

Two New Australian Grenadiers of the *Coelorinchus fasciatus* Species Group (Macrouridae: Gadiformes: Teleostei)

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Coelorinchus maurofasciatus and *C. parvifasciatus* were originally described from New Zealand by McMillan and Paulin, 1993. The first species has been recorded as widespread around southern Australia, but close examination of specimens from the west coast has revealed them to be a closely similar but undescribed species. *C. parvifasciatus* was also reported from southeastern Australia, but comparison of many Australia and New Zealand specimens has shown that the Australian population represents a distinct and undescribed species. The two species are herein described as *Coelorinchus hoangi* and *C. gormani*, respectively. With the new species, Australia's grenadier fauna (including bathygadids, trachyrincids, macrouroidids and macrourids) now total 104 species, of which 22 are apparently endemic; 13 of the endemics are species of *Coelorinchus*.

The genus *Coelorinchus*¹ comprises more than 100 species whose distributions are primarily confined between lower-shelf and middle-slope depths of subtropical and tropical waters of the world's oceans. The greatest concentration of species lies in the broad region of the Indo-Australian Archipelago and the Philippines, with an extension out to the tropical western boundaries of the Pacific Ocean. A secondary area of species diversification appears in waters off New Zealand and southern Australia, where a primarily subtropical element resides. Most of this southern subtropical element consists of members of the *Coelorinchus fasciatus* species group, a clade defined by Iwamoto et al. (2004), which (with the inclusion of the species herein described) comprises 15 species whose distributions roughly coincide with the northern elements of the eastward-flowing Antarctic Circumpolar Current or West Wind Drift. The species of this clade are characterized by the combination of:

- (a) short, usually blunt snout, its length about equal to or usually shorter than the large orbit,
- (b) lateral and mesial processes of nasal bone not connected laterally,
- (c) dermal window of light organ well developed and placed variously from midway between the anus and the pelvic fins to between the pelvic fins,

¹ Eschmeyer (1990:70) incorrectly changed the spelling of the generic name from the previously used *Coelorinchus* to *Caelorinchus*, a spelling subsequently followed by Sazonov and Iwamoto (1992) and others. However, Dr. Dirk Nolf (*in litt.*), of the Institut Royal des Sciences Naturelles de Belgique, has made it clear that use of the diphthong oe in the name is correct. A return to the original spelling has been explained in FishBase and in a forthcoming publication (T. Iwamoto, Family Macrouridae, in K.E. Carpenter, editor, *FAO species identification guide for fishery purposes. The living marine resources of the eastern central Atlantic*).

- (d) body scales large, generally with 9 or more parallel rows (5–7 slightly divergent rows in *C. bollonsi*) of uniformly small spinules,
- (e) swim bladder divided into a single posterior chamber and a deeply bilobed anterior chamber, and
- (f) saddle or other body markings in most species.

Two new species belonging to the *C. fasciatus* group are here described from Australia. The first was previously included by Iwamoto and Williams (1999) in the similar *C. maurofasciatus*. It is known only from Western Australia (WA) and overlaps the range of the more widely distributed *C. maurofasciatus* along the southern coast of Western Australia (Fig. 1). The second species was treated by Iwamoto and Graham (2001) as *C. parvifasciatus* McMillan and Paulin, 1993, although differences between Australian and New Zealand specimens were discussed. It is now proposed that *C. parvifasciatus* is confined to New Zealand waters while a new sister species is described from southeastern Australian waters.

METHODS AND MATERIALS

Methods for taking counts and measurements and the abbreviations used are as described in Iwamoto and Sazonov (1988). Institutional abbreviations follow Leviton et al. (1985). Collection

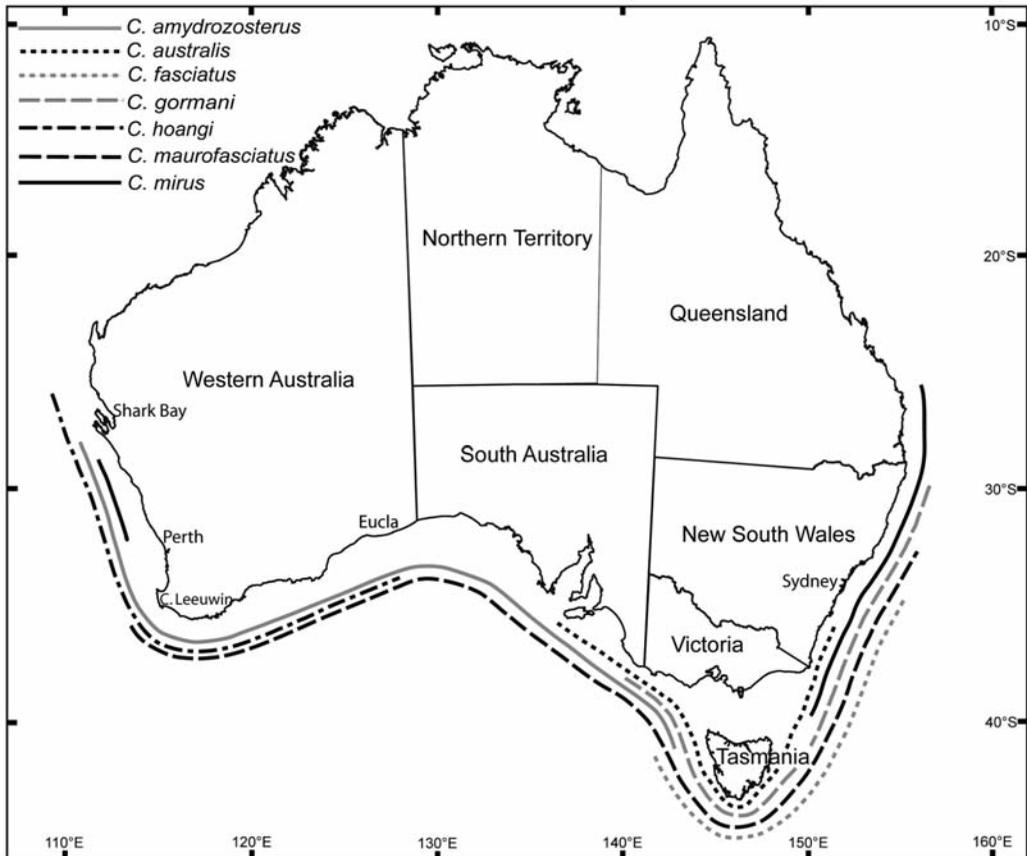


FIGURE 1. Distribution of the seven Australian species of the *Coelorinchus fasciatus* group.

data for stations of the FRV *Kapala* (abbreviated with a K followed by the last two digits of the year, the cruise number, and the drag number) are available in Iwamoto and Graham (2001).

DESCRIPTIONS

Diagnostic characters of the genus are described in Iwamoto (*in* Cohen et al., 1990:111–112). The *Coelorinchus fasciatus* species group is discussed in greater detail in Iwamoto et al. (2004: 193–194). Characters listed above for the species group are not repeated in the descriptions of the two new species unless they differed or needed further clarification.

Coelorinchus hoangi Iwamoto and Graham, sp. nov.

Figures 2, 3, 4 (*lower*), 8b.

Coelorinchus maurofasciatus (not of McMillan and Paulin, 1993) Williams et al., 1996:148 (WA distr.). Williams et al., 2001: Fig. 6 (WA). Iwamoto and Williams, 1999:150–152 (*in part*: WA specimens only).

DIAGNOSIS.— A species of the *Coelorinchus fasciatus* group (see characters of group above) with terminal snout scute small, broad, blunt. Underside of head completely naked; dorsal surface of snout behind leading edge almost fully scaled; nasal fossa usually partially scaled. Prominent saddle bands on body; anterior three pale interspaces between bands angled slightly posteroventrally from dorsal median line. Anal fin dusky overall, coarsely peppered with melanophores and lacking a dark distal stripe. Lens-shaped naked fossa of light organ about midway between anal and pelvic fins; pyloric caeca 17–23.

COUNTS AND MEASUREMENTS.— 1D. II,9–10; P. (rarely i16) i17–i20; GR-I (inner) (1–2)+(6–7), 7–9 total, GR-II (outer/inner) 0+(6–7)/(1–2)+(6–7), 7–9 total; scales 1D.5.0–6.0, midbase 1D. 3.5–4.5, 2D. 4.0–5.5, lateral-line scales from anterior origin posteriorly over distance equal to length from snout tip to first dorsal fin 25–29; pyloric caeca 17–23 (\bar{x} = 19.8, SD = 1.3, N = 14).

Total length 160–283 mm; HL 36.9–63.3 mm. The following in percent of HL (exceptional measurements in parentheses): snout length 30–35; preoral length 28–34; internasal width 21–25;



FIGURE 2. *Coelorinchus hoangi*, sp. nov. Holotype, CSIRO H2604-09 (227 mm TL) from Western Australia southwest of Ledge Point, in 512 m. Lateral view (upper); dorsal view (lower).

interorbital width 19–23; orbit diameter 37–40 (43); suborbital width 14–18; postorbital length 27–33; distance orbit to preopercle 29–35; length upper jaw 26–29; length barbel 9–13; length outer gill slit 12–15; pre-A. length (136) 141–163; length V.-A. 38–49; distance isthmus to A. (65)69–90; body depth 56–73; 1D.-2D. interspace 19–27; height 1D. 51–67; length P. 47–54; length V. 40–53 (60); diameter posterior nostril 7–11; length dermal window of light organ 9–14.

DESCRIPTION OF HOLOTYPE (condition in other specimens in parentheses).— Head large,

broad, 4.5 (4.2–4.6) into TL; snout short, acutely pointed and moderately produced, but blunt when viewed dorsally; orbits large, oval, horizontal diameter slightly longer than snout length, 2.7 (2.5–2.7) in HL, anterodorsal margin entering dorsal profile; suborbital ridge well developed, dividing dorsal and ventral surfaces of head; subopercle weakly produced ventrally into a short flap; mouth small, premaxillary extends to below about midorbit; chin barbel short, thin.

First dorsal fin 61% of HL, less than postrostral length of head, 70% HL; spinous second ray about 0.5 mm shorter than adjacent segmented ray; second dorsal fin low to end of tail, where it meets anal fin; interspace between fins short, 21% HL, less than base of first dorsal, 27% HL. Anal fin well developed to end of tail. Base of pelvic fins below (slightly anterior to) origin of first dorsal fin; outer ray of fin prolonged, almost double length of second ray, extending posteriorly to fifth anal fin ray; second pelvic ray extending to origin of anal fin.

Terminal snout scute small, broad, blunt; ridges of head strong, stoutly armed with modified scutelike scales. Lunate dorsal areas behind leading edge of snout fully covered with small scales. Underside of head completely naked; nasal fossa partially scaled ventrally. Body scales large, adherent, covered with short, small spinules; scales below first dorsal with 9 or 10 (to 11 or more depending on size of fish) parallel to slightly divergent rows; scales on belly with 9 rows; a weak median-dorsal ridge on nape from supraoccipital scute to origin of first dorsal fin, formed by modified scales with somewhat higher and stouter median spinule rows.

Fossa of light organ, lens-shaped, naked, relatively small, about midway between anal and pelvic fins; anus immediately adjacent to origin of anal fin. Pyloric caeca long, slender, 21 in number.

Teeth all small, in bands in both jaws; premaxillary band short and broad, anterior teeth slightly longer than posterior and mesial teeth. Dentary band all small, broad anteriorly, tapering posteriorly.

Ground color in preserved specimen light brown to creamish, paler ventrally except light bluish to purplish over abdomen and posteriorly on chest, but pale along broad margin behind gill cover and anteriorly on chest; dark blue to blackish on opercular bones and branchiostegal membranes; black on inner side of pectoral fin base and ventral light organ; blackish in region of light



Figure 3. *Coelorinchus hoangi*, sp. nov. Holotype, CSIRO H2604-09. Close-up of lateral view of head and trunk (*upper*); close-up of ventral view of head and belly (*lower*).

organ and periproct. Anterodorsal edge of orbit blackish. Eleven (9–11) prominent dark to medium-brown saddle bands on body, the first narrow and faint, beginning at about supraoccipital scute and above opercle, the second beginning above pectoral fin base and terminating below anterior one-fourth of first dorsal fin, the third between dorsal-fin interspace, the second, fourth and sixth noticeably darker than first, third and fifth saddles; eleventh at posterior tip of tail; pale interspaces between saddles angled slightly posteroventrally from dorsal median line. Dark saddle pigmentation extends onto adjacent dorsal fin rays, although not readily apparent on preserved holotype (clearly present on dorsal and anal fins on recently preserved specimens, e.g., CSIRO H6376-03). First dorsal fin dusky to blackish, whitish on spinous second ray, paler near base and distal tip; anal fin dusky overall, coarsely peppered with melanophores and lacking a dark distal stripe; pelvic fins blackish, outermost ray whitish, fin paler distally. Oral and branchial cavities dark; inner lip of upper jaw black, lower pale. Underside of head with sparse scattering of relatively large melanophores. Scales covered with scattered melanophores; in areas of dark saddles, melanophores very small but dense; in pale interspaces and belly, melanophores relatively large but sparsely scattered.

SIZE.— To about 35 cm TL.

DISTRIBUTION.— From Shark Bay to Eucla, Western Australia (Fig. 1). Depth range 480–700 m.

ETYMOLOGY.— The new species is dedicated to friend and patron Tuan Hoang, M.D., for his long and enthusiastic support of ichthyology at the California Academy of Sciences.

COMPARISONS AND REMARKS.— *Coelorinchus hoangi* is closely similar to *C. maurofasciatus* McMillan and Paulin, 1993 and has been confused with that species. Saddle marks differ in minor but consistent ways between the

two species: these differences are best seen in Fig. 4 where the pigmentation patterns in the two species are compared. The extent to which the first dorsal fin when laid down subtends the fourth saddle (the third saddle spans the interspace between the dorsal fins) differs: in *C. hoangi* the fin scarcely reaches beyond the anterior margin of the saddle, whereas in *C. maurofasciatus*, it extends well onto the saddle and sometimes beyond. In *C. maurofasciatus* the anal fin has a prominent black stripe over almost the entire length of fin; there is no such stripe in *C. hoangi*. Certain morphometric and meristic characters of *C. hoangi* and *C. maurofasciatus* are compared in Table 1. The new species attains a relatively small adult size, probably not much greater than 35 cm in TL (32 cm in largest specimen examined); in contrast, *C. maurofasciatus* exceeds 50 cm TL. The new species is known only from the west and southwest coasts of Australia from Shark Bay to Eucla, on the border of Western Australia and South Australia; *C. maurofasciatus* ranges across southern Australia from about Cape Leeuwin to central New South Wales, and also to northern and central New Zealand. The distributions of the two species overlap off the south coast of Western Australia.

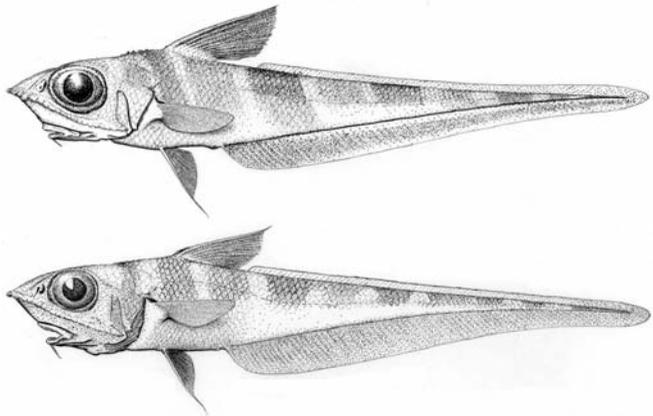


FIGURE 4. Stylized drawings of *Coelorinchus maurofasciatus* (upper) and *C. hoangi* (lower) to show differences in body pigmentation (saddles somewhat exaggerated).

The second new species described in this report, *C. gormani*, and *C. amydrozosterus* Iwamoto and Williams, 1999 are readily distinguished from *C. hoangi* by their fainter saddles (which are also oriented differently), usually paler body and fin pigmentation, and broad naked areas on dorsal snout surfaces behind the leading edges. *Coelorinchus hoangi* is distinguished from *C. fasciatus* by its more

TABLE 1. Comparison of selected measurements and counts for *Coelorinchus hoangi* and *C. maurofasciatus* (HL, head length; ADW, anterior dermal window; GR-I, gill rakers on first arch; SD, standard deviation).

	<i>C. hoangi</i>			<i>C. maurofasciatus</i>		
	range	mean (SD)	n	range	mean (SD)	n
Orbit diameter (%HL)	37–43	39.1 (1.6)	33	38–46	42.0 (1.8)	21
Barbel length (%HL)	9–13	11.4 (1.1)	18	10–16	12.4 (1.6)	19
Pelvic to anal fin (%HL)	38–45	43.5 (2.9)	17	34–44	39.8 (3.1)	18
Length pectoral fin (%HL)	47–53	50.5 (2.1)	15	53–61	56.2 (2.6)	21
Length pelvic fin (%HL)	48–63	51.8 (4.0)	17	51–59	54.4 (2.1)	21
Length ADW (%HL)	10–14	11.8 (1.1)	14	6–11	8.9 (1.6)	17
No. GR-I (inner)	7–9	8.4 (0.6)	17	7–9	8.4 (0.9)	13
Scales below 2D	4.0–4.5	4.6 (0.4)	17	4.0–4.5	4.3 (0.2)	19
Pyloric caeca	17–23	19.7 (1.3)	13	24–34	28.9 (4.0)	7

adherent scales (highly deciduous in *C. fasciatus*), absence of heavily modified predorsal scales with high median spinule ridges, paler median fins, slight differences in saddle marks, and smaller maximum size. In most characters, *C. hoangi* is most similar to *C. cookianus* McCann and McKnight from New Zealand, but that species has a larger, broader terminal snout scute, smaller scales (4.5–5.5 rows below midbase of first dorsal fin *cf.* 3.5–4.5, 29–32 lateral line scales over distance equal to predorsal length *cf.* 25–29), the second and third pale interspaces between saddle marks generally trend diagonally forward (*vs.* anteroventrally), and branchiostegal rays and subopercle are paler, without blackish pigmentation. Other species of the *C. fasciatus* group are readily differentiated by characters given in the key below.

TYPE SPECIMENS.— Holotype: CSIRO H2604-09 (50.3 mm HL, 227 mm TL); Western Australia, sw. of Ledge Point; 31°14.9'S, 114°52.3'E; 512 m; RV *Southern Surveyor* sta. SSI1/91/70. Paratypes (33 specimens): AMS I.31171-009 (2: 45.3–51.6 HL, 210+197+ TL); 26°35.7'S, 112°29.0'E; 500–508 m; SSI/91/37. CSIRO H6376-03 (3: 59.5–73.2 HL, 247+–318+ TL); 29°01'S, 113°43'E; 680 m. NMV A9606 (6: 35.8–57.4 HL, 160–260 TL) and CSIRO H2591-15 (56.5 HL, 250 TL); 29°20.5'S, 113°58.3'E; 490–505 m; SSI/91/57. NMV A9660 (6: 38.5–63.3 HL, 168–282 TL); 30°00.0'S, 114°27.1'E; 480–490 m; SSI/91/65. CSIRO H2604-11 (49.3 HL, 215+ TL); same data as for holotype. NMV A9639 (6: 49.0–54.2 HL, 210–225 TL); 32°02.3'S, 114°54.5'E; 640–670 m; SSI/91/72. WAM 30495.001 (4: 219–235 TL); 34°43'S, 114°32'E, 625–630 m; 11 Jun 1992. NMV A6186 (172 TL); 35°26.3'S, 116°46'E; 606–671 m. CSIRO H6383-04 (2: 59.0–73.0 HL, 235+–313 TL); 35°22'S, 118°19'E; 680 m. AMS I.18711-020 (2: 52.5–52.9 HL, 210–209+ TL); 33°29'S, 127°15'E; 640–650 m; RV *Dmitry Mendeleev* sta. DM 1372; 28 Feb 1976. CSIRO H3025-06 (52.7 HL, 230 TL); 33°06'S, 114°30'E; 596 m.

***Coelorinchus gormani* Iwamoto and Graham, sp. nov.**

Figures 5, 10, 11

Coelorinchus sp. 3: McMillan, in Gomon et al. 1994:349. fig. 309 (as “Little Whiptail”).

Coelorinchus parvifasciatus (not of McMillan and Paulin, 1993): Williams and Bax 2001:536. Iwamoto and Graham, 2001:453–454, fig. 70 (NSW captures).

DIAGNOSIS.— A species of the *C. fasciatus* group with underside of head entirely naked. Snout blunt with broad naked areas dorsally behind leading edge; nasal fossa naked. Orbit diameter

44–49% of HL. Saddles obscure anteriorly, more prominent posteriorly on body; pale interspaces between saddles narrow, occupying one or two scale rows on dorsomedian line and giving appearance of white spots when viewed dorsally. All fins generally dark dusky to blackish. Naked fossa of light organ extends forward close to line connecting pelvic-fin insertions. Pyloric caeca 19–26. (\bar{x} = 21.8)

COUNTS AND MEASUREMENTS (see also table below).— 1D. II,9–11 (usually 10); GR-I (inner) (1–2)+(6–7), 7–9 total, GR-II (outer/inner) 0+(6–7)/(1–2)+(6–7); scales below 1D. 5.0–6.0, below midbase 1D. 3.5–4.5 (usually 4.5), below 2D. 4.5–5.5, lateral-line scales from origin posteriorly over distance equal to predorsal length 26–28.

Total length 145–260 mm; HL 27–56 mm. The following in percent of HL (exceptional measurements in parentheses): preoral length 28–34; internasal width 21–25; interorbital width 18–23; postorbital length 28–33; distance orbit to preopercle 29–35; length outer gill slit 12–16; pre-A. length 136–164; length V.-A. 34–49; length isthmus to A. 62–84; body depth 59–73; 1D.-2D. interspace (13) 15–25; height 1D. 57–80; length P. 45–61; length V. 48–59 (63); diameter posterior nostril 6–9; length dermal window of light organ 6–13.

DESCRIPTION OF HOLOTYPE.— Head length about five in TL, its greatest width 1.7 length and slightly more than greatest depth. Body relatively shallow, depth under origin of first dorsal fin about 1.6 into HL. Snout pointed in lateral view, broadly angular in dorsal view, tipped with a small, broad, blunt scute. Orbit huge, much greater than snout length, about 2.2 into HL; anterodorsal margin forms part of dorsal profile of head. Subopercle with a short ventral tab mostly hidden beneath slightly lobelike posteroventral margin of preopercle. A stout suborbital ridge running from tip of snout to preopercle, terminating in a sharp point; the ridge forming a sharp separation between scaled upper part and naked underside of head. Mouth small, inferior, end of premaxillary falling somewhat behind vertical of midorbit. A short, slender barbel under anterior end of lower jaw. Gill membranes broadly connected to isthmus, lacking a free posterior fold.

Teeth all small, in bands in both jaws. Premaxillary band short and broad, its length about half length of rictus; outer series of teeth very slightly larger than inner teeth. Dentary teeth all small, tooth band broad anteriorly, tapering posteriorly, ending at about end of rictus.

First dorsal fin high, longer than postrostral length (orbit plus postorbital length); second dorsal fin low anteriorly, increasing in height towards end of tail. Interspace between first and second dorsal fins shorter than base of first dorsal. Anal fin well developed to end of tail, where it is confluent with the second dorsal fin. Pectoral fins about 60% of HL; their upper margin situated below the midlateral line, about five scale rows below highest point of lateral line. Pelvic fins small, their

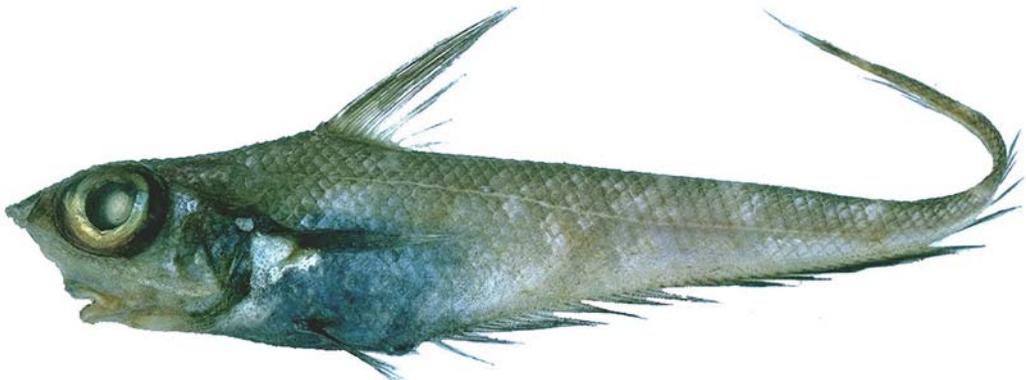


FIGURE 5. *Coelorinchus gormani*, sp. nov. Paratype, AMS I.26240-001, from east of Broken Bay, New South Wales, in 421–457 m.

origin behind that of pectoral fins, but anterior to that of first dorsal fin; outermost ray slightly prolonged extending to about sixth anal fin ray.

Body scales large, relatively adherent; large scales below first dorsal fin fully covered with 15–17 more or less parallel rows of short reclined spinules. Ridges of head marked by stout, coarse, scutelike scales, none of which are prominently enlarged. Underside of head naked. Lunate areas dorsally behind leading edge of snout broadly naked, but with a few scattered small, deeply embedded scales anteriorly. Nasal fossa naked.

Light organ manifested externally by an elongated black dermal window situated in a shallow medioventral fossa on belly between pelvic fins, about midway between inner bases of pelvic fins and anterior end of periproct. Anus ringed by narrow black margin of periproct, which lies immediately before anal fin; a small genital papillae at posterior margin of periproct.

Color in preservative grayish-brown overall, paler ventrally under head and tail, bluish over abdomen, blackish over opercle, subopercle, and part of preopercle. Chest area mostly swarthy but somewhat paler behind margin of gill membranes. Saddle marks or bands on body relatively faint, but about 11 or 12 saddles discernible, more prominent posteriorly, generally confined to dorsum above lateral midline, each separated by a narrow pale vertical interspace two or three scale rows wide. Banding pattern more prominent when viewed dorsally, with pale interspaces spot-like. Mouth and gill cavity blackish; lips pale except upper lips dark anteriorly; chin barbel pale. Base of pectoral fin black mesially, but completely lacking pigmentation on lateral face. Dorsal and pectoral fins dark dusky, but narrowly pale along base of each fin. A blackish blotch on pelvic fin, paler near base and near tip, with outermost elongated ray distally white. A dark stripe along middle of anal fin (in many paratypes anal fin dark dusky with little or no trace of a stripe).

SIZE.— To about 30 cm.

ETYMOLOGY.— Named after fishery scientist Terry Gorman who pioneered deepwater fishery research in Australia in the 1970s and 1980s with the New South Wales FRV *Kapala*; it was from collections made during this research that the extent of the southeast Australian grenadier fauna came to the attention of the authors.

DISTRIBUTION.— Southeastern Australia, from northern New South Wales (about 29°30'S) to eastern Victoria, eastern and western Tasmania, and western Victoria (Fig. 1). Williams et al. (1996: 148) listed this species from Western Australia (CSIRO H2604-02), but that specimen is a *C. amydrozosterus* Iwamoto and Williams, 1999. There are no confirmed records of *C. gormani* west of the Victoria—South Australia border. The species is found in upper-slope depths from about 200 to 700 m, but primarily in 250–550 m.

REMARKS.— This is a species of relatively small size and possibly the most abundant *Coelorinchus* off NSW, and “an especially abundant species in trawl fish grounds off southwestern Victoria” (McMillan in Gomon et al. 1994:349).

COMPARISONS.— The new species agrees in most respects with the common New Zealand species *C. parvifasciatus* McMillan and Paulin, 1993, but the two differ in the ranges of certain measurements and counts, as seen in Table 2. The anterior dermal window of the light organ was generally larger in New Zealand specimens, but there was overlap in the proportional measurements of that structure. Finally, the new species completely lacks the one to three small scales commonly found in *C. parvifasciatus* on the ventral surface of the head above the articulation of the lower jaws (18 of 28 specimens of *C. parvifasciatus* we examined had one or more of these scales).

Of the sympatric Australian members of the group, *Coelorinchus gormani* most closely resembles *C. amydrozosterus*, but that species has a more prominent and slightly different banding pattern, a much larger dermal window of the light organ, fewer pyloric caeca (15–17), and a distinct series of predorsal scales (with high median ridge). *Coelorinchus gormani* is easily distinguished

TABLE 2. Comparison of selected measurements and counts for *Coelorinchus gormani*, *C. parvifasciatus*, and *C. amydrozosterus* (HL, head length; SD, standard deviation).

	<i>C. gormani</i>			<i>C. parvifasciatus</i>			<i>C. amydrozosterus</i>		
	range	mean (SD)	n	range	mean (SD)	n	range	mean (SD)	n
Pectoral fin rays	i17–i20	18.2 (0.9)	56	i15–i18	17.0 (1.0)	20	i15–i20	17.4 (1.1)	46
Pyloric caeca	19–26	21.8 (2.8)	28	22–28	25.3 (1.8)	11	13–16	14.7 (1.0)	7
Snout length (%HL)	27–31	29.3 (1.0)	28	27–34	30.6 (1.5)	20	29–34	31.4 (1.3)	25
Orbit diameter (%HL)	44–49	46.0 (1.6)	28	39–44	42.2 (1.2)	19	38–42	40.3 (1.4)	21
Suborbital width (%HL)	16–18	16.4 (0.7)	28	13–16	14.7 (0.8)	20	15–18	15.8 (0.9)	25
Upper jaw length (%HL)	26–33	28.0 (1.2)	28	22–29	26.3 (1.9)	20	28–31	29.2 (0.8)	24
Barbel length (%HL)	9–14	11.3 (2.5)	28	5–11	8.4 (1.1)	10	8–14	11.8 (1.8)	24

from *C. mirus* by the notably large dermal window of the light organ in that species (extends anteriorly onto the chest). It also differs from *C. maurofasciatus* and *C. fasciatus* in having less prominent saddle marks, spotlike pale markings along the dorsal midline of the tail, paler first dorsal and anal fins (without prominent markings), and broad naked areas behind the leading edge of the snout. *Coelorinchus australis* is strongly distinguished from the new species in having multiple longitudinal stripes on the body and scaled undersurface of head. The last four species also attain a much larger size than does the new species.

TYPE SPECIMENS.— Holotype: AMS I.20301-006 (39.0 mm HL, 190 mm TL); New South Wales e. of Woolli; 29°53'S, 153°42'E; 502 m; RV *Kapala* sta. K77-13-12; 23 Aug 1977. Paratypes: **New South Wales.** CAS 212159 (10: 35.1–57.2 HL, 170+–273+ TL); 36°46'S, 150°21'E; 521–567 m; FV *Shelley H.* AMS I.15968-013 (5: 37.0–56.3 HL, 155+–245+ TL); 33°42'S, 151°50'E; 366 m; K71-05-04. AMS I.15973-008 (3: 45.4–52.0 HL, 215+–255+ TL); 33°35'S, 152°01'E; 375–384 m; K71-07-03. AMS I.18838-017 (18: 28.1–55.2 HL, 150–270 TL); 33°04'S, 152°33'E; 448+466 m; K75-05-03. AMS I.18839-054 (34.0 HL, 155+ TL); 33°27'S, 152°05'E; 410 m; K75-05-04. AMS I.24127-001 (48.5 HL, 250 TL); 34°17'S, 151°26'E, 410 m; K75-05-02. AMS I.26240-001 (46.1 HL, 222+ TL); 33°36'S, 151°57'E; 421–457 m; K85-17-02. **Tasmania.** NMV A3756 (27: 33.6–53.0 HL, 124+–233+ TL) and CAS 68410 (formerly NMV A3754)(5: 29.5–49.1 HL, 145–218+ TL); 42°41.7'S, 148°24.9'E, 444–448 m; RV *Soela* SO5/84/70. **Victoria (western).** NMV A3408 (3: 35.5–44.3 HL, 180–225 TL); 38°40'S, 141°15'E; 293–329 m. NMV A2139 (2: 29.8–41.6 HL, 161–214 TL); 38°25'S, 140°41'E, 650–680 m; FV *Halcyon* [field no. MFG 113]; 26 Oct 1981.

NON-TYPE MATERIAL.— **New South Wales.** AMS I.15970-027 (4: 37.1–40.4 HL, 195–190 TL); 33°46'S, 151°52'E; 503 m; K71-06-04. AMS I.15975-036 (43.0 HL, 209+ TL); 33°14'S, 152°21'E; 549–567 m; K72-04-01. AMS I.16565-003 (34.0 HL, 162+ TL); 33°45'S, 151°49'E; 457 m; K72-04-01. AMS I.19205-003 (4: 44.2–50.5 HL, 227–255 TL); 33°30'S, 151°58'E; 375–384 m; K76-07-01. **Victoria (eastern).** AMS I.15994-007 (25: 29.5–48.6 HL, 211–238 TL) and NMNZ P.043187 (10: 41.8–51.8 HL, 210–240+ TL); 37°42'S, 150°14'E; 412–439 m; K71-13-02. AMS I.18774-001 (47.0 HL, 220 TL); 37°42'S, 150°15'E; 412–439 m; K75-03-02. **Tasmania.** CAS 79577 (formerly NMV A3752)(10: 30.8–42.3 HL, 153+–236 TL); 42°42'18"S, 148°25'24"E; 428–450 m; RV *Soela*.

DISCUSSION

These two new species are additional examples of grenadiers that had previously escaped recognition because of their close similarity to previously described ones. It was only after close examination of many specimens that consistent characters were found that distinguished these species from their closest counterparts. Differences in pigmentation patterns were the first characters to capture our attention, which is contrary to what one might expect from members of a fami-

ly that are usually drab and without prominent markings or color patterns. However, the shallower-water species of *Coelorinchus*, and especially members of the *C. fasciatus* group, often possess highly characteristic pigmentation. The patterns are frequently subtle, but once recognized, they are characters that one can dependably utilize to differentiate between otherwise similar species. It seems likely that other “cryptically” hidden species will be found among the grenadier fauna, and it is incumbent on investigators to examine species that may otherwise appear to have broad geographical or vertical distributions. *Coelorinchus fasciatus* and *C. mirus* are two such species requiring closer scrutiny. It is noteworthy that DNA barcoding of Australia’s fishes for the mitochondrial gene COI (Ward et al., 2005) has produced a preliminary cladogram of *Coelorinchus*: four species (*C. hoangi*, *C. maurofasciatus*, *C. australis*, and *C. mirus*) of the *C. fasciatus* species group form a single clade with *C. hoangi* and *C. maurofasciatus* as sister taxa (R.D. Ward, pers. comm.). It is hoped that additional taxa can be analyzed soon to provide a more cohesive understanding of relationships within this large genus.

The diversity of the *C. fasciatus* species group and the relatively restricted ranges of most of the species are notable for the family. Of the 15 known species, only *C. fasciatus* can be considered as truly widespread, being known from Australia, New Zealand, and from both sides of the southern tip of South America (but, again, this should be looked at more closely). *Coelorinchus maurofasciatus* is found off both Australia and New Zealand, while five species are confined to Australia, seven to New Zealand, one to South Africa, and one to the southwestern Indian Ocean and southeastern Atlantic Ocean. Species in the group and their general distributions are (e., w., s., se. = eastern, western, southern, and southeast):

<i>C. amydrozosterus</i> Iwamoto and Williams, 1999	s. and w. Australia
<i>C. aspercephalus</i> Waite, 1911	New Zealand
<i>C. australis</i> Richardson, 1839	se. Australia
<i>C. biclinozonalis</i> Arai and McMillan, 1982	New Zealand
<i>C. bollonsi</i> McCann and McKnight, 1980	New Zealand
<i>C. cookianus</i> McCann and McKnight, 1980	New Zealand
<i>C. fasciatus</i> (Günther, 1878)	se. Australia, New Zealand, s. Chile and Argentina
<i>C. maurofasciatus</i> McMillan and Paulin, 1993	s. Australia and New Zealand
<i>C. mirus</i> McCulloch, 1926	e. and w. Australia
<i>C. mystax</i> McMillan and Paulin, 1993	New Zealand
<i>C. parvifasciatus</i> McMillan and Paulin, 1993	New Zealand
<i>C. simorhynchus</i> Iwamoto and Anderson, 1993	s. Africa
<i>C. vityazae</i> Iwamoto, Shcherbachev, and Marquardt, 2004	sw. Indian Ocean
<i>C. hoangi</i> new species	w. Australia
<i>C. gormani</i> new species	se. Australia

Of the 104 species of grenadiers now known to occur off Australia, 22 species are considered to be endemic. This represents a high percentage of endemics for a deep-sea fish group that was once thought to mostly comprise broadly distributed species. Various physical, biological, or historical factors have acted on this group to produce its high diversity, but what the specific factors were remain little known or mostly speculative.

A provisional key is provided below to facilitate identification of the included species. For the most part, proportional measurements were not used in preference to more visible and readily usable characters, but their use was unavoidable in the couplet where *C. parvifasciatus* and *C. gormani* are separated (however, their geographic distributions are distinct). Counts of pyloric caeca are useful in differentiating some species, but overlap in counts among most species precludes their being used exclusively. A phylogenetic analysis of the clade has yet to be made: it would be instructive to determine if the species compose a cohesive group, and if so, to determine what species are the closest relatives.

Key to the Species of the *Coelorinchus fasciatus* Group

- 1a. Underside of head completely scaly. 2
 1b. Underside of head mostly to fully naked, some species with isolated scales or patches of scales above and posterior to end of upper jaws (Fig. 6) 4
- 2a. Multiple narrow longitudinal stripes on dorsal aspects of body and part of head. *australis*
 2b. No longitudinal stripes on body. 3
- 3a. Two prominent saddle marks on body, one on nape anterior to first dorsal fin, the other below anterior end of second dorsal fin *biclinozonalis*
 3b. Several faint diagonal bands on body oriented obliquely down and forward *aspercephalus*
- 4a. A small black spot at base of pectoral fin; a large black blotch on pelvic fin (Figs. 6, 7a); dermal window of light organ (ADW) notably large (Fig. 7a), extending forward beyond line connecting anterior ends of pelvic fin bases; underside of head behind upper jaws mostly scaled *mirus*
 4b. No black spot on pectoral fin; pelvic fins lacking prominent black blotch (although middle of fin may be substantially darker than proximal and distal parts); ADW moderate to small, not extending forward beyond line connecting anterior ends of pelvic fin bases (Fig. 7b, c); underside of head naked or with small isolated scales 5
- 5a. Saddle marks or bands on body dark and prominent in some species, faint in other species. . 7
 5b. No saddle marks on body. 6
- 6a. Body scales with 5–7 divergent rows of spinules; two small scale patches on ventral surfaces of preopercle, one above articulation of lower jaw, the other close to posterior margin of preopercle (Fig. 8) (saddles present on specimens <30 cm TL). *bollonsi*
 6b. Body scales with as many as 15 parallel rows of spinules; underside of head naked, without scales *simorhynchus*
- 7a. Lips thick, heavily papillated; barbel well developed, 22–27% of HL, about equal to diameter of orbit; pyloric caeca more than 100 *mystax*
 7b. Lips moderate, not heavily papillated; barbel generally short, less than 20% HL, much shorter than orbit diameter; pyloric caeca fewer than 40 8
- 8a. Snout tipped with a large, sharply pointed terminal scute, such that viewed dorsally, snout profile forms an acute angle (Fig. 9). *vityazae*
 8b. Terminal snout scute broad and blunt; snout profile viewed dorsally forming an oblique angle 9
- 9a. The ADW relatively large, its anterior end at or just behind transverse line connecting inner edges of pelvic fin bases (Fig. 7c); several predorsal scales with sharp raised crests formed of enlarged spinules on median line; first dorsal and anal fins pale to dark dusky, without black blotches, margins, or stripes *amydrozosterus*
 9b. The ADW small to moderate in size, not reaching transverse line through inner margins of pelvic fin bases; predorsal scales with or without enlarged ridgelike scales; first dorsal and anal fins variously pigmented. 10
- 10a. Body scales with 5–7 slightly divergent spinule rows; two small patches of scales on underside of head above and behind angle of jaws (Fig. 8). *bollonsi*

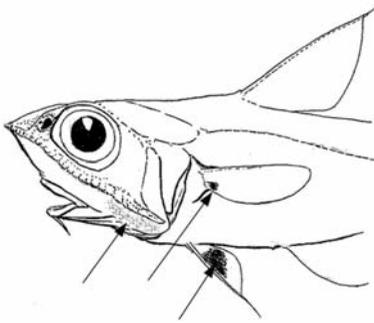


FIGURE 6. Lateral view of *Coelorinchus mirus*; arrows point out scaly underside of head behind vertical of upper jaws and black spots on pectoral and pelvic fins.

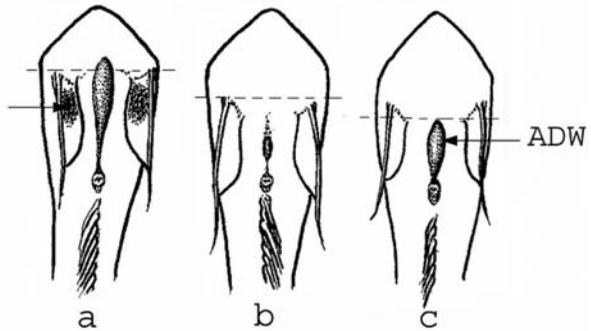


FIGURE 7. Ventral view of trunk of (a) *Coelorinchus mirus* showing large anterior dermal window of light organ (ADW) and large spot on pelvic fins; (b) *C. hoangi* showing size and position of ADW; (c) *C. amydrozosterus* showing size and position of ADW.

- 10b. Body scales with 7 or more parallel spinule rows; few isolated scales or none on underside of head 11
- 11a. Saddle marks faint or absent anteriorly; pale interspaces between saddles posteriorly on tail spot-like viewed dorsally (Fig. 10); broad areas on each side of midline dorsally behind leading edge of snout usually naked (Fig. 11), but sometimes scaly 12
- 11b. Saddle marks generally prominent from nape to tip of tail, pale interspaces not spotlike; areas dorsally behind leading edge of snout densely scaled 13
- 12a. Underside of head naked; pyloric caeca 19–26; orbit diameter 44–49% HL, suborbital 16–18% HL *gormani*
- 12b. One or two small scale patches often present on underside of head; pyloric caeca 22–28; orbit diameter 31–46% HL, suborbital 13–16% HL *parvifasciatus*
- 13a. Scales on predorsal midline notably thick and elevated, with raised median crest of large spinules; body scales deciduous *fasciatus*
- 13b. Predorsal scales not notably thick or elevated; body scales relatively adherent 14
- 14a. Black distal two-thirds of first dorsal fin set off from paler proximal portions; dark anterior part of anal fin forming dark stripe *maurofasciatus*
- 14b. First dorsal fin light to dark dusky, not sharply set off into dark and pale regions; anal fin dusky to coarsely peppered, lacking dark stripe 15
- 15a. Branchiostegal rays and membranes pale; preopercle dark dorsally, subopercle paler; anal fin with dark stripe; scales below mid-base of first dorsal fin 4.5–5.5 (usually 5.5); pyloric caeca 19–27 *cookianus*
- 15b. Branchiostegal rays and membrane blackish; preopercle and subopercle blackish; anal fin usually uniformly dusky; scales below mid-base of first dorsal fin 3.5–4.5; pyloric caeca 17–23 *hoangi*

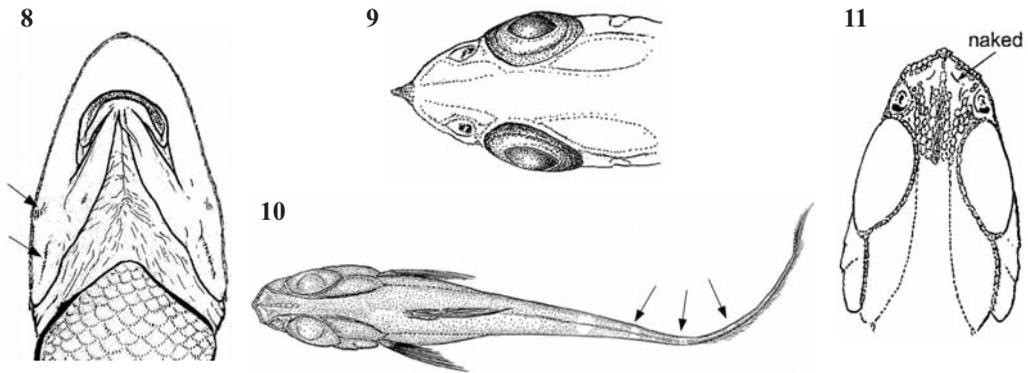


FIGURE 8. Ventral view of head of *Coelorinchus bollonsi* showing small scale patches above angle of lower jaws and on preopercle.

FIGURE 9. Dorsal view of head of *Coelorinchus vityazae* showing pointed snout

FIGURE 10. Dorsal view of *Coelorinchus gormani* new species showing pale spots on dorsum of tail.

FIGURE 11. Dorsal view of head of *Coelorinchus gormani* new species showing naked areas above snout.

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