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A review of the genus *Apristurus* (Chondrichthyes: Carcharhiniformes: Scyliorhinidae) from Taiwanese waters

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Abstract

Sharks of the genus *Apristurus* from Taiwanese waters are reviewed for the first time, and incorrect scientific names and wrong taxonomic information given in the literature are corrected. After extensive examination of specimens deposited in various museums, universities and fisheries institutions in Taiwan, Japan and China, the following five species are recognized from Taiwanese waters: *Apristurus herklotsi* (Fowler, 1934)*, A. longicephalus* Nakaya, 1975*, A. gibbosus* Meng, Chu & Li, 1985, *A. macrostomus* Chu, Meng & Li, 1985, and *A. platyrhynchus* (Tanaka, 1909). *Apristurus herklotsi, A. longicephalus, A. gibbosus* and *A. macrostomus* are reported from Taiwanese waters for the first time, and the presence of *A. platyrhynchus* is formally recognized based on a single voucher specimen. Each species is fully described, and a key to the species of *Apristurus* in Taiwanese waters is provided. Morphological and biological information of each species is also provided.

Key words: taxonomy, identification key, Taiwan, *Apristurus, A. gibbosus*, *A. herklotsi, A. longicephalus, A. macrostomus*, *A. platyrhynchus*

Introduction

The genus *Apristurus* Garman, 1913 is a group of deepwater catsharks that inhabit continental slopes and submarine elevations at depths of 400–2000 m in all oceans, except for polar waters. Since the description of *Scyllium spinacipellitum* Vaillant, 1888, a total of 47 nominal species have been described, but some species are poorly known or known only from the type specimens. Intraspecific variation (e.g. individual, ontogenetic, sexual and geographic variation) is consequently hardly understood in many species due to lack of specimens. Therefore, the genus *Apristurus* is always one of the most taxonomically confusing genera among living sharks.

The taxonomy of the genus *Apristurus* had locally or partially been established by Springer (1966, 1979) and Cadenat & Blache (1981), and was summarized by Compagno (1984, 1988). Worldwide taxonomic studies of the genus are being made by Nakaya and colleagues, e.g. Nakaya (1975, 1988a, 1988b, 1989, 1991), Nakaya & Sato (1998, 1999, 2000), Nakaya *et al*. (2008a, 2008b), Nakaya & Séret (1992, 1999, 2000), Nakaya & Stehmann (1998), Iglésias *et al*. (2002, 2004, 2005), Iglésias & Nakaya (2004), Kawauchi *et al*. (2008), Sasahara *et al*. (2008), and Sato *et al*. (1999, 2008, 2013). In addition, White *et al*. (2008) and Iglésias (2012) presented new species descriptions from Australia and New Caledonia, respectively. Currently, 37 species are considered valid among 47 nominal species described since Vailant (1888).

The genus *Apristurus* includes 13 valid species from the western North Pacific, but the genus from Taiwanese waters has never been studied before, and incorrect scientific names are given in the literature (Chen, 1963; Shen, 1984; Chen & Joung, 1993; Shen & Wu, 2012). Therefore, we conducted extensive collections throughout Taiwan, and examined Taiwanese specimens in museums, institutions and fisheries laboratories in Taiwan and other countries. We also included many specimens collected in other waters for a better understanding of each species.

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The purposes of the present paper are to review the species of the genus *Apristurus* around Taiwan, to give accurate taxonomic descriptions based on voucher specimens, to give an effective key to identify the Taiwanese species, and to summarize morphological and biological information on those species.

Materials and methods

Measurements and meristic counts follow Nakaya *et al*. (2008b). Vertebral counts were determined by radiographs. Terminology for claspers follows Compagno (1988), and those of the egg cases follow Cox (1963) and Flammang *et al*. (2007). Dermal denticles were taken from the dorsolateral side of the body below first dorsal fin. Sexual maturity stages were determined as "immature" (clasper very short, and gonads completely undeveloped), "adolescent" (clasper elongate but soft, and gonads developing) and "adult" (clasper long and stiff, and gonads completely developed and large), following Nakaya & Stehmann (1998). Institution acronyms follow Sabaj Pérez (2012).

Key to the species of *Apristurus* from Taiwanese waters

1a. Pre-outer nostril length much greater than interorbital width . . . . . 2 ('longicephalus group')
1b. Pre-outer nostril length much shorter than interorbital width . . . . . 3 ('brunneus group')
2a. Spiral valves less than 13 (8–12); duodenum short, less than half length of valvular intestine; teeth numerous, 44–60 rows on upper jaw and 44–61 rows on lower jaw; clasper hook present . . . . . *A. herklotsi*
2b. Spiral valves 13 or more (13–17); duodenum long, almost equal to length of valvular intestine; teeth less numerous, 35–45 rows on upper jaw and 29–40 rows on lower jaw; clasper hook absent . . . . . *A. longicephalus*
3a. First dorsal fin origin above pelvic fin base; interspace between pectoral fin base and pelvic fin base longer than anal fin base (ceratotrichia); anal fin triangular with short base . . . . . *A. gibbosus*
3b. First dorsal fin origin behind pelvic fin base; interspace between pectoral fin base and pelvic fin base shorter than anal fin base (ceratotrichia); anal fin low with a long base 4
4a. First dorsal fin origin anterior to midpoint of interspace of pelvic and anal fin bases; clasper hooks present; mature at about 40 cm TL in both sexes; egg capsules short and stocky with coiled tendrils on posterior end . . . . . *A. macrostomus*
4b. First dorsal fin origin posterior to midpoint of interspace of pelvic and anal fin bases; clasper hook absent; mature at about 60 cm TL in both sexes; egg capsules long and slender without coiled tendrils on posterior end . . . . . *A. platyrhynchus*

Apristurus herklotsi (Fowler, 1934)

English name: Longfin catshark
Taiwanese name: Chang-wen-bi-sa
Japanese name: Yari herazame
(Figures 1–6, Table 1)

Pentanchus herklotsi Fowler, 1934: 238, fig. 3 (original description, type locality: Philippines); Fowler, 1941: 53 (key to species and description, Philippines).

Apristurus herklotsi: Springer & Garrick, 1964: 86 (material, Philippines); Compagno, 1984: 264 (description, Philippines); Compagno, 1988: 170 (taxonomic comments, Philippines); Nakaya, 1988a: 437 (comparative materials); Nakaya, 1988b: 133, figs. 1–12 (description, Philippines and Japan); Nakaya, 1991: 999, figs. 1–8 (comparative materials, Philippines, China, and Japan); Nakaya & Shirai, 1992: 40 (fauna and zoogeography, Japan); Compagno, 1999: 478 (list); Nakaya & Sato, 1999: 315 (taxonomic comments); Nakaya & Séret, 1999: 307 (comparative materials); Yoshino & Aonuma, 2002: 130 (key to species, Japan); Compagno *et al*., 2005: 190 (not fig., not pl. 32, description, China, Philippines, and Japan); Ebert *et al*., 2013: 289 (not fig, not pl. 39, description).

Apristurus xenolepis Meng, Chu and Li, 1985: 47, fig. 4 (original description, type locality: China).

Apristurus abbreviatus Deng, Xiong & Zhan, 1985: 102, fig. 1 (original description, type locality: China).

Apristurus brevicaudatus Chu, Meng & Li, 1986: 269, fig. 1 (original description, type locality: China).

Apristurus longianalis Chu, Meng & Li, 1986: 271, fig. 3 (original description, type locality: China).

Apristurus longicaudatus Li, Meng & Chu, 1986: 272, fig. 4 (original description, type locality: China).

Material examined. *Taiwan*: ASIZP 58264, 2 females, 375 mm TL and 403 mm TL, Da-xi. ASIZP 60560, 2 females, 445 mm TL and 450 mm TL, Da-xi. ASIZP 61686, female, 298 mm TL, 24–52'N, 122-01'E (East of

Keelung), 423–538 m. NMMBP 9497, 203 mm TL, female, 263 mm TL, female, 429 mm TL, male, 400 m, NMMBP 7406, 378 mm TL, female, 390 mm TL, female, 412 mm TL, female, NMMBP 14811, 295 mm TL, male, NMMBP 17510, 443 mm TL, female, Da-xi. HUMZ 170382, male, 486 mm TL, HUMZ 170415, male, 362 mm TL, HUMZ 170416, male, 336 mm TL, HUMZ 170417, female, 415 mm TL, HUMZ 170418, male, 464 mm TL, HUMZ 170419, female, 442 mm TL, HUMZ 170420, male, 430 mm TL, HUMZ 170421, female, 482 mm TL, HUMZ 170422, male, 520 mm TL, HUMZ 170448, male, 364 mm TL, HUMZ 170449, female, 450 mm TL, HUMZ 170492, female, 453 mm TL, HUMZ 170932, male, 323 mm TL, HUMZ 185159, female, 419 mm TL, HUMZ 185160, female, 402 mm TL, HUMZ 185161, female, 378 mm TL, HUMZ 185162, male, 268 mm TL, HUMZ 185169, male, 337 mm TL, all from Da-xi fishing port, near Kuei-shan Island. *Other regions* (type specimens): USNM 93134 (holotype of *A. herklotsi*), female, 326 mm TL, Cagayan Island, Jolo Sea, Philippines (9°37′N, 121°12.5′E). ECSFI E-1547 (holotype of *Apristurus abbreviates*), female, 430 mm TL, male, East China Sea, 692 m depth; ECSFI E-1000 (paratype of *A. abbreviates*), female, 365 mm TL. ECSFI E-1001 (paratype of *A. abbreviates*), female, 407 mm TL, East China Sea (29°28.00′N, 127°33.0′E), 655 m depth. ECSFI E-1417 (paratype of *A. abbreviates*), male, 355 mm TL, East China Sea (31°24.00′N, 129°03.00′ E), 716 m depth. ECSFI E-1548 (paratype of *A. abbreviatus*), male, 340 mm TL. ECSFI E-1597 (paratype of *A. abbreviatus*), female, 311 mm TL, East China Sea (31°34.04′N, 129°06.00′E), 692 m depth. SCSFRI D-1125 (holotype of *Apristurus brevicaudatus*), male, 397 mm TL, South China Sea, 864 m depth. SCSFRI S-6530 (holotype of *Apristurus longianalis*), female, 366 mm TL, South China Sea, 533 m depth. SCSFRI D-811 (holotype of *Apristurus longicaudatus*), male, 324 mm TL, South China Sea, 840 m depth. SCSFRI D-42 (holotype of *Apristurus xenolepis*), female, 415 mm TL, South China Sea, 546 m depth. SFC D-32, SFC D-1126 (2 paratypes of *A. brevicaudatus*), 2 males, 412–419 mm TL, South China Sea, 864 m depth. SFC D-571 (paratype of *A. longianalis*), female, 359 mm TL, South China Sea, 604 m depth. SFC-564 (paratype of *A. longicaudatus*), male, 330 mm TL, South China Sea, 619 m depth. *Other regions* (non types): BSKU 23109, female, 318 mm TL, BSKU 23110, female, 317 mm TL, 615 m depth, Kochi Prefecture, Japan. BSKU 26647, male, 320 mm TL, 900 m depth, BSKU 27598, male, 350 mm TL, 610–640 m depth, BSKU 27882, female, 437 mm TL, 520–542 m depth, Okinawa Trough, Japan. FUMT-P 10142, female, 485 mm TL, FUMT-P 10143, male, 373 mm TL, FUMT-P 10144, female, 438 mm TL, Choshi Fish Market, Chiba Prefecture, Japan.

Diagnosis. A species of *Apristurus* with the following characters: upper labial furrows subequal to or longer than the lowers; first dorsal fin much smaller than second dorsal fin, originating slightly posterior to pelvic fin insertion; second dorsal-fin insertion anterior to anal-fin insertion; snout narrow and long; pre-outer nostril length greater than interorbital width; abdomen short; P1–P2 space much shorter than anal-fin base length (ceratotrichia); pectoral-fin tip always extending beyond midpoint of P1–P2 space; duodenum short, less than half of valvular intestine; intestinal spiral valves 8–12; monospondylous + precaudal diplospondylous vertebrae 28-33 + 31–35; clasper hook present on edge of exorhipidion; body uniformly pale brownish to light grayish; mature size 400–450 mm TL in males and 550–600 mm TL in females.

Description. Proportional measurements and meristic counts are given in Table 1. Body cylindrical, slender and elongate (Figure 1). Head dorso-ventrally flattened, posterior part of body compressed laterally. Snout very long, narrow; its tip tapering evenly. Pre-outer nostril length greater than interorbital width, 2.0–2.5 times internarial width. Pre-oral length slightly less than pre-orbital length, 3.1–4.0 times internarial width, much greater than mouth width and interorbital width. Pre-orbital length 1.9–2.1 times interorbital length, 3.4–4.9 times orbit length. Internarial width longer than orbit length and subequal to nostril width. Nostril relatively large, expanding obliquely inward from snout edge; length about half of pre-outer nostril length. Nostril-mouth space about half of internarial width. Mouth arched, with well developed labial furrows; upper labial furrow1.0–1.6 times longer than lower one. Upper labial furrow reaching beyond midpoint between mouth corner and posterior margin of nostril. Orbit narrow and slender, with a weak subocular fold. Spiracle small placed slightly below level of horizontal axis of orbit. Five small gill slits present; fourth gill slit above pectoral-fin origin; fifth gill slit smallest above pectoral fin base. Gill septa without projection, covered with dermal denticles. Abdomen short; P1–P2 space shorter than anal-fin base length (ceratotrichia); pectoral-fin tip always reaching beyond midpoint of P1–P2 space. Pectoral fin large, broad, sub-triangular; outer margin not parallel to inner margin. Pelvic fin low and short, its length subequal to pre-inner nostril length. Dorsal fins similar in shape. First dorsal fin much smaller than second; origin slightly

posterior to pelvic-fin insertion; insertion slightly posterior to anal-fin origin. Second dorsal-fin origin slightly posterior to middle of anal-fin base; insertion anterior to anal-fin insertion. Anal fin low, with a long base much greater than P1–P2 space; apex clearly posterior to first dorsal-fin insertion; posterior margin straight; anal and caudal fins separated only by a notch. Caudal fin slender; ventral lobe high: apex of ventral lobe rather rounded; subterminal notch distinct; length of terminal lobe twice caudal terminal lobe height. Caudal peduncle height 0.4–0.6 times pre-outer nostril length. Duodenum short, length less than half of valvular intestine.

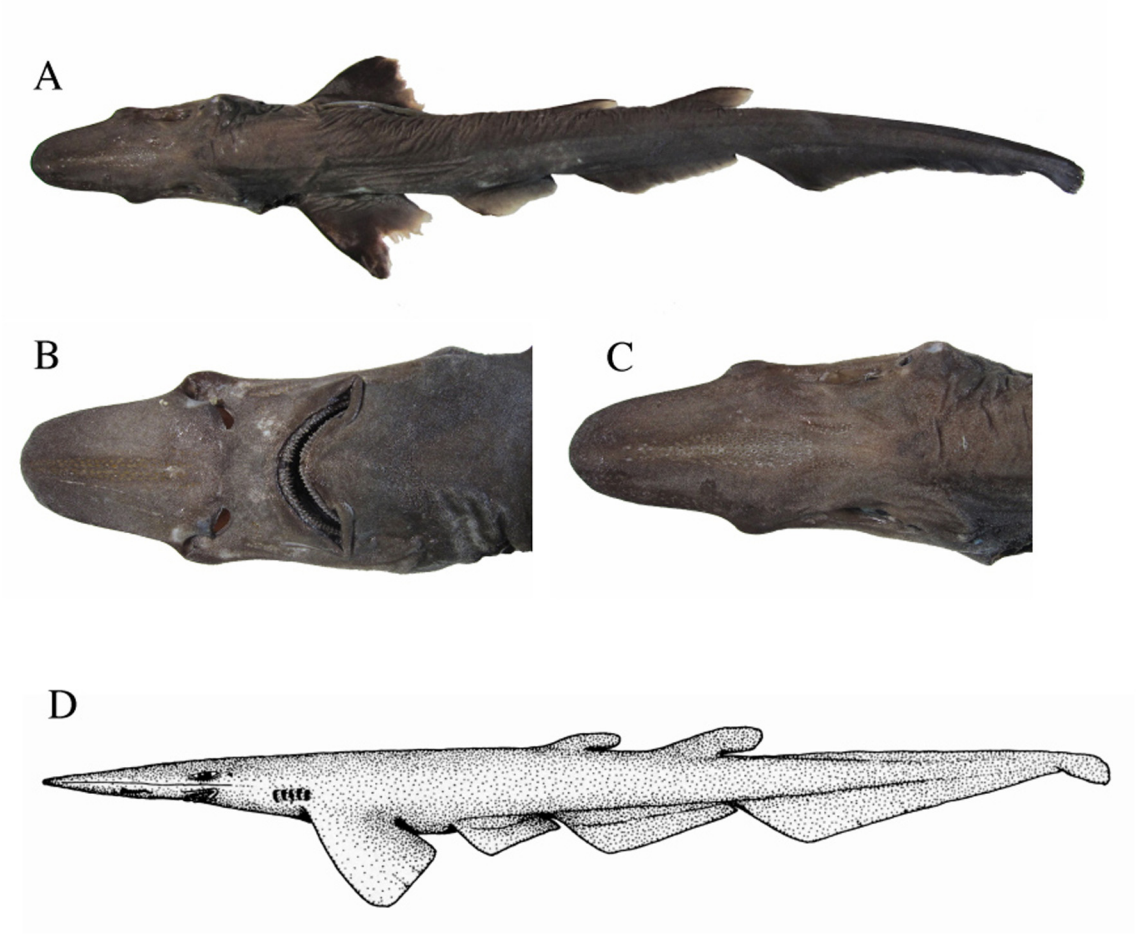

FIGURE 1. *Apristurus herklotsi.* A, B, C: NMMBP 17510, 443 mm TL, female, Da-xi. D: Holotype (drawing by Nakaya).

Intestinal spiral valves 8–12. Monospondylous vertebrae 28–33; precaudal diplospondylous vertebrae 31–35.

Teeth numerous and small, 44–60 rows on upper jaw, 44–61 rows on lower jaw; usually one (sometimes two) lateral cusp on anterior upper jaw teeth and usually two (sometimes one) on posterior upper jaw and lower jaw teeth.

Egg capsule taken from 482 mm TL specimen (HUMZ 170421) (Figure 2) 47.3 mm long and 15.4 mm wide in a cylindrical shape, without coiled tendrils on both ends; anterior margin of capsule rounded without fibrous thread at each corner; lateral edges straight; posterior tip forming narrow and relatively long tapering tube. Surface of egg capsule with ridges. Color light brown.

Dermal denticles from dorso-lateral side of body (Figure 3) small, overlapping each other, tricuspid, with a long ridged central cusp and shorter lateral cusps; outer surface of denticles completely structured by reticulations. No modified dermal denticles on the dorsal margin of caudal fin. Dermal denticles densely present around the gill slits and on gill septa.

Clasper (Figure 4) stout at base, tapering posteriorly. Ventral and outer sides of surface densely covered with dermal denticles. Dorsal side of clasper naked and ventral and lateral sides covered with clasper denticles; clasper hooks present on edge of exorhipidion; pseudosiphon slit-like in shape; cover rhipidion vestigial; pseudopera large and deep; exorhipidion simple in shape, lacking free posterior end.

FIGURE 2. Egg capsule of *Apristurus herklotsi* from HUMZ 170421, female, 482 mm TL. Scale bar = 1 cm.

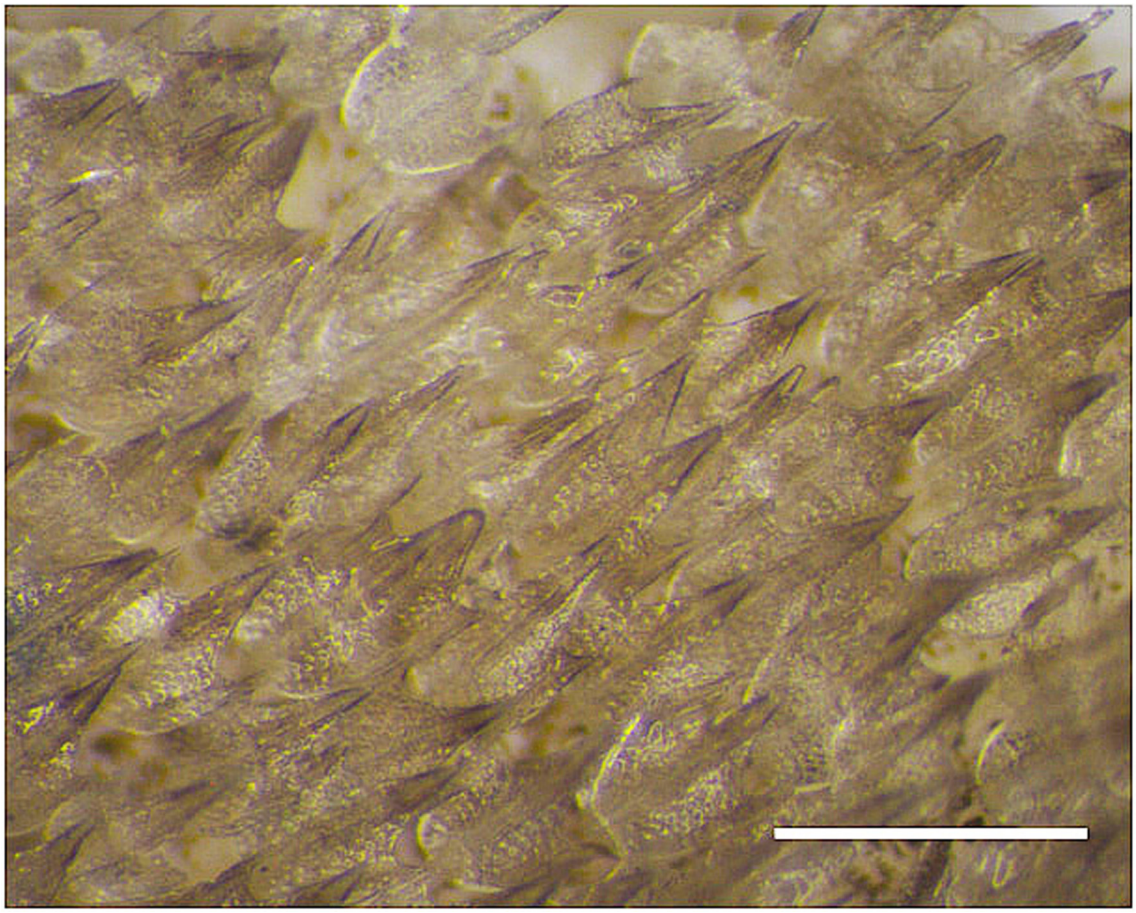

FIGURE 3. Dermal denticles of *Apristurus herklotsi*, HUMZ 185159, female, 419 mmTL. Scale bar = 0.5 mm.

Color. Upper and lower surfaces of body and fins uniformly pale brownish to light grayish with blackish naked areas along the fin margins. Tongue and palate blackish brown.

Size. Maximum size 520 mm TL in male (Figure 5). Males less than 373 mm TL in maturity stage 1 (immature) with short claspers, less than 2.5 % TL. One male of 430 mm TL in maturity stage 2 (adolescent) with developing but soft claspers. Most males more than 397 mm TL in maturity stage 3 (adult) with long, well-developed and

hardened claspers. Females less than 378 mm TL in maturity stage 1. Females in 401.5–450 mm TL in maturity stage 2. Females more in 437–482 mm TL in maturity stage 3.

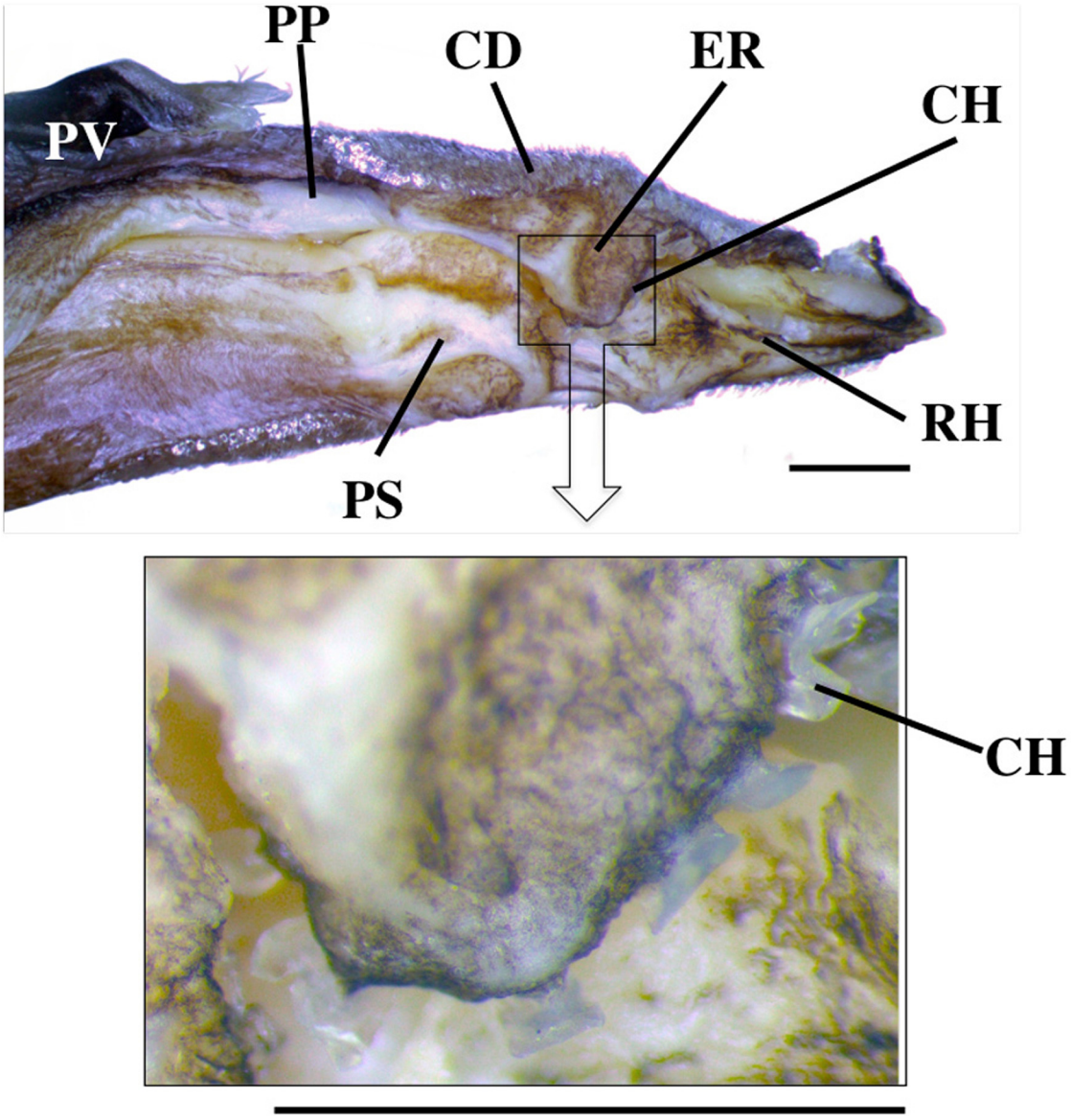

FIGURE 4. Dorsal views of right clasper of *Apristurus herklotsi*, HUMZ 170382, male, 486 mm TL. CD, clasper denticles; CH, clasper hooks; ER, exorhipidion; PP, pseudopera; PS, pseudosiphon; PV, pelvic fin; RH, rhipidion. Scale bars = 0.25 cm.

Distribution. Philippines, Taiwan (Da-xi), South China Sea, East China Sea (Okinawa Trough), Mainland of Japan (Tosa Bay and northward to Choshi, Chiba Prefecture), in 533–864 m depth (Figure 6).

Remarks. *Apristurus herklotsi* was originally described by Fowler (1934) based on an immature female collected from the Philippines. This species belongs to the 'longicephalus group' (*sensu* Nakaya & Sato, 1999) of the genus *Apristurus*, typically characterized by having a very long and slender pre-outer nostril snout, which is longer than the interorbital width.

The 'longcephalus group' contains nine nominal species from the western Pacific and Indian oceans, but five of them are recognized as junior synonyms of *Apristurus herklotsi* (Nakaya, 1991). Therefore, the 'longicephalus group' contains four valid species, *A. herklotsi* Fowler (1934) from the Philippines, *A. longicephalus* Nakaya, 1975 from Japan, *A. australis* Sato, Nakaya & Yorozu, 2008 from Australia, and *A. garricki* Sato, Stewart & Nakaya, 2013 from New Zealand.

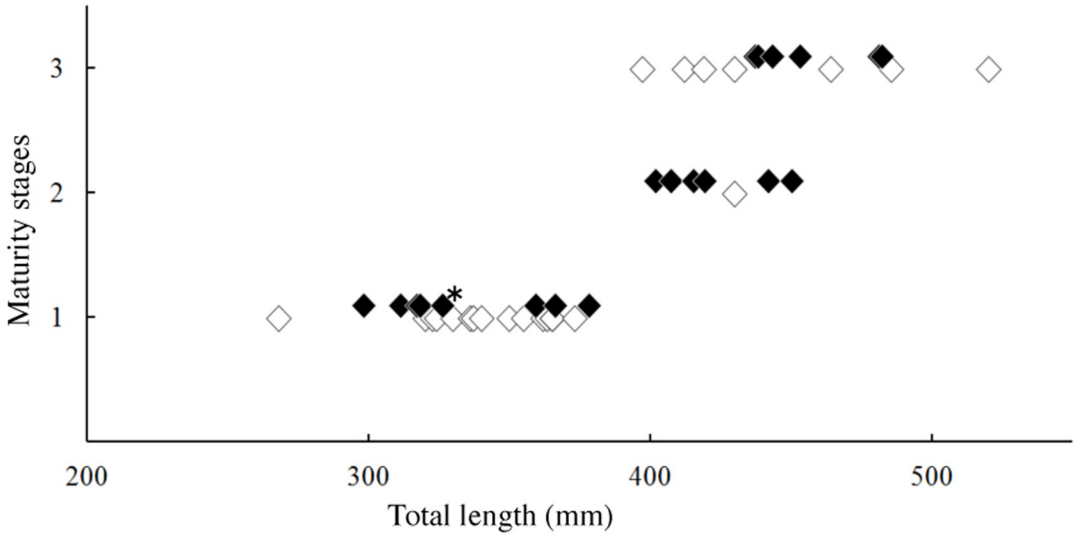

FIGURE 5. Maturity stages of *Apristurus herklotsi.* Open symbols, males; solid symbols, females. Asterisks indicate holotypes.

Apristurus herklotsi and *A. longicephalus* occurs in Taiwan, but they are clearly distinguishable by the position of first dorsal fin origin (behind pelvic insertion in *A. herklotsi* vs. above pelvic fin base in *A. longicephalus*), the number of spiral valves (8–12 in *A. herklotsi* vs. 13–17 in *A. longicephalus*), and the length of duodenum (less than half of valvular intestine in *A. herklotsi* vs. considerably long, almost equal to the valvular intestine in *A. longicephalus*).

This is the first report of *A. herklotsi* from Taiwan.

TABLE 1. Proportional measurements and counts of *Apristurus herklotsi*.

	A. herklotsi		
	Taiwan	Holotype	Other regions (other types)
	10 males, 10 females	female	12 males, 10 females (9 males, 5 females)
Total length (mm)	268–520	326	311–481 (311–430)
Proportion (%TL)			
PreD2-origin length	55.7–60.9	57.4	54.1–59.9 (55.3–59.9)
PreD1-origin length	44.7–49.3	46.6	43.1–49.6 (43.7–49.4)
PreP1 length	21.8–25.7	24.0	22.7–25.1 (22.8–24.5)
PreP2 length	36.6–40.6	37.7	36.6–40.9 (37.2–40.1)
Preanal length	47.8–52.5	48.5	46.7–52.6 (47.7–52.6)
Precaudal length	62.9–66.9	64.7	61.9–68.3 (63.6–68.3)
Pre-branchial length	18.8–22.6	21.7	18.7–21.9 (18.7–21.6)
Pre-orbital length	11.1–13.7	13.9	11.2–14.2 (11.2–13.6)
Pre-outer nostril length	6.4–10.6	7.9	6.7–8.6 (6.7–8.1)
Pre-inner nostril length	8.5–10.6	10.3	8.6–11.0 (8.6–10.6)
Pre-oral length	10.1–12.8	11.9	10.5–14.3 (10.5–13.2)
Head length	22.7–26.9	24.9	22.6–25.8 (23.5–24.4)

..... *continued on the next page*

TABLE 1. (Continued)

	A. herklotsi		
	Taiwan	Holotype	Other regions (other types)
	10 males, 10 females	female	12 males, 10 females (9 males, 5 females)
Mouth width	5.0–7.6	8.4	5.5–9.1 (6.5–7.8)
Internarial width	2.8–3.6	4.0	3.0–3.8 (3.0–3.7)
Upper labial furrow length	2.9–3.7	3.3	3.0–3.8 (3.1–3.8)
Lower labial furrow length	2.2–3.3	2.9	2.4–3.6 (2.4–3.1)
Orbital length	2.4–3.5	2.9	2.5–3.3 (2.5–3.1)
Nostril length	2.5–3.4	3.6	2.5–3.8 (2.5–3.3)
Interorbital width	4.1–6.4	6.7	3.3–6.7 (5.4–6.7)
1st gill height	0.9–2.6	0.6	1.3–2.3 (2.0–2.3)
3rd gill height	1.2–3.2	0.6	1.4–2.3 (2.0–2.3)
5th gill height	1.1–2.2	1.0	1.1–2.8 (1.1–2.0)
D1-D2 space	4.7–7.2	7.1	4.1–6.8 (4.1–6.8)
D1-D2 origins	7.6–11.8	—	10.3–12.6 (12.6)
D1-D2 insertions	10.4–12.8	—	10.6–11.0 (—)
P1-P2 space	5.6–9.8	5.4	6.9–9.0 (7.0–9.0)
P1 tip to P2 origin	1.7–5.4	—	1.6 (—)
P1-P2 origins	13.5–16.4	14.4	14.5 (—)
D1 base length	2.2–8.0	4.7	3.9–9.0 (4.8–9.0)
D1 height	0.6–4.6	1.3	1.1–1.6 (1.1–1.6)
D1 free lobe length	1.9–3.3	—	2.5–3.6 (—)
D2 base length	3.6–7.2	6.2	5.4–7.7 (5.4–7.5)
D2 height	1.6–2.5	2.4	1.9–2.7 (1.9–2.5)
D2 free lobe length	2.9–4.5	—	3.0–3.6 (—)
P1 anterior margin	8.9–13.9	—	10.2–12.8 (—)
P2 length	5.3–8.6	10.1	7.5–9.6 (—)
Anal base length (ceratotrichia)	12.4–16.6	16.3	13.7–17.0 (13.7–17.0)
Anal height (muscle)	1.7–3.1	3.7	2.3–3.8 (2.3–3.7)
Caudal length	32.6–37.6	35.6	32.1–37.2 (32.1–36.4)
Clasper outer length	1.2–5.1	—	1.3–4.6 (1.3–4.6)
Counts			
Tooth rows:			
upper	44–57	53	45–60 (45–60)
lower	44–53	56	49–61 (49–61)
Vertebrae:			
monospondylous	31–33	28	31–33 (—)
precaudal diplospondylous	31–35	—	31–35 (—)
Spiral valves	8–10	—	10–12 (—)

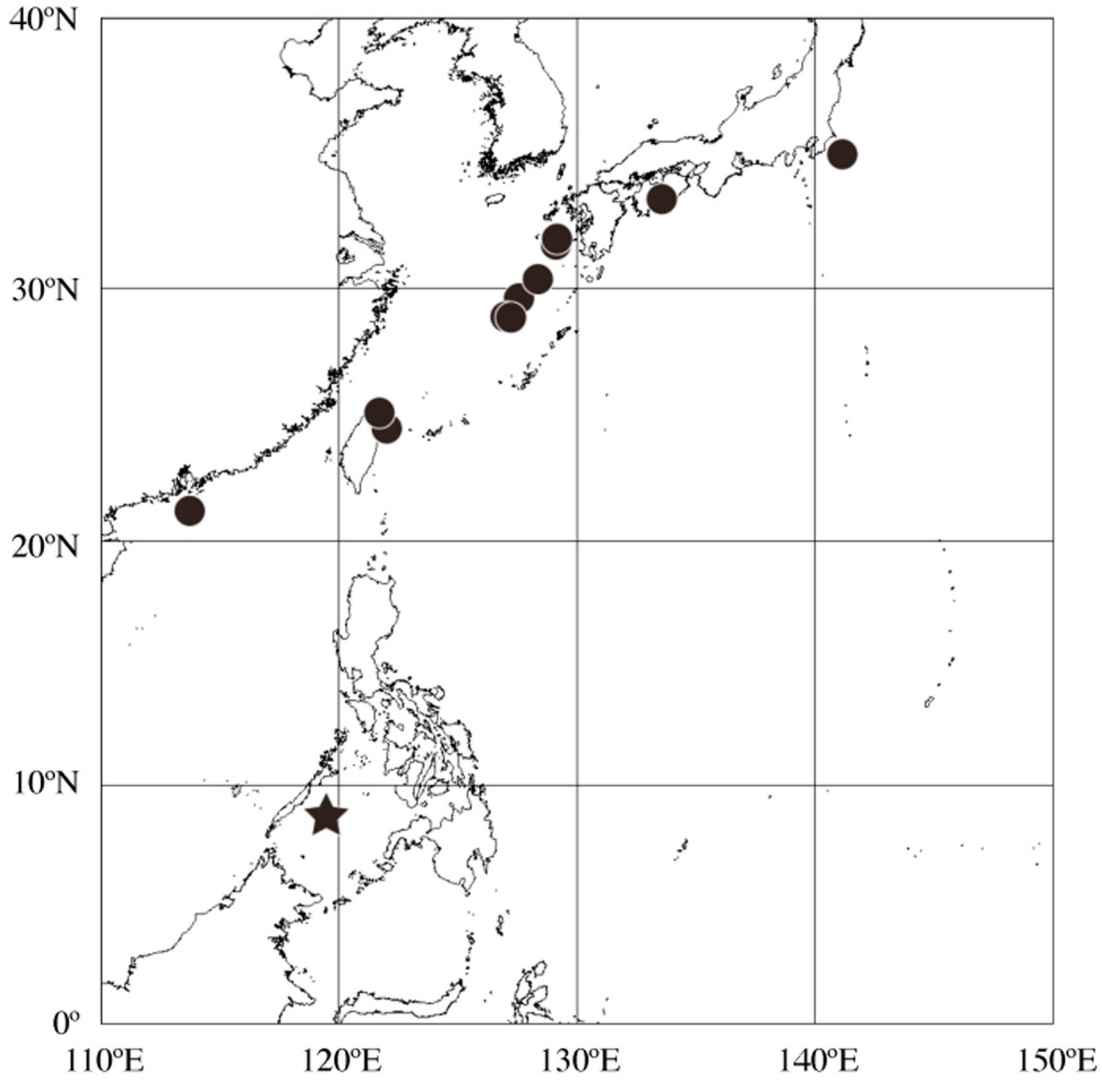

FIGURE 6. Distribution of *Apristurus herklotsi*. Star, holotype; circles, non-types.

***Apristurus longicephalus* Nakaya, 1975**
English name: Longhead catshark
Taiwanese name: Chang-tou-bi-sa
Japanese name: Tengu herazame
(Figures 7–12, Table 2)

Apristurus longicephalus Nakaya, 1975: 32, figs. 15–16 (original description, type locality: Japan); Compagno, 1984: 271 (description, Japan); Nakaya, 1984: 4, pl. 3-D (description, Japan); Nakaya, 1984: 43 and 296, pl. 10 (description, Japan); Nakaya, 1988a: 431, figs. 1–13 (description, Japan); Nakaya, 1988b: 134 (comparative materials, Japan); Compagno, 1988: 170 (taxonomic coments); Nakaya, 1991: 999 (comparative materials, Japan); Last and Stevens, 1994: 180 (description, Japan, China, Taiwan, Philippines, Australia, and Seychells); Compagno, 1999: 478 (checklist); Nakaya & Sato, 1999: 315 (taxonomic comments); Nakaya & Séret, 1999: 307 (comparative materials), Yoshino & Aonuma, 2002: 130 (key to species, Japan); Compagno *et al*., 2005: 194, pl. 32 (description, Japan, China, Taiwan, Philippines, Australia, and Seychelles); Iglésias *et al*., 2005a: 417 (description, East China, Japan, Seychelles, Mozambique, New Caledonia, and Australia); Iglésias *et al*., 2005b: 574 (molecular phylogeny, New Caledonia); Last & Stevens, 2009: 191, figs.11, 31.4 (description, East China Sea, Japan, Seychelles, Mozambique, Philippines, New Caledonia, and Australia); Ebert *et al*., 2013: 292, pl. 37 (description).

TABLE 2. Proportional measurements and counts of *Apristurus longicephalus*.

	A. longicephalus		
	Taiwan	Holotype	Other regions
	1 female	hermaphroditic female	13 males, 16 females, 8 unknown sex
TL (mm)	258	367	270–500
Proportion (%TL)			
PreD2-origin length	53.5	55.6	53.1–62.5
PreD1-origin length	41.9	45.8	41.3–49.1
PreP1 length	23.3	25.7	22.5–27.6
PreP2 length	37.2	38.8	34.9–46.0
Preanal length	46.1	48.4	44.6–52.8
Precaudal length	61.6	62.7	56.2–69.1
Pre-branchial length	18.4	21.3	18.0–22.9
Pre-orbital length	12.1	13.2	10.0–13.7
Pre-outer nostril length	7.3	7.9	5.9–7.9
Pre-inner nostril length	8.3	9.6	7.7–10.2
Pre-oral length	9.6	11.6	9.0–11.9
Head length	23.2	22.3	22.8–27.3
Mouth width	7.2	8.7	4.9–7.9
Internarial width	4.6	4.6	3.5–4.6
Upper labial furrow length	3.3	3.4	2.9–3.7
Lower labial furrow length	2.7	2.8	1.7–3.4
Orbital length	2.6	3.0	2.4–3.5
Nostril length	2.4	3.1	1.9–3.5
Interorbital width	—	6.5	3.7–6.6
1st gill height	—	—	1.1–2.6
3rd gill height	—	1.8	1.5–3.3
5th gill height	—	—	1.3–2.5
D1-D2 space	6.9	6.0	4.5–8.3
D1-D2 origins	10.7	—	10.0–13.5
D1-D2 insertions	14.3	12.7	10.3–14.8
P1-P2 space	7.3	14.8	5.4–11.2
P1 tip to P2 origin	1.7	—	0.5–5.8
P1-P2 origins	13.8	14.8	11.7–17.9
D1 base length	4.4	4.7	4.0–8.0
D1 height	1.4	1.6	1.1–2.3
D1 free lobe length	2.5	—	2.1–3.6
D2 base length	6.8	6.3	3.3–7.9
D2 height	2.6	2.4	2.1–3.0
D2 free lobe length	3.6	—	2.6–6.1
P1 anterior margin		—	7.8–12.3
P2 length	8.7	10.0	5.5–9.7
Anal base length (ceratotrichia)	15.0	14.6	13.7–18.4
Anal height (muscle)	3.1	2.8	2.2–3.9

..... continued on the next page

TABLE 1. (Continued)

	A. longicephalus		
	Taiwan	Holotype	Other regions
	1 female	hermaphroditic female	13 males, 16 females, 8 unknown sex
Caudal length	37.5	36.5	29.9–38.1
Clasper outer length	0.9	2.6	0.4–4.8
Counts			
Tooth rows:			
upper	42	36	35–45
lower	36	31	29–40
Vertebrae:			
monospondylous	33	32	29–33
precaudal diplospondylous	30	29	26–35
Spiral valves	17	15	13–16

Material examined. *Taiwan*: ASIZP 64264, female, 258 mm TL, 25°13.61'N, 122°49.5'E (East of Keelung), 992 m depth. *Other regions (type specimen)*: HUMZ 42399 (holotype), hermaphroditic female, 367 mm TL, Tosa Bay, Kochi Prefecture, Japan (33°13'N, 133°44.4'E), 610–740 m depth. *Other regions (non types)*: BSKU 22338, hermaphroditic female, 328 mm TL, Kochi Prefecture, Japan. BSKU 23012, male, 424 mm TL, Kochi Prefecture, Japan, 615 m depth. BSKU 26358, hermaphroditic female, 270 mm TL, 1000–1140 m depth, BSKU 26455, hermaphroditic male, 326 mm TL, 910–990 m depth, BSKU 26512, hermaphroditic male, 310 mm TL, 680-770 m depth, BSKU 26648, hermaphroditic female, 312 mm TL, BSKU 26649, hermaphroditic female, 280 mm TL, BSKU 26650, hermaphroditic male, 278 mm TL, BSKU 26651, hermaphroditic female, 386 mm TL, 900 m depth, BSKU 26867, male, 295 mm TL, BSKU 26868, hermaphroditic female, 412 mm TL, 750–760 m depth, 4 Feb. 1978, BSKU 27596, male, 417 mm TL, 610–640 m depth, BSKU 28096, hermaphroditic female, 336 mm TL, BSKU 28097, female, 390 mm TL, 820–830 m depth, BSKU 28166, hermaphroditic female, 311 mm TL, 908–915 m depth; BSKU 33519, hermaphroditic female, 411 mm TL, BSKU 33520, hermaphroditic female, 403 mm TL, 780–810 m depth; BSKU 33999, hermaphroditic female, 362 mm TL, BSKU 34000, hermaphroditic female, 413 mm TL, 600–620 m depth, Okinawa Trough, Japan. HUMZ 145151, hermaphroditic male, 380 mm TL, HUMZ 145153, female, 331 mm TL, East China Sea, depth unknown; HUMZ 145154, hermaphroditic female, 500 mm TL, East China Sea, depth unknown. HUMZ 191310, hermaphroditic female, 349 mm TL, 547–567 m depth, HUMZ 193669, male, 435 mm TL, 516–523 m depth off Sumatra, Indonesia. HUMZ 194156, hermaphroditic female, 358 mm TL, HUMZ 194157, hermaphroditic female, 321 mm TL, HUMZ 194158, hermaphroditic female, 375 mm TL, HUMZ 194159, hermaphroditic female, 315 mm TL, HUMZ 194161, male, 418 mm TL, 684–693 m depth, off Jakarta, Indonesia. HUMZ 194265, female, 473 mm TL, HUMZ 194266, female, 412 mm TL, 820–860 m depth. PPSI 317, male, 585 mm TL, 800–1350 m depth, PPSI 330, male, 327 mm TL, 810 m depth; PPSI 341, female, 507 mm TL, 790–820 m depth, PPSI 353, male, 405 mm TL, 820–900 m depth, southeast of Seychelles. ISH 376, male, 290 mm TL, 900–950 m depth, ISH 377, female, 237 mm TL, 980–1000 m depth, Mozambique.

Diagnosis. A species of *Apristurus* with the following characters: upper labial furrows 0.9–2.2 times the lowers; first dorsal fin much smaller than the second dorsal fin, originating above posterior half of pelvic-fin base; second dorsal-fin insertion anterior to anal-fin insertion; snout narrow and long; pre-outer nostril length greater than interorbital width; abdomen short; P1–P2 space shorter than anal-fin base length (ceratotrichia); pectoral-fin tip always extending beyond midpoint of P1–P2 space; duodenum long, length equal to valvular intestine; intestinal spiral valves 13–17; monospondylous + precaudal diplospondylous vertebrae 29–33 + 26–35; clasper hook absent on edge of exorhipidion; body uniformly dark brown to light grayish; mature size at least 400 mm TL in males.

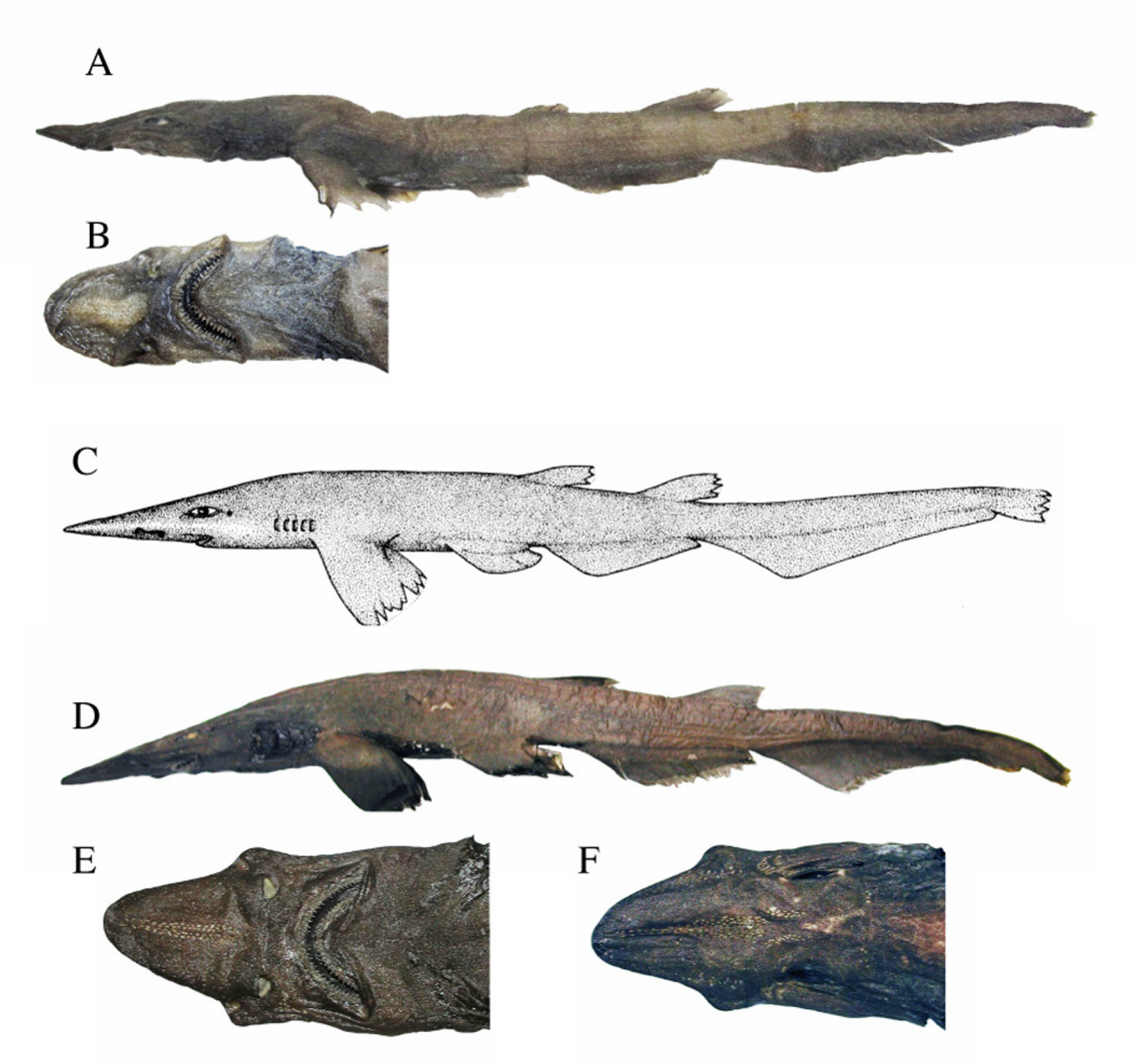

FIGURE 7. *Apristurus longicephalus*. A–B, ASIZP 64264, female, 258 mm TL, Keelung, Taiwan; C, Original drawing of holotype (from Nakaya, 1975); D–F, HUMZ 193669, male, 435 mm TL, Indonesia.

Description. Proportional measurements and meristic counts are given in Table 2. Body cylindrical, slender and elongate (Figure 7). Head dorso-ventrally flattened, posterior part of body compressed laterally. Snout long, narrow; tip tapering in adults, rounded in young specimens. Pre-outer nostril length greater than interorbital width, 1.4–2.2 times internarial width. Pre-oral length subequal to or slightly less than pre-orbital length, 2.2–3.2 times internarial width, 1.3–2.0 times mouth width and much greater than interorbital width. Pre-orbital length 2.0–3.0 times interorbital length, 3.5–6.0 times orbit length. Internarial width slightly greater than orbit length and nostril width. Nostril expanding obliquely inward from snout edge; length 0.3–0.6 times pre-outer nostril length. Nostril-mouth space about half of internarial width. Mouth broadly arched, with well developed labial furrows; upper labial furrow 0.9–2.2 times lower one. Upper labial furrow reaching beyond midpoint between mouth corner and posterior margin of nostril. Orbit slender and narrow, with a weak subocular fold. Spiracle small placed slightly below level of horizontal axis of orbit. Five small gill slits present; fourth gill slit above pectoral-fin origin; fifth gill slit smallest above pectoral fin base. Gill septa with projection, covered with dermal denticles. Abdomen short; P1–P2 space shorter than anal-fin base length (ceratotrichia); pectoral-fin tip always extending beyond midpoint of P1–P2 space. Pectoral fin relatively large, broad, sub-triangular; outer margin parallel to inner margin. Pelvic fin low and long, its length subequal to or slightly greater than P1–P2 space. Dorsal fins similar in shape. First dorsal fin smaller than second; origin above posterior half of pelvic-fin base; insertion slightly posterior to anal-fin origin. Second dorsal-fin origin above middle of anal-fin base; insertion anterior to anal-fin insertion. Anal fin low, with a base much longer than P1–P2 space; apex clearly posterior to first dorsal-fin insertion; posterior margin straight;

anal and caudal fins separated only by a notch. Caudal fin slender; ventral lobe high but not produced: apex of ventral lobe rather rounded; subterminal notch distinct; length of terminal lobe twice caudal terminal lobe height. Caudal peduncle height subequal to pre-outer nostril length. Duodenum very long, length almost equal to valvular intestine (Figure 8).

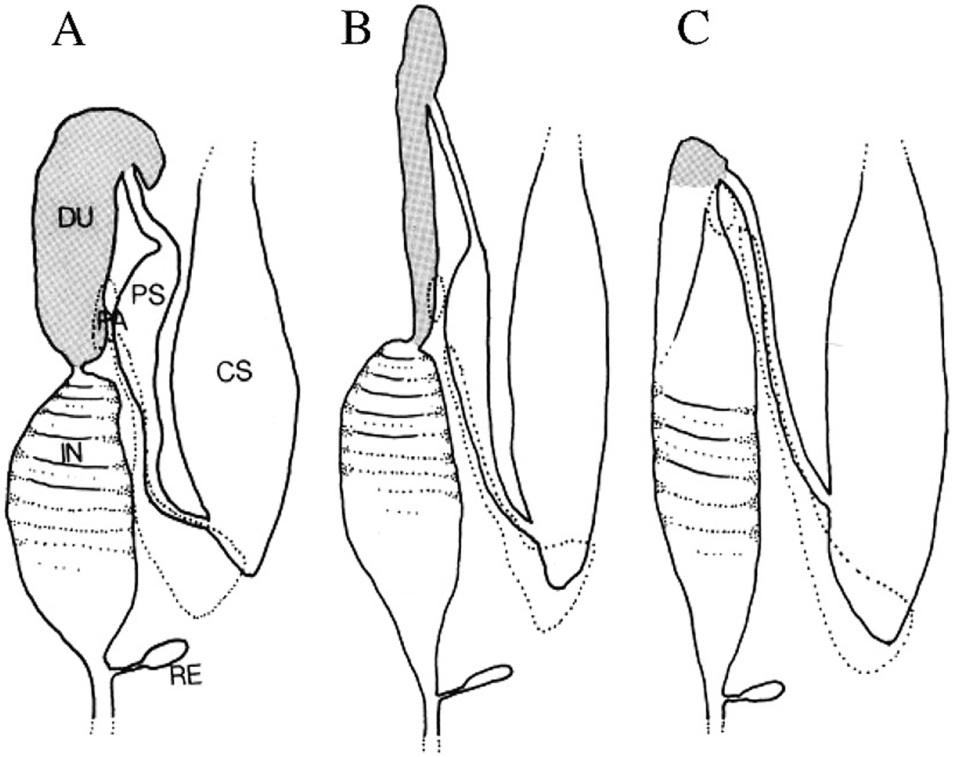

FIGURE 8. Digestive tract of *Apristurus longicephalus* (A, B) and *A. herklotsi* (C), showing duodenum (DU). A, holotype (HUMZ 42399); B, BSKU 27596; C, BSKU 27598. CS, cardiac stomach; IN, intestine; PA, pancreas; PS, pyloric stomach; RE, rectal gland.

Intestinal spiral valves 13–17. Monospondylous vertebrae 29–33; precaudal diplospondylous vertebrae 26–35.

Teeth numerous and small, 35–45 rows on upper jaw, 29–40 rows on lower jaw with one long central cusp and short lateral cusps; usually one (sometimes two) lateral cusp on anterior upper jaw teeth and usually two (sometimes one) on posterior upper jaw and lower jaw teeth.

Egg capsule unknown.

Dermal denticles from dorso-lateral side of body small (Figure 9), overlapping each other, tricuspid, with a long ridged central cusp and shorter lateral cusps; outer surface of denticles completely structured by reticulations. No modified dermal denticles on the dorsal margin of caudal fin. Dermal denticles densely present around gill slits and on gill septa.

Clasper stout at base (Figure 10), tapering posteriorly. Ventral and outer sides of surface densely covered with dermal denticles. Dorsal side of clasper naked and ventral and lateral sides covered with clasper denticles; clasper hooks absent on edge of exorhipidion; pseudosiphon slit-like in shape; cover rhipidion vestigial; pseudopera broad and deep; exorhipidion simple in shape, lacking free posterior end.

Color. Upper and lower surfaces of body and fins uniformly dark brown to light grayish with blackish naked areas along fin margins. Tongue and palate blackish brown.

Size. Maximum size 585 mm TL in male (Figure 11). Males less than 367 mm TL in maturity stage 1 (immature) with short claspers, less than 2.6 % TL. Males in 358–424mm TL in maturity stage 2 (adolescent) with developing but soft claspers. Males more than 434.5 mm TL in maturity stage 3 (adult) with long, well developed and hardened claspers. Females less than 361.5 mm TL in maturity stage 1. Females in 368–411 mm TL in maturity stage 2. Females more than 472.5 mm TL in maturity stage 3.

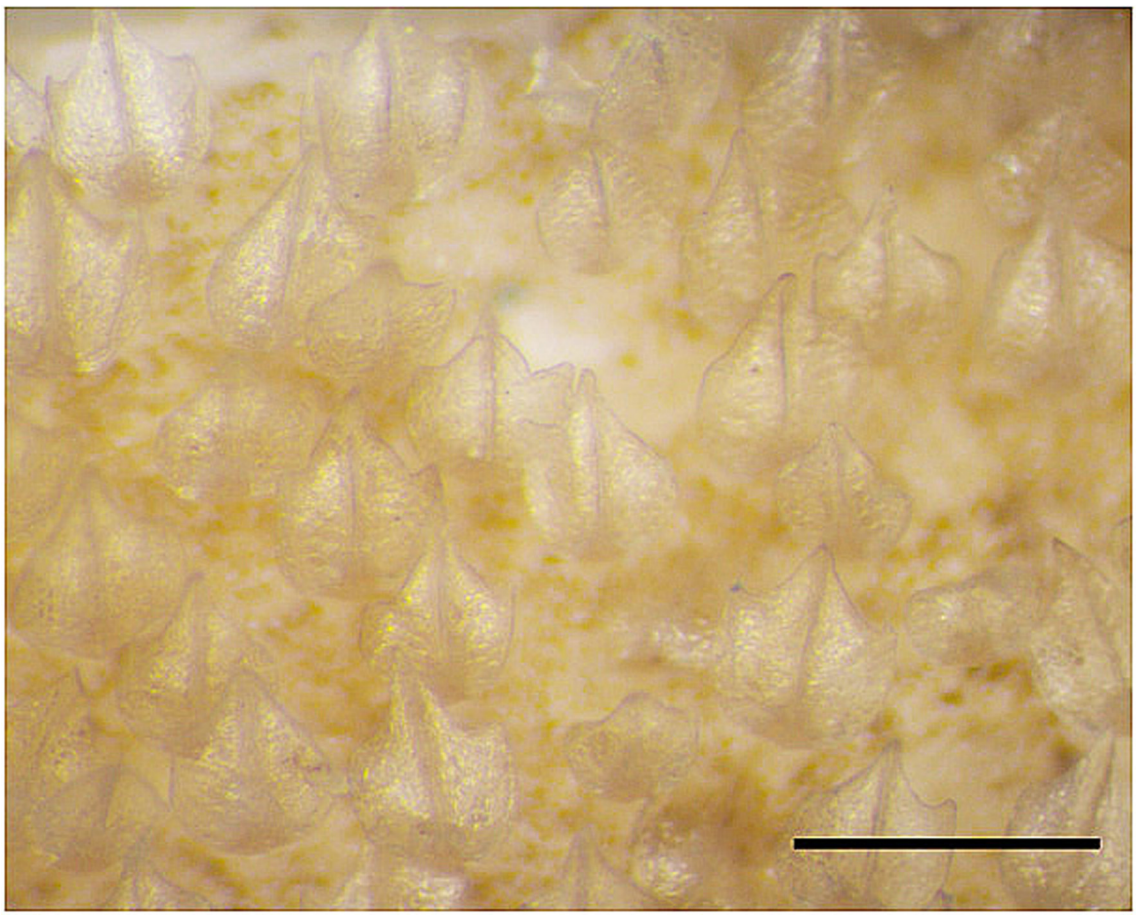

FIGURE 9. Dermal denticles of *Apristurus longicephalus,* HUMZ 42399, holotype, hermaphroditic female, 367 mm TL. Scale bar = 0.5 mm.

Distribution. Tosa Bay, East China Sea (Okinawa Trough), Taiwan, and China, Philippines, Indonesia (off Jawa and Sumatra), New Caledonia, Australia, Seychelles, and Mozambique, at depths of 516–1350 m (Figure 12).

Remarks. *Apristurus longicephalus* was originally described by Nakaya (1975) based on an immature "male" specimen collected from Japan. This species belongs to the 'longicephalus group' (*sensu* Nakaya & Sato, 1999) of the genus *Apristurus*; see remarks of *A. herklotsi* in further notes on the species of the 'longicephalus group'.

Both *Apristurus longicphalus* and *A. herklotsi* appear in Taiwan, and they are clearly distinguishable by the position of first dorsal fin origin (above pelvic fin base in *A. longicephalus* vs. behind pelvic base in *A. herklotsi*), number of spiral valves (13–17 in *A. longicephalus* vs. 8–12 in *A. herklotsi*), length of duodenum (considerably long, almost equal to the valvular intestine in *A. longicephalus* vs. very short in *A. herklotsi*), among other characters.

Iglésias *et al*. (2005b) reported hermaphroditism in *Apristurus longicephalus* as the first case in the elasmobranch fishes. Nakaya (1975) described *A. longicephalus* based on an immature "male" holotype with small claspers, but Iglésias *et al*. (2005b) found the holotype to have been an adolescent hermaphroditic "female" with a developing ovary. They also pointed out that the ratios of hermaphroditism in this species differed by region (i.e., 49 out of 50 specimens were hermaphroditic and only one was gonochoristic in New Caledonia, and 18 out of 22 specimens were hermaphroditic in Japanese waters, while all six specimens were gonochoristic in the Indian Ocean). The present specimen from Taiwan is a small "male" (255 mm TL) with undeveloped claspers, but its functional (true) sex could not be determined, because its internal sexual organs are not developed yet.

This is the first report of *Apristurus longicephalus* from Taiwan.

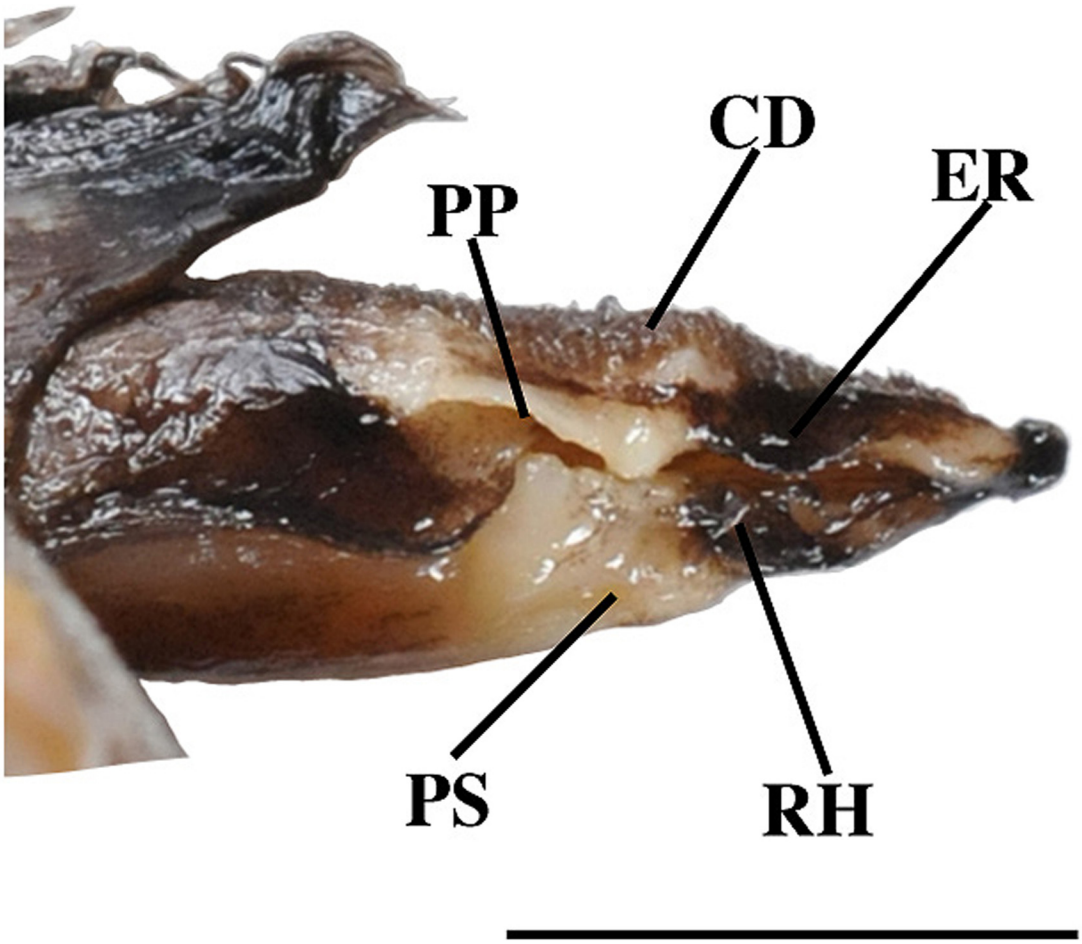

FIGURE 10. Dorsal view of right clasper of *Apristurus longicephalus*, HUMZ 193669, male, 435 mm TL. CD, clasper denticles; ER, exorhipidion; PP, pseudopera; PS, pseudosiphon; PV, pelvic fin; RH, rhipidion. Scale bar = 1 cm.

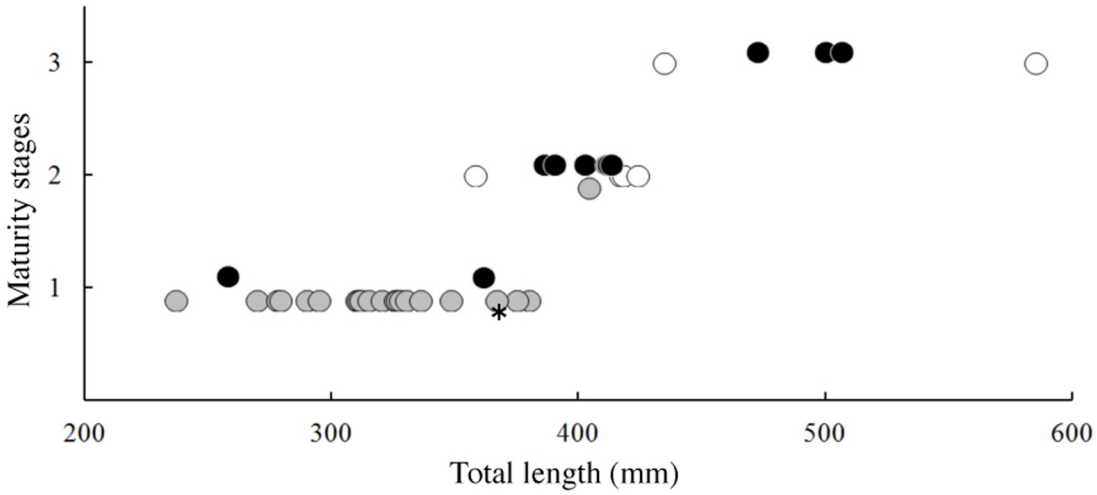

FIGURE 11. Maturity stages of *Apristurus longicephalus*. Open symbols, males; solid symbols, females; grey symbols, unknown sex. Asterisk indicates holotype.

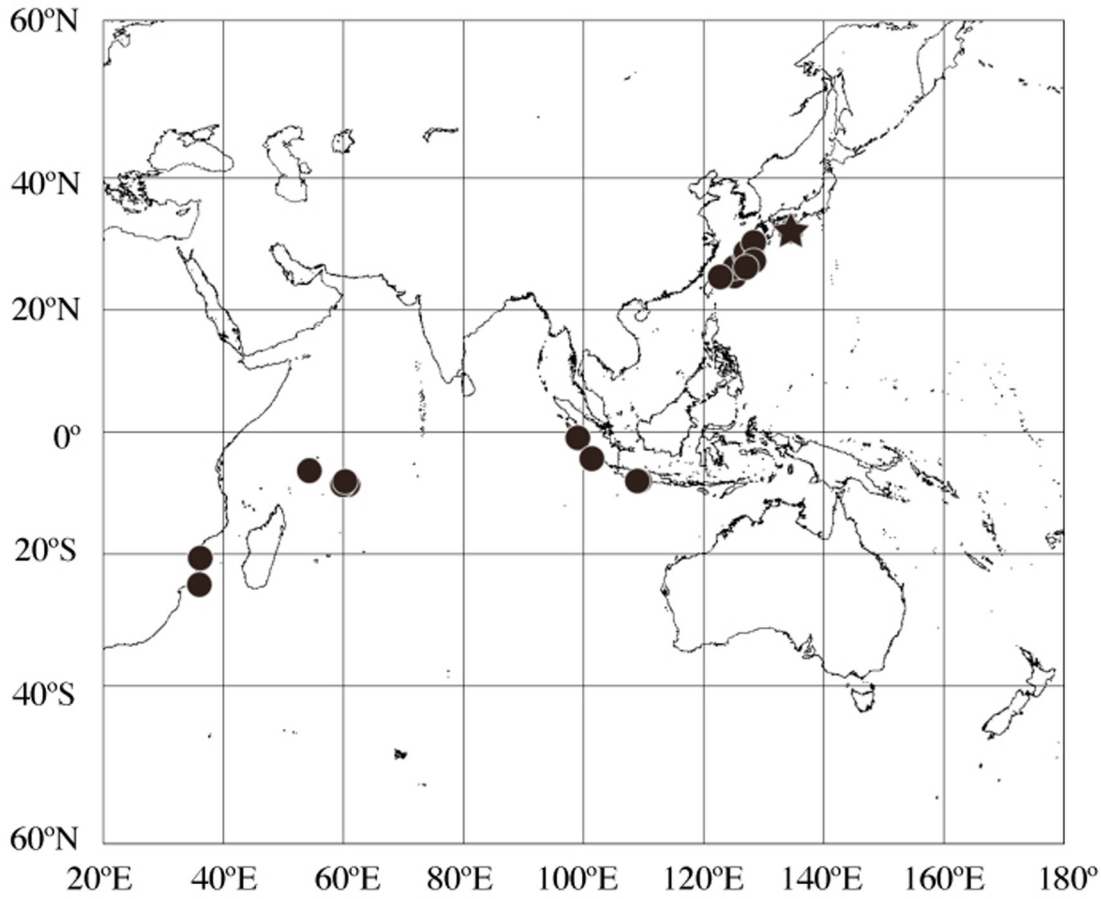

FIGURE 12. Distribution of *Apristurus longicephalus*. Star, holotype; circle, non-types.

***Apristurus gibbosus* Meng, Chu & Li, 1985**
English name: Humpback catshark
Taiwanese name: Tuo-bei-bi-sa
Japanese name: Nankai herazame
(Figure 13–21, Table 3)

Apristurus gibbosus Meng, Chu & Li, 1985: 43, fig. 1 (original description, type locality: South China Sea); Nakaya & Sato, 1999: 316 (taxonomic comments, South China Sea); Nakaya & Séret, 1999: 307 (taxonomic comments, South China Sea), Compagno, 1999: 478 (taxonomic comments, South China Sea); Compagno *et al*., 2005: 189–190, pl. 33 (description, China); Ebert *et al*., 2013: 288, pl. 39 (description).

Material examined. *Taiwan*: NMMBP 17562, mature female, 491 mm TL, Da-xi. *Other regions (type specimens)*: SCSFRI D-01121 (holotype of *A. gibbosus*), female, 425 mm TL, off the estuary of Pearl River, South China Sea, China, 913 m depth. SFC D-01133 (paratype of *A. gibbosus*), female, 396 mm TL, SFC D-0084 (paratype of *A. gibbosus*), female, 369 mm TL, off the estuary of Pearl River, South China Sea, China, 913 m depth. *Other regions (non types)*: BSKU 23016, female, 281 mm TL, BSKU 23017, female, 358.1 mm TL, BSKU 23060, female, 306.5 mm TL, BSKU 26357, male 337 mm TL, BSKU 26454, female, 333 mm TL, BSKU 26511, female, 325 mm TL, BSKU 28098, female, 475.8 mm TL, BSKU 28099, male, 547.5 mm TL; BSKU 28100, female, 392 mm TL, BSKU 28101, male, 403 mm TL, BSKU 28165, female, 444 mm TL, BSKU 33526, male, 231 mm TL, Okinawa Trough, East China Sea, Japan; HUMZ 145164, male, 476 mm TL, Okinawa Trough, East China Sea, Japan (28°00.03'N, 128°21.90'E-27°59.88'N, 128°24.56'E); HUMZ 145166, male, 309 mm TL, HUMZ 145171, male, 542 mm TL, Okinawa Trough, East China Sea, Japan (28°33.29'N, 127°09.96'E-28°35.30'N, 127°11.22'E); SFU D-0094, male, 494 mm TL, SFU D-0300, male, 387 mm TL, SFU D-0339, female, 426 mm TL, SFU D-0700,

female, 313 mm TL, SFU D-2268, male, 382 mm TL, SFU E-0174, female, 404 mm TL, SFU e18-00097, male, 465 mm TL, East China Sea, China.

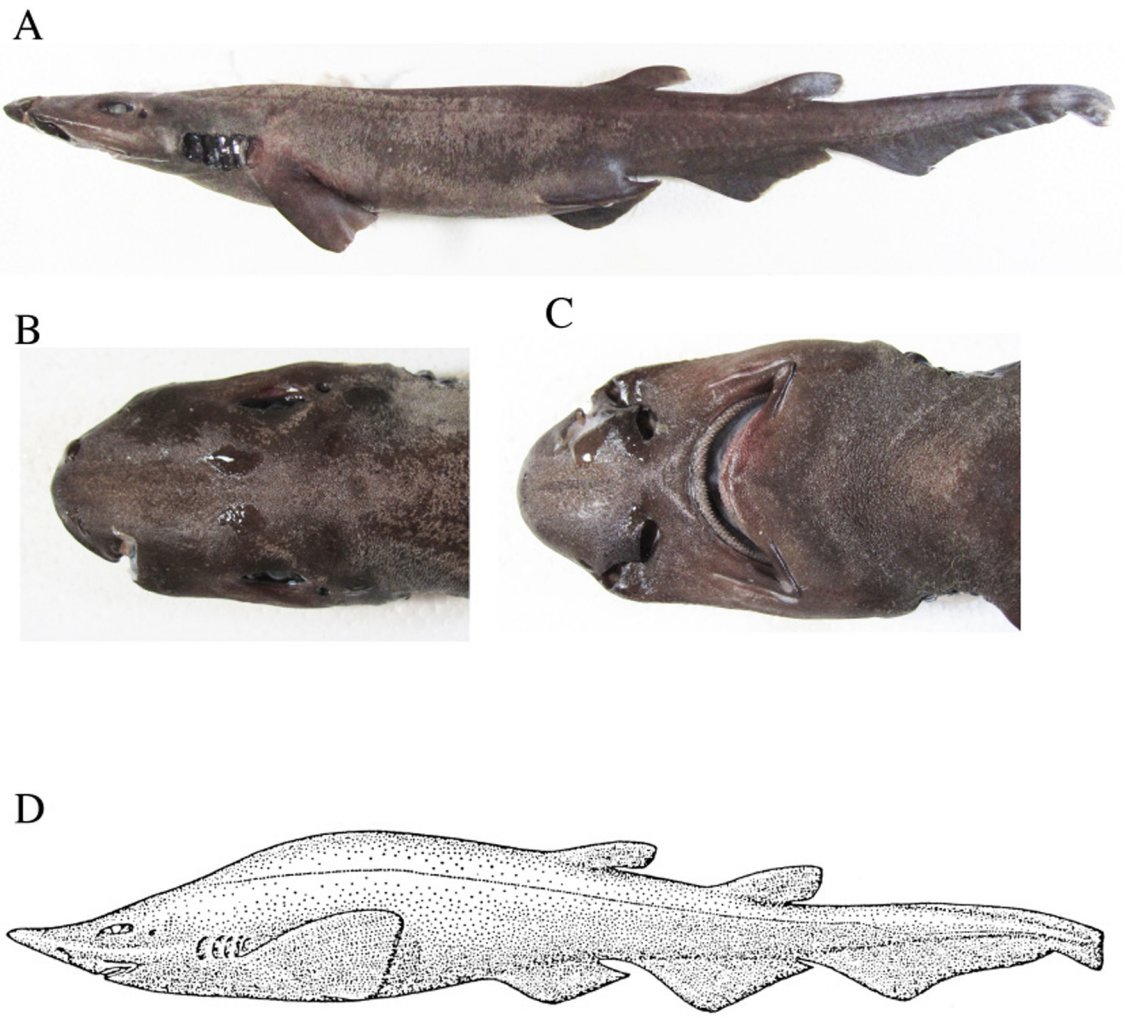

FIGURE 13. *Apristurus gibbosus*. A–C, NMMBP 17562, female, 491 mm TL, Taiwan. D, Original drawing of holotype, SCSFRI D-01121, female, 425 mm TL, China (from Meng *et al*., 1985).

Diagnosis. A species of *Apristurus* with the following characters: upper labial furrows longer than the lowers; first dorsal fin slightly smaller than second dorsal fin, originating above middle of pelvic-fin base; second dorsal-fin insertion anterior to anal-fin insertion; snout relatively short and broad; tip bell-shaped; abdomen long; P1–P2 space longer than anal-fin base length (ceratotrichia); pectoral-fin tip always anterior to midpoint of P1–P2 space; intestinal spiral valves 16–21; monospondylous + precaudal diplospondylous vertebrae 37–43 + 25–31; small dermal denticles giving a velvety texture to body surface; clasper hook absent on edge of exorhipidion, posterior margin of exorhipidion lacking free posterior end; body uniformly dark to blackish brown; maturingsize at least 400 mm TL in males and 450 mm TL in females.

Description. Proportional measurements and meristic counts are given in Table 3. Body cylindrical, moderately slender and elongate (Figure 13). Head dorso-ventrally flattened, posterior part of body compressed laterally. Snout relatively short andbroad; its tip bell-shaped. Pre-outer nostril length 0.9–1.4 times internarial width. Pre-oral length 0.8–1.0 times pre-orbital length, 1.9–2.7 times internarial width, 0.8–1.1 times mouth width and 1.0–1.3 times interorbital width. Pre-orbital length1.2–1.6 times interorbital length, 2.8–4.8 times orbit length. Internarial width slightly greater than orbit length and shorter than nostril width. Nostril expanding obliquely inward from snout edge; length about 2/3 of pre-inner nostril length. Nostril-mouth space about half of internarial width. Mouth

broadly arched, with well developed labial furrows; upper labial furrow1.1–1.6 times longer than lower one. Upper labial furrow reaching beyond midpoint between mouth corner and posterior margin of nostril. Orbit relatively large and slender, with a weak subocular fold. Spiracle small placed slightly below level of horizontal axis of orbit. Five small gill slits present; fourth gill slit above pectoral-fin origin; fifth gill slit smallest, above pectoral fin base. Gill septa with a projection, densely covered with dermal denticles. Abdomen long; P1–P2 space longer than anal-fin base length (ceratotrichia); pectoral-fin tip always anterior to midpoint of P1–P2 space. Pectoral fin small in size, rather narrow, sub-trianglular; outer margin not parallel to inner margin. Pelvic fin relatively low and long; its length subequal to pre-orbital length. Dorsal fins similar in shape. First dorsal fin slightly smaller than second; origin above middle of pelvic-fin base; insertion anterior to anal-fin origin. Second dorsal-fin origin above middle of anal-fin base; insertion anterior to anal-fin insertion. Anal fin relatively high, triangular, with a base much shorter than P1–P2 space; apex clearly posterior to first dorsal-fin insertion; posterior margin straight; anal and caudal fins separated only by a notch. Caudal fin slightly slender; ventral lobe not produced: apex of ventral lobe rounded; subterminal notch distinct; length of terminal lobe twice caudal terminal lobe height. Caudal peduncle height 1.0–1.4 times pre-outer nostril length. Duodenum very short

FIGURE 14. Egg capsule of *Apristurus gibbosus* from BSKU 28165, female, 444 mm TL. Scale bar = 1 cm.

Intestinal spiral valves 16–21. Monospondylous vertebrae 37–43; precaudal diplospondylous vertebrae 25–31.

Teeth numerous and small, 63–96 rows on upper jaw, 64–98 rows on lower jaw with one long central cusp and one to two short lateral cusps.

Egg capsule (Figure 14) taken from 444 mm TL specimen (BSKU 28165) 48.5 mm long and 18.7 mm wide in a cylindrical shape, with fibrous thread on anterior ends and coiled tendrils on posterior ends; anterior margin of the capsule rounded with fibrous thread at each corner; lateral edges flanged; posterior tip separated with tendrils. Surface of egg capsule with ridges. Color light brownish.

Dermal denticles from dorso-lateral side of body small (Figure 15), overlapping each other, tricuspid, with a long ridged central cusp and shorter lateral cusps; outer surface of denticles completely structured by reticulations. No modified dermal denticles on the dorsal margin of the caudal fin. Dermal denticles densely present around the gill slits and on gill septa.

Clasper stout at base, tapering posteriorly (Figure 16). Ventral and outer side of surface covered with dermal denticles. Dorsal side of clasper naked and ventral and lateral sides covered with clasper denticles; clasper hooks absent on edge of exorhipidion; pseudosiphon slit-like in shape; cover rhipidion vestigial; pseudopera large and deep; exorhipidion simple in shape, without free posterior end.

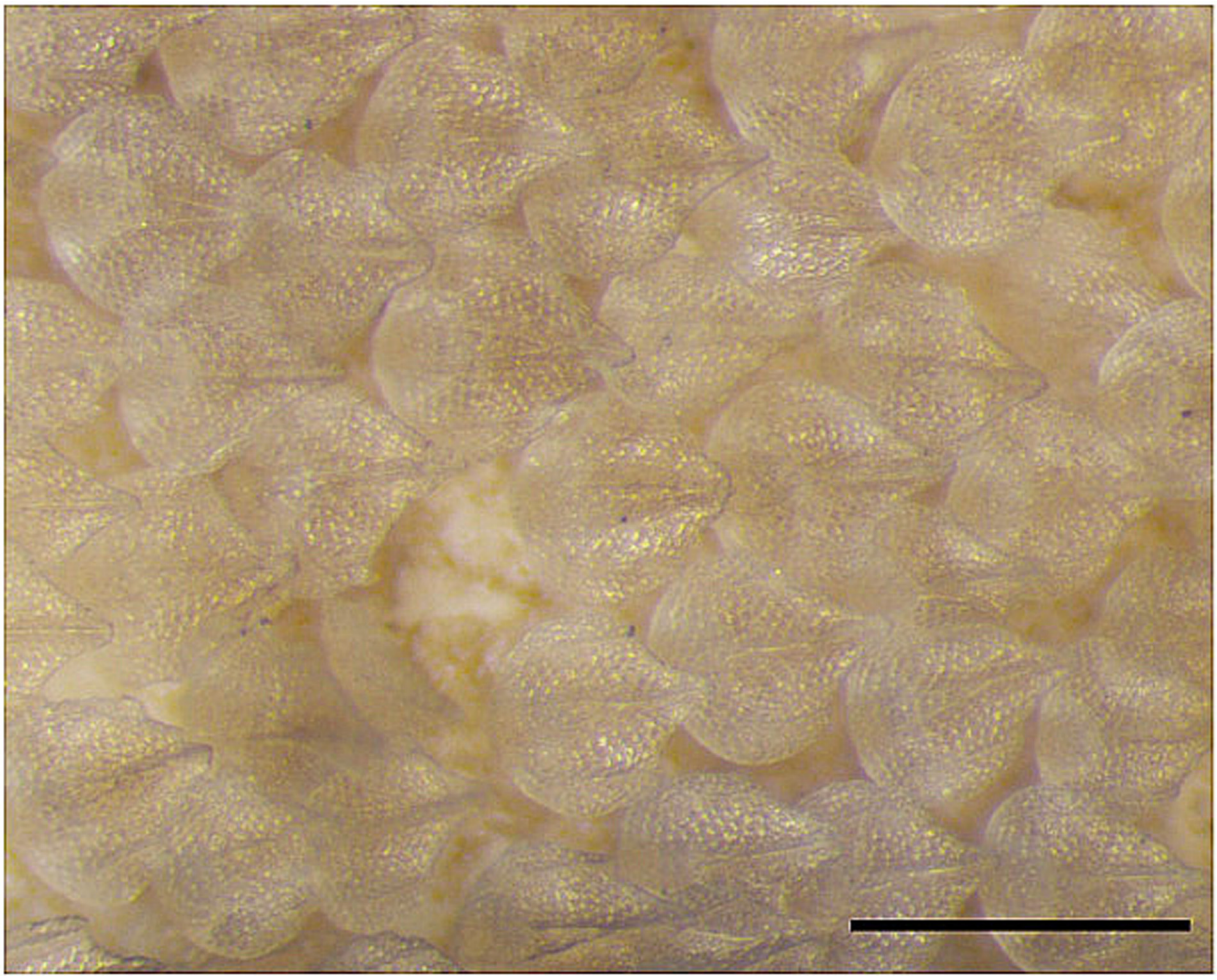

FIGURE 15. Dermal denticles of *Apristurus gibbosus.* HUMZ 145171, male, 542 mm TL. Scale bar = 0.5 mm.

Color. Upper and lower surfaces of body and fins uniformly dark to blackish brown with light brownish naked areas along the fin margins. Tongue and palate blackish brown.

Size. Maximum size 547.5 mm TL in male (Figure 17). Males less than 403 mm TL in maturity stage 1 (immature) with short claspers, less than 3.3% TL. Males more than 465 mm TL in maturity stage 3 (adult) with long, well developed and hardened claspers. Females less than 444 mm TL in maturity stage 1. Females more than 450 mm TL in maturity stage 3.

Distribution. South China Sea and northward to East China Sea (Okinawa Trough) (Figure 18).

Remarks. *Apristurus gibbosus* was originally described by Meng *et al*. (1985) based on three specimens collected from the South China Sea. This species belongs to the 'brunneus group' (*sensu* Nakaya & Sato, 1999) of the genus *Apristurus*, characterized by having a considerably longer labial furrow on the upper jaw than on the lower jaw, and more numbers of spiral valves in the intestine.

Apristurus gibbosus is characterized by a long P1–P2 space, which is greater than the anal-fin base length (ceratotrichia) and pectoral-fin tip that does not reach the midpoint of the P1–P2 space. As such, *A. gibbosus* is clearly distinguishable from other species of Taiwanese *Apristurus* by these characters. Although Meng *et al.* (1985) described "dorsal outline behind eye highly convexed" as one of the diagnostic characters of this species, this is apparently based on a transformation during fixation (personal observation of the type specimens by Nakaya).

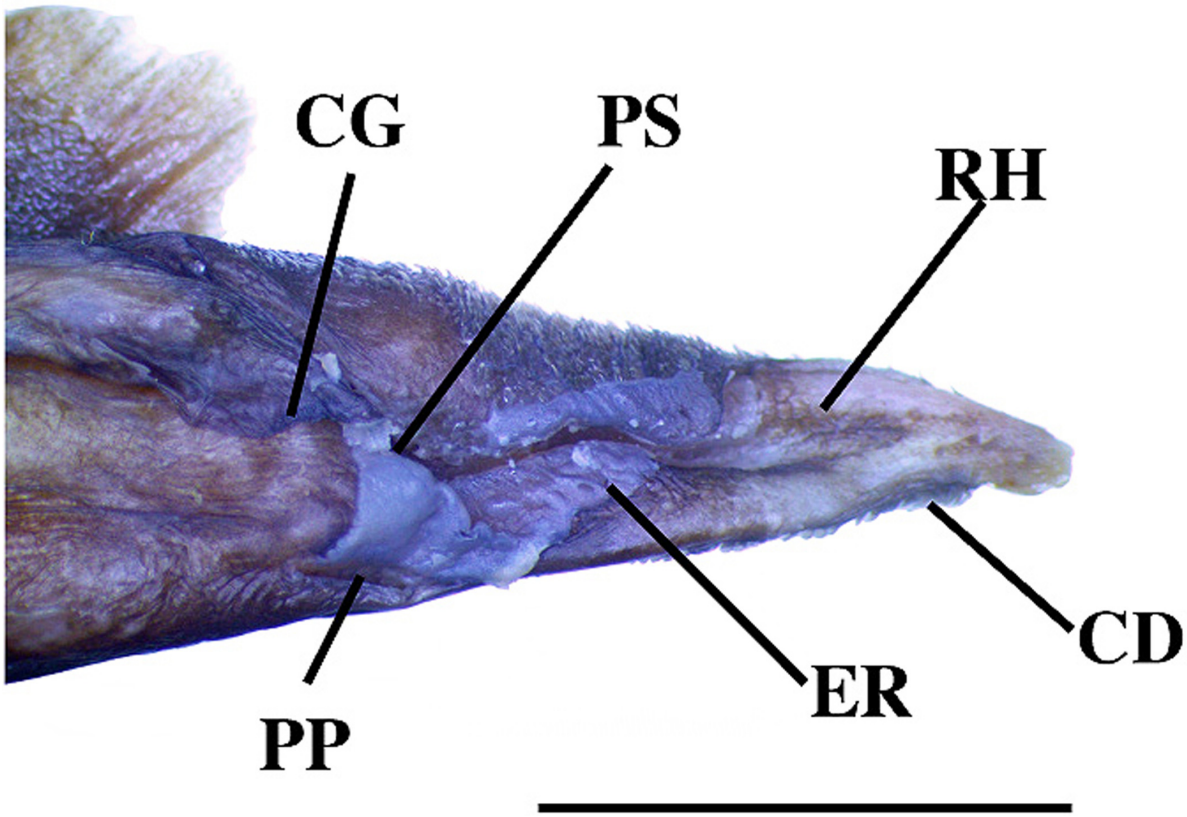

FIGURE 16. Dorsal view of left clasper of *Apristurus gibbosus*, HUMZ 145171, male, 542 mm TL. CD, clasper denticles; CG, clasper groove; ER, exorhipidion; PP, pseudopera; PS, pseudosiphon;RH, rhipidion. Scale bar = 1 cm.

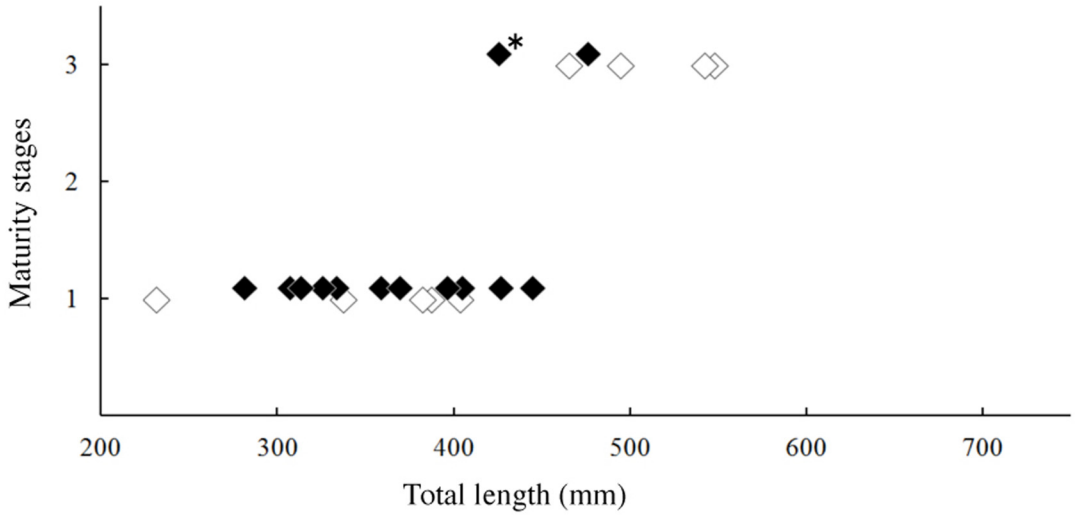

FIGURE 17. Maturity stages of *Apristurus gibbosus*. Open symbols, males; solid symbols females. Asterisk indicates holotype.

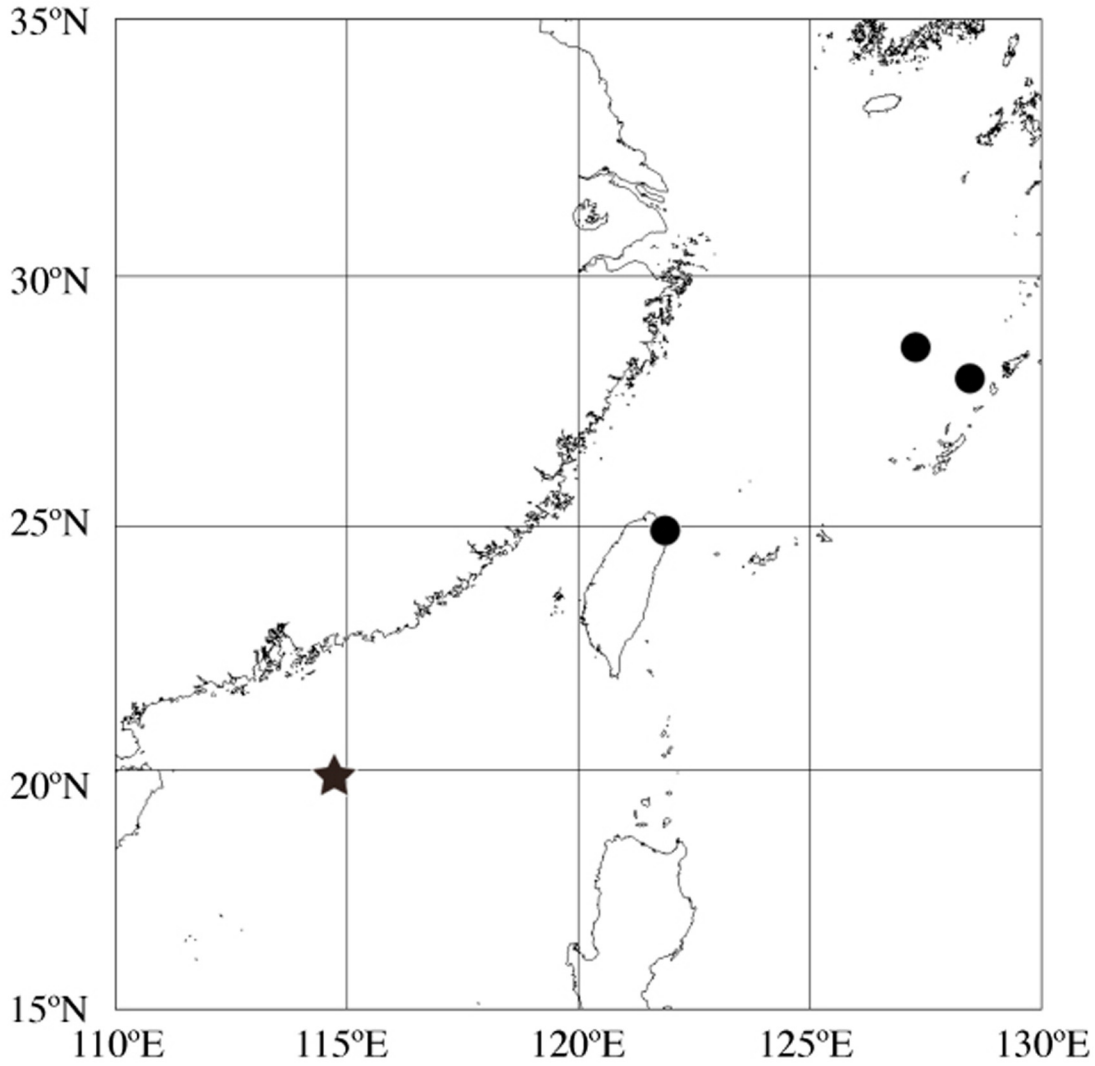

FIGURE 18. Distribution of *Apristurus gibbosus*. Star, holotype; circles, non-types.

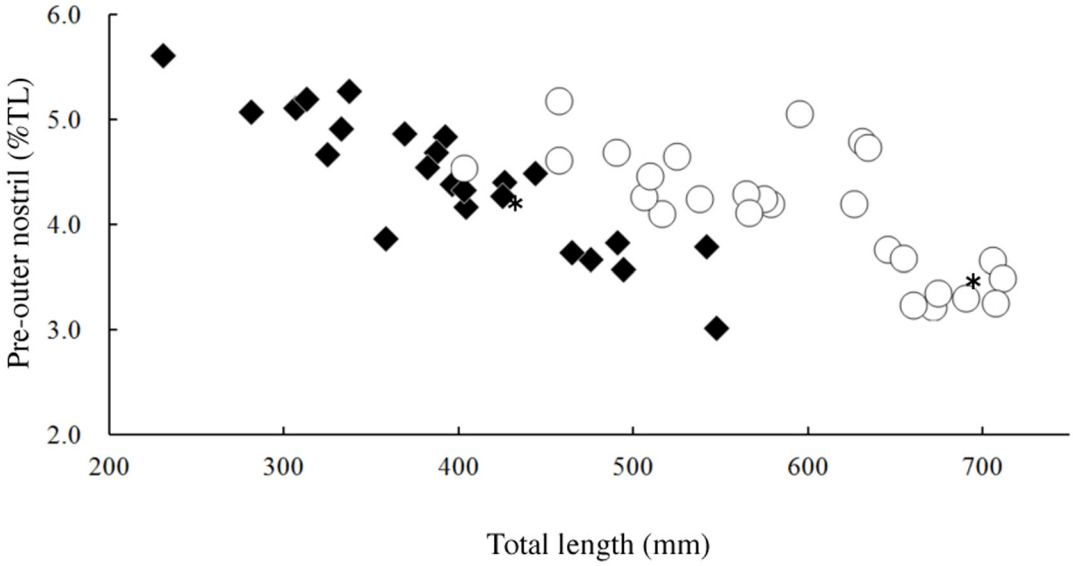

FIGURE 19. Pre-outer nostril length (%TL) of *Apristurus gibbosus* (diamonds) and *A. japonicus* (circles). Asterisks indicate holotypes.

TABLE 3. Proportional measurements and counts of *Apristurus gibbosus*.

	A. gibbosus			
	Taiwan	Holotype	Paratypes	East China Sea
	female	female	2 females	11 males , 11 females
TL (mm)	491	425	369–396	231–548
Proportion (%TL)				
PreD2–origin length	63.1	64.7	64.0–65.2	58.8–65.8
PreD1–origin length	49.3	48.5	51.5–51.8	46.5–52.4
PreP1 length	20.6	22.4	20.7–22.4	20.4–25.4
PreP2 length	44.2	44.5	43.9–44.4	40.3–46.6
Preanal length	58.2	57.9	59.3–59.6	52.6–60.4
Precaudal length	73.3	72.0	72.1–72.3	64.9–74.2
Pre–branchial length	16.3	17.7	16.9–17.7	16.6–21.5
Pre–orbital length	9.2	9.0	9.4–9.9	8.3–11.9
Pre–outer nostril length	3.8	4.3	4.4–4.9	3.0–5.6
Pre–inner nostril length	6.7	6.9	7.3–7.8	5.8–8.5
Pre–oral length	8.5	7.9	7.9–8.2	7.0–9.6
Head length	21.2	21.5	21.3–22.1	19.8–25.0
Mouth width	8.8	7.9	8.6–9.4	7.8–10.5
Internarial width	3.3	—	3.6–3.8	3.0–4.3
Upper labial furrow length	3.7	3.3	3.0–3.6	3.2–4.1
Lower labial furrow length	2.7	2.5	2.6–2.8	2.0–3.2
Orbital length	3.3	3.2	2.8–2.9	2.5–4.0
Nostril length	4.1	3.9	4.0–4.1	3.5–5.1
Interorbital width	8.6	7.8	7.4–8.3	6.4–8.7
1st gill height	2.2	—	—	1.4–2.2
3rd gill height	2.6	—	—	1.5–2.8
5th gill height	2.3	—	—	1.4–2.2
D1–D2 space	7.8	8.7	6.6–7.9	6.8–9.7
D1–D2 origins	13.9	—	—	10.9–16.0
D1–D2 insertions	14.2	15.3	13.4–14.1	12.6–16.6
P1–P2 space	17.6	18.0	14.3–16.7	12.9–17.1
P1 tip to P2 origin	12.8	—	—	7.3–13.4
P1–P2 origins	23.7	23.1	22.0–23.2	19.5–21.9
D1 base length	6.7	—	—	4.1–7.3
D1 height	1.9	—	—	1.8–2.8
D1 free lobe length	3.8	—	—	—
D2 base length	6.8	—	—	2.6–3.3
D2 height	2.5	—	—	5.8–7.8
D2 free lobe length	4.2	—	—	—

..... continued on the next page

TABLE 3. (Continued)

	A. gibbosus			
	Taiwan	Holotype	Paratypes	East China Sea
	female	female	2 females	11 males , 11 females
P1 anterior margin	11.2	13.2	11.8–12.8	9.8–12.2
P2 length	11.7	—	—	10.3–11.6
Anal base length (ceratotrichia)	14.1	14.1	13.5–14.2	12.5–15.8
Anal height (muscle)	5.0	5.4	5.6	4.0–6.3
Caudal length	28.6	27.6	26.0	15.8–32.7
Clasper outer length	—	—	—	1.3–5.7
Counts				
Tooth rows:				
upper	78	96	80–87	63–82
lower	76	98	79–84	64–91
Vertebrae:				
monospondylous	41	—	—	37–43
precaudal diplospondylous	31	—	—	25–31
Spiral valves	—	—	—	16–21

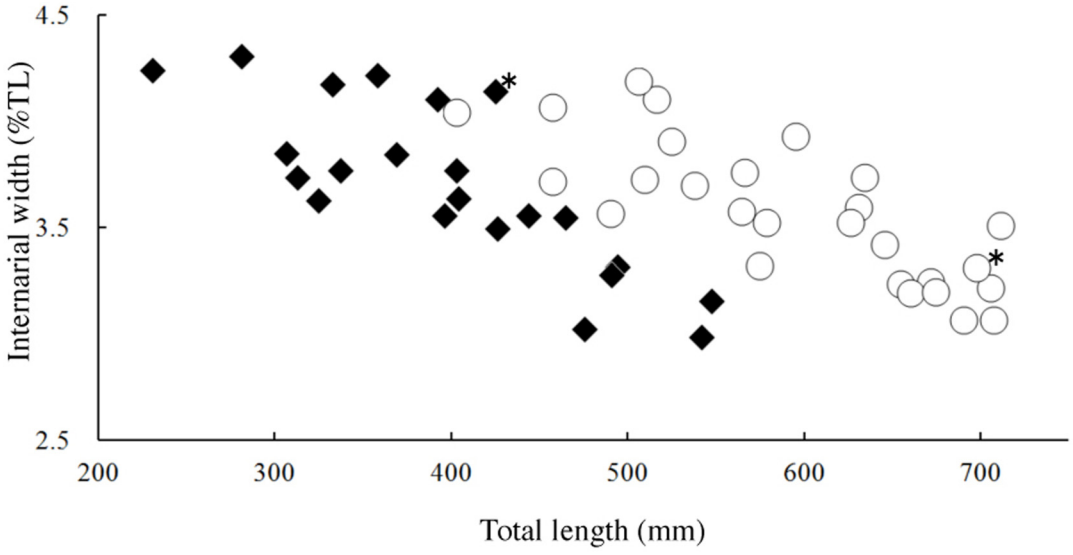

FIGURE 20. Internarial width (%TL) of *Apristurus gibbosus* (diamonds) and *A. japonicus* (circles). Asterisks indicate holotypes.

*Apristurus gibbosus*is similar to Japanese *A. japonicus* in having a long P1–P2 space, but *A. gibbosus* is distinct from *A. japonicus* in having a shorter snout (Figure 19) and a narrower internarial width (Figure 20). *Apristurus gibbosus* is apparently a smaller species, which matures at lengths of 40–45 cm TL in both sexes, and attains 57 cm TL, while *A. japonicus* matures at lengths of 55–60 cm TL, and attains more than 70 cm TL (Figure 21).

This is the first report of *Apristurus gibbosus* from Taiwan.

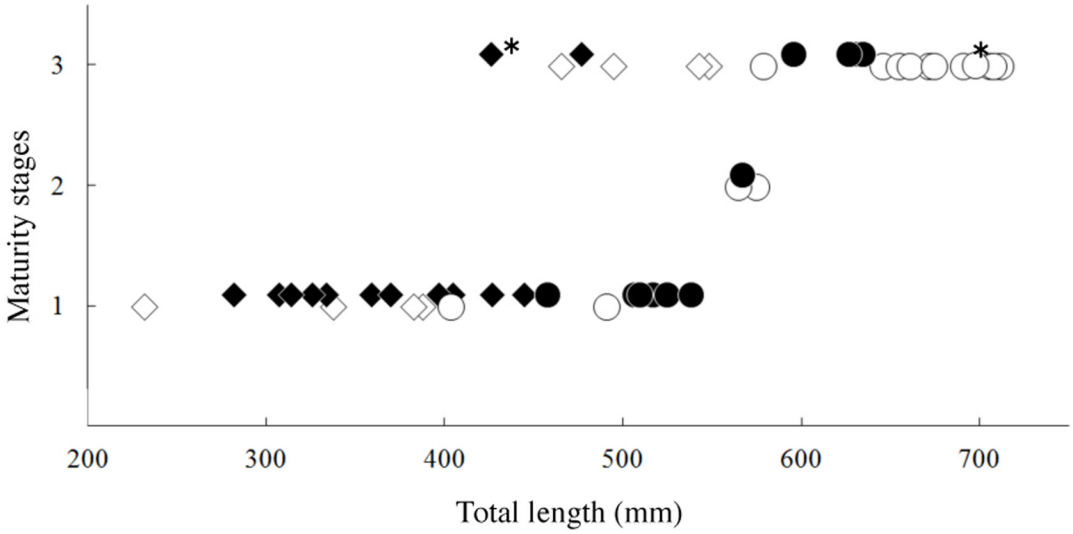

FIGURE 21. Maturity stages of *Apristurus gibbosus* (diamonds) and *A. japonicus* (circles). Open symbols, males; solid symbols, females. Asterisks indicate holotypes.

***Apristurus macrostomus* Chu, Meng & Li, 1985**

English name: Broad-mouth catshark

Taiwanese name: Da-ko-bi-sa

Japanese name: Ryukyu herazame

(Figures 22–30, Table 4)

Apristurus macrostomus Chu, Meng & Li, 1985 *in* Meng, Chu & Li, 1985: 45, fig. 2 (original description, type locality: China); Compagno *et al*., 2005: 195, pl. 31 (description, China); Ebert *et al*., 2013: 293, pl. 39 (description).

Apristurus macrorynchus: Chen, 1963, 33, fig. 11 (description, Taiwan); Chen & Joung in Shen *et al.*, 1993: 53, pls. 5–7 (description, Taiwan); Shen & Wu, 2011: 63 (description, Taiwan).

Apristurus platyrhynchus: Shen & Wu, 2011: 63 (description, Taiwan).

Material examined. *Taiwan*: NMMBP 7457, 307 mm TL, female, 347 mm TL, male, NMMBP 7458, 316 mm TL, female, 344 mm TL, male, NMMBP 7497, 203 - 429 mm TL, 1 male and 2 females, NMMBP 12052, 309 mm TL, male, 318 mm TL, male, 333 mm TL, female, NMMBP 12055, 420 mm TL, male, Da-xi. NMMBP 13718, 325–456 mm TL, 4 males and 1 female, Dong-gang. NMMBP 14837, 249 mm TL, male, NMMBP 16546, 286 mm TL, female, 370 mm TL, male, Da-xi. NMMBP 17561, 465 mm TL, male. HUMZ 170355, male, 421.5 mm TL, HUMZ 170356, male, 292.1 mm TL, HUMZ 170357, male, 285.2 mm TL, HUMZ 170358, male, 414.8 mm TL, HUMZ 170387, female, 348.9 mm TL, HUMZ 170388, female, 266.1 mm TL, HUMZ 170389, female, 318.0 mm TL, HUMZ 170390, male, 266.3 mm TL, HUMZ 170392, male, 369.8 mm TL, HUMZ 170393, female, 210.1 mm TL, HUMZ 170394, female, 226.3 mm TL, HUMZ 170450, female, 352.1 mm TL, HUMZ 170451, female, 334.0 mm TL, HUMZ 170452, female, 351.9 mm TL, HUMZ 170453, female, 386.4 mm TL, HUMZ 170454, male, 411.3 mm TL, HUMZ 170485, male, 486.9 mm TL, HUMZ 170486, female, 473.8 mm TL, HUMZ 170478, female, 328.2 mm TL, HUMZ 170488, male, 388.6 mm TL, HUMZ 170489, female, 282.2 mm TL, HUMZ 170929, male, 373.4 mm TL, HUMZ 170930, male, 252.5 mm TL, HUMZ 170931, female, 259.2 mm TL, HUMZ 170933, male, 282.1 mm TL, HUMZ 170965, female, 322.1 mm TL, HUMZ 171435, female, 332.5 mm TL, HUMZ 170436, female, 341.0 mm TL, HUMZ 170437, male, 316.9 mm TL, HUMZ 171438, female, 251.8 mm TL, HUMZ 185163, male, 340.1 mm TL, HUMZ 185164, male, 348.3 mm TL, HUMZ 185165, male, 325.0 mm TL, HUMZ 185166, male, 295.7 mm TL, HUMZ 185167, male, 366.2 mm TL, HUMZ 185168, male, 326.5 mm TL, HUMZ 185171, male, 316.7 mm TL, HUMZ 185172, male, 334.5 mm TL, HUMZ 198612, male, 468 mm TL, Da-xi fishing port, collected from around Kuei-Shan Island, Taiwan. *Other regions (type specimen)*: SCSFRI D 00807 (holotype of *A. macrostomus*), male, 389 mm TL, off the estuary of Pearl River, South China Sea, China,

913 m depth. *Other regions (non types)*: BSKU 15546, female, 194.5 mm TL, Sulu Sea, Philippines, 495 m depth, 500 m depth. BSKU 29574, female, 475.0 mm TL, Okinawa Trough, Japan, 220 m depth. BSKU 32566, male, 439 mm TL, Okinawa Trough, Japan, 600 m depth. BSKU 43664, female, 573.1 mm TL, Mimase, Kochi Prefecture, Japan. HUMZ 191137 and HUMZ 191138, 1 male and 1 female, 324–329 mm TL, off Sumatra Island, Indonesia, 547–567m depth. HUMZ 191416, male, 406 mm TL, off Jawa Island, Indonesia, 850–916 m depth, 12 Sep. 2004. HUMZ 191498, male, 451 mm TL, 989–850 m depth; HUMZ 191531, female, 436 mm TL, HUMZ 193968, female, 432 mm TL, 516–523 m depth, off Sumatra Island, Indonesia. HUMZ 194139 and 194140, 1 male and 1 female, 385-439 mm TL, 570–601 m depth, HUMZ 194160, male, 166 mm TL, 684–693 m depth, HUMZ 194448, female, 382 mm TL, 600–620 m depth, off Jawa Island, Indonesia. HUMZ 194668, female, 477 mm TL, 784–780 m depth, HUMZ 194676 and 194677, 1 male and 1 female, 440–457 mm TL, 561-526 m depth, off Sumatra Island, Indonesia. PPSI 15 (2 specimens), 1 male and 1 female, 390–400 mm TL, Sumatra Island, Indonesia, 800m depth. SCSFRI 800546, female, 435.7 mm TL, corresponds to the continental shelf, South China Sea, China, 200–2000 m depth. USNM 168185, male, 142.3 mm TL, Philippines.

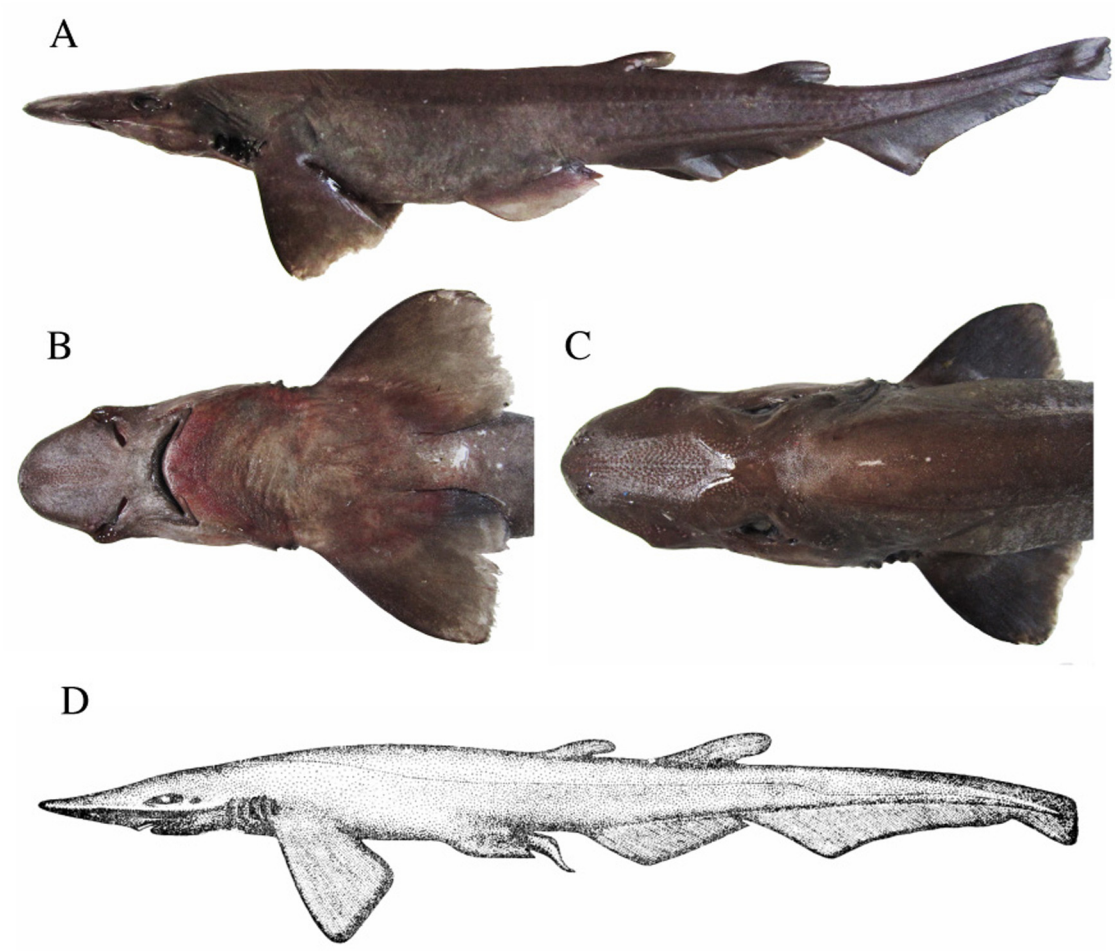

FIGURE 22. *Apristurus macrostomus*. A–C, NMMBP 17561, female, 465 mm TL, Taiwan; D, Original drawing of holotype, SCSFRI D-00807, male, 389 mm TL, China (from Meng *et al*., 1985).

Diagnosis. A species of *Apristurus* with the following characters: upper labial furrows longer than the lowers; first dorsal fin slightly smaller than second dorsal fin, originating behind pelvic fin base or above anterior half of P2–anal space: second dorsal-fin insertion anterior to anal-fin insertion; snout rather long; tip bell-shaped; abdomen short; P1–P2 space much shorter than anal-fin base length (ceratotrichia); pectoral-fin tip always extending beyond midpoint of midpoint of P1–P2 space; intestinal spiral valves 18–21; monospondylous + precaudal diplospondylous vertebrae 33–37 + 31–40; clasper hook present on edge of exorhipidion; maturing size around 40 cm TL in both sexes.

FIGURE 23. Egg capsule of *Apristurus macrostomus* taken from HUMZ 194668, female, 477 mm TL. Scale bar = 1 cm.

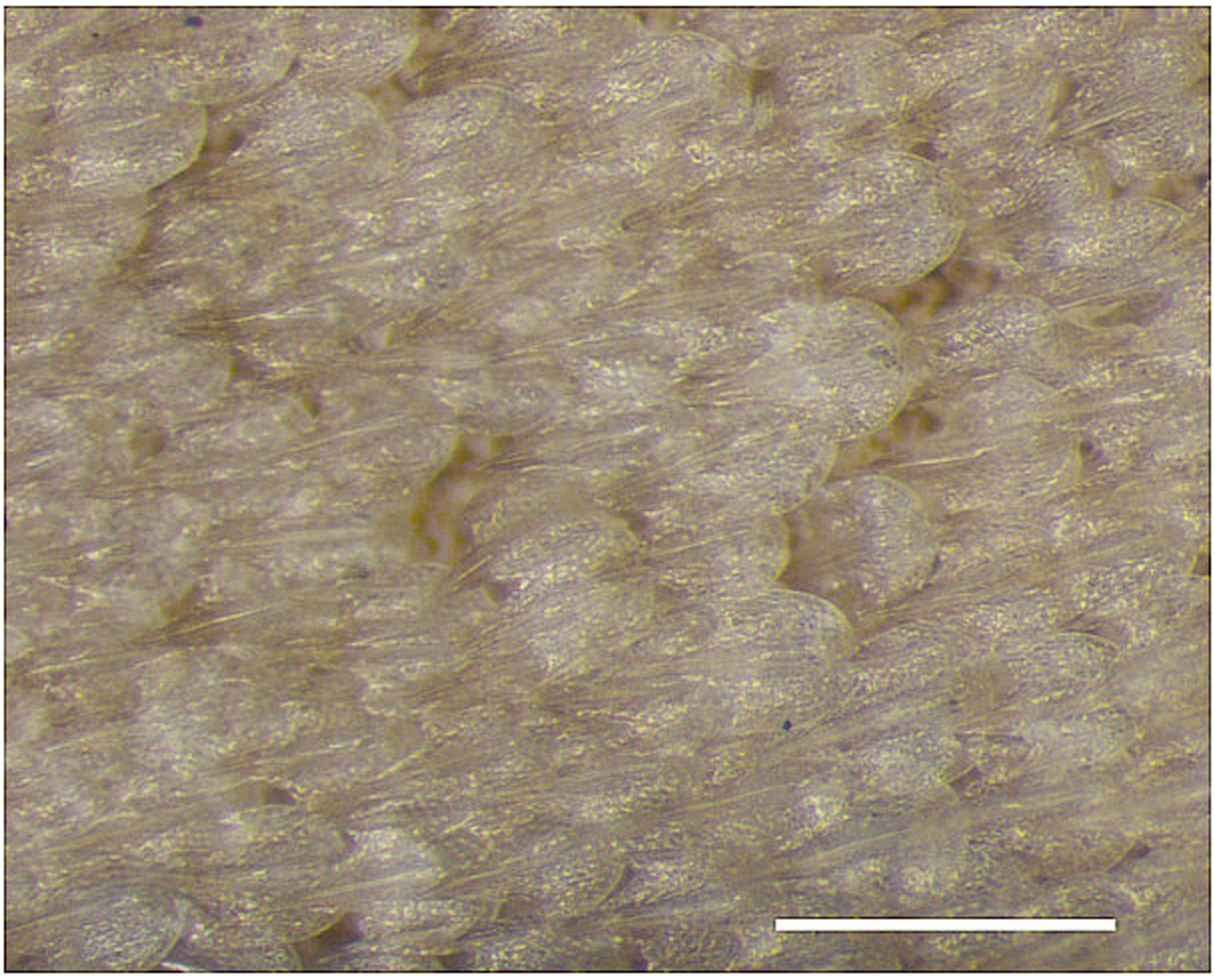

FIGURE 24. Dermal denticles of *Apristurus macrostomus*, HUMZ 194676, male. Scale bar = 0.5 mm.

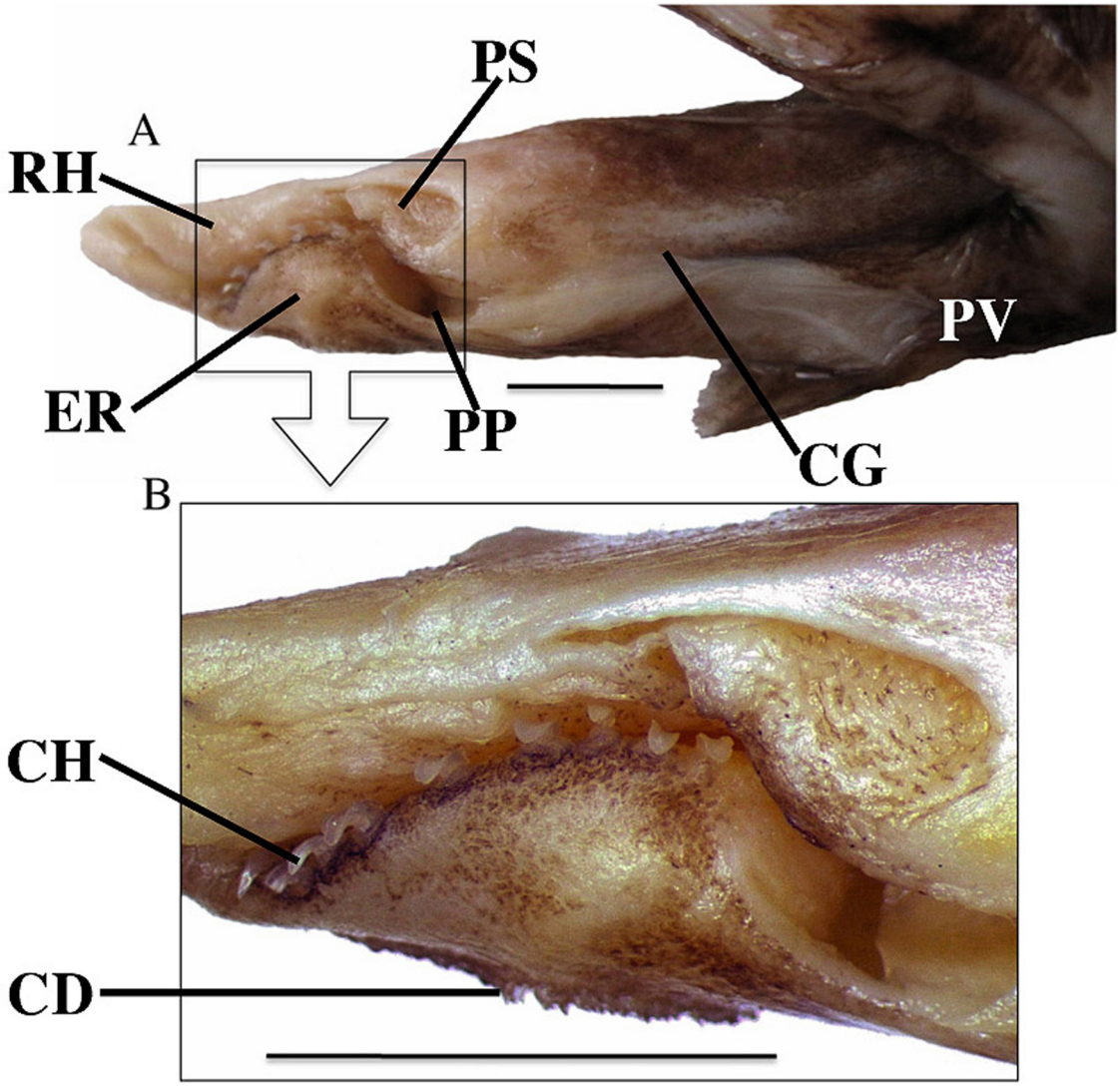

FIGURE 25. Dorsal views of right clasper of *Apristurus macrostomus,* HUMZ 170485, male, 486.9 mm TL. CD, clasper denticles; CH, clasper hooks; ER, exorhipidion; PP, pseudopera; PS, pseudosiphon; PV, pelvic fin; RH, rhipidion. Scale bars = 5 mm.

Description. Proportional measurements and meristic counts are given in Table 4. Body cylindrical, slender and elongate (Figure 22). Head dorso-ventrally flattened, posterior part of body compressed laterally. Snout rather long; tip ball-shaped. Pre-outer nostril length 1.3–1.9 times internarial width. Pre-oral length slightly less than pre-orbital length, 2.5–3.4 times internarial width, subequal to mouth width and greater than interorbital width. Pre-orbital length 1.7–2.1 times interorbital length, 2.9–4.2 times orbit length. Internarial width subequal to orbit length and nostril width. Nostril relatively large, expanding obliquely inward from snout edge; length about half of pre-inner nostril length. Nostril-mouth space about half of internarial width. Mouth broadly arched, with well developed labial furrows; upper labial furrows 1.1–1.6 times longer than lower one. Upper labial furrow reaching beyond midpoint between mouth corner and posterior margin of nostril. Orbit narrow and slender, with a weak subocular fold. Spiracle small placed slightly below level of horizontal axis of orbit. Five small gill slits present; fourth gill slit above pectoral-fin origin; fifth gill slit smallest, above pectoral fin base. Gill septa with projection, densely covered with dermal denticles. Abdomen short; P1–P2 space much shorter than anal-fin base length (ceratotrichia); pectoral-fin tip always reaching beyond midpoint of P1–P2 space. Pectoral fin relatively large, wide, sub-trianglular; outer margin nearly parallel to inner margin. Pelvic fin relatively low and long, length subequal to pre-orbital length. Dorsal fins similar in shape. First dorsal fin smaller than second; origin behind pelvic fin base or above anterior half of P2–anal space; insertion above anal-fin origin. Second dorsal-fin origin above middle of

anal-fin base; insertion anterior to anal-fin insertion. Anal fin low, triangular, with a base much longer than P1–P2 space; apex clearly posterior to first dorsal-fin insertion; posterior margin straight; anal and caudal fins separated only by a notch. Caudal fin slender; ventral lobe slightly produced: apex of ventral lobe rather rounded; subterminal notch distinct; length of terminal lobe twice caudal terminal lobe height. Caudal peduncle height 0.5–0.9 times pre-outer nostril length. Duodenum very short.

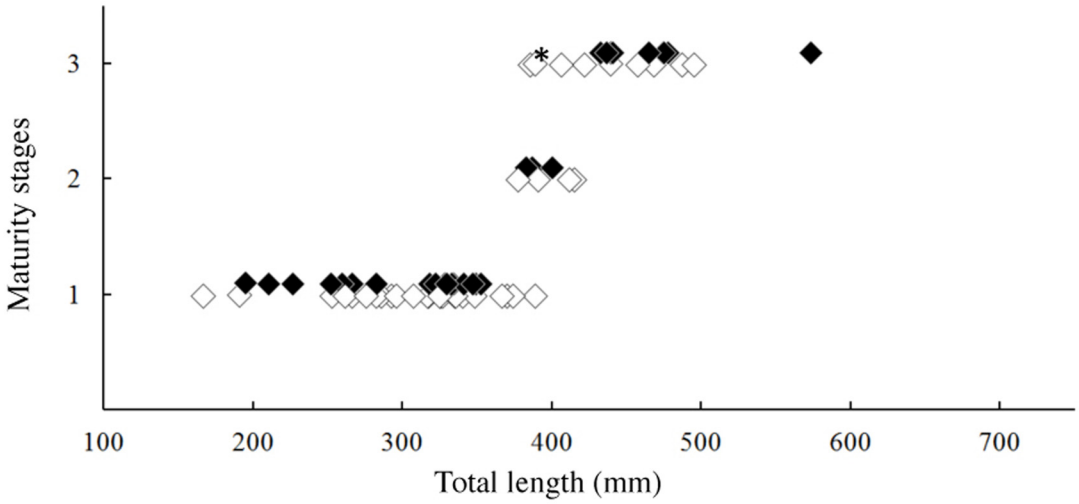

FIGURE 26. Maturity stages of *Apristurus macrostomus.* Open symbols, males; solid symbols, females. Asterisk indicates holotype.

Intestinal spiral valves 18–21. Monospondylous vertebrae 31–37; precaudal diplospondylous vertebrae 31–40.

Teeth numerous and small, 62–86 rows on upper jaw, 55–81 rows on lower jaw with one long central cusp and one to two short lateral cusps.

Egg capsule taken from 477 mm TL specimen (HUMZ 194668) short and stocky (Figure 23), 69.7 mm long and 23.8 mm wide, with fibrous thread on anterior ends and coiled tendrils on posterior ends; anterior margin of the capsule rounded without fibrous thread at each corner; lateral edges flanged; posterior tip separated with tendrils. Surface of egg capsule with no ridges. Color yellowish.

Dermal denticles from dorso-lateral side of body small (Figure 24), overlapping each other, tricuspid, with a long ridged central cusp and shorter lateral cusps; outer surface of denticles completely structured by reticulations. No modified dermal denticles on the dorsal margin of the caudal fin. Dermal denticles densely present around the gill slits and on gill septa.

Clasper stout at base, tapering posteriorly (Figure 25). Ventral and outer side of surface covered with dermal denticles. Dorsal side of clasper naked and ventral and lateral sides covered with clasper denticles; clasper hooks present on edge of exorhipidion; pseudosiphon rounded hole-like in shape; cover rhipidion vestigial; pseudopera broad and deep; exorhipidion simple in shape, without free posterior end.

Color. Upper and lower surfaces of body and fins uniformly grey to dark brown with blackish naked areas along the fin margins. Tongue and palate blackish brown, peritoneum white.

Size. Maximum size 495 mm TL in male, and 573.1 mm TL in female (Figure 26). Most males less than 388.6 mm TL in maturity stage 1 (immature) with short claspers, less than 3.7% TL. Males in 377–414.8 mm TL in maturity stage 2 (adolescent) with developing but soft claspers. Most males more than 385 mm TL in maturity stage 3 (adult) with long, well developed and hardened claspers. All females less than 348.9 mm TL in maturity stage 1. Females in 382–400 mm TL in maturity stage 2. All females more than 432 mm TL in maturity stage 3.

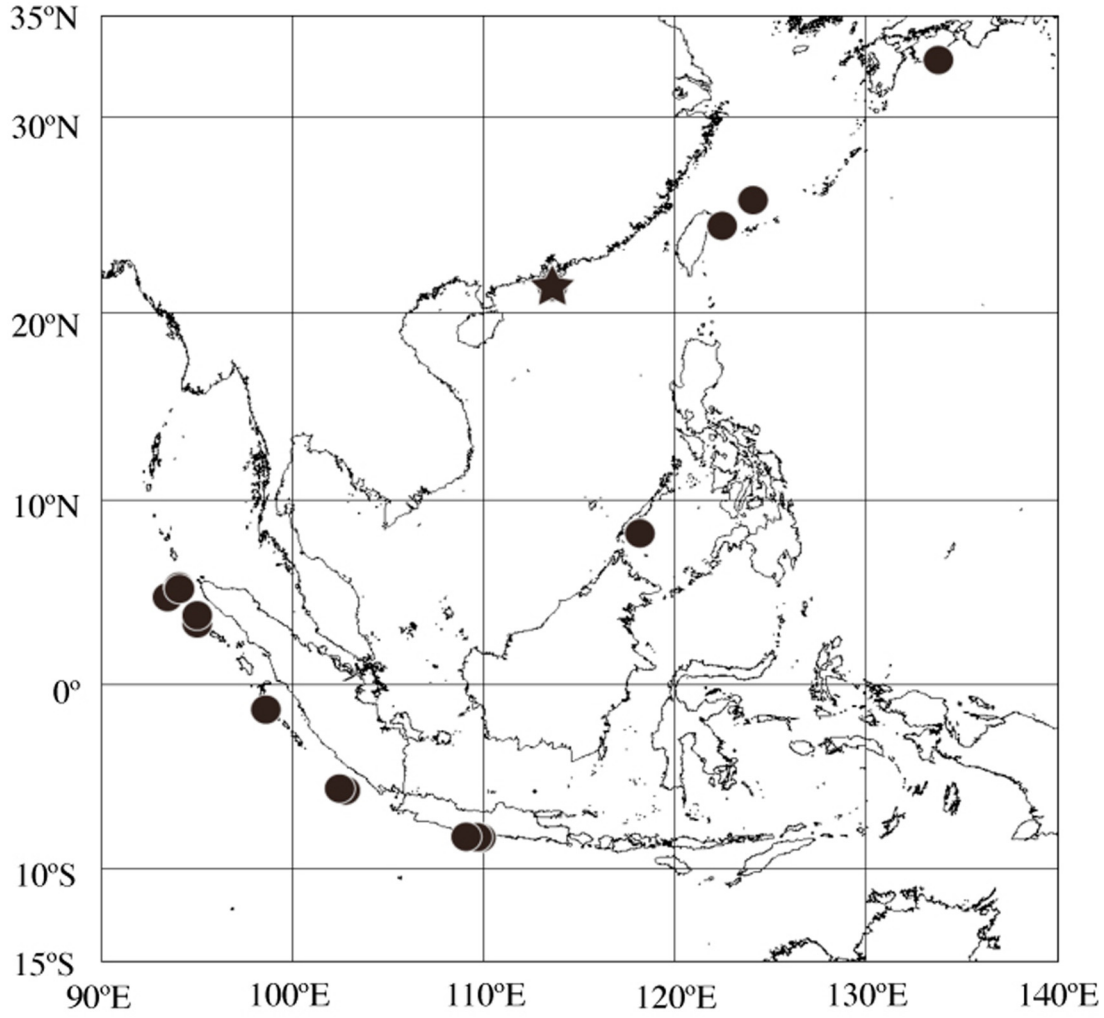

FIGURE 27. Distribution of *Apristurus macrostomus*. Star, holotype; circles, non-types.

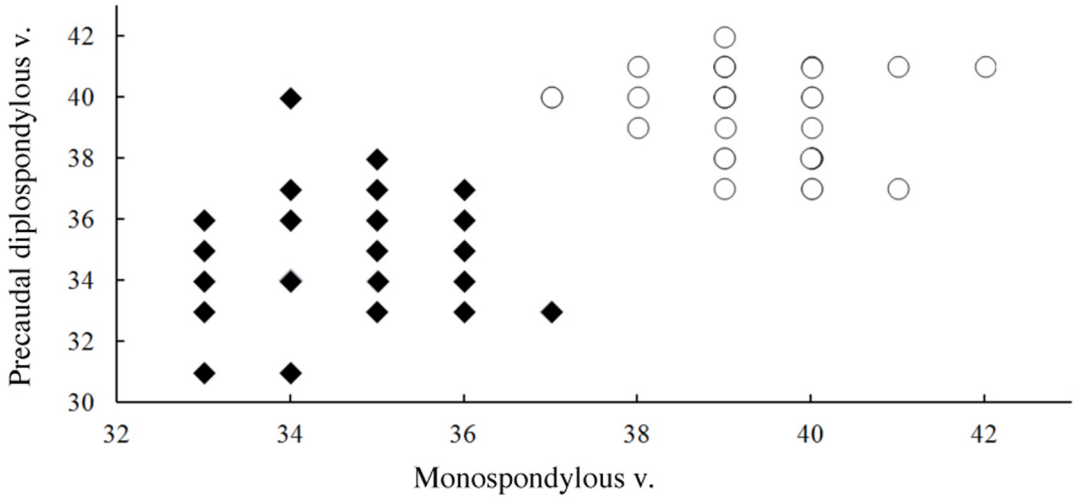

FIGURE 28. Relation of monospondylous and precaudal diplospondylous vertebrae in *Apristurus macrostomus* (diamonds) and *A. macrorhynchus* (circles).

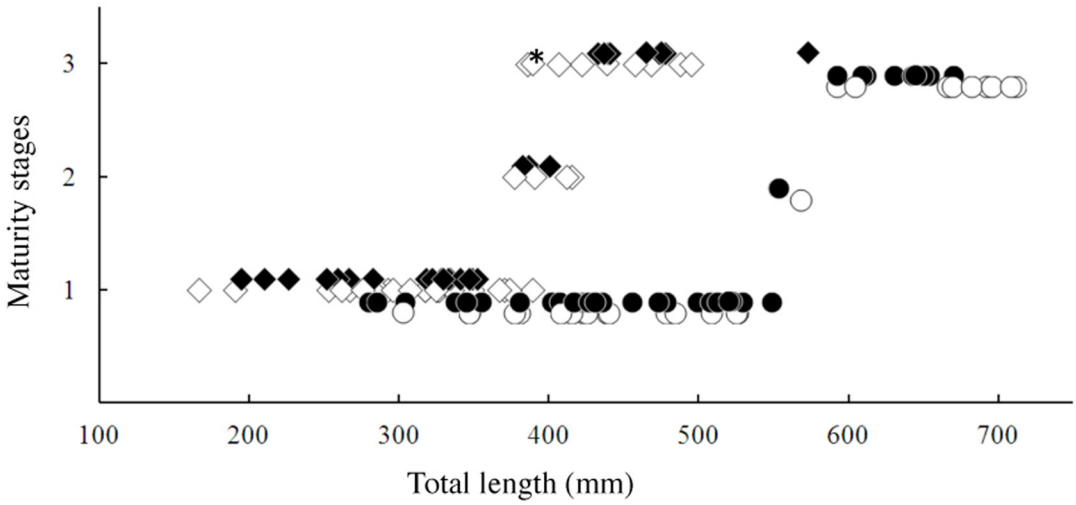

FIGURE 29. Maturity stage of *Apristurus macrostomus* (diamonds) and *A. platyrhynchus* (circles). Open symbols, males; solid symbols, females. Asterisk indicates holotype.

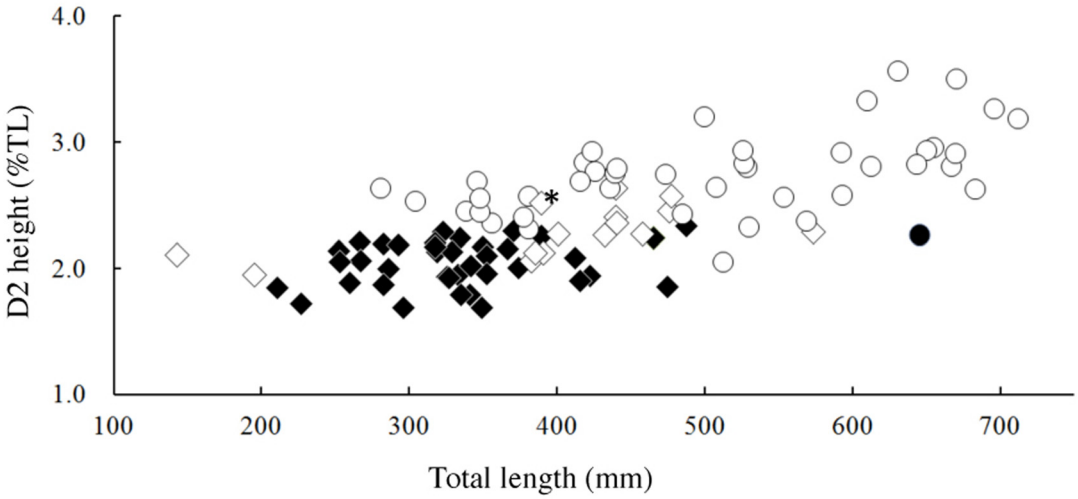

FIGURE 30. D2 height in *Apristurus macrostomus* (diamonds) and *A. platyrhynchus* (circles). Solid symbols, specimens from Taiwan; open symbols, specimens from other regions. Asterisk indicates holotype.

Distritbution. Japan (northward to Kochi, East China Sea (Okinawa Trough), Taiwan (Da-xi, Kaohsiung, Dong-gang), China (South China Sea), Philippines, and Indonesia (Sumatra Island) (Figure 27), at depths of 220–1069 m.

Remarks. *Apristurus macrostomus* was originally described by Chu, Meng & Li *in* Meng, Chu & Li (1985), based on a mature male specimen collected from South China Sea. This species belongs to the 'brunneus group' (*sensu* Nakaya &Sato, 1999) of the genus *Apristurus*, characterized by having considerably longer labial furrows on the upper jaw than on the lower jaw and more numbers of spiral valves in the intestine.

Apristurus macrostomus has not formerly been reported from the waters of Taiwan, because this species has been confused with *A. macrorhynchus* and *A. platyrhynchus* (Chen, 1963; Shen &Wu, 2011). Actually, this species resembles these two species in having rather long snout, and narrow interspace between pectoral and pelvic fin bases. However, *A. macrostomus* is distinguishable from *A. macrorhynchus*, which is currently not reported from Taiwan, by having a much smaller first dorsal fin as compared with the second dorsal fin (slightly smaller in *A.*

macrorhynchus), first dorsal fin originating behind the pelvic fin base (above or before pelvic fin insertion in *A. macrorhynchus*), and by having fewer vertebrae (more in *A. macrorhynchus*; Figure 28).

TABLE 4. Proportional measurements and counts of *Apristurus macrostomus*.

	A. macrostomus		
	Taiwan	Holotype	Other regions
	26 males, 20 females	male	9 males, 12 females
TL (mm)	210–487	389	142–475
Proportion (%TL)			
PreD2-origin length	59.1–63.1	59.6	55.6–62.3
PreD1-origin length	45.0–49.7	—	40.6–49.9
PreP1 length	21.3–23.7	23.4	20.2–24.1
PreP2 length	36.9–40.0	38.6	35.8–39.9
Preanal length	49.3–53.6	52.4	46.9–53.6
Precaudal length	66.1–71.1	67.4	65.1–70.0
Pre-branchial length	17.8–21.0	17.6	17.9–21.1
Pre-orbital length	10.4–11.7	9.6	9.6–12.3
Pre-outer nostril length	4.9–6.5	5.1	4.6–5.6
Pre-inner nostril length	8.0–9.5	8.0	6.9–9.1
Pre-oral length	9.0–11.6	8.9	8.6–11.0
Head length	21.8–24.6	20.9	21.7–25.7
Mouth width	7.3–9.7	—	6.7–9.3
Internarial width	3.1–4.0	3.6	3.1–4.1
Upper labial furrow length	3.0–3.9	4.7	2.7–4.0
Lower labial furrow length	2.2–3.0	2.5	1.9–3.4
Orbital length	2.7–3.4	3.9	2.5–4.4
Nostril length	3.5–4.6	3.5	3.4–4.9
Interorbital width	5.3–6.8	5.2	5.5–7.2
1st gill height	1.0–2.1	2.3	0.8–2.9
3rd gill height	1.5–2.6	2.4	1.4–3.2
5th gill height	1.2–2.2	1.9	1.5–2.9
D1-D2 space	7.3–10.6	5.5	8.1–10.6
D1-D2 origins	11.8–15.5	11.6	12.5–15.0
D1-D2 insertions	12.9–15.7	13.0	13.3–15.9
P1-P2 space	7.4–12.2	7.3	7.2–11.2
P1 tip to P2 origin	1.7–6.1	2.0	1.4–5.2
P1-P2 origins	14.4–18.8	13.7	13.4–20.7
D1 base length	3.5–5.8	5.6	3.8–7.2
D1 height	0.9–1.7	1.4	0.7–2.3
D1 free lobe length	3.3	3.1	2.8–3.7
D2 base length	4.7–6.5	7.1	5.0–8.4
D2 height	1.7–2.3	2.5	2.0–3.2
D2 free lobe length	3.4	3.6	3.2–4.6
P1 anterior margin	9.1–12.4	13.9	9.8–14.7

..... *continued on the next page*

TABLE 4. (Continued)

	A. macrostomus		
	Taiwan	Holotype	Other regions
	26 males, 20 females	male	9 males, 12 females
P2 length	8.7–12.1	11.3	10.2–12.7
Anal base length (ceratotrichia)	14.7–18.9	15.9	13.4–19.2
Anal height (muscle)	2.6–5.1	4.5	3.1–5.1
Caudal length	29.4–33.9	31.4	29.9–35.2
Clasper outer length	1.5–6.0	6.0	1.4–6.2
Counts			
Tooth rows:			
upper	63–86	76	62–84
lower	55–80	73	65–81
Vertebrae:			
monospondylous	34–37	—	31–36
precaudal diplospondylous	33–40	—	31–37
Spiral valves	18–21	—	18–21

Apristurus macrostomus and *A. platyrhynchus* are quite similar each other morphologically, but they are apparently different species. *A. macrostomus* is a small-sized species attaining up to 57 cm TL, and begins to mature at around 40 cm TL. On the other hand, *A. platyrhynchus* is a large-sized species attaining 80 cm TL, and becomes mature at around 60 cm TL (Figure 29). In *A. macrostomus,* the egg capsule is short and stocky with long tendrils on the posterior end of the capsule (Figure 23), whereas the egg capsule of *A. platyrhynchus* is very slender and long without tendrils (Figure 32). The claspers are also different, with clasper hooks in *A. macrostomus* (Figure 25), and without clasper hooks in *A. platyrhynchus* (Figure 34). *A. macrostomus* has a relatively lower second dorsal fin (Figure 30), and the origin of the first dorsal fin is located above the anterior half of P2–anal space, while *A. platyrhynchus* has a relatively higher second dorsal fin (Figure 30), and the origin of the first dorsal origin is located above the middle of the P2–anal space.

Apristurus macrostomus and *A. platyrhynchus* can be primarily distinguished by total length and maturity. As shown in Figure 29, the adolescent and mature individuals less than 55 cm TL could be identified as *A. macrostomus*. Immature individuals larger than 40 cm TL, adolescent individuals between 55 and 60 cm TL and the mature individuals larger than 60 cm TL could be identified as *A. platyrhynchus*. However, smaller individuals less than 40 cm TL includes both species and it is necessary to work on these specimens further in order to determine good discriminating characters.

Apristurus macrostomus is the most populous species of *Apristurus* in Taiwan, but it was incorrectly reported as *A. macrorhynchus* or *A. platyrhynchus*. Therefore, this is the first report of the species from Taiwan.

***Apristurus platyrhynchus* (Tanaka, 1909)**

English name: Spatula-snout catshark
Taiwanese name: Bien-wen-bi-sa
Japanese name: Herazame
(Figures 31–36, Table 5)

Scyliorhinus platyrhynchus Tanaka, 1909: 4–6 (original description, type locality: Japan); Jordan *et al*., 1913: 10.

Apristurus platyrhynchus: Garman, 1913: 98 (description, Japan); Nakaya, 1975: 28, fig. 12 (description, Japan); Springer, 1979: 26 (description, Japan); Compagno, 1984: 278–279 (description, Japan); Nakaya *in* Masuda *et al*., 1984: 4, pl. 335-B (description, Japan); Nakaya, 1989: 201, fig. 2 (comparative material); Nakaya & Sato, 1999: 316 (taxonomic comments); Nakaya & Séret, 1999: 307 (comparative materials); Nakaya & Sato, 2000: 224 (description, Japan, China, Philippines, and Indonesia; figs 1–2; Yoshino & Aonuma, 2002: 130 (key to species, Japan); Compagno *et al*., 2005: 198,

pl. 32 (description, Japan, Philippines and Australia); Kawauchi *et al*., 2008: 75, figs 1, 3, 6 (description, Japan, East China Sea, Philippines, South China Sea, and Australia); Last & Stevens, 2009: 194, fig. 25, 31.7 (description, Japan, Philippines and Australia); Ebert *et al*., 2013: 297, pl. 38 (description).

Apristurus macrorhynchus: Chen, 1963: 33, fig. 11 (description, Taiwan).

Pentanchus verweyi Fowler, 1934: 237, fig. 2 (original description, type locality: Indonesia); Fowler, 1941: 57 (key to species and description, Japan).

Apristurus verweyi: Compagno, 1984: 287 (description, Indonesia); Compagno, 1988: 170 (description, Indonesia); Compagno, 1999: 478.

Pentanchus platyrhynchus: Fowler, 1941: 57 (in part), not fig. 5 (description, Philippines).

Apristurus acanutus Chu, Meng & Li *in* Meng, Chu & Li, 1985: 46, fig. 3 (original description; type locality: China); Nakaya & Sato, 1999: 316 (description, China).

Apristurus sp. B: Last & Stevens, 1994: 169, 174, key fig. 24, pl. 19 (description, Australia).

Material examined. *Taiwan*: ASIZP 66206, male, 645 mm TL, South China Sea, 20°84'N, 117°45'E, 731 m. *Other regions (type specimens)*: SCSFRI D-0172 (holotype of *Apristurus acanutus*), female, 522 mm TL, estuary off Pearl river, South China Sea, 594 m depth. SFU D-0161 (paratype of *A. acanutus*), 520 mm TL, South China Sea. USNM 93135 (holotype of *Apristurus verweyi*), male, 303.0 mm TL, Sibuko Bay, Borneo. *Other regions (non-types)*: BSKU 22337, female, 345 mm TL, Kochi Prefecture, Japan. BSKU 22788, female, 355 mm TL, Tosa Bay, 960–985 m depth. BSKU 26866, male, 347 mm TL, 750–760 m depth, BSKU 27062, female, 499 mm TL, BSKU 27063, male, 415 mm TL, BSKU 27064, male, 425 mm TL, BSKU 27065, female, 418 mm TL, 650 m depth, BSKU 27594, male, 423 mm TL, BSKU 27597, male, 377 mm TL, 610–640 m depth, BSKU 33521, female, 473 mm TL, BSKU 33522, female, 435 mm TL, BSKU 33523, female, 380 mm TL, BSKU 33524, male, 380 mm TL, BSKU 33525, male, 347 mm TL, 780-810 m depth, BSKU 33972, female, 280 mm TL, 700–715 m depth, HUMZ 103699, female, 528 mm TL, Okinawa Trough, Japan. HUMZ 103700, male, 484 mm TL, Kumano-Nada, Mie Prefecture, Japan. HUMZ 105984, male, 438 mm TL, HUMZ 105985, male, 445 mm TL, locality unknown. HUMZ 145155, female, 455 mm TL, HUMZ 145156, female, 407 mm TL, HUMZ 145162, female, 337.5 mm TL, HUMZ 145163, female, 303.8 mm TL, HUMZ 145169, female, 478 mm TL, HUMZ 145157, female, 402 mm TL, HUMZ 145158, male, 478 mm TL, HUMZ 145159, female, 422 mm TL, HUMZ 145160, female, 403 mm TL, HUMZ 145170, female, 591.9 mm TL, Okinawa Trough, Japan. HUMZ 191332, male, 490 mm TL, off Sumatra Island, Indonesia, 960-760m depth. FRLM 27652, male, 692 mm TL, Kumano-nada, Mie Pref., Japan. TMFE 21, female, 645 mm TL, TMFE 22, female, 680 mm TL, TMFE 23, female, 651 mm TL, Suruga Bay, Shizuoka Prefecture, Japan. TMFE 40, male, 536 mm TL, Suruga Bay, off Hagachi Cape, Shizuoka Prefecture, Japan, 675–720 m depth. TMFE 286, female, 609 mm TL, TMFE 287, female, 630 mm TL off Heta, Shizuoka Prefecture, Japan, 625–750 m depth. TMFE 520, male, 739 mm TL, locality unknown. TMFE 591, male, 602 mm TL, TMFE 592, female, 617 mm TL, off Omaezaki, Shizuoka Prefecture, Japan, 400–600 m depth. ZUMT 3424, female, 654 mm TL, locality unknown. AMS I 20068-016, male, 408 mm TL, east of Broken Bay, New South Wales, Australia, 886–895 m depth. AMS I 20920-020, female, 285 mm TL, north-east of Raine Island, Queensland, Australia, 900 m depth. AMS I 21724-018, male, 708 mm TL, east of Broken Bay, New South Wales, Australia, 1005 m depth. AMS I 24101-005, male, 604 mm TL, off Sydney, New South Wales, Australia, 830 m depth. AMS I 24356-008, female, 552 mm TL, off Shoalhaven Bight, New South Wales, Australia, 1043–1061 m depth. CSIRO H 913-01, male, 666 mm TL, east of Sugarloaf Point, New South Wales, Australia, 905–960 m depth. CSIRO H 1201-02, female, 426 mm TL, Houtman Albrolhos Islands, Western Australia, Australia, 880 m depth. CSIRO H 1280-07, female, 512 mm TL, east of Nowra, New South Wales, Australia, 981–990 m depth. CSIRO H 1286-03, female, 548 mm TL, Marian Plateau, northeast of Whitsunday Group, Queensland, Australia, 1005–1013 m depth. CSIRO H 1343-01, male, 669 mm TL, east of Nowra, New South Wales, Australia, 891–909 m. CSIRO H 1537-02, female, 416 mm TL, east of Brush Island, New South Wales, Australia, 930–950 m depth. CSIRO H 1543-01, female, 507 mm TL, east of Brush Island, New South Wales, Australia, 890–910 m depth. CSIRO H 2265-02, male, 695 mm TL, west of Geraldton, Western Australia, Australia, 960 m depth, 29 Jan 1989. CSIRO H 2336-01, male, 682 mm TL, CSIRO H 2336-02, female, 553 mm TL, CSIRO H 2336-03, male, 508 mm TL, CSIRO H 2336-04, female, 430 mm TL, east of Tuncurry, New South Wales, Australia, 1025–1080 m depth. CSIRO H 2337-01, female, 529 mm TL, east of Nowra, New South Wales, Australia, 995–1050 m depth. CSIRO H 2500-01, male, 568 mm TL, east of Broken Bay, New South Wales, Australia, 1037–1049 m. FSFL ED 308, male, 525 mm TL, Norfolk Ridge, Australia, 885 m depth.

TABLE 5. Proportional measurements and counts of *Apristurus platyrhynchus*.

	A. platyrhynchus	
	Taiwan	Other regions (types of junior synonyms)
	1 male	37 males, 46 females (1 male, 2 females)
TL (mm)	645	280–739 (303–522)
Proportion (%TL)		
PreD2-origin length	60.5	56.6–68.0 (60.1–68.0)
PreD1-origin length	48.7	45.5–51.5 (47.9–48.9)
PreP1 length	20.3	19.3–24.0 (20.8–23.5)
PreP2 length	36.6	35.7–40.8 (37.3–40.8)
Preanal length	51.2	47.6–53.0 (51.0–52.5)
Precaudal length	69.5	65.4–72.6 (67.8–68.9)
Pre-branchial length	17.2	15.3–20.6 (18.7–19.8)
Pre-orbital length	9.5	8.2–12.0 (9.7–12.0)
Pre-outer nostril length	4.7	3.8–6.0 (4.9–5.6)
Pre-inner nostril length	6.8	6.1–9.5 (7.1–8.8)
Pre-oral length	8.1	7.6–11.0 (8.7–10.6)
Head length	22.0	19.6–23.8 (22.6–23.8)
Mouth width	7.9	7.0–11.3 (8.0–9.0)
Internarial width	3.6	3.0–4.3 (3.4–4.0)
Upper labial furrow length	3.4	2.2–4.4 (2.8–3.5)
Lower labial furrow length	2.0	1.6–2.8 (1.9–2.1)
Orbital length	3.1	2.0–3.7 (3.1–3.5)
Nostril length	3.3	3.0–5.2 (3.2–4.0)
Interorbital width	6.2	5.1–7.6 (6.1–7.5)
1st gill height	1.6	1.0–2.7 (1.0)
3rd gill height	2.0	1.0–3.2 (1.0–2.2)
5th gill height	1.9	0.9–2.5 (0.9)
D1-D2 space	8.1	6.0–10.5 (6.9–7.8)
D1-D2 origins	13.1	10.9–14.9 (12.3)
D1-D2 insertions	14.9	12.6–16.8 (14.5)
P1-P2 space	6.8	6.9–10.2 (7.9–9.6)
P1 tip to P2 origin	2.6	1.1–4.6 (3.8–4.2)
P1-P2 origins	15.7	7.0–18.3 (14.5–17.0)
D1 base length	5.2	3.0–7.7 (3.7–4.0)
D1 height	1.5	1.1–3.9 (1.2–1.4)
D1 free lobe length	3.3	2.5–4.0 (—)
D2 base length	6.9	4.6–7.7 (6.1–6.8)
D2 height	2.3	2.1–4.3 (2.2–2.4)
D2 free lobe length	3.0	2.5–4.3 (—)
P1 anterior margin	13.3	11.0–15.3 (11.1–12.3)
P2 length	11.9	8.7–11.6 (9.9–11.5)
Anal base length (ceratotrichia)	17.1	15.9–20.6 (16.1–19.0)
Anal height (muscle)	4.9	2.7–6.2 (4.3–4.5)

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TABLE 4. (Continued)

	A. platyrhynchus	
	Taiwan	Other regions (types of junior synonyms)
	1 male	37 males, 46 females (1 male, 2 females)
Caudal length	31.1	29.0–33.5 (31.2–31.9)
Clasper outer length	4.7	1.1–5.7 (1.8)
Counts		
Tooth rows:		
upper	69	60–86 (67–74)
lower	74	57–87 (73–85)
Vertebrae:		
monospondylous	37	33–40 (35)
precaudal diplospondylous	42	37–45 (—)
Spiral valves	—	16–20 (17–18)

Diagnosis. A species of *Apristurus* with the following characters: upper labial furrows much longer than the lowers; first dorsal fin much smaller than second dorsal fin, originating above middle of P2–anal space; second dorsal-fin insertion well anterior to anal-fin insertion; snout rather long, tip bell-shaped; abdomen very short; P1–P2 space shorter than three fifths of anal-fin base length (ceratotrichia); pectoral-fin tip always extending beyond midpoint of P1–P2 space; intestinal spiral valves 16–20; monospondylous + precaudal diplospondylous vertebrae 33–40 + 37–45; clasper hook absent on edge of exorhipidion; body uniformly light blown or grey to dark blown; maturing size larger than 55 cm TL in both sex.

Description. Proportional measurements and meristic counts are given in Table 5. Body cylindrical, slender and elongate (Figure 31). Head dorso-ventrally flattened, posterior part of body compressed laterally. Snout rather long; tip bell-shaped. Pre-outer nostril length slightly greater than internarial width. Pre-oral length slightly less than pre-orbital length, 2.2–2.9 times internarial width, slightly greater than mouth width and greater than interorbital width. Pre-orbital length 1.3–2.1 times of interorbital length, 2.4–4.3 times orbit length. Internarial width subequal to orbit and nostril width. Nostril expanding obliquely inward from snout edge; length about half of pre-inner nostril length. Nostril–mouth space about half of internarial width. Mouth widely arched, with well developed labial furrows; upper labial furrows 1.3–1.8 times longer than lower one. Upper labial furrow reaching beyond midpoint between mouth corner and posterior margin of nostril. Orbit narrow and slender, with a weak subocular fold. Spiracle very small placed slightly below level of horizontal axis of orbit. Five small gill slits present; third gill slit above pectoral-fin origin; fifth gill slit smallest, above pectoral fin base. Gill septa with projection, covered closely with dermal denticles. Abdomen very short; P1–P2 space shorter than three fifths of anal-fin base length (ceratotrichia); pectoral-fin tip always reaching beyond midpoint of P1–P2 space. Pectoral fin large, wide, triangular; outer margin not parallel to inner margin. Pelvic fin moderate in size, its length equal to pre-orbital length. Dorsal fins different in shape; first dorsal fin much lower and narrower than second one. First dorsal fin origin above middle of P2–anal space; insertion posterior to anal-fin origin. Second dorsal-fin origin slightly behind middle of anal-fin base; insertion anterior to anal-fin insertion. Anal fin low, triangular, with a base much longer than P1–P2 space; apex clearly posterior to first dorsal-fin insertion; posterior margin straight; anal and caudal fins separated only by a notch. Caudal fin slender; ventral lobe a little produced: apex of ventral lobe rather angular; subterminal notch distinct; length of terminal lobe moderate ca. 1.8 times caudal terminal lobe height. Caudal peduncle height ca. 0.7–1.4 times pre-outer nostril length. Duodenum very short.

Intestinal spiral valves 16–20. Monospondylous vertebrae 33–40; precaudal diplospondylous vertebrae 37–45.

Teeth numerous and small, 60–86 rows on upper jaw, 57–87 rows on lower jaw with one long central cusp and one to two short lateral cusps; one to two short sharp lateral cusps on upper teeth and one short and one minute lateral cusps on lower jaw teeth.

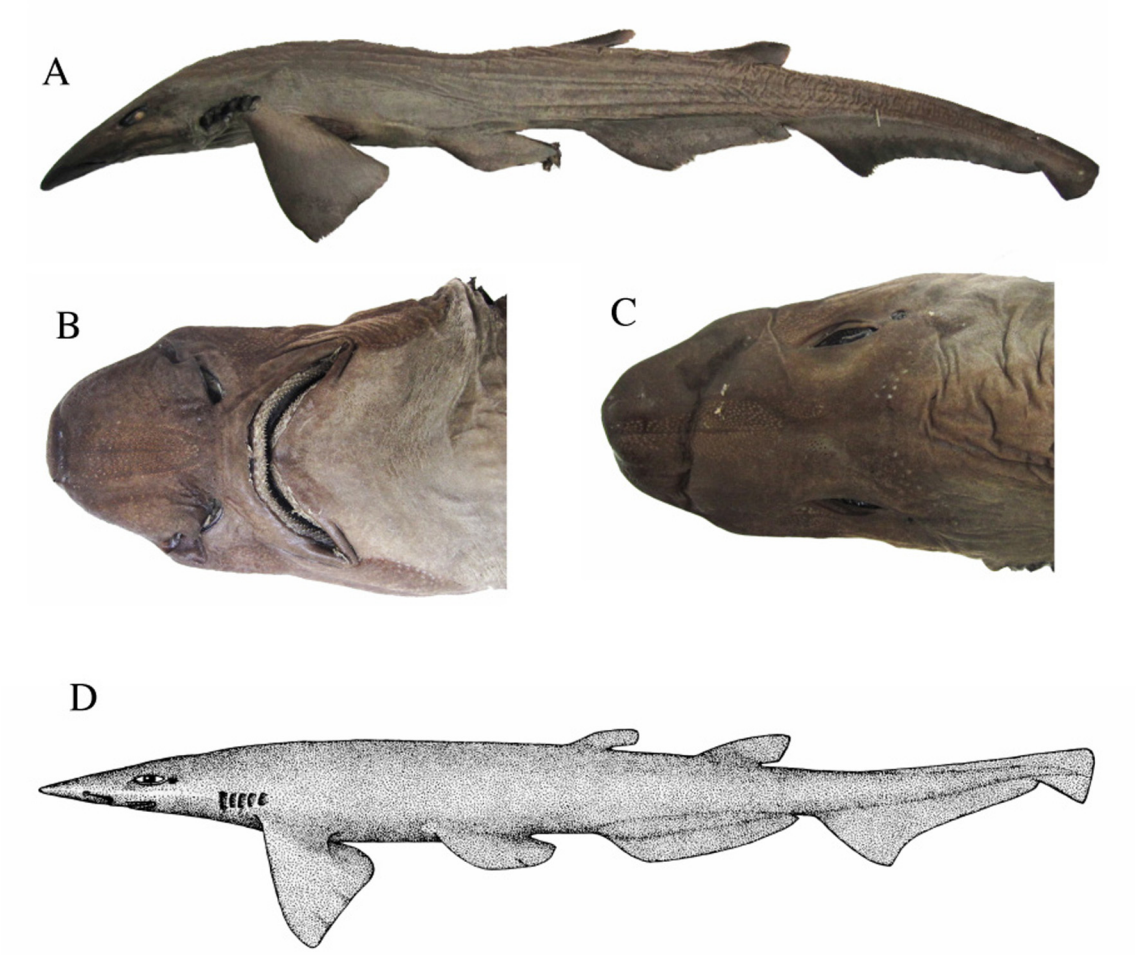

FIGURE 31. *Apristurus platyrhynchus*. A–C, ASIZP 66206, male, 645 mm TL, South China Sea; D, Drawing from Nakaya (1975).

FIGURE 32. Egg capsule of *Apristurus platyrhynchus* from TMFE 23, female, 651 mm TL. Scale bar = 1 cm.

Egg capsule taken from 651 mm TL specimen (TMFE 23) (Figure 32) very slender and long, 94.5 mm in length and 21.8 mm in width, without coiled tendrils on anterior and posterior ends; anterior margin of the capsule rounded without projection at each corner; lateral edges flanged, fused at posterior end; posterior tip forming narrow tapering tube. Surface of egg capsule with ridges. Color dark to reddish brown.

Dermal denticles from dorso-lateral side of body small (Figure 33), overlapping each other, tricuspid, with a long ridged central cusp and shorter lateral cusps; outer surface of denticles completely structured by reticulations. No modified dermal denticles on the dorsal margin of the caudal fin. Dermal denticles densely present around the gill slits and on gill septa.

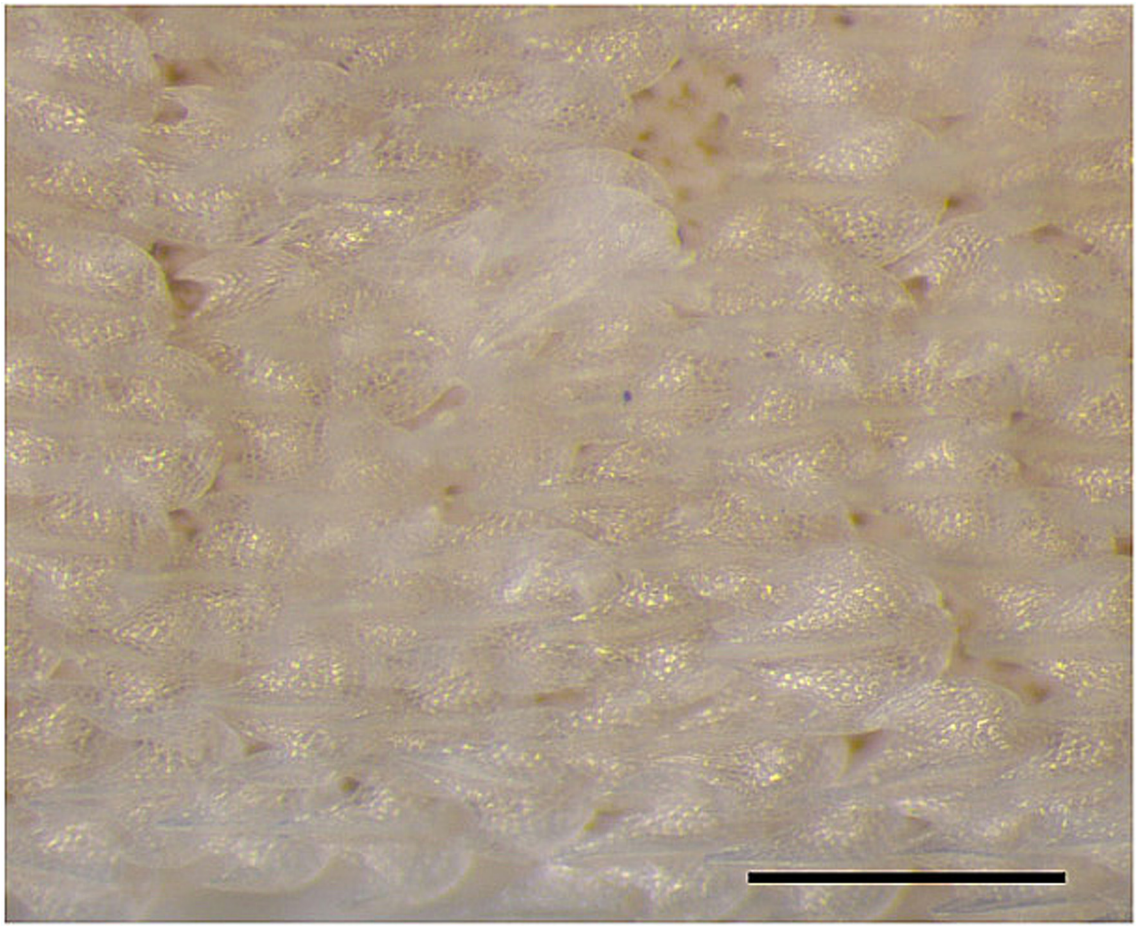

FIGURE 33. Dermal denticles of *Apristurus platyrhynchus*, TMFE 520, male, 711 mm TL. Scale bar = 0.5 mm.

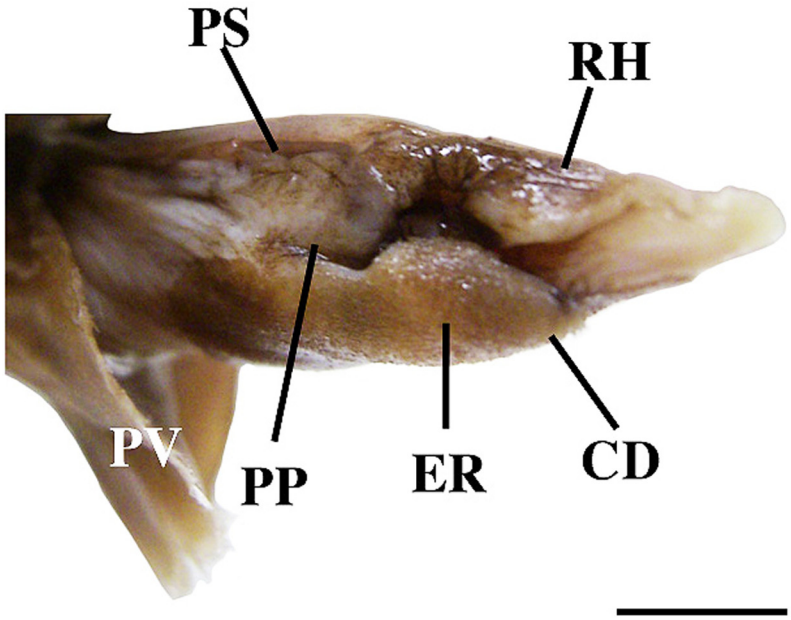

FIGURE 34. Dorsal view of left clasper of *Apristurus platyrhynchus*, TMFE 520, male, 711 mm TL. CD, clasper denticles; ER, exorhipidion; PP, pseudopera; PS, pseudosiphon; PV, pelvic fin; RH, rhipidion. Scale bar = 1 cm.

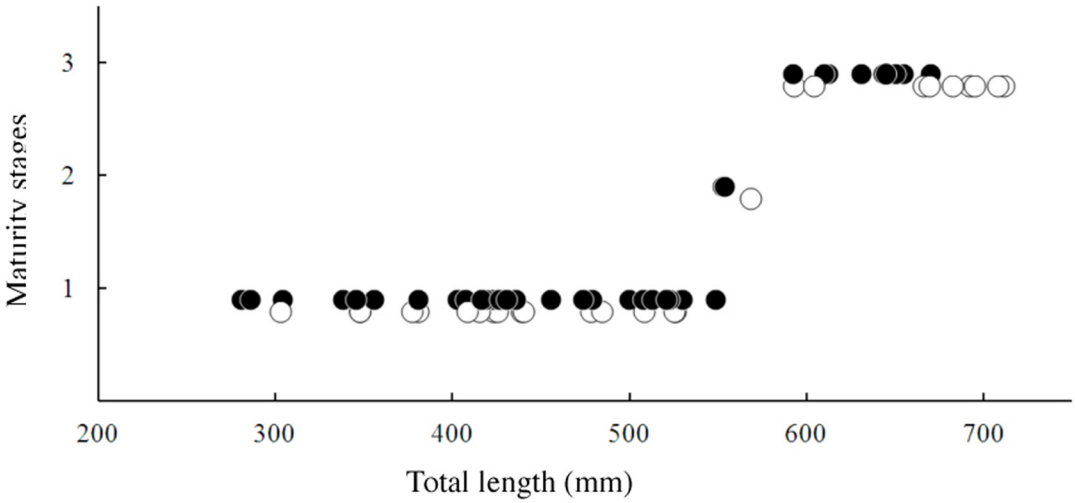

FIGURE 35. Maturity stages of *Apristurus platyrhynchus.* Open symbols, males; solid symbols, females.

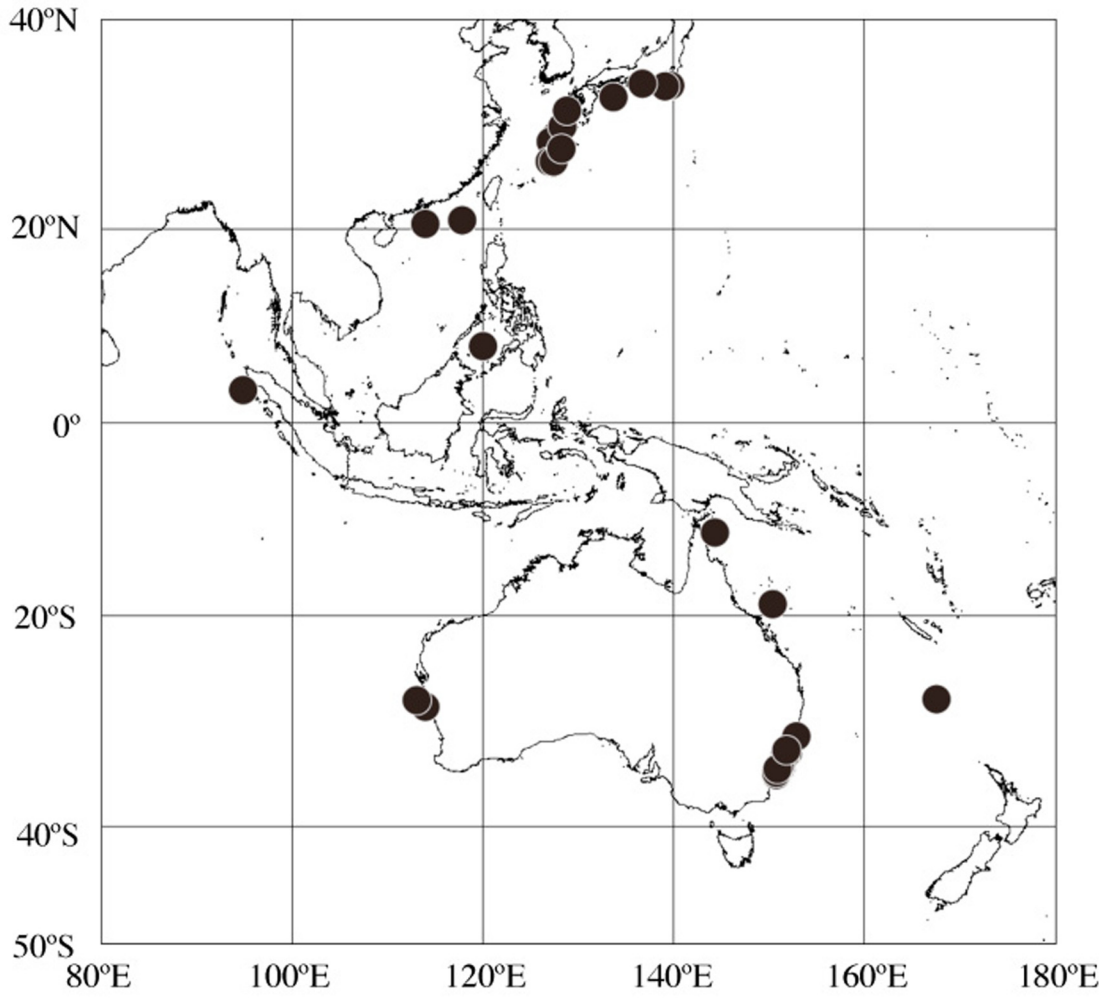

FIGURE 36. Distribution of *Apristurus platyrhynchus*.

Clasper stout at base, tapering posteriorly (Figure 34). Ventral and outer side of surface covered with dermal denticles. Dorsal side of clasper naked and ventral and lateral sides covered with clasper denticles; clasper hooks absent; pseudosiphon slit-like in shape and deep; cover rhipidion vestigial; pseudopera not distinctively long; exorhipidion flat and simple in shape, with free posterior end.

Color. Upper and lower surfaces of body and fins uniformly light brown or grey to dark brown with blackish naked areas along the fin margins. Tongue and palate light brown.

Size. Maximum size 800 mm TL in male (holotype), and 669.5 mm TL in female (Figure 35). Most males less than 525.5 mm TL in maturity stage 1 (immature) with short claspers, less than 2.1% TL. One male of 568 mm TL in maturity stage 2 (adolescent) with developing, but soft claspers. All males more than 592.1 mm TL in maturity stage 3 (adult) with long, well developed and hardened claspers. All females less than 548 mm TL in maturity stage 1. One female in 553 mm TL in maturity stage 2. All females more than 591.9 mm TL in maturity stage 3.

Distribution. Japan (northward to Suruga Bay), East China Sea (Okinawa Trough), Taiwan, Philippines, South China Sea, Indonesia, Australia (Norfolk Ridge, Queensland, New South Wales and Western Australia) and New Caledonia (Figure 36), at depths of 400–1080 m.

Remarks. *Apristurus platyrhynchus* was originally described by Tanaka (1909) based on a mature male collected from Suruga Bay, Japan. This species belongs to the 'brunneus group' (*sensu* Nakaya & Sato, 1999) of the genus *Apristurus*, characterized by having considerably longer labial furrows on the upper jaw than those on the lower jaw, and a greater number of spiral valves in the intestine.

Since the original description of the species, no one worked on it until Nakaya (1975) made a taxonomic revision of Japanese scyliorhinid sharks. Later, Nakaya & Sato (2000) worked on *A. platyrhynchus* and its five related species, and synonymized both *A. verweyi* (Fowler, 1934) from the Philippines and *A. acanutus* Chu, Meng & Li, 1985 from the South China Sea with *A. platyrhynchus*. Recently, Kawauchi *et al*. (2008) further examined the specimens from Indonesia and Australia, and suggested that this species is widespread in Japan, Philippines, Indonesia, and even Australia.

Among the species of Taiwan, *Apristurus platyrhynchus* resembles *A. macrostomus* in having a rather long snout, and a narrower interspace between the pectoral and pelvic fin bases, butit is distinguishable by a more posterior position of first dorsal fin, a higher second dorsal fin, the absence of hooks on the clasper, larger sizes at maturity, and larger maximum size (see *A. macrostomus* for detailed discussion).

Apristurus platyrhynchus was reported from Taiwan by Shen & Wu (2011), but this record refers to *A. macrostomus*, and *A. platyrhynchus* has not been correctly reported from Taiwan before. The specimen used here (ASIZP 66206) was collected from the southwestern waters of Taiwan, and this is the first reliable report of this species based on a voucher specimen.

Discussion

Nakaya & Sato (1999) tried to subdivide the species of genus *Apristurus* and recognized three species groups in the genus ('longicephalus group', 'spongiceps group' and 'brunneus group'), based on several phenetic characteristics. This division was later supported by data from morphological systematics (Sato, 2000), egg capsule morphology (Flammang *et al*., 2007) and molecular systematics (Iglésias *et al*., 2005a; Naylor *et al*, 2012a, 2012b), suggesting these three groups represent real lineages. Since Nakaya & Sato (1999), eight species were newly described, of which two belong to the 'longicephalus group' and three each belong to the 'brunneus group' and 'spongiceps group'. Of the current 37 valid species, four belong to the 'longicephalus group', 20 to the 'brunneus group', and 13 to the 'spongiceps group'.

Thirteen species are known from the western North Pacific Ocean, including Java, Flores and Banda Seas (two species in the 'longicephalus group', nine species in the 'brunneus group', and two species in the 'spongiceps group'). We confirmed occurrences of the five species from Taiwanese waters (i.e., *Apristurus herklotsi* and *A. longicephalus* in the 'longicephalus group', and *A.gibbosus*, *A.macrostomus* and *A. platyrhynchus* in the 'brunneus group'). None of the species from the 'spongiceps group' have been collected. Considering the presence of the 'spongiceps group' in the neighboring waters such as Japan and China, a few more species, especially of the 'spongiceps' group, will possibly be added to the elasmobranch fauna of Taiwan.

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