A New Species, *Caelorinchus sheni*, and 19 New Records of Grenadiers (Pisces: Gadiformes: Macrouridae) from Taiwan

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This paper reports 1 new species, *Caelorinchus sheni* sp. nov., and 19 new records of grenadiers (Macrouridae) from Taiwan which were collected by bottom trawler and landed at the fishing harbors of Tashi and Nanfangao in northeastern Taiwan and Tungkang in southwestern Taiwan. The diagnostic characters for *C. sheni* sp. nov. are the prominent banding pattern on the body, the large mouth with conical teeth in a relatively long band, and the anterolateral snout margin incompletely supported by bone. *Caelorinchus sheni* is similar to *C. quadricristatus* and *C. celaenostomus*. The 3 species differ in details of the dentition, the shape of the preopercle and subopercle, banding patterns, and proportions. The species newly recorded in Taiwan are *Bathygadus antrodes*, *B. garretti*, *B. nipponicus*, *Gadomus colletti*, *Caelorinchus asteroides*, *C. longissimus*, *C. productus*, *Hymenocephalus lathemnomus*, *Hymenogadus gracilis*, *Kumba japonica*, *Lucigadus lucifer*, *Nezumia condylura*, *Pseudocetonurus septifer*, *Ventrifossa atherodon*, *V. divergens*, *V. longibarbata*, *V. macroptera*, *V. rhipidodorsalis*, and *V. saikaiensis*. In addition to the description of the new species and 19 new records, color photos of each species and a diagnostic key for all 40 species in the family Macrouridae are provided.

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Key words: Fish fauna, Macrouridae, Fish taxonomy, Deep-sea fishes, New species.

Grenadiers occupy all oceans from the low Arctic to Antarctic with most species living at depths of between 200 and 2000 m. The food of these fishes consists of a wide range of fish and both benthic and pelagic invertebrates. Most grenadiers are benthopelagic. Four subfamilies (or families, see Iwamoto 1990), 38 genera, and more than 375 species (Iwamoto 1990; personal records of TI) are currently recognized in the world. Three genera, *Caelorinchus*, *Coryphaenoides*, and *Nezumia*, comprise over 1/2 of the species.

The earliest literature reporting on grenadiers of Taiwan probably dates from 1920 when Gilbert and Hubbs listed 3 genera and 5 species from the region. In 1970, Okamura listed 3 genera and 7 species. Iwamoto (1990) listed 3 genera and 5 species. The first synoptic work on grenadiers of Taiwan was done by Shen (1984), who listed a total number of 3 genera and 9 species. Chen and Yu (1986) added 1 genus and 5 species. According to *Fishes of Taiwan* (Shen et al. 1993), 1 subfamily, 5 genera, and 19 species were known to occur in Taiwan. The present study attempts to review this group of fishes by re-examining previously deposited specimens and collecting new specimens retrieved by deep-sea bottom trawlers, which operate at the depths of from 300 to 800 m in northeastern waters near Tashi and Nanfangao and southwestern waters near Tungkang. Our preliminary results obtained total of 2 subfamilies and 11 genera. They include 2 new species of *Caelorinchus* and 19 new records. One of the new species, *C. leporhinus*, has been described.

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elsewhere (Chiou et al. 2004). The new present species, *C. sheni*, and the following 19 species described are newly added to the Taiwanese fauna: *Bathygadus antrodes*, *B. nipponicus*, *B. garretti*, *Gadomus colletti*, *Caelorinchus astero- des*, *C. brevirostris*, *C. longissimus*, *C. productus*, *Hymenocephalus lethonemus*, *Hymenogadus gracilis*, *Kumba japonica*, *Lucigadus lucifer*, *Nezumia condylura*, *Pseudocetonurus septifer*, *Ventifossa atherdon*, *V. divergens*, *V. longibarbata*, *V. macroptera*, *V. ripidodorsalis*, and *V. saikaiensis*. Thus, the total number of Macrouridae collected from the waters around Taiwan is increased to 40 species.

**MATERIALS AND METHODS**

Most specimens were collected by deep-sea bottom trawlers from the fishing ports of Tashi or Nanfangao in northeastern Taiwan, and from Tungkang on the southwestern coast of Taiwan. A portion of the specimens was borrowed from the collections of National Taiwan University (NTUM), Institute of Zoology, Academia Sinica (ASIZP), Tunghai University (THUP), and National Sun Yat-Sen University (NSYSU). All counts of meristic characters and measurements of morphometric characters follow Iwamoto (1990). Abbreviations used for characters include: A, anal fin; ADW, anterior dermal window; BD, body length; D, dorsal fin; GR-I, gill-rakers on 1st arch, GR-II, gill-rakers on 2nd arch; HL, head length; LP-A, distance between base of outer pelvic ray and anal origin; LR, longitudinal scale rows in a series from the middle of the 1st dorsal base; Orbit, greatest orbit diameter; P, pectoral fin; Pc, pyloric caeca; PDW, posterior dermal window; PO, preoral length of snout; Postorb, least postorbital length of head; SL, snout length; TL, total length; and V, pelvic fin. Descriptions of body coloration are based on fresh specimens. All specimens we collected are deposited at the Institute of Zoology, Academia Sinica (ASIZP) and National Taiwan University (NTUM).

**Family Macrouridae**

**Key to subfamilies, genera, and species of the family Macrouridae in Taiwan**

1a. Second dorsal fin better developed than anal fin and starting close behind 1st dorsal; outer gill rakers on 1st arch slender, lathlike, not tubercular; outer gill slit not restricted by folds of skin connecting upper and lower extent of 1st gill arch with operculum (Bathygadinae) ............................................. 2

1b. Anal fin better developed than 2nd dorsal; with distinct gap between dorsal fins; gill rakers all tubercular; outer gill slit restricted by folds of skin (Macrourinae) ............................................. 5

2a. Barbel always present, much longer than orbit; teeth exceedingly minute, in villiform bands; interopercle high and trapezoid; olfactory bulbs in contact with forebrain...... ................................. *Gadomus colletti*

2b. Barbel present or absent, if present, much shorter than orbit; teeth coarser, granular, in bands; interopercle slender, posterior portion directed downward; olfactory bulbs between orbits (Bathygadus) ............................................. 3

3a. Head exceedingly broad; interorbital space much wider than 1.5-times diameter of orbit; gill-rakers exceeding 26; mandibular ramus with a single series of scales; no barbel ............................................. *Bathygadus antrodes*

3b. Head moderately broad; interorbital space narrower than 1.5-times diameter of orbit; gill-rakers fewer than 23; mandibular ramus with 1.5 or 2 series of scales; barbel present or absent............................................. 4

4a. Barbel absent; pelvic rays 9 ..........*Bathygadus nipponicus*

4b. Minute barbel present; pelvic rays 10 or 11................... ................................. *Bathygadus garretti*

5a. Six branchiostegal rays (Caelorinchus and Coryphaenoides)........................................................................ 6

5b. Seven branchiostegal rays .......................................................... 23

6a. Gill-rakers absent on lateral side of 1st gill arch .......... ........ 7

6b. Gill-rakers present on lateral side of 1st gill arch............. ................................. *Coryphaenoides microps*

7a. Body scales strongly developed; light organ short; anterior end not crossing forward of line connecting pelvic fin bases ............................................................................. 8

7b. Body scales weak; light organ long, anterior end crossing forward of line connecting pelvic fin bases .......... ................................. 16

8a. Little or no external evidence of light organ............... ...... 9

8b. A distinct blackish fossa of light organ on belly .......... .... 11

9a. Prominent vertical bars on body ..........*Caelorinchus sheni*

9b. Body without vertical bars .............................................. 10

10a. Underside of head scaled; spinule rows parallel............. ................................. *Caelorinchus paralelalus*

10b. Underside of head naked; spinule rows divergent ........... ................................. *Caelorinchus gilberti*

11a. Scale spinules in 1 row between occipital ridges .............. ................................. *Caelorinchus japonicus*

11b. Scale spinules with several diverging rows between occi- pital ridges ............................................................................. 12

12a. Spinules of median nasal ridge scales in stellate arrange- ment ............................................................................. *Caelorinchus asteroides*

12b. Spinules of median nasal ridge scales in divergent arrange- ment ............................................................................. 13

13a. Underside of head scaled ..........*Caelorinchus smithi*

13b. Underside of head mostly naked.............................. ................................. 14

14a. A patch of scales on ventral surface of preopercle .......... ................................. *Caelorinchus leptorhinus*

14b. No small patch of scales on ventral surface of preopercle ............................................. 15

15a. Body scales with stout spinules in 4 to 10 divergent rows... ................................. *Caelorinchus anatropis*

15b. Body scales with weak spinules in 3 to 5 divergent rows.. ................................. *Caelorinchus productus*

16a. A prominent blackish blotch above and behind pectoral fin base ............................................. *Caelorinchus kishinouyei*

16b. No blackish blotch behind pectoral fin base .......... ........ 17

17a. Spinules on body scales relatively long and slender; spi- nule rows parallel.......................................................... 18
17b. Spinules on body scales short; spinule rows divergent.............. .............................................. 19
18a. Prominent body markings consisting mostly of blotches and saddle marks; spinous 2nd ray short, less than HL...... ........................................................................ 19
18b. No body markings; spinous 2nd ray developed and elongated to greater than HL............................ 20
19a. Three longitudinal streaks on body; 2nd dorsal fin high....... ................................................................ 20
19b. No body marks; 2nd dorsal fin low................................. ................ 20
20a. A small patch of scales ventrally on preopercle.................. .......................................................... 20
20b. Preopercle naked .......................................................... 21
21a. Body markings prominent, consisting of broken stripes..... .................................................................... 21
21b. Body markings not prominent ............................................ 22
22a. Pelvic fins uniformly blackish; spinules short, triangular .......................................................... 22
22b. Pelvic fins not blackish; spinules slender and weak......... ................................................................ 22
23a. Ventral striae on gular membrane, side of isthmus, over shoulder girdle; integument of head membranous, essentially transparent; head bones thin, fragile ...................... 24
23b. No ventral striae; head integument thick; head bones not especially fragile ........................................ 24
24a. Spinous dorsal ray serrated; fewer than 15 inner gill rakers on lower limb of 1st arch ...................... 25
24b. Spinous dorsal ray smooth; more than 15 inner gill rakers on lower limb of 1st arch ......................... 25
25a. No chin barbel, pelvic fin rays 11 to 12............................ 26
25b. Chin barbel long, pelvic fin rays 8................................. 26
26a. Barbel length more than orbit length............................ 26
26b. Barbel length less than orbit length.............................. 26
27a. Lateral line scales absent ............................................. 28
27b. Lateral line scales present ............................................ 28
28a. Lower jaw teeth large, widely spaced, in 1 row; scales present on lowermost branchiostegal rays.................. ........................................................................ 29
28b. Lower jaw teeth moderate to small, closely spaced, in more than 1 row; no branchiostegal scales .......... 29
29a. Upper jaw not extending posteriorly beyond orbit.......... 30
29b. Upper jaw extending posteriorly beyond orbit......... .............................................................. 30
30a. Second spiny ray smooth ............................................. 31
30b. Second spiny ray serrated ............................................. 31
31a. Pores of head rather prominent .................................... 32
31b. Pores of head small, inconspicuous ............................... 32
32a. Pelvic fin rays 7 to 8 .................................................. 32
32b. Pelvic fin rays 10 to 12 ................................................. 32
33a. Spinules on body scales broadly triangular..................... ................................................................ 33
33b. Spinules on body scales conical to narrowly lanceolate..... .................................................................... 34
34a. Above longitudinal stripe, body and tail with dusky band........................ ....................................... 34
34b. Above longitudinal stripe, body and tail without dusky band .......................................................... 34
35a. A prominent black blotch on 1st dorsal fin ..................... 35
35b. First dorsal fin uniformly dusky or somewhat darker basally ............................................................ 35
36a. Anal fin with a black margin anteriorly.......................... 36
36b. Anal fin without a black margin anteriorly ....................... 36
37a. Barbel length greater than orbit length........................... ...................................................................... 37
37b. Barbel length less than orbit length.............................. ...................................................................... 37
38a. Scale pockets brown .................................................. 38
38b. Scale pockets not dark-edged .............................. Ventrifossa divergens 39
39a. Suborbital ridge developed ............................................ 39
39b. Suborbital ridge weak ................................................. 39

**Caelorinchus sheni sp. nov.**

(Fig. 1)

**Material examined:** Holotype: ASIZP 061348, ♀ (113 mm HL, 420+ mm TL), northeastern Taiwan, off Tashi; 24°54’63”N, 120°03’49”E, in 400-650 m; taken by trawler “Gin Ton Long”, 30 May 2001.

**Paratypes:** ASIZP 061232, ♀ (257 mm HL, 937+ mm TL); Lauto; 22°20’05”N, 120°12’12”E; 1 Mar. 1999. CAS 215541 (110 mm HL, 427 mm TL); Taiwan, 2002.

**Diagnosis:** A species of the genus Caelorinchus, Group II, as defined by Iwamoto (1990), characterized by the following combination of characters: snout relatively long, length about 2.5 in HL, with blunt tip, anterolateral margin incompletely supported by bone; suborbital ridge composed of 2 rows of thick, stout, modified scales; orbit large, about 2.0 in snout length; mouth opening large, rictus more than 2/3 length of upper jaw; opercular opening far forward, with a free fold across isthmus; underside of head scaled; nasal fossa fully scaled; body scales large, with 5-7 sharp, divergent rows of spinules; light organ small with a short and slender blackish streak; numerous prominent saddle markings on body; dusky triangular marking anteriorly on isthmus.

**Description:** Counts: 1D. II, 8-9; PI. 18-19; V. rays 7; GR-I (inner) 9-10, GR-II (outer) 6-8; scales 1: 937+ mm TL; Lauto; 22°20’05”N, 120°12’12”E; 1 Mar. 1999. CAS 215541 (110 mm HL, 427 mm TL); Taiwan, 2002.

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![Fig. 1. Caelorinchus sheni n. sp. Holotype, ASIZP0061348, 113 mm HL, 420+ mm TL, from the northeastern coast of Taiwan in 400-650 m.](image-url)
below 1D. 4.5-5, below 2D. 5-6, lat. line 33-41. Measurements: TL of specimens examined 420-937+ mm; HL 113-257 mm. The following in percent of HL: snout length 41-56; preoral length 32-26 internasal width 20-21; interorbital width 25-26; orbit diameter 20-21; suborbital width 6-8; postorbital length 37-40; distance from orbit to angle of preopercle 39-42; upper jaw length 30-37; barbel length 9-11; length of 1st gill slit 10-13; preanal length 30-42; greatest body depth 61-64; body depth at A. origin 45-46; interspace between 1st and 2nd dorsal fins 22-23; height 1D. 45-48; length P. 44-50; length outer V. ray about 42; outer V. to A. about 37.

Head about 3.6-3.7 in TL, greatest width more than snout length. Body relatively stout depth about 5.7-6.5 in TL. Snout in lateral view deep, dorsal profile gently convex; viewed dorsally, snout narrow with gently curving sides. Terminal snout scute small, tricuspid, blunt, heavy, and spiny. Orbit large, diameter about 1/2 length of snout. Length of postorbital less than that of pectoral fin. Interorbital space wide, about 1.2-1.3 into orbit. Terminal angle of subopercle forming broad flap. Suborbital ridge well developed along entire length, 2 stoutly spinulated rows along preopercular section and under orbit, latter series separated from ventral margin of orbit by 2 rows of much smaller scales. Opercular opening large, extending to below posterior margin of orbit, with a narrow free fold of gular membrane across isthmus. Mouth rather large, snout tip below anterior nostril; rictus length greater than 2/3 of upper jaw length; maxilla not extending beyond posterior margin of orbit; lips thick and fleshy. Posterior nostrils large. Chin barbel slender and short, equal to about 1/2 orbit diameter.

Premaxillary teeth conical, in long broad bands occupying about 2/3 of upper jaw, peripheral teeth enlarged. Mandibular teeth villiform, in long broad band extending entire length of rictus. Body scales large, covered with sharp, overlapping, recurved, blade-like spinules, arranged in 5-7 widely divergent, ridge-like rows (Figs. 2, 3); base of spinules with buttresses. Scales of head ridges stout but not particularly prominent except along suborbital ridge. No enlarged occipital or supraoccipital scale. Underside of head completely and uniformly covered with small scales encircled by small spinules aligned in longitudinal rows. Nasal fossa covered with small scales anteriorly and ventrally.


Ground color uniformly light brownish; bluish on abdomen. At least 15 broad, brownish saddle markings on body from trunk to tip of broken tail.

Figs. 2-3. Scale from region below first dorsal fin (above lateral line). *Caelorinchus sheni*, ASIZP0061348 (113 mm HL).

Fig. 4. *Caelorinchus sheni* n. sp. Holotype, ASIZP 0061348, 113 mm HL, 420+ mm TL, from the northeastern coast of Taiwan in 400-650 m.
the 1st beginning on nape below base of 1st dorsal fin, saddles alternatively deep brown and light brown. All saddle-like markings extending below midlateral line. Posterior portion of supraoccipital, anterior margin of opercle, lips, barbel, gill membranes, and 2nd dorsal fin pale. All anterior parts of head from behind orbits to snout tip appearing pale in photographs, even on the underside of head. Anterior part of supraoccipital, occipital region, oral cavity, underside of head, gill cavity, and ramus of lower jaw dark. Most of opercle, a triangular section on chest, pelvic fins (but not prolonged outer ray, which is white), and margin of anal fin blackish.

**Size:** To greater than 937 mm TL.

**Distribution:** Known only from 3 specimens captured off northeastern and southeastern Taiwan at 450-650 m in depth.

**Etymology:** Named in honor of Dr. S.C. Shen of National Taiwan Univ., for his many contributions to ichthyology.

**Comparisons:** *Caelorinchus sheni* closely resembles *C. quadricristatus* Alcock, 1891 from the Indian Ocean and *C. celaenostomus* McMillan and Paulin, 1993 from New Caledonia and New Zealand. The 3 appear to form a species group characterized by each having the combination of incomplete support of the anterolateral snout margin, similar dentition and squamation, prominent saddle marks, a similar snout shape, a large mouth, a small light organ, and a fully scaled underside of the head. *C. aelorinchus hexfasciatus* Okamura, 1982, *C. longicephalus* Okamura, 1982, and *C. tokiensis* (Steindachner and Döderlein, 1887) are also closely similar to these species except that the underside of the head is almost entirely naked (a patch of scales usually present on ventral surface of preopercle).

*C. celaenostomus* differs from *C. sheni* in the uniformly brownish color of the saddles and the orientation of the markings: in *C. sheni* all saddles extend downwards and backwards from the dorsal profile; in *C. celaenostomus* the saddles on the trunk and those below the anterioriormost part of the 2nd dorsal fin extend more or less downwards and forwards, while those behind are defined by pale interspaces that go both ways. Scales on top of the head and the general shape of the snout and head differ, and the subopercle in *C. celaenostomus* terminates in a slender flexible flap. The preopercle is more rounded in *C. sheni*. The chin barbel in *C. celaenostomus* is longer and stouter, the lips thicker, the pelvic fins shorter (not extending beyond the origin of the anal fin), the light organ lacks an external blackish streak, and the gill opening does not extend as far forward as in *C. sheni*. Morphometric differences include orbit diameter (1.7-1.9 in snout length in *C. celaenostomus* cf. 2.0 in *C. sheni*), internasal width (12%-20% HL cf. 20.6%-21%), head width (about equal to or less than snout length cf. more than snout length), suborbital width (8%-14% HL cf. 6%).

*C. quadricristatus* differs from *C. sheni* in having the saddle-like markings not crossing the midlateral line of the abdomen; the anal fin uniformly pale to dusky and lacking a blackish margin; a sharper, narrower terminal snout scute; and the 2nd dorsal fin beginning closer behind the 1st (interdorsal space about 1/2 D1 base in *C. quadricristatus* cf. about equal to D1 base in *C. sheni*).

*C. sheni* and *C. tokiensis* are the only species of the genus from Taiwan waters having prominent saddle-like markings on the body. *C. tokiensis* differs from *C. sheni* in having a slightly longer snout, the underside of head almost entirely naked, and most scales between occipital ridges with spinules arranged in a single keel-like row.

**Remarks:** A rare species, the huge specimen of attaining 937+ mm TL was taken by a commercial trawler at about 600 m in depth. It is the largest specimen ever seen in this genus. The species of *C. longicephalus* Okamura, 1982 was the previous record holder at 89 cm, although *C. celaenostomus* approached 83 cm TL. Most adults of the species of this genus are less than 30 cm in TL. The holotype shows differences from the smaller paratype in dentition, body proportions, and color. The teeth size, head length, trunk length, and terminal snout scute are all relatively shorter than in the paratype. The pectoral fin in the holotype is uniformly blackish, but paler in the paratype.

### Bathygadus Günther, 1878


There are between 9 (Howes and Crimmen 1990) and 14 (Iwamoto 1990) species of this genus in the world, with 2 species reported in Taiwan.

### Bathygadus antrodes (Jordan & Gilbert, 1902)

(Fig. 5)

*Melanobranchus antrodes* Jordan and Gilbert, 1902: 606, pl. 4. fig.1, Sagami Bay, Japan (original description).
Fig. 5. *Bathygadus antrodes*, ASIZP 061225, TL 635 mm.

Fig. 6. *Bathygadus garretti*, ASIZP 061228, TL 458 mm.

Fig. 7. *Bathygadus nipponicus*, ASIZP 061227, TL 362 mm.

Fig. 8. *Gadmus colletti*, ASIZP 061223, TL 363 mm.

Fig. 9. *Caelorinchus asteroides*, ASIZP 061339, TL 302 mm.

Fig. 10. *Caelorinchus longissimus*, ASIZP 061337, TL 202 mm.

Fig. 11. *Caelorinchus productus*, ASIZP 061326, TL 296 mm.

Fig. 12. *Hymenocephalus lethonemus*, ASIZP 061231, TL 126 mm.
Fig. 13. *Hymenogadus gracilis*, ASIZP 061229, TL 118 mm.

Fig. 14. *Kumba japonica*, ASIZP 061240, TL 162 mm.

Fig. 15. *Lucigadus lucifer*, ASIZP 061308, TL 110 mm.

Fig. 16. *Nezumia condylura*, ASIZP 061238, TL 186 mm.

Fig. 17. *Pseudoctenurus sepitfer*, ASIZP 061237, TL 147 mm.

Fig. 18. *Ventrifossa atherodon*, ASIZP 061311, TL 245 mm.

Fig. 19. *Ventrifossa divergens*, ASIZP 061309, TL 220 mm.

Fig. 20. *Ventrifossa longibarbata*, ASIZP 061242, TL 272 mm.

Diagnosis: D1. II, 7-9; P. i15-i16; V. 9; Scales 1D. 8-9, 2D. 9-10; GR-I (outer/inner) 26-30/19-21; Pc. 14-16. Head very wide and rather elongate. Bones of head soft and cavernous. Orbit small. Mouth terminal and oblique. Teeth minute, roughly equal, with arrow-shaped tip, set in broad band on premaxillary and in narrow band on dentary. No teeth on vomer or palatine. No barbel. Scales cycloid, small, and deciduous. Scales on mandibular ramus comparatively large, arranged in a single row.

Distribution: Southern Japan and northeastern Taiwan.

**Bathygadus garretti** Gilbert & Hubbs, 1916
(Fig. 6)

*Bathygadus garretti* Gilbert and Hubbs, 1916: 151, pl. 8, Suruga Gulf, Japan (original description).


Diagnosis: D1. II, 9; P. i18; V. 10-11; Scales 1D. 7-8, 2D. 10-15; GR-I (outer/inner) 5+18/4+16; Pc. 49. Head moderately wide and comparatively firm, slightly longer than 1/2 length to vent. Snout low, not broad, slightly longer than or as long as orbit; width at frontal margin of orbit much narrower than twice preocular length. Orbit large. Mouth terminal and lateral, slightly oblique. Teeth minute, rather conical in shape, set in broad band on premaxillary and in narrow band on dentary. Scales small, cycloid, thin, and deciduous. Mandibular ramus with double scale rows, one of which consisting of large scales and the other smaller ones.

Distribution: Southern Japan and northeastern Taiwan.

**Bathygadus nipponicus** (Jordan & Gilbert, 1902)
(Fig. 7)


Material: ASIZP 061227, 1 specimen, 362 mm TL, June 2000, Tashi.

Diagnosis: D1. II, 9-10; P. i18; V. 9-10; Scales 1D. 7, 2D. 10; GR-I (outer/inner) 5+18/3+15; Pc. 49. Head moderately wide, longer than 1/2 length to vent. Snout low, broad, longer than or as long as orbit; width at frontal margin of orbit much narrower than preocular length. Orbit large. Mouth terminal and lateral, no chin barbel. Teeth minute, rather conical in shape, set in broad band on premaxillary and in narrow band on dentary. Scales cycloid. Mandibular ramus with double scale rows.

Fig. 21. *Ventrifossa macroptera*, ASIZP 061244, TL 199 mm.

Fig. 22. *Ventrifossa rhipidodorsalis*, ASIZP 061246, TL 170 mm.

Fig. 23. *Ventrifossa saikaiensis*, ASIZP 061248, TL 250 mm.
Distribution: Southern Japan and northeastern Taiwan.

Gadomus Regan, 1903

Gadomus Regan, 1903: 459 (type-species by original designation: Bathygadus longifilis Goode and Bean).

There are about 12 species of this genus in the world (Howes and Crimmen 1990,IWamoto and Williams 2001); only 1 species occurs in Taiwan.

Gadomus colletti Jordan & Gilbert, 1904

(Fig. 8)

Gadomus colletti Jordan and Gilbert, 1904: 603, Suruga Bay, Japan (original description).


Materials: ASIZP 061223, 1 specimen, 363 mm TL, Mar. 1999, Tashi; ASIZP 061224, 1 specimen, 382 mm TL, June 2001, Tashi.

Diagnosis: D1. II,9-12; P. i18-21; V. 8; Scales 1D. 7.5-8.5, 2D. 14-16; GR-I (outer/inner) 24-27/18-20; Pc. 105-134. Bones of head rather firm and not cavernous. Snout low, not blunt at tip, decidedly shorter than diameter of orbit and not protruding beyond mouth; width at frontal margin of orbit slightly wider than 1/2 length of snout. Mouth large, terminal, and lateral; teeth in villiform bands on both jaws. No teeth on vomer or pala-tine. Barbel filamentous, about as long as, or a little shorter than length of head. Gill-opening wide, extending to a vertical through center of pupil. Scales cycloid. Mandibular ramus provided with but 1 scale row. Color pale. Jaws white. All fins dusky; dorsal and anal fins darkening toward edge.

Distribution: Southern Japan and northeastern Taiwan.

Caelorinchus Giorna, 1810

Caelorinchus Giorna, 1810: 179 (type-species by original designation: Lepidolepus caelorhincus Risso).

Krohnius Cocco, 1884: 1 (type-species by original designation: Krohnius filamentosus Cocco=Coelorhynchus coelorhyn-chus (Risso)).

Paramacrurus Bleeker, 1874: 370 (type-species by original designation: Lepidolepus australis Richardson).

Oxyacrus Bleeker, 1874: 370 (type-species by original designation: Macronurus jāponicus Temminck and Schlegel).

Oxygadus Gilbert and Hubbs, 1920: 515 (as a subgenus of Coelorhynchus for Macrurus parallelus (Günther)).

There are more than 100 valid species of this genus in the world (Eschmeyer 1998; personal data of TI); 17 species have been found in Taiwan.

Caelorinchus asteroides Okamura, 1963

(Fig. 9)

Coelorinchus asteroides Okamura, 1963: 21, figs.1-4, off Owase, Mie Pref., Japan (original description).

Materials: ASIZP 061339, 1 specimen, 302 mm TL, June 2000, Tashi; ASIZP 061340, 1 specimen, 310 mm TL, Dec. 2000, Tungkang.

Diagnosis: D1. II,8-9; P. i17-i19; GR-I (inner) 1+6; Scales 1D. 3-3.5, 2D. 4-4.5; Pc. 40-50. Head about as wide as deep, depressed anteriorly; middle of length of head behind anterior border of pupil. Snout short and broadly protruding, with acute rostral spine; lateral margin strongly curved. Teeth in premaxillaries conical, not arrow-shaped, in 5 to 8 irregularly oblique series, forming a wide band as a whole, those of outer series evenly enlarged and widely spaced. Scales on body large, hexagonal, and rather deciduous; spinules stout and pungent, forming 4-11 divergent ridges, last spine of each series more or less projecting beyond apical margin of scales. Scales on head coarser, less imbricated, and more adhesive than those on body; scales 7 or 8 in a longitudinal series on nasal crest, with spinous rows radiating in all directions from center of each scale, spinules never on ridges but independently rising from surface of scales. This median series of scales followed on each side by a single series of less-modified scales. Nasal fossa naked. No naked area on dorsal surface of snout, but a naked groove extending from base of rostral spine backward to interorbital space alongside median rostral series of scales. Underside of head, including mandibular regions and branchiostegal membranes, entirely naked. Vent immediately before anal fin and preceded by a luminous organ of short type.

Distribution: Southern Japan and Taiwan.

Caelorinchus longissimus Matsubara, 1943

(Fig. 10)

Coelorinchus longissimus Matsubara, 1943: 140, fig. 5 (type locality, Kumano-Nada, Japan).

Materials: ASIZP 061337, 1 specimen, 202 mm TL, Mar. 1999, Tashi; ASIZP 061338, 1 specimen, 292 mm TL, Tungkang.

Diagnosis: D1. II,8-10; P. i16-i20; GR-I (inner) 2+6; Scales 1D. 3-4.5, 2D. 3.5-4.5; Pc. 16-23. Head large, about as wide as deep, usually longer than 1/4 total length of body. Orbit oval, moderate in size. Sensory canals on head spacious. Mouth small, entirely inferior. Teeth conical. Scales near-
ly hexangular, thin and rather deciduous; spinules weak, slender, in 6-14 divergent rows. A large naked area present dorsally behind anterolateral margin of snout. Nasal fossa largely naked. Luminoe organ long, superficial blackish streak about as long as head exclusive of snout; anterior photophore fossa-like, but scaled.

**Distribution:** Southern Japan and Taiwan.

**Caelorinchus productus** Gilbert & Hubbs, 1916

(Fig. 11)

*Caelorinchus productus* Gilbert and Hubbs, 1916, 51: 175, pl. 9, fig. 1 (Suruga Gulf, Japan, 360-543 m).

**Materials:** ASIZP 061326, 1 specimen, 296 mm TL, May 2000, Tashi; ASIZP 061327, 1 specimen, 278 mm TL, June 2001, Tashi.

**Diagnosis:** D1. II,8-10; P. i17-i18; V. 11-12; GR-I (inner) 1+7; Scales 1D. 3.5-4, 2D. 4.5; Pc. 22-27. Snout moderately long, pointed, 1.5 to 1.7 times in orbit diameter. Teeth in broad, short band in premaxillary, band falling well short of end of rictus. Underside of head naked except for small patch below preopercle angle. Light organ small, length 2.8-3 times orbit diameter; periproct, slightly removed from anal fin origin, fossa of light organ narrow, extending forward immediately before anus, anterior end about equidistant from pelvic fin insertions and anal fin origin. Body scales covered with dagger-like spinules in 3-5 slightly divergent ridge-like rows, median row strongest.

**Color:** Overall brownish to swarthy, silvery ventrally; fins dusky to blackish; mouth and gill cavities blackish.

**Distribution:** Southern Japan, East China Sea, and northern Taiwan.

**Hymenogadus Gilbert & Hubbs, 1920**

*Hymenogadus* Gilbert and Hubbs, 1920: 521 (as a subgenus of *Hymenocephalus* for *Hymenocephalus gracilis* Gilbert and Hubbs).

*Hymenogadus gracilis* Gilbert & Hubbs, 1920

(Fig. 13)


**Materials:** ASIZP 061229, 1 specimen, 118 mm TL, Dec. 1999, Nanfangao; ASIZP 061230, 1 specimen, 120 mm TL, Dec. 1999, Nanfangao.

**Diagnosis:** D1. II,9-12; P. i15-i17; V. 8; Scales 1D. 2, 2D. 3; GR-I (outer/inner) 11-19/8-12; Pc. 105-134. Body slender and subcylindrical, compressed posteriorly. Mouth large, slightly oblique, contained in underside of head. Teeth minute, in narrow bands on both jaws. Barbel slender, usually about as long as 2/3 diameter of orbit. Scales
large, thin, and cycloid. Luminous organ elongated and with 2 external lenses. Black streak present along anterolateral margin of snout, along upper margin of orbit, along inner margin of each lip, and along both sides of mandibular sensory canal. Ventral striae, consisting of alternate lines of black and silver, well developed on isthmus and on ventral regions. Luminous organ, except for lenses, jet black.

**Distribution:** Southern Japan and northeastern Taiwan.

### Kumba Marshall, 1973


There are 7 species of this genus in the world (Iwamoto and Sazonov 1994); only 1 species occurs in Taiwan.

### Kumba japonica (Matsubara, 1943)

(Fig. 14)

*Lionurus japonicus* Matsubara, 1943: 149-152, fig. 9 (holotype: FAKU 1951, 176 mm TL; Kumano-Nada, Japan; paratype FAKU 1938, 155 mm TL). Kamohara, 1959: 8 (Tosa Bay, Japan).


*Ventrifossa japonica* Okamura, in Okamura et al. 1982: 147, 349, fig. 91 (10 specimens; Japan and Kyushu-Palau Ridge, 550-710 m).

**Materials:** ASIZP 061240, 1 specimen, 162 mm TL, Dec. 2000, Tungkang; ASIZP 061241, 1 specimen, 156 mm TL, Dec. 2000, Tungkang.

**Diagnosis:** D1. II,10-11; P. i19-i21; V. 11-12; GR-I (outer/inner) 8-10/12-13; Pc. 40-52. Head firm, non-inflated head sensory canals with prominent pores; scaleless area on dorsal surface of snout extending only to lateral nasal angles; V. 11-12; orbit 36%-43% HL, snout and interorbital much shorter than orbit, snout about 1.25-1.5, interorbital 1.4-1.7 in orbit; ADW and PDW lens-like and widely separated. Three small black pigmented areas near mid-length of anal fin base.

**Distribution:** Southern Japan and northeastern Taiwan.

### Lucigadus lucifer (Smith & Radcliffe, 1912)

(Fig. 15)

*Macrourus lucifer* Smith and Radcliffe, 1912: 113, pl. 24, fig. 1, Philippine Islands (original description).

**Material:** ASIZP 061308, 1 specimen, 110 mm TL, Mar. 1999, Nanfangao.

**Diagnosis:** D1. II,8; P. i14-i20; V. 8; GR-I (outer/inner) 6/11; Scales 1D. 7, 2D. 9. Ventral parts of body appearing to have shifted forward so that anal fin origin often lies below 1st dorsal fin origin; pelvic fins below operculum; snout short, bluntly rounded and high. Pores of head rather prominent. Scales present on lowermost branchiostegal rays. Tip and leading edge of snout without distinct pigmentation. Mandibular teeth in a narrow to wide band; premaxillary teeth not present posterior to hind margin of maxillary process. Spinules on scales in more or less parallel horizontal rows. Abdominal vertebrate 10 to 11.

**Distribution:** The Philippines and northeastern Taiwan.

### Nezumia Jordan, 1904


*Sphagemacrurus* Fowler, 1925: 162 (type-species by original designation: *Macrurus hirundo* Collett).

There are about 46 species of this genus in the world (Iwamoto 1990, Iwamoto and Williams 1999, personal data of TI); only 1 species occurs in Taiwan.

### Nezumia condylura Jordan & Gilbert, 1902

(Fig. 16)

*Nezumia condylura* Jordan and Gilbert, 1902 (1904): 620, Suruga Bay, Japan (original description); Jordan et al. 1913: 413; Kamohara, 1938: 71; 1952: 98.

**Materials:** ASIZP 061238, 1 specimen, 186 mm TL, June 2000, Nanfangao; ASIZP 061239, 8 specimens, 124-116 mm TL, Dec. 1999, Nanfangao.

**Diagnosis:** D1. II,10-13; P. i18-i23; V. 13-17; Scales 1D. 8-9, 2D. 12-13; GR-I (outer/inner) 9-11/7-10; Pc. 25-28. Snout short, blunt; terminal and lateral snout scutes large, blunt; undersides of snout, mandible, most of suborbital, and part of lower margin of preopercle naked; pores prominent in these areas. Teeth in rather broad, tapered bands, outer series in upper jaw slightly enlarged. First dorsal fin with 2 spines, serrations on 2nd spine slender and rather widely spaced. Scales
small, spinules on body scales sharp, needlelike, greatly reclined, in 4 to 16 parallel rows; scales below midbase of 1st dorsal fin 8 or 9, below 2nd dorsal fin 12 or 13. Color: grayish brown, bluish over abdomen; gill membranes blackish; fins dusky, 1st dorsal fin blackish distally; oral and branchial linings blackish.

Distribution: Southern Japan and northeastern Taiwan.

**Pseudocetonurus** Sazonov & Shcherbachev, 1982


*Pseudocetonurus septifer* Sazonov & Shcherbachev, 1982  (Fig. 17)


**Material:** ASIZP 061237, 1 specimen, 147 mm TL, May 2001, Tashi.

**Diagnosis:** D1. II, 9-11; P. i19-i23; V. 8-9; GR-I (outer/inner) 10-14/16-20; GR-II 16-19; Scales 1D. 8.5-10.5. Teeth in premaxilla in broad bands, those in outer series distinctly enlarged, conical, recurved canines with arrowhead-shaped tips; mandibular teeth in 2 irregular series, inner series slightly enlarged. First dorsal fin with 2 spines and 9 or 10 rays, 1st spinous ray lacking serrations. Scales small; spinules very small, short, conical, erect; scale rows below 2nd dorsal fin origin 7 or 8; over a distance equal to predorsal length, 47 to 56. Snout with black margins along leading edge, supranarial ridges, and a median nasal ridge; 1st dorsal fin uniformly dusky.

**Distribution:** Known from Hawaii, the southeastern Pacific, and Taiwan.

**Remarks:** Only the single species is known.

**Ventrifossa Gilbert & Hubbs, 1920**

*Ventrifossa* Gilbert and Hubbs, 1920: 543 (type species *Coryphaenoides garmani* Jordan and Gilbert, 1904, by original designation).

There are 22 species of this genus in the world; 10 are found in Taiwan.

**Ventrifossa atherodon** (Gilbert & Cramer, 1897)  (Fig. 18)


**Material:** ASIZP 0061311, 1 specimen, 245 mm TL, Mar. 2001, Tashi.

**Diagnosis:** D1. II, 9-11; P. i19-i23; V. 11-12; GR-I (outer/inner) 10-14/16-20; GR-II 16-19; Scales 1D. 8.5-10.5. Teeth in premaxilla in broad bands, those in outer series distinctly enlarged, conical, recurved canines with arrowhead-shaped tips; mandibular teeth in 2 irregular series, inner series slightly enlarged. First dorsal fin with 2 spines and 9 or 10 rays, 1st spinous ray lacking serrations. Scales small; spinules very small, short, conical, erect; scale rows below 2nd dorsal fin origin 7 or 8; over a distance equal to predorsal length, 47 to 56. Snout with black margins along leading edge, supranarial ridges, and a median nasal ridge; 1st dorsal fin uniformly dusky.

**Distribution:** Hawaiian Islands and northeastern Taiwan.

**Ventrifossa divergens** Gilbert & Hubbs, 1920  (Fig. 19)

*Ventrifossa divergens* Gilbert and Hubbs, 1920: 100; 1(7): 549, fig. 37 (Sibuko Bay, Borneo; 557 m; ALBATROSS stn. 5592).

**Materials:** ASIZP 061309, 1 specimen, 220 mm TL, Dec. 2000, Tungkang; ASIZP 061310, 1 specimen, 182 mm TL, June 2001, Tashi.

**Diagnosis:** D1. II, 9-11; P. i19-i23; V. 8-9; GR-I (outer/inner) 15-17; Scales 2D. 8-10. Teeth small, in broad bands in premaxilla, outer series slightly enlarged, some with arrowhead tips; mandibular teeth in rather narrow band. First dorsal fin with 2
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<th>Scientific name</th>
<th>Chinese name</th>
<th>Shen, 1984</th>
<th>Chen &amp; Yu, 1986</th>
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* new record  ** new species  # specimen lost  x misidentified  s synonym  + species reported correctly  n correctly recorded for the first time
spines and 9 to 11 rays, spinous ray finely serrated along leading edge. Scales medium-sized, uniformly covered with fine, conical, reclined spinules in widely divergent V-rows or quincunx order; scale rows below 2nd dorsal fin 8 to 10; over distance equal to predorsal length 43 to 48. Snout with a black margin along leading edge extending posteriorly onto suborbital shelf, but not over supranarial or median nasal ridges; 1st dorsal fin uniformly dusky or darker proximally, but lacking a distinct black blotch.

**Distribution**: The Philippines, South China Sea near Hong Kong, Borneo, Indian Ocean off South Africa, Mozambique, southern Japan, and Taiwan.

**Ventrifossa longibarbata** Okamura, 1982  
(Fig. 20)

*Ventrifossa longibarbata* Okamura, 1982: 156 (Kyushu-Palau Ridge; 605 m).


**Diagnosis**: D1. II, 9-10; P. i21-i23; V. 8-9; GR-I (outer/inner) 10-12; Scales1D. 12-14, 2D. 9-10, Pc. 70. Mouth inferior, lower jaw tipped with a long barbel, relatively small body scales, and spineless scales behind 1st dorsal fin. Head comparatively small; snout short and broad, angulated along anterolateral edge; tip of snout without spinulous tubercle. Teeth conical, with band on both jaws. Second dorsal spine finely serrated except for basal portion. Spinules on body scales slender, not triangular in shape, arranged in quincunx order. Luminous organ small, between pelvic bases. Sides of head and body bright silvery. First dorsal fin blackish with white base and tip.

**Distribution**: Southern Japan and southeastern Taiwan.

**Ventrifossa macroptera** Okamura, 1982  
(Fig. 21)


**Materials**: ASIZP 061244, 1 specimen, 199 mm TL, May 2001, Tungkang; ASIZP 061245, 1 specimen, 202 mm TL, May 2001, Tungkang.

**Diagnosis**: D1. II, 9-11; P. i9-i22; V. 9-11; GR-I (outer/inner) 11-17; GR-II 16-19; Scales 1D. 6-8, 2D. 8-10. Premaxillary teeth in narrow bands 4 or 5 teeth wide, outer series enlarged with arrowhead-like tips; mandibular teeth in 2 series, the inner large. First dorsal fin with 2 spines and 9 to 11 rays, 2nd spinous ray smooth. Scale rows below midbase of 1st dorsal fin 6.5 to 7.5, below 2nd dorsal origin 8 to 10; lateral-line scales over a distance equal to predorsal length 49 to 55. Scales covered with slender, sharp spinules in 5 widely divergent rows or irregularly in quincunx order. Snout with a black margin along leading edge and posteriorly over 1/2 of supranarial ridges; 1st dorsal fin uniformly blackish or dusky.

**Distribution**: Kyushu-Palau Ridge, Hawaiian Islands, southern Japan, and northeastern Taiwan.

**Ventrifossa rhipidodorsalis** Okamura, 1984  
(Fig. 22)

*Ventrifossa rhipidodorsalis* Okamura, 1984: 204 (Okinawa Trough; 500-535 m).


**Diagnosis**: D1. II, 9-11; P. i9-i22; V. 8-9; GR-I (outer/inner) 11-17; GR-II 16-19; Scales 1D. 6-8, 2D. 8-10. Premaxillary teeth in narrow bands 4 or 5 teeth wide, outer series enlarged with arrowhead-like tips; mandibular teeth in 2 series, the inner large. First dorsal fin with 2 spines and 9 to 11 rays, 2nd spinous ray smooth. Scale rows below midbase of 1st dorsal fin 6.5 to 7.5, below 2nd dorsal origin 8 to 10; lateral-line scales over a distance equal to predorsal length 49 to 55. Scales covered with slender, sharp spinules in 5 widely divergent rows or irregularly in quincunx order. Snout with a black margin along leading edge and posteriorly over 1/2 of supranarial ridges; 1st dorsal fin uniformly blackish or dusky.

**Distribution**: Kyushu-Palau Ridge, Hawaiian Islands, southern Japan, and northeastern Taiwan.

**Ventrifossa saikaiensis** Okamura, 1984  
(Fig. 23)

*Ventrifossa saikaiensis* Okamura, 1984: 208 (type locality; Okinawa Trough; 700-740 m).

**Materials**: ASIZP 061248, 1 specimen, 250 mm TL, May 2001, Tashi; ASIZP 0061249, 18 specimens, 164-226 mm TL, May 2001, Tashi.

**Diagnosis**: D1. II, 9-11; P. i9-i22; V. 8-9; GR-I (outer/inner) 11-17; GR-II 16-19; Scales 1D. 6-8, 2D. 8-10. Premaxillary teeth in narrow bands 4 or 5 teeth wide, outer series enlarged with arrowhead-like tips; mandibular teeth in 2 series, the inner large. First dorsal fin with 2 spines and 9 to 11 rays, 2nd spinous ray smooth. Scale rows below midbase of 1st dorsal fin 6.5 to 7.5, below 2nd dorsal origin 8 to 10; lateral-line scales over a distance equal to predorsal length 49 to 55. Scales covered with slender, sharp spinules in 5 widely divergent rows or irregularly in quincunx order. Snout with a black margin along leading edge and posteriorly over 1/2 of supranarial ridges; 1st dorsal fin uniformly blackish or dusky.

**Distribution**: Kyushu-Palau Ridge, Hawaiian Islands, southern Japan, and northeastern Taiwan.
behind 1st dorsal. Scale sacs on upper 1/2 of body and along base of anal fin with narrow, dark-brown posterior margin. Ventral luminous organ comparatively large, situated between pelvic bases and connected with periproct by narrow naked groove. Snout more or less pointed. Mouth moderately large, upper jaw extending to a vertical from posterior rim of orbit. Upper lip with rather broad dark margin. Vent much nearer to pelvic base than to anal fin. First dorsal fin uniformly dark.

_Distribution_: Southern Japan and northeastern Taiwan.

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