Zootaxa 4801 (3): 559–569
https://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4801.3.8
http://zoobank.org/urn:lsid:zoobank.org:pub:67D938A6-BB3F-4E60-926F-FEBEF7D7797D

Bregmaceros anchovia sp. nov., a new codlet species from the western Pacific Ocean (Gadiformes: Bregmacerotidae)

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Abstract

A new codlet species is described from Japan, Taiwan, Indonesia and Australia. It is distinguished from its congeners by having a pointed snout extending beyond jaws, a stripe of black dots above anal-fin base, a black vertical band on caudal-fin base, and the following combination of characters: ventral surface of head and abdomen devoid of melanophores; ventral portion of abdominal vertebrae with a pointed parapophysis and a blunt ventral post-zygapophysis; peritoneum, pyloric caeca, and intestine pale; dorsal-fin rays 46–52; anal-fin rays 47–55; pectoral-fin rays 15–17; principal caudal-fin rays 12–14; caudal vertebrae 35–39; total vertebrae 50–54. Furthermore, as a result of this study, *Bregmaceros pescadorus* Shen described from southwestern Taiwan is herein recognized as a junior synonym of *Bregmaceros nectabanus* Whitley.

Key words: Pisces, Actinopterygii, taxonomy, synomym, *Bregmaceros nectabanus*

Introduction

The codlet family Bregmacerotidae is a group of small codfishes in the order Gadiformes, with a single genus, *Bregmaceros* Thompson, 1840, and 15 valid species recognized previously (Cohen et al., 1990; Harold & Golani, 2016; Ho *et al.*, 2020). They are characterized by the first dorsal fin consisting of a single long occipital ray on top of the head, the second dorsal fin and anal fin with well-developed anterior and posterior lobes, the pelvic fins inserted under the operculum, with long, thick rays that extend posteriorly beyond the anterior lobe of the anal fin, the caudal fin well-developed and the lateral line running along the dorsal margin of the body (Cohen *et al.*, 1990).

D'Ancona & Cavinato (1965) reviewed the family and recognized 7 valid species, out of 13 nominal names. Masuda & Ozawa (1979) provided redescriptions of *B. japonicus* Tanaka, 1908 and *B. nectabanus* Whitley, 1941 based on holotype of each species. Masuda *et al.* (1986) described *B. neonectabanus* and a different form of *B. nectabanus* from near Fiji. In 2003 and 2004, Akihisa Torii and colleagues redescribed *B. mcclellandi* Thompson, 1840 (Torii *et al.*, 2003a), *B. japonicus* (Torii *et al.*, 2003b), and *B. lanceolatus* Shen, 1960 (Torii *et al.*, 2004), type specimens of *B. bathymaster* Jordan & Bollman, 1890, *B. rarisquamosus* Munro, 1950, and *B. cayorum* Nichols, 1952 (Torii *et al.*, 2003c), and described a new species, *B. pseudolanceolatus* Torii, Javonillo & Ozawa, 2004.

In the last decade, only a few works have focused on the taxonomy of this group. Ho *et al.* (2011) reviewed the genus in Taiwan and recognized four species, *B. japonicus*, *B. lanceolatus*, *B. pescadorus* and *B. pseudolanceolatus*. However, some confusion remains; for example, their specimens of *B. pescadorus* appear to have more anal-fin rays than those reported previously (e.g., Shen, 1960, Shen & Wang, 1991). Harold & Golani (2016) identified *B. nectabanus* as the only species of the family from the Mediterranean Sea and compared the species to all other known valid species. Ho *et al*. (2020) described *Bregmaceros retrodorsalis* from the western Pacific.

Although Torii (2003, unpublished thesis) recognized 11 undescribed species, only one of them (*B. pseudolanceolatus*) has been formally described subsequently (e.g., Torii *et al*. 2004). In this study, we collected large numbers

Accepted by K. Tang: 24 May 2020; published: 19 Jun. 2020

of specimens from off Taiwan and Japan. One species represents one of Torii's undescribed species and a formal description is now provided.

As mentioned above, some confusion with respect to *B. pescadorus* described from Taiwan has remained. After investigating information provided in previous references and comparing many recently collected specimens, we conclude that *B. pescadorus* be treated as a junior synonym of *B. nectabanus*.

Methods and materials

Methods for taking morphometric measurements and meristic counts, and terminology usage follow Hubbs & Lagler (1958), with modifications by Torii *et al.* (2003a, b) and Harold & Golani (2016). Vertebral numbers were counted from radiographs taken by a digital machine set up in the National Museum of Marine Biology & Aquarium, Taiwan. Data of selected type specimens were taken as part of the measurements and meristic counts are difficult to be made precisely without being stained by Alizarin Red S or cleared and stained (C&S). For instead, large among of C&S non-type specimens were examined to confirm the range of the meristic counts. The protocol for making C&S specimens followed Song & Parenti (1995).

The specimens examined are deposited at the Laboratory of Marine Biology, Kochi University, Kochi, Japan (BSKU), The Commonwealth Scientific and Industrial Research Organization, Hobart, Australia (CSIRO), National Museum of Marine Biology & Aquarium, Pingtung, Taiwan (NMMB-P), the Museum of Victoria, Melbourne, Australia (NMV), Museum and Art Gallery of the Northern Territory, Darwin, Australia (NTM), and Museum of Zoology, National Taiwan University, Taipei, Taiwan (NTUM).

Results

Family Bregmacerotidae

***Bregmaceros anchovia* Ho, Endo & Lee, sp. nov.**
(New common name: False anchovy codlet; new Japanese name: Hitosuji-saiuo)
Figs. 1–3; Table 1
http://zoobank.org/urn:lsid:zoobank.org:act:FC00BDC3-4CD2-452A-94C6-40EFB7A4287E

Bregmaceros nectabanus (not of Whitley): Gloerfelt-Tarp & Kailola, 1984: 83, 311 (Indonesia; based on NTM S. 10824-005).

Holotype. BSKU 74079 (43.7 mm SL), ca. 33°28' N, 133°30' E, Tosa Bay, off Haruno (Haruno fishing port), Kochi City, Kochi, Shikoku Island, Japan, by-catch of floating trawl net for young sardines, coll. by E. Katayama and W. Hiramatsu, 18 Dec. 2004.

Paratypes. Seventy specimens, 35.0–81.5 mm SL. **Japan**: BSKU 4652 (1, 71.5), Tosa Bay, off Susaki, Kochi, Shikoku Island, 2 Jun. 1955; BSKU 43422 (1, 51.2), off Kagoshima, 30°50.5' N, 132°32.4' E, 115–118 m, 1 Nov. 1986; BSKU 50708 (1, 68.3), Tosa Bay, off Haruno, Kochi, 35 m, coll. by Kochi Prefectural Fisheries Experiment Station, 27 Mar. 2012; BSKU 73826 (1, 49.5), Tosa Bay, Mimase fish market, Kochi, 5 Dec. 1998; BSKU 108708 (1, 49.6), BSKU 108709 (1, 56.4), BSKU 108710 (1, 49.7), 33°26' N, 133°32' E, Tosa Bay, off Haruno, Kochi, 45 m, coll. by Kochi Prefectural Fisheries Experiment Station, 27 Mar. 2012; BSKU 108717 (1, 57.7), BSKU 108718 (1, 58.4), Tosa Bay, off Haruno, Kochi City, 33°27.7' N, 133°31.7' E–33°28' N, 133°32.5' E, 25 m, coll. by Kochi Prefectural Fisheries Experiment Station, 27 Mar. 2012; KAUM–I.806 (1, 73.0), Uchinoura Bay, Kimotsuki, Kagoshima, Pacific coast, 31°17' N, 131°05' E, 40 m, set net, coll. by M. Yamada (from Kagoshima City Aquarium), 6 Apr. 2006; KAUM–I.07465 (1, 46.9), off Chiringa-shima Island, Ibusuki, Kagoshima, 31°16.4' N, 130°40.2' E, 25 m, set net, coll. by Orita Fishery, 9 Dec. 2007; KAUM–I.14737 (1, 58.9), 31°16.4' N, 130°40.2' E, off Chiringa-shima Island, Ibusuki, Kagoshima, 25 m, set net, coll. by M. Meguro and M. Yamashita, 25 Feb. 2009; KAUM–I.27767 (1, 67.2), off Kasasa, Minami-satsuma, Kagoshima, East China Sea, 31°25' N, 130°11' E, gill net, coll. by M. Itou, 15 May 2010; NSMT-P 132876 (9, 38.5–44.9), out of BSKU 125154. **Taiwan**: NMMB-P25588 (10, 51.7–69.8) (measured & counted); NMMB-P25589 (10, stained, 67.3–81.5) (measured & counted); NMMB-P25590 (1, 71.9); NMMB-P25591 (3, 68.5–76.1); NMMB-P25593 (20, C&S, 35.0–63.1) (counted); all collected from off Ke-tzu-

liao, Kaohsiung, southwestern Taiwan, northern South China Sea, bottom trawl, 30–50 m, 5 Dec. 2016. **Indonesia**: NTM S.10824-005 (1, 73.5), Semarang harbor, Sumatra, Indonesia, 65 m, 3 May 1983. **Australia**: CSIRO H 4138-04 (1, 66.0), FRV Soela, 19°04' N, 118°50' E, north of Port Hedland, Western Australia, 82 m, benthic trawl, 16 Feb 1983; CSIRO H 4195-04 (1, 57.0), 19°04' N, 118°50' E, northeast Port Hedland, Western Australia, 30 Oct 1983, 81 m, benthic trawl; NMV A 29686-002 (1, 53.5), Imperieuse L23 transect, 18° 25' 31" S, 120° 05' 55" E, 103–105 m, beam trawl, 19 Jun 2015.

Non-types. Japan: BSKU 17049 (1), 5°13.5'–5°13.7' N, 107°0.8'–107°1.1' E, South China Sea, 60 m, 10 Jul. 1972; BSKU 41125 (1), off Cape Ashizuri, ca. 250 m, Mimase fish market, Kochi City, Kochi, 22 Mar. 1985; BSKU 41997 (1), 3 Jul. 1985; BSKU 72772 (1), Tosa Bay, off Saga, Kuroshio Town, Kochi, 21 Nov. 2003; BSKU 102870 (1), Tosa Bay, R/V Kotaka-maru, St. 1-1, 120 m, 11 Dec. 2008; BSKU 110294 (1), Japan Sea, off Mishima, Yamaguchi Pref., 85–86 m, R/V Tansei-maru (KT-98-17, St.13-512), 29 Sep. 1998; BSKU 125151 (10), BSKU 125152 (102), Tosa Bay, 33°09.3' N, 133°19. 9' E–33°07.8' N, 133°23.8' E, mid-water trawl, 20–40 m (103–125 m at bottom), R/V Tenyo-maru, T3-1, 28 Nov. 2000; BSKU 125153 (14), BSKU 125154 (249), Tosa Bay, 33° 08.9' N, 133°21.6' E–33°07.1' N, 133°25.4' E (time: 19:47–20:58), mid-water trawl, 25–45 m (117–141 m at bottom), R/V Tenyo-maru, T3-2, 28 Nov. 2000; BSKU 125284 (4), 33°15.9' N, 133°33.6' E–33°16.2' N, 133°35.6' E (time: 18:53–19:55), surface to mid-water trawl (128–130 m at bottom), R/V Tenyo-maru, MT3, 24 Nov. 1999; BSKU 125286 (1), Tosa Bay, 33°09.3' N, 133°19.9' E–33°07.8' N, 133°23.8' E (time: 17:35–18:37), midwater trawl, 20–40 m (103–125 m at bottom), R/V Tenyo-maru, T3-1, 28 Nov. 2000; BSKU 125300 (2), Tosa Bay, 33°00.3' N, 133°14.6' E–32°57.9' N, 133°17.7' E (time: 19:10–20:20), midwater trawl 10–68 m, (124–148 m at bottom), R/V Tenyo-maru, T3-4, 30 Nov. 2000; BSKU 125301 (9), Tosa Bay, 33°08.9' N, 133°21.6' E–33°07.1' N, 133°25.4' E (time: 19:47–20:58), mid-water trawl 25–45 m (117–141 m at bottom), R/V Tenyo-maru, T3-2, 28 Nov. 2000; BSKU 125302 (2), Tosa Bay, 33°20.6' N, 133°46.6' E–33°20.5' N, 133°48.1' E (time: 18:46–19:39), mid-water trawl, 60–127 m (141–145 m at bottom), R/V Tenyo-maru, MT-2, 23 Nov. 1999; KAUM-I.77876 (1, 64.9), 31°17.3' N, 131°6.6' E, Uchinoura Bay, Kimotsuki, Kimotsuki-gun, Kagoshima, Pacific coast, 40 m, 19 May 2015, set net. **Taiwan**: KAUM–I.114136 (1, 37.6), KAUM–I.114138 (1, 38.5), KAUM–I.114268 (1, 37.0), KAUM–I.114270 (1, 38.7), KAUM–I.114271 (1, 36.4), off Dong-gang, Pingtung County, Taiwan, 8 Mar. 2018, midwater trawl; NMMB-P25588 (12 of 22), Ke-tzu-liao, 5 Dec. 2015; NMMB-P25593 (1, 49.5), Dong-gang, 20 Jan. 2017; NMMB-P25595 (34, C&S), Ke-tzu-liao, 5 Dec. 2015; NMMB-P25766 (1, 58), Dong-gang, 2017; NMMB-P25592 (4, 63–69) (dissected), Ke-tzu-liao, 5 Dec. 2015. **Indonesia**: NTM S.10740-005 (1, 68.6), south of Lombok, Indonesia, Jul. 1981; NTM S.11914-001 (1), south of Lombok, Indonesia, Jul. 1981; NTM S.11915-001 (1, 74.5), Postillon Island, Indonesia. Jul. 1981. **Australia**: CSIRO H 2182-02 (1, 32.0), FRV Soela, 19°05.1' S, 118°53.4' E, north of Port Hedland, Western Australia, 15 Feb 1983, 83 m, epibenthic sled; CSIRO H 2253-05 (3, 27.0–46.0), FRV Soela, 19°05' S, 118°57' E, northeast of Port Hedland, Western Australia, 82 m, benthic trawl, 28 Apr 1983. CSIRO H 2806-03 (2, 13.0–38.0), FRV Soela, 19°3.4' S, 119°2.4' E, North West Shelf, northeast of Port Hedland, Western Australia, 82 m, epibenthic sled, 28 Apr. 1983.

Diagnosis. A species of *Bregmaceros* with a pointed snout extending beyond jaws, a stripe of black dots above anal-fin base, a vertical black band on caudal-fin base, and the following combination of characters: ventral surface of head and abdomen devoid of melanophores; ventral portion of abdominal vertebrae with a pointed parapophysis and a blunt ventral post-zygapophysis; peritoneum, pyloric caeca, and intestine pale; dorsal-fin rays 46–52 (usually 47–50); anal-fin rays 47–55 (usually 48–52); pectoral-fin rays 15–17 (usually 16); principal caudal-fin rays 12–14 (usually 13 with middle 11 branched); caudal vertebrae 35–39 (usually 36–37); total vertebrae 50–54 (usually 51–52).

Description. Meristic characters and body proportions of the holotype and selected paratypes are presented in Table 1.

Body moderately elongate, slightly compressed. Snout more pointed than rounded, its tip protruding beyond the jaws. Mouth oblique and slightly subterminal. Upper jaw ending posteriorly below area between center of eye and posterior margin of pupil. Interorbital space smoothly convex. Eye partially covered over its dorsal margin with adipose eyelid. Two nostrils just anterior to eye. Premaxilla with band of two or three rows of conical teeth, all slightly curved inward, those on outer row largest. Dentary teeth biserial, conical, those on inner row larger than those on outer row. Small conical teeth in a V-shaped cluster on vomer anteriorly. First gill arch with multiple rows of small teeth on both limbs.

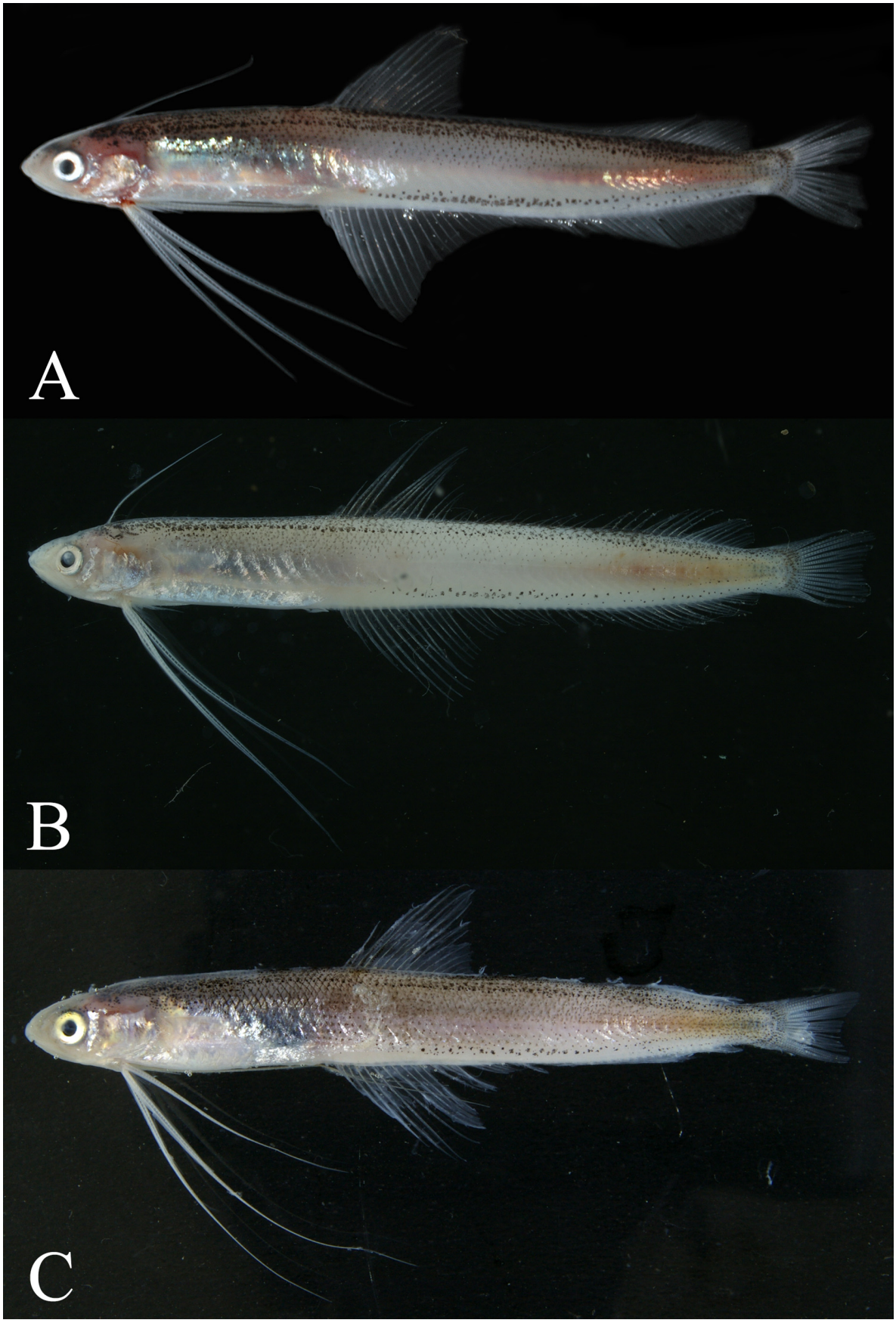

FIGURE 1. Fresh coloration of *Bregmaceros anchovia* **sp. nov.** A. holotype, BSKU 74079, 43.7 mm SL, Kochi. B. paratype, KAUM–I.07465, 46.9 mm SL, Kagoshima. C. paratype, KAUM–I.14737, 58.9 mm SL, Kagoshima.

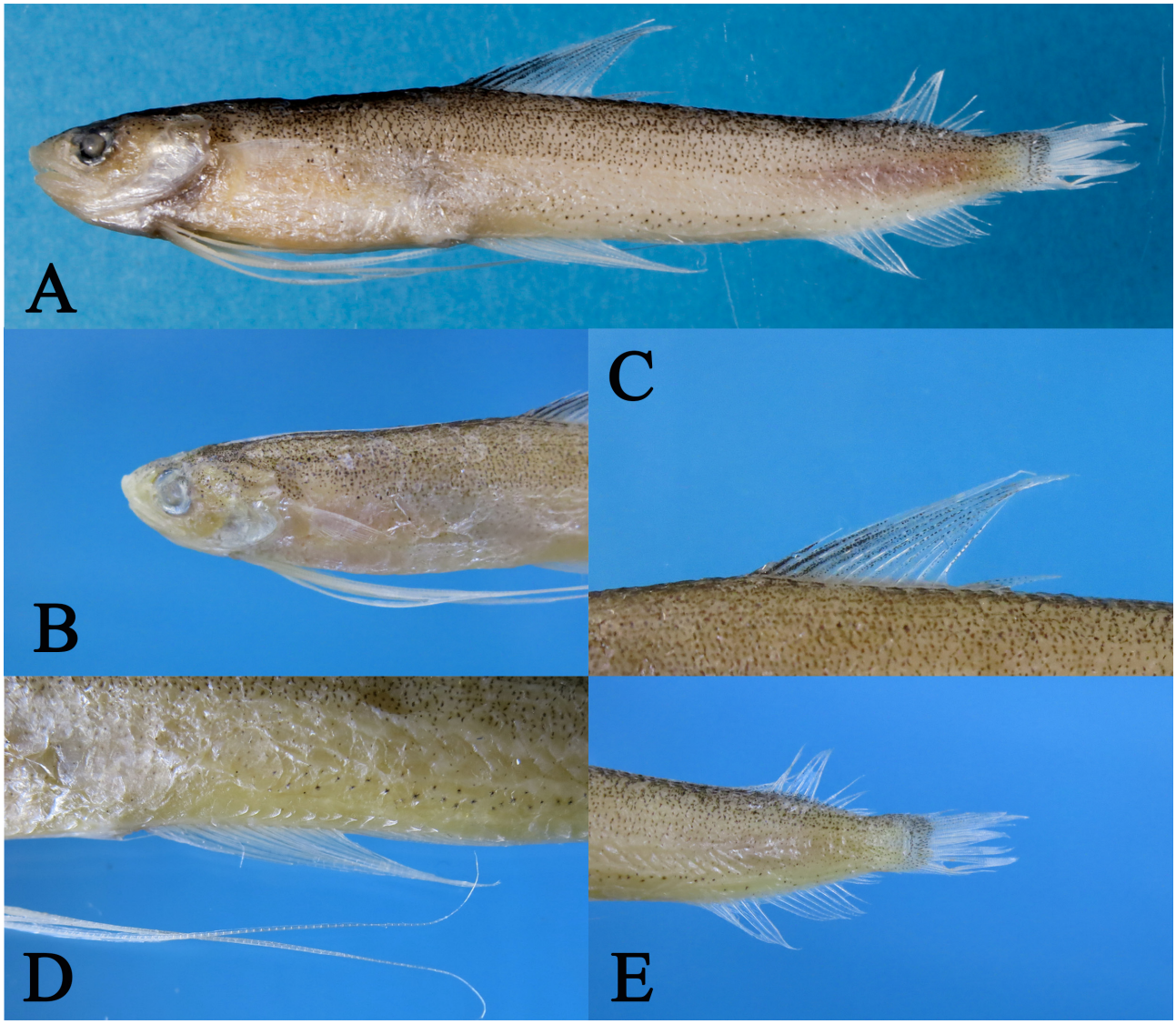

FIGURE 2 . *Bregmaceros anchovia* **sp. nov.**, paratype, NMMB-P25590, 71.9 mm SL, Taiwan, preserved. A. lateral view. B. head and trunk. C. anterior lobe of dorsal fin. D. anterior lobe of anal fin. E. posterior portion of tail. Not to scale.

Pectoral fin inserted at middle of body axis, distal margin pointed, lower 3–6 rays branched. Caudal fin emarginate, principal rays usually 13 (12–14), middle 11 (10–12) rays branched, 7 rays supported by caudal plate (*sensu* Masuda *et al.*, 1986). Pelvic fin insertion at throat, tip of longest ray reaching to between middle portion of anterior lobe and origin of posterior lobe of anal fin; outer 3 rays greatly elongate, finely segmented, unbranched; inner rays short with multiple branches.

First dorsal fin with a single slender occipital ray, its tip reaching to just before origin of second dorsal fin. Origin of second dorsal fin above first or second anal-fin ray. Second dorsal and anal fins with long bases, nearly identical in profile. Both divided confluently into three portions: anterior lobe high, triangular; middle portion low, consisting of rudimentary rays; posterior lobe of moderate height. A rather deep groove bordered by a pair of longitudinal dermal ridges (=lateral line), housing occipital ray, with irregularly shaped scales along groove from middle or posterior fourth of groove to origin of second dorsal fin. A pair of rather wide dermal flaps bordering a groove along ventral contour from insertion of pelvic fin to posterior end of anterior lobe of anal fin; the groove scaleless, internally flat, except a short ridge along middle of groove just after insertion of pelvic fin and before anus.

Opercle slender, smoothly convex along anterior margin, tapering to a blunt point dorsally, a simple or slightly forked point ventrally, and a slender, simple (in younger specimens), bifurcate or multi-branched (in larger specimens; Figs. 3A, B; especially visible when stained), nearly horizontally directed shaft projecting from dorsoposte-

rior margin; length of upper arm to lower arm of opercle 85.8% (84.5–89.0%). Axillary flap attached to shoulder girdle, lower half covered by pectoral fin; slender and tapering to a sharp point dorsally and attached to back of pectoral fin ventrally with a nearly round projection on its lower half.

Ventral surface of abdominal vertebrae with a pointed parapophysis anteriorly and a blunt ventral post-zygopophysis posteriorly, both divided by a deep notch (Fig. 3C).

Scales on middle of body nearly circular, small, cycloid, deciduous, with circuli concentric around focus on exposed part, longitudinally straight and truncated at anterior border on covered part (Fig. 3D). Small, round cycloid scales on isthmus; scales absent from cheek. Lateral line beginning at about midpoint between dorsal edge of gill cover and insertion of occipital ray, running along dorsum from above posterior margin of gill cover to about middle of posterior lobe of second dorsal fin, and declining diagonally, ending shortly behind declination point.

TABLE 1. Morphometric and meristic data of *Bregmaceros anchovia* **sp. nov.**

	Holotype	Selected paratypes			
		Japan		Taiwan	
SL (mm)	43.7	43.7–71.5 (n=8)		66.1–81.5 (n=12)	
%SL		Mean (Range)	SD	Mean (Range)	SD
Head length (HL)	17.0	17.7 (16.7–18.6)	0.7	18.8 (17.5–20.2)	0.8
Upper fork of opercle	4.3	4.2 (3.6–4.7)	0.4	4.6 (4.0–4.9)	0.3
Lower fork of opercle	4.0	3.8 (3.2–4.2)	0.4	4.3 (3.8–4.7)	0.3
Body depth	13.2	13.4 (12.5–14.3)	0.5	15 (13.3–16.9)	1.0
Predorsal length	39.6	40.7 (39.6–43.6)	1.3	42.9 (40.7–44.9)	1.0
Preanal length	37.5	41.2 (37.5–42.9)	1.8	43.8 (41.2–45.5)	1.0
Pectoral fin	8.7	9.8 (8.5–10.9)	0.9	11.3 (10.2–11.9)	0.5
Caudal depth	5.8	5.2 (4.7–5.8)	0.4	5.3 (5.0–5.6)	0.2
Eye diameter	4.8	4.6 (4.0–5.2)	0.4	5.4 (4.7–6.1)	0.4
Interorbital width	3.7	3.2 (2.7–3.8)	0.4	3.7 (3.3–4.0)	0.2
Snout length	5.4	4.9 (4.2–5.4)	0.4	4.6 (4.3–5.0)	0.2
Upper-jaw length	8.4	8.2 (7.8–8.7)	0.3	9.0 (8.3–9.9)	0.4
%HL					
Eye diameter	28.1	25.8 (22.1–28.1)	2.0	28.6 (26.3–30.9)	1.7
Interorbital width	21.9	18.1 (15.6–21.9)	2.1	19.8 (17.5–21.3)	1.2
Snout length	31.4	27.6 (25.0–31.4)	2.2	24.6 (22.7–27.7)	1.4
Upper-jaw length	49.5	46.6 (43.1–49.5)	2.1	47.7 (45.5–49.6)	1.2
Meristics		**n=8**		**n=33**	
Dorsal-fin rays	49	47–51		46–52	
Anal-fin rays	50	48–52		47–55	
Pectoral-fin rays	16	15–17		15–17	
Principal caudal-fin rays	13	13		12–14	
Total caudal-fin rays	26	26–29		27–31	
Prehaemal vertebrae	15	15		15	
Caudal vertebrae	37	36–39		35–38	
Total vertebrae	52	51–54		50–53	
Longitudinal scales rows	77	75–78		74–79	

Coloration. When fresh, body unevenly covered by melanophores, dense melanophores on dorsum and posterior fourth of the body; lower parts of body pale. A horizontal band of large black dots on dorsal fourth of body, originating from above pectoral fin to posterior end of second dorsal fin. Ventral half of body largely devoid of pigment, except for band of one to four irregular rows of scattered black dots above anal-fin base, originating from slightly in front of origin of anal fin to end of fin base.

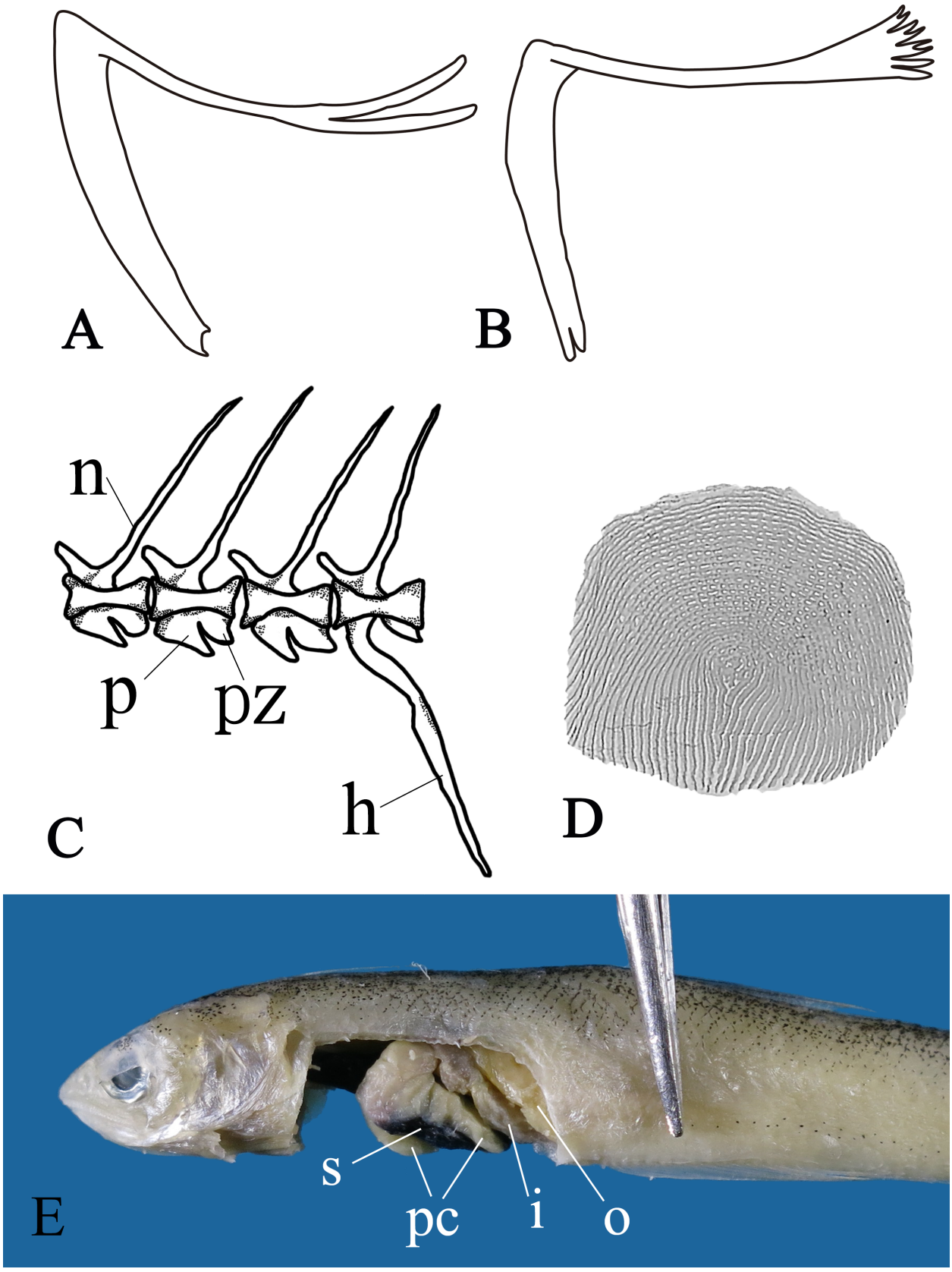

FIGURE 3. *Bregmaceros anchovia* **sp. nov.** A. opercle, NMMB-P25593, 38.9 mm SL. B–D. from NMMB-P25590, 71.9 mm SL. B. opercle. C. posterior three prehaemal and first caudal vertebrae, h=haemal spine, n=neural spine, p= parapophysis, and pz= post-zygapophysis. D. scale on trunk. E. NMMB-P25592, 1 of 4, 69.0 mm SL, dissected, i=intestine, o=ovary, pc=pyloric caeca and s=stomach. Not to scale.

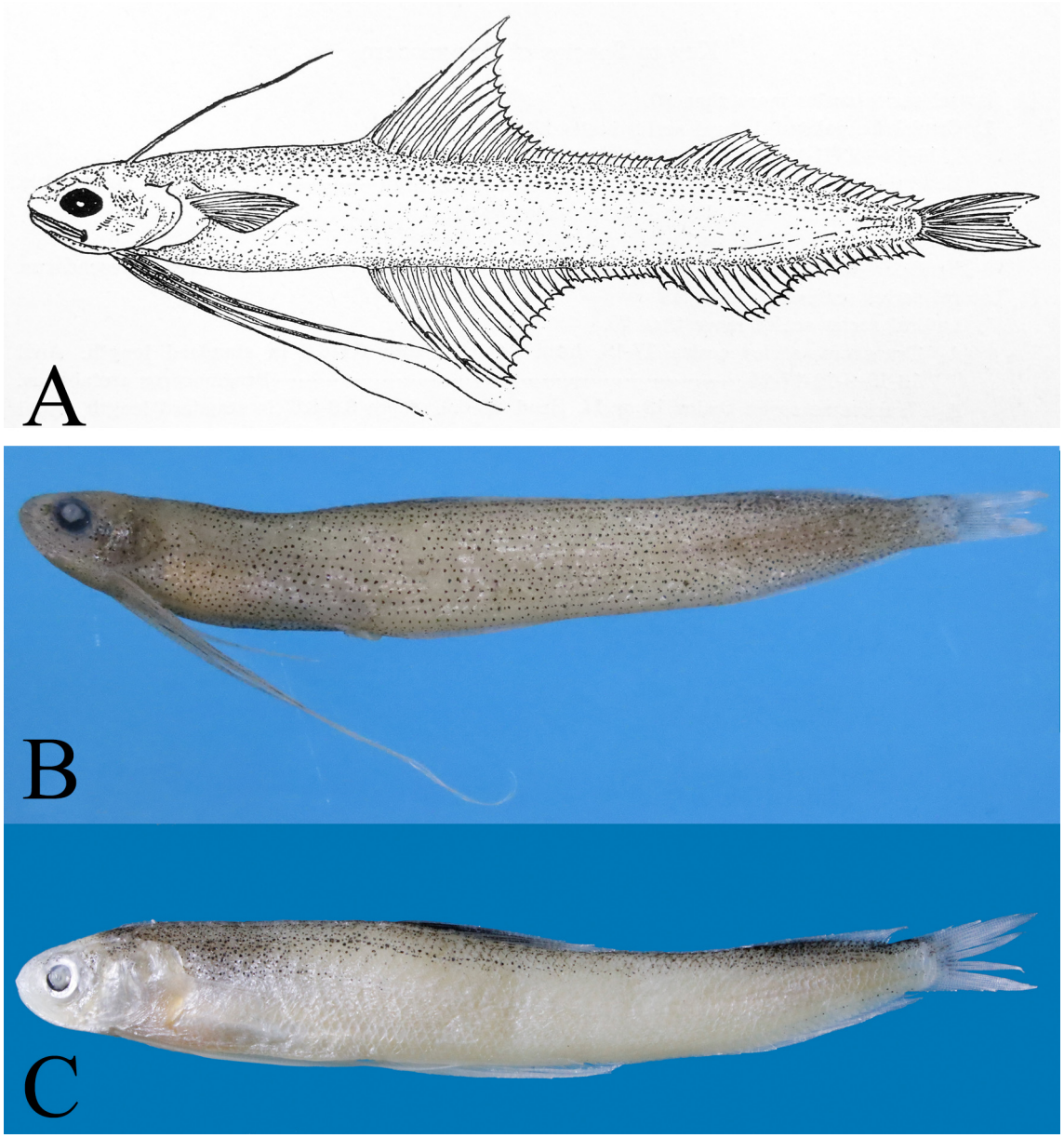

FIGURE 4. A. Original drawing of holotype of *Bregmaceros pescadorus* Shen, 1960. B. *Bregmceros* cf. *arabicus*, NMMB-P25600, 51.5 mm SL. C. *Bregmaceros nectabanus*, NMMB-P25580, 56.0 mm SL.

Posterior half of dorsal surface of head densely covered by melanophores, gradually becoming less dense from above eyes to tip of snout anteriorly; V-shaped black mark on snout in dorsal view; lateral surface of head, including both jaws, gill cover, isthmus, and branchiostegal membranes, devoid of pigment. Dorsal margin of adipose eyelid and upper half of scapular covered by dense melanophores.

Second dorsal fin covered by scattered melanophores, denser on anterior than posterior lobe. Pectoral, pelvic, and anal fins devoid of melanophores, or only occasionally few scattered ones at anterior base of fins. Caudal fin with dense melanophores on base forming a vertical band, remaining section covered by scattered melanophores.

Dorsal groove with scattered melanophores; ridges on each side of groove densely covered with melanophores; longitudinal central ridge and lateral dermal flaps of ventral groove devoid of melanophores.

Stomach black; peritoneum, pyloric caeca, and intestines pale (Fig. 3E).

Preserved specimens with body creamy white ground color and pigmentation pattern as described above.

Size. The largest specimen examined is 81.5 mm SL (NMMB-P25589, 1 of 10).

Etymology. The specific name *anchovia*, as a noun in apposition, a genus of anchovies (family Engraulidae), refers to the outline of the fish which is very similar to anchovies.

Distribution. Known from Japan (off Kagoshima and Kochi), southwestern Taiwan (off Ke-tzu-liao and Dong-gang) and Indonesia (off Lombok and Postillon Islands), and Australia (North West Shelf). Bathymetric range 10–120 m.

Remarks. *Bregmaceros anchovia* is no doubt the same as *B.* "*pseudonectabanus*" [an unavailable name] proposed by Torii (2003, unpublished thesis). The pointed snout and a stripe of black dots above the anal-fin base distinguish it from all other species in the family.

Bregmaceros anchovia is most similar to *B. nectabanus*, which also occurs in the western Pacific Ocean, but differs from *B. nectabanus* in having a pointed snout that projects well beyond the jaws (vs. snout rounded and barely projecting beyond jaws) and a stripe of dots above anal-fin base (vs. no such pigmentation in same area). The emarginate caudal fin and lack of scales on the cheek distinguish *B. anchovia* from *B. lanceolatus* and *B. pseudolanceolatus*, both of which possess a pointed (sometimes rounded) caudal fin and scales on the cheek.

Examination of the large number of specimens of *B. anchovia* showed that the upper arm of the opercle changes with growth in shape. In many smaller individuals (ca. <30 mm SL), the upper arm terminates in a single tapering point, whereas, in large individuals (ca. >30 mm SL), it is bifurcated and divided into many small branches in some individuals (>60 mm SL) (Figs. 3A, 3B). This variation is rare in *Bregmaceros*, as we found the forked or simple conditions to be usually quite consistent. For example, in *B. japonicus*, the upper arm is always simple, whereas in *B. lanceolatus*, *B. pseudolanceolatus*, and *B. nectabanus*, the upper arm is always bifurcate to trifid in small individuals (ca. < 40 mm SL), and gradually showsmore branches in larger individuals (Torii *et al*, 2003a, b, c, 2004). Judging from the combination of other characters, such as meristics, pigmentation, and shape of snout, we are confident that all specimens of *B. anchovia* belong to a single species despite the variations of the upper opercular arm.

Comments on the status of *Bregmaceros pescadorus* Shen, 1960

Shen (1960) described *B. pescadorus* based on 3 specimens collected from Wu-kan-li, Penghu, Taiwan, on 11 Nov. 1958 (Fig. 4A), but all these types were lost (Shen & Wang, 1991). In their taxonomic revision of the genus, Shen & Wang (1991) redescribed *B. pescadorus* with designation of a neotype (NTUM 7509, 44 mm SL, collected off Dong-gang) and provided data of three additional specimens (NTUM 7510, 38.8 mm SL, NTUM 7511, 39.9 mm SL, and NTUM 7512, 39.0 mm SL). They provided figures of a 40-mm SL specimen (Shen & Wang, 1991: fig. 6) and a cleared and stained specimen (Shen & Wang, 1991: fig. 7; size not specified). Although not specified, the former might be NTUM 7511 based on the size provided, but the latter is uncertain.

Torii (2003, unpublished thesis) examined one specimen of *B. pescadorus* (NTUM 7508, 34.6 mm SL, collected on 17 Oct. 1987). The same catalog number was published as *B. lanceolatus* (73.5 mm) by Shen & Wang (1991). Moreover, their photograph of that specimen shows a clear black patch on the upper part of the pectoral fin and is clearly a *B. pseudolanceolatus*, a species described by Torii *et al.* (2004) subsequently. Actually, the 34.6-mm SL specimen examined by Torii is much smaller than those four specimens examined by Shen & Wang (1991) and is unlikely to be one of the latter. All of these lots were lost according to the collection manager of NTUM (Y.-J. Lin, pers. comm., 2016, 2017).

Shen (1960) provided the following information for his specimens of *B. pescadorus*: "83–84 lateral scales and 14–15 transverse scale rows; dorsal-fin rays 53 (holotype), 54, 46; anal-fin rays 49, 47, 46" and "color in formalin yellowish throughout the body and with black dots on the back. Fins hyaline." The original drawing (reproduced as Fig. 4A herein) shows identical values of the dorsal- and anal-fin rays as the holotype and therefore is here regarded as indeed representing the holotype.

Shen & Wang (1991) provided counts of 45–55 dorsal-fin rays and 45–51 anal-fin rays [in text; but 51–53 in the table] for their specimens of *B. pescadorus*. Both data sets provided by Shen (1960) and Shen & Wang (1991), however, are not likely a natural condition for *Bregmaceros*. Based on our examination and previous references, *Bregmaceros* species always have 1–5 more rays on the anal fin than the dorsal fin. Torii (2003, unpublished thesis) evidently adopted Shen & Wang's (1991) data and did not provide any fin values for the only specimen he examined.

Based on the photograph of a cleared and stained specimen of *B. pescadorus* provided by Shen & Wang (1991: fig. 7), we count at least 51 dorsal-fin rays and 55 or 56 anal-fin rays plus at least 3 further rays implied by but not clearly shown in the photograph (resulting in 54 dorsal-fin rays and 58 or 59 anal-fin rays). This cleared and stained specimen has an emarginate caudal fin and therefore is neither *B. lanceolatus* nor *B. pseudolanceolatus*. The number of anal-fin rays given by Shen & Wang (1991) appears to be incorrect.

Another problem in Shen & Wang (1991) is the description of the coloration of their specimens: "regular rows of dots on lateral side of body," which was completely different from the original description of *B. pescadorus*. The original drawing of *B. pescadorus* (*sensu* Shen, 1960) did not show "regular rows of dots" as the photograph shown in Shen & Wang (1991: fig. 6). We collected many specimens with regular rows of dots (e.g., one dot associated with one scale) on lateral side of body from Dong-gang (Fig. 4B), the same locality of their neotype. However, none of them have such low numbers of dorsal- and anal-fin rays (all with 54–58 dorsal-fin rays and 57–61 anal-fin rays). It is therefore suggested that the neotype and the specimens used by Shen & Wang (1991) were different from the original type series of *B. pescadorus*. In this case, the designation of a neotype would be against Article 75.3.5 of the International Code of Zoological Nomenclature (ICZN, 1999) and thus is herein regarded as invalid.

Torii (2003, unpublished thesis) argued that there is no difference between *B. pescadorus* (*sensu* Shen & Wang, 1991) and *B. arabicus* D'Ancona & Cavinato, 1965. Ho *et al.* (2011) also noticed that their specimens have more anal-fin rays than those described in Shen & Wang (1991). Therefore, Ho *et al.*'s (2011) specimens in question are here tentatively identified as *B.* cf. *arabicus* (Fig. 4B) until such time that direct comparison can be made with the type series of *B. arabicus*. In addition, many specimens of *B. nectabanus* (Fig. 4C) were also collected from the southern Taiwan Strait, which is closed to the type locality of *B. pescadorus* (*sensu* Shen, 1960).

Judging from the above observations and rationale, it is suggested that the specimens used in Shen & Wang (1991) belong to a species different from the original description of *B. pescadorus*. The low fin-ray counts, especially anal-fin rays, provided by them are most likely erroneous; consequently, we regard their designation of a neotype as invalid.

The original description of *B. pescadorus* (*sensu* Shen, 1960) is very similar to that for *B. nectabanus*, which has 46–55 dorsal-fin rays, 47–57 anal-fin rays, and 82–85 lateral-line scales (Harold & Golani, 2016; this study). Masuda *et al.* (1986) suggested that *B. pescadorus* is a junior synonym of *B. nectabanus*. The subsequent description of a neotype and additional specimens of *B. pescadorus* (*sensu* Shen & Wang, 1991) is most likely a misidentification of *B.* cf. *arabicus*, despite the low fin-ray counts provided by the authors. In conclusion, *B. pescadorus* is recognized as a junior synonym of *B. nectabanus*, as suggested by Masuda *et al.* (1986).

Comparative materials

***Bregmaceros nectabanus*:** NMMB-P25580 (1, 56.0), Dong-gang, 6 Jan. 2017. NMMB-P25581 (9, 42.0–61.0), Ke-tzu-liao, 20 Jan. 2017. NMMB-P25582 (91, 37.0–59.0), Ke-tzu-liao, 5 Dec. 2016. NMMB-P25583 (17, 48.0–61.0), Ke-tzu-liao, 5 Dec. 2016 [X-rayed]. NMMB-P25584 (5, stained, 59.0–67.0), Ke-tzu-liao, 5 Dec. 2016. [measured, counted] NMMB-P25585 (3, 56.0–63.0), Ke-tzu-liao, 5 Dec. 2016. NMMB-P25586, (68, C&S, 42.0–62.0), Ke-tzu-liao, 5 Dec. 2016. NMMB-P25587 (22, C&S, 38.0–64.0), Ke-tzu-liao, 5 Dec. 2016 [counted]. NMMB-P25596 (1, C&S), ex. NMMB-P25474, Ke-tzu-liao, 5 Dec. 2016. NMMB-P25613 (1, C&S), ex. NMMB-P25613, Dong-gang, 6 Jan. 2017. NMMB-P25614 (1, C&S), ex. NMMB-P25475, Dong-gang, 20 Feb. 2016.

***Bregmaceros* cf. *arabicus*:** NMMB-P25048 (3, 44.0–50.0), Dong-gang, 31 Mar. 2016 [DNA Breg-03, 04, 05]. NMMB-P25599 (6, 41.8–48.0), Dong-gang, 20 Jan. 2017. NMMB-P25600 (2, 46.5–51.5), Dong-gang, 6 Jan. 2017. NMMB-P25610 (14, stained, 37.0–53.0), Dong-gang, 6 Jan. 2017. NMMB-P25598 (1, 44.0), ex. NMMB-P25488, Dong-gang, 11 Oct. 2016.

Acknowledgements

We thank A. Hay, K. Graham (AMS), T. Naito, K. Mizumachi, K. Mizowaki (BSKU); P. Last, A. Graham, J. Pogonoski (CSIRO); H. Motomura (KAUM); W.-C. Ma (NMMB-P); M. Gomon, D. Bray (NMV); M. Hammer, B. Russell (NTM) for curatorial assistance; Masahiro Kitano (BSKU) for his preliminary study on *Bregmaceros* in Tosa Bay. This study was supported by the Ministry of Science and Technology, Taiwan and National Museum of Marine Biology & Aquarium, Taiwan.

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