

## Two New Grenadiers (Teleostei, Gadiformes, Macrouridae) from the Seychelles and Mascarene Ridge, Western Indian Ocean

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*Coelorinchus yurii* and *C. amirantensis* are newly described from the western Indian Ocean. They belong to the group of *Coelorinchus* having a small ventral light organ that is not visible externally, anus immediately before anal fin, long pointed snout with anterolateral margin not completely supported by bone, coarsely spined head ridges, notably heavy scales with bladelike spinules in high ridge-like rows, and underside of head completely or almost completely scaled. *Coelorinchus yurii* is similar to *C. lasti* and *C. kermadecus*, but differs in several squamation and proportional features. *Coelorinchus amirantensis* is similar to *C. trachycarus*, but differs in ground color, squamation, and a few head proportions. The two new species add to the more than 100 species of *Coelorinchus* currently recognized.

During a December 1998 cruise of the R/V *Sea Surveyor*, a three-walled monofilament trammel net was set at a depth of 1900 m between the islands of Alphonse and Bijouteire, Seychelles. After an overnight soak, the net was hauled aboard with the catch (Fig. 1), which included three grenadiers of the genus *Coelorinchus* and three damaged specimens of *Coryphaenoides*, a 229 cm TL specimen of *Pseudotriakis microdon*, a 116.5 cm TL specimen of *Centroscymnus coelolepis*, and some geryonid crabs. The two sharks were recorded by Baranes (2003) and the crabs by Galil and Manning (2001) (who mistakenly reported the depth as 1400 m). The three *Coelorinchus* specimens represented two undescribed species, which we herein describe.

The two new *Coelorinchus* species were previously captured off the Mascarene Ridge to the southeast of the Seychelles by the former Soviet Union research vessels *Fiolent* and *Zvezda Kryma* in 1976 and 1977, and the *Vityaz' II* in 1989. It had been the intent since 1988 of the first author and Yuri N. Shcherbachev (P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences) to collaborate in describing the two species, but diversions from other projects interfered with completion of this effort. Owing to recent medical problems, Shcherbachev is no longer able to work on this project. We therefore name one of these two species after Shcherbachev to recognize his contributions to the knowledge of Indian Ocean grenadiers and other deepwater fishes.

### MATERIALS AND METHODS

Type specimens are deposited in the following institutions, whose abbreviations follow that proposed by Leviton et al. (1985) and Leviton and Gibbs (1988): California Academy of Sciences (CAS); Zoological Museum, Tel-Aviv University (TAU); Zoological Museum, Moscow State

University (ZMMGU). Methods for taking counts and measurements follow procedures described by Iwamoto and Sazonov (1988). In the descriptions, the characteristics or values for the paratypes are enclosed in parentheses.

The trammel net used to capture the fishes is a type used by commercial fishermen in the Mediterranean. The three walls of the net are each 50 m long and 2 m high; the outer two nets are of 150 mm mesh, the middle net of 40 mm mesh. The net was baited with small fish in perforated plastic bags tied to the net. A small boat (7 m long) was used to cast the net, which was weighted to keep it on the ocean floor and connected by a long line to a buoy on the surface.



FIGURE 1. Partial catch from trammel net set in 1900 m between the islands Alphonse and Bijouteire, Seychelles. Upper three grenadiers are an unknown species of *Coryphaenoides*, the two *Coelorinchus* below those are the holotype and a paratype of *C. amirantensis* sp. nov., the bottom-most and largest is the holotype of *C. yurii* sp. nov. The two uppermost geryon crabs are *Chaceon cosnieri* Manning & Holthuis, 1989; the three small crabs below represent *C. goreni* Galil & Manning, 2001.

### *Coelorinchus yurii* Iwamoto, Golani, Baranes, and Goren, sp. nov.

Figures 2–3

**TYPE SPECIMENS.**— HOLOTYPE: TAU P.11602 (154 mm head length, 541+ mm total length); Seychelles between Alphonse and Bijoutier islands; by trammel net in 1900 m; 17 Dec. 1998; collector M. Goren. PARATYPES: CAS 66472 (2, , 84.7–94.3 mm HL, 275+–313 mm TL); Mascarene Ridge, off Saya de Malha Bank; 8°32'S, 59°41'E; 960–1130 m; *R/V Vityaz' II* cr. 17, st. 2820; 29-m otter trawl; 10 Jan. 1989. ZMMGU uncat. (7, 71–92.6 HL, 249+–375+ TL) and CAS 223466 (3, 72.0–76.5 HL, 245–290 TL); Mascarene Ridge, Saya de Malha Bank; 9°32.7'S, 60°02'E; 800 m; *R/V Fiolent* cr. 7, trawl 156; 26 Sept 1977. ZMMGU uncat. (84.7 HL, 250+ TL); Mascarene Ridge, Saya de Malha Bank; 9°51'S, 60°18'E; 820 m; *R/V Fiolent* cr. 7, trawl 156A; 26 Sept. 1977.

**DIAGNOSIS.**— Snout 2.1 to 2.5 times into HL, 1.4 to 1.8 times orbit diameter, acutely pointed in lateral and dorsal views, its anterolateral margin not completely supported by bone; light organ small, not externally visible; underside of snout covered with tiny scales having 1 to 4 short, conical to bladelike spinules; nasal fossa naked except for few scattered tiny scales near ventral border; body scales large, 3½ to 4½ rows between lateral line and mid-base of first dorsal fin, exposed field of largest scales on dorsum beset with small spinules aligned in 6 to 8 more-or-less parallel rows, the middle row slightly enlarged so as to give appearance of fine longitudinal striations on body; interspace between dorsal fins short, usually less than (but sometimes slightly more than) length base of first dorsal fin; head ridges armed with heavy, coarsely spinulated scales; overall coloration dark brown in large adults, light brown in smaller (<100 mm HL) specimens; fins all blackish.

**COUNTS** (see Table 1 for measurements).— 1D. II,8 (8–9); P. i,18 (i,16–18); V. 7; inner gill rakers first arch 2+6 (2 + 5–7; 7 or 8 total), second arch (outer/inner) 0+6 / 2+6 (0–1+5–6 = 5–7 total / 1–2 + 5 = 7 or 8 total); scales below origin of 1D. 5 (4.5–5.5), below mid-base of 1D. 4.5 (4.0–4.5); below origin of 2D. 5.5 (4.5–5.5); pyloric caeca (11, 1 spec.).

**DESCRIPTION.**— Head large, broad, length about 3.5 (3.3–4.5) into total length, width about equal to greatest body depth or postrostral length of head. Body deepest under origin of first dorsal fin, tapering fairly rapidly behind anus to long tail. Trunk moderately long, about three-quarters length of head. Snout acutely pointed, tipped with a broad, somewhat diamond-shaped terminal scute. Orbits large, about 1.7 (1.4–1.8) into snout length, slightly less than (0.9–1.1) interorbital width. Suborbital region broad, with a stout, bony, longitudinal ridge passing from tip of snout to posterior angle of preopercle dividing head into dorsal and ventral parts. Dorsal surface of suborbital almost vertical (to inclined laterally), the lower surface below suborbital ridge sharply inclined mesially. All ridges of head strong, consisting of stout, thick, scute-like scales armed with short, conical spinules. Mouth broad, gape little restricted at posterior angles of jaws; posterior edge of maxilla below posterior one-fourth or less of orbit; anterior end of jaws below anterior nostril; posterior nostril large, greatest diameter about 2.8 into greatest orbit diameter. Nasal fossa large, circumference with strong, adherent scales, but almost all fossa surface naked except for scattered tiny scales at anteroventral end (entirely naked in paratypes). Preopercle large, hind margin inclined at about 60° angle, forming moderately angular lobe at posteroventral corner, beyond which extending slender narrow tip of subopercle. Interopercle completely covered by preopercle. Gill membranes connected across isthmus, with a slight free fold; gill opening extending ventrally to vertical under preopercle. Chin barbel short and slender, its length about 2.4 (2.8–4.2) into orbit diameter. Gill rakers short, tubercular; gill filaments of moderate length; outer and innermost gill slits restricted by folds of skin attached to upper and lower ends of gill arch, as typical for all members of genus. Light organ short, not externally visible.

Teeth in short, fairly uniformly wide band; smaller inner teeth about three rows deep and a single outer series of slightly larger teeth. Mandibular teeth all small, conical, in rather narrow band

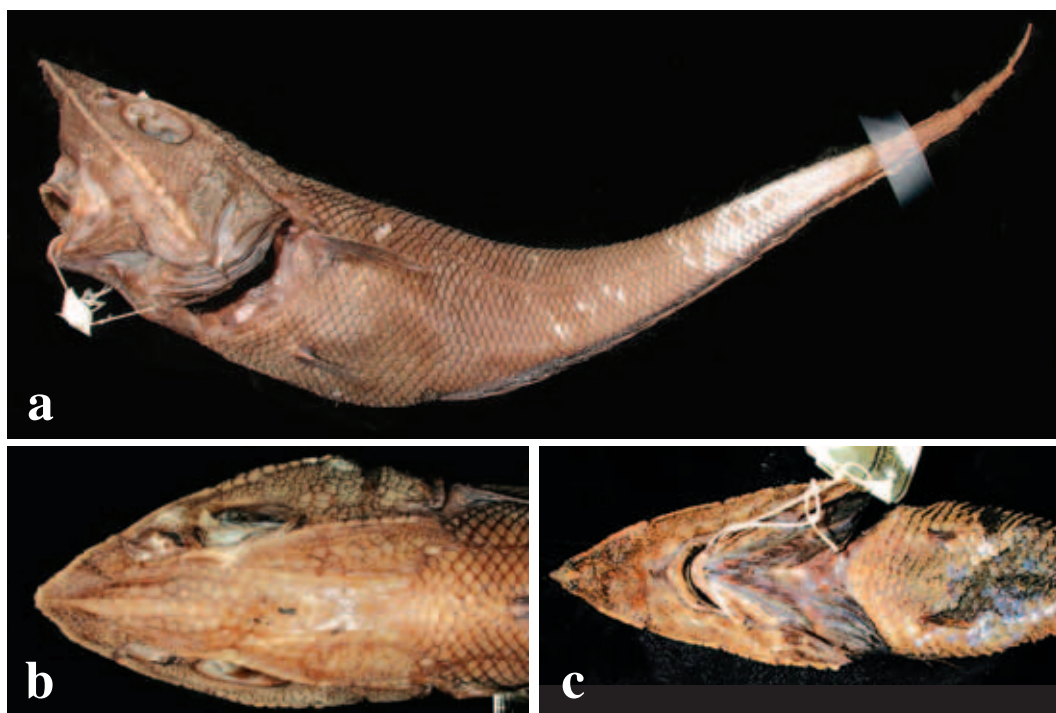


FIGURE 2. *Coelorinchus yurii* sp. nov. Holotype, TAU P.1602 (154 mm HL, 541+ mm TL), from 1900 m in the Amirantes Basin, Seychelles. (a) Lateral view; (b) dorsal view of head; (c) ventral view of head and trunk.

about three to four rows deep. Premaxillary tooth band extends laterally only about two-thirds length of rictus; mandibular tooth band extending to near end of rictus.

First dorsal fin short based, fairly high, length of second spinous ray 2.1 (1.5–2.3) into head length, its tip fine and scarcely extending beyond first segmented ray. Long-based second dorsal fin low to end of tail. Anal fin deep throughout its length. Pectoral fin relatively short, narrow based, tip falling short of vertical through (slightly beyond) anal-fin origin. Pelvic fin narrow based, its outer ray hair fine at tip and extending to anus (to third or fourth anal-fin ray).

All scales strong and adherent, those on body large; those under origin of second dorsal fin with spinules in roughly 8 to 12 (6–8) irregularly parallel rows (Fig. 3a); middle row of spinules slightly enlarged, giving appearance of horizontal striations on body surfaces, especially on flanks and tail, less so on anterior parts of trunk and nape, where spinules rows divergent. Lateral rows of spinules usually short, some with only 2 or 3 spinules per row, and often incomplete, usually falling short of posterior edge of scale. Anterior spinules much smaller and more slender than those along posterior margin of scale. Spinules narrowly triangular, somewhat trihedral in cross section, with prominent transverse buttresses on each side of base; spinules reclined almost 30 degrees from horizontal and overlapping, with lateral buttresses of two or more spinules in adjacent rows often joined, sometimes forming concentric series of low ridges across exposed field of scale (buttresses little developed and not joined in paratypes, which are much smaller than holotype). Scales more posteriorly on tail with spinules more slender; buttresses less extensive with fewer joined to those of adjacent spinules. Head scales strong, greatly variable in size, most of those in occipital region, on parts of preopercle, and alongside supranarial ridge largest, covered with widely divergent rows of small, short spinules; scales on interorbital space between occipital ridges with short spinules in slightly divergent rows. Areas immediately above and behind leading edge of snout with small scales beset with short, erect, somewhat conical spinules; other areas of dorsal and lateral surfaces of head intermixed with small and large scales. Underside of head and mandibular rami almost fully covered with small, non-imbricate scales (Fig. 3b), except for a median swath of naked skin on lower surface of snout (scales confined to lateral margins of snout in some paratypes); these scales armed with one to four erect spike-like or blade-like spinules; naked swath covered with slender, pointed, black papillae, most ranging 0.6 to 1.6 mm long (smaller in paratypes). Head ridges all strongly and stoutly armed with coarse scute-like scales having short, conical spinules; scales on supranarial ridge notably broad, with spinule rows in a radial pattern. Supraoccipital and postoccip-

TABLE 1. Comparison of selected measurements and counts of *Coelorinchus yurii* and *C. amirantensis*. Values in parentheses represent those of the holotypes; proportional measurements are in percent of HL.

Character	<i>C. amirantensis</i>	<i>C. yurii</i>
Total length (mm)	149–525+	245–375+ (541+)
Head length (mm)	41–157 (157)	71–154 (154)
Snout length (%HL)	46–51 (47)	41–44 (42)
Internasal width (%HL)	17–20 (18)	18–21 (19)
Interorbital width (%HL)	20–24 (23)	20–24 (26)
Orbit diameter (%HL)	21–25 (23)	24–29 (24)
Suborbital width (%HL)	12–16 (15)	13–14 (14)
Postorbital length (%HL)	29–33 (33)	30–34 (37)
Length orbit-preop. (%HL)	29–34 (34)	32–35 (40)
Length upper jaw (%HL)	20–23 (23)	22–26 (31)
Barbel length (%HL)	4–7 (4)	6–9 (10)
Length 1st gill slit (%HL)	9–13 (13)	9–12 (14)
Body depth	34–47 (47)	45–54 (62)
Height 1D	27–39 (29)	43–67 (47)
Length base 1D	9–13 (15)	17–21 (16)
1D-2D interspace	9–15 (14)	18–30 (16)
Length P	27–39 (29)	37–42 (41)
Length V	27–32 (31)	34–41 (41)
Lateral-line scales over pre-1D length	35–40	27–33 (40)



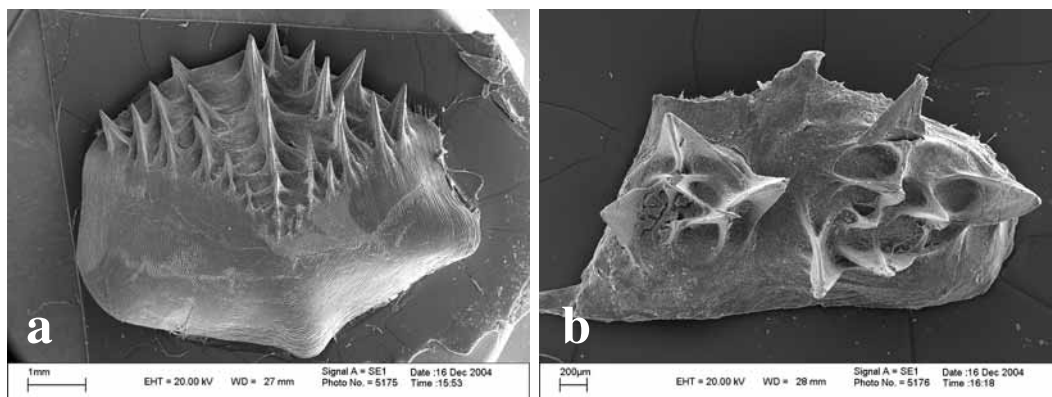


FIGURE 3. *Coelorinchus yurii* sp. nov. (a) Scale from dorsum between second dorsal-fin origin and lateral line; (b) scale from underside of head.

ital scutes stout and coarsely spinulated. Scales along outer margin of gill cover end abruptly, with none actually covered by gill membranes. Branchiostegal and gular membranes naked.

Color uniformly dark brown (medium to light brown in paratypes, which are much smaller than holotype); color of abdomen like that of remainder of trunk and not darker (bluish in paratypes lacking scales over abdomen). Gular membrane somewhat darker (whitish in some paratypes), branchiostegal membranes blackish (dusky); lips black (pale). Fins all black (dusky in some). Eye ring and septum between nostrils black (blackish). Mouth pale to dusky; lining of gill cavity black.

**DISTRIBUTION.**— Known only from the Seychelles and Mascarene Ridge in the western Indian Ocean, at depths of 800 to 1900 m.

**ETYMOLOGY.**— The species is named in honor of Yuri N. Shcherbachev of the Institute of Oceanology, Russian Academy of Sciences, who initially recognized this species as new and had planned to describe it with the first author.

**COMPARISONS.**— *Coelorinchus yurii* falls in a group of *Coelorinchus* species characterized by the combination of small light organ, usually not externally apparent; anus immediately before anal-fin origin; snout long, orbit diameter usually 1.4 or more times into snout length; anterolateral margin of snout not completely supported by the nasal bone; underside of head completely or almost completely scaly; and no prominent body markings. The naked nasal fossa (except for a few scales ventrally in large holotype), large body scales, and characteristic spinulation on scales of body and head serve to distinguish the new species from all others of the genus. *Coelorinchus yurii* is similar in most features to *C. kermadecus* Jordan and Gilbert, 1904, a species of southeastern Australia and New Zealand, but the nasal fossa in *C. yurii* is not as extensively scaled as in *C. kermadecus*, the dorsal fin is slightly higher (43–66% HL in adults, cf. less than 45%), and spinule rows on body scales are more numerous (usually 8–12 cf. 3–7) and not as widely divergent.

*Coelorinchus lasti* Iwamoto and Williams, 1999 shares many important characters with *C. yurii*, notably a dark-brown coloration in large adults, closely similar body proportions and counts, naked or sparsely scaled nasal fossa, and similar scale morphology and distribution of scales on head and body surfaces. However, the spinules on body scales are in 3–5 divergent rows in *C. lasti* and spinules on scales on the underside of the head are bladelikey and in high ridgelike rows. The snout in adults of *C. yurii* is longer (41–48% of head length, cf. 37–38%; preoral length 37–42%, cf. 30–32%).

The species is closely similar to the second new species *Coelorinchus*, here described, but differs in a number of proportional measurements, which are compared in Table 1. The scale spinules

in *C. amirantensis* are much broader overall than those in *C. yurii*, with higher buttresses that form a greater interconnection between adjacent scales (*cf.* Figs. 3a and 5a). This is most noticeable in the dorsal and ventral extremities of the exposed fields in scales on the trunk and tail. Overall, the squamation of *C. yurii* is less harsh than in *C. amirantensis*.

**REMARKS.**— Many proportional measurements of the large holotype differed considerably from those of the much-smaller paratypes. Although somewhat troubled by this, we attribute these differences to size-related changes and assume that a graded size series will eventually show ontogenetic changes explaining the differences.

***Coelorinchus amirantensis* Iwamoto, Golani, Baranes, and Goren, sp. nov.**

Figures 4–5.

**TYPE SPECIMENS.**— HOLOTYPE: TAU P.11600 (157 mm HL, tail incomplete); Seychelles between Alphonse and Bijoutier islands; by trammel net in 1900 m; 17 Dec. 1998; collector M. Goren. PARATYPES: TAU P.11603 (139.6 HL, 420+ TL); same data as for holotype. CAS 223467 (3, 96–126.5 HL, 285+–374 TL) and ZMMGU uncat. (3, 109–124 HL, 347–417 TL); Mascarene Ridge, 8°26.4'S, 59°29'E; 1300–1260 m; *R/V Fiolent* cr. 7, trawl 52; 2 Sept. 1977. ZMMGU uncat. (2, 41–79.7 HL, 149–265 TL); Mascarene Ridge, 8°07'S, 59°18.6'E; 1300–1240 m; *R/V Fiolent* cr. 7, trawl 53; 3 Sept. 1977. ZMMGU uncat. (84–145 HL, 262+–525+ TL); Mascarene Ridge, 8°29'S, 59°35'E; 950–1200 m; *R/V Zvezda Kryma*, cr. 6, trawl 4; 19 June 1976. ZMMGU uncat. (81 HL, 258 TL); Mascarene Ridge, 8°08'S, 59°37.6'E; 1247–1269 m; *R/V Zvezda Kryma*, cr. 6, trawl 210.

**DIAGNOSIS.**— Snout long, 2.0 to 2.2 times into HL, 2.5 times orbit diameter, acutely pointed in lateral and dorsal views, its anterolateral margin not completely supported by bone; light organ small, not externally visible; underside of snout covered with tiny scales having 1 to 4 short, conical to bladelike spinules; nasal fossa naked or with a scattering of tiny scales along ventral margin; body scales large, 4½ rows between lateral line and mid-base of first dorsal fin, exposed field of largest scales on dorsum beset with small spinules aligned in 6 to 10 more-or-less parallel rows, the middle row enlarged so as to give appearance of longitudinal striations on body; interspace between dorsal fins short, about equal to length base of first dorsal fin; head ridges armed with heavy, coarsely spinulated scales; overall coloration medium brown, fins all black or dark.

**COUNTS** (see Table 1 for measurements).— 1D. II, 7(7–8); P. i17 (i16–i18); V. 7; total inner gill rakers first arch 8 (7–8), second arch (outer/inner) 6 / 8 (6–7 / 7–8); scales below origin of first dorsal fin 5.5 (4.5–6.5), below mid-base of first dorsal 4.5(3.5–4.5); below origin of second dorsal fin 4.5 (4.5–5.5); over distance equal to predorsal length (35–40).

**DESCRIPTION.**— Head large, broad, width across preopercles more than greatest body depth; (length 3.0–3.6 in TL). Body relatively shallow, tapering smoothly to end of tail. Snout long, (2.0–2.2 in HL), sharply pointed, depressed, tipped with a broad flat shield-shaped median scute. Orbit oval to oblate (about 1.8–2.3 into snout length, usually 1.0–1.1 into interorbital width). Subopercular region broad, sharp longitudinal ridge separating upper and lower surfaces; ridge continuous from tip of snout to posterior angle of preopercle, ending in long, thick, spiny scute having one or two sharp spinules projecting posteriorly. Head ridges strong, with notably stout modified scales armed with short, coarse, sharp spinules. Mouth broad, its gape restricted by lip folds at posterior corner; maxilla extending to below posterior one-third of orbit. Nasal fossa large, naked area extending to modified scales of suborbital ridge, but a scattering of small scales along ventral margin of fossa (entirely or almost entirely naked in smaller paratypes). Preopercle large, its vertical margin inclined to form lobe; corner margins of preopercle somewhat crenulate. Subopercle produced posteriorly into slender tag protruding beyond preopercle. Gill membranes broadly connected across, and attached mesially to, isthmus, without a free fold. Gill opening ventrally closer to

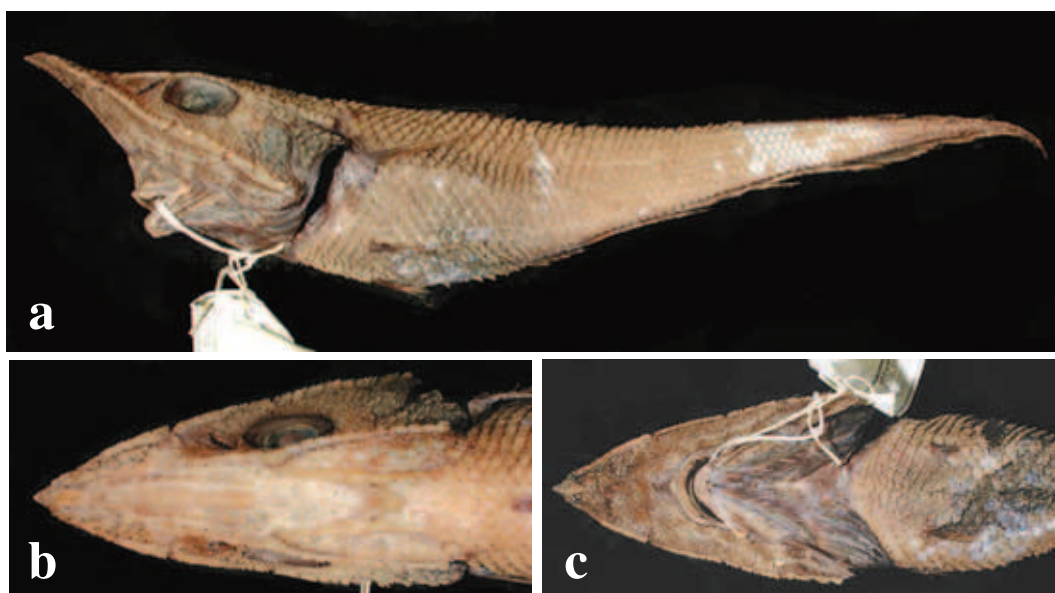


FIGURE 4. *Coelorinchus amirantensis* sp. nov. Holotype, TAU P.1600 (157 mm HL, tail incomplete), from 1900 m in the Amirantes Basin, Seychelles. (a) Lateral view; (b) dorsal view of head; (c) ventral view of head and trunk.

vertical through posterior end of preopercle than to orbit. Chin barbel short, its length much shorter than posterior nostril, about 5 times into greatest orbit diameter. Gill rakers short, tubercular or plate-like, none on outer side of first arch (as characteristic for members of genus). Free neuromasts on head and nape prominent (less so in smallest paratype), black; short black, hairlike papillae on underside of snout. Light organ short, not externally manifested.

Upper jaw teeth all small, in broad short cardiform band, tooth band spanning about half rictus length. Lower jaw teeth similarly all small, but in long narrow tapered band that extends to posterior end of rictus.

First dorsal fin relatively low, its greatest height about equal to postorbital length of head, much shorter than snout length; base short, about equal to interspace between first and second dorsal fins. Second dorsal fin low over most of length, higher posteriorly; anal fin well developed and much deeper than second dorsal fin.

All scales strongly adherent and coarsely spinulated. Head ridges strong, formed of stout, sharply spinulated, heavily modified scales. Body scales large, those on dorsum in area between dorsal fins and below origin of second dorsal fin (Fig. 5a) covered with high, blade-like, trihedral spinules with broad buttresses that interconnect with buttresses on adjacent spinules. Individual spinules broadly triangular or shield-shaped, each with dorsal keel closely overlapped by spinule immediately anterior in position along each row. Rows more or less parallel along longitudinal axis, but rows often obscured by short spinule rows and high buttresses; about 8–10 (6–8 in smaller paratypes) irregular rows in largest scales, with middle row largest and highest, producing distinctive striated appearance to body surfaces. Broad posteriormost spinules on scales usually extending well beyond posterior margin. Head scales highly variable in size and spinulation. Supraoccipital and postoccipital scutes stout and coarsely spinulated. Scales on interorbital space small, sparsely armed with broadly bladelike, erect, non-imbricate spinules. Those over dorsal surfaces of snout similar but with more numerous spinules aligned in slightly divergent rows. Ventral surfaces of snout almost completely covered with small non-imbricate scales, each armed with few short, erect,

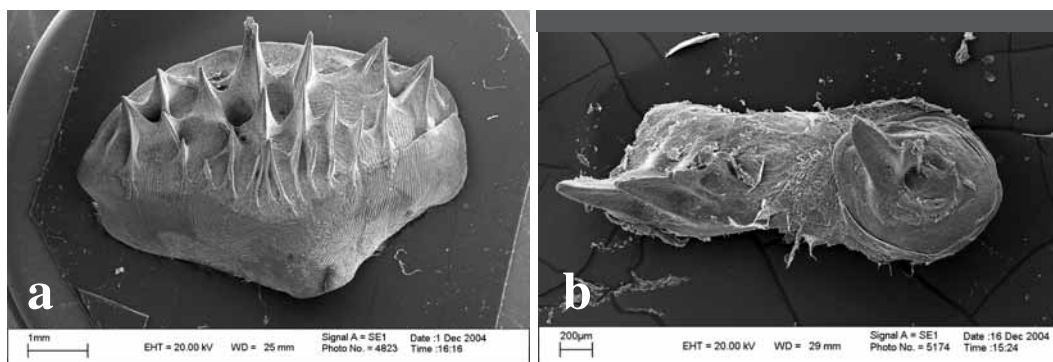


FIGURE 5. *Coelorinchus amirantensis* sp. nov. Scale from (a) dorsum between second dorsal-fin origin and lateral line, and (b) from underside of head.

spikelike to bladelike, trihedral spinules (Fig. 5b); small triangular area immediately before mouth naked (naked area larger in smaller paratypes). Scales along gill cavity ending abruptly, none covered by gill membrane.

Color overall light to medium brown, darker and somewhat swarthy over abdomen and tinged with blue; gill membranes, lips, posterior half of operculum, eye ring, external jaw membranes, and fins black (blackish). Underside of head, jaws, mouth, and gill cavities dark (medium brown in smaller paratypes). Base of pectoral fins, especially mesially, dark, almost black. Outer rim of posterior nostril black edged.

**DISTRIBUTION.**— Known only from the Seychelles and Mascarene Plateau in the western Indian Ocean, at depths of 950 to 1900 m.

**ETYMOLOGY.**— The species name is derived from the Amirantes Basin, the type locality of the species.

**COMPARISONS.**— Specimens of this new species are very reminiscent of *C. trachycarus* Iwamoto, McMillan, and Shcherbachev, 1999 from the Tasman Sea and southern Australia, especially in the harsh, coarse, scale spinules on the body and on head ridges, in the dark overall color of membranes and fins, and in most proportions. The body color is paler, however, and lacks the distinctive purplish tinge in the integument of that species. The snout is longer as a proportion of the orbit, and the postorbital and interorbital proportions differ. Scale spinules are also much broader overall and in fewer rows. Naked areas along the suborbital and the lower preopercular margins are less than in *C. trachycarus*. Proportional differences include orbit into postorbital 1.2–1.5 in *C. amirantensis* cf. 1.0–1.2 in *C. trachycarus*, orbit into snout 1.8–2.1 cf. 1.4–1.9.

The species is very similar to another apparently undescribed species of *Coelorinchus* with which it apparently co-occurs on the Mascarene Ridge. *Coelorinchus amirantensis* differs from that species in having coarser, more spiny scales, and a slightly broader snout with lateral contours more convex. Differences between this third undescribed species, which Yuri Shcherbachev recognized as new, have not been adequately investigated. Its description awaits further examination of specimens and documentation of diagnostic characters.

## DISCUSSION

The discovery of two (and possibly three) undescribed species of *Coelorinchus* from the Seychelles and the Mascarene Ridge to the southwest is indicative of the scant collecting efforts conducted on oceanic elevations in the tropical western Indian Ocean. The few deepwater trawl col-



lections available from such areas are almost exclusively those made by the former Soviet Union in the 1970s and 1980s. Shcherbachev (1987) provided a preliminary list of the thalassobathyal fishes collected in the subtropical and tropical Indian Ocean. He and his Russian colleagues, including (the late) Y.I. Sazonov, N.V. Parin, A.S. Piotrovsky, and N.P. Pakhorukov, published numerous articles describing the grenadiers and other deepwater fishes from those collections (for a partial list, see the literature citations in Shcherbachev and Iwamoto 1995).

In 1988 Iwamoto, Sazonov, and Shcherbachev began a collaborative effort to report on all of the grenadiers from the Indian Ocean. Several papers resulted from that collaboration and the genera *Coryphaenoides* (Iwamoto and Shcherbachev 1991, Shcherbachev and Iwamoto 1995), *Kumba* (Iwamoto and Sazonov 1994), and *Kuronezumia* (Shcherbachev et al. 1992) were treated in depth. One article describing a new species of *Coelorinchus* from Walters Shoals (Iwamoto et al. 2004) was the last of such collaborations. The most speciose genus, *Coelorinchus*, the bathygadines, the genus *Nezumia*, and several minor genera were left untreated. It is apparent that many Indian Ocean grenadiers, especially in the genus *Coelorinchus*, remain undescribed or unrecorded.

The capture of the three large specimens of *Coelorinchus* in the Seychelles using a trammel net fished at depths much greater than those fished by Soviet trawlers off the Mascarene Ridge suggests an effective means by which large grenadiers can be collected at great depths. Use of such nets is much less expensive in terms of vessel and equipment costs and is probably more effective than bottom trawls, longlines, and traps for grenadiers in rough-bottom areas. The size of vessels used for such work can be relatively small, with limitations dictated primarily by proximity to ports and prevailing oceanographic conditions.

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#### LITERATURE CITED

- BARANES, ALBERT. 2003. Sharks from the Amirantes Islands, Seychelles, with a description of two new species of squaloids from the deep sea. *Israel Journal of Zoology* 49:33–65.
- GALL, BELLA S., AND RAYMOND B. MANNING. 2001. A new geryonid crab from the Amirante Basin, western Indian Ocean (Crustacea: Decapoda: Brachyura). *Proceedings of the Biological Society of Washington* 114 (1):104–108.
- IWAMOTO, TOMIO, AND YURI I. SAZONOV. 1988. A review of the southeastern Pacific *Coryphaenoides* (sensu lato) (Pisces, Gadiformes, Macrouridae). *Proceedings of the California Academy of Sciences*, ser. 4, 45(3):35–82.
- IWAMOTO, TOMIO, AND YURI I. SAZONOV. 1994. Revision of the genus *Kumba* (Pisces, Gadiformes, Macrouridae), with the description of three new species. *Proceedings of the California Academy of Sciences*, ser. 4, 48(11):221–237.
- IWAMOTO, TOMIO, AND YURI I. SCHERBACHEV. 1991. Macrourid fishes of the subgenus *Chalinura*, genus *Coryphaenoides*, from the Indian Ocean. *Proceedings of the California Academy of Sciences*, ser. 4, 47(7):207–233.
- IWAMOTO, TOMIO, YURI N. SCHERBACHEV, AND BRYAN MARQUARDT. 2004. Grenadiers (Gadiformes, Teleostei) of Walters Shoals, southwestern Indian Ocean, with description of a new “West-Wind Drift” species. *Proceedings of the California Academy of Sciences* 55(10):190–307.
- LEVITON, ALAN E., ROBERT H. GIBBS, JR., ELIZABETH HEAL, AND CHARLES E. DAWSON. 1985. Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetol-

- ogy and ichthyology. *Copeia* 1985(3):823–832.
- LEVITON, ALAN E., AND ROBERT H. GIBBS, JR. 1988. Standards in herpetology and ichthyology. Standard symbolic codes for institution resource collections in herpetology and ichthyology. Supplement no. 1: additions and corrections. *Copeia* 1988(1):280–282.
- SHCHERBACHEV, YURI 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 *Journal of Ichthyology* 27(2): 37–46]
- SHCHERBACHEV, YURI N., AND TOMIO IWAMOTO. 1995. Indian Ocean grenadiers of the subgenus *Coryphaenoides*, genus *Coryphaenoides* (Macrouridae, Gadiformes, Pisces). *Proceedings of the California Academy of Sciences*, ser. 4, 48(14):285–314.
- SHCHERBACHEV, YURI N., YURI I. SAZONOV, AND TOMIO IWAMOTO. 1992. Synopsis of the grenadier genus *Kuronezumia* (Pisces: Gadiformes: Macrouridae), with description of a new species. *Proceedings of the California Academy of Sciences*, ser. 4, 48(3):97–108.