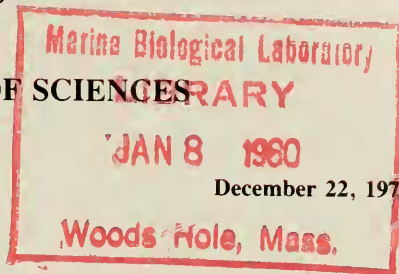


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EASTERN PACIFIC MACROURINE GRENADIERS WITH SEVEN
BRANCHIOSTEGAL RAYS (PISCES: MACROURIDAE)

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ABSTRACT: Seventeen species representing eight genera of macrourine grenadiers with seven branchiostegal rays are treated as part of the eastern Pacific fauna. Among the eight genera, *Nezumia* is the most diverse, with 10 species represented. *Nezumia ventralis* new species, is described from two Galápagos specimens; the high pelvic fin ray count of 15 contrasts this species with all other eastern Pacific *Nezumia*. Two apparently disjunct populations of *N. loricata* are given subspecific recognition: subspecies *loricata* from the Galápagos and subspecies *atomos* (new) from central Chile. *Echinomacrus*, *Hymenocephalus*, *Paracetonurus*, *Ventrifossa*, *Malacocephalus*, *Mataeocephalus*, and *Mesobius* are each represented by only one species—the first four genera listed are first recorded from the eastern Pacific. *Echinomacrus occidentalis* (a second species in the genus) is newly described from a single specimen taken off Peru in 4,334 m. *Macrurus fragilis* Garman, 1899, is tentatively aligned with members of *Paracetonurus*. *Ventrifossa* is recognized as consisting of three subgenera: *Ventrifossa*, *Lucigadus*, and *Sokodara* (new). Only subgenus *Lucigadus* is represented in the eastern Pacific.

INTRODUCTION

The large grenadier subfamily Macrourinae is divisible into two distinct groups based on branchiostegal ray counts. Those macrourines with six branchiostegal rays, typified by *Macrourus* Bloch and *Coryphaenoides* Gunnerus, form one group; those with seven branchiostegal rays and one monotypic genus (*Pseudonezumia* Okamura) with seven or eight form a second group. This second group may be further divided by species differences in the development and location of the periproct region (the specialized area surrounding the anal and urogenital openings) and the development of ventral light organs. *Hymenocephalus* is the most distinctive member of this second group and forms a phylogenetic line well removed from the others. Another line of related genera, characterized by the members having a broad periproct situated

close to the origin of the anal fin, includes such diverse genera as *Echinomacrus* Roule, *Paracetonurus* Marshall, *Cetonurus* Günther, *Trachonurus* Günther, and *Sphagemacrus* Fowler. These genera contrast with *Nezumia* Jordan, *Malacocephalus* Günther, *Ventrifossa* Gilbert and Hubbs, *Kumba* Marshall, and *Pseudonezumia* Okamura, members of which have a smaller periproct removed by some distance from the origin of the anal fin and preceded by an anteriorly extended light organ of various size. *Mataeocephalus* Berg falls somewhere between these two divisions in that members of one species (*M. adjustus*) have a periproct that is well removed from the anal fin origin, and they also have a distinct dermal window of the light organ extended forward of the periproct, while members of the other species apparently have a periproct situated close before the anal

fin, and their light organ lacks a distinct dermal window.

The 16 species here considered constitute about 40 percent of the total (approximately 40 spp.) macrourid fauna of the eastern Pacific. The genus *Coelorinchus* from this region (6 spp.) was reviewed in a previous paper (Iwamoto 1979). A review of the large complex of macrourines with six branchiostegal rays and the trachyrincines (2 spp.) from the eastern Pacific is currently underway. A summary of past studies of the Macrouridae from eastern Pacific waters is given in Iwamoto and Stein (1974). In addition, the recent works of Hubbs and Iwamoto (1977), Chirichigno and Iwamoto (1976), Shcherbachev et al. (1979), Ojeda and Camus (1977), and Parin et al. (1973, 1976) should be consulted.

METHODS

Methods for making counts and measurements generally follow procedures described by Hubbs and Lagler (1958) and modified for macrourids by Iwamoto (1970, 1978). Six or seven branchiostegal rays are found in all but one species of macrourid. The exception is *Pseudonezumia* Okamura, 1971a, which has seven or eight (personal communications, Osamu Okamura, September 1978). Four of the rays are attached laterally on the epihyal and ceratohyal; the remaining two or three (or probably four in *Pseudonezumia*; condition not known) are attached anteriorly and medially on the ceratohyal—thus only the latter group of rays need be counted to determine the total number. However, these anteriormost rays (i.e., those closest to the isthmus) are generally small and slender, making them difficult to see without probing or dissection.

Synonymies are limited to primary synonyms and other combinations. Materials for this study are based primarily on collections made by the ANTON BRUUN in 1966 and the TE VEGA in 1968; most of these are deposited in the ichthyological collection of the California Academy of Sciences (CAS). Other sources have been extensively used, and abbreviations for the depositories are as follows: AMNH, American Museum of Natural History, New York; BMNH, British Museum of Natural History, London; CAS-SU, Natural History Museum, Stanford University, now housed at CAS; FAKU, Faculty of Agriculture, Kyoto University, Maizuru; FSFRL,

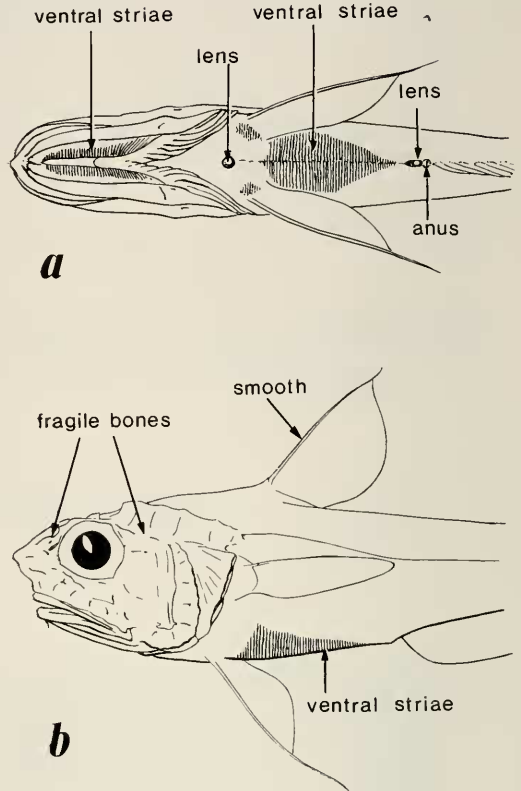


FIGURE 1. Diagrammatic ventral (a) and lateral (b) views of a hypothetical representative of the genus *Hymenocephalus*, showing diagnostic features of the genus.

Far Seas Fisheries Research Laboratory, Shimizu; IMARPE, Instituto del Mar, Callao; LACM, Natural History Museum of Los Angeles County, Los Angeles; MCZ, Museum of Comparative Zoology, Harvard University, Cambridge; SIO, Scripps Institution of Oceanography, La Jolla; UMML, School of Marine and Atmospheric Science, University of Miami, Miami; USNM, National Museum of Natural History, Washington, D.C.

KEY TO THE ADULTS OF EASTERN PACIFIC MACROURINE SPECIES WITH SEVEN BRANCHIOSTEGAL RAYS

- 1a. Ventral striae (fine black transverse lines, most readily visible under magnification) present over gular membranes, isthmus, and parts of chest and abdomen (Fig. 1). Anus situated immediately before anal fin and preceded by a small,

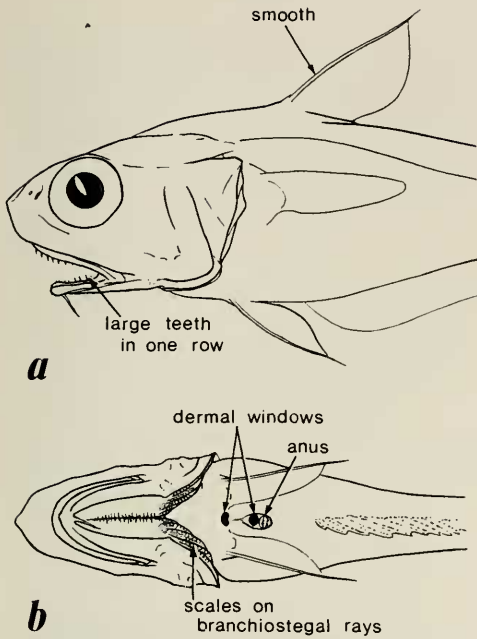


FIGURE 2. *Malacocephalus laevis*. (a) Lateral view showing smooth leading edge of second spinous dorsal ray and enlarged teeth of lower jaw. (b) Ventral view showing scales on branchiostegal rays and location of anus and light organ structures.

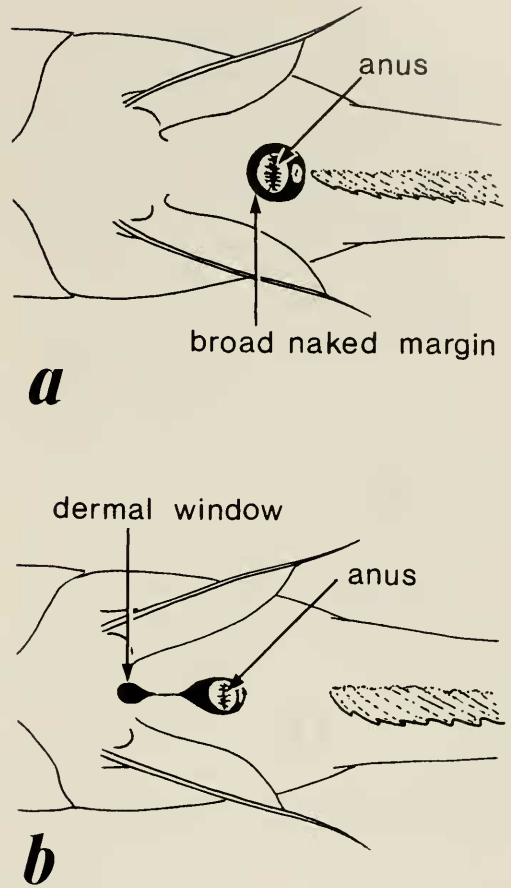


FIGURE 3. Diagrammatic ventral views of abdomen of grenadiers showing periproct location (a) abutting or close to (separated by a few scale rows in some individuals) origin of anal fin, and (b) periproct far removed from origin of anal fin.

- raised lenslike structure; this structure connected by a thin (often obscure) black median line to similar structure on chest. Head bones extremely fragile, some almost membranous. Gill-rakers numerous, more than 20 (total count) on first arch. Second spinous dorsal ray smooth *Hymenocephalus* sp. (p. 140)
- 1b. No ventral striae. Anus removed by a short to moderate distance from anal fin; lenslike structure, if present, far removed from anal fin origin and usually located in a shallow fossa. Head bones relatively strong. Gill-rakers fewer than 20 (total) on first arch. Second spinous dorsal ray smooth or serrated 2
- 2a. Spinous second ray of first dorsal fin with smooth leading edge (Fig. 2a) 3
- 2b. Spinous second ray of first dorsal fin with serrated leading edge 5
- 3a. Chin barbel absent
 *Mesobius berryi* Hubbs and Iwamoto (p. 141)

- 3b. Chin barbel present, well developed 4
- 4a. Teeth large, in a single row on lower jaw (Fig. 2a); scales on branchiostegal membrane (Fig. 2b)
 .. *Malacocephalus laevis* (Lowe) (p. 149)
- 4b. Teeth small, in a narrow band on lower jaw; no scales on branchiostegal membranes
 *Nezumia liolepis* (Gilbert) (p. 157)
- 5a. Periproct close to or abutting (Fig. 3a) origin of anal fin; anus usually closer to origin of anal fin than to insertion of pelvic fins 6
- 5b. Periproct far removed from origin of anal fin (Fig. 3b); anus usually closer to in-

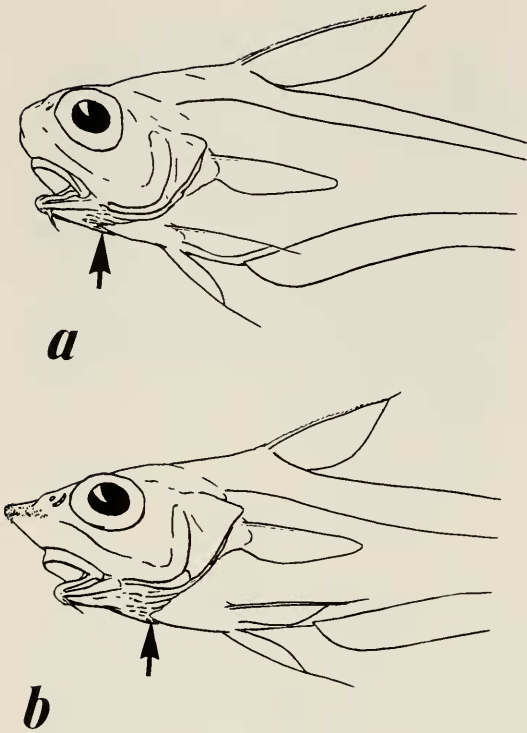


FIGURE 4. Ventrolateral views of (a) *Ventrifossa nigromaculata* and (b) *Nezumia latirostrata* comparing relative lengths of first dorsal fin, anterior extent of gill openings (arrows), and relative positions of pelvic and anal fins.

- 8
- 6a. Head massive, globose; snout broadly rounded. Scales on body distinctly non-imbricate (not overlapping), the exposed field of each scale separated by a fleshy border from the exposed fields of adjacent scale..... 8
- Echinomacrus occidentalis* n. sp. (p. 143)
- 6b. Head relatively slender, angular; snout pointed. Body scales distinctly imbricate; exposed fields of adjacent scales not distinctly separated from each other by a fleshy border..... 7
- 7a. Head bones stout; head ridges strongly armed with coarse scutelike scales. Mouth small, notably inferior, and distinctly U-shaped. Scales densely covered with spinules..... 7

- *Mataeocephalus tenuicauda* (Garman) (p. 145)
- 7b. Head bones fragile; head ridges naked or with unmodified scales. Mouth moderate in size, not notably inferior, and more normally shaped. Scales with few or no spinules on exposed field.....
- *Paracetonus fragilis* (Garman) (p. 147)
- 8a. Height of first dorsal fin much greater than length of head. Opercular opening extends far forward to vertical through hind edge of maxillae (Fig. 4a).....
- *Ventrifossa (Lucigadus) nigromaculata* (McCulloch) (p. 153)
- 8b. Height of first dorsal fin about equal to or less than length of head. Anteriormost extent of opercular opening much posterior of vertical through hind edge of maxillae (Fig. 4b)..... 9
- 9a. Second ray of first dorsal fin with 0 to 4 weak denticles on leading edge (Fig. 5a). Scales thin, highly deciduous with few or no spinules on exposed fields of body scales.....
- *Nezumia liolepis* (Gilbert) (p. 157)
- 9b. Second ray of first dorsal fin with numerous prominent denticulations on leading edge (Fig. 5b). Scales relatively adherent, with spinules densely covering exposed fields..... 10
- 10a. Species bathypelagic. Gill filaments short; length about half diameter of eye lens. Outer pelvic ray prolonged, 70–160% HL. Body scales small, bearing 1–15 slender, erect spinules that render body surface velvety; 11–14 scale rows below origin of second dorsal fin. Color black to brownish black.....
- *Nezumia parini* Hubbs and Iwamoto (p. 176)
- 10b. Species benthopelagic. Gill filaments moderate to long; length about equal to or greater than diameter of eye lens. Outer pelvic ray usually less than 70% HL. Body scales small to moderate; spinules on scales few to numerous, moderately to greatly inclined, conical, lanceolate, or shield shaped, usually rough in texture; fewer than 11 scale rows below origin of second dorsal fin. Color

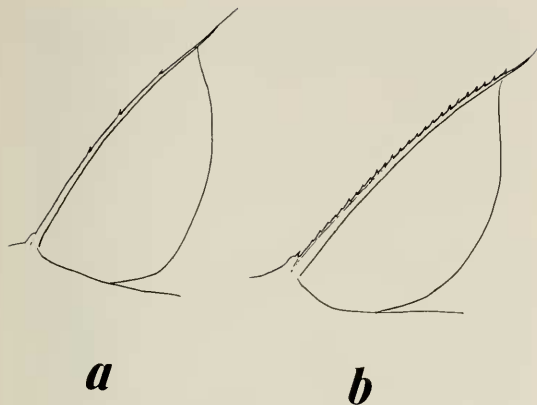


FIGURE 5. Comparison of denticulations on leading edge of second spinous dorsal rays of (a) *Nezumia liolepis* and (b) *Nezumia loricata*.

- 12a. Patches of small scales on base of lowermost branchiostegal rays (Fig. 6a). Spinules on body scales relatively broad, lanceolate, arranged in a somewhat quincunx pattern, rows not discretely parallel or slightly convergent and ridgelike. Chin barbel long, 20–25% HL. Rays of pelvic fin 10–11. Orbit diameter 25–29% HL -----
 .. *Nezumia stelgidolepis* (Gilbert) (p. 161)
- 12b. Few isolated scales or no scales on branchiostegal rays. Spinules on body scales narrow, usually conical, arranged in discrete parallel or slightly convergent rows. Length of chin barbel 10–16% HL. Rays of pelvic fin 11–12. Orbit diameter 30–34% HL -----
 *Nezumia pulchella* (Pequeño) (p. 159)
- 13a. Gill-rakers on inner side of first (outermost) arch 9 or fewer (total count), 5–6 (rarely 7) on lower limb -----
 .. *Nezumia convergens* (Garman) (p. 171)
- 13b. Gill-rakers on inner side of first arch 9 or more (total), 8 or 9 on lower limb ----
 ----- 14
- 14a. Pelvic fin rays 9. First dorsal with prominent black blotch distally, pale basally. Interorbital region narrow, width 17–19% HL -----
 *Nezumia orbitalis* (Garman) (p. 167)
- 14b. Pelvic fin rays 9–12. First dorsal fin usually uniformly blackish. Interorbital width moderate, 17–26% (usually more than 20%) HL ----- 15

various shades of blue, violet, brown, or black ----- 11

- 11a. Mandibular rami usually completely naked; pores of lateralis system large and prominent on mandibular rami and along ventral border of suborbital region (Fig. 6a). Mouth relatively large, length upper jaw usually 30–36% HL. Outer gill-slit relatively wide, 17–22% HL ----- 12
- 11b. Most of mandibular rami scaled, although anterior end naked in some; pores of cephalic lateralis system small, relatively inconspicuous (Fig. 6b). Mouth relatively small, length upper jaws 23–32% HL. Length outer gill-slit 12–16% HL ----- 13

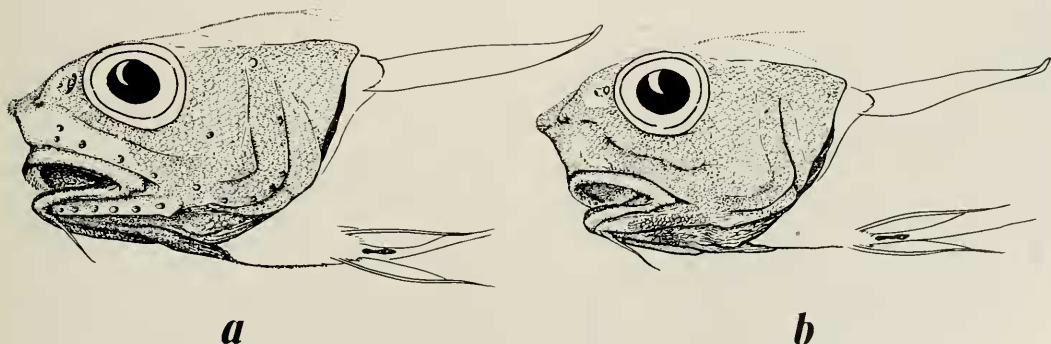


FIGURE 6. Ventrolateral views of (a) *Nezumia stelgidolepis* and (b) *Nezumia pudens* comparing pore development (slightly exaggerated) and squamation of head in the two species.

- 15a. Snout relatively blunt, high. Suborbital region smoothly and almost completely scaled; scales along ridges not especially stout and coarse (Fig. 6b). Barbel long, 19–25% HL *Nezumia pudens* Gilbert and Thompson (p. 163)
- 15b. Snout pointed, low. Suborbital region often with ventral surfaces partially naked; scales along ridges stout, coarse. Barbel shorter, less than 17% HL 16
- 16a. Pelvic fin rays 9–10. First dorsal fin rays II,8–11 (usually 9–10) Length barbel 5–10% HL
 .. *Nezumia latirostrata* (Garman) (p. 168)
- 16b. Pelvic fin rays 10–12. First dorsal fin rays II,9–12 (usually 10–12). Length barbel 10–17% HL
 *Nezumia loricata* (Garman) (p. 174)

Hymenocephalus Giglioli

Hymenocephalus GIGLIOLI, 1882:199 (type-species *Hymenocephalus italicus* Giglioli, 1884, by monotypy).

Mystacconurus GÜNTHER, 1887:124 (as subgenus of *Macrurus*) (type-species *Hymenocephalus italicus* Giglioli, 1884, by subsequent designation of Jordan and Evermann 1898:2580).

Hymenogadus GILBERT AND HUBBS, 1920:521 (as subgenus) (type-species *Hymenocephalus gracilis* Gilbert and Hubbs, 1920, by original designation). —Okamura 1970a:58 (recognized as genus).

DIAGNOSIS.—Macrourine grenadiers with anus immediately before anal fin. Striae, consisting of fine parallel black lines over silvery pigment, on most ventral areas of body. Two lenslike dermal windows of light organ on midventral line; one immediately before anus and one on chest before pelvic fin bases; dermal window connected by black ridge along midventral wall of abdominal cavity. Head large, cavernous; bones thin, head covering membranous. Mouth large, subterminal. Gill openings and outer gill-slit relatively wide. Gill-rakers numerous, more than 15 on lower limb of outer arch except in slender, cylindrical-bodied species (subgenera *Hymenogadus* and *Spicomacrurus*). Second dorsal spine smooth or weakly denticulate (in *Hymenogadus*). Small species, usually less than 200 mm TL. (Adapted after Iwamoto 1970:374–375.)

REMARKS.—Okamura (1970a) elevated the subgenus *Hymenogadus* to full generic status, including in it *H. gracilis* Gilbert and Hubbs, 1920, *H. tenuis* Gilbert and Hubbs, 1917, and *H. kuronumai* Kamohara, 1938. The three

species are obviously closely related and form a distinct group readily distinguished from most other *Hymenocephalus* (sensu lato), but it is not the differences between the species groups in *Hymenocephalus* but the similarities among them that are most striking. Used in its widest sense, the genus *Hymenocephalus* encompasses a group of species that is notably distinct and distantly removed from other groups of macrourine grenadiers. By recognizing both *Hymenocephalus* and *Hymenogadus*, differences are emphasized and the obvious close relationship of the two groups is masked. This is regrettable and entails a needless proliferation of names. Recognition of *Hymenogadus* (with *gracilis* and *tenuis*) and *Spicomacrurus* (with *kuronumai*) as subgenera within *Hymenocephalus* is to me a more practicable and meaningful treatment of the species groups involved.

Hymenocephalus sp.

DIAGNOSIS.—Refer to generic diagnosis.

COUNTS AND MEASUREMENTS.—1D, II,8; gill-rakers on outer arch about 20. The following in millimeters: estimated HL 25; estimated TL 170; horizontal orbit diameter 10.3; length upper jaw 15.0; width suborbital 3.8; orbit to angle of preopercle 12.3; length barbel 3.7.

REMARKS.—The single specimen of this genus from eastern Pacific waters was in such poor condition when examined in June 1975, that an adequate description could not be prepared. The head was damaged and had become separated from the trunk, and the paired fins were gone; but there was no question as to its genus because of the presence of striae on the gular membrane and along the abdomen; the presence of two lenslike light organs on the chest and before the anus; the number, shape, and coloration of the gill-rakers; and the shape of the preopercle ridge—these combined features uniquely characterize the genus *Hymenocephalus*.

This specimen represents the first record of the genus from eastern Pacific waters. The genus is common throughout the warm-water regions of the Atlantic, Indian, and most of the central and western Pacific oceans. That only a single specimen has been collected—and that a fair-sized adult taken in a midwater haul—suggests that the species is not a regular inhabitant of eastern Pacific waters. The specimen may represent a stray or an expatriate, possibly from populations far to the westward.

MATERIAL EXAMINED.—USNM 149049 (1 specimen, est. 170 mm TL); Peru, off Aguja Pt., 5°57'30"S, 81°50'W; vertical haul, 732–0 m over bottom depth of 4,023 m; ALBATROSS sta. 4655, 12 Nov. 1904.

Mesobius Hubbs and Iwamoto

Mesobius HUBBS AND IWAMOTO, 1977:235 (type-species *Mesobius berryi* Hubbs and Iwamoto, 1977, by original designation).

DIAGNOSIS.—Bathypelagic. Periproct region broad, somewhat raised, close to anal fin origin (removed from origin by 2–4 scale rows in some individuals); anus centrally located within periproct. Large light organ abutting rectum, but no anterior extensions between pelvic fin bases or on chest. Abdomen short, distance isthmus to anal fin origin 1.0–1.5 of orbit diameter in adults. Chin barbel absent. Dentition in both jaws consist of narrow bands of small teeth. Scales of head elongate, each bearing 1–3 rows of spinules that form low, sharp ridges with 2–9 spinules per row. Head and body laterally compressed. Swim bladder greatly reduced, bearing 2 retia and 2 gas glands. Postlarvae and prejuveniles pass through a polka-dotted ("phal-acromacrusus") stage; adults mostly black. (Adapted from original description.)

REMARKS.—Since publication of the genus description, Dr. Carl L. Hubbs and I have received information concerning additional specimens of the genus. Dr. Nikolai V. Parin has written (to Hubbs, 25 Nov. 1977) that representatives of the genus have been collected by Russian vessels in the Atlantic and Indian oceans between latitudes 31° and 37°S. These specimens are presumably those recently reported by Shcherbachev et al. (1979) who recorded *M. berryi* from the Indian Ocean, and *M. antipodum* from the Indian Ocean and the Atlantic Ocean off the southwestern tip of Africa. Unlike the type-specimens of both species, the Russian specimens were captured in bottom trawls. The largest *M. antipodum* recorded by Shcherbachev et al. was more than 661 mm in total length and 136 mm in head length, and their six specimens ranged 104–136 mm HL and 465+ to 661+ mm TL. Their five specimens of *M. berryi* ranged 64.5–75.5 mm HL and 330+ to 412+ mm TL. The *M. antipodum* specimens are considerably larger than any of the *M. antipodum* and *M. berryi* Dr. Hubbs and I had examined (the largest *M. berryi* we had was 392 mm in total length and 70 mm in head length; the holotype

of *M. antipodum* was 390 mm long, with an incomplete tail, and 75 mm in head length). Dr. Christine Karrer has also informed us (personal communication, Oct. 1977) of having examined specimens of *Mesobius* in the Institut für Seefischerei (ISH), Hamburg, that were captured in the Atlantic by the WALTHER HERWIG. Four of these (ISH 1816/68; 88–107 mm HL) were borrowed through the kindness of Dr. M. Stehman and were identified as *M. antipodum*. Takao Arai (1979) recently reported the collection of 12 specimens of *M. antipodum* off New Zealand, the largest of which was 128 mm in head length. It thus appears that *M. antipodum* attains a much larger size than *M. berryi*, and that speculation (Hubbs and Iwamoto 1977:246) as to the probable distribution of *M. antipodum* extending widely across the Southern Hemisphere is supported.

Mesobius berryi Hubbs and Iwamoto

(Figure 7a)

Mesobius berryi HUBBS AND IWAMOTO, 1977:236–244, figs. 1–8, 10A (original description; holotype and 18 paratypes from eastern North Pacific).

DIAGNOSIS.—A species of *Mesobius* with 12–17 pyloric caeca; mesial gill-rakers on first arch 10–13 (\bar{x} = 11.8), on second arch 10–12 (\bar{x} = 11.0). Length posterior nostril less than 4 into least suborbital width. Differentiated squamation of posttemporal region not extending posteriorly of vertical through origin of pectoral fin. Outer margin of gill cover not notably incised at subopercle.

REMARKS.—General features of the fish can be seen in Figure 7a. This species has been adequately described in the original description, and in the recent reports by Arai (1979) and Shcherbachev et al. (1979). *Mesobius berryi* and *Nezumia parini* are the only eastern Pacific species of macrourid normally living bathypelagically as adults (adults of other species make excursions into bathypelagic depths, but their normal habitat is near bottom, i.e., benthopelagic; see Marshall and Merrett (1977) and Merrett (1978) for recent discussions on this subject). The unique squamation of the head of *Mesobius berryi* is unlike that of any other species encountered in the eastern Pacific and makes adults of the species easily recognizable. The specific differences originally reported between *M. berryi* from the North Pacific and *M. antipodum* from the South Pacific have generally

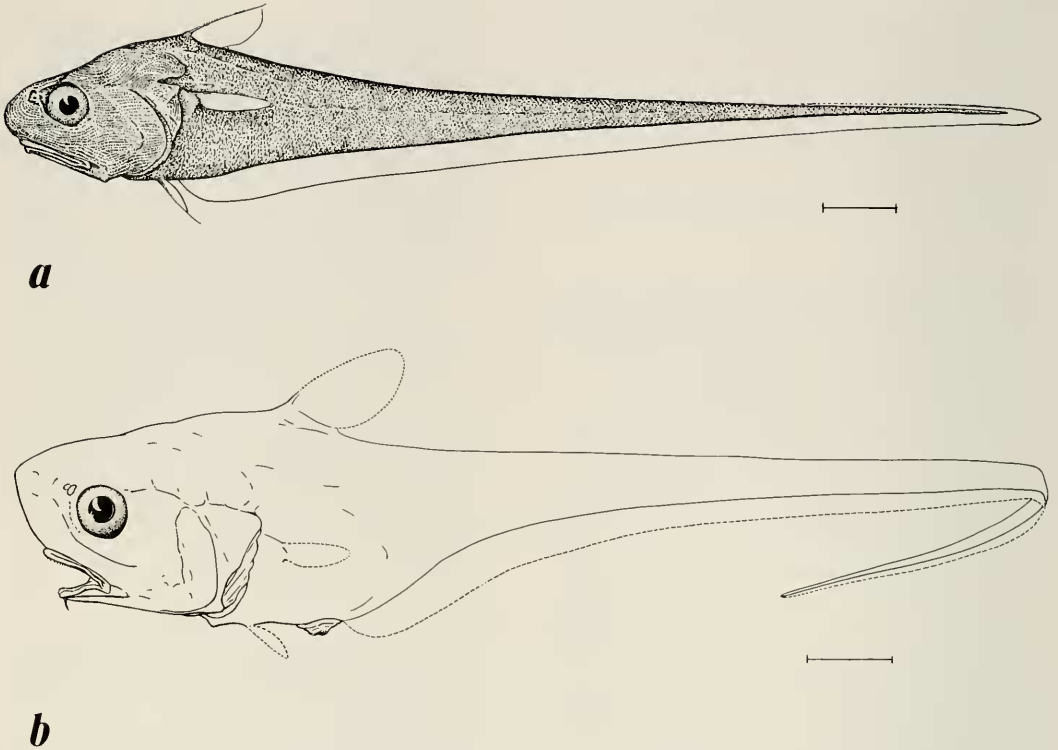


FIGURE 7. (a) *Mesobius berryi* Hubbs and Iwamoto. (Adapted from fig. 1 in Hubbs and Iwamoto 1977.) (b) *Echinomacurus occidentalis* Iwamoto, new species. Reconstruction of holotype, USNM 135612, collected by the ALBATROSS off Peru in 4,334 m.

been confirmed by Arai (1979) upon his examination of 12 specimens of *M. antipodum* captured off the New Zealand shelf and by Shcherbachev et al. (1979) from examination of specimens from the Indian Ocean and the southwestern Atlantic. Meristic features show the best differences (see Table 1), with the pyloric caeca count showing no overlap (12–17 in eight specimens of *M. berryi*, 30–43 in more than six specimens of *M. antipodum*) (data from Hubbs and Iwamoto (1977), Shcherbachev et al. (1979), and Arai (1979)); the last author gave only the range of counts in his 12 specimens of *M. antipodum*).

Echinomacurus Roule

Echinomacurus ROULE, 1916:22 (type-species *Echinomacurus mollis* Roule, 1916, by monotypy).

DIAGNOSIS.—Macrourine grenadiers with anus located within a broad naked area that lies immediately adjacent to anal fin origin; head massive, swollen by the expansive cephalic lateral-

line canals; second spinous ray of first dorsal fin serrated along leading edge; scales nonimbricate, with slender, erect spinules; scales along dorsal fins not especially enlarged (as in *Cetomurus*); no scales on gular and branchiostegal membranes; swim bladder reduced or absent. (See Marshall (1973:599) for additional characters.)

REMARKS.—The genus *Echinomacurus* has hitherto been known only from the eastern North Atlantic and the western Indian Ocean (Marshall 1973). The eastern Pacific specimen here reported is the first Pacific and, at 4,334 m, the shallowest record of the genus. Other specimens of *Echinomacurus* have been taken at depths from 5,000 to 5,413 m, and except for one Indian Ocean specimen, all were taken in nets fished at the bottom—Marshall (1973) thus considers *E. mollis* bathypelagic to benthopelagic in habit.

The genus is closely related to *Cetomurus* Vaillant, 1888; the two agree in most diagnostic characters given above but not in squamation

TABLE 1. COMPARISON OF SELECTED COUNTS IN *MESOBIBUS BERRYI* AND *M. ANTIPODUM*. Data from Hubbs and Iwamoto (1977), Arai (1979), and Shcherbachev et al. (1979).

Total gill-rakers on first arch				
	range	\bar{x}	S.D.	<i>n</i>
<i>M. berryi</i>	10–13	11.7	0.82	19
<i>M. antipodum</i>	12–15	13.9	0.85	31
Total gill-rakers on second arch				
	range	\bar{x}	S.D.	<i>n</i>
<i>M. berryi</i>	10–12	11.2	0.62	20
<i>M. antipodum</i>	12–16	13.9	0.89	31
Pectoral fin rays				
	range	\bar{x}	S.D.	<i>n</i>
<i>M. berryi</i>	12–14	12.9	0.63	33
<i>M. antipodum</i>	13–16	14.5	0.68	31
Pelvic fin rays				
	range	\bar{x}	S.D.	<i>n</i>
<i>M. berryi</i>	7–9	7.7	0.57	35
<i>M. antipodum</i>	6–7	6.9	0.35	30

and swim-bladder characters. *Cetonus* has imbricate scales over most of the body and notably enlarged scales along the base of the second dorsal fin; it also has scales over the lower branchiostegal rays and on the gular membrane, and a well-developed swim bladder.

Echinomacrus occidentalis new species

(Figure 7b)

DIAGNOSIS.—An *Echinomacrus* with 12 pelvic fin rays. Orbits about 20 percent HL. Eleven gill-rakers on mesial side of second arch. Interspace between first and second dorsal fins 31 percent HL.

COUNTS.—1D. ca. 11.9; 1P. il8/il8; 2P. ca. 12/12. Gill-rakers on first arch 1 + 9; on second arch 2 + 9. Pyloric caeca 6.

MEASUREMENTS (all in mm; measurements preceded by ca. are estimates).—Total length ca. 400; head length ca. 80; snout length ca. 27; preoral length ca. 23; horizontal orbit diameter 16; least postorbital length 39; orbit to angle of preopercle 36; suborbital width 10; length upper jaw 22.5; length barbel 7; length outer gill-slit 9; preanal length ca. 110; length snout to anus ca.

102; outer pelvic to anal 29; isthmus to anal ca. 54; greatest body depth ca. 62; depth over anal origin ca. 53; 1D.–2D. interspace 31.

DESCRIPTION.—Head deep, massive, presumably swollen in appearance when fresh; snout high, broad; nostrils high, located at about level of dorsal margin of orbits; interorbital space broad, convex. Mouth rather small, subinferior, but upper jaw extends near to vertical through hind edge of orbit; ascending limb of premaxilla high (height about 0.9 of ramus length), inclined forward. Interopercle mostly covered by, and closely adhered to, preopercle. A distinct notch in outline of gill cover formed by posteroventral border of subopercle.

Scales small, nonimbricate, almost in mosaic pattern on parts of head, more widely spaced on body. Thin, erect spinules cover most scales, giving shagreenlike feel to skin. Scales everywhere cover exposed surfaces of head and body except on fins, lips, parts of subopercle, wide margin surrounding anus, small areas behind pectoral and dorsal fins, and gill membranes. Shoulder girdle beneath gill cover naked; border between naked and scaled areas of shoulder sharply demarcated. Periproct large, raised, immediately adjacent to anal fin and occupying almost half distance between insertion of pelvic fins and origin of anal fin; anus slightly protruding. Premaxillary teeth small, conical, recurved, in a narrow, tapered band of about four rows deep anteriorly, tapering to a single row posteriorly; band extends about three-fourths length of premaxillary ramus; outer series of teeth slightly enlarged. Mandibular dentition about the same as that of premaxillary, but without enlarged outer teeth.

Gill-rakers short, spiny, tubercular. Outer gill-slit relatively long; about 8 rudimentary rakers on outer side of first arch, 1 + 9 on inner side, these armed with slender conical spines. Pyloric caeca 6, large, thick. Specimen a male with 2 well-developed testes.

Linings of gill, buccal, and peritoneal cavities black. Stomach black.

REMARKS.—It is with some reluctance that I describe this single eastern Pacific specimen of *Echinomacrus* as a new species, because of its extremely poor condition. It is unlikely, however, that any additional material of this rare species will be soon forthcoming, and there is little doubt that the specimen represents an undescribed taxon. The pelvic fin ray count of 12,

which I have confirmed on the right fin by staining, is distinctly higher in the eastern Pacific specimen than the 9–10 reported for *E. mollis* by Nybelin (1957) and Marshall (1973:599). The larger orbit (20 percent HL cf. 10–15 percent), which goes into the distance orbit to angle of preopercle about 2.2 times (compared with 2.5 or more in *E. mollis*), the slightly more rays of the first dorsal fin (II.9 in *E. occidentalis*, II.10 or II.11 in *E. mollis*), and the somewhat higher gill-raker count on the second arch (11 compared with 9–10 for *E. mollis*) are other noteworthy differences. Additionally, comparison of the holotype of *E. occidentalis* with a specimen of *E. mollis* from the Swedish Deep-Sea Expedition of 1947–48 (reported on by Nybelin (1957) and borrowed through the courtesy of Dr. Hubendick of the Natural History Museum, Göteborg) has revealed that the scales on the abdomen of the new species are smaller, with about seven scale rows separating the periproct from the pelvic fin bases as compared with three at the most separating the two regions in *E. mollis*. The pelvic girdle of *E. occidentalis* is much shorter than that of *E. mollis*—its length from anterior point to base of pelvic fin goes about 2.5 into distance orbit to angle of preopercle, as compared with about 2.0 for the same measurement in *E. mollis*. The new species is otherwise closely similar to its congener, for which Nybelin (1957) gives an excellent description and a photograph of two freshly caught specimens.

DISTRIBUTION.—Known from only the holotype taken off the northern coast of Peru in 4,334 m.

MATERIAL EXAMINED.—**Holotype:** USNM 135612 (1, ca. 80 mm HL, ca. 400 mm TL); off Peru, 8°30'S, 85°36'W, 4,334 m, ALBATROSS sta. 4658, 14 Nov. 1904.

Mataeocephalus Berg

Coelocephalus GILBERT AND CRAMER, 1897:422 (*non* Agassiz, 1843) (type-species *Coelocephalus acipenserinus* Gilbert and Cramer, 1897, by monotypy).

Mataeocephalus BERG, 1898:43 (replacement name for *Coelocephalus* Gilbert and Cramer, 1897, preoccupied).

DIAGNOSIS.—Macrourine grenadiers with anus located within a moderately broad to broad naked area (periproct) whose posterior edge is immediately adjacent to or close to anal fin origin; anus usually closer to origin of anal fin than to insertion of pelvic fins. Spinous ray of first dorsal fin with a serrated leading edge or serrations obsolete (in *M. adjustus*). Snout produced, dor-

soventrally depressed, with a stout, two-pronged scute. Mouth small (less than 30 percent HL), inferior; suborbital ridge stout, sharply angular in cross section. Premaxillary and mandibular teeth in broad bands which are usually confined to anterior portion of jaws and which usually fall well short of posterior corners of mouth opening. Gill openings restricted; gill membranes broadly connected to isthmus. Outer gill-rakers on first arch rudimentary or absent.

COMPARISONS.—*Mataeocephalus* appears superficially close to *Coelorrinchus* Giorna but is immediately distinguished from that genus by the branchiostegal ray count of 7 (6 in *Coelorrinchus*), the strongly serrated spinous ray in first dorsal fin (except in *M. adjustus* with serrations obsolete; cf. smooth or, rarely, with few distal teeth in *Coelorrinchus*), and the two-pronged terminal snout scute (one- or three-pronged in *Coelorrinchus*). The genus *Mataeocephalus* is closest to *Nezumia* but differs in: (1) anus closer to anal fin origin than to pelvic fin insertion (anus generally closer to pelvic fin insertion in *Nezumia*); (2) premaxillary and mandibular teeth in short, broad bands except in *M. adjustus* (cf. narrow tapering bands that extend posteriorly to rictus except in *N. burragei* (Gilbert, 1905)); (3) generally longer snout, and smaller, more inferior mouth; and (4) outer rakers of first arch rudimentary or absent (cf. tubercular rakers present in *Nezumia* species). Members of the genus are unlikely to be confused with any other macrourine grenadier with the combination of seven branchiostegal rays and periproct adjacent or close to anal fin origin because of their small, inferior mouth, much produced snout, and sharp, angular suborbital ridge.

REMARKS.—*Mataeocephalus* includes a small group of about five closely related species confined to the tropical waters of the Pacific and Indian oceans. The genus is not known from the Atlantic Ocean.

Mataeocephalus adjustus (Smith and Radcliffe, 1912) from the Philippines appears to be the most primitive member judged by the following characters: relatively large mouth that is not strongly U-shaped; dentition in both jaws extending posteriorly in a tapered band; head and snout not dorsoventrally depressed to the extent found in the other members; ventral surfaces of snout and suborbital regions completely scaled; terminal snout scute rather small; and periproct area relatively small. Most of these supposedly

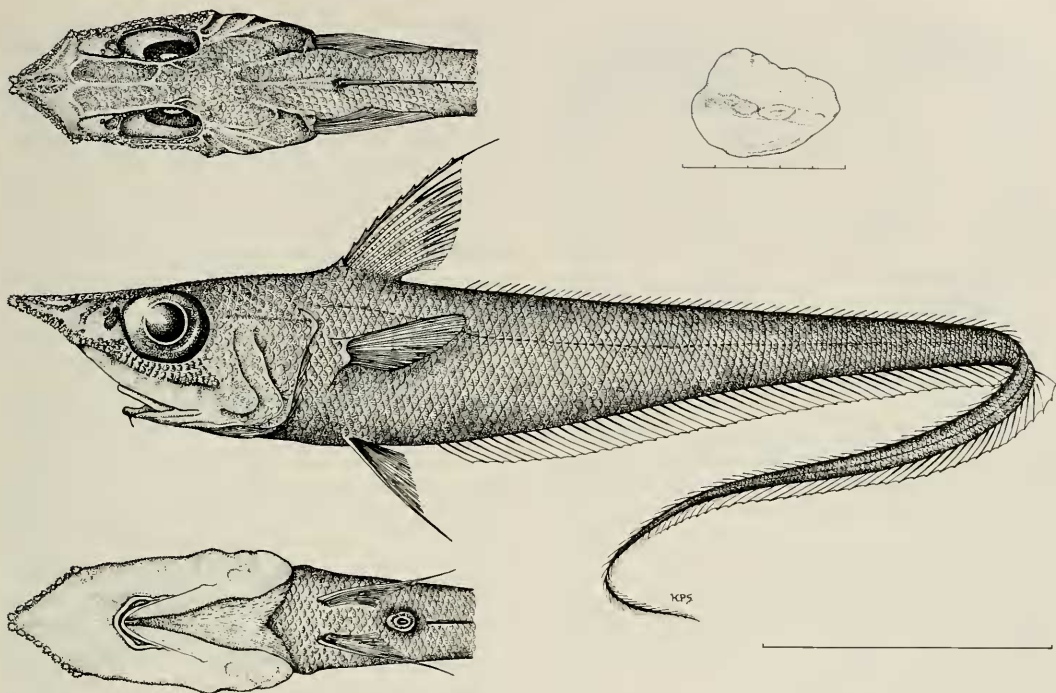


FIGURE 8. *Mataeocephalus tenuicauda* (Garman). Composite drawing from specimens catalogued AMNH 8451, 8467, and 8468, collected by the ARCTURUS, 96 km south of Cocos Island. Scale bar under otolith represents 5 mm; that under tail, 25 mm.

primitive features of *M. adjustus* cloud the otherwise strong differences between the genera *Mataeocephalus* and *Nezumia*, but viewing the group as a whole, and on the basis of the diagnosis given above, recognition of each as distinct genera seems justified.

Mataeocephalus tenuicauda (Garman)

(Figure 8)

Macrurus tenuicauda GARMAN, 1899:216-217, pl. 49, fig. 1 (original description; type-locality Gulf of Panama, 838 m, ALBATROSS sta. 3384).

Mataeocephalus tenuicauda: GILBERT AND HUBBS, 1916:146 (name only).

DIAGNOSIS.—A species of *Mataeocephalus* with 8 (9 in three fins of 18 specimens) pelvic fin rays; 22-26 pectoral fin rays. Chin barbel about 4-6 percent HL. Upper jaw 19-28 percent HL. No small naked fossa (anterior dermal window of light organ) anterior to periproct.

DESCRIPTION.—General features of fish seen in Figure 8. Head shallow, depressed; greatest width of head about equal to or more than greatest depth of head. Dorsal and ventral surfaces of head sharply demarcated by a strong ridge

running from snout tip posteriad to preopercle, but not connected to preopercular ridge. Mouth small, inferior, protrusible, U-shaped. Periproct region large, situated almost midway between origin of anal fin and insertion of pelvic fins, but slightly closer to former. No separate dermal window of light organ apparent in specimens examined. Swim bladder large, with two long, slender, uncoiled retia and two small, flattened gas glands. Males with large drumming muscles on each side of anterior end of swim bladder. Pyloric caeca simple, short, thick; 16 to 21 in five specimens. Intestine with two major loops, the first extending posterodorsally from pylorus, the second extending anteroventrally along dorsal wall of abdomen, passing anteriorly and sinistrally around front of stomach and caecal mass. Opercular openings restricted dorsally and ventrally; gill membranes broadly connected and attached to isthmus with no free posterior fold. A fleshy ridge on shoulder girdle along posterodorsal margin of gill cavity. Outer gill-rakers of first arch rudimentary, platelike, 3 or 4 in number.

Dorsal fin with thornlike spinous first ray

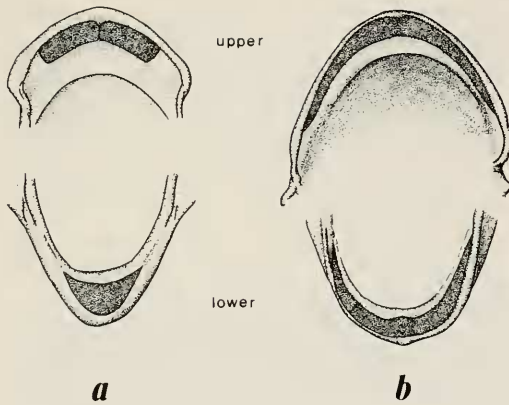


FIGURE 9. View of upper and lower jaws showing shape of tooth bands in (a) *Mataeocephalus tenuicauda* (Garman), specimen 48 mm HL and (b) *Nezumia latirostrata* (Garman), specimen 40.5 mm HL.

closely appressed to spinous second ray, the latter with widely spaced teeth along leading edge. Outer ray of pelvic fins prolonged, extending well beyond anal fin origin.

Scales on body with slender, conical spinules arranged in sharp, ridgelike rows. Scales on head variously developed; those on ridges more coarsely developed with spinule rows arranged in a stellate pattern in some and a broad posteriorly radiating pattern in others; those on top of head generally with low, longitudinal spinule rows that diverge slightly posteriorly. Ventral surfaces of head naked except for a small patch of scales at anteroventral corner of preopercle and along leading edge of snout where large, coarse, spinous, nonimbricate scales overlap slightly onto ventral surfaces. Tip of snout armed with two closely appressed, conical scutes. Suborbital region covered dorsally with two distinct rows of large, coarse, nonimbricate, strongly adherent scales. Supraorbital and supranarial ridges coarsely scaled. A prominent lunate naked groove dorsally along each side of anterior snout margin.

Premaxillary teeth in broad, short, cardiform bands truncated at posterior ends (Fig. 9a). Mandibular teeth in a broad, short band with tapered ends; tooth band falling well short of lateral corners of mouth.

Coloration in alcohol. All specimens examined have lost most of their body scales. Overall color brown to swarthy, often with a violet tinge on trunk and tail. Abdominal region blackish.

Naked ventral surfaces of head pale to dusky. Fins dusky to blackish. Oral, branchial, and peritoneal cavities blackish.

COUNTS (from 18 specimens unless otherwise indicated).—1D. 11.8–10; 1P. 22–26 (\bar{x} = 23.76); 2P. 8–9 (9 rays in 3 of 36 fins). Gill-rakers on first and second arch 0–1 + 6–7 (6–8 total; \bar{x} = 7.18); on second arch 0–1 + 5–7 (6–8 total; \bar{x} = 7.29). Scales below first dorsal 7–11 (6 specimens); below midbase of first dorsal $6\frac{1}{2}$ to 9 (6 specimens); below second dorsal $8\frac{1}{2}$ to 11 (9 specimens); over distance equal to predorsal length of head 37–48 (4 specimens).

MEASUREMENTS (from 18 specimens unless otherwise indicated).—Total length 131+ to 303 mm; head length 30.0–65.3 mm. The following in percent of head length: postrostral length of head 60–66 (\bar{x} = 61.8; S.D. = 1.56); snout length 36–42 (\bar{x} = 39.9; S.D. = 1.46); preoral length 35–43 (\bar{x} = 38.6; S.D. = 2.31); internasal width 19–22 (\bar{x} = 20.5; S.D. = 0.80); orbit diameter 26–30 (\bar{x} = 27.2; S.D. = 1.48); interorbital width 19–22 (\bar{x} = 20.3; S.D. = 0.93); postorbital length 29–36 (\bar{x} = 32.7; S.D. = 1.51); orbit to angle of preopercle 28–33 (\bar{x} = 30.0; S.D. = 1.25); suborbital width 13–16 (\bar{x} = 14.6; S.D. = 0.96); upper jaw length 19–28 (\bar{x} = 22.4; S.D. = 2.07); barbel length 3.7–5.7 (\bar{x} = 4.7; S.D. = 0.61); length outer gill slit 8.5–12.7 (\bar{x} = 10.4; S.D. = 1.08; n = 13); preanal length 122–138 (\bar{x} = 129.5); outer 2P. to A. 21–29 (\bar{x} = 25.9; S.D. = 2.16; n = 15); greatest body depth 42–56 (\bar{x} = 52.2; S.D. = 3.47; n = 14); 1D.–2D. interspace 19–29 (\bar{x} = 25.1); height 1D. 52–63 (\bar{x} = 58.5; n = 8); length 1P. 37–41 (\bar{x} = 38.7; n = 12); length 2P. 37–49 (\bar{x} = 43.2).

COMPARISONS AND RELATIONSHIPS.—*Mataeocephalus tenuicauda* closely resembles the Hawaiian endemic *M. acipenserinus* (Gilbert and Cramer, 1897) but differs in having a longer upper jaw (22–28 percent HL vs. about 19–21.5), a somewhat longer chin barbel (3.7–5.7 percent HL vs. 2.6–4.0), and in lacking a small naked fossa anterior to the periproct. *M. nigrescens* (Smith and Radcliffe, 1912) from the Philippines also closely resembles both *M. tenuicauda* and *M. acipenserinus*, and the three are considered as close allies by Gilbert and Hubbs (1920:564). My cursory examination of five paratypes of *M. nigrescens* (USNM 149310; 149311 [2 specimens]; 149312; 149313) revealed minimal differences between *nigrescens* and *tenuicauda*. Morphometric features of the two are indistin-

guishable. Scale-row counts, however, show notable separation; *nigrescens* specimens had about 7½ rows between the origin of the second dorsal fin and 5½ below the midbase of the first dorsal fin, whereas *tenuicauda* specimens had 8½ to 11 and 6½ to 9, respectively.

Mataeocephalus adjustus (Smith and Radcliffe, 1912) is readily distinguished from *tenuicauda*, *nigrescens*, and *acipenserinus* by the following characters: fewer pelvic rays (7 cf. 8 or 9), fewer pectoral rays (19 or fewer cf. 21–26), bands of teeth in both jaws extending posteriorly about to end of rictus. Because of the many features distinguishing *M. adjustus* on the one hand and *M. tenuicauda*, *M. nigrescens*, and *M. acipenserinus* on the other, a wide phylogenetic divergence between the two groups is suggested. The lack of specimens of *M. microstomus* (Regan, 1908) from the Indian Ocean and the paucity of information in the original description preclude an adequate comparison of this species with its congeners.

DISTRIBUTION.—Mainland Pacific coasts of Panama and Ecuador between latitudes 6°36'N and 3°15'S; in the Galápagos; and south of Cocos Island.

SIZE.—To at least 65 mm HL and 303 mm TL.

MATERIAL EXAMINED (55 specimens, 7 localities).—**Panama:** USNM 148879 (2, 57–59 mm HL, 202–253 mm TL), 6°36'N, 81°45'W, 581 fms (1,063 m), ALBATROSS sta. 4621, 21 Oct. 1904. **Ecuador:** CAS 38325 (1, 34 HL, 155 TL), 3°15'S, 80°55'W, 945–960 m, ANTON BRUUN cr. 18B, sta. 770 (field no. LWK66–120), 10 Sep. 1966. Cocos Island (60 miles [96 km] S of): AMNH 8451 (7, 35–64 HL), AMNH 8467 (6 specimens), AMNH 8468 (23 specimens), AMNH 8469 (5 specimens), AMNH 8470 (7 specimens), all from ARCTURUS sta. 74, May 1925. **Galápagos:** CAS-SU 25239 (1, 55 HL, 230 TL), 0°29'S, 89°54'30"W, 392 fms [717 m], ALBATROSS sta. 2818, 15 Apr. 1888.—USNM 135340 (1, 43 HL, 185+ TL), 0°36'30"S, 89°19'00"W, 634 fms [1,159 m], ALBATROSS sta. 2808, 4 Apr. 1888.—CAS 42075 (2, 30–31 HL, 158–131+ TL), 1°06'S, 89°22'W, 700–800 m, TE VEGA cr. 19, sta. 102, 12 Apr. 1968.

Paracetonus Marshall

Paracetonus MARSHALL, 1973:615 (type-species *Macrurus parvipipes* Smith and Radcliffe, 1912, by original designation).

DIAGNOSIS.—A macrourine grenadier with anus and urogenital openings within a broad, black periproct immediately preceding anal fin origin. Spinous ray of first dorsal fin with a serrated leading edge. Snout relatively high, broad; suborbital region relatively deep, without a strong spinous ridge. Scales flanking base of second dorsal fin not enlarged. (Adapted from Marshall 1973.)

REMARKS.—Marshall (1973:615) erected this genus to include *Macrurus flagellicauda* Koefoed, 1927, *M. parvipipes* Smith and Radcliffe, 1912, and *Lionurus cetonuroopsis* Gilbert and Hubbs, 1916—three species that are closely related to *Cetonurus* Günther, 1887, but which are distinguished by their somewhat less-inflated head and their lack of enlarged scales along the base of the second dorsal fin. The monotypic genus *Kumba* Marshall, 1973, is also closely related to *Paracetonus* but differs primarily in lacking serrations on the second spinous ray of the first dorsal fin.

I have included *Macrurus fragilis* Garman, 1899, in *Paracetonus* for reasons given in the description of that species. By doing so, the definition of the genus is expanded and its contrast with the genera *Cetonurus* and *Kumba* is lessened. I recognize, however, that a detailed study comparing features of *P. fragilis* and the three other species of the genus may necessitate a further rearrangement of the taxon, but the material available does not allow such a study at this time.

Paracetonus fragilis (Garman)

(Figure 10)

Macrurus fragilis GARMAN, 1899:203–204, pl. 46, fig. 1 (original description; ALBATROSS specimens from off Panama and Colombia, 3,058–3,334 m).

Lionurus (Lionurus) fragilis: GILBERT AND HUBBS 1916:146 (listed).

Sphagmacrurus fragilis: MARSHALL 1973:623 (listed).

DIAGNOSIS.—A species of *Paracetonus* with 8–9 pelvic rays. Nasal rostrum extremely fragile; head covering thin, almost membranous.

COUNTS.—1D. II, 6–9; 1P. 19–21; 2P. 8–9. Gill-rakers on inner side of first arch 1–2 + 8–10 (10–11 total); on inner side of second arch 1–2 + 8–9 (9–11 total).

MEASUREMENTS (from three specimens; most measurements are estimates).—Head length about 26–35 mm; total length 175+ to 200 mm. The following in percent of head length: snout length about 28–40; orbit diameter about 22–23; interorbital width 24–27; orbit to angle of preopercle 33–44; suborbital width 14–18; length upper jaw 31–39; length barbel 19–24; length outer gill-slit 17–20; greatest body depth 66–69.

DESCRIPTION.—Head moderately wide, trunk short, tail very long and straplike. Head bones thin, fragile, particularly nasal rostrum, which most often is bent to side giving appearance of

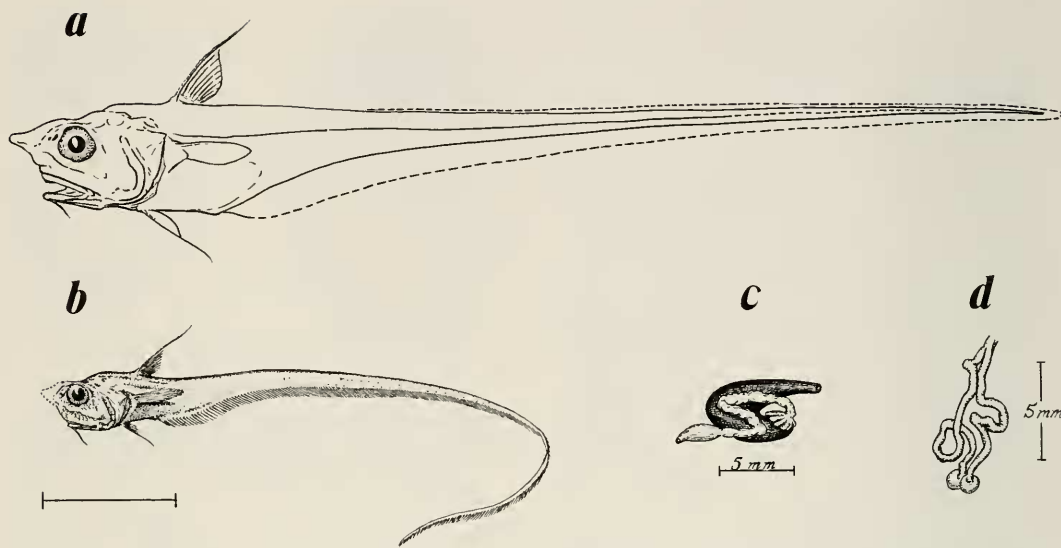


FIGURE 10. *Paracetonus fragilis* (Garman). (a) Diagrammatic reconstruction from paratype MCZ 28585 and UMML uncat. (b) SIO 55-265, snout reconstructed. (c) Stomach and intestines of UMML uncat. (d) Retia and gas glands of UMML uncat. Scale rule for a and b equals 25 mm.

blunt snout. Snout relatively high and wide. Interorbital region broad, width usually greater than diameter of orbit. Suborbital region deep, without a strongly angular ridge. Mouth moderately large, upper jaws extend to vertical through hind margin of orbits or slightly beyond. Barbel moderately long, slender, length equal to or slightly greater than length outer gill-slit. Gill openings extend forward to below posterior third of orbit. Gill membranes little restricted (probably with a moderate free fold posteriorly over isthmus). Gill-rakers tubercular, gill lamellae short. Pyloric caeca short, thick, 10–15 in UMML specimen. Intestine short, only two loops from pyloric caeca to anus. Esophagus and caecal portion of stomach black; pyloric portion of stomach grayish brown. Rectum black, remainder of intestine and pyloric caeca pallid. Retia long, well developed, 2; gas glands 2.

First dorsal fin short, base low; second spinous ray weakly serrated and produced beyond segmented rays. Second dorsal fin rudimentary, originating posterior to vertical through origin of anal fin. Pectoral and pelvic fins small; the latter far forward, origin below preopercle angle, with outer ray slightly produced and extended past origin of anal fin.

Snout and probably most of anterior and ven-

tral parts of head naked and covered with thin black integument. (I could find no scale pockets on the head of specimens I examined, but Garman's (1899:pl. 46, fig. 1) figure suggests that there are some over the gill covers.) Garman (1899:204) describes the scales as "small, thin, deciduous, with concentric striae; five scales in a row from the lateral line to the base of the first dorsal or thirty-one in a series from this dorsal to the anal." Garman's figure of a scale shows a single point on the posterior edge, but an otherwise spinuleless exposed field.

Teeth short, slender, sharp, in roughly two rows in premaxillae, in narrow band in mandibles; no enlarged series.

Coloration in alcohol. Head and abdominal region black, remainder of body brownish. Oral, branchial, and peritoneal cavities black. Gill arches and rakers blackish but lamellae pallid.

DISTRIBUTION.—The species is known only from the tropical eastern Pacific where it is found in waters of considerable depths. Specimens were obtained in three trawls fished on bottom in 3,058–3,334 m, and a single specimen was taken in an open midwater trawl fished to a depth of 1,335 m.

COMPARISONS AND REMARKS.—As the name implies, members of this species are extremely fragile. The few specimens available for exami-

nation were in such poor condition that an adequate description and illustration could not be prepared. The thin, flexible rostrum is often damaged and folded to the side (as is the rostrum on the specimen illustrated by Garman 1899:pl. 46, fig. 1), but when intact, the rostrum is moderately long and pointed. The fragile head, and particularly the rostrum, is highly reminiscent of the condition obtaining in specimens of *Hymnocephalus*, but members of that genus and *P. fragilis* differ in many other fundamental features. The small adult size of *P. fragilis* is indicated by the ripe condition of a 200-mm-TL female paratype (MCZ 28585), whose ovaries contained eggs as large as 1.3 mm in diameter.

This species is quite unusual and may represent a genus distinct from *Paracetonurus*, but it is placed in that taxon out of convenience, because an adequate study comparing it with other related forms could not be made. It differs from other members of *Paracetonurus* in having a less inflated head; thin, membranous, and mostly naked head covering (cf. moderately thick, completely scaled head covering); more pelvic fin rays (8–9 cf. 6–7); and a larger mouth (upper jaw extends posteriad to below hind third of orbits, cf. below middle third of orbits). The species is also fairly close to members of the genus *Sphagemacrurus* Fowler (in which Marshall (1973) has placed the species), but it differs in lacking a strong spinous suborbital ridge, a high first dorsal fin base, and a short blunt snout—all characteristic of *Sphagemacrurus*. The origin of the vent is also more anteriorly placed in species of *Sphagemacrurus* (below anterior third of first dorsal fin compared with below hind edge of first dorsal fin in *P. fragilis*).

MATERIAL EXAMINED (7 specimens, 4 localities).—**Panama:** MCZ 28586 (holotype, about 230 mm TL); 6°17'N, 82°05'W, 3,058 m, beam trawl, ALBATROSS sta. 3360, 24 Feb. 1890. —UMML uncat. (1, about 26 HL, 175+ TL); 6°53'N, 79°27'W, 3,193 m, R/V PILLSBURY sta. 526, 5 May 1967. **Colombia:** MCZ 28585 (3 paratypes, about 29–35 HL, 190+ to 200 TL) and USNM 57857 (1, est. 26 HL, est. 175 TL); 2°35'N, 83°53'W, 3,334 m, beam trawl, ALBATROSS sta. 3374, 3 Mar. 1890. **Eastern Pacific:** SIO 55–265 (1, 117 TL); 00°02'S, 100°23'W, 0–1,335 m, 3-m midwater trawl, R/V HORIZON sta. ET(b)-H-65.

Malacocephalus Günther

Malacocephalus GÜNTHER, 1862:396 (as subgenus of *Macrurus*) (type-species *Macrurus laevis* Lowe, 1843, by monotypy).

DIAGNOSIS.—A macrourine grenadier with

anus remote from anal fin and closer to pelvic fins; periproct large. Two large dermal windows of light organ, the anterior one in a bean-shaped depression situated between bases of pelvic fins, the posterior one in a shallow circular depression close before the anus. Teeth large, widely spaced, in single row in lower jaw; usually larger posteriorly. Teeth in upper jaw in two rows or in narrow band; outer series distinctly spaced and enlarged. Pyloric caeca numerous (50–100 or more), multiply branched. Lowermost three or four branchiostegal rays scaled. Mouth large, upper jaw usually more than 45 percent of head length. No strongly developed scutelike scales on head ridges.

REMARKS.—*Malacocephalus* comprises a close-knit group of about six species, one of which is undescribed (see Iwamoto 1970:410). Relationships of the genus lie closest to *Ventrifossa* Gilbert and Hubbs, 1920, a taxon represented in the eastern Pacific by a single member (of the subgenus *Lucigadus*), although the genus is common in most other warm-water areas. Members of the genus *Malacocephalus* are confined to upper-slope waters of tropical and warm-temperate regions. Three of the six species (*laevis* (Lowe, 1843), *nipponensis* Gilbert and Hubbs, 1916, and *hawaiiensis* Gilbert, 1905) are closely related and may eventually prove to represent one widely distributed species. Okamura (1970a:69) has, in fact, synonymized *M. nipponensis* with *M. laevis*.

Malacocephalus laevis (Lowe)

(Figure 11)

Macrurus laevis LOWE, 1843:92 (original description; off Madeira).

Malacocephalus laevis: GÜNTHER 1862:397–398. —HUBBS, FOLLETT, AND DEMPSTER 1979:14 (list; first record from eastern Pacific).

Macrurus (Malacocephalus) laevis: GÜNTHER 1887:148, pl. 38, fig. b. See Marshall 1973:653 for extensive synonymy. *Malacocephalus* sp.: HUBBS AND IWAMOTO 1977:243 (1 spec. from California).

DIAGNOSIS.—A species of *Malacocephalus* with spinous second ray of first dorsal fin smooth; teeth in upper jaw in two distinct rows; pectoral fin rays 19–20; upper jaw less than 50 percent of head length.

DESCRIPTION OF EASTERN PACIFIC SPECIMEN.—General features of fish seen in Figure 11. Head compressed and deep. Ridges not sharp or coarsely scaled; head contours smoothly rounded. Snout narrow, pointed (in somewhat

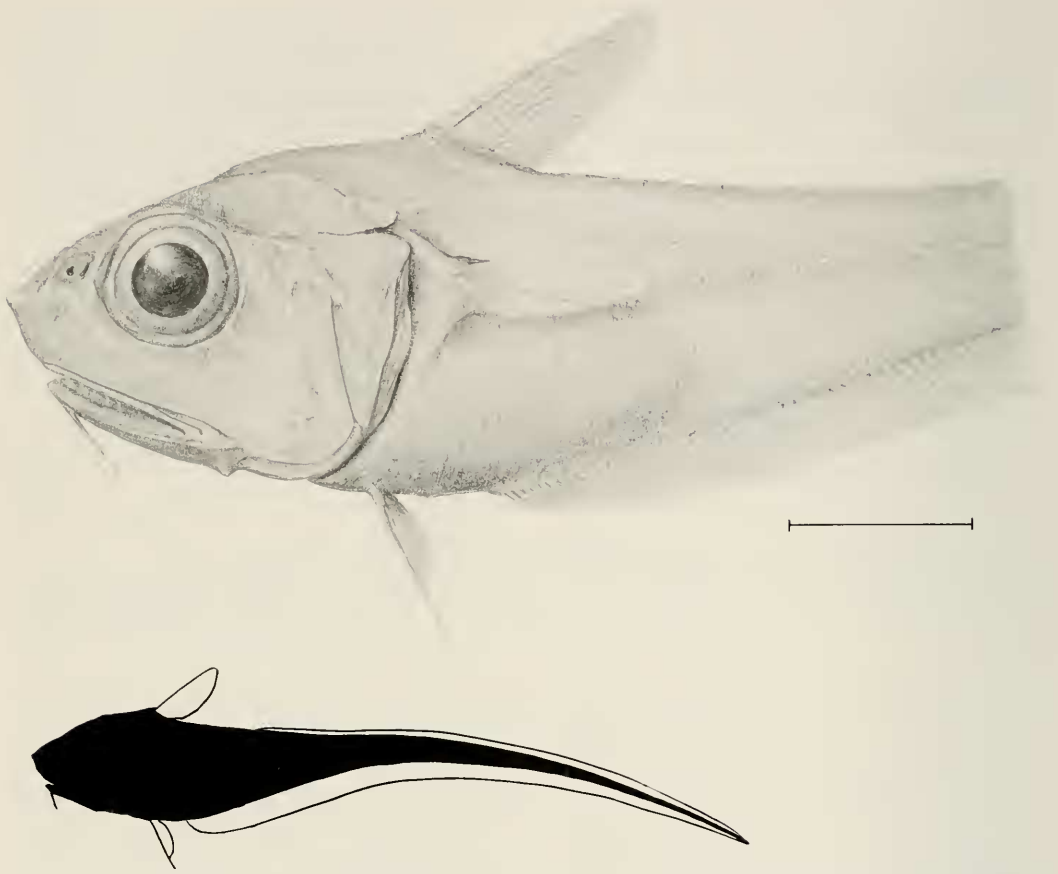


FIGURE 11. *Malacocephalus laevis* (Lowe). SIO 79-344, 58 mm HL, from off Santa Barbara County, California, in 229 m.

shriveled eastern Pacific specimen; probably rounded in life). Gill openings wide, extending anteroventrally to below hind margin of orbit. Gill membranes loosely connected to isthmus with a posterior free fold. Interopercle broadly exposed and scaled ventrally. Periproct region large, long-ovate, anus and urogenital opening at broader posterior end of region; anterior dermal window of light organ in deep, lunate to bean-shaped fossa between bases of pelvic fins and separated from periproct by a broad isthmus of scales. Several partially digested euphausiids in stomach. Pyloric caeca fragile, thin, branched, difficult to count, but more than 50 terminal digits.

Scales uniformly small and finely spinulated. Snout and suborbital region completely scaled, without prominent naked areas. Coarse, scute-like scales completely absent; ridges of head all

smoothly rounded. Lower jaw uniformly scaled. Lowermost branchiostegal rays scaled; gular membrane apparently without scales (but scales here normally highly deciduous and may have been present in life).

Color gray-brown overall; violet over abdominal region, shoulder girdle, and opercle; and blackish over chest, on branchiostegal membrane, and on gular region (violet regions probably not as prominent in undenuded and fresh specimens). Peritoneum brownish black. Oral valves and lower lips peppered with melanophores, remainder of oral cavity pale. First dorsal fin, pectoral fin, pelvic fin, and anterior portion of anal fin brownish black; second dorsal fin and most of anal fin pale or dusky.

COUNTS.—1D. 11,11; 1P. 20/19; 2P. 9/8. Gill-rakers on first arch 3 + 9; on second arch 3 + 7. Scales below first dorsal approximately 16.

MEASUREMENTS.—Total length 335 mm; head length 58 mm. The following in percent of head length: postrostral length of head 78; snout length 26; preoral length 17; internasal width 17.5; orbit diameter 36; interorbital width 27; postorbital length of head 41; distance orbit to angle of preopercle 43; suborbital width 12; upper jaw length 48; barbel length 17; length first gill-slit 26; preanal length 123; outer pelvic ray to anal origin 28; anus to anal origin 17; greatest body depth 85; interspace between 1D. and 2D. 48.

COMPARISONS AND RELATIONSHIPS.—I have tentatively identified this single eastern Pacific specimen of *Malacocephalus* as *M. laevis*. All morphometric and meristic characters examined fell within the range of variation enumerated in a previous paper (Iwamoto 1970) for specimens I examined from the Atlantic Ocean. However, the snout length and interorbital width in the Pacific specimen were at the lower limits of the range for these characters in Atlantic specimens, and the orbit diameter was at the upper limit. Close comparison of the eastern Pacific specimen with others from the Atlantic Ocean showed only one difference—scales were absent on the gular membrane whereas most Atlantic specimens had a small patch of scales there. The deciduous nature of the scales in this area, however, may account for their absence in the somewhat denuded eastern Pacific specimen. Comparison of SIO 79-344 with specimens of *M. hawaiiensis* (USNM 51618, holotype; CAS-SU 8522, 3 paratypes) showed slightly lower values in relative snout length (26 percent head length cf. 28–29), preoral length (17 cf. 19–21), internasal width (17.5 cf. 21–25), interorbital width (27 cf. 31–35), length snout to anus (111 cf. 117–120), and 1D.–2D. interspace (48 cf. 57–75). Similar comparison of proportional measurements with specimens of *M. nipponensis* (FAKU 13316, 13318, 13321, and 13878) showed lower values in the eastern Pacific specimen in snout length (26 percent HL cf. 28–31), preoral length (17 cf. 20–21), interorbital width (27 cf. 30–35), and barbel length (17 cf. 21–24), but a greater value for the orbit diameter (36 cf. 29–34). The gill-raker count of 12 was also slightly higher than the 10–11 of the *M. nipponensis* specimens. Whether or not these slight differences are meaningful in delimiting species is as yet conjectural. Adequate series of each population should be compared before definitive

statements are made regarding the number of valid species in the genus. Until then it seems wisest to retain the established names.

REMARKS.—*Malacocephalus laevis* is listed by Hubbs, Follett, and Dempster (1979:14) in their "List of the fishes of California" on the basis of the present specimen. Mr. Eiichi Fujii has informed me (in litt., 6 Mar. 1979) of having collected specimens of the species from seamounts off the coast of Baja California while aboard the KAIYO MARU in January and February of 1979.

MATERIAL EXAMINED.—SIO 79-344 (1, 57.8 mm HL, 335 mm TL), California, Santa Barbara County, between Gavioia and Point Conception, 229 m, otter trawl, 10 Dec. 1968.

Ventrifossa Gilbert and Hubbs

Ventrifossa GILBERT AND HUBBS, 1920:553 (type-species *Corphyphaenoides garmani* Jordan and Gilbert, 1904, by original designation).

DIAGNOSIS.—A genus of macrourine grenadier with anus removed from anal fin origin and closer to pelvic fin insertion; anus situated posteriorly in an oval-shaped area of naked black skin (the periproct) that extends forward to a small fossa (anterior dermal window) between pelvic fin bases. An often-inconspicuous lenslike posterior dermal window in front of anus. Second spinous ray of first dorsal fin slightly produced and finely toothed along leading edge (except in *V. atherodon*). Jaw teeth small, in narrow to moderately broad bands in upper jaw, outer series slightly enlarged in most species; lower-jaw teeth small, none enlarged, in one to several irregular series laterally. Branchiostegal membranes naked (in subgenus *Ventrifossa*) or usually with patches of scales (in subgenus *Lucigadus*) along exposed lowermost branchiostegal rays. No sharp, coarsely scaled, angular ridges on head; suborbital region with flat to gently rounded contours—scales here not modified to form stout shelves or ridges (as in *Nezumia*). Snout angular to rounded in profile, either without a spiny terminal scute or with a small unilateral one; supranarial ridge without modified scutelike scales; lateral angles of snout without spinous tubercular scale at tip. Body and head scales generally small, densely covered with fine, slender, conical or shield-shaped spinules.

REMARKS.—*Ventrifossa* as here diagnosed comprises three major groups which I treat as subgenera: *Ventrifossa*, *Lucigadus*, and *Soko-*

dara (new). In describing *Ventrifossa*, Gilbert and Hubbs (1920:543) recognized four subgenera, three of which were monotypic: *Atherodus* (with *Optonurus atherodon* Gilbert and Cramer, 1897), *Lucigadella* (with *Macrourus nigromarginatus* Smith and Radcliffe, 1912), and *Lugigadus* (with *Macrourus lucifer* Smith and Radcliffe, 1912). *Atherodus* was distinguished from the other subgenera on the basis of dentition (teeth of lower jaw in two series, arrowhead-shaped canines on upper jaw), scale spinules (few and short), orbit size (3 in head), and dorsal spine (without denticulations). My studies of the genus have shown that all but the last character are nondiagnostic for the subgenus in that the character states are shared with other members of the genus, or that they are part of a graduated character spectrum within the genus. The absence of denticulations on the dorsal spine appears to be the sole character distinguishing *V. atherodon* from other members of the genus. The sister-group relationship of *V. atherodon* and *V. ctenomelas* (Gilbert and Cramer, 1897) is strongly suggested in other shared specializations and in the common occurrence of the two species in the Hawaiian Islands, where *V. atherodon* is apparently endemic (*V. ctenomelas* is also found in the western Pacific).

Characters that Gilbert and Hubbs (1920) used to separate *V. lucifer* into a distinct subgenus, *Lucigadus*, include the ventral light organ ("a conspicuous pearly body in a sheath"), mouth angle ("highly oblique"), and spinules on scales ("in quincunx order"). My reexamination of the type-specimens of *V. lucifer* has shown that the "sheath" in which the "pearly body" lies is an artifact of preservation, the "sheath" having formed by the ripping midventrally of the thin abdominal wall below the light organ. The pearly color of the organ is from the reflective layer surrounding the organ. The light organ in *V. lucifer* is not notably different from that of other closely related members of the genus, including *V. nigromarginata*. The arrangement of spinules on the scales appears to show no meaningful relationships in this genus nor in the closely related *Nezumia*—the character is useful, however, at the species level. The notably oblique mouth of *V. lucifer* represents one extreme in a graded series that includes—from mouth little oblique to mouth notably oblique—*Macrourus nigromarginatus*, *Macrurus fasciatus* Weber,

1913, *Macruropus ori* Smith, 1968, *Macrourus nigromaculatus* McCulloch, 1907, and *Macrourus lucifer*. I consider these five species as representatives of the subgenus *Lucigadus* Gilbert and Hubbs.

The subgenera of *Ventrifossa* as I recognize them can be characterized in the following manner:

Subgenus *Ventrifossa* Gilbert and Hubbs, 1920:553 (type-species *Coryphaeuoides garmani* Jordan and Gilbert, 1904).

1. Mandibular teeth in one to three irregular series laterally.
2. Premaxillary teeth in a narrow band with outer series slightly to prominently enlarged; tooth band extends posteriad beyond maxillary process.
3. Mouth slightly oblique, moderate to large, upper jaw length 42–53 percent head length.
4. Tip of snout with a blackish spot, or entire leading edge black.
5. Branchiostegal and gular membranes completely naked.
6. Gill-rakers 13–20 total on inner series of outer (first) arch.
7. Pores of cephalic lateral line system small and inconspicuous.
8. Pyloric caeca numerous, 40–70 in distal count, usually branched near base.
9. Snout without spinous tubercular scute at tip.
10. Abdominal vertebrae 11–12.
11. Ventral aspects of body not appearing to have shifted notably forward.
12. Infraorbital shelf not exceedingly narrow anteriorly.

Included species: *V. atherodon* (Gilbert and Cramer, 1897), *V. ctenomelas* (Gilbert and Cramer, 1897), *V. divergens* Gilbert and Hubbs, 1920, *V. garmani* (Jordan and Gilbert, 1904), *V. macropogon* Marshall, 1973, *V. mucocephalus* Marshall, 1973, *V. petersonii* Alcock, 1891, and one or two undescribed species (specimens in the CAS collection).

Subgenus *Lucigadus* Gilbert and Hubbs (type-species *Macrourus lucifer* Smith and Radcliffe, 1912).

1. Mandibular teeth in several irregular series laterally or in a narrow to moderately wide band.

2. Premaxillary teeth in a narrow to moderately wide band with outer series slightly enlarged; teeth not present posteriorly of hind margin of maxillary process.
3. Mouth slightly to greatly oblique, moderate in size, 33–45 percent HL.
4. Tip and leading edge of snout without distinct pigmentation.
5. Lowermost of branchiostegal rays scaled.
6. Gill-rakers 7–16 total on inner series of outer (first) arch.
7. Pores of cephalic lateral line system prominent in most species.
8. Pyloric caeca 30–55, generally unbranched.
9. Snout tip without stout, spinous, scutellate scale.
10. Abdominal vertebrae 10–11.
11. Ventral aspects of body appearing to have migrated far forward resulting in anal origin below first dorsal; pelvic origin below operculum; gill membranes united below orbits; snout high, rounded; base of first dorsal high.
12. Infraorbital shelf not especially narrow anteriorly.

Included species: *V. fasciata* (Weber and de Beaufort, 1929), *V. lucifer* (Smith and Radcliffe, 1912), *V. nigromarginata* (Smith and Radcliffe, 1912), *V. nigromaculata* (McCulloch, 1907), and *V. ori* (Smith, 1968).

Subgenus *Sokodara* Iwamoto, new subgenus (type-species *Coryphaenoides misakius* Jordan and Gilbert, 1904).

1. Mandibular teeth in a narrow band of two to three irregular series laterally.
2. Premaxillary teeth in a narrow band; outer series scarcely enlarged.
3. Mouth slightly oblique, large, 35–42 percent head length.
4. Tip of snout blackish.
5. Branchiostegal and gular membranes completely naked.
6. Gill-rakers 14–16 total on inner series of outer (first) arch.
7. Pores of cephalic lateral line system small and inconspicuous.
8. Pyloric caeca 54–65 in distal count, branched near base.
9. Snout with a small, unilateral, spinous scute at tip.
10. Abdominal vertebrae 14.

11. Ventral aspects of body not appearing to have shifted notably forward.
12. Infraorbital shelf greatly narrowed anteriorly.

Included species: *V. misakia* and one or two undescribed species (specimens in CAS and USNM collections).

DISTRIBUTION.—The genus *Ventrifossa* is represented in the eastern Pacific by one wide-ranging, Southern Hemisphere species, *V. (Lucigadus) nigromaculata*. That representatives of the more diverse subgenus *Ventrifossa* are entirely absent from this region forms a striking parallel with a similar situation in the eastern Atlantic, where the genus is entirely unknown (except off Cape Point, South Africa)—this despite the presence in the western Atlantic of two species of subgenus *Ventrifossa* (*V. macropogon* and *V. mucocephalus*) and one of subgenus *Lucigadus* (species cf. *V. ori*). *Ventrifossa* is known in most other warm-water regions of the Pacific and Indian oceans.

Ventrifossa nigromaculata (McCulloch)

(Figures 12a, 18d)

Macrourus nigromaculatus McCULLOCH, 1907:346–348, pl. 63, figs. 1, 1a (original description; holotype and 4 paratypes; 56 km E of Sydney, Australia, in 1,463 m).

Lionurus nigromaculatus: McCULLOCH 1919:32 (listed), pl. 11, fig. 114a.

?*Macruroplus nigromaculatus*: SMITH 1949: 135 (brief description; southern Africa).

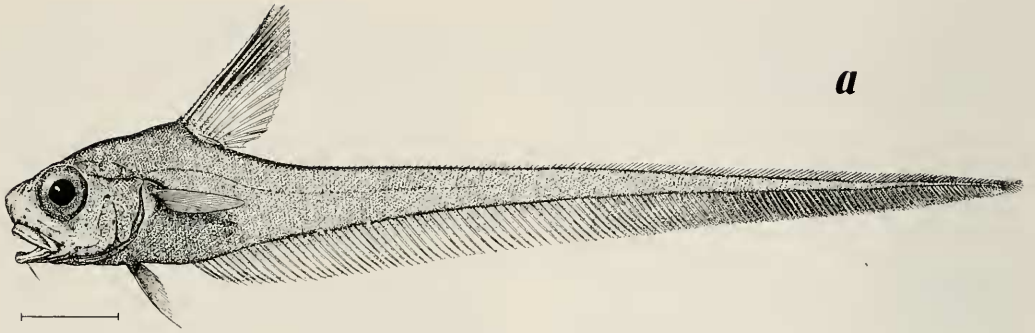
Nezumia nigromaculata: MAKUSHOK 1967:207 (name).

Macruroplus potronus Pequeño, 1971:290–291, fig. 15 (original description; holotype only, off Chile, 34°58'S, 72°36'W, in 200 m).

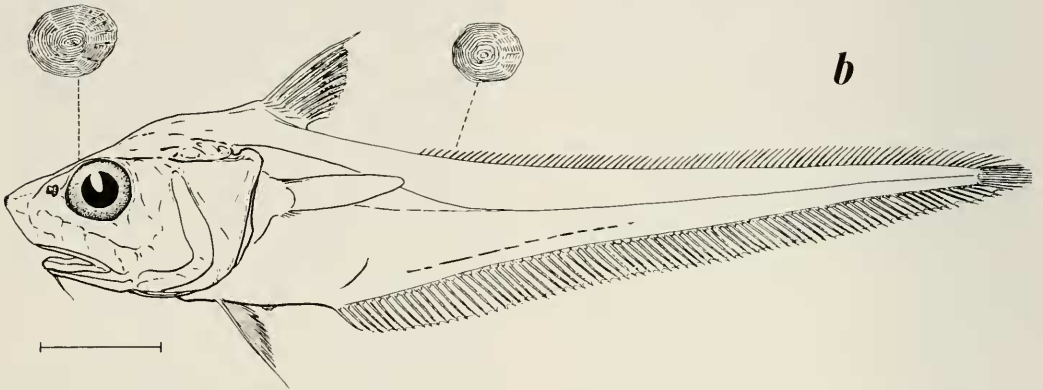
DIAGNOSIS.—A species of *Ventrifossa*, subgenus *Lucigadus*, with 13–15 pelvic fin rays. Total gill-rakers on first arch 12–16; on second arch 12–14. Upper jaw length 39–45 percent HL. Scales below first dorsal fin about 16–20; below second dorsal fin 10–12. First dorsal fin with a prominent black blotch.

DESCRIPTION.—General features of the fish are best seen in Figure 12a. Gill membranes unite across isthmus at a point below middle of orbits and slightly ahead of posterior end of maxillae. Head ridges virtually nonexistent; all surfaces smoothly rounded; suborbital region almost flat. Pores on head well developed but not especially prominent.

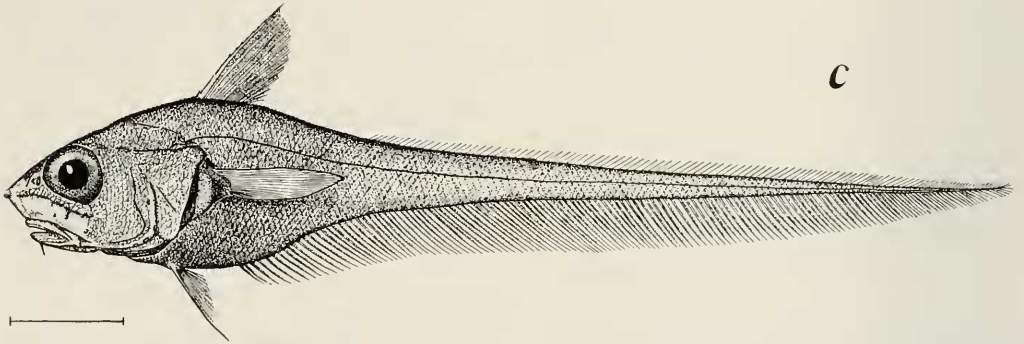
Pyloric caeca well developed, numerous, rather large; unbranched except at very base.



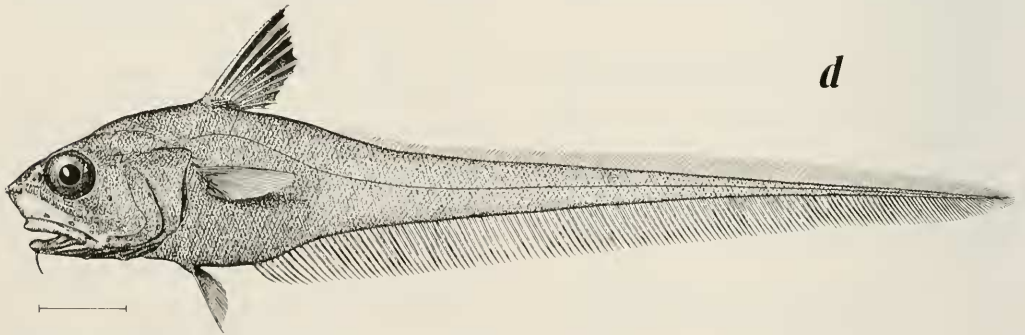
a



b



c



d

Configuration of intestinal tract a rather simple 'S' pattern. Gas glands a flattened kidney shape; mesial surfaces of the two glands closely abutting; retia attached mesially at about middle of each gland. Retia slender, short, uncoiled.

Spinules on body scales very small, slender, conical, greatly reclined, and arranged in more or less parallel horizontal rows in middle part of vertically elongate exposed field. Spinule rows number 11–12 on larger scales of CAS specimens. Scales present on lowermost three or four branchiostegal rays and also densely cover exposed ventral surfaces of interopercle.

Anterior dermal window of light organ large, situated between pelvic fin bases, and connected to periproct by isthmus of naked black skin. Posterior dermal window relatively prominent in most specimens examined, discernible as a discrete translucent area lying immediately anterior of anus and occupying most of anterior portion of periproct.

Fins well developed. First dorsal fin large; height about equal to or greater than length of head. Anal fin high along almost entire length. Pelvic fins broad but not especially long; outer ray slightly produced, extending slightly beyond anal fin origin.

Coloration in alcohol. Ground color tawny to grayish. Trunk region with violet tinge becoming bluish over abdomen and blackish around periproct and pelvic fins. First dorsal fin with a prominent black blotch on distal one-half to two-thirds; blotch not extending to margin of fin. Anal rays lightly punctate anteriorly and blackish along distal margins. Median fins blackish posteriorly towards tail tip. Pelvic fins blackish or covered with bold punctations. Gill covers and gill membranes blackish or densely punctate. Oral cavity generally pale with few scattered small areas blackish or densely punctate. Outer wall of gill cavity black along first gill-slit and around outer margins, but pale otherwise. Gill-rakers and gill-arches blackish, but gill filaments pale. Lips dusky to somewhat blackish.

COUNTS (from 13 specimens).—1D. 11,10–11;

1P. 19–23; 2P. 13–15 (one specimen with 12 on left fin, 13 on right fin). Total gill-rakers on first arch 12–16; on second arch 12–14. Scales below first dorsal about 16–20; below second dorsal 10–12; over distance equal to predorsal length 42–45. Pyloric caeca 30, 32, and about 57 in three specimens.

MEASUREMENTS.—Twelve specimens examined ranged 17–50 mm HL; 94+ to 339 mm TL. The following are in percent of head length: postrostral length 73–81 (\bar{x} = 77.2; S.D. = 2.57); snout length 25–30 (\bar{x} = 28.1; S.D. = 1.55); ventral length of snout 18–22 (\bar{x} = 19.1; S.D. = 1.38); orbit diameter 40–47 (\bar{x} = 42.9; S.D. = 2.71); interorbital width 20–26 (\bar{x} = 22.1; S.D. = 2.07); suborbital width 12–18 (\bar{x} = 15.7; S.D. = 2.14); length upper jaw 39–45 (\bar{x} = 41.2; S.D. = 1.80); length barbel 18–26 (usually 20–26); length outer gill-slit 23–30 (\bar{x} = 26.0; S.D. = 1.68); preanal length 140–158; outer pelvic ray to anal origin 41–54; anus to anal origin 20–30; greatest body depth 92–112 (usually over 100); depth over anal origin 75–105; 1D.–2D. interspace 32–58; height 1D. 101–134; length 1P. 63–73; length 2P. 44–58.

REMARKS.—*Macruropus potronus* Pequeño, 1971, was described from a single specimen taken off Chile in 200 m. The specimen was examined and photographed by Dr. William N. Eschmeyer in 1974. Examination of his photographs and the original description leaves no doubt as to the conspecificity of that specimen with those I have examined from the eastern Pacific and called *Ventrifossa nigromaculata*. Should these eastern Pacific specimens prove distinct from western Pacific specimens now referred to this species, the name *potronus* remains available.

Ventrifossa nigromaculata is a distinctive species widely distributed in temperate waters of the South Pacific. Although considerable variation was found in several characters in the specimens examined, the material available did not suggest a difference in populations from opposite sides of the Pacific. Atlantic Ocean spec-

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FIGURE 12. (a) *Ventrifossa nigromaculata* (McCulloch). Specimen CAS 41668, 35 mm HL, from off Chile in 750 m. (b) *Nezumia liolepis* (Gilbert), CAS-SU 21402, 55 mm HL, from off Santa Cruz Island, California in 1,397–1,629 m. Enlarged views of scales from interorbital region and region just below anterior end of second dorsal fin. (c) *Nezumia pulchella* (Pequeño), CAS 28763, 46 mm HL, from off Peru in 272 m. (d) *Nezumia stelgidolepis* (Gilbert), CAS 33109, 56 mm HL, off Pescadero Point, California, in 439 m.

imens previously referred to this species are apparently distinct and may represent an undescribed species.

DISTRIBUTION.—Australia, New Zealand, and Chile, in 230–1,463 m.

SIZE.—To about 50 mm in head length and about 340 mm total length.

MATERIAL EXAMINED (13 specimens, 8 localities).—**Chile:** USNM uncat. (2, 20–35 mm HL, 140–246 mm TL), NW of Valparaíso, ca. 400 m; M/V RUIZ I; 11 Feb. 1966. —CAS 41669 (1, 33 HL, 240 TL), 32°08.5'S, 71°43'W, 960 m, ANTON BRUUN cr. 18A, sta. 703 (field no. LWK66–47), 12 Aug. 1966. —CAS 41668 (1, 35 HL, 262 TL), 34°06.5'S, 72°18.5'W, 750 m, ANTON BRUUN cr. 18A, sta. 687 (field no. LWK66–25), 5 Aug. 1966.

New Zealand: BMNH 87.12.7.118 (1, 17 HL, 94+ TL), CHALLENGER sta. 166, 275 fms (503 m). —LACM 11336-3 (1, 38 HL, 280 TL), 41°35'S, 175°00'E, 256–490 m, ELTANIN sta. 1848, 19–20 Dec. 1961. —LACM 10968–12 (5, 25–37 HL, 192–283 TL), 44°00'S, 178°06'W, 230–421 m, ELTANIN sta. 1398, 29 Nov. 1964. —FAKU 42147 (1, 41 HL, 300 TL), KAIYO MARU sta. 29, July 1968. —FSFRL B3052 (1, 50 HL, 339 TL), 44°20.5'S, 179°17.5'W, 750 m, KAIYO MARU sta. 33, 15 July 1968.

Nezumia Jordan

Nezumia JORDAN, 1904, in Jordan and Starks: 620 (type-species *Nezumia condylura* Jordan and Gilbert, 1904, by original designation).

?*Macruroplus* BLEEKER, 1874:369 (type-species *Macrouirus serratus* Lowe, 1843, by monotypy) (nomen nudum; see Poll 1953:238).

Lionurus: auct. (non Günther, 1887).

DIAGNOSIS.—A macrourine grenadier with anus removed from anal fin origin (closer to pelvic fin insertion in most species) and situated in an oval-shaped area of naked black skin (the periproct). A small fossa (anterior dermal window of ventral light organ), round to teardrop shaped, forming anterior point of periproct in most species, detached from periproct in some species. Teeth small, in narrow to broad bands in both jaws; outer series of teeth in upper jaw of most species uniformly spaced and slightly enlarged. Teeth on premaxillary bone do not arise posteriad of maxillary process. Mouth moderate to small, upper jaw length less than 40 percent of head length in most species. Snout pointed or bluntly rounded, with stout, spiny, tuberclelike scales at tip and lateral angles, prominent in almost all species. Barbel present. Suborbital shelf covered with two (in most species) or more rows of stout, deeply embedded (except in *N. liolepis*), nonimbricate, spinous scales; these scales form a prominent edge or crest that runs longitudinally from lateral an-

gle of snout to preopercle bone and divides suborbital region into upper and lower halves. Body scales covered with needlelike to shield-shaped spinules (spinules almost obsolescent in *N. liolepis*). Snout and suborbital areas with some naked areas along ventral margins in most species, almost entirely naked ventrally in these areas in several species. Total gill-raker number on mesial side of outer (first) arch less than 12 in all but a few species. Color various shades of black, brown, blue, or violet; some species with last two colors have silvery reflections on body. Pyloric caeca unbranched and fewer than 30 in distal count in most species, as many as 60 in the few species with branched caeca. Retia two (occasional individuals may have four), slender, uncoiled; gas glands globular, sometimes somewhat flattened.

REMARKS.—The genus *Nezumia* is a diverse group of slightly more than 40 species of which ten are known and confined to the eastern Pacific. Most of these ten species have restricted distributions, but *N. stelgidolepis* is known from southern Peru to southern British Columbia, and *N. convergens* is common in waters from northern Peru to Costa Rica and is here recorded from the Islas Tres María and the Gulf of California. The distribution of six species (*latirostrata*, *liolepis*, *orbitalis*, *parini*, *pudens*, *pulchella*) each spans fewer than 30 degrees of latitude. *N. loricata* is known only from isolated captures in the Galápagos and off central Chile.

Although most other genera are poorly represented in the eastern Pacific, the region has proved rich in *Nezumia* species. The ten species here recorded rank the fauna among the largest found in broadly comparable geographical areas. Based on my examination of specimens and from the literature, a breakdown of the number of *Nezumia* species by area is as follows:

Eastern Pacific—10 spp.

Atlantic—14 spp.

Eastern—10 spp.

Western—9 spp.

Japan (8) + Philippines (4)—10 spp.

Hawaii—7 spp.

Western Indian Ocean—?4 spp.

Central Indian Ocean—?4 spp.

The few species recorded from the Philippines is surprising, as the area is otherwise exceedingly rich in grenadier species, especially of the genus *Coelorinchus*. Despite the extensive col-

lecting by the ALBATROSS in the early part of the century, the area remains poorly known in terms of its deepwater fauna, and doubtless, other species of *Nezumia* will subsequently be found there. The South China Sea and the Indo-Australian Archipelago likewise remain relative unknowns, and more deepwater collecting is badly needed in these biologically rich areas. Indian Ocean grenadiers have not been comprehensively reviewed by recent workers; the generic allocations of many species are still questionable.

Members of the genus are of small to moderate size; only a few attain lengths of more than 340 mm in total length (only *N. stelgidolepis* in the eastern Pacific, but other species in the Atlantic and western Pacific). The larger species tend to have a larger, more terminal mouth and stronger, longer teeth—these features being suggestive of a predatory habit on larger, more active prey. The smaller species with their smaller, more inferior mouth, and longer, more pointed snout most likely feed on small prey captured on or in the bottom substratum. *Nezumia parini* is an enigma, however, in that it is strictly bathypelagic (the only member of the genus to be so), yet it retains a physiognomy much like that of its bottom-dwelling congeners (see Hubbs and Iwamoto (1977) for additional discussion of this peculiar species).

The genus is primarily one of upper- and middle-slope fishes, with few species ranging deeper than 2,000 m. Of the eastern Pacific species (Table 2), *N. convergens* not only has the second broadest horizontal range, but also the greatest vertical range, and it is probably the deepest-living species. In contrast, *N. stelgidolepis*, which has the broadest horizontal range of the eastern Pacific species, has only a moderate depth range and has been captured at the shallowest depth.

The sole bathypelagic member of the genus, *N. parini*, has been captured in midwater nets fished primarily in depths of 1,000 m or greater. In the type-series, 14 of 23 captures of the fish were made in nets fished to an estimated depth of 1,000 m or greater; in seven, the nets were fished to depths estimated at between 675 and 940 m; and only in two were the nets fished shallower (estimated depths of 420 and 455 m) (Hubbs and Iwamoto 1977).

Genera most closely related to *Nezumia* are *Ventrifossa* Gilbert and Hubbs, 1920, and *Mal-*

TABLE 2. COMPARISON OF CAPTURE DEPTHS OF NINE SPECIES OF *NEZUMIA* FROM THE EASTERN PACIFIC OCEAN.

Species	Capture depths (m)		
	min.	max.	difference
<i>stelgidolepis</i>	227	909	632
<i>pulchella</i>	272	735	463
<i>orbitalis</i>	523	800	277
<i>ventralis</i>	549	717	168
<i>pudens</i>	580	1,238	758
<i>loricata</i>	600	1,480	880
<i>convergens</i>	600	1,865	1,265
<i>latirostrata</i>	605	1,400	795
<i>liolepis</i>	682	1,629	947

acocephalus Günther, 1887; the three constitute a close-knit unit which I (Iwamoto 1972) have called the tribe Malacocephalini. The unifying characters of this tribe are the presence in the members of seven branchiostegal rays, a well-developed periproct region that is remote from the anal fin origin, and the presence of one or two dermal windows of the light organ anterior to the anus.

Nezumia liolepis (Gilbert)

(Figures 12b, 18c)

Macrurus (Lionurus) liolepis GILBERT, 1890:117 (original description, off southern California, ALBATROSS sta. 2980, in 1,103 m).

Lionurus liolepis: GOODE AND BEAN 1896:409 (occurrence).

Macrurus liolepis: GARMAN 1899:199–200 (description; records from ALBATROSS sta. 3418, 3424, 3436).

Macrurus barbiger GARMAN, 1899:197, pl. 45, figs. 2–2b (original description; off Islas Tres Marias, Mexico, ALBATROSS sta. 3424, in 676 fm [1,236 m]).

Lionurus (Lionurus) barbiger: GILBERT AND HUBBS 1916:146 (listed).

Lionurus (Lionurus) liolepis: GILBERT AND HUBBS 1916:146 (listed).

Nezumia liolepis: FITCH AND LAVENBERG 1968:142 (listed).

Ventrifossa barbiger: MARSHALL 1973:654 (listed).

DIAGNOSIS.—A *Nezumia* with 10–11 (rarely 12) pelvic fin rays. Few serrations on second spinous ray of first dorsal fin. Thin, deciduous scales on body with few or no spinules on exposed field. Small ventral light organ. Upper jaw 31–40 percent HL.

DESCRIPTION.—General features of fish seen in Figure 12b. Head moderately compressed and deep. Suborbital ridge rounded; shallow, obtuse angle formed by dorsal and ventral surfaces. Interorbital region shallowly concave; width about equal to or less than orbit diameter. Snout narrow, bluntly pointed, protruding slightly beyond

rather large, almost lateral mouth. Jaws only slightly restricted by lip-folds at posterior angle. Opercular openings wide, extending above a horizontal through dorsal edge of orbit; gill membranes loosely attached to isthmus. Nape high, strongly arched in large adults. First dorsal fin base low. Periproct region about equidistant from pelvic fin insertion and anal fin origin; ventral light organ poorly developed, inconspicuous without dissection. Gill-rakers small, tubercular. Gill filaments long; length of longest more than half diameter of orbit, about equal to or longer than least width of suborbital region. Pyloric caeca slender; rather short, less than diameter of orbits; biramosely branched, each main stem branching one or two times.

Fin rays all relatively slender and delicate. Second spinous ray of dorsal fin slightly prolonged; leading edge smooth except for a few small denticles near distal end. Outer ray of pelvic fin slender; filamentous tip extends slightly beyond origin of anal fin.

Overall coloration grayish brown tinged with violet; surface over abdomen much darker, over operculum blackish, but anteriorly over rest of head and especially snout paler. Lips dark brown to blackish; fins dusky to blackish. Gill membranes black. Outer-wall lining of gill chamber blackish; inner-wall lining grayish to pale. Lining of oral cavity blackish.

Scales highly deciduous; few specimens with any scales remaining. A sizable patch remaining dorsally on head and snout of CAS-SU 2545, 50 mm HL. Larger of these scales with 5–7 rows, each with 2–3 long conical spinules (Fig. 12b). Scales over dorsal surface of snout either with one to several low ridges that are sometimes armed with one or a few short spinules, or scales completely lack ridges and spinules. Dorsal surface of snout lacks scales along leading edge and along snout ridges. Ventrally, snout entirely naked back onto suborbital region to vertical through end of maxillary, but a narrow, thin wedge of small, thin, cycloid scales extends forward to about level of anterior border of orbits. Rami of lower jaw with small, fine, spinuleless scales located mainly about median axis of each ramus.

COUNTS (from 38 specimens).—1D. 11.8–11 (total 10–13; \bar{x} = 11.87; S.D. = 0.75); 1P. 20–25 (\bar{x} = 22.72; n = 61; S.D. = 1.23); 2P. 10–11 (rarely 12). Gill-rakers on first arch 1–3 + 7–10 (total 9–12, usually 10–11); on second arch

1–3 + 7–10 (9–12 total). Scales below first dorsal 8–10; below second dorsal 7–10; over distance equal to predorsal length of head 39–44 (3 specimens). Pyloric caeca 25–37 (6 specimens).

MEASUREMENTS (from 38 specimens).—Total length 114–290 mm; head length 26–63 mm. The following in percent of head length [range (\bar{x} ; n ; S.D.)]: postrostral length of head 73–81 (77.68; 34; 1.77); snout length 24–28 (25.95; 36; 1.12); preoral length 13–23 (19.12; 34; 2.00); internasal width 17–23 (19.00; 26; 1.50); orbit diameter 25–31 (27.18; 38; 1.50); interorbital width 21–27 (23.28; 37; 1.25); postorbital length of head 43–56 (50.17; 35; 3.42); distance orbit to angle of preopercle 36–44 (39.39; 37; 1.88); suborbital width 11–15 (12.92; 37; 0.96); upper jaw length (28) 31–40 (34.12; 38; 2.31); barbel length 10–20 (14.68; 37; 2.59); length first gill-slit 14–23 (17.38; 37; 1.65); preanal length 119–142 (131.52; 27; 5.81); outer pelvic ray to anal origin 32–57 (42.26; 26; 6.24); anus to anal origin 13–27 (19.76; 24; 4.66); greatest body depth 60–82 (70.89; 29; 4.86); 1D.–2D. interspace 28–48 (34.63; 36; 6.15); 1D. height 58–73 (62.267; 21; 4.27); 1P. length 43–53 (49.15; 24; 3.30); 2P. length 42–55 (48.03; 25; 6.13).

COMPARISONS AND RELATIONSHIPS.—*Nezumia liolepis* belongs with that group of *Nezumia* species characterized by (1) a moderate-sized mouth, (2) a relatively deep, compressed head, (3) a rather blunt, high, and usually weakly armed snout, and (4) relatively wide gill openings. This group includes such geographically separated species as *N. stelgidolepis* (Gilbert), *N. atlantica* (Parr, 1946), *N. africana* (Iwamoto, 1970), *N. bubonis* Iwamoto, 1974, *N. dara* (Gilbert and Hubbs, 1916), *N. burragei* (Gilbert, 1905), *N. hebetata* (Gilbert, 1905), *N. holocentrus* (Gilbert and Cramer, 1897), *N. kamoharai* Okamura, 1970, and *N. macronema* (Smith and Radcliffe, 1912). *N. liolepis* is readily distinguished from these species in having the combination of (1) few serrations on the dorsal spine, (2) reduced spinulation on the scales of the head and body, (3) extensive naked areas on the dorsal and ventral surfaces of the snout and suborbital region, (4) a distinctive shape of the operculum, and (5) a relatively posteriad position of the anus.

REMARKS.—Garman (1899:197) described *Macrurus barbiger* from a 10-inch (25-cm) specimen taken off the state of Guerrero, Mexico.

He contrasted the species with *N. liolepis*, reporting that *barbiger* has "the head more round, the cheeks more convex, the snout narrower, and the barbel longer, besides which differences there are others in the fins and the colors." I compared the holotype of *M. barbiger* (MCZ 28597) with specimens Garman identified as "*Macrurus liolepis*" and found that these differences do not hold up. There is little doubt that the *M. barbiger* holotype and the "*M. liolepis*" specimens are conspecific.

DISTRIBUTION.—The species is known from off Monterey Bay, California (36°49'20"N), to south of Guerrero, Mexico (17°24'N), including the Gulf of California south of Guaymas (Garman 1899:200, ALBATROSS sta. 3436). Capture depths have ranged from 768–823 m (CAS 26638) to 1,655 m (ALBATROSS sta. 3436).

MATERIAL EXAMINED (40 specimens from 9 localities).—**California** (north to south): CAS-SU 5351 (4, 28–52 mm HL), off Monterey Bay, 36°49'20"N, 122°12'30"W, 834 m, ALBATROSS sta. 3126, 13 Mar. 1889. —CAS-SU 21402 (5, 53–63), off Santa Cruz Islands, 1,397–1,629 m, ALBATROSS sta. 4428, 14 Apr. 1904. —USNM 44271, syntypes (2, 45–50), E of Santa Cruz Islands, 33°49'45"N, 119°24'30"W, 1,103 m, ALBATROSS sta. 2980, 12 Feb. 1889. —CAS 26638 (4, 41–56), off San Mateo Point, 33°15'30"N, 117°38'W, 768–823 m, N. B. SCOFIELD sta. 53B59, 23 June 1953. —CAS-SU 2545 (6, 27–50), off San Diego, 32°49'N, 117°27'30"W, 656 m, ALBATROSS sta. 2936, 4 Feb. 1889. —USNM 77495 (3, 33–33), off Point Loma, San Diego, 940–989 m, ALBATROSS sta. 4333, 9 Mar. 1904.

Mexico: MCZ 28597 (holotype of *Macrurus barbiger* Garman, 1899, 54 mm HL), off Islas Tres Marias, 21°15'N, 106°23'W, 1,236 m, ALBATROSS sta. 3424, 18 Apr. 1891. —CAS 40230 (10, 38–47), off Jalisco, 19°43.5'N, 105°35.5'W, 700–900 m, TE VEGA cr. 19, sta. 17, 10 July 1968. —CAS 40231 (5, 51–58), off Guerrero, 17°24'N, 101°31'W, 940–1,000 m, TE VEGA cr. 19, sta. 19, 12 July, 1968.

Nezumia pulchella (Pequeño, 1971)

(Figures 12c, 18b)

Macruroplus pulchellus PEQUEÑO, 1971:293–294, fig. 17 (original description; off Chile; type-locality 25°26'S, 70°37'W, 374–424 m).

DIAGNOSIS.—A species of *Nezumia* with 11–12 pelvic fin rays. Gill-rakers on first arch 9–11 total; on second arch 8–10. Spinules on body scales conical, in distinct, slightly convergent rows. Ventral surfaces of snout, suborbital region, mandibular rami, and gular and branchiostegal membranes usually naked, but occasionally with few scattered scales. Barbel 9–16 percent of HL; upper jaw 30–34 percent HL.

DESCRIPTION.—General features of fish seen in Figure 12c. Head moderately compressed, trunk deep in large adults, less so in smaller in-

dividuals. Suborbital ridge prominent in study material, accentuated by shrunken lower portion of region; suborbital ridge of fresh specimens probably not as pronounced. Other head ridges rather smoothly rounded without reinforcing spiny scutelike scales. Snout narrow and short, relatively blunt; armed with small spiny scutes at tip and at lateral angles. Mouth moderately large, lateral, unrestricted by lip folds at angle. Posterodorsal corner of opercle slightly produced. Interopercle broadly exposed posteriorly and ventrally. Gill openings wide, membranes broadly connected over isthmus with a moderately broad free fold. Anterior dermal window of light organ small, in shallow fossa between bases of pelvic fins and slightly removed from periproct. Gill filaments long; length of longest about equal to diameter of pupil, greater than width of suborbital region. Pyloric caeca well developed, but fairly short (about 0.6 into orbit diameter), branched only at bases; 23–31 in nine specimens.

Scales of body with distinct, slightly convergent rows of small conical spinules on exposed fields. Scales generally lacking on gular membrane, mandibles, lower part of snout and suborbital region, and branchiostegal membrane, but one specimen (CAS 38323) with two small scales on right gill membrane near base of fifth branchiostegal ray. Small areas dorsally behind leading edge of snout naked. Stout, spiny scales at tip and lateral angles of snout and in two rows along dorsal surface of suborbital region, but scales otherwise not modified. Sensory pores along ventral margins of suborbital region and preopercle, and along inner margins of mandibles large and prominent.

Teeth in both jaws in rather narrow band; teeth small except for outer premaxillary series, which is composed of enlarged, spaced, sharp, conical teeth.

Coloration in alcohol medium brown overall with bluish tinge over abdomen and blackish ventrally on trunk. Gill membranes black; fins blackish. Lining of buccal cavity pale except for grayish oral valves. Peritoneal cavity pale but peppered with small melanophores.

COUNTS (from 16 specimens).—1D, 11, 10–11 (9 in one specimen); 1P, 19–28 (\bar{x} = 24.52; n = 31; S.D. = 2.06); 2P, 11–12. Mesial gill-rakers on first arch 1–3 + 7–9 (9–11 total); on second arch 1–2 + 7–9 (8–10 total). Scales below first dorsal 6½–8½; below second dorsal 5½–7½;

below midbase of first dorsal $4\frac{1}{2}$ –6; over distance equal to predorsal length 35–44 (usually 37–40).

MEASUREMENTS (from 15 specimens, 22-mm-HL specimen from SIO 65–675 excluded).—Total length 137+ to 286+ mm; head length 29–61 mm. The following in percent of head length [range (\bar{x} ; n ; S.D.)]: postrostral length of head 79–82 (80.47; 15; 1.06); snout length 21–26 (23.59; 15; 1.38); preoral length 16–19 (17.61; 15; 0.62); internasal width 15–21 (18.47; 15; 1.42); orbit diameter 30–34 (32.29; 15; 1.47); interorbital width 20–25 (22.79; 15; 1.31); postorbital length 40–46 (43.34; 15; 1.88); orbit to angle of preopercle 34–38 (36.05; 15; 1.30); suborbital width 11–13 (11.85; 15; 0.66); upper jaw length 30–34 (32.15; 15; 1.29); length barbel 9–16 (11.73; 15; 3.38); length first gill-slit 17–23 (19.95; 15; 1.54); preanal length 117–150 (131.93; 15; 7.51); greatest body depth 68–88 (79.80; 15; 5.43); 1D.–2D. interspace 31–56 (41.83; 15; 7.40); height first dorsal fin 65–76 (69.30; 10; 4.00); length pectoral fin 51–70 (61.53; 15; 5.17); length pelvic fin 39–53 (45.87; 15; 3.48).

COMPARISONS AND RELATIONSHIPS.—*Nezumia pulchella* is closely related to *N. stelgidolepis* but differs primarily in having 11–12 pelvic fin rays rather than the 9–10 of *N. stelgidolepis*. Scale spinules also show notable differences between the two species. In *N. pulchella* the spinules are all conical and in distinct rows that converge slightly towards the midline, whereas in *stelgidolepis* the spinules are conical to lanceolate and arranged in a more quincunx pattern. Retia and gas glands of *pulchella* are also much larger and stouter, the barbel is shorter, and the branchiostegal rays are naked except for occasional scattered scales (as opposed to short rows of deciduous scales along the bases of the lowermost branchiostegal rays in *stelgidolepis*).

Nezumia pulchella is readily distinguishable from *N. pudens* in having extensive naked areas on the ventral surface of the head and on the mandibles (as compared with surfaces mostly scaled in *pudens*), fewer scale rows below the first and second dorsal fins ($6\frac{1}{2}$ to $8\frac{1}{2}$ vs. $10\frac{1}{2}$ to 12 below the first dorsal; $5\frac{1}{2}$ to $7\frac{1}{2}$ vs. $8\frac{1}{2}$ to $10\frac{1}{2}$ below the second dorsal, fewer pyloric caeca (23–31 vs. 37–44), and a shorter barbel (9–16 vs. 20–25).

SIZE.—To at least 286 mm in total length (in

a specimen, IMARPE uncat., 61 mm in head length). A specimen in the type-series measured 67 mm HL and 272 mm TL (Pequeño 1971:294, table).

DISTRIBUTION.—Northern Peru ($7^{\circ}49'S$) to central Chile (about $33^{\circ}S$) in 250–960 m.

MATERIAL EXAMINED (16 specimens from 8 localities).—Peru: CAS 38323 (3, 54–57 mm HL, 207+ to 270 mm TL), $7^{\circ}49'S$, $80^{\circ}38'W$, 605–735 m. ANTON BRUUN cr. 18B, sta. 754 (field no. LWK66–93), 5 Sep. 1966. —CAS 28761 (1, 43 HL, 187 TL) and IMARPE uncat. (1, 61 HL, 286+ TL), $13^{\circ}49.4'S$, $76^{\circ}46.9'W$, 570 m, 24 Jan. 1972. —CAS 28763 (1, 46 HL, 226 TL), $13^{\circ}53.3'S$, $76^{\circ}42.0'W$, 272 m, 25 Jan. 1972. —CAS 28764 (1, 35 HL, 164 TL), $16^{\circ}31.0'S$, $73^{\circ}12.2'W$, 510 m, 1 Feb. 1972. —IMARPE uncat. (1, 34 HL, 161 TL), $18^{\circ}07'S$, $71^{\circ}02.5'W$, 28 Jan. 1972. Chile: CAS 38320 (6, 26–39 HL, 135–185 TL), $23^{\circ}41'S$, $70^{\circ}34'W$, 250–400 m. ANTON BRUUN cr. 18A, sta. 717 (field no. LWK66–63), 17 Aug. 1966. —CAS 38318 (1, 38 HL, 158 TL), $32^{\circ}08.5'S$, $71^{\circ}43'W$, 960 m, ANTON BRUUN cr. 18A, sta. 703 (field no. LWK66–47), 12 Aug. 1966. —SIO 65–675 (1, 22 HL, 104 TL), about 29 km off Valparaíso Harbor (ca. $33^{\circ}N$), 22–23 Dec. 1965.

Nezumia stelgidolepis (Gilbert)

(Figures 12d, 13, 18i)

Macrurus stelgidolepis GILBERT, 1890:116 (original description; off Pt. Conception, California, ALBATROSS sta. 2960, in 488 m).

Macrurus gracillicauda GARMAN, 1899:206–207, pl. H, fig. 1 (original description; Gulf of Panama, ALBATROSS sta. 3384 and 3385, in 837 and 523 m).

Lionurus (Nezumia) stelgidolepis: GILBERT AND HUBBS 1916:145 (listed).

Lionurus stelgidolepis: BARNHART 1936:24 (brief description). *Nezumia stelgidolepis*: ROEDEL 1951:509, fig. 183 (16 records off California).

Nezumia gracillicauda: MARSHALL AND IWAMOTO in MARSHALL 1973:626 (listed).

DIAGNOSIS.—A species of *Nezumia* with 9–10 pelvic fin rays. Gill-rakers on first arch 8–12 total; on second arch 8–11 total. Spinules on body scales conical to narrowly lanceolate. Ventral surfaces of snout, most of suborbital region, and anterior half or more of mandibular rami naked. Lowermost branchiostegal rays scaled. Barbel 15–26 percent HL; upper jaw 31–37 percent.

DESCRIPTION.—General features of fish seen in Figures 12d and 13. Head moderately compressed and deep; ridges of head not strongly developed, usually somewhat rounded; suborbital region relatively flat. Snout narrow, bluntly pointed (more pointed in young), protruding slightly beyond rather large mouth, which is only slightly restricted at posterior angle by lip folds. Posterodorsal corner of opercle somewhat

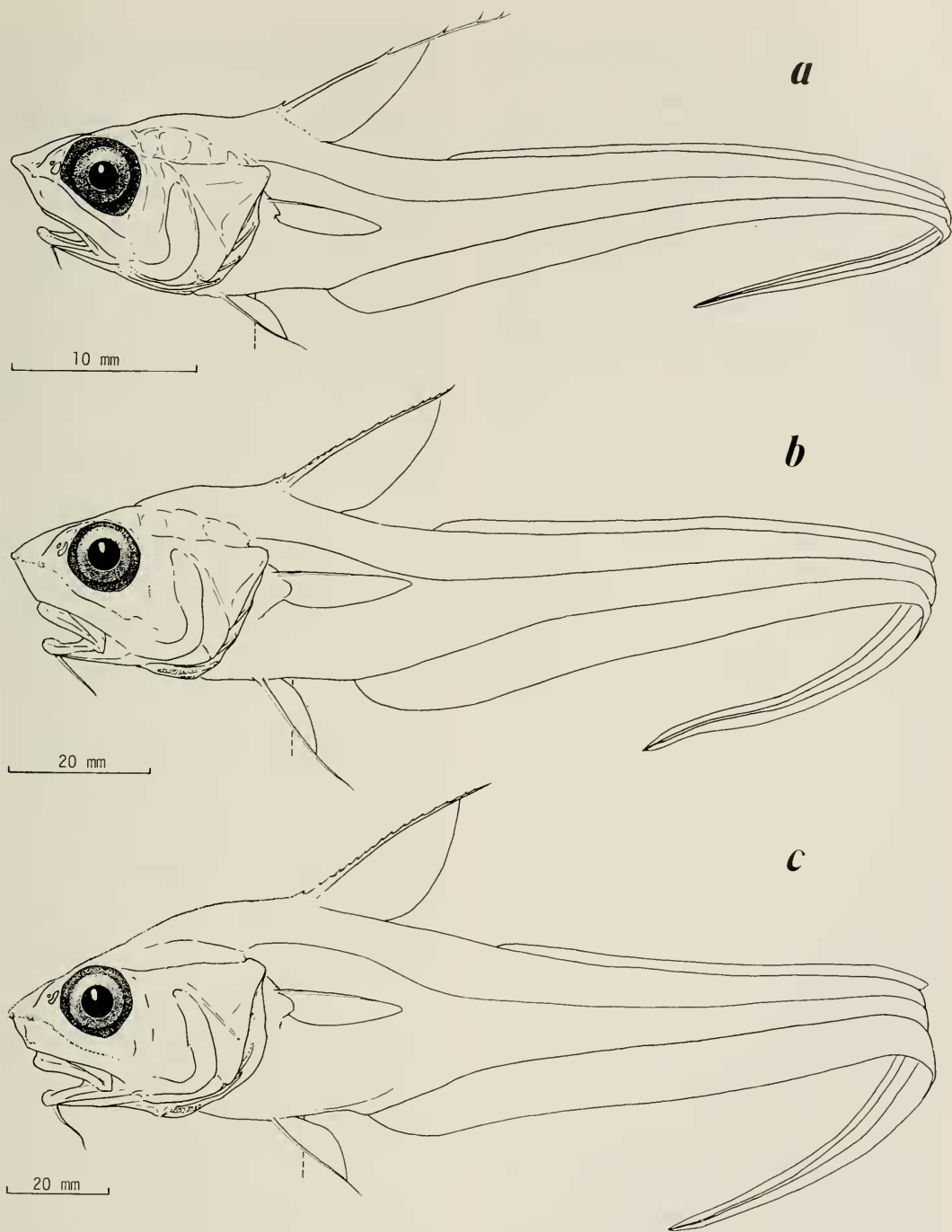


FIGURE 13. *Nezumia stelgidolepis* (Gilbert). (a) CAS 44197, 14.7 mm HL, 73 mm TL (fins and head region somewhat reconstructed after 13.5-mm-HL specimen from same station). (b) USNM 120272, 28.7 mm HL, 280 mm TL, partially reconstructed. (c) CAS 40022, 53 mm HL, 255 mm TL.

flaplike, posterior margin of gill cover steeply oblique along opercle, gently rounded along subopercle, connecting to broadly exposed (and scaled) interopercle. Shape of gill cover similar to that in *N. liolepis*. Gill openings wide; gill membranes rather narrowly connected over isthmus, with free posterior fold. Nape region slightly arched. Anus within lenticular area of black naked skin, situated slightly behind bases of pelvic fins, but closer to these than to anal fin. Anterior dermal window of light organ small, in shallow fossa between pelvic fin bases. Gill filaments well developed; length longest filament equal to or longer than least suborbital width and about equal to pupil diameter. Pyloric caeca numerous, branched; counts highly variable, in eight specimens 24, 34, 36, 38, 38, 40, 43, and 58. Periproct region relatively large, close behind pelvic fin bases; anterior window of light organ small, circular, lying between inner edges of pelvic fin bases.

Scales densely covered with long, narrowly lanceolate to conical spinules arranged in short, slightly convergent rows. Ventral surfaces of snout and most of suborbital region, and anterior half to two-thirds of lower jaw naked. Sensory pores rather prominent over these naked areas. Short rows of small deciduous scales along bases of one or more branchiostegal ray.

Coloration of fresh specimen (CAS 40022) swarthy overall with blackish predominant over ventral aspects of abdomen, chest, head, and gill covers. Bluish tinge over blackish abdominal walls. Fins dusky to blackish; first dorsal slightly paler basally. Lining of buccal cavity pale, but oral valves gray. Pharyngeal region dark gray; gill-rakers gray but gill filaments pale. In juveniles (CAS 41196 and 41197), oral cavity densely peppered with small melanophores.

Dentition in broad bands in both jaws, narrowly tapered posterolaterally. Outer series of upper jaw teeth slightly enlarged and evenly spaced.

Four juvenile specimens presumably of this species were captured in midwaters. The largest of these (LACM 30611-16) measured 19 mm in HL, 106 mm in TL, and was taken in an Isaacs-Kidd midwater trawl off the northwestern coast of Baja California between the surface and about 600 m, over a bottom depth of 1,600 to 1,100 fms (2,962-2,012 m). This specimen was dark colored, superficially resembling *N. parini*, but the coarse scale spinules, the large pores on the

head and mandibles, the distinct lateral line, the number of pelvic fin rays, and the large gill filaments distinguish the species as *N. stelgidolepis*. The three other specimens (CAS 41196 and 41197) captured in midwaters were too small to positively identify without more comparative material, but the general appearance (see Fig. 13c) and counts (of dorsal and pelvic fin rays, and gill-rakers) also suggest *N. stelgidolepis* as the correct identification. Proportional measurements of these juveniles were generally divergent from those of the adults, indicating substantial allometric growth in such features as preoral length of snout, orbit diameter, interorbital width, postorbital length of head, distance orbit to angle of preopercle, upper jaw length, and barbel length.

The smallest examined specimen (USNM 57861) captured in a bottom trawl measured 39 mm in head length and 176 mm in total length.

COUNTS (from 33 specimens).—1D. II,9-10 (8 in one specimen, 11 in two specimens); 1P. 20-26 (\bar{x} = 21.00; n = 59; S.D. = 3.30); 2P. 9-10 (8 in one specimen, 11 in two others). Gill-rakers on first arch 10-11 total (8 in one, 9 in one, 12 in three specimens); on second arch 9-11 total. Scales below first dorsal 8-9 (rarely 10); below second dorsal 7-8 (9 in one); below mid-base of first dorsal 6-7; over distance equal to predorsal length of head 34-47, usually between 36 and 42.

MEASUREMENTS (from 38 specimens, juveniles excluded).—Total length 176-405+ mm; head length 39-96 mm. The following in percent of head length [range (\bar{x} ; n ; S.D.)]: postrostral length of head 73-82 (78.60; 35; 1.80); snout length 22-28 (24.51; 36; 1.34); preoral length 12-18 (14.86; 36; 1.28); internasal width 14-19 (16.46; 30; 1.19); orbit diameter 26-32 (28.06; 38; 1.68); interorbital width 20-26 (23.46; 38; 1.55); postorbital length 43-52 (46.56; 33; 2.17); orbit to angle of preopercle 35-45 (39.81; 37; 2.01); suborbital width 11-16 (12.84; 37; 1.01); upper jaw length 31-37 (34.93; 38; 1.49); length barbel 15-26 (20.98; 36; 2.72); length first gill-slit 12-18 (16.37; 36; 1.54); preanal length 119-157 (135.95; 37; 9.51); greatest body depth 70-90 (77.68; 33; 5.77); 1D.-2D. interspace 26-58 (45.92; 38; 11.19); height first dorsal fin 48-68 (60.73; 29; 4.26); length pectoral fin 44-56 (49.69; 35; 3.23); length pelvic fin 35-49 (43.48; 34; 3.61).

COMPARISONS AND RELATIONSHIPS.—In the eastern Pacific, *Nezumia stelgidolepis* is most

closely related to *N. loiepis* and *N. pulchella*, but is readily distinguished from these two by differences in scale spinulation, squamation pattern, pelvic ray count, and other features noted in the key. *Nezumia stelgidolepis* is representative of that group of *Nezumia* spp. characterized by relatively blunt snout, large mouth, broadly unrestricted gill openings, deep body, and large size. Some of the species in this group (e.g., *Nezumia atlantica* (Parr, 1946), *N. africana* (Iwamoto, 1970)) have been treated in other works (Parr 1946; Iwamoto 1970; Marshall 1973) as members of the genus *Ventrifossa*.

SIZE.—*Nezumia stelgidolepis* is the largest eastern Pacific member of the genus, attaining a total length of at least 445 mm (see Roedel 1951:509). *Nezumia atlantica*, a close relative from the western Atlantic, attains a comparable size, probably exceeded in the genus only by the peculiar species *N. bubonis* Iwamoto, 1974, from the Hawaiian Islands and the western Atlantic.

DISTRIBUTION.—British Columbia (off Vancouver Island) to southern Peru (18°10.0'S), in 277–909 m (Makushok (1967:table 18) gives the depth distribution as "(61–91)379–909").

MATERIAL EXAMINED (excluding material previously listed in Iwamoto and Stein 1974:49–50).—**California:** CAS 23396 (1. 63 mm HL, 310 mm TL), off Ft. Bragg in 475–494 m. —CAS 33110 (1. 43 HL, 243 TL), off Bodega Bay, 494–585 m, 23 Feb. 1965. —CAS 31509 (1. 73 HL, 365+ TL), off Point San Simeon, 530 m, N. B. SCOFIELD sta. 54BB71, 25 Oct. 1954. —CAS 40022 (1. 53 HL, 255 TL), off Santa Barbara County, 34°18.4'N, 120°14.4'W, 439–443 m, COMMANDO, 10 Aug. 1977. —USNM 87579 (1, 68 HL), ALBATROSS. —USNM 127072 (1, 39 HL, 280+ TL), off southern California, ALBATROSS.

Mexico: LACM 30611–16 (1, 19 HL, 106 TL), Guadalupe I., 28°57'15"N, 118°05'19"W, est. fishing depth 0–600 m, bottom depth 2,926–2,012 m, IKMT, VELERO sta. 12494, 21 Nov. 1968. —AMNH 12902 (4, 55–70 HL, 250–305+ TL), San Cristobal Bay, 27°07'08" gN, 114°33'10"W, 519 m, ALBATROSS sta. 5675, 15 Mar. 1911.

Galápagos: USNM 135605 (1, 77 HL, 346 TL), ALBATROSS. **Ecuador:** CAS 44196 (1, 14 HL, 67+ TL), 4°14'S, 81°26'W, 0–1,830 m, IKMT, ANTON BRUUN cr. 18B, sta. 756B (field no. LWK66–113), 8 Sep. 1966.

Peru: LACM 33883 (1, 66 HL, 303 TL), 6°42'S, 80°59'05"W, 780 m, sta. SNP1–25, 22 Jan. 1974. —LACM 33886 (1, 41 HL, 168 TL), 7°44'05"S, 80°30'05"W, 750–760 m, sta. SNP1–28, 23 Jan. 1974. —CAS 38324 (7, 48–66 HL, 180+ to 280 TL), 7°49'S, 80°38'W, 605–735 m, ANTON BRUUN cr. 18B, sta. 754 (field no. LWK66–93), 5 Sep. 1966. —CAS 41197 (2, 13.5–14.7 HL, 66–73 TL), 11°53'S, 78°05'W, 0–1,125 m, IKMT, ANTON BRUUN cr. 16, sta. 656–0, 14 June 1966. —IMARPE uncat. (1, 74 HL, 290+ TL), 18°10'S, 71°29'W, 610 m, 23 Aug. 1972.

Nezumia pudens Gilbert and Thompson

(Figures 6b, 14c, 18h)

Nezumia pudens GILBERT AND THOMPSON, 1916:472–473, pl. 5, fig. 2 (types from ALBATROSS sta. 2791 off Lota, Chile, 38°08'S, 75°53'W, 1,240 m).

Lionurus (Nezumia) pudens: GILBERT AND HUBBS 1916:146 (name only).

Macruroplis pudens: FOWLER 1944:48, fig. (list).

DIAGNOSIS.—A species of *Nezumia* with 10–11 pelvic fin rays. Gill-rakers on first and second arches 9–10 total. Spinules on body scales slender, sharp, conical, in dense cluster on exposed fields. Head surface fully scaled except for small area along ventromedian line of snout and over gill membranes. Barbel 20–25 percent of HL; upper jaw 30–39 percent HL.

DESCRIPTION.—General features of fish seen in Figure 14a. Head rather compressed, surfaces smoothly rounded. Suborbital ridge low, rounded. Snout short, blunt narrow; blunt scutes at terminal and lateral angles not especially spiny or set off from adjacent scales. Mouth subterminal, rather short; posterior corners somewhat restricted by lip folds; lips thick, papillaceous, especially in large adults. Barbel rather thick throughout, not tapering to filamentous tip. Interopercle broadly exposed posteriorly and ventrally. Posterodorsal corner of opercle angular, without broad tablike extension. Gill membranes rather broadly connected over isthmus, with a narrow free fold. Anus located in middle third of distance between pelvic fin base and anal fin origin. Anterior dermal window small, round, lying between or slightly in advance of line connecting insertion of pelvic fins. Gill filaments well developed but relatively short; length of longest less than diameter of eye lens, about 0.6 into least suborbital width. Pyloric caeca slender, numerous, 37, 39, and 44 in three specimens, branched two or three times at base; length of longest about equal to interorbital width.

Exposed fields on body scales densely covered with relatively erect, slender, stilettoshaped spinules arranged in quincunx pattern or in close, strongly convergent rows. Almost all of head uniformly covered with small, relatively adherent scales (Fig. 6b). Small area along ventral midline and ventral margin of snout naked. Scales along dorsal half of suborbital region heavier, larger, more adherent, and in two distinct rows. Mandibles and exposed surfaces of

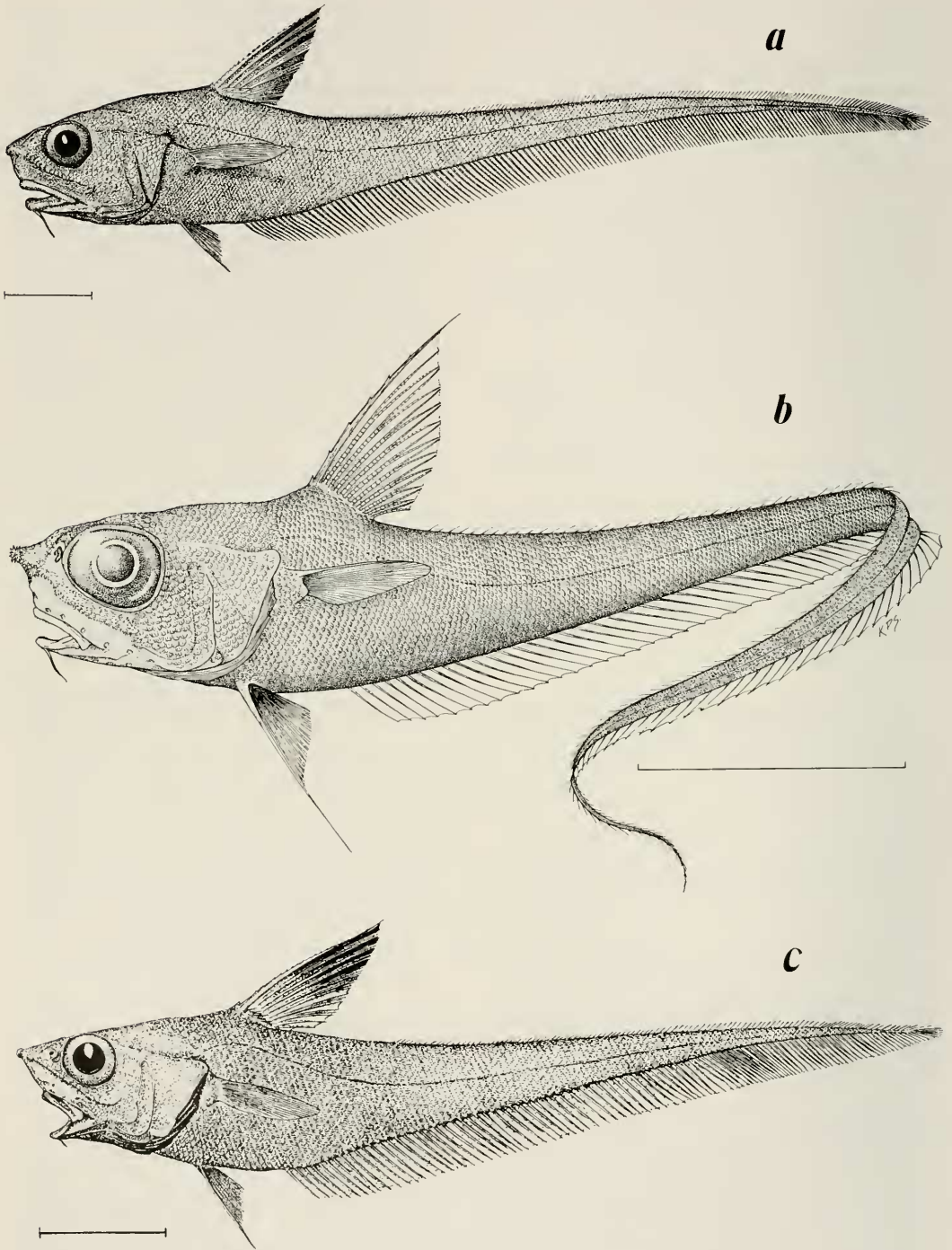


FIGURE 14. (a) *Nezumia pudens* (Gilbert and Thompson). CAS 38310, 50 mm HL, from off Chile in 750 m. (b) *Nezumia ventralis* Hubbs and Iwamoto, new species. Holotype. CAS-SU 68361, 26.4 mm HL, taken off the Galápagos in 549 m. (c) *Nezumia orbitalis* (Garman), LACM 33885-2, 48 mm HL, off Peru in 800 m.

interopercle covered with small scales, but gill membranes naked.

Fins moderate in size. First spinous ray of dorsal fin slender, sharp, spikelike; second spinous ray slightly prolonged, armed along leading edge with slender, sharp spikes spaced sufficiently apart so that spikes do not overlap. Outer ray of pelvic fins with filamentous tip extending well beyond origin of anal fin. First dorsal fin placed rather far posteriad; origin about on same vertical as anus and about one eye-lens diameter behind vertical through origin of pectoral fins.

Jaw teeth in rather broad, coarse bands that narrow posteriorly. Outer series of upper jaw slightly enlarged, particularly along anterior border.

Coloration in alcohol medium brown with abdominal and cheek area blackish tinged with violet. Gill membranes black; naked margins of snout, nostrils, lower jaw, opercular bones, and rim of orbit blackish or darkly swarthy. Fins all blackish; distal and anterior portions of membranes of first dorsal fin more intensely blackish. Lining of mouth and gullet blackish; that of gill cavity blackish along external margins but pale towards inner portions; that of abdominal cavity black to swarthy.

COUNTS (from 7 specimens).—1D. II,9–11; 1P. 19–24; 2P. 10–11. Medial gill-rakers on first arch 1–2 + 7–9, usually 2 + 8 (9–10 total); on second arch 1–2 + 8–9 (9–10 total). Scale rows (from 4 specimens) below first dorsal 10½ to 12; below second dorsal 8½ to 10½; below midbase of first dorsal 7½ to 8½; over distance equal to predorsal length 43–46.

MEASUREMENTS (from 6 specimens; 22-mm-HL specimen excluded).—Total length 165–400 mm; head length 32–68 mm. The following in percent of head length: postrostral length of head 74–76; snout length 28–30; preoral length 18–22; internasal width 19–23; orbit diameter 31–35; interorbital width 22–23; postorbital length of head 40–48; distance orbit to angle of preopercle 37–43; suborbital width 15–16; upper jaw length 30–39; length barbel 20–25; length first gill-slit 14–18; preanal length 143–158; greatest body depth 73–81; 1D.–2D. interspace 34–43; height first dorsal fin 80–93; length pectoral fin 56–64; length pelvic fin 44–58.

COMPARISONS AND RELATIONSHIPS.—*Nezumia pudens* is readily distinguished from its most closely related eastern Pacific congeners *N. stelgidolepis*, *N. pulchella*, and *N. liolepis* by: (1) ventral surface of snout, suborbital re-

gion, and mandibular rami scaled (vs. mostly naked in these other species); (2) mucous pores in these areas not prominent (vs. prominent); (3) posterodorsal angle of opercle not produced into a short tab or flap (vs. a distinct flap or tab); (4) gill filaments relatively short, length less than diameter of eye lens (greater than eye lens in others); (5) first dorsal fin originating more posteriad than others; and (6) buccal cavity completely blackish (mostly pale in *stelgidolepis* and *pulchella*, but blackish in *liolepis*). Its relationship to other Pacific species of *Nezumia* is uncertain and probably distant.

Nezumia pudens bears some resemblance in general physiognomy of the head and body to *N. sclerorhynchus* (Valenciennes, 1838), and *N. suilla* Marshall and Iwamoto, 1973, from the Atlantic, but the higher pelvic fin ray count and the more complete squamation on the ventral aspects of the head in *N. pudens* are distinguishing.

SIZE.—To at least 68 mm HL and 400 mm TL.

DISTRIBUTION.—Known only off central Chile between latitudes 32°S and 38°S, in 580–1,238 m.

MATERIAL EXAMINED (7 specimens, all from Chile).—USNM uncat. (formerly CAS 38317) (1, 39 mm HL, 240 mm TL), 32°08.5'S, 71°43'W, 960 m, ANTON BRUUN cr. 18A, sta. 703 (field no. LWK66-47), 12 Aug. 1966. —CAS 38315 (2, 22–39 HL, 106+ to 234 TL), 32°17'S, 71°39.5'W, 580 m, ANTON BRUUN cr. 18A, sta. 702 (field no. LWK66-44), 11 Aug. 1966. —CAS 38310 (2, 50–68 HL, 267–400 TL), 34°06.5'S, 72°18.5'W, 750 m, ANTON BRUUN cr. 18A, sta. 687 (field no. LWK66-25), 5 Aug. 1966. —USNM 76860 (holotype, 32 HL, 170 TL) and CAS-SU 22727 (paratype, 34 HL, 165 TL), 38°08'S, 75°53'W, 1,238 m, ALBATROSS sta. 2791, 14 Feb. 1888.

Nezumia ventralis Hubbs and Iwamoto,
new species

(Figure 14b)

DIAGNOSIS.—A *Nezumia* with 15 pelvic fin rays and 24–27 pectoral fin rays. Mandibular rami, ventral surfaces of snout, and most of ventral surfaces of suborbital region naked; mucous pores over these surfaces large. Scales small, about 9½ below origin of second dorsal fin; spinules on body scales slender, conical, greatly reclined, in parallel to subparallel rows.

DESCRIPTION OF HOLOTYPE.—General features of fish seen in Figure 14b. Head and trunk moderately compressed and deep. Suborbital region divided into an upper portion covered with two longitudinal rows of stout scales and

a lower portion with almost no scales; the surfaces of the two halves meet along the suborbital ridge at an obtuse angle. Opercular opening moderately restricted, extends ventrally to below a point anterior of preopercular ridge. Gill membranes restricted, without a free fold over isthmus. Trunk short, distance isthmus to anal fin origin less than postrostral length of head. Periproct moderate in size, anus much closer to insertion of pelvic fins than to origin of anal fin. Ventral light organ well developed; a large, oval dermal window forms anterior extension of periproct; dermal window extends forward almost to a line connecting pelvic fin insertions. Gill filaments long, well developed; longest filament about 3.5–4.0 mm, about as long as diameter of eye lens. About 23 slender pyloric caeca.

Teeth in moderately broad bands in both jaws; bands narrower posteriorly on jaws. Outer series of teeth in upper jaw slightly enlarged.

Scales of body covered with slender, conical, reclined spinules arranged in parallel to subparallel ridgelike rows that give a somewhat striated appearance to body surfaces. Four to five rows of spinules on larger body scales. Spinules on head scales more erect than those on body scales, and spinules often arranged in divergent rows. Scales behind bases of paired fins, behind first dorsal fin, and beneath outer margin of gill covers without spinules. Scales dorsally on suborbital region stout, adherent, and covered with coarse spinules. Scales at tip and lateral angles of snout large, tuberclelike, and coarsely spined. Exposed posterior tip of interopercle scaled. Mandibular rami, ventral surfaces of snout, and most of ventral surface of suborbital region naked; mucous pores large and prominent in these areas. There appear to be some scale pockets along lowermost branchiostegal rays of holotype, but condition of specimen left doubts as to their actual presence (the "pockets" may simply be torn skin).

Fins generally well developed. First dorsal fin high, length almost as long as head length (longest ray broken at tip in holotype and paratype). Leading edge of spinous second ray armed with sharp, widely spaced denticles. Outer ray of pelvic fin slightly prolonged, extends beyond origin of anal fin. Pelvic and anal fins originate relatively far forward; pelvic fin origin below subopercle, anal fin origin below hind third of first dorsal fin base.

Holotype too badly faded for accurate description of coloration. See color description of paratype.

DESCRIPTION OF PARATYPE.—The single paratype is in poor condition and falling apart. The snout region is destroyed, and the posterior half of the tail has broken off and almost completely disintegrated. The fins and scales are intact, however, and most of the diagnostic features of the species could be examined. The specimen is notably larger than the holotype (postrostral length of head 31.0 mm compared with 20.8 mm) and the two exhibit some ontogenetic differences. Thus, the spinules on scales are more numerous than in the holotype, and the larger spinules on body scales tend to be lanceolate rather than conical. Spinule rows on body scales are also more numerous, six to eight on the larger scales of paratype compared with four to five in comparable scales of holotype.

The paratype had 29 pyloric caeca compared with the approximate count of 23 obtained in the holotype (I did not enlarge the original slit in the abdominal wall of the holotype for fear of damaging the specimen further). Two spinulated scales were present at the base of the left fourth branchiostegal ray, but none were on the opposite member.

Ground color of paratype dark brown with violet tinge over abdomen. Fin membranes, gill membranes, and naked surfaces of snout, suborbital region, and mandibular rami chocolate-brown. Gill cavity brown on inner wall and along periphery of outer wall but pallid everywhere else. Gill filaments and gill arches pale, the tubercular rakers dusky.

COUNTS (paratype counts, if different, in brackets).—ID. II.10; IP. 24 (left), 27 (right) [25, 25]; 2P. 15. Mesial gill-rakers on first arch 2 + 9 [2 + 10], on second arch 2 + 8 [2 + 9]. Scales below first dorsal about 12 [about 13]; below second dorsal 9½; below midbase of first dorsal about 8 [about 9½]; lateral line scales over distance equal to predorsal length 41 [not taken in paratype]. Pyloric caeca about 23 [29].

MEASUREMENTS OF HOLOTYPE.—Total length 142 mm, head length 26.4 mm. The following in percent of head length: postrostral length of head 79.0; snout length 23.8; preoral length 20.4; internasal width 19.7; orbit diameter 36.7; interorbital width 22.0; postorbital length of head 38.2; distance orbit to angle of preopercle 34.0;

suborbital width 12.1; upper jaw length 27.2; barbel length 14.0; length first (outer) gill-slit 15.9; preanal length 129; isthmus to anus 47.4; outer pelvic ray to anal origin 34.0; greatest body depth 68; depth over anal origin 57; 1D.—2D. interspace 34; length pectoral fin about 53; length outer pelvic ray about 53.

COMPARISONS AND RELATIONSHIPS.—*Nezumia ventralis* appears most closely related to two Atlantic species, *N. sclerorhynchus* (Valenciennes, 1838) and *N. suilla* Marshall and Iwamoto, 1973. The combination of general head and body shape, the presence of broad naked areas on the ventral surfaces of the snout and suborbital region, the naked mandibular rami, the large pores on the head, the general coloration, and the placement and size of the fins suggest this relationship. The new species is readily distinguished from the two by its high pelvic fin ray count of 15, compared with 7 in *suilla* and usually 9 (rarely 7, 8, or 10) in *sclerorhynchus*. *N. propinqua* (Gilbert and Cramer, 1897) is the only other species of the genus having a pelvic fin ray count as high as that of *N. ventralis*, but *N. ventralis* lacks the distinct black blotch on the tip of the first dorsal fin that is so prominent in *propinqua*, and it has more pectoral fin rays (23 or fewer in *propinqua*), a shallower body, a more anteriorly placed pelvic fin, and fewer scale rows below the second dorsal fin.

DISTRIBUTION.—The species is known from only two specimens taken by the ALBATROSS in the Galápagos Islands.

ETYMOLOGY.—From the Latin *ventralis*, adj., of or belonging to the belly—in reference to the ventral light organ.

REMARKS.—The paratype was first examined (circa 1920) by Dr. Carl L. Hubbs, who recognized the distinctness of the specimen and gave it the manuscript name of "*Lionurus ventralis*." Because of other commitments, Dr. Hubbs was unable to formally describe the species at the time and consequently returned the specimen to the National Museum along with other macrourids collected by the ALBATROSS in the eastern Pacific in 1888 and 1904.

MATERIAL EXAMINED.—**Holotype:** CAS-SU 68361, 26.4 mm HL, 142 mm TL, Galápagos Islands, off Hood (Española) I., 1°30'30"S, 89°39'W, 549 m, ALBATROSS sta. 4642, 7 Nov. 1904.

Paratype: USNM 135345, 1 badly deteriorated specimen.

Galápagos Islands, 00°29'S, 89°54'30"W, 717 m, ALBATROSS sta. 2818, 15 Apr. 1888.

***Nezumia orbitalis* (Garman)**

(Figure 14c)

Macrurus orbitalis GARMAN, 1899:207–208, pl. 47, figs. 1–1b (original description; Gulf of Panama, ALBATROSS sta. 3385, in 523 m).

Lionurus (Nezumia) orbitalis: GILBERT AND HUBBS 1916:146 (listed).

Nezumia orbitalis: MAKUSHOK 1967:table 18.

DIAGNOSIS.—A species of *Nezumia* with 9 pelvic fin rays. Gill-rakers on first arch 1–2 + 8–10 (10–11 total); on second arch 1–3 + 7–9 (9–11 total). Spinules on body scales slender, conical to narrowly lanceolate; no enlarged middle row of spinules on scales. Barbel length 6–12 percent HL; upper jaw length 27–32 percent HL. First dorsal fin with distinct black tip.

DESCRIPTION.—General features of fish seen in Figure 14c. A petite species probably not exceeding 200 mm in total length. Head about 21–25 percent of total length in specimens with complete tails. Snout pointed; head ridges relatively well developed with spinous tubercles at terminal and lateral points of snout. Dorsal profile arched high over nape to give distinctive humpbacked appearance. Gill membranes broadly attached across isthmus, with only a narrow posterior free fold. Anterior dermal window of light organ small, circular, situated in a shallow fossa between bases of pelvic fins; anus close behind.

Spinous second ray of first dorsal fin armed along leading edge with small, closely spaced teeth. Outer pelvic ray slightly prolonged, extends past origin of anal fin. Pelvic fin origin forward of pectoral fin origin, which in turn is slightly forward of first dorsal fin origin.

Body scales with slender, conical to narrowly lanceolate spinules densely covering exposed fields, disposed in as many as 15 rows in large specimens, with spinule rows converging towards middle of field; no enlarged middle row of spinules. Most ventral surfaces of snout and suborbital region naked. Lower jaw surfaces naked except for a line of loose scales along midline of each ramus.

Coloration. Garman (1899:208) has given a good color description from the types: "Blackish over the body cavity; reddish brown over the muscular portions of the caudal section; lighter to translucent on the head and snout; en-

tire surface tinted with grayish, from the spinules of the scales. Fins light; first dorsal and pectorals tipped with black. Orbit surrounded by a narrow border of black." The peritoneal lining of the lectotype is silvery with bold punctations.

Dentition of jaws consists of small teeth in moderately wide bands with outer series of upper jaw slightly enlarged.

COUNTS (from 15 specimens).—ID. 11.9–10 (11 in one specimen); 1P. 20–22 (\bar{x} = 20.8); 2P. 9. Gill-rakers on first arch 1–2 + 8–10 (9–11 total; \bar{x} = 10.3); on second arch 1–3 + 7–9 (9–11 total; \bar{x} = 10.2). Scales below first dorsal 7–9; below second dorsal 6½ to 7; below midbase of first dorsal 4½ to 5½; lateral-line scales over distance equal to predorsal length of head 36–45. Pyloric caeca 17, 17, and 23 in three specimens.

MEASUREMENTS (from 15 specimens).—Total length 115–186 mm; head length 27–41 mm. The following in percent of head length [range (\bar{x} ; n ; S.D.)]: postrostral length of head 73–78 (76.0; 14; 1.47); snout length 25–30 (27.8; 15; 1.27); preoral length 20–25 (22.9; 15; 1.81); internasal width 18–22 (19.9; 15; 0.97); orbit diameter 29–34 (31.9; 15; 1.28); interorbital width 17–19 (17.7; 15; 0.72); postorbital length 39–45 (41.5; 13; 2.11); orbit to angle of preopercle 33–40 (34.5; 15; 1.96); suborbital width 11–14 (12.4; 15; 0.83); upper jaw length 27–32 (28.5; 15; 1.55); length barbel 6–12 (9.0; 13; 1.59); length outer gill-slit 14–18 (15.9; 15; 1.33); preanal length 119–146 (123.8; 15; 12.42); outer pelvic ray to anal origin 28–41 (33.9; 15; 5.19); anus to anal origin 14–29 (21.5; 15; 4.81); greatest body depth 63–82 (72.2; 15; 6.45); ID.–2D. interspace 34–57 (44.1; 15; 7.35); height first dorsal fin 75–90 (80.4; 10; 6.15); length pectoral fin 48–78 (55.6; 12; 7.35); length pelvic fin 41–58 (49.2; 11; 4.49).

RELATIONSHIPS AND COMPARISONS.—*Nezumia orbitalis* is closely related to *N. latirostrata* and the two have narrow, coincident, geographic ranges, although *N. orbitalis* is usually found at shallower levels than *N. latirostrata* (the two species were represented together in only one haul, SNP1-28, off Peru in 800 m, the deepest record for *N. orbitalis*). Meristic and morphological features of the two species are close, and the general appearance is similar. Color differences are the most noticeable. The first dorsal fin of *N. orbitalis* is distinctly pallid basally and black tipped distally, whereas in *N.*

latirostrata the fin is uniformly blackish. The head of *N. orbitalis* is paler than that of *N. latirostrata*, and the prominent black orbital ring of the former is essentially lacking in the latter. The area ventrally on the naris appears smudged with black in *N. latirostrata* but is scarcely pigmented in *N. orbitalis*. Silvery reflections persist on the preopercle of *N. orbitalis* specimens but not in *N. latirostrata* specimens, and the belly denuded of scales has a more bluish cast in *N. orbitalis*. *Nezumia latirostrata* is generally a much darker fish.

The low pelvic fin ray count, the number of gill-rakers, and the short barbel together serve to distinguish *N. orbitalis* from other eastern Pacific members of the genus.

The species appears close to the widespread Atlantic species *N. aequalis* (Günther), the two sharing many meristic, morphometric, and coloration features. Even the humpbacked appearance of *N. orbitalis* is shared with one population of *N. aequalis*—that population being coincidentally also one from the eastern side of an ocean (the Gulf of Guinea) (see Marshall and Iwamoto in Marshall 1973:641). *N. orbitalis* is readily distinguished from *N. aequalis*, however, by its somewhat shorter snout length (20–25 percent HL cf. 25–32 in *aequalis*), its relatively longer head length compared with the total length (head length 21–25 percent of total length, cf. 15–18), and its smaller adult size (probably less than 200 mm TL, as judged from the 175-mm length of the ripe female lectotype, cf. more than 270 mm TL in *aequalis* [Marshall and Iwamoto in Marshall 1973:643]).

DISTRIBUTION.—Gulf of Panama to Peru, in 523–800 m.

SIZE.—To at least 41 mm HL and 186 TL.

MATERIAL EXAMINED (15 specimens, 4 localities).—Panama: MCZ 28578 (lectotype, 41 mm HL, 175+ mm TL), MCZ 50956 (5 paralectotypes, formerly MCZ 28578, 28–35 HL, 115+ to 153 TL), and USNM 57856 (2 paralectotypes, 28–34 HL, 129+ to 130+ TL), all from Gulf of Panama, 7°32'36"N, 79°16'W, 286 fms (523 m), ALBATROSS sta. 3385, 8 Mar. 1891.

Peru: LACM 33885 (2, 40–40 HL, 174+ to 186 TL), 7°46'S, 80°31'W, 800 m, sta. SNP1-27, 23 Jan. 1974. —LACM 33886 (4, 27–39 HL, 118–178 TL), 7°44'05"S, 80°30'05"W, 750–760 m, sta. SNP1-28, 23 Jan. 1974. —IMARPE (1, 40 HL, 175+ TL), 13°57.2'S, 76°42.0'W, 580–600 m, 7 Aug. 1972.

Nezumia latirostrata (Garman)

(Figures 4b, 15a, 18e)

Macrurus latirostratus GARMAN, 1899:211–212, pl. 48, fig. 2 (original description; types from ALBATROSS sta. 3354, 3384 and 3394 in Gulf of Panama, 322–511 fms [589–935 m]).

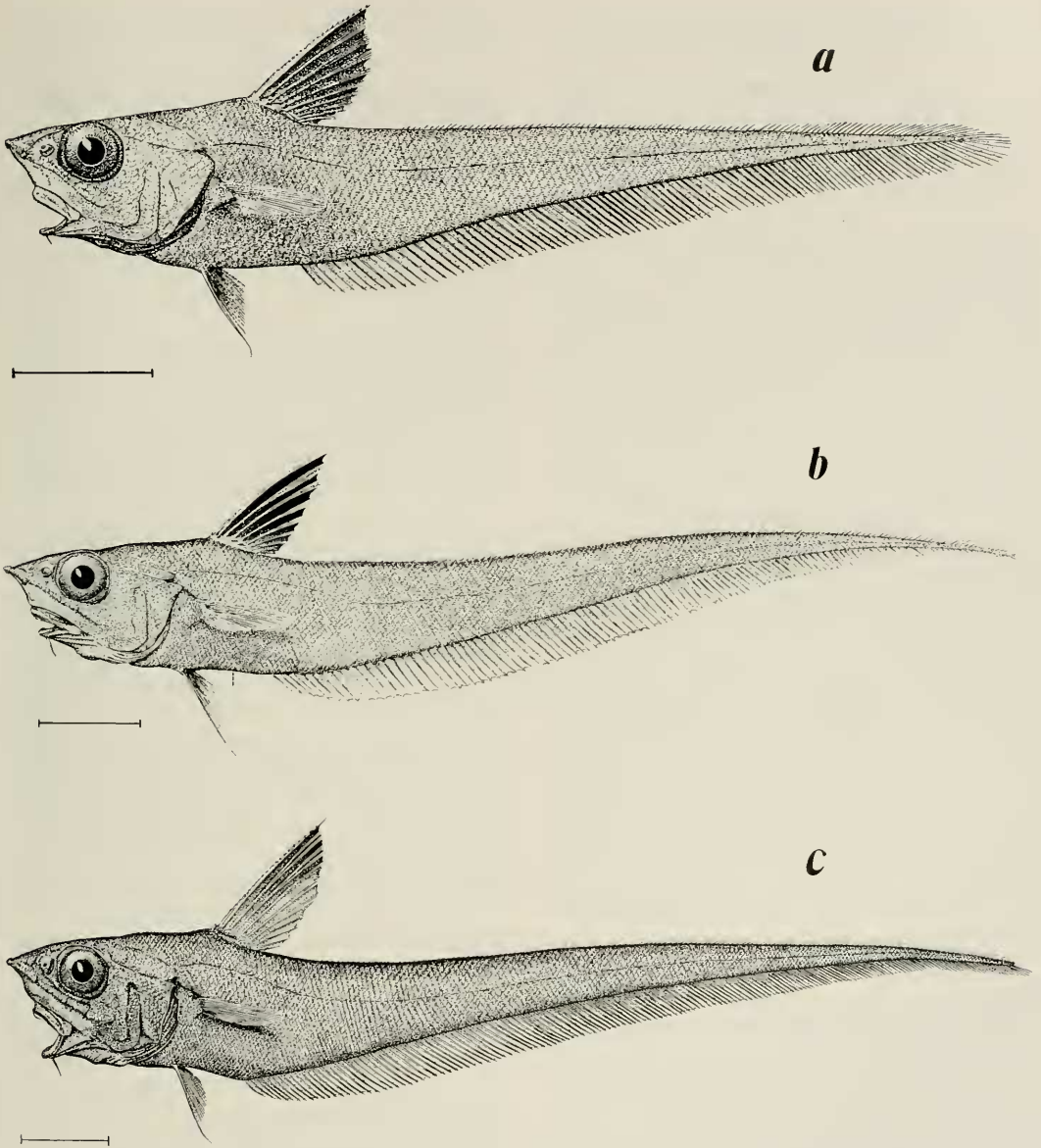


FIGURE 15. (a) *Nezumia latirostrata* (Garman), CAS 38330, 40 mm HL, from off Ecuador in 700–1,000 m. (b) *Nezumia convergens* (Garman), CAS 36816, 44 mm HL, from off Ecuador in 850–1,400 m. (c) *Nezumia loricata atomos* new subspecies. Holotype, CAS 38312, 51 mm HL, 297+ TL, from off Chile in 1,170–1,480 m.

Lionurus (*Nezumia*) *latirostratus*: GILBERT AND HUBBS 1916:146 (name only).

Nezumia latirostrata: MAKUSHOK 1967:table 18.

DIAGNOSIS.—A species of *Nezumia* with 9–10 pelvic fin rays. Gill-rakers on first and second arch 9–11 total (7–9 on lower limb). Barbel length 5–10 percent of HL; upper jaw length 27–

32. Spinules on body scales lanceolate, arranged in indistinct rows without enlarged middle row. Scales below first dorsal $7\frac{1}{2}$ to 9; below second dorsal 6 to $7\frac{1}{2}$. First dorsal fin uniformly blackish.

DESCRIPTION.—General features of fish seen in Figure 15a. Head and trunk moderately com-

pressed, tail greatly so. Head ridges prominent, suborbital ridge strongly angular. Mouth subterminal; rictus extends to below anterior edge of eye lens; maxilla extends to below middle of eye. Terminal and lateral angles of snout armed with small but stout, spiny tubercular scales. Interorbital region slightly concave, width about 60 percent of orbit diameter. Gill membranes broadly attached over isthmus (Fig. 4b), with a narrow posterior free fold; gill opening extends anteroventrally slightly anterior of a vertical through posterior edge of preopercle. Body moderately deep in adults, generally more slender in the young; greatest body depth more than postrostral length of head in all specimens larger than about 30 mm HL. Light organ externally represented by a small, black, oblate, naked fossa between bases of pelvic fins and anterior to anus. Anus situated notably closer to insertion of pelvic fins than to origin of anal fin. Gill filaments short; length of longest slightly shorter than diameter of eye lens.

First dorsal fin of moderate height, length of longest ray less than head length; second spinous ray slightly produced into a thin filament; leading edge of ray armed with small, closely spaced teeth; in some specimens, tip of each tooth overlaps base of adjacent tooth. Paired fins of moderate size; outer ray of pelvic fin produced, extends posteriorly well beyond origin of anal fin.

Body scales moderately deciduous, as judged from generally denuded state of specimens examined. Spinules on body scales distinctly lanceolate, densely covering exposed fields, arranged in indistinct longitudinal rows that converge towards middle of field. Scales absent on ventral surface of snout, but surface copiously dotted with dark sensory papillae. Suborbital region below ridge with a wedge-shaped cluster of small scales. Mandibles with small loose scales along midline of each ramus but naked at anterior end.

Teeth small, in bands of moderate width in both jaws. Outer series of teeth in upper jaw scarcely enlarged.

Coloration in alcohol swarthy. Bluish tinge over trunk and violet tinge over head and tail pronounced in denuded specimens. All fins dark brown to brownish black. Lining of oral cavity dusky, that of gill cavities black except for pale areas ventrally and along medial wall. Peritoneal

cavity pale but peppered with large melanophores.

COUNTS (from 57 specimens).—1D. 11.9–10 (11.8 in two specimens, 11.11 in two others); 1P. 18–23 (\bar{x} = 20.65; n = 105; S.D. = 1.0); 2P. 9–10. Gill-rakers on first and second arch 1–3 + 7–9 (total 9–11). Scales below first dorsal $7\frac{1}{2}$ to 9 (rarely 7); below second dorsal 6 to $7\frac{1}{2}$; lateral-line scales over distance equal to predorsal length of head 32–38 (\bar{x} = 35.88; n = 34; S.D. = 1.5). Pyloric caeca 17–25 (\bar{x} = 21.23; n = 30; S.D. = 2.4).

MEASUREMENTS (from 56 specimens).—Total length 128–231 mm; head length 26–48 mm. The following in percent of head length [range (\bar{x} ; n ; S.D.)]: postrostral length of head 71–77 (73.53; 56; 1.78); snout length 27–34 (29.97; 56; 4.36); preoral length 23–31 (26.16; 56; 1.78); internasal width 20–26 (23.39; 55; 1.23); orbit diameter 30–36 (33.78; 55; 1.46); interorbital width 17–25 (20.84; 56; 1.57); postorbital length of head 36–43 (38.94; 54; 1.52); orbit to angle of preopercle 33–39 (35.25; 55; 1.36); suborbital width 13–17 (15.18; 56; 1.11); upper jaw length 27–32 (29.55; 56; 1.30); length barbel 5–10 (8.19; 49; 1.57); length first gill-slit 11–16 (13.59; 54; 1.13); pre-anal length 123–157 (140.93; 56; 7.57); outer pelvic ray to anal fin origin 27–48 (37.14; 55; 4.59); anus to anal fin origin 16–33 (22.27; 52; 3.78); greatest body depth 66–96 (77.22; 56; 11.01); 1D.–2D. interspace 34–55 (one specimen with 72) (45.41; 56; 6.30); height first dorsal fin 75–98 (83.78; 18; 6.10); length pectoral fin 52–68 (59.32; 50; 4.96); length pelvic fin 41–67 (55.57; 49; 6.92).

COMPARISONS AND RELATIONSHIPS.—*Nezumia latirostrata* and *N. convergens* are closely related and specimens of the two are difficult to differentiate. Chief differences between the two species lie in (1) gill-raker counts, (2) barbel length, (3) scales below first dorsal, (4) scales over distance equal to predorsal length, and (5) body length. *Nezumia latirostrata* generally has 7–9 gill-rakers on the lower limb of the first and second arches, whereas *N. convergens* has 5–7. Barbel lengths contrast at 5–10 percent HL for *N. latirostrata* and 8–20 percent (12–18 in most) for *N. convergens*. Scale rows below the origin of the first dorsal fin are less numerous in *latirostrata* ($7\frac{1}{2}$ to 9) than in *convergens* ($8\frac{1}{2}$ to 10, a few individuals with 11). The number of anterior lateral-line scales over

a distance equal to the predorsal length is generally lower in *latirostrata* (32–38 in most specimens compared with 36–42 in *convergens*), but there is considerable overlap with *convergens* in this feature. The body is somewhat shorter in *latirostrata*; the ratio HL:TL is between 1:4.5 and 1:5.5 (fewer than 12 percent of the specimens with an intact tail had a ratio of more than 1:5.2), whereas in *convergens* it is 1:5.3 to 1:5.8.

Nezumia latirostrata also closely resembles *N. loricata*. The principal differences between the two rest in the pelvic fin ray counts (9–10 in *latirostrata*, 10–12 in *loricata*); barbel length (5–10 percent HL vs. 10–17); number of scale rows below midbase of first dorsal fin (usually 4½ to 5½ vs. 6½ to 7½) and below the origin of the second dorsal fin (6 to 7½ vs. 8–9); and the ratio of head length to body length (1:4.8 to 1:5.5 vs. 1:5.1 to 1:6.1).

Nezumia latirostrata is readily distinguished from other eastern Pacific species of *Nezumia* by characters given in the key. *Nezumia latirostrata* is distinguishable from the Hawaiian species of the genus by a combination of characters that includes snout shape (blunter and shorter in *holocentrus* (Gilbert and Cramer, 1897); *burragei* (Gilbert, 1905); *hebetata* (Gilbert, 1905); and *ectenes* (Gilbert and Cramer, 1897)) and pelvic fin ray count (more in *propinqua* (Gilbert and Cramer, 1897) and *obliquata* (Gilbert, 1905)). Of the Japanese species reported by Okamura (1970a), all but four (*proxima* (Smith and Radcliffe, 1912, in Radcliffe), *tomiyamai* (Okamura, 1963), *burragei* (Gilbert, 1905), and *dara* (Gilbert and Hubbs, 1916)) can be differentiated from *latirostrata* by the number of pelvic fin rays, but *N. tomiyamai*, *N. burragei*, and *N. dara* have more scale rows below the origin of the second dorsal fin than does *N. latirostrata*, and *N. proxima* has a longer barbel (less than two times into orbit diameter compared with three or more times in *latirostrata*).

Most Atlantic members of the genus (see Marshall and Iwamoto in Marshall 1973:624–649) are distinguishable from *N. latirostrata* by a combination of pelvic fin ray count, barbel length, and shape of scale spinules. The western Atlantic species *N. cyrano* Marshall and Iwamoto, 1973, is "probably most closely related to *N. latirostratus*" (ibid.:629), but the two differ in snout length (longer in *cyrano*, 32–36 percent HL, as opposed to 27–34, most specimens below

33, in *latirostrata*), upper jaw length (24–28 in *cyrano* vs. 27–32 in *latirostrata*), and length of first gill-slit (6–10 vs. 11–16).

DISTRIBUTION.—Panama (SE of Punta Mala) to northern Peru (SE of Lobos de Afuera) in 605–1,400 m.

SIZE.—To at least 48 mm HL and more than 234 mm TL.

MATERIAL EXAMINED (182 specimens from 11 localities).—**Panama:** USNM 57855 (2 syntypes, 39–41 mm HL, 198+ to 205 mm TL), 7°21'N, 79°35'W, 935 m, ALBATROSS sta. 3394, 10 Mar. 1888. —GCRL 14259 (2, 47–48 HL, 215–198+ TL), 7°18'N, 79°38'W, 732–805 m, CANOPUS sta. 1285, 24 Mar. 1974. —GCRL 14260 (1. 41 HL, 167+ TL), 7°13'N, 79°18'W, 805–841 m, CANOPUS sta. 1291, 12 Mar. 1974. —CAS-SU 25246 (2, 44–46 HL, 195+ to 245 TL), "between Galapagos and Panama ALBATROSS 1888" (no other data).

Ecuador: CAS-SU 24091 (8, 28–41 HL) and CAS-SU 25223 (9, 38–42 HL), 00°37'S, 81°00'W, 733 m, ALBATROSS sta. 2792, 2 Mar. 1888. —CAS 38328 (1, 42 HL, 175+ TL), 2°20'S, 81°16'W, 850–1,400 m, TE VEGA cr. 19, sta. 84, 4 Aug. 1968. —CAS 38330 (49, 25–45 HL, 133–215 TL), 2°25'S, 81°10'W, 700–1,000 m, TE VEGA cr. 19, sta. 148, 1 Sep. 1968. —CAS 40826 (60, 38–45 HL, 190–234 TL), 3°15'S, 80°55'W, 945–960 m, ANTON BRUUN cr. 18B, sta. 770 (LWK66–120), 10 Sep. 1966.

Peru: USNM 118019 (1, 42 HL, 215+ TL), 5°47'S, 81°24'W, 1,030 m, ALBATROSS sta. 4653, 12 Nov. 1904. —LACM 33885 (2, 37–38 HL, 175–192 TL), 7°46'S, 80°31'W, 800 m, sta. SNPI-27, 23 Jan. 1974. —CAS 38321 (35, 16–46 HL, 81–205 TL) and CAS 38322 (10, 27–46 HL, 100+ to 203 TL), 7°49'S, 80°38'W, 605–735 m, ANTON BRUUN cr. 18B, sta. 754 (LWK66–93), 5 Sep. 1966.

In addition, the following ALBATROSS specimens were examined but no measurements or counts were taken from them: MCZ 28570 (6 syntypes), sta. 3354; MCZ 28571 (10 syntypes), sta. 3384; and MCZ 28572 (3 syntypes), sta. 3394.

Nezumia convergens (Garman)

(Figures 15b, 18f)

Macrurus convergens GARMAN, 1899:210–211, pl. 48, fig. 1 (Gulf of Panama, 695–1,020 fms [1,271–1,865 m], ALBATROSS sta. 3353, 3357, and 3393).

Macrurus cuspidatus GARMAN, 1899:209–210 (Gulf of California, 27°34'N, 110°53'40'W, 905 fms [1,655 m], ALBATROSS sta. 3436).

Macrurus trichiurus GARMAN, 1899:215 (Gulf of Panama, 555 fms [1,014 m], ALBATROSS sta. 3358).

Lionurus (*Nezumia*) *convergens*: GILBERT AND HUBBS 1916:146 (listed).

Lionurus (*Nezumia*) *cuspidatus*: GILBERT AND HUBBS 1916:146 (listed).

Lionurus (*Nezumia*) *trichiurus*: GILBERT AND HUBBS 1916:146 (listed).

Nezumia convergens: MAKUSHOK 1967:table 18.

Nezumia cuspidata: MAKUSHOK 1967:table 18.

Nezumia trichiura: MAKUSHOK 1967:table 18.

Sphagemacrus trichiurus: MARSHALL 1973:623 (listed).

DIAGNOSIS.—A species of *Nezumia* with pel-

vic fin rays 10–11. Gill-rakers on first arch 7–9 (5–7 on lower limb); on second arch 8–9. Spinules on body scales slender, conical to narrowly lanceolate, in discrete longitudinal rows, middle row often enlarged. Barbel length 8–20 percent HL (usually 2.5–3.0 in orbit); upper jaw length 26–32. First dorsal fin uniformly blackish.

DESCRIPTION.—General features of fish seen in Figure 15b. Head slightly compressed, ridges of head generally well developed; suborbital ridge prominent. Mouth subterminal, upper jaw extends posteriad to below middle of eye. Snout moderately pointed; terminal and lateral angles with stout tubercles armed with radiating rows of small spinules. Interorbital region flat to slightly concave, narrow, somewhat more than half orbit diameter. Gill membranes broadly attached over isthmus, with only a narrow posterior free fold; gill openings extend anteroventrally to beneath posteroventral angle of preopercular ridge (Fig. 4b). Body slender; greatest body depth (at origin of first dorsal fin) less than postrostral length of head; 7–8 in total length in large adults. Light organ not well developed externally; no scaleless fossa between pelvic fins. Anus within middle third of distance between pelvic fin insertion and anal fin origin. Gill filaments rather short, length of longest shorter than diameter of eye lens.

Second spinous ray of first dorsal fin longer than postrostral length of head; leading edge armed with rather closely spaced, nonoverlapping slender, sharp teeth. Pectoral and pelvic fins originate about on same vertical, which is anterior to origin of first dorsal fin. Outer pelvic ray in adults extends slightly past anal fin origin. Second dorsal fin rudimentary throughout.

Body scales somewhat deciduous. Slender, sharp, conical spinules uniformly cover exposed fields, aligned in slightly convergent longitudinal rows; spinules in middle row usually larger than those of lateral rows; 10–12 rows of spinules on scales of large adults. Almost all of ventral snout surface and part of anteroventral portion of suborbital region without scales. Mandibular rami covered posteriorly with narrow band of small, loose scales; mandibles generally naked anteriorly, but liberally pocketed there with small pores.

Dentition composed of small teeth in broad bands in both jaws; outer series of teeth in upper jaw not notably enlarged.

Coloration in alcohol generally brownish

black with hint of violet (especially on tail); bluish tinge over abdomen. Fins uniformly black or brownish black. Oral cavity dusky; peritoneal cavity flesh colored, often lightly peppered with large melanophores.

COUNTS (from 80 specimens). —1D. 11.9–10 (rarely 8 or 11); 1P. 18–22 (\bar{x} = 20.18; n = 142; S.D. = 1.02); 2P. 10–11 (rarely 9). Gill-rakers on first and second arch 1–2 + 5–7 (total 7–9; \bar{x} = 8.04; n = 80; S.D. = 0.56). Scales below first dorsal 8½–10 (rarely 11); below second dorsal 5½–9 (usually 6½–9); lateral line scales over distance equal to predorsal length of head 33–44 (usually 36–42). Pyloric caeca 21–32 (usually 25–30) (\bar{x} = 26.97; n = 35; S.D. 2.55).

MEASUREMENTS (from 80 specimens, 25 localities, 17.5–51.6 mm HL, 97–300 mm TL), expressed as percentage of head length [range (\bar{x} ; n ; S.D.)]: postrostral length of head 69–76 (72.60; 79; 1.43); snout length 27–34 (30.46; 80; 1.37); preoral length 22–31 (26.99; 78; 1.59); internasal width 17–23 (20.50; 70; 1.31); orbit diameter 31–37 (33.74; 80; 1.31); interorbital width 16–23 (19.73; 79; 1.29); postorbital length 34–40 (37.78; 78; 1.59); orbit to angle of preopercle 32–40 (35.17; 77; 1.72); suborbital width 12–17 (14.41; 77; 0.96); upper jaw length 26–32 (28.83; 78; 7.37); length barbel 8–20 (14.08; 74; 2.64); length first gill-slit 11–19 (13.22; 76; 1.36); preanal length 133–181 (150.13; 73; 8.47); distance outer pelvic ray to anal origin 27–55 (40.11; 75; 5.24); vent to anal origin 14–28 (20.54; 66; 3.11); greatest body depth 60–78 (71.21; 64; 5.23); 1D.–2D. interspace 28–68 (45.74; 75; 9.00); height first dorsal fin 68–93 (79.68; 53; 5.13); length pectoral fin 46–60 (52.30; 64; 3.52); length pelvic fin 36–61 (46.03; 59; 4.85).

RELATIONSHIPS AND COMPARISONS.—In the eastern Pacific, *Nezumia convergens* appears closest to *N. latirostrata* (Garman), *N. loricata* (Garman), and *N. orbitalis* (Garman), but it is readily distinguished from these three by its fewer gill-rakers on the first arch (9 or fewer total, 5–6 [rarely 7] on lower limb, as compared with 9 or more total, 7–11 on lower limb). Spinules on body scales are generally more slender and conical than those of *N. latirostrata* and *N. loricata*, and they are arranged in discrete parallel rows with the middle row often enlarged (this compares with spinules in a somewhat quincunx arrangement or in rows that converge strongly toward the midline in the other two species). In addition, the body is somewhat more slender

than that of the other three species (greatest depth less than 75 percent of head length in most adults of *N. convergens* compared with more than 75 percent in most adults of other species), the anus is usually more posteriorly placed, often closer to the anal fin origin than to the insertion of the pelvic fins (always closer to the pelvic fin insertion in the others), and the anterior dermal window of the light organ is poorly defined externally (well defined in others). The barbel is slightly longer than that of *N. latirostrata*, and the first dorsal fin is uniformly blackish, not black blotched as in *N. orbitalis*.

Nezumia convergens seems closely related to the western Atlantic species *N. suilla* Marshall and Iwamoto, 1973, with which it shares a close similarity in general physiognomy, coloration, scale spinulation, and extent of naked areas on the ventral surfaces of the head. The lower pelvic fin ray count (7) and broader scale spinules in that species, nonetheless readily distinguish it from *N. convergens*.

REMARKS ON SYNONYMY.—In my studies of the grenadiers described by Garman (1899), I have encountered three instances where he described different specimens of a single species-group taxon as different species. In the present instance, the nominal species concerned are *Macrurus cuspidatus*, *M. convergens*, and *M. trichiurus*. As first revisor, I have chosen to establish the name *M. convergens* over the other two, primarily because the type-series for the species is large and representative, while *M. cuspidatus* and *M. trichiurus* were each described from single specimens, the last from a juvenile.

The holotype of *M. cuspidatus* agrees well with the many well-preserved type-specimens of *M. convergens* except for its much deeper body. The entire trunk area of the holotype, in fact, appears to be abnormally swollen, as if it had been over-injected with preservative. If this is true, the deeper body is of no consequence. The Gulf of California capture of *M. cuspidatus* represents the northernmost record of the species and the only record from the Gulf.

The holotype of *M. trichiurus* is a young specimen (17.5 mm HL, 111 mm TL) slightly damaged ventrally. It agrees in all salient features with small specimens of *N. convergens* I have examined. Although Garman (1899:215) gave a pelvic fin ray count of 8 for the species, I counted 10 on both fins of the holotype. The gill-raker

count on that specimen was 1 + 6 on the mesial side of both the first and the second arches.

DISTRIBUTION.—*Nezumia convergens* is one of the most numerous and widely distributed grenadier in the eastern Pacific Ocean. The species has the greatest latitudinal range of any *Nezumia* in the eastern Pacific except *N. stelligolepis*, although present collections show a broad gap between the Islas Tres Marias and Costa Rica. This gap is of little significance, however, in that deep trawling along the Central American coast between the Gulf of Panama and the Gulf of California has been extremely limited. One Gulf of California record; others from off northern Mexico, Costa Rica, Panama, Cocos Ridge, Galápagos, Ecuador, Peru, and Chile (to 34°53.5'S). Capture depths from 600 m to 1,865 m.

SIZE.—To at least 50 mm HL and 300 mm TL.

MATERIAL EXAMINED.—**Mexico:** MCZ 28575 (1, 52 mm HL; holotype of *Macrurus cuspidatus* Garman, 1899), Gulf of California off Guaymas, Sonora, 27°34'N, 110°53'40"W, 1,655 m, ALBATROSS sta. 3436, 22 Apr. 1891. —LACM 31124-4 (3, 43-45 HL, 250-270 TL), N of Islas Tres Marias, 21°52'30"N, 106°47'36"W, 800-550 m, VELERO IV sta. 13770, 21 Jan. 1970.

Costa Rica: LACM 33588 (4, 28-50 HL, 161-295 TL), 9°45'18"N, 85°52'24"W, 1,865-1,372 m, VELERO IV sta. 18932, 12-13 May 1973.

Panama: MCZ 28574 (1 damaged syntype), 7°15'N, 79°36'W, 1,865 m, ALBATROSS sta. 3393, 10 Mar. 1891. —GCRL 14258 (1, 26 HL, 132+ TL), 7°13'N, 79°18'W, 805-841 m, CANOPUS sta. 1291, 12 Mar. 1974. —MCZ 28573 (3 syntypes, 31-42 HL, 170+ to 220+ TL), 7°06'15"N, 80°34'W, 1,271 m, ALBATROSS sta. 3353, 23 Feb. 1891. —MCZ 28556 (1, 17.5 HL, 111 TL; holotype of *Macrurus trichiurus* (Garman, 1899), 6°30'N, 81°44'W, 1,006 m, ALBATROSS sta. 3358, 24 Feb. 1891.

Cocos Island: AMNH 3471 (3, 29-43 HL), 96 km s of Cocos, ARCTURUS sta. 74, May 1925.

Galápagos: CAS 36814 (1, 47 HL, 248 TL), 27 km SSE of Isla San Cristobal, 1°06'S, 89°22'W, 700-800 m, TE VEGA cr. 19, sta. 102, 12 Aug. 1968.

Ecuador: CAS 36817 (1, 47 HL, 265 TL), off Gulf of Guayaquil, 2°10'S, 81°13'W, 800-1,000 m, TE VEGA cr. 19, sta. 144, 31 Aug. 1968. —CAS 36816 (8, 19-44 HL, 101-252 TL), 2°20'S, 81°16'W, 850-1,400 m, TE VEGA cr. 19, sta. 84, 4 Aug. 1968. —CAS 36815 (2, 22-30 HL, 108-175 TL), 2°25'S, 81°10'W, 700-1,000 m, TE VEGA cr. 19, sta. 148, 1 Sep. 1968. —CAS 36812 (35, 23-48 HL, 134-230+ TL), 3°15'S, 80°55'W, ANTON BRUUN cr. 18B, sta. 770 (field no. LWK66-120).

Peru: CAS 36813 (3, 40-43 HL, 205-230 TL), 4°10'S, 81°27'W, 1,815-1,860 m, ANTON BRUUN cr. 18B, sta. 766 (field no. LWK66-115), 9 Sep. 1966. —CAS 28760 (1, 21 HL, 97 TL), 17°08'05"S, 73°28'04"W, 860 m, 27 Jan. 1972. —IMARPE (1, 37 HL, 206+ TL), 18°17.3'S, 71°11'W, 600 m, 28 Jan. 1972. —CAS 28762 (1, 33 HL, 177 TL), 18°19'S, 71°12'W, 810 m, 28 Jan. 1972. —IMARPE (1, 32 HL) (bottle label illegible), 800 m, 1972.

Chile: SIO 72-184 (3, 35-39 HL, 182-205+ TL), 18°40.4'S, 70°36.0'W, 768-967 m, THOMAS WASHINGTON, field no.

TABLE 3. RANGE, MEAN (\bar{x}), AND STANDARD DEVIATION (S.D.) OF SELECTED MEASUREMENTS (VALUES IN PERCENTAGE OF HEAD LENGTH) AND COUNTS OF TWO SUBSPECIES OF *NEZUMIA LORICATA* (GARMAN).

Character	Sub-species	n	Range	\bar{x}	S.D.
1D. rays (total)	<i>loricata</i>	11	12-14	12.73	0.8
	<i>atomos</i>	9	11-13	11.78	0.8
1P. rays	<i>loricata</i>	23	20-24	21.48	1.1
	<i>atomos</i>	18	21-25	22.22	1.0
2P. rays	<i>loricata</i>	24	10-11	10.92	0.3
	<i>atomos</i>	18	11-12	11.28	0.5
GR I (total)	<i>loricata</i>	12	9-12	10.58	0.9
	<i>atomos</i>	9	11-14	12.44	0.9
GR II (total)	<i>loricata</i>	12	10-12	10.83	0.7
	<i>atomos</i>	9	11-13	12.56	0.7
Postrostral len. of head	<i>loricata</i>	10	70-75	72.60	1.4
	<i>atomos</i>	9	67-72	69.56	1.3
Snout length	<i>loricata</i>	12	29-32	30.75	1.1
	<i>atomos</i>	9	32-37	33.89	1.4
Internasal length	<i>loricata</i>	11	20-24	22.00	1.2
	<i>atomos</i>	9	22-25	23.56	1.0
Interorbital width	<i>loricata</i>	12	19-24	21.00	1.4
	<i>atomos</i>	9	22-26	23.78	1.6
Orbit to preopercle	<i>loricata</i>	12	32-36	33.92	1.0
	<i>atomos</i>	9	34-38	35.89	1.2

MV72-11-27, 7 May 1972. —CAS 36807 (6, 27-50 HL, 150+ to 287 TL), 24°29.5'S, 70°40'W, 950 m, ANTON BRUUN cr. 18A, sta. 714 (field no. LWK66-60), 16 Aug. 1966. —CAS 36810 (7, 34-41 HL, 184+ to 220 TL), 32°08.5'S, 71°43'W, 960 m, ANTON BRUUN cr. 18A, sta. 703 (field no. LWK66-47), 12 Aug. 1966. —CAS 36809 (3, 36-42 HL, 218-220 TL), 32°17'S, 71°39.5'W, 580 m, ANTON BRUUN cr. 18A, sta. 702 (field no. LWK66-44), 11 Aug. 1966. —CAS 36805 (28, 29-50 HL, 162-300+ TL), 33°39'S, 72°09.5'W, 1,170-1,480 m, ANTON BRUUN cr. 18A, sta. 699 (field no. LWK66-41), 10 Aug. 1966. —CAS 36811 (2, 35-39 HL, 208-224 TL), 34°06.5'S, 72°18.5'W, 750 m, ANTON BRUUN cr. 18A, sta. 687 (field no. LWK66-25), 5 Aug. 1966. —CAS 36808 (8, 28-39 HL, 148+ to 203 TL), 34°53.5'S, 72°44'W, 780-925 m, ANTON BRUUN cr. 18A, sta. 698 (field no. LWK66-40), 9-10 Aug. 1966.

Nezumia loricata (Garman)

(Figures 15c, 16, 18g; Table 3)

Macrurus loricatus GARMAN, 1899:208-209, pl. 47, figs. 2-2b (original description; specimens from ALBATROSS sta. 3409 and 3410, off Galápagos Islands, 327-331 fms).

Lionurus (*Nezumia*) *loricatus*: GILBERT AND HUBBS 1916:146 (listed).

Nezumia loricata: MAKUSHOK 1967:table 18.

DIAGNOSIS.—A species of *Nezumia* with 10-12 (usually 11) pelvic fin rays. Gill-rakers on first arch 11-14 (8-11 on lower limb); on second arch 10-13 (8-11 on lower limb). Spinules on body scales moderately to broadly lanceolate; no enlarged middle row of spinules on scales. Barbel

length 10-17 percent HL; upper jaw length 29-33. First dorsal fin uniformly blackish.

DESCRIPTION.—General features of fish seen in Figure 15c. Body rather deep, especially in adults; greatest depth at origin of first dorsal fin significantly greater than postrostral length of head. Head length varies from 17 to 20 percent of total length. Rictus extends to below middle of orbit; maxillary extends to vertical slightly behind middle of orbit. Tubercular scutelike scales at tip and lateral angles of snout spiny and stout; the terminal scute bifid. Interorbital space flat to slightly concave, relatively narrow, 1.3-1.7 into orbit. Gill membranes broadly attached across isthmus with little, if any, free fold. Gill openings extend anteroventrally to a point slightly behind vertical through posterior margin of orbits. Dermal window of light organ small, roundish, situated between pelvic fin bases. Anus much closer to origin of pelvic fin than to origin of anal fin. Gill filaments short, length of longest less than half diameter of orbit.

Second spinous ray of dorsal fin stout, armed on leading edge with sharp, pointed, reclined teeth; tip of ray slightly produced. Paired fins moderate in size; outer ray of pelvic fin extends beyond first three or four anal rays, other pelvic rays barely (or do not) reach anal fin origin.

Body scales relatively adherent (compared with those of *N. convergens* and *N. latirostrata*). Spinules on body scales dagger-shaped to narrowly triangular, densely cover exposed fields, arranged in longitudinal series that converge towards middle of field. Scales absent on ventral surface of snout and posteriorly along part of suborbital region; naked areas dotted with sensory papillae, arranged in discrete rows and clusters in most specimens. Mandibular rami covered with small, thin, rather deciduous scales.

Teeth small, in bands of moderate width in both jaws. Outer series of teeth in upper jaw slightly enlarged.

Color in alcohol swarthy to medium brown. Ventral aspects of trunk and head much darker. All fins blackish. Oral cavity dusky. Peritoneal lining blackish and densely punctate in Chilean specimens (subspecies *atomos*), but more flesh colored with scattered large punctations in TE VEGA Galápagos specimens (subspecies *loricata*).

GEOGRAPHIC VARIATION.—I here recognize two subspecies of *Nezumia loricata* based on

differences in certain counts, measurements, and structural features enumerated and discussed below.

Key to the Subspecies of *Nezumia loricata*

- 1a. Terminal snout scute composed of two distinctly separated halves. Gill-rakers on first arch 9–12 total. Postrostral length of head 70–75% of head length (\bar{x} = 72.6); snout length 26–32% (\bar{x} = 30.8). Head length 17.6–20.0% of total length (\bar{x} = 19.0). Galápagos Islands -----
 ----- *N. loricata loricata*
- 1b. Each half of terminal snout scute closely adpressed, without a deep, median gap between them. Gill-rakers on first arch 11–14 total. Postrostral length of head 67–71% HL (\bar{x} = 69.6); snout length 32–37 (\bar{x} = 33.9). Head length 16.6–18.2% of total length (\bar{x} = 17.5). Off Chile -----
 ----- *N. loricata atomos*, new subspecies

The few specimens of restricted size representing the populations off Chile and the Galápagos Islands limit comparisons, but there appear to be sufficient differences in the study material to warrant formal recognition of the two populations. Frequency distributions of counts and measurements showing notable differences between the subspecies are enumerated in Table 3. Chief among the other differences is the shape of the terminal snout scute (Fig. 16)—in Galápagos specimens, the scute is composed of two coarsely spined halves medially split almost to the base, whereas in Chilean specimens, the scute is rather finely spined with the two halves closely adjoined medially, with little gap between. The tubercular scales along the leading edge of the snout and at the lateral angles are also more coarsely spined in the Galápagos specimens, and the Chilean specimens have a broader double row of thickened scales along the suborbital region.

The two populations of *N. loricata* are widely disjunct, and apparently, no material from intervening areas has been collected despite numerous trawl hauls at appropriate depths along the coasts of Ecuador, Peru, and Chile.

The subspecific name *atomos* is derived from the Greek word meaning indivisible or uncut, in reference to the relatively undivided terminal snout scute of this subspecies.

COUNTS (of both subspecies combined).—1D.



FIGURE 16. *Nezumia loricata* (Garman). Dorsal views of terminal snout scute in two subspecies: (a) *N. loricata loricata*; (b) *N. loricata atomos*.

II, 9–12; 1P, 20–25; 2P, 10–12. Gill-rakers on first arch 1–3 + 8–11; on second arch 2 + 8–11. Scales below first dorsal 9 to 12½; below second dorsal 7½ to 9; below midbase of first dorsal 6½ to 7½; over distance equal to predorsal length of head 35–41. Pyloric caeca 20–32 (\bar{x} = 25.9, n = 9).

MEASUREMENTS (of both subspecies combined, other than those given in Table 3).—Total length 175+ to 297+ mm, head length 34–52. The following in percent of head length: preoral length 25–30; orbit diameter 31–36; postorbital length of head 36–40; suborbital width 14–17; upper jaw length 29–33; length pelvic fin 44–68; length barbel 10–17; length outer gill slit 14–17; preanal length 140–157; base outer pelvic ray to anal origin 31–44; anus to anal origin 16–28; greatest body depth 67–87; height first dorsal fin 80–101; length pectoral fin 48–63.

COMPARISONS AND RELATIONSHIPS.—*Nezumia loricata* appears most closely related to *N. latirostrata*, but the two are readily distinguished by differences given in the key and in the description of *N. latirostrata*. *Nezumia loricata* may be distinguished from another close relative, *N. convergens*, by differences in gill-raker numbers, spinules on body scales, relative body depth, and placement of anus (see comparisons in description of *N. convergens*). Other eastern Pacific species of the genus are differentiated from *N. loricata* by characters given in the key.

DISTRIBUTION.—Galápagos (subspecies *loricata*) and central Chile (subspecies *atomos*).

SIZE.—To at least 52 mm HL and 300 mm TL.

MATERIAL EXAMINED.—Galápagos (subspecies *loricata*): MCZ 28577 (4 syntypes, 45–55 mm HL, 215+ to 250 mm TL), and USNM 57859 (1 syntype, 47 HL, 240+ TL), 00°19'N, 90°34'W, 331 fms (605 m), ALBATROSS sta. 3410, 3 Apr. 1891. —MCZ 28576 (1 syntype, 48 HL, 260 TL), 00°18'40"N, 90°34'W, 327 fms (598 m), ALBATROSS sta. 3409, 3 Apr. 1881.

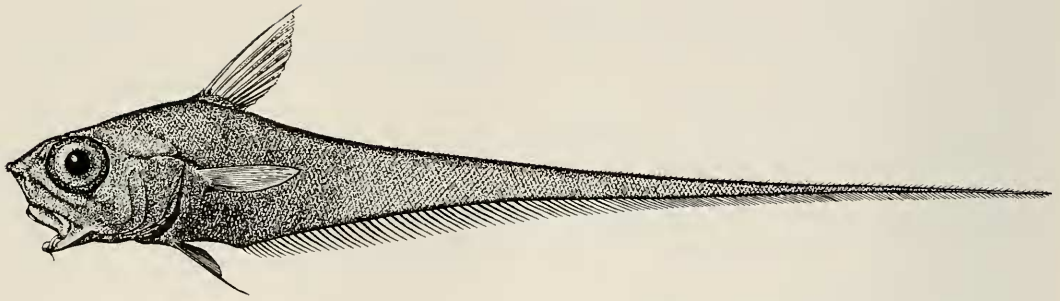


FIGURE 17. *Nezumia parini* Hubbs and Iwamoto, 1977. Paratype, CAS 29414, 35 mm HL, 216 mm TL, from off Peru.

—USNM 135603 (remains of about 6 specimens, mostly disintegrated), 00°29'S, 89°54'30"W, 392 fms (717 m), ALBATROSS sta. 2818, 15 Apr. 1888. —CAS 38329 (7, 34–50 HL, 175+ to 250 TL), 1°06'S, 89°22'W, 700–800 m, TE VEGA cr. 19, sta. 102, 12 Aug. 1968. —CAS-SU 25246 (2, 44–46 HL, poor condition), captured "between Galapagos and Panama, ALBATROSS 1888."

Chile (subspecies *atomos*): HOLOTYPE, CAS 38312 (51 mm HL, 297+ mm TL) and 8 PARATYPES, CAS 43427 (47–51 HL, 270–290 TL), 33°39'S, 72°09'W, 1,170–1,480 m, ANTON BRUUN cr. 18A (field no. LWK66–41), 10 Aug. 1966.

Nezumia parini Hubbs and Iwamoto

(Figures 17, 18a)

Nezumia parini HUBBS AND IWAMOTO, 1977:246–250, fig. 8, 11, table 4.

DIAGNOSIS.—A bathypelagic species of *Nezumia* with 11–12 pelvic fin rays. First and second gill arches each with 10–13 rakers. Small, circular body scales each with 1–15 long, erect, needlelike spinules. Scale rows below second dorsal about 11–14. Barbel length 7–13 percent HL; upper jaw length 31–36 percent HL; outer pelvic fin ray length 71–160 percent HL. Overall color dark brown to black.

REMARKS.—General features of the fish can be seen in Figure 17. This distinctive species, described in detail in the original description, is the only *Nezumia* with bathypelagic adults, although in other species (e.g., *N. stelgidolepis*) the early-life stages are probably bathypelagic. The relationships of *N. parini* are obscure, but probably lie closest to the *convergens-latirostrata-loricata-orbitalis* complex of species. The dense, fine, erect spinules on the small scales give a distinctive furry texture and feel to body surfaces.

SIZE.—*Nezumia parini* is a small species at-

taining a head length of 35 mm and a total length of 216 mm.

DISTRIBUTION.—Midwaters of the equatorial eastern Pacific and off the western shores of the Americas between Panama (7°30'N) and northern Chile (20°00'S).

MATERIAL EXAMINED.—See original description. In addition, one specimen recently discovered in the CAS-SU collections filed under unidentified Gadidae: CAS-SU 57651 (formerly New York Zoological Society cat. no. 28704), (1, 35.6 mm HL, 202 mm TL), off Colombia, 4°45'N, 78°02'W, meter net fished over bottom depth of 500 fms (914 m), ZACA sta. 233, 3 Apr. 1938.

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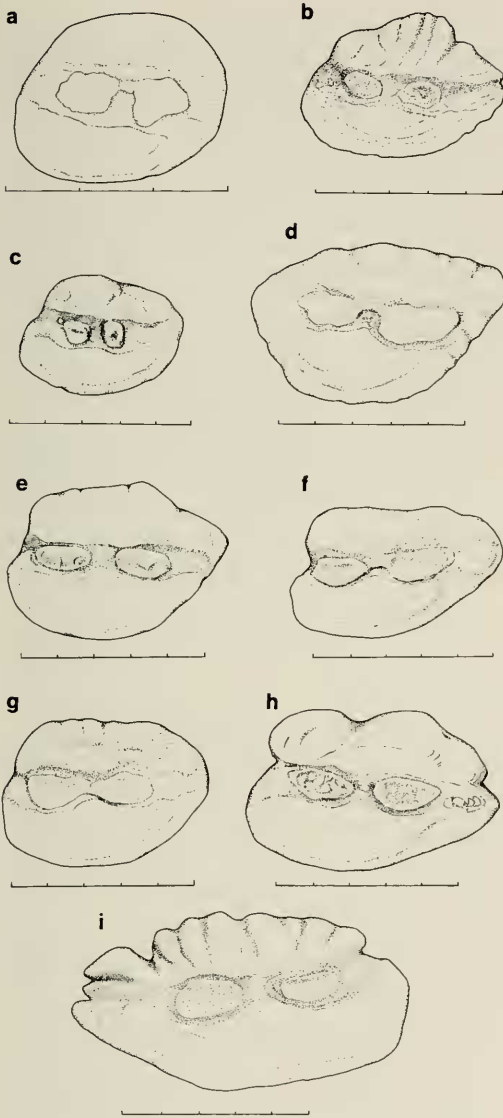


FIGURE 18. Otoliths (left saggita) from (a) *Nezumia parini*, (b) *N. pulchella*, (c) *N. liolepis*, (d) *Ventrifossa nigromaculata*, (e) *Nezumia latirostrata*, (f) *N. convergens*, (g) *N. loricata atomos*, (h) *N. pudens*, and (i) *N. steligidolepis*. Increments on scale bars equal 1 mm.

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