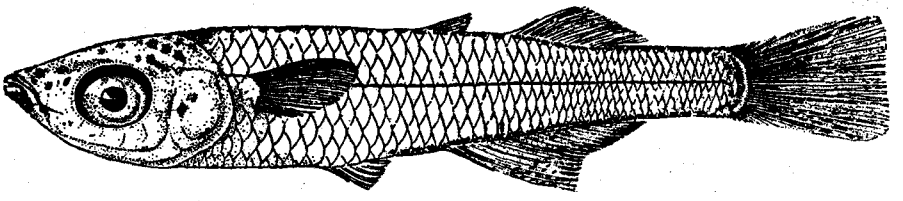

FIG. 105.—*Menidia menidia*. Young fish, 10 millimeters long

Chesapeake localities.—(*a*) Previous records: Havre de Grace, Baltimore, Riverside, lower Potomac, mouth of Rappahannock River, Fortress Monroe, Hampton, and Cape Charles city. (*b*) Specimens in collection: Many; from numerous localities from Havre de Grace, Md., to Cape Charles and Cape Henry, Va., throughout all months of the year; generally common, particularly southward.

94. Menidia beryllina (Cope). Silverside.

Chirostoma berrylinum Cope, Trans., Amer. Phil. Soc., 1866, p. 403; Potomac River, Washington, D. C.
Menidia beryllina Smith, 1892, p. 70, Pl. XX; Smith and Bean, 1899, p. 185; Kendall, 1902, p. 260; Fowler, 1912, p. 54.
Menidia gracilis Jordan and Evermann, 1896–1900, p. 797; Evermann and Hildebrand, 1910, p. 160.
Menidia gracilis beryllina Jordan and Evermann, 1896, p. 797, Pl. CXXIV, fig. 338; Evermann and Hildebrand, 1910, p. 160.

Head 3.9 to 4.7; depth 5.4 to 6.6; D. IV or V—I, 8 to 11 (usual formula IV or V—I, 9 or 10); A. I, 14 to 20 (usual formula I, 15 to 18); scales 37 to 41 (12 to 14 oblique rows on sides between upper angle of gill opening and base of spinous dorsal). Body slender, moderately compressed; caudal peduncle rather long, its depth 2.2 to 3.1 in head; head somewhat depressed above, narrower below; snout moderately pointed, its length 3.2 to 4.6 in head; eye 2.4 to 3.1; interorbital 3 to 4.1; mouth rather small, terminal, strongly oblique, moderately protractile; teeth in the jaws small, pointed, in very narrow bands; scales firm, with margins entire, extending somewhat on the base of caudal but not on base of soft dorsal and anal; origin of spinous dorsal equidistant from tip of snout and base of caudal, or somewhat nearer the latter; soft dorsal over middle of base of anal; caudal fin moderately forked; anal fin rather short, its base equal to or slightly longer than head; ventral fins rather small, inserted about equidistant from tip of snout and end of anal base; pectoral fins moderate, 1.15 to 1.45 in head.

Color pale greenish; lower parts silvery; sides with a well-defined silvery band, narrower than half the eye, bounded above by a dark line; scales on the back with numerous brown dots; fins plain; peritoneum silvery, usually with dark dots.

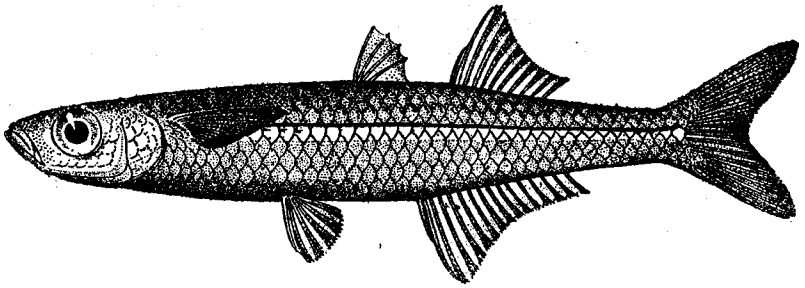

FIG. 106.—*Menidia beryllina*

Many specimens of this species are at hand, varying in length from 15 to 75 millimeters. Two varieties (subspecies) have been recognized by Kendall (1902, pp. 260 and 261), who regarded the Potomac River fish(the typical *beryllina*) as subspecifically distinct from the salt-water, coastwise form, which he named *cerea*. The salt-water form is said to have a somewhat blunter snout, less

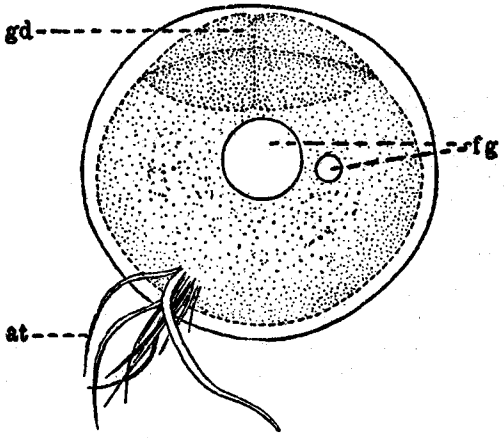

FIG. 107.—Egg, two-cell stage. *at*, adhesive threads; *gd*, germinal disk; *fg*, fat globules

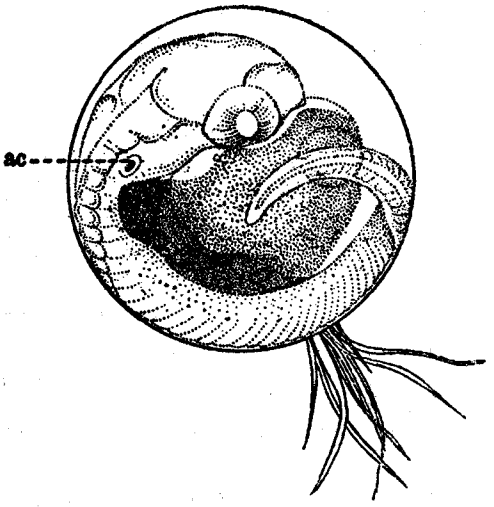

FIG. 108.—Egg with large embryo, 2½ days after fertilization; *ac*, auditory canal

compressed body, and usually a shorter caudal peduncle. The Chesapeake Bay specimens are partly from fresh, partly from brackish, and partly from salt water. The specimens, however, appear to be quite uniform, and they are here all regarded as representing the typical *beryllina*. This species is recognized by its small size, short anal fin, rather large scales, and the pale silvery

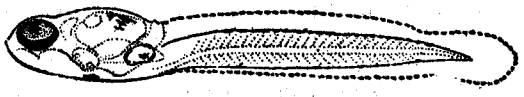

FIG. 109.—Recently-hatched larva, 3.5 millimeters long

peritoneum. The number of soft rays in the anal fin rarely overlaps with *M. menidia*. The average number, however, is quite distinct. In the present species in 156 specimens the anal fin has 14 soft rays in 2 specimens, 15 in 24, 16 in 54, 17 in 55, 18 in 11, 19 in 9, and 20 in 1 specimen. The num-

ber of scales in a lateral series, as well as the number in advance of the dorsal, appear to be quite distinct in the two species.

The food of this fish, as indicated by the contents of 20 stomachs, consists of the following, named in the order of their apparent importance: Small crustaceans, small mollusks, insects, and worms. A few strands of algæ also were found.

The spawning season of this fish is a protracted one, as ripe or nearly ripe fish were taken from April 10 to September 19, 1921. It is also quite probable that the fish spawns more than once during a season, since the female, for example, has ova of several sizes in the ovaries at one time; and when one lot of eggs is ripe those of the next largest size are big enough to be plainly visible to the unaided eye. The eggs, when spawned (Hildebrand, 1922, p. 120), are not quite spherical, and they are somewhat smaller than those of *M. menidia*, their greatest diameter being approximately 0.75 millimeters. The eggs, as in *M. menidia*, are provided with gelatinous threads, which in the present species are comparatively few in number, and one of them is always much enlarged. The eggs adhere to objects in the water by means of these adhesive threads. Hatching took place in 8 to 10 days in water varying from 78° to 82° F. The newly hatched larvæ are approximately 3.5 millimeters in length, very slender, and highly transparent.

The females appear to grow somewhat larger than the males. The maximum size, according to Chesapeake specimens, is 75 millimeters (about 3 inches) for the female and 70 millimeters (2¾ inches) for the male. The fish is abundant in the bay and it is found in association with *M. menidia*, being more fresh-water in its habits, however. It is more common in brackish than in salt water, and it ascends streams into strictly fresh water, the species having first been discovered in the Potomac River at Washington. It was not taken in deep water at beam-trawl stations. Because of its small size this silverside is of no direct commercial importance; its chief value is as food for larger predatory fish.

Habitat.—Cape Cod, Mass., to South Carolina, entering streams and fresh water.

Chesapeake localities.—(*a*) Previous records: Baltimore, Washington, Alexandria, Bryans Point, lower Potomac, Hampton, and Cape Charles city. (*b*) Specimens in collection: From many points from Havre de Grace, Md., to Cape Charles and Lynnhaven Roads, Va.

72. Genus MEMBRAS Bonaparte. Rough silversides

Margins of scales strongly lacinate; base of dorsal and anal with a sheath of large deciduous scales. The genus probably contains only two species, one from Martinique and one from the Atlantic and Gulf coasts of the United States.

95. Membras vagrans (Goode and Bean). Silverside; Sardine; Silverfish.

Chirostoma vagrans Goode and Bean, Proc., U. S. Nat. Mus., 1879, p. 148; Pensacola, Fla.

Kirtlandia vagrans Jordan and Evermann, 1896-1900, pp. 794 and 2840, Pl. CXXIV, fig. 336; Evermann and Hildebrand, 1910, p. 160.

Head 4 to 5.9; depth 4.9 to 6.7; D. IV to VI–I, 6 to 8; A. I., 17 to 22 (usual formula I, 18 to 21); scales 42 to 49. Body elongate, moderately compressed; caudal peduncle rather strongly compressed, its depth 1.1 to 1.4 in head; head rather flat above, narrower below; snout pointed, 2.85 to 3.15 in head; eye 2.5 to 3.55; interorbital 2.45 to 2.9; mouth small, oblique, strongly protractile; lower jaw included; teeth in the jaws small, pointed, in narrow bands, the outer series of teeth somewhat enlarged; scales firm, lacinate, distinctly rough to the touch in adults, the lacinations not evident in young of less than 30 millimeters; scales extending on the base of vertical fins; origin of spinous dorsal usually over origin of anal, about equidistant from posterior margin of opercle and base of caudal; soft dorsal placed over posterior part of anal base, the two fins being nearly coterminal; caudal fin moderately forked; anal fin rather long, its origin about equidistant from margin of opercle and base of caudal; ventral fins rather small, inserted about equidistant from tip of snout and base of caudal; pectoral fins pointed, the upper rays longest, 1.1 to 1.4 in head.

Color greenish on back, silvery on lower parts of side and belly; sides with a broad silvery band, bounded above by a dark line, width of band equal to about three-fourths diameter of eye; scales on the back with numerous dusky points; occipital region and tip of snout often bluish or dusky; caudal fin more or less dusky, yellowish in life; other fins mostly plain; peritoneum silvery with dusky punctulations.

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This species is represented by numerous specimens ranging in length from 22 to 115 millimeters (⅞ to 4½ inches). The young of less than 30 millimeters do not show the lacinated scales distinctly, although indications of projections on the margins of the scales may be detected under magnification. The young of this species and those of the genus Menidia, unlike the adults, can not be separated readily by the character of the scales. The present species, however, differs from *Menidia menidia* in having fewer anal rays, a character that is available in separating the young. This character, unfortunately, can not be used in *M. beryllina*, as the fin rays in that species are about the same in number as in *M. vagrans*. In these species, however, the position of the dorsal fin with reference to the anal, is helpful, for in *M. beryllina* the first dorsal is wholly in advance of the anal and the origin of the second dorsal is over about the middle of the anal. In *M. vagrans* the origin of the first dorsal is over the origin of the anal and that of the second dorsal is behind the middle of base of anal.

Two species of Membras have been described from the United States. One of these, *M. vagrans*, was supposed to represent the Gulf coast form and the other, *M. laciniatus*, the Atlantic coast form, and they were supposed to differ in the number of soft rays in the anal fin and in the number of scales in a lateral series. The Chesapeake Bay fish, according to the range assigned, therefore should be *M. laciniata*. In 119 specimens examined the number of anal rays varies from 17 to 22, 2 of this number having 17 rays, 15 having 18 rays, 30 having 19 rays, 48 having 20 rays, 19 having 21 rays, and 5 having 22 rays. The number of scales in a lateral series, in 38 specimens, varies from 42 to 50, as follows: Four specimens with 42 scales, 3 with 43, 5 with 44, 6 with 45, 4 with 46, 6 with 47, 8 with 48, 1 with 49, and 1 with 50. This range covers the extremes of both forms, as given in current works. The extremes are not covered with respect to the number of anal rays, since specimens from the Gulf coast with as few as 14 rays have been recorded; a pronounced intergradation nevertheless is evident. Smith (1907, p. 178) referred *laciniata* to the synonomy of *vagrans*. Jordan and Hubbs (1919, p. 57) show that Atlantic and Gulf specimens intergrade, but they retain the names, regarding them as representing subspecies. The data presented herein appear to show that the retention of the names as representing subspecies is scarcely tenable.

The food of this silverside, according to 13 stomachs taken from fish collected at various times and places, consists mainly of small crustaceans, and among them copepods constituted the main bulk of the material eaten. Other foods found consisted of fragments of insects and small ova of unknown origin. A few films of algæ also were found.

The spawning period in this species appears to be a protracted one, as specimens with well distended sexual organs, captured from May to August, occur in the collection. It seems probable that this silverside, like *Menidia menidia*, spawns among vegetation, to which the eggs become attached.

This fish reaches a maximum length in Chesapeake Bay of about 4½ inches. It is common in the southern part of the bay but rather rare in the northern sections. No specimens were secured during the winter months. It runs up streams to brackish water, being somewhat more salt-water in its habits, however, than *Menidia menidia*. The species is of no direct commercial importance; its main value is as food for larger predatory food fishes.

Habitat.—New York to Tampico, Mexico, if *M. vagrans* and *M. laciniata* are regarded as identical.

Chesapeake localities.—(*a*) Previous record: Cape Charles city. (*b*) Specimens in collection: From numerous localities from Havre de Grace, Md., to Cape Charles and Norfolk, Va.; common toward the mouth of the bay.

Family XLVI.—MUGILIDÆ. The mullets

Body elongate, somewhat compressed; mouth rather small, the jaws with small teeth or none; premaxillaries protractile; gills 4, a slit behind the fourth; branchiostegals 5 or 6; scales large, cycloid; no lateral line, the scales, however, with furrows forming lateral streaks; air bladder large; intestinal canal long; two short dorsal fins, well separated, the anterior one with four stiff spines; caudal fin forked; anal fin with two or three graduated spines; ventral fins abdominal with I, 5 rays. A single genus of this family of fresh-water and marine fishes, inhabiting the warmer regions of the world, occurs in Chesapeake Bay.

73. Genus MUGIL Linnæus. Mullets

Body robust, somewhat compressed; head moderate, usually about as broad as deep, scaled above and on sides; eye in adult with a strongly developed adipose membrane, small or wanting in young; mouth subinferior, oblique, the gape wide but not deep; lower jaw angulated; jaws with one or a few series of small, flexible, villiform teeth; no teeth on palatines and vomer; anal fin in very young with two spines, adults constantly with three spines, the first soft ray in the young transforming into a spine; stomach with very heavy, muscular walls, gizzardlike.

The species of this genus run in schools, frequently swimming at the surface, where their movements may be observed and whereby they betray their presence to the fishermen. Certain species, at least, have the habit of leaping from the water, sometimes clearing the water as much as 3 feet. It is from this habit that the common name "jumping mullet" has originated. Only two species of mullets are known from the Chesapeake.

KEY TO THE SPECIES

a. Anal fin with III, 8 (very young with II, 9) rays; second dorsal and anal fins with few or no scales; rows of scales on sides with dark longitudinal stripes (very young, bright silvery) ..... *cephalus*, p. 193

aa. Anal fin with III, 9 (very young with II, 10) rays; second dorsal and anal fins densely scaled in adults; rows of scales on sides without definite dark stripes (very young, bright silvery) ..... *curema*, p. 196

96. Mugil cephalus Linnæus. Striped mullet; Jumping mullet; "Jumper"; Mullet; "Fatback."

Mugil cephalus Linnæus, Syst. Nat., ed. X, 1758, p. 316, Europe; Jordan and Evermann, 1896–1900, p. 811, Pl. CXXVI, fig. 343.
Mugil lineatus Uhler and Lugger, 1876, ed. I, p. 140; ed. II, p. 120.
Mugil albula Bean, 1891, p. 92.
(?) *Querimana gyrans* Jordan and Evermann, 1896–1900, p. 818; Evermann and Hildebrand, 1910, p. 160.

Head 3.3 to 4.5; depth 3.3 to 3.75; D. IV–I, 8; A. III, 8 (young of about 50 millimeters and less with II, 9 rays); scales 38 to 42. Body rather robust, somewhat compressed; caudal peduncle rather strongly compressed, its depth 3.1 to 3 in head; head at eyes about as broad as deep; snout

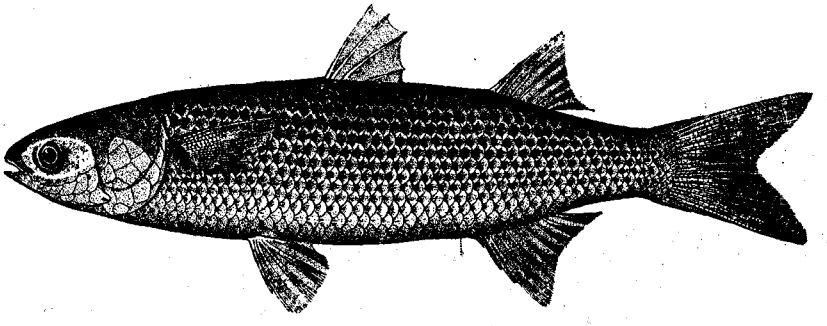

FIG. 110.—*Mugil cephalus*. From a specimen 7.1 inches long

short and broad, 4 to 6 in head; eye 3.3 to 4.2; interorbital 2.25 to 3.5; mouth moderate, oblique, the lower jaw included, the gape somewhat broader than deep; adipose eyelid strongly developed in adult, undeveloped in young; gill rakers numerous, slender, close-set; scales moderate, with crenate membranous borders, extending on caudal fin and a few on the anterior rays of dorsal and anal; origin of spinous dorsal nearer base of caudal than tip of snout in adults, the opposite being true of the young; origin of soft dorsal a little behind origin of anal; caudal fin forked, the lobes of about equal length; anal fin similar to second dorsal, but longer; ventral fins abdominal, inserted about equidistant from tip of snout and middle of anal base in adult, proportionately more posterior in young; pectoral fins not reaching opposite origin of first dorsal, 1.3 to 2 in head.

Color of adult bluish gray and greenish above, silvery below; scales on sides with dusky centers, forming dark longitudinal lines along the rows of scales; fins mostly plain, some of them more or less dusky; dorsals, caudal, and pectorals sometimes grayish green in life; axil of pectoral bluish. Young, bright silvery.

Many specimens, ranging from 28 to 255 millimeters (1⅛ to 10 inches) in length, are at hand. This species is distinguished from *M. curema* by the slightly shorter anal fin, fewer scales on the dorsal and anal fins, and by the dark stripes along the rows of scales. The young mullets of about 50 millimeters and less in length have two spines and nine soft rays in the anal. Later, however, the first soft ray is transformed into a spine. The anal count is quite constant, but Jacot (1920, p. 200) states that in rare cases the number of anal supports (spines and rays) may be either 10 or 12. The young mullets also differ notably in color from the adult, as they are bright silvery. For these reasons the young were considered as of a different genus for a long time.

The food of this mullet, according to the contents of 33 stomachs, consists of microscopic organisms, mainly of diatoms and Foraminifera, intermixed with considerable quantities of mud and vegetable débris.

Exact information as to where spawning takes place and a knowledge relating to the development of the eggs are wanting, notwithstanding that a number of investigators have made these matters a point of special study. It is known, however, that spawning takes place late in the fall and that the eggs are moderately large. In the Chesapeake region no roe mullet were observed by us and, so far as we know, none have been reported from the bay. At Beaufort, N. C., mullet with large roe (but not prime ripe) are taken mostly in October and early November. In northern Florida most of the spawning takes place during November and December. One of us (Schroeder) made

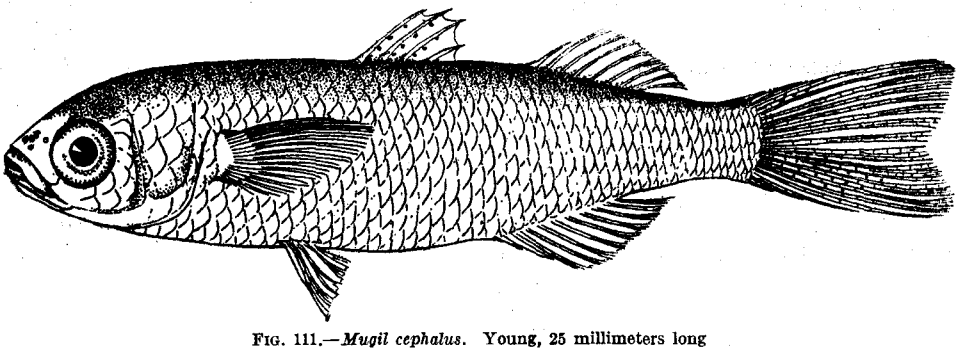

FIG. 111.—*Mugil cephalus*. Young, 25 millimeters long

a study of the spawning of the mullet in the region of Marco, on the southwest coast of Florida. Here it was found that the chief spawning period ranged from the middle of December until the end of January and that some fish spawned in February, but no fully ripe fish were seen nor was the locality of spawning found. It was evident from the appearance of the ovaries that all of the eggs were not spawned at one time.

Several fishermen in Florida have informed us that they have seen mullets spawning, and we include a description of their alleged observations in the hope that it will be an aid for future study. Capt. J. L. Sweat, of St. Petersburg, Fla., told us that since 1895 he had observed the mullet closely, and that off Indian Pass, near by, there is a locality where mullets spawn each year during the latter part of November and in December. This spawning ground is near the beach, where the water is about 24 feet deep and the bottom is of rock. The fish are so thick at the time of spawning "that a pole can scarcely be pushed through them." Captain Sweat stated that he had actually seen the spawn, and that the water was yellowish-white from the eggs and milt and "that the water smelled of fish" for some distance away. (The odor could have been caused by a flowering of diatoms.) He declared that the fish always spawn in the outside waters and not in the bays, rivers, or inlets. Some time after spawning he observed very small mullets near the spawning grounds. The fry swam so compactly that, looking down from above, they appeared like a large black ball. Several fishermen at Marco and Caxambas, Fla., agreed that mullets spawned in the outside waters and that at the time the water was "sticky and yellowish white from the eggs and milt."

We are satisfied that the mullet does not spawn in Chesapeake Bay, for the 10 to 12 inch fish that comprise the bulk of the catch in October proved to be immature. Mullets larger than these sizes seldom occur in the Chesapeake; yet spawning may take place not far from the mouth of the

bay; otherwise it is difficult to account for the schools of fry slightly more than 1 inch long present in the lower bay beginning in April. These 1-inch fry probably are found along our entire coast, from Virginia to Texas, in the spring, for we have found them in North Carolina and along various parts of the Florida coast. It is not believed that these young migrate from southern waters to Chesapeake Bay.

The growth of the mullet fry is very slow during the winter, at least in the more northern waters. At Beaufort, Jacot (1920, p. 203), on December 22, collected fish 22 to 32 millimeters long. He found them the same size during January and early February and only 24 to 36 millimeters by February 24. These represented the full range of the sizes caught during each period. Many young mullets of the following sizes were collected in Chesapeake Bay: April, 25 to 36 millimeters; May, 30 to 49 millimeters; June, 43 to 60 millimeters. At the same time, and throughout the summer and fall, larger mullets were taken as follows: April, 175 to 194 millimeters; May, 118 to 160 millimeters; June, 102 to 132 millimeters; July, 113 to 167 millimeters; August, 150 to 155 millimeters; September, 107 to 200 millimeters; October, 230 to 301 millimeters.

The growth of the young during the spring appears to be quite regular, but we are unable to follow this growth after June. It is difficult to determine the age and growth of larger fish with the limited data at hand. In the spring, schools of mullets 4 to 6 inches long are rather common; in the summer, 5 to 8 inches; and in the fall 8 to 12 inches. However, mullets 4 to 12 inches long are taken throughout this period. Jacot (1920, p. 220) believes that, according to their scales, 5 to 8 inch jumping mullets arriving in April at Beaufort, N. C., are 14 to 17 months old.

The mullets in 1920 ranked thirteenth in quantity and fourteenth in value in Chesapeake Bay, the total catch amounting to 282,020 pounds, worth approximately $10,207.

In Maryland the mullets ranked tenth in quantity and twelfth in value, the catch being 35,337 pounds, value at $1,861. Approximately 36 per cent of this amount was caught in fyke nets, 23 per cent in haul seines, 21 per cent in gill nets, and 20 per cent in pound nets. The counties taking the largest quantities were Cecil, Kent, and Somerset.

In Virginia the mullets ranked eleventh in quantity and fourteenth in value, the catch being 246,683 pounds, valued at $8,346. Approximately 85 per cent of this amount was caught with gill nets, 14 per cent with haul seines, and 1 per cent in pound nets. The counties making the largest catches were Norfolk, Elizabeth City, Accomac, and Princess Anne. It is believed that a large part of the catch credited to Norfolk County was actually taken in North Carolina waters.[16]

The striped mullet is taken in the Chesapeake from June until November. It is found in all parts of the bay, particularly on the western shore, which is considerably broken up with islands, small bays, and creeks. It is especially common in Mobjack Bay, the lower York River, Back River, and Lynnhaven Bay.

The first run of fish usually appears in the lower part of the bay some time in June. The fish at this season are scarcely large enough to make fishing profitable, however, as they are only about 5 to 7 inches in length. As the season advances the size of the fish caught increases, and by September and October, when a definite run of fish occurs, the usual length is 10 to 12 inches. Fishermen and people residing along the water front catch a large number of mullets for their own use, of which no record is obtainable. During October, when the mullets are most abundant, of fair size, and in prime condition, many are caught with small seines and salted down for home consumption during the winter months. In the vicinity of Back River and Buckroe Beach as many as six small fishing crews are commonly seen at one time during October watching for schools of mullets. As the striped mullet usually betrays its presence by its habit of jumping out of the water, a practiced eye can discern an approaching school of fish at a considerable distance. The fish usually follow the shore and therefore are captured rather easily if the fishermen use precision and speed, for the mullet is an elusive fish. It is a fast swimmer and a good jumper, and when no other avenue of escape is available many individuals often obtain their freedom by jumping over the net. (An account of the methods used for catching mullet is given by Schroeder, 1924, p. 36.) A typical crew for catching mullets for home consumption is composed of the owner of the seine and several of his neighbors, who fish together and share the catch.

[16] The catch of mullets assigned to Virginia from Norfolk County, quite certainly is too great because of the shipment of mullets from North Carolina waters through the inland waterway to Norfolk City. However, it is impossible to separate or even to estimate with a degree of accuracy the fish taken locally and those coming from North Carolina.

The entire catch of mullets is consumed locally, as it is an esteemed food fish, and if a surplus exists it is salted for future use. In the fall and winter the Baltimore and Norfolk markets receive mullets from North Carolina and Florida. During 1921 and 1922 the fishermen received from 8 to 15 cents per pound and the retail price varied from 15 to 25 cents a pound.

"Mullet," "jumping mullet," and "jumper" are the names commonly used in the bay. "Fatback" is a term apparently applied only at Cape Charles. The last-mentioned name probably alludes to the rather broad back and the layer of fat present there in the fish. Jumping mullet and jumper, of course, refer to the characteristic jumping habit of this species, to which reference already has been made.

In North Carolina the mullet is one of the principal species taken, and in Florida it is the most valuable of the many species of fish taken within the waters of that State, the catch in 1918 amounting to 35,527,840 pounds, with a value of $1,565,843.

The size of the Chesapeake mullet averages from 8 to 12 inches in length, and the maximum is about 15 inches. These sizes are considerably smaller than those attained farther south, where 20-inch fish are common and 30 inches is the maximum. Following are weights of Chesapeake Bay striped mullets: Seven and one-half inches, 2.5 ounces; 8½ inches, 4.6 ounces; 9 inches, 5 ounces; 9½ inches, 5.6 ounces; 10 inches, 6.7 ounces 10½ inches, 7.5 ounces; 12 inches, 10 ounces.

Habitat.—Warm waters of both hemispheres; on the Atlantic coast of America from Cape Cod to Brazil.

Chesapeake localities.—(*a*) Previous records: "Salt water of Chesapeake Bay," Hampton and Cape Charles city, Va. (*b*) Specimens in collection: From many localities from Love Point, Md., southward to Cape Charles and Norfolk, Va.

97. Mugil curema Cuvier and Valenciennes. Silver mullet; White mullet; Mullet.

Mugil curema Cuvier and Valenciennes, Hist. Nat. Poiss., XI, 1836, p. 87; Brazil, Martinique, Cuba. Bean, 1891, p. 92; Jordan and Evermann, 1896-1900, p. 813, Pl. CXXVI, fig. 344.

Mugil albula Uhler and Lugger, 1876, ed. I, p. 140; ed. II, p. 119.

(?) *Querimana gyrans* Evermann and Hildebrand, 1910, p. 160.

Head 3.6 to 4.1; depth 3.1 to 4.75; D. IV–I, 8; A. III, 9 (young of about 50 millimeters and less in length with II, 10 rays); scales 35 to 41. Body moderately compressed; caudal peduncle rather strongly compressed, its depth 2.1 to 2.35 in head; head at eyes scarcely deeper than broad; snout rather short, its length 4.35 to 6 in head; eye 3.15 to 4.35; interorbital 2.4 to 2.9; mouth moderate, oblique, the lower jaw included, the gape somewhat broader than deep; adipose eyelid well developed in adult, undeveloped in young; gill rakers numerous, slender, close set; scales moderate, with crenate membranous edges, extending on the base of caudal and covering almost entirely the second dorsal and anal fins; origin of spinous dorsal about equidistant from tip of snout and base of caudal; origin of second dorsal a little posterior to origin of anal; caudal fin moderately forked; anal fin similar to but longer than second dorsal; ventral fins inserted about equidistant from tip of snout and middle of anal base; pectoral fins not quite reaching opposite origin of first dorsal, 1.25 to 1.6 in head.

Color in life dark greenish on back; silvery on sides; abdomen pale; opercle yellowish; dorsals, caudal, and pectorals more or less yellowish, sometimes with dusky tips; other fins plain; axil of pectoral bluish black.

Many small specimens, ranging in length from 30 to 150 millimeters ($1\frac{3}{16}$ to 6 inches), are at hand. This species differs from *M. cephalus* in its plain coloration, having no evident dark stripes along the rows of scales; by the densely scaled, soft dorsal and anal fins; and by having one more ray in the anal fin. The differences between the young and the adults of this species appear to be similar to those described for *M. cephalus*. No doubt remains relative to the identity of the young mullets formerly recognized under the generic name "Querimana." The young of this species and *M. cephalus* can be separated nearly as readily as the adults. The number of spines and rays in the anal fins of these two mullets is quite constant but can not be relied upon wholly as a means of identification. The young of this species usually has II, 10 rays and ordinarily is readily separable from the young of *M. cephalus*, which usually has II, 9 rays in the anal fin. However, Jacot (1920, p. 200) points out that specimens of *M. curema* sometimes have 11 or 13 anal fin supports (rays or spines) and that *M. cephalus* occasionally has 10 (rarely 12) anal fin supports.

Earlier investigators appear not to have separated the young mullets of the Atlantic coast of the United States into species, but considered them all identical, calling them *Querimanna gyrans*. Bean (1903, p. 365) stated that Querimanna was nothing but the young of Mugil. He, however, placed *Querimana gyrans* in the synonymy of *Mugil trichodon*, a southern species, probably because the number of scales given by Jordan and Gilbert, who first described *Q. gyrans*, suited that species. Indeed, it is probable that *Q. gyrans*, the type of which we have not seen, was based upon the young of *M. trichodon*, as the type specimens came from Key West, where that species occurs. *Querimana gyrans* later was recorded from as far north as Cape Cod, where *M. trichodon* does not occur. Bean's reference led Smith (1907, p. 182) to say: "The present writer is inclined to accept Doctor Bean's general conclusion in the matter, but regards it as unfortunate that *Querimana gyrans* has not been shown to be the young of the striped mullet or the silverside mullet. The chief obstacle to such an identification is the difference in the number of scales in the lateral series, and until this is overcome the question must be considered unsettled." The scales in the young are quite easily lost, but in specimens from Chesapeake Bay in which they are present the usual number possessed by *M. curema* and *M. cephalus* may be counted.

The food of this mullet apparently is identical with that of *M. cephalus*, consisting almost wholly of minute organisms, which are found mixed with quantities of mud and vegetable débris.

The spawning habits of this species are as imperfectly known as in *M. cephalus*. Limited evidence has been produced (Jacot, 1920, p. 226) which would suggest that the species spawns in the spring of the year, whereas *M. cephalus* spawns in late autumn.

The growth of the silver mullet in Chesapeake Bay is difficult to follow with the limited data at hand. A single young fish taken in May measured 41 millimeters (1.6 inches), whereas the many young taken during June were 25 to 33 millimeters (1 to 1.3 inches) in length. No small fish were caught during the summer, and the next sizes at hand are 115 to 136 millimeters (4.5 to 5.3 inches), taken in September, and 95 to 148 millimeters (3.8 to 5.8 inches), caught in October. Jacot (1920, p. 203) seined young at Beaufort, N. C., 30 to 36 millimeters (1.2 to 1.4 inches) long, in May, took these sizes and somewhat larger fish throughout the summer, and young as small as 20 to 28 millimeters (0.8 to 1.1 inches) in September.

The silver mullet is taken in small quantities in Chesapeake Bay and is found under virtually the same conditions as the striped mullet. Much that has been said of the latter, therefore, applies also to this species. Neither the fishermen nor the markets distinguish the two kinds of mullets; *M. curema* forms but a very small part of the marketable catch.

This mullet seldom exceeds a length of 9 inches in the bay. Most of those seen are small unmarketable fish, 6 inches or less in length, and are taken incidentally with other species of fish. The small catch of silver mullets is included in the statistics given for the striped mullet. In southern waters the average length is about 10 inches and the maximum about 14 inches.

Habitat.—On the Atlantic coast, from Cape Cod to Brazil, and on the Pacific coast from the Gulf of California to Chile.

Chesapeake localities.—(*a*) Previous records: Cape Charles city, Hampton, and "southern part of Chesapeake Bay." (*b*) Specimens in the collection: From Annapolis, Md., lower York River, vicinity of Norfolk, and Cape Charles, Va.

Family XLVII.—SPHYRÆNIDÆ. The barracudas

Body very elongate, little compressed; head long, pointed, pikelike; mouth large, nearly horizontal; jaws elongate, the lower one strongly projecting; jaws and palatines with large teeth of uneven size; opercular bones without spines or serrations; gill membranes separate, free from the isthmus; gill rakers very short or obsolete; branchiostegals 7; gills 4, a slit behind the fourth; pseudobranchiæ well developed; air bladder large, bifurcate anteriorly; pyloric cæca numerous; scales small, cycloid, present on cheeks and opercles; lateral line well developed; first dorsal with five spines, second dorsal remote from the first, similar to anal and at least partly opposite it; caudal fin forked; pectoral fins short, placed in or below the axis of the body.

74. Genus SPHYRÆNA Röse. Barracudas

The characters of the genus are included in the family description.

KEY TO THE SPECIES

a. Scales moderate, about 120 in a lateral series; ventral fins inserted in advance of first dorsal; maxillary reaching eye in adults; pectorals reaching past base of ventrals--*guachancho*, p. 198

aa. Scales smaller, about 135 in a lateral series; ventral fins inserted under origin of first dorsal; maxillary failing to reach eye; pectorals failing to reach base of ventrals----*borealis*, p. 198

98. Sphyræna guachancho Cuvier and Valenciennes. Barracuda.

Sphyræna guachancho Cuvier and Valenciennes, Hist. Nat. Poiss., III, 1829, p. 342; Havana. Jordan and Evermann, 1896–1900, p. 824.

Head 3.4; depth 7.15; D. V–I, 9; A. I, 8; scales 120. Body very elongate, nearly cylindrical, scarcely deeper than broad at base of first dorsal; caudal peduncle moderately compressed, its depth 4 in head; head low, quadrate, with prominent ridges above; snout long and pointed, 2.1 in head; eye 6.4; interorbital 4.8; mouth large, a little oblique; lower jaw sharply pointed and strongly projecting; maxillary broad, reaching anterior margin of eye, 2.15 in head; teeth in the jaws and on palatines large, lance-shaped, the lateral ones in lower jaw smaller; gill rakers obsolete; scales small, present on cheeks and opercles, also extending on the second dorsal, anal, and caudal fins; dorsal fins far apart, the first with five slender spines, its origin behind base of ventrals; second dorsal short, its origin in advance of anal and about equidistant from origin of spinous dorsal and

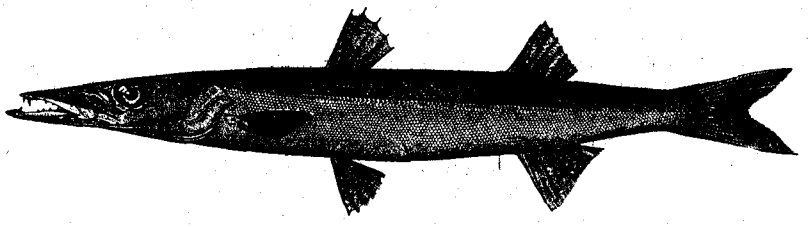

FIG. 112.—*Sphyræna borealis*. From a specimen 9 inches long

base of caudal; caudal fin forked, the lower lobe the longer; ventral fins rather small; pectoral fins small, reaching well beyond base of ventrals, 2.6 in head.

Color bluish gray above, silvery below; dorsals and caudal dusky, other fins pale. The specimen in hand is of uniform color. Some specimens, however, are irregularly blotched with black and the very young have black crossbars.

A single specimen of this species, 395 millimeters (15½ inches) in length, was secured.

This barracuda is reported from Woods Hole, Mass., but it does not appear to have been taken elsewhere north of Florida. The specimen at hand was trapped in a pound net in Lynnhaven Roads on July 11, 1921. The fish was unknown by the fishermen, which indicates that barracudas are very rare in Chesapeake Bay. This species is said to reach a length of 2 feet. In the Tropics it has some value as a food fish.

Habitat.—Woods Hole, Mass., to Panama; apparently rather rare north of Florida.

Chesapeake localities.—(*a*) Previous records: None. (*b*) Specimen in collection: From Lynnhaven Roads, Va.

99. Sphyræna borealis DeKay. Barracuda; Northern barracuda.

Sphyræna borealis De Kay, Fauna, New York, Fishes, 1842, p, 39, Pl. LX, fig. 196; New York. Jordan and Evermann, 1896–1900, p. 825; Evermann and Hildebrand, 1910, p. 160.

This species is recorded from Chesapeake Bay by Evermann and Hildebrand (1910, p. 160), who had two small specimens, 1 and 3 inches in length. Bean (1891, p. 83) states that William P. Seal observed a Sphyræna at Cape Charles city but secured no specimen. The species that was observed, therefore, was undetermined. No specimens of this barracuda occur in the present collection, and the fish quite certainly is very rare in Chesapeake Bay.

This species is distinguished from *S. guachancho* (the only other species of the genus recorded from waters north of Florida) principally by the smaller scales, the more posterior position of the ventral fins with reference to the spinous dorsal, and by the smaller mouth. A comparison of these characters is presented in the key to the species.

This is the smallest of the barracudas, rarely reaching a length of more than 1 foot. It has been called the Northern barracuda because it was thought to be entirely of northern distribution, its range having only recently been found to extend into the Tropics.

Habitat.—Cape Cod to Panama.

Chesapeake localities—(*a*) Previous records: Cape Charles city, Va. (*b*) Specimens in collection: None.

Family XLVIII.—POLYNEMIDÆ. The threadfins

Body oblong, compressed; snout conical, projecting beyond mouth; eye anteriorly placed, with a well-developed adipose eyelid; mouth large, nearly horizontal; teeth in villiform bands on jaws, palatines, and sometimes on vomer; gills 4, a slit behind the fourth; branchiostegals 7; lateral line complete, continued on caudal fin; dorsal fins 2, rather remote from each other, the first with 7 or

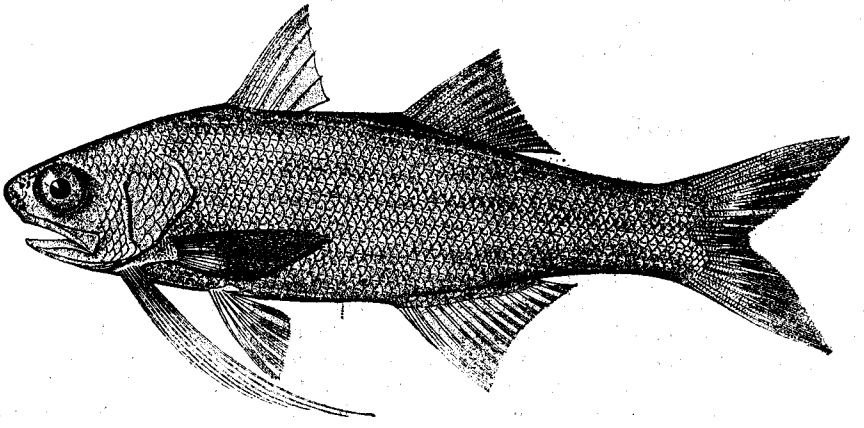

FIG. 113.—*Polynemus octonemus*

8 rather high, feeble spines; caudal fin deeply forked; anal fin either similar to second dorsal or much longer; ventral fins abdominal, with I, 5 rays; pectoral fins placed low, in two parts, the lower part consisting of free articulated filaments.

75. Genus POLYNEMUS Linnæus

Vomer with teeth; preopercle serrate, its lower posterior angle with a scaly flap; anal fin not much longer than second dorsal, consisting of about 13 or 14 rays; pectorals with 3 to 9 free filaments, all shorter than body. A single species was taken in Chesapeake Bay.

100. Polynemus octonemus Girard. Threadfin.

Polynemus octonemus Girard, Proc., Ac. Nat. Sci., Phila., 1858, p. 167; Brazos, Santiago, and Galveston.
Ploydactylus octonemus Jordan and Evermann, 1896–1900, p. 830, Pl. CXXVIII, fig. 350.

Head 3.25 to 3.4; depth 3.1 to 3.35; D. VIII–I, 12; A. III, 13; scales about 58 (most of the scales are lost in specimens at hand). A fairly accurate count, however, is obtainable from one specimen, which gives the result stated when counting oblique series running upward and backward above lateral line. Jordan and Evermann (1906, p. 830) give 70 scales in a lateral series. It is probable that these authors started counting the series from the nape. Gill (1860, p. 280) states that the lateral line runs through 60 scales. Body compressed; caudal peduncle rather strongly compressed, deep, 2.2 in head; head moderate, compressed; snout conical, projecting far beyond mouth, its length 5.3 to 5.55 in head; eye 4.75; interorbital 4 to 4.3; mouth moderate, inferior, horizontal; maxillary broad, 2.35 to 2.45 in head; teeth small, in villiform bands on jaws, vomer, and palatines;

gill rakers long, 21 or 22 on lower limb of first arch; scales moderate, ctenoid, moderately deciduous, extending forward on snout and on fins, the second dorsal and anal densely scaled; lateral line complete, forked at base of caudal, the branches extending on the fin; origin of spinous dorsal a little behind margin of opercle and about an eye's diameter nearer origin of second dorsal than tip of snout; the longest spine 1.4 in head; origin of second dorsal a little in advance of anal; caudal fin deeply forked; anal fin similar to second dorsal, its base only a little longer; ventral fins rather small, inserted about an eye's diameter nearer origin of anal than tip of lower jaw; pectoral fins rather long, 1.15 in head, the filaments well separated from the rest of the fin, eight in number, the longest ones reaching nearly to origin of anal.

Color in alcohol olivaceous; the fins dusky, the pectoral fins darkest. The fins are said to be mostly pale in the young.

Only three specimens of this species—respectively, 233, 233, and 235 milimeters (9⅛, 9⅛, and 9⅜ inches) in length—are at hand. This fish, although recorded from as far north as New York, does not appear to have been taken previously in Chesapeake Bay, where it is scarcely known by the fishermen. The specimens at hand were the only ones seen during extensive collecting expeditions, and they were trapped in a pound net in Lynnhaven Roads, Va. The species of this genus are considered good food fishes on the Isthmus of Panama, where several species are abundant.

Habitat.—New York to the Rio Grande.

Chesapeake localities.—(*a*) Previous records: None. (*b*) Specimens in collection: From Lynnhaven Roads, Va.

Family XLIX.—SCOMBRIDÆ. The mackerels

Body fusiform, more or less compressed; head depressed above; snout pointed; caudal peduncle slender, with one or more keels; mouth large; premaxillary not protractile; maxillary without a supplemental bone; jaws with large or small sharp teeth; preopercle unarmed except in very young; opercle entire; gill openings large, the membranes separate, free from the isthmus; gills 4, a slit behind the fourth; pseudobranchiæ large; gill rakers long; dorsal fins 2, the first of weak spines, the second similar to anal, followed by detached rays, known as finlets; caudal fin large, forked.

Scombroid fishes of the Orient have recently been studied in great detail by Kishinouye,[17] who has grouped the fishes of that region into three families, placing (of the genera represented in the present report) Scomber in Scombridæ and Sarda in Cybiidæ. Scomberomorus, however, does not occur in the Orient, hence this genus is not included in Kishinouye's work. It seems probable that a detailed study would show this genus to be as distinct and equally as much deserving of family rank as some of the groups recognized as families by Kishinouye. While we do not question the arrangement of families in Kishinouye's very excellent work, we prefer to retain in this report the family Scombridæ as understood by Jordan and Evermann (1896–1900 p. 863) and others, principally because we do not know where to place *Scomberomorus* in the new arrangement and we have neither the time nor specimens to go into a study of this matter on this occasion.

KEY TO THE GENERA

a. Caudal peduncle without a median lateral keel but with two small keels, one above and one below the median line and placed more or less on base of caudal; first dorsal with 9 to 14 feeble spines.
  b. Air bladder wanting; first dorsal with 10 to 14 weak spines ..... Scomber, p. 201
  bb. Air bladder present; first dorsal with 9 or 10 weak spines ..... Pneumatophorus, p. 202
aa. Caudal peduncle with a median keel on each side and with a smaller one above and below this one; dorsal fin with 14 to 22 spines.
  c. Scales not forming a corselet on anterior part of body; pectorals inserted near level of the eyes; sides sometimes with yellowish spots and occasionally with one or more straight dark lines ..... Scomberomorus, p. 203
  cc. Scales forming a corselet; pectoral fins placed lower than eye; sides without yellow spots.
    d. Vomer toothless; sides with black longitudinal oblique bands ..... Sarda, p. 205
    dd. Vomer with villiform teeth; sides without black longitudinal bands ..... Thunnus, p. 207

[17] Contributions to the comparative study of the so-called scombroid fishes. Journal, College of Agriculture, Imperial University, Tokyo, Vol. VIII, No. 3, (1923), pp. 293 to 475, Pls. XIII—XXXIV, fig. A–Z. Tokyo.