

large, the mandible projecting well beyond snout, the jaws closing; lips rather thick and fleshy, concealing the teeth; teeth compressed, sharply pointed, in a single series in jaws, some of those in anterior part of jaws canine-like; vomerine teeth developed as 2 or 3 large depressible fangs on anterior part of roof of mouth; anterior nostrils in small tubes at tip of snout, posterior nostrils above anterior margins of eyes; interorbital space convexly flattened; gill-opening rather large, about equal to eye; skin smooth, tough, with some longitudinal wrinkles upon lower surface of head; a number of pores on head; lateral line complete; origin of dorsal midway between corner of mouth and gill-opening; caudal small, roundly pointed.

Color in life, dull reddish brown, marked above and on side with a number of slightly darker fine lines; about 22 vertical crossbars of deep rich brown as broad as space between them, and even still broader on posterior portion of tail; belly and lower surface of head light, though the broad dark vertical bands on sides meet, being narrowly constricted in the center, the edges at these places white; wrinkles on throat with dark lines; edge of dorsal fin blackish and white alternately, the dark bands forming a black margin on each side of which is a white spot, between which and the succeeding white spot is a blackish blotch, though only upon the edges of fin; anal similar, but with the white

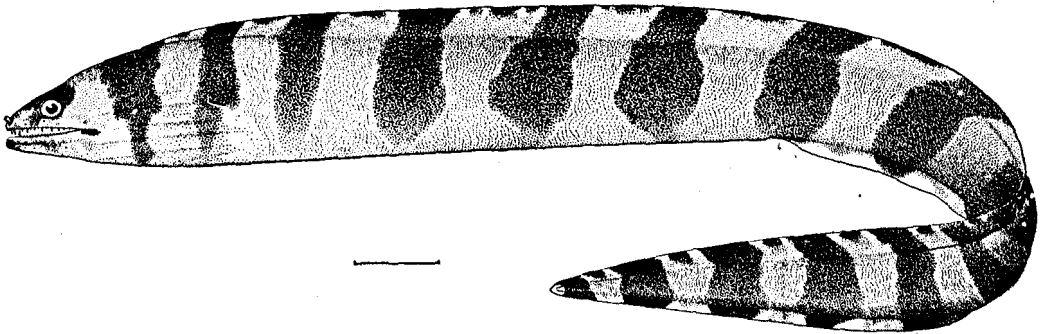


FIG. 27.—*Gymnothorax petelli* (Bleeker). Type of *G. leucacme* Jenkins.

tracts predominating and without any of the general body color. When fresh the specimen showed a bright chrome-yellow area from near end of snout backward between eyes, over top of head, to and encroaching on first brown band. Smaller examples do not show this yellow.

The above description is based upon a specimen (No. 03513) 28 inches long, from Honolulu, from which locality we have several other examples. The specimens vary some in respect to the bands meeting on the belly, in many cases only the posterior ones being joined. Two examples obtained at Honolulu in 1889 by Dr. Jenkins have the white tracts on the edge of the anal very distinct.

Specimens were also obtained by the *Albatross* at Honolulu in 1902. The 7 specimens which we have examined, all from Honolulu, range in length from 20 to 30 inches. The species is common at Samoa.

Muraena petelli Bleeker, Nat. T. Ned. Ind., XI, 1856, 84, Java.

Gymnothorax leucacme Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1904), 427, fig. 7, Honolulu. (Type, No. 50682, U. S. Nat. Mus.); Snyder, op. cit. (Jan. 19, 1904), 518 (Honolulu).

59. *Gymnothorax steindachneri* Jordan & Evermann. Fig. 28.

Head 7.3 in length; depth 9.5; eye 9.5 in head; snout 5; interorbital 7.2; gape 2; distance from tip of snout to vent less than distance from vent to tip of tail by more than half length of head.

Body moderately long and slender, much compressed; head small; snout small and pointed, the anterior dorsal profile concave above the eyes; the nape and sides of head much swollen; gape long, extending far behind eye; lower jaw shorter than the upper, curved so that the mouth does not quite completely close; lips moderately thick, entirely covering the teeth in the closed mouth; eye small, about midway between tip of snout and angle of mouth; teeth on sides of upper jaw in a single series, rather close-set, short, compressed, triangular canines, those in front scarcely enlarged; vomer with a single row of bluntly rounded teeth; each side of lower jaw with a single series of rather strong, back-

wardly directed canines, the anterior ones somewhat enlarged, those on tip of jaw movable; anterior nostril in a long tube, its length about half diameter of eye, situated near tip of snout just above lip; posterior nostril without tube, just above anterior edge of eye; pores on sides of jaws inconspicuous. Origin of dorsal fin about midway between gill-opening and angle of mouth, its height about equal to length of snout; anal similar to soft dorsal, but much lower; tail moderately slender and pointed; a series of inconspicuous pores along middle of side; gill-opening a long oval slit exceeding diameter of orbit.

Color in alcohol, pale brown or whitish, sprinkled with ragged or dendritic brown spots formed more or less into irregular vertical blotches or crossbands; margins of fins narrowly creamy white or yellowish, that of the anal much wider; corner of mouth and space about gill-opening deep blackish-brown; about 5 longitudinal blackish-brown grooves on lower side of head; under side of lower jaw with 2 blackish longitudinal lines which meet at an acute angle under chin; throat and belly creamy white, with few scattered brownish markings; sides and top of head whitish, with small, sparingly scattered, irregular brownish spots most numerous around and between the eyes.

This species is related to *G. kidako* (Schlegel), from which it differs much in coloration, being much paler and less reticulated, the angle of the mouth with more black, the gill-opening surrounded

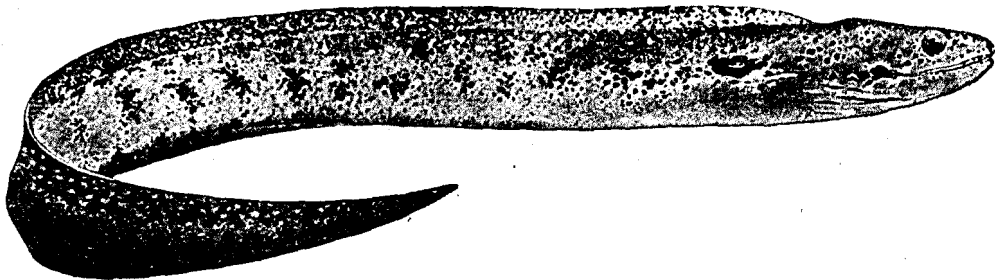


FIG. 28.—*Gymnothorax steindachneri* Jordan & Evermann; after Steindachner.

by a broad black area (nearly or quite absent in *kidako*), and the white border to the dorsal fin much more distinct.

The specimens from Laysan, which Dr. Steindachner identified with *Muraena flavimarginata* Rüppell, and of which he gives a good figure, evidently belong to this species. As suspected by Dr. Steindachner, the species is quite different from *G. flavimarginatus*, of which we have examined several specimens from Pedang, on the west coast of Sumatra, from Samoa, and from Hawaii.

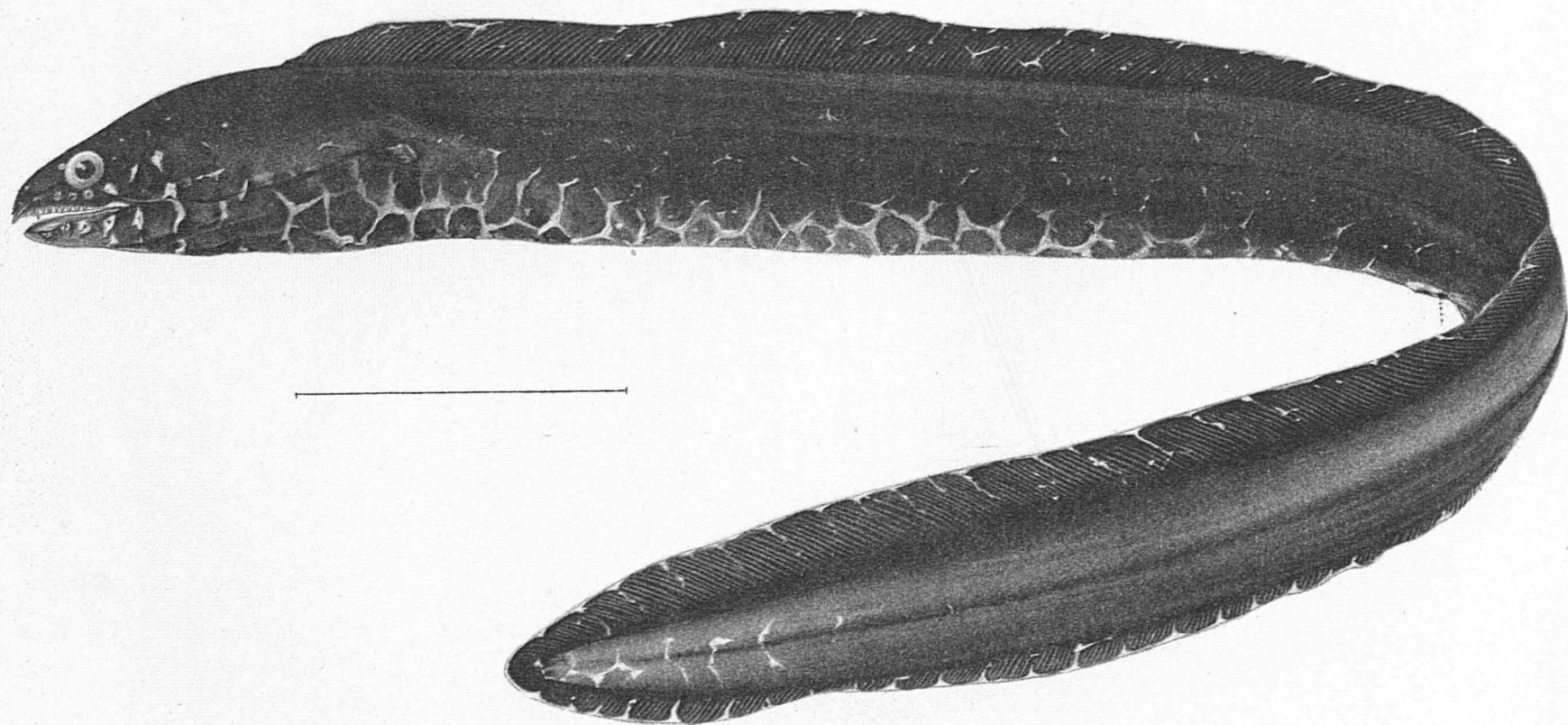
This description is based upon a specimen (No. 03775) 2 feet long, from Honolulu. (Type, No. 50616, U. S. Nat. Mus.) The species is known from the 2 specimens which Dr. Steindachner had from Laysan, 8 obtained by Jenkins in 1889 at Honolulu, 1 by the *Albatross* at Honolulu in 1891, 3 secured by us at Honolulu in 1901, at least 1 recorded by Mr. Snyder from Honolulu in 1902, and others recently sent us from Honolulu by Mr. Berndt.

Muraena flavimarginata var., Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 514, pl. VI, fig. 3 (Laysan); not of Rüppell. *Gymnothorax steindachneri* Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (Apr. 11, 1903), 166, Honolulu; Jenkins, op. cit. (Sept. 23, 1903), 426 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 518 (Honolulu).

60. *Gymnothorax hilonis* Jordan & Evermann. Plate 18.

Head 8.2 in length; depth 16; eye 7 in head; snout 6; interorbital 6; gape 2.4; distance from tip of snout to vent 1.2 in distance from vent to tip of tail.

Body rather short, moderately compressed, the tail more compressed and bluntly pointed; head short, the nape swollen; interorbital space broad; a distinct median groove from near tip of snout to origin of dorsal; angle of mouth posterior to eye a distance equal to eye's diameter; lower jaw but slightly curved, shorter than the upper; front of upper jaw with 3 short, bluntly pointed, movable teeth; side of upper jaw with a single series of short, pointed canines directed backward; shaft of vomer with short, blunt teeth; lower jaw on each side with a single series of rather long, pointed canines, longest in front and curved backward; anterior nostril in a long tube, about 2 in eye, near tip of snout just above lip; posterior nostril small, round, without tube, situated just above anterior part



GYMNOTHORAX HILONIS JORDAN & EVERMANN. TYPE.

of eye; gill-opening small, its direction obliquely forward toward nape; a series of 4 pores on each side of upper jaw; similar pores on lower jaw. Origin of dorsal fin on nape midway between gill-opening and middle of eye; dorsal fin well developed, its greatest height somewhat exceeding length of snout; anal similar to dorsal, but lower.

Color in alcohol, rich velvety black above, paler below where it is marbled and reticulated with narrow white lines; series of pores on side of upper jaw and those on tip of lower, white; cheek with a few irregular white spots; gill-opening whitish; side of body anteriorly with some small white specks and irregular whitish markings; lower jaw with larger, oblong, white cross-lines; dorsal fin rich brownish black, the edge posteriorly with a narrow, irregular, white border, sometimes interrupted by black; anal brown, with a narrow white edge from which extend narrow intrusions of white, some reaching base of fin; end of tail with a few small white spots, the tip narrowly white.

The only known example of this species is the type, No. 50618, U. S. Nat. Mus. (field No. 04902), a specimen 9.5 inches long, obtained at Hilo, Hawaii.

Gymnothorax hiltonis Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (Apr. 11, 1903), 167, Hilo.

61. *Gymnothorax nuttingi* Snyder. Plate 15, fig. 1.

Head, measured from tip of snout to gill-opening, 6.9 in length, 3.6 in head and trunk, 3.3 in tail; depth 2 in head; cleft of mouth 2.2; snout 5.2. Snout rounded, jaws equal, closing completely; lips very thick; teeth in a single series, firmly embedded, close-set, largest below middle of snout, growing gradually smaller posteriorly, basal halves with finely serrated edges; no median fangs; vomer with very short, blunt teeth; eye on a vertical passing midway between tip of snout and corner of mouth; distance between eyes 1.35 in snout; anterior nostril tube 2 in eye; posterior nostril located above and just anterior to margin of eye, its opening with a low rim; gill-opening a narrow slit equal to vertical diameter of eye, situated on a level with pupil; origin of dorsal on a vertical anterior to gill-opening a distance equal to length of snout, the membrane fleshy, though not greatly thickened; height in region of vent equal to length of snout; anal inserted immediately behind vent, its height near middle of tail equal to diameter of orbit; tail not slender and pointed, but rather stubby, the dorsal, caudal, and anal forming a bluntly rounded terminal fin.

Color in spirits brown, covered with white spots, those on head minute and close together, scarcely discernible on snout and end of lower jaw; spots on the body larger and more elongate, growing round on tail, where their diameter is about equal to half that of pupil; gill-opening and corner of mouth brown; dorsal spotted like tail, the spots on edge of fin elongate, narrow, and close together, coalescing posteriorly to form a white border; anal spotted, with a white border.

The species is represented by a single individual 31 inches long, obtained in the Honolulu market.

Of the spotted Hawaiian eels this species can only be confused with *Gymnothorax goldsboroughi*, which may be distinguished at a glance by its slender, pointed tail, the larger, circular spots, and dark throat-patch, which are its most striking characters.

Gymnothorax nuttingi Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 518, pl. 4, fig. 7, Honolulu. (Type, No. 50866, U. S. Nat. Mus.)

62. *Gymnothorax pictus* (Ahl). "*Puhi kapa'a*." Plate 19.

Head 2.75 in trunk; head and trunk about equal to tail; eye a little over 2 in snout, 1.3 in interorbital space; mouth 3; snout 5.5 in head; interorbital space 9.5.

Body rather thick, roundly compressed; tail tapering rather thickly posteriorly; head compressed, somewhat swollen above, pointed in front; snout rather long and pointed, tip somewhat blunt; eye small, about midway between tip of snout and corner of mouth; mouth large, horizontal, closing, teeth concealed by the thick lips, snout projecting slightly beyond mandible; teeth powerful, in a single series in jaws, directed backward; teeth on vomer rounded; anterior nostrils in short tubes; posterior nostrils above eye in front; interorbital space convex; skin tough, thick, a number of pores on head; no lateral line; origin of dorsal in last fifth of space between corner of mouth and gill-opening; dorsal rather high; caudal short and rounded.

Color in life (No. 03394), light olive dusted with black, the spots forming marblings posteriorly; no black on gill-opening; no dark or light edge on dorsal fin; a slight pale margin on anal; belly pale; no black at angle of mouth.

Color in alcohol, deep brown above, everywhere clouded and mottled with darker, also marked with very fine pale broken reticulations, and sides with rather large blotches of deep brown; lower surface of body soiled whitish; gill-openings pale.

This description is based chiefly upon an example (No. 03724), 28 inches long, from Kailua, Hawaii. Our collection contains 8 fine specimens (Nos. 03710, 03711, 03717, 03720, 03721, 03722, 03724, and 03725) from the same place, and one (No. 03394) from Honolulu. Other specimens were obtained by the *Albatross* in 1902 at Honolulu and Puako Bay, Hawaii.

Length 2 to 4 feet; our specimens range from 22 to 40 inches. This species is subject to considerable variation, the form with coarser and darker markings being the *M. sidera* of Richardson.

Muraena picta Ahl, De Muræna et Ophichto, Dissert., III, 8, pl. 2, fig. 2, 1789, East Indies.

Gymnothorax pictus, Bloch & Schneider, Syst. Ichth., 529, 1801 (after Ahl); Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 518 (Honolulu; Puako Bay, Hawaii).

Muraenophis pantherina Lacépède, Hist. Nat. Poiss., V, 628, 641, 613, 1803, no locality given.

Muraena variegata Quoy & Gaimard, Voy. Uranie, Zool., 246, pl. 52, fig. 1, 1824, Guam.

Muraena sidera Richardson, Voy. Erebus and Terror, Fish., 85, 1846, Australia.

Muraena pfeifferi Bleeker, Nat. Tyds. Nederl. Ind., V, 1853, 173, Macassar; Ceram.

Sidera pfeifferi, Kaup, Cat. Apod. Fish., 70, 1856 (Ceram, Macassar, Celebes).

Sidera pantherina, Kaup, Cat. Apod. Fish., 71, 1856 (Australia, New Guinea).

Gymnothorax pantherinus, Bleeker, Ned. Tyds. Dierk., I, 152, 1863 (Batjan).

63. *Gymnothorax xanthostomus* Snyder. Plate 14, fig. 2.

Head, measured to gill-opening 8 in length, 4.5 in tail; depth 1.46 in head; snout 5; cleft of mouth 1.6. Snout acutely rounded, lower jaw projecting slightly; profile from tip of snout to interorbital area convex and gently rising, that of occipital region rising abruptly, nuchal muscles well developed; diameter of eye 2.5 in snout; width of space between eyes 1.3 in snout; mouth closing completely, the cleft extending about one-third its length beyond posterior margin of orbit; teeth of jaws in a single series, close set and firmly imbedded; those at symphysis small; lateral ones large anteriorly, growing gradually smaller posteriorly, the basal two-thirds of their edges denticulate; a median, depressible canine near tip of upper jaw; vomer without teeth; anterior nostril tube equal in length to diameter of pupil; posterior nostril with a minute rim; gill-opening oval, the diameter equal to 1.5 times that of eye, the lower margin on a level with mouth. Origin of dorsal on a vertical passing midway between corner of mouth and anterior edge of gill-opening, membrane fleshy; height of fin near vent, 1.33 in snout; anal inserted immediately behind the vent, where it is but a low ridge of skin, much higher and less fleshy posteriorly, height near its middle portion equal to half the length of snout; caudal slightly longer than diameter of eye.

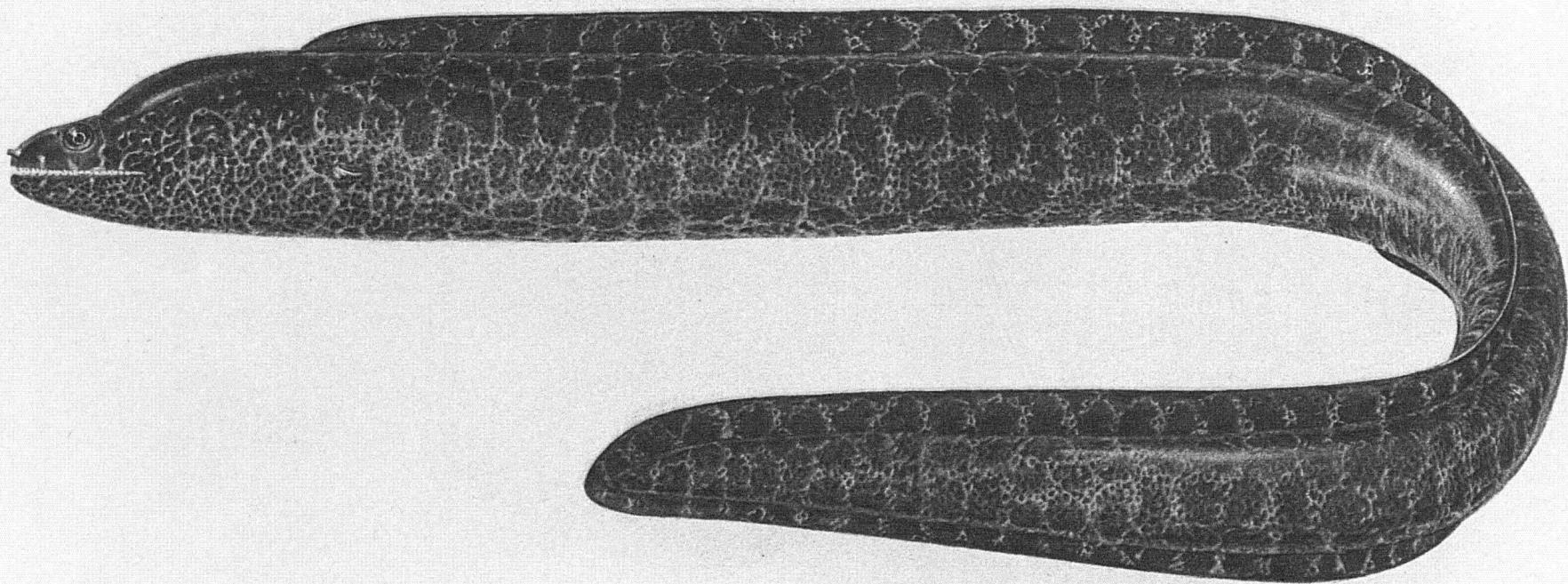
Color in life, yellowish olive on anterior third, becoming a rich brown posteriorly; head and body covered with conspicuous, light, ocellated spots, the light part of which is clearly defined, the dark part more intense next the white, growing diffuse without; spots on head very small, 0.1 to 0.2 diameter of eye, placed from 1 to 3 times their width from each other, their centers tinged with yellow; behind the gill-opening the spots grow rapidly larger for a short distance, then very gradually increase in size to the tail, where they are nearly as large as the eye and 1 to 2 or 3 times their diameter apart; posteriorly and on the fins the spots are pure white or cream colored; opercles with a brownish black margin; mouth, within and at corners, bright lemon-yellow.

The color in alcohol differs but little from that of the living example.

Described from the type, No. 50869, U. S. Nat. Mus., 35.83 inches long, obtained in the Honolulu market. Two other examples were obtained from the same place; one agreeing closely with the type, except that the lower jaw projects beyond the upper a distance equal to the diameter of the eye. The belly is without spots. The other (cotype, No. 12792, L. S. Jr. Univ. Mus.) has the body very thick and robust, nuchal region greatly enlarged; head 7.46 in length, 4.35 in tail; depth 1.67 in head.

This species may be known from all other Hawaiian eels by the yellow mouth and the very large, dark-bordered, white spots in few rows.

Gymnothorax xanthostomus Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 519, pl. 5, fig. 10, Honolulu.



GYMNOTHORAX PICTUS (AHL).

Genus 57. EURYMYCTERA Kaup.

The tube of the anterior nostril stretches considerably beyond the lips, and its tip is dilated above and below; posterior nostril surrounded by a funnel-formed border, and situated before the eye.

This genus differs from *Gymnothorax* in the slender, acuminate snout.

Eurymyctera Kaup, Apodes, 72, 1856 (*crudetis*).

64. *Eurymyctera acutirostris* (Abbott).

Head much compressed, the facial outline moderately oblique; eye large, circular, equal to 0.2 of length of side of head, measuring from angle of jaws; jaws greatly attenuated, very slender, the lower somewhat the smaller and with a gentle upward curve at its extremity; teeth uniserial, compressed, very acute, the palatines, vomerines, and mandibulars all inwardly directed; the palatine teeth 13, of a uniform size, the series commencing below center of orbit and terminating shortly anteriorly to angle of jaws; 12 compressed acute teeth upon vomer in a direct line, the anterior tooth much the largest; mandible with 26 teeth upon each side, the anterior 4 of each side being nearly 3 times the others in size, more widely set, the posterior pair with a single, compressed, very small tooth between them; nasal teeth 14, widely set and from 3 to 5 minute teeth between each pair; 3 teeth placed upon mesial line, the second one very slender and the longest tooth in mouth; the third twice as great in circumference, and but little shorter than the second tooth; orbits one diameter distant, and the distance from upper edge of orbit to facial outline equal to distance between lower margin of orbit and free edge of upper lip; gill-opening rather small and oblique; pores upon snout and lateral line not visible; fold of skin enveloping dorsal fin unusually thin and arising within a short distance of occiput, with a slope of about forty-five degrees; gill-opening situated as far posteriorly to commencement of dorsal as that is posterior to angle of jaws; dorsal fin equal in width to 0.88 width of body, with no perceptible decrease until it approaches posterior eighth of body, when it decreases rapidly and at its termination is only equal to one-seventh of width of fin upon back.

Ground color in alcohol, dark hair-brown, nearly black upon occiput and cheek, and along base of dorsal fin; head, body, and both fins irregularly reticulated with narrow bands of white, varying in width and becoming yellow on posterior fifth of dorsal fin, and upon that portion of body, but in a less degree; 3 broken lines of black extending along body from angle of jaws to gill-opening; iris chrome yellow.

This species is known only from Abbott's type (No. 998, Mus. Phila. Acad.) collected in the Hawaiian Islands in 1835 by Dr. J. K. Townsend.

Muraena acutirostris Abbott, Proc. Ac. Nat. Sci. Phila. 1860, 476, Hawaiian Islands; Günther, Cat., VIII, 127, 1870; after Abbott.

Iqecodontis acutirostris, Fowler, Proc. Ac. Nat. Sci. Phila. 1930, 494, Pl. XVIII, fig. 5; from Abbott's type.

Genus 58. ECHIDNA Forster.

The name *Echidna* was suggested for these eels long before its application by Cuvier to a genus of Australian monotremes (properly called *Tachyglossus*), and includes some 12 or 15 species, most of them belonging to the western Pacific. They represent the highest degree of specialization among the morays, as *Uropterygius* represents the extreme degradation. The genus is well marked, distinguished from the other morays by the blunt teeth. It is represented in Hawaiian waters by 7 nominal species.

Echidna Forster, Enchiridion, 31, 1778 (*variegata*).

Gymnomuraena Lacépède, Hist. Nat. Poiss., V, 648, 1803 (*doliata* = *marmorata*).

Gymnopsis Rafinesque, Analyse Nature, 1815, 93 (*doliata*).

Pecilophis Kaup, Apodes, 98, 1856 (*catenatus*).

a. Vertical fins low, almost obsolete; body encircled by alternating light and dark rings, 30 to 100 in number.. *zebra*, p. 106

aa. Vertical fins well developed; body rings, when present, broader, 20 to 30 in number.

b. Jaws completely closing; body color-rings narrower than eye.

c. Upper jaw with 1 series of teeth on sides; body with about 27 narrow brown bands alternating with wider light bands; corner of mouth brown without distinct black spot..... *psalion*, p. 106

cc. Upper jaw with 2 series of teeth on sides; body with about 23 dark bands, indistinct on middle part of body; corner of mouth with a distinct black spot..... *obscura*, p. 107

- bb. Jaws not completely closing; body color-rings wider than eye.
- d. Lower jaw with not more than 2 series of teeth on sides; body with alternating light and dark rings, the latter 25 in number.
- e. Upper jaw with 2 series of teeth on sides; body with reddish brown rings completely encircling it..... *zonata*, p. 108
- cc. Upper jaw with 1 series of teeth on sides; body not completely encircled by the broad, dark brown cross-bands..... *zonophæa*, p. 109
- dd. Lower jaw with more than 2 series of teeth on sides; body without alternating light and dark rings, except sometimes near the end of tail.
- f. Teeth on sides of lower jaw apparently in 3 series; color in life uniform yellowish brown; no reticulated dark blotches on sides..... *teihala*, p. 109
- ff. Teeth on sides of lower jaw apparently in 4 series; body with from 20 to 25 more or less reticulated blotches on the side, sometimes solid and band-like near tail..... *nebulosa*, p. 110

65. *Echidna zebra* (Shaw). Plate 20.

Head 5.2 in trunk; tail a little over 2 in head and trunk; eye 1.8 in snout, 2 in interorbital space; snout 7.3 in head; mouth, from tip of snout, 2.75.

Body rather deep and compressed; head deep, compressed, and swollen; eye small, anterior, midway between tip of snout and corner of mouth; mouth large, somewhat undulate; snout projecting well beyond tip of mandible; lips thick and fleshy; teeth all broad, smooth, and molar-like; anterior nostrils in fleshy tubes, the posterior pair with their rims slightly elevated, each situated above anterior margin of eye; interorbital space elevated, convex, and as the upper profile of head is concave above the eyes the forehead rises somewhat abruptly behind; gill-openings small; skin smooth, very tough and thick; no lateral line; pectoral fins obsolete; dorsal beginning behind gill-opening; tail deep, strongly compressed posteriorly; caudal with its margin bluntly rounded. The vertical fins in our specimens are rather low, almost obsolete, and not nearly so well defined as shown in Bleeker's plate.

Color in alcohol, deep or dark brown, encircled more or less completely over the body by numerous narrow white cross-bars with blackish margins, which fade away into the brown bands between; all of the bands or rings are not complete, though they are very seldom forked or broken up into small bars.

Color in life (No. 03543) dark reddish-brown, the dark stripes along or bordering each white band or ring darker brown than the general body color. Another specimen (No. 02994) rich, purplish brown throughout, crossed by about 69 pale yellowish rings, each about one-twelfth of an inch in width, or less than half the eye. Most of these rings are complete or nearly so, some fragmentary, others broken up into spots, soon fading into whitish, and bounded by darker than the general color.

The above description is based chiefly upon No. 03543, a specimen 31 inches long, obtained at Honolulu. The collection contains also a specimen (No. 02994) 26 inches long from the same place, and one (No. 03712) from Kailua, Hawaii. Another was obtained by the *Albatross* at Honolulu in 1902. This species was not obtained by Dr. Jenkins, and does not appear to be abundant among the Hawaiian Islands, but it is very abundant at Samoa.

Gymnothorax zebra Shaw, Natural. Miscell., IX, plate 322, 1797, American seas.

Gymnothorax zebra, Bloch & Schneider, Syst. Ichth., 528, 1801; after Shaw.

Gymnomuræna dollata Lacépède, Hist. Nat. Poiss., V, 648, 649, pl. 19, fig. 4, 1803, near the coast of New Britain.

Muræna zebra, Cuvier, Règne Animal, Ed. I, 234, 1817.

Muræna molendinaria Bennett, Proc. Zool. Soc. London, I, 1833, 32, Mauritius.

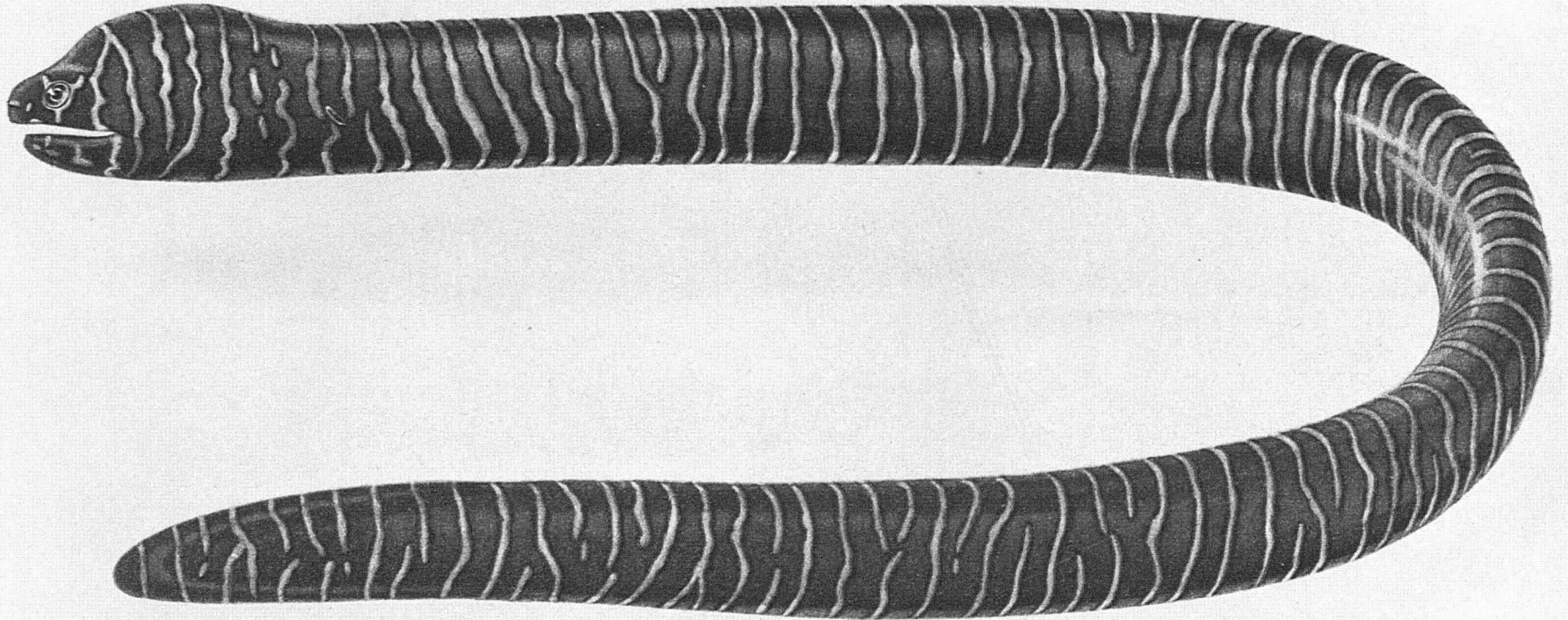
Gymnomuræna fasciata Kaup, Cat. Apod. Fish., 103, fig. 69, 1856, Muscat; on type of *M. molendinaria* of Bennett.

Echidna zebra, Bleeker, Atlas, Ichth., IV, 81, pl. 171, fig. 1, 1864-65 (Sumatra; Kajeli, Buro; Amboyna; Timor); Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 520 (Honolulu).

66. *Echidna psalion* Jenkins. Fig. 29.

Head 7.25 in body, or 3.4 in distance from tip of snout to vent; depth 13; snout 5.5; eye slightly less than snout and slightly nearer tip of snout than angle of mouth; gape 2.5 in head; tip of snout to vent 1.2 in tail; interorbital about equal to eye.

Body moderately elongate, compressed posteriorly; tail slender, pointed; gill-opening very small, inconspicuous; anterior nostril tubular, about 2 in eye, near tip of snout, well above the lip; posterior nostril without tube, oval, above eye just anterior to its middle; a series of pores along upper lip and a series on each side of lower jaw; upper jaw with a single series of blunt, conic teeth in front, those on sides smaller and in a single series; roof of mouth with 2 series of large molars; vomer in front with



ECHIDNA ZEBRA (SHAW).

a single series of about 3 strong, bluntly conical, depressible teeth; lower jaw with 2 series of blunt, conic teeth, the inner the larger; origin of dorsal in front of gill-opening a distance equal to one-fourth the head.

Color in alcohol, a series of 27 narrow brown bands alternating with wider light bands, the narrowest bands mostly somewhat narrower than eye, the broader ones mostly twice eye; a series of

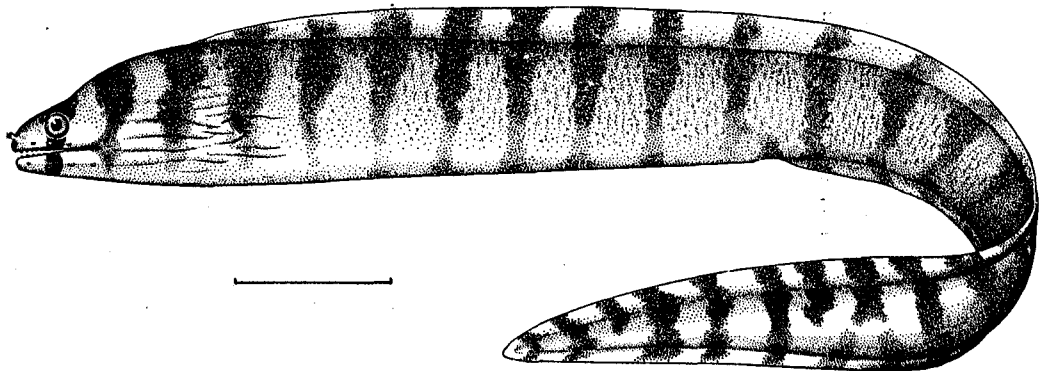


FIG. 29.—*Echidna psalion* Jenkins; from the type.

narrow parallel brown longitudinal lines on side of head in front of gill-opening; the anterior brown band running through eye, the second around head posterior to gape; angle of mouth brown.

Only one specimen, type, No. 50685, U. S. Nat. Mus. (original No. 2355), 13 inches long, obtained by the *Albatross* in 1896 at Honolulu.

Echidna psalion Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 431, fig. 12, Honolulu.

67. *Echidna obscura* Jenkins. Fig. 30.

Head 8.3 in total length; depth 17; eye 9.5 in head; snout 5.75; interorbital 5.75; gape 2.8; distance from tip of snout to vent slightly less than from vent to tip of tail.

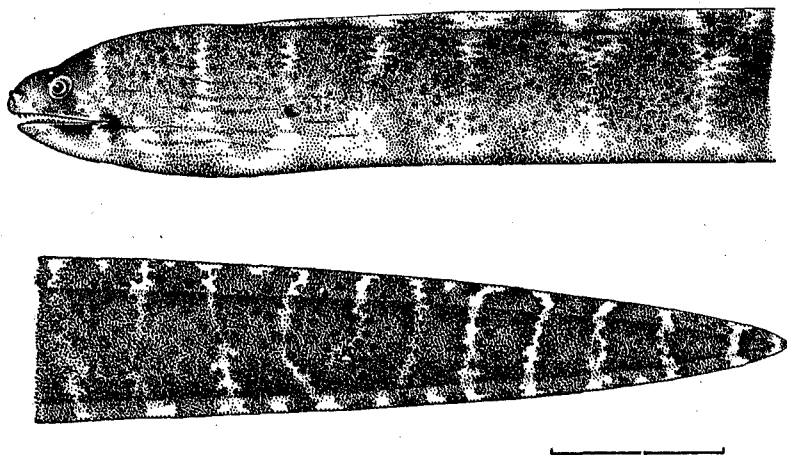


FIG. 30.—*Echidna obscura* Jenkins; from the type.

Body moderately elongate, rather deep and somewhat compressed; head narrow, somewhat swollen above; mouth large, the gape extending more than an eye's diameter beyond eye; lower jaw shorter than upper and somewhat curved; eye about midway between tip of snout and angle of mouth;

interorbital equals snout; origin of dorsal in front of gill-opening a distance equal to length of mouth; dorsal fin somewhat higher than anal, its height greater than length of snout; tail compressed and moderately slender; a few short conical teeth in anterior parts of each jaw; 2 series of conical teeth in each side of upper jaw; roof of mouth paved with molars, in 2 rows anteriorly, in 4 posteriorly; molars in 2 series in each side of lower jaw; gill-opening small, narrow, length less than diameter of eye; anterior nostril tubular, near tip of snout, considerably above margin of mouth; posterior nostril round and inconspicuous, near middle of upper margin of eye.

Color in alcohol, dark brownish with about 23 dark cross-bands mostly as broad as depth of body, indistinct on middle part of body, but quite distinct anteriorly and on tail; alternating with them are white ones which are narrower than eye and which extend on anal and dorsal fins; the edges of the bands jagged, the white bands widening toward the belly; extreme tip of tail brown (in the cotypes the tip is narrowly edged with white); side of lower jaw brown, angle of mouth black with white spot in front on lower jaw; gill-opening without dark border. The 2 cotypes show some differences in color. In the larger example (No. 2351), 16.5 inches long, the body is more uniformly dark brown and the light cross-bands are very indistinct except on tail; in the other cotype (No. 2353), 9.5 inches in length, the white cross-bands are very distinct, all completely encircling the body except 3 or 4 anterior to vent.

The species was not taken by us. Three specimens were obtained by Dr. Jenkins in 1889, the type, No. 50686, U. S. Nat. Mus. (field No. 2352), a specimen 12.5 inches long, collected at Honolulu; cotypes, No. 7725, L. S. Jr. Univ. Mus. (field No. 2351), a specimen 16.5 inches long; and No. 2754, U. S. Fish Commission (field No. 2353), a specimen 9.5 inches long, both from Honolulu.

Echidna obscura Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 430, fig 11, Honolulu.

68. *Echidna zonata* Fowler. Fig. 31.

Head 7.2 in total length, or 3.75 in distance from tip of snout to vent; vent about midway between tip of snout and tip of tail; depth about 2.2 in head; eye 10 in head, 1.6 in snout, or 1 in interorbital space; length of mouth 2.7 in head.

Body moderately elongate, compressed; tail strongly compressed and pointed; head swollen; mouth moderate, gape reaching beyond eye a distance equal to length of snout; lower jaw shorter

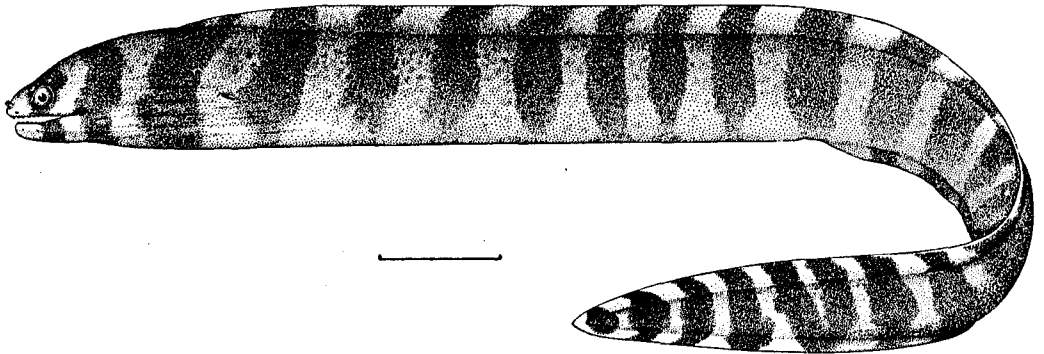


FIG. 31.—*Echidna zonata* Fowler. Type of *E. vineta* Jenkins.

than upper, curved so that the mouth does not close completely; teeth bluntly conic, in a single series in front in upper jaw, in 2 series laterally; teeth on vomer bluntly conic, in a single series of 3 teeth, depressible anteriorly, in a double series of molar teeth posteriorly, about 7 teeth in each series; lower jaw with a double series of bluntly conic teeth on each side, and a median series of similar teeth.

Color in life, body crossed by 25 (by error 24 in drawing) broad reddish-brown nonreticulating bands, the width of those at middle of body exceeding snout and eye; the bands completely encircling the body, and separated by somewhat narrower light bands; tip of snout yellowish white; the first dark band through eye broadening on interorbital space; second dark band crossing side of head and



very broad on nuchal region; tip of tail narrowly white. In some of the cotypes, the dark cross-bands tend to break up below and form reticulations.

This species is not rare about Honolulu among the coral rocks. It apparently does not reach a large size, the examples in hand ranging from 15 inches down to 6 inches in length.

Echidna vineta Jenkins (type, No. 50687, U. S. Nat. Mus., a specimen 13.5 inches long, obtained at Honolulu. Cotypes, No. 7492, L. S. Jr. Univ. Mus., 15 inches long; No. 2753, U. S. F. C.; No. 2753, Field Museum), appears to be identical with this species. Specimens were also obtained by the *Albatross* at Honolulu in 1902.

Echidna zonata Fowler, Proc. Ac. Nat. Sci. Phila. 1900 (Nov. 6), 495, pl. XVIII, fig. 2, Honolulu. (Type, No. 16484, Phila. Ac.)

Echidna polyzona, Fowler, op. cit. 496 (Honolulu); not of Richardson.

Echidna vineta Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 429, fig. 10, Honolulu; Snyder, op. cit. (Jan. 19, 1904), 521 (Honolulu).

69. *Echidna zonophæa* Jordan & Evermann. Plate 21.

Head 3 in trunk, or 6.5 in total; tail longer than head and trunk by a little more than the snout; eye 2 in snout, 1.5 in interorbital space; snout 6; interorbital space 7.75; mouth 2.8.

Body compressed, the tail tapering rather narrowly posteriorly; head deep and compressed, pointed in front; snout rather long and pointed, the tip obtusely rounded and projecting considerably beyond the mandible; eye rather small, midway between tip of mandible and corner of mouth; mandible arched below so that only the anterior teeth touch the front of the jaw above, though the thick fleshy lips conceal them all; teeth molar, those in front of jaws pointed; anterior nostrils in short tubes, the posterior pair above the eye with a slightly elevated margin; interorbital space convex; top of head more or less swollen or convex in profile; gill-opening 1.67 in eye; skin smooth; head with a few pores; origin of dorsal beginning at last fourth of space between corner of mouth and gill-opening; caudal small.

Color in alcohol, grayish white, the body and tail crossed by about 25 broad rich-brown bands, extending upon the dorsal and anal fins; dark bands anteriorly broadest above and not meeting across belly, their width about equal to the distance from tip of snout to middle of eye; first brown band through eye, second across nape, the fourth across gill-opening; gray bands of ground color anteriorly broad and widening much upon belly; posteriorly the gray bands are narrower and better defined, especially on the fins, their width scarcely greater than half that of the brown bands; tip of tail very narrowly white; body anteriorly, especially within the gray bands, profusely covered with numerous small, roundish, black specks, less numerous and more scattered posteriorly; no black spots on head; angle of mouth black, with a small white blotch immediately in front on lower jaw, continued across under jaw as a broad whitish band; side of head with about 4 or 5 narrow blackish lines between mouth and gill-opening; region of gill-opening marbled with dark brown and whitish, the opening dark. One example (No. 03545) had much yellow on the head and between the brown zones. This species is known from the type and 3 cotypes, all obtained by us at Honolulu.

Echidna zonophæa Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (April 11, 1903), 167, Honolulu (Type, No. 50621, U. S. Nat. Mus.).

70. *Echidna leihala* Jenkins. Fig. 32.

Head 7 in total length; depth 2.1 in head; tip of snout to angle of mouth 2.5 in head; eye 10 in head; interorbital 8.5; gill-opening a very small narrow slit, 3 in eye, with no distinguishing color marking; origin of dorsal well in advance of gill-opening, 3 in head; jaws curving away from each other, closing only at tip; a few sharp fixed teeth in anterior portions of jaws, the remaining all blunt; teeth in anterior portion of upper jaw sharp, in a single series; in the posterior portion a double series of blunt teeth, between which the roof of the mouth is crowded with blunt teeth, becoming as many as 6 series posteriorly; teeth in lower jaw in 2 series anteriorly, becoming blunt posteriorly and apparently in 3 series; anterior nostril tubular, near tip of snout above margin of lip; posterior nostril smooth, near the middle of the upper margin of the eye.

Color in life, uniform yellowish brown, not lighter on the belly, being distributed over the whole body in fine granular markings; no transverse bands appearing in life, but evidence of bands,

especially toward tip of tail, appears some hours after death. (The figure shows alcoholic specimen.) Snout white, angles of mouth brown; iris yellow; no other conspicuous markings. (Jenkins.)

Dr. Jenkins obtained 3 specimens in 1889, as follows: The type, 17 inches in length, No. 50844, U. S. Nat. Mus. (field No. 283), Honolulu; and cotypes, No. 7783, L. S. Jr. Univ. Mus. (field No.

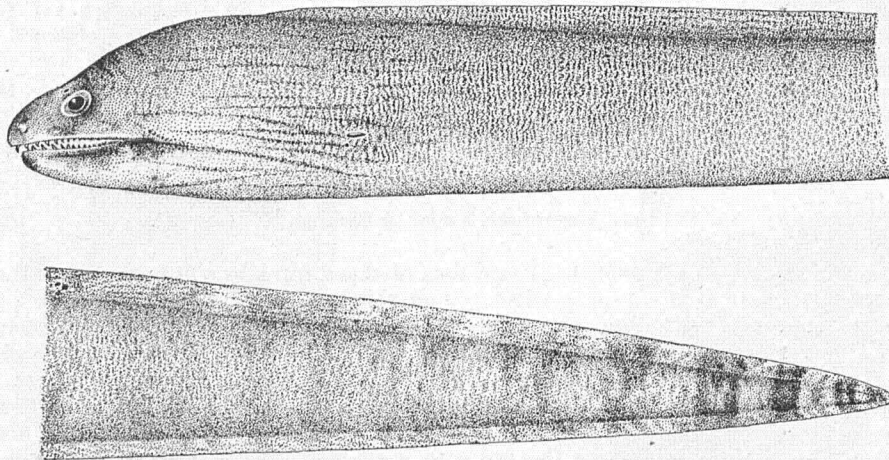


FIG. 32.—*Echidna leihala* Jenkins; from the type.

2368), 15.5 inches long; and No. 2752, U. S. Fish Commission (field No. 2369), 12 inches long, all from the reef in front of Honolulu.

It is possible that this species and *zonata*, *zonophaea*, *obscura*, and *psalion* are all color variations of one for which the earliest name is *Echidna tritor*.

Echidna leihala Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 428, fig. 9, Honolulu.

? *Pacilophis tritor* Vaillant & Sauvage, Rev. et Mag. Zool., 3d series, III, 287, 1875, Hawaiian Islands.

71. *Echidna nebulosa* (Ahl). "Puhī kāpa." Plate I.

Head 3.25 in trunk; tail shorter than head and trunk by a little more than snout and eye; eye 2.5 in snout and a little over 2 in interorbital space; snout 5.5; interorbital space 6.5; mouth 2.2.

Body compressed; tail tapering gradually; head large, thick, compressed, swollen above, so that the upper profile is convex from eyes; snout deep, compressed, rounded, the extremity blunt; eye small, high, nearer tip of snout than corner of mouth; mouth horizontal; jaws nearly equal; teeth in anterior part of jaws conical, those posterior molar-like; anterior nostrils in small tubes, posterior pair above the eyes anteriorly; interorbital space convex; gill-opening a little larger than eye; skin smooth and tough, with some pores on head; origin of dorsal about midway between posterior edge of eye and gill-opening; tip of tail rounded.

Color, in alcohol, whitish, finely spotted and speckled with blackish brown, crossed by about 27 cross-bands formed of deep blackish-brown reticulations, each divided so as to form 2 lateral series; spots on lower surface of body more or less solid, and the ground color with fewer small spots between; tip of snout and caudal white. This description from a specimen (No. 03774) 29 inches long, taken at Honolulu.

The *puhī kāpa* is "a kind of eel that makes havoc among all kinds of fish. Hence Kamehameha (King of Hawaii) was called 'Puhī kāpa' because 'victorious over all.'"

^a "Tail of same length as body. Branchial opening of same size as eye, surrounded by a black spot more or less distinct. Intermaxillary teeth in a single row in front, in two rows behind, conical and quite short; maxillary teeth shorter, in two rows; the three anterior vomerine teeth weak, of same size as the intermaxillary teeth, a large vomerine plate composed of rounded teeth as those of *Daurades*, small, numerous, in two rows in front, in six rows in the middle. Anterior mandibular teeth pointed, in two rows; posterior teeth conical, arranged in three series. Anterior nostril tubes very short. Angle of mouth black; some horizontal black lines under the throat. Honolulu." (Vaillant & Sauvage.) This brief description is not full enough for certain identification. The species may be identical with *E. leihala* Jenkins.

In life the irregular dark areas are dark brown, with chrome-yellow spots, the bars between these dark areas gray and brown; anterior tubular nostril orange; iris orange. An example from Hilo, gray with black spots and bands almost meeting on the belly, and quite meeting on the tail; spots of deep yellow in the black spots, those of belly edged with yellow; anterior nostril orange; snout and chin livid brownish; vent deep yellow, border of fins grayish white, like tip of tail.

The natives say that this eel goes ashore in the grass, wriggling quickly to the water again when disturbed. They also claim that it is savage and will bite.

We have a number of specimens from Honolulu, Hilo, and Kailua. Dr. Jenkins obtained one from Honolulu, in 1889, which we have examined, and the *Albatross* obtained one at Honolulu in 1902. The species is very common at Samoa.

Muraena nebulosa Ahl, De Muraena et Ophichtho, Thurnb. Dissert., III, 5, pl. 1, fig. 2, 1789, East Indies.

Gymnothorax nebulosus, Bloch & Schneider, Syst. Ichth., 528, 1801; after Ahl.

Gymnothorax echidna Bloch & Schneider, Syst. Ichth., 526, 1801, Huahia; Tahiti.

Muraena ophis Rüppell, Atlas zu der Reise im Nordl. Afrika, 116, taf. 29, fig. 2, 1828, Red Sea.

Thaerodontis ophis, McClelland, Calc. Journ. Nat. Hist., V, 1844, 217.

Echidna variegata Forster in Lichtenstein, Descript. Animal., 181, 1844, seas Huahainam; Bolam-Bolam; Tonga-Tabu.

Muraena variegata, Richardson, Voy. Ereb. & Terror, Fish., 94, pl. 47, figs. 1-5 and 11-16, 1846 (Indian Ocean; Chinese Sea; coasts of Australia).

Peciliophis variegata, Kaup, Cat. Apod. Fish. Brit. Mus., 98, tab. 13, fig. 67, 1856; after Richardson.

Muraena nebulosa, Günther, Cat., VIII, 130, 1870 (Port Natal; Zanzibar; Madagascar; Seychelles; India; Moluccas; Amboyna; Macassar; Siam; China Seas; Fiji; Trinity Bay; Australia).

Echidna nebulosa, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 429 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 520 (Honolulu).

Genus 59. UROPTERYGIUS Rüppell.

This genus contains most of those morays with fins altogether wanting, or developed only at the tip of tail; teeth small, pointed, subequal, the mouth of moderate size, and only the anterior nostrils provided with a tube. The typical species have the tail about as long as the rest of the body.

Gymnomuraena Lacépède, Hist. Nat. Poiss., V, 648, 1803 (*doliata*=*marmorata*); restricted first by Kaup in 1856 to *doliata*, which is an *Echidna*.

Ichthyophis Lesson, Voy. de la Coquille, II, 131, 1830 (*pantherinus*=*marmoratus*); not of Fitzinger 1829, a genus of reptiles.

Uropterygius Rüppell, Neue Wirb., Fische, 83, 1838 (*concolor*).

Scutica Jordan & Evermann, Fishes North and Mid. Amer., I, 403, 1896 (*necturus*).

a. Posterior nostril with elevated rim; jaws equal; no dorsal fin evident.....*marmoratus*, p. 111

aa. Posterior nostril without rim; jaws unequal; dorsal fin evident on tail.....*leucurus*, p. 112

72. *Uropterygius marmoratus* (Lacépède). Fig. 33.

Head 2.25 in trunk; tail longer than head and trunk by a little less than half of head; eye 2.3 in snout, 2 in interorbital space; snout 5.67 in head; interorbital space 7.5; mouth 2.5.

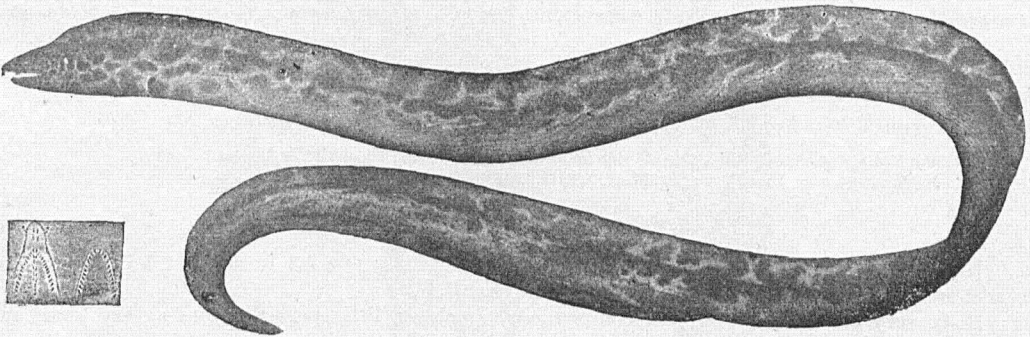


FIG. 33.—*Uropterygius marmoratus* (Lacépède); after Bleeker.

Body compressed; tail tapering gradually behind to a rather thick point; head rather large, compressed, obtusely pointed; snout long, pointed, the tip blunt; eye small, a little nearer tip of snout than corner of mouth; mouth with thick lips concealing the teeth; teeth large and sharp pointed, biserial in the jaws, the outer series much smaller and more numerous than the inner, which are

depressible; vomerine teeth in a single median series; anterior nostrils in short tube, the posterior pair with elevated rims; interorbital space elevated; no fins, except an obsolete-rayed development around end of tail.

Color in alcohol, dark blackish brown above, paler beneath, marked all over with indistinct blackish reticulations; chin pale brown, somewhat soiled.

One adult (No. 03730) 11 inches long was obtained by Mr. Goldsborough at Kailua, Hawaii, and about a score of young individuals 1.3 to 4.72 inches long were dredged or taken in the tangles by the *Albatross* off the south coast of Molokai and between Maui and Lanai in 21 to 46 fathoms. In life the young are dark brown, the throat and lower jaw much lighter, almost white in some specimens, there being no dark markings as in the adult. The mucous pores on the head are white.

Gymnomuraena marmorata Lacépède, Hist. Nat. Poiss., V, 648, 650, 1803, coast of New Britain.

Ichthyophis pantherinus Lesson, Voy. Coq., Poiss., II, 131, 1826-1830, Oualan, Caroline Islands.

?*Muraena micropterus* Bleeker, Nat. Tyds. Ned. Ind., III, 298, 1852, Wahaï, southern Ceram.

?*Uropterygius xanthopterus* Bleeker, Nat. Tyds. Ned. Ind., XIX, 350, 1859, Patjitan, southeast Java.

?*Gymnomuraena xanthopterus* Bleeker, Atlas, IV, 114, pl. 20, fig. 4, 1864.

?*Gymnomuraena micropterus*, Bleeker, op. cit., 115, pl. 20, fig. 2, 1864.

?*Gymnomuraena macrocephalus* Bleeker, Ned. Tyds. Dierk., II, 54, 1865, Amboyna.

Uropterygius marmoratus, Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 521 (*Albatross Stations* 3847, 3850, 3872, 3876).

73. *Uropterygius leucurus* Snyder. Plate 13, fig. 2.

Head, measured to gill-opening, 8.3 in length; tail 1.9; depth 2.6 in head; snout 5; cleft of mouth 2.9; lower jaw shorter than upper, tip extending to base of nostril tubes; teeth of jaws in 2 series, outer ones small and close set, inner ones fang-like and widely spaced; a median, depressible fang in upper jaw; a single row of sharp teeth on vomer; anterior nostrils with tubes equal in length to diameter of eye; posterior nostrils without rims, located above eyes; eye located above middle of cleft of mouth; gill-opening a horizontal slit equal to diameter of eye. The dorsal fin becomes evident at a point about half the length of head from tip of tail, being represented anteriorly by a mere fold of the skin which extends to occiput; caudal pointed; a mere trace of an anal which joins the caudal.

Color brown, finely spotted above with white; ventrally the spots become elongate and unite, also increasing in size until on the belly the color is white with fine reticulations of brown; upper parts with figures formed by the union of elongate spots; end of snout, upper lip, lower jaw, and throat white; fin around end of tail white.

This species resembles the young of *U. marmoratus*. It differs in color, that form being neither spotted nor otherwise figured with white. The jaws of *U. marmoratus* are equal, and no dorsal fin is evident on the tail.

One specimen, 4.3 inches long, was taken in 28 fathoms of water, station 3874, between Maui and Lanai. Type, No. 50871, U. S. Nat. Mus.

Uropterygius leucurus Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 521, pl. 6, fig. 12, *Albatross Station* 3874, between Maui and Lanai.

Genus 60. SCUTICARIA Jordan & Snyder.

This genus differs from *Uropterygius* in having the posterior nostrils in tubes.

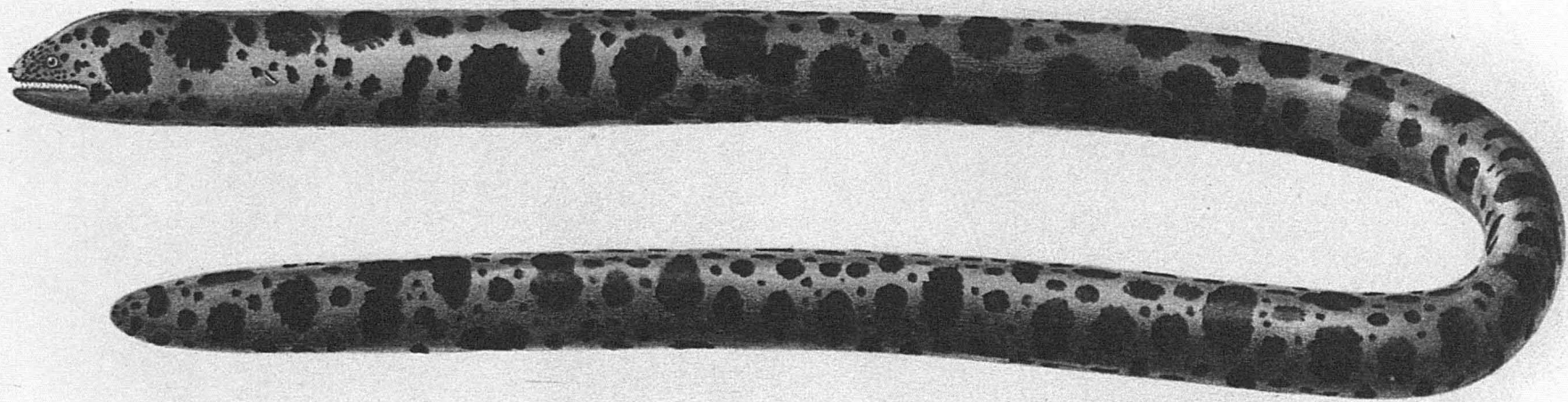
Muraenoblenna Kaup, Cat. Apod. Fish., 97, 1856 (*tigrina*): not of Lacépède, 1803, which is *Myxine*.

Scuticaria Jordan & Snyder, Proc. U. S. Nat. Mus., XXIII, 1901, 886 (*tigrina*).

74. *Scuticaria tigrina* (Lesson). Plate 22.

Head 6.4 in trunk; tail a little over 2 in head and trunk; eye 2.8 in snout, 2.5 in interorbital space; snout a little over 7 in head; mouth a little over 3.

Body very elongate, round; tail compressed, tapering a little posteriorly to a very blunt and rounded tip; head round, blunt in front; snout round and blunt; eye very small, nearer tip of snout than corner of mouth; mouth nearly horizontal, jaws even; lips thick and tough; teeth all sharp-pointed, 2 series in upper jaw of which the inner are the larger; mandible with a short double series in front, those on vomer in a single series; anterior nostrils in short tubes nearer tip of snout, and posterior also in short tubes above anterior margins of eyes; interorbital space elevated and convex; gill-opening equal to eye; skin thick and tough, with a few mucous pores on head; no fins.



SCUTICARIA TIGRINA (LESSON).

Color in alcohol, pale reddish brown, marked everywhere with numerous blotches of blackish brown edged with a paler brown than the general body-color; between the large dark blotches many small spots similarly edged; snout and mandible mottled with dark brown.

Here described from a specimen (No. 04815) 42 inches long, taken at Honolulu. We have also a specimen (No. 04831) 40 inches long, from the same place, and 3 others (Nos. 03706, 03718, and 03719), 48, 35, and 35 inches long, respectively, from Kailua, Hawaii.

Ichthyophis tigrinus Lesson, Mém. Soc. Hist. Nat. Paris, IV, 399, 1829, Borabora, Society Islands.

Murenoblema tigrina, Bleeker, Act. Soc. Sci. Ind. Neerl., II, 1857, 93.

Gymnomurana tigrina, Bleeker, Atlas. Ichth., IV, 113, pl. 165, fig. 3, 1864 (Prigi, Java; Nova Selma; Cocos Island; Amboyna; Celebes; Timor); Kner, Reise Novara, I, 387, 1867 (Tahiti); Günther, Cat., VIII, 133, 1870 (Mauritius; Zanzibar; East Indies; India); Smith & Swain, Proc. U. S. Nat. Mus. 1882, 121 (Johnston Island).

Order H. LYOPOMI.

This group, which contains the single family of *Halosauridæ*, is thus defined by Gill:

Scapular arch constituted by proscapular, postero-temporal and post-temporal, the post-temporal discrete from side of cranium and impinging on supraoccipital; hypercoracoid and hypocoracoid lamellar; a foramen in upper margin of hypocoracoid; mesocoracoid absent; actinosts normal; cranium with the condyle confined to basioccipital; opercular apparatus characteristic, the preopercle entirely detached from the suspensorium (rudimentary and connected only with the lower jaw); operculum normally connected, subopercle enlarged and partly usurping the usual position of the preopercle, in company with the suborbital chain which is extended backward to the opercular margin; bones of jaws, palatines, and pterygoid complete and normal; anterior vertebræ separate; ventrals abnormal.

Family XXXIV. HALOSAURIDÆ.

Body elongate, compressed anteriorly, tapering into a very long and slender tail, which becomes compressed and narrowed into a sort of filament; abdomen rounded; scales rather small, cycloid, deciduous; sides of head scaly; lateral line present, running along the side of the belly, its scales in the known species enlarged, each in a pouch of black skin with a luminous organ at its base; no barbels; head subconical, depressed anteriorly, the flattened snout projecting beyond the mouth; mouth inferior, horizontal, of moderate size, its anterior margin formed by the premaxillaries, its lateral margin by the maxillaries, which are of moderate width; teeth small, in villiform bands, on the jaws, the rudimentary palatines and pterygoids, none on vomer and tongue; eye rather large; facial bones with large muciferous cavities; opercular apparatus peculiar, the preopercle entirely detached from suspensorium, rudimentary and connected only with lower jaw; opercle normally connected; subopercle enlarged and partly usurping the usual position of the preopercle, in company with the suborbital chain, which is extended backward to the opercular margin; bones of head unarmed; gills 4, a slit behind the fourth; pseudobranchiæ none; gillrakers short; gill-membranes separate from the isthmus; branchiostegals numerous (about 14); dorsal fin short, rather high, inserted behind ventrals and before vent; no adipose fin; no caudal fin; anal fin extremely long, extending from vent to tip of tail (its rays about 200 in number); ventrals moderate, not very far back; pectorals rather long, narrow, inserted high; no axillary scales; shoulder-girdle weak, its uppermost bone (supraclavicle or post-temporal) touching the cranium at the nuchal region, but not connected with it laterally; air-bladder large, simple; stomach coecal; pyloric cœca in moderate number; intestines short; ovaries not closed; vertebræ very many, 60+x. Fishes of the deep sea.

Genus 61. ALDROVANDIA Goode & Bean.

Ventrals normal; no second dorsal fin; vertex scaleless; scales of lateral line enlarged, provided with photophores; head with pointed snout and prominent lateral ridges; anal moderate, high, its height one-third to one-fourth that of dorsal. The 3 Hawaiian species of this genus are fully described in Section II.

Aldrovandia Goode & Bean, Oceanic Ichth., 132, 1896 (*rostrata*).

Halosouropsis Collett, Poiss. Hirondelle, 146, pl. V, fig. 23, 1896 (*macrochir*).

Order I. HEMIBRANCHII.—The Hemibranchs.

Interclavicles developed; gills pectinate; post-temporal simple, not furcate; supraclavicle quite small; superior pharyngeal bones reduced in number, the bones of the gill-arches also reduced except in *Gasterosteidae*; inferior pharyngeals present, not united; ventral fins abdominal or subabdominal, joined to the intraclavicle or else detached from it through partial atrophy of the shoulder-girdle; mouth bounded above by premaxillaries only; shoulder-girdle simple in structure; basis of cranium simple and without tube; 4 anterior vertebrae more or less elongate; snout usually more or less produced, the small mouth at its end. A small group, well distinguished from the *Percosoces* and other *Telecephali*, from ancestors of which it is probably descended, differing in the presence of the interclavicles and in the reduction of the shoulder-girdle and other structures. Its relations to the *Lophobranchii* are close, the characters of the latter being largely extremes of the same modifications.

FAMILIES OF HEMIBRANCHII.

a. Only one dorsal fin.

b. Dorsal preceded by 8 to 12 free spines *Aulostomidae*, p. 114

bb. Dorsal without spines and not followed by finlets *Fistulariidae*, p. 115

aa. Dorsal fins 2, the anterior of spines only, the posterior of soft rays *Macrorhamphosidae*, p. 117

Family XXXV. AULOSTOMIDÆ.—The Trumpet-Fishes.

Body compressed, elongate, covered with small ctenoid scales; lateral line continuous; head long; mouth small, at the end of a long, compressed tube; lower jaw prominent, with a barbel at the symphysis; premaxillary feeble, not protractile; maxillary broad, triangular, with a supplemental bone; teeth minute, in bands, on lower jaw and vomer; branchiostegals 4; gills 4, a slit behind the fourth; pseudobranchiæ well developed; gillrakers obsolete; gill-membranes separate, free from the isthmus; air-bladder large; spinous dorsal present, of 8-12 very slender free spines; soft dorsal and anal rather long, similiar, posterior, with 23 to 28 rays each; caudal small, rhombic, the middle rays longest, but not produced into a filament; ventrals abdominal, of 6 rays, all articulated; pectorals broad, rounded, the space in front of them scaly; first 4 vertebrae elongated; 2 pyloric coeca. A single genus, with 2 species, found in tropical seas.

Genus 62. AULOSTOMUS Lacépède.

Characters of the genus included above.

Aulostomus Lacépède, Hist. Nat. Poiss., V, 357, 1803 (*chinensis*).

Aulostoma Schlegel, Fauna Japonica, 320, 1850; changed spelling.

Polyptericthys Bleeker, Nat. Tyds. Ned. Ind., IV, 1853, 608 (*valentini*=*chinensis*).

Solenostomus Gronow, Cat. Fishes, ed. Gray, 146, 1854 (*chinensis*).

75. *Aulostomus valentini* (Bleeker). "Nunu." Fig. 34.

Head 3; depth 3.75 in snout; snout 1.5; eye 8 in snout; maxillary 4 in snout; mandible 2.65 in snout; D. x1-27; A. 26; scales about 19-250-20.

Body elongate, compressed, covered with small ctenoid scales; lateral line continuous, slightly arched over base of pectoral; head long; eye moderate, posterior; mouth small, oblique, at the end of a long compressed tube; lower jaw prominent, hooked and with a barbel at the symphysis; premaxillary slender; maxillary broad; minute teeth on lower jaw, vomer, and palatines; dorsal similar to anal, both posterior, dorsal directly over anal, their posterior bases arching and nearly meeting on the long slender caudal peduncle.

Color in alcohol, brown with about 14 lighter colored cross-bands, about as wide as eye, extending around the body; base of dorsal and anal black; a black spot on upper anterior half of caudal, and one usually present on lower rays; a similar spot on base of each ventral; first rays of dorsal black; fins otherwise pale yellowish; a black spot on middle of maxillary; sometimes a series of 2 to 5 or 6 small black spots on median line of belly in front of anal; sometimes other black spots on belly.

The above description chiefly from a specimen (No. 03327) 19.5 inches long, from Honolulu. Other examples somewhat smaller are darker in coloration, some of them uniform chocolate-brown

without cross-bars except on caudal peduncle and between dorsal and anal fin, where there are light bars which tend to break up into white spots. The caudal usually has the 2 black spots, though the lower one is often absent.

The color of this species seems subject to great variation. Garrett, in *Fische der Südsee*, figured 2 forms, one a uniform lemon-yellow and another light brown with 5 or 6 rosy-brown longitudinal stripes each less than pupil in width; a narrow line of same color on caudal peduncle with a broader crossbar at each end and one at its middle; head pale rosy with 3 deeper rosy oblique bars on snout; fins all pale rosy; middle caudal rays scarcely rosy; a black spot on maxillary, one on base of ventral and 2

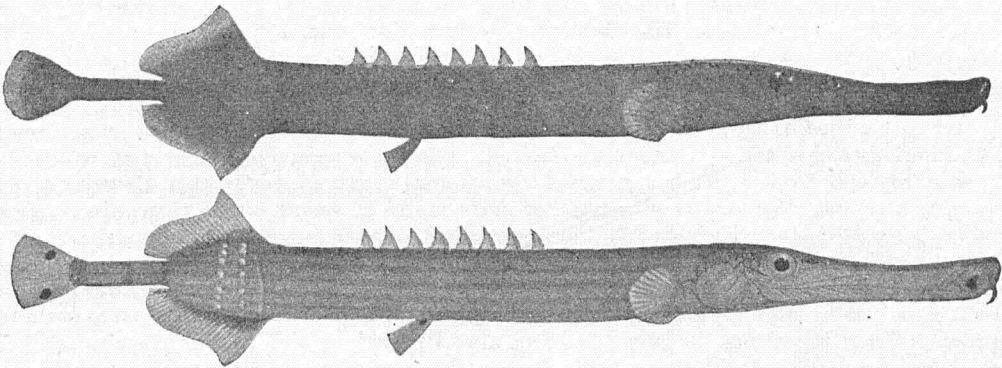


FIG. 34.—*Autostomus valentini* (Bleeker); after Günther.

on caudal fin. In the yellow figure there is a black spot on maxillary and one on upper caudal rays, but none below nor on ventral.

This species is fairly abundant at Honolulu, where specimens were obtained by Jenkins in 1889, by the *Albatross* in 1896 and 1902, by Wood in 1898, and by us in 1901. The *Albatross* obtained it also at Laysan, and it occurs at Johnston Island.

Polypterichthys valentini Bleeker, Nat. Tyds. Ned. Ind., IV, 1853, 608, Ternate.

Autostoma chinense, Streets, Bull. U. S. Nat. Mus., No. 7, 74, 1877 (Honolulu); Günther, *Fische der Südsee*, VII, 221, pl. 123, figs. b and c, 1881 (Hawaiian, Society, Pomotu islands; Aneityum); Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 502 (Honolulu; Laysan).

Autostomus chinensis, Smith & Swain, Proc. U. S. Nat. Mus., V, 1882, 121 (Johnston Island); Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 500 (Oahu); not *Fistularia chinensis* of Linnaeus, which is based on the American species.

Autostomus valentini, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 437 (Honolulu); Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 523 (Honolulu; Laysan Island).

Family XXXVI. FISTULARIIDÆ.—The Cornet-Fishes.

Body extremely elongate, much depressed, broader than deep; scaleless but with bony plates on various parts of the body, mostly covered by the skin; head very long, the anterior bones of the skull much produced, forming a long tube, which terminates in the narrow mouth; this tube formed by the symplectic, proethmoid, metapterygoid, quadrate, palatines, vomer, and mesethmoid; both jaws, and usually the vomer and palatines also, with minute teeth; membrane uniting the bones of the tube below, very lax, so that the tube is capable of much dilation; post-temporal coossified with the cranium; branchiostegals 5 to 7; gills 4, a slit behind the fourth; gill-membranes separate, free from the isthmus; gillrakers obsolete; basibranchial elements wanting; pseudobranchiæ present; air-bladder large; spinous dorsal entirely absent; soft dorsal short, posterior, somewhat elevated; anal fin opposite and similar to soft dorsal; caudal fin forked, the middle rays produced into a long filament; pectorals small, with a broad base, preceded by a smooth area as in *Gasterosteidæ*; pectoral ossicles 3; interclavicles greatly lengthened; supraclavicles very small; ventral fins very small, wide apart, abdominal (through partial atrophy of the girdle, by which they lose connection with the interclavicles), far in advance of the dorsal, composed of 6 soft rays; pyloric coeca few; intestine short; vertebrae very numerous (4+44 to 49+28 to 33); the first 4 vertebrae very long. Fishes of the tropical seas, related to the sticklebacks in structure, but with prolonged snout and different ventral fins. A single genus, with few species.

Genus 63. *FISTULARIA* Linnæus.

Characters of the genus included with those of the family.

Fistularia Linnæus, Syst. Nat., Ed. X, 312, 1758 (*tabacaria*).

Cannorhynchus Cantor, Malayan Fishes, 211, 1850 (*tabacaria*); *Fistularia* being preoccupied by *Fistularia* Donati, 1750, a pre-Linnæan genus of Polyps.

Flagellaria Gronow, Cat. Fishes, ed. Gray, 146, 1854 (*fistularis*=*tabacaria*).

- a. The long plates of posterior portion of lateral line unarmed.....*petimba*, p. 116
 aa. The long plates of lateral line each armed with a compressed spine directed backward.....*serrata*, p. 116

76. *Fistularia petimba* Lacépède.

Head 2.65 in length; depth 13 in head; eye 10 in head; snout 3.5 in body; interorbital 10; mandible 4.5 in snout; D. 14 (14 to 17); A. 14 or 15.

Interorbital space slightly concave with a strong median ridge and fainter lateral ones, diverging both anteriorly and posteriorly; a rosette of short, diverging lines upon top of snout at about one-ninth distance from eye; 2 ridges on upper surface of snout nearest together mesially, then diverging slightly, inclosing a central ridge and coming together again at tip of snout; lateral ridges finely serrate, anteriorly smooth; other ridges smooth, the lower lateral ridge serrate posteriorly, not showing from above; serrations on posterior rim of orbit above and on lateral occipital ridges; body much depressed, entirely smooth; depth one-half width; lateral line along middle of side, ascending, the lines from the 2 sides coming near together on back behind pectorals for a distance about equal to postorbital portion of head; lateral line on large specimens armed posteriorly with a series of embedded keels, which become smaller anteriorly, entirely disappearing somewhat in advance of dorsal; in small examples this keeled portion is asperate; distance of origin of dorsal fin from base of caudal about half length of snout; height of dorsal about twice eye; anal opposite dorsal and similar to it; caudal lobes smaller than dorsal; caudal filament 1.5 in snout; ventrals short, equal to eye.

Color in alcohol, brown above, lighter below; fins pale.

The above description chiefly from a specimen (No. 03584) 42 inches long, from Honolulu. We have also from Honolulu 2 examples (Nos. 02945 and 03131) 39 and 37 inches long, respectively; 98 examples 6 to 17.5 inches long, from Hilo, and 1 specimen 19 inches long from Kailua; specimens from Japan and Samoa, and numerous specimens obtained by the *Albatross* in 1902 at Honolulu, Hilo, Necker Island, and Hanalei Bay, Kauai. We have examined 13 examples collected in 1889 by Dr. Jenkins at Honolulu, 20 small specimens obtained by the *Albatross* November 8, 1899, in the harbor of Papeete, Tahiti, and a large example from the Philippines. Snyder mentions finding skeletons of this fish at Necker Island, where the fish had been carried ashore by birds.

Fistularia petimba Lacépède, Hist. Nat. Poiss., V, 349, 1803, New Britain, Isle of Reunion, equatorial Pacific; Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 437 (Honolulu; Tahiti); Snyder, I. c. (January 19, 1904), 523 (Honolulu: Hilo; Hanalei Bay, Kauai; Necker Island).

Fistularia depressa Günther, Report Shore Fishes, Challenger, 69, pl. 32, fig. D, 1880, Sulu Archipelago (others from Natal; Zanzibar, Amboyna; China; New Guinea; New South Wales, Fiji Islands; and California); Jordan & Evermann, Fishes North & Mid. Amer., I, 757, 1896; Seale, Occas. Papers Bishop Mus., I, No. 3, 64, 1901 (Guam).

77. *Fistularia serrata* Cuvier.

Head 3.6 in length; D. 13 to 15; A. 14 or 15; V. 6; branchiostegals 7.

The tube into which the head is produced is exceedingly long, the part of the head situated behind the orbit being contained 6.5 times in its length; it is distinctly serrated on the outer edge, as high as broad near its base, and somewhat compressed in its anterior portion; a vertical cut across its middle would be hexagonal. The cleft of the mouth is horizontal, extending nearly as far backward as the maxillary. Lower jaw prominent; internaxillary styliform, not protractile; jaws and palatines armed with a series of small teeth; vomerine teeth rudimentary, if present.

The upper surface of the tube is covered with a very thin skin; the middle is much more elevated than the lateral portions, at least on the basal half of the tube, and is formed by crenulated ridges, the outer of which arise from the anterior angle of the orbit, first convergent, and then keeping a parallel direction. The lateral edge of the tube is very distinctly serrated and provided with rather prominent spines posteriorly. The eye is elongate ovate, much longer than high, its horizontal diameter one-

half of its distance from the base of the pectoral fin; it is protected by prominent angles of the frontal bones anteriorly and posteriorly; the bony ridge between the orbits is concave and narrow, its width being less than the vertical diameter of the eye; crown of head rather convex, with slight crenulated striae; nostrils close together, one before the other, in front of the anterior angle of orbit on side of head; opercle not quite twice as long as high, and covered with a thick membrane which is prolonged beyond margin of bone and fixed to base of pectoral; gill-opening wide, but not extending upward beyond base of pectoral; 6 slender branchiostegals; shields of anterior portion of trunk are the following: 1, a narrow strip along the median line; 2, a pair of broader ones occupying the sides of the back; 3, a narrow one on each side; 4, the pubic bones on the belly.

Body depressed, nearly twice as broad as high; naked, without dermal ossifications; lateral line marked by pores and small narrow bony shields, sunk in the skin anteriorly, becoming broader on the tail, and armed with a compressed spine directed backward; spines forming a kind of serrature.

Base of pectoral fin obliquely curved; fin somewhat longer than the orbit and rounded; a small foramen posteriorly in its axil; ventral fins widely apart, their distance from the pectoral $\frac{2}{7}$ of that from the caudal; ventrals much shorter than pectoral and composed of 6 soft rays; a series of feeble spines embedded in the skin along median line of back and of abdomen; these spines do not belong to the endoskeleton for if the skin is removed these spines follow, and are easily detached from its outer surface. (Günther.)

Color in life, upper parts dark drab; lower, white; tips of dorsal, anal, and lobes of caudal rosy with dusky shades; pectoral transparent. Fifteen specimens were taken at Honolulu. (Jenkins.)

Not obtained by us in 1901 nor by the *Albatross* in 1902.

Fistularia serrata Cuvier, Règne Animal, Ed. I, II, 349, 1817, America (after Bloch); Günther, Cat., III, 533, 1861 (China; East Indies); Streets, Bull. U. S. Nat. Mus., No. 7, 74, 1877 (Honolulu); Jordan & Gilbert, Synopsis, 390, 1883; Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 437 (Honolulu).

Fistularia immaculata Cuvier, Règne Animal, Ed. I, 349, 1817, seas of the Indies (after Commerson and John White.)

Fistularia commersoni Rüppell, Neue Wirbelthiere, Fische, 142, 1837, Red Sea; no definite locality given.

Cannorhynchus immaculatus, Cantor, Cat. Malay. Fish., 211, 1850, (Sea of Pinang).

Fistularia petimba, Jordan & Snyder, Proc. U. S. Nat. Mus., XXVI, 1902, 67 (Japan); not of Lacépède.

Family XXXVII. MACRORHAMPHOSIDÆ.

Body compressed, oblong, or elevated, covered with small, rough scales; no lateral line; some bony strips on side of back, and on margin of thorax and abdomen, the former sometimes confluent into a shield; bones of skull much prolonged anteriorly, forming a long tube which bears the short jaws at the end; no teeth; gill-openings wide; branchiostegals 4; branchiaryals and pharyngeals mostly present, the fourth superior branchiaryal and the first and fourth superior pharyngeals only wanting; 2 dorsal fins, the first of 4 to 7 spines, the second of which is very long and strong; soft dorsal and anal moderate; ventral fins small, abdominal, of 1 spine and 5 soft rays; pectorals short; caudal fin emarginate, its middle rays not produced; air-bladder large; pseudobranchiæ present; gills 4, a slit behind the fourth; vertebrae about 24. the 4 anterior ones much lengthened; no pyloric cœca; intestinal canal short.

Genus 64. MACRORHAMPHOSUS Lacépède.

Body oblong, graduating into the caudal peduncle; back straight; dorsal spines about 7; characters otherwise included above. The single Hawaiian species of this genus is fully described in Section II.

Macrorhamphosus Lacépède, Hist. Nat. Poiss., V, 136, 1803 (*cornutus*=*scolopax*).

Centriscus Cuvier, Règne Anim., Ed. I, II, 350, 1817 (*scolopax*; not *Centriscus* L.).

Macrognathus Gronow, Cat. Fishes, 147, 1854 (*scolopax*).

Orthichthys Gill, Proc. Ac. Nat. Sci. Phila. 1862, 234 (*velularis*).

Order J. LOPHOBRANCHII.

Gills tufted, not laminated, composed of small rounded lobes attached to the gill-arches; interclavicles well developed; scapula suspended to the cranium by a post-temporal; superior branchiaryals and pharyngeals, and basal branchiaryals wanting or not ossified; mouth very small, bounded above by the

premaxillaries; post-temporal simple, coossified with the cranium; basis of cranium simple; pectoral fins with elevated bases; anterior vertebræ modified, the diapophyses much expanded; air-bladder simple, without air-duct; snout produced, bearing the small, toothless mouth at the end; gill-covers reduced to a large simple plate; skin with bony plates; muscular system little developed; the *Syngnathidæ* have neither spinous dorsal nor ventral fins; the *Solenostomidæ* of the Indian Ocean, constituting the suborder *Solenostomi*, have all the fins well developed.

FAMILIES OF LOPHOBRANCHII.

a. Spinous and soft dorsal present; ventral fins present; gill-openings wide.....*Solenostomidæ*, p. 118
 aa. Spinous dorsal fin wanting; no ventral fins; gill-openings narrow.....*Syngnathidæ*, p. 119

Family XXXVIII. SOLENOSTOMIDÆ.

Body compressed; tail very short; snout long, compressed, all parts covered with thin skin, below which is the dermal skeleton with star-like ossifications; spinous dorsal short; soft dorsal and anal long, with elevated base; caudal long; ventrals close together, inserted opposite spinous dorsal, each of 7 rays; the fins free in the male, in the female adnate to the body, forming a large pouch for the reception of the eggs; branchiostegals 4, very thin; intestinal canal simple. Singular fishes of the East Indies, constituting 1 genus.

Genus 65. SOLENOSTOMUS Lacépède.

Characters of the genus included above.

Solenostomus Lacépède, Hist. Nat. Poiss., V, 360, 1803 (*paradozus*).

78. *Solenostomus cyanopterus* Bleeker. Fig. 35.

Head 2.2 in length; depth 5; D. v-20; P. 27; V. 7; A. 19; C. 15; depth of snout at middle 4.5 in its length; eye 6.25 in snout; dorsal spines 2 in head; ventral equal to snout or a little more; caudal a little shorter than head; caudal peduncle shorter than base of second dorsal.

Color pink, with small black dots like ink specks scattered over head and upper part of body; eye red; fins pale, the spinous dorsal with 2 long black ocelli (said to be dark blue in life) on men-

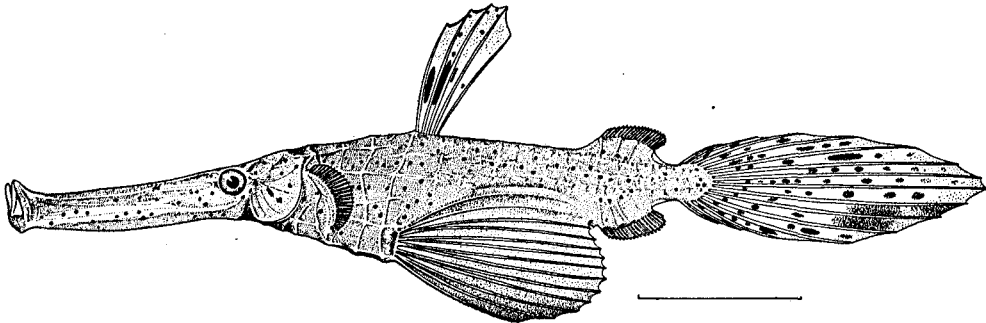
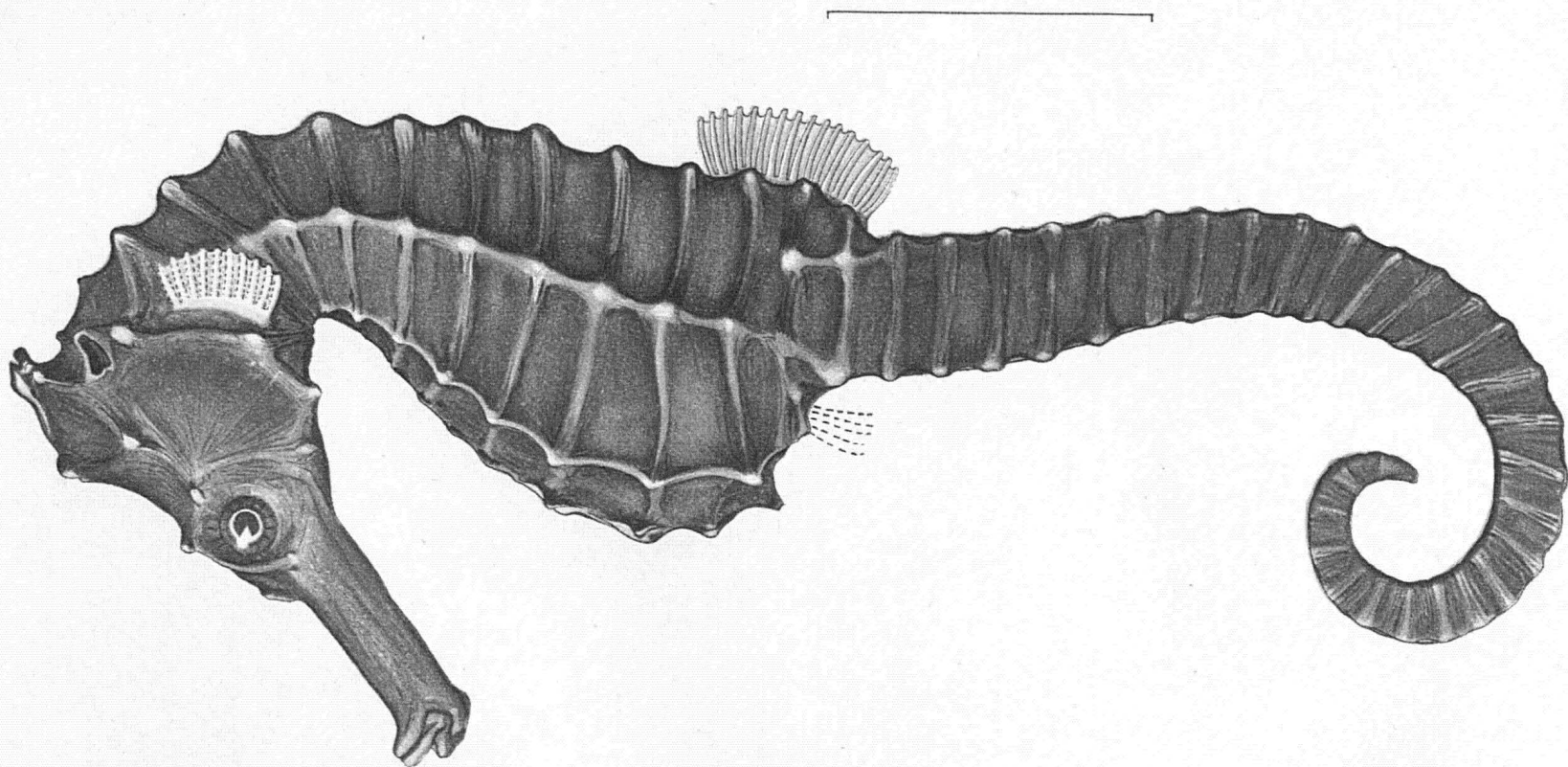


FIG. 35.—*Solenostomus cyanopterus* Bleeker.

branes of first and second spines; besides black dots, caudal with small inky spots like those on body, but more elongate, several of them drawn out into lines. The above description is taken from Jordan and Snyder's Japanese specimen. The only Hawaiian reference is that given by Bleeker. It is doubtful if the species really occurs in these islands.

Solenostomus paradoxus, Bleeker, Nat. Tyds. Ned. Ind., III, 1852, 308 (Hawaii and Ceram); Kaup, Lophobranchiates, 1856, 2 (Ile de France, India, New Guinea); not of Pallas.

Solenostomus cyanopterus Bleeker, Nat. Tyds. Ned. Ind., VI, 1854, 507, Hawaii and Ceram; Günther, Fishes of Zanzibar, 137, pl. XX, figs. 2, 3, 1866 (Zanzibar); Günther, Cat. Fish., VIII, 1870, 151 (Zanzibar, Ceram, China); Duméril, Hist. Poiss., II, 1870, 497 (New Guinea); Jordan & Snyder, Proc. U. S. Nat. Mus., XXIV, 1902 (Sept. 27, 1901), 4, pl. 3 (Boshu (Awa) Japan).



HIPPOCAMPUS HILONIS JORDAN & EVERMANN. TYPE.

Family XXXIX. SYNGNATHIDÆ.—The Pipe-Fishes.

Body elongate, usually slender, covered with bony plates which are firmly connected, forming a bony carapace; head slender, the snout long, tube-like, bearing the short toothless jaws at the end; gill-opening reduced to a small aperture behind the upper part of the opercle; tail long, prehensile or not, usually provided with a small caudal fin; male fishes with an egg-pouch usually placed on the under side of the tail, sometimes on the abdomen, commonly formed of 2 folds of skin which meet on the median line; the eggs are received into this pouch and retained until some time after hatching, when the pouch opens, permitting the young to escape; dorsal fin single, nearly median, of soft rays only; pectorals small or wanting; ventrals none; anal fin minute, usually present. Genera about 15; species 150. Small fishes, found in all warm seas, sometimes entering fresh waters.

- a. Hippocampinae*: Tail prehensile; caudal fin small; head placed at a large angle with axis of body... *Hippocampus*, p. 119
aa. Syngnathinae: Tail not prehensile, usually with a caudal fin; axis of head usually in line with axis of body.
b. Egg-pouch of male on body; dorsal with 25 rays; rings 18+14 *Doryrhamphus*, p. 120
bb. Egg-pouch of male on tail; dorsal with 22 rays; rings 16+36..... *Ichthyocampus*, p. 121

Genus 66. HIPPOCAMPUS Rafinesque. The Sea-Horses.

Body strongly compressed, the belly gibbous, tapering abruptly to a long, quadrangular, prehensile tail; head with a distinct curved neck, placed nearly at a right angle with the direction of the body, surmounted by a compressed occipital crest, on the top of which is an angular, star-shaped coronet; top and sides of the head with spines; physiognomy remarkably horse-like, like that of a conventional "knight" at chess; body and tail covered with bony plates, forming rings, those on the body each with 6 spines or tubercles, those of the tail with 4; pectoral fins present, short and broad; anal minute, usually present; dorsal fin moderate, opposite the vent; egg-pouch in male a sac at base of the tail, terminating near the vent. Species numerous, in all warm seas. These fishes attach themselves by their tails to seaweed and other floating substances, and are often carried to great distances by currents.

Hippocampus Rafinesque, Indice d'Ittiologia Siciliana, 37, 1810 (*heptagonus*=*hippocampus*).

Hippocampus Leach, Zool. Misc., 103, 1814 (*hippocampus*).

- a. Eye small, 4 in snout; a short keel in front of coronet* *hilonis*, p. 119
aa. Eye larger, 2.8 in snout; no keel before coronet..... *fisheri*, p. 119

79. *Hippocampus hilonis* Jordan & Evermann. Plate 23.

Eye about 4 in snout; snout 2 in head; D. 16, on 3 rings; rings 12 + 35. Tail a little longer than head and trunk; trunk rather deep, compressed, its width 2 in depth; eye small, equal to interorbital width, which is concave, broader posteriorly; gill-opening high, rather large; spines on head and body very blunt, rounded or obsolete, though forming knobs of more or less equal size along tail; coronet with rounded knobs, before which is a short keel or trenchant ridge; base of dorsal about 1.35 in snout.

Color in alcohol, dark or blackish brown, more or less uniform.

This species is known to us only from the example described above. It is closely related to the Japanese *Hippocampus aterrimus* Jordan & Snyder, but on comparison with the type of that species, was found to differ in the presence of the keel on the top of the head and in other minor characters. It is also close to *H. ringens*.

Hippocampus hilonis Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (April 11, 1903), 169, Hilo. (Type, No. 50626, U. S. Nat. Mus. Coll. A. M. Wilson.)

80. *Hippocampus fisheri* Jordan & Evermann. Fig. 36.

Eye 2.8 in snout; snout 2 in head; D. 18, on 4 rings; A. 4; P. 15; rings 12+34.

Tail longer than head and trunk; trunk rather deep, compressed, its width 1.7 in depth; eye small, equal to interorbital width; interorbital space concave; gill-opening small, high; spines on head and body rather high, sharp; 2 rings on trunk between each pair of larger spines; tail with 3 rings between each pair of larger spines; coronet well developed, with 5 spines; spines over eye blunt; base of dorsal about equal to snout; anal small, long; pectoral broad, rays rather long.

Color in life, trunk below middle row of rings yellowish golden, above middle row blackish brown on orange ground; knobs orange; lower portion of knobs on 8 to 11 rings spotted with dark brown; side and top of tail same as back of trunk; ventral side pale dirty orange; head, crown and snout dirty dark brown; an orange band across snout and one before eyes; pale brownish golden over gills; chin orange; iris yellowish golden with 8 reddish streaks radiating from pupil; fins pale; a red spot before each eye at each side of preorbital spine.

Color in alcohol, pale brown, upper surface with dark brown marblings; side with small roundish dark spots.

The above description is from the type, No. 50625, U. S. Nat. Mus. (field No. 03835), a specimen 2.6 inches long, obtained at Kailua, Hawaii, where the species was new to the natives. We have 5

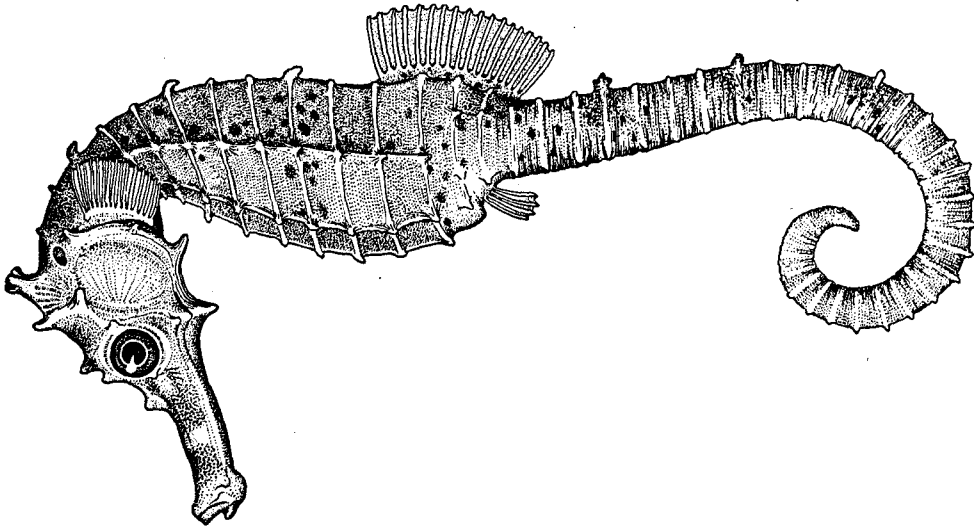


FIG. 36.—*Hippocampus fisheri* Jordan & Evermann: from the type.

other examples, each about 3 inches long, taken from the stomach of a dolphin (*Coryphæna* sp.) which was captured at Hilo, July 18, 1901.

When fresh, No. 03507, a male, was pink or pale cardinal along and near the keels; plates on back and above middle row of knobs on side mottled blackish on pale red ground; plates below middle row of knobs and on belly porcelain white; egg-pouch uniform pale cardinal-red, paler than rest of body; tail same pink or pale cardinal, mottled with blackish blotches; top of head and crown blackish on pale red; cheek, jaw, and snout pink. Some examples had ventral side of tail and portion behind fourth prominent spine of tail uniform pale cardinal-red.

Hippocampus fisheri Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (April 11, 1903), 169, Kailua, Hawaii.

Genus 67. DORYRHAMPHUS Kaup.

This genus differs from *Siphostoma* chiefly in the position of the egg-pouch of the male, which is under the abdomen instead of the tail. The angles of the body are strongly ridged. Tail shorter than body. Tropical seas.

Doryrhamphus Kaup, Lophobranchii, 54, 1856 (*exciatus*).

Cheroichthys Kaup, op. cit., 55 (*valencienni*).

Doryichthys Kaup, op. cit., 56 (*bitineatus*).

Microphis Kaup, op. cit., 63 (*cuncatus*).

Belonichthys Peters, Reise Nach Mosambique, IV, Flussfische, 109, taf. 20, fig. 5, 1868 (*zambezensis*).

81. *Doryrhamphus pleurotænia* (Günther). Fig. 37.

D. 25; osseous rings 18+14; edge of each ring terminating in a slightly prominent spine; lateral line continuous, passing into the lower caudal edge; snout with denticulated ridges; operculum with a slightly oblique raised line, below which are several other radiating keels; snout shorter than remaining portion of head; interorbital space concave, the supraorbital ridge being raised but scarcely serrated; vent behind middle of dorsal fin, equidistant from root of pectoral and snout; distance of snout from vent 1.16 inches; distance of vent from end of caudal 0.75 inch. Color light grayish, with a brownish-black band from snout along the middle of body and caudal fin. Off Honolulu, 18 fathoms. (Günther.) A specimen was obtained by the *Albatross* at Honolulu in 1902.



FIG. 37.—*Doryrhamphus pleurotænia* (Günther); after Günther.

Our single specimen of this species was lost. The color note taken in the field is as follows: Color in life (No. 03553) with a reddish-brown lateral band from tip of snout through eye to base of caudal, other parts of body olivaceous brown; white band on top of snout from tip to forehead; 2 red spots on each side of snout a short distance behind the angles of mouth; pectoral, dorsal, and anal transparent; caudal brilliantly colored, dusky orange with brown, margin lemon-yellow.

Doryrhamphus pleurotænia Günther, Challenger Rept., Zool., I, part VI, Shore Fishes, 62, pl. XXVI, fig. D, 1879 (1880), off Honolulu; Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 523 (Honolulu).

Genus 68. *ICHTHYOCAMPUS* Kaup.

Head short, with a shorter, compressed, sharp-ridged snout; orbits slightly projecting; operculum round, swollen, higher than broad, and grained like the head; tail almost as thick as the body and suddenly pointed at the setting on of the very rudimentary caudal fin; anus situated under the beginning of the dorsal fin; the edges of the concave back coalesce with those of the tail into one line which runs without interruption to the caudal fin; egg-pouch of male under the tail. A single species of this genus is known from the Hawaiian Islands. (See Section II.)

Ichthyocampus Kaup, Wieg. Archiv, XIX, 1853, 231 (*Syngnathus carce*); Kaup, Cat. Lophobranchii, 29, 1856.

Order K. *SYNENTOGNATHI*.—The Synentognathous Fishes.

Lower pharyngeal bones fully united; second and third superior pharyngeals variously enlarged, not articulated to the cranium, sending processes forward, the fourth small or fused with the third; vertebrae numerous (45 to 70), the abdominal ones much more numerous than the caudal; ventral fins abdominal, without spine, the rays more than 5; scapula suspended to cranium by a post-temporal bone, which is slender and furcate; articular bone of lower jaw with a small supplemental bone perhaps corresponding to the coronoid bone; parietal bones much produced, well separated by the supraoccipital; supraclavicle not distinct; no interclavicles; no mesocoracoid; maxillary very close to premaxillary and sometimes firmly joined to it, the suture always distinct; basis of cranium double in front, but without muscular tube; no adipose fin; fins without spines; lateral line concurrent with the belly, peculiar in structure; air-bladder usually large, without pneumatic duct; intestinal tract simple, without pyloric caeca. This order is allied to the *Haplomi* on the one hand and to the *Peresoces* on the other, and like these groups, it marks the transition from the soft-rayed to the spiny-rayed fishes. In their anatomical characters the *Syngnathi* most resemble the latter, but there are never spines in the fins, and the lower pharyngeals are united. The group is divisible into 4 closely related families, which have usually been regarded as subfamilies of one family, *Exocoetidae* or *Scomberesocidae*.

- a. Third superior pharyngeal on each side scarcely enlarged, not longer than its anterior process, and armed with comparatively few (about 15) pointed teeth; fourth superior pharyngeal distinct on each side; lower pharyngeals united into a small linear plate, armed with small teeth; vertebræ with zygapophyses; both jaws produced in a long beak in the adult (the upper short in the young); teeth in jaws strong, unequal; maxillaries firmly appressed to the premaxillaries; a distinct suture along the boundary; coronoid bone (attached to the articular) evident. Species carnivorous.....*Belonidae*, p. 122
- aa. Third superior pharyngeal greatly enlarged, covered with bluntish, tricuspid teeth; fourth superior pharyngeal wanting or fused with the third; lower pharyngeals large, fused into a thick triangular bone with transversely concave surface, covered with blunt tricuspid teeth; teeth in jaws always small conic or tricuspid; maxillary close to premaxillary, but not suturally joined to it, there being some open space between; coronoid bone present, but small; no canine teeth; no zygapophyses to the vertebræ.
- b. Third superior pharyngeal solidly joined with its fellow to form an ovoid plate, which sends 2 processes forward; cleft of mouth narrow; lower jaw usually produced; teeth of jaws tricuspid; herbivorous species...*Hemiramphidae*, p. 126
- bb. Third superior pharyngeal more or less closely appressed, but not united; dorsal and anal without finlets; pectoral fins more or less produced, forming an organ of flight; species at least partly carnivorous.....*Exocoetidae*, p. 130

Family XL. BELONIDÆ.—The Needle-fishes.

Body elongate, very slender, compressed or not, covered with small, thin scales; lateral line very low, running as a fold along side of belly; both jaws produced in a beak, the lower jaw the longer, very much the longer in the young, which resemble *Hemiramphus*; maxillaries grown fast to premaxillaries; each jaw with a band of small, sharp teeth, besides a series of longer, wide-set, sharp, conical teeth; no finlets; dorsal fin opposite anal, both fins rather long; air-bladder present; lower pharyngeals united to form a long, slender, narrow plate, with flat surface covered with small, pointed teeth; upper pharyngeals distinct, the third pair little enlarged, each with some 15 moderate, unequal, pointed teeth (*Tylosurus marinus*), fourth pair well developed, with similar teeth, but without anterior processes; vertebræ numerous, with zygapophyses; ovary single. Voracious, carnivorous fishes, bearing a superficial resemblance to the gar-pikes; found in all warm seas, sometimes entering rivers. Genera 4; species about 50, the majority of them American. Their habits are ordinarily much like those of the pike, but when startled they swim along the surface with extraordinary rapidity, often leaping above the water for short distances. When thus leaping the large species of the Tropics are sources of danger to incautious fishermen, sometimes piercing the naked abdomens of the savages. Most of them are good food-fishes, but the green color of the bones of the larger species often causes them to be avoided for no good reason.

- a. Gillrakers present.....*Belone*, p. 122
- aa. Gillrakers none.
- b. Body subterete or slightly compressed, its breadth more than two-thirds its greatest depth.....*Tylosurus*, p. 123
- bb. Body much compressed, its breadth not half its greatest depth.....*Athlennes*, p. 125

Genus 69. BELONE Cuvier.

This genus differs from *Tylosurus* in the possession of gillrakers, and is confined to the Old World and the islands of the Pacific.

Belone Cuvier, Règne Animal, Ed. I, II, 185, 1817 (*belone*).

82. *Belone platyura* Bennett. Fig. 38.

Head (tip of mandible slightly damaged) about 1.88 in trunk; depth in trunk a little over 16; D. 13; A. 19; P. 12; V. 6; scales about 177 or more to base of caudal; greatest width of head equal to its depth; upper jaw a little over 1.5 in head; eye 2 in postocular part of head, 1.25 in interorbital space; pectoral about 4.3 in space between tip of snout and opercle; ventral 6.5.

Body elongate, depressed on the back and upper surface and also below, the sides rounded; head long, broadened and flattened above, somewhat constrained below; eye rather large and a trifle longer than deep; jaws very long and slender, the upper much shorter than the lower, and the groove of maxillary extending well beyond anterior margin of eye; teeth in mandible not extending beyond tip of upper jaw, and with a median asperous ridge; no vomerine teeth; tongue small, bluntly pointed, a rather thin fleshy flap a little free in front; nasal cavity large and close to upper surface of eye; interorbital space broad and flattened; gill-openings large, the isthmus very narrow, long, and slender; gillrakers rather large, in moderate number; no pseudobranchiæ; peritoneum gray, or marked with numerous dark dots.

Scales moderately large and narrowly imbricated, those on middle of back enlarged; no fin flaps; scales on cheeks, opercles and a number of small ones on top of head; lateral line running low or along the ventral part of the body, and posteriorly below keel on side of caudal peduncle; origin of dorsal a little nearer that of ventral than base of caudal and well behind anal; anterior dorsal rays longest, the posterior or last rays also elongated, longer than middle ones but not as long as the anterior; anal with anterior rays longest; caudal deeply emarginate, the rays strong, the lower lobe the longer, and the entire length of the fin a little more than that of pectoral; pectoral with rays all more or less firm and strengthened, the uppermost enlarged; ventrals rather short and placed a little nearer base of pectoral than base of caudal; caudal peduncle very broad and depressed, its greatest width twice its least depth, and with a sharp keel along each side.

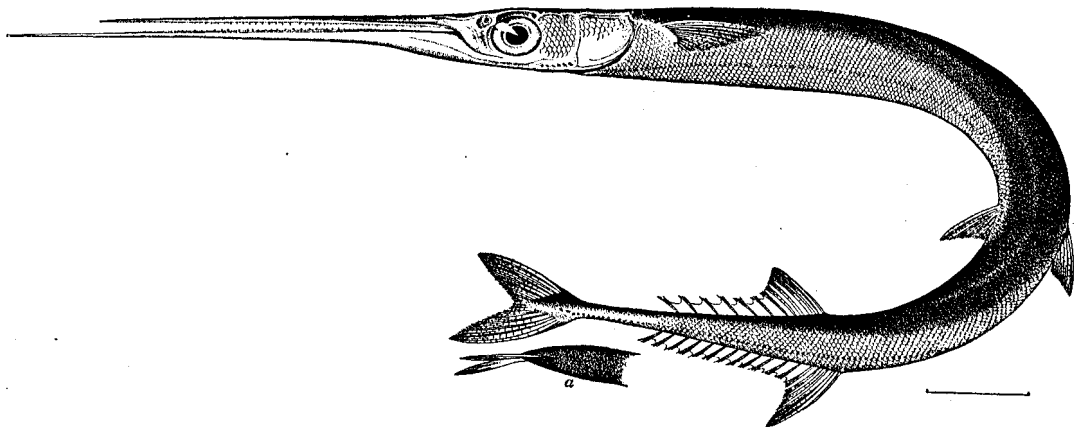


FIG. 38.—*Belone platyura* Bennett.

Color in alcohol, deep blue-black above, sharply defined along the sides from the silvery white of the lower surface; pectoral, ventrals, and anal all more or less grayish. In the young there is a black lateral band and the dorsal is high.

This description is from an example (No. 04992) 14 inches long, taken at Kailua. We have a number of examples taken at Honolulu and Kailua. Several were obtained by Dr. Jenkins at Honolulu in 1889, and others by the *Albatross* in 1902. The species also occurs in Samoa.

Belone platyurus Bennett, Proc. Comm. Zool. Soc. London, 1830, 168, Mauritius; Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 433 (Honolulu).

Belone platyura, Rüppell, Neue Wirbelthiere, Fisch., 1837, 73, pl. 20, fig. 1 (Red Sea); Cuvier & Valenciennes, Hist. Nat. Poiss., XVIII, 461, 1846 (Massawah); Bleeker, Act. Soc. Sci. Indo-Neerl., II, 85, 1857; Günther, Cat., VI, 237, 1866 (Red Sea, Mauritius, Amboyna); Streets, Bull. U. S. Nat. Mus., No. 7, 75, 1877 (Honolulu); Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 30 (Laysan); Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 521 (Honolulu).

Belone carinata Cuvier & Valenciennes, Hist. Nat. Poiss., XVIII, 437, 1846, Hawaiian Islands; Günther, Cat., VI, 236, 1866 (copied).

Mastacembelus platurus, Bleeker, Nat. Tyds. Dierk., III, 1866, 234 (Singapore; Amboyna).

Genus 70. TYLOSURUS Cocco.

Body elongate, very slender, not much compressed; both jaws prolonged into a beak, the lower jaw somewhat the longer, much the longer in young fishes, the very young resembling *Heniramphus*; each jaw armed with a band of small, sharp teeth, beside which is a series of longer, wide-set, sharp, conical, unequal teeth; no teeth on vomer or palatines; scales small, thin; lateral line running along side of belly, becoming median on the tail, no finlets, dorsal fin more or less elevated anteriorly; caudal fin short, unequally lunated or forked; pectorals moderate; ventrals small, the latter inserted behind the middle of body; gillrakers obsolete; bones usually more or less green; size comparatively large. Species numerous. Voracious fishes, chiefly American, one species crossing to Europe; some of them entering rivers.

Only one species is known to occur in the Hawaiian Islands.

Tylosurus Cocco, Lettere in Giornale Sci. Sicilia, XVII, 18, 1829 (*cantrainsi*=*imperialis*=*acus*).

83. *Tylosurus giganteus* (Schlegel). "*Áhalha*," "*Auan*." Fig. 39.

Head a little over 2 in trunk; depth 9.5 in trunk; D. 24; A. 22; P. 14; V. 6; scales about 370 or more to base of caudal; depth of head a little more than its greatest width; eye about 2.13 in post-ocular part of head, 1.3 in interorbital space; pectoral about 3.5 in space between tip of snout and opercle; ventral 3.85.

Body elongate, more or less rounded, the sides a little compressed; head long, flattened above, the sides compressed, somewhat constricted below; eye moderate, a little longer than deep; jaws long, strong, and rather powerful, the lower a trifle the longer; groove of maxillary extending posteriorly for nearly half the eye diameter; teeth developed as large canines in both jaws, and with villiform bands along the edges; also a median roughened ridge on the mandible; no vomerine teeth; tongue small, blunt, little free in front, and fleshy; nasal cavity large, close to upper margin of eye and with a thick fleshy flap over the nostril; interorbital space broad, slightly convex; top of head with bony striae; gill-openings large, the isthmus very narrow, long and thin; no gillrakers; no pseudobranchiae; peritoneum gray; scales very small, narrowly imbricated, very much smaller on back than elsewhere; no fin flaps; cheek scaled, a few scales on top of head, but opercles bare; lateral line running inferiorly along side and up on side of caudal peduncle; origin of dorsal nearer that of ventral than base of caudal by about length of pectoral, the origin of anal only slightly in advance; anterior dorsal rays elongate, those forming posterior half of fin rather long, but shorter than the former; anterior anal rays forming a rather long lobe; caudal rays strong, deeply emarginate, lower lobe the longer, length of fin about 2.3 in entire length of head; pectoral rather small, upper ray enlarged; ventrals inserted nearer base of pectoral than base of caudal by a space equal to that between middle of eye and posterior margin of opercle; least width of caudal peduncle only a trifle more than its least depth, the keel along side more or less obsolete.

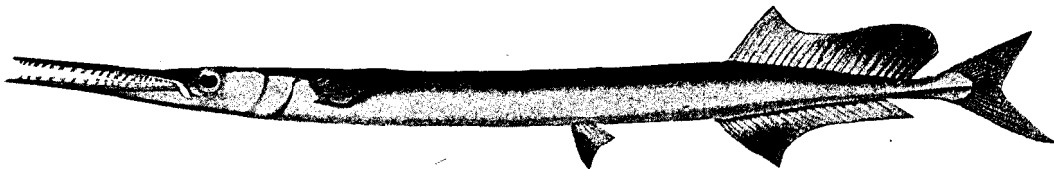


FIG. 39.—*Tylosurus giganteus* (Schlegel); after Bleeker.

Color in alcohol more or less silvery white below, the upper surface greenish brown; fins tinted with yellowish about their bases.

This description taken from an example (No. 05006) 18 inches long obtained at Honolulu. We have others taken at Honolulu, one by Dr. Jenkins in 1889. In an example from Hilo the color markings are better preserved. It has a dark or blackish lateral band from over pectoral to near base of caudal, the dorsal, caudal, and pectoral are more or less blackish, and the margin of the preopercle is broadly marked with blackish brown.

This fish reaches a rather large size, one of our numerous examples being 40 inches long. It is a food-fish of considerable importance, living in the open sea.

Belone gigantea Schlegel, Fauna Japonica, Poiss., 245, 1846, Nagasaki, Japan.

Belone annulata Cuvier & Valenciennes, Hist. Nat, Poiss., XVIII, 447, pl. 550, 1846, Celebes, Tongatabu, Seychelles, Pondicherry; Günther, Cat., VI, 240, 1866 (Pinang, China, Formosa, Gilolo); Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 512 (Honolulu; Samoa).

Belone melanurus Bleeker, Verh. Bat. Genoot., XXII, 1849, 11, Madura, Madura.

Belone cylindrica Bleeker, Verh. Bat. Genoot., XXIV, 1852, 13, Bijd, Soend.

Mastacembelus choram Bleeker, Ned. Tyds. Dierk., III, 1866, 227, East Indies.

Mastacembelus annulatus, Bleeker, Atlas Ichth., VI, 48, pl. 258, fig. 3, 1869-71 (Java, Madura, Bawean, Cocos Island, Sumatra, Singapore, Pinang, Bangka, Celebes, Batjan, Ternate, Amboyna).

Tylosurus annulatus, Seale, Occas. Pap. Bishop Mus., I, 64, 1901 (Guam).

Tylosurus giganteus, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 433 (Honolulu).

Genus 71. *ATHLENNES* Jordan & Fordice.

This genus is close to *Tylosurus*, differing chiefly in the greatly compressed, almost ribbon-shaped body. The single species is American and Pacific.

Athlenes Jordan & Fordice, Proc. U. S. Nat. Mus. 1886, 342 (*hians*).

84. *Athlenes hians* (Cuvier & Valenciennes). "*Áhaáha*." Fig. 40.

Head (tip of beak broken) 2.6 in trunk; depth 9 in trunk; D. 25; A. 26; P. 12; V. 6; scales about 520 in a lateral series to base of caudal; depth of head about twice its width; eye about 2 in postocular part of head, 1 and a trifle over in interorbital space; pectoral 3.3 in head; ventral a little over 4.

Body very elongate, narrowly compressed, the sides flattened; head flattened on top, the sides strongly compressed and the under surface narrowly constricted; eye rather large, much longer than deep; jaws long, the upper strongly arched upward at the base, so that the mouth can not be closed, the mandible very broad and deep at the base; groove of maxillary extending to below middle of eye at least; many large canines in each jaw, and the floor of the mandible with a median asperous ridge; no vomerine teeth; tongue well developed, rather small, and free in front; nasal cavity large, near

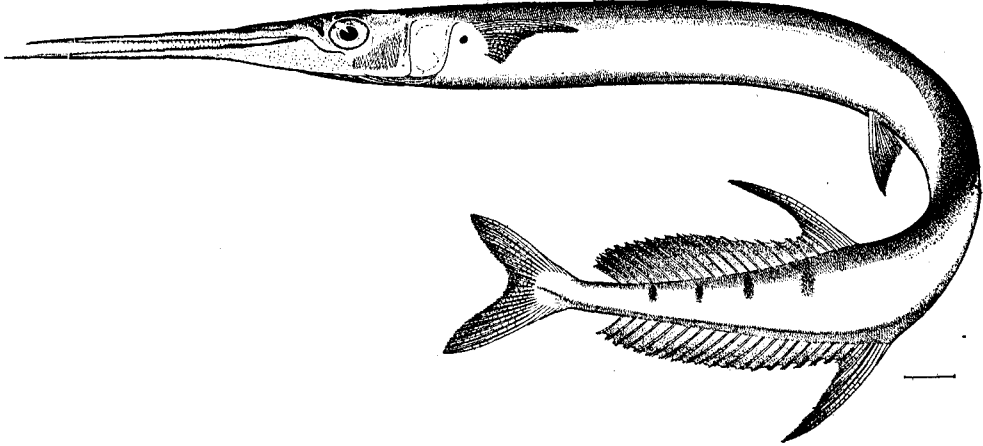


FIG. 40.—*Athlenes hians* (Cuvier & Valenciennes).

upper margin of eye, and with a thick fleshy flap over the nostril; interorbital space broad, flattened; top of head with a few bony striae; gill-opening large, the isthmus a thin frenum; no gillrakers; no pseudobranchiae.

Scales very minute and narrowly imbricated; top of head and a large patch on cheeks scaled, otherwise naked; no fin flaps; lateral line running along the ventral surface of body, also along the lower side of caudal peduncle to base of caudal; origin of dorsal a little nearer base of ventral than that of caudal, and the anterior rays very long and forming a falcate lobe; anal similar to dorsal, the anterior rays long and forming a long falcate lobe, the origin of the fin only a trifle in advance of that of the dorsal; caudal small, the rays rigid, strong, the edge emarginate, and the lower lobe the longer; pectoral with the uppermost ray enlarged; ventrals inserted a trifle nearer anterior margin of nasal cavity than base of caudal; caudal peduncle compressed, its least width two-thirds its least depth, and no keel along sides.

Color in alcohol, brown above, the lower portions, including the sides, silvery white, and the fins all more or less brownish; 3 large blackish blotches sometimes present on back below dorsal.

This description taken from an example (No. 03561) 30 inches long obtained at Honolulu in 1889 by Dr. Jenkins. We have also 2 others collected by him at Honolulu and 5 large examples collected by ourselves from the same locality. The species is recorded by Steindachner from Acapulco. Our specimens range in length from 29 to 40 inches.

This fish was common in the Honolulu market, where it is regarded as a good food-fish. We have thus far failed to find any difference between the Pacific species and the common *Athlennes hians* of the West Indies.

Belone hians Cuvier & Valenciennes, Hist. Nat. Poiss., XVIII, 432, 1846, Havana, Bahia; Günther, Cat., vi, 1866, 248 (copied); Steindachner, Ichth. Beitr., III, 64, 1875 (Acapulco).

Tylosurus hians, Jordan & Gilbert, Synopsis, 373, 901, 1883.

Athlennes hians, Jordan & Evermann, Fish. North & Mid. Amer., I, 718, 1896; Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 433 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 521 (Lahaina, Maui).

Family XLI. HEMIRAMPHIDÆ.—The Balaas.

Body elongate, more or less compressed, covered with large cycloid scales; upper jaw short, lower jaw variable, sometimes much produced, the toothed portion at base fitting against the toothed premaxillaries; teeth equal, mostly small and tricuspid; maxillaries ankylosed to premaxillaries; gillrakers long; caudal fin rounded or forked; if forked, the lower lobe the longer; anal fin modified in the viviparous species (*Zenarchopterus*), unmodified in the others and usually similar to the dorsal; no finlets; air-bladder large, sometimes cellular; third upper pharyngeal on each side much enlarged, solidly united with its fellow to form an oval plate, with slightly convex surface and covered with blunt tricuspid teeth; this is about as large as the united lower pharyngeals and fits into the concavity of the latter; fourth upper pharyngeal wanting or grown fast to the third; lower pharyngeal large, thick, triangular, with concave surface; vertebrae about 50. Probably not separable from the *Exocoetidae*.

Herbivorous fishes of the warm seas; mostly shore species, a few pelagic. They feed chiefly on green algae, and, like the related forms, swim at the surface, occasionally leaping into the air. Size rather small, about a foot in length. Genera about 7; species about 75.

a. Body moderately compressed; pectoral moderate. Shore fishes.

b. Ventrals inserted anteriorly, far in advance of dorsal; air-bladder simple; sides of body more or less convex.....*Hyporhamphus*, p. 126

bb. Ventrals inserted posteriorly, not far before dorsal; air-bladder cellular; sides of body nearly vertical and parallel.....*Hemiramphus*, p. 127

aa. Body very slender and compressed, more or less band-like; pectoral fin very long, ventral very short, inserted posteriorly. Pelagic species.....*Euleptorhamphus*, p. 128

Genus 72. HYPORHAMPHUS Gill. The Halfbeaks.

Body elongate, moderately compressed, the sides of body not vertical, but more or less convex, the dorsal outline parallel with that of the belly. Upper jaw short; lower jaw prolonged into a slender beak, bordered with membrane, this beak shorter in the young; premaxillaries forming a triangular plate, the teeth of which fit against the toothed portion of the mandible; maxillaries joined to premaxillaries; teeth feeble, mostly tricuspid; gillrakers rather long; head covered with large shield like scales; scales deciduous; caudal fin more or less forked, the lower lobe the longer; no finlets; dorsal and anal similar, opposite each other, not modified in the males; last ray of dorsal usually short; ventrals small, inserted well forward, nearly midway between opercle and base of caudal. Air-bladder large, simple, not cellular. Young with the lower jaw short. Sides in our species with a distinct silvery band, as in *Atherina*. Oviparous. Species numerous in all warm seas, going in large schools, but usually remaining near shore, feeding chiefly on green algae. Size comparatively small.

One species known from Hawaiian waters.

Hyporhamphus Gill, Proc. Ac. Nat. Sci. Phila. 1859, 131 (*tricuspidatus* = *unifasciatus*).

85. *Hyporhamphus pacificus* (Steindachner). Fig. 41.

Head (from tip of snout) 4.6 in trunk; depth 9.5 in trunk; D. 15; A. 18; P. 12; V. 6; scales about 64 in a lateral series; width of head about 1.5 in its depth; snout 2.67 in head; eye 4.25, 1.5 in postocular part of head, about 1.67 in snout, and 1 in interorbital space; pectoral 1.5 in head; ventral 2.67.

Body moderately elongate, compressed, the back rounded rather broadly; head flattened above, the sides compressed, and the lower surface narrowly constricted; snout a trifle over 4 in space

between front margin of eye and tip of beak; eye moderate, a trifle longer than deep; mouth a little less than eye; teeth in small villiform bands in jaws; no teeth on roof of mouth; tongue more or less rounded, rather thick and little free around edges; nasal cavity level with the upper part of eye in front and with a small fleshy flap over nostril; interorbital space flattened, and posteriorly the top of the head slightly convex; gill-opening with a long, thin, narrow and sharp-edged isthmus; gillrakers numerous, thin, sharp-pointed; no pseudobranchiæ; scales rather large, very deciduous, and the sides of the head more or less scaly; no scaly fin flaps; lateral line running low along the side to base of caudal; origin of dorsal nearer that of ventral than base of caudal by a space equal to postocular part of head, and about opposite that of anal; anterior dorsal rays the longest; anal more or less similar to dorsal; caudal well forked, the lower lobe the longer, and the length of the fin a little less than head measured to tip of snout; ventrals small, inserted a little posterior to middle of space between base of pectoral and that of caudal by a space about equal to width of head; caudal peduncle compressed, its least width 2 in its least depth.

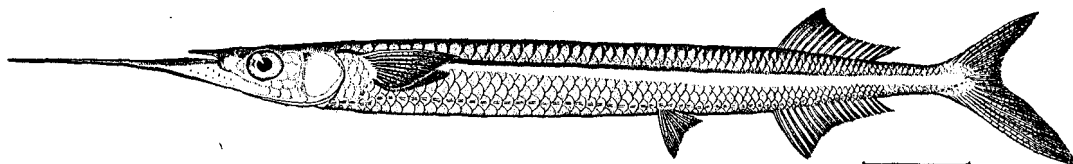


FIG. 41.—*Hyporhamphus pacificus* (Steindachner).

Color in alcohol, dull brown above, and as the scales have all more or less fallen, the edges of the pockets are narrowly blackish; side with a slaty and a silvery lateral band, both together running to caudal; lower surface of body silvery; all the fins more or less tinged with gray; beak blackish.

This description from an example (No. 03562) 10 inches long, taken at Kailua, from which place the collection contains 69 examples, ranging in length from 3 to 10 inches. The usual length seems to be 8 to 10 inches. The species was not seen at Honolulu. Two specimens in the Museum of the Philadelphia Academy (Nos. 7507 and 23338), both young, collected "near the Sandwich Islands" by Dr. Wm. H. Jones, doubtless belong to this species.

Hyporhamphus sp., Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 498, near the Hawaiian Islands (young).

Hemiramphus pacificus Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 511, Laysan Island.

Hyporhamphus pacificus, Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 522 (Laysan Island).

Genus 73. HEMIRAMPHUS Cuvier.

Body more robust than in *Hyporhamphus* and different in form, the sides being compressed and nearly vertical and parallel; head and jaws as in *Hyporhamphus*. Dorsal longer than anal fin and inserted farther forward, its last ray more or less produced in American species; ventral fins small and inserted well backward, much nearer base of caudal than gill-opening; air-bladder cellular, with many partitions (in *H. browni*). Species probably numerous, but most of them have not been examined as to the characters which separate the genus from *Hyporhamphus*.

Only one species known from the Hawaiian Islands.

Hemiramphus Cuvier, Règne Animal, Ed. I, II, 186, 1817 (*brasilienensis* = *browni*).

86. *Hemiramphus depauperatus* Lay & Bennett. "M'émé'e," "Thehe." Fig. 42.

Head (from tip of snout) 4.3 in trunk; depth about 6.1 in trunk; D. 14; A. 13; P. 11; V. 6; scales about 60 in a lateral series to base of caudal; width of head about 1.5 in its depth; snout 3 in head; eye 4 in head, 1.4 in snout, 1.6 in postocular portion of head, about one in interorbital space; pectoral less than head by about 0.5 eye diameter; ventral 2 in head.

Body moderately elongate, rather thick, the sides compressed and flattened; head compressed, more or less flattened and rounded above, the lower surface not constricted narrowly; snout about 4.6 in space between front margin of eye and tip of beak; eye moderately large, longer than deep; mouth about 1.75 in eye; teeth in small villiform bands in the jaws; no teeth on roof of mouth; tongue more or less rounded, thick, and a little free around the edges; nasal cavity moderately large above and in

front of eye, and with a thick flap over nostril; interorbital space flattened, the top of the head convex posteriorly; gill-opening large, with a long, thin, narrow sharp-edged isthmus; gillrakers rather long, thin, pointed, and numerous; no pseudobranchiae; peritoneum dark brown; scales rather large, very deciduous and narrowly imbricated, especially along the sides; no scaly flaps at bases of pectorals or ventrals; a number of small scales on the basal portions of the anterior dorsal rays. Lateral line running low along the side to base of caudal; origin of dorsal well before that of anal and about the last fourth of the space between front margin of eye and base of caudal; dorsal with anterior rays longest; anal similar to dorsal, its base 1.5 in that of the latter; caudal forked, the lower lobe much longer and stronger than the upper; pectoral long, the upper ray enlarged and longest; ventrals rather short, the rays all strong, flattened, and the inner ones much the longer, the margin of the fin concave, ending in sharp points; caudal peduncle compressed, its least width 2 in its least depth.

Color in alcohol, more or less deep silvery, dull bluish black on the back, and as the scales have all

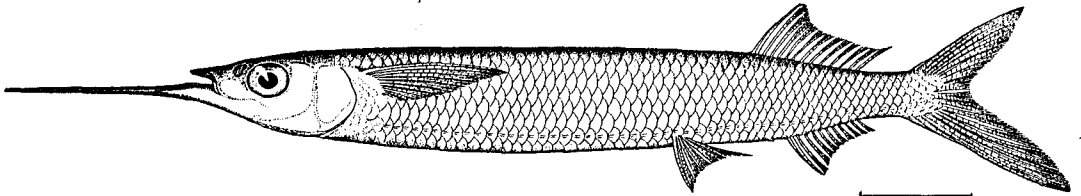


FIG. 42.—*Hemiramphus depauperatus* Lay & Bennett.

more or less fallen, the edges of the pockets are blackish; sides and lower portions silvery white; fins all more or less gray, the dorsal and caudal deeper; top of the head and beak blackish.

This description is from a specimen 14 inches long (No. 03564). We have many specimens, varying in length from 13.5 to 15.5 inches. All were taken at Honolulu, some in 1889 by Dr. Jenkins, who considers the species identical with *H. brasiliensis*. It may be distinguished from the latter, however, by its longer pectoral fin.

? *Esox maxilla inferiore producta* Browne, Hist. Jamaica, 443, 1756, Jamaica.

? *Esox brasiliensis* Linnaeus, Syst. Nat., Ed. X, 314, 1758, Jamaica; after Browne; the Timucu of Maregrave wrongly included in the synonymy; Bloch, Ichth., 391, 1801, corrected synonymy and description.

? *Hemiramphus marginatus* Le Sueur, Journ. Ac. Nat. Sci. Phila., II, 1823, 135, Lesser Antilles; not of Forsskål.

Hemiramphus depauperatus Lay & Bennett, Zool. Beechey's Voyage, 66, 1839, Oahu; Fowler, Proc. Ac. Nat. Sci. Phila., 1900, 499, Pl. XIX, fig. 3 (Hawaiian Islands); Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 522 (Honolulu; Albatross Station 3834).

? *Hemiramphus browni* Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 13, 1846, Guadeloupe; Martinique.

? *Hemiramphus pleii* Cuvier & Valenciennes, l. c., 19, Martinique; San Domingo; Günther, Cat., VI, 369, 1866; Meek & Goss, Proc. Ac. Nat. Sci. Phila. 1884, 225.

? *Macrogathus brevirostris* Gronow, Cat., 148, 1854, Jamaica; after Browne.

? *Hemiramphus filamentosus* Poey, Memorias, II, 297, 1861, Cuba.

? *Hemiramphus brasiliensis*, Günther, Cat., VI, 270, 1866; Jordan & Gilbert, Synopsis, 224, 1883.

Hemiramphus brasiliensis, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 434 (Honolulu).

Genus 74. EULEPTORHAMPHUS Gill.

This genus consists of pelagic species related to *Hemiramphus*, the body much more slender and greatly compressed, and the pectorals very long, approaching those of the flying-fishes; air-bladder not described, probably cellular.

Two or 3 species known, 1 from the Hawaiian Islands.

Euleptorhamphus Gill, Proc. Ac. Nat. Sci. Phila. 1859, 151 (*brevoorti* = *relax*).

87. *Euleptorhamphus longirostris* (Cuvier). "Theihe." Fig. 43.

Head (from tip of snout) 6 in trunk; depth 10.75 in trunk; D. 24; A. 23; P. 9; V. 6; scales about 105, according to the pockets; width of head about 1.25 in its depth; snout about 3.17 in head; eye about 3.17 in head, 1.17 in postocular part of head, a little greater than width of interorbital space; pectoral 1.6 in head to end of broken beak; ventral 3 in head (from tip of snout).

Body very long, greatly compressed, the sides flattened, and the middle of the back with a sub-carinate ridge; head compressed, flattened on top and the lower surface narrowly constricted; snout

about 8 in beak (broken at tip), to front margin of eye; eye rounded, as deep as long; mouth 2 in eye; teeth in small villiform bands in the jaws and on the vomer; tongue rather thick, flattened, fleshy; and a little free in front and around the edges; nasal cavity somewhat small, above the eye in front, and with a well developed fleshy flap; interorbital space broad and flattened and the top of the head posteriorly convex; gill-opening large, the isthmus a rather long thin narrow frenum; gillrakers short, moderately numerous, rather weak, and pointed; no pseudobranchiae; scales rather small, very deciduous, the head naked; no scaly fin flaps; lateral line running low along the side; origin of the dorsal about the last third in the space between the front of the nasal cavity and the base of the caudal and well in advance of the anal; dorsal rays long; caudal deeply forked, the lower lobe much the longer; anal long, the rays also long; pectoral very long, and reaching for more than two-thirds the distance to ventrals, the rays all strong and the upper enlarged; ventral very small, only a little posterior to the center of the space between the bases of pectoral and caudal; caudal peduncle with its least width 2 in its least depth.

Color in life (No. 02993) pale bluish silvery above; scales on back with darker edges; lower side and belly silvery; top of head dark bluish, side silvery; bill bluish black; fins pale bluish, anal white; upper lobe of caudal with a diffuse curved black band parallel with the edge.

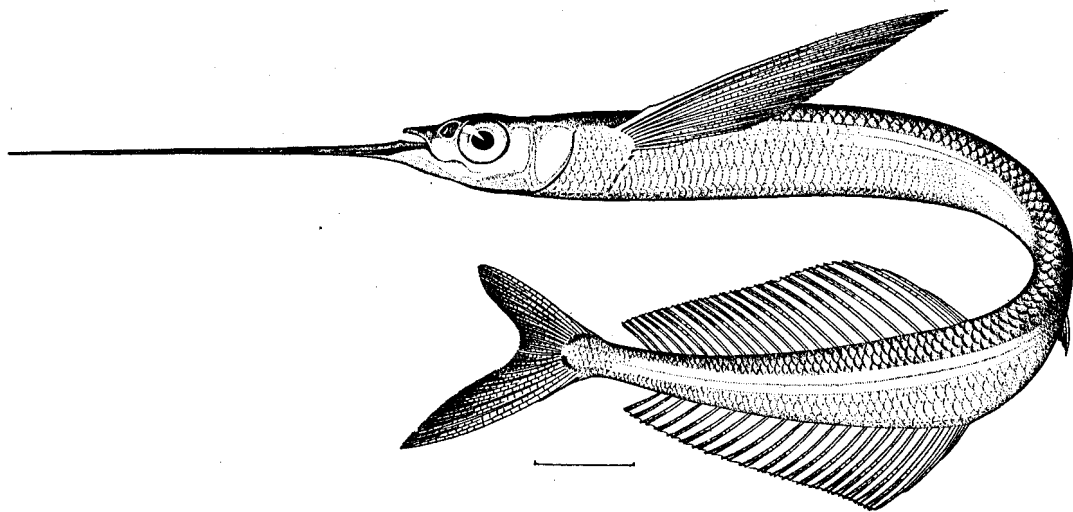


FIG. 43.—*Euleptorhamphus longirostris* (Cuvier).

Color in alcohol, more or less silvery, dull brown above, and as the scales have all more or less fallen, the edges of the pockets are narrowly blackish; side with a slaty silvery lateral band to caudal; all the fins more or less dull olivaceous gray, the anal and ventrals whitish; beak blackish.

This description from an example (No. 03193) 17 inches long, taken at Honolulu, where we obtained many others. We have also examined a number of examples collected by Dr. O. P. Jenkins at Honolulu in 1889. Our specimens range in length from 16 to 18 inches.

Hemiramphus longirostris Cuvier, Règne Animal, Ed. 2, II, 235, 1829, Pondicherry (after Kuddera of Russell); Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 52, 1846 (Pondicherry).

Hemiramphus macrorhynchus Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 1846, 55, pl. 556, open sea, 177° E., 7° S.

Hemiramphus longirostris, Günther, Cat., VI, 276, 1866 (copied); Day, Fishes of India, 513, 1877 (Coromandel, coast of India).

Hemiramphus macrorhynchus, Günther, Cat., VI, 276, 1866 (copied).

Euleptorhamphus longirostris, Putnam, Proc. Bost. Soc. Nat. Hist. 1870, 239; Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 434 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 522 (Honolulu).

Family XLII. EXOCETIDÆ.—Flying-fishes.

Body oblong or elongate, covered with cycloid scales, which are rather deciduous; lateral line running very low, along the side of the belly; head more or less scaly with vertical sides; mouth moderate, terminal, the jaws not prolonged into a beak; premaxillaries not protractile, hinged at base mesially; margin of the upper jaw chiefly formed by the premaxillaries, the short maxillaries entering the lateral margin; maxillary free from the premaxillary, its edge slipping under the front of the preorbital; dentition various, the teeth small and weak; dorsal fin without spines, inserted on the posterior part of the body, opposite the anal and more or less similar to it; ventrals abdominal, of several soft rays, inserted posteriorly; pectoral fin inserted high, used as an organ of flight; shoulder-girdle and pectoral muscles very strong; caudal fin forked, the lower lobe the longer; no finlets; vent close in front of anal; nostrils large, double, near the eye; lower pharyngeals enlarged and fully united, forming a large, transversely concave plate, covered with large, close-set, blunt, tricuspid teeth; third upper pharyngeal greatly enlarged, not united with its fellow, both covered with large, blunt, tricuspid teeth; fourth superior pharyngeal wanting in the adult (probably co-ossified with the third)—these characters verified on *Exocetus californicus*—vertebræ without zygapophyses; gill-membranes not united, free from the isthmus; pseudobranchiæ hidden, glandular; gillrakers various; gills 4, a slit behind the fourth; air-bladder very large, not cellular so far as known, and extending far backward among the hæmopophyses of the caudal vertebrae; vertebrae about 50; intestinal canal simple, without cæca. Carnivorous or herbivorous fishes. Genera 6 or 8; species about 65; abounding in all warm seas, mostly pelagic, swimming near the surface, and skipping or sailing through the air, sometimes for considerable distances.

- a. Pectoral fins moderate, not reaching beyond middle of dorsal fin; dorsal more or less elevated; anal long, its base scarcely shorter than dorsal.
- b. Pectoral not reaching the ventrals *Evolantia*, p. 130
- bb. Pectoral reaching beyond ventrals to dorsal or for the first third of its length *Paracocetus*, p. 131
- aa. Pectoral fins very long, their tips usually reaching to base of caudal; lower jaw little prominent, snout short.
- c. Ventral fins inserted anteriorly, much nearer tip of snout than base of caudal, not used as organs of flight, their tips not reaching nearly to front of dorsal; anal fin long, its base nearly equal to that of dorsal .. *Exocetus* p. 132
- cc. Ventral fins inserted posteriorly, more or less near base of caudal than tip of snout, used as organs of flight, and their tips reaching past middle of base of anal.
- d. Anal fin long, equal to dorsal fin *Exonantes*, p. 133
- dd. Anal fin short, not equal to dorsal fin *Cypsilurus*, p. 134

Genus 75. EVOLANTIA Snodgrass & Heller.

This genus differs from other genera of flying-fishes chiefly in the short pectoral, which does not reach the ventrals; no teeth on roof of mouth; ventrals small, midway between pectorals and base of caudal.

Evolantia Snodgrass & Heller, Fishes of the Galapagos Islands, in Proc. Wash. Ac. Sci., V, 1903 (Sept. 12), 189 (*microptera*).

88. *Evolantia microptera* (Cuvier & Valenciennes). "*Malolo*." Fig. 44.

Head 4.25 in length; depth 6; D. 13; A. 15; P. 12; V. 6; scales to base of caudal about 45; about 10 scales in a transverse series to middle of belly; width of head less than its depth and about 2 in its length; snout 4 in head, eye 3.5, 1.5 in postocular part of head, 1 in interorbital space; ventral 2.3 in head; base of dorsal 1.3; pectoral 2.75 in body.

Body elongate, compressed; head elongate, pointed in front, the upper profile more or less convex; snout rather short, pointed, and rounded; eye anterior, well behind center of length of head, and the bony rim behind slightly keeled outward; mouth small, superior, the mandible projecting well beyond the snout; teeth in jaws minute, none on roof of mouth; tongue rounded, and free around the edges; nasal cavity moderately small, above eye in front, and with a thick, fleshy flap; interorbital space broad, very slightly concave; gillrakers slender, pointed, rather numerous, and much shorter than the long gill-filaments; peritoneum brown; scales cycloid; lateral line running along the lower part of side; origin of dorsal apparently nearer tip of caudal (damaged) than base of pectoral, and well in advance of the anal; dorsal high, the median ridge elevated; anal high, the anterior rays elevated; caudal deeply forked, the lower lobe the longer; pectoral moderately long, not reaching the origin of

ventrals; ventrals small, about midway between origin of pectoral and base of caudal, and not reaching anus; caudal peduncle moderately deep and compressed.

Color in alcohol, brown above, whitish beneath, washed with silvery; along the side a broad, leaden silvery longitudinal band; pectoral gray-brown, edged with whitish; dorsal and caudal dark, the anal and ventrals whitish.

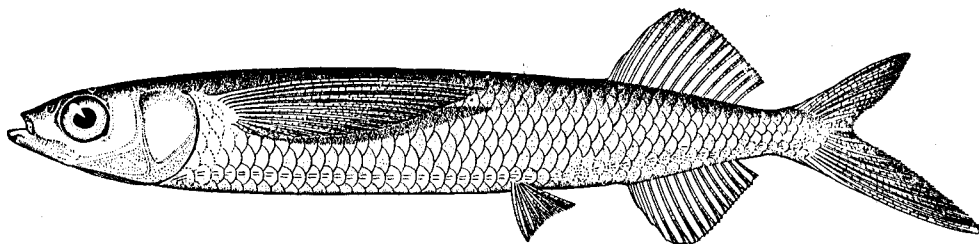


FIG. 44.—*Evolantia microptera* (Cuvier & Valenciennes).

This description from an example 7.5 inches long, obtained at Honolulu in 1889 by Dr. Jenkins. We have a number of others 6 to 7 inches in length from the same place.

This species does not appear to reach a greater length than about 8 inches.

Erocetus micropterus Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 127, 1846, pl. 563, Port King George, New Holland; Carteret, New Ireland; Buru; Malabar; Bleeker, Act. Soc. Sci. Indo-Néerl., I, 1856, 63; Günther, Cat., VI, 279, 1866 (Amboyna).

Cypsilurus micropterus, Bleeker, Nederl. Tydsch. Dierk., III, 128, 1865 (Amboyna).

Evolantia microptera, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 434 (Honolulu).

Genus 76. PAREXOCETUS Bleeker.

Body moderately elongate, elliptical in cross-section; snout short; lower jaw not produced; roof of mouth (vomer, palatines, and pterygoids) fully provided with teeth; pectoral fins moderate, not reaching beyond middle of dorsal; ventrals long, inserted behind middle of body; anal fin about as long as dorsal; dorsal high. Small flying-fishes of the tropical coasts widely distributed.

Parexocetus Bleeker, Nederl. Tydsch. Dierk., III, 1865, 126 (*mento*).

a. Head about 4 in length; D. 9; A. 10 *rostratus*, p. 131
 aa. Head shorter, 4.67 in length; D. 13; A. 14 *brachypterus*, p. 131

89. *Parexocetus rostratus* (Günther).

Head a little more than 4 in length; depth 5.5; D. 9; A. 10; scales in lateral line 40; 24 scales between occiput and dorsal fin, and 8 longitudinal series between the origins of dorsal and anal; depth of head equaling distance between extremity of snout and center of eye; eye 4.3 in head, less than width of interorbital space, which is flat.

Snout much produced, its length a little more than that of postorbital part of head; mouth cleft directed upward, subvertical; dorsal beginning scarcely in advance of anal, elevated, its anterior rays when depressed extending to caudal; anal fin low; lower caudal lobe not much shorter than the head; pectoral reaching to dorsal, its length less than one-half the total body length (without caudal); ventral extending to vent. Dorsal black, with the last ray white; pectoral black, with the upper and lower rays white; ventral and anal whitish. Length 6.5 inches. Hawaiian Islands. (Günther).

Known only from the type, which is in the British Museum.

Erocetus rostratus Günther, Cat., VI, 280, 1866, Hawaiian Islands.

90. *Parexocetus brachypterus* (Solander). "Malolo," "Puhiki'i." Plate III.

Head 4.67 in length; depth 5; D. 13; A. 14; P. 12; V. 6; scales 42 to base of caudal; 8 scales in a transverse series to middle of belly; greatest width of head 1.3 in its depth; snout 4 in head; eye 3, about 1.25 in postocular part of head, 1 in interorbital space; ventral 1.2; depressed dorsal 2.75 in body; pectoral 1.88.

Body elongate, spindle-shaped and laterally compressed; head elongate, compressed, pointed;

snout short, blunt; eye moderately large, impinging upon the upper profile; maxillary small, reaching to the anterior margin of the eye; teeth small, villose, the mandible projecting and pointed; nasal cavity small, and with a small fleshy flap over nostril; interorbital space broad and flattened; gillrakers fine, slender, and rather numerous; peritoneum pale or grayish, with rather dark dots or spots; scales large, cycloid; lateral line running low along the lower part of side and also lower portion of caudal peduncle to base of caudal fin; dorsal very long, the median rays the longest, the edge of the fin rounded and when depressed reaching angle in emargination of caudal fin; origin of dorsal a little in advance of that of anal, or about midway between base of pectoral and tip of upper caudal lobe; anal rather low, the rays not prolonged; caudal deeply forked, the lower lobe much longer than the upper; pectoral very long, reaching the first third of base of dorsal; ventrals long, reaching below second and third anal rays.

Color when fresh (No. 03418) with the upper portion of body dark ultramarine blue, the lower surface silvery white; dorsal blue, except a large blackish blotch on the upper marginal portion; posterior half of caudal blue; pectoral transparent with a rosy tinge; margin of ventral red, or the color on the first, second, third, and fourth rays rosy above.

This description from an example (No. 03418) 6.5 inches long from Honolulu.

Our collections from Honolulu contain 29 examples of this species (7 of them numbered 02953 to 02958, and 03418), and 2 specimens obtained at Hilo. Dr. Jenkins obtained 8 specimens at Honolulu in 1889; 2 of these are numbered 150 and 211; 2 other examples (No. 6010) were obtained by Dr. Wood. Specimens were obtained by the *Allatross* at station 3829 off the southern coast of Molokai.

These numerous specimens are almost uniformly 7 inches in total length, which seems to be about the maximum size of this species.

This flying fish is apparently the most abundant species among the Hawaiian Islands. Early in June numerous schools were seen near and in the harbor of Honolulu, and it continued a common fish in the Honolulu market during the summer.

Exocetus brachypterus Solander in Richardson, Ichth. China, 265, 1846, Otaheite; Günther, Cat., VI, 280, 1866 (China Seas); Streets, Bull. U. S. Nat. Mus., No. 7, 75, 1877 (Hawaiian Islands); Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 512 (Honolulu and Laysan).

Exocetus hillianus, Gosse, Nat. Sojourn in Jamaica, II, 11, Pl. I, fig. 1, 1851 (Jamaica); Lütken, Vid. Medd. Natur. Foren., 397, 1876 (Atlantic; Antilles; Honolulu).

Parezcocetus mesogaster, Jordan & Meek, Proc. U. S. Nat. Mus. 1885, 47 (Hawaiian Islands); Jordan & Evermann, Fishes North & Mid. Amer., I, 728, 1896; Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 500 (Hawaiian Islands); (probably not *Exocetus mesogaster* of Bloch.).

Parezcocetus brachypterus, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 435 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 522 (off southern coast of Molokai).

Genus 77. EXOCETUS Linnæus.

This genus is characterized mainly by the short ventrals which are anteriorly placed and terminate in advance of the anal fin, not being used as organs of flight; pectoral fins very long; no teeth on palate. Open seas.

Exocetus Linnæus, Syst. Nat., Ed. X, 316, 1768 (*volitans*).

Halocyprælus Weinland, Proc. Bost. Soc. Nat. Hist., VI, 1858, 385 (*mesogaster*=*evolans*=*volitans*).

91. *Exocetus volitans* Linnæus. "*Malolo*." Fig. 45.

Head 4.25 in length; depth 4.88; D. 12; A. 12; P. 15; V. 6; scales about 42 to base of caudal, 10 scales in a transverse series; head a little deeper than wide; snout 4.5 in head; eye 3.67, 1.67 in post-ocular part of head, 1.3 in interorbital space; ventral 1.75 in head; base of dorsal 1.2; base of anal 1.2.

Body elongate, the sides compressed and flattened; head subconic, blunt; snout very obtuse, short, rounded; eye anterior, the posterior margin about the middle of the head; mouth very oblique, superior, the maxillary not reaching the eye, the mandible projecting and the jaws forming a thin, horny, cutting edge; small teeth on vomer; tongue flattened, moderately broad, rounded and free; nasal cavity moderate, above the eye in front, and with a small thick flap; interorbital space broad, only very slightly convex; gillrakers slender, rather numerous and not quite half the eye; peritoneum pale; scales large, cycloid, head scaled; lateral line running low and stopping short behind anal fin; origin of dorsal nearer base of pectoral than tip of upper caudal lobe, and a trifle behind origin of anal; anterior dorsal

rays elevated and the fin similar to anal; caudal deeply forked, the lower lobe much the longer; pectoral very long, the second ray divided, the second and third the longer, and extending to base of caudal; origin of ventral almost midway between tip of snout and middle of base of anal; caudal peduncle rather deep and compressed.

Color above, brown, the lower surface whitish, washed with silvery; pectorals dark brown with pale edges; dorsal and caudal more or less grayish; ventrals and anal whitish.

Here described from an example 6 inches long, taken at latitude $28^{\circ} 03' 42''$ N., longitude $143^{\circ} 10' 05''$ W., by the *Albatross*, December 21, 1891. We also have another example, a little larger, with the same data, and Dr. Jenkins obtained a small one at Honolulu, in 1889. None was seen by us in 1901.

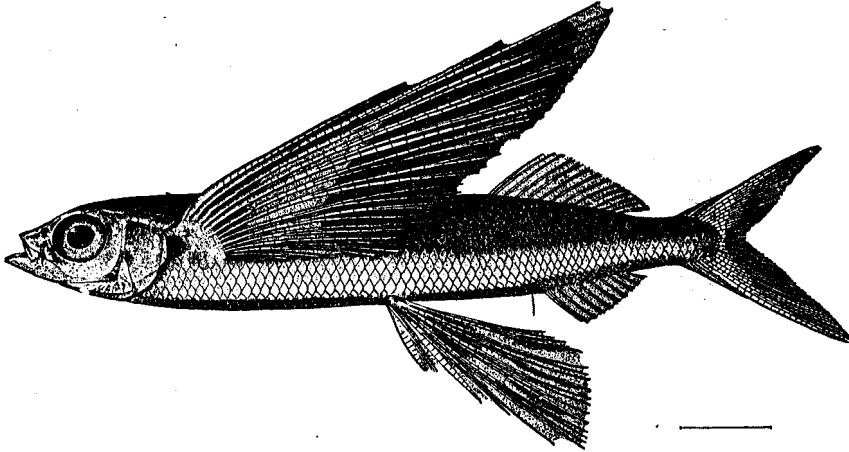


FIG. 45.—*Exocetus volitans* Linnæus; after Jordan and Evermann.

An example came aboard the *Albatross* at night at about 24° N. and 151° W., and another at station 3808, near Oahu, during the investigations of 1902.

Exocetus volitans Linnæus, Syst. Nat., Ed. X, 316, 1758, locality not known (after Balk, who copied from Artedi); Jordan & Evermann, Fish. North & Mid. Amer., III, 2835, 1898; Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 500 (Hawaiian Islands); Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 435 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 522 (*Albatross* stations 3804, 3805, and 3808).

Exocetus volans Linnæus, Syst. Nat., Ed. XII, 521, 1766 "in Oceano Hispanico" (after Gronow); Günther, Cat., VI, 282, 1866 (Mediterranean; Demerara; between Zanzibar and Seychelles; Java; India; China seas; north coast of Australia); Lütken, Vid. Medd. Naturh. Foren., 1876, 102, 395.

Exocetus splendidus Abel, Narr. Voyage China, 4, 1818, China (vide Valenciennes).

Exocetus georgianus Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 136, 1846, 5° N., 92° W.; Günther, Cat., VI, 279, 1866 (copied); Lütken, Vid. Medd. Naturh. Foren., 101, 394, 1876 (young examples with barbel).

?*Exocetus nanocirrhus* Richardson, Ichth. China, 265, 1846, China; Günther, Cat., VI, 279, 1866 (Sea of China).

Exocetus chilensis Abbott, Proc. Ac. Nat. Sci. Phila. 1860, 472, Chile.

Exocetus obtusirostris Günther, Cat., VI, 283, 1866, Cape de Verde Islands; India; New Orleans.

Exocetus speculiger, Streets, Bull. U. S. Nat. Mus., 7, 75, 1877 (Hawaiian Islands).

Halocypselus evolvans, Jordan & Gilbert, Synopsis, 377, 1883; Jordan & Meek, Proc. U. S. Nat. Mus. 1885, 49; Jordan & Evermann, Fish. North & Mid. Amer., I, 730, 1896.

Halocypselus obtusirostris, Jordan & Gilbert, Synopsis, 378, 1883.

Genus 78. EXONAUTES Jordan & Evermann.

Exonautes differs from *Cypsilurus* in the longer anal, which is as long as the dorsal and with about as many rays.

Exonautes Jordan & Evermann, Check-list of North American Fishes, 322, 1895 (*exsiliens*).

92. *Exonautes gilberti* Snyder. Plate 24.

Head, to end of opercular flap, 4.6 in length; depth 7; width of body at base of pectorals 7; depth of caudal peduncle 3.6 in head; eye 3; snout 3.6; interorbital space 2.6; D. 10; A. 10; scales in lateral series beginning above base of pectoral 48; between occiput and base of dorsal 32; between lateral line and dorsal 6.

As indicated by the above measurements of the body, this is one of the most slender of the flying fishes. Body quadrangular in section; back broader than belly, convex; some of the median scales of back with low keels; interorbital space concave; snout a little shorter than diameter of eye; lower jaw slightly projecting beyond upper; maxillary extending to posterior border of nostril. No teeth on tongue or roof of mouth, those on jaws scarcely perceptible; gillrakers on first arch 25, long and slender; lateral line disappearing near end of anal fin.

The pectoral fin extends to within about an eye's diameter of base of caudal; has 18 rays, first and second simple; second a third of its length longer than first, which is 3.81 times diameter of eye; third ray divided near tip of first; tip of fin formed by branches of fourth ray, those of fifth being slightly shorter; second ray of dorsal fin longest, 2 in head; base of fin equal to 2 times diameter of eye; anal inserted the width of a scale posterior to dorsal, its base shorter than that of dorsal by an amount equal to the space between 2 rays; height of first and second rays about equal to that of fourth dorsal; ventrals inserted midway between base of caudal and a point anterior to the edge of opercle, a distance equal to diameter of pupil; extending posteriorly a little beyond the base of anal, not beyond tip of last ray when depressed; upper lobe of caudal pointed, its length 3 times the width of the interorbital space; lower lobe an eye's diameter longer.

Color in alcohol, dark brown above, silvery below; pectoral without spots, dusky, the free edge with a white area as wide as pupil, proximal to which is a blackish band two-thirds as wide as the eye; upper or anterior edge of fin light, an indistinct dark area extending along the first to fourth rays; lower or posterior edge of fin along the last 4 rays white; middle rays of ventrals dusky, the fin indistinctly bordered with white; free edge of caudal bordered with white; dorsal dusky; anal white.

In life, steel-blue above, silvery below.

This species is apparently related to *Exonautes rondeletii* (Cuv. & Val.) of the Atlantic. The type (No. 50872, U. S. N. M.) is the only specimen known. It is 10.43 inches long (snout to end of lower caudal lobe). It came aboard the *Albatross* at night near 28° 30' N. and 140° W.

Exonautes gilberti Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 522, pl. 7, fig. 13, northeast of Honolulu between Albatross stations 3799 and 3800.

Genus 79. *CYPSILURUS* Swainson.

Body elongate, broad above, somewhat compressed; head short, blunt, narrowed below; mouth small; jaws very short, about equal; chin without barbel; maxillaries not joined to the premaxillaries; teeth very feeble or wanting; eyes large; gillrakers moderate; scales large, deciduous; no finlets; dorsal fin short, opposite anal, which is considerably shorter than dorsal; caudal widely forked, the lower lobe the longer; pectoral fins very long, reaching past the beginning of anal, and serving as organs of flight, their great size enabling the fishes to sustain themselves in the air for some time; ventral fins large, posteriorly inserted, also used as organs of flight; air-bladder very large; no pyloric coeca. Species numerous, in all warm seas, living mostly in the open water and swimming in large schools. The species are largely cosmopolitan, differing from *Exonautes* in the much shorter anal.

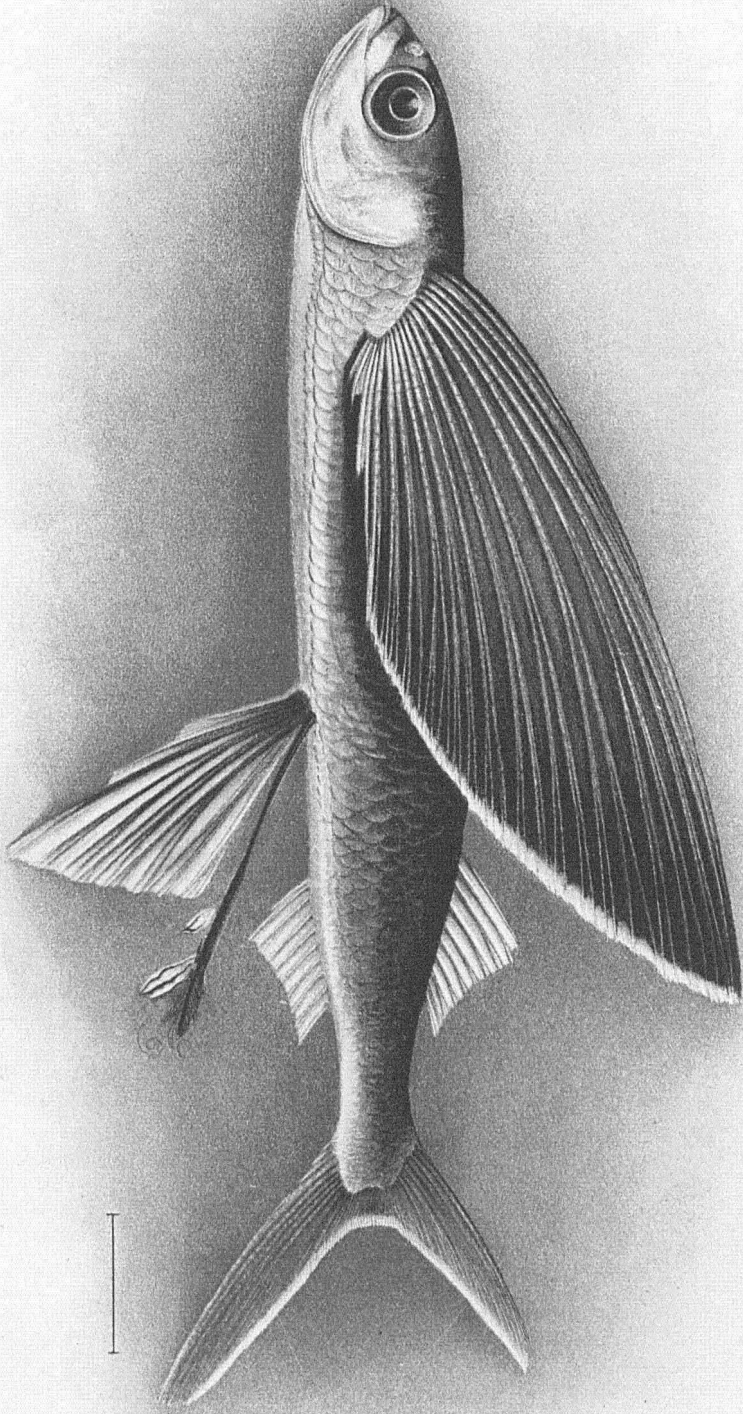
Cypsilurus Swainson, Class. Fish., II, 296, 1839 (*multalli*).

a. Dorsal 12; anal 8; scales 43; dorsal plain *simus*, p. 134
 aa. Dorsal 14; anal 11; scales 50; dorsal black above *bahiensis*, p. 136
 aaa. Dorsal 15; anal 10; scales 60; dorsal with a large dark spot *atrignis*, p. 136

93. *Cypsilurus simus* (Cuvier & Valenciennes). "Malolo." Fig. 46.

Head 4 in length; depth 4.67; D. 12; A. 8; P. 15; V. 6; scales 43 to base of caudal; 12 scales in a transverse series to middle of belly; greatest width of head about 1.2 in its depth; snout 4.67 in head; eye 3.2, 1.3 in postocular part of head, 1.4 in interorbital space; depth of caudal peduncle about 3 in head; base of dorsal 5 in body; base of anal 3 in head; ventral about 3.6 in body.

EXONAUTES GILBERTI SNYDER.



Body elongate, the sides compressed and flattened; head subconic, the sides constricted below; snout blunt, rounded and short; eye large, impinging upon the upper profile of the head, and also with its posterior margin a little behind the center of its length; mouth nearly terminal, small, oblique, the small maxillary reaching about below nasal cavity, the mandible included; teeth minute in jaws, none on vomer or palatines; tongue smooth, not broad, rounded and free in front; nasal cavity small, near front of eye above, and with a well developed fleshy flap; interorbital space broad, concave in the middle; about 13 gillrakers developed, the longest nearly a third the length of the eye, compressed and pointed; peritoneum pale; scales rather large, cycloid, and each with several striae, at least on the sides; lateral line running along the lower part of the body, falling short of base of caudal by several scales, behind anal fin; origin of dorsal a little nearer base of pectoral than tip of upper caudal lobe and a little in advance of anus; anal originating below middle of dorsal, similar to dorsal with the anterior rays elevated; caudal deeply forked, the lower lobe much the longer; pectoral very long, falling a little short of base of caudal; ventrals nearer base of caudal than base of pectoral, and reaching back nearly to the posterior base of anal; caudal peduncle rather deep, much compressed.

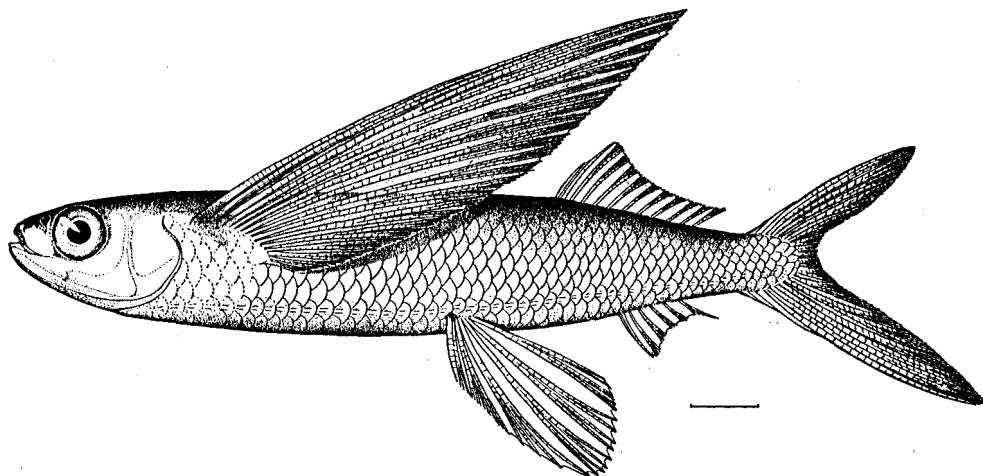


FIG. 46.—*Cypsilurus simus* (Cuvier & Valenciennes).

Color in life (No. 03421) with top of head and upper parts of body reddish purple, lower parts white; membranes of pectoral covered with numerous minute black dots, upper side of rays purplish; outer edge of soft dorsal black; ventrals and anal colorless. One specimen (No. 03424) has a large black area on dorsal fin, the fin itself bright; top of head and body blue, ends silvery; belly white; caudal dusky; no spots on pectoral, upper surface bright purple; ventrals transparent. Other specimens were dark blue above, silvery below with blue reflections; pectoral purple. One (No. 03542) from Honolulu had very large black spots on pectoral.

Color in alcohol, brownish above, the lower surface whitish washed with silvery; dorsal, caudal, and pectorals brownish; ventrals and anal whitish. Color in life, dark blue above, silvery below with blue reflections; pectoral purplish, usually with many large round black spots.

This description from an example (No. 02945) 12 inches long, taken at Honolulu. Of this species we have 21 examples taken at Honolulu, and we have examined 15 examples taken at the same place by Dr. Jenkins in 1889. Specimens were obtained by the *Albatross* at Honolulu; Waimea and Hanalei Bay, Kauai; and Napili, Molokai. The maximum length of this species is about 14 inches. This is the common flying fish seen in thousands in the sea about Honolulu.

Exocoetus simus Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 105, 1846, Hawaiian Islands.

Exocoetus neglectus Bleeker, Ned. Tydsch. Dierk., III, 1865, 112, Sumatra; Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 512 (Honolulu).

Cypsilurus simus, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 435 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 522 (Honolulu; Kauai; Molokai).

94. *Cypsilurus bahiensis* (Ranzani).

Head 4.67 in length; depth 4.75; D. 14; A. 9 or 10; P. 15; V. 6; scales to base of caudal 50,-14; snout 3.5 in head; eye 4, 1.8 in postocular part of head, 1.5 in interorbital space; base of dorsal 5.5 in body; base of anal 9; length of ventral 4.

Body elongate, the sides compressed and flattened; head elongate, subconic; snout moderately elongate, flattened above, and somewhat obtuse; eye anterior, the posterior margin a little behind center of length of head, and the eyelid somewhat adipose in front above; mouth oblique, equal to eye, the maxillary reaching below nasal cavity; teeth small and sharp in the jaws, none on vomer and palatines; tongue rather small, elongate, somewhat narrow, rounded and free in front; nasal small, above and in front of eye, and with a shallow groove leading down in front of the eye, the nasal flap thick; interorbital space broad, flattened, or only slightly concave, like the top of the head in front; gillrakers in moderate number, rather short, less than the gill-filaments in length; peritoneum white; scales large, cycloid; head scaled; lateral line running along the lower part of side, stopping behind the anal a few scales before base of caudal; origin of dorsal nearer base of pectoral than tip of upper caudal lobe, before the anus, nearer origin of anal than base of ventrals, the anterior rays elongated; anal similar to dorsal, the anterior rays the longer; caudal deeply forked, the lower lobe much the longer; pectoral very long, reaching within a very short distance of the base of caudal; ventrals long, reaching well beyond first anal rays; caudal peduncle deep and compressed.

Color in alcohol, brown above, the sides and lower surface white, washed with silvery; pectorals deep brown, more or less margined with white; dorsal with a large black blotch, otherwise pale brown; caudal pale brownish; anal and ventrals whitish.

Described from a gravid female (No. 03567) 19 inches long, taken at Hilo in July. We have another example from Hilo and 8 from Honolulu, 3 of the latter taken by Dr. Jenkins in 1889 and 1 by Dr. Wood. The species is readily recognized in life when skimming over the waves by its reddish-brown pectorals. It is common in the sea about Honolulu, but less abundant than *C. simus*.

Exocoetus bahiensis Ranzani, Nov. Comm. Ac. Sci. Inst. Bonon., V, 1842, 326, pl. 38, Bahia; Günther, Cat., VI, 293, 1866; Poey, Synopsis, 384 and 385, 1868; Lütken, Vid. Medd. Naturh. Foren., 402, 1876; Jordan & Evermann, Fishes North and Mid. Amer., I, 739, 1896; Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 512 (Honolulu).

Cypsilurus bahiensis, Jordan & Evermann, Fishes North and Mid. Amer., III, 2836, 1898; Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 436 (Honolulu).

95. *Cypsilurus atrisignis* Jenkins. Plate 25.

Head 4.3 in length; depth 5.5; D. 15; A. 10; P. 14; lateral line about 60; scales before dorsal fin 34; scales between origin of dorsal and lateral line 9.

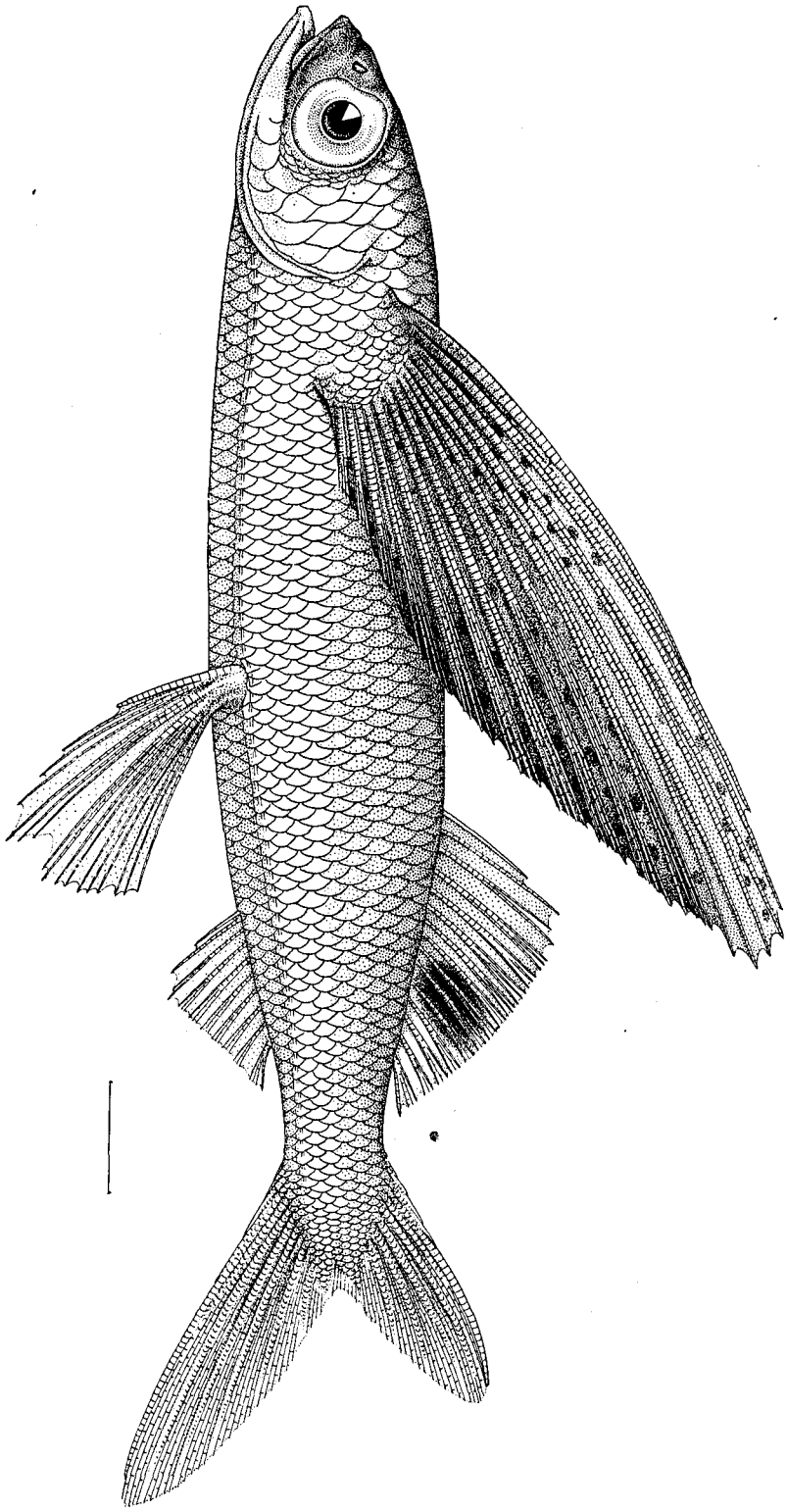
Body elongate, broad dorsally, narrow ventrally, broadest just in front of base of pectorals, where it is nearly as broad as the depth; top of posterior portion of head broad, narrowing toward tip of snout, somewhat concave between the eyes; interorbital space equaling distance from posterior margin of eye to margin of opercle; eye large, its center anterior to center of head; snout less than eye, somewhat pointed, lower jaw slightly projecting; maxillary included and falling considerably short of anterior margin of eye; pectoral reaching tip of last dorsal ray; ventral reaching to one-third the base of anal, its origin half way between eye and base of caudal; origin of dorsal much in advance of vent, its distance from first caudal ray 1.4 times head, the longest ray, the anterior one, about 2 in head; lower lobe of caudal the longer.

Color in alcohol, dark purple above, light below; dorsal fin with black spot about 0.7 diameter of eye between the eighth and eleventh spines; caudal and ventrals colorless, unmarked; ventrals white, without spots; pectoral rays and membranes very dark purple above, the rays light below, the membranes with black spots on anterior and posterior portions.

One specimen (No. 197), 13.5 inches in length, was taken by Dr. Jenkins in 1889 at Honolulu. Type, No. 50713, U. S. N. M. Another is in the museum of Stanford University, taken by Mr. A. P. Lundin, at Kusai (Strong Island), one of the Carolines.

Cypsilurus atrisignis Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 436, pl. 3, Honolulu. (Type, No. 50713, U. S. N. M., Coll. O. P. Jenkins.)

CYPSILURUS ATRISIGNIS JENKINS.



Order L. ACANTHOPTERI.—The Spiny-rayed Fishes.

Anterior vertebrae unmodified and without ossicula auditus; no mesocoracoid and no interclavicles (so far as known); border of mouth formed by premaxillary; maxillary normally distinct from it and always present, but sometimes coossified with it; gills laminated; shoulder-girdle attached to the skull by a post-temporal, which is normally furcate and usually not coossified with the skull; hypercoracoid and hypocoracoid distinct, ossified, the former usually perforate; pharyngeals well developed, the lower rarely united, the third upper pharyngeal largest, the fourth often wanting; pectoral actinosts always present, opercular apparatus complete; gill-openings in advance of the pectorals; pectoral fins above the plane of the abdomen; ventral fins more or less anterior, normally attached by the pelvis to the shoulder-girdle, typically with 1 spine and 5 rays, these sometimes wanting, sometimes without spine or with many rays, or otherwise modified; anterior rays of dorsal and anal typically simple or spinous, but all the fin rays often articulate; air-bladder typically without duct in the adult; scales various, typically ctenoid; lateral line usually running high. To this group are referable the great body of existing marine fishes.

Suborder PERCESOCES.

Ventral fins abdominal, 1, 5; branchial arches well developed, the bones all present except the fourth superior branchial; third superior pharyngeal much enlarged; lower pharyngeals distinct; scales cycloid; pectorals elevated, about on a level with the upper posterior angle of opercle; spinous dorsal usually present.

a. Lateral line wanting; teeth small or wanting; gillrakers present, long and slender.

b. Anal with only 1 or no anal spine, weak; first dorsal with 3 to 8 slender, flexible spines; head elongate; vertebrae more than 35; stomach not gizzard-like; intestine short.....*Atherinidae*, p. 137

bb. Anal with 2 or 3 spines, stouter; first dorsal with 4 stiff spines; head short and broad; vertebrae fewer than 35, about 24; stomach gizzard-like; intestine long.....*Mugilidae*, p. 138

aa. Lateral line present, teeth very strong, unequal; gillrakers very short or obsolete.....*Sphyranidae*, p. 141

Family XLIII. ATHERINIDÆ.—The Silversides.

Body rather elongate, somewhat compressed, covered with scales of moderate or small size, which are usually, but not always, cycloid; no lateral line; some scales often with rudimentary mucous tubes; cleft of mouth moderate; teeth small, on jaws and sometimes on vomer and palatines, rarely wanting; premaxillaries protractile or not; opercular bones without spines or serrature; gill-openings wide, the gill-membranes not connected, free from the isthmus; gills 4, a slit behind the fourth; pseudo-branchiæ present; gillrakers usually long and slender; branchiostegals 5 or 6; dorsal fins 2, well separated, the first of 3 to 8 slender flexible spines, the second of soft rays; anal with a weak spine, similar to the soft dorsal, but usually larger; ventral fins small, abdominal, not far back, of 1 small spine and 5 soft rays; pectorals moderate, inserted high; air-bladder present; no pyloric cœca; vertebrae numerous, usually about 23+23=46; third and fourth superior pharyngeals coossified, with teeth. Carnivorous fishes, mostly of small size, living in great schools near the shore in temperate and tropical seas; a few species in fresh water. All the species have a silvery band along the side, this sometimes underlaid by black pigment. Genera about 15, species 60. All that are large enough highly valued as food, hence the common name of "fishes of the king," Pescados del Rey, or Pesce Re, or Peixe Rey.

Only one genus of silversides is known from the Hawaiian Islands.

Genus 80. ATHERINA (Artedi) Linnæus. The Friars.

Body oblong, compressed; mouth large, terminal, oblique; jaws about equal, their edges nearly straight; maxillary extending to front of eye; premaxillaries narrow posteriorly, strongly protractile; villiform teeth in bands on jaws, vomer, and palatines. Species numerous, mostly European.

Atherina (Artedi) Linnæus, Syst. Nat., Ed. X, 315, 1758 (*hepsetus*).

Membras Bonaparte, Fauna Italica, 1836 (no type indicated).

96. *Atherina insularum* Jordan & Evermann. Fig. 47.

Head 4 in length; depth 4.75; eye 3 in head; snout 4; interorbital 2.8; maxillary 2.5; mandible 2.2; D. VI-I, 11; A. 17; scales 46, 6 rows from anterior base of anal upward and forward to spinous dorsal.

Body oblong, compressed; head triangular, the sides compressed, top flat; mouth large, oblique, maxillary reaching front of pupil, lower jaw included; teeth in rather broad villiform bands on jaws, vomer, and palatines; interorbital space very broad and flat; snout broad, truncate; origin of spinous dorsal slightly posterior to vertical at vent, slightly nearer tip of snout than base of caudal; longest dorsal spine about 2.4 in head, reaching nearly to vertical at front of anal; distance between spinous and soft dorsals equal to distance from tip of snout to middle of pupil; edge of soft dorsal concave, anterior rays somewhat produced, their length 1.9 in head; last dorsal ray about one-half longer than one preceding; base of soft dorsal 1.8 in head; origin of anal considerably in advance of that of soft dorsal, the fins similar, anterior rays about 1.7 in head, base of anal 1.3 in head; caudal widely forked, the lobes equal; ventral short, barely reaching vent; pectoral short, broad, and slightly falcate, its length about 1.4 in head; scales large, thin, and deep, 19 in front of spinous dorsal, 6 rows between the dorsals and 9 on median line of caudal peduncle.

Color when fresh, clear olive-green with darker edges to scales; lateral stripe steel-blue above, fading into the silvery belly; fins uncolored.

Color in alcohol, olivaceous above, silvery on sides and below; scales of back and upper part of side with numerous small round coffee-brown specks, disposed chiefly on the edges, median line of

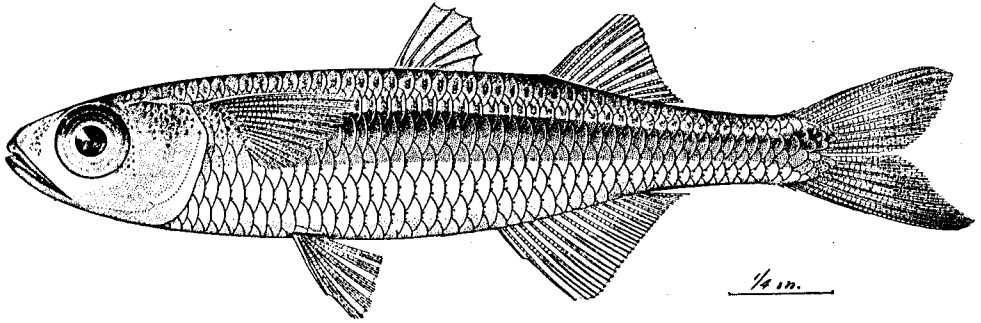


FIG. 47.—*Atherina insularum* Jordan & Evermann; from the type.

back with a darkish stripe; middle of side with a broad silvery band, plumbeous above, especially anteriorly, more silvery below; top of head and snout with numerous dark brownish or black specks; side of head silvery, opercle somewhat dusky, sides and tip of lower jaw dusky; dorsals and caudal somewhat dusky, other fins pale; pectoral without dark tip.

This small fish is common inside the reef in shallow bays everywhere in the Hawaiian Islands. Many individuals were seen off the wharf at Lahaina on Maui. Our collections of 1901 contain 20 specimens from Kailua, from 1.5 to 3.5 inches long; 43 from Hilo, 1.5 to 2.25 inches long; and 1 from Honolulu, 2.25 inches in length. Numerous specimens were obtained by the *Albatross* at Honolulu in 1902, one of which is taken as our type and three others as cotypes.

Type, No. 50819, U. S. N. M., 4.25 inches long, obtained by the *Albatross* at Honolulu. Cotypes, No. 2741, U. S. F. C., 3.9 inches long; No. 2302, Am. Mus. Nat. Hist., 3.9 inches long; and No. 4063, Field Col. Mus., 3.5 inches long, all collected at Honolulu by the *Albatross*.

Atherina insularum Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (Apr. 11, 1903), 170, Honolulu (Kailua; Hilo). Jenkins, op. cit. (Sept. 23, 1903), 437 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 523 (Laysan Island, *Albatross* stations 3834, 3860, 3870, and 3905).

Family XLIV. MUGILIDÆ.—The Mulletts.

Body oblong, more or less compressed, covered with rather large cycloid scales; no lateral line, but the furrows often deepened on the middle of each scale so as to form lateral streaks; mouth small, the jaws with small teeth, or none, the teeth various in form; premaxillaries protractile; gill-openings

wide, the membranes separate, free from the isthmus; branchiostegals 5 or 6, gillrakers long and slender; gills 4, a slit behind fourth; pseudobranchiæ large; 2 short dorsal fins, well separated, the anterior with 4 stiff spines, the last one of which is much shorter than the others; second dorsal longer than the first, similar to anal; anal spines 2 or 3, graduated; ventral fins abdominal, not far back, composed of 1 spine and 5 rays; caudal forked; air-bladder large, simple; intestinal canal long; peritoneum usually black; vertebræ 24. Genera 8 or 10, species about 100, inhabiting the fresh waters and coasts of warm regions, feeding on organic matter contained in mud. "In the genus *Mugil*, a considerable indigestible portion of the latter is swallowed, and in order to prevent larger bodies from passing into the stomach or substances from passing through the gill-openings, these fishes have the organs of the pharynx modified into a filtering apparatus. They take in a quantity of sand or mud, and, after having worked it for some time between the pharyngeal bones, they eject the roughest and indigestible portion of it. The upper pharyngeals have a rather irregular form; they are slightly arched, the convexity being directed toward the pharyngeal cavity, tapering anteriorly and broadening posteriorly. They are coated with a thick soft membrane, which reaches far beyond the margin of the bone, and is studded all over with minute horny cilia. Each branchial arch is provided with a series of long gillrakers, which are laterally bent downward, each series closely fitting to the sides of the adjoining arch; together they constitute a sieve admirably adapted to permit a transit for the water, retaining at the same time every solid substance in the cavity of the pharynx." (Günther.)

a. Jaws without true teeth; anal spines 3.

b. Orbit with a well-developed adipose eyelid covering part of the iris; cilia slender, in one or few series; cleft of mouth chiefly anterior..... *Mugil*, p. 139

bb. Orbit without distinct adipose eyelid; cleft of mouth lateral; lower jaw narrow, the upper very thick and very protractile; cilia broad, in many series, pavement-like..... *Chenomugil*, p. 140

aa. Small teeth in 1 or 2 series in the upper jaw, and sometimes in the lower and on the palate; no adipose eyelid; anal spines 3..... *Myxus*, p. 141

Genus 81. MUGIL (Artedi) Linnæus.

Body oblong, somewhat compressed, covered with large scales; head large, convex, scaled above and on sides; mouth small, subinferior, the lower jaw angulated; jaws with one or a few series of short, flexible, ciliiform teeth; no teeth on vomer or palatines; eye large, with a large adipose eyelid, which is little developed in the young; stomach muscular, like the gizzard of a fowl. Species very numerous, living on mud and running in great schools along the shores and in brackish lagoons of all warm regions.

Mugil (Artedi) Linnæus, Syst. Nat., Ed. X, 316, 1758 (*cephalus*).

97. *Mugil cephalus* Linnæus. "*Ama-ama*;" Mullet. Fig. 48.

Head 4 in length; depth 4.2; snout 4.2 in head; eye 3.9; D. IV-1, 8; A. III, 8; scales 40,-13, transverse series counted from anus upward and backward to soft dorsal; dorsal spine 1.75 in head; soft dorsal 1.6 in head; anterior base of spinous dorsal midway between end of snout and base of caudal.

Body oblong, rather robust, slightly compressed; head subconic; lower jaw slightly included; maxillary hidden; no teeth, except a single row of very small teeth in outer fleshy part of upper jaw; jaw narrow, the distance from the symphysis to posterior edge of lip being equal to greatest width of mouth; eye anterior, moderate, the adipose lid covering entire eye except pupil; head scaly; soft dorsal and anal almost naked; soft dorsal concave; anal similar to dorsal but not so concave; caudal deeply forked, upper lobe slightly the longer; pectoral not quite reaching to spinous dorsal.

Color in life, from a 10.5-inch specimen (No. 02995) taken at Honolulu, bluish gray, white below; cheek dusky; spinous dorsal and pectoral dusky; caudal pale, finely dusted with dark specks, edges dark; anal sparsely dusted; ventrals white.

Ten specimens from Honolulu, from 1.5 to 10.5 inches long, and 3 specimens, 3.75 to 4.75 inches long, from Kailua. We have also examined a number of specimens collected by Dr. Jenkins at Honolulu in 1889 and 1 specimen 10 inches long collected by R. C. McGregor on Molokai in March, 1900.

This species of mullet, the *ama ama* of the natives, is perhaps the most abundant and important food-fish of the Hawaiian Islands. It is the species which has received most attention from the natives in the way of protection and cultivation. The mullet ponds have been an institution of importance

ever since the days of the earliest kings. A full discussion of this subject is given elsewhere in this report.

We are unable to find any difference between the Hawaiian *ama ama* and the striped mullets of the United States, Japan, Chile, or the Mediterranean. If different from any of these it is distinct from all and should receive a new name.

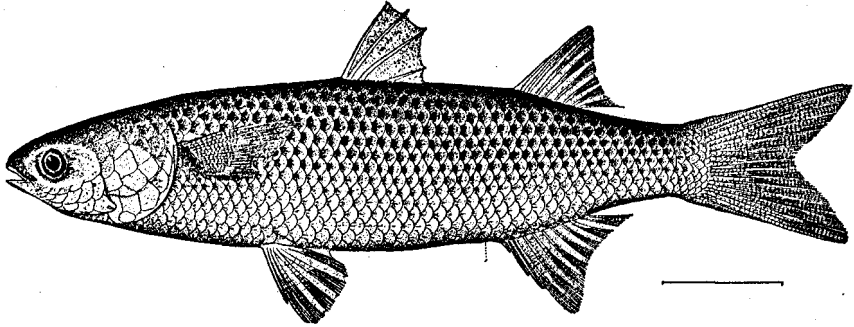


FIG. 48.—*Mugil cephalus* Linnæus; after Jordan and Evermann.

- Mugil cephalus* Linnæus, Syst. Nat., Ed. X, 316, 1758, **European Ocean** (based on Artedi); Jordan & Swain, Proc. U. S. Nat. Mus. 1884, 263; Jordan & Evermann, Fish. North and Mid. Amer., I, 811, 1896; Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 438 (Honolulu).
- Mugil albulus* Linnæus, Syst. Nat., Ed. XII, 520, 1766, **Charleston, S. C.** (Coll. Dr. Garden); Jordan & Gilbert, Synopsis, 403, 1883; Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 523 (Waimea, Huleia, and Hanapepe rivers, Kauai, Honolulu; Station 3844 off southern coast of Molokai).
- Mugil tang* Bloch, Ichthyologia, XI, 134, pl. 395, 1797, **Guinea, Tranquebar.**
- Mugil plumieri* Bloch, op. cit., 136, pl. 396, 1797, **St. Vincent, W. I.** (on a drawing by Plumier).
- Mugil oour* Forskål, **Red Sea.**
- Mugil cephalotus* Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 98, 1836, **Pondicherry.**
- Mugil lineatus* Mitchill in Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 96, 1836, **New York.**
- Mugil rammelsbergii* Tschudi, Fauna Peruana, Ichth., 20, 1845, **Peru.**
- Mugil berlandieri* Girard, U. S. and Mex. Bound. Surv., 20, pl. 10, figs. 1 to 4, 1859, **St. Josephs Island, Indianola; Brazos Santiago; Brazos; Galveston; all on the coast of Texas** (coll. Würdemann, Clark, and Kennerly).
- Mugil mexicanus* Steindachner, Ichth. Beiträge, III, 58, pl. VIII, 1875, **Acapulco** (no adipose eyelid shown on plate).
- Mugil cephalotus* Eydoux & Souleyet, Voy. Bonite, I, 175, pl. 4, 1841, **Sandwich Islands; Streets, Bull. U. S. Nat. Mus., No. 7, 73, 1877 (Honolulu).**
- Mugil cephalus*, Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 19, 1836 (Mediterranean).
- Mugil guntheri*, Gill, Proc. Ac. Nat. Sci. Phila. 1863, 169 (western coast of Central America); not of Steindachner.
- Mugil dobula*, Günther, Fische der Südsee, VI, 214, plate CXX, fig. a, 1877 (Hawaiian Islands); Günther, Shore Fishes, Challenger, 61, 1880 (Hilo, Hawaii); Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 501 (Honolulu); not of Günther, Cat., III, 420, 1861, a species from rivers of western Australia.
- Mugil kelaartii*, Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 500; *ibid.*, Proc. Ac. Nat. Sci. Phila. 1903, 743 (Sandwich Islands); not of Günther.

Genus 82. CHÆNOMUGIL Gill.

Cleft of mouth lateral; lower jaw narrow; dentiform cilia in very many series, broad, flat, and somewhat paved; upper lip very thick; no adipose eyelid. Small mullets of the tropical shores.

Chænomugil Gill, Proc. Ac. Nat. Sci. Phila. 1863, 169 (*proboscideus*).

98. *Chænomugil chaptalii* (Eydoux & Souleyet) "*Uouba*." Fig. 49.

Head 4 in length; depth 3.9; snout 3.75 in head; eye 3.4; D. 1v-1, 9; A. III, 10; scales 43,-13.

Body robust, more compressed posteriorly; head moderate; snout subconic, rather pointed; mouth slightly oblique, its cleft deeper than long; maxillary entirely hidden; front part of upper lip very thick; lower margin of each lip covered with rather strong papillæ or weak pectinate teeth; lower jaw included, rather narrow; no teeth evident; eye large, anterior; interorbital space convex, 2 in head; first dorsal spine 2 in head; soft dorsal and anal slightly convex; caudal forked, lower lobe the longer and heavier; ventrals truncate; pectoral falcate, 1.3 in head.

Color in alcohol, dull olivaceous above with silvery reflections gradually fading into lighter and becoming white on belly; top of head and snout brown; indications of brown on opercles; dorsal, caudal, and pectorals dusky, pectorals the darkest; other fins pale.

Eight specimens 1 to 9.2 inches long from Honolulu; 33 from 1.2 to 6.5 inches long from Hilo, and 18 specimens from 2 to 4.5 inches long from Kailua. We have also examined several specimens taken by Doctor Jenkins at Honolulu in 1889.

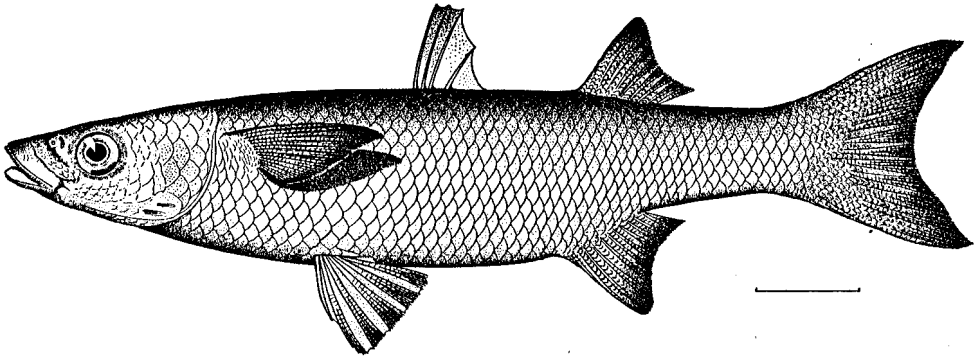


FIG. 49.—*Chanomugil chaptalii* (Eydoux & Souleyet).

Mugil chaptalii Eydoux & Souleyet, Voyage Bonite, Zool., I, 171, pl. 4, fig. 1, 1841, Hawaiian Islands.

Myxus (*Neomyxus*) *scleteri* Steindachner, Ichth. Beiträge, VII, in Sitz. Ak. Wiss. Wien, LXXVII, 1878, 384, Kingsmill and Hawaiian Islands.

Chanomugil chaptalii Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (September 23, 1903), 438 (Honolulu).

Genus 83. MYXUS Günther.

Cleft of mouth extending on sides of snout, but not to orbit. Small teeth in a single series in upper jaw, and sometimes in lower and on palate. Upper lip not particularly thick; anterior margin of mandible sharp. Anal spines 3.

Myxus Günther, Cat., III, 466, 1861 (*elongatus*).

Neomyxus Steindachner, Sitz. Ak. Wiss. Wein 1878, 77, 384 (*scleteri*).

99. *Myxus pacificus* Steindachner.

Head about 4 in length; depth nearly 4; snout 4 in head; D. iv-i, 8; A. iii, 8; scales 39 or 40, -13.5, about 24 scales before the dorsal; head moderately small, the greatest depth about 1.4 in length; greatest breadth between opercles about 1.6 in length of head; upper profile very slightly curved to origin of second dorsal, then falling suddenly the length of the base of this fin; eye with well developed lids; upper lip moderately small; mouth cleft a little longer than broad; preorbital with the lower and posterior edge serrate; between the jaws a band of small movable teeth, those of the outer row larger than those of inner; origin of first dorsal a trifle nearer base of caudal than tip of snout, the first dorsal moderately strong, a little more than 1.65 length of head; caudal a little longer than head, length of its middle rays about 1.6 times length of head; ventral flap shorter than half length of fin; a dark band along upper edge of pectoral. Length, 5.85 inches. Laysan. (Steindachner.) This species is known from Dr. Steindachner's description only.

Myxus pacificus Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 500, Laysan.

Family XLV. SPHYRÆNIDÆ.—The Barracudas.

Body elongate, subterete, covered with small cycloid scales; head very long, pointed, pike-like, scaly above and on sides; mouth horizontal, large; jaws elongate, the lower considerably projecting; upper jaw nonprotractile, its border formed by the premaxillaries, behind which are the broad maxillaries; large sharp teeth of unequal size on both jaws and palatines, none on the vomer; usually a very strong, sharp canine near tip of lower jaw; opercular bones without spines or serratures; gill-

openings wide, the gill-membranes not united, free from the isthmus; gillrakers very short or obsolete; branchiostegals 7; gills 4, a slit behind the fourth; pseudobranchiæ well developed; air-bladder large, bifurcate anteriorly; many pyloric coeca; lateral line well developed, straight; pectoral fins short, placed in or below line of axis of body; ventrals 1, 5, abdominal, in advance of middle of body; first dorsal over ventrals, of 5 rather stout spines; second dorsal remote from first dorsal, similar to anal and opposite to it; caudal fin forked; vertebrae 24; first superior pharyngeal not present; second, third, and fourth separate, with teeth; lower pharyngeals separate. A single genus of about 20 species; carnivorous, pike-like fishes, often of large size, active and voracious, inhabiting warm seas, many of them highly valued as food.

Genus 84. SPHYRÆNA (Artedi) Bloch & Schneider.

Characters of the genus included above.

Sphyraena (Artedi) Bloch & Schneider, Syst. Ichth., 109, 1801 (*sphyraena*).

Spharina Swainson, Nat. Hist. Fishes, etc., II, 175, 1839 (*europæa*=*sphyraena*).

a. Scales rather large, 11-85-9..... *snodgrassi*, p. 142

aa. Scales smaller, 14-135-15..... *helleri*, p. 143

100. *Sphyraena snodgrassi* Jenkins. "Kāku." Fig. 50.

Head 3.25 in length; depth 6.5; eye 7.3 in head; snout 2.1; D. v-1, 9; A. 1, 9; scales 11-85-9; longest dorsal spine 3.1 in head, ray 2.5 in head; anal 2.4; ventral 3.2; pectoral 2.9; interorbital 4.7, nearly twice vertical diameter of eye; maxillary 2.2. Body and head regularly fusiform; lower jaw projecting

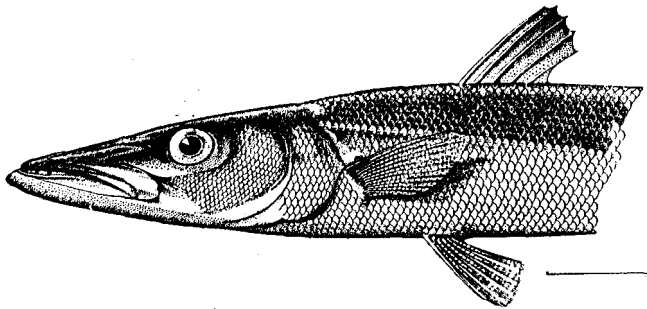


FIG. 50.—*Sphyraena snodgrassi* Jenkins; from the type.

beyond upper a distance equal to two-thirds diameter of pupil, tip blunt, not terminated by fleshy appendages; eye slightly ovate, larger and anterior; interorbital space flat; maxillary reaching front of eye; suborbital scaled; about 18 rows of vertical scales from eye to edge of preopercle, 8 rows on opercle, those of opercle enlarged, rest of head naked; opercle without spines, but with 1 or 2 blunt flexible points; each side of upper jaw with 2 long, sharp, canine teeth in front and 5 or 6 nearly as large but broader teeth, growing gradually smaller posteriorly; lower jaw with 2 large anterior median teeth similar to anterior teeth in upper jaw and back of them a single series of about 15 smaller teeth on each jaw; second and third dorsal spines the longest; caudal forked, lobes equal; anal fin slightly behind soft dorsal, the 2 similar in form; lateral line slightly decurved on body before second dorsal, posterior part straight.

Color in life, dark olive-brown above; side silvery; about 20 very faint short blackish bars just above lateral line, their depth about 4 rows of scales, the bars rather wider than the silvery interspaces; membranous edge of opercle jet black; first dorsal blackish, second with a jet-black central blotch, the tips white; caudal black with white tips; anal like the second dorsal, the blackish blotch fainter; pectoral dusky at base; ventrals white; young with 13 dark crossbars.

Description from a specimen 17 inches long. We have 5 specimens 13 to 18 inches long from Honolulu, one 8.25 inches long from Hilo, 6 about 5 inches long from Waialua, and one very large example (No. 04515), 33 inches long, from Honolulu. Specimens 4 to 6 feet in length were seen in the market at Honolulu. This is a large voracious species of wide range, entering the open sea.

Sphyraena commersonii, Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 501 (Hawaiian Islands); Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 438 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 523 (Honolulu).

†*Sphyræna chussumieri* Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 508, 1831 Red Sea, Ile de France, Bourbon.

Sphyræna nodigrassi Jenkins, Bull. U. S. Fish Comm., XIX, 1899 (1901), 388, fig. 2, Honolulu (coll. Drs. O. P. Jenkins and T. D. Wood. Type, No. 49693, U. S. Nat. Mus.).

Sphyræna agam, Steindachner, Denks. Ak. Wiss. Wien, LXX, 500, 1900 (Honolulu); not of Rüppell.

101. *Sphyræna helleri* Jenkins. "Kawalea." Fig. 51.

Head 3.1 in length; depth 7.8; eye 6.1 in head; snout 2; maxillary 3.1; interorbital 6, slightly greater than vertical diameter of eye; D. v-1, 9; A. 1, 8; scales 14-135-15; 13 rows of scales on preopercle, 14 on opercle; longest dorsal spine 3.8 in head; ray 4.5; longest anal ray 3.8; pectoral 3.6; ventral 3.6.

Body long and slender, the head tapering, the snout long, the lower jaw projecting nearly the width of pupil beyond upper, terminating in a fleshy appendage; eye large, posterior; maxillary not reaching eye, being separated from it by a distance about equal to diameter of eye; opercle without spines; 2 sharp canine-like teeth hooked backward, the second the larger, on the front row of upper jaw, back of these on each jaw 5 or 6 similar teeth bent inward; 2 large close-set teeth like those in upper jaw, in median part of lower jaw; back of these on each side a row of 15 to 18 smaller teeth; distances between occiput and first dorsal fin, first dorsal and second dorsal, and second dorsal and last vertebra equal, and each equal to distance from tip of snout to posterior margin of eye; insertion of ventrals below front of first dorsal fin, two-thirds of eye behind tip of pectoral; caudal deeply forked; anterior base of anal on line with that of dorsal.

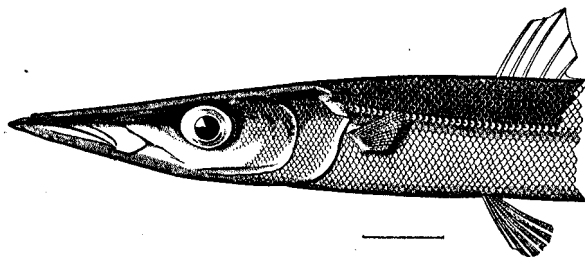


FIG. 51.—*Sphyræna helleri* Jenkins; from the type.

Color in alcohol, brown above, with bluish silvery reflections, becoming lighter below, white on belly and lower part of side; spinous dorsal color of back; soft dorsal pale, caudal dusky; anal and ventral pale; pectoral dusky.

Six specimens from Honolulu 13 to 26 inches long, and 2 from Hilo 24 inches long. This fish is very abundant in the mullet ponds, where it is destructive to the mullet. It reaches but a small size, and is rarely found except near shore.

Sphyræna helleri Jenkins, Bull. U. S. Fish Comm., XIX, 1899 (1901) 387, fig. 1, Honolulu (coll. Dr. Jenkins. Type, No. 49692, U. S. Nat. Mus.); Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 438 (Honolulu).

Suborder HYPOSTOMIDES.

Characters included with those of the following family:

Family XLVI. PEGASIDÆ.

Body entirely covered with bony plates, ankylosed on the trunk and movable on the tail; barbels none; the margin of the upper jaw formed by the intermaxillaries and their cutaneous prolongation, which extends downward to the extremity of the maxillaries; gill-cover formed by a large plate, homologous to the opercle, preopercle and subopercle; interopercle a long fine bone, hidden below the gill-plate; one rudimentary branchiostegal; the gill-plate united with the isthmus by a narrow membrane; gill-opening narrow in front of base of pectoral fin; gills 4, lamellated; pseudo-branchiæ and air-bladder absent; one short dorsal and anal fin, opposite to each other; ventral fins present; ovarian sacs closed.

Genus 85. PEGASUS Linnæus.

This genus contains those species of *Pegasidæ* which have the tail short and not attenuate and compressed toward the tip, and in which the pectoral rays are all slender and simple, none of them spine-like. The single Hawaiian species of this genus is fully described by Dr. Gilbert in Section II.

Pegasus Linnæus, Syst. Nat., XII, 418, 1766 (*volans*).

Zaltes Jordan & Snyder, Proc. U. S. Nat. Mus., XXIV, 1902, 2 (*draconis*).

Suborder RHEGNOPTERI.

Actinosts of pectoral fin of 3 forms, 2 of them normal, supporting the pectoral fin, one of them longitudinal, without rays, and the fourth a plate on the coracoid, supporting 3 to 10 free and separate rays or feelers; post-temporal and shoulder-girdle normal; vertebrae $10 + 14 = 24$; 2 separate dorsal fins, the first of a few spines; pseudobranchiae concealed; ventrals subabdominal, behind pectorals. One family, *Polymemidae*, of uncertain origin and affinities.

Family XLVII. POLYNEMIDÆ.—The Threadfins.

Body oblong, compressed, and covered with rather large, loosely inserted, ctenoid scales; lateral line continuous, continued on the tail, usually forked, with a branch on each lobe; head entirely scaly, snout more or less conical, projecting over the mouth, which is rather large, inferior, with lateral cleft; premaxillary protractile, its basal process vertical; maxillary without supplemental bone, extending much beyond the eye, which is anterior, lateral, rather large, with a well-developed adipose eyelid; villiform teeth on jaws, palatines and sometimes on vomer; pseudobranchiae concealed; branchiostegals 7; gill-membranes separate and free from the isthmus; gills 4, a slit behind the fourth; 2 separate dorsals, somewhat remote from each other, the first of 8 feeble but rather high spines, the first and last spines very short, the third longest; the second dorsal of soft rays only, equal to first in height, but with base somewhat longer; anal fin either similar to or much longer than soft dorsal; caudal fin rather long, widely forked; second dorsal, anal and caudal fins more or less covered with small scales; the first 3 or 4 dorsal spines winged; ventrals 1, 5, abdominal, but not far removed from pectorals; pectoral fins moderate, placed low, in 2 parts, the lower and anterior portion of several filiform articulated appendages free from each other, used as organs of touch. In the young, the dorsal, caudal, and pectoral fins are dusky, the anal and ventral fins white; all the fins grow darker with age, the pectorals usually becoming black, the opercle blackish. Bones of the skull with a well developed muciferous system as in *Sciænidæ*. Basis cranii double, with muscular tube; post-temporal bifurcate; hypercoracoid with median foramen; superior pharyngeal bones 4; pectoral actinosts divided, 2 of them normal, supporting the pectoral fin, 1 longitudinal without rays, and 1 a plate on the coracoid, supporting the pectoral filaments; stomach coecal with many pyloric appendages; air-bladder various, sometimes wanting; vertebrae $10 + 14 = 24$. Genera 4, species about 25, inhabiting sandy shores of tropical seas, and sometimes entering rivers. Most of them are valued as food-fishes, their flesh being like that of the *Sciænidæ*. The relations of this peculiar family appear to be with the *Sciænidæ* on the one hand, and with the *Mugilidæ* on the other, but all these resemblances may be superficial.

Genus 86. POLYDACTYLUS Lacépède.

Anal fin not much longer than soft dorsal, of about 13 or 14 rays; vomer with teeth; free filaments of pectorals mostly shorter than body; teeth in villiform bands on both jaws, vomer, palatines, and pterygoids; preopercle sharply serrated on its posterior margin, its angle with a scaly flap; scales rather small, finely ctenoid; first dorsal with 7 or 8 feeble, rather high spines, the first and last short; soft dorsal and anal fins about equal; pectoral filaments 3 to 9; pyloric coeca in great number. Species numerous, in warm seas.

Polydactylus Lacépède, Hist. Nat. Poiss., VIII, 181, 1832 (*plumieri=virginicus*).
Polymemus Günther, Cat., II, 319, 1860 (*microstoma*); not of Linnæus.

102. *Polydactylus sexfilis* (Cuvier & Valenciennes). "Moi," "Moi-li."

Head 3.3 in length; depth 3.5; eye 4 in head; snout 5.5; maxillary 2.2; interorbital 3.6; preorbital 2.75 in eye; D. VII-1, 13; A. III, 11; scales 8-66-12; third dorsal spine longest, 1.4 in head; ray 1.4; longest anal 1.6; 6 pectoral filaments, longest 3.1 in body; pectoral ray 1.5 in head; ventral 2.1; caudal peduncle 2; distance from anterior base of soft dorsal to upper edge of gill-opening equal to distance from same base to base of caudal fin; this last distance equals distance from posterior base of soft dorsal to fork of caudal fin; distance between anterior bases of dorsals equaling distance from anterior base of spinous dorsal to posterior edge of eye; base of soft dorsal slightly greater than base of anal.

Body rather deep, compressed, back slightly arched, anterior profile from snout to tip of first dorsal when depressed evenly arched; head moderate, snout conic, projecting almost its entire length beyond mouth, which is large, inferior, with lateral cleft; premaxillary protractile, maxillary without supplemental bone, extending for nearly half its length beyond eye; teeth in villiform band on jaws, vomer, palatine, and posterior end of tongue; the tongue free for a distance equal to two-thirds of orbit, not quite rounded in front, its straight front edge nearly equal to orbit, the front portion rather thin, becoming thick and heavy posteriorly; eye large, anterior, lateral, with a well-developed eyelid; gill-membranes free from isthmus; gillrakers 16+13, long and slender, longest equal to diameter of pupil; preopercle serrated on its posterior margin, not serrated at angle; first dorsal falcate; second deeply forked; caudal deeply forked, upper lobe slightly the larger and longer and slightly longer than head; anal similar to soft dorsal but not so deeply forked; scales moderate, finely ctenoid on entire body and head; lateral line straight on body, slightly decurved on base of caudal, extending to tip just below angle.

Color in alcohol, yellowish white with silvery reflections, becoming lighter, almost white on belly; upper edge of spinous dorsal dark; soft dorsal tipped with dark; tips of caudal lobes dark; anal with light brown on lower half, upper part paler; ventrals pale with small plumbeous spots; pectorals dark bluish on outer third, rest dusky pale. The color in alcohol of the young examples, 2 to 4 inches long, is quite different from the larger examples. The young are brown above lateral line with 3 broad bands of darker, the first band extending over head and to spinous dorsal, second wedge-shaped, extending from anterior base of spinous dorsal to and including about half of soft dorsal, the rest of soft dorsal pale; third band extending from posterior base of soft dorsal to base of caudal; between these bars below lateral line, silvery white; posterior half of anal and ventral white; pectoral pale; spinous dorsal dark; caudal lobes dark; a light band across base of caudal.

Six specimens 9 to 11 inches long from Honolulu and 25 specimens 3 to 4.6 inches long from Hilo. We have also examined a specimen 9 inches long taken by Dr. Jenkins in 1889 and a similar specimen obtained by the *Albatross* in 1891, both from Honolulu. The species is known also from Johnston Island.

Polynemus seefllis Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 515, 1831, **Isle of France**; Günther, Shore Fishes, Challenger, 59, 1880 (Hilo, Hawaii); Steindachner, Denks. Ak. Wiss. Wien, LXX, 492, 1900 (Honolulu); Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 439 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 523 (Honolulu)

Trichidion seefllis, Bleeker, Poiss. Madagascar, 79, 1874 (Mauritius).

Polynemus hexanemus, Cantor, Cat. Malay. Fish., 33, 1850 (Sea of Pinang); not of Cuvier & Valenciennes.

Polydactylus pfeifferi, Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 501 (Hawaiian Islands); not of Bleeker.

Polynemus kuru, Smith & Swain, Proc. U. S. Nat. Mus. 1882, 122 (Johnston Island); not of Bleeker.

Suborder BERYCOIDEI.—The Berycoid Fishes.

Body naked or variously scaly, the scales sometimes highly specialized; dorsal fin with few or many spines, ventral fins thoracic or subabdominal, each with 1 spine and usually 7 soft rays, the number of soft rays varying from 5 to 10; in one family (*Monocentridæ*) the spine is greatly enlarged and the number of rays reduced; head with conspicuous mucous cavities; air-bladder in some species retaining its duct through life (a character verified only in *Beryx*); vertebrae in species examined 24 to 30; shoulder-girdle and pharyngeals normal; no suborbital stay, orbitosphenoid bone always present. A varied group allied to the *Percoidæ* and *Scombroidei*, but characterized as a whole by the retention of the archaic characters of the persistent air-duct and the increased number of ventral rays. In the deep-sea forms the spinous dorsal is scarcely developed and the scales are usually either cycloid or wanting. In the species of tropical shores the spinous armature of fins and scales is better developed than in most of the percomorphous fishes. The group is a very old one in geologic time, the allies of *Beryx* being among the earliest spiny-rayed fishes known. All are marine fishes, inhabiting the tropical shores or the abysses of the ocean.

Family XLVIII.—BERYCIDÆ.

Body oblong or ovate, compressed, covered with ctenoid or cycloid, foliate or granular scales; head with large muciferous cavities, covered by thin skin; eye lateral, usually large; mouth wide, oblique; premaxillaries protractile; maxillary rather large, usually with a supplemental bone; suborbitals narrow, not sheathing the cheeks; bands of villiform teeth on jaws, and usually on vomer and

palatines; canines sometimes present; opercular bones usually spinous; branchiostegals 7 or 8; gill-membranes separate, free from the isthmus; gills 4, a slit behind the fourth; pseudobranchiæ present; gillrakers moderate; cheeks and opercles scaly; no barbels; dorsal fin continuous, with 2 to 8 weak spines; anal with 2 to 4 spines; ventral fins thoracic, mostly 1, 7, the number of rays usually greater than 1, 5; caudal fin usually forked; pyloric cæca numerous. Fishes mostly of the deep seas; general color, red or black.

Genus 87. MELAMPHAES Günther.

Head large and thick, with nearly all the superficial bones modified into wide muciferous channels; cleft of mouth of moderate width, obliquely descending backward, with the jaws nearly equal in front; eye small; a narrow band of villiform teeth in each jaw; palate toothless; eight branchiostegals; pseudobranchiæ present; no barbels; opercles not armed; scales large, cycloid, rather irregularly arranged; one dorsal; ventrals with 7 rays; caudal forked; anal spines very feeble. The single Hawaiian species of this genus is fully described in Section II.

Metopias Lowe, Proc. Zool. Soc. Lond. 1843, 90 (*typhlops*); name preoccupied in entomology.
Melamphaes Günther, Cat., V, 433, 1864 (*Metopias typhlops*).

Genus 88. CAULOLEPIS Gill.

Contour laterally oval or broad pyriform, the body compressed, covered with small, pedunculated leaf-like scales; forehead abruptly declivous; eye small; a pair of very long pointed teeth in front of upper jaw, closing in front of lower; a similar pair of still longer pointed teeth in the lower, received in foveæ of the palate; on the sides of each jaw 2 long teeth, terminating in bulbous tips; a row of minute teeth on the posterior half of the supramaxillaries; palate toothless. The single Hawaiian species (*Caulolepis longidens*) of this genus is described in Section II.

Caulolepis Gill, Forest and Stream, XXI, Aug. 30, 1883, and in Proc. U. S. Nat. Mus., VI, 1884, 258 (*longidens*).

Family XLIX. HOLOCENTRIDÆ.—The Squirrel-Fishes.

Body oblong or ovate, moderately compressed, covered with very strongly ctenoid or spinous scales; head with large muciferous cavities; eye lateral, very large; preorbital very narrow; mouth moderate, oblique; premaxillaries protractile; maxillary very large, with supplemental bone; bands of villiform teeth on jaws, vomer, and palatines; opercular bones and membrane bones of head generally serrated or spinescent along the edges; branchiostegals 8; gill-membranes separate, free from isthmus; gills 4, a slit behind fourth; pseudobranchiæ present; gillrakers moderate; no barbels; sides of head scaly; lateral line present; dorsal fin very long, deeply divided, with about 11 strong spines depressible in a scaly groove; anal with 4 spines, the third longest and strongest; ventrals thoracic, with 1 spine and 7 rays; caudal deeply forked, with sharp rudimentary rays or fulcra at the base; vertebrae about 27; pyloric cæca 8 to 25; air-bladder large, sometimes connected with the organ of hearing. General color red. Young with snout sharp and produced (constituting the nominal genera *Rhynchichthys*, *Rhamphoberyx*, and *Rhinoberyx*, based on peculiarities of immature examples). Genera about 7; species about 70; gaily colored inhabitants of the tropical seas, abounding about coral reefs.

- a. Preopercle without a conspicuous spine at its angle.
 b. Scales with rather rough surface.
 c. Scales small, about 40 to 45 in the lateral line; lower jaw projecting and fitting in a deep notch in the upper jaw.....*Holotrachys*, p. 147
 cc. Scales large, about 29 in the lateral line; opercular spine usually elongate and rough-edged.....*Ostichthys*, p. 147
 bb. Scales with comparatively smooth surface.....*Myripristis*, p. 149
 aa. Preopercle with a conspicuous spine at its angle.
 d. Mouth very large; chin much projecting; lower jaw considerably more than one-half length of head.....*Flammco*, p. 155
 dd. Mouth moderate; lower jaw slightly projecting or included, its length less than one-half length of head.....*Holocentrus*, p. 158

Genus 89. *HOLOTRACHYS* Günther.

This genus is close to *Myripristis*, from which it differs in the small, very rough scales and in the projecting lower jaw, which fits in a deep notch in the upper jaw.

Holotrachys Günther, *Fische der Südsee*, I, 93, Pl. LXIII, fig. A, 1874 (*lima*).

Harpage De Vis, *Proc. Linn. Soc. New South Wales*, 1884, 447 (*rosea*).

103. *Holotrachys lima* (Cuvier & Valenciennes). Plate IV.

Head 2.6 in length; depth 2.5; eye 3.5 in head (4.3 in an example 6 inches long); snout 5.5; interorbital 5.5; maxillary 1.65; D. XII, 15; longest dorsal spine 2.4 in head; A. IV, 11; longest anal spine 3.1; scales 5-42 (40 to 42)-8.

Body oblong, compressed; dorsal outline evenly arched from tip of snout to base of soft caudal; ventral outline almost straight; head subconic, compressed; mouth large, nearly horizontal; jaws equal, a knob at tip of lower fitting into a depression in upper, the bony portion of preorbital slightly overhanging lip; blunt, conic, pavement-like teeth on jaws, vomer, and palatines; tongue broad, free anteriorly, rounded and rather thin on anterior and thin portion; eye high, anterior; maxillary long, reaching beyond eye, its broadest part nearly equaling diameter of eye; gillrakers 11+8, longest half diameter of eye, finely serrate; fourth and fifth dorsal spines longest; soft dorsal rays of nearly equal length; caudal slightly forked; soft anal rounded; posterior edges of pectoral and ventral nearly equal; lateral line slightly arched anteriorly, thence obliquely downward to middle of caudal peduncle, across the middle of which it extends to base of caudal fin; edges of scales very rough, each scale with many rather long sharp spines, these longer on scales on posterior part of body.

Color in life (No. 03164) upper parts of head and body bright rock-candy red, becoming paler on side; under parts pale rosy white, edges of scales darkest, forming red lines; membranes of spinous dorsal blood-red, the spines white; soft dorsal, caudal, and anal bright red; anal spines white; pectoral and ventrals paler rosy; iris blood-red, with yellow blotches.

Color in alcohol, grayish-yellow, fins all pale.

This species is a very common market fish at Honolulu and Hilo, and was also obtained by us at Kailua, by the Albatross at Honolulu and Laysan Island, and by Doctor Jordan at Samoa, where it was found to be a common fish. Our numerous specimens range in length from 4 to 7.5 inches. *H. rosea* from the South Sea Islands is probably *H. lima*.

Myripristis lima Cuvier & Valenciennes, *Hist. Nat. Poiss.*, VII, 493, 1831, *Ile de France*; Günther, *Cat.*, I, 28, 1859 (copied).

Myripristis humilis Kner & Steindachner, *Stiz. Ak. Wiss. Wien*, LIV, 1866, 357, pl. 1, fig. 1, Samoa.

Myripristis (Holotrachys) lima, Günther, *Fische der Südsee*, III, 93, pl. 63, fig. A, 1874 (Mauritius; Kingsmill; Samoa; Society; Hawaiian Islands).

Myripristis (Holotrachys) lima, Steindachner, *Denks. Ak. Wiss. Wien*, LXX, 492, 1900 (Honolulu).

Holotrachys lima, Jenkins, *Bull. U. S. Fish Comm.*, XXII, 1902 (Sept. 23, 1903), 439 (Honolulu); Snyder, *op. cit.* (Jan. 19, 1904), 523 (Honolulu; Laysan Island).

Genus 90. *OSTICHTHYS* (Langsdorf) Jordan & Evermann.

This genus is closely related to *Myripristis*, differing especially in the very rough surface of the large scales. The opercular spine is usually elongate and rough edged. *Holotrachys*, another genus with similarly rough scales, differs from *Ostichthys* in having the scales very much smaller, about 40 to 45 in the lateral line, instead of 29 as in *Ostichthys*.

Ostichthys Langsdorf MS., Cuvier & Valenciennes, *Hist. Nat. Poiss.*, III, 173, 1829 (*japonicus*); name only, passing reference.

Ostichthys Jordan & Evermann, *Fishes North and Mid. Amer.*, I, 846, 1896 (*japonicus*).

104. *Ostichthys pillwaxii* (Steindachner). Fig. 52.

Head 2.45 in length; depth 2.5; eye 3.75 in head; snout 3.75; maxillary 1.9; interorbital 7.3; D. XII, 14, A. IV, 11; scales 4-29-6; Br. 7; gillrakers short, blunt, about 7+5.

Body oblong, compressed; dorsal outline somewhat more arched than ventral, in a long, low curve from nape to origin of soft dorsal, thence descending abruptly to caudal peduncle; ventral outline straighter; base of anal abruptly ascending to caudal peduncle; head very large and rugose; mouth very large, the maxillary reaching posterior edge of pupil; supplemental maxillary very broad;

tip of maxillary (with supplemental bone) 1.25 in eye; jaws about equal, the lower fitting in a deep notch in the upper; jaws, vomer, and palatines with broad bands of villiform teeth; eye large, high up, far above axis of body; interorbital space narrow, more than 2 in eye; bones of head rough everywhere; interorbital with 4 low rough ridges; prenasals rough, ending in 3 blunt, more or less serrated points; preorbital, postocular, preopercle, subopercle, and opercle all strongly toothed, no enlarged spine at angle of preopercle; nape rugose, with ridges radiating posteriorly; bones of mandible rough; edge of each branchiostegal rough; opercle with a moderately stout spine above, its surface rugose; caudal peduncle short and slender, its length about equal to diameter of eye, its least width 2.5 in its least depth, which is 1.4 in eye; origin of spinous dorsal about equidistant between tip of snout and base of first dorsal ray, almost directly over base of pectoral; dorsal spines strong, folding well in a groove, the fourth longest, about 2.6 in head; base of soft dorsal very oblique, 3 in head, the longest ray slightly longer than base; first anal spine very short, the third longest and strongest, its length 3.25 in head, base of anal oblique like that of soft dorsal, 2.5 in head, longest anal ray equaling that of soft dorsal; caudal forked, the longest rays about 2.1 in head; ventrals short, reaching about two-fifths the distance to vent, their length about 2.25 in head; pectoral coterminous with ventrals, its length 2

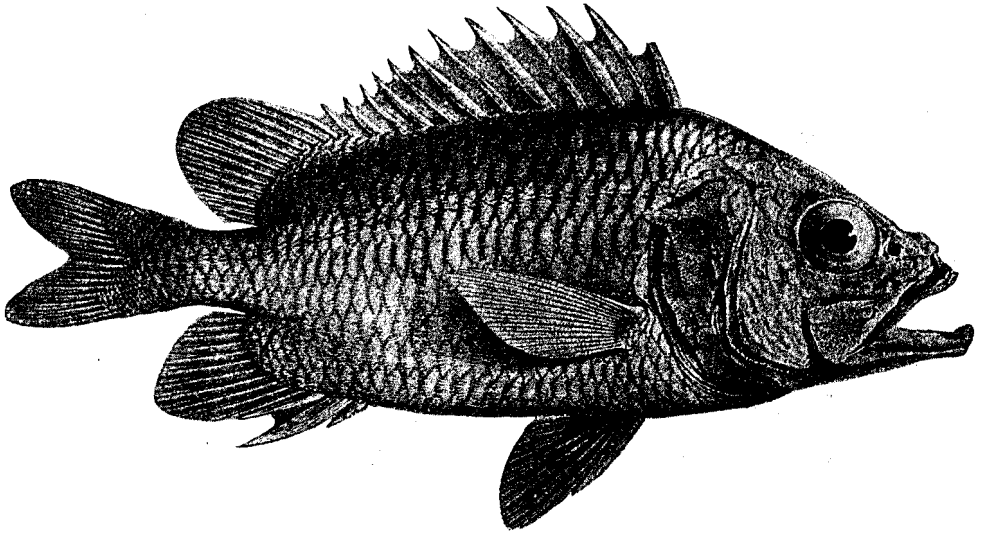


FIG. 52.—*Ostichthys pillwaxii* (Steindachner); after Steindachner.

in head; scales very large, firm and very spinigerous, each scale with about 16 to 22 very sharp, short spines, each of which is continued as a ridge on the surface of the scale; lateral line following curvature of back; nape and breast with strong scales; cheeks scaled, rest of head naked; base of pectoral with smaller scales; a sheath of small triangular scales at base of soft dorsal and anal; membranes of caudal fin with small, spinescent scales.

Color in alcohol, pale yellowish with orange, silvery, brassy, and rosy reflections; back along spinous dorsal orange; nape rosy red; back and side with traces of about 3 or 4 rosy streaks; under parts white, with some rosy; branchiostegals orange at base.

The color in life was doubtless deep red or rosy.

This species differs from *Holotrachys lima* chiefly in the much larger scales and the more numerous spines on the scales; also in the larger eye and in having but 1 enlarged spine instead of 2 at the upper edge of the opercle; the mandible and maxillary are less rough.

The above description is based upon No. 05500, a specimen 12 inches long, obtained in the Honolulu market by Mr. E. Louis Berndt, through whose kindness it came into our possession. No other specimens have been seen by us.

Myripristis pillwaxii Steindachner, Beiträge, XVI, in Sitz. Ak. Wiss. Wien, CII, abt. I, 1893, 215, Pl. I, Honolulu.

Genus 91. MYRIPRISTIS Cuvier.

This genus is closely related to *Holocentrus*, differing externally chiefly in the absence of the large spine at the angle of the preopercle. The air-bladder is divided into 2 parts by a transverse constriction, the anterior part extending to the otocrane. The pyloric caeca are rather few (9).

Species numerous in the tropical seas; gaily colored inhabitants of reefs and rock pools.

Myripristis Cuvier, Règne Animal, Ed. 2, Vol. II, 150, 1829 (*jacobus*).

Myriopristis Gill, Proc. Ac. Nat. Sci. Phila. 1863, 87; amended spelling.

Rhanphoberye Gill, Proc. Ac. Nat. Sci. Phila. 1863, 87 (*pacilopus*).

- a. Scales large, 34 or more in the lateral line.
- b. Edge of opercle blackish.
- c. Dorsal rays 16 or 17; scales 40 to 43.....*multiradiatus*, p. 149
- cc. Dorsal rays 14 or 15; scales larger, 34 to 36.
- d. Fins golden in life; scales 34; D. x-1, 14; A. iv, 12.....*chryseres*, p. 150
- dd. Fins red in life; scales 36; D. x-1, 15; A. iv, 14.....*symmetricus*, p. 151
- bb. Edge of opercle pale; scales 35 to 38.....*scalei*, p. 151
- aa. Scales smaller, fewer than 34 in the lateral line.
- c. Edge of opercle black; axil black; scales fewer than 33.
- f. Scales 30; vertical fins with first rays white.....*murđjan*, p. 152
- ff. Scales 32; vertical fins without white rays.....*berudti*, p. 153
- cc. Edge of opercle silvery or pale; axil merely dusky; scales 33.....*argyromus*, p. 154

105. *Myripristis multiradiatus* Günther.

Head 3 in length; depth 2.3; eye 2 in head; snout 7; maxillary 1.9; mandible 1.9; interorbital 3.9; D. x or x1-1, 16 or 17; A. iv, 15; scales 4-40 to 43-5.

Body short, deep, and compressed; dorsal outline evenly convex from tip of snout to origin of soft dorsal; ventral outline nearly equally convex, somewhat flattened under ventrals; head short, snout blunt; mouth small, the jaws equal, the maxillary reaching posterior line of pupil, triangular, the posterior side concave, the end nearly straight, the anterior edge with a few blunt teeth at the angle; mandible smooth, without knob at tip; no distinct notch in tip of upper jaw; eye moderate, somewhat greater than postocular part of head; interorbital space nearly flat, the 2 median ridges convex, close together in front, then diverging, then coming nearly together on the nape; outside of these on the nape on each side, 4 short diverging striae; suborbital rim finely serrate on both edges; edges of opercular bones all serrate, the serrae strongest at the angles; the teeth on jaws small, in narrow villiform bands. Scales comparatively small, much deeper than long, the edges striate and finely dentate; humeral scale small; lateral line gently arched. Origin of spinous dorsal slightly posterior to base of pectoral, the spines slender, the first 1.8, the second about 1.2 in eye, the others increasing to the fourth, the last very short; interval between dorsals very short; anterior dorsal rays slightly produced, their length about 2 in head, the edge of the fin somewhat concave, the last rays about 2.5 in first; anal similar to soft dorsal, the anterior rays rather longer than those of dorsal, anal spines graduated, the first very small, the second somewhat larger, the third considerably longer and stronger, its length about 1.3 in eye; fourth anal spine still a little longer than the third but more slender; caudal fin widely forked, the lobes equal, their length about 1.2 in head; pectoral slender, its length equal to that of caudal lobes, its tip reaching beyond those of ventrals; ventrals short, the spine slender, its length equal to diameter of orbit, the longest rays about equal to snout and orbit.

Color of a nearly fresh specimen (No. 03163) 6.5 inches long, top of head and upper part of side rich rosy red; lower parts and side below lateral line pale rosy with silvery reflection; jaws rich rosy; cheeks and opercles rosy and whitish; upper half of edge of opercle rusty reddish brown, this extending to shoulder-girdle; axil of pectoral dark reddish; spinous dorsal pale rosy, anterior membrane and outer part of others orange; soft dorsal pale rosy, first ray white, outer half of next 6 or 7 rays rich rosy red; caudal rich rosy red, edges paler; anal spines white, the soft part same color as caudal; pectoral pale rosy; ventrals very pale rosy, the spine and its membrane white, the second membrane deeper rosy; iris clouded red above, pale yellow below.

Another example (No. 03480) was red in life, though paler than *M. murđjan*; side coppery silvery; black opercular bar covering axil; first dorsal rosy, distal half yellowish orange; soft dorsal, anal, and caudal deep cherry red, the edge scarcely paler; pectoral and ventral pink, a little darker on first rays, also on anal rays behind last spine; iris red.

Color in alcohol, rather uniform yellowish silvery, most yellow above, most silvery below lateral line and on belly; upper edge of opercle black; cheek and opercle silvery; axil of pectoral dusky; fins all pale yellowish white; upper edge of eye dusky, the rest whitish and golden; side below lateral line with about 5 broad lighter horizontal stripes showing plainly only in certain lights.

There is some variation in the number of rays in the dorsal, there being usually 17, but sometimes 16, and more rarely 18. The scales in the lateral line vary from 40 to 43.

This species was originally described by Doctor Günther from a small example, 6 inches long, from the island of Vavau, of the Tonga or Friendly Group. It seems to be an abundant fish among the Hawaiian Islands and at Samoa. Five specimens were obtained by Dr. Jenkins at Honolulu in 1889, one by Dr. Wood in 1896, a fine series was taken by us at Honolulu and Hilo, and it was obtained by the *Albatross* at Laysan Island. Our numerous specimens range in length from 3.8 to 7.5 inches.

Myripristis multiradiatus Günther, Fische der Südsee, I, 93, 1874, Vavau, one of the Friendly Islands; Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 439 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 523 (Laysan Island).

106. *Myripristis chryseres* Jordan & Evermann. "Pauú." Plate VI.

Head 2.75 in length; depth 2.5; eye 2.4 in head; snout 5.5; maxillary 1.9; mandible 1.8; interorbital 5; D. x-1, 14; A. iv, 12; scales 4-34-6.

Body short, stout, and compressed; dorsal profile evenly convex from tip of snout to origin of soft dorsal; ventral outline nearly straight to origin of anal, whose base is equally oblique with that of soft dorsal; caudal peduncle short but slender and not greatly compressed, its length from base of last dorsal ray to first short spinous caudal ray 1.3 in eye, its least width about 3 in its least depth, which is 1.8 in eye; head heavy, short; mouth moderately large, the gape in closed mouth reaching vertical of middle of eye; maxillary very broad, triangular, reaching nearly to vertical of posterior line of eye, with a broad, curved supplemental border; surface of maxillary roughly striated, anterior edge near the angle strongly dentate; lower jaw strong, somewhat projecting, the tip with 2 rounded, rough prominences fitting into a distinct notch in upper jaw; teeth short, in narrow villiform bands in jaws and on palatines, a small patch on vomer, none on tongue; eye very large, orbit exceeding postocular part of head; lower edge of eye on level with axis of body; snout short, 2 in orbit; interorbital space nearly flat, strongly rugose; 2 long ridges from preorbitals to nape; outside of these a short ridge beginning above front of pupil, extending backward, and branching upon nape; supraocular ridge spinescent posteriorly; suborbital narrow, strongly dentate below, upper edge in front somewhat roughened; opercular bones all strongly toothed; opercular spine short and obscure (stronger in most of the cotypes); dorsal spines slender, fifth longest and strongest, its length 2.5 in head; first dorsal spine somewhat posterior to base of pectoral, its length 2 in eye, spines gradually shorter from fifth; space between dorsals very short, about equal to length of tenth spine; dorsal rays long, length of longest a little greater than orbit, last equal to pupil; first anal spine very short, second short and triangular, its length about 1.5 in pupil; third anal spine long, strong, and straight, longer than fourth, its length equal to diameter of orbit; fourth anal spine slender, its length 1.3 in orbit; anal rays longer than those of dorsal; caudal widely forked, lobes equal, their length 1.5 in head; pectoral long and narrow, its length 1.4 in head, the tip reaching past tips of ventrals; ventrals slender, pointed, nearly reaching vent and nearly as long as pectoral.

Scales smaller than in *M. murdjan*, number in lateral line 34 in type, 35 to 38 in some of the cotypes; scales strongly dentate, and striate near the edges; a strongly dentate humeral scale.

Color in life, bright scarlet, centers of the scales paler; a blackish-red bar behind and on edge of opercle, continued as red (not black) into the axil; first dorsal golden, with red basal blotches on membranes; second dorsal golden, with crimson at base, spine and first ray white; caudal golden, first ray white above and below; anal golden, the spines and first ray white; all the vertical fins narrowly edged with red; ventrals mostly pink, with golden wash on first rays; pectoral plain crimson; axil light red.

Color in alcohol, yellowish or orange white, the edges of the scales paler; some of the scales with small brownish dustings on the edges; edge of opercle black; opercle and cheek somewhat silvery; fins all pale yellowish, without dark edges. In some individuals the general color is more silvery, and in one example (No. 04860) the axil of the pectoral is somewhat dusky. In life the color is more scarlet than in *M. murdjan* and the fins yellow, not red as in the latter and all other Hawaiian species.