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Two new species of the conger eel genus *Bathycongrus* (Anguilliformes: Congridae) from Taiwan

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Abstract

Two new species of the congrid eel genus *Bathycongrus* are described from the deep waters of eastern Taiwan. *Bathycongrus albimarginatus* **sp. nov.**, which belongs to the species group with two enlarged teeth on the vomer and more total vertebrae, is described from 16 specimens and can be distinguished by vertical fins with broad white margins, more pores on head and predorsal lateral line, total vertebrae 195–201. *Bathycongrus brunneus* **sp. nov.**, which has no enlarged teeth on the vomer, is described from one specimen and can be distinguished by 12 subequal teeth on the vomer and 174+ total vertebrae.

Key words: Congridae, taxonomy, *B. albimarginatus*, *B. brunneus*, Taiwan, new species

Introduction

The congrid eel genus *Bathycongrus* is a group of small to moderate-size eels (up to 100 cm TL) that inhabit the bottom of the outer continental shelf and continental slope in tropical and subtropical waters around the world. It can be distinguished from other genera in the family Congridae by having body moderately elongate; tail slender, markedly attenuate to filiform; snout projecting beyond lower jaw, fleshy part of snout extending anteriorly beyond intermaxillary teeth; intermaxillary teeth conical or fang-shaped, separated from maxillary and vomerine teeth, mostly excluded from closed mouth; vomerine teeth forming a small patch on head of vomer (Smith, 1989).

Castle & Smith (1999) reassessed the genus and recognized eight valid species. Subsequently, five new species were described and one species was redescribed (Karmovskaya & Smith, 2008; Karmovskaya, 2009, 2011). Another species, *Pseudophichthys macroporis*, is provisionally reassigned to this genus (Smith & Ho, 2018, this volume), which bring the total number of species in the genus to 26.

The above mentioned species can be divided into two subgroups, one with a few enlarged teeth surrounding by small teeth on the vomer (except *B. wallacei* has only 1 to 3 small teeth behind), and one (*Bathycongrus dubius* (Breder, 1927) group, *sensu* Karmovskaya, 2009) with many small teeth forming a large patch and which also has less than 140 total vertebrae.

In Taiwan, three species had been previously recorded: *Bathycongrus guttulatus* (Günther, 1887), *Bathycongrus wallacei* (Castle, 1968) and *Bathycongrus retrotinctus* (Jordan & Snyder, 1901) (Ho *et al*., 2015a). In the context of reviewing all known eels of Taiwan, a total of 207 species were recognized, which gives Taiwan the highest known diversity of eels in the world (Ho *et al*., 2015a, b). During the survey, more undescribed forms were collected and are waiting to be described. The first species was recognized as new by the third author (YHC) in her unpublished master thesis.

Here we describe two new species of the congrid eel genus *Bathycongrus*, one with two enlarged teeth on the

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vomer and more numerous total vertebrae and the other one with 12 subequal teeth on the vomer and relatively numerous vertebrae. The species can be distinguished from their congeners by having different body proportions, coloration and meristic characters.

Methods and materials

Methods for taking measurements and counts followed Smith (1989) and as explained in Ho *et al* (2015b). Vertebral counts were made by x-ray films or digital x-ray machine set up in National Taiwan Ocean University and National Museum of Marine Biology & Aquarium.

Specimens were registered to the collections of Laboratory of Aquatic Ecology, Department of Aquaculture, National Taiwan Ocean University (TOU-AE); Biodiversity Research Center, Academia Sinica (ASIZP); National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM); and National Museum of Marine Biology & Aquarium (NMMB-P).

Taxonomy

Family Congridae

Subfamily Congrinae

Genus *Bathycongrus* Ogilby, 1898

Bathycongrus Ogilby, 1898: 292 (type species: *Congromuraena nasica* Alcock, 1894)

Remarks. Smith & Ho (2018, this volume) review the genus from Taiwan and describe three additional new species which are different from the two species described in the present work. As these species were studied by different authors, two separate works were prepared and a total of 10 species number of *Bathycongrus* are currently known from Taiwan.

Bathycongrus albimarginatus Huang, Smith, Chang & Chen, sp. nov.

White-margin deep-sea conger
Figs. 1–2; Tables 1–2

Holotype. TOU-AE 7280 (560 mm TL), 23°14'N, 121°25'E, off Wushibi, Changbin township, Taitung county, Taiwan, 250–300 m, 4 Jan. 2017, coll. J.-S. Chiu.

Paratypes. 15 specimens, 362–651+ mm TL. TOU-AE 5548 (573 mm TL), TOU-AE 5549 (524 mm TL), TOU-AE 5550 (396 mm TL), TOU-AE 5561 (362 mm TL), 23°14'N, 121°25'E, off Wushibi, Changbin township, Taitung county, Taiwan, 20 May 2010, coll. J.-S. Chiu. TOU-AE 6678 (651+ mm TL), 23°29'N, 121°30'E, off Shihtiping, Fengbin township, Hualien county, Taiwan, 2 Nov. 2012, coll. J.-S. Chiu. TOU-AE 7233 (511 mm TL), TOU-AE 7234 (427 mm TL), 23°14'N, 121°25'E, off Wushibi, Changbin township, Taitung county, Taiwan, 8 May. 2014, coll. J.-S. Chiu. TOU-AE 7276 (491 mm TL), NMMB-P25749 (formerly TOU-AE 7275) (537 mm TL), 23°29'N, 121°30'E, off Fengbin township, Hualien county, Taiwan, 250–300 m, 18 Dec. 2016. TOU-AE 7277 (558+ mm TL), NMMB-P25750 (formerly TOU-AE 7278) (490 mm TL), 23°14'N, 121°25'E, off Changbin township, Taitung county, Taiwan, 250–300 m, 15 Jan. 2017. TOU-AE 7268 (580+ mm TL), 18 Dec. 2014. TOU-AE 7269 (531 mm TL), 9 Jan. 2015. All specimens collected by J.-S. Chiu. USNM 437349 (515+ mm TL), Changbin, 15 Sep. 2011. USNM 441813 (490+ mm TL), Chang-bin, 7 Nov. 2011.

Diagnosis. A moderately large, robust species of *Bathycongrus* with 2 enlarged teeth surrounded by small teeth on the vomer; body dark grayish with broad bright white margins on dorsal and anal fins; 5 pores on supratemporal canal; preanal vertebrae 50–52, precaudal vertebrae 68–70, total vertebrae 196–201; and preanal lateral-line pores 47–53.

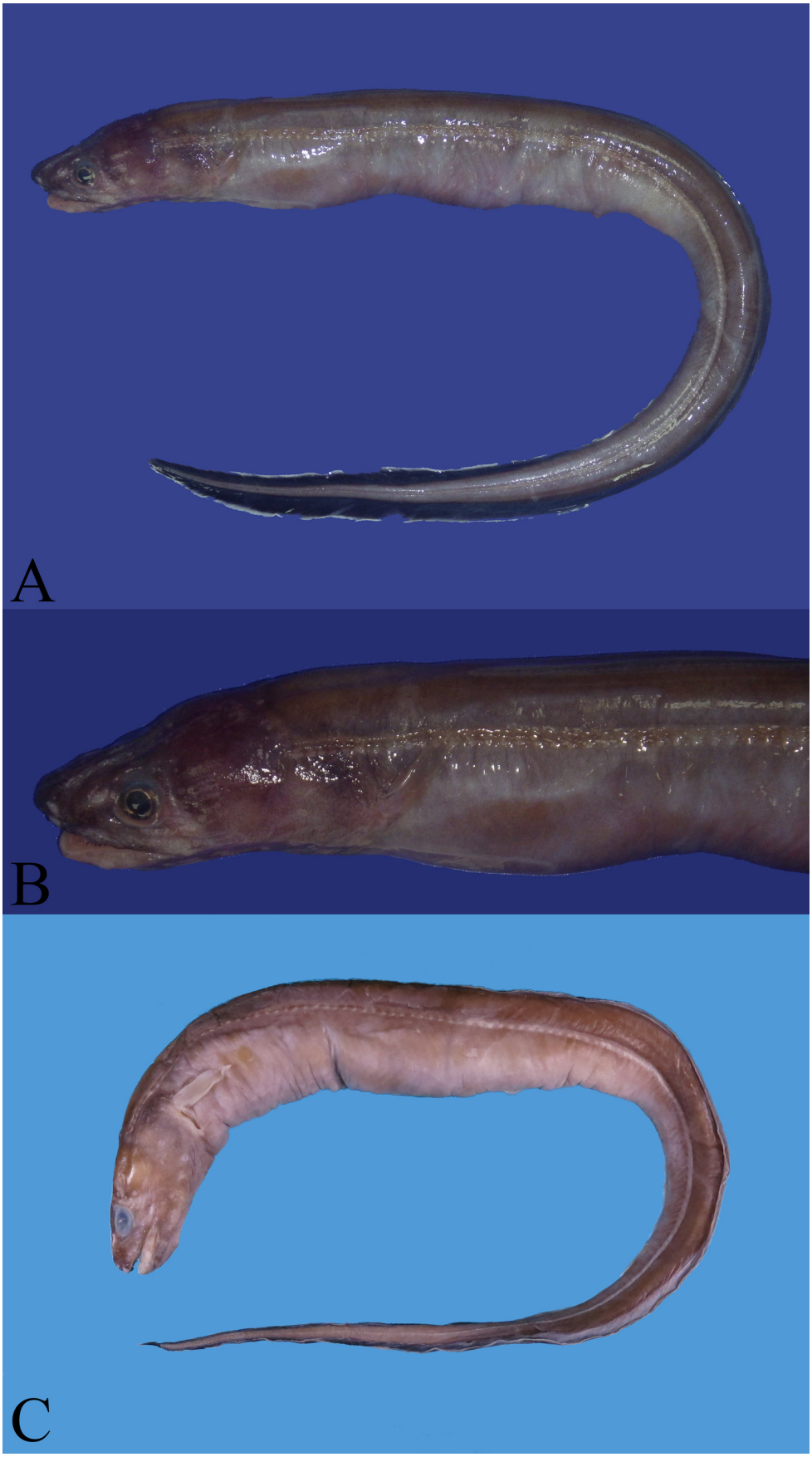

FIGURE 1. ***Bathycongrus albimarginatus*** **sp. nov.**, A-C, holotype, 560 mm TL, TOU-AE7280. A, B. fresh color after frozen, C. preserved.

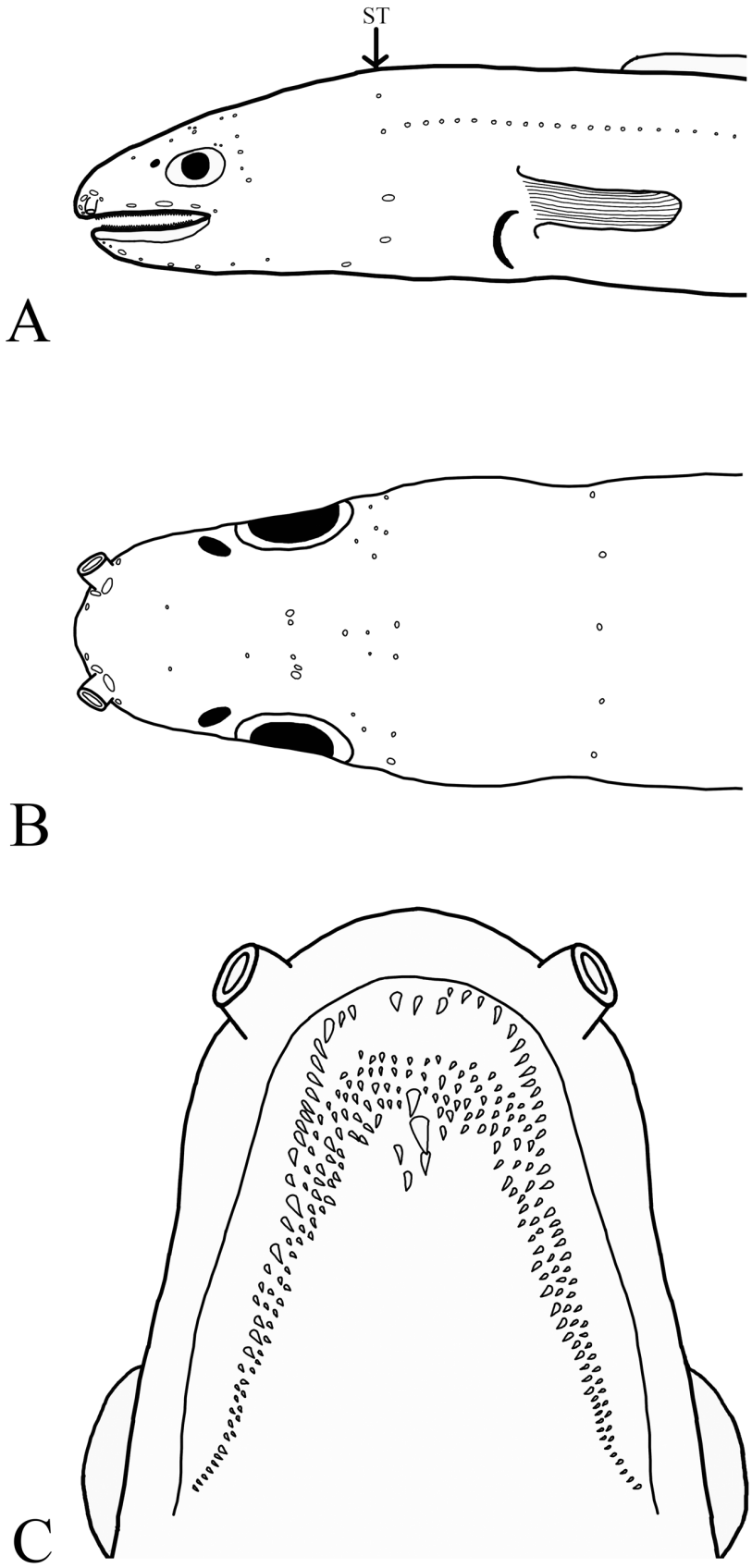

FIGURE 2. ***Bathycongrus albimarginatus*** **sp. nov.**, from the holotype, 560 mm TL, TOU-AE7280. A. lateral view of head showing the head pores. B. Dorsal view of head. C. ventral view of upper mouth showing the jaw teeth.

TABLE 1. Morphometric and meristic data of two *Bathycongrus* species described in this study.

	B. albimarginatus sp. nov.		*B. brunneus* sp. nov.
	Holotype	Types	Holotype
TL (mm)	560	379–651+ (n=16)	540+
%TL			
Head length	12.1	10.9–13.1 (11.8)	–
Trunk length	27.9	25.9–29.6 (27.7)	–
Tail length	60.0	59.7–62.8 (60.8)	–
Predorsal length	16.3	14.7–16.4 (15.4)	–
Preanal length	40.0	37.5–40.3 (39.2)	–
Depth at anus	6.1	4.1–6.3 (5.1)	–
%PAL			
Head length	30.4	27.9–33.5 (30.1)	40.5
Trunk length	69.6	66.5–73.7 (70.4)	59.5
Predorsal length	40.6	36.6–41.7 (39.5)	44.9
%HL			
Eye diameter	13.1	13.1–17.8 (15.5)	17.2
Interorbital width	22.1	21.1–25.9 (23.3)	–
Snout length	26.6	24.5–29.1 (26.0)	25.7
Interbranchial width	29.7	26.2–30.9 (28.6)	24.1
Pectoral fin length	35.0	31.0–38.4 (34.6)	30.6
Gill opening length	15.4	13.1–18.1 (15.0)	18.2
Upper jaw length	42.1	38.9–42.1 (40.1)	41.1
Lower jaw length	38.4	35.7–39.9 (37.7)	36.7
Vertebrae			
Pre-dorsal	14	14	13
Pre-anal	52	50–52	44
Pre-caudal	69	68–70	59
Total	197	196–201 (n=11)	174+
MVF		14-52-198	
Lateral-line pores			
Pre-pectoral	6	5–6	6
Pre-dorsal	13	11–13	10
Pre-anal	51	48–53	44
Total	134+	160–174	117+
Head pores			
Supraorbital			3
Infraorbital	Vary in number, please refer to the description of the species		5
POM (POP+M)			10 (2+8)
Supratemporal			1

Description. The following values are given for the holotype, followed by the range of all types in parentheses.

Body rather stout, rounded in cross section anteriorly, becoming more compressed behind anus and in posterior portion; head strong and stout, its depth and width slightly smaller than those of trunk; trunk moderately long, its length 2.3 (2.0–2.5) times head length; tip of tail tapering and filiform; anus near anterior two-fifths of total length (when tail complete).

Dorsal fin begins over posterior half of pectoral fin, continuous around tip of tail with caudal and anal fins. Anal fin begins immediately behind anus. Pectoral fin well developed, roundly pointed distally with a narrow base. Gill opening large, about same as eye diameter or slightly smaller, its upper end nearly opposite middle of pectoral-fin base. Interbranchial width much greater than twice width of gill opening.

Head relatively small, its length 12.1% (10.9–13.1%) TL, 30.4% (27.9–33.5%) PAL, deepest at about occiput, slightly tapering anteriorly from this point; dorsal profile nearly flat from occiput to internasal space; snout stout and broadly rounded, its length greater than eye diameter, projecting beyond lower jaw; lower jaw longer than snout; fleshy part of snout with a weak median keel on underside, projecting anteriorly beyond anterior end of intermaxillary tooth patch; rictus below posterior half of eye.

Anterior nostril tubular, near tip of snout, directed ventrolaterally. Posterior nostril elliptical, with a clear raised rim, in front of upper margin of eye. Upper lip with flange greatly reduced; lower lip with a well-developed downturned flange. Tongue free, long, and broad.

Lateral line complete, first pore on each side slightly reduced, the canal extended to caudal-fin base; 13 (11–13) before dorsal-fin origin, 6 (5–6) before pectoral-fin base, 51 (48–53) pores before anal-fin origin; total pores 134+ (160–174).

Head pores vary in size, mostly small but some enlarged (Figs. 2A, B). Supraorbital canal with at least 9 pores, the first (ethmoidal) on ventral side of tip of snout, just ahead of lip; the second enlarged and immediately in front of anterior nostril; the third greatly enlarged and immediately above anterior nostril; a small fourth pore on dorsal surface of snout between both nostrils, some paratypes have none while others have 1–4 small pores at same region, but not arranged symmetrically; frontal region with 2 pores. Infraorbital canal with four regular pores along the upper jaw; the first pore at posterodorsal corner of anterior nostril; the second enlarged, between both nostrils; the third greatly enlarged, beneath eye at vertical between posterior nostril and anterior margin of eye; the fourth small, below middle of eye; the fifth small and behind rictus and below posterior margin of eye; 4 principal pores behind eye, with some additional small pores behind the eye, some forming small clusters. Preoperculomandibular canal with 11 pores, six before and five behind rictus, posteriormost 3 pores (e.g. preopercular) enlarged (TOU-AE6678 has 8 additional small pores on right side and 2 on left side above the POP pores; TOU-AE7276 has 1 additional mandibular pore on both sides). Supratemporal with 5 pores, the lowermost pore slightly below level of first lateral-line pore.

Predorsal vertebrae 14 (14); preanal vertebrae 52(50–52); precaudal vertebrae 69 (68–70); total vertebrae 197 (196–201).

Teeth various in size, conical and all sharp distally (Fig. 2C). Intermaxillary in about two transverse rows, clearly separated from maxillary and vomerine teeth by a large space, barely excluded from closed mouth. Maxillary and mandibular teeth in bands, wider anteriorly, roughly in four to five rows anteriorly, gradually narrower posteriorly, in one or two rows; outermost teeth slightly larger than innermost. Vomerine tooth patch longer than width, reaches to nearly level of posterior nostril, teeth conical, in approximately four rows anteriorly, narrower posteriorly, the middle teeth larger than outer ones and slightly smaller than those of intermaxillary.

Measurements for holotype (in mm): total length 560; head length 68.0; predorsal length 91.0; preanal length 224.0; trunk length 156.0; tail length 336.0; depth at gill opening 28.8; depth at mid-anus 34.4; eye diameter 8.9; interorbital width 15.0; snout length 18.1; interbranchial width 20.2; body width 30.2; postorbital length 42.4; pectoral fin length 23.8; gill opening length 10.5; upper jaw length 28.6; lower jaw length 26.1.

Coloration. Body when fresh (Fig. 1) generally dark grayish, ventral surface of anterior two-thirds of body paler; pectoral fins pale white. Vertical fins light grayish anteriorly, gradually turning to dark grayish posteriorly, with prominent broad white margins. Caudal fin dark grayish. Lateral-line pores with white margin. Mouth cavity and gill chamber pale. Peritoneum pale with numerous tiny grayish dots; outer surface of stomach pale; intestine black.

Size. The largest specimen examined is a mature male with 651+ mm TL (the tail tip is broken).

TABLE 2. Selected characters of nine known *Bathycongrus* species with 2 enlarged teeth on the vomer for comparison. V=vertebrae. Data sources: 1. This study. 2. Castle & Smith, 1999. 3. Karmovskaya, 2009. 4. Smith & Ho, 2017 [this volume].

Taxon	Predorsal vertebrae	Preanal vertebrae	Precaudal vertebrae	Total vertebrae	Supratemporal pores	Preanal pores	Data source and literature cited
B. albimarginatus sp. nov.	14	50–52	68–70	196–201	5	48–53	1
B. guttulatus	8–10	35–40	48–53	157–169	1	35–41	2, 4
B. longicavis	9	47	67	167+	1	46	3
B. macrocercus	8–9	38–40	46–47	157–162	1	37–39	2, 3
B. nasicus	9–10	30–33	43–47	149–152	?	29–32	1, 2
B. odontostomus	9–10	35–42	45–54	164–177	1	32–41	2, 3
B. parapolyporus	9–10	33–35	41–42	158–160	1	31–33	, 3
B. retrotinctus	9	35	45	144–148	1	33	1, 4
B. wallacei	8–10	37–42	54–58	163–178	1	36–39	2, 4

Etymology. From the Latin words *albus* (white) and *margin* (margin) in reference to the borderline color on the dorsal, caudal and anal fins.

Distribution. Known from the type series collected from eastern Taiwan off three localities, Changbin, Shihtiping and Wushibi by hook and line at about 250–300 m.

Remarks. *Bathycongrus albimarginatus* **sp. nov.** belongs with the congeners with 2 enlarged teeth surrounded by small teeth on the vomer, which comprise 8 species previously, and can be distinguished by having more total vertebrae (196–201). Table 2 shows 6 meristic characters to differentiate these species (Castle & Smith, 1999; Karmovskaya, 2009; Smith & Ho, 2018).

Of them, *B. albimarginatus* is most similar to *Bathycongrus parapolyporus* Karmovskaya, 2009 in having 11 preopercular-mandibular pores and 8 infraorbital pores. It can be further distinguished from *B. parapolyporus* in having the rictus extend to nearly below posterior margin of eye (vs. to mid-eye level); 196–201 total vertebrae (vs. 158–160); 11–13 pores before dorsal-fin origin (vs. 9–10); 5 supratemporal pores (vs. 1); additional small pores on head (vs. none); and clear white margin on vertical fins (vs. no clear white margin). The character of vertical fins with distinct white margin in *B. albimarginatus* rarely appears on the other *Bathycongrus* species.

The outermost supratemporal pore is located at the junction of the temporal, preopercular, and lateral-line canals. We assign it to the supratemporal canal because it resembles the supratemporal pores in size (smaller than lateral-line pores) and is located at the junction of the canals, whereas the true first lateral-line pore is distinctly behind that point.

There seems to be considerable variation in the number of head pores. In some specimens there are differences between one side and the other in some canals.

Bathycongrus brunneus Huang, Ho & Chen, sp. nov.

Brown deep-sea conger

Figs. 3–4; Tables 1–2

Holotype. TOU-AE 7261 (540+ mm), mature female, Changbin, Taitung, eastern Taiwan, hook and line, bottom, 15 Dec. 2014, coll. J. -S. Chiu.

Diagnosis. A moderately slender species of *Bathycongrus* with tail presumably tapering, filiform; body uniformly brownish, and dorsal and anal fins black to gray with narrow white margin; vomerine teeth forming a long triangular patch, with 13 subequal teeth at front and sides; preanal vertebrae 44, precaudal vertebrae 59, total vertebrae 174+; and preanal lateral-line pores 44.

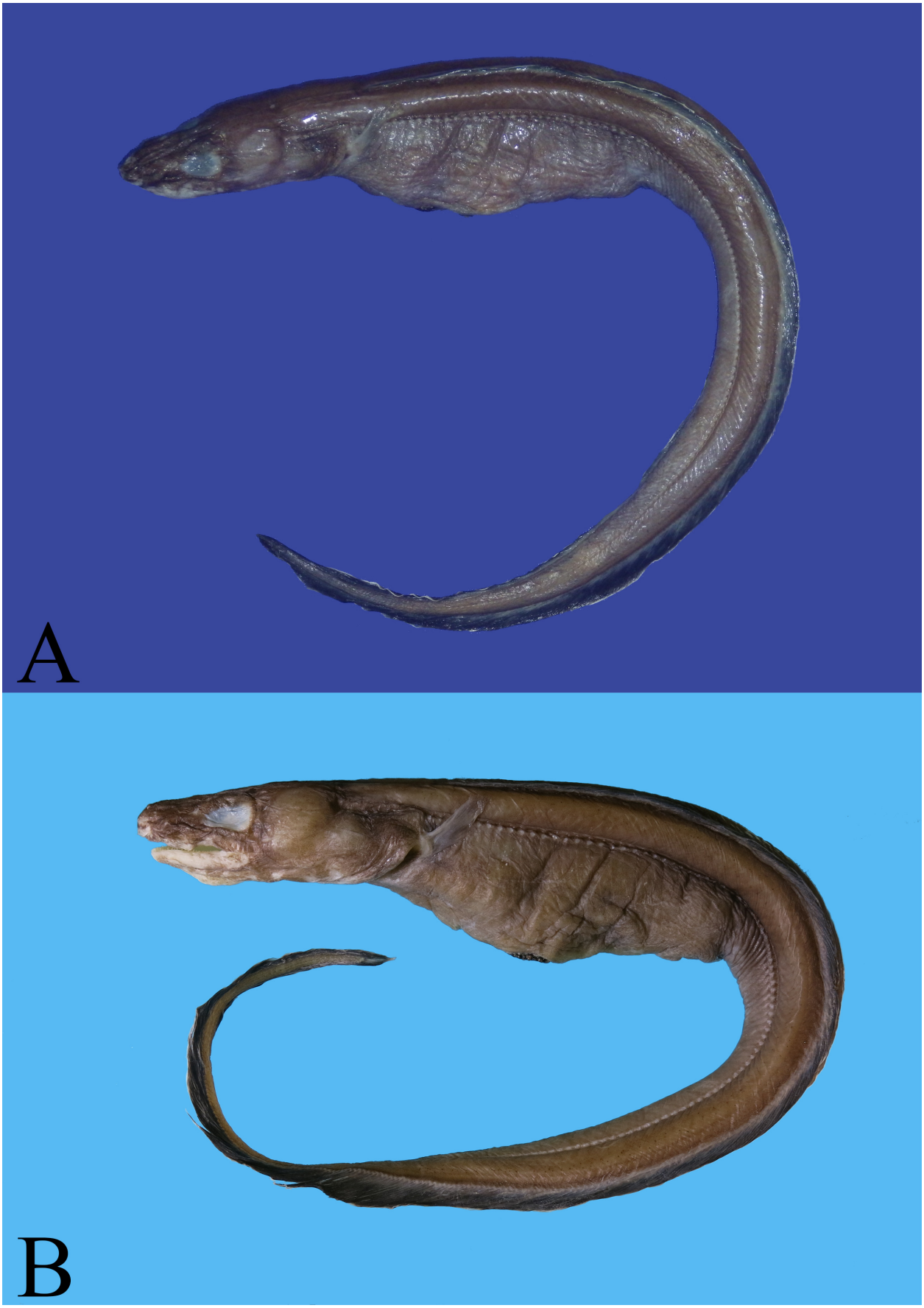

FIGURE 3. ***Bathycongrus brunneus*** **sp. nov.**, A–B, holotype, 540+ mm TL, TOU-AE7261. A. fresh color after frozen, B. preserved.

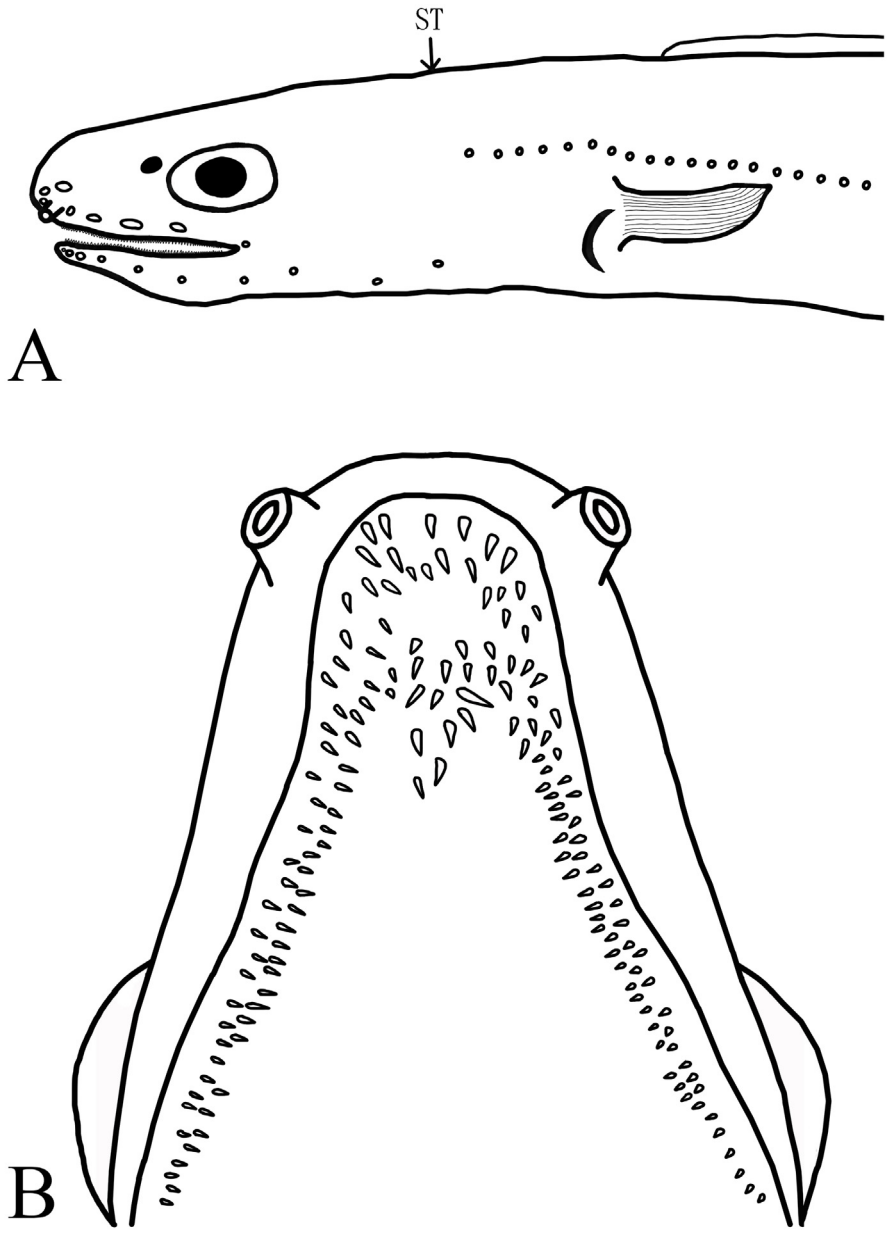

FIGURE 4. ***Bathycongrus brunneus*** **sp. nov.**, from the holotype, 540+ mm TL, TOU-AE7261. A. lateral view of head showing the head pores. B. ventral view of upper mouth showing the jaw teeth.

Description. Body rather stout, rounded in cross section anteriorly, becoming more compressed behind anus and posterior portion; head moderately slender, its depth and width about same as these of trunk; trunk moderately long, its length 1.5 times head length; tip of tail tapering and presumably filiform (tip of tail slightly damaged and healed); anus near anterior third of total length.

Dorsal fin begins over anterior half of pectoral fin, continuous around tip of tail with caudal and anal fins. Anal fin begins immediately behind anus. Pectoral fin well developed, pointed distally with a narrow base. Gill opening relatively large, about same as eye diameter, its upper end nearly opposite middle of pectoral-fin base. Interbranchial broader than gill opening and eye.

Head relatively large, its length 40.5% PAL (ca. 14.6% TL), deepest at about occiput, slightly tapering anteriorly from this point; dorsal profile nearly flat from occiput to internasal space; snout long and broadly pointed, its length 1.5 times eye diameter, projecting beyond lower jaw; lower jaw longer than snout; fleshy part of

snout with a high median keel on underside, projecting anteriorly beyond anterior end of intermaxillary tooth patch; rictus below middle of eye.

Anterior nostril tubular, near tip of snout, directed ventrolaterally. Posterior nostril elliptical, with a clear raised rim, in front of eye nearly at upper eye level. Upper lip with flange strongly reduced; lower lip with a well-developed downturned flange. Tongue free, long, and broad.

Lateral line complete, first pore on each side slightly enlarged, the canal extended to caudal-fin base; 10 pores before dorsal-fin origin, 6 pores before pectoral-fin base, 44 pores before anal-fin origin; total pores 117+.

Head pores vary in size (Fig. 4A), mostly enlarged. Supraorbital canal with 3 pores; the first (ethmoidal pore) on ventral side of snout tip, just ahead of lip; the second enlarged, about twice the size of first, and immediately in front of anterior nostril; the third greatly enlarged and immediately above anterior nostril, about same size of anterior nostril; no pore at frontal region. Infraorbital canal with 5 pores, first 3 enlarged; the first at posterodorsal corner of anterior nostril; the second to fourth along lip; the second and third between anterior and posterior nostrils; the fourth below anterior margin of eye; and the fifth small and behind rictus; no pores behind eye. Preoperculomandibular canal with 10 pores; mandibular pores 7 along lower jaw and 3 behind rictus; the first pore small, near anterior tip of lower jaw, the third greatly enlarged; 3 pores in preopercular section. Supratemporal commissure with a single small median pore.

Predorsal vertebrae 13; preanal vertebrae 44; precaudal vertebrae 59; total vertebrae 174+ (tip of tail damaged, but probably only few vertebrae lost).

Teeth large, conical and sharp (Fig. 4B). Intermaxillary teeth largest, curved, in about 4 transverse rows, separated from maxillary and vomerine teeth, mostly excluded from closed mouth. Maxillary and mandibular teeth in bands, wider anteriorly, roughly in 4 rows, narrower posteriorly, in 1 or 2 rows; outermost teeth greatly enlarged, innermost teeth smallest. Vomerine teeth forming a long triangular patch, with 13 subequal teeth; some are somewhat enlarged, but not much larger than the rest as in those congeners with two enlarged teeth on the vomer.

Measurements of holotype in mm. Total length 540+, head length 79.0, preanal length 195, predorsal length 87.6, trunk length 116, tail length 345+, depth at gill opening 28.8, depth at anus 34.0, width at anus 22, snout length 20.3, eye diameter 13.6, rictus 32.5, lower jaw 29.0, gill opening width 14.4, interbranchial width 19.0, pectoral-fin length 24.2.

Coloration. When preserved (Fig. 3C), body, tail and head uniformly grayish brown, except for irregular unpigmented areas on lateral sides of snout, lips and underside of head. Pectoral fin pigmented internally and basally. Mouth cavity and gill chamber pale, except for some small scattered patches of black pigments on roof of mouth and wall of gill chamber. Dorsal and anal fins pigmented internally with white membranes in anterior portions, gradually becoming a narrow white base and broadly blackish with narrow white margins, then entirely black to the caudal fin. Stomach and intestine uniformly black; peritoneum densely covered by black pepper dots making the membrane brownish.

Etymology. From Latin *brunneus*, brown.

Remarks. *Bathycongrus brunneus* **sp. nov.** may belong to the high-vertebral-count group. However, the teeth on the vomer are not especially enlarged as in the congeners. Of these species, it is most similar to *B. wallacei* and *Bathycongrus longicavis* Karmovskaya, 2009. It can be separated from *B. wallacei* by having 13 subequal teeth on the vomer (vs. 2 enlarged teeth followed by 2 or 3 smaller ones behind); relatively more preanal vertebrae (44 vs. 38–43, mainly 40–42); relatively more precaudal vertebrae (59 vs. 53–57); a relatively short trunk (59.5% vs. 59.7–63.6% PAL). It differs from *B. longicavis* in having 13 subequal teeth on the vomer (vs. 2 enlarged teeth followed by 3 small ones behind); a shorter trunk (59.5% vs. 65.4% PAL); a larger head (40.5% vs. 34.3% PAL); a shorter snout (25.7% vs. 30.9% HL); a larger eye (17.2% vs. 15.9% HL); more predorsal vertebrae (13 vs. 9); fewer preanal vertebrae (44 vs. 47); and fewer precaudal vertebrae 59 (vs. 67).

The other species with similar vertebral count is *Bathycongrus odontostomus* (Fowler, 1934) (total vertebrae 164–177) which has a black mouth and branchial cavities and can be easily separated from the new species.

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