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GRENADIERS (PISCES, GADIFORMES) OF THE NAZCA AND SALA Y GOMEZ RIDGES, SOUTHEASTERN PACIFIC

By

Yuri I. Sazonov

Department of Ichthyology, Zoological Museum, Moscow Lomonosov State University, Herzen Street 6, Moscow 103009, Russia

and

Tomio Iwamoto

Department of Ichthyology, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118, U.S.A.

ABSTRACT: Twenty-five species of grenadiers are recorded from the Nazca and Sala y Gomez ridges in the southeastern Pacific. New species include: *Caelorinchus immaculatus, C. multifasciatus, C. nazcaensis, C. spilonotus, Hymenocephalus neglectissimus, H. semipellucidus, Kuronezumia pallida, Ventrifossa macrodon, V. teres,* and *V. obtusirostris. Caelorinchus immaculatus* is very similar to *C. karrerae* from the southeastern Atlantic and Indian Ocean. The *H. striatissimus* complex is examined using new data. *Hymenocephalus semipellucidus* and *H. neglectissimus* appear to be part of this complex. The subspecies *H. s. hachijoensis* from Japan is elevated to full species status. *Kuronezumia,* formerly considered a subgenus of *Nezumia,* is redefined and elevated to generic status to include *K. pallida, K. bubonis, K. leonis, K. macronema, K. dara,* and two undescribed species. Despite proximity of the ridges to the mainland coast of Peru, relationships of the associated fauna are to the west, particularly the western Pacific and Hawaiian Islands. Of the 25 species from these ridges, eight are definitely known from the vicinity of the Hawaiian Islands: *Caelorinchus spilonotus, Cetonurus crassiceps,* Coryphaenoides paradoxus,* H. striatulus, Malacocephalus laevis,* Mataeocephalus acipenserinus, Nezumia propinqua,** and *Pseudocetonurus septifer.* Three other species whose identifications are undetermined may be part of, or have close counterparts in, the Hawaiian fauna: *Gadomus* sp. cf. *melanopterus, Hymenocephalus* sp. cf. *aterrimus,* and *Trachonurus villosus*?* The four species marked with an asterisk are broadly distributed through the Pacific, Indian, and Atlantic oceans. *Malacocephalus laevis* is known from the continental slopes of southern California and on seamounts off Baja California, but nowhere else along the Pacific coast of Central and South America. *Caelorinchus immaculatus* is also recorded from mainland South America; *Nezumia convergens* is questionably represented by a specimen from the Sala y Gomez Ridge.

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INTRODUCTION

The research vessel *Ichthyandr* of the Sevastopol Bureau of Underwater Researches of the former USSR Ministry of Fisheries surveyed the Nazca and Sala y Gomez oceanic ridges (Fig. 1) off the southwestern coast of Peru on its fifth cruise between April and November 1979. Preliminary studies (Parin et al. 1981) of the material collected during that cruise suggested the existence of an extremely diverse ichthyofauna on these ridges. The species composition of the macrourid fishes, or grenadiers, differed markedly from that known along the nearby continental margins and, in fact, appeared to be more similar to those from the Indo-Pacific region, not the eastern Pacific.

Subsequently, between 1979 and 1987, several other Soviet expeditions investigated the ridges and collected many grenadiers from depths of about 300–800 m, with a few trawls below 1,000 m. In preparing the section on the grenadiers for the preliminary report (Parin et al. 1981), Sazonov recognized 11 species, eight of which he considered new or of uncertain taxonomic status. Additionally, Sazonov and Shcherbachev (1982) described a new genus and species (*Pseudocetonurus septifer*) from the Sala y Gomez Ridge.

Because of the obvious Indo-West Pacific affinities of the grenadiers, it was necessary to examine many type specimens deposited in U.S. museums, particularly the U.S. National Museum of Natural History (USNM) and the California Academy of Sciences (CAS). The idea of studying the fauna on a cooperative basis was initially proposed by N. V. Parin during a Workshop on Cold-Water Fishes held in Orono, Maine, in 1979. The study was begun in 1981 and a preliminary manuscript was drafted in 1988 after Iwamoto spent 3.5 months in the Laboratory of Oceanic Ichthyofauna, Russian Academy of Sciences, Moscow. This paper presents the results of the cooperative effort.

Twenty-five species of grenadiers are herewith recorded from the Nazca and Sala y Gomez ridges, ten of which are described as new. Two others may represent undescribed taxa, but the available material does not justify their formal recognition. Considering that for the most part only the shallowest levels of these oceanic ridges have been sampled, the faunal list can be expected to grow, especially in bathybenthic and abyssal forms.

MATERIALS AND METHODS

Almost all specimens reported here were collected by Soviet oceanographic and fishery research vessels. Most collections were made between 1979 and 1987, although a few specimens found at the Zoological Institute in St. Petersburg

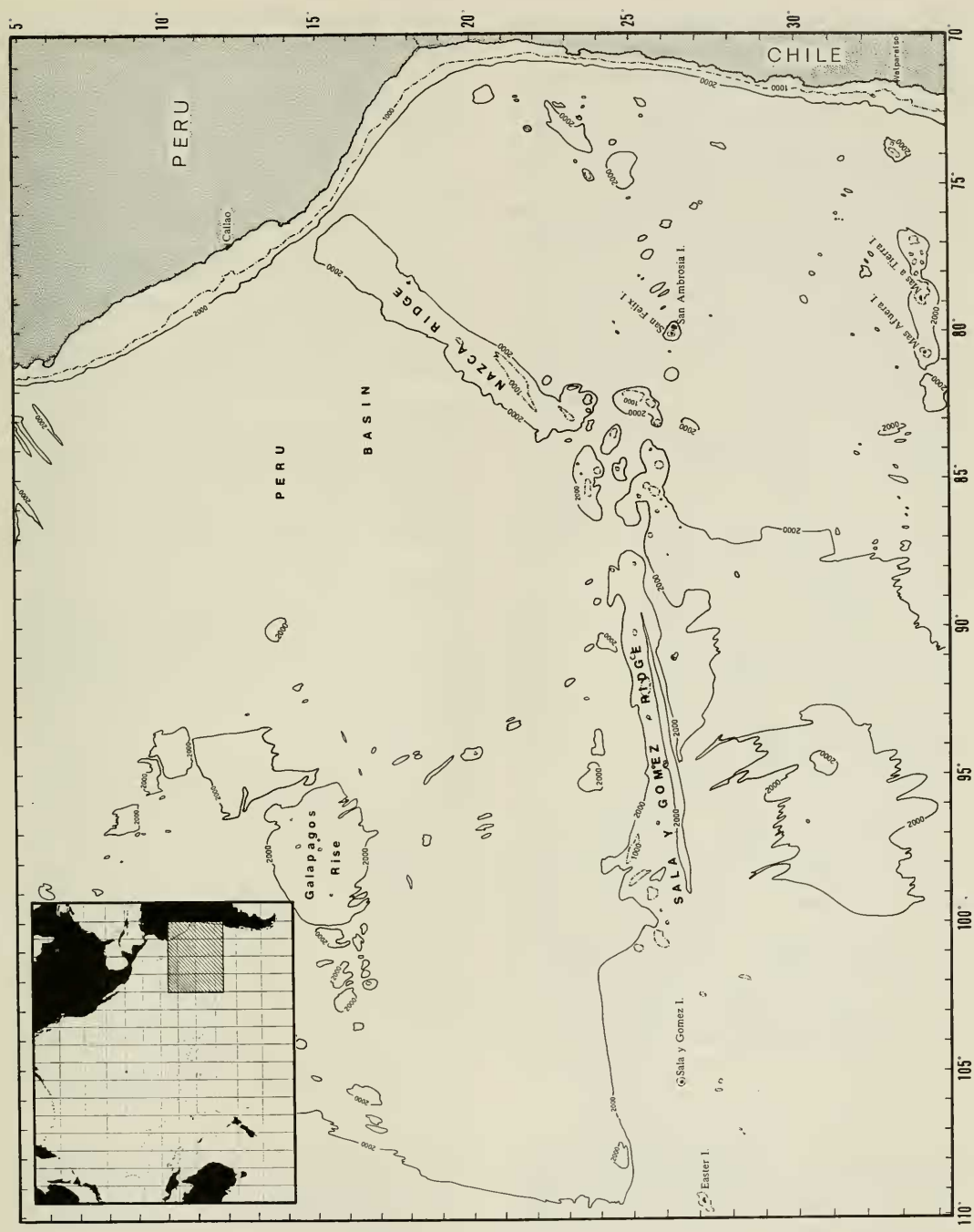

FIGURE 1. Map of southeastern Pacific showing location of the Nazca and Sala y Gomez ridges. Inset shows general location of larger map. Depth contours in fathoms (solid lines represent 2,000 fathoms or about 3,658 m; broken lines represent 1,000 fathoms or about 1,829 m). Based in part on a chart by Mammerickx et al. 1975.

(ZIN) and the Zoological Museum, Moscow State University (ZMMGU) were procured in 1973 and 1975 during cruises of the *Hercules* and *Astronomer* of the Pacific Fisheries and Oceanography Research Institute, Vladivostok (TINRO). Most of the specimens used for this report are deposited in the Institute of Oceanology, Russian Academy of Sciences, Moscow (IOAN) and ZMMGU, with representatives also deposited in CAS and ZIN. A list of Russian vessels and station data are provided in Table 1.

Institutional abbreviations follow Leviton et al. (1985) as amended by Leviton and Gibbs (1988). Abbreviations and methods of taking measurements and counts are the same as those described in a previous paper (Iwamoto and Sazonov 1988). The abbreviation NSG is used throughout to refer to the combined Nazca and Sala y Gomez ridges. The following abbreviations are also used: cr.—cruise; fm(s)—fathom(s); HL—head length; spec.—specimen; sta.—station; TL—total length; tr.—trawl.

The descriptions of species are based mainly on the materials examined from NSG and usually do not include specimens from outside the area, even though such additional materials have been examined when available. These peripheral specimens are usually considered in the Remarks and Comparisons sections.

Several species have been adequately described and illustrated in recent literature. For these, a brief diagnosis or a short diagnostic description is provided. For other species, more extensive descriptions are given, but synonymies are kept to a minimum; those included are limited to recent references and a few older ones with good descriptions or illustrations. As this is not meant to be a comprehensive revision of the groups treated, generic accounts are for the most part very brief, and synonyms are omitted.

Classification of Grenadiers

There has been a recent surge of interest in the higher classification of gadiform fishes, which culminated in a workshop on the systematics of the group in 1986 (see Cohen 1989). The workshop brought together disparate workers in the group to air their views on its classification and phylogeny and search for a modicum of agreement. For the so-called macrouroid fishes, or grenadiers, there was none. Howes (1988, 1989), in a radical departure, removed the bathygadine

Table 1. Soviet research vessels and trawl stations on the Nazca and Sala y Gomez ridges at which grenadiers were collected.

Hercules (1973)
- tr. 40: Nazca Ridge, 19°30.4′S, 80°11.2′W; 950 m; bot. trawl; 20.X.1973.

Hercules (1975)
- sta. 68: Sala y Gomez Ridge, 25°18.8′S, 93°34.2′W; 610 m; bot. trawl; 1.XI.1975.
- sta. 70: Sala y Gomez Ridge, 25°01′S, 91°18′W; 610–620 m; bot. trawl; 2.XI.1975.
- sta. 74: Sala y Gomez Ridge, 24°57.5′S, 88°27.1′W; 550–630 m; bot. trawl; 5.XI.1975.
- sta. 110: between Nazca and Sala y Gomez ridges, 25°35.0′S, 85°13′W; 1,600–2,000 m; midwater trawl; 3.XII.1975.

Astronomer (1975)
- tr. without no.: Nazca Ridge, 23°30.5′S, 81°45′W; 300–330 m; bot. trawl; 29.VI.1975.
- sta. 104: Sala y Gomez Ridge, 25°00′S, 88°30′W; 550 m; bot. trawl; 24.VII.1975.
- tr. without no.: Sala y Gomez Ridge, 25°02′S, 88°35′W; 550 m; bot. trawl; 24.VII.1975.

Ichthyandr cr. 5 (1979)
- tr. 1: Nazca Ridge, 19°40′S, 80°18′W; 980 m; 26.VIII.1979.
- tr. 13: Nazca Ridge, 21°30′S, 81°42′W; 330 m; 5.IX.1979.
- tr. 14: Nazca Ridge, 21°24′S, 81°41′W; 330–340 m; 6.IX.1979.
- tr. 15: Nazca Ridge, 21°27′S, 81°41′W; 330 m; 7.IX.1979.
- tr. 17: Nazca Ridge, 21°41′S, 81°41′W; 310–330 m; 9.IX.1979.
- tr. 40: Sala y Gomez Ridge, 25°52′S, 86°47′W; 440 m; 24.IX.1979.
- tr. 44: Nazca Ridge, 21°32′S, 81°38′W; 330 m; 30.IX.1979.
- tr. 50: Sala y Gomez Ridge, 25°07′S, 99°37′W; 450–480 m; 24.X.1979.
- tr. 51: Sala y Gomez Ridge, 25°07′S, 99°39′W; 360–400 m; 24.X.1979.
- tr. 52: Sala y Gomez Ridge, 25°02′S, 99°26′W; 770 m; 24.X.1979.
- tr. 53: Sala y Gomez Ridge, 25°02′S, 88°32′W; 540 m; 29.X.1979.
- tr. 54: Sala y Gomez Ridge, 25°01′S, 88°27′W; 535–575 m; 30.X.1979.
- tr. 55: Sala y Gomez Ridge, 25°00′S, 88°31′W; 345–540 m; 30.X.1979.
- tr. 56: Sala y Gomez Ridge, 25°46′S, 86°33′W; 410 m; 31.X.1979.
- tr. 57: Sala y Gomez Ridge, 25°42′S, 86°32′W; 420 m; 31.X.1979.

Ichthyandr cr. 6 (1980)
- tr. 1: Nazca Ridge, 21°27′S, 81°40′W; 340 m; 5.VIII.1980.
- tr. 2: Nazca Ridge, 21°08′S, 81°39′W; 320 m; 5.VIII.1980.
- tr. 3: Nazca Ridge, 21°28′S, 81°39′W; 340 m; 6.VIII.1980.
- tr. 10: Nazca Ridge, 21°27′S, 81°41′W; 320–340 m; 9.VIII.1980.
- tr. 33: Nazca Ridge, 21°28′S, 81°41′W; 330 m; 21.IX.1980.
- tr. 56: Sala y Gomez Ridge, 25°45′S, 86°35′W; 430 m; 2.X.1980.

Odissey cr. 2 (1981–82)
- tr. 11: Nazca Ridge, 22°11′S, 81°21′W; 235 m; bot. trawl; 23.XII.1981.

Table 1. Continued.

tr. 14: Nazca Ridge, 22°11.6′S, 81°18.8′W; 230 m; bot. trawl; 25.XII.1981.
tr. 15: Nazca Ridge, 22°12′S, 81°19′W; 230–250 m; bot. trawl; 25.XII.1981.

Akademik Kurchatov cr. 34 (1983)

sta. 3594: Nazca Ridge, 21°28.8′S, 81°42.0′W; 340 m; Sigsbee trawl; 25.XI.1982.

Professor Mesiatzev cr. 13 (1983)

tr. 1: Sala y Gomez Ridge, 24°58.6′S, 88°28′W; 565–555 m; 1.IX.1983.
tr. 2: Sala y Gomez Ridge, 24°59.8′S, 88°25′W; 550–560 m; 1.IX.1983.
tr. 4: Sala y Gomez Ridge, 25°45′S, 86°37′W; 410–420 m; 2.IX.1983.
tr. 7: Sala y Gomez Ridge, 25°41′S, 85°31′W; 285–300 m; 3.IX.1983.
tr. 10: Sala y Gomez Ridge, 25°34.4′S, 85°20.7′W; 1,070–1,100 m; 4.IX.1983.
tr. 14: Sala y Gomez Ridge, 25°52.7′S, 84°34.2′W; 1,050 m; 5.IX.1983.
tr. 17: between Sala y Gomez and Nazca ridges, 23°38.8′S, 85°27.5′W; 1,220–1,230 m; 7.IX.1983.
tr. 23: Nazca Ridge, 22°08′S, 81°19′W; 235–250 m; 12.IX.1983.
tr. 25: Nazca Ridge, 22°04′S, 81°17′W; 235–225 m; 12.IX.1983.
tr. 31: Nazca Ridge, 22°06′S, 81°17′W; 225–240 m; 14.IX.1983.
tr. 35: Nazca Ridge, 22°07′S, 81°18′W; 340–325 m; 14.IX.1983.
tr. 36: Nazca Ridge, 22°07′S, 81°18′W; 235–230 m; 14.IX.1983.
tr. 39: Nazca Ridge, 22°06′S, 81°16′W; 230–240 m; 16.IX.1983.
tr. 43: Nazca Ridge, 20°46′S, 80°52′W; 320–325 m; 18.IX.1983.
tr. 44: Nazca Ridge, 20°44.9′S, 80°52.3′W; 340–780 m; 18.IX.1983.
tr. 94: Nazca Ridge, 19°35.5′S, 80°15.7′W; 940–960 m; 10.XI.1983.
tr. 109: Nazca Ridge, 22°06′S, 81°17′W; 225–240 m; 15.XI.1983.
tr. 120: Nazca Ridge, 22°05′S, 81°17′W; 230 m; 18.XI.1983.

Professor Mesiatzev cr. 15 (1984)

tr. 49: Sala y Gomez Ridge, 25°01.7′S, 88°26.9′W; 525–530 m; 10.X.1984.
tr. 50: Sala y Gomez Ridge, 25°57′S, 88°31′W; 565 m; 11.X.1984.
tr. 52: Sala y Gomez Ridge, 25°45′S, 88°36′W; 400 m; 11.X.1984.
tr. 53: Sala y Gomez Ridge, 25°44′S, 86°36′W; 390–385 m; 11.X.1984.
tr. 54: Sala y Gomez Ridge, 25°48′S, 86°15′W; 304 m; 12.X.1984.

Professor Shtokman cr. 18 (1987)

sta. 1826: Nazca Ridge, 20°44.8′S, 80°53.7′W; 300–0 m over bot. depth 330–340, IKMWT; 17.IV.1987.
sta. 1828/35: Nazca Ridge, 20°48.8′S, 80°53.5′W; 730–720 m; traps; 18.IV.1987.

Table 1. Continued.

sta. 1845: Nazca Ridge, 21°24.0′S, 81°38.6′W; 330 m; bot. trawl; 19.IV.1987.
sta. 1851: Nazca Ridge, 21°23.2′S, 81°38.3′W; 330–350 m; bot. trawl; 19–20.IV.1987.
sta. 1856: Nazca Ridge, 21°43.9′S, 81°04.9′W; 900–920 m over bot. depth 1,270–1,200 m; IKMWT; 20.IV.1987.
sta. 1864/76: Nazca Ridge, 22°04.1′S, 81°16.7′W; 530–500 m; traps; 21.IV.1987.
sta. 1867: Nazca Ridge, 22°06.1′S, 81°17.0′W; 225–247 m; bot. trawl; 21.IV.1987.
sta. 1873: Nazca Ridge, 22°07.1′S, 81°16′W; 235 m; bot. trawl; 22.IV.1987.
sta. 1879/1882: Nazca Ridge, 23°26.4′S, 83°20.1′W; 505 m; traps; 23.IV.1987.
sta. 1887: between Sala y Gomez and Nazca ridges, 24°41′S, 85°25.6′W; 50–300 m over bot. depth 408–>2,000 m; IKMWT; 24.IV.1987.
sta. 1925: Sala y Gomez Ridge, 25°32.4′S, 85°29.5′W; 50–300 m over bot. depth 1,200–>2,000 m; IKMWT; 27.IV.1987.
sta. 1938: Sala y Gomez Ridge, 25°42.4′S, 86°35.3′W; 380 m; Sigsbee trawl; 28.IV.1987.
sta. 1940: Sala y Gomez Ridge, 25°41.0′S, 86°35.9′W; 380 m; bot. trawl; 28.IV.1987.
sta. 1941: Sala y Gomez Ridge, 25°48.6′S, 86°34.1′W; 410–385 m; 28.IV.1987.
sta. 1949: Sala y Gomez Ridge, 25°37.5′S, 86°29.4′W; 200–0 m over bot. depth 390 m; IKMWT; 29.IV.1987.
sta. 1955/62: Sala y Gomez Ridge, 24°57.7′S, 88°36.1′W; 560 m; traps; 29–30.IV.1987.
sta. 1956/61: Sala y Gomez Ridge, 24°54.0′S, 88°32.0′W; 580 m; traps; 29–30.IV.1987.
sta. 1964: Sala y Gomez Ridge, 24°56.3′S, 88°32.6′W; 580–564 m; bot. trawl; 30.IV.1987.
sta. 1965: Sala y Gomez Ridge, 24°58.5′S, 88°29.3′W; 562–545 m; bot. trawl; 30.IV.1987.
sta. 1970: Sala y Gomez Ridge, 25°34.2′S, 89°09.1′W; 540–560 m; Sigsbee trawl; 1.V.1987.
sta. 1971: Sala y Gomez Ridge, 25°30.4′S, 89°10.3′W; 570–580 m; bot. trawl; 1.V.1987.
sta. 1976: Sala y Gomez Ridge, 25°33.6′S, 89°11.9′W; 563–590 m; 1.V.1987.
sta. 1977: Sala y Gomez Ridge, 25°09.9′S, 90°18.7′W; 545–600 m; bot. trawl; 1–2.V.1987.
sta. 1996: Sala y Gomez Ridge, 25°08.2′S, 99°25′W; 750–800 m, 5.V.1987.
sta. 2018: Sala y Gomez Ridge, 25°07.9′S, 99°26.8′W; 730–790 m; 7.V.1987.
sta. 2019: Sala y Gomez Ridge, 25°05.7′S, 99°27.7′W; 750 m; Sigsbee trawl; 7.V.1987.
sta. 2023: Sala y Gomez Ridge, 25°07′S, 99°40′W; 439–500 m; bot. trawl; 8.V.1987.

and trachyrincine grenadiers from the suborder Macrouroidei and included them in the suborder Gadoidei, raising both to family status (see also Howes and Crimmen 1990). Okamura (1989)

maintained the original view of the Macrouroididae as a distinct family in the Macrouroidei and also raised the Trachyrincinae to family status, but he kept them and the Bathygadinae in the Macrouroidei, and also added to this suborder the enigmatic Euclichthyidae. Iwamoto (1989), Markle (1989), and Nolf and Steurbaut (1989a, b) maintained more traditional views of Trachyrincinae, Macrouroidinae, Bathygadinae, and Macrourinae as subfamilies of Macrouridae.

We recognize that there are apt to be changes in the higher classification of what we now consider as macrouroid fishes, and that the traditional view of the family Macrouridae being monophyletic will probably not stand. There will undoubtedly be a sorting-out period before a consensus is reached based on additional research. For the purposes of this paper, we find it convenient to follow a conservative classification and treat the major groups as subfamilies, with the exception of the Bathygadidae, and call them all grenadiers.

Description of Nazca and Sala y Gomez Ridges

One of the most notable geologic features of the oceanic basin of the southeastern Pacific is a long, deep, and broken submarine range that extends westward from the Peru-Chile Trench in the vicinity of Nazca, Peru, and traverses the basin to connect with the East Pacific Rise around longitudes 110°–115°W (Fig. 1). It is one of the world's major mountain ranges, but it is exposed at the surface only on San Ambrosio, San Felix, Sala y Gomez, and Easter islands (Norris 1961).

The Nazca Ridge forms the easternmost part of this range, beginning at the western rim of the Peru-Chile Trench at a latitude of about 15°S and extending in a southwesterly direction for about 600 nautical miles. The northeastern half of the ridge arises from a bottom depth of more than 4,500 m to reach upwards to within 2,200–2,900 m of the surface. Only a few pinnacles in this part of the ridge are taller. This contrasts with the higher southeastern half, where a considerable portion lies above the 2,000-m isobath. Dominating this half is an elongated prominence, offset from the main axis of the ridge, that rises to within 320 m of the sea surface.

The central part of the range lies to the east of Sala y Gomez Island and forms a well-defined ridge that rises 2,400–3,000 m above the surrounding sea floor (Norris 1961). This ridge, called the Sala y Gomez Ridge (Fisher and Norris 1960), extends more than 1,000 nautical miles to the east. It is punctuated by many prominences that rise to within 1,500 m of the surface. Several peaks that lie between longitudes 97°W and 101°W come to within the upper 500 m of the surface.

Between the Nazca and Sala y Gomez ridges and to the south of the Nazca Ridge are a cluster of high seamounts that rise close to the surface. San Felix and San Ambrosio islands constitute the tips of the easternmost peaks of this cluster. The seamounts in this region were extensively investigated by Russian vessels.

Key to NSG Species of Grenadiers

This key is presented as a convenient guide to the identification of grenadiers from the Nazca and Sala y Gomez ridges. It should be used only as a guide, however, and preliminary identifications should be confirmed with the descriptions. It can be confidently used only for adult specimens, as juveniles undergo ontogenetic changes that render many of the key characters useless. Because its coverage is geographically limited, some character states that key out NSG genera will not agree with the broader range of states given in the diagnoses for genera (e.g., pelvic rays in *Caelorinchus* is given as seven in the key but six or seven in the diagnosis because six is found only in one western Pacific species). Figures for the key are mainly from FAO Species Identification Sheets. For a more comprehensive key to the genera and species of grenadiers, the reader is referred to the *FAO Species Catalogue* on Gadiformes of the world (Cohen et al. 1990).

1a. One dorsal fin, no portion elevated, spinous rays absent; pelvics small or absent; head enormous, globose; eyes 10 or more in HL (Macrouroidinae) (Fig. 2a) 2

1b. Two dorsal fins, the first elevated, first two rays spinous; pelvics small to large; head moderate to large; eyes 5 or less in HL (Fig. 2b) 3

2a. Pelvic fins absent ..... *Macrouroides inflaticeps* (p. 38)

2b. Small pelvics with 5 or 6 rays ..... *Squalogadus modificatus* (p. 39)

3a. Mouth large, terminal (Fig. 2c); first (outermost) gill slit unrestricted; gill rakers

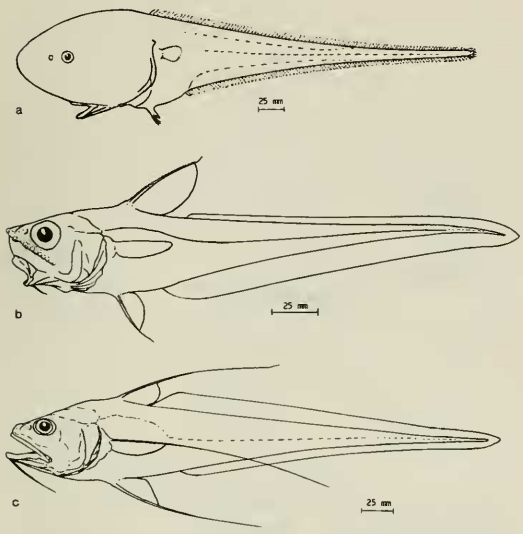

FIGURE 2. (a) *Squalogadus*, (b) *Nezumia*, (c) *Gadomus*.

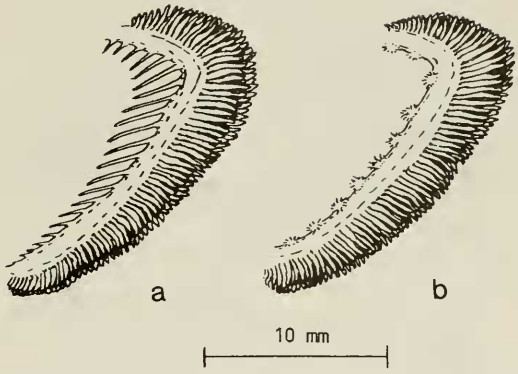

FIGURE 3. Outer gill arches of (a) *Gadomus* and (b) *Nezumia*.

on first arch long and numerous (Fig. 3a); second dorsal begins close behind first dorsal, its rays longer than those of anal; scales without spinules ... (Bathygadidae) ... *Gadomus* sp. cf. *melanopterus* (p. 36)

3b. Mouth small to large, usually subinferior (Fig. 2b); first gill slit restricted by membranes connecting upper and lower portions of first arch to gill cover; gill rakers tubercular or tablike (Fig. 3b); second dorsal separated by a distinct gap from first dorsal, its rays usually shorter than those of anal; scales beset with spinules in all but a few species (Macrourinae) ... 4

4a. Branchiostegal rays 6 ... 5

4b. Branchiostegal rays 7 ... 9

5a. Snout blunt, scarcely protruding; ridge of stout scales, if present, not continuous to preopercle, and ends in a blunt or rounded tip (Fig. 4a); rakers present on both sides of first arch; pelvic rays 9–11 (rarely 8) ... *Coryphaenoides paradoxus* (p. 52)

5b. Snout sharply and distinctly pointed; a continuous ridge of stout scales from tip of snout to angle of preopercle, the ridge ending in a sharp point (Fig. 4b); rakers absent on outer side of first gill arch; pelvic rays 7 (*Caelorinchus*) ... 6

6a. Light organ long, the anterior end just behind isthmus (Fig. 5a); prominent body markings present ... 7

6b. Light organ short, the anterior end not extending to a line between pelvic fin origins (Fig. 5b); no body markings ... 8

7a. A series of about 7 saddlemarks on body; first dorsal not black tipped ... *Caelorinchus multifasciatus* (p. 44)

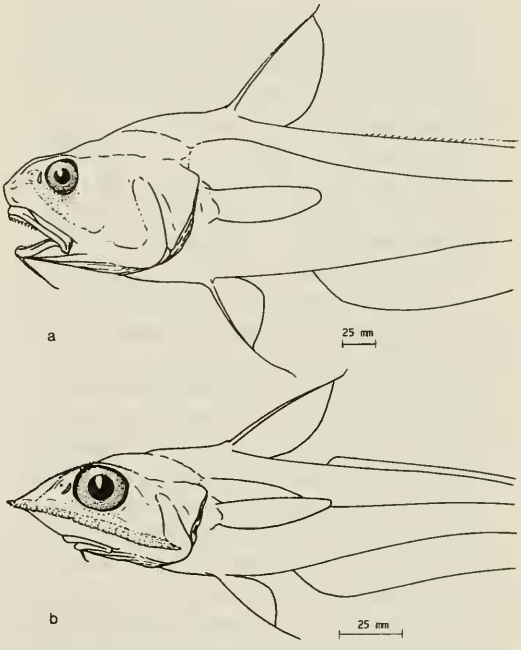

FIGURE 4. Diagrammatic illustrations of (a) *Coryphaenoides paradoxus* and (b) *Caelorinchus* comparing snout shape and suborbital ridge. Figure (a) redrawn from Iwamoto and Sazonov (1988, fig. 28).

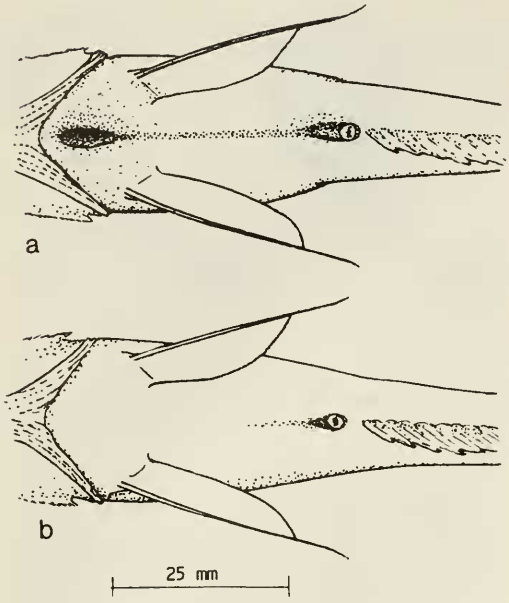

FIGURE 5. Diagrammatic ventral views of *Caelorinchus* showing (a) long light organ extending from anus forward to large fossa on chest and (b) short light organ, scarcely apparent, anterior to anus.

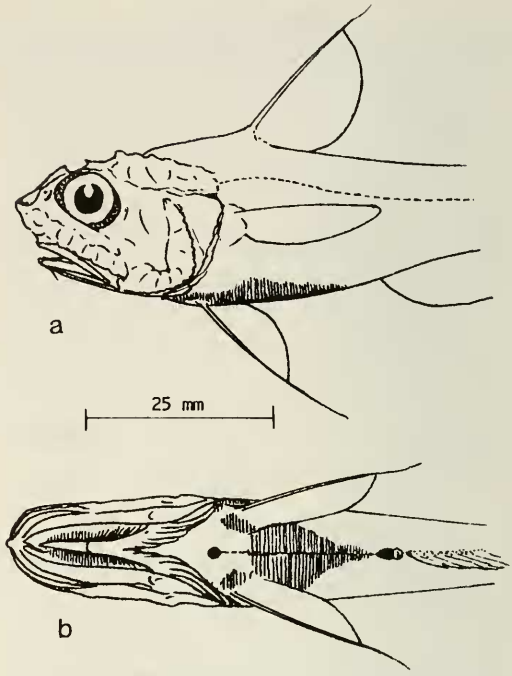

FIGURE 6. Diagrammatic lateral (a) and ventral (b) views of *Hymenocephalus* showing extent of ventral striations and location of vent and light organs.

7b. Not more than 2 or 3 saddlelike marks on body; first dorsal fin black tipped ..... *Caelorinchus spilonotus* (p. 49)

8a. Snout rather short, much less than orbit diameter; anterolateral edge of snout not supported by bone ..... *Caelorinchus nazcaensis* (p. 46)

8b. Snout long, much longer than orbit; anterolateral edge of snout completely supported by bone ..... *Caelorinchus immaculatus* (p. 41)

9a. Ventral striae, consisting of parallel lines of black over a silvery ground, over much of isthmus, shoulder girdle, and ventral aspects of abdomen; ventral light organ with two lenslike bodies, one immediately before anus and connected to another on the chest by a black midventral line (Fig. 6). (*Hymenocephalus*) 10

9b. No ventral striae; light organ not as above 14

10a. Body terete, head about as deep as wide; small serrations along leading edge of second spinous ray of first dorsal fin; gill rakers on lower limb of outer arch fewer than 15 .. *Hymenocephalus gracilis* (p. 55)

10b. Body laterally compressed, head deeper than wide; second spinous ray of first dorsal smooth; gill rakers on lower limb of outer arch more than 15 11

11a. Pelvic rays 8; orbits 42–55% HL 12

11b. Pelvic rays 13–15; orbits 21–43% HL 13

12a. Many pigment cells scattered ventral and posterior to black blotch on dorsum of trunk and part of caudal region; pectoral rays i14–i19 (usually i16–i17); interorbital width 16.5–22.1, suborbital width 8.5–11.8, snout length 20.9–27.0% of HL ..... *Hymenocephalus semipellucidus* (p. 60)

12b. Black blotch on dorsum with sharp outlines, surrounded by singular pigment cells with few (if present) above and behind blotch; pectoral rays i12–i14 (rarely i15), usually i12–i13; interorbital width 20.8–27.4, suborbital width 5.2–9.5, snout length 16.4–23.8% of HL ..... *Hymenocephalus neglectissimus* (p. 56)

13a. Orbits 21–23% HL; pelvic rays 13; barbel absent ..... *Hymenocephalus* sp. cf. *aterrimus* (p. 54)

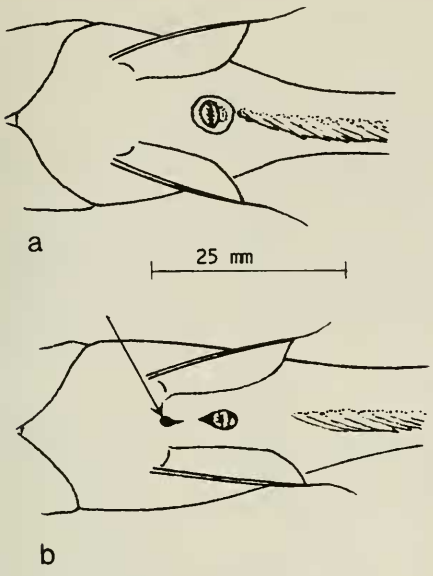

FIGURE 7. Diagrammatic ventral views of (a) *Cetonurus* and (b) *Nezumia* showing positions of pelvic and anal fins relative to periproct region. Arrow in (b) points to small fossa between pelvic fin bases.

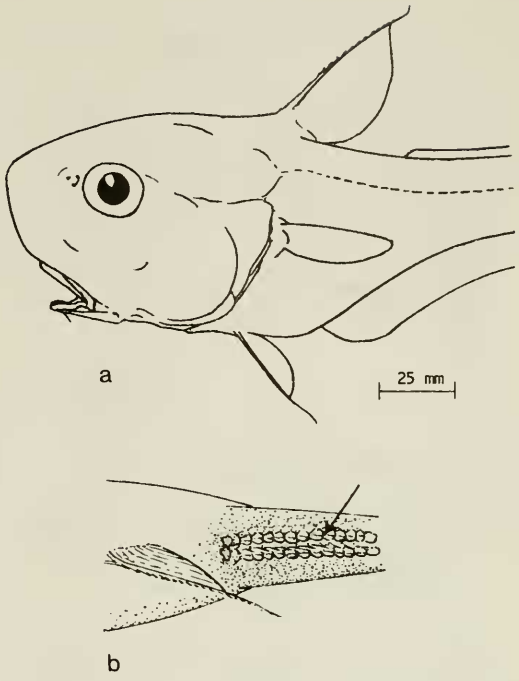

FIGURE 8. Diagrammatic lateral (a) and dorsal (b) views of *Cetonurus*. Arrow in (b) points to enlarged scales along second dorsal fin.

13b. Orbits 35–42% HL; pelvic rays 14–15; barbel rudimentary or obsolescent ..... *Hymenocephalus striatulus* (p. 63)

14a. Anus and urogenital opening surrounded by a broad naked margin, the entire region (periproct) closely abutting or narrowly separated from anal fin origin, the anus closer to anal origin than to pelvic insertions; no accessory fossa of light organ anterior to anus (Fig. 7a) 15

14b. Periproct moderate to small, broadly separated from anal fin origin by several scale rows, anus usually closer to pelvic insertions than to anal origin; usually a small fossa anterior to periproct (Fig. 7b) 17

15a. Spinous ray of first dorsal smooth; pelvic origin below midbase of first dorsal fin, far behind vertical through pectoral origin ..... *Trachonurus villosus* (p. 77)

15b. Spinous ray of first dorsal serrated; pelvic origin below or anterior to origin of first dorsal fin, about on same vertical as pectoral origin 16

16a. Head stout, somewhat depressed; snout long and pointed; no enlarged scales along dorsal and anal fins ..... *Mataeocephalus acipenserinus* (p. 70)

16b. Head soft, inflated; snout broadly rounded (Fig. 8a); a series of enlarged spiny scales along dorsal and anal fins (Fig. 8b) ..... *Cetonurus crassiceps* (p. 39)

17a. Lower jaw teeth large, widely spaced in 1 row; second spinous dorsal ray smooth; scales on branchiostegal membrane; anterior fossa of light organ bean shaped (Fig. 9) ..... *Malacocephalus laevis* (p. 68)

17b. Lower jaw teeth small, closely spaced, in 1 or more rows; spinous dorsal ray serrated or smooth; no scales on branchiostegal membrane, or if scaled, dorsal ray serrated; anterior fossa usually tear-drop shaped 18

18a. Head notably large and broad, preopercle and suborbital bones deep and large; interorbital width 33–44%, suborbital width 19–26%, orbit-preop. 53–64% HL ..... *Pseudocetonurus septifer* (p. 75)

18b. Head more normally proportioned for a macrourid; interorbital <31%, suborbital <21%, orbit-preop. <47% HL 19

19a. Snout distinctly pointed and tipped with a spiny bifid tubercle; a suborbital shelf

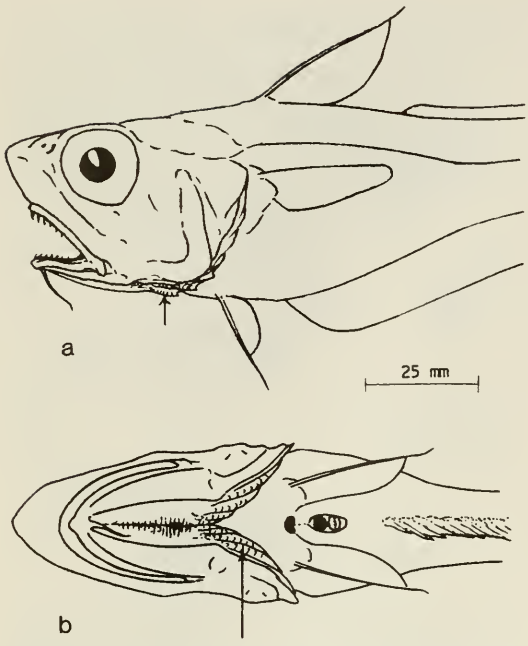

FIGURE 9. Diagrammatic lateral (a) and ventral (b) views of *Malacocephalus*. Arrows point to scales on branchiostegal rays.

formed of two rows of coarse, modified scales; snout partially or extensively naked ventrally; mouth small, upper jaw length 26–38% HL (*Nezumia*) 20

19b. Snout bluntly rounded to pointed, tipped with a single, rather small tubercle or terminal tubercle absent; suborbital shelf of more than two rows or no modified scales; snout almost entirely scaled ventrally; mouth moderate to large, upper jaw 35–55% HL 21

20a. Pelvic rays 14–18; inner gill rakers of first arch 9–12 ..... *Nezumia propinqua* (p. 72)

20b. Pelvic rays 11; inner gill rakers of first arch 6–10 ..... *Nezumia convergens* (p. 71)

21a. Pelvic rays 11; inner gill rakers of first arch 8–9; suborbital about 20% HL ..... *Kuronezumia pallida* (p. 65)

21b. Pelvic rays 8–10; inner gill rakers of first arch 12–19; suborbital 8–14% HL (*Ventrifossa*) 22

22a. Spinous second ray of first dorsal fin smooth ..... *Ventrifossa macrodon* (p. 81)

22b. Spinous second ray of first dorsal fin serrated 23

23a. Barbel long, much greater than orbit diameter, about one-half HL ..... *Ventrifossa obtusirostris* (p. 84)

23b. Barbel moderate to short, <orbit diameter, <¼ HL 24

24a. Interorbital broad, 28–33% HL; barbel short 13–19%; suborbital 10–14%; orbit-preop. 39–43% ..... *Ventrifossa johnboborum* (p. 78)

24b. Interorbital 18–24% HL; barbel 19–27%; suborbital 7–12%; orbit-preop. 35–39% ..... *Ventrifossa teres* (p. 86)

BATHYGADIDAE

The family is found world-wide in most tropical to temperate seas, but is not known from the western continental margins of the New World. It is first recorded here from the southeastern Pacific. Howes (1988, 1989) removed the group from the Macrouroidei, placing it as a family among the Gadoidei. Howes and Crimmen (1990) have reviewed the Bathygadidae, recognizing 22 species, 12 in the genus *Gadomus*.

Gadomus Regan, 1903

Type species: *Bathygadus longifilis* Goode and Bean, 1885, by original designation.

DIAGNOSIS.—Bathygadids with a greatly elongated ray in pelvic and usually also in first dorsal and pectoral fins. Chin barbel usually well developed (rudimentary in *G. capensis* [Gilchrist and von Bonde, 1924]). Four retia mirabilia in swim bladder.

DISTRIBUTION.—As for family.

Gadomus sp. cf. **melanopterus**

?*Gadomus melanopterus* Gilbert, 1905:658–659, fig. 256 (Hawaiian Is., vicinity of Kauai I.; 444–478 fms [812–874 m]). Howes and Crimmen 1990: 199–200 (synonymized *Melanobranchus micronema* Gilbert, 1905).

Gadomus multifilis: Parin 1990:16 (listed from area between Nazca and Sala y Gomez ridges).

DIAGNOSIS.—A *Gadomus* with orbit diameter 24–27% HL, about equal to or (usually) somewhat larger than interorbital width (23–27% HL). Barbel about one-half to two-thirds HL. Small premaxillary teeth in a relatively narrow band, broadest band width 2 or more into least (bony) suborbital width. Outer gill rakers on first arch 7 + (28–30). A greatly prolonged fin ray in first dorsal, pectoral, and pelvic fins; 1P. rays i17–

TABLE 2. Selected measurements (in millimeters) and counts of *Gadomus* sp. cf. *melanopterus*? from the Sala y Gomez Ridge.

ZMMGU Cat. No.	17685	17687	17685	17686	17686
TL	401	313	238	129+	123.5
HL	63	47	41	24.3	20.2
Postrostral	48.4	34.5	30.4	18.0	15.5
Snout	16.5	14.0	11.6	7.0	5.2
Orbit	15.0	11.8	10.5	5.9	5.5
Interorbital	14.2	11.6	10.0	6.5	4.9
Postorbital	33.3	24.2	21.0	13.0	10.2
Orbit-preop.	29.0	21.8	17.8	11.1	9.5
Upper jaw	37.5	29.5	26.1	14.0	12.0
Barbel	36.5	27.7	27.0	13.3	7.5
Body depth	50.5	34.7	33.5	18.0	13.2
Predorsal	67.4	53	45	27	21
V.-A.	53.6	33.9	27.3	17.3	16.0
1D. base	20.0	16.0	12.3	8.0	5.2
1D. height	108	107	—	42	—
1P.	138	120	101+	61	37
V.	115+	116	100	—	—
Counts					
1D. (total)	12	12	12	11	11
1P. (total)	20/19	18/–	18/–	19/–	19/–
GR-I (outer)	7 + 29	7 + 27	7 + 30	7 + 29	7 + 28
GR-I (inner)	3 + 23	4 + 21	4 + 23	4 + 23	4 + 24
GR-II (outer)	3 + 23	3 + 22	3 + 23	3 + 22	3 + 22
GR-II (inner)	4 + 23	4 + 22	4 + 23	4 + 22	4 + 22

i19, V. 8. Pyloric caeca 13–16. Mouth and gill cavities almost entirely black; gill rakers blackish.

COUNTS AND MEASUREMENTS.—See Table 2.

DESCRIPTION OF NSG SPECIMENS.—Body slender, greatest depth about 80% or less of HL; trunk short, pelvic to anal distance less than HL; anus slightly removed, by about a pupil diameter, from anal fin origin. Head short, about 6 or more into TL; orbit diameter about one-fourth HL, slightly less than snout length, and about equal to interorbital width; barbel long and slender, extending posteriorly about to angle of lower jaw, length two or more times orbit diameter. Outer gill rakers on first arch slender and sharply pointed; inner rakers shaped like the head of a laterally flattened club, the head facing inward and armed with small spinules.

First dorsal with a rudimentary first ray and a prolonged, filamentous second spinous ray; other rays of fin much shorter, less than half HL. Pectoral fins with a rudimentary or splintlike uppermost ray and a prolonged second ray; other rays of fin about equal to or less than snout length. Pelvic fins large, outermost ray thick and greatly prolonged; other rays much shorter, falling short of, or reaching to, anus.

Swim bladder large; retia 4, long and slender, tracing circuitous paths to small gas glands. Pyloric caeca small, rather slender, 13, 13, and 16 counted in three specimens.

Scales deciduous, pockets in small specimens poorly defined and difficult to count; in largest (401 mm TL) specimen, scales below 1D. about 9, below midbase of 1D. 8; below origin of 2D. 9. About 20 diagonal scale rows from anal fin origin posterodorsally to second dorsal fin in 313 mm specimen.

Color in alcohol: Overall tawny; fins rather lightly dusky; snout and interorbital region pale, whitish; jaws, gular and branchiostegal membranes black; nostril membranes faintly blackish. Inner linings of mouth and gill chamber entirely black; gill arches and bases of gill filaments dark; intestines blackish.

SIZE.—Attains at least 40 cm.

DISTRIBUTION.—Known from three collections on the Sala y Gomez Ridge, in 1,050–1,230 m, but may be a Hawaiian Island faunal component, if the species is determined to be *Gadomus melanopterus*.

REMARKS AND COMPARISONS.—Our treatment of this species has been most frustrating, and we have not adequately resolved the identification

problems, despite having extensive comparative material. Our hopes for a satisfactory resolution were raised upon the publication of Howes and Crimmen's (1990) review of the Bathygadidae. We were disappointed, however, in their treatment of the two species *G. multifilis* and *G. melanopterus,* with which we felt our NSG specimens were most likely to be conspecific. Their study material did not represent the range of variation in meristic and morphometric features that our specimens showed, and we have been unable to determine whether the variation represents intraspecific or interspecific differences.

Based on the revisionary work of Gilbert and Hubbs (1920), we initially identified the NSG specimens as *G. multifilis.* For comparison, we examined three specimens from eastern Luzon, Philippines (CAS-SU 15435), Darvel Bay, Borneo [Celebes Sea] (CAS-SU 25436), and Japan (CAS-SU 23978) that were reported by Gilbert and Hubbs (1920:406–408) as *G. multifilis.* (Their fourth specimen from the Gulf of Tomimi, Celebes [Molucca Sea] is deposited in the USNM, cat. no. 99447). In addition, we examined representatives of the genus in the ZSI identified as "Bathygadus longifilis" by Alcock, three Maldive specimens included among Howes and Crimmen's (1990) material of *G. multifilis,* and numerous specimens throughout the Indian Ocean collected by Russian vessels. Our NSG specimens agree in most respects with those specimens believed to be *G. multifilis,* the main exception being the unusually high outer gill-raker count (7 + [28–30] compared with the 6 + 25 attributed to the holotype and to other *G. multifilis* specimens examined by Howes and Crimmen). Other differences were found among the various populations from the Indian Ocean, but the problems are complex and beyond the scope of this paper. Suffice to say that we are uncomfortable with Howes and Crimmen's (1990) treatment of *G. multifilis* and suspect that further investigation will necessitate a different circumscription of the species.

Our NSG specimens agree most closely with *G. melanopterus,* as the high gill-raker count (7 + [28–29]) is beyond the range found in *G. multifilis* and most other species of the genus. The chief difference is the nine pelvic fin rays of the holotype of *G. melanopterus,* compared with eight in our NSG specimens. Pelvic fin ray numbers in members of this genus are normally quite consistent for each species, and finding a one-ray difference is unusual. It is therefore difficult to reconcile in our minds that the NSG specimens (and, according to Howes and Crimmen 1990, *Melanobranchus micronema* Gilbert, 1905) are conspecific with *G. melanopterus.* Aside from the small specimen (112 mm TL, CAS-SU 8545) reported by Gilbert (1905) from the vicinity of Kauai, there are no other specimens of *Gadomus* known from the Hawaiian Islands, as far as we have determined. (Gilbert left the identity of that small specimen indeterminate; its counts were 1D. II, 10, 1P. 22 or 23, V. 8, GR-I 6 + 27.)

Material Examined.—(all *Prof. Mesiatzev* cr. 13) **Sala y Gomez Ridge:** ZMMGU 17685 (2:41–63 mm HL, 238–401 mm TL); 1,070–1,100 m; tr. 10. ZMMGU 17686 (2:20.2–24.3 HL, 123.5–129+ TL); 1,050 m; tr. 14. ZMMGU 17687 (47 HL, 313 TL); 1,220–1,230 m; tr. 17.

Macrouridae

Subfamily Macrouroidinae

Two genera, each with a single, widespread, tropical to warm-temperate species. The species are benthopelagic or bathypelagic. Okamura (1970a, b) gives detailed descriptions of the group (treated as a family).

Macrouroides Smith and Radcliffe, 1912

Type species: *Macrouroides inflaticeps* Smith and Radcliffe, 1912, by original designation.

Diagnosis.—Head enormous, globose; eyes small, 10 or more in HL; jaws inferior; no chin barbel; outer gill silt unrestricted; outer gill rakers numerous (>20) and long. Branchiostegal rays 7, upper 2 on epihyal. Scales small, bearing few to many fine erect spinules. One dorsal fin, no portion elevated, spinous rays absent; pelvics absent.

Remarks.—Only the single species known.

Macrouroides inflaticeps Smith and Radcliffe, 1912

Macrouroides inflaticeps Smith and Radcliffe *in* Radcliffe, 1912: 138, pl. 31, fig. 2 (Philippines, near Batan I., Lagonoy Gulf, Luzon, 13°23'S, 124°00'30"W, 408 fms [746 m], *Albatross* sta. 5450). Norman 1939:48 (1 spec., near Maldives, Indian Ocean); Marshall 1964:92; 1973:516; Marshall and Tâning 1966:1–5, pl. 1 (1 spec., South Atlantic off St. Helena); Parin et al. 1981:11 (1 spec., se. Pacific on Nazca Ridge); Shcherbachev and Piotrovskiy 1982:45–47 (10 spec., Indian Ocean); Arai *in* Uyeno et al. 1983:209 (12 spec., Suriname and French Guiana). Parin 1990:17 (listed from area between Nazca and Sala y Gomez ridges).

DIAGNOSIS.—As for genus.

DISTRIBUTION.—Philippines; Indian Ocean (including off SW tip of Australia); E and W tropical Atlantic; and E Pacific on Nazca Ridge. Midwater to bottom in bathyal and abyssal depths (747–4,000 m) (Shcherbachev and Piotrovskiy 1982).

SIZE.—To more than 48 cm.

REMARKS.—Only one specimen of this distinctive species was taken off NSG. That 475+ mm individual, the largest known, was reported by Parin et al. (1981). Radcliffe (1912) and Marshall and Tåning (1966) provide good descriptions and illustrations; Shcherbachev and Piotrovskiy (1982) provide a distribution map plotting all known records of the species, including theirs from the Saya de Malha Bank and Naturaliste Plateau in the Indian Ocean.

MATERIAL EXAMINED.—ZMMGU 17683 (158 mm HL, 475+ mm TL); **Nazca Ridge**, 1,600–2,000 m; *Hercules*; midwater trawl 110.

Squalogadus Gilbert and Hubbs, 1916

Type species: *Squalogadus modificatus* Gilbert and Hubbs, 1916, by original designation.

DIAGNOSIS.—As for *Macrouroides*, but having a small pelvic fin of five or six rays.

REMARKS.—Only the single species known.

Squalogadus modificatus Gilbert and Hubbs, 1916

(Figure 2a)

Squalogadus modificatus Gilbert and Hubbs, 1916:156, pl. 8, fig. 2 (off Kyushu, Japan; 32°32′N, 132°23′W; 720 fms [1317 m]; *Albatross* sta. 4956). Golovan' 1978:222 (2 spec., West Africa, 1,450–1,550). Pakhorukov 1981:26 (3 spec., Whale Ridge; 850–1,550 m). Shcherbachev and Piotrovskiy 1982: 47 (17 spec., Indian Ocean; Pacific over Lord Howe Rise, 800–1,740 m). Shiobara 1982:143–146 (2 spec., Suruga Bay, Japan). Sawada *in* Amaoka et al. 1983:192 (1 spec., Iwate Pref., Japan; about 39°N). Parin 1990: 17 (listed from area between Nazca and Sala y Gomez ridges).

Squalogadus intermedius Grey, 1959:330, fig. 53 (Gulf of Mexico, 29°07′N, 87°54′W; 600 fms [1,097 m]; *Oregon* sta. 1426) (See Marshall [1973] for additional earlier references.)

DIAGNOSIS.—As for genus.

SIZE.—To more than 41 cm.

DISTRIBUTION.—Worldwide in tropical seas, and in temperate western North Pacific and North Atlantic, but not yet recorded from central and eastern North Pacific and western South Atlantic. Shcherbachev and Piotrovskiy (1982) provide a distribution map, to which may be added our Nazca specimen, the first record from the eastern South Pacific. They state that the species is restricted to bathyal depths of 600–1,740 m, "where it may be found together with *M. inflaticeps*."

REMARKS.—Our two specimens had six pelvic fin rays on each fin compared with the five generally reported in this species. *Squalogadus modificatus* is occasionally taken in great numbers in the north-central Gulf of Mexico. In an unpublished report of cruise 14 of the *R/V Oregon II* (issued by the National Marine Fisheries Service, Pascagoula Fisheries Laboratory, Pascagoula, Mississippi), during a three-week period in January 1970, "*Squalogadus intermedius* [=*Squalogadus modificatus*] ... was taken frequently, catches ranging up to 219 pounds [about 100 kg] per 4-hour tow with a 70-foot [21.3 m] trawl." Deepwater trawling during that cruise was conducted at 500 to 1,000 fathoms [914–1,829 m].

MATERIAL EXAMINED.—ZMMGU 17684 (152 mm HL, 459+ mm TL) and CAS 67408 (154 HL, 410 TL); **Nazca Ridge**, 1,050 m; *Prof. Mesiatzev* cr. 13, tr. 14.

SUBFAMILY MACROURINAE

The largest subfamily in the Macrouridae with more than 250 species, generally allocated to 30 or more genera. A diverse assemblage that may not be monophyletic. Size at maturity ranges from 12 cm in some *Hymenocephalus* to more than 160 cm in *Albatrossia pectoralis* (Gilbert, 1892). Species predominantly benthopelagic, but a few strictly bathypelagic species known. Distribution worldwide in depths from about 200 m to more than 6,000 m.

Cetonurus Günther, 1887

Type species: *Coryphaenoides crassiceps* Günther, 1878, by monotypy.

DIAGNOSIS.—Macrourine grenadiers with 7 branchiostegal rays. Head large, broad; interorbital width much greater than orbit diameter; suborbital width more than orbit diameter; snout high, broad. Mouth rather small, subterminal; armed with small teeth in 1–3 irregular rows. Barbel very small to rudimentary. Head and body essentially completely covered with small scales beset with fine erect spinules; a series of enlarged scales along each side of dorsal fins and anteriorly along anal fin. Lateral line without grooved scales; lateral line course marked by a series of widely

spaced black papillae (free neuromasts). First dorsal with a serrated spinous ray; V. 8–10. Anus within a broad naked area (periproct) that abuts anal fin origin. Swim bladder with 2 retia mirabilia.

Distribution.—Warm waters of the Atlantic, Pacific, and Indian oceans. Usual capture depths range from about 1,000–1,800 m, but *C. globiceps* recorded from more than 4,200 m.

Remarks.—Only two broadly distributed and closely related benthopelagic species.

Cetonurus crassiceps (Günther, 1878)

Coryphaenoides crassiceps Günther, 1878:25 (n. of Kermadec Is., *Challenger* sta. 170 and 171; 520 and 650 fm).

Coryphaenoides (*Cetonurus*) *crassiceps*: Günther 1887:143, pl. 37.

Cetonurus crassiceps: Marshall 1973:613 (in key); Pakhorukov 1976:327 (4 spec., Rio Grande Rise); 1981:25 (Walvis Ridge); Sazonov and Shcherbachev 1985:180, fig. 1b, 2, 3 (diagnosis, distribution). Parin 1990:15 (listed from Nazca and area between Nazca and Sala y Gomez ridges).

Diagnosis.—Orbits, 4.3–5.7 in HL (4.3–4.6 in NSG specimens); interorbital width about one-half HL; barbel very short to rudimentary, less than 3.5% HL; upper jaw extends to below posterior half of orbit.

Counts and Measurements.—1D. II,8–10; 1P. i16–i19; V. 10–11; GR-I (outer/inner) (4)7–9/1 + 1 + (10–11), GR-II (0–1) + 1 + (10–12) /1 + 1 + (10–11); scales 1D. 12–14, mid.-1D. 6–11, 2D. 10–13; caeca 10–11 (3 spec.).

Measurements in percent HL (8 spec., smallest excluded): postrostral 68.2–72.5; snout 35.4–42.7; preoral 32.3–38.0; orbit 21.7–23.0; interorbital 46.6–53.6; suborbital 23.7–30; postorbital 50.7–58.9; orbit-preop. 50.3–58.2; upper jaw 31–37.1; gill slit 9.4–12.9; pre-1D. 99–106; pre-V. 95–127; pre-A. 118–139; body depth 73–95; V.-A. 23–31; height 1D. 39–46 (3 spec.); base 1D. 17.3–21.7; 1D.–2D. 25.6–32.8; 1P. 41–47 (2 spec.); V. 26–42 (4 spec.).

Size.—To more than 44 cm.

Distribution.—*Cetonurus crassiceps* has been reported from the subtropical South Atlantic, central tropical Atlantic, off Kermadec Islands, and off Hawaii (see Sazonov and Shcherbachev 1985: fig. 3). Records from the Nazca and Sala y Gomez ridges are the first in the southeastern Pacific, but are not unexpected. Surprisingly, however, the species is yet to be found in the Indian Ocean.

Comparisons.—Sazonov and Shcherbachev (1985) readily differentiated *C. crassiceps* from its congener *C. globiceps* (Vaillant, 1888) and showed the circumglobal distribution of the latter species. Their records show a common occurrence of the two species only on the Sierra Leone Rise in the eastern Atlantic. The NSG specimens of *C. crassiceps* show no apparent difference from representatives from other localities.

Material Examined.—(9 spec.) **Sala y Gomez Ridge:** ZMMGU 17688(5:29–68 mm HL, 112+–314+ mm TL) and CAS 75971 (3:41–73.5 HL, 183–315+ TL); 1,070–1,100 m; *Prof. Mesiatzev* cr. 13, tr. 10. **Nazca Ridge:** ZMMGU 17689 (1, 62 HL, 320+ TL); 940–960 m; *Prof. Mesiatzev* cr. 13, tr. 94.

Caelorinchus Giorna, 1809

Type species: *Lepidoleprus caelorhincus* Risso, 1810, by subsequent designation.

Diagnosis.—Macrourine grenadiers with branchiostegal rays 6. Snout blunt and barely protruding to greatly elongated and sharply pointed. Orbit large, oval to elliptical, the long axis horizontal (or nearly so). Mouth small and inferior to moderately large (to about 40% HL). Outer gill slit greatly restricted; no gill rakers on outer side of first arch. Ridges of head often stout and sharply spined. A stout suborbital ridge formed of modified sales running from tip of snout posteriorly onto preopercle, ending in a sharp point. Scales covered with spinules, which vary widely in size, shape, arrangement, and density. Spinous first dorsal ray smooth (a few terminal denticles in a few species). Pelvic fin rays almost always 7 (6 in one species). Anus at or near anal fin origin. Ventral light organ variously developed; elongated with two large dermal windows at each end in some, to almost rudimentary in others; lens absent. Abdominal vertebrae 11–12. Swim bladder oval to bilobed anteriorly; retia mirabilia usually 4, but number variable in a few species (as many as 9–11 in *C. canus*).

Distribution.—Worldwide in tropical to temperate seas, but absent in high polar latitudes. Two species found south of Antarctic Convergence. Species most numerous in tropical waters.

Remarks.—We follow Eschmeyer (1990:70) in the use of the spelling of the generic name. The dipthong *ae* as originally used by Giorna (1809) was changed to *oe* by later workers on the

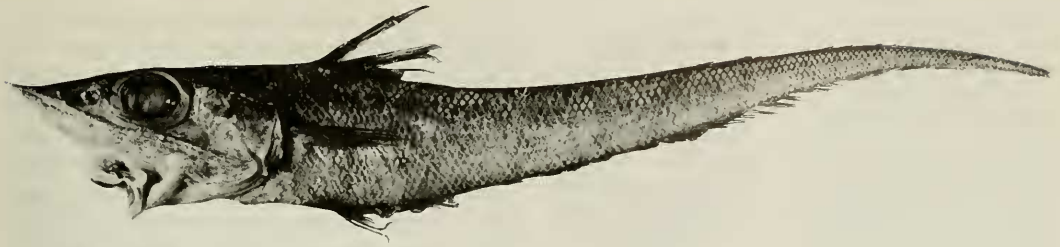

FIGURE 10. *Caelorinchus immaculatus* new species; holotype, ZMMGU 17692 (69 mm HL, 268+ mm TL) captured on Sala y Gomez Ridge in a trap set at 560 m, *Prof. Shtokman* cr. 18, sta. 1955/62, 29–30 April 1987. Photograph by Sergei Dudarev.

assumption that the name *Coelorinchus* was derived from 'hollow snout.' The name *Caelorinchus,* meaning burin snout, alludes to the lozenge-shaped snout tip of the type species, *C. caelorhincus* (note: a burin is an engraving tool, sometimes having a lozenge- or diamond-shaped tip).

The genus is a distinctive and diverse group with more than 100 species, although only about three-quarters of that number are named. Its relationship is closest to *Macrourus* (Okamura 1970a, b; Iwamoto and Sazonov 1988). Three of the four species recorded from NSG are most closely similar to species of the Indo-West Pacific. The fourth (*C. nazcaensis*) appears similar to *C. aconcagua* Iwamoto, 1978 from the continental slopes of the eastern Pacific.

Caelorinchus immaculatus new species

(Figures 10, 11a, 12)

Coelorinchus innotabilis: Iwamoto 1978:329–332 (in part; 1 spec., Chile).—Parin et al. 1981:11.

"*Coelorinchus* sp. nova 2 Sazonov et Iwamoto": Parin 1990: 15 (listed from Nazca and Sala y Gomez ridges). Parin et al. 1990:42 (stomach contents). Kotlyar and Parin 1990:104, fig. 3v (otolith).

DIAGNOSIS.—Snout sharp, slender, longer than orbits, anterolateral margins completely supported by bone. Subopercle forms a narrow pointed triangle. Upper jaw teeth in broad short bands that fall well short of posterior angle of jaws; upper jaw about one-fourth HL. Underside of head scaleless except for a small patch posteroventrally on preopercle. Scales with short, greatly reclined spinules in parallel rows; scales below 2D. (7–8.5) + 1 + (11–13). Anterior rays of second dorsal almost as well developed as opposite members of anal fin; 1D.–2D interspace less than base of first dorsal. No bold markings on body. Anus separated by 2–3 scale rows from anal fin; ventral light organ small with short pedicel.

COUNTS AND MEASUREMENTS (data for holotype in square brackets).—D. II,10 [II,10] + 102–113, A. 99–116, 1P. i18–i21 [i19]; GR-I (outer/inner) 0/(1–2) + (0–1) + (6–7) 8–9 total [1 + 1 + 7], GR-II 0 + 1 + (5–7), 6–8 total/(1–2) + (6–8) 8–10 total [1 + 0 + 8]; scales below 1D. 7–9 [9.5], below 2D. (7–10) + 1 + (10.5–15) [9.5 + 1 + 10] (18.5–24 total scales in diagonal row to A.), below mid-1D. 5.5–8 [5.5], lat.l. 39–48 [41].

Total length of specimens examined 137–315 mm, HL 37.9–70 mm; the following in percent HL: postrostral 58–65 [61.7]; snout 37–43 [39.1]; preoral 35–45 [40.7]; orbit 28–32 [31.0]; interorbital 19–23 [19.3]; suborbital 12–15 [13.6]; postorbital 27–33 [30.9]; orbit-preop. 30–35 [31.7]; upper jaw 22–26 [23.9]; gill slit 8–11 [10.9]; barbel 5.6–13.5 [12.3]; body depth 40–56 [55]; pre-A. 133–151 [151]; V.-A. 31–45 [36]; height 1D. 36–57 [47]; 1D.–2D. 5–15 [10.4]; 1P. 37–45 [45]; V. 29–49 [37].

DESCRIPTION.—Head 3.8–4.2 in TL, about as wide as deep. Trunk and tail moderately compressed laterally. Anus slightly removed from anal origin a distance equal to about 0.5 diameter of pupil. Head ridges rather strong, sharp, and generally narrow; head divided into dorsal and ventral parts by suborbital ridge. Snout sharply pointed; median and lateral processes of nasal bones connected and forming a complete bridge across anterolateral edges of snout. Interopercle completely hidden behind preopercle; ventral tip of subopercle produced into a flexible, pointed tab, its tip slightly exposed beyond posteroventral margin of preopercle. Gill membranes broadly connected to isthmus without a free posterior fold. Gill slits restricted, the outermost about as long as pupil diameter. Uppermost (epi-

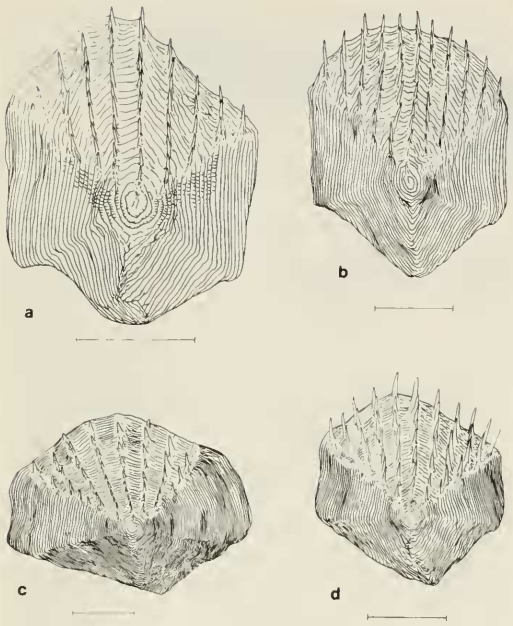

FIGURE 11. Scales from dorsum below interspace between dorsal fins of: (a) *Caelorinchus immaculatus*; (b) *C. innotabilis*; (c) *C. nazcaensis*; and (d) *C. spilonotus*. Drawn by Tomio Iwamoto. Scale bars equal 1.0 mm.

branchial) gill rakers padlike; lower rakers tubercular and armed with very small spines. Chin barbel thin, short, less than diameter of pupil.

Scales on body (Fig. 11a) of moderate size and covered with short, reclined spinules, each aligned in close longitudinal rows (9–12 rows in 48 mm HL specimen, 12–13 in a 58 mm HL specimen); outer rows on field slightly divergent from middle rows. Posteriormost spinules extend beyond scale margin. Middle spinule row not enlarged. Scales on head generally with more divergent spinule rows; those dorsally between head ridges mostly with small, reduced spinules or spinules absent. A small scutelike scale at posterior end of occipital sensory canal and before lateral line; no supraoccipital ridge scale. Terminal snout scute somewhat arrowhead-shaped in dorsal view, dorsoventrally flattened, and armed with several longitudinal rows of small spinules, the rows diverging posteriorly from the anterior apex. Broad areas around nostrils and behind leading anterolateral margin of snout naked. Underside of head, including mandible, completely and smoothly naked except for a narrow file of thin scales on posterior end of preopercle. Head pores not prominent.

Light organ small, externally manifested in some specimens by a blackish median streak before anus; streak lacking in others. Luminescent gland housed within body wall and in a flattened, black, oval structure connected to rectum. Entire length of gland about 0.5–1.2 pupil diameter.

Intestine with multiple loops and somewhat similar to that of *C. smithi* Gilbert and Hubbs, 1920, as illustrated by Okamura (1970b: fig. 65B). Pyloric caeca of three specimens 9, 9, and 10, short and unbranched. Gas bladder with 4 large retia and gas glands.

Fins generally small; first dorsal shorter than postrostral length of head, its spinous second ray scarcely longer than adjacent segmented rays. Second dorsal close behind first dorsal, their interspace less than length of base of latter; anteriormost rays of second dorsal relatively long for a macrourine grenadier, slightly shorter but distinctly slimmer than anterior rays of anal fin. Outer pelvic fin ray somewhat prolonged beyond inner rays, reaching to anteriormost 1 to 3 anal rays; inner rays extend, at most, only to anus.

Color in alcohol generally light brown to somewhat swarthy on head, but abdomen and operculum dark bluish to blackish; scale pockets prominently outlined. Ventral surfaces of head grayish; in smaller specimens peppered with small melanophores. Anterior rim of orbits and septum between anterior and posterior nostrils black. Fins all blackish or dusky. First dorsal in smaller specimens blackish basally, but pale distally; the distinction less obvious in large *Prof. Mesiatzev* specimens. Oral, branchial, and peritoneal linings black. Gill arches blackish, but rakers and filaments pallid.

We found two color variants. One variant, confined to specimens trawled on the Sala y Gomez Ridge, is very pale with almost unpigmented pectoral fins and small melanophores scattered over naked areas of the head. The other variant, represented by all specimens from the Nazca Ridge and those taken in traps on the Sala y Gomez Ridge, have darkly pigmented pectorals and large melanophores densely covering naked areas of the head. The darkly pigmented head areas contrast strongly with the light adjacent scaled and ridged areas. The holotype and two paratypes (ZMMGU 18116 and 17693 [213 mm TL]) attributed to the dark variant, however, have somewhat intermediate pigmentation patterns. (A 220+ mm paratype from ZMMGU 17643 is a more typical dark variant.)

FOOD.—Parin et al. (1990:42) found a high percentage of polychaet worms (Polinoidae and Tomopteridae) and copepods (the harpacticoid *Cervicornia* sp. and pelagic calanoids *Clausocalanus* sp., *Chirundia streetse, Bradyidius* sp., *Aetideus* sp., *Pseudocalanus* sp., and *Oncaea conifera*) in the alimentary canal of 20 individuals examined. Also present were shrimps, isopods, amphipods (Gammaroidea, including Oedicerotidae), foraminiferans, and ophiurans (*Ophiura*).

SIZE.—To about 32 cm.

DISTRIBUTION.—Nazca and Sala y Gomez ridges and off central Chile in 340–780 m, its primary depth distribution probably around 400–550 m.

ETYMOLOGY.—From the Latin, *immaculatus,* not spotted; in reference to the lack of a distinctive color pattern in the species, in contrast to two other NSG species, *C. spilonotus* and *C. multifasciatus,* which have prominent blotches on the body.

COMPARISONS AND REMARKS.—*Caelorinchus immaculatus* is close in all diagnostic characters to *C. karrerae* Trunov, 1984, a species originally described from material collected in the southeastern Atlantic off South-West Africa (Namibia), Valdivia Seamount, Discovery Seamount, and also reported from the southwestern Indian Ocean. (Other specimens of *C. karrerae,* deposited in CAS, IOAN, ZMMGU, and ZIN, have been examined by us from the Saya de Malha Bank, Broken Ridge [West Australian Ridge], and Madagascar Ridge.) Differences between the two species are slight and may represent populational differences, but we think they are sufficient to justify our current treatment. In our comparison of specimens of the two species, *C. immaculatus* specimens have a somewhat more upturned snout, the orbit shape is less "squared off" anteriorly than in *C. karrerae,* the count of diagonal scale rows below the second dorsal is slightly higher (18.5–24 vs. 16–20 in *C. karrerae*), the snout is shorter (37–43% HL vs. 42–46%), the posterior nostril is somewhat smaller (6.9–9.1% HL vs. 7.7–11.5%), and the upper jaw is longer (22–26% HL vs. 19–23%). Furthermore, there are two or three rows of non-spinulated scales (rarely with rudimentary ridges) lateral to the median nasal ridge in *C. immaculatus,* whereas in *C. karrerae,* there is a single row of large scales bearing 4–8 well-developed subparallel ridges with numerous small reclined spinules.

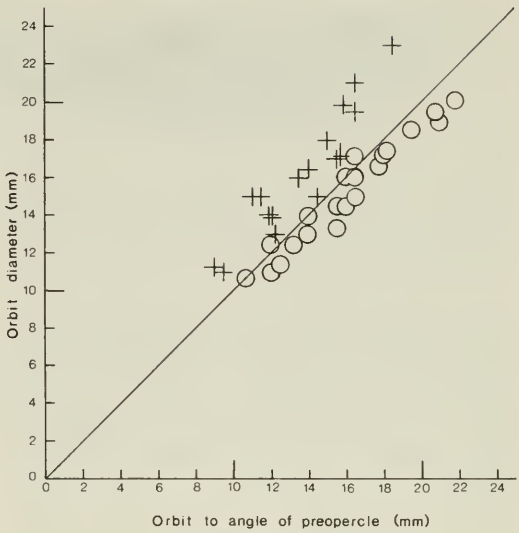

FIGURE 12. Scatter diagram comparing relationship of distance orbit to angle of preopercle with orbit diameter in *Caelorinchus innotabilis* (plus signs) and *C. immaculatus* (circles). Diagonal line represents 1:1 ratio of the two measurements.

The new species is also closely similar to the New Zealand and Australian species *C. innotabilis* McCulloch, 1907, with which the single Chilean specimen was identified by Iwamoto (1978). It differs from that species, however, in having (1) an overall blackish first dorsal (*C. innotabilis* has a pale first dorsal base and blackish tips); (2) no scales on underside of head above and lateral to mouth (*C. innotabilis* has patches of small scales there; (3) a shorter trunk and tail (HL about 3.7–4.2 in TL cf. about 4.2–5.5 TL in *innotabilis*); (4) a more prolonged preopercle (distance orbit to angle of preopercle less in *C. innotabilis*; see Fig. 12); (5) a longer upper jaw (22–26% HL cf. 19–21%); (6) a longer postorbital distance (27–29% HL cf. 25–26%); (7) usually more pectoral rays (i18–i21 cf. i15–i19); (8) more scale rows below 1D. and 2D; and (9) a somewhat deeper body (about 50% HL vs. less than 50%).

The two color variants of *C. immaculatus* present a bit of a problem. Differences between the variants are not restricted to color, but also include some morphometric features. The dark variants have on average a shorter snout and shorter preoral length, and they are somewhat larger (all >59 mm, cf. <68 mm in pale variants.). The different capture localities and capture gear suggest some geographical and ecological separation. The differences may be related

FIGURE 13. *Caelorinchus multifasciatus* new species; holotype, ZMMGU 18117 (32.7 mm HL, 135 mm TL), from Sala y Gomez Ridge in 439–500 m. Photograph by Sergei Dudarev.

to ontogenetic changes in body shape and habitat. Certainly, the proportional-measurement differences are interrelated and attributable to the longer snout of the light variant. More specimens and study are necessary before we can firmly establish the taxonomic status of the two variants.

MATERIAL EXAMINED.—(dark variants noted with an asterisk) Holotype: ZMMGU 17692* (69 mm HL, 268+ mm TL); **Sala y Gomez Ridge**, 560 m; *Prof. Shtokman* cr. 18, sta. 1955/62.

Paratypes (85 spec. from 15 stations). CHILE. CAS 38314 (50.6 HL, 215 TL); 32°17'S, 71°39.5'W; 580 m; *Anton Bruun* cr. 18A, sta. 702. **Sala y Gomez Ridge:** ZMMGU 17690 (2: 47.5–50 HL, 180–224 TL) and CAS 50895 (37.9 HL, 161+ TL); 535–574 m; *Ichthyandr* cr. 5. tr. 54. ZMMGU 17691 (39 HL, 177 TL); 25°02'S, 88°35'W; 550 m; *Astronomer* no trawl no. ZMMGU 17693* (2: 59.3–59.5 HL, 213+–220 TL); 580 m; *Prof. Shtokman* sta. 1956/61. ZMMGU 17694 (26: 27.4–63.3 HL, 117–249 TL); 580–564 m; *Prof. Shtokman* cr. 18, sta. 1964. ZMMGU 17695 (13: 40.5–51.8 HL, 162–220 TL); 562–545 m; *Prof. Shtokman* cr. 18, sta. 1965. ZMMGU 17698 (61 HL, 243 TL); 550–630 m; *Hercules* tr. 74. ZMMGU 18110 (3: 53.5–57.5 HL, 214+–231+ TL); 540 m; *Ichthyandr* cr. 5, tr. 53. ZMMGU 18111 (37.7 HL, 151 TL) and CAS 50896 (2: 39.4–39.9 HL, 137+–139+ TL); 420 m; *Ichthyandr* cr. 5, tr. 57. ZMMGU 18112 (48.2 HL, 180+ TL); 550–560 m; *Prof. Mesiatzev* cr. 13, tr. 2. ZMMGU 18113 (18: 38–50.7 HL, 135–214 TL); 563–590 m; *Prof. Shtokman* cr. 18, sta. 1976. ZMMGU 18114 (32 HL, 147 TL); 545–600 m; *Prof. Shtokman* cr. 18, sta. 1977. **Nazca Ridge:** ZMMGU 17696* (5: 64–70 HL, 254–315 TL) and CAS 75975 (4: 64–68 HL, 245+–307 TL); 340–780 m; *Prof. Mesiatzev* cr. 13, tr. 44. ZMMGU 17697* (69.5 HL, 310 TL); 940–960 m; *Prof. Mesiatzev* cr. 13, tr. 94. ZMMGU 18115* (62.7 HL, 282 TL); 730–720 m; *Prof. Shtokman* cr. 18, sta. 1828/35. ZMMGU 18116* (63.6 HL, 261 TL); 505 m; *Prof. Shtokman* cr. 18, sta. 1879/82.

Caelorinchus multifasciatus new species

(Figures 13, 14)

"*Coelorinchus* sp. nova 4 Sazonov et Iwamoto": Parin 1990: 16 (listed from Sala y Gomez Ridge).

DIAGNOSIS.—Body terete and shallow, width across pectoral bases about equal to greatest depth. Anterolateral margins of snout incompletely supported by bone. Underside of head

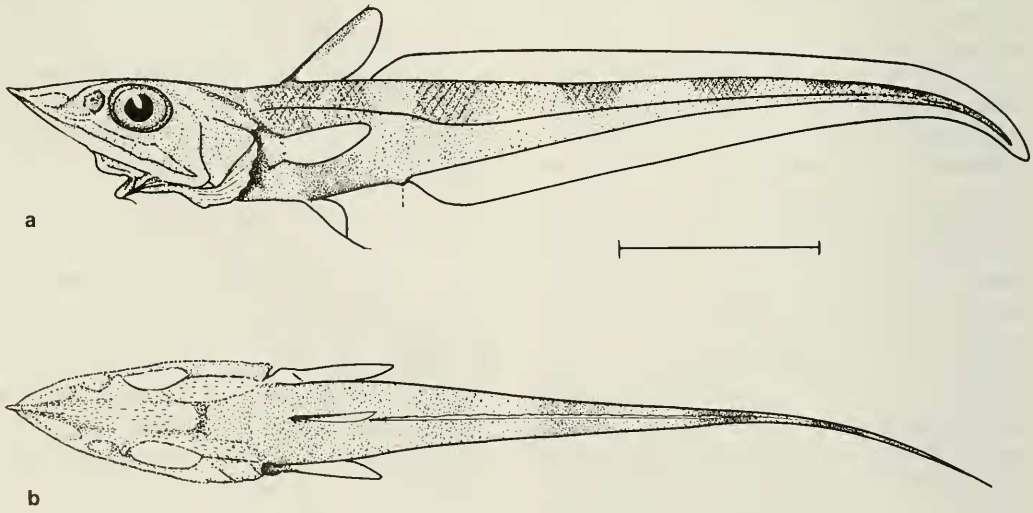

FIGURE 14. Lateral view (a) and dorsal view (b) of holotype, ZMMGU 18117 (32.7 mm HL) of *Caelorinchus multifasciatus* new species. Drawn by Tomio Iwamoto. Scale bar equals 25 mm.

completely naked except for a few scales overlapping anterior edge of snout. Spinules on body scales in 5–6 discrete parallel rows, those on scales atop head between lateral occipital ridges in a single ridgelike longitudinal row on each scale. Second dorsal fin close behind first dorsal, its rays about as high as opposites of anal fin. A series of about 7 dark broad bands or saddles on body. A long light organ extending from anus almost to isthmus, the opposite ends expanded, each recessed in a shallow fossa.

COUNTS AND MEASUREMENTS.—D. II,10 + 85+; 1P. i17–i18; GR-I (inner) 0 + 1 + 5, GR-II (outer/inner) 0 + 1 + 6; scales below 1D. 6, mid-1D. 5.5, 2D. 6.5, lat.l. 35.

Measurements in mm, percent HL in parentheses: postrostral 18.3 (56.0); snout 14.6 (44.6); preoral 14 (42.8); internasal 6.5 (19.9); interorbital 6.9 (21.1); orbit 8.2 (25.1); suborbital 4.4 (13.5); postorbital 9.7 (29.7); orbit-preop. 9.5 (29.1); upper jaw 7 (21.4); barbel 3.5 (10.7); gill slit about 3.0 (9.2); pre-D. 36 (110); pre-A. 51.3 (157); V.-A. 15.6 (48); body depth 15 (46); 1D.–2D. 4.3 (13.1); base 1D. 6.8 (20.8); height 1D. 15.5 (47); 1P. 14 (43); V. 14 (43).

DESCRIPTION.—Body and head long, slender, terete; width over opercles about equal to body depth, width over pectoral base slightly less. Snout sharply pointed, a slender scute at tip; profile of snout viewed from above a slender convex cone. A prominent bony suborbital ridge, strengthened with thickened coarsely spined scales, runs from snout tip to preopercle, its posterior tip pointed, the ridge dividing the head into upper and lower parts. Orbits about 4 in head, shorter than snout, about 1.2 in postorbital length of head. Interorbital space flat, width slightly less than orbit diameter. Mouth small, inferior, rictus restricted; upper jaw less than orbit; barbel rather thick at base but tapers rapidly distally. Subopercle forms a narrow short tip posteroventrally.

Branchiostegal membranes broadly attached to isthmus; gill openings strongly restricted, extend anteriorly only to level of posterior edge of preopercle. Gill rakers few, tubercular; outer gill slit restricted, length about equal to barbel length.

Scales of body with needlelike spinules aligned in 5 or 6 parallel rows, spinules in middle row slightly if at all larger than those in adjacent rows. Scales atop head somewhat elongated, with spinules erect and aligned in single, longitudinal, sharp, ridgelike rows. Dorsally on each side of median nasal ridge and behind leading edge of snout with scattered small scales, each covered with few erect spinules, and extensive naked areas. A squarish naked area medially at end of occipital region and a few boundary areas on head with naked margins. Whether these naked areas become more extensively scaled in larger specimens is unknown. Ridges of head with modified scales; those on suborbital in 2 rows, heavily thickened and beset with stout spinules. Tip of snout with a slender sharp scute. Underside of head entirely naked, although some scales overlap anterolateral snout edges onto ventral surface; whether these become more extensive or better defined in larger specimens is uncertain.

Teeth in both jaws small and scarcely visible above thick gum papillae; those in upper jaw in short broad band that falls well short of posterior extent of rictus; those in lower jaw in a long tapered band roughly half width of premaxillary band.

Fins rather small; first dorsal short, its second spinous ray slender with 3 fine needlelike spines near distal tip; second dorsal well developed and about equal in height to anal fin. Interspace between dorsals short, much less than length base of first dorsal. Outer pelvic ray slightly thickened and prolonged, extending just past vent.

Light organ large and prominently developed along ventral midline of abdomen and chest. Posterior end abuts anus, which lies immediately before anal fin; anterior end in a shallow fossa on chest, just behind isthmus and before pelvic fin bases, the two ends connected by a broad black median line.

Pigment pattern highly distinctive, marked most prominently by a series of about seven broad saddles or bands, the anteriormost one at anterior end of nape and separated (by a narrow pale area that runs from hind margin of gill cover over nape) from a second band that extends over 9 or 10 scale rows to near the posterior border of the first dorsal. A faint diagonal pale strip leads to another more diffuse band that subtends only about 6 scale rows and ends under the 2nd or 3rd ray of second dorsal. A much darker band (9–10 scales wide) begins below the 5th or 6th ray of second dorsal. Broad pale areas separate the remaining bands, which are dark and subtend 8–9 scale rows each; the last band blending imperceptibly into darkened tail tip. Abdomen dark, somewhat bluish, covered with large melanophores having silvery middle. Interorbital region with a dark narrow band; another across lateral

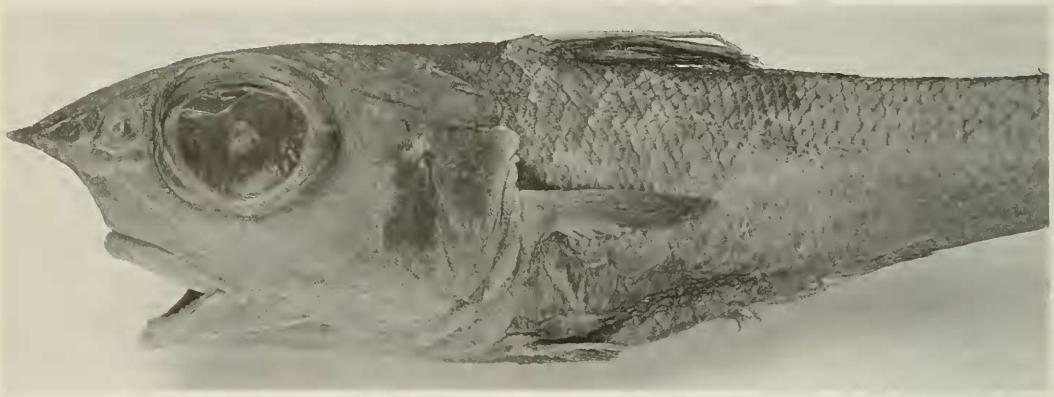

FIGURE 15. *Caelorinchus nazcaensis* new species; paratype, CAS 50949 (70 mm HL, 280 mm TL), from Nazca Ridge in 340 m. Photograph by Susan Middleton.

occipital ridges at posterior margin of naked area at head of nape. Dorsal aspects of head gray, underside pale, virtually white except for faint punctations over gill membranes, gular region, posteroventrally on preopercle, and along ascending process of premaxilla. Anterior parts of mouth white, but inner walls dark. Lips and barbel white. Long spinous ray of first dorsal black on basal one-third or so, remainder dusky; fin somewhat darker distally and anteriorly. Other fins pale to sparsely flecked with small melanophores. Lining of gill cavity, the gill arches, and rakers heavily punctate.

SIZE.—Probably a small species, attaining at least 14 cm.

DISTRIBUTION.—Known only from a single small specimen taken on the Sala y Gomez Ridge in 439 m.

ETYMOLOGY.—From the Latin *multo,* many, and *fasciatus,* with bands, for the distinctive color pattern on the new species.

COMPARISONS AND REMARKS.—The new species is one of the more striking members of the genus, with its slender, terete body, sharply pointed snout, and multiple bold saddle marks. It appears to be most closely related to *C. cingulatus* and *C. spilonotus,* the three being equally characterized by the combination of long light organ extending almost to the isthmus; anterolateral margin of snout incompletely supported by bone; underside of head naked; long, slender, sharply pointed snout; spinules on scales needlelike and arranged in relatively few parallel rows; rays of second dorsal about equal in height to those of anal; orbit about four in HL, longer than upper jaw; and saddle marks on body. *Caelorinchus multifasciatus* is easily distinguished from the other two species by its more numerous bands and more terete body; its median nasal process not dark as in the others; its first dorsal lacking a black tip; its snout somewhat longer and more slender; and its spinules on scales atop head in single, longitudinal, ridgelike rows.

The species appears to be unavailable to trawl gear because of its rocky-bottom habitat; only a single small specimen was captured in a torn bottom trawl. The holotype was captured on one of the westernmost seamounts sampled during the 18th cruise of the *Prof. Shtokman* in spring of 1987. No other *Caelorinchus* was collected there, but specimens of *Mataeocephalus* were captured at depths of 739–763 m in the area surrounded by rocks near the peak of the seamount.

MATERIAL EXAMINED.—Holotype: ZMMGU 18117 (32.7 mm HL, 135 mm TL); **Sala y Gomez Ridge**, 439–500 m; *Prof. Shtokman* cr. 18, sta. 2023.

Caelorinchus nazcaensis new species

(Figures 11c, 15, 16)

Coelorinchus sp.: Parin et al. 1981:11 (brief description, 12 spec. Nazca Ridge, here reported).

"*Coelorinchus* sp. nova 1 Sazonov et Iwamoto": Parin 1990: 15 (listed from Nazca Ridge). Parin et al. 1990:42 (stomach contents). Kotlyar and Parin 1990:104, fig. 3a (otolith).

DIAGNOSIS.—Snout shorter than orbit, anterolateral margin not supported by bone, terminal scute sharply pointed; orbit 2.5–3.0 in HL, 0.9–1.2 into postorbital length. Free end of subopercle variably prolonged into a flap. Mouth rather

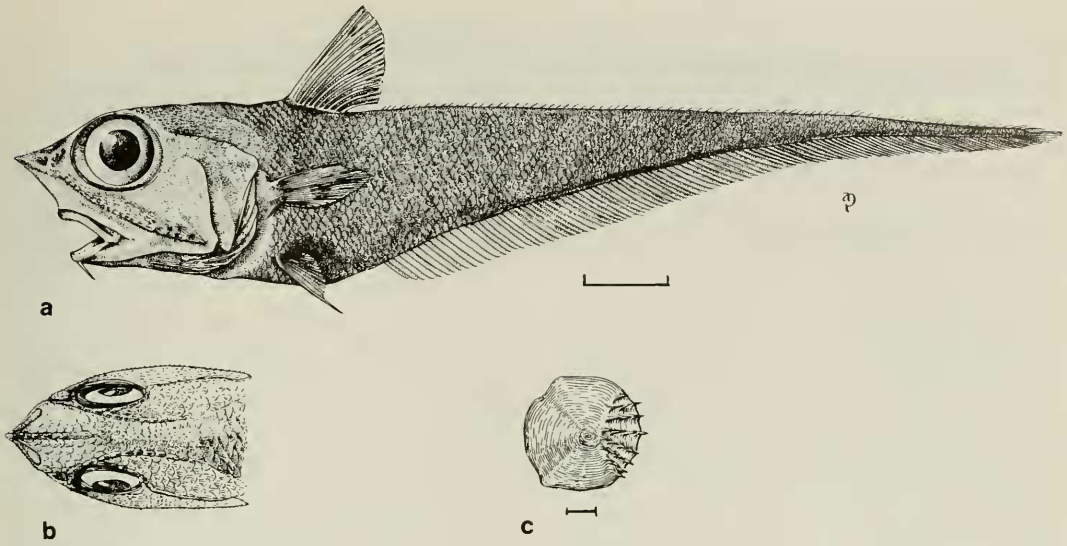

FIGURE 16. *Caelorinchus nazcaensis* new species; paratype, CAS 50898 (77 mm HL, 322 mm TL), from Nazca Ridge in 340 m. Scale bar for (a) and (b) equals 25 mm; that for (c) equals 1.0 mm. Drawn by Amy Pertschuk.

large for genus and unrestricted at posterior angle, upper jaw about one-third HL. Upper jaw teeth in narrow bands extending to posterior angle of mouth. GR-I about 12–14 total. Underside of head (including lower jaws) naked except for small patch of scales above end of mandible. Anus separated by 1–3 scale rows from anal fin; light organ very small, length slightly more than length posterior nostril; no pedicel.

COUNTS AND MEASUREMENTS.—(data for holotype in square brackets). D. II,9–11 [II,10] + 118–129; 1P. i19–i23 [i20/i21]; A. about 123–138; GR-I (outer/inner) 0/(1–3) + 1 + (9–11) (total 12–14), GR-II (1–2) + (0–1) + (9–11) (total 11–13) [1 + 1 + 10]/(1–3) + (0–1) + (8–11) (total 11–13) [3 + 1 + 10]; scales below 1D. 7–10 [8], below mid-1D. 5.5–7 [5], below 2D. 6.5–8 [6], lat.l. 35–43 [42]; pyloric caeca 30–44.

Head length 46–94 [67.7] mm; other dimensions given as percent HL: snout 28.2–32.1 [31.3]; preoral 23.6–29.2 [29.0]; orbit 33.8–39.7 [37.4]; interorbital 18.9–24.5 [21.9]; suborbital 10.4–13.3 [11.8]; postorbital 34.9–41.4 [33.5]; orbit-preop. 34.2–40.7 [35.6]; upper jaw 30.0–37.8 [33.8]; gill slit 14.6–22.3 [18.9]; barbel 10.9–18.1 [17.1]; body depth 58–79 [67]; pre-D. 100–111 [107]; pre-V. 104–116 [106]; pre-A. 130–156 [139]; V.-A. 32–51 [37]; height 1D. 44–56 [52]; 1D. base 23.2–28.0 [25.1]; 1D.–2D. 27.8–52.1 [38.7]; 1P. 38–50 [51]; V. 29–42 [39].

DESCRIPTION.—Head large, about 4 in total length, broad, greatest width slightly less than greatest depth of head. Orbits huge, more than one-third HL, much longer than snout, 0.9–1.2 postorbital length, about 0.95–1.2 of length from orbit to angle of preopercle. Posteroventral end of subopercle variously developed into a short flap directed ventrally or posteroventrally. Interopercle completely hidden behind preopercle. Snout rather short, sharply pointed, tipped with a stout, narrowly conical scale. Median and lateral processes of nasal bones separated by a broad gap, leaving anterolateral margin of snout unsupported by bone. Mouth of moderate size, upper jaw about one-third HL; maxilla extends to below middle of orbits.

Dentition consists of small, conical, slightly recurved teeth in moderately wide bands, the mandibular band narrower than that of premaxillary. Premaxillary band about 6–7 teeth rows wide, tapering posteriorly to a few teeth wide and extending along most of mouth gape, but falling just short of end of rictus. Mandibular band similarly shaped but longer than premaxillary band, extending beyond end of rictus.

Squamation characterized by rather large scales covering most of body and dorsal surfaces of head, but almost entirely absent on ventral head surfaces (a few small scales ventrally near junction of infraorbital and preopercular ridges in

some specimens). A narrow half-moon-shaped naked area on each side of leading edge of snout. Gill and nasal membranes naked. Suborbital shelf formed of two rows of stout, spiny, scutelike scales, the lower margin forming a distinct ridge that extends from snout to just short of preopercle angle. Angle formed by dorsal and ventral planes of suborbital region obtuse. Median nasal ridge low, formed by a row of about 8 broad scales, each covered with about 12 low spinule ridges that radiate from an anteromedian focus. Two rows of smaller scales on either side of median nasal ridge, these separated laterally by a shallow naked groove from a row of scales along mesial side of supranarial ridges. Surpanarial ridges incompletely scaled in smaller paratypes. A narrow spiny ridge one scale wide separating orbit from nostril region. Head ridges other than those of suborbital not endowed with markedly heavy, enlarged, and spiny scutelike scales. No supraoccipital ridge. Scales of trunk below interspace of dorsal fins beset with 5–8 slightly divergent, ridgelike rows of short, sawtooth-shaped spinules (Fig. 11c). As with most species of macrourids, spinule rows on scales probably become more numerous with size.

A small scaleless black fossa of light organ immediately preceding anus (fossa may be covered by scales in fully scaled specimens, but in our study specimens, scales missing from area). Anus separated from anal fin by 1–3 scale rows.

Swim bladder in 72.2 mm HL male about 40 mm long, broader anteriorly, with two short horns directed anteriorly; closely attached to ribs on either side of vertebral column. Drumming muscles well developed in ventrolateral position behind each horn. A long oval window on dorsal surface. Five short broad retia, each terminating in a small globular gas gland (but a smaller, 70 mm HL male, CAS 50949, had 4 retia and gas glands). Swim bladder in a female of 88.9 mm HL similar in shape, but drumming muscles rudimentary and 4 retia.

Fins all short; height first dorsal much less than postrostral length of head; pectorals slightly more than postorbital length of head and barely extending to level of vent; pelvic rays fall well short of that level except for outermost ray, which just reaches to vent in some specimens.

Color in alcohol overall swarthy to grayish brown, paler ventrally on head, but anteroventral margin of snout markedly darker than more posterior areas; opercular region darkish; abdomen bluish. Fins generally dusky, outer ray of pelvic fins whitish. Branchial, oral, and peritoneal linings bluish to brownish black. Lips and barbel pale.

Food.—Parin et al. (1990:42) recorded mostly pelagic food items in the stomachs of 10 specimens examined. These included the shrimp genera *Gennada, Sergestes, Plesionika,* the mysid *Paralophogaster glaber,* the copepod *Pleuromamma,* squid, and fish (*Chauliodus* sp., *Lampanyctus* sp., Myctophidae gen., sp.).

Size.—To about 40 cm.

Distribution.—Known only from the type-specimens taken in 225–530 m on the Nazca Ridge.

Etymology.—Derived from the type locality, the Nazca Ridge.

Comparisons and Remarks.—*Caelorinchus nazcaensis* is closely similar to *C. aconcagua* Iwamoto, 1978, from the Pacific coast of Chile, sharing with that species a rather deep head (deeper than broad); relatively large mouth (almost one-third HL); essentially completely naked underside of head (note exception in new species); naked areas on either side of leading edge of snout; small light organ without pedicel immediately before anus; rather wide outer gill slit (more than one-half orbit diameter); numerous gill rakers (12 or more total on first arch) compared with other members of genus; snout much shorter than orbit diameter; gill membranes narrowly joined across isthmus and forming a deep "V"; and similar-shaped opercular bones. The two species are readily differentiated by (1) orbit diameter (somewhat larger in *C. aconcagua,* 37.4–43.5% HL cf. 33.8–39.7%); (2) barbel length (shorter in *C. aconcagua,* 6.2–10.8% HL cf. 10.9–18.1%); (3) pectoral fin length (51.9–66.3% HL in *C. aconcagua* cf. 37.8–51.1%); (4) dark bluish color of trunk (extends around entire body in *C. aconcagua,* but restricted ventrally on belly below level of pectoral fin origin in new species); (5) oral cavity (white in *C. aconcagua,* blackish throughout in new species); (6) pyloric caeca (more than 30 in new species cf. 16–20 in *C. aconcagua*); (7) scale spinulation; and (8) head covering (thinner, and scales dorsally on head not as dense as in *C. aconcagua*).

Caelorinchus nazcaensis also resembles *C. fasciatus* (Günther, 1878), sharing with that and related southern hemipshere species (including *C. aspercephalus* Waite, 1911, *C. australis* (Richardson, 1839), *C. biclinozonalis* Arai and Mc-

FIGURE 17. *Caelorinchus spilonotus* new species; paratype, ZMMGU 18124 (52.8 mm HL), from Sala y Gomez Ridge in 545–600 m, *Prof. Shtokman* cr. 18, sta. 1977, 1–2 May 1987. Photograph by Sergei Dudarev.

Millan, 1982, *C. bollonsi* McCann and McKnight, 1980, *C. cookianus* McCann and McKnight, 1980, and *C. mirus* (McCulloch, 1926) the following features: (1) snout short, rather blunt; (2) orbits huge, much longer than snout, about equal to or greater than postorbital length; (3) anterolateral margin of snout not supported by bone; (4) light organ rather small, not extending to level of bases of pelvics; (5) posteroventral angle of subopercle rounded to variably produced, but not into a long narrow point. The new species differs from *C. aspercephalus, C. australis,* and *C. biclinozonalis* in lacking scales on the underside of the head (except for a few isolated ones in some individuals). Features differentiating *C. nazcaensis* from *C. mirus, C. fasciatus, C. cookianus,* and *C. bollonsi* include: longer premaxillary tooth bands (not extending to end of rictus in others); mouth opening not notably restricted as in other species; first dorsal fin shorter than postrostral length of head (equal to or longer than in others); pectoral and pelvic fins shorter; spinules on body scales broadly sawtooth-shaped (cf. smaller, finer, greatly reclined and imbricate); and terminal snout scute sharply pointed (blunt in others).

MATERIAL EXAMINED.—(all from **Nazca Ridge**) Holotype: ZMMGU 18094 (67.7 mm HL, 288 mm TL); 235–250 m; *Prof. Mesiatzev* cr. 12, tr. 23.

Paratypes (33 spec.): CAS 50949 (2:65–70 HL, 270–280 TL); 340 m; *Ichthyandr* cr. 6, tr. 1. CAS 50948 (54 HL, 240 TL); 320 m, *Ichthyandr* cr. 6, tr. 2. CAS 50898 (77 HL, 322 TL); 340 m; *Ichthyandr* cr. 6, tr. 3. CAS 50897 (84 HL, 350 TL) and ZMMGU 17699 (8:46–89 HL, 197–383 TL); 330 m; *Ichthyandr* cr. 5, tr. 13. ZMMGU 17700 (59.5 HL, 242 TL); 330–340 m; *Ichthyandr* cr. 5, tr. 14. ZMMGU 17701 (3:60–93 HL, 270–402 TL) and CAS 50899 (69 HL, 265+ TL); 330 m; *Ichthyandr* cr. 5, tr. 15. ZMMGU 17702 (2:69.5–75 HL, 270+–307 TL); 310–330 m; *Ichthyandr* cr. 5, tr. 17. CAS 50900 (2:70–76 HL, 290–305 TL); 330 m; *Ichthyandr* cr. 5, tr. 33. ZMMGU 17703 (6:71–82.5 HL, 289–357 TL); 330 m; *Prof. Shtokman* cr. 18, sta. 1845. ZMMGU 17704 (4:53.5–86 HL, 225–370 TL); 330–350 m; *Prof. Shtokman* cr. 18, sta. 1851. ZMMGU 17705 (82 HL, 310 TL); 530–500 m; *Prof. Shtokman* cr. 18, sta. 1864/76.

Non-type material (47 spec.): ZMMGU 18093 (2:62.2–70 HL, 239+–295+ TL); 300–330 m; *Astronomer* trawl without no. (23°30.5'S, 81°45'W). ZMMGU 18095 (78.4 HL, 336+ TL); 235–225 m; *Prof. Mesiatzev* cr. 13, tr. 25. ZMMGU 18096 (59 HL, 255 TL); 340–325 m; *Prof. Mesiatzev* cr. 13, tr. 35. ZMMGU 18097 (72.7 HL, 329 TL); 235–230 m; *Prof. Mesiatzev* cr. 13, tr. 36. ZMMGU 18098 (70.5 HL, 294+ TL); 230–240 m; *Prof. Mesiatzev* cr. 13, tr. 29. ZMMGU 18099 (2: 58–59.5 HL, 247–253 TL); 320–325 m; *Prof. Mesiatzev* cr. 13, tr. 43. ZMMGU 18100 (3:63–80.5 HL, 267+–324+ TL); 340–780 m; *Prof. Mesiatzev* cr. 13, tr. 44. ZMMGU 18101 (68.5 HL, 286 TL); 225–240 m; *Prof. Mesiatzev* cr. 13, tr. 109. ZMMGU 18102 (91 HL, 399 TL); 225–240 m; *Prof. Mesiatzev* cr. 13, tr. 31. ZMMGU 18103 (2:72–74.5 HL, 295–315 TL); 230 m; *Prof. Mesiatzev* cr. 13, tr. 120. ZMMGU 18104 (81.8 HL, 342 TL); 320–340 m; *Ichthyandr* cr. 6, tr. 10. ZMMGU 18105 (72.3 HL, 278+ TL); 230–250 m; *Odissey* cr. 2, tr. 15. ZMMGU 18106 (2:65.5–71.3 HL, 273–297 TL); 235 m; *Odissey* cr. 2, tr. 11. ZMMGU 18107 (80 HL, 348 TL); 230 m; *Odissey* cr. 2, tr. 14. ZMMGU 18108 (75 HL, 320 TL); 225–247 m; *Prof. Shtokman* cr. 18, sta. 1867. ZMMGU 18109 (5: 68–87.5 HL, 292–366 TL); 235 m; *Prof. Shtokman* cr. 18, sta. 1873. IOAN uncat. (21:61–92 HL, 252+–400 TL); 340 m; *Akademik Kurchatov* cr. 34, sta. 3594.

Caelorinchus spilonotus new species

(Figures 11d, 17, 18)

Coelorinchus cingulatus: Parin et al. 1981:11 (12 spec. from Sala y Gomez Ridge).

"*Coelorinchus* sp. nova 3 Sazonov et Iwamoto": Parin 1990: 15 (listed from Sala y Gomez Ridge). Kotlyar and Parin 1990:104, fig. 3b (otolith).

DIAGNOSIS.—Snout acutely pointed, tipped with a narrow, pointed scute; median nasal bone blackish; anterolateral margins of snout not supported by bone; ventral surfaces of snout entirely naked. Subopercle posteroventrally produced into a short triangular flap. Mouth small, restricted at posterior angle; upper jaw 20–26% of HL. Upper jaw teeth in broad short bands that fall short of posterior angle of mouth. Scales on body with slender, conical, reclined, imbricate spinules arranged in 5–10 parallel to slightly divergent rows (more rows in larger specimens). Anterior rays of second dorsal fin as long as opposite members of anal fin. Interspace between dorsal fins short,

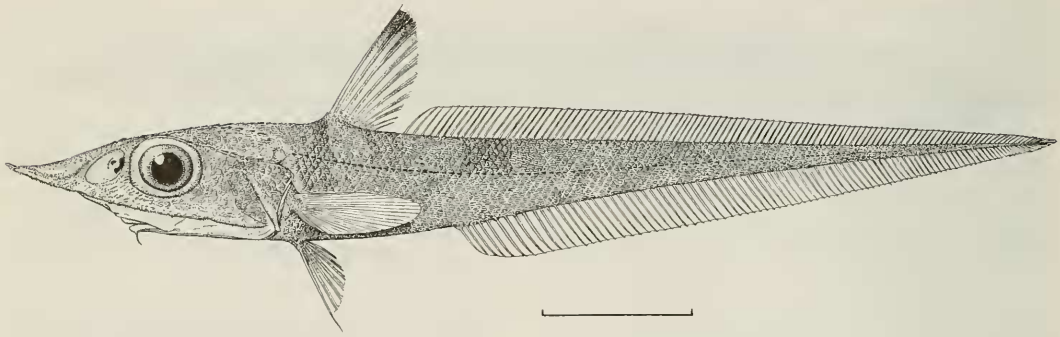

FIGURE 18. *Caelorinchus spilonotus* new species; paratype, CAS 50950 (50.3 mm HL), from Sala y Gomez Ridge in 440 m. Drawn by Tomio Iwamoto. Scale bar equals 25 mm.

less than base of first dorsal. Two prominent saddle marks, one immediately before first dorsal fin connecting to broad pectoral blotch, second saddle separated from first by a distance about equal to snout length. First dorsal fin black tipped. Anus immediately before anal fin. Light organ extends forward between pelvic fins and onto middle of chest, both ends expanded into a teardrop shape and lying within a shallow fossa.

COUNTS AND MEASUREMENTS (from 26 specimens; mean, $\bar{x}$, in parentheses, holotype in square brackets).—1D. II,8–10 (II,9.35) [II,9]; 1P. i17–i22 (i19.73, n = 52) [i19]; GR-I (outer/inner) total 6–8 [0/0 + 1 + 5], GR-II total 5–7 [0 + 0 + 5/1 + 1 + 5]/total 6–8; scales below 1D. 6.5–8 [7.5], below 2D. 5.5–7.5 [7], below mid-1D. 4.5–5.5 [5], lat.l. 37–44 [43].

Total length of specimens examined +96–206 mm [184+ mm], HL 29.5–60 mm [60 mm]. The following in percent HL: postrostral 49.7–60.5 (55.5) [54.5]; snout 41.8–51.4 (46.1) [46.7]; preoral 35.4–44.8 (39.1) [40.5]; internasal 17–22 [19.3]; orbit 21.2–27.9 (24.7) [24.2]; interorbital 18.0–24.1 (20.6) [21.0]; suborbital 10.8–14.8 (12.5) [12.8]; orbit-preop. 25.3–32.8 (29.8) [29.2]; upper jaw 20.3–26.0 (24.0) [24.2]; gill slit 8.6–13 [13.3]; barbel 4.8–9.0 (6.9) [7.8]; body depth 37.6–47.5 (41.7) [44.2]; light organ 47.3–60.7 (51.7) [53.3]; pre-D. 102–115 (107) [107]; pre-V. 100–115 (107) [106]; pre-A. 139–161 (150); V.-A. 38–55.8 (46.6) [46.7]; height 1D. 34–49 (41.3) [44]; 1D. base 13.8–21.6 (18.7) [17.8]; 1D.–2D. 4.2–13.3 (9.2) [9.5]; 1P. 37–45 (40) [38]; V. 27–39 (33) [33].

DESCRIPTION.—Head about as deep as wide. Snout sharply pointed; anterolateral margins not supported by bone; a broad gap between median and lateral processes of nasal bone. Head ridges distinct but not especially strong, except for sharp suborbital ridge, which divides ventral and dorsal portions of head. Supraoccipital ridge weakly developed. Interopercle completely hidden behind preopercle; subopercle developed posteroventrally into a short triangular flap. Gill membranes broadly attached to isthmus, without a free posterior fold. Gill slits somewhat restricted, outer slit slightly longer than pupil diameter. Gill rakers low, epibranchial rakers shaped like flattened disks; remainder tubercular. Chin barbel short, almost rudimentary, usually shorter than length of posterior nostril.

Scales of body (Fig. 11d) moderate sized, covered with parallel to slightly divergent rows of small, sharp, conical, imbricate spinules, the posteriormost tips extending beyond margin of scale. About 5 or 6 spinule rows in smallest specimens examined (about 30 mm HL); 9 or 10 in largest specimens (about 60 mm HL). Scales on head generally like those of body, but with shorter, more erect spinules in fewer, more divergent rows. Nostril membranes completely naked, but suborbital shelf below and behind nostrils completely scaled. Narrow strips on either side of median nasal ridge naked. Terminal snout scute sharp, rather small, narrow, and weak (tip broken off in several specimens); protrudes directly forward or slightly upwards; upcurve of tip more highly developed in smaller specimens.

Light organ large, long, extending from anus to chest just behind isthmus. Luminescent glands as described and illustrated for the subgenus *Quincuncia* by Okamura (1970b:figs. 43, 81). Alimentary canal about like that illustrated for *Caelorinchus longissimus* by Okamura (1970b: fig. 64D). Extent of anteriormost bends could not be accurately determined because all specimens

had everted stomachs that distorted bending pattern. Pyloric caeca short, thick; 9–12 in 9 specimens. Swim bladder oval, blunter end anteriad, with 4 or 5 (in 5 specimens) short retia, each tipped with a broad, flat gas gland. Eggs in the large ovaries of CAS 50951 (58.8 mm HL) distinct, the largest about 1.0 mm in diameter.

Fins generally small, height first dorsal about as long as snout, second spinous ray not produced. Pectoral fin short, about equal to snout length. Outer pelvic ray about equal to or slightly longer than postorbital length of head, falls short of anal fin. Second dorsal relatively well developed for genus, height of rays anteriorly about equal to opposite members of anal fin. Interspace between dorsal fins short, less than length base of first dorsal.

Color in alcohol light brown to tawny overall, paler ventrally on head and on tail; darker ventrally on trunk. Saddles and blotches darker brown. Two prominent saddles, one before first dorsal fin, the second posteriorly about one snout length behind first and originating at position of 9th ray of second dorsal fin. The first saddle blending in larger specimens with large blotch above pectoral fin base. This pectoral blotch 5 or 6 scale rows wide, posterior saddle 6 or 7 rows wide. A faint blotch in larger specimens between dorsal-fin interspace and lateral line. Underside of head entirely lacking pigmentation except for fine scattered punctations posteriorly. Median process of nasal bone blackish or dusky. Mouth pale except for scattered punctations posteriorly on roof of mouth and in gullet. Gill chamber and gill membranes pale with scattered punctations; gill arches and filaments pale. Peritoneal membrane blackish; stomach pale to dusky near esophagus. Fin rays whitish except for black-tipped first dorsal, and uppermost pectoral ray often darker.

Food.—One female (58.8 mm HL, CAS 50951) had a large squid beak in its otherwise empty stomach; all other specimens had everted stomachs.

Size.—A small species, maximum length slightly more than 20 cm.

Distribution.—Known only from the Sala y Gomez Ridge and Hawaiian Islands in 330–600 m.

Etymology.—From the Greek, *spilos* (spot), and *notos* (back), in reference to the peculiar coloration of this species.

Comparisons.—The species is most similar to, and may be conspecific with, *C. cingulatus* Gilbert and Hubbs, 1920, a species known only from the two small type-specimens taken in the Philippines and one 232 mm specimen recently recorded from the Okinawa Trough by Okamura (*in* Okamura and Kitajima 1984:229, 366, fig. 161). The holotype (USNM 78221, 40.2 mm HL) and small paratype (41.4 mm HL, 148+ mm TL; USNM 78233) of *C. cingulatus* were examined for comparison. Most meristic and morphometric features of the two species are similar, but their pigmentation patterns differ. (Pigmentation in the paratype is almost totally lost from long preservation; thus, color-pattern comparisons were made from the original description and from the description and illustration by Okamura *in* Okamura and Kitajima 1984.) *Caelorinchus cingulatus* lacks the large blotch above the pectoral fin base that is so prominent in *C. spilonotus*. Furthermore, the first saddle mark begins on the nape in front of the first dorsal fin and extends ventrally to join the pectoral blotch. None of this saddle lies below the soft rays of the first dorsal fin, as described and illustrated by Okamura for *C. cingulatus*. The second saddle mark does not extend below the lateral line in the new species, but does so in *C. cingulatus*, and the second saddle begins under the 7th–10th rays of the second dorsal in the new species, but under the sixth in *C. cingulatus*.

Gilbert and Hubbs (1920:483) describe brown streaks that "radiate backward from the eye . . . the upper one, more conspicuous, extends horizontally backward, just below the postorbital scaly ridge, to the upper angle of the branchial aperture, where it is continuous with the dusky opercular blotch." This upper streak is prominent in Okamura's (*in* Okamura and Kitajima 1984, fig. 161, p. 228) photograph of his specimen but completely lacking in our specimens of *C. spilonotus*. In *C. cingulatus* a diagonal streak extends anteriorly and ventrally from the second saddle mark, joining the darker abdominal region. This streak is also absent in *C. spilonotus*.

The new species may have fewer gill rakers on the inner series of the second arch (7 or 8 cf. 9 in *C. cingulatus*) and fewer pyloric caeca 9–12 (cf. about 14 in the holotype and 15 in the paratype of *C. cingulatus*, although Gilbert and Hubbs [1920:482] reported 21 for the paratype). With so few specimens of *C. cingulatus*, these enumerated characters cannot be adequately assessed to determine their value as species char-

acters. The possibility exists that they may simply reflect individual or geographic variation within one species.

The three Hawaiian specimens of *C. spilonotus* have noticeably longer, more attenuated snouts, with the terminal scute narrow, long, and sharply pointed. Naked areas laterodorsally behind the leading edges of the snout are more extensive than in the NSG specimens. Punctations on the underside of the head are lacking in the NSG specimens but noticeably present in the Hawaiian specimens (and in *C. cingulatus*). Head coloration of the Hawaiian specimens is slightly darker than that of the NSG specimens and follows more closely the color description of *C. cingulatus*. We do not consider these differences as sufficient to recognize the Hawaiian population as distinct. The elongation of the snout is reminiscent of the situation in *C. caribbaeus* (Goode and Bean, 1885), where the snout length is remarkably variable within a single population in the northern Gulf of Mexico (see Marshall and Iwamoto 1973).

Among other Pacific members of the genus, the new species and *C. cingulatus* share many important characters with *C. gladius* Gilbert and Cramer, 1897 from the Hawaiian Islands. The chief differences are: *C. gladius* lacks saddle marks but has a prominent black blotch over the pectoral base; the snout is sharp and narrow, with the terminal scute remarkably long and devoid of spinules dorsally. The second spinous ray of the first dorsal fin has a few minute denticulations distally along the anterior margin in the two *C. gladius* specimens examined (47 and 66 mm HL, CAS-SU 8517), and surprisingly, also in the Hawaiian specimens of *C. spilonotus*. Certain proportions differ notably as a result of the extremely elongated snout of *C. gladius* (e.g., the snout length is considerably greater than the postrostral length of the head in *C. gladius* but is much shorter than that measure in *C. spilonotus* from the NSG, and about equal in the Hawaiian representatives).

Material Examined.—Holotype: ZMMGU 18125. (60 mm HL, 187+ mm TL); **Sala y Gomez Ridge**, 545–600 m; *Prof. Shtokman* cr. 18, sta. 1977.

Paratypes (82 spec.). **Sala y Gomez Ridge:** CAS 50950 (50.3 mm HL, 182 mm TL); 440 m; *Ichthyandr* cr. 5, sta. 40. CAS 50952 (2:30.6–38.4 HL, 108+–115+ TL); 480 m; *Ichthyandr* cr. 5, sta. 50. ZMMGU 17706 (4:42.5–56.5 HL, 138+–204+ TL); 540 m; *Ichthyandr* cr. 5, tr. 53. ZMMGU 17707 (6:29.5–58.5 HL, 96+–201 TL) and CAS 50951 (6:43.5–58.8 HL, 131+–202 TL); 410 m; *Ichthyandr* cr. 5, tr. 56. CAS 50953 (56.2 HL, 192+ TL); 420 m; *Ichthyandr* cr. 5, tr. 57. ZMMGU 17708 (12:30.5–43.6 HL, 116–162 TL); 380 m; *Prof. Shtokman* cr. 18, sta. 1940. ZMMGU 17709 (5:35–52 HL, 133–188 TL); 410–385 m; *Prof. Shtokman* cr. 18, sta. 1941. ZMMGU 18123 (15:42.7–52.3 HL, 130+–172 TL); 563–590 m; *Prof. Shtokman* cr. 18, sta. 1976. ZMMGU 18124 (30:25–58 HL, 98–198 TL); 545–600 m; *Prof. Shtokman* cr. 18, sta. 1977. **Hawaiian Islands:** LACM 45409-1 (3:52.7–58.2 HL, 176+–181+ TL); *Townsend Cromwell* tr. 57; Mar–Apr 1972.

Non-type material (7 spec.). **Sala y Gomea Ridge:** ZMMGU 18118 (30.5 HL, 97+ TL); 360–400 m; *Ichthyandr* cr. 5, tr. 51. ZMMGU 18119 (2:48.5–56.5 HL, 162+–182+ TL); 535–575 m; *Ichthyandr* cr. 5, tr. 53. ZMMGU 18120 (44.5 HL, 157 TL); 550 m; *Astronomer* trawl without no. (25°02′S, 88°35′W). ZMMGU 18121 (48.8 HL, 174 TL); 565 m; *Prof. Mesiatzev* cr. 15, tr. 50. ZMMGU 18122 (2:44.7–54 HL, 138+–170+ TL); 400 m; *Prof. Mesiatzev* cr. 15, tr. 52.

Coryphaenoides Gunnerus, 1765

Type species: *Coryphaenoides rupestris* Gunnerus, 1765, by monotypy.

Diagnosis.—Macrourine grenadiers with 6 branchiostegal rays. Snout shape variable but never greatly produced beyond mouth. Suborbital ridge variously and usually weakly developed, not connected to preopercular ridge, which in turn is never sharply angular at its posterior end. Dentition variable among species, arranged in broad bands to 1 or 2 rows, but teeth never few and fanglike. Barbel present. Second spinous ray of first dorsal finely serrated along leading edge, although serration occasionally obsolete in large individuals of some species. Gill rakers tubercular to short and tablike, those of outer series of first arch rudimentary. Anus immediately in advance of anal fin or slightly anterior to it; no light organ. Pyloric caeca simple, unbranched, usually fewer than 20. Retia and gas glands 4–7. (Adapted from Iwamoto and Sazonov 1988.)

Coryphaenoides paradoxus (Smith and Radcliffe, 1912)

Macrourus paradoxus Smith and Radcliffe *in* Radcliffe 1912: 115–116, pl. 25, fig. 1 (off eastern Palawan, Philippines, 2,021 m).

Coryphaenoides (Nematonurus) paradoxus: Gilbert and Hubbs 1916:143.

?*Nematonurus macrocephalus* Maul, 1951:17 (type locality Madeira).

?*Coryphaenoides macrocephalus*: Marshall and Iwamoto 1973: 575–578 (North Atlantic).

Coryphaenoides sp.: Parin et al. 1981:11 (Nazca Ridge).

Coryphaenoides paradoxus: Wilson et al. 1985:1,243–1,254 (Darwin Guyot, central North Pacific, about 1,600 m). Iwamoto and Sazonov 1988:72–75, fig. 3c, 24, 28 (se. Pacific). Parin 1990:16 (listed from Nazca ridge and area between Nazca and Sala y Gomez ridges).

DIAGNOSIS.—A large species (120+ cm) in subgenus *Coryphaenoides* with 1D. II,9–11, 1P. i16–i21, V. 9–11 (rarely 8). Snout low, scarcely protruding. Orbits relatively small, about 1.5 into snout, 1.8–1.9 into interorbital space, 5.0–6.0 into HL. Interopercle barely exposed as a broad fleshy naked tab. Suborbital region vertical; no strong sharp ridges on head. Mouth large, almost terminal, upper jaw extends to below posterior orbit margin. Teeth prominent, an outer enlarged series on premaxillary behind which a narrow villiform band; mandibular teeth in about 3 irregular series near symphysis, becoming uniserial posteriorly. Head fully scaled except lips, gill membranes, interopercle. (After Iwamoto and Sazonov 1988.)

SIZE.—A large species attaining more than 120 cm.

DISTRIBUTION.—Broadly distributed in the Pacific (Kermadecs, Hawaiian Islands, Nazca Ridge), Indian Ocean [our data], and Atlantic (if *C. macrocephalus* is a synonym).

REMARKS.—The two specimens from NSG were fully described by Iwamoto and Sazonov (1988). In the eastern Pacific, the species is likely to be confused only with *C. bulbiceps,* which attains a similar large size. The stronger teeth, longer barbel, smaller orbit, lower snout, and higher pelvic fin ray count readily distinguish *C. paradoxus* from *C. bulbiceps.* Although we (Iwamoto and Sazonov 1988:75) previously alluded to the similarity of *C. paradoxus* and *C. rudis* Günther, 1878, we now strongly suspect that the two are the same. We have examined the type specimens of *C. paradoxus* and *C. rudis* and found no characters that would suggest specific difference. The scale spinules in the *C. rudis* lectotype appeared longer and more densely placed, but these features of the spinules tend to be highly variable in most grenadiers. If this synonymy proves correct, *C. rudis* has priority. We are reluctant at this point, however, to make this synonymy because of the lack of comparative material from near the type locality. As far as we can determine, only the lectotype of *C. rudis* is known (the paralectotype is a species of *Nezumia*). McCann and McKnight's (1980:35) record of the species from off New Zealand stems from misidentification of a specimen representing a perhaps-undescribed species. Brauer's (1906:246) record from the western Indian Ocean is based on a specimen (ZMB 17641) representing an undescribed species of *Kuronezumia.*

MATERIAL EXAMINED.—ZMMGU 16528 (155 HL, 765 TL); **Nazca Ridge**, 980 m; *Ichthyandr* cr. 5, sta. 1. ZMMGU 16527 (166 HL, 820 TL); **Sala y Gomez Ridge**, 1,070–1,100 m; *Prof. Mesiatzev* cr. 13, tr. 10.

Hymenocephalus Giglioli, 1884

Type species: *Hymenocephalus italicus* Giglioli, in Giglioli and Issel, 1884, by original designation (also monotypic).

DIAGNOSIS.—Branchiostegal rays 7. Head bones weak, often paper-thin. Head covering membranous. Ventral striae on abdomen, chest, and shoulder girdle; light organ with two lens-like bodies, one before the anus, the second on the chest anterior to pelvic fin bases, both connected externally by a long median-ventral line.

DISTRIBUTION.—The genus is primarily tropical to warm temperate in distribution and generally absent in high-latitude waters. With five species, the genus (sensu lato, including *Spicomacrurus* Okamura, 1970a and *Hymenogadus* Gilbert and Hubbs, 1920) is surprisingly well represented on the Sala y Gomez and Nazca ridges. Four species are found off the Hawaiian Islands. The genus is absent, however, along the entire mainland Pacific coasts of the Americas (although a single, apparent stray of undetermined species was reported by Iwamoto 1979: 140).

In contrast, the genus is well represented in the western Pacific. Gilbert and Hubbs (1920) recorded seven species and three subspecies from the Malay Archipelago (to include their terms "Philippine Islands and East Indies"); Okamura (*in* Okamura and Kitajima 1984) recorded five species from the Okinawa Trough, and six species and two subspecies (Okamura 1970a) from waters off Japan. The number of species in the Indian Ocean is as yet undetermined, but probably ranges between two and four in the western and central parts, and more from the Malay Archipelago and Australia. No *Hymenocephalus* species is known from New Zealand; only two have been reported from Australia, although representatives of other species are deposited in IOAN, ZMMGU, and AMS from warm-water regions of that continent. The Atlantic has only four representatives.

Some of the species of *Hymenocephalus* have wide distributions; others appear to be rather narrowly confined. *Hymenocephalus gracilis* is an example of a widely distributed species, having first been described from off the Philippines and subsequently recorded from Japan (Oka-

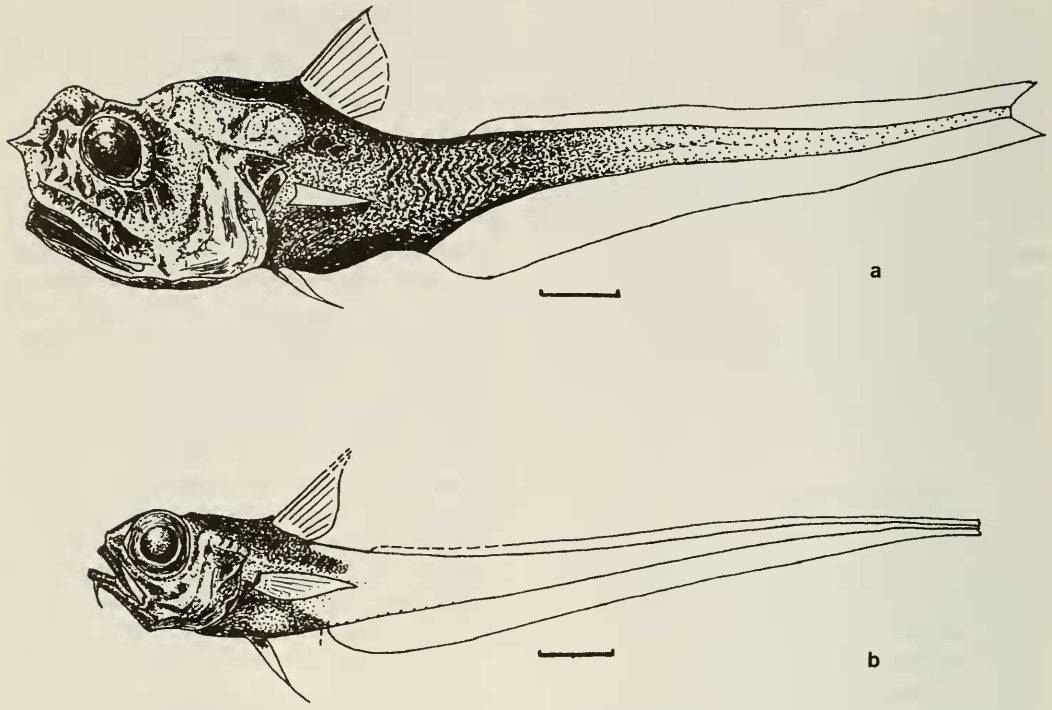

FIGURE 19. (a) *Hymenocephalus* sp. cf. *aterrimus*. (b) *H. neglectissimus*, holotype ZMMGU 18219 (18.5 mm HL, 123+ mm TL) from off Sala y Gomez Ridge in 580–564 m. Drawn by Y. I. Sazonov.

mura 1970a), the Atlantic (Marshall and Iwamoto 1973), the western Indian Ocean (Iwamoto 1982), and now the southeastern Pacific. The Hawaiian species *H. aterrimus* has also been recorded from the western Atlantic (Marshall and Iwamoto 1973) and western Indian Ocean (Shcherbachev 1987); a related form is here reported from NSG. *Hymenocephalus striatulus*, originally described from Hawaii, is now known from Soviet collections from the NSG, and its closest relative appears to be *H. billsamorum* Marshall and Iwamoto, 1973, from the Gulf of Mexico and Caribbean Sea. *Hymenocephalus longiceps* Smith and Radcliffe, 1912 and *H. striatissimus* Jordan and Gilbert, 1904, are widespread in the western Pacific, from Japan south to Indonesia; the latter is represented by four geographic subspecies, and its closest relative appears to be the new species from NSG. Most of the remaining species have relatively confined distributions, although available collections are still inadequate to circumscribe their limits with certainty.

REMARKS.—A distinctive group of about 22 or more small species, few attaining lengths of more than 25 cm.

Hymenocephalus sp. cf. **aterrimus** Gilbert, 1905?

(Figure 19a)

?*Hymenocephalus aterrimus* Gilbert, 1905:666, pl. 93 (Holotype: USNM 51649; off Kauai, Hawaii, 385–500 fms; *Albatross* sta. 3989). Parin 1990:16 (listed from Nazca Ridge and area between Nazca and Sala y Gomez ridges).

DIAGNOSIS.—A species of subgenus *Papyrocephalus*, with orbit diameter 21–23% HL; interorbital width 24–35% HL; outer gill slit 27–30% HL. Barbel absent. Pelvic fin rays 13. Color mostly blackish.

COUNTS AND MEASUREMENTS.—1D. II,9–10; 1P. i13–i15; GR-I (outer/inner) 17–19/4 + 17–19; GR-II 3 + 17–18/3 + 15–16. Total length 84–136 mm; HL 26.5–35 mm. Following dimensions in percent HL (3 spec.): postrostral 71.4–75.5; snout 26.4–34.3; suborbital 20–21.9; postorbital 48.5–51; orbit-preop. 52.8–55.4; upper jaw 45.4–48.7; body depth 69–76; light organ 59–68; pre-1D. 104; pre-V. 103–110; pre-A. 147–

160; V.-A. 50–59; base 1D. 31.4–37.9; 1D.–2D. 32.1–40.8; 1P. 70; V. 60.

DESCRIPTION.—Trunk and tail strongly compressed laterally, dorsal and ventral profiles taper rapidly behind first dorsal fin for about one HL distance. As typical for subgenus, head large and deep, bones generally paper-thin, scale bones over occipital region large and thin. Orbits small, more than 4 into head. Snout high, median nasal ridge notably elevated. Subopercle deep; propercle large, forming most of gill cover, outer edges crenulated; opercle commensurately small; a deep subopercular notch. Preopercular ridges forming a large triangular process at posteroventral corner.

Teeth in moderately wide bands in both jaws, the individual teeth uniformly short and stoutly conical with rather blunt tips.

Scales all missing, but scale pockets large.

Anterior lens of light organ small, round, difficult to see; posterior lens slightly larger, oval, within a broad, teardrop-shaped, black, naked area immediately before anus, as typical of genus. Black line connecting the two lenses poorly defined. Ventral striae generally as described for others of genus, but not as well defined and much more difficult to see.

Pectoral and pelvic fins about on same vertical; first dorsal origin slightly behind that; anal fin begins midway below long interspace between dorsal fins. Pectoral and pelvic fins rather long, both extending slightly past anal origin.

Color overall black or swarthy, darkest over trunk and ventral aspects of fish; tail mostly dark brown. A broad midlateral band of heavier melanophores beginning above midlateral portion of trunk, extending posteriorly onto and eventually completely including tail. Paired and first dorsal fins with dark rays and pale interradial membranes; anal fin pale but bases of rays black. Floor of buccal cavity below tongue forming a black triangle; tongue, however, pale dorsally with only a few scattered large melanophores on ventral surface. Roof of mouth with splotches of black.

SIZE.—To at least 130 mm.

DISTRIBUTION.—Known only from the Nazca and Sala y Gomez ridges.

COMPARISONS AND REMARKS.—The NSG specimens are similar in many characters to *H. aterrimus* and *H. papyraceus*. Using the key provided by Gilbert and Hubbs (1920:520), our four specimens key out to *H. aterrimus*, and most meristic and morphometric features agree with the original and Marshall and Iwamoto's (1973: 607) descriptions of that species. However, comparison of the four with Hawaiian paratypes (CAS-SU 8513) of *H. aterrimus*, four Atlantic representatives (CAS 14514), and others from the Atlantic and Indian oceans deposited in IOAN and ZMMGU suggests that the head is too deep and narrow, and the median nasal ridge is too high to be that species. The poor condition of the specimens, however, might account for the apparent differences. We also compared our material with a 32.4 mm HL specimen of *H. papyraceus* (ZMMGU 18258) taken in the East China Sea off southern Japan. Among other characters, *H. papyraceus* differs in having a smaller barbel, fewer pelvic fin rays (11), larger orbit, narrower suborbital, and longer upper jaw. With more and better specimens, it should be possible to better compare and quantify these apparent differences, but for now, it seems best to leave the identity as questionably *H. aterrimus*.

MATERIAL EXAMINED.—ZMMGU 17729 (2:33–34.3 mm HL, 125–131+ mm TL) and CAS 75792 (34 HL, 134 TL); **Sala y Gomez Ridge**, 1,070–1,100 m; *Prof. Mesiatzev* cr. 13, tr. 10. ZMMGU 18128 (26.5 HL, 84+ TL); **Nazca Ridge**, 340–780 m; *Prof. Mesiatzev* cr. 13.

Hymenocephalus gracilis Gilbert and Hubbs, 1920

(Figure 20a)

Hymenocephalus gracilis Gilbert and Hubbs, 1920:522, fig. 31 (Holotype: USNM 78227, *Albatross* sta. 5292, 162 fms, off Luzon, Philippines). Marshall and Iwamoto 1973:602, fig. 31 (N. Atlantic spec.). Parin 1990:16 (listed from Nazca and Sala y Gomez ridges).

Hymenogadus gracilis: Okamura 1970a:61, pl. 17, fig. 27 (Japan); 1984:201, 359, fig. 143 (E. China Sea).

DIAGNOSTIC DESCRIPTION.—Body low, terete, gradually tapering posteriorly; tail laterally compressed. Head low, its length 18–22% TL; ridges low and poorly developed. Snout low, rather long, 1.3–1.7 in orbit (usually 1.3–1.4, relatively shorter in juveniles), pointed and protruding well beyond mouth. Orbit oval, 29–41% HL, upper margin reaching upper profile of head. Maxillary extends to vertical through posterior margin of orbit. Nasal and medial rostral ridges conspicuous; suborbital ridge developed, dividing suborbital region into upper and lower portions, the former very narrow.

COUNTS AND MEASUREMENTS.—(30 NSG spec.) 1D. II,9–11; 1P. i15–i18; V. 8 (1 spec. with 8/7);

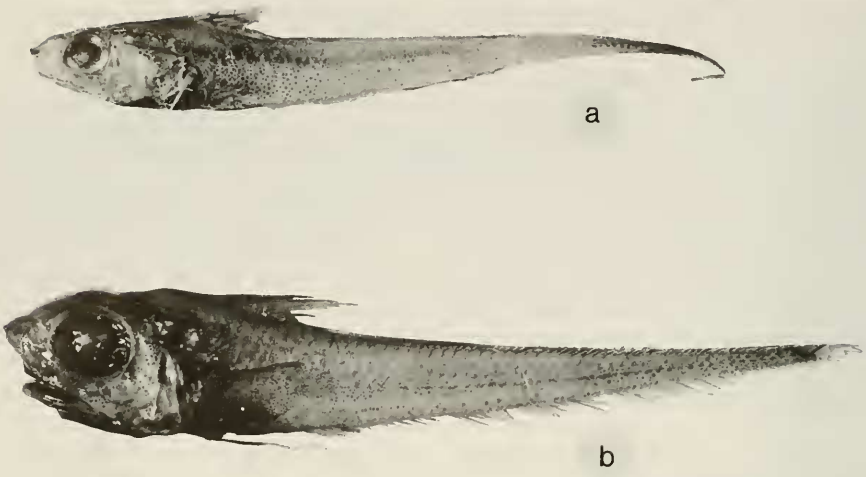

FIGURE 20. *Hymenocephalus* species from Sala y Gomez Ridge, collected on the 18th cruise of *Prof. Shtokman*. (a) *Hymenocephalus gracilis*, ZMMGU 17740 (22 mm HL), sta. 1941, in 410–385 m, 28 April 1987. (b) *Hymenocephalus striatulus*, ZMMGU 17715 (27.8 mm HL), sta. 1970, in 540–560 m, 1 May 1987. Photographs by Sergei Dudarev.

GR-I (outer/inner) 7–11/3–4 + 14–16 (17–18 total), GR-II 14–18 total.

Total length 58+–125 mm; HL 11.8–24 mm. Following in percent HL: postrostral 73–82; snout 22.6–27.9; preoral 11.1–17.3; orbit 29.2–40.7; interorbital 14.7–22.6; suborbital 7.5–10.6; postorbital 28.8–36.5; orbit-preop. 32.6–43.3; upper jaw 42.3–49.6; gill slit 20.8–29.8; barbel 23.7–32.4; body depth 47–67; light organ 54–70; pre-1D. 98–113; pre-V. 93–108; pre-A. 143–163; V.-A. 49–66; 1D. height 47–77 (6 spec.); base 1D. 31–45; 1D.–2D. 30–87; 1P. 35–56; V. 44–55.

SIZE.—To 130 mm.

DISTRIBUTION.—South China Sea off Luzon, Japan, East China Sea, southeastern Pacific, tropical western North Atlantic, eastern Atlantic off Morocco, and Indian Ocean off Zanzibar (our unpublished data).

COMPARISONS AND REMARKS.—This species seems to have a preference for island areas. The capture of three specimens in midwater trawls fished well off bottom suggests occasional forays into the bathypelagic realm. *Hymenocephalus tenuis* Gilbert and Hubbs, 1917, is a closely related species known only from the immature holotype collected in the Hawaiian Islands. Differences between the two species are slight (see Gilbert and Hubbs 1920:520) and should be reevaluated when more specimens of *H. tenuis* become available.

MATERIAL EXAMINED.—(39 spec., 7 sta.) **Sala y Gomez Ridge** (eastern part): ZMMGU 17735 (20.7 mm HL, 98+ mm TL); 390–385 m; *Prof. Mesiatzev* cr. 15, tr. 53. ZMMGU 17736 (10.9 HL, 56+ TL); 300–0 m over bot. depth >2,000 m; IKMT; *Prof. Shtokman* cr. 18, sta. 1887. ZMMGU 17737 (about 6.2 HL, 28 TL); 300–0 m over bot. depth >2,000 m; IKMT; *Prof. Shtokman* cr. 18, sta. 1925. ZMMGU 17738 (2: 11.8–16.8 HL, 58+–93+ TL); 380 m; Sigsbee trawl; *Prof. Shtokman* cr. 18, sta. 1938. ZMMGU 17739 (10:19–23.2 HL, 80+–120 TL) and CAS uncat. (10:11.3–23 HL, 64–124 TL); 380 m; *Prof. Shtokman* cr. 18, sta. 1940. ZMMGU 17740 (8: 18–24 HL, 84–120 TL) and CAS uncat. (5:19–23 HL, 97–116 TL); 410–385 m; *Prof. Shtokman* cr. 18, sta. 1941. IOAN uncat. (12.0 HL, 58.5 TL); 200–0 m over bot. depth >2,000 m; IKMT; *Prof. Shtokman* cr. 18, sta. 1949.

Hymenocephalus neglectissimus new species

(Figures 19b, 21)

No literature applies to this species.

DIAGNOSIS.—Orbits large, greatest diameter about 44–55% HL; interorbital 20.8–27.4%; barbel thin, 15–28%; GR-I (lower limb, inner series, including raker at angle) 13–17, rarely 18. Body depth over anal origin 47–58% HL. Pectoral rays i12–i14 (rarely i15); V. 8. Black blotch on dorsum with clear-cut outlines; few isolated or no pigment cells above its posterior projection, few or none behind it, and few small widely spaced dots below (on sides of abdominal region).

COUNTS AND MEASUREMENTS.—(see also DIAGNOSIS) (data on holotype in square brackets) 1D. II,7–8 (rarely 9) ($\bar{x}$ = II,7.9, n = 50) [II,8];

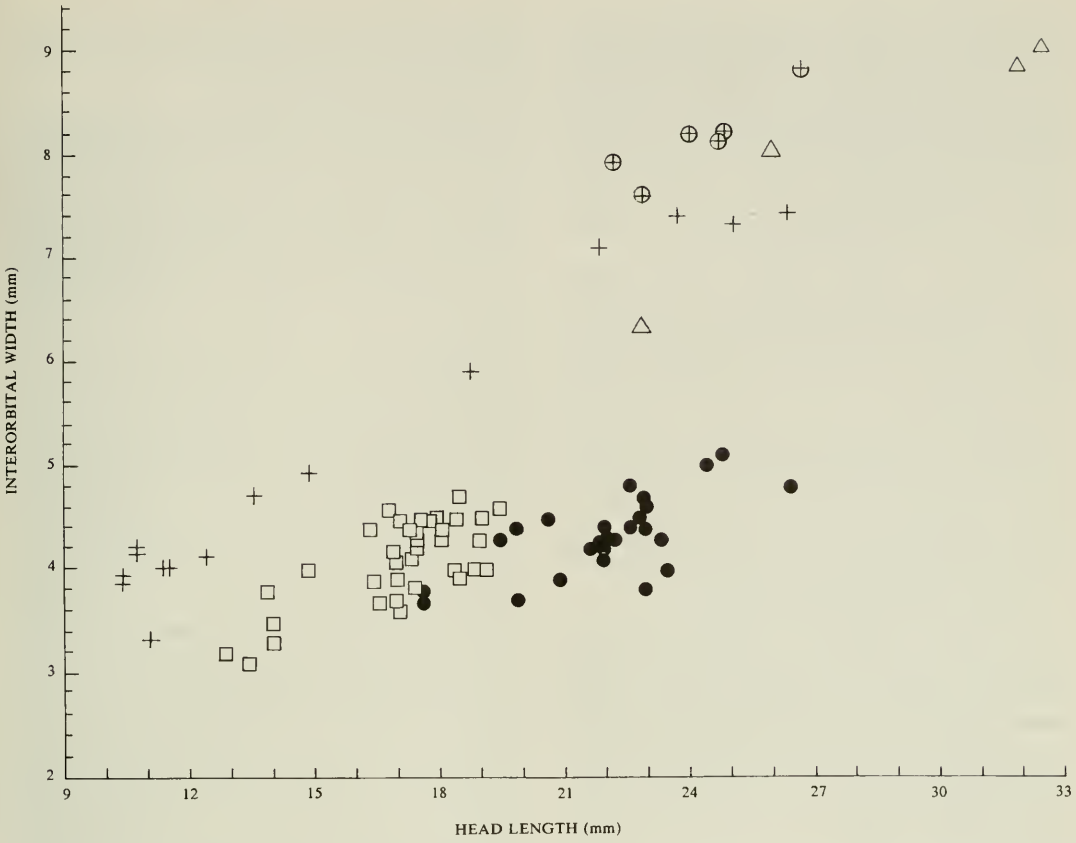

FIGURE 21. Scatter diagram showing relationship of interorbital width to head length in *H. semipellucidus* (solid circles), *H. neglectissimus* (squares), *H. s. striatissimus* (plus signs), *H. s. aeger* (circled plus signs), and *H. hachijoensis* (triangles). Data for *Hymenocephalus s. aeger* from Gilbert and Hubbs (1920), for *H. hachijoensis* from Okamura (1970a).

1P. i12–i14 (rarely i15) ($\bar{x}$ = 12.8, n = 92); GR-I (outer) 11–15 ($\bar{x}$ = 12.9, n = 51) [14]; GR-I (inner) (2–3) + (0–1) + (13–17, rarely 18), total 16–21 ($\bar{x}$ = 18.2, n = 51) [3 + 0 + 15]; GR-II (outer) (2, rarely 3) + (1, rarely 0) + (13–16), total 16–19 ($\bar{x}$ = 17.4, n = 51) [2 + 1 + 15]; GR-II (inner) (2–3) + (0–1) + (13–15), total 16–19 ($\bar{x}$ = 17.1, n = 51) [3 + 1 + 14]; caeca 10–11 ($\bar{x}$ = 10.3, n = 12).

Total length 78+–125 mm; HL 12.5–19.2 mm ($\bar{x}$ = 16.5, n = 29) [18.5]. The following in percent of HL: postrostral 77.9–89.6 ($\bar{x}$ = 85.4, n = 28) [86.5]; snout 16.4–23.8 ($\bar{x}$ = 19.6, n = 27) [17.3]; preoral 10.4–18.9 ($\bar{x}$ = 14.8, n = 15) [13.0]; postorbital (greatest length) 37.5–43 ($\bar{x}$ = 40.8, n = 8) [37.8], (least length) 26.7–38.6 ($\bar{x}$ = 33.8, n = 28); suborbital 5.2–9.5 ($\bar{x}$ = 6.9, n = 29) [7.0]; orbit-preop. 28.1–37.3 ($\bar{x}$ = 32.3, n = 28) [28.6]; orbit (max.) 44.8–54.8 ($\bar{x}$ = 49.9, n = 29) [49.7], (horizontal) 44.6–49.7 [49.7]; upper jaw 53.3–58.8 ($\bar{x}$ = 56.1, n = 28) [55.7]; interorbital 20.8–27.4 ($\bar{x}$ = 23.9, n = 26) [21.1]; gill slit 31.1–36.9 ($\bar{x}$ = 33.3, n = 16) [32.4]; barbel 15.3–28.0 ($\bar{x}$ = 21.5, n = 28) [18.9]; pre-A. 146–166 ($\bar{x}$ = 155, n = 28) [162]; pre-V. 92–113 ($\bar{x}$ = 105, n = 28) [109]; V.-A. 47.5–68 ($\bar{x}$ = 587, n = 28) [60.5]; body depth 66–88 ($\bar{x}$ = 77, n = 46) [78], depth over A. origin 47–58 ($\bar{x}$ = 54, n = 24) [55]; light organ 65–89 ($\bar{x}$ = 80, n = 24) [76.8]; height 1D. 75–92 ($\bar{x}$ = 83, n = 9); 1D.–2D. 60.1–90.4 ($\bar{x}$ = 72.4, n = 26) [73.5]; length 1P. 63–92 ($\bar{x}$ = 77, n = 24) [80]; length V. 71 (n = 1).

DESCRIPTION.—Head 6.5–7.6 into TL (21 specimens); greatest body depth usually somewhat less than postorbital length of head, the trunk tapering more rapidly to origin of anal fin

than beyond in adults, but tapering gradually in smaller fishes. Head moderately broad, its greatest width notably less than depth of head over midorbit. Orbit circular (rarely greatest diameter oblique); both maximum and horizontal diameters of orbit exceed maximum postrostral length of head. Snout short, rather low, bluntly rounded, not produced beyond anterior tip of premaxillary.

Dentition consists of small, conical, slightly recurved teeth in 2–4 irregular rows on premaxillary and 1–3 on dentary (one row on short posteriormost part of tooth band adjacent to coronoid process).

Luminescent organ as illustrated for *H. s. striatissimus* by Okamura (1970b, fig. 74A), but externally both lenses seem somewhat larger and lack pigmentation on surface. Alimentary canal short and simple with only 2 bends (see Okamura 1970b, fig. 62A). Pyloric caeca short, 10–11.

Scales on all specimens now lost.

Fins weak, often broken, especially pelvics. Pectoral and pelvic (in one specimen only) fins slightly produced beyond anal fin origin, extending to about 4th to 8th anal ray. Spinous second ray of first dorsal fin with a short threadlike prolongation; its overall length about equal to postrostral length. Second dorsal rudimentary over almost entire length, its origin above 13th to 16th anal ray.

Color superficially resembles that of *H. semipellucidus* (see below) or *H. striatissimus* (as illustrated by Okamura 1984), but with numerous constant differences. Blackish blotch on dorsum darker and with clear-cut outlines (see Fig. 19b); its posterior projection rather short with isolated (if any) small pigment cells above, very few behind (posterior end of projection appears somewhat eroded), and few pigment cells below projection (some in short midlateral series); pigment rarely passes from trunk to tail beyond vertical of 5th to 7th anal fin ray. Tail appears transparent over almost entire length. Dorsalmost 5–9 ceratobranchial rakers on second gill arch blackish; those more ventral whitish; lateral rakers on first arch all unpigmented. Stomach light to dark gray.

Size.—To at least 130 mm.

Distribution.—Known only from the Sala y Gomez Ridge in 525–600 m.

Etymology.—Latin *neglectus* (neglected or unnoticed) is used in the superlative, *neglectissimus,* to reflect the late discovery of the species. *Hymenocephalus semipellucidus* and *H. neglectissimus* were first collected together in 1983, but the latter was not recognized as being distinct from the former until 1990.

Comparisons and Remarks.—*Hymenocephalus neglectissimus* is very similar to *H. semipellucidus* from NSG and to the species in the *H. striatissimus* complex from the tropical western Pacific. It is partially sympatric with *H. semipellucidus,* the two having been collected together at four localities bounded by latitudes 25°00′S and 25°30′S and longitudes 88°30′W and 89°00′W.

Superficially, the two NSG species of *Hymenocephalus* may be easily and faultlessly separated by their color patterns. *Hymenocephalus neglectissimus* differs from members of *H. semipellucidus* and also the western Pacific *H. striatissimus* complex in having a more contrasting outline of the dark dorsal blotch, with a rather short posterior projection that is somewhat eroded caudally and surrounded by few or no isolated pigment cells. In contrast, *H. semipellucidus* and *H. striatissimus* have a dorsal blotch with eroded outlines surrounded by numerous, relatively large pigment cells and a relatively long posterior projection to the blotch that extends well back (posteriorly) onto the tail. *Hymenocephalus neglectissimus* also differs in having unpigmented lateral gill rakers on the first arch. It further differs from *H. semipellucidus* in having fewer pectoral fin rays (i12–i14 vs. i14–i18) (Table 3), a somewhat shorter snout, wider interorbital (Fig. 21), narrower suborbital, slightly longer upper jaw, and longer barbel, but considerable overlap is seen in these mensural features. Body depth in *H. neglectissimus* appears to decrease more rapidly posteriorly than it does in *H. semipellucidus*; the difference between the maximum body depth in, and the depth at anal origin of, 23 specimens varied from 11.2–33.1% ($x = 22.7$) in the former, compared with 5.5–27.9% ($x = 16.7$) in 18 specimens of the latter. In this respect, *H. neglectissimus* more closely compares with *H. striatissimus* (14–29%, usually 22–26%).

The new species differs from *H. striatissimus* (including subspecies *striatissimus, aeger,* and *torvus,* but excluding *H. hachijoensis*) in having a somewhat shorter snout, larger orbit, shorter postorbital, and narrower interorbital (see Fig. 21). Gill rakers are also fewer in *H. neglectissimus,* but this character shows considerable overlap (see Table 3).

Hymenocephalus neglectissimus is a smaller

TABLE 3. Selected counts of pectoral fin rays and gill rakers of the *Hymenocephalus striatissimus* complex.

	Pectoral fin rays										
	12	13	14	15	16	17	18	19	$\bar{x}$	SD	*n*
H. semipellucidus	–	–	2	13	46	29	7	1	16.30	0.899	98
H. neglectissimus	21	41	29	1	–	–	–	–	13.11	0.763	92
H. striatissimus:											
sp. Tasman Sea	–	1	1	–	–	–	–	–	13.50	–	2
Timor and Coral seas	2	3	–	1	–	–	–	–	13.00	1.095	6
Molucca Sea	1	1	4	1	–	–	–	–	13.71	0.951	7
Sulu Sea	1	4	6	9	–	–	–	–	14.15	0.933	20
S. China Sea	–	1	1	–	–	–	–	–	13.50	–	2
Japan	3	1	–	2	2	–	–	–	13.88	1.808	8

	Inner gill rakers, first arch, lower limb									
	13	14	15	16	17	18	19	$\bar{x}$	SD	*n*
H. semipellucidus	1	16	25	9	–	–	–	14.82	0.740	51
H. neglectissimus	–	6	27	16	1?	1?	–	15.29	0.782	51
H. striatissimus:										
sp. Tasman Sea	–	–	–	1	–	–	–	16.00	–	1
Timor and Coral seas	–	–	–	1	–	1	2	18.00	–	4
Molucca Sea	–	–	–	2	3	–	–	16.60	–	5
Sulu Sea	–	–	–	–	7	3	2	17.58	0.793	12
S. China Sea	–	–	–	–	1	–	–	17.00	–	1
Japan	–	–	–	–	–	2	1	18.22	–	3

	Total gill rakers, second arch											
	15	16	17	18	19	20	21	22	23	$\bar{x}$	SD	*n*
H. semipellucidus	5	19	17	8	1	1	–	–	–	16.69	1.049	51
H. neglectissimus	1	2	24	21	3	–	–	–	–	17.25	1.647	51
H. striatissimus:												
sp. Tasman Sea	–	–	1	–	–	–	–	–	–	17.00	–	1
Timor and Coral seas	–	–	–	1?	–	–	1	2	1	21.20	–	5
Molucca Sea	–	–	–	3	2	–	–	–	–	18.40	–	3
Sulu Sea	–	–	–	–	2	1	6	2	1	20.92	–	12
S. China Sea	–	–	–	–	–	–	1	–	–	21.00	–	1
Japan	–	–	–	–	–	–	3	–	–	21.00	–	3

	Total inner gill rakers, second arch										
	15	16	17	18	19	20	21	22	$\bar{x}$	SD	*n*
H. semipellucidus	6	20	19	6	–	–	–	–	16.49	0.857	51
H. neglectissimus	–	13	22	13	3	–	–	–	17.12	0.864	51
H. striatissimus:											
sp. Tasman Sea	–	1	–	–	–	–	–	–	16.00	–	1
Timor and Coral seas	–	–	–	–	1	–	2	–	20.33	–	3
Molucca Sea	–	2	1	2	–	–	–	–	17.10	–	5
Sulu Sea	–	–	1	1	6	2	1	–	19.09	1.044	11
S. China Sea	–	–	–	–	–	1	–	–	20.00	–	1
Japan	–	–	–	–	–	1	1	1	21.00	–	3

species (maxima at about 130 mm TL and 20 mm HL) than *H. semipellucidus* (130–160 mm TL and 20–26.5 mm HL) and *H. striatissimus* (150–180 mm TL, 25–28 mm HL; data from Okamura et al. 1982, Okamura and Kitajima 1984, and our material). It may well be the smallest macrourid species.

MATERIAL EXAMINED.—(all from **Sala y Gomez Ridge**) Holotype: ZMMGU 18219 (18.5 mm HL, 123+ mm TL); 580–564 m; *Prof. Shtokman* cr. 18, sta. 1964.

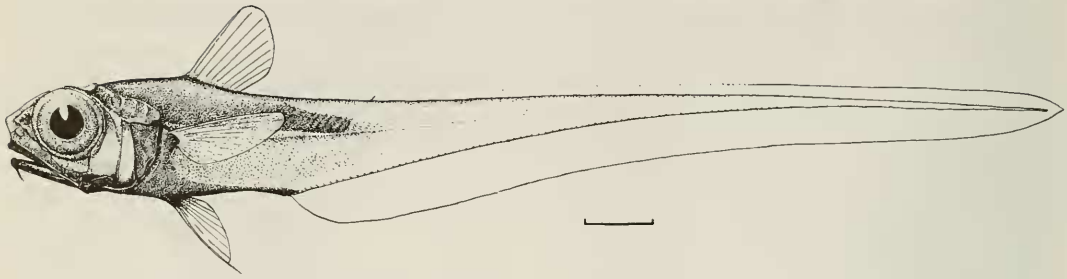

FIGURE 22. *Hymenocephalus semipellucidus* new species; paratype, CAS 75978 (26 mm HL), from Sala y Gomez Ridge in 565–555 m, *Prof. Mesiatzev* cr. 13, tr. 1, 1 Sept. 1983. Drawn by Tomio Iwamoto. Scale bar equals 10 mm.

Paratypes (marked with an asterisk *) and other material (270 specimens from 8 localities). ZMMGU 18220 (30* + 94: 15.5–19.6 HL, 60+–130 TL); data as for holotype. ZMMGU 17724 (55:12.6–18.2 HL, 90–128 TL); 562–545 m; *Prof. Shtokman* cr. 18, sta. 1965. ZMMGU 17726 (25:14.2–18.5 HL, 85–115 TL); 545–600 m; *Prof. Shtokman* cr. 18, sta. 1977. ZMMGU 18140 (20* + 20:12.5–18.7 HL, 78+–125 TL); 525–530 m; *Prof. Mesiatzev* cr. 15, tr. 49. ZMMGU 18217 (17.5 HL, 99+ TL) and CAS 75976 (16.3 HL, 116+ TL); 565–555 m; *Prof. Mesiatzev* cr. 13, tr. 1. ZMMGU 18218 (7:16.5–19 HL, 86+–115 TL); 550–560 m; *Prof. Mesiatzev* cr. 13, tr. 2. ZMMGU 18221 (27:14.2–18.7 HL, 80+–123 TL); 563–590 m; *Prof. Shtokman* cr. 18, sta. 1976.

Hymenocephalus semipellucidus new species

(Figures 21–23)

"*Hymenocephalus* sp. nova Sazonov et Iwamoto": Parin 1990: 17 (listed from Sala y Gomez Ridge).

Hymenocephalus striatissimus (non Jordan and Gilbert, 1904): Parin et al. 1990:42 (stomach contents). Kotlyar and Parin 1990:106 (otolith).

DIAGNOSIS.—Orbits large, greatest diameter about 43–51% HL; interorbital 16.5–22.1% HL; barbel thin, 13–22% HL; GR-I (lower limb, inner series) 14–16 (rarely 13). Body depth over anal fin origin 48–64. Pectoral rays i14–i18 (rarely i19); V. 8.

COUNTS AND MEASUREMENTS.—(holotype data in square brackets) 1D. II,7–9 (x = 8.1, n = 51) [II,8]; 1P. i14–i19 (x = i16.5, n = 98) [i17]; GR-I (outer) 9–15 (x = 11.6, n = 51) [13]; GR-I (inner) (2–4) + (0–1) + (13–15), total 16–20 (x = 17.9, n = 51) [3 + 0 + 14]; GR-II (outer) (1–4) + (0–1) + (12–16), total 15–19 (x = 16.7, n = 51) [2 + 1 + 13]; GR-II (inner) (2–3) + (0–1) + (12–15), total 15–18 (x = 16.5, n = 51) [2 + 1 + 13]; caeca 9–13 (x = 11.4, n = 17).

Total length 102+–165 mm; HL 17.7–26.5 mm. The following in percent of HL: postrostral 76.9–86.8 (x = 81.9, n = 25) [79.6]; snout 20.9–27.0 (x = 24.6, n = 25) [24.9]; preoral 11.8–17.4 (x = 14.1, n = 21) [15.1]; orbit max. 42.9–50.5 (x = 45.7, n = 26) [49.0]; orbit horiz. 37.0–48.2; interorbital 16.5–22.1 (x = 19.6, n = 25) [20.4]; postorbital (greatest) 38.3–45.1 (x = 42.0, n = 24) [40.8]; postorbital (least) 33.1–44.9 (x = 37.9, n = 24) [37.1]; suborbital 8.5–11.8; orbit-preop. 30.2–39.6 (x = 35.5, n = 25) [35.9]; upper jaw 49.2–56.8 (x = 52.6, n = 25) [52.2]; gill slit 26.7–34.5 (x = 31.4, n = 16) [31.4]; barbel 13.0–22.0 (x = 17.7, n = 26) [15.5]; body depth (max.) 61–85 (x = 72, n = 26) [66]; depth over A. orig. 48.2–63.9 (x = 54.9, n = 18) [53.1]; pre-A. 152–173 (x = 162, n = 26) [165]; pre-V. 97–111 (x = 103, n = 26) [97]; V.-A. 53.6–81.8 (x = 69.0, n = 26) [80.8]; height 1D. 66–96 (x = 77, n = 17) [78]; 1D.–2D. 67.6–88.9 (x = 77.5, n = 24) [71.8]; 1P. 58–78 (x = 70, n = 25) [76.7]; V. 62–78 (x = 71, n = 22) [67]; light organ 71.9–92.6 (x = 80.8, n = 18) [77.6].

DESCRIPTION.—Head 6–7 into TL; greatest body depth usually somewhat less than postrostral length of head, the trunk tapering gradually to and beyond origin of anal fin. Head rather broad, its greatest width slightly less than depth of head over midorbit. Greatest diameter of orbit oblique and about equal to or somewhat more than postorbital length of head (taken from orbit margin to uppermost posterior angle of opercle). Snout rather low, bluntly rounded, not produced beyond anterior tip of premaxillary.

Dentition consists of small, conical, slightly recurved teeth in 1–3 irregular rows in both jaws in most specimens (a few individuals have premaxillary bands 4 or 5 teeth wide).

Luminescent organ as illustrated for *H. s. striatissimus* by Okamura (1970b, fig. 74A). Alimentary canal short and simple, with only 2 bends (see Okamura 1970b, fig. 62A). Pyloric caeca short, thick; 9–13 in 17 specimens.

Few scales remain, almost all of these lacking spinules. A few isolated scales with short conical spinules as illustrated for genus by Okamura (1970b, fig. 2).

Fins rather weak, tips of first dorsal broken off in all specimens; pectoral and pelvic fins extend posteriad to level of 4th to 9th anal fin ray. Second dorsal rudimentary over almost entire length, its origin above 14th to 16th anal ray.

Color description given by Gilbert and Hubbs (1920:533–534) for *H. striatissimus aeger* accurate for new species as well—this and other characters suggest close affinity of the two species. Black blotch on dorsum with eroded outlines, surrounded by large pigment cells with numerous branched projections; posterior projection of blotch variable in length (extends either to level of anal-fin origin or to vertical of origin of 13th–18th anal ray). Pigment cells surrounding blotch numerous below and behind, fewer (rarely absent) above. Arrangement of these cells varies greatly: from irregularly scattered to grouped along myosepta (more densely along those going dorsad and posteriad above lateral line, and ventrad and anteriad below blotch). Some cells may be arranged in a line going posteriad along midlateral myosepta. Dark pigment attains level of 9th to 25th anal ray. Dorsalmost 9 or so ceratobranchial rakers on second gill arch blackish, lateral rakers on first arch also blackish (sometimes pale on anteriormost few); those more ventral pale. Stomach blackish.

Hymenocephalus semipellucidus and Russian specimens from Japan of *H. striatissimus* do not show the silvery sheen and black striations as prominently as in *Albatross* specimens of latter species, but differences probably an artifact of preservation. Alcohol-fixed specimens retain silvery appearance, whereas those fixed in formalin lose silvery reflections. Thick translucent skin covers abdominal region of NSG specimens, but careful teasing and stripping away of epidermis reveals striations underneath. Black melanophore pattern over body of new species prominent (see Fig. 22). Similar dark pigment patterns may have been present in *H. striatissimus* specimens examined, but specimens currently faded and show only faint traces of such patterns.

Food.—Parin et al. (1990:42) found the species to feed predominantly on copepods (including *Pleuromamma* sp., *Gaussia scotti, Phyllopus mutatus, Chirundina streetsi, Arietellus* sp., and Aetideidae sp.). Benthic polychaets (including Polinoidae) and the gonostomatid fish *Cyclothone* were also important.

Size.—To at least 165 mm.

Distribution.—Known only from the Sala y Gomez Ridge in 550–800 m.

Etymology.—From Latin *semi,* half, and *pellucidus,* clear or transparent, in reference to the partially transparent head covering, and the translucent caudal region where the vertebra can be seen in fresh specimens.

Comparisons and Remarks.—The new species keys out to *H. striatissimus* using Gilbert and Hubbs's (1920:520) key, but it differs from that species in a number of important features. The gill-raker counts, notably the inner series in the first (outermost) arch, show the best separation of the two species (see Table 3) in our material. Note from the table that gill raker counts in our *H. striatissimus* specimens suggest a clinal difference in populations of that species, with the Molucca Sea specimens, representing *H. s. aeger,* completely separated from the typical subspecies *H. s. striatissimus* of Japan, and the Sulu Sea and South China Sea specimens intermediate in their counts. South China Sea specimens were considered by Gilbert and Hubbs (1920:531) to be an intergrade between *H. s. torvus* and *H. s. striatissimus.*

In gill-raker counts, ZMMGU specimens of *H. striatissimus* from the Coral and Timor seas appear closest to *H. striatissimus* specimens from the Sulu Sea. A small specimen (ZMMGU 18260) from the Tasman Sea, however, is almost indistinguishable from *H. semipellucidus* and *H. neglectissimus,* differing only in having a distinct color pattern similar to that of *H. striatissimus* and slightly different morphometry from that of *H. semipellucidus.*

Pectoral ray counts in the new species tend to be higher than those of *H. striatissimus,* but there is considerable overlap in this feature (Table 3).

The suborbital region appeared to be narrower in the new species, and a scatter diagram plotting measurements of the least width against the greatest diameter of the orbit (Fig. 23) showed a good separation between the Malay Archipelago specimens of *H. striatissimus* on the one hand, and Japan specimens of that specimens, and *H. semipellucidus* specimens on the other hand. The separation of the Japanese specimens of *H. striatissimus* from other specimens of that species lends additional support for continued recognition of subspecies. A more extensive study may

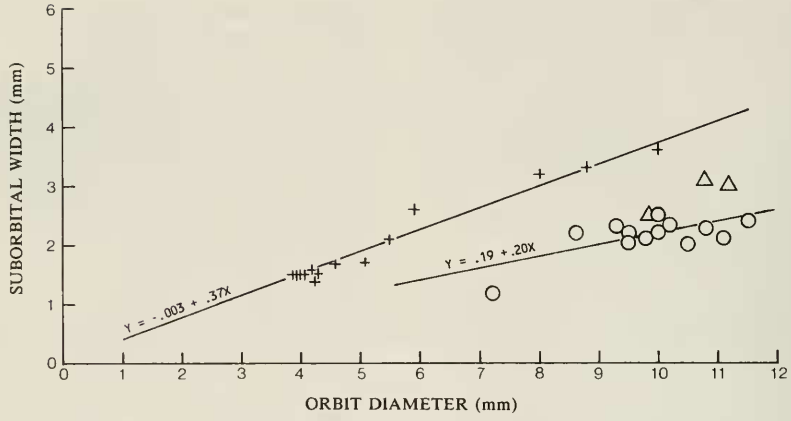

FIGURE 23. Scatter diagram showing relationship of suborbital width to orbit diameter in *Hymenocephalus semipellucidus* (circles), *H. s. striatissimus* from Japan (triangles), and *H. striatissimus aeger* from the Malay Archipelago (plus signs).

necessitate elevation of two or more of the subspecies to species level.

The interorbital width is distinctly narrower in *H. semipellucidus,* ranging 16.5–22% HL, as compared with about 28% HL in Japanese specimens of *H. striatissimus,* and 28–39% in Malay Archipelago specimens. Although there is considerable overlap in this character between *H. semipellucidus* and *H. neglectissimus,* the scatter diagram (Fig. 21) comparing the interorbital width of five populations of *Hymenocephalus* shows a distinct separation between the two species.

The new species also appears to have a more gradually tapered body than does *H. striatissimus.* This is best reflected in a comparison of the body depth below the origin of the first dorsal fin (greatest body depth) and the depth over the anal fin origin. In the new species, the first measurement ranged about 61–85% HL, the second 48–64% HL, with a difference in each specimen of 5.5–27.9% between the two proportions. In contrast, the *H. striatissimus* specimens had body depths of 55–81% HL, and 37–56% HL, with a difference of 14–29% (most examples at 22–26%).

Differences between *H. semipellucidus* and *H. neglectissimus* were discussed under the description of the latter species. *Hymenocephalus semipellucidus* differs from the three subspecies of *H. striatissimus* (*H. s. stratissimus, H. s. aeger,* and *H. s. torvus*) more than each differs one from another. The fourth subspecies, *H. s. hachijoensis,* from Japanese waters, may represent a separate species intermediate (as Okamura 1970a suggested) between *H. striatissimus* and *H. longiceps.* We have examined three specimens of *H. s. hachijoensis* (ZMMGU 18243 and 18244 from the North-West (=Emperor) Ridge and ZMMGU uncat. from the Kyushu-Palau Ridge) and found that they differ from the three other subspecies of *H. striatissimus* (as well as the two NSG species) in color pattern and barbel length, which would seem sufficient to elevate *H. hachijoensis* to species level.

MATERIAL EXAMINED.—(103 spec. from 7 sta.) **Sala y Gomez Ridge:** Holotype: ZMMGU 18129 (24.5 mm HL, 152 mm TL); 750 m; *Prof. Shtokman* cr. 18, sta. 2019.

Paratypes (40 spec.): ZMMGU 17723 (7:20.0–24.8 HL, 138–162 TL); 580–564 m; *Prof. Shtokman* cr. 18, sta. 1964. ZMMGU 17725 (14:17.7–23.3 HL, 106+–150 TL); 563–590 m; *Prof. Shtokman* cr. 18, sta. 1976. ZMMGU 17728 (3:22.0–22.8 HL, 104+–138 TL); data as for holotype. ZMMGU 17721 (4:19.5–23 HL, 91+–149 TL) and CAS 75978 (2:20.0–26.5 HL, 137–165 TL); 565–555 m; *Prof. Mesiatzev* cr. 13, tr. 1. ZMMGU 17722 (6:18–21 HL, 105+–132+ TL) and CAS 75977 (4:22–23 HL, 108+–142+ TL); 550–560 m; *Prof. Mesiatzev* cr. 13, tr. 2.

Other material: ZMMGU 17727 (53:19.5–26.5 HL, 96+–164 TL); 730–790 m; *Prof. Shtokman* cr. 18, sta. 2018. ZMMGU 18205 (9:22.5–26 HL, 121–184 TL); 750–800 m; *Prof. Shtokman* cr. 18, sta. 1996.

Specimens of *Hymenocephalus striatissimus* used for comparisons.—**Coral Sea:** ZMMGU 18259 (2:23.7–26.5 HL, 125+–147 TL); 18°48′S, 149°58′E; 660 m; *Lyra* tr. 20; 14 Jun. 1968. **Timor Sea:** ZMMGU uncat. (3: ca. 22–25.2 HL, 110+–146 TL); 9°00′S, 130°38.8′E; 445–520 m; *Akademik Berg* tr. 553. **Tasman Sea:** ZMMGU 18260 (questionably identified as *H. striatissimus*) (15.1 HL, 97.5 TL), 34°17.8′S, 171°30.9′E; 670–630 m; *Dmitry Mendeleev* cr. 16, sta. 1265; 5 Jan. 1976. JAPAN. CAS-SU 8549 (paratype of *H. striatissimus*: 25 mm HL, 110+ mm TL); Suruga Bay; *Albatross* (no other data). **Molucca Sea:** CAS-SU 25463 (8 paratypes of *H. s. aeger*: 11.2–26.5 HL, 69–146 TL); 00°15′N, 127°24′36″E: 545 m; *Albatross* sta. 5621; 28 Nov. 1909. CAS 57180 (3:25.1–28.1 HL, 160–178 TL); Suruga Bay, off Heda [Heta]; shrimp trawl; 18 Feb. 1969.

PHILIPPINES. CAS-SU 25620 (18.8 HL, 111 TL); near Jolo, 6°02′55″N, 120°53′E; 186 fms [340 m]; *Albatross* sta. 5173, 5 Mar. 1908. CAS uncat. (14.7 HL, 93 TL); off n. Luzon, 18°29′45″N, 121°39′E; 150 fms [274 m]; *Albatross* sta. 5328, 19 Nov. 1908. CAS-SU 25464 (9.9–13.5 HL, 50–88 TL); between Jolo and Tawi Tawi, 5°48′12″N, 120°30′48″E; 224 fms [410 m]; *Albatross* sta. 5563, 21 Sep. 1909.

Specimens of *H. hachijoensis* used for comparisons: Emperor Seamounts: ZMMGU 18243 (32.7 HL, 205 TL); ca. 32°N, 173°E; depth unknown; *Mys Unony* tr. 86; Sep. 1979. ZMMGU 18244 (26.2 HL, 163+ TL); 41°04′N, 170°32′E; 1,050–1,060 m; *Mys Unony* tr. 103; 22 Sep. 1979. Kyushu-Palau Ridge. ZMMGU uncat. (ca. 29.5 HL, 160+ TL); no exact data on catch; *Prof. Deryugin*; 1971.

Hymenocephalus striatulus Gilbert, 1905

(Figure 20b)

Hymenocephalus striatulus Gilbert, 1905:665–666, fig. 259 (type-locality Hawaii, off SW coast Oahu; 192–352 fathoms [351–644 m]). Parin 1990:16 (listed from Sala y Gomez Ridge). Parin et al. 1990:41–42 (stomach contents). Kotlyar and Parin 1990:104, fig. 3d (otolith).

Hymenocephalus sp.: Parin et al. 1981:11–12 (67 specimens from Sala y Gomez Ridge).

Diagnosis.—A species of subgenus *Hymenocephalus,* with snout rather low, pointed, projecting beyond mouth, about as long as interorbital or longer; orbit diameter 35–43% HL, much greater than interorbital width; suborbital narrow, 9–15% HL; barbel rudimentary (1.5 or more into least suborbital width) or obsolete. Pectoral rays i14–i20; V. 14–15.

Counts and Measurements.—(from more than 100 Sala y Gomez specimens; mean values in square brackets) 1D. II,8–11 [x = II,9.5; 1P. i14–i20 [i16.9]; V. 14–15 [14.5; GR-I [outer/inner] 17–23 [20.2]/(4–6) + (21–25) [5.0 + 1 + 22.5], GR-II (3–5) + 1 + (20–24) [4.4 + 1 + 22.0]/(3–5) + 1 + (19–23) [4.2 + 1 + 20.9].

Total length 103–180; HL 28.5–34.5 mm. The following in percent of HL: postrostral 73.3–81.2 [76.9]; snout 23.2–30.5 [27.5; orbit 34.7–42.8 [39.1]; interorbital 21.2–29 [24.9]; postorbital 33–42 [37.0]; orbit-preop. 34.2–40.6 [37.2]; suborbital 9.1–14.9 [10.9]; upper jaw 47.2–58.8 [51.6]; barbel 3.1–12; gill slit 29.2–37 [33.3]; pre-D. 95–106 [102]; pre-A. 138–152 [146]; pre-V. 95–113 [102]; V.-A. 43.8–59.1 [50.8]; 1D. base 28.6–36.8 [32.3]; 1D. height 52–75 [63]; 1D.–2D. 35.3–73.4 [55.2]; 1P. 48–61 [53]; V. 55–84 [70]; light organ 51.5–62.5 [56.7]; body depth 58–70 [65].

Description.—Body slender, subcylindrical, greatest width over pectoral bases about three-fourths greatest depth; the trunk tapering gradually posteriorly to tail tip. Head low and broad, greatest width about equal to or more than its depth. Head bones somewhat stouter than most others of genus, and mucous cavities less developed—these conditions somewhat intermediate between those of subgenus *Hymenogadus* and *Hymenocephalus.* Head covering transparent. Orbit large, its greatest diameter on a diagonal and slightly shorter than postorbital length. Interorbital space moderately broad, although sharply narrowed forward of midorbit level. Preopercle ridges form a large triangular process at posteroventral corner. Snout moderately pointed and protruding beyond large mouth. Upper jaws extend posteriorly to hind edge of orbit.

Teeth in moderately wide bands in both jaws, the individual teeth uniformly short and stoutly conical, with rather blunt tips.

Small round anterior lens of luminescent organ in middle of chest, but difficult to discern; posterior lens slightly larger, oval, within a broad teardrop-shaped black naked area immediately before anus, as typical for genus. Black line connecting the two lenses poorly defined. Ventral striae not especially prominent and less extensive than in *H. striatissimus.*

Pyloric caeca 11 or 12, short (less than orbit diameter or interorbital width) and thick. Two slender retia terminate in 2 flattened half-moon-shaped gas glands.

First dorsal fin long-based, its height somewhat less than postrostral length; second dorsal scarcely developed except near tail tip; pectoral fins slender, extending to about level of anal origin; pelvic fins moderate in size, the outermost ray slightly prolonged, extending to about 5th to 8th anal ray.

Color in alcohol overall grayish or blackish except over transparent head covering. Abdomen from base of pectoral fins ventrally to pelvics and back to vent dark violet to blue; chest and bases of paired fins black. Scattered melanophores of different sizes cover all of trunk and tail, the melanophores generally larger and more widely spaced on ventral half of body. A broad, dense midlateral band of melanophores begins about midlateral portion of trunk and extends posteriorly onto, and eventually completely includes, tail. Anterior edge of nape and leading edge of snout black. Large scattered melanophores cover most of suborbital and lower portion of preopercle, all of opercle, and parietal region. Jaws anteriorly, and gular and branchiostegal membranes black. Floor of mouth below tongue forming a black triangle; tongue, how-

ever, pale dorsally with only a few scattered large melanophores on ventral surface; roof of mouth with splotches of black. Gill filaments pale; arches and rakers lightly peppered with small melanophores or pale. Paired and first dorsal fins with dark rays and pale interradial membranes; anal fin pale, but bases marked by small black dots.

Food.—Parin et al. (1990:42) found *H. striatulus* to feed predominantly on pelagic organisms, especially copepods (*Pleuromamma* sp., *Oncaea conifera, Xanthocalanus* sp., Aetideidae spp.), but also small fish, chaetognaths, gammarids (Lysianassidae), shrimp (*Bentheogennema pasithea*), and mysids (*Paralophogaster glaber*). Benthic polychaets (including the family Polinoidae) were also important food items.

Size.—A small species, attaining about 180 mm TL.

Distribution.—Known only from the Hawaiian Islands and the Sala y Gomez Ridge in depths of about 350 to 640 m.

Comparisons and Remarks.—Gilbert's (1905) original description and illustration of the species are excellent; they should be referred to for additional details. Specimens from the Sala y Gomez Ridge show one notable difference from those collected off Hawaii; they have a rudimentary but distinct mental barbel, the length of which goes about 1.5 times into the least suborbital width, in contrast to the almost obsolete barbel in Hawaiian specimens. We do not feel this single difference is sufficient to recognize the species as distinct from *H. striatulus,* especially knowing that barbel length in species of *Hymenocephalus* can vary widely. A notable example is the wide-ranging species *H. striatissimus* of Japan, South China Sea, Philippines, and East Indies. Gilbert and Hubbs (1920:527) recognized three subspecies of *H. striatissimus,* and Okamura (1970a: 50) described a fourth, based in part on geographical differences in barbel development. Perhaps the Sala y Gomez specimens should also be recognized as a subspecies of the Hawaiian *H. striatulus,* but we choose not to recognize them as such at this time.

Gilbert and Hubbs's (1920:521) key to the subgenera and species of *Hymenocephalus* can be used to distinguish *H. striatulus* from all other known species of the genus except *H. billsamorum* Marshall and Iwamoto, 1973, from the tropical western Atlantic. The two species share in common a relatively slender body, low pointed snout, high pelvic fin ray counts (13–15), and a rudimentary or obsolescent barbel. *Hymenocephalus striatulus* differs from *H. billsamorum* in having larger orbits, narrower suborbital and interorbital regions, and slightly more pectoral fin rays (i16–i18 vs. i14–i15).

Material Examined.—**Sala y Gomez Ridge:** ZMMGU 17711 (33 spec.:24–34.5 mm HL, 117+–150+ mm TL); 540 m; *Ichthyandr* cr. 5, tr. 53. ZMMGU 17712 (34:25–37 HL; 112+–180+ TL); 345–540 m; *Ichthyandr* cr. 5, tr. 55. ZMMGU 17713 (275:17.8–34 HL, 90–170 TL); 580–564 m; *Prof. Shtokman* cr. 18, sta. 1964. ZMMGU 17714 (185:19.2–36.5 HL, 91–164 TL); 562–545 m; *Prof. Shtokman* cr. 18, sta. 1965. ZMMGU 17715 (2:27.8–29.3 HL, 116+–118+ TL); 540–560 m; *Prof. Shtokman* cr. 18, sta. 1970. ZMMGU 17716 (4:23.5–30.8 HL, 80+–144 TL); 570–580 m; *Prof. Shtokman* cr. 18, sta. 1971. ZMMGU 17717 (37:18.8–32.5 HL, 95–154 TL); 563–590 m; *Prof. Shtokman* cr. 18, sta. 1976. ZMMGU 17718 (100:15.3–33.5 HL, 75–135 TL); 545–800 m; *Prof. Shtokman* cr. 18, sta. 1977. ZMMGU 17719 (3:30.6–32.2 HL, 125–142 TL); 750–800 m; *Prof. Shtokman* cr. 18, sta. 1996. ZMMGU 17720 (24:16–35 HL, 62.5+–165 TL); 730–790 m; *Prof. Shtokman* cr. 18, sta. 2018. ZMMGU 18212 (7:28–34.5 HL, 103+–180 TL); 565–555 m; *Prof. Mesiatzev* cr. 13, tr. 1. ZMMGU 18213 (10:29–34 HL, 128+–185 TL); 550–560 m; *Prof. Mesiatzev* cr. 13, tr. 2. ZMMGU 18214 (2:30.7–32 HL, 122+–141 TL); 410–420 m; *Prof. Mesiatzev* cr. 13, tr. 4. ZMMGU 18215 (13:20–32.3 HL, 100–158 TL); 530 m; *Prof. Mesiatzev* cr. 15, tr. 49. ZMMGU 18216 (2:28.9–32.5 HL, 125–134+ TL); 400 m; *Prof. Mesiatzev* cr. 15, tr. 52.

Kuronezumia Iwamoto

Kuronezumia Iwamoto, 1974 [as subgenus of *Nezumia* Jordan, 1904].

Type species: *Nezumia (Kuronezumia) bubonis* Iwamoto, 1974.

Diagnosis.—Macrourines with 7 branchiostegal rays. Body and head compressed and deep, greatest depth below origin of first dorsal fin about 90–110% HL. Snout rounded in profile, almost entirely covered (except narrow median ventral and ventralmost margin) with small uniform, finely spinulated scales. Suborbital region vertical, without an angular midlateral ridge, the region covered with small scales without a row of enlarged, scutelike scales. Mouth moderate in size, upper jaw extends posteriorly to below anterior half of orbit, length 30–44% HL. Dentition in broad villiform bands in both jaws; lower jaw band broad and short; outer series on premaxillary slightly enlarged. Gill rakers 8–11 (total) on outer side of second arch. Small patches of scales on branchiostegal membranes in most species. Body scales rather small, adherent, densely covered with long slender spinules; transverse ridges in most adults (but variously absent in some). Anus far removed from anal fin, closer to pelvic bases. Anterior dermal window of light

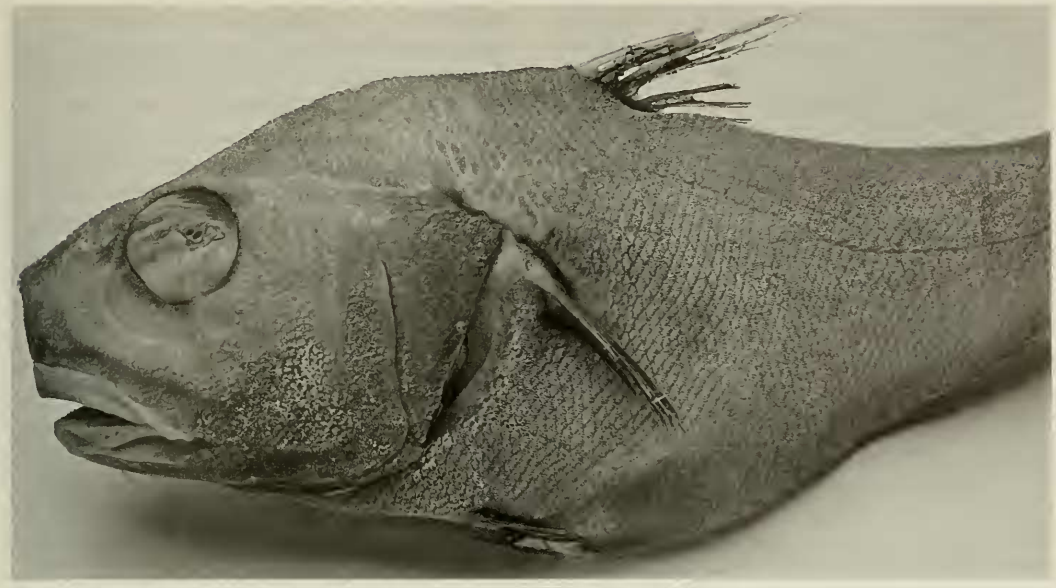

FIGURE 24. *Kuronezumia pallida* new species; holotype, ZMMGU 17730, 98.5 mm HL, from Sala y Gomez Ridge in 550 m. Photograph by Susan Middleton.

organ usually small, situated between pelvic fin bases and separated from anus by a broad scaly area, which is greatly swollen in two species. Pyloric caeca about 35–40 except *K. leonis,* which has 15–18. Color overall light gray or brown to swarthy, fins dusky to blackish, naked membranes blackish to dark gray. Abdominal vertebrae 12–13.

REMARKS.—The genus, here elevated from subgeneric status, includes *K. bubonis, K. pallida, K. dara* (Gilbert and Hubbs, 1916), *K. leonis* (Barnard, 1925), *K. macronema* (Smith and Radcliffe, 1912), and two undescribed species. The definition of the genus has had to be expanded to accommodate *K. leonis* and one of the undescribed species. The peculiarly enlarged, bulbous swelling housing the light organ in *K. bubonis* was used to diagnose the subgenus *Kuronezumia,* but *K. pallida* and *K. dara* lack this swelling. The combination of other features, especially the head physiognomy and squamation, nonetheless serve to unite the seven species and justify recognizing them as representatives of a distinct taxon. The genus is now known from the tropical western Atlantic, throughout the Pacific (NSG, Hawaii, Japan, off southeastern Australia [AMS specimens provided by J. R. Paxton], off New Zealand [specimen of *K. leonis* examined in LACM and NMNZ, and *K. bubonis* in NMNZ], and the Indian Ocean (Madagascar Ridge, West Australian Ridge [Shcherbachev 1987]; Kerguelen Plateau [one juv. of *K. leonis,* ZMMGU uncat.]).

Kuronezumia pallida new species

(Figures 24, 25a)

Nezumia sp.: Parin et al. 1981:12 (brief descr. of specimens here described as new).

"*Kuronezumia* sp. nova Sazonov et Iwamoto": Parin 1990:16 (listed from Sala y Gomez Ridge).

DIAGNOSIS.—No large pores of sensory canals on head. Length upper jaw 34–42 HL, smaller in juveniles. GR-I (inner) 8–9 total; scales below 1D. 11–14; V. 11. No bulblike swelling of light organ; anterior dermal window represented by a small, lenticular scaleless area between midbases of pelvic fins. Color pale brown, except branchiostegal membranes and fins darker.

COUNTS AND MEASUREMENTS.—(data for holotype followed in parentheses by 79 mm paratype and 25 mm juvenile) 1D. II,11 (II,13, II,11); 2D. about 140+; 1P. i24/i25 (i25/i24, i25/i27); V. 11/11 (11/11, 11/11); GR-I [outer/inner] 7 (8, 7)/0 + 9 (0 + 8, 1 + 8), GR-II 0 + 7 (1 + 8, 1 + 9)/0 + 9, (0 + 9, 1 + 9); scales below 1D. 11 [about 14 on right side] (12–13, 12), below

2D. 11 [about 14 on right side] (11, 12). Abdominal vertebrae 12; anal pterygiophores anterior to first haemal spine 12.

The following in percent of HL: postrostral 74.1 (73.4, 64.0); snout 28.4 (28.5, 28.8); preoral 17.3 (15.8, 17.6); orbit 23.9 (25.3, 34.8); interorbital 24.4 (26.6, 25.2); orbit-preop. 46.3 (42.4, 34.8); suborbital 19.8 (20.2, 18.0); upper jaw 40.1 (42.4, about 34); barbel 26.4 (23.4, 22.8); gill slit 17.8 (17, —); body depth about 95 (94, 86); pre-D. 120 (110, 111); pre-V. 104 (104, 94); pre-A. 144 (137, 131); pre-vent 119 (114, 114); V.-A. 46.3 (38.6, 37.2); 1D. height—(82, 101); 1D. base 28.9 (29.1, 31.2); 1D.–2D. 35.0 (38.6, 29.2); 1P. —(61, 68); V.—(73, 101).

Description.—A large, deep-bodied species, greatest depth about equal to HL in adults, about 5.5 in TL; head deep, relatively compressed. Snout high, blunt, with vertical anterior profile. Orbits moderate in size, circular, diameter less than snout length, about equal to interorbital width. Mouth large, jaws subterminal; posterior end of maxillary extends to vertical through middle of orbit. Head ridges inconspicuous; infraorbital region deep, vertical, without modified scutelike scales, about 13 scales wide, 6 or 7 in upper portion. Scaled areas of opercle and subopercle together form a deep, inverted triangle. Interopercle narrowly exposed and scaled along ventral and posterior margins. Free margin of preopercle smooth. Gill membranes broadly united (at level of hind border of orbits), almost without free margin behind their connection with isthmus. Mental barbel moderately thick, long, about equal to orbit diameter, tapered to a fine tip.

Sensory canals on head not broadened or swollen; no enlarged open pores. Free neuromasts serially arranged along surfaces of supraorbital, infraorbital, postorbital, and mandibular canals, and on anterior surface of snout. Olfactory cavity rather small (about diameter of pupil), nasal rosette occupies small portion of cavity; anterior nostril rounded, much smaller than posterior nostril, which is semi-elliptical and about 2.1 into least suborbital width; internarial membrane narrow, with flap length equal to diameter of anterior nostril.

Premaxillary teeth in broad, abruptly tapered bands that fall short of rictus (about 5 rows wide anteriorly); outermost series notably enlarged, straight, conical. Dentary teeth band short, broad, 3–5 rows wide; all teeth uniformly small. Lips, interdental spaces, and adjacent portions of oral cavity covered with numerous, branched (at tips), hairlike papillae that almost cover teeth. Similar papillae on anteriormost portion of snout above upper jaw.

Head scales densely covered with erect to suberect needlelike spinules in 2–10 divergent series; those bordering orbits with 1–2 prolonged crests radiating from orbit (most pronounced on suborbital). Spinules on scales more densely placed in paratype, whereas in holotype spinulated surfaces of adjacent scales separated from each other by smooth interspaces. No scutelike scales at tip of snout and anterior end of nasal bones; scales around tip scarcely stouter than more peripheral ones. Head almost completely scaled except over gular membranes, anterior end of mandible, and along lower part of snout and suborbital immediately above upper lip. Scales present over lowermost branchiostegal rays in two patches on each side in holotype; upper patch much smaller than lower one. Body scales (Fig. 25a) small, densely covered with conical retrose spinules forming 7–15 radiating series. Transverse ridges (reticulate pattern) absent in holotype, but this may be size related—in a 56 mm HL paratype of *K. bubonis* (CAS 27874), transverse ridges were sparse but present around the focus (Fig. 25b). Scales cover proximal part of pelvics between fin rays.

Light organ represented by black, scaleless, rather small anterior dermal window situated between midbases of pelvics and separated from periproct by convex scale-covered area. Periproct rather narrow, preceded by posterior dermal window of size about equal to anterior window. Internally, light organ consists of large bulblike black luminous gland separated from body cavity by peritoneum, without muscular tissue over upper surface; smaller reflector situated between luminous gland and pelvic bones immediately above anterior dermal window. Inner layer of skin between both dermal windows uniform in consistency, becoming thinner anteriorly, blackish with slight opalescence, without indication of separate lenses.

Swim bladder moderately large, oval, with blunt end anteriad. Two gas glands well developed, connected to two relatively long retia. Stomach everted in paratype; number of pyloric caeca not determinable.

Origin of first dorsal fin slightly behind, origin of pelvic fins well before, vertical through pec-

toral origins. Spinous second ray of first dorsal scarcely extended beyond longest branched rays; serrations on leading edge relatively small and low. Interspace between dorsals rather short, about one-third longer than base of first dorsal. Pectoral fin moderately long, originating well below level of top of gill opening. Pelvic fin with long filamentous outer ray extending to about 8th–10th anal ray. Origin of anal fin somewhat before vertical of posterior end of first dorsal.

Color in alcohol: body and head grayish with yellow tinge. Gular membrane light gray, branchiostegal membrane blackish. Fins dark gray to blackish, but anal fin blackish on anterior portion only. Oral and branchial cavities unpigmented.

Size.—To about 55 cm TL.

Distribution.—Known only from the Sala y Gomez Ridge in 540–800 m.

Etymology.—From the Latin *pallida,* light or pale, in reference to the pale coloration of the species, contrasted with the dark-colored *K. bubonis.*

Comparisons and Remarks.—The new species appears most closely related to *K. dara* (Gilbert and Hubbs, 1916) from Japanese waters. Previous to Okamura's report (*in* Okamura and Kitajima 1984:217, 363, fig. 153) of two specimens (220–318 mm TL) from the Okinawa Trough, the three known specimens of that species were too small to make comparisons with other species of *Kuronezumia.* Okamura's description and excellent color figure of the larger Okinawa specimen show the close similarity of that species to other members of the genus. The similarities lie not just in the physiognomy of the head, but also in the structure of the fins, the squamation, and the overall color. *Kuronezumia pallida* appears to differ from *K. dara* in having smaller orbits (24–25% HL cf. 25–36%), longer upper jaw (34–42% HL cf. 30–35%), interorbital space about equal to or slightly more than orbit diameter (cf. about equal to or less than orbit diameter), and barbel about equal to orbit (cf. much shorter than orbit, at least in small *K. dara*; condition not stated for large specimen by Okamura). The 171 mm juvenile (ZMMGU 18066) in our material agrees closely in these proportional measurements with *K. dara.* Allometric growth probably accounts for the differences between juveniles and adults of the species. It thus seems that juveniles of *K. dara* and *K. pallida* are indistinguishable by these measurements. The new species differs from *K. bubonis* and an undescribed species from the South China Sea (see Iwamoto 1974) primarily in lacking the bulbous swelling before the periproct and in having a paler coloration.

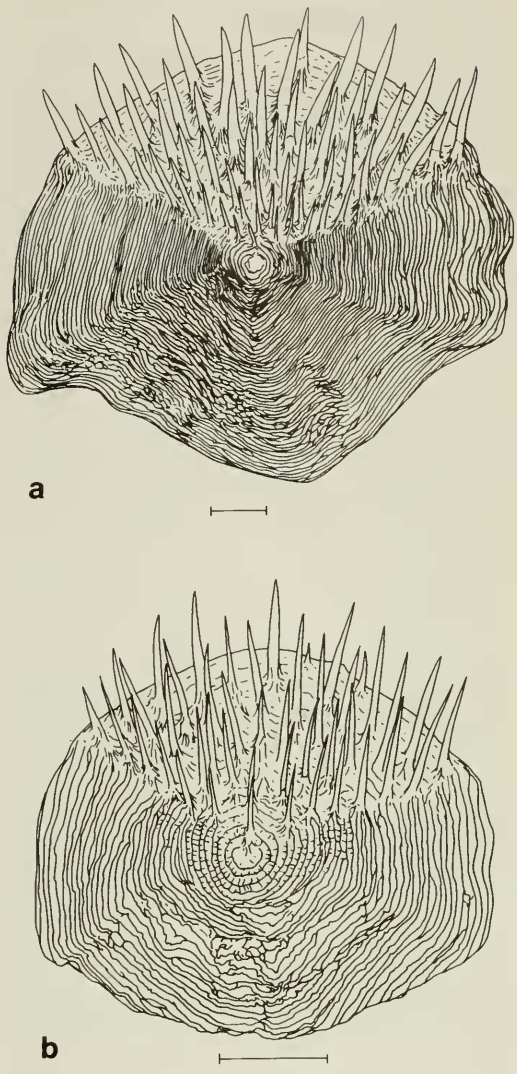

Figure 25. Scales from below interspace between dorsal fins of (a) *Kuronezumia pallida* (holotype, ZMMGU 17730, 98.5 mm HL) and (b) *K. bubonis* (paratype, CAS 27874, 56 mm HL). Scale bars represent 0.5 mm. Drawn by Tomio Iwamoto.

Material Examined.—**Sala y Gomez Ridge:** Holotype: ZMMGU 17730 (98.5 mm HL, 548+ mm TL); 550 m; *Astronomer* sta. 104.

Paratype: ZMMGU 17731 (79 mm HL, 379+ mm TL); 540 m; *Ichthyandr* cr. 5, tr. 53.

Non-type material: ZMMGU 18066 (25 HL, 171 TL); 750–800 m; *Prof. Shtokman* cr. 16, sta. 1996.

Malacocephalus Günther, 1862

Type species: *Macrourus laevis* Lowe, 1843, by monotypy.

DIAGNOSIS.—Macrourines with 7 branchiostegal rays. Mouth large, usually greater than 45% HL; GR-I (inner series) usually less than 12 total. Teeth large, widely spaced, in 1 row in lower jaw, usually larger posteriorly; in 2 rows to narrow band in premaxillary. Head completely and uniformly scaled, lacking enlarged, modified scales; suborbital area vertical or nearly so and covered with small, finely spinulated scales; lowermost branchiostegal rays scaled; scales without transverse ridges. Anus removed from anal fin and closer to pelvic fin, preceded by 2 naked fossae (dermal windows of light organ), one round to bean-shaped fossa between pelvic fin bases, the other immediately before anus at anterior end of periproct region. Pyloric caeca 50–100, multiply branched.

DISTRIBUTION.—Worldwide in warm to temperate seas.

REMARKS.—The genus is divided into two subgenera by some authorities: subgenus *Pawnurus* Parr, 1946 (two species, with serrated first dorsal fin ray) and subgenus *Malacocephalus* (two to four species, lacking serrated first dorsal ray). *Malacocephalus boretzi* Sazonov, 1985, described from the central North Pacific, has characters that lessen the distinction between the two nominal subgenera. Sazonov (1985:17), however, supported their continued recognition and also provided evidence (in the internal structure of the light organ) that showed a close relationship of *Lucigadus* Gilbert and Hubbs, 1920 (which he elevated to full genus) to *Malacocephalus*.

A question still remains whether or not there is more than one species in the *Malacocephalus laevis* complex (see REMARKS in following description).

Malacocephalus laevis (Lowe, 1843)

Macrourus laevis Lowe, 1843:92 (off Madeira).
Malacocephalus laevis: Günther 1862:397. Parin et al. 1981: 12 (Sala y Gomez Ridge). Golovan' and Pakhorukov 1987: 73 (Nazca and Sala y Gomez ridges). Parin 1990:16 (Sala y Gomez Ridge). Parin et al. 1990:43 (stomach contents). Kotlyar and Parin 1990:106 (otolith).
Macrurus (*Malacocephalus*) *laevis*: Günther 1887:148.

DIAGNOSIS.—Upper jaw 45–54% HL. Premaxillary teeth in 2 distinct rows, mandibular teeth in 1 row. A smooth spinous second ray of first dorsal; fin rays V. 9 (occasionally 8 or 10); 1P. i16–i21.

REMARKS.—This widespread species has been more than adequately described and illustrated by numerous recent authors (e.g., Marshall 1973; Okamura 1970a), and the reader is referred to other sources for a complete description. Iwamoto (1979) reported a single individual from off southern California, the first record of the species from the eastern Pacific. Subsequent to that report, numerous specimens were collected in 1979 on seamounts off the Baja California peninsula by the Japanese fishery research vessel *Kaiyo Maru* (Eichii Fujii, Tokai Regional Fishery Research Laboratory, Tokyo, per. comm. with TI, Dec. 1979) and by Soviet vessels off the Sala y Gomez Ridge (Parin et al. 1981:12). The *Kaiyo Maru* specimens were examined (by TI) in 1980 at the Far Seas Fishery Research Laboratory in Shimizu, Japan. The Soviet collections constitute the primary basis for this account.

We identify the eastern Pacific specimens with *Malacocephalus laevis*, a species originally described from the North Atlantic. The status of three other nominal Pacific species of the genus has not been completely resolved. The three include *M. nipponensis* Gilbert and Hubbs, 1916, *M. hawaiiensis* Gilbert, 1905, and *M. luzonensis* Gilbert and Hubbs, 1920. Okamura (1970a:69) placed *M. nipponensis* into the synonymy of *M. laevis*, but later (Okamura *in* Okamura et al. 1982: 145, 347–348) recognized *M. nipponensis* based on its lack of "scaled patch on the gular membrane and in a few other characters." Iwamoto (1970:411) recognized all three species and provided a key to the genus based on the literature and examination of relatively few specimens. Marshall (1973:650–652) also recognized the three species but noted that "Examination of a good series of individuals may show that *nipponensis* is identical with *hawaiiensis*." In Table 4, selected counts and measurements of specimens of *Malacocephalus* from three oceans are compared. Although the data were not treated statistically, a casual inspection suggests that they do not support taxonomic recognition of the populations. (The raw data for this table are deposited in the library of the Department of Ichthyology, California Academy of Sciences; photocopies are available to any interested party.)

SIZE.—To at least 52 cm.

DISTRIBUTION.—Probably worldwide in temperate to tropical waters, but absent on the con-

TABLE 4. Comparison of selected measurements and counts of *Malacocephalus laevis* from the Sala y Gomez Ridge, the Atlantic Ocean, and the Indian Ocean.

Character	Sala y Gomez	Indian Ocean	Atlantic Ocean
TL (mm)	231–458	265–492	326–450
HL (mm)	37.5–79.0	52.5–93.0	49–76
% of HL [no. of specimens]	[18]	[5]	[10]
Snout	22.6–29.6	26.6–28.7	21.4–29.6
Orbit	29.8–36.7	30.8–37.1	30.4–36.1
Interorbital	26.6–34.7	31.7–34.8	27.6–36.1
Orbit-preop.	38.7–45.6	42.6–48.4	40.7–45.7
Postorbital	41.4–45.6	43.8–48.1	40.7–48.5
Suborbital	11.6–14.7	9.9–12.4	11.2–13.0
Upper jaw	47.1–53.5	46.7–52.4	45.9–53.0
Gill slit	24.1–29.3	23.1–29.5	22.4–28.7
Barbel	19.5–32.0	22.6–26.3	22.4–27.0
Pre-A.	117–148	130–140	121–154
Body depth (max.)	74.4–91.6	77.0–84.4	78.5–94.6
Height 1D.	40–69 [7]	62–69 [2]	62–64 [2]
1D.–2D.	40.0–69.0	49.2–61.0	46.1–70.3
Length 1P.	53–56 [3]	51–59 [4]	63–66 [3]
Length V.	30–38 [5]	32–46 [5]	33–40 [5]
Counts			
1D.	II,10–13	II,10–11	II,10–12
1P.	i16–i20	i17–i19	i17–i21
V.	8–10	8–9	8–9
GR-I (outer) total	8–11	7–9	7–11
GR-I (inner) total	10–13	10–12	11–14
GR-II (outer) total	9–12	9–11	11–14
GR-II (inner) total	9–12	10–11	11–14

tinental slopes of the eastern central and South Pacific. Depth range generally between 300 and 700 m, but often encountered shallower or deeper.

MATERIAL EXAMINED.—(84 spec., 19 sta.) **Sala y Gomez Ridge:** ZMMGU 18074 (2:63.7–73.3 mm HL, 392+–420+ mm TL); 550 m; *Astronomer* trawl without no.; 25°02′S, 88°35′W; 24 Jul. 1975. ZMMGU 18075 (6:39.5–78.5 HL, 231+–463+ TL); 345–540 m; *Ichthyandr* cr. 5, tr. 55. ZMMGU 18076 (14:41.7–53.3 HL, 255–322 TL); 410 m; *Ichthyandr* cr. 5, tr. 56. ZMMGU 18077 (3:37.5–66.8 HL, 230+–403+ TL); 540 m; *Ichthyandr* cr. 5, tr. 53. ZMMGU 18078 (2:50.5–61 HL, 288+–359+ TL); 535–575 m; *Ichthyandr* cr. 5, tr. 54. ZMMGU 18079 (72 HL, 440+ TL); 420 m; *Ichthyandr* cr. 5, tr. 57. CAS uncat. (8:42.5–79 HL, 248–443 TL); 430 m; *Ichthyandr* cr. 6, tr. 56. ZMMGU 18080 (4:40–74.5 HL, 257–410 TL); 565–555 m; *Prof. Mesiatzev* cr. 13, tr. 1. ZMMGU 18081 (4:61.5–67 HL, 281+–443+ TL); 550–560 m; *Prof. Mesiatzev* cr. 13, tr. 2. ZMMGU 18082 (38 HL, 239 TL); 410–420 m; *Prof. Mesiatzev* cr. 13, tr. 4. ZMMGU 18083 (2:39–53.5 HL, 238–295 TL); 285–300 m; *Prof. Mesiatzev* cr. 13, tr. 7. ZMMGU 18084 (3:40–49.5 HL, 242–288 TL); 400 m; *Prof. Mesiatzev* cr. 15, tr. 52. ZMMGU 18085 (5:37.8–44.1 HL, 239+–264+ TL); 530 m; *Prof. Mesiatzev* cr. 15, tr. 49. ZMMGU 18086 (43.5 HL, 271 TL); 304 m; *Prof. Mesiatzev* cr. 15, tr. 54. ZMMGU 18087 (6: 42.8–86.2 HL, 255–475 TL); 410–385 m; *Prof. Shtokman* cr. 18, sta. 1941. ZMMGU 18088 (5:39.5–88 HL, 214+–463 TL); 580–564 m; *Prof. Shtokman* cr. 18, sta. 1964. ZMMGU 18089 (5:40.5–84 HL, 237–490 TL); 562–545 m; *Prof. Shtokman* cr. 18, sta. 1965. ZMMGU 18090 (5:38.3–57.7 HL, 238+–333+ TL); 563–590 m; *Prof. Shtokman* cr. 18, sta. 1976. ZMMGU 18092 (7:45.5–100 HL, 237+–480 TL); 545–600 m; *Prof. Shtokman* cr. 18, sta. 1977.

Mataeocephalus Berg, 1898

Type species: *Coelocephalus acipenserinus* Gilbert and Cramer, 1897, by original designation.

DIAGNOSIS.—Macrourines with 7 branchiostegal rays. Snout long, pointed, somewhat depressed, tipped with a two-pronged scute. Mouth inferior, upper jaw less than 30% HL. Teeth in most species in short, broad bands, confined to anterior end of jaws. Outer gill rakers on first arch rudimentary or absent. Spinous ray of first dorsal fin serrated or smooth. Periproct at or close to anal fin origin.

DISTRIBUTION.—Tropical waters of Pacific and Indian oceans in upper to mid-slope depths of about 550–1,700 m (according to our unpubl. data).

REMARKS.—A small genus, comprising five or more species, in need of revision. See Iwamoto (1979:144) for a discussion of the genus.

Mataeocephalus acipenserinus (Gilbert and Cramer, 1897)

Coelocephalus acipenserinus Gilbert and Cramer, 1897:422–423, pl. 42, fig. 1 (Kaiwi Channel, Hawaiian Is.; 572–728 m; Holotype: USNM 47721).

Mataeocephalus acipenserinus: Berg, 1898:41. Parin 1990:16 (listed from Sala y Gomez Ridge). Kotlyar and Parin 1990: 106 (otolith).

DIAGNOSIS.—Teeth in lower jaw confined to a short, broad, lunate patch at tip of jaws, none laterally. Underside of head anterior to lower jaw angle naked; scales below mid-1D. 6–7.5, below 2D. 8 or 9 (rarely 7). Some denticulations on leading edge of dorsal spine; V. 8; 1P. i20–i25. Anus at posterior end of a broad, oval, naked area situated close to anal fin origin and far removed from pelvic fin insertions.

COUNTS AND MEASUREMENTS.—(of 21 Sala y Gomez spec.) (see also DIAGNOSIS) 1D. II,8–10; V. 8 (7/8 in one spec.); GR-I (outer/inner) 3–5 total/6–8 total, GR-II 5–8 total/6–9 total; scales below 1D. 8–9.

Total length 118–250 mm, HL 26.5–54 mm. The following in percent HL: postrostral 58.1–64.8; snout length 38.5–44.0, width at lateral angles 34.1–43.2; preoral 37.8–46.2; orbit 28.9–34.4; interorbital 19.7–23.0; postorbital 26.3–33.0; suborbital 13.9–17.1; orb.-preop. 27.7–35.0; upper jaw 20.0–27.5; barbel 3.5–8.6; gill slit 7.4–10.4; pre-1D. 105–113; pre-A. 126–140; pre-vent 116–135; pre-V. 96–119; V.-A. 22.6–35; body depth 47–60; 1D. base 17.3–22; 1D. height 50–63; 1D.–2D. 13.5–32.2; 1P. 41–57; V. 45–70.

DESCRIPTION.—Entire head profile sharply conical in lateral view, the profile continuing smoothly to dorsal fin base dorsally and to pelvic or anal fin bases ventrally; thereafter profile tapers to slender, attenuated tail tip. Orbit large, about 1.5 into snout, almost equal to postorbital; sides of snout viewed dorsally gently curved from orbits to bifid scute on snout tip; interorbital about 1.3 into orbit, equal to width between supranarial ridges, space slightly concave; mouth "U" shaped, small, inferior, the rictus greatly restricted by lip folds laterally; upper jaw extends to a vertical slightly posterior to midorbit; barbel very small, length much less than large posterior nostril; suborbital forming a rounded triangle at posteroventral corner; interopercle exposed along posteroventral margins.

Gill membranes broadly attached to isthmus; gill openings extend only to below preopercular ridge. Gill slits restricted, the first (outermost) slit about 10% of HL; other slits restricted by narrow fold of membrane between lowermost parts of arches. Rakers on outer side of first arch small, scarcely visible as tiny pimples that show no contrast with dark arches; rakers elsewhere short and tubercular.

Scales below origin of second dorsal in 51 mm HL specimen with fine needlelike spinules arranged in 5–8 parallel rows, fewer rows in smaller specimens. Underside of head naked forward of jaw angle except for overlapping series of modified scales along leading edge of snout; some scale patches ventrally on preopercle. Suborbital strongly angular in cross section; heavy, modified, scutelike scales in 2 rows on dorsal part leading forward to rather sharp edge of snout. Tip of snout with a pair of spiked, conical tubercles, as characteristic of genus. Ridges other than suborbital not strongly supported by heavy scales. A prominent naked groove dorsally behind broad anterolateral margins of snout.

Jaw teeth all small, in a broad short band in premaxillae, in a short tapered band only at anterior end of lower jaw. Disposition of teeth as illustrated for *M. tenuicauda* by Iwamoto (1979, fig. 9).

Lengths of first dorsal and pectoral fins about half HL. Serrations on spinous dorsal ray weakly and sparsely developed, but present in all examined specimens. Outer pelvic ray slightly thickened and prolonged, extending past anal origin to level of 10th anal ray or beyond in some specimens. Anal fin well developed, origin about on vertical through first dorsal insertion; pectoral and pelvic origins about on same vertical, that of first dorsal well behind. Interspace between dorsals 1–2 times length base of first dorsal.

Periproct region broad, the region black, naked, and separated by a narrow gap from anal fin. Anus at posterior end of periproct, much closer to anal fin than to pelvic fin insertions. A large lenslike structure forming anterior portion of periproct extending forward towards, but falling short of, pelvic girdle. Photophore length 6.2–8.5% HL in 12 Sala y Gomez specimens (this compares with 6.7–8.1% in 3 Hawaiian paratypes and 3.1–6.7%, usually less than 6%), in 21 specimens of *M. microstomus* from the Indian Ocean. Pyloric caeca short and thick: 14, 14, and 15 counted in 3 specimens.

Overall color variable, but Sala y Gomez specimens generally rather light grayish overall, whitish on underside of head anterior to lower jaw

angle, and deep bluish over opercles and abdomen. Fins clear to light dusky. Rim of nostrils narrowly blackish. Mouth black; gill cavity black dorsally and along gill slits and arches, but pale ventrally and on gill filaments.

Size.—Attains at least 25 cm TL.

Distribution.—Our Sala y Gomez Ridge specimens were collected at two closely adjacent stations on the westernmost seamount surveyed during the 18th cruise of the *Prof. Shtokman.* Until this cruise, *M. acipenserinus* was known only from off Hawaii. Its presence on the Sala y Gomez Ridge was unexpected, although several slope-dwelling Hawaiian species of other families have been captured on the ridge (Parin et al. 1981:5, and N.V. Parin, pers. comm.), suggesting a closer affinity of the two faunas than previously realized.

Comparisons and Remarks.—A revision of the genus *Mataeocephalus* is in preparation by one of us (YS) and Y. N. Shcherbachev. Preliminary findings show the genus to comprise two species groups—*M. adustus* group and *M. microstomus* group—each with several species of uncertain status. Our Sala y Gomez Ridge specimens of *Mataeocephalus* belong to the second group, which includes *M. microstomus* (Regan 1908), *M. nigrescens* Smith and Radcliffe, 1912 (probably a synonym of the former species), *M. tenuicauda* (Garman 1899), and *M. acipenserinus.* The species in this group lack scales on the underside of the snout, and the mandibular teeth are in short lunate patches (as illustrated by Iwamoto 1979, fig. 9a).

Proportional measurements and counts of all species in the *M. microstomus* group are similar. Differences between species are slight, and the main differentiating character appears to be the degree of development of the light organ. In this regard, our specimens agree most closely with the Hawaiian species, *M. acipenserinus,* in having the light organ anteriorly prolonged. In contrast, *M. microstomus* has a small subtriangular gland with a tiny anterior dermal window (ADW) just in front of the periproct, and *M. tenuicauda* has a rudimentary gland and no ADW.

Our Sala y Gomez specimens differ slightly from paratypes of *M. acipenserinus* in that the anterior margin of the ADW in the paratypes is much closer to the insertion of the inner pelvic rays than is the case in our specimens. This reflects the shorter distance between pelvic and anal fins in the paratypes (22.6–31.9% HL, usually less than 26% cf. usually 26%–34.9% [but 22.6% in one specimen]). Considering the great variability and consequent low taxonomic value of this character, and in the absence of other discernible differences, we recognize the Sala y Gomez populations as *M. acipenserinus.*

Material Examined.—**Sala y Gomez Ridge:** ZMMGU 17732 (8:26.5–51.5 mm HL, 117–250 mm TL) and CAS uncat. (5: 40–50 HL, 166+–182+ TL); 750–800 m; *Prof. Shtokman* cr. 18, sta. 1996. ZMMGU 17733 (8:32.3–54.7 HL, 155–240 TL); 730–790 m; *Prof. Shtokman* cr. 18, sta. 2018. **Hawaiian Islands:** CAS-SU 3142 (4 paratypes, 44–51.5 HL, 161–177 TL); 21°08′30″N, 157°49′W; 627 m; *Albatross* sta. 3470.

Nezumia Jordan, 1904

Type species: *Nezumia condylura* Jordan and Gilbert, 1904, by original designation.

Diagnosis.—Macrourines with 7 branchiostegal rays. Teeth small, in narrow to broad bands in both jaws; those on premaxillary do not occur past maxillary process. Gill rakers <12 on inner side of first arch in most species. Snout variously naked on ventral surfaces, anteriorly tipped with spiny tubercles in most species. Suborbital shelf with 2 rows of modified scutelike scales forming a prominent ridge. Body scales covered with needlelike to shield-shaped spinules; transverse ridges present. Spinous second ray of first dorsal fin serrated in most species. Anus removed from anal fin origin and situated within an oval-shaped periproct. A small naked fossa of light organ between pelvic fins.

Distribution.—Worldwide in temperate to tropical seas; most species found at upper to middle continental-slope depths (about 200–1,500 m).

Nezumia convergens (Garman, 1899)

(Figure 26)

Macrurus convergens Garman, 1899:210, pl. 48, fig. 1 (Gulf of Panama, 695–1,020 fm [1,271–1,865 m]; *Albatross* sta. 3353, 3357, 3393).

Nezumia convergens: Parin and Sazonov 1982:86 (5 spec.; Peru). Parin 1990:16 (recorded from area between Nazca and Sala y Gomez ridges).

See Iwamoto (1979:171) for synonymy.

Diagnosis.—Body slender, greatest depth 7–8 in TL in large adults. Upper jaw 26–33% HL; barbel 8–20% HL (usually 1.5–2.0 in orbit); GR-I and GR-II (inner series) (1–2) + (5–8) (usually 5–7 on lower limb). Spinules on body scales conical to narrowly lanceolate, aligned in 10–12 slightly convergent longitudinal rows in large

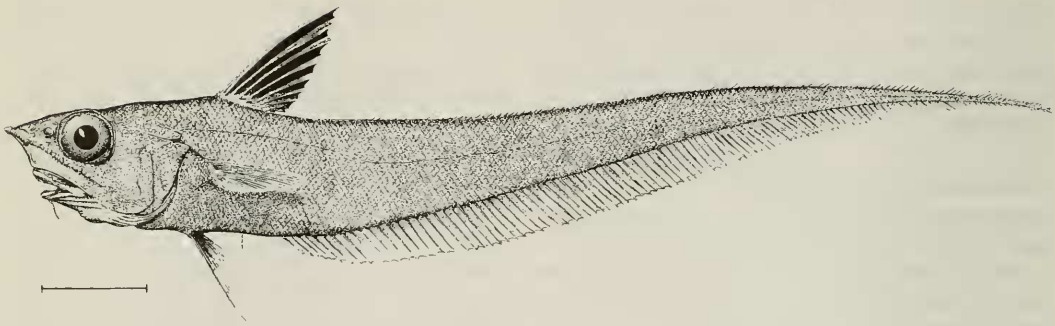

FIGURE 26. *Nezumia convergens*. From Iwamoto (1979:fig. 15b)

adults, middle row often slightly enlarged. Almost all of ventral surfaces of snout and anteroventral surface of suborbital naked; mandibles naked anteriorly. Second spinous ray of first dorsal fin longer than postrostral length of head, its leading edge beset with closely spaced teeth; first dorsal fin uniformly dusky; V. 10–11. Anus in middle half of space between pelvic fin insertion and anal fin origin. Light organ not well developed externally; scaleless fossa not present between pelvic fin bases.

COUNTS AND MEASUREMENTS.—(of NSG specimen only) 1D. II,10; 1P. i23; V. 11; total GR-I [outer/inner] 9/10, GR-II 10/10; scales below 1D. 11, below mid-1D. about 10, below 2D. 9.5; lat.l. 46.

The following in mm, percent HL in parentheses: snout 14.1 (29.1); preoral 11.6 (23.9); orbit 14.5 (29.9); interorbital 9.9 (20.4); postorbital 20.8 (42.9); orbit-preop. 18.8 (38.8); suborbital 7.4 (15.3); upper jaw 16.2 (33.4); barbel 7.5 (15.5); gill slit 6.8 (14.0); pre-A. 75 (154); pre-vent 66 (137); 1D.–2D. 14.5 (30); height 1D. 49 (101); 1P. 29 (59); V. 30 (62); body depth 36 (73).

SIZE.—To about 30 cm.

DISTRIBUTION.—Broadly distributed along continental slopes of eastern Pacific, from Gulf of California and northern Mexico south to Chile (lat. 35°S) and also in Galapagos Archipelago. Depth range 600–1,865 m.

REMARKS.—See Iwamoto (1979:171, figs. 15b, 18f) for a description and illustration. This fine specimen taken near the Sala y Gomez Ridge agrees well in most respects with specimens of *N. convergens* from the continental margins, although a few characters fall outside the ranges established for the species by Iwamoto (1979). Most notable is the gill raker count, which was high by one raker in the inner series of the first and second arches. Scale spinules also appeared to be more broadly lanceolate. The lateral line scale count over a distance equal to the predorsal length differed by two (46 vs. 36–44), the postorbital length was slightly longer (43% HL vs. 34–40%), and the height of first dorsal was greater (101% HL vs. 68–93%). Unfortunately, only the single specimen was collected, thus precluding a more meaningful analysis of these differences.

MATERIAL EXAMINED.—ZMMGU 17734 (1:48.5 mm HL, 272+ mm TL); area between the **Nazca** and **Sala y Gomez** ridges, 1,050 m; *Prof. Mesiatzev* cr. 13, tr. 14.

Nezumia propinqua (Gilbert and Cramer, 1897)

(Figures 27, 28a, b)

Macrourus propinquus Gilbert and Cramer, 1897:424, pl. 42, fig. 2 (type-locality Kaiwi Channel, Hawaiian Islands; 642 m). Gilbert 1905:667.

Lionurus propinquus: Gilbert and Hubbs 1916:144 (list).

Nezumia propinquus: Marshall and Iwamoto 1973:625 (list). Okamura *in* Okamura et al. 1982:163, 350, color fig. 97 (6 spec., 216–250 TL; Kyushu-Palau Ridge; 695–219 m).

Nezumia propinqua: Iwamoto 1983:8; 1986:339 (2 spec.; Mozambique; 740 m). Parin 1990:16 (listed from Sala y Gomez Ridge). Kotlyar and Parin 1990:106 (otolith).

DIAGNOSIS.—Body scales covered with slender conical spinules in 5–8 parallel rows (in adults to about 20 cm TL); scales below 2D. 10–13. Mandibles and underside of head to posterior angle of mouth naked. A distinct black tip on first dorsal fin. Length pectoral fin about 60% HL. Pelvic fin rays 14–18; 1P. rays i18–i22 (count data included for specimens from other areas).

COUNTS AND MEASUREMENTS.—(from 17 Sala y Gomez specimens) 1D. II,11–13; 1P. i19–i22; V. 15–17 (rarely 14 or 18); total GR-I (outer/inner) 7–12/9–12; total GR-II 9–11/8–11; scales below 1D. 12–14, below mid-1D. 8–11, below 2D. 10–13, lat.l. 43–47; caeca 24 (1 spec.).

FIGURE 27. *Nezumia propinqua* (approximately 30 mm HL) from Sala y Gomez Ridge, collected on *Prof. Shtokman* cr. 18. Photograph by Sergei Dudarev.

Total length 125+–200+ mm; HL 19.3–34 mm. The following in percent of HL: snout 26–32; preoral 20–29; orbit 31–40; interorbital 22–28; postorbital (greatest) 41–45, (least) 34–39; orbit-preop. 32–40; suborbital 12–15 (19); upper jaw 31–38; barbel 17–28; gill slit 14–19; pre-A. 131–159; pre-V. 96–121; pre-vent 119–142; V.-A. 36–53; 1D.–2D. (17) 24–57; height 1D. 84–108; 1P. 58–69; V. (74) 80–99; body depth 78–100.

DESCRIPTION.—Head about 6 in TL, body depth slightly less than head length; trunk short, length abdominal cavity much less than HL. Snout bluntly pointed, tipped with a broad coarse tubercle; mouth subterminal, small, upper jaw about one-third HL, extends to below hind edge of pupil; barbel short but prominent, about one-half orbit diameter; gill membranes rather narrowly restricted across isthmus with a moderately free posterior fold, the gill openings extending forward to below hind edge of orbits. Anus within a broad periproct, somewhat closer to anal fin origin than to pelvic origins. A small oval dermal window between pelvic bases. Abdominal cavity terminates above 9th or 10th anal ray.

First dorsal fin with a small keellike first spine; second spinous ray prolonged, armed along leading edge with sharp and widely spaced serrations, length of spine about equal to HL. Second dorsal fin rudimentary over entire length. Pectoral and pelvic fins rather short; outer ray of pelvics slightly prolonged into a filament that extends to end of abdominal cavity. Origin of pelvics below posterior margin of opercle and in advance of pectoral base, which in turn is in advance of first dorsal origin; anal origin below midbase of first dorsal.

Scales with about 7–10, more or less parallel rows of small, reclined, needlelike spinules (Fig.

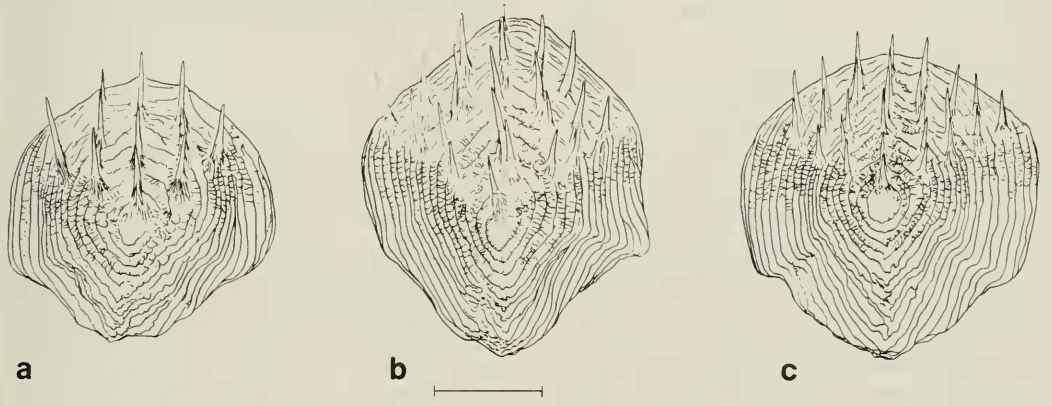

FIGURE 28. Scales from dorsum below interspace between dorsal fins of: (a) *Nezumia propinqua* (CAS-SU 8538; Hawaii); (b) *N. propinqua* (Sala y Gomez Ridge); (c) *N. condylura* (CAS-SU 22925; Japan). Scale bar represents 0.5 mm. Drawn by Tomio Iwamoto.

28b). Suborbital shelf formed of a double row of stout scales. Ventral aspects of snout, most of suborbital, and lower jaw completely naked. Cephalic lateral-line pores rather prominent along lower margins of snout, suborbital, preopercle, and lower jaws.

Teeth in broad bands in both jaws; outer series of upper jaw slightly enlarged. Large papillae densely interspersed between teeth and along mesial side of jaw, giving superficial appearance of mandibular band being much broader than it actually is.

A 29-mm HL specimen from CAS 75990 had 24 short, thick pyloric caeca, their lengths about equal to pupil diameter. Ovaries in that specimen moderately developed, but no eggs yet visible. Largest Sala y Gomez specimen (ZMMGU 17749, 34 mm HL) a mature female with well-developed ovaries containing eggs about 1.0 mm in diameter.

Color in alcohol pale yellowish brown overall; abdomen bluish, turning to blackish ventrally on trunk. Fins all pale except distally black on first dorsal. Mouth pale; broad outer margins of gill cavity dark; gill rakers and gular membranes dark or blackish. Underside of head pale.

Size.—To about 25 cm.

Distribution.—*Nezumia propinqua* has been reported from Hawaii, the Kyushu-Palau Ridge, off Vietnam, off western Australia, and off Mozambique, in 523–870 m.

Comparisons and Remarks.—*Nezumia propinqua* and *N. condylura* are extremely close and may be conspecific. Okamura (*in* Okamura et al. 1982:350) used the distance anus to anal fin as the primary character to distinguish the two species. From measurements we have made, that distance ranges from 15–20% HL in *N. condylura* compared with 12–32% HL (most greater than 20% HL) in *N. propinqua.* On that basis, the Sala y Gomez specimens would fall into *N. condylura.* The length of pelvic fins also suggests a separation of the two: 79–100% in *N. propinqua* vs. 68–81% in *N. condylura.* Based on this measurement, the Sala y Gomez specimens fall into *N. propinqua.* Another character that may offer a means of separating the two species is the number of spinule rows on body scales. In specimens of 27–28 mm HL, *N. propinqua* specimens had 5–8 spinule rows on scales below the interspace of the dorsal fins, whereas *N. condylura* specimens had 8–12 rows (see Fig. 28). No other character we have examined suggests a separation, but a good size-series of fresh, well-preserved specimens of each have not been compared. For now, its seems best to treat the current material as *N. propinqua,* recognizing, however, that future workers making a more thorough study may arrive at another conclusion.

Nezumia evides Gilbert and Hubbs, 1920, represents another closely related species that can be distinguished by its slightly fewer scale rows below the second dorsal fin (9–10).

Material Examined.—(17 spec.) **Sala y Gomez Ridge:** ZMMGU 17741 (31.5 HL, 188+ TL); 565–555 m; *Prof. Mesiatzev* cr. 13, tr. 1. ZMMGU 17742 (2:22.3–31.5 mm HL, 151+–191.5 mm TL) and CAS 75990 (2:29–32 HL, 164+–200+ TL); 550–560 m; *Prof. Mesiatzev* cr. 13, tr. 2. ZMMGU 17749 (34 HL, 175+ TL); 540–550 m; *Prof. Shtokman* cr. 18, sta. 1970. ZMMGU 17750 (4:20–29.5 HL, 125+–169+ TL); 750–800 m; *Prof. Shtokman* cr. 18, sta. 1996. ZMMGU 18070 (6: 19.3–33 HL, 121+–174.5+ TL); 730–790 m; *Prof. Shtokman* cr. 18, sta. 2018. ZMMGU 18126 (26 HL, 157+ TL); 580–564 m; *Prof. Shtokman* cr. 18, sta. 1964.

Pseudocetonurus Sazonov and Shcherbachev, 1982

Type species: *Pseudocetonurus septifer* Sazonov and Shcherbachev, 1982, by original designation.

Diagnosis.—Macrourines with 7 branchiostegal rays. Head notably large and broad, preopercle and suborbital bones deep and large, opercle commensurately small; orbit small, 19–30% HL, diameter much less than broad interorbital; snout high, slightly projecting beyond mouth. Mental barbel small, 10% or less of HL. Gill opening wide, extending forward to below hind end of maxilla; gill membranes loosely and narrowly attached to isthmus. Gill rakers usually 16 or 17 total on inner series of first arch. Teeth small, close-set, in narrow tapered band on premaxilla, uniserial on dentary. Scales with numerous small, awl-shaped spinules; no reticulations on anterior field; lateral line scales absent, a series of dark papillae in its place. Vent about halfway between pelvic fin insertion and anal fin origin (usually closer to pelvic insertion), surrounded by a black, oval to teardrop-shaped naked area and preceded by a small, round dermal window of light organ between pelvic fin bases. Pyloric caeca short, 22–34. Color black to dark brown overall.

Distribution.—Known from Hawaii and the Nazca and Sala y Gomez ridges.

Remarks.—Only the single species known.

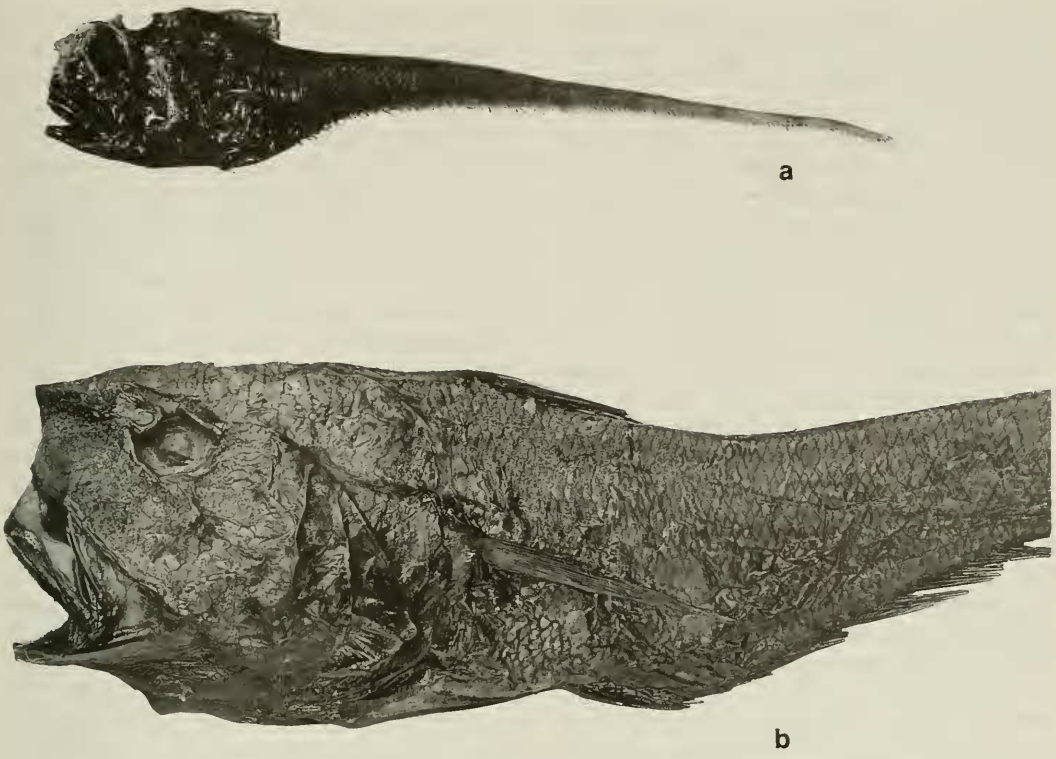

FIGURE 29. *Pseudocetonurus septifer*: (a) Juvenile (ZMMGU 18127, 26.7 mm HL), *Professor Shtokman* sta. 1856, IKMWT in 900–0 m, 20 April 1987. (b) Adult (ZIN uncat., 72 mm HL, 393+ mm TL) from Nazca Ridge in 950 m; *Hercules* sta. 40. Photograph by Susan Middleton.

Pseudocetonurus septifer Sazonov and Shcherbachev, 1982
(Figure 29)

Pseudocetonurus septifer Sazonov and Shcherbachev, 1982:712, fig. 2 (type locality Sala y Gomez Ridge, 850–860 m). Parin 1990:16–17 (listed from NSG). Iwamoto *in* Cohen et al. 1990, fig. 229 (in key).

DIAGNOSIS.—As for the genus.

COUNTS AND MEASUREMENTS.—1D. II,8–12 (usually 9 or 10); 1P. i16–i20; V. 9 or 10, rarely 8; GR-I (outer/inner) 7–12 (usually 9–11)/(1–2) + (12–16) (total 13–18, usually 16 or 17), GR-II (1–3) + (12–15) (total 14–18, usually 15 or 16)/(1–3) + (12–15) (total 14–17, usually 15 or 16); scales 1D.-A. 33–39 (n = 18), midbase 1D.-A. 25–34; 2D.-A. 18–24 (n = 17); caeca 22–34 (n = 10).

Total length 117+–393+ mm; HL 24–72 mm. The following in percent HL: postrostral 72.3–79.1; snout 25.1–34.4; preoral 18.8–27.0 (usually 20–25); orbit 18.8–31.2; interorbital 32.8–44.4; postorbital 46.6–58.6; orbit-preop. 52.5–64.4; suborbital 19.3–25.5; upper jaw 40.9–48.5; barbel 6.5–10.3; outer gill slit 22.6–30.6; body depth 75.4–94.5; pre-D. 95–111; pre-V. 102–127; prevent 109–134; pre-A. 119–146; V.-A. 12–38.1; 1D. height 52–66; 1D. base 22.8–30.2; 1D.–2D. 24–38; 1P. 68–81; V. 41–63.

DESCRIPTION.—Head large, 5.0–5.5 into TL, relatively broad and deep, greatest width about 1.5 into greatest depth; trunk compressed, gradually tapering into a long straplike tail (the tip often missing). Orbits small, semi-elliptical to oval, its greatest diameter usually oblique. Interorbital broad, irregularly convex, 2.3–3.0 into HL. Suborbital region deep, almost vertical, convex, without division into upper and lower parts, and without stout scutelike scales. Preopercle notably large, with posterior margin oblique, more strikingly so in smaller specimens. Subopercle posterior margin forming a deep notch; subopercle and interopercle broadly exposed beyond preopercle in holotype and 393 mm specimen

(ZIN uncat.), but interopercle narrowly exposed in smaller specimens. Free margins of opercular bones crenulated. Snout short, bluntly pointed, and high, forming a pronounced hump in dorsal profile, its length usually greater than orbit diameter; anterior profile subvertical. Mouth large, jaws subterminal; posterior end of maxillary extends to vertical through midorbit. Mental barbel very small, almost a rudiment, length less than half orbit diameter. Gill membranes narrowly attached to isthmus below hind end of upper jaws (opercular opening consequently wide).

Sensory canals on head large. Free neuromasts on head indistinct and poorly developed. Lateral line canal absent on body, being replaced by small black papillae (free neuromasts?) situated somewhat irregularly along normal course of lateral line. Olfactory capsules small; posterior nostril slightly larger than anterior; internarial membrane forming a prominent flap equal to diameter of anterior nostril in 393 mm ZIN specimen, but flap inconspicuous in smaller specimens.

Teeth in jaws small, conical, closely spaced; uniserial on dentary; in narrow band 3–4 irregular rows wide anteriorly on premaxillary, narrowing to about 2 rows wide posteriorly, outer series slightly enlarged.

Squamation in 393 mm specimen overall forming a smooth, velvety cover without coarse ridges or scutes. Head almost completely scaled, including underside of snout, suborbital region, and mandibular rami. No scaly ridges on head; no scutes at terminal and lateral tips of snout. Scales on posterior margins of opercular bones lacking spinules (or absent?). Scales absent on gular and branchiostegal membranes, over supranasal ridge, dorsal edge of orbit, on posterior portion of median nasal ridge, and in rather wide band surrounding postorbital sensory canal. Scales greatly enlarged over postorbital canal and posterior portion of interorbital space to level of anterior margin of pupil, but very small anteriorly on snout, especially along leading edges, with some scales nonimbricate. Elsewhere on head, scales intermediate and about equal in size. Body scales large, covered with numerous slender, suberect, slightly curved spinules in quincunx order.

Light organ externally consists of a teardrop-shaped anterior dermal window between midbase of pelvic fins, connected by a narrow isthmus to posterior dermal window at anterior end of periproct. Anus much closer to pelvic fin bases than to origin of anal fin. Swim bladder well developed. Pyloric caeca short, unbranched. Radiographs of two specimens showed abdominal vertebrae 12; anal pterygiophores before first haemal spine 12.

Origin of first dorsal fin opposite that of pelvic fin; pectoral fin situated slightly anterior to these; anal fin origin slightly behind vertical through last ray of first dorsal. Second unbranched ray of first dorsal high, not especially stout, terminating in a short filament; leading edge smooth except for distal one-fifth or so where numerous small, inconspicuous denticles present. Rays of second dorsal moderately developed, but much finer and shorter than opposites of anal fin. Interdorsal space about equal to snout length. Pectoral fins long, more than two-thirds HL, situated well below level of top of gill opening; pelvic fin long, outer ray filamentous and extending well past anal fin origin.

Color in alcohol overall black to brownish black. Scale pockets on head and body of largest specimens dark blue with black margins; in smaller specimens most dorsal surfaces of head, snout, and suborbital grayish. Opercle, gular and gill membranes, and jaws black; in small specimens leading edge of snout and rim of olfactory capsule faintly blackish; oral cavity mostly black, but floor anteriorly whitish; branchial cavity black except pale anteriorly on isthmus and gill filaments. All fins black. Holotype generally lighter in color than above description suggests, but this probably a result of fading, which was not so evident in other specimens.

SIZE.—To more than 39 cm.

DISTRIBUTION.—Nazca and Sala y Gomez ridges and Hawaiian Islands, in 340–950 m.

REMARKS.—The collection of many small additional specimens of this species, originally described from a single large individual, has shown its similarity to members of the genus *Ventrifossa*. This supports moving *Pseudocetonurus* even farther from *Cetonurus*, with which it was initially loosely grouped, but "without . . . indicating a close kinship" (Sazonov and Shcherbachev 1982:6). In fact, aside from the lack of a developed lateral line, the expanded interorbital, suborbital and preopercular regions, the relatively large head, and the high snout, there is little to suggest that *Ventrifossa* and *Pseudocetonurus* are much different.

The dark color, small eyes, and enlarged sensory canals suggest a bathypelagic existence, and the capture of many specimens in a midwater

trawl over the Nazca Ridge lends support to this idea. The swim bladder is rather well developed, nonetheless, and in large adults it is enveloped in a tough tunica externa and filled with spongy tissue. The rete-gas gland complex of a small 150 mm specimen was well developed and consisted of a straplike rete that terminated posteriorly in a tightly appressed pair of flattened, horse-hoof-shaped gas glands. The rete bundle did not appear to be separated into two bundles, although closer inspection may show them to be so, as it is in other members of the tribe Malacocephalini.

The discovery of four specimens in good condition from the Hawaiian Islands was surprising and suggests the possibility of a much wider distribution for this species. The specimens were dip netted at the surface in 1950 after having been killed by the lava flow from a volcanic eruption of Mauna Loa on the Island of Hawaii. Gosline et al. (1954) and Gosline (1954) reported on the kill and collection of the fishes from this eruption.

MATERIAL EXAMINED.—**Sala y Gomez Ridge:** Holotype: ZMMGU P16011 (54 mm HL, 257+ mm TL); 25°20.2'S, 93°35.5'W; 850–860 m.

OTHER MATERIAL: **Nazca Ridge:** ZMMGU 17743 (19:24–41.5 HL, 93+–212+ TL) and CAS 67409 (10:29.5–38.5 HL, 125+–184+ TL); 340–780 m; IKMWT; *Prof. Mesiatzev* cr. 13, sta. 44. ZIN uncat. (72 HL, 393+ TL); 950 m; bottom trawl; *Hercules* tr. 40. ZMMGU 18127 (26.7 HL, 126+ TL); 900–920 m over bottom depth of 1,270–1,200 m; IKMWT; R/V *Prof. Shtokman* cr. 18, sta. 1856. **Hawaiian Islands:** LACM 45410-1 (4:39–45 HL, 209–231 TL); lava flow kill, Kona, Hawaii; Y. Yamaguchi, collector; 7.VI.1950.

Trachonurus Günther, 1887

Type species: *Coryphaenoides villosus* Günther, 1877, by monotypy.

DIAGNOSIS.—Macrourines with 7 branchiostegal rays. Teeth in narrow bands in both jaws. Scales bristly, covered with short to moderately long, erect, conical spinules; head entirely scaled, including patches on gular and (in some) branchiostegal membranes; scales along second dorsal and anal fins somewhat enlarged and thickened in most species. Second spinous ray of first dorsal fin slender, flexible, without serrations; 6–8 segmented first dorsal rays; pelvic fin with 6 or 7 rays, its origin below base (usually midbase) of first dorsal. Anus in middle of broad oval periproct spanning most of distance between anal and pelvic fins, a broad, naked anterior extension ending at pelvic fin bases. Abdominal vertebrae 12 or 13. Swim bladder with 2 retia mirabilia. Pyloric caeca 6–14, stubby to moderately long and thick. Color blackish to dark brown.

SIZE.—To at least 64 cm.

DISTRIBUTION.—Worldwide in tropical to warm-temperate waters, but not recorded from continental slopes of eastern Pacific.

REMARKS.—The genus constitutes a small group of four nominal species, all of which were synonymized by Marshall (1973) with *Trachonurus villosus*. A closer re-examination of specimens from Hawaiian and Atlantic waters may require a re-evaluation of the status of *T. sentipellis* Gilbert and Cramer, 1897, and *T. sulcatus* (Goode and Bean, 1885). Study (by TI) of old *Albatross* collections from the Philippines and recent collections from Australia and New Zealand suggests the possibility of as many as four undescribed species represented. Shcherbachev et al. (1979) reported numerous specimens of *T. villosus* from the Indian Ocean; our subsequent examination of this material suggests that some of the specimens may represent undescribed species.

Trachonurus villosus (Günther, 1877)?

Coryphaenoides villosus Günther, 1877:441 (south of Yeddo [=Tokyo]).

Macrurus (*Trachonurus*) *villosus*: Günther 1887:142, pl. 36, fig. B (lectotype, BMNH 1887.12.7.105, here designated; s. of Yeddo, *Challenger* sta. 232 in 345 fm [631 m]. Paralectotype, BMNH 1887.12.7.106; s. of Philippine Is., *Challenger* sta. 214 in 500 fm [914 m]).

Trachonurus villosus: Parin 1990:17 (listed from vicinity of Nazca and Sala y Gomez ridges).

DIAGNOSIS.—Orbit about 15–16% HL; suborbital width about half orbit diameter. Outer premaxillary teeth slightly enlarged. A well-developed grooved lateral line; scale spinules relatively short and stout; diagonal scale rows from hind edge of first dorsal to anal fin more than 25; gular and branchiostegal membranes heavily scaled. Rays 1P. il6–il8. Pyloric caeca moderately long, not stubby.

REMARKS.—The two specimens from the Sala y Gomez Ridge appear quite similar to specimens of *Trachonurus* from the Gulf of Mexico and Caribbean Sea, and some specimens from Australia. A more thorough study is necessary to determine if they are the same. They differ from a syntype of *T. villosus* (BMNH 1887.12.7.105; 26 mm HL, 177+ mm TL), taken south of Yeddo (Tokyo) in having a smaller or-

bit, broader suborbital, longer distance orbit-preopercle, longer upper jaw, and more pectoral fin rays. It cannot be discounted that the exceptionally large size of these Sala y Gomez specimens may account for these differences in proportional measurements. A second syntype (BMNH 1887.12.7.106) from south of the Philippines appears to be a different species with a longer upper jaw, longer barbel, longer first gill slit, wider 1D.–2D. interspace, and larger scales. (This specimen was in poor shape when examined by TI in Oct. 1986.) The features characterizing *T. villosus* have not been properly assessed, and the relationships of the species with others of the genus have not been adequately determined. Because two species are probably represented in the syntypic series of *T. villosus,* the Yeddo syntype is here designated as the lectotype. It was obviously the one used by Günther in his original description, which listed only "south of Yeddo" as the type locality, and it was the specimen figured in his report on the *Challenger* fishes (Günther 1887:142, pl. 36B).

The Sala y Gomez specimens differ from Hawaiian specimens of the genus (nominally *T. sentipellis*) in having a deeper body, a more rounded, less conical snout, more diagonal scale rows below the hind margin of first dorsal, more numerous pectoral fin rays, smaller orbit, narrower suborbital, and more heavily scaled gular and branchiostegal membranes.

Material Examined.—(2 spec., both *Prof. Mesiatzev*) **Sala y Gomez Ridge:** ZMMGU 17744 (1:124 mm HL, 637+ mm TL); 1,070–1,100 m; cr. 13, tr. 10. ZMMGU 17745 (1:65 HL, 303+ TL); 1,050 m; cr. 13, tr. 14.

Ventrifossa Gilbert and Hubbs, 1920

Type species: *Coryphaenoides garmani* Jordan and Gilbert, 1904, by original designation.

Diagnosis.—Macrourines with 7 branchiostegal rays. Head smoothly rounded, without coarse, angular ridges, and lacking stout, modified scales; snout without a terminal scutelike scale except in subgenus *Sokodara.* Mouth moderate to large, upper jaw 35–55% HL. Jaw teeth in narrow to moderately broad bands in upper jaw, outer series enlarged; lower jaw teeth small, none enlarged, in 1 to several irregular series laterally. Gill rakers 12–20 total on inner series of first arch. Branchiostegal membranes naked. Body scales small, densely covered with slender conical or triangular spinules; no transverse ridges on anterior field. Spinous second ray of first dorsal finely serrated along leading edge or smooth. Anus removed from anal fin origin and closer to pelvic fin; periproct oval-shaped, extending forward to small fossa between pelvic fin bases. Pyloric caeca about 34–75.

Size.—To at least 53 cm.

Distribution.—Tropical waters of the Indo-Pacific, but with an isolated pocket of two species in the tropical western Atlantic (Gulf of Mexico and Caribbean Sea). Species generally confined to upper continental slope depths ranging from about 200 m to more than 1,000 m, but most often captured at 500–800 m.

Remarks.—A medium-sized group with 24 named species and several more known to us, yet to be described. Sazonov (1985) removed the subgenus *Lucigadus* Gilbert and Hubbs, 1920, with its five species, and elevated it to the status of genus. Iwamoto (1979) has recently treated the group in some detail.

Ventrifossa johnboborum Iwamoto, 1982

(Figure 30)

Ventrifossa johnboborum Iwamoto, 1982 (in part):55–61, fig. 1 (type locality Bismarck Sea; non-type specimens are *V. fusca* Okamura, 1982). Shcherbachev et al. 1986:202 (3 spec. from western Indian Ocean on Freda Seamount, 810 m). Shcherbachev 1987:7 (listed from Indian Ocean). Parin 1990: 17 (listed from Sala y Gomez Ridge). Kotlyar and Parin 1990:107, fig. 4a (otolith).

Malacocephalus sp.: Parin et al. 1981:13 (1 spec., ZMMGU 17746, here reported, from *Ichthyandr* cr. 5, tr. 53).

Diagnosis.—A broad-headed species of subgenus *Sokodara* (see Iwamoto 1979). Interorbital width 27.8–33.4% HL, slightly less than orbit diameter, which goes about 3 in head; upper jaw 39–45% HL; barbel 13–19% HL. Scales small, 65–71 from lateral line origin over distance equal to pre-1D. length. Dorsal spines weakly serrated in adults; 1D. II,10–11 (13); 1P. i21–i23; V. 9–10.

Counts and Measurements.—(5 specimens; see also Diagnosis) GR-I (outer/inner) 7–10/12–14 total; GR-II (outer/inner) 10–13/11–14 total; caeca 65–73 (2 spec.); vertebrae 14–16.

Total length 280+–391+ mm, HL 66.5–85.1. The following in percent of HL: postrostral 73.8–76.7; snout 27.8–31.6; preoral 19.2–23.8; orbit 31.4–35.7; suborbital 10.5–14.0; postorbital 38.3–43.6; orbit-preop. 39.1–42.7; gill slit 20.4–28.7; pre–1D. 101–110; pre-V. 97–114; pre-A. 127–137; V.-A. 33–49; base 1D. 23.8–31.0; 1D.–2D. 33.1–45.1.

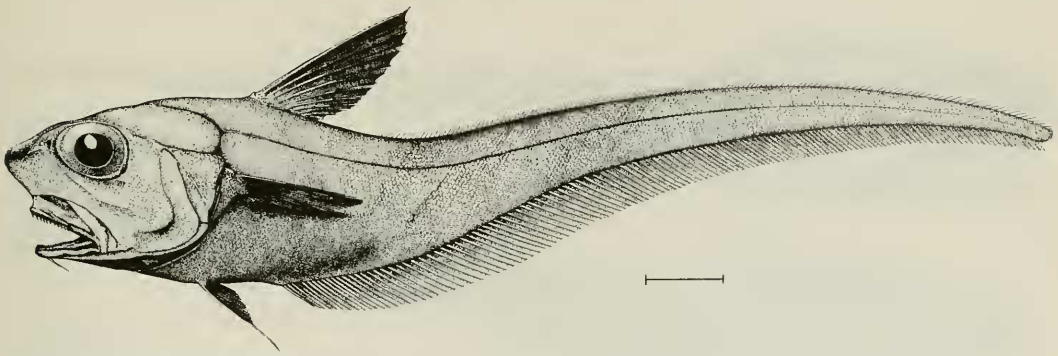

FIGURE 30. *Ventrifossa johnboborum*. Sala y Gomez Ridge in 540 m, *Ichthyandr* cr. 5, sta. 53. Drawn by Tomio Iwamoto. Scale bar equals 25 mm.

DESCRIPTION.—Greatest body depth slightly more than postrostral length of head, about 1.3–1.4 in HL, more than 6 in TL. Head width more than half its length. Snout broad, width at lateral angles (anterior to nostrils) slightly less than both interorbital width and snout length; moderately protruding beyond large subterminal mouth, length less than orbit diameter. Orbits large, 2.7–3.2 in HL, about 1.2–1.3 in postorbital length. Suborbital region gently rounded, separated into upper and lower regions by a ridge-line that runs close to orbital rim anteriorly but diverges widely posteriorly; scales on suborbital not modified into heavy tubercular scutes. Preopercle broadly rounded; interopercle exposed along posterior and ventral margins of preopercle. Upper jaw 2.2–2.4 into HL; maxillary extends to below posterior one-third of orbits; rictus not restricted posteriorly. Barbel small, slender, about 1.8–2.5 in orbits.

Premaxillary dentition in holotype in narrow band 4–5 irregular rows wide near symphysis, narrowing posteriorly. In Sala y Gomez specimens, teeth in 2 or 3 irregular rows, outer series slightly enlarged. A wide toothless gap at premaxillary symphysis. Mandibular dentition small, in 2 or 3 irregular series that taper to 1 row posteriorly; inner series larger than outer series.

Scales all small, densely covered with small, slender, conical, relatively erect spinules arranged in irregularly quincunx or widely divergent, V-shaped rows. Scales uniformly cover all of head except gill membranes, lips, and nostril membranes. A row of small scales on anterior orbital rim between posterior nostril and orbit. Scale pockets present on exposed interopercle surfaces, although no scales remain there on examined specimens. No stout spiny ridges or heavily modified scales on head or body, except tip of snout has small, blunt, tubercular median scale (not noticeably enlarged or protruding). Fins unscaled.

Pyloric caeca about 65 in holotype, 73 in a male 325+ mm TL. Caeca short, about equal to suborbital width, branched at base. Retia 2, long, slender; gas glands small. Paired drumming muscles in 325 mm male large, covering almost half anteroventral surface of swim bladder. Stomach in that specimen contained remains of cephalopods, including beaks, eyes, and body parts. Light organ with 2 dermal windows, the anterior one between pelvic bases small and round.

First dorsal and paired fins moderately large for genus. Height of first dorsal fin about equal to postrostral length of head; spinous second ray weakly serrated distally, scarcely prolonged beyond succeeding rays; when laid back, longest rays barely reach or extend slightly beyond origin of second dorsal fin. Base of first dorsal about 1.1–1.6 into space between first dorsal and second dorsal. Origin of pelvic fin anterior to that of pectoral, which is anterior to that of first dorsal. Outer pelvic fin ray slightly produced into a filament that extends to about 3rd or 4th anal ray. Origin of anal fin under hind edge of first dorsal. Length of pectoral about equal to length of snout plus orbit.

Color in alcohol overall grayish brown to swarthy, bluish over abdomen; fins black. Gill membranes and entire oral cavity black. Gill chamber pallid over epihyal, ceratohyal, anteroventral

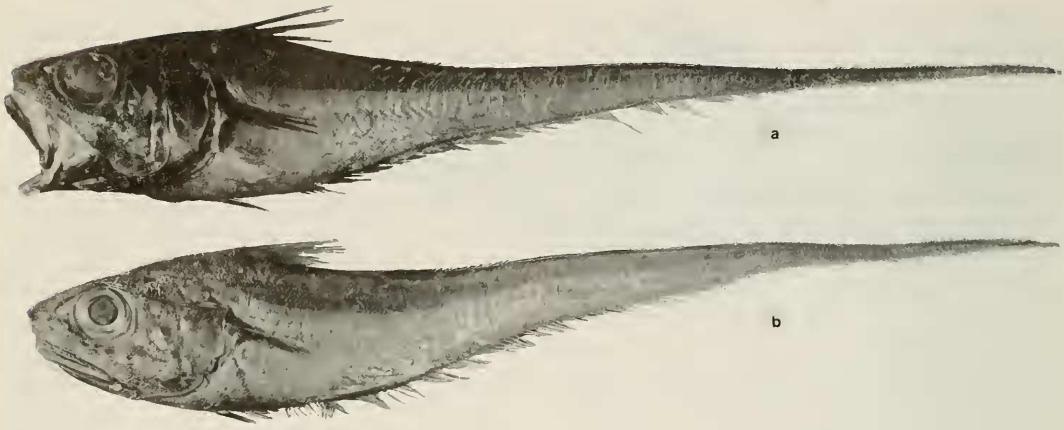

FIGURE 31. *Ventrifossa macrodon* new species; non-type material, ZMMGU 18139, from Sala y Gomez Ridge, in 730–790 m, *Prof. Shtokman* cr. 18, sta. 2018, 7 May 1987: (a) specimen 67.5 mm HL; (b) 69 mm HL. Photograph by Sergei Dudarev.

portion of cleithrum, and gill filaments; remainder dark dusky to blackish. Gill arches and rakers, leading edge of snout, and periproct region blackish. Peritoneum and stomach black. Anal rays blackish anteriorly fading to dusky posteriorly. Barbel overall pallid but base blackish. Lips edged with thin black margin.

COMPARISONS AND REMARKS.—*Ventrifossa johnboborum* is most closely related to *V. fusca* Okamura, 1982, described from the Kyushu-Palau Ridge, and *V. misakia* Jordan and Gilbert, 1904, from Japan. *Ventrifossa johnboborum* can be distinguished from the other two species by its blackish lining of the oral cavity (compared with pallid or white) and pelvic fin ray count (9–10 cf. 8). It is further distinguished from *V. fusca* by its larger orbit (2.9–3.1 in HL, cf. 3.4–3.6), shorter interspace between dorsal fins (2.3–3.0 in HL cf. 1.8–2.1), and longer barbel (1.8–2.7 in orbit diameter, cf. 3.8–4.1).

The original description of *V. johnboborum* was based on the holotype and three other specimens not designated as type-specimens. These other specimens, one from off Batag Island in the Philippines, the other two from the South China Sea, were sufficiently different from the holotype so as to cast doubt as to their conspecificity, but their differences (V. 8, barbel length 11–12% HL, upper jaw length 36–39% HL) did not justify description of a second species. The specimens otherwise agree closely with *V. johnboborum* and also *V. fusca,* especially concerning the pelvic ray count, and proportional measurements of the barbel and upper jaw. They disagree with *V. fusca* in having dark mouth linings (which questions the validity of that character in *V. johnboborum*), but otherwise seem so similar that they are tentatively identified with that species. (Dr. Osamu Okamura, BSKU, kindly loaned two paratypes of *V. fusca* for comparison with southeastern Pacific specimens of *V. johnboborum.*)

The subgenus *Sokodara* is represented by three Pacific species (two in the western Pacific, one in the South Pacific), and two Indian Ocean species. *Ventrifossa misakia* is known only from off Japan; *V. fusca* from the western North Pacific south of Japan; *V. johnboborum* from the Bismarck Sea, the western Indian Ocean, and on the Sala y Gomez Ridge; and *V. nasuta* Smith, 1935, from South Africa and Mozambique. The distributions of *V. fusca* and *V. johnboborum* will undoubtedly be extended with more collecting, and it should be interesting to see if and where the two distributions abut or adjoin.

SIZE.—To at least 47.5 cm (Shcherbachev et al. 1986).

DISTRIBUTION.—Known from the western Indian Ocean, the Bismarck Sea, and the Sala y Gomez Ridge in 540–810 m, but probably extends across the intervening areas on seamounts and oceanic ridges of the Indian Ocean and South Pacific Ocean.

MATERIAL EXAMINED.—**Bismarck Sea:** Holotype: AMS I.15602-002 (85.1 mm HL, 360+ mm TL). **Sala y Gomez Ridge** (5 spec.): ZMMGU 17746 (70.3 HL, 340+ TL); 540 m; *Ichthyandr* cr. 5, tr. 53. ZMMGU 17747 (2:66.5–70.7 HL,

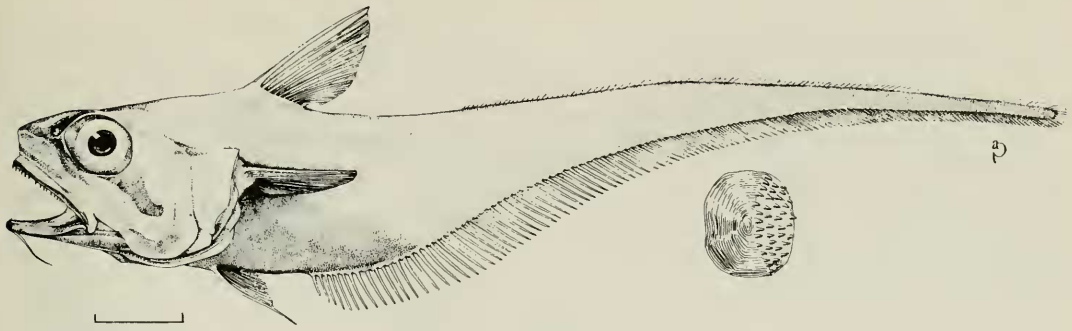

FIGURE 32. *Ventrifossa macrodon* new species; paratype, CAS 51796, from Nazca Ridge in 540 m. Drawn by Amy Pertschuk. Scale bar equals 25 mm.

280+–325+ TL); 610–620 m; *Hercules* tr. 70. ZMMGU 17748 (2:72.5–78.5 HL, 361+–391+ TL); 750–800 m; *Prof. Shtokman* cr. 18, sta. 1996.

Ventrifossa macrodon new species

(Figures 31–33)

Ventrifossa sp. 1: Parin et al. 1981:12 (counts and measurements of 24 specimens here described as new).

Ventrifossa sp. nova 1 Sazonov and Iwamoto": Parin 1990:17 (listed from Sala y Gomez Ridge). Parin et al. 1990:42 (stomach contents). Kotlyar and Parin 1990:106, fig. 4b (otolith).

DIAGNOSIS.—A species of subgenus *Ventrifossa* with moderately deep body (depth 76–87% HL). Interorbital 20–24% HL, much less than orbit diameter, which goes about 3 in HL; upper jaw 46–50% HL; barbel less than snout length, 23–27% HL; GR-I 17–19 total (inner). No enlarged spinules on body scales. Second spinous ray of first dorsal fin not serrated; 1D. II,9–11; 1P. i19–i26; V. 9–10. Leading edge of snout, supranarial ridges, and median nasal ridge blackish; first dorsal fin blackish, without distinct black blotch.

COUNTS AND MEASUREMENTS.—(24 specimens; data for holotype in square brackets) 1D. II,9–11 [II,9]; 1P. i19–i26 (x = i22.07; SD = 2.129) [i23/i24]; V. 9–10 (11) [10]; GR-I (outer/inner) 8–14 [11]/(2–3) + (0–1) + (13–16) (16–19 total) [3 + 14], GR-II (1–3) + (0–1) + (12–15) (15–18 total) [3 + 14]/(2–3) + (0–1) + (12–15) (15–18 total) [3 + 14]; scales below midbase 1D. 7.5–10 [8]; below 2D. 8.5–11 [10]; caeca 50 in 54.5 mm HL paratype; vertebrae 12 (5 spec.).

Total length 157+–363+ [350] mm, HL 26.7–72 [67.7] mm. The following in percent HL: postrostral 73.7–80 [77.1]; snout 23.2–28.9 [25.6]; preoral 6.5–10.5 [7.8]; orbit 29.2–43.0 [30.7]; interorbital 19.6–26.2 [21.7]; suborbital 9.4–13.2 [11.4]; postorbital 39.0–46.7 [41.9]; orbit-preop. 38.0–46.6 [44.2]; upper jaw 46.2–54.8 [51.7]; gill slit 22.5–29.1 [22.2]; barbel 22.7–33.9 [29.2]; body depth 73–88 [87]; pre-D. 98–118 [110]; pre-V. 100–123 [105]; pre-A. 127–152 [137]; V.-A. 26–43 [38]; height 1D. 46–77 [—]; 1D. base 21.8–29.1 [27.0]; 1D.–2D. 48.6–76.8 [66.2]; 1P. 49–61 [53.5]; V. 30–46 [32].

DESCRIPTION.—Head and trunk compressed, relatively deep; greatest width of head about equal to width of trunk over pectoral fin bases, slightly more than postorbital length, about three-fifths body depth. Greatest body depth more than 6 in TL, 1.1–1.3 in HL. Snout low, blunt, scarcely protruding beyond the large mouth; distance between supranarial ridges less than (1.1–1.3 into) least interorbital width, 1.4–1.8 into orbit diameter. Orbits large, longer than snout, about 3 (2.8–3.4) in HL, but about 2.3–2.7 in juveniles with HL less than 35 mm. Interorbital space flat to slightly convex, width slightly more than that across supranarial ridges. Ridges on head not well developed; rounded or smoothly angular where present. Suborbital region narrow, gently rounded; a ridge line apparent but not demarcated by stout scales (as in species of *Nezumia*). Preopercle deep and broadly lobate; posterior border slightly inclined forward and with a shallow inflection. A relatively deep notch formed along posterior margin of subopercle. Interopercle exposed along its posterior and ventral borders. Strongly toothed jaws unrestricted at angles by lip folds; extend to below level of posterior third of orbits. Barbel long, slender, slightly longer than interorbital width. Gill membranes of opposite sides narrowly united under posterior third of orbits, forming a narrow free fold.

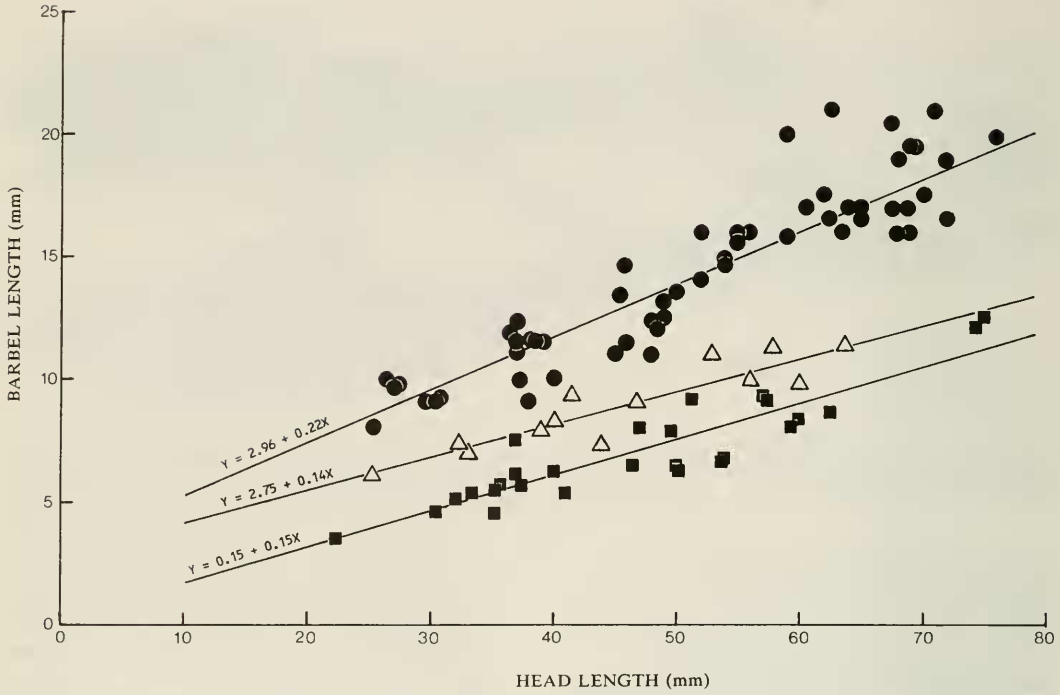

FIGURE 33. Comparison of barbel lengths in three species of the *Ventrifossa atherodon* species complex. *Ventrifossa macrodon* (circles), *V. atherodon* (squares), *V.* sp. (South China Sea) (triangles).

Premaxillary dentition consists of moderately wide band of small teeth (4–6 rows wide) flanked by a row of widely spaced, enlarged, conical teeth with arrowhead-shaped tips. Mandibular teeth smaller than enlarged premaxillary teeth and arranged in basically 1 row anteriorly, but 2 irregular rows laterally (small but prominent teeth with arrowhead-shaped tips form a continuous regularly spaced series interspersed laterally and posteriorly with 1 to 3 much smaller teeth that are not exposed above the gum papillae).

Thin, finely spinulated scales uniformly cover all of head except over nostril membranes, lips, fins, and gill membranes. Head scales densely covered with short, conical, erect spinules (none enlarged) giving a shagreenlike feel to surface. No scutelike scales on ridges; no enlarged terminal scute at snout tip. Scales over suborbital shelf small, generally similar to other scales of head. Body scales rather deciduous; those along base of second dorsal fin lack spinules or only partially covered with spinules; those more ventrad densely covered with minute, fine, conical, reclined spinules, arrayed in roughly quincunx pattern; 50–70 spinules per scale on larger of these scales in specimens 63.3–70.5 mm HL. Spinules of head and body scales flecked with melanophores. Fins unscaled except at base.

Vent region as for most others of genus (see Marshall 1973:655, fig. 49; Okamura 1970a:74, text-fig. 32). Light organ and alimentary canal similar to that illustrated by Okamura (1970a, text-fig. 34). A small, ill-defined posterior dermal window immediately before anus, connected by a narrow isthmus of black skin to a small oval anterior dermal window situated in a shallow fossa between bases of pelvic fins.

Pyloric caeca numerous, thin walled, short (length less than pupil diameter), branched at bases. Ovaries of 63.6 mm HL female (CAS 51795) and 63.3 mm HL female (CAS 51796) large, but eggs small, 0.3–0.4 mm diameter.

First dorsal fin relatively low, height less than postrostral length of head, about equal to length pectoral fin; first ray of first dorsal fin rudimentary, closely appressed to spinous second ray, which is slender and without serrations; second dorsal fin poorly developed over entire length, begins far posterior to first dorsal.

Color in alcohol somewhat swarthy overall;

abdominal region bluish to violet. Ridges of snout along leading edge, over medial nasal ridge, and over supranarial ridges marked with prominent black edges. A diffuse transverse band extends across each parietal ridge at posterior end of supraoccipital region. Behind level of orbits, parietal region blackish. Suborbital region darker dorsally than ventrally. An irregularly triangular area of black pigmentation extends posteroventrally from orbit to preopercle. A blackish horizontal streak on ventral aspect of eye just below cornea in some but not in others. Lips, gular membrane, and gill membranes blackish; barbel blackish at base, grayish to pale distally. Papillae of gums blackish; oral valve on roof of mouth edged with black; most linings of mouth whitish; pharynx gray. Gill filaments, gill arches, and hyoid region of gill cavity pale, remainder of gill chamber blackish. Peritoneal lining finely peppered with small melanophores ventrally, dusky to blackish dorsally; stomach pale. Fins blackish; anal fin paler posteriorly.

Food.—Stomachs of two individuals (CAS 51795 and 51796) contained unidentifiable remains of a fish and a shrimplike crustacean. Parin et al. (1990:42) reported the mysid *Paralophogaster glaber* in the diet of 31% of their 13 specimens; a galatheid crab, *Munida* sp., in 15%. Penaeids, copepods (*Pleromammama* sp.), amphipods (Eurisidae), and the fish genus *Cyclothone* were also eaten.

Size.—To about 40 cm.

Distribution.—Known only from the Sala y Gomez Ridge in 345–770 m.

Etymology.—The name *macrodon* (latinized Greek *macros,* long, and *odus,* tooth) refers to the presence of enlarged teeth in the outer row of the premaxillary, a not uncommon character in this genus. The name, however, also reflects the close relationship of the new species to *V. macroptera* Okamura, 1982, and *V. atherodon* (Gilbert and Cramer, 1897) by the combination of elements forming each name.

Comparisons and Remarks.—The new species is most closely related to *V. atherodon, V. macroptera,* and an undescribed species from the South China Sea. The four can be distinguished from each other by characters given in the key that follows. In addition, the new species has a somewhat longer barbel than the other three: 23–34% HL cf. 12–24% in *V. atherodon,* 18–24.5% in *V. macroptera,* and 17–22% in the South China Sea species (see also Fig. 33).

Key to the species in the *Ventrifossa atherodon* complex

1a. Scales below second dorsal fin with distinctly enlarged spinules ..... species (South China Sea)
1b. No enlarged spinules on scales 2
2a. Pectoral fin 1.3–1.5 in HL; orbits 25–32.5% HL ..... *macroptera* (Kyushu-Palau Ridge)
2b. Pectoral fin 1.7–2.0 in HL; orbits 20–43% HL 3
3a. Length barbel 23–34% HL; outer gill slit 22–29% HL (usually 22–26%) ..... *macrodon* (Sala y Gomez Ridge)
3b. Length barbel 12–24% HL; outer gill slit 26–32% HL (usually 26–28%) ..... *atherodon* (Hawaiian Islands)

The four species constitute a well-defined species group in the genus *Ventrifossa* distinguished by a non-serrated spinous dorsal ray, low blunt snout, high gill raker counts, rather large mouth, and 9–10 pelvic fin rays. The subgeneric name *Atherodus* Gilbert and Hubbs, 1920, is available for this group. Although a count of V. 9 is common among species of *Ventrifossa,* a count of 10 is normally encountered only in this species group and in *V. ctenomelas* (usually 9–10), a species endemic to the Hawaiian Islands where it is sympatric with *V. atherodon.*

Material Examined.—(138 spec.) all from **Sala y Gomez Ridge:** Holotype: ZMMGU 18132 (67.7 mm HL, 350 mm TL); 580–564 m; *Prof. Shtokman* cr. 18, sta. 1964.

Paratypes (39 spec.): ZMMGU 17751 (2:38–55 HL, 192–277+ TL); 770 m; *Ichthyandr* cr. 5, tr. 52. CAS 51796 (2:63–69 HL, 290+–305 TL) and ZMMGU 17752 (55 HL, 307+ TL); 540 m; *Ichthyandr* cr. 5, tr. 53. ZMMGU 17753 (9:30.5–56 HL, 169+–307 TL) and CAS 51794 (2:48–60 HL, 265–290 TL); 535–575 m; *Ichthyandr* cr. 5, tr. 54. ZMMGU 17754 (9:36.3–69 HL, 201+–367+ TL) and CAS 51795 (3:38–70.5 HL, 210+–353+ TL); 345–540 m; *Ichthyandr* cr. 5, tr. 55. ZMMGU 17755 (2:59–72 HL, 325+–350+ TL); 550 m; *Astronomer* tr. 104. ZMMGU 18133 (9:54–69 HL, 245+–350 TL); same data as for holotype.

Other material: ZMMGU 18071 (3:26.7–50 HL, 157–260 TL); 565–555 m; *Prof. Mesiatzev* cr. 13, tr. 1. ZMMGU 18072 (4:34.3–53 HL, 177–271 TL); 550–560 m; *Prof. Mesiatzev* cr. 13, tr. 2. ZMMGU 18073 (2:39.5–46.3 HL, 184+–246 TL); 530 m; *Prof. Mesiatzev* cr. 15, tr. 49. ZMMGU 18134 (11:32–76 HL, 168–404 TL); 562–545 m; *Prof. Shtokman* cr. 18, sta. 1965. ZMMGU 18135 (33.7 HL, 181 TL); 570–580 m; *Prof. Shtokman* cr. 18, sta. 1971. ZMMGU 18136 (13:29–55 HL, 160–260+ TL); 563–590 m; *Prof. Shtokman* cr. 18, sta. 1976. ZMMGU 18137 (36:29–61 HL, 132+–288+ TL); 545–600 m; *Prof. Shtokman* cr. 18, sta. 1977. ZMMGU 18138 (11: 29.5–73 HL, 169–383 TL); 750–600 m; *Prof. Shtokman* cr.

FIGURE 34. *Ventrifossa obtusirostris* new species; holotype, ZMMGU 18130 (49 mm HL), from Sala y Gomez Ridge in 739–760 m, *Prof. Shtokman* cr. 18, sta. 1996. Photograph by Sergei Dudarev.

18, sta. 1996. ZMMGU 18139 (17:26.3–73 HL, 131+–359 TL); 730–790 m; *Prof. Shtokman* cr. 18, sta. 2018.

Ventrifossa obtusirostris new species

(Figure 34, 35)

"*Ventrifossa* sp. nova. 3 Sazonov and Iwamoto": Parin 1990: 17 (listed from Sala y Gomez Ridge).

DIAGNOSIS.—A species of subgenus *Ventrifossa* with snout blunt and rounded, scarcely produced beyond mouth, its length 26.5–28.3% HL; upper jaw 47.7–52% HL; barbel long, 137–166% of orbit diameter, 48–54% of HL; pectoral fins long, 72–78% HL. Color dark overall, first dorsal blackish distally, paler near base; anterior portion of anal fin with black margin.

COUNTS AND MEASUREMENTS.—(from 5 specimens; holotype data in square brackets) 1D. II,11 [11]; 1P. i21–i23 [i21]; V. 9–10 [9/10]; GR-I (outer/inner) 8–10 [9]/(1–2) + (12–14) [2 + 13] (14–15 total), GR-II 2 + 12/(1–2) + (11–13) [2 + 11] (11–14 total); scales below 1D. 10–13 [11], below midbase 1D. 7.5–9.5 [9.5], below 2D. 9–10 [9].

Total length 249+–294 mm, HL 44.0–51.5 mm. The following in percent HL: postrostral 74.8–78.6 [78.3]; snout 26.5–28.1 [27.2]; preoral 11.7–17.3; interorbital 25.7–27.4 [26.5]; orbit 33.5–36.3 [33.5]; suborbital 13.5–14.3 [13.5]; postorbital 42.7–46.3 [46.3]; orb.-preop. 40.9–45.5 [44.6]; upper jaw 47.7–52.0 [51.1]; barbel 47.7–54.3 [54.3]; gill slit 26.3–30.4 [30.4]; pre-1D. 112–122 [123]; pre-A. 128–133 [133]; prevent 111–121 [119]; pre-V. 102–110 [111]; V.-A. 26–31 [27.8]; body depth 80–100 [100]; 1D.–2D. 39–54 [54]; 1D. base 30–36 [32.6]; 1D. height 77–89 [80]; 1P. 72–78 [78]; V. 39–45 [45].

DESCRIPTION.—Body deep, greatest depth al-

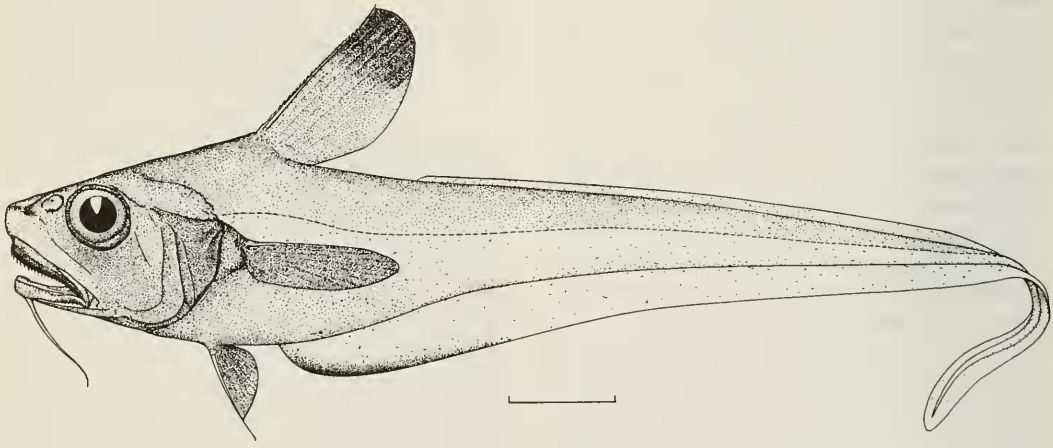

FIGURE 35. *Ventrifossa obtusirostris* new species; paratype, ZMMGU 17756 (51.5 mm HL), Sala y Gomez Ridge in 739–760 m; *Prof. Shtokman* cr. 18, sta. 1996. Drawn by Tomio Iwamoto. Scale bar equals 25 mm.

most equal to HL, tapering abruptly behind abdomen before leveling off to long tail. Head 5.5–6.0 into TL, width slightly more than postorbital length of head. Snout blunt, low, scarcely protruding beyond mouth, its length about equal to its width across lateral angles, about equal to orbit diameter. Orbits large, about 1.4 into postorbital length, uppermost rim barely entering dorsal profile of head. Interorbital essentially flat, width less than orbit. Suborbital region almost vertical, gently curved in cross-section, the ridge scarcely discernible in well-preserved specimens, the dorsal shelf uniformly wide. Preopercle margin and ridge broadly rounded, not formed into a lobe; interopercle broad, exposed along posteroventral margins. Upper jaw about 2 in HL, maxillary extends to below posterior one-third of orbits; rictus extends to below midorbit. Barbel notably long, moderately thick, extending beyond junction of gill membranes, its length more than postorbital, about 2 in HL.

Teeth all small, short, conical, rather bluntly pointed, in a broad band in premaxillary with a slightly enlarged outer series. Mandibular teeth similarly small, barely perceptible among gum papillae, in a long narrow band.

Scales small, uniformly covering all of body and head except fins, gill membranes, lips, nasal membranes. Scales thin, covered with short, fine, black, partially reclined spinules, rather sparsely and irregularly arranged in an irregularly quincunx pattern.

Abdominal area anterior to anal fin short, distance pelvic fin base to anal fin origin much less than distance isthmus to pelvic fin base. Vent close between pelvic fins, slightly behind their insertions; periproct region with anterior extension to small teardrop-shaped dermal window situated anterior to pelvic fin origin.

First dorsal fin moderate in height, slightly more than postrostral length of head, its second spinous ray finely serrated along leading edge, rather flexible and weak, its tip scarcely prolonged; second dorsal fin rudimentary for almost entire length; anal fin well developed. Pectoral fin extends to end of abdomen; pelvic fin rather small, outer ray thin, short, extending past base of third or fourth anal fin ray. Origin of pelvics far forward, below hind margin of operculum; pectoral fin origin slightly behind that; first dorsal origin about on same vertical as pectoral or slightly behind, anal fin origin below or forward of hind edge of first dorsal.

Color in alcohol dark brownish dorsally, paler on body below midlateral line; bluish to dark gray or blackish over abdomen and head. Leading edge of snout blackish, but inconspicuous because of dark ground color. Pectoral and pelvic fins black; first dorsal overall blackish, but somewhat paler along base; anal fin pale except anterior rays blackish distally. Barbel starkly contrasting in white. Oral cavity completely pale or white except for thin dark edge of dorsal oral valve and gums of lower jaws; lips black. Gill cavity black along inner wall and peripherally on outer wall; pale in remaining areas; gill arches, rakers, and filaments pale.

Size.—To at least 30 cm.

Distribution.—Known only from a single collection on the Sala y Gomez Ridge in 750–800 m.

Etymology.—From the Latin, *obtusus,* blunt, and *rostrum,* snout, in reference to the short blunt snout of the species as compared with others of the genus. The name is to be treated as a feminine adjective.

Comparisons and Remarks.—It is somewhat perplexing that this species was collected only once in the NSG region, despite relatively extensive trawling at appropriate depths. Whether this scarcity of collections can be attributed to unavailability of populations to the sampling gear, insufficient collecting within their primary range, or a general scarcity of individuals is not known.

Relationships of *V. obtusirostris* appear to be closest to three western tropical Pacific species, all of which have a relatively long barbel (about one-half HL): *V. saikaiensis* Okamura, 1984, *V. longebarbata* Okamura, 1982, and *V. rhipidodorsalis* Okamura, 1984. The first species differs from *V. obtusirostris* in the following: somewhat fewer pelvic rays (8–9), a broad area of spinuleless scales behind the first dorsal, a slightly shorter pectoral fin (61–72% HL), and a slightly shorter barbel (115–133% of orbit). Members of the last two species can be distinguished by their shorter pectoral fin (less than 70% HL). In addition, *V. longebarbata* has a somewhat shorter postorbital length (39–41%) and narrower interorbital (23–24% HL). The long pectoral fin characteristic of *V. obtusirostris* is matched only in *V. macroptera,* but that species differs in its members having a shorter barbel (20–25% HL, less than orbit diameter), more gill rakers (GR-I 16–18 total inner), a smaller orbit (18–31% HL), and broader interorbital (30–32% HL).

FIGURE 36. *Ventrifossa teres* new species; holotype, ZMMGU 18131 (52.2 mm HL), from Sala y Gomez Ridge in 730–790 m, *Prof. Shtokman* cr. 18, sta. 2018, 7 May 1987. Photograph by Sergei Dudarev.

MATERIAL EXAMINED.—(all from **Sala y Gomez Ridge**) Holotype: ZMMGU 18130 (46.0 mm HL, 275+ mm TL); Sala y Gomez Ridge, 750–800 m; *Prof. Shtokman* cr. 18, sta. 1996, trawl 29.

Paratypes (same locality as holotype): ZMMGU 17756 (3: 44.5–51.5 HL, 258+–294 TL) and CAS uncat. (44.0 HL, 249+ TL).

Ventrifossa teres new species

(Figures 36, 37)

Ventrifossa sp. 2: Parin et al. 1981:12 (counts and measurements of 4 specimens from Sala y Gomez Ridge).

"*Ventrifossa* sp. nova 2 Sazonov et Iwamoto": Parin 1990:17 (listed from Sala y Gomez Ridge). Kotlyar and Parin 1990: 107, fig. 4b (otolith).

DIAGNOSIS.—A species of subgenus *Ventrifossa* with slender body (greatest depth 57–75% HL). Interorbital width 18–24% HL, much less than orbit diameter, which goes about 3 in HL; upper jaw 40–45.5% HL; barbel less than snout length, 19–27% HL. First dorsal fin spine weakly serrated; 1D. II,9–10; V. 8–9; GR-I 13–15 total (inner). Leading edge of snout blackish; no black median nasal streak; first dorsal blackish, without distinct black blotch.

COUNTS AND MEASUREMENTS.—(from 38 spec.; holotype data in square brackets) 1D. II,(8) 9–10 [II,10]; 1P. i20–i22 (rarely i19 or i23) [i23]; V. 8–9 [9]; GR-I (outer/inner) 7–12 [10]/(1–2) + (0–1) + (10–13) [1 + 1 + 12] (12–15 total), GR-II (1–2) + (0–1) + (9–12) [2 + 11] (11–14 total)/(1–2) + (0–1) + (9–12) [1 + 1 + 12] (11–14 total); caeca 34–36 (4 spec.); abdominal vertebrae 11.

Total length 131–239 mm, HL 23.8–52.2. The following in percent HL: postrostral 72–78 [75.7]; snout 26.4–31.8 [26.8]; preoral 11.2–17.6 [13.6]; orbit 31.6–37.3 [31.4]; interorbital 18.5–23.9 [18.1]; suborbital 7.2–12.3 [9.2]; postorbital 37.0–41.4 [38.3]; orbit-preop. 32.9–38.5 [36.8]; upper jaw 38.7–44.7 [42.1]; gill slit 18.8–25.9 [21.1]; barbel 19.4–26.7 [27.4]; body depth 57–75 [71]; pre-D. 103–112 [111]; pre-V. 99–122 [107]; pre-A. 126–159 [144]; V.-A. 27–49 [42]; 1D. height 47–68 [49]; 1D. base 20.5–30.2 [27.8]; 1D.–2D. 48–80 [63]; 1P. 49–61 [54]; V. 28–37 [34].

DESCRIPTION.—A slender-bodied species of *Ventrifossa*, width across pectoral fin bases about three-fourths body depth; greatest head width three-fourths its depth; greatest body depth about 1.3–1.8 into HL, 6.4–8.7 into TL. Nape and first dorsal fin base low. Snout low, conical in lateral profile; relatively blunt and narrow in dorsal view, width across anterolateral angles slightly greater than interorbital width; length about 1.2 into orbit. Orbits large, about 3 in head, about 1.3 into postorbital length. Interorbital space probably relatively flat in live specimens, but slightly concave in examined preserved specimens. Suborbital region traversed by a low, rounded ridge, the upper and lower surfaces of region meeting at an obtuse angle (in cross-section); upper shelf area not markedly narrowed anteriorly. Preopercle broadly lobate; interopercle broadly exposed posteriorly beyond preopercle. Upper jaw long, about 2.2–2.6 into HL; maxillary extends to below posterior one-third of orbits; rictus (mouth cleft) not restricted posteriorly. Barbel slender, moderately long, about equal to interorbital width.

Dentition of premaxillary in a moderately wide band; inner teeth very small, bordered by an outer series of slightly enlarged, widely spaced, conical, recurved teeth. Mandibular teeth all small, in 2 irregular series. Tips of outer premaxillary teeth and all mandibular teeth shaped like arrowheads.

Scales uniformly cover all of head except for nostril membranes, lips, gill membranes, and a narrow median triangular area above upper lip. Head scales thin, densely covered with short,

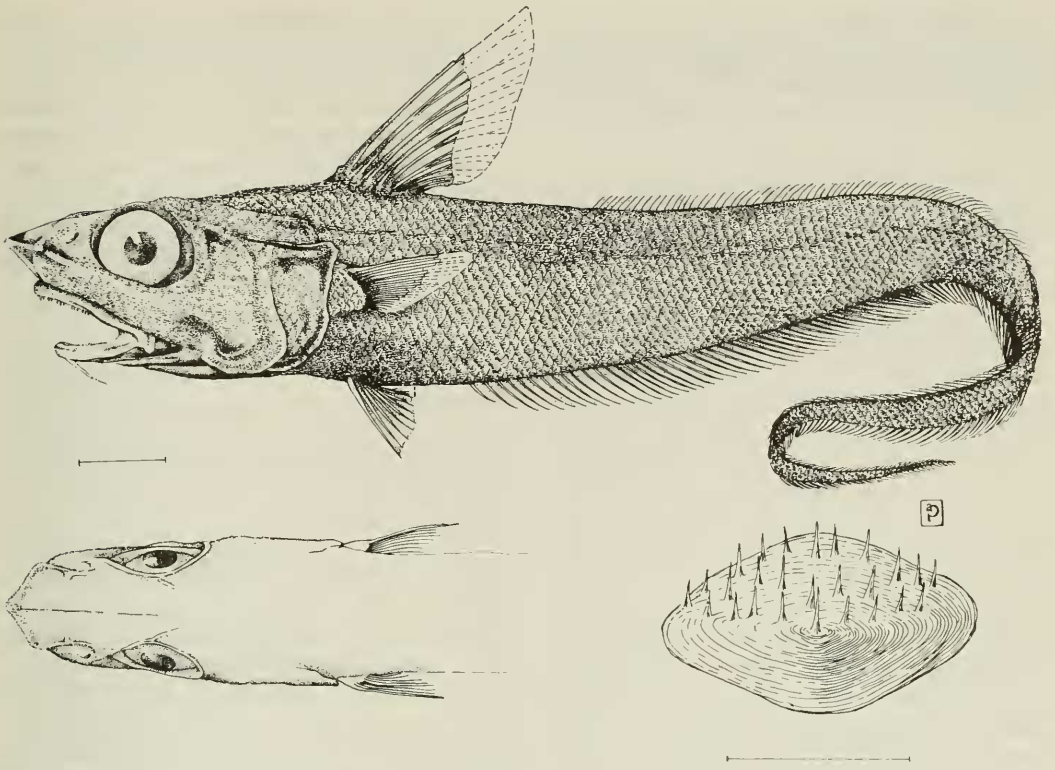

FIGURE 37. *Ventrifossa teres* new species; paratype, ZMMGU 17759 (39.5 mm HL), Sala y Gomez Ridge in 354–540 m, *Ichthyandr* cr. 5, trawl 55. Drawn by Amy Pertschuk. Scale bar under head equals 10 mm, that under scale equals 1.0 mm.

conical, erect spinules, none enlarged. No scutelike scales on ridges; no enlarged terminal scute at snout tip; scales over suborbital shelf not coarse or scutelike. Most body scales missing on type specimens; those remaining dorsally below second dorsal fin covered with fine, conical, reclined spinules, arrayed in roughly quincunx pattern; 24–26 spinules per scale on larger of these scales. Spinules of head and body scales flecked with melanophores. Fins unscaled except at base.

The 43.5 mm HL specimen from CAS 51797 had large ovaries filled with eggs of different sizes, some measuring as much as 1.4 mm in diameter. Pyloric caeca relatively few for a *Ventrifossa* (accurate number could not be determined), length slightly less than interorbital diameter. Ventperiproct region much like that of other members of genus; anterior dermal window of light organ small, circular, slightly anterior to pelvic bases.

First dorsal fin relatively short, length less than postrostral length of head; first spinous ray closely appressed to second spinous ray and not protruding through integument. Second spinous ray weakly denticulate, the short denticles confined to distal half. Paired fins moderate in size, neither pelvics nor pectorals much longer than postorbital length of head.

Color in alcohol overall pale with widely spaced dots on ventral half of trunk and tail; abdomen bluish. Branchiostegal and gular membranes blackish on exposed surfaces. Lips edged with thin black margin. Diffuse blackish blotches over posterior part of posttemporal and ventrally on preopercle at junction with infraorbitals. Barbel completely white to base. Edges of mandibular ramus black. Leading edge of snout posteriorly to anterior end of suborbital ridge blackish; supranarial ridges blackish, this coloration extending onto tops of orbital rim. Outer edge of gill cover with a diffuse blackish margin; upper edge of opercle with a thin black margin; a diffuse horizontal black streak slightly below upper edge of opercle. Oral cavity completely pallid; branchial cavity generally pallid with scattered punc-

tations and blackish outer margins. Gill filaments pale; arches and rakers dusky. Paired fins black; first dorsal blackish with no pronounced blotches, but base pale; anal and second dorsal pale.

SIZE.—A small species, attains about 24 cm.

DISTRIBUTION.—Known only from the Sala y Gomez Ridge, in 345–610 m.

ETYMOLOGY.—From Latin, *teres,* terete, in reference to the slender, cylindrical body.

COMPARISONS AND REMARKS.—*Ventrifossa teres* resembles *V. mucocephalus* Marshall, 1973, from the tropical western Atlantic in its low head profile, relatively terete body, and small chin barbel. The two species differ in the following: (1) *V. teres* usually has V. 9, rarely 8, cf. V. 8, seldom 7 or 9 in *V. mucocephalus*; (2) 1D. II,9 or 10 in *V. teres* cf. 1D. II,11–12 (rarely II,10); (3) interorbital 18.5–23.9% of HL in *V. teres* cf. 23–28% HL; (4) orbit to preopercle distance 32.9–38.5% HL cf. 40.5–46.0%; (5) black margin along supranarial ridges in *V. teres,* but unmarked in *V. mucocephalus*; and (6) *V. teres* is a smaller species attaining about 24 cm TL, cf. more than 41 cm in *V. mucocephalus. Ventrifossa teres* also resembles *V. nasuta* (Smith, 1964) from southern Africa in its low head profile and relatively terete shape, but the two differ markedly in the latter having a stout terminal snout scute and lacking distinctive head markings. Several morphometric and meristic features also distinguish the two.

MATERIAL EXAMINED.—(39 spec., all from **Sala y Gomez Ridge**) Holotype: ZMMGU 18131 (mature ♀, 52.2 mm HL, 237 mm TL); 730–790 m; *Prof. Shtokman* cr. 28, sta. 2018.

Paratypes: CAS 51797 (2:39.0–43.5 HL, 174–184 TL); 770 m; *Ichthyandr* cr. 5, tr. 52. ZMMGU 17758 (38 HL, 188 TL); 535–575 m; *Ichthyandr* cr. 5, tr. 54. ZMMGU 17759 (39.5 HL, 196 TL); 345–540 m; *Ichthyandr* cr. 5, tr. 55. ZMMGU 17760 (2:41–48.5 HL, 196+–226+ TL); 610 m; *Hercules* tr. 68. ZMMGU 17761 (13:36.5–47.5 HL, 157+–214+ TL); 750–800 m; *Prof. Shtokman* cr. 18, sta. 1996. ZMMGU 18067 (4: 23.8–49.2 HL, 131–239 TL); 562–545 m; *Prof. Shtokman* cr. 18, sta. 1965. CAS uncat. (5:41–45 HL, 184+–202+ TL) and ZMMGU 18068 (8:38–46.5 HL, 172.5+–207+ TL); same data as for holotype. ZMMGU 18069 (2:31.1–32.7 HL, 143+–143+ TL); 545–600 m; *Prof. Shtokman* cr. 18, sta. 1977.

BIOGEOGRAPHICAL CONSIDERATIONS

Table 5 lists the 25 species of macrourids known from NSG and compares their distributions in various parts of the world's oceans. Only two species are known from the continental slope of South America: *Caelorinchus immaculatus* and *Nezumia convergens,* and the identification of the latter from a single specimen is as yet tentative. *Caelorinchus immaculatus* is a representative of a southern temperate fauna, as its relationships appear closest to *C. karrerae* of the southeastern Atlantic and southern part of the Indian Ocean, from Africa to Australia. None of the NSG species are common to the tropical eastern Pacific fauna, although the widespread *Malacocephalus laevis* is also known from the northeastern Pacific in slope waters of southern California and on seamounts off California and Mexico.

Eight of the 25 species are widespread tropical or subtropical taxa: *Macrouroides inflaticeps, Squalogadus modificatus, Cetonurus crassiceps, Coryphaenoides paradoxus, Hymenocephalus gracilis, Malacocephalus laevis, Nezumia propinqua,* and *Trachonurus villosus* (but unresolved taxonomic problems exist with *Trachonurus*).

Eight species are endemic to NSG and four (possibly five) others (*Caelorinchus spilonotus, Hymenocephalus striatulus, Mataeocephalus acipenserinus, Pseudocetonurus septifer,* and possibly *Gadomus* sp. cf. *melanopterus*) are known only from NSG and the Hawaiian Islands. The ties to the Hawaiian fauna are strong, with 11 species (three are questionably included here) common to the two areas, the most for any region. The western tropical Pacific and Indian Ocean also show a high affinity, with eight and nine species in common, although all but *Ventrifossa johnboborum* are widespread species. Those areas are followed closely by the Atlantic Ocean, with seven species in common with the NSG.

Thus, despite the proximity of the Nazca Ridge to the mainland coast of Peru, the relationship of the fauna of the Nazca and Sala y Gomez ridges is clearly to the west, in the tropical central and western Pacific. This is in line with the distributions of other deep-sea fish and invertebrate taxa known from this area (see Parin 1990; Parin et al. 1981; Nesis 1990) and also the shore fauna of many eastern Pacific islands (Rosenblatt et al. 1972; Springer 1982). Wilson et al. (1985) discuss this relationship in the fauna of seamounts of the central North Pacific. The 32% endemism of the grenadier fauna (8 of 25 spp.) is somewhat lower than the 46% endemism (65 of 141 spp.) recorded by Parin (1990) for the entire NSG fish fauna. That so many of the grenadiers represented are circumglobal species accounts for the lower percentage of endemic species. It can be expected that more drags made below 1,500 m

TABLE 5. List of the grenadiers of the Nazca and Sala y Gomez ridges, comparing their distributions in different areas. Species denoted with an asterisk (*) may have still-unresolved taxonomic problems and may involve more than one species. A question mark (?) following a plus sign (+) indicates the possible occurrence of the species in the region. Abbreviations: A—Atlantic Ocean; E—endemic to Nazca and Sala y Gomez ridges; ESP—continental eastern South Pacific; HI—Hawaiian Island region; IO—Indian Ocean; Nazca—Nazca Ridge; SyG = Sala y Gomez Ridge; WP—western tropical Pacific; WSP—Australian-New Zealand region (western South Pacific).

	E	Nazca	SyG	HI	WP	WSP	ESP	IO	A
1. *Gadomus* sp. cf. *melanopterus**	–	–	+	+?	–	–	–	–	–
2. *Macrouroides inflaticeps*	–	+	–	–	+	–	–	+	–
3. *Squalogadus modificatus*	–	+	–	–	+	–	–	+	+
4. *Cetonurus crassiceps*	–	+	+	+	–	+	–	–	+
5. *Caelorinchus nazcaensis*	+	+	–	–	–	–	–	–	–
6. *C. spilonotus*	–	–	+	+	–	–	–	–	–
7. *C. immaculatus*	–	+	+	–	–	–	+	–	–
8. *C. multifasciatus*	+	–	+	–	–	–	–	–	–
9. *Coryphaenoides paradoxus**	–	+	+	+	+	+?	–	+?	+?
10. *Hymenocephalus gracilis*	–	–	+	–	+	–	–	+	+
11. *H. neglectissimus*	+	–	+	–	–	–	–	–	–
12. *H. semipellucidus*	+	–	+	–	–	–	–	–	–
13. *H. striatulus*	–	–	+	+	–	–	–	–	–
14. *H.* sp. cf. *aterrimus**	–	+	+	+?	–	–	–	+?	+?
15. *Kuronezumia pallida*	+	–	+	–	–	–	–	–	–
16. *Malacocephalus laevis**	–	–	+	+	+	+	–	+	+
17. *Mataeocephalus acipenserinus*	–	–	+	+	–	–	–	–	–
18. *Nezumia propinqua*	–	–	+	+	+	–	–	+?	–
19. *N.* sp. cf. *convergens*	–	–	–	–	–	–	+?	–	–
20. *Pseudocetonurus septifer*	–	+	+	+	–	–	–	–	–
21. *Trachonurus villosus*	–	–	+?	+?	+	+?	–	+?	+?
22. *Ventrifossa johnboborum*	–	–	+	–	+	–	–	+	–
23. *V. macrodon*	+	–	+	–	–	–	–	–	–
24. *V. teres*	+	–	+	–	–	–	–	–	–
25. *V. obtusirostris*	+	–	+	–	–	–	–	–	–
Totals	8	8	21	11	8	4	2	9	7

will result in the capture of other species that will further reduce the percentage of endemics, because abyssal grenadiers are more broadly distributed than their shallow-water counterparts, as a general rule.

The relative richness of the two ridges is clearly skewed towards the Sala y Gomez Ridge, with 21 species of grenadiers represented, compared with only eight on the Nazca Ridge (see Table 5). *Nezumia* sp. cf. *convergens* was taken only in the region between the two ridges; *Macrouroides inflaticeps* was taken in the intermediate area and on the Nazca Ridge; *Cetonurus crassiceps* and *Hymenocephalus* sp. cf. *aterrimus* were taken on both ridges and in the intervening area. Parin (1990) considered the Nazca fauna a depauperate one containing a few peculiar elements that make it distinctive from that of the Sala y Gomez. Nesis (1990), using cephalopod data, confirmed the existence of a zoogeographical boundary on the southwestern side of the Nazca Ridge at about 84°–85°W.

Comparison of the grenadiers of the NSG and Hawaiian Islands shows some interesting parallels and contrasts (Table 6). The Hawaiian Island region has a slightly greater number of recorded species (29) than NSG (25), and the number of endemics is notably higher (15, or 52%, compared with 9 and 36%). This high endemism of the Hawaiian fauna is reflected in the few species shared in common with the western tropical Pacific—the number of NSG species in this category is twice that of the Hawaiian Islands (8 vs. 4). Strangely, however, the number of Indian Ocean and Altantic Ocean species shared in common with NSG on the one hand, and the Hawaiian Islands on the other hand, are comparable. If we exclude five wide-ranging (and problematic) species (*Cetonurus crassiceps, Coryphaenoides paradoxus, Hymenocephalus aterrimus, Malacocephalus laevis,* and *Trachonurus villosus*), the contrasts become even more interesting. In the Hawaiian fauna, *Kuronezumia bubonis* and *Mesobius berryi* remain as the only

TABLE 6. List of the grenadiers of the Hawaiian Islands region, comparing their distributions in different areas. Species denoted with an asterisk (*) may have still-unresolved taxonomic problems and may involve more than one species. A question mark (?) following a plus sign (+) indicates the possible occurrence of the species in the region. Abbreviations: A—Atlantic Ocean; E—endemic to Hawaiian Islands region; ESP—continental eastern South Pacific; IO—Indian Ocean; Nazca—Nazca Ridge; SyG—Sala y Gomez Ridge; WP—western tropical Pacific; WSP—Australian-New Zealand region (western South Pacific).

	E	Nazca	SyG	WP	WSP	ESP	IO	A
1. *Gadomus melanopterus**	–	–	+?	–	–	–	–	–
2. *Bathygadus bowersi*	+	–	–	–	–	–	–	–
3. *Bathygadus micronemus**	+	–	–	–	–	–	–	–
4. *Cetonurus crassiceps*	–	+	+	–	+	–	–	+
5. *Caelorinchus aratrum*	+	–	–	–	–	–	–	–
6. *C. spilonotus*	–	–	+	–	–	–	–	–
7. *C. doryssus*	+	–	–	–	–	–	–	–
8. *C. gladius*	+	–	–	–	–	–	–	–
9. *Coryphaenoides paradoxus**	–	+	+	+	+?	–	+?	+?
10. *C. longicirrhus**	–	–	–	–	–	–	+?	–
11. *Hymenocephalus striatulus*	–	–	+	–	–	–	–	–
12. *H. antraeus*	+	–	–	–	–	–	–	–
13. *H. tenuis*	+	–	–	–	–	–	–	–
14. *H. aterrimus**	–	+?	+?	–	–	–	+?	+?
15. *Kuronezumia bubonis*	–	–	–	–	+	–	+	+
16. *Malacocephalus laevis**	–	–	+	+	+	–	+	+
17. *Mataeocephalus acipenserinus*	–	–	+	–	–	–	–	–
18. *Mesobius berryi*	–	–	–	–	–	–	+	+
19. *Nezumia propinqua*	–	+	+	+	–	–	+?	–
20. *N. burragei**	+	–	–	–	–	–	–	–
21. *N. ectenes**	+	–	–	–	–	–	–	–
22. *N. holocentra*	+	–	–	–	–	–	–	–
23. *N. obliquata*	+	–	–	–	–	–	–	–
24. *N. hebetata**	+	–	–	–	–	–	–	–
25. *Pseudocetonurus septifer*	–	+	+	–	–	–	–	–
26. *Sphagemacrurus gibber*	+	–	–	–	–	–	–	–
27. *Trachonurus villosus**	–	–	+	+	+	–	+	+
28. *Ventrifossa atherodon*	+	–	–	–	–	–	–	–
29. *V. ctenomelas*	+	–	–	–	–	–	–	–
Totals	15	5	11	4	5	0	8	7

two species also found in the Indian and Atlantic oceans. Of the NSG fauna, only *Hymenocephalus gracilis* and *Squalogadus modificatus* remain.

That the two faunas are closely related is shown in the number of species they share exclusively: *Gadomus melanopterus, Caelorinchus spilonotus, Hymenocephalus striatulus, Mataeocephalus acipenserinus,* and *Pseudocetonurus septifer.* It thus appears that the two faunas share a host of wide-ranging species as well as several unique ones, but each has been isolated long enough to develop a large percentage of endemic elements.

Okamura and Yatou (*in* Okamura et al. 1982) reported on the grenadiers from the Kyushu-Palau Ridge and Tosa Bay, collected by the Fisheries Agency of the Government of Japan (Table 7). The Kyushu-Palau Ridge extends in a southeasterly direction from the island of Kyushu to the Palau Islands at a latitude of approximately 6°N. The ridge area investigated was confined to approximately 25°–30°N. Of the 25 species recorded, 15 were confined to the Kyushu-Palau Ridge, and 10 others were taken on the continental slope off Tosa Bay (Shikoku Island, Japan) and other continental margins.

Although the coverage area and collection depths were much more limited in the Japanese surveys than in the Soviet surveys of the NSG, some interesting comparisons can be made. There were three species that were possibly the same in the two areas: *Malacocephalus nipponensis* (?=*M. laevis*), *Nezumia propinqua,* and *Trachonurus villosus* (?). Six of the 15 species (40%) were endemic to the Kyushu-Palau Ridge, and these were equally divided among *Caelorinchus* and *Ventrifossa.* The two genera were represented in

the NSG fauna by four and three endemic species. The Kyushu-Palau Ridge, although being relatively closely adjacent to an exceeding rich faunal region (Japan and the Philippines), nonetheless has a distinctive fauna, which appears to be less diverse than the faunas of the Hawaiian Archipelago and the Nazca and Sala y Gomez ridges. The propensity for the genera *Caelorinchus* and *Ventrifossa* to have the most species in these ridge areas is notable, although the thought is tempered with the knowledge that *Caelorinchus* is by far the most diverse genus of grenadiers, with more than 100 species.

Table 7. Grenadiers of the Kyushu-Palau Ridge and Tosa Bay (after Okamura et al. 1982).

Species found on the Kyushu-Palau Ridge (species endemic to ridge marked with an asterisk*):

1. *Gadomus colletti* Jordan and Gilbert, 1904
2. *Caelorinchus gilberti* Jordan and Hubbs, 1925
3. *C. hexafasciatus* Okamura, 1982*
4. *C. longicephalus* Okamura, 1982*
5. *C. matsubarai* Okamura, 1982*
6. *Hymenocephalus longiceps* Smith and Radcliffe, 1912
7. *H. striatissimus* Jordan and Gilbert, 1904
8. *H. lethonemus* Jordan and Gilbert, 1904
9. *Malacocephalus nipponensis* Gilbert and Hubbs, 1916
10. *Nezumia propinqua* (Gilbert and Cramer, 1897)
11. *Trachonurus villosus* (Günther, 1877)
12. *V. fusca* Okamura, 1982*
13. *V. japonica* (Matsubara, 1943)
14. *V. longibarbata* Okamura, 1982*
15. *V. macroptera* Okamura, 1982*

Tosa Bay species not found on Kyushu-Palau Ridge:

1. *Caelorinchus anatirostris* Jordan and Gilbert, 1904
2. *C. smithi* Gilbert and Hubbs, 1916
3. *C. japonicus* (Temminck and Schlegel, 1884)
4. *Coryphaenoides nasutus* Günther, 1877
5. *C. marginatus* Steindachner and Döderlein, 1884
6. *Kuronezumia dara* (Gilbert and Hubbs, 1916)
7. *Nezumia condylura* Jordan and Gilbert, 1904
8. *N. proxima* (Smith and Radcliffe, 1912)
9. *Ventrifossa garmani* (Jordan and Gilbert, 1904)
10. *V. nigrodorsalis* Gilbert and Hubbs, 1916

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Resumen

Hay registrado veinticinco especies de granaderos desde las cordilleras submarinas de Nazca y Sala y Gomez en el sur del Pacifico Oriente. Las especies nuevas incluyen: *Caelorinchus immaculatus, C. multifasciatus, C. nazcaensis, C. spilonotus, Hymenocephalus neglectissimus, H. semipellucidus, Kuronezumia pallida, Ventrifossa macrodon, V. teres,* y *V. obtusirostris. Caelorinchus immaculatus* es muy semejante a *C. karrerae* desde el sur el Atlántico Oriente y el mar de las Indias. El complejo de *H. striatissimus* está examinado usando informaciónes nuevas. *Hymenocephalus semipellucidus* y *H. neglectissimus* parecen pertenecer a este complejo. El sub-

espécie de *H. s. hachijoensis* de Japón está elevado a la categoría del espécie pleno. *Kuronezumia,* considerado antes como subgénero de *Nezumia,* está redefinado y elevado a la categoría de género incluyendo *K. pallida, K. bubonis, K. leonis, K. macronema, K. dara,* y dos especies no descritos. A despecho de la proximidad de las cordilleras submarinas a la cuesta del Peru, los afines de la fauna asociada están hacía del oeste, particularmente al Pacífico Occidental y las Islas Hawaii. Ocho de los veinticinco especies de estas cordilleras submarinas eran definitivamente conocidos de la proximidad de las Islas Hawaii: *Caelorinchus spilonotus, Cetonurus crassiceps,* Coryphaenoides paradoxus,* H. striatulus, Malacocephalus laevis,* Mataeocephalus acipenserinus, Nezumia propinqua,** y *Pseudocetonurus septifer.* Tres otros especies cuyos identificaciones no son determinados pueden ser parte o tener afines en la fauna de las Islas Hawaii: *Gadomus* sp. cf. *melanopterus, Hymenocephalus* sp. cf. *aterrimus,* and *Trachonurus villosus**? Los cuatro espécies marcados con asterisco están distribuidos ampliamente por los oceanos Pacifico, Indio y Atlántico. *Malacocephalus laevis* se conoce de los taludes continentales en el sur de California y por las montañas submarinas cerca de Baja California, pero nunca se los encuentra por las cuestas de América Central y América del Sur. *Caelorinchus immaculatus* también se nota de América del Sur; *Nezumia convergens* está representada discutiblemente en un espécimen único de la cordillera submarina de Sala y Gomez.

Literature Cited

Amaoka, K., K. Nakaya, H. Araya, and T. Yasui, eds. 1983. Fishes from the North-eastern Sea of Japan and the Okhotsk Sea off Hokkaido. The intensive research of unexploited fishery resources on continental slopes. Japan Fish. Resource Conser. Assoc., Tokyo. 371 pp.

Arai, T. and P. J. McMillan. 1982. A new macrourid fish, *Coelorinchus biclinozonalis* from New Zealand, and redescription of *C. australis* from Australia. Japan. J. Ichthyol. 29(2):115–126.

Barnard, K. H. 1925. Descriptions of new species of marine fishes from S. Africa. Ann. Mag. Nat. Hist., Ser. 9, 15(87): 498–504.

Berg, C. 1898. Substitución de nombres genéricos. Comm. Mus. Nac. Buenos Aires 1:41–43.

Brauer, A. 1906. Die Tiefsee-Fische. I. Systematischer Teil. Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia," 1898–1899, 15:1–432, text-figs. 1–176, pls. 1–18.

Cohen, D. M., ed. 1989. Papers on the systematics of gadiform fishes. Nat. Hist. Mus. Los Angeles County, Sci. Ser. 32. 262 pp.

Cohen, D. M., T. Inada, T. Iwamoto, and N. Scialabba. 1990. FAO species catalogue. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers and other gadiform fishes known to date. FAO Fish. Synop. no. 125, Vol. 10. 442 pp.

Eschmeyer, W. N. 1990. Catalog of the genera of Recent fishes. Calif. Acad. Sci., San Francisco. 697 pp.

Fisher, R. L. and R. M. Norris. 1960. Bathymetry and geology of Sala y Gomez, southeast Pacific. Geol. Soc. Amer. Bull. 71:497–502.

Garman, S. 1899. Reports on an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz, by the U.S. Fish Commission steamer "Albatross" during 1891. Lieut.-Commander Z. L. Tanner, U.S.N., commanding. Part 26. The fishes. Mem. Mus. Comp. Zool. Harv. Coll. 24:1–431, pls. 1–84, A–N.

Giglioli, E. H. 1884. Pelagos, saggi sulla vita et sui prodotti del mare. Genova. 433 pp.

Gilbert, C. H. 1892. Scientific results of explorations by the U.S. Fish Commission steamer "Albatross." No. 22. Descriptions of thirty-four new species of fishes collected in 1888 and 1889, principally among the Santa Barbara Islands and in the Gulf of California. Proc. U.S. Natl. Mus. 14:539–566.

———. 1905. The deep-sea fishes of the Hawaiian Islands. Pp. 575–713, figs. 230–276, pls. 66–101 *in* Jordan, D. S. and B. W. Evermann (eds.), The aquatic resources of the Hawaiian Islands. Bull. U.S. Fish Comm. 1903, 22(pt. 2, sect. 2).

Gilbert, C. H. and F. Cramer. 1897. Report on the fishes dredged in deep water near the Hawaiian Islands, with descriptions and figures of twenty-three new species. Proc. U.S. Natl. Mus. 19(1114):403–435, pls. 36–48.

Gilbert, C. H. and C. L. Hubbs. 1916. Report on the Japanese macrouroid fishes collected by the United States fisheries steamer "Albatross" in 1906, with a synopsis of the genera. Proc. U.S. Natl. Mus. 51:135–214, pls. 8–11.

———. 1917. Description of *Hymenocephalus tenuis,* a new macrouroid fish from the Hawaiian Islands. Proc. U.S. Natl. Mus. 54(2231):173–175.

———. 1920. The macrourid fishes of the Philippine Islands and the East Indies. U.S. Natl. Mus. Bull. 100, 1(pt. 7):369–588.

Gilchrist, J. D. F. and C. von Bonde. 1924. Deep-sea fishes procured by the S. S. "Pickle." Part II. Rep. Fish. Mar. Biol. Surv. S. Afr. 3(1922):1–24, pls. 1–6.

Giorna, M. E. 1809. Mémoire sur des poissons d'espèces nouvelles et de genres nouveau. Mém. Acad. Sci. Turin (1805–1808)16(1):177–180.

Goode, G. B. and T. H. Bean. 1885. Descriptions of new fishes obtained by the United States Fish Commission mainly from deep water off the Atlantic and Gulf coasts. Proc. U.S. Natl. Mus. 8(37–38):589–605.

Golovan', G. A. 1978. Composition and distribution of the ichthyofauna of the continental slope of north-western Africa. [In Russian, with English summary.] Trans. Inst. Oceanol. Acad. Sci. USSR 111:195–258.

Golovan', G. A. and N. P. Pakhorukov. 1987. Distribution and behavior of fishes on the Naska and Sala y Gomez submarine ranges. Voprosy Ikhtiologii (3):369–376.

Gosline, W. A. 1954. Fishes killed by the 1950 eruption of Mauna Loa. II. Brotulidae. Pac. Sci. 8(1):68–83.

Gosline, W. A., V. E. Brock, H. L. Moore, and Y. Yamaguchi. 1954. Fishes killed by the 1950 eruption of Mauna Loa. I. The origin and nature of the collections. Pac. Sci. 8(1):23–27.

Grey, M. 1959. Deep sea fishes from the Gulf of Mexico with the description of a new species *Squalogadus intermedius* (Macrouroididae). Field. Zool. 39(29):323–346.

Gunnerus, J. E. 1765. Efterretning om berglaxen, en rar norsk fishk, som kunde kaldes: *Coryphaenoides rupestris*. K. Norske Videnskabers Selskab Skrifter Trondhjem, 3(4):50–58, pl. 3, fig. 1, 2.

Günther, A. 1862. Catalogue of the fishes of the British Museum 4:1–534.

———. 1877. Preliminary notes on new fishes collected in Japan during the expedition of H.M.S. 'Challenger.' Ann. Mag. Nat. Hist., ser. 4, 20:433–446.

———. 1878. Preliminary notices of deep-sea fishes collected during the voyage of H.M.S. 'Challenger.' Ann. Mag. Nat. Hist., ser 5, 2:23–28.

———. 1887. Report on the deep-sea fishes collected by H.M.S. Challenger during the years 1873–76. Rep. Sci. Res. Challenger 22(Zool.)(pt. 1)[text]:1–335; (pt. 2)[plates]:pls. 1–73.

Howes, G. J. 1988. The cranial muscles and ligaments of macrouroid fishes (Teleostei: Gadiformes); functional, ecological and phylogenetic inferences. Bull. Brit. Mus. (Nat. Hist.), Zool. Ser., 54(1):1–62.

———. 1989. Phylogenetic relationships of macrouroid and gadoid fishes based on cranial myology and arthrology. Pp. 113–128 *in* Cohen, D. M. (ed.), Papers on the systematics of gadiform fishes. Nat. Hist. Mus. Los Angeles County, Sci. Ser. 32. 262 pp.

Howes, G. J., and O. A. Crimmen. 1990. A review of the Bathygadidae (Teleostei: Gadiformes). Bull. Br. Mus. Nat. His. (Zool.) 56(2):155–203.

Iwamoto, T. 1970. The R/V Pillsbury Deep-Sea Biological Expedition to the Gulf of Guinea, 1964–65. 19. Macrourid fishes of the Gulf of Guinea. Stud. Trop. Oceanogr. (4)(pt.2): 316–431.

———. 1974. *Nezumia* (*Kuronezumia*) *bubonis*, a new subgenus and species of grenadier (Macrouridae: Pisces) from Hawaii and the western North Atlantic. Proc. Calif. Acad. Sci., ser. 4, 39(22):507–516, figs. 1–3.

———. 1978. Eastern Pacific macrourids of the genus *Coelorinchus* Giorna (Pisces: Gadiformes), with description of a new species from Chile. Proc. Calif. Acad. Sci., ser. 4, 41(12):307–337, figs. 1–20.

———. 1979. Eastern Pacific macrourine grenadiers with seven branchiostegal rays (Pisces: Macrouridae). Proc. Calif. Acad. Sci. 42(5):135–179, figs. 1–18.

———. 1982. *Ventrifossa johnboborum*, a new grenadier from the western Pacific (Macrouridae: Pisces). Austr. Zool. 21 (pt. 1):55–61.

———. 1983. Family No. 93: Macrouridae. Pp. 330–341 *in* Smith, M. M. and P. C. Heemstra (eds.), Smiths' sea fishes. Macmillan South Africa, Johannesburg.

———. 1989. Phylogeny of grenadiers (suborder Macrouroidei): another interpretation. Pp. 159–173 *in* Cohen, D. M. (ed.), Papers on the systematics of gadiform fishes. Nat. Hist. Mus. Los Angeles Co., Sci. Ser. 32. 262 pp.

Iwamoto, T. and Y. I. Sazonov. 1988. A review of the southeastern Pacific *Coryphaenoides* (sensu lato) (Pisces, Gadiformes, Macrouridae). Proc. Calif. Acad. Sci. 45(3):35–82, figs. 1–9.

Jordan, D. S. 1904. See Jordan and Gilbert 1904.

Jordan, D. S. and C. H. Gilbert. 1904. Macrouridae. Pp. 602–621, *in* Jordan, D. S. and E. C. Starks. List of fishes dredged by the steamer *Albatross* off the coast of Japan in the summer of 1900, with descriptions of new species and a review of the Japanese Macrouridae. Bull. U.S. Fish Comm. 22(1902):577–630, pls. 1–8.

Kotlyar, A. N. and N. N. Parin. 1990. Otoliths and age of bottom and near-bottom fishes from the Nazca and Sala y Gómez Submarine Ridges. [In Russian with English summary.] Tr. Inst. Okeanol. Akad. Nauka SSSR 125:97–126.

Leviton, A. E. and R. H. Gibbs, Jr. 1988. Standards in herpetology and ichthyology: standard symbolic codes for institutional resource collections in herpetology and ichthyology. Supplement No. 1: additions and corrections. Copeia 1988(1):280–282.

Leviton, A. E., R. H. Gibbs, Jr., E. Heal, and C. E. Dawson. 1985. Standards in herpetology and ichthyology: part 1. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. Copeia 1985(3):802–832.

Lowe, R. T. 1843. Notices of fishes newly observed or discovered in Madeira during the years 1840, 1841 and 1842. Proc. Zool. Soc. Lond. 11:81–95.

Mammerickx, J., R. N. Anderson, H. W. Menard, and S. M. Smith. 1975. Morphology and tectonic evolution of the east-central Pacific. Geol. Soc. Amer. Bull. 86:111–118.

Markle, D. F. 1989. Aspects of character homology and phylogeny of the Gadiformes. Pp. 59–88 *in* Cohen, D. M. (ed.), Papers on the systematics of gadiform fishes. Nat. Hist. Mus. Los Angeles County, Sci. Ser. 32. 262 pp.

Marshall, N. B. 1964. Bathypelagic macrourid fishes. Copeia 1964(1):86–93.

Marshall, N. B. 1973. Family Macrouridae. Pp. 496–665, *in* Cohen, D. M. (ed.) Fishes of the western North Atlantic. Mem. Sears Found. Mar. Res. (1)(pt.6).

Marshall, N. B. and T. Iwamoto. 1973. Genus *Coelorhynchus* Giorna 1809, pp. 538–563, Genus *Hymenocephalus* Giglioli 1882, pp. 601–612, and Genus *Nezumia* Jordan 1904, pp. 624–649, *in* Cohen, D. M. (ed.) Fishes of the western North Atlantic. Mem. Sears Found. Mar. Res. (1)(pt.6).

Marshall, N. B. and A. V. Tåning. 1966. The bathypelagic macrourid fish, *Macrouroides inflaticeps* Smith and Radcliffe. Dana-Rep. 69. 6 pp., 1 pl.

Maul, G. E. 1951. Monographia dos peixes do Museu Municipal do Funchal. Familia Macrouridae e Merlucciidae. Bol. Mus. Munic. Funchal 5(12):5–55.

McCann, C. and D. G. McKnight. 1980. The marine fauna of New Zealand: macrourid fishes (Pisces: Gadida). New Zealand Oceanogr. Inst. Mem. 61:1–91.

McCulloch, A. R. 1907. The results of deep sea investigation in the Tasman Sea. II. The expedition of the "Woy Woy." 1. Fishes and crustaceans from eight hundred fathoms. Rec. Aust. Mus. Sydney 6:345–355, pls. 63–65.

———. 1926. Report on some fishes obtained by the F.I.S. "Endeavour" on the coasts of Queensland, New South Wales, Victoria, Tasmania, South and South-western Australia. Part V. Biogical results of the fishing experiments carried on by the F.I.S. "Endeavour" 1909–1914, 4(pt. 5):157–216, pls. 43–56.

Nesis, K. N. 1990. Bottom and near-bottom cephalopods of the Nazca and Sala y Gómez Submarine Ridges (Pacific Ocean). [In Russian with English summary.] Tr. Inst. Okeanol. Akad. Nauka SSSR 125:178–191.

Nolf, D. and E. Steurbaut. 1989*a*. Evidence from otoliths

for establishing relationships between gadiforms and other groups. Pp. 37–45 *in* Cohen, D. M. (ed.), Papers on the systematics of gadiform fishes. Nat. Hist. Mus. Los Angeles County, Sci. Ser. 32. 262 pp.

———. 1989*b*. Importance and restrictions of the otolith-based fossil record of gadiform and ophidiiform fishes. Pp. 47–58 *in* Cohen, D. M. (ed.), Papers on the systematics of gadiform fishes. Nat. Hist. Mus. Los Angeles County, Sci. Ser. 32. 262 pp.

Norman, J. R. 1939. Fishes. Sci. Rep. John Murray Exped. 1933–1934, 7(Zool.)(1):1–116.

Norris, R. M. 1961. Sala y Gomez—lonely landfall. Pac. Disc. 13(6)(Nov.–Dec.):20–25.

Okamura, O. 1970*a*. Fauna Japonica. Macrourina (Pisces). Academic Press, Tokyo. 216 pp., 64 pls.

———. 1970*b*. Studies on the macrouroid fishes of Japan. Morphology, ecology and phylogeny. Rep. Usa Mar. Biol. Sta. 17(10–2):1–179.

———. 1982. See Okamura et al. 1982.

———. 1984. See Okamura et al. 1984.

———. 1989. Relationships of the suborder Macrouroidei and related groups, with comments on Merlucciidae and *Steindachneria*. Pp. 129–142 *in* Cohen, D. M. (ed.), Papers on the systematics of gadiform fishes. Nat. Hist. Mus. Los Angeles County, Sci. Ser. 32. 262 pp.

Okamura, O., K. Amaoka, and F. Mitani, eds. 1982. Fishes of the Kyushu-Palau Ridge and Tosa Bay. The intensive research of unexploited fishery resources on continental slopes. Japan Fish. Resource Conserv. Assoc., Tokyo. 435 pp.

Okamura, O. and T. Kitajima, eds. 1984. Fishes of the Okinawa Trough and the adjacent waters. I. The intensive research of unexploited fishery resources on continental slopes. Japan Fish. Resource Conserv. Assoc., Tokyo. 414 pp.

Pakhorukov, N. P. 1976. Preliminary list of the bathyal bottom fishes of the Rio Grande Rise. [In Russian.] Biology and distribution of the tropical deep-sea fishes. Trans. P.P. Shirshov Inst. Oceanol. 104:318–331.

———. 1981. Deep sea bottom fishes of the Whale Ridge and adjacent area. [In Russian.] Pp. 19–31 *in* Parin, N. V. (ed.), Fishes of the open ocean. Shirshov Inst. Oceanol. Acad. Sci. USSR, Moscow. 120 pp.

Parin, N. V. 1990. Preliminary review of fish fauna of the Nazca and Sala y Gómez Submarine Ridges (southern East Pacific Ocean). [In Russian with English summary.] Tr. Inst. Okeanol. Akad. Nauka SSSR 125:6–36.

Parin, N. V., G. A. Golovan', N. P. Pakhorukov, Y. I. Sazonov, and Y. N. Shcherbachev. 1981. Fishes from the Nazca and Sala-y-Gomez underwater ridges collected in cruise of R/V "Ikthiandr." [In Russian.] Pp. 5–18 *in* Parin, N. V. (ed.), Fishes of the open ocean. Shirshov Inst. Oceanol. Acad. Sci. USSR, Moscow. 120 pp.

Parin, N. V., T. A. Gorelova, and O. D. Borodulina. 1990. Feeding and trophic relationships of fishes inhabiting the Nazca and Sala y Gómez Submarine Ridges. [In Russian with English summary.] Tr. Inst. Okeanol. Akad. Nauka SSSR 125:37–57.

Parin, N. V. and Y. I. Sazonov. 1982. Deep-sea fishes collected during a cruise of R/V "Professor Mesyatzev" along the Peruvian coasts in 1972. [In Russian.] Pp. 79–91 *in* Parin, N. V. (ed.), Insufficiently studied fishes of the open ocean. Shirshov Inst. Oceanol. Acad. Sci. USSR, Moscow. 140 pp.

Parr, A. E. 1946. The Macrouridae of the western North Atlantic and Central American seas. Bull. Bing. Oceanogr. Coll. 10(1):1–99.

Radcliffe, L. 1912. Descriptions of a new family, two new genera, and twenty-nine new species of anacanthine fishes from the Philippine Islands and contiguous waters. Proc. U.S. Natl. Mus. 43:105–140, pls. 22–31.

Regan, C. T. 1903. On the systematic position and classification of the gadoid or anacanthine fishes. Ann. Mag. Nat. Hist., ser. 7, 11(65):459–466.

———. 1908. The Percy Sladen Trust Expedition to the Indian Ocean in 1905 under the leadership of Mr. J. Stanley Gardiner. No. XIV.—Report on the marine fishes collected by Mr. J. Stanley Gardiner in the Indian Ocean. Pp. 217–255, pls. 23–32.

Richardson, J. 1939. Account of a collection of fish from Port Arthur, Van Diemen's Land. Trans. Zool. Soc. Lond. 7:95–100.

Risso, A. 1810. Ichthyologie de Nice, ou histoire naturelle des poissons du département de Alpes-Maritimes. Paris, xxxvi + 388 pp., 11 pls.

Rosenblatt, R. H., J. E. McCosker, and I. Rubinoff. 1972. Indo-West Pacific fishes from the Gulf of Chiriqui, Panama. Contrib. Sci. Nat. Hist. Mus. Los Angeles County 234:1–18.

Sawada, Y. 1983. See Amaoka et al. 1983.

Sazonov, Y. I. 1985. Two new macrourid species (Gadiformes) from northern Pacific seamounts. [In Russian with English summary.] Voprosy Ikhtiologii (5):719–727.

Sazonov, Y. I. and Y. N. Shcherbachev. 1982. A preliminary review of grenadiers related to the genus *Cetonurus* Günther (Gadiformes, Macrouridae). Descriptions of new taxa related to the genera *Cetonurus* Günther and *Kumba* Marshall. [In Russian, with English summary.] Voprosy Ikhtiologii 22 (5):707–721, figs. 1–4. [also Engl. transl., J. Ichthyol. 22(5):1–15.]

———. 1985. Preliminary list of macrourids related to the genus *Cetonurus* Günther (Gadiformes, Macrouridae). II. Genus *Cetonurus* Günther. Comparative taxonomical analysis of recognized groups. [In Russian.] Voprosy Ikhtiologii 26 (2):179–195.

Shcherbachev, Y. N. 1987. Preliminary list of thalassobathyal fishes of the tropical and subtropical waters of the Indian Ocean. [In Russian.] Voprosy Ikhtiologii (1):3–11. [English version in J. Ichthyol. 27 (2):37–46.]

Shcherbachev, Y. N., N. V. Parin, N. P. Pakhorukov, and A. C. Piotrovskiy. 1986. Mesobenthic and mesobenthopelagic fishes from submarine rises in the western Indian Ocean. [In Russian.] Tr. Inst. Okeanol., Akad. Nauk SSSR 121:195–214.

Shcherbachev, Y. N. and A. S. Piotrovskiy. 1982. On the bathymetric and geographical distribution of the species of the subfamily Macrouroidinae (Gadiformes, Macrouridae). [In Russian, with English summary.] Bull. Moscow Soc. Natural., Biol. Ser. 87(5):45–48.

Shcherbachev, Y. N., Y. I. Sazonov, and A. S. Piotrovskiy. 1979. Occurrence of *Trachonurus villosus* (Günther) and *Mesobius* (Hubbs et Iwamoto) (Macrouridae, Osteichthyes) in the Indian Ocean. [In Russian.] Voprosy Ikhtiologii 19: 20–28, figs. 1–2. [English version in J. Ichthyol. 19(1):16–23.

Shiobara, Y. 1982. A deep-sea macrouroid fish, *Squalogadus modificatus* from the inshore areas of Suruga Bay, Japan. [In Japanese, with English abstract.] Ann. Rep. Mar. Sci. Mus., Tokai Univ. (10):143–146.

Smith, H. M. and L. Radcliffe. 1912. [See Radcliffe, 1912.]

Smith, J. L. B. 1935. New and little known fishes from South Africa. Rec. Albany Mus. 4:169–235, pls. 18–23.

Springer, V. G. 1982. Pacific plate biogeography, with spe-

cial reference to shorefishes. Smithsonian Contrib. Zool. (367). 182 pp.

Trunov, I. A. 1984. Characteristics of some species of the genus *Coelorinchus* Giorna (Osteichthyes, Macrouridae) from the Southeast Atlantic. [In Russian.] Voprosy Ikhtiologii 24(3): 355–367.

Uyeno, T., K. Matsuura, and E. Fujii, eds. 1983. Fishes trawled off Suriname and French Guiana. Japan Marine Fishery Resource Research Center: Tokyo. 519 pp.

Vaillant, L. L. 1888. Expéditions scientifiques du *Travailleur* et du *Talisman* pendant les années 1880, 1881, 1882, 1883. Poissons. Masson: Paris. Pp. 1–406, pls. 1–28.

Waite, E. R. 1911. Scientific results of the New Zealand Government Trawling Expedition, 1907. Pisces—Part II. Rec. Canterbury Mus. 1(3):157–272, pls. xxii–lvii.

Wilson, R. R., Jr., K. L. Smith, and R. H. Rosenblatt. 1985. Megafauna associated with bathyal seamounts in the central North Pacific Ocean. Deep-Sea Res. 32(10):1,213–1,254.