



Description of a new *Coelorinchus* (Macrouridae, Gadiformes, Teleostei) from Taiwan, with notable new records of grenadiers from the South China Sea

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Abstract

Among recent collections of grenadiers procured from fishery ports in northeastern Taiwan were ten specimens of an undescribed species of *Coelorinchus*, which we here describe as *C. fuscigulus* **sp. nov.** One of the specimens was recorded previously as *C. cylindricus* Iwamoto and Merrett, 1997, but that species differs from the new species most notably in having a complete bony support of the anterolateral snout margin, compared with margin incompletely supported. Other differences include proportional measurements (preoral length, orbit diameter, distance orbit to preopercle, postorbital length of head, length of upper jaw, and body depth), scale row counts, and body markings. Three other species (*Coryphaenoides asper*, *Coelorinchus spinifer*, *Kumba gymnorhynchus*) recently collected by deepwater trawls in the South China Sea are the second records for the species; specimen data are provided for these species.

Key words: Taxonomy, *Coelorinchus fuscigulus* **sp. nov.**, *Coryphaenoides asper*, *Coelorinchus spinifer*, *Kumba gymnorhynchus*, Macrouridae, Taiwan

Introduction

Fish landings by commercial fishing vessels have long been valuable sources of scientific specimens for ichthyologists throughout the world. Fishing ports in Taiwan where deepwater trawlers offload their catches have been targeted recently for intensive sampling by staff and students of the Biodiversity Research Center of the Academia Sinica, Taiwan. Many of the trawlers towards the end of their fishing operations will fill out their holds by retaining all the bycatch after the more-valuable crustaceans and fishes have been picked out. The bycatch, which comprises a wide variety of fish and invertebrates, is ground into a meal and used in the aquaculture and poultry industries in Taiwan. The fishing ports of Tashi and Nanfangao in northeastern Taiwan have been particularly fruitful in providing many rare and unusual specimens of deepwater fishes, including many members of the grenadier families Macrouridae and Bathygadidae (see Chiou *et al.*, 2004a, b; Shao *et al.*, 2008).

The macrourid genus *Coelorinchus* was the most abundant in terms of species collected at these fishing ports. Shao *et al.* (2008: table 2) reported 21 species known from Taiwan. One of these, *C. cylindricus* Iwamoto and Merrett, 1997, was recorded from a single specimen taken from northeastern Taiwan in 400–600 m. The second author subsequently collected four other specimens for the ASIZ collection (two were recently transferred to CAS) and five others were found in earlier collections mis-identified as *C. cingulatus* or *C. brevirostris*. A close examination of those specimens and comparisons with the original description of the

single holotype of *C. cylindricus* taken off New Caledonia revealed significant differences, such that it became obvious that the Taiwan specimens represented an undescribed species, which we herein describe as new. Other grenadier specimens of note were collected off Taiwan on deepwater trawl surveys (to 3,000 m) during a deep-sea biodiversity research program supported by the Taiwan National Science Council (see Shao *et al.*, 2008).

Materials and methods

Specimens of the new species are deposited in the collections of the Biodiversity Research Center of the Academia Sinica of Taiwan (ASIZ) and the California Academy of Sciences (CAS). Comparative materials were examined in BSKU, HUMZ, NSMT, and USNM. Institutional abbreviations follow Fricke and Eschmeyer (2009).

Methods for taking measurements and counts follow Iwamoto (1970) and Iwamoto and Sazonov (1988). Terms used to describe otolith shape follow the standards and terminology of Smale *et al.* (1995). The character of anterolateral snout margin fully or incompletely supported by bone can be determined quite easily by pushing lightly along the edge of the snout with a fingernail. If the margin yields at any point, then the lateral and medial nasal processes are not joined along the edge; a solid feeling along the entire margin indicates the two processes are fully joined. This character can also be checked by a radiograph taken in dorsal view or by making a small incision on the underside and lifting a flap of skin to reveal the bony processes.

Systematics

Coelorinchus fuscigulus sp. nov.

Figs 1A–E, 2A–B; Table 1

Coelorinchus cylindricus (non Iwamoto and Merrett, 1997): Shao *et al.* 2008: table 2 (listed, one spec.; northeastern Taiwan; 400–600 m).

Holotype. ASIZP 70169 (female, 74.8 mm HL, 322 mm TL); 24.94°N, 121.9°E, Tashi, Yilan, northeastern Taiwan; coll. H-C Ho; 23 May 2007.

Paratypes. Northeastern Taiwan: ASIZP 63249 (56.1 HL, 233 TL), Tashi, Yilan, coll. H-C Ho, 21 Mar 2004. ASIZP 66922 (66.2 HL, 286 TL), R/V Ocean Researcher I, st. CP248, 24.8656°N, 122.0411°E, 536 m, 28 Aug 2004. ASIZP 66973 (72.7 HL, 293 TL), Nanfangao fish market, coll. H-C Ho, 26 Jan 2007. ASIZP 70168 (77.1 HL, 301+ TL) and CAS 228337 (ex. ASIZP70168) (2, 66.9–74.1 HL, 302+–285+ TL), Tashi, Yilan, coll. H-C Ho, 29 Jun 2007. CAS 228338 (ex CAS 224583, in part) (66.9 HL, 266 TL), Nanfangao fish market, coll. H-C Ho (field no. NFOFM 30-VIII-2005). **East China Sea:** ASIZP 63193 (52.2 HL, 228 TL) and CAS 224492 (ex. ASIZP63193) (45.4 HL, 190 TL), 25°75'N, 123°48'E, Diaoyutai Archipelago, Yilan, Taiwan, coll. H-C. Ho, 24 Apr 2004.

Diagnosis. A species of *Coelorinchus* with two dermal windows of light organ, one immediately before anus, the other in a shallow fossa on chest just behind isthmus, the two windows not connected by an externally visible black mesial line; snout moderately elongated, 1.4–1.7 times orbit diameter, tipped with a sharp terminal scute, anterolateral margins incompletely supported by bone; underside of head fully naked except for scales along anterolateral snout margin and occasional isolated cluster below junction of preopercle and infraorbital ridges (above angle of lower jaw); rays of second dorsal fin high, about equal to opposite members of anal fin; spinules on body scales small, in 10–14 parallel rows; about 8–11 saddle bands on body; branchiostegal membranes prominently black or blackish, chest and abdomen blue; gums and upper oral valve dark.

Counts and Measurements. See Table 1.

TABLE 1. Comparative data for five species of *Coelorinchus*. Figures in parentheses are outside the range of most specimens. Figures in square brackets in the *fuscigulus* column are for the holotype.

Species	<i>fuscigulus</i>	<i>brevirostris</i>	<i>cingulatus</i>	<i>hubbsi</i>	<i>matsubarai</i>
No. of specimens	10	8	8	13	8
Total Length (mm)	190–[322]	170+–215+	122–233+	103–275	208+–241
Head Length (mm)	45.4–[74.8]	45.9–53.8	35.1–56.4	25.0–67.3	51–60
Measurement (in % HL)					
Snout Length	[36]–41	40–44	45–56	41–48	40–49
Preoral Length	[30]–34	33–39	34–44	37–44	32–45
Internasal Width	[17]–20	19–20	17–21	19–22	17–20
Interorbital Width	20–22[21]	19–22	19–22	21–24	20–23
Orbit Diameter	24–[25]	25–28	22–26	25–29	25–28
Suborbital Height	12–[14]	13–14	13–14	12–14	12–14
Postorbital Length	36–[39]	32–34	27–38	28–32	28–32
Orbit to Preopercle	35–[38]	31–34	29–36	28–32	27–32
Upper Jaw	26–[30]	21–24	21–27	21–26	21–27
Length Barbel	[9]–11	4–7	5–10	8–12	9–12
Length 1st Gill Slit	9–16[14]	13–13	10–14	8–13	10–13
Preanal Length	152–[170]	101–171	141–162	140–164	153–177
Outer V to A origin	51–[70]	36–53	37–53	42–60	52–67
Isthmus–A.	82–[104]	84–91	60–80	73–87	79–97
Body depth (great)	50–58[57]	39–48	36–45	37–55	44–50
1D–2D interspace	10–[15]	7–13	8–13	7–16	10–18
Height 1D	52–64[57]	80–127	46–86	53–70	48–60
Length P	40–[45]	39–46	33–43	38+42	39–46
Length V	39–45[46]	37–45	32–46	37–42	35–42
1D base length	18–[23]	15–18	16–24	18–23	19–25
Counts					
1D rays (segmented)	8–[9]	(7)8	8–9	9(8)	9–10
P rays (excl. <i>i</i>)	16–[18]	15–19	15–20	(13)17–19	16–18
GR-I (mesial)	1-2+5-7[2+7]	1-3+5-7	1-2+5-6	1-2+6-7	1-2+6-8
GR-II (lateral)	0+5-6[0+6]	0+5	0+5	0+5-6	0+6-7
GR-II (mesial)	1-2+6-7[2+6]	1-2+5-6	1-2+5-7	1-2+6-8	1-2+6-8
Scales below 1D origin	[7.5]–8.5	5.0–6.5	5–7	5.5–7.0	5.5–7.5
Scales below 2D origin	6.5–[7.5]	4.5–5.5	4–6.5	4.5–6.5	5.5–6.5
Scales below midbase 1D	5.5–[6.5]	4.5–4.5	4.5–6.5	4.0–5.5	4.5–5.5
Scales on lateral line over distance equal to pre1D	[28]–34(38)	27–33	27–28	29–37	33–36

Description of holotype. (data for paratypes in parentheses). —Body and head long, slender, relatively shallow; head about 4.3 (3.9–4.5) in TL, body width about 1.26 (1.2–1.4) into greatest body depth; trunk long, length isthmus to anal fin 104% (82–104%) of HL. Snout sharply pointed, terminal scute horizontally

flattened with tiny spines more or less longitudinally arrayed; the scute flanked at base and adjoined at each side by much smaller scute-like scale. Suborbital ridge sharply separates dorsal and ventral parts of head; ridge composed of a row of modified, thickened scales, dorsal to which a second row of somewhat smaller but thickened scales run from below nasal fossa to posterior end of ridge. Scales above ridge rows more normal shaped, with finer, sharper spinules. Nasal fossa naked except ventral and anteroventral margins, which have small scales (paratypes vary from almost no scales on fossa to condition in holotype). Bridge between nasal fossa and orbit narrow but fully scaled. Underside of head almost entirely naked except for margin of scales along anterolateral edges of snout and cluster of small scales seemingly encroaching from junction of infraorbital and preopercular portions of suborbital ridge onto naked surface above angle of lower jaw (few or no scales above angle of lower jaw in paratypes). Subopercle extended ventrally into a short tab protruding beyond preopercle margin.

Mouth subinferior, upper jaw less than one-third of head length, upper jaw extends posteriorly to below hind quarter of pupil; mouth opening slightly restricted at jaw angles. A short, finely tapered barbel behind symphysis of lower jaw, its length less than half of orbit diameter. Sensory papillae of cephalic-sensory system on dorsal surface of snout well developed; pores on naked underside of head prominent, owing to pale color of pores set in darker skin. Fossa of anterior dermal window shallow and covered with scales; dermal window not black, as in many other species of genus; posterior light organ adjoining vent region ill-defined and poorly developed. Pyloric caeca moderately long, 20 (19 and 24 in two paratypes); ovaries in holotype large, eggs free and probably in or approaching terminal stage.

Premaxillary teeth small, conical, pointed, in broad short bands that occupy less than half length of rictus. Dentary teeth similarly small, in moderate bands that extend posterolaterally beyond rictus.

Branchiostegal membranes broadly attached to isthmus; gill openings extend anteroventrally to a vertical approximately one eye lens behind orbit. Gill rakers tubercular, none on outer side of first gill arch; outer gill slit greatly restricted, its vertical opening greater than barbel length (slightly longer in one paratype).

Body scales densely covered with diminutive, needlelike spinules greatly reclined and arrayed in 10–14 subparallel to slightly divergent rows on larger scales of dorsum (Fig. 1C). Scales of parietal, postorbital and lateral nasal ridges small and little modified; supraoccipital scale scarcely developed; median nasal ridge composed of 10 modified platelike scales with short erect spinules. Scales of interorbital region covered with multiple slightly divergent rows of short, needlelike, moderately reclined, closely spaced spinules.

Paired fins relatively short and small; first dorsal fin with slightly prolonged spinous ray; interspace between first and second dorsal fins short, much less than length of first dorsal fin base; fin rays of second dorsal fin high and almost equal in length to opposite rays of anal fin, but usually somewhat more slender. Origin of anal fin far posterior to vertical through origin of second dorsal fin.

Otolith (Figs. 1D–E, based on right sagitta otolith taken from holotype). Otolith large (13 mm in diameter), oval in outline with anterior part slightly narrow. Distal surface concave to irregular, proximal surface slightly convex. Dorsal area narrower than ventral area, dorsal depression a narrow band, ventral depression absent. Dorsal, ventral and posterior margins crenate; anterior margin rounded. Sulcus groove moderate, ostium (anterior sulcus) longer than cauda (posterior sulcus); opening ostio-caudal. Colliculum not well-developed. Crista superior and inferior well-developed. Rostrum and antirostrum absent, excisura a small notch, pseudo-excisura absent.

Coloration (in preserved holotype). Overall color of head and dorsum medium brown or grayish-brown; ventral regions generally paler, almost white on tail. Prominent saddlelike bands along length of body, the anteriormost on nape and below anterior half of first dorsal fin, the second below anterior part of second dorsal fin, followed by a prominent narrow (1 or 2 scales wide) pale interspace, then a broad third saddle, behind which saddles less distinct and not extending below lateral line. Two pale interspaces between anterior three saddles directed down and forward; second saddle appears to slant diagonally forward to merge with dark area on abdomen. A pale horizontal streak two or three scales deep and roughly six or seven (four or five) scales wide positioned two scale rows below lateral line and a short distance behind dorsal margin of gill cover. Abdominal and chest regions underlain with blue integument, with faint silvery reflections showing

through pale brownish squamation. Naked underside of snout and suborbital/preopercle regions uniformly light brownish, but lips and jaws completely pale. Thin ventral edge of mandible black, but gular region pale, behind which branchiostegal membrane intensely black, with only thin dorsal edge of membrane at tips of uppermost branchiostegals pale. Paired and first dorsal fins black; second dorsal and anal fins dark.

Coloration of a fresh specimen, CAS 224492, is seen in Figure 2A. The ventral half of the head and body are broadly white to ivory with none of the blue trunk color of the preserved holotype visible. The saddle marks are much more prominent and the distal tips of the first dorsal and pelvic fins appear clear or whitish; the pectoral fin appears clear.

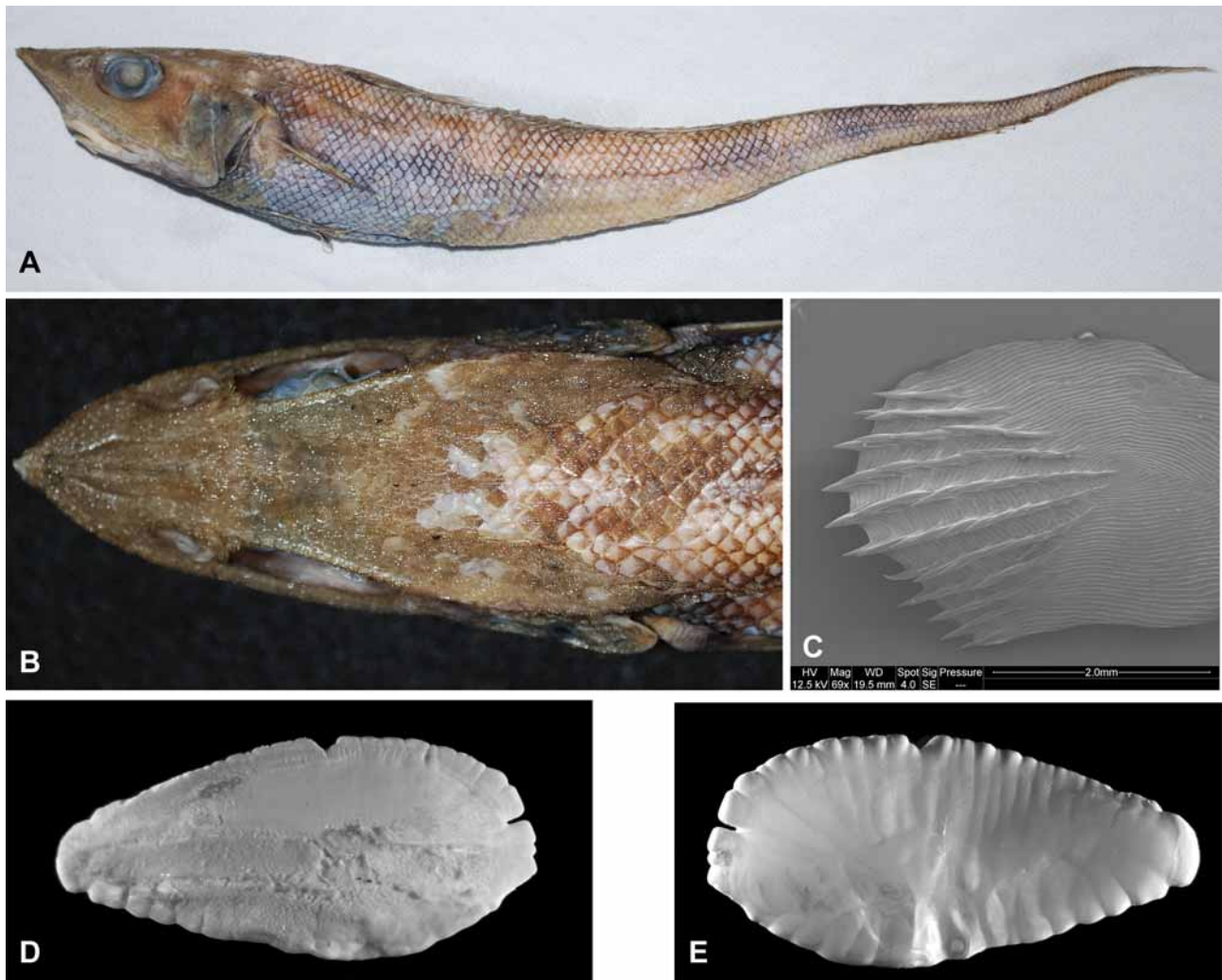


FIGURE 1. *Coelorinchus fuscigulus* sp. nov., holotype, ASIZP 70169, female, 74.8 mm SL, NE Taiwan, preserved specimen. A. Lateral view of body. B. Dorsal view of head. C. Scanning electron micrograph (SEM) of scale, taken from between first and second dorsal fins. D. Right sagitta otolith, 13 mm in diameter, proximal surface, and E. same otolith, distal surface.

Distribution. *Coelorinchus fuscigulus* n. sp. appears to be confined to the northeastern coast of Taiwan and the East China Sea on the Diaoyutai Archipelago, due west of Okinawa. Depth range unknown, but likely less than 600 m.

Etymology. From the Latin *fuscus*, dark, swarthy, and *gula*, throat, in reference to the blackish branchiostegal membranes.

Comparisons. *Coelorinchus fuscigulus* sp. nov. falls in that group of species that includes *C. brevirostris* Okamura in Okamura and Kitajima, 1984, *C. cingulatus* Gilbert and Hubbs, 1920, *C. cylindricus*, *C. gladius* Gilbert and Cramer, 1897, *C. hubbsi* Matsubara, 1936, *C. matsubarai* Okamura in Okamura *et al.*, 1982, *C.*

melanosagmatus Iwamoto and Anderson, 1999, *C. multifasciatus* Sazonov and Iwamoto, 1992, and *C. spilonotus* Sazonov and Iwamoto, 1992. Okamura (1984:227) considered “seven species, *hubbsi*, *matsubarai*, *cingulatus*, *gladius*, *acutirostris*, *brevirostris*, and an undescribed species at hand.” to be members of the *C. hubbsi* complex of the subgenus *Quincuncia*. Chiou *et al.* (2004a: 302–303) subsequently included the other species listed as belonging to this complex. Members of this group all have: (1) a relatively slender, somewhat cylindrical body; (2) sharply pointed snout; (3) high second dorsal fin whose rays are about equal in length to those of the anal fin; (4) short interspace between the dorsal fins; (5) long light organ with a dermal window on the chest distantly separated from the dermal window in front of the anus; (6) underside of head naked except for a narrow margin of scales along anterolateral edge of snout and occasional small scales below junction of infraorbital and preopercle ridges (above angle of lower jaw); (7) nasal fossa naked except along ventral margin; (8) body scales covered with short needlelike to narrowly lanceolate spinules in 5–14 subparallel to slightly divergent rows; and (9) origin of anal fin well posterior to origin of second dorsal fin. *Coelorinchus acutirostris* Smith and Radcliffe in Radcliffe, 1912 agrees in most of these characters, but it does not have the same elongated body shape of the others, and like *C. cylindricus*, it has a completely supported anterolateral snout margin, whereas all others have the anterolateral margin incompletely supported.



FIGURE 2. *Coelorinchus fuscigulus* sp. nov. A. ASIZP 70168, paratype, female, 77.1 mm HL, NE Taiwan, preserved specimen. B. CAS 224492, paratype, 45.4 mm HL, Diaoyutai Archipelago, fresh specimen.

Coelorinchus fuscigulus is similar to *C. cylindricus* in body markings and most other external features. In addition to the character of fully supported anterolateral snout margin, the two differ (enumerated in Table 1) in several proportional measurements (preoral length, orbit diameter, distance orbit to preopercle, postorbital length of head, length upper jaw, and body depth) and scale row counts. Compared to *C. cingulatus*, the new species lacks a prominent horizontal dark streak running below the postorbital ridge (along dorsal margin of preopercle and opercle) and a diagonal dark saddle mark below the first dorsal fin that runs down and forward to behind the upper corner of the opercle. The new species also has a darker branchiostegal membrane, and the first dorsal fin is black to the base (but possibly distally paler), as compared to black midlaterally on fin in *C. cingulatus*; and the first dorsal lacks a notably prolonged spinous ray. *Coelorinchus matsubarai* and *C.*

gladius are readily distinguished from the new species by their large, ocellated black spot above the pectoral fin, and first dorsal fin blackish distally; *C. hubbsi* has prominent longitudinal stripes along the body; *C. brevirostris* lacks distinct body markings, has a greatly elongated spinous dorsal ray, and a number of meristic and proportional differences; *C. multifasciatus* has extensive naked areas atop the snout and head and a shorter abdomen (distance from outer pelvic ray to anal fin origin less than postrostral length); *C. spilonotus* has first dorsal fin black tipped; *C. melanosagmatus* has different body markings, a black median stripe connecting the two windows of the light organ, and black-tipped first dorsal fin.

Remarks. The ten members of this loosely defined group (not including *C. acutirostris*) fall more or less into the subgenus *Quincuncia* Gilbert and Hubbs, 1920, except that none have the characteristic quincunx arrangement of spinules on body scales that was an original diagnostic feature of the taxon. Okamura (1970: 154) expanded and refined the diagnosis of *Quincuncia* to include: scales with spinules “usually arranged in quincunx order...but sometimes in divergent rows (for example, in *C. hubbsi*, *C. longissimus* and partly in *C. formosanus*),” “median and lateral processes of nasal bone not united along anterolateral margin of snout,” “snout very long...the anterolateral dorsal surface largely naked (except in *C. hubbsi*),” and a number of additional characters. The subgeneric grouping breaks down when all ten members of the *Coelorinchus hubbsi* complex are included, which suggests that a more-thorough analysis is necessary to properly determine the phylogenetic relationships and clades within the genus *Coelorinchus*.

Most of the species in this complex are restricted in their geographic distribution, and all are largely oceanic and island-associated. Their relatively long, slender, terete body and well-developed second dorsal fin suggest a more active, off-bottom existence, in contrast to most of its congeners which for the most part are tied close to the bottom. Of these species, *C. cingulatus* appears to have the most widespread geographical distribution, as it has been reported from Japan south through Taiwan, the Philippines, New Caledonia, Vanuatu, the Loyalty Islands, Wallis and Futuna Islands, and the east coast of Australia to 28°S (Merrett and Iwamoto 2000: 744); however, Merrett and Iwamoto (*loc. cit.*) stated that their specimens did not entirely agree with the original description of the species and Iwamoto and Graham (2001: 442) treated their New South Wales (Australia) specimens as a species that could be compared with *C. cingulatus*.

***Coryphaenoides asper* Günther, 1877**

Fig 3A–C

Coryphaenoides asper Günther, 1877:440 (holotype BMNH, 13 inches; off Tokyo, Japan; 34°37'N, 140°32'E, 1875 fm [3,429 m]; *Challenger* sta. 237, 17 June 1875).

Macrurus asper: Günther, 1887:137, pl. 36, fig. A (description, figure)

Specimen examined. ASIZP 66107 (92.3 mm HL, 432+ mm TL), R/V Ocean Researcher I, sta. CD325, South China Sea; 20°40'N, 118°03'E, 1982 m, 20 Aug 2005.

Counts. 1D II,11; P i19/i21; V 10; gillrakers first arch (outer/inner) 0+4 / 2+ 5, gillrakers second arch (outer/inner) 1+6 / 1+ 8; scales below 1D origin 7.5, below 2D origin 5.5, below mid-base 1D 5, lateral line scales over distance equal to predorsal length 37.

Measurements (in mm, percent of head length in parentheses). Snout length 26.8 (29); preoral length 14.6 (16); internasal width 21.7 (24); interorbital width 26 (28); orbit diameter 17.4 (19); suborbital height 12.8 (14); postorbital length 48.7 (53); distance orbit to preopercle angle 44.3 (48); length upper jaw 30.2 (33); length barbel 12.8 (14); length outer gill slit 6.8 (7); preanal length 153 (166); length isthmus to A 80 (87); length V origin to A origin 45 (49); greatest body depth 75 (81); depth at A origin 61 (66); body width 53 (57); head width 54 (59); 1D–2D interspace 19 (21); height 1D 84 (91); length base 1D 24 (26); length P – [damaged]; length outer V ray 77 (83).

Description of ASIZ P66107. Head broad, with overall shape much like those in *C. rudis* Günther, 1878 and *C. marshalli* Iwamoto, 1970, but scales cover entire snout and suborbital regions. Interorbital space broad,

about equal to snout length, much greater than orbit diameter (Fig. 3B). Snout slightly protruding beyond mouth; terminal snout scute stout and prominent. Orbit about 2.7 times into postorbital length of head. Upper jaw about one-third head length, extending posteriorly about to vertical through middle of orbit. Suborbital region smoothly curved, without an acute ridge, but scales along ridge prominent and slightly modified, as are scales over orbit and median nasal ridge. Posterior margin of preopercle slightly angulate forming a shallow lobe; interopercle slightly protruding at posterior end, where it is blackish and without scales. Chin barbel short, slender, about equal to least depth of suborbital. Gill membrane broadly attached to isthmus without a free fold. Tip of isthmus approximately under posterior angle of preopercular ridge.

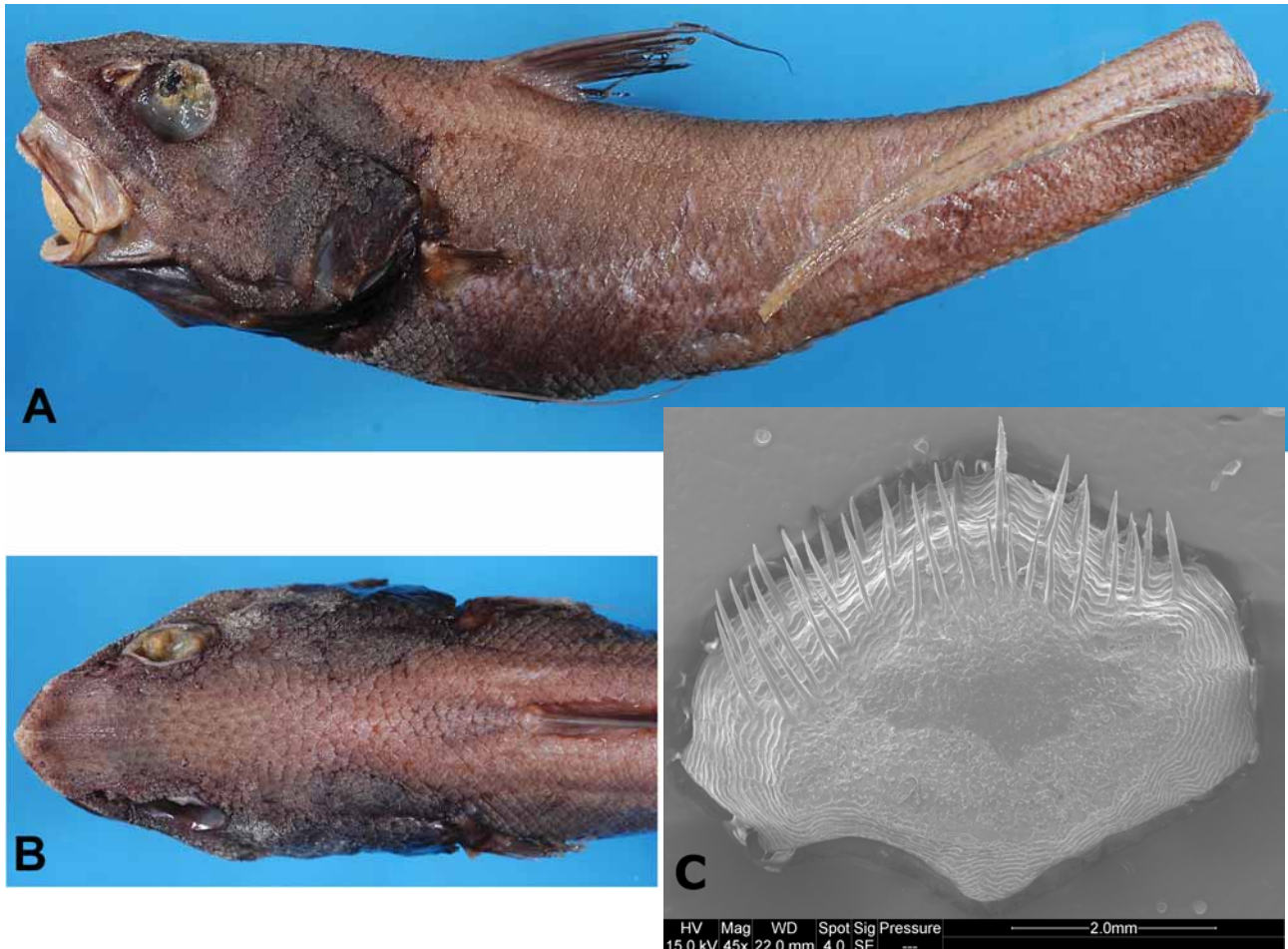


FIGURE 3. *Corphaenoides asper*, ASIZP 66107, 92.3 mm HL, South China Sea, preserved specimen. A. Lateral view of body. B. Dorsal view of head. C. SEM of scale, taken from lateral body posterior to pectoral fin.

Head and body uniformly covered with scales except on gill and gular membranes, fins, and lips. Scales on dorsum densely covered with greatly reclined conical spinules in irregularly parallel to slightly convergent rows; larger scales with 15 or 16 rows of spinules (Fig. 3C). The last spinule in middle of scale often longer than others and projects farther beyond scale margin; this enlarged spinule not prominent, however, and together do not render surface of fish with a striated appearance. Stomach everted and clogging mouth; inner surfaces of stomach beset with numerous nematodes, hanging from stomach wall.

Premaxillary dentition consists of small conical teeth in broad tapered band with the outer series slightly enlarged and spaced; dentary band with small teeth in broad band at symphysis but band narrows rapidly laterally and posteriorly.

First dorsal fin with moderately elongated second spinous ray; second dorsal fin rudimentary anteriorly, interspace between first and second dorsal fins short, about equal to orbit diameter, less than length of base of

first dorsal; pectoral fins damaged, with broken tips; outer pelvic ray considerably prolonged, reaching well beyond anal-fin origin to 9th or 10th anal fin ray.

Body overall grayish-brown; abdomen and chest more swarthy gray-brown. Head much darker than (and contrasts with) body; most of head swarthy gray to black, especially over the opercle and suborbital. Gular and branchiostegal membranes entirely black, barbel dusky, lips black, but gums pale, and mouth dark gray. Sensory papillae prominent under and atop head and on mandibular rami. First dorsal and pectoral fins black, but bases somewhat paler; pelvic fins dark dusky to blackish with outer prolonged ray pale.

Remarks. This nicely preserved Taiwan specimen of *C. asper* is only the second one captured of this rare deepwater grenadier. It agrees rather well with the short original description by Günther (1877) and the fine, detailed drawing in the *Challenger Reports* (Günther 1887: pl. 26, fig. A). One difference of note lies in the spinulation of the scales; those depicted in the holotype have spinules in rather few slightly divergent rows, whereas those in the Taiwan specimen are arranged in many (15–16 in larger scales, Fig. 3C) subparallel to slightly convergent rows. We cannot evaluate the significance of this difference without additional specimens for comparisons.

The recent acquisition of a specimen of *Coryphaenoides asper* is a good example of how little we still know of the fauna of the greater depths of the oceans, even in an area as well explored as the waters off Japan, where the holotype was taken 134 years ago. The recent captures in more than 3,000 m off Japan of two undescribed species of *Coryphaenoides* (one of which will be described by Nakayama and Endo of Kochi University, the second to be reported on in a separate work by Nakayama, Endo, and Iwamoto) are additional examples of this lack of adequate collecting at greater ocean depths.

***Coelorinchus spinifer* Gilbert and Hubbs, 1920**

Fig 4A–B

Coelorhynchus spinifer Gilbert and Hubbs, 1920:516–519, fig. 30 (holotype USNM 78226, 185 mm TL; Gulf of Tomini, Celebes; 0°04'S, 121°36'E; 1392 m; *Albatross* sta. 5607).

Coelorinchus spinifer: Iwamoto in Cohen *et al.* 1990:138 (listed). Shao *et al.* 2008:24, table 2 (listed, one spec.; South China Sea, 1098 m)

Material examined. ASIZ P66748 (51.1 HL, 180 TL); South China Sea, 20°44'N, 117°39'E, 1098 m; sta. CD322; 19 Aug 2005.

Counts. 1D II, 11; P i16/i16; V 8; gillrakers first arch (inner) 2+7, gillrakers second arch (outer/inner) 1+7 / 2+6; scale rows below 1D 8, below midbase 1D 7, below 2D 6; lateral line scales over distance equal to predorsal length ca. 43.

Measurements (in mm, percent HL in parentheses). Snout 26.5 (52); preoral 15.8 (31); internasal width 9.7 (19); interorbital width 12.8 (25); orbit diameter 11.0 (22); suborbital height 6.3 (12); postorbital length 15.3 (30); distance orbit to preopercle 15.5 (30); length upper jaw 11.4 (22); length barbel 2.2 (4); length isthmus to A origin 29.4 (58); length base 1D 6.7 (13); P length 15.4 (30); length V 9.8 (19).

Remarks. This specimen is almost the same size as the holotype (185 mm), and agrees very well with the original description by Gilbert and Hubbs (1920:516–519, fig. 30), although ASIZP 66748 is a juvenile in poor condition. The snout region is damaged and lacks the terminal snout scute and most of the body scales are gone; however, there is enough left to say with a degree of certainty that the two are conspecific. The heavily spinulated character of the scales may be a juvenile feature and may possibly change with size.

Coelorinchus spinifer is one of the deepest-living members of the genus, the holotype having been captured at a depth of 1392 m and the ASIZ specimen at 1098 m. Most species of *Coelorinchus* occur in depths of less than about 800 m. However, the following 10 species of *Coelorinchus* are known from captures below 1200 m: *C. spinifer*, *C. acanthiger* Barnard, 1925 (800–1270 m), *C. amirantensis* Iwamoto *et al.*, 2006 (950–1900 m), *C. chilensis* Gilbert and Thompson in Thompson, 1916 (260–1480 m), *C. kaiyomaru* Arai and

Iwamoto, 1979 (845–1360 m), *C. labiatus* (Koehler, 1896) (460–2220 m), *C. obscuratus* McMillan and Iwamoto, 2008 (1013–1460 m), *C. osipullus* McMillan and Iwamoto, 2008 (600–1340 m), *C. trachycarus* Iwamoto *et al.*, 1999 (1015–1234 m), and *C. yurii* Iwamoto *et al.*, 2006 (800–1900 m).



FIGURE 4. *Coelorinchus spinifer*, ASIZP 66748, 51.1 mm HL, South China Sea, dorsal view (above) and lateral view (below), preserved specimen.

***Kumba gymnorhynchus* Iwamoto and Sazonov, 1994**

Fig 5

Kumba gymnorhynchus Iwamoto and Sazonov, 1994:229–231, fig. 3, 4 (holotype CAS 77313, 68.3 HL, 402+ TL) and paratype ZMMGU P.17766 (75.3 HL, 496+ TL); West Australian Ridge [Broken Ridge], 30°46'S, 93°20'E; 1260–1370 m; 2 Sep 1976. Shao *et al.* 2008:25, table 2 (listed, one spec.; South China Sea, 736–1040 m)

Material examined. ASIZ P65527 (1 spec., 64.9 HL, 316 TL; South China Sea, 22°16'N, 120°06'E, 736–1040 m; sta. CD134; 22 Nov 2001).

Counts. 1D II, 11; P i18/i18; V 8; gillrakers first arch (outer/inner) 1+6 / 1+9, gillrakers second arch (outer/inner) 2+9 / 2+8; scale rows below 1D 11, below midbase 1D 9, below 2D 12, lateral line scales over distance equal to predorsal length ca. 52.

Measurements (in mm, percent HL in parentheses). Head length 64.9; snout 17.8 (27); preoral 13.4 (21); internasal width 14.0 (22); interorbital width 15.7 (24); orbit diameter 16.9 (26); suborbital height 10.3 (16); postorbital length 25.7 (40); distance orbit to preopercle 32.2 (50); length upper jaw 26.9 (41); length barbel 7.6 (12); length isthmus to A origin 28.7 (44); height 1D 41.3 (64); length base 1D 20.1 (31); P length 34.7 (53); length V 54.1 (83).

Remarks. This specimen represents the first record of the species from the western Pacific and only the third known specimen. The original description was based on two specimens collected from the West Australian Ridge in the eastern Indian Ocean. Another specimen was examined by the first author in the Museum of Victoria (NMV 23944, 61 mm HL, 360 mm TL); it was captured off Albany, Western Australia (35°S, 118°E). The species is also expected to be in the southwestern Pacific.



FIGURE 5. *Kumba gymnorhynchus*, ASIZP 65527, 64.3 mm HL, South China Sea, lateral view, preserved specimen.

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