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A new cryptic species of the pineapple fish genus *Monocentris* (Family Monocentridae) from the western Pacific Ocean, with redescription of *M. japonica* (Houttuyn, 1782)

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Abstract

A new pineapple fish is described based on 26 type and 80 non-type specimens collected from Taiwan, Vanuatu, the Solomon Islands, and Queensland, Australia. This new species is sympatric with and similar to *Monocentris japonica* but can be distinguished from the latter in having only 6 or 7 scales on the third scale row below the lateral line; excisura notched and a small pseudo-excisura present on the sagittal otolith; consistently greater head depth, body depth, postorbital length, dorsal-fin–pelvic-fin length, and dorsal-fin–pectoral-fin length in proportion to standard length. A detailed description and designation of neotype are provided for *M. japonica*. DNA barcoding analysis supports the distinction of the new species with an estimated average COI gene divergence of 3.6 % from *M. japonica*.

Key words: Actinopterygii, Trachichthyiformes, taxonomy, DNA barcoding, biodiversity

Introduction

The pineapple or pinecone fish family Monocentridae is a group of small marine fishes up to 26 cm standard length. They are widely distributed in the Indo-Pacific Ocean and the southeastern Pacific Ocean, inhabiting at depths less than 300 meters (Paxton 1999). They are well-known for their yellowish body covered by enlarged, non-overlapping bony plates; deep mucous cavities on top of the head; two dorsal fins, the first with 4–7 strong free spines alternatingly angled side to side; pelvic fin with a strong spine and 2–4 small rays; no lateral line; and two light organs on the lower jaw placed either anteriorly just below the tip (*Monocentris*) or on the side under the eyes (*Cleidopus*) (Kotlyar 1985; Paxton 1999).

Currently, two genera with three valid species are recognized, including *Cleidopus gloriamaris* De Vis, 1882 from Australia, *Monocentris japonica* (Houttuyn, 1782) from the Indo-West Pacific, and *Monocentris reedi* Schultz, 1956 from the southeastern Pacific. Four other names have been proposed for members of the family, *Sciaena cataphracta* Thunberg, 1790 (type locality: Nagasaki, Japan), *Monocentris carinata* Bloch & Schneider, 1801 (type locality: Japan), and *Cleidopus neozelanicus* Powell, 1938 (type locality: New Zealand), which are synonyms of *M. japonica* (Kotlyar 1985, 1996; Paxton *et al.* 1989); and *Cleidopus gloriamaris occidentalis* Whitley, 1931, a junior synonym of *C. gloriamaris* (Kotlyar 1985, 1996).

A recent genetic analysis based on mitochondrial cytochrome C oxidase I (COI) sequences revealed that vouchers identified as *M. japonica* collected off Taiwan were separable into two clades. Further investigation identified one of the two as representing *M. japonica,* and the other clade as an undescribed species. In addition, a literature survey revealed that *Sciaena cataphracta* and *Monocentris carinata* should be regarded as junior synonyms of *M. japonica*, but *Cleidopus neozelanicus* is a valid species of *Monocentris* (Su *et al.*, in prep.).

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In this work, a new, cryptic species very similar to *M. japonica*, is described on the basis of both morphological and genetic features, and a neotype for *M. japonica* is designated, to clarify and maintain its taxonomic status (Article 75; ICZN, online).

Materials and Methods

Morphological data. Specimens were fixed in 4% formaldehyde and subsequently transferred to 70% ethanol or 50% isopropanol. Specimens are deposited in the following institutions: Auckland War Memorial Museum, Auckland, New Zealand (AIM); Australian Museum, Sydney (AMS); The Commonwealth Scientific and Industrial Research Organization, Hobart, Australia (CSIRO); Department of Marine Science, National Sun Yat-sen University (DOS); Division of Fishes, Department of Zoology, Field Museum of Natural History, Chicago, Illinois, U.S.A (FMNH); Kagoshima University Museum, Ichthyology, Kagoshima, Japan (KAUM); Muséum National d'Histoire Naturelle, Paris, France (MNHN); Pisces collection of the National Museum of Marine Biology and Aquarium, Taiwan (NMMB-P).

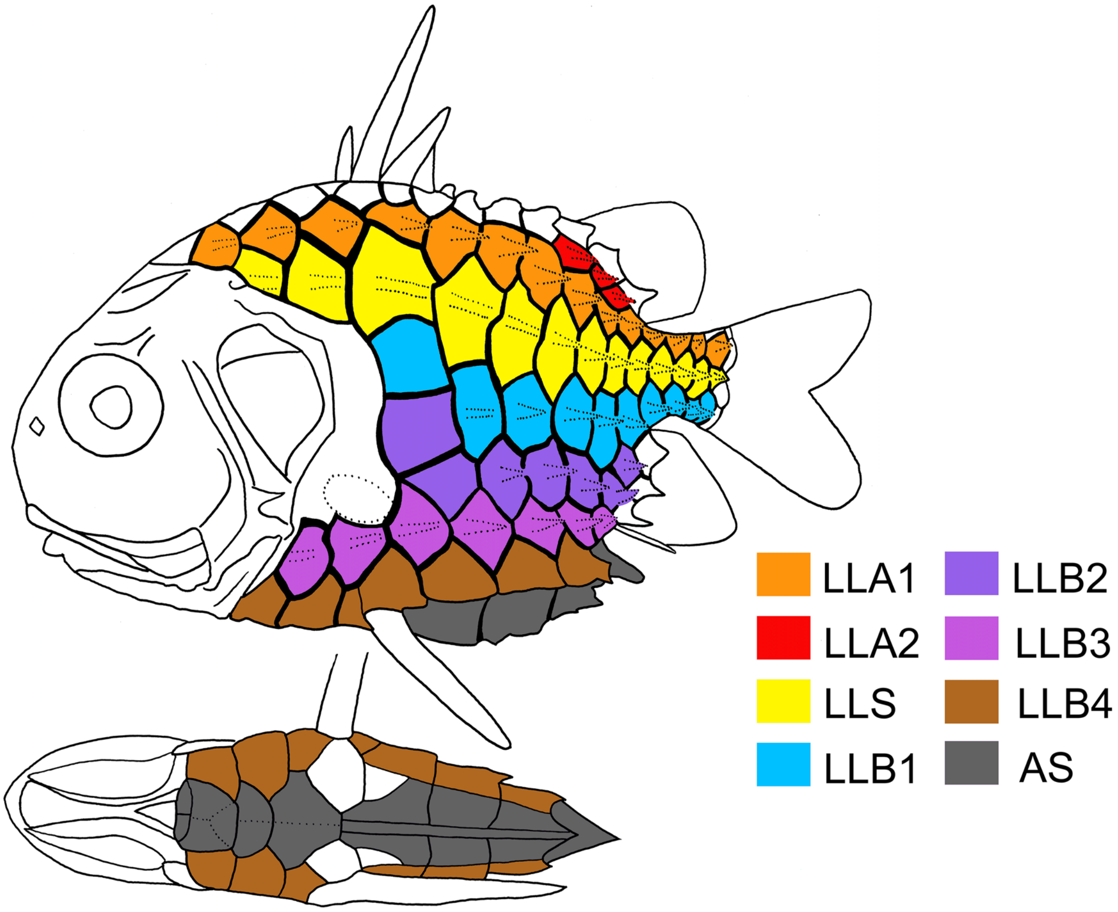

FIGURE 1. Definition of scale rows counted in *Monocentris* spp. AS, abdominal scutes; LLA1 and LLA2, scales rows above lateral line; LLB1, LLB2, LLB3 and LLB4, scale rows below lateral line; and LLS, lateral-line scales. Colors in key correspond to colors identifying scale rows.

Terminology and methodology follow Kotlyar (1996), except for the following: the length of caudal peduncle was measured from the posterior end of the anal-fin base to the center of the posterior margin of the hypural plate (caudal-fin base); suborbital height was measured from the lower margin of the eye to premaxilla with mouth closed; two “snout lengths” were measured, the distance between upper-jaw gape and the anterior margin of eye (snout length 1 [SNL1]), and distance between the anterior margin of snout and the anterior margin of eye (snout length 2 [SNL2]); first-four dorsal-fin spines were measured; body width was measured at the dorsal-fin origin.

Counts of paired-fin characters were taken from the left side of specimens unless damaged, for which the fin on the right side was substituted and noted. Dorsal-fin spine and soft ray formula is presented as: spines, unbranched soft rays + branched soft rays = total soft rays (e.g., VI, i+9=10). Pectoral-fin ray formula is presented as: unbranched soft rays + branched soft rays + unbranched soft rays (e.g., ii+11+i). Anal-fin ray formula is presented as: unbranched soft ray + branched soft rays = total soft rays (e.g., i+9=10). The number of gill rakers and pseudobranchial filaments were counted on the right side. Gill-raker numbers represent developed rakers on the outer surface of the first gill arch and are presented as: rakers on upper limb + angle + lower limb = total rakers (e.g., 6+1+19=20).

Vertebrae were counted from radiographs taken by a digital radiograph machine set up in the National Museum of Marine Biology and Aquarium. The ural centrum with attached hypural complex was counted as a single vertebra. Scale rows (bony plates) were defined and counted as follows (Fig. 1): lateral-line scales (LLS), including the small scales on caudal-fin base; two scale rows above lateral line (LLA1–2), not including small scales on caudal-fin base; four scale rows below lateral line (LLB1–4), not including small scales on caudal-fin base; and abdominal scutes (AS). All scales were counted on both sides. Predorsal scales were counted on midline of dorsal profile (Fig. 2).

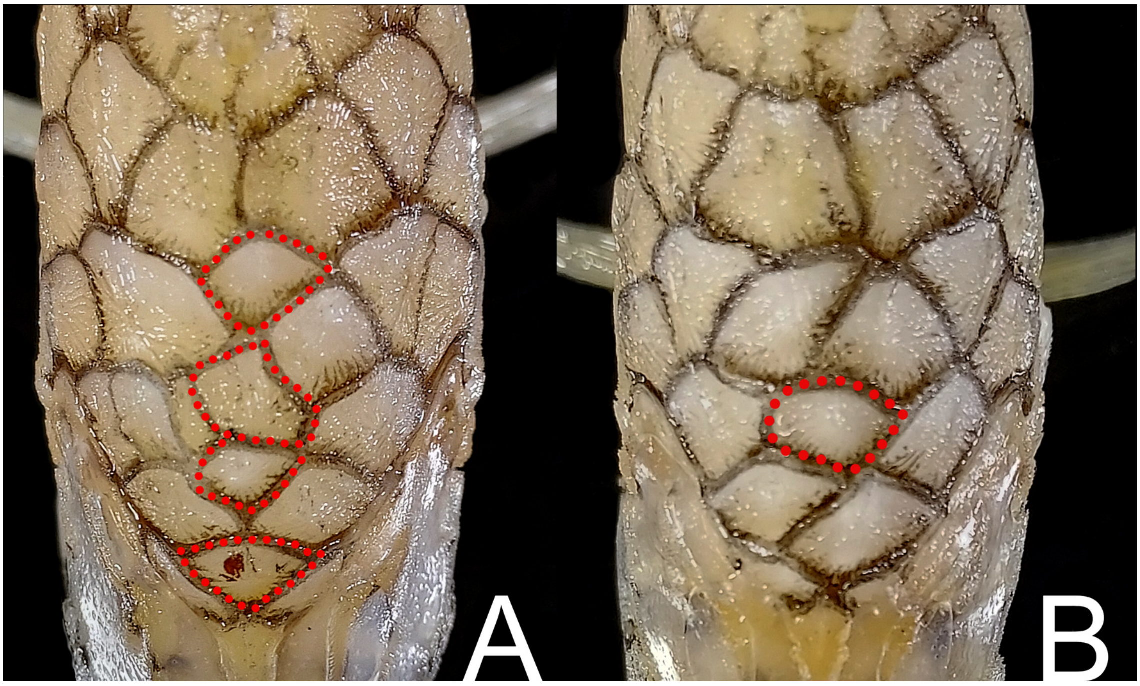

FIGURE 2. Variation in medium-predorsal scales of *Monocentris chrysadamas* **sp. nov.**, outlined by red dots. A. NMMB-P36126, holotype, 115.5 mm SL. B. NMMB-P36127, paratype, 110.7 mm SL.

Measurements were taken using a 150 mm digital caliper rounded to the nearest 0.1 mm. Morphometric data were expressed as ratios or percentages of standard length (SL) and/or head length (HL), except where otherwise indicated.

Genetic analysis. Before fixation in 4% formaldehyde, the right pectoral fin was removed and preserved in 95% EtOH and stored at room temperature. DNA was then extracted following the protocol of the Tissue & Cell Genomic DNA Purification Kit (Biokit). Fragments of mitochondrial cytochrome c oxidase subunit I gene (COI) were amplified and sequenced using the primer pair FishF1 (5'-TCAACCAACCACAAAGACATTGGCAC-3') and FishR1 (5'-TAGACTTCTGGGTGGCCAAAGAATCA-3') published by Ward *et al.* (2005).

All sequences of *Monocentris* that were publicly available on Genbank (Benson *et al.* 2012) and the Barcode of Life Data System (BOLD) (Ratnasingham & Hebert 2007) were retrieved, and *Cleidopus gloriamaris* was selected as an outgroup. All sequences were aligned by the ClustalW model (Thompson *et al.* 1994) using the default settings in Geneious v.8.1.9 (Kearse *et al.* 2012), trimmed to 654 base pairs before analysis, and submitted to Genbank with accession numbers: ON025550–ON025565 (Table 1).

A hypothesized tree was reconstructed using the maximum-likelihood method. The Kimura-2-Parameter (K2P) (Kimura 1980) model was selected and 1000 bootstrap pseudoreplicates were performed by the software MEGAX (Kumar *et al.* 2018), with gamma distribution. Genetic distances were calculated with the K2P model.

TABLE 1. COI sequences used for genetic analysis in this study. Sequences generated for this study were marked with asterisks * and others were retrieved from Genbank (Benson *et al.*, 2012) or BOLD system (Ratnasingham & Hebert 2007).

Species	Accession Numbers
Monocentris chrysadamas **sp. nov.**	FOAN1315-12, GBMIN94139-17, KP267633.1, *ON025560–ON025565
Monocentris japonica	DSFSG1044-13, DQ648452.1, GBGC7815-09, GBMNA14567-19, GBMTG305-16, KU176362.1, KU943262, TZSAL784-13, TZSAL763-13, ZOSKT393-16, ZOSKT394-16, *ON025550–ON025559
Cleidopus gloriamaris	FMVIC227-08, FOAF165-07

Results

Family Monocentridae

Monocentris Bloch & Schneider, 1801

Monocentris Bloch & Schneider, 1801:100 (Type species: *Monocentris carinata* Bloch & Schneider 1801).
Lepisacanthus Lacepède, 1801:320 (Type species: *Lepisacanthus japonicus* Lacepède 1801).
Ericius Tilesius, 1809:243 (Type species: *Monocentris carinata* Bloch & Schneider 1801).

Two genera are recognized in the family Monocentridae. *Monocentris* differs from *Cleidopus* De Vis, 1882, in having a broad (deep) suborbital space (> 8.2 % SL); a large mouth with upper jaw straight; relatively long snout, subequal to eye diameter; a black light organ at tip of lower jaw; toothless vomer; and relatively smaller maximum size (usually less than 15 cm SL), whereas *Cleidopus* has a very narrow suborbital space with lower margin of eye almost adjacent the upper jaw (2.9–3.2 % SL); small with S-shaped upper jaw; snout clearly shorter than eye diameter; an orange light organ on each side of lower jaw under eye; vomer with teeth; and a relatively larger maximum size (up to 26 cm).

According to Paxton (1999), the lateral line is absent in monocentrids, however, our specimens possess a small canal through each scale in a row where a lateral line is commonly found in beryciform fishes (LLS in Fig. 1). Thus, we recognized this row of scales as lateral-line scales.

Previously, the genus has comprised two species: *M. japonica* in the Indo-West Pacific and *M. reedi* in the southeastern Pacific. A third species similar to *M. japonica* is described below.

Monocentris japonica (Houttuyn, 1782)

Figs. 3–4, 5A, 6, 10, 12A, 13–14. Tables 2–4

Gasterosteus japonicus Houttuyn, 1782:329 (Type locality: Nagasaki, Japan; no types known).
Sciaena cataphracta Thunberg, 1790:108, pl. 3 (Type locality: Nagasaki, Japan).
Monocentris carinata Bloch & Schneider, 1801:100, pl. 24 (Type locality: Japan; no types known).
Monocentris japonica (Houttuyn, 1782): Yamakawa in Okamura *et al.* 1985:431, 651; Yamada & Okamura 1986:116; Masuda & Allen 1987:87; Shen *et al.* 1993:210; Masuda & Kobayashi 1994:61; Kotlyar 1996:202; Okamura & Amaoka 1997:158; Paxton in Carpenter & Niem 1999:2214; Hayashi in Nakabo 2002:502; Shao & Chen 2003:148; Heemstra & Heemstra 2004:133; Shen & Wu 2011:290; Shao *et al.* 2013:41; Jawad *et al.* 2014:1; Iwatsubo & Motomura 2017; Ali *et al.* 2018:315; Jawad *et al.* 2018:102; Eagderi *et al.* 2019:24; Psomadakis *et al.* 2020:347.
Monocentris japonicus (Houttuyn, 1782): Siebold *et al.* 1883:50; Kotlyar 1985:534; Sainsbury *et al.* 1985:84; Smith 1986:413; Konishi 1999:50.

Neotype (herein designated). KAUM–I.73145 (138.8 mm SL), 4 miles off Rocket Center, Kimotsuki, Kimotsuki-gun, Kagoshima, Japan, 31°12'35.4"N, 131°09'03.6"E, 95 m, 27 May 2015, rolling net, coll. K. Koeda & H. Hata. *COI:* ON025552.

Non-types. Eighty specimens, 16.4–147.0 mm SL. **Taiwan (58 specimens)**: CSIRO H 7398-16 (1 specimen, 92.1 mm SL), off Dong-gang fishing port (ca. 22°22'22"N, 120°27'34"E), Pingtung, southwestern Taiwan, 18 Mar. 2012. NMMB-P03656 (1, 104.9), NMMB-P03678 (2, 94.3–101.6), off Dong-gang, 28 May 2002, coll. J.-H. Wu. NMMB-P04146 (2, 100.4–100.9), 14 Aug. 1997. NMMB-P06200 (1, 82.4), off Daxi (ca. 24°53'37"N, 121°55'26"E), Yilan, northeastern Taiwan, 8 May 2003, bottom trawl, coll. Y.-M. Ju. NMMB-P09063 (1, 100.3), off Dong-gang, 13 Jun 2008, coll. C.-W. Chang. NMMB-P24055 (1, 61.9), off Ke-Tzu-Liao (ca. 22°42'53"N, 120°13'12"E), Kaohsiung, southwestern Taiwan, 11 March 2015, bottom trawl, coll. H.-C. Ho. NMMB-P30547 (1, 73.6), off Dong-gang, 6 Dec. 2018, bottom trawl, coll. H.-C. Ho. NMMB-P33774 (1, 51.1) Ke-Tzu-Liao, 23 May 2019, coll. H.-C. Ho. NMMB-P36037 (3, 94.6–116.7), Keelung, northeastern Taiwan, *COI*: ON025557–ON025559. NMMB-P36195 (20, 102.6–144.0), NMMB-P36196 (20, 84.5–130.3), NMMB-P36197 (3, 94.2–101.8), black individuals, all collected from outside Tainan, western Taiwan, 150–200 m, 2021. NMMB-P36198 (1, 120.0), 23°10'N, 119°31'E, off Chimei Island, south of Penghu, 27 Jan. 2022. NMMB-P36199 (1, 104.0), 22°50'N, 119°54'E, off Chiehdin, Kaohsiung, 12 Feb. 2021. **Japan (11)**: KAUM–I.71509 (1, 99.8), East China Sea, *COI*: ON025550. KAUM–I.73146 (1, 130.4), collected with neotype, *COI*: ON025551. KAUM–I.127912 (1, 103.8), off Tanabe, Wakayama, 33°39'24.0"N, 135°12'07.2"E, 13 July 2018, *COI*: ON025553. KAUM–I.131687 (1, 54.7), off Uchinoura Bay, Kimotsuki, Kagoshima, 31°16'54.5"N, 131°04'56.7"E, 30–35 m, 9 Jul. 2019, set net, coll. M. Yamada, *COI*: ON025554. KAUM–I.149072 (1, juvenile, 16.4), off Bandokorobana National Park, Beppu, Ei, Minami-kyushu, Kagoshima, 31°14'29.4"N, 130°25'33.0"E, 0.3 m, 16 Dec. 2020, hand net, coll. R. Furuhashi, *COI*: ON025555. KAUM–I.153257 (1, juvenile, 24.6), east of Sakinoyama, Kataura, Kasasa, Minami-satsuma, Kagoshima, 31°25'26.4"N, 130°11'29.4"E, 4 Jan. 2021, set net, coll. M. Itou, *COI*: ON025556. MNHN 0000-5116 (1, 90.4), 1868. MNHN 0000-7355 (1, 91.1), Japan, no other data. MNHN A-0448 (1, 97.4), dry specimen. MNHN 1889-0015 (1, ca. 102), dry specimen. MNHN 1904-0292 (1, ca. 122), dry specimen. **China (2):** MNHN 0000-7354 (1, 104.7), no other data. MNHN 0000-8375 (1, 101.5), no other data. **Australia (1)**: NMMB-P00593 (1, 147.0), 1 May 1985, bottom trawl, no other data. **New Caledonia (4)**: MNHN 1996-0967 (1, 140.2), 20°00'00.0"S, 158°46'01.2"E, Chesterfield Islands, Coral Sea, 225 m, 22 Jul. 1984. MNHN 1996-0969 (1, 133.2+, tail broken), 23°40'58.8"S, 167°58'58.8"E, 280 m, 23 May 1987. MNHN 1996-0970 (1, 130.4), 19°46'22.8"S, 158°25'04.8"E, Chesterfield Islands, Coral Sea, 203–208 m, 1 Aug. 1988. MNHN 2014-2709 (1, 109.4+, tail broken), 20°30'6.5"S, 158°42'2.1"E, Chesterfield Islands, Coral Sea, 196–213 m, 13 Oct. 2005. **Reunion (2)**: MNHN 1966-0849 (1, 137.4), 20°58'01.2"S, 54°34'58.8"E, west of Reunion, 180 m, Jun. 1966. MNHN 1966-0731 (1, 134.6), 20°45'S, 53°15'E, northwest of Reunion, 80 m, 1964. **Madagascar (1)**: MNHN 1996-0968 (1, 141.6), 23°19'58.8"S, 43°34'01.2"E, off Tulear, 300 m, 17 Mar. 1969.

Diagnosis. A species of *Monocentris* differing from its congeners in having following combination of characters: LLS 13–17; LLB1 11–14, modally 11–12; LLB3 8; total gill rakers 16–20; scales between LLB4 and AS small, its posterior tip not reaching second postpelvic scute; vomer without teeth; and mouth large, reaching vertical through posterior margin of eye.

Description. Meristic and morphometric values are provided in Tables 2 and 3. Data below are for the neotype, followed by range in other specimens in parentheses, except where indicated.

Dorsal-fin rays V, i+10=11 (V–VII, i–ii+9–11=10–12); anal-fin rays i+9=10 (i+8–10=9–11); principal caudal-fin rays 10+9=19 (9–10+8–9=17–19), uppermost and lowermost rays unbranched; procurrent caudal-fin rays 5 (3–5) dorsally and 4 (3–5) ventrally; pectoral-fin rays ii+12+0=14 (ii+9–12+0–ii=13–15); pelvic-fin rays I, 3; gill rakers 6+1+12=19 (5–7+1+10–13=16–20); LLA1 15/15 (13–17/13–16); LLA2 6/6 (2–6/2–6); LLS 15/14 (13–17/13–16); LLB1 12/12 (11–14/11–13); LLB2 8/8 (8–9/7–9); LLB3 8/8; LLB4 3 (prepelvic)+4 (postpelvic)/3+4; scales surrounding dorsal-fin base 23 (19–23); scales surrounding anal-fin base 6 (6–8); medium predorsal scales 3 (2–4, mode 3); abdominal scutes 2 (rudimentary)+3 (prepelvic)+4 (postpelvic) (rarely 2+3+5); vertebrae 12+14=26 (12+13–14=25–26, n=25); pyloric caeca 6–8 (based on NMMB-P36037, n=3); pseudobranchial filaments 19 (14–21, n=16); branchiostegal rays 8.

Body oblong, longer than deep, depth at dorsal-fin origin 1.9 (1.4–2.0) in SL. Head large, its length 2.3 (2.1–2.4) in SL, and subequal to its height, 1.0 (0.8–1.0) in HL; upper profile in front of dorsal fin roundly convex, with forehead region gently concave; forehead narrow, its width 4.1 (3.6–5.1) in HL; eyes moderately small, 3.9 (2.6–3.7) in HL; snout broadly rounded, extending clearly before maxilla, its length 3.3 (3.2–4.0) or 3.6 (3.5–4.8) in HL; space between eyes convex and broad, interorbital width 2.5 (3.3–3.7) in HL; crests on head bones well-developed, connected by thin membranes with numerous tiny pores.

Mouth large, posterior end of maxilla (lower corner) extending clearly beyond vertical thorugh posterior margin of eye. Nostrils nearly connected to each other but separated by narrow membranes, both immediately in front of anterior margin of eye and above horizontal through of eye; posterior nostril much larger than anterior one. Long groove extending from symphysis of premaxillae to tip of snout. Small blunt dentigerous knob at each side of symphysis of dentaries, with a concavity right behind the knob where the light organ is housed. Supramaxilla elongate, rectangular posteriorly, covering most of posterior portion of maxilla with long needle-like process at anterodorsal corner; posteroventral corner of maxilla exposed.

Most portions of lateral and medial surfaces of premaxilla covered with villiform teeth; anterior third and inner portion of posterior two-thirds of dentary covered with villiform teeth, a long fleshy patch of papillae on outer portion of dentary; symphyseal notch of premaxilla naked and knob at symphysis of dentaries with villiform teeth. Palatine with narrow band of teeth; vomer toothless. Gill rakers rod-shaped, somewhat laterally compressed, with villiform teeth on their tips and inner surfaces; those in outer row of first arch longest; rakers on inner row of first arch and both inner and outer rows of second to third arches short; small tooth patches forming bumps, present on midline of all four outer arches. Villiform teeth present on fifth ceratobranchial. Small villiform tooth patch on second pharyngeal arch forming oval patch. Large teardrop-like tooth patch on third pharyngeal arch.

Body covered with enlarged firmly-attached bony scales, scales slightly overlapping; spines on anterior scales rudimentary, and eventually developed as central spine pointing backward; pectoral-fin base covered with 3 rows of cycloid scales; caudal-fin base covered with several small scales with a central spine; abdominal margin with single row of serrated scutes, the last forming a strong posterior spine; 2 scales present between LLB4 and AS on inner surface of pelvic-fin base (Fig. 5A), second scale large, reaching anterior margin of second post-pelvic scute; isthmus with 1 or 2 enlarged scales; gular region naked, without scales.

Dorsal-fin spines thickened, second spine longest, and subsequent spines progressively shorter; first four spines connected with membranes at base, and alternating side to side; bases of spinous dorsal fin concave, forming groove to receive spines; outer margin of soft rays rounded. Pectoral fin short, 1.5 (1.4–1.7) in HL, its tip reaching lateral line, but not reaching vertical through anal-fin origin. Pelvic-fin spine enlarged, its length 1.3 (1.0–1.8) in HL; abdominal scutes and LLB4 forming a large groove to receive pelvic spine. Caudal-fin margin slightly concave, tips rounded. Pyloric caeca pale, unbranched.

TABLE 2. Meristic characters of *Monocentris chrysadamas* **sp. nov.** and *M. japonica.* Values presented as left/right when available. Abbreviations: NT, Non-type; PT, Paratype.

	M. chrysadamas **sp. nov.**		*M. japonica*	
	Holotype	PT+NT (n=23)	Neotype	NT (n=24)
Dorsal-fin elements	VI, i+9=10	V–VII, i–ii+8–10=10–12	V, i+10=11	V–VII, i–ii+9–11=10–12
Pectoral-fin elements	ii+11+i=14	ii+10–12+0–i=13–15	ii+12+0=14	ii+9–12+0–ii=13–15
Anal-fin elements	i+9=10	i+9–10=10–11	i+9=10	i+8–10=9–11
Gill rakers	6+1+12=19	5–7+1+10–12=16–20	6+1+12=19	5–7+1+10–13=16–20
Pseudobranchial filaments	16	14–21 (n=16)	19	14–21 (n=17)
Pyloric caeca	8	7 (n=2)	N/A	6–8 (n=3)
Vertebrae	12+14	12+14	12+14	12+13–14
LLA1	14/13	12–15/12–15	15/15	13–17/13–16
LLA2	5/5	2–7/2–6	6/6	2–7/2–6
LLS	14/13	12–15/12–15	15/14	13–17/13–16
LLB1	10/10	9–12/9–11	12/12	11–14/11–13
LLB2	7/7	7–9/7–8	8/8	8–9/7–9
LLB3	7/6	6–7/6–7	8/8	8/8
LLB4	3+4/3+4	3+4/3+4	3+4/3+4	3+4/3+4
Predorsal scales	4	1–4	3	2–4
Scales surrounding dorsal-fin base	22	18–21	23	19–23
Scales surrounding anal-fin base	6	6–8	6	6–8

TABLE 3. Morphometric data for specimens of *Monocentris chrysadamas* **sp. nov.** and *M. japonica*. Abbreviations: A, Anal-fin; C, Caudal-fin; CPD, Caudal-peduncle; D, Dorsal-fin; NT, Non-type; P, Pectoral-fin; PT, Paratype; SD, Standard deviation; SNL, Snout length; V, Pelvic-fin.

	M. chrysadamas **sp. nov.**			*M. japonica*		
	Holotype	Selected PT+NT (n=23)		Neotype	NT (n=20)	
SL (mm)	115.5	97.2 (38.8–127.6)		138.8	93.9 (16.4–147.0)	
%SL		Mean (range)	SD		Mean (range)	SD
Head length	46.0	46.5 (43.8–50.1)	1.6	42.7	45.3 (41.2–48.6)	2.0
Head depth	47.7	49.3 (45.8–57.0)	2.8	42.0	47.8 (42.0–56.5)	3.7
Body depth	59.5	62.4 (57.9–71.3)	3.4	52.0	59.5 (50.9–69.5)	4.5
Body width	20.6	19.9 (17.9–21.4)	1.0	18.8	20.1 (16.7–23.1)	1.7
SNL 1	13.7	13.5 (12.0–15.5)	1.0	13.1	12.8 (10.8–15.3)	1.1
SNL 2	12.2	12.3 (11.3–13.3)	0.5	11.9	11.5 (9.4–12.9)	1.0
Eye diameter	13.4	13.7 (12.0–16.7)	1.2	11.0	14.1 (11.5–17.9)	1.9
Forehead height	10.6	11.3 (9.9–14.0)	1.1	10.3	11.0 (8.4–13.2)	1.3
Interorbital width	17.1	18.2 (16.9–21.2)	1.2	17.1	18.5 (14.0–24.8)	2.4
Suborbital width	10.6	10.8 (9.6–11.8)	0.6	10.1	10.0 (8.2–12.1)	0.9
Upper-jaw length	26.2	25.6 (23.2–29.0)	1.5	21.9	23.1 (18.3–27.8)	2.3
Lower-jaw length	26.3	25.2 (23.2–26.9)	1.0	22.2	24.0 (22.2–28.1)	1.8
Postorbital length	23.1	24.3 (22.6–26.1)	0.9	21.7	22.5 (20.7–24.2)	1.0
Predorsal length	55.2	58.1 (53.6–62.9)	2.5	49.3	54.9 (49.1–60.7)	3.5
Prepectoral length	43.7	43.9 (40.5–49.0)	2.2	43.1	43.4 (39.3–46.9)	2.0
Prepelvic length	53.1	52.5 (47.3–59.6)	2.9	50.7	52.5 (46.1–60.5)	3.5
Preanal length	83.8	83.3 (78.8–87.9)	2.2	84.4	84.4 (82.0–87.4)	1.5
D–P length	42.6	43.9 (40.6–50.7)	2.9	35.7	42.2 (35.8–53.1)	4.1
D–V length	59.6	61.9 (56.7–70.8)	4.3	50.8	58.3 (48.7–67.0)	4.4
P–V length	12.8	14.5 (12.7–18.0)	1.6	12.3	13.7 (11.7–17.2)	1.3
V–A length	39.6	38.8 (35.0–40.7)	1.6	38.5	39.3 (37.0–42.8)	1.8
D–A length	62.0	65.4 (61.1–72.2)	3.3	58.8	63.6 (67.7–57.8)	2.8
1st D spine	10.2	12.1 (5.9–17.5)	2.7	11.7	14.7 (8.1–21.7)	3.8
2nd D spine	N/A	31.5 (25.8–39.9)	3.5	N/A	27.5 (12.8–35.4)	6.2
3rd D spine	30.6	29.0 (22.7–39.7)	3.8	23.3	25.0 (12.5–33.5)	5.7
4th D spine	14.2	11.8 (5.8–22.1)	4.1	10.4	11.9 (6.9–22.1)	4.1
D length	47.1	48.8 (44.6–55.6)	2.5	48.1	49.4 (46.1–52.0)	1.7
D height	14.7	17.9 (10.5–25.4)	3.1	17.8	16.6 (14.2–20.1)	1.4
P length	29.1	31.0 (27.2–35.8)	2.3	27.7	29.1 (24.7–32.5)	2.0
V spine	34.0	35.4 (30.3–41.2)	2.8	33.2	35.7 (25.5–43.9)	4.1
A length	13.7	15.4 (12.8–21.1)	1.8	13.3	14.5 (12.6–16.1)	1.1
A height	18.2	19.0 (16.0–22.9)	1.8	14.9	18.1 (14.2–21.2)	1.6
CPD height	10.5	11.0 (9.9–16.6)	1.3	10.0	10.9 (9.4–19.3)	2.1
CPD length	14.7	15.6 (13.1–20.9)	1.9	15.3	14.2 (11.5–17.2)	1.4
C length	25.6	26.6 (23.7–32.8)	2.7	24.3	27.6 (24.1–30.4)	1.7

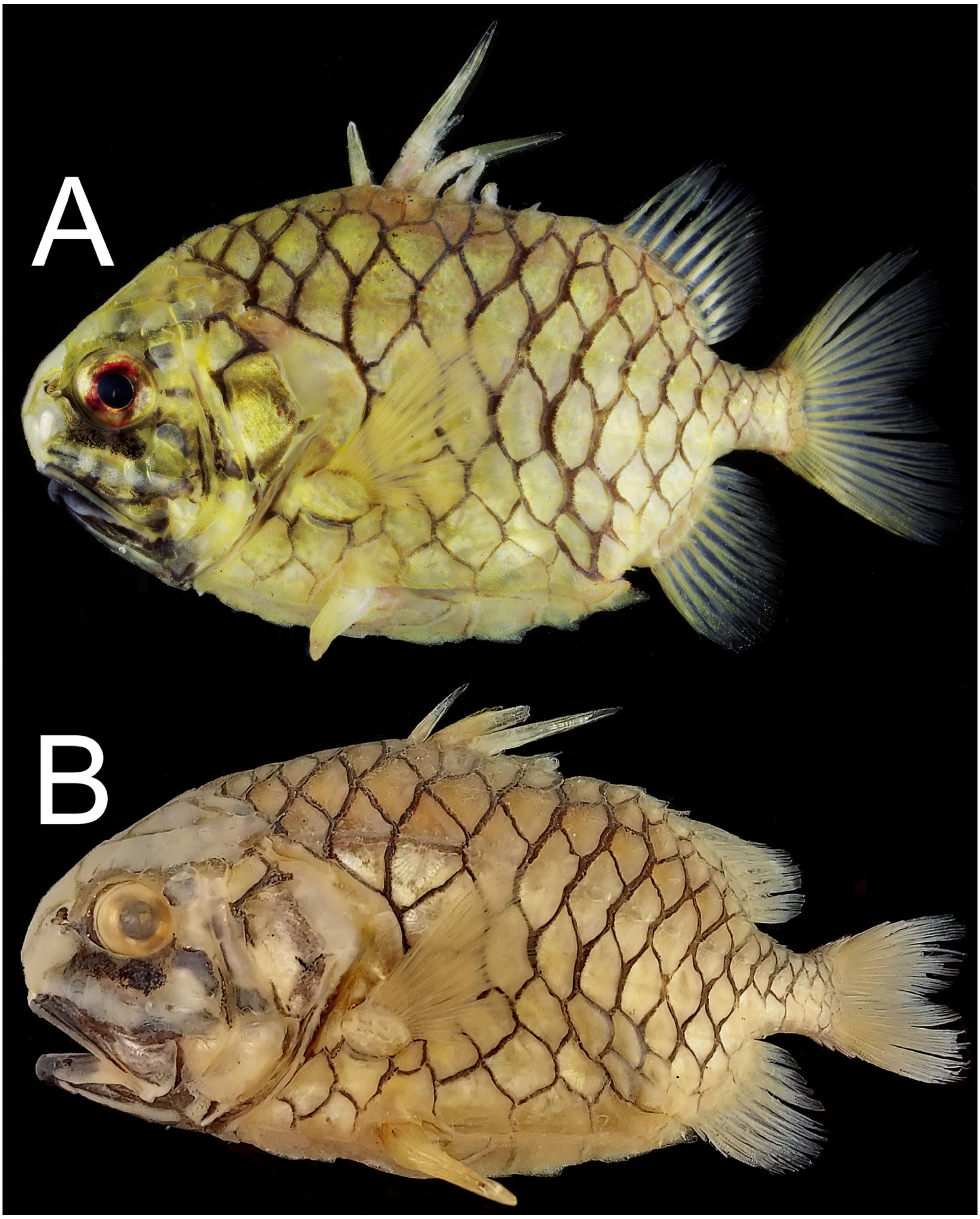

FIGURE 3. *Monocentris japonica* (Houttuyn, 1782). A. KAUM–I.73146, non-type, 130.4 mm SL, fresh, photo by KAUM. B. KAUM–I.73145, neotype, 138.8 mm SL, preserved.

Size. Moderately small species, the largest specimen examined by us is 147.0 mm SL; reported up to 170 mm SL in Australia (Sainsbury *et al.* 1985).

Coloration. When fresh, body yellowish, body scales with distinct black margin (Figs. 3A, 4). Mouth cavity, including underside of the tongue, peritoneum, and stomach whitish. Vomer, palatine, outer margin of premaxilla, and dentary black. Preserved specimens with a darker yellowish body (Fig. 3B). In some moderately large individuals, the body is darker than normal (NMMB-P36197, 94.2–101.8 mm SL, Fig. 4B), but never found in larger individuals.

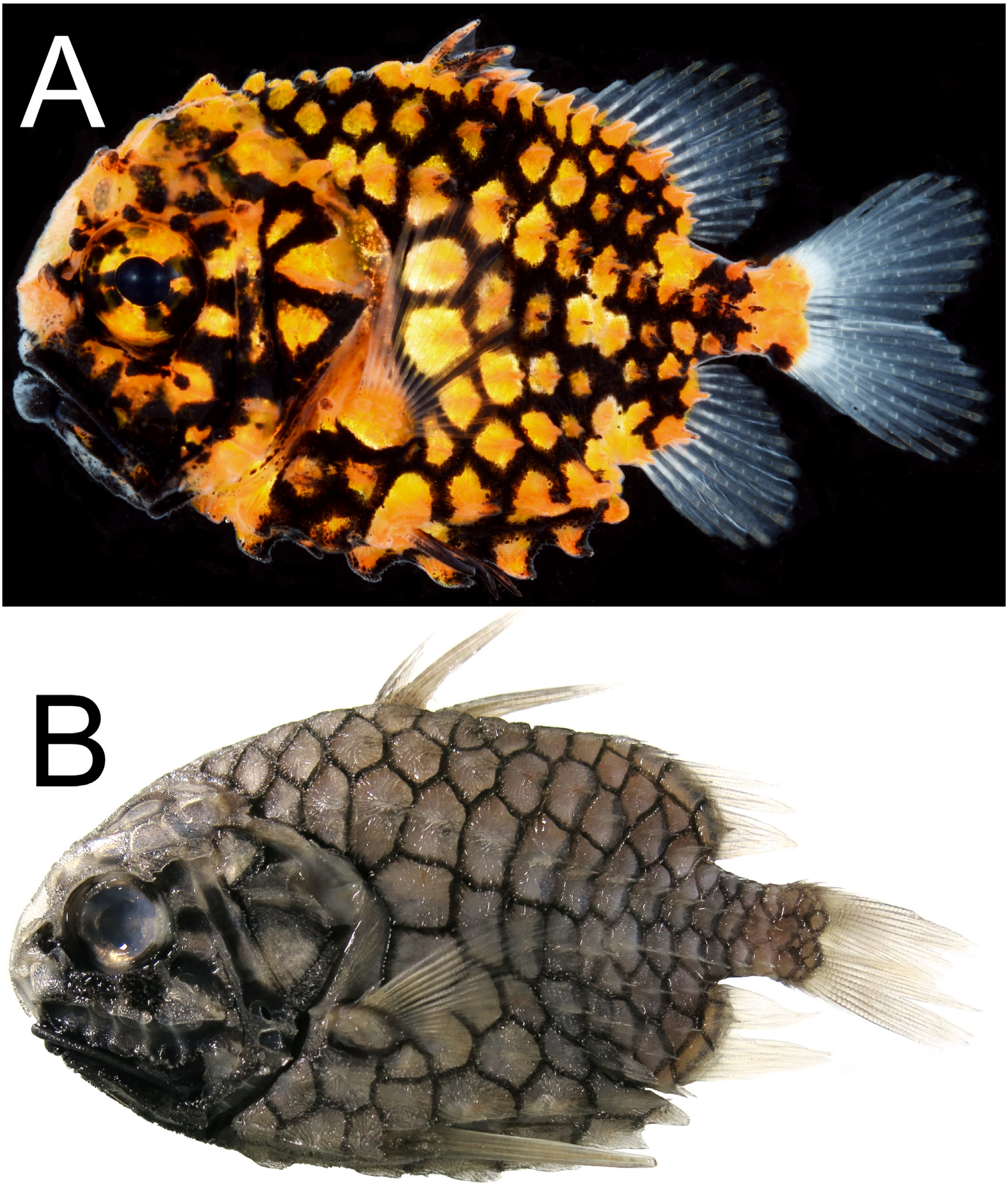

FIGURE 4. *Monocentris japonica* (Houttuyn, 1782). A. KAUM–I.149072, 16.4 mm SL, juvenile, fresh, photo by KAUM. B. NMMB-36197, 1 of 3, 96.5 mm SL, a black individual, previously frozen.

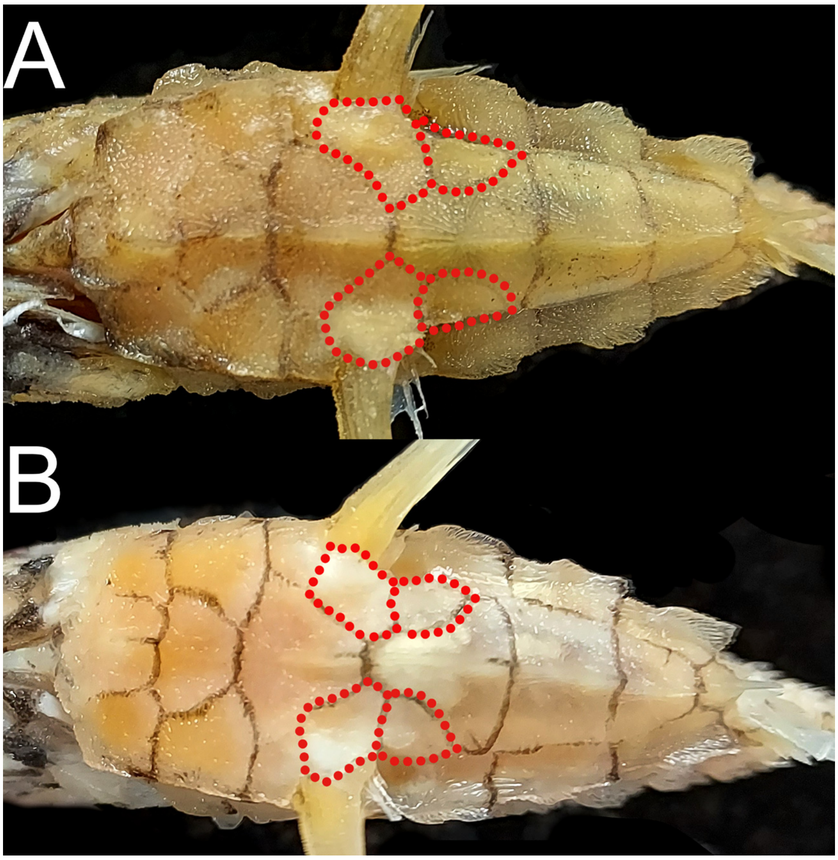

FIGURE 5. Ventral view of *Monocentris* species showing scales between AS and LLB4 (outlined by red dots). A. *M. japonica*, KAUM–I.71509, non-type, 99.8 mm SL, preserved. B. *M. chrysadamas* **sp. nov.**, DOS 08609, paratype, 82.1 mm SL, preserved. Anterior to left.

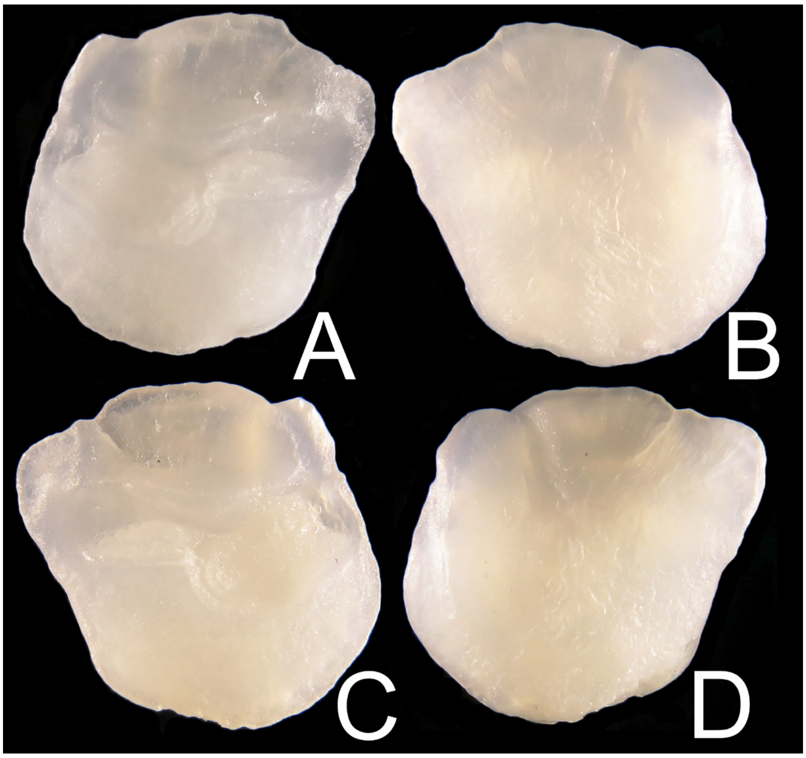

FIGURE 6. Sagittal otoliths taken from *Monocentris japonica*, NMMB-P36199, non-type, 117.0 mm SL. Showing outer (A, C) and inner face (B, D). A–B. right-side otolith, 9.8 mm otolith length. C–D. left-side otolith, 9.7 mm otolith length.

Otolith morphology. Two sagittal otoliths taken from NMMB-P36199 (117.0 mm SL) measured 9.7 and 9.8 mm in length (Fig. 6). Otolith square to rhomboidal, 8.3–8.4 % SL, length/depth ratio 1.15. Dorsal margin irregular crenate, roughly divided into 3 lobes; ventral margin smoothly curved; posterior margin entire, slightly convex, no pseudo-excisura or pseudo-rostrum; distal surface flat to slightly convex with some shallow grooves associated with the lobes on dorsal margin; proximal surface slightly concave; sulcus groove deep and wide, heterosulcoid, ostium clearly larger and wider than cauda, ostium not open anteriorly; colliculum heteromorph; crista superior well-developed to ridge-like, crista inferior not developed; rostrum steep, its margin nearly straight; antirostrum poorly developed; no notch on excisura; dorsal depression deep and broad, extending from antirostrum nearly to posterior end of cauda; ventral depression absent.

Distribution. Widely distributed in the Indo-West Pacific, including Japan, Taiwan, China, New Caledonia (including Chesterfield Islands), Australia, Red Sea, Reunion, Madagascar, and South Africa. Inhabits from shallow waters to ca. 300 m depth. Records from New Zealand belong to a distinct species (Su *et al.* in preparation).

Monocentris chrysadamas **sp. nov.**

urn:lsid:zoobank.org:act:8F8CEFC7-19C2-44BD-9019-5437BE7AF6F2
New English name: Golden-diamond pineapple fish
New Chinese name: 金鑽鳳梨魚
Figs. 2, 5B, 7–10, 12B, 13–14. Tables 2–4

Monocentris japonica (non Houttuyn): Fourmanoir 1981:91; Kweon in Kim & Nakaya 2013:68.
Monocentris japonicus (non Houttuyn): Shimizu in Masuda *et al.* 1984:109; Okamura & Amaoka 1997:158; Shao *et al.* 2013:41; Koeda in Koeda & Ho 2019:442

Holotype. NMMB-P36126 (115.5 mm SL), off Dong-gang (ca. 22°22'22"N, 120°27'34"E), Pingtung, southwestern Taiwan, northern South China Sea, 20 Oct. 2021, bottom trawl, collected by Y. Su and S.-C. Chung. *COI*: ON025560.

Paratypes. Twenty-five specimens, 38.8–127.6 mm SL. **Taiwan (18):** AIM MA73643 (2 specimens, 90.5–105.4) and FMNH 146587 (2, 89.2–111.8), out of NMMB-P22837. DOS 08609 (1, 82.1), off Ke-Tzu-Liao, 25 Aug. 2021, bottom trawl, coll. Y. Su, N.-S. Leung, and S.-L. Ng, *COI*: ON025564. KAUM–I.111010 (1, 115.9), off Dong-gang, 27 Nov. 2017, bottom trawl, coll. K. Koeda, S. Tashiro and S. Morishita, *COI*: ON025565. NMMB-P20499 (1, 118.3), off Dong-gang fishing port, Pingtung, southwestern Taiwan, 21 Mar. 2013, bottom trawl, coll. H.-C. Ho. NMMB-P22837 (2, 87.6–87.9), off Ke-Tzu-Liao (ca. 22°42'53"N, 120°13'12"E), Kaohsiung, southwestern Taiwan, 11 Feb. 2015, bottom trawl, coll. H.-C. Ho. NMMB-P24006 (1, 38.8), off Ke-Tzu-Liao, Kaohsiung, southwestern Taiwan, 12 Mar. 2015, bottom trawl, coll. H.-C. Ho. NMMB-P27579 (1, 49.1), off Ke-Tzu-Liao, bottom trawl, 6 Apr. 2017, coll. H.-C. Ho. NMMB-P 30666 (1, 114.0), off Dong-gang, 25 Oct. 2018, bottom trawl, coll. K. Koeda and M.-Y. Lee. NMMB-P31576 (1, 96.3), off Dong-gang, 21 Mar. 2018, bottom trawl, coll. H.-C. Ho. NMMB-P36127 (1, 110.7), off Dong-gang, 17 Sep. 2021, bottom trawl, coll. S.-L. Ng, *COI*: ON025561. NMMB-P 36128 (1, 100.9), off Dong-gang, 29 Oct. 2021, bottom trawl, coll. S.-L. Ng. NMMB-P36129 (1, 43.5), off Ke-Tzu-Liao, 1 May 2021, bottom trawl, coll. Y. Su, *COI*: ON025562. NMMB-P36131 (1, 86.0), off Ke-Tzu-Liao, 17 Feb. 2022, bottom trawl, coll. Y.-C. Chen. NMMB-P 36136 (1, 103.9), dried specimen, off Ke-Tzu-Liao, coll. H.-C. Ho. **Vanuatu (4):** MNHN 2010-0778 (1, 127.6), MNHN 2010-0779 (1, 120.9), MNHN 2010-0781 (1, 123.3), MNHN 2010-0782 (1, 116.9), 15°33'46.8"S, 167°18'54.0"E, Tutuba, 330–341 m, 30 Sep. 2006. **Solomon Islands (1):** MNHN 2014-0261 (1, 108.2), 10°25'60.0"S, 161°24'00.0"E, San Cristobal, 190–232 m, 23 Sep. 2007. **Australia (2):** AMS I.25805-009 (1, 116.7), R/V Soela, st. SO1/86/11, north of Townsville, Queensland, 18°00'00.0"S 147°04'00.0"E, 260–264 m, 10 Jan. 1986. CSIRO H 3642-14 (1, 107 mm SL), east of Rockingham Bay, Queensland, 18°03'24.0"S, 147°04'48.0"E, 30 Nov. 1993, coll, G. Yearsley.

Non-types. Eighty specimens, 37.1–123.3 mm SL. **Taiwan (68):** NMMB-P08072 (1, 50.7), off Dong-gang, Pingtung, southwestern Taiwan, 16 Jun. 2016, bottom trawl, coll. Y.-M. Ju. NMMB-P08360 (1, 96.5), off Dong-gang, 16 Mar. 2005, coll. Y.-M. Ju. NMMB-P11962 (1, 82.6), off Dong-gang, 26 Feb. 2011, bottom trawl, coll. H.-C. Ho. NMMB-P15423 (1, 91.0), no other data. NMMB-P21017 (1, 103.8), off Dong-gang, 12 Mar. 2014, bottom trawl, coll. H.-C. Ho. NMMB-P24444 (1, 81.5), off Ke-Tzu-Liao, Kaohsiung, southwestern Taiwan, 19 Mar. 2016, bottom trawl, coll. H.-C. Ho. NMMB-P21995 (1, 63.3), off Dong-gang, 25 Sep. 2013, bottom trawl, coll. H.-C. Ho. NMMB-P22427 (1, 103.2), off Dong-gang, 17 Feb. 2015, bottom trawl, coll. H.-C. Ho. NMMB-P28218 (1, 102.6),

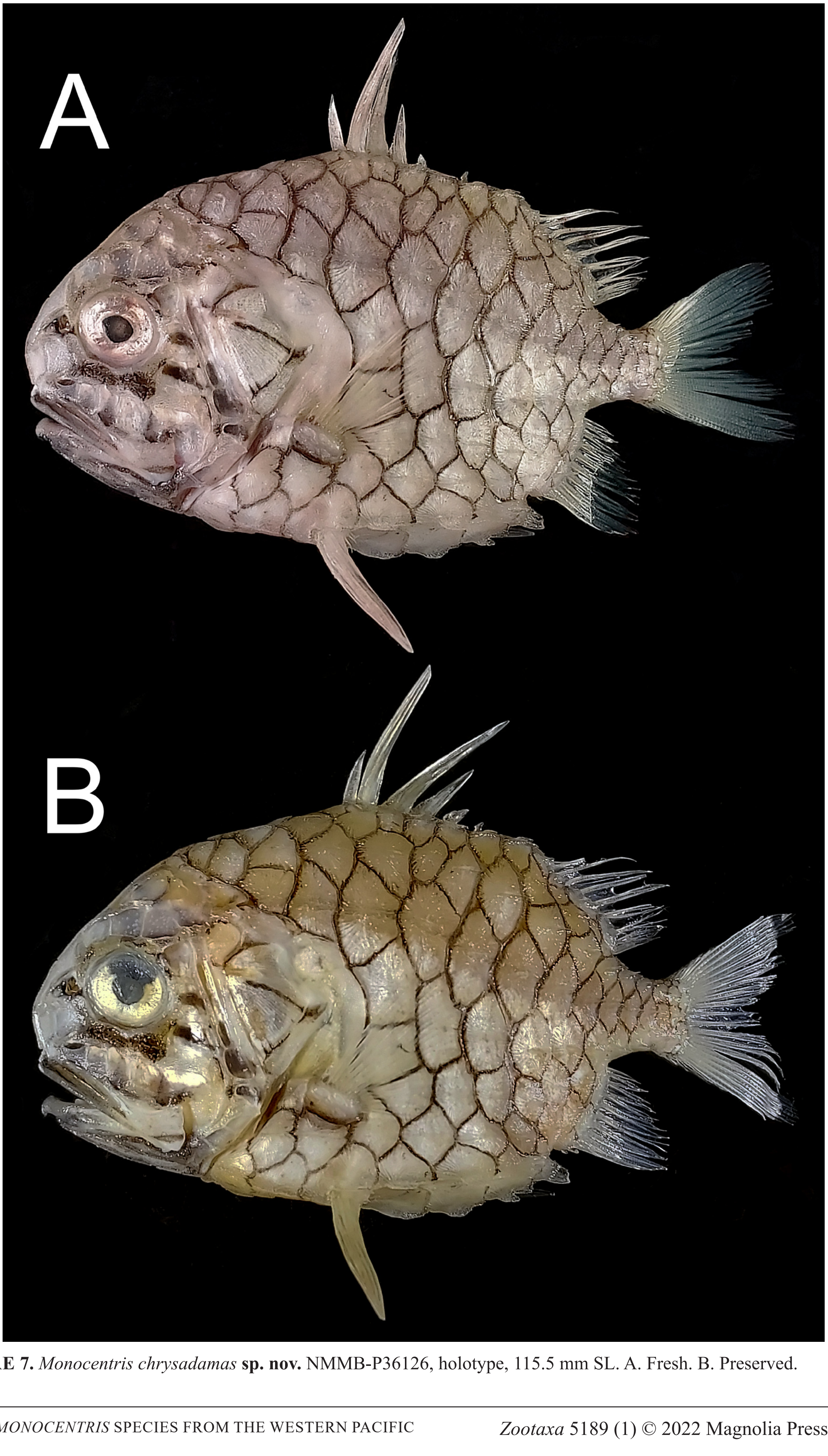

FIGURE 7. *Monocentris chrysadamas* **sp. nov.** NMMB-P36126, holotype, 115.5 mm SL. A. Fresh. B. Preserved.

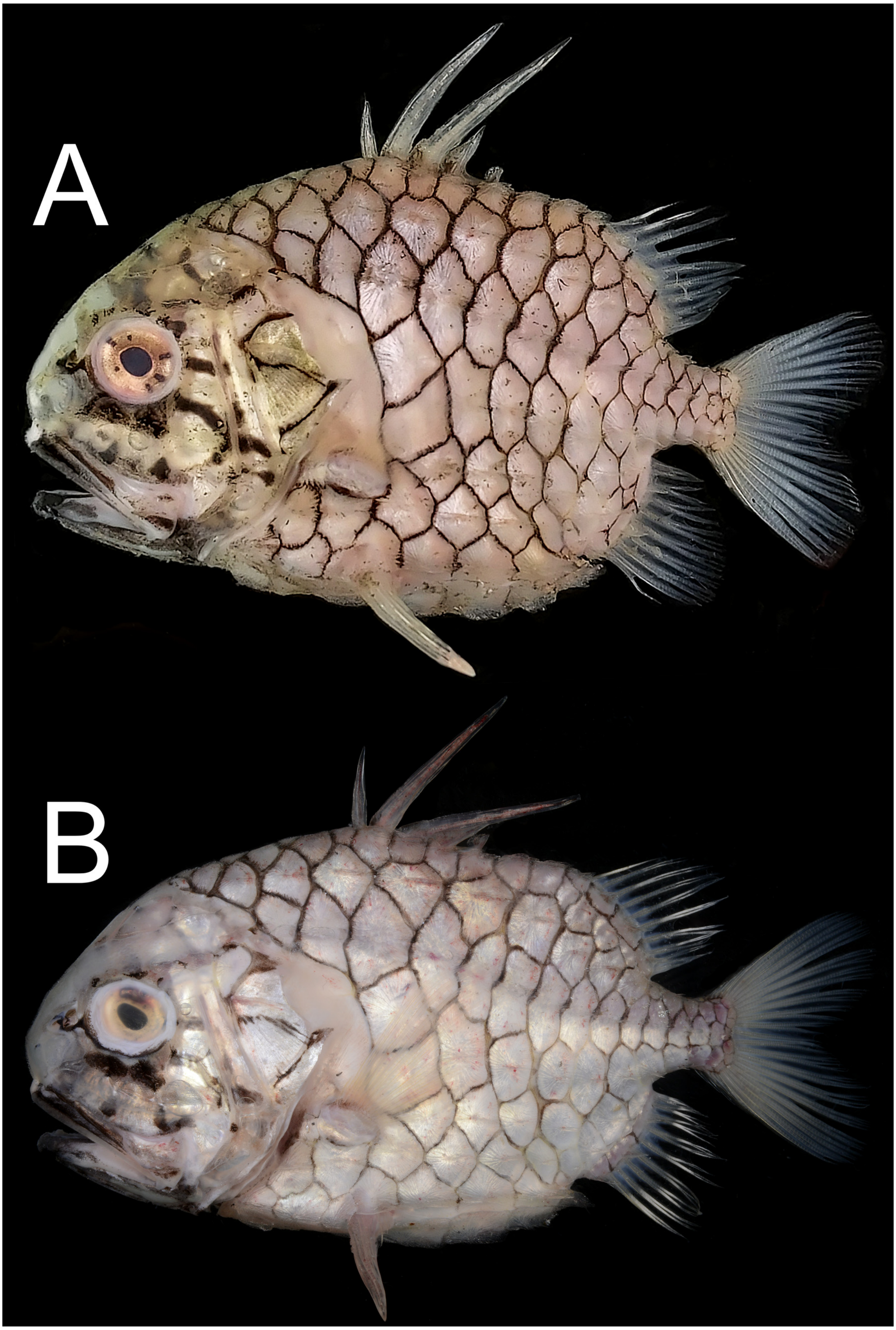

FIGURE 8. *Monocentris chrysadamas* **sp. nov.** A. NMMB-P36131, paratype, 86.0 mm SL. B. KAUM–I.111010, paratype, 115.9 mm SL, fresh, photo by KAUM.

off Dong-gang, 13 Oct. 2017, bottom trawl, coll. H.-C. Ho. NMMB-P32733 (1, 110.5), off Dong-gang, 18 Aug. 2010, bottom trawl, coll. C.-W. Chang. NMMB-P33032 (9, 88.0–114.0), off Dong-gang, 19 Jul. 2019, bottom trawl, coll. H.-C. Ho. NMMB-P34253 (1, 55.9), off Dong-gang, 15 May 2020, bottom trawl, coll. H.-C. Ho. NMMB-P36137 (1, 74.6), dried specimen, collected with NMMB-P36136. NMMB-P36200 (30, 81.0–108.3), NMMB-P36201 (17, 79.0–118.0), off Tainan, western Taiwan, 150–200 m. **Australia (12):** AMS I.25805-009 (6, 97.2–117.2), R/V Soela, st. SO1/86/04, north of Townsville, Queensland, 18°00'S, 147°02'E, 220 m, 9 Jan. 1986. CSIRO H 592-16 (1, 109.6), FRV Soela, sta. SO06/84/43, south of Flinder's Reefs. Queensland, 17°57'S, 146°58'E, 212 m, 29 Nov. 1985. CSIRO CA 1415 (1, 122.2), FRV Soela, sta. SO04/80/59, south of Clarke Reef, Western Australia, 18°07'S, 119°21'E~18°08'S, 119°22'E, 160–175 m, 12 Jun 1980. CSIRO H 3642-22 (1, 108.1) and CSIRO H 3643-24 (1, 114.8), FRV Southern Surveyor, sta. SS0793/T1, east of Rockingham Bay, Queensland, 18°03.4'S, 147°04.8'E–18°00.5'S, 147°00.9'E, 205–214 m, demersal trawl, 30 Nov. 1993. CSIRO H 5635-21 (1, 118.4) and CSIRO H 5635-22 (1, 121.0), east of Rockingham Bay, Queensland, 17°36'S, 146°48'E–18°08'S, 147°09'E, demersal trawl, 223–248 m, 21 Aug 2000.

Possible hybrid individuals. Six specimens, all collected around Taiwan. NMMB-P33032, 1 of 10, off Dong-gang, 19 Jul. 2019, coll. H.-C. Ho. NMMB-P36138 (1, 65.9), collected with NMMB-P36136. NMMB-P36130 (1, 80.7), collected with NMMB-P36037, *COI*: ON025563. NMMB-P36202 (3, 98.5–124.7), ca. 23°00'56.4"N, 119°56'02.2"E, off Tainan, 150–200 m, 2021.

Etymology. The specific name *chrysadamas*, treated as a noun in apposition, is a combination of Greek "chrys" and "adamas", meaning "golden" and "diamond", in reference to its yellowish body color when alive and diamond-shaped body scales. Moreover, the meaning of these two words in Chinese also refers to a famous agricultural variety of pineapple in Taiwan, which this new pineapple fish resembles.

Diagnosis. A species of *Monocentris* differing from its congeners in having following combination of characters: LLS 12–15; LLB1 10–11, modally 10; LLB3 6–7; total gill rakers 16–20; scales between LLB4 and AS small, its posterior tip not reaching second postpelvic scute; vomer without teeth; and mouth large, reaching a vertical through posterior margin of eye.

Description. Meristic and morphometric values are provided in Tables 2 and 3. Data below are for the holotype, followed by the range for selected paratypes and non-types in parentheses, except where indicated.

Dorsal-fin rays VI, i+9=10 (V–VII, i–ii+8–10=10–12); anal-fin rays i+9=10 (i+9–10=10–11); principal caudal-fin rays 10+9=19 (9–10+9=18–19), uppermost and lowermost rays unbranched; procurrent caudal-fin rays 5 (4–5) dorsally and 4 ventrally; pectoral-fin rays ii+11+i=14 (ii+10–12+0–i=13–15); pelvic-fin rays I, 3; developed gill rakers 6+1+12=19 (5–7+1+10–12=16–20); LLA1 14/13 (12–15/12–15); LLA2 5/5 (2–7/2–6); LLS 14/13 (12–15/12–15); LLB1 10/10 (9–12/9–11, mode 10/10); LLB2 7/7 (7–9/7–8); LLB3 7/6 (6–7/6–7); LLB4 3 (prepelvic)+4 (postpelvic)/3+4; scales surrounding dorsal-fin base 22 (18–21); scales surrounding anal-fin base 6 (6–8); medium predorsal scales 4 (1–4, mode 3); abdominal scutes 2 (rudimentary)+3 (prepelvic)+4 (postpelvic) (rarely 2+2+4); vertebrae 12+14=26; pyloric caeca 8 (7, n=2); pseudobranchial filaments 16 (14–21); branchiostegal rays 8.

Body oblong, longer than deep, depth at dorsal-fin origin 1.7 (1.4–1.7) in SL. Head large, its length 2.2 (2.0–2.3) in SL, and subequal to its height, 1.0 (0.9–1.0) in HL; upper profile in front of dorsal fin slightly rounded, with forehead region gently concave; forehead narrow, its width 4.3 (3.6–4.6) in HL; eyes moderately small, 3.4 (2.8–3.2) in HL; snout broadly rounded, extending clearly before maxilla, its length 3.4 (2.9–3.9) or 3.8 (3.3–4.1) in HL; space between eyes convex and broad, interorbital width 2.7 (2.4–2.8) in HL; crests on head bones well-developed, connected by thin membranes with numerous tiny pores.

Mouth large, posterior end of maxilla (lower corner) extending clearly beyond vertical through posterior margin of eye. Nostrils nearly connected but separated by narrow membranes, both immediately in front of anterior margin of eye and above horizontal thorugh center of eye; posterior nostril much larger than anterior one. Long groove extending from symphysis of premaxillae to tip of snout. Small blunt dentigerous knob at each side of symphysis of dentaries, with concavity right behind the knob where the light organ is housed. Supramaxilla elongate, rectangular posteriorly, covering most of posterior portion of maxilla with long needle-like process at anterodorsal corner; posteroventral corner of maxilla exposed.

Most of lateral and medial surfaces of premaxilla and covered with villiform teeth; anterior third and inner portion of posterior two-thirds of dentary covered with villiform teeth, a long fleshy patch of papillae on outer portion of dentary; symphyseal notch of premaxilla and knob at symphysis of dentaries naked. Palatine with narrow band of teeth; vomer toothless. Gill rakers rod-shaped, somewhat laterally compressed, with villiform teeth on their tips and inner surfaces; those in outer row of first arch longest; rakers on inner row of first arch and both inner and outer rows of second to third arches short; small tooth patches forming bumps, present on midline of all four outer arches. Villiform teeth present on fifth ceratobranchial. Small villiform tooth patch on second pharyngeal arch forming oval patch. Large teardrop-like tooth patch on third pharyngeal arch.

Body scales enlarged and firmly attached to each other and slightly overlapped; spines on anterior scales rudimentary, and eventually developed as central spine pointing backward on posterior portion; pectoral-fin base covered with 3 rows of small cycloid scales; caudal-fin base covered with several small scales, each with a central spine; abdominal margin covered with single row of serrated scutes, the last forming a strong posterior spine; 2 small scales present between LLB4 and AS, posterior tip of second scale not reaching second postpelvic scute (Fig. 4B); isthmus with 1 or 2 enlarged scales; gular region naked, without scales.

Dorsal-fin spines thickened, second spine longest, and subsequent spines progressively shorter; first four spines connected by membranes at base and alternating side to side; base of spinous dorsal fin concave, forming a groove to house the spines; outer margin of soft dorsal fin rounded. Pectoral fin short, 1.6 (1.3–1.7) in HL, its tip reaching lateral line, but not reaching vertical through anal-fin origin. Pelvic-fin spine enlarged, its length 1.4 (1.1–1.6) in HL; abdominal scutes and LLB4 forming a large groove to receive pelvic-fin spine. Caudal-fin margin slightly concave, its lobes rounded. Pyloric caeca pale, unbranched.

Size. Moderately small species. The largest specimen examined was 127.6 mm SL, a female with well-developed eggs, implying it is a moderately small species and smaller than *M. japonica*.

Coloration. When fresh (Figs. 7A, 8), body slightly yellowish. Underwater photo in Okamura & Amaoka (1997) shows a more bright-yellow body color, implying it has a bright-yellowish color when alive. Scales with black margin. Oral cavity, including underside of the tongue, peritoneum, and stomach whitish. Vomer, palatine, outer margin of premaxilla, and dentary black. When preserved, coloration similar to fresh but paler in appearance.

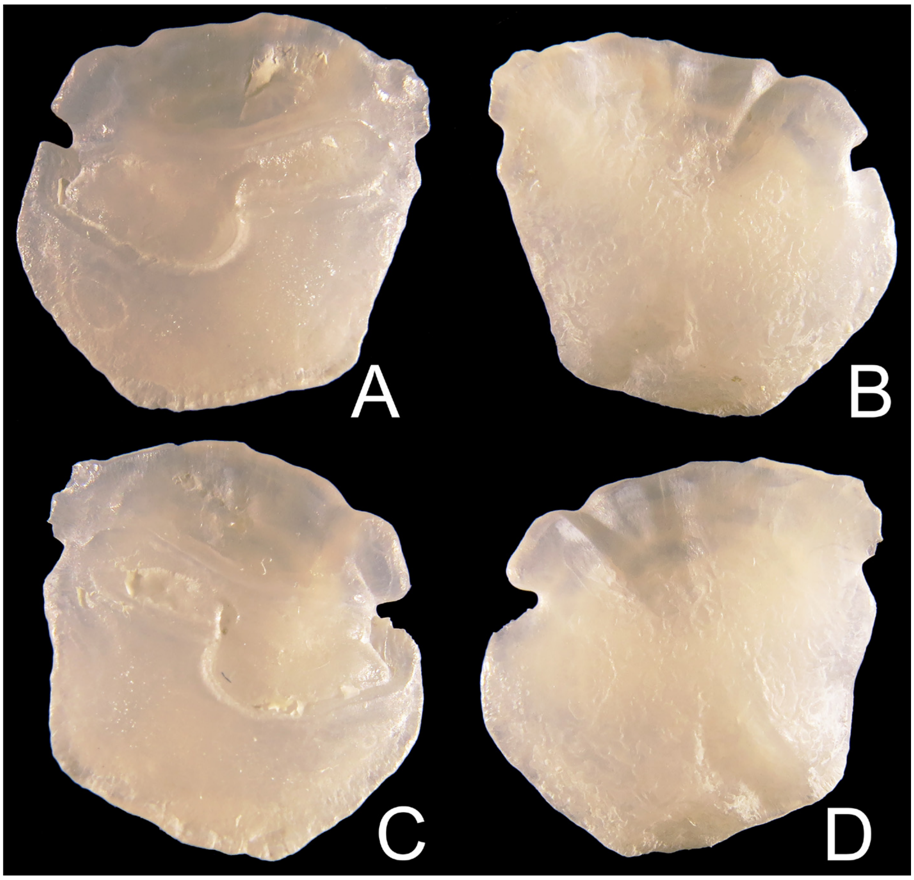

FIGURE 9. Sagittal otoliths taken from *Monocentris chrysadamas* **sp. nov.**, NMMB-P36200, 1 of 30, non-type, 105.0 mm SL. Showing outer (A, C) and inner face (B, D). A–B. right side, 10.0 mm otolith length. C–D. left side, 9.9 mm otolith length

Otolith morphology. Two sagittal otoliths were taken from NMMB-P36200 (105.0 mm SL), 9.9 and 10.0 mm in length (Fig. 9). Otolith square to rhomboidal, 9.4–9.5 % SL, length/depth ratio 1.14–1.17. Dorsal margin irregular crenate, divided into indistinct lobes; ventral margin convex, nearly straight; posterior margin entire, slightly convex and wave-like with a small pseudo-excisura and a blunt pseudo-rostrum; distal surface slightly depressed dorsally with some shallow grooves associated with the lobes on dorsal margin and convex ventrally with rough surface; proximal surface slightly concave; sulcus groove deep and wide, heterosulcoid, ostium clearly larger and wider than cauda, ostium opens anteriorly to excisura; colliculum heteromorph; crista superior well-developed to ridge-like, crista inferior not developed; rostrum convex; antirostrum small, blunt; a clear notch on excisura; dorsal depression deep and broad, extending from antirostrum to nearly posterior end of cauda; ventral depression absent.

Distribution. Records from literature and this study suggest a wide distribution in the western Pacific, including Taiwan (Shao *et al.* 2013; Koeda & Ho 2019; this study), Korea (Kim & Nakaya 2013), Japan (Shimizu in Masuda *et al.* 1984; Okamura & Amaoka 1997), the Philippines (Fourmanoir 1981), Vanuatu (this study), the Solomon Islands (this study), and Western Australia and Queensland, Australia (this study). Records from Vanuatu imply it may inhabit depths to 341 m, slightly deeper than that of *M. japonica*.

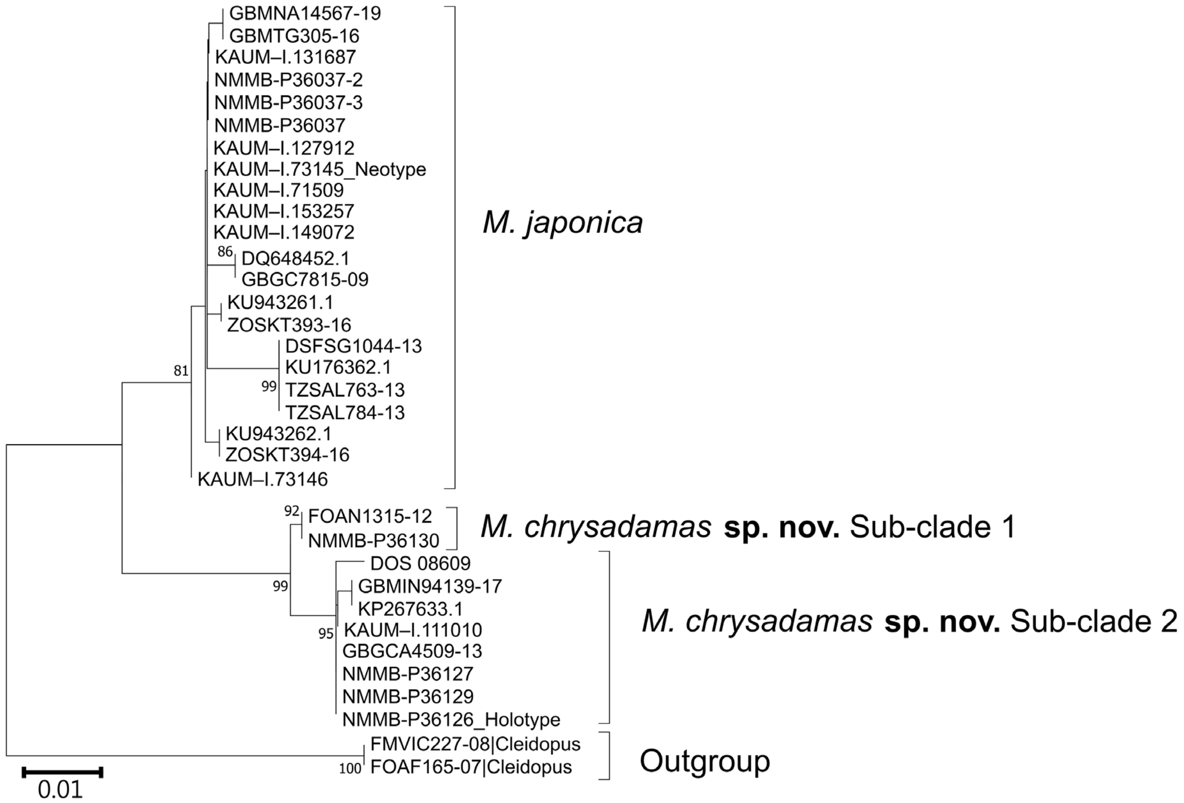

FIGURE 10. Maximum-likelihood tree based on COI sequences of *Monocentris* spp. generated by Kimura-2-parameter model (Kimura, 1980) with 1000 bootstrap pseudoreplicates, with *Cleidopus gloriamaris* chosen as the outgroup. Numbers beside each node represent bootstrap values, with values <75% omitted. Scale bar on bottom-left corner denotes the number of substitutions per unit length on tree.

TABLE 4. Average pairwise genetic distance of COI sequences calculated by K2P model (Kimura 1980). Values are percent (%). Number in first row corresponds to that of group name in first column.

	n	1	2	3	4
1. *M. japonica*	22	0.713	3.207	3.667	3.566
2. *M. chrysadamas* Sub-clade 1	2	-	0.000	0.835	0.779
3. *M. chrysadamas* Sub-clade 2	8	-	-	0.190	0.436
4. All *M. chrysadamas*	10	-	-	-	0.424

Genetic analysis. The maximum-likelihood tree strongly supports the monophyly of both *M. chrysadamas* **sp. nov.** and *M. japonica* at species-level distinction, with a 99% and 81% bootstrap value, respectively (Fig. 10). Although *M. chrysadamas* possesses two sub-clades on the tree, the genetic distance calculated by K2P model shows only a 0.835% difference among these two sub-clades, which is much lower than expected species-level differences (Table 4). Overall, *M. chrysadamas* has a genetic distance of 3.566% with *M. japonica*, with an intraspecific distance of 0.424%.

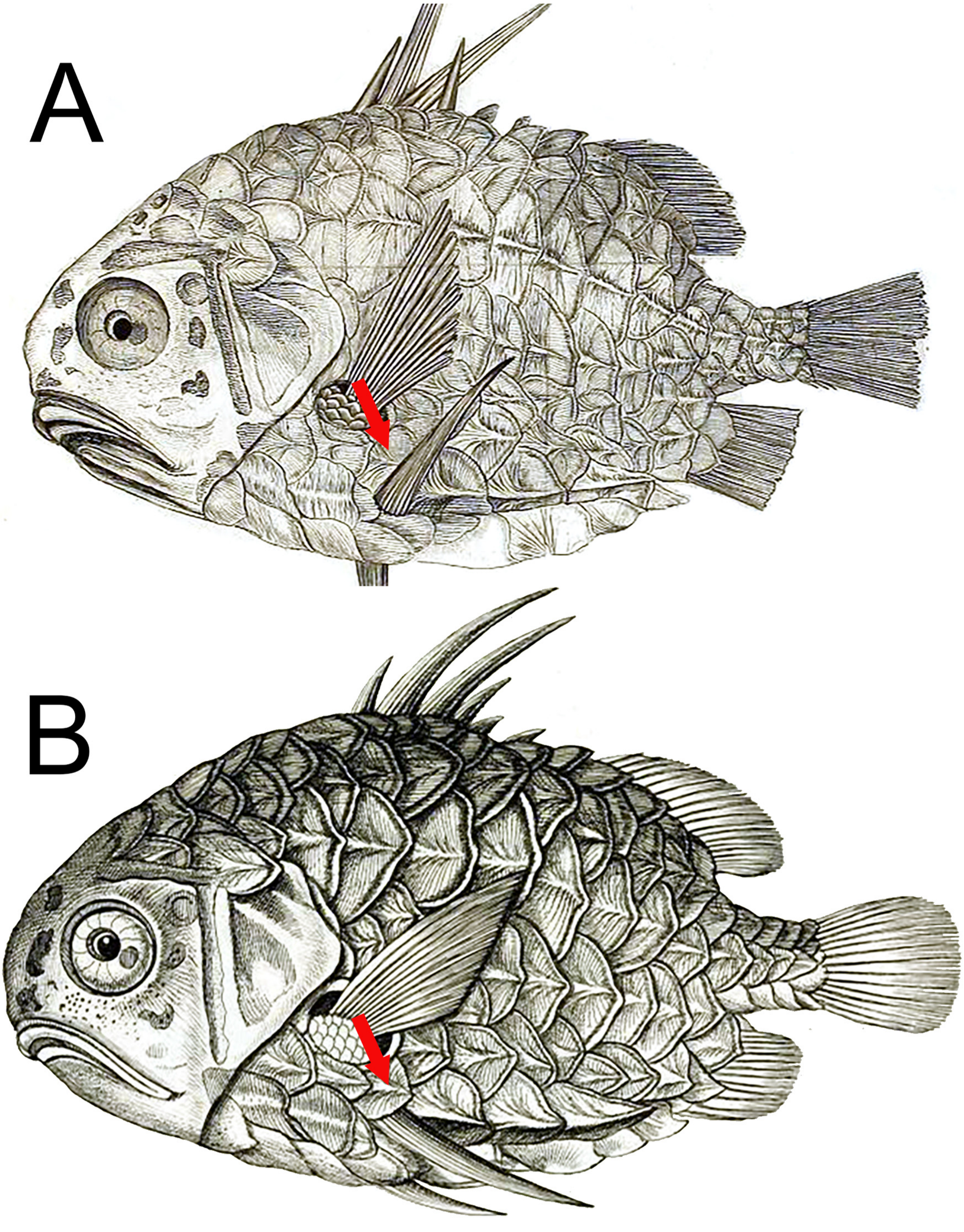

FIGURE 11. Original drawings of junior synonyms of *Monocentris japonica*. A. *Sciaena cataphracta*, reproduced from Thunberg (1790). B. *Monocentris carinata*, reproduced from Bloch & Schneider (1801). Arrow indicates an extra scale below pectoral-fin base.

Discussion

Nomenclature and identification of *Monocentris japonica*

Monocentris japonica, previously published as *Gasterosteus japonicus*, was described based on materials collected from Nagasaki, Japan, by Houttuyn (1782). A figure of the type specimen has never been published and the specimens were believed to be lost (Boeseman 1995; Boeseman & de Ligny 2004). In addition, the original description lacks diagnostic characters and it is difficult to verify the species described. A neotype designation by Fricke (1999) did not meet the criteria of Article 75.3 and 75B, International Code of Zoological Nomenclature (ICZN 1999), and is thus invalid (Motomura 2001).

We examined specimens and several photos taken from Japanese waters, including some from Kagoshima (near the type locality Nagasaki). All of them have an additional small scale below the pectoral-fin base (i.e., 8 scales on LLB3). Moreover, we found that this form is to be common in Japan historically, including more than a century ago (see MNHN specimens listed under *M. japonica*), and none of them was identifiable as *M. chrysadamas* described above, even though a few literature records with color figures exist (e.g., Masuda *et al.* 1984; Okamura & Amaoka 1997). In order to stabilize the taxonomic status of *Monocentris japonica* (Article 75 of ICZN; ICZN, 1999) and to prevent possible confusion with our newly described congener *M. chrysadamas*, we assign a neotype based on a specimen collected from Kagoshima and provide its morphological and genetic data here.

A literature survey revealed that original drawings of both junior synonyms of *M. japonica*: *Sciaena cataphracta* (Fig. 11A) and *Monocentris carinata* (Fig. 11B) have an additional small scale below the pectoral-fin base, which further verifies their status as junior synonyms of *M. japonica*.

We also examined many high-resolution photographs of the holotype of *Cleidopus neozelanicus*, considered by Paxton *et al.* (2015) as a junior synonym of *M. japonica*, together with the information and a photo published in Roberts *et al.* (2015: 1008, fig. 138.1). Based on this evidence, the population in New Zealand is different in morphology, squamation, body morphometry, and maximum body size from *M. japoinica* reported herein and should be recognized as a distinct species (Su *et al.*, in prep.).

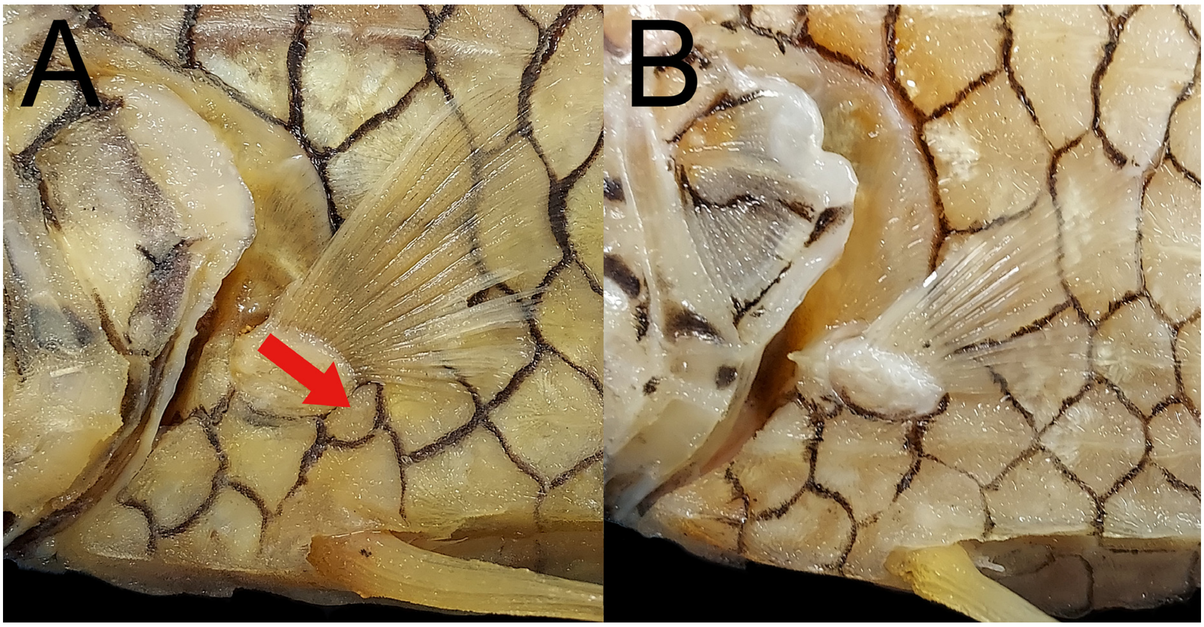

FIGURE 12. Lateral view of pectoral-fin region, showing (A) an extra scale (red arrow) below pectoral-fin base in neotype of *M. japonica*, and (B) absent in paratype, DOS 08609, 82.1 mm SL, of *M. chrysadamas*. Anterior to left.

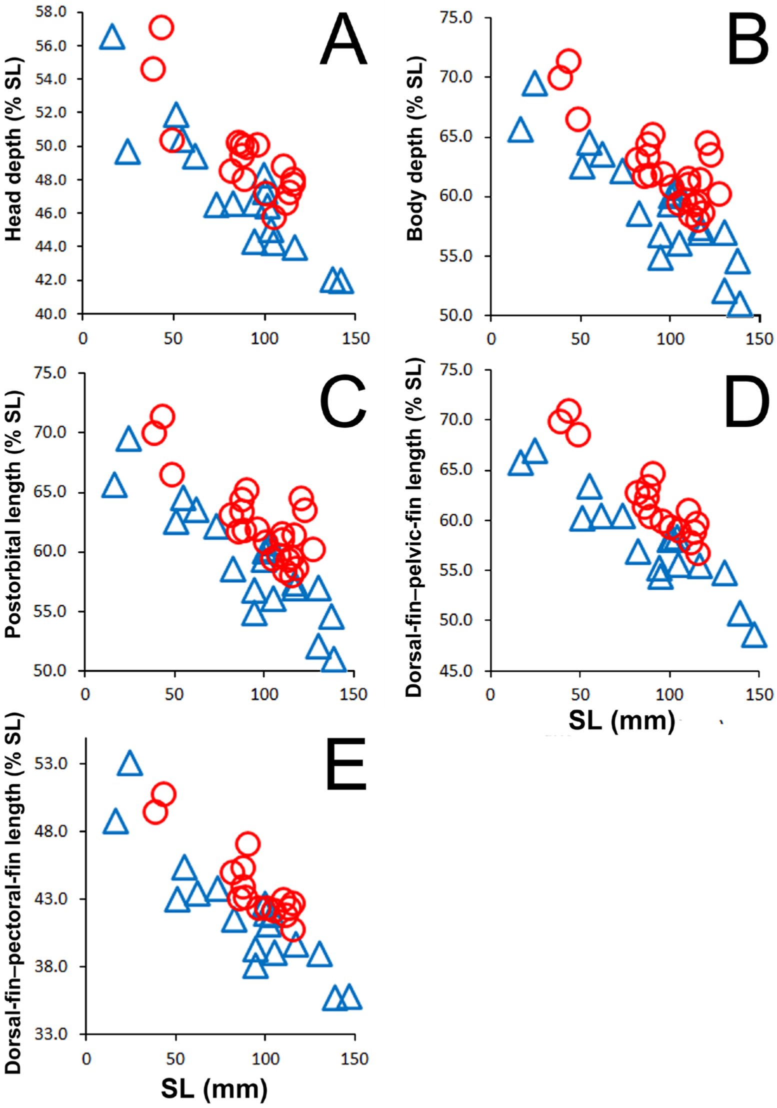

FIGURE 13. Allometric growth in *M. chrysadamas* **sp. nov.** (red circle) and *M. japonica* (blue triangle). A. Head depth (% SL vs. SL). B. Body depth (% SL vs. SL). C. Postorbital length (% SL vs. SL). D. Dorsal-fin–pelvic-fin length (% SL vs. SL). E. Dorsal-fin–pectoral-fin length (% SL vs. SL).

Comparison

Monocentris chrysadamas is similar to *M. japonica* in general appearance, but can be distinguished from it in lacking an extra small scale below the pectoral-fin base (Fig. 12), resulting in 6 or 7 scales in the LLB3 (vs. a small scale present, thus 8 scales in LLB3). Although the values overlap, *M. chrysadamas* has relatively few scales in the LLS (12–15) and LLB1 (10–11, modally 10), whereas *M. japonica* has 13–17 in the LLS and 11–14 LLB1, modally 11–12 (Table 2). In addition, they also differ in the otolith morphology (Fig. 6, 9), the sagittal otoliths of *M. chrysadamas* possessing a notched excisura with the ostium opened into it, rostrum and antirostrum present, and a small pseudo-exisura and pseudo-rostrum present; whereas the ostium is closed, and there is no excisura, pseudo-excisura, rostrum and antirostrum in *M. japonica*.

Among the 35 morphometric parameters measured in this study, some allometric growth was observed, especially in head depth, body depth, postorbital length, dorsal-fin–pelvic-fin length, and dorsal-fin–pectoral-fin length in both species (Fig. 13). All of them have a negative correlation versus standard length, with similar slopes in both species, although *M. chrysadamas* has consistently higher proportional values than *M. japonica*.

The largest individual examined is 127.6 mm SL in *M. chrysadamas* and 147.0 mm SL in *M. japonica* among specimens examined (Fig. 14). Based on the frequency, we suggest *M. chrysadamas* has a relatively smaller adult body size than *M. japonica*.

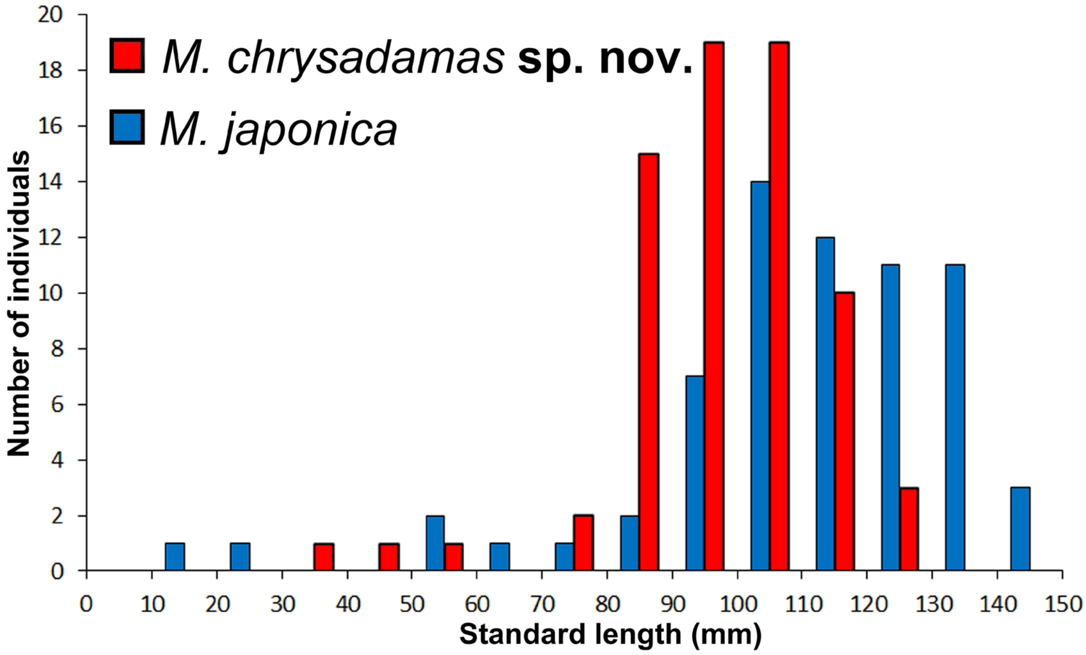

FIGURE 14. Frequency of standard length in *M. chrysadamas* **sp. nov.** (n=71) and *M. japonica* (n=66). Color of bars correspond with species' colors in key.

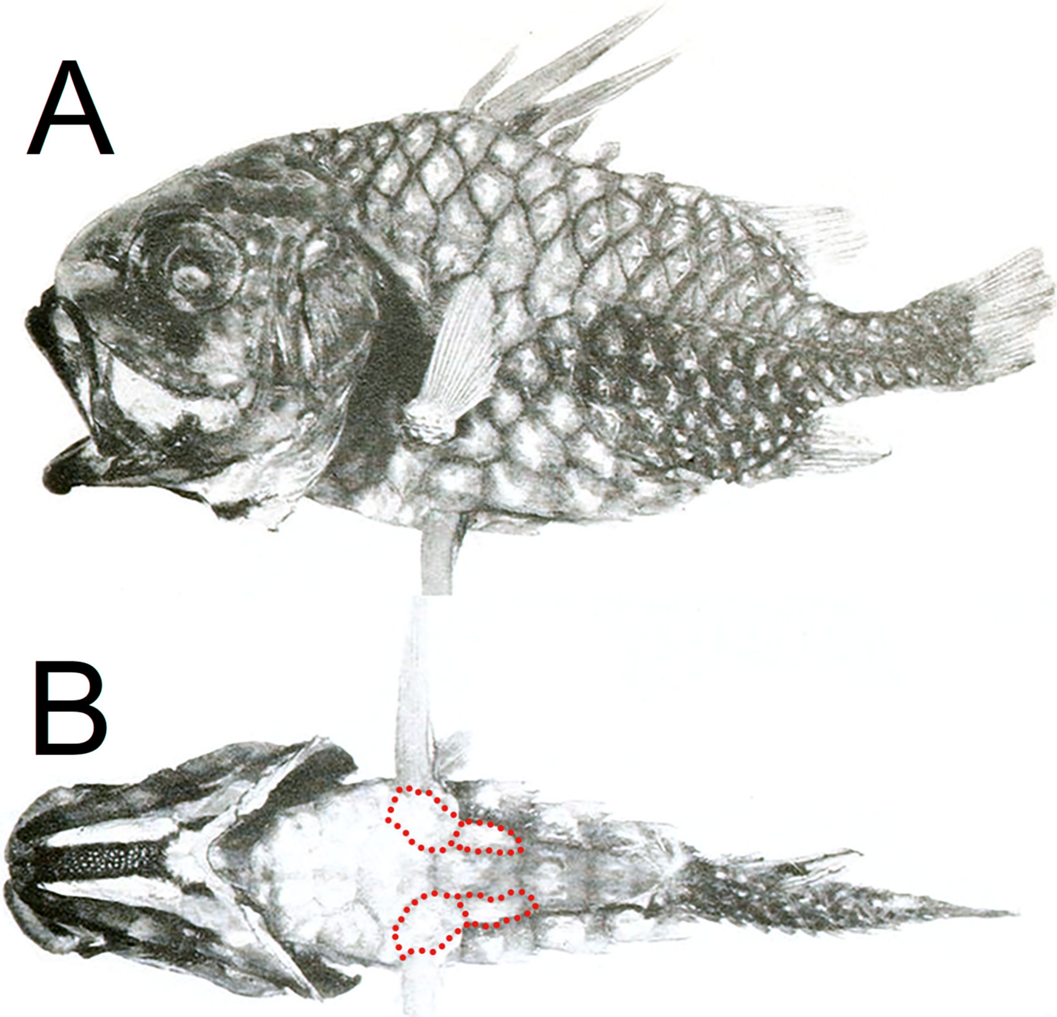

FIGURE 15. Holotype of *Monocentris reedi* Schultz, 1956, reproduced from Schultz (1956). Scales between LLB4 and AS were outlined by red dots. A. Lateral view. B. Ventral view.

Based on the original description (Schultz 1956) and data provided in Kotlyar (1996), *M. chrysadamas* and *M. japonica* can be distinguished from their eastern Pacific congener *M. reedi* (Fig. 15) by having 16–20 total gill rakers (vs. 22–26 in *M. reedi*); 12–17 LLS (vs. 17–21); small scales between LLB4 and AS, small second scale that does not reach the second postpelvic scute (vs. second scale large and reaching second postpelvic scute, Fig. 15B); and uniformly white-yellowish body-color (vs. body silvery gray with blue tints).

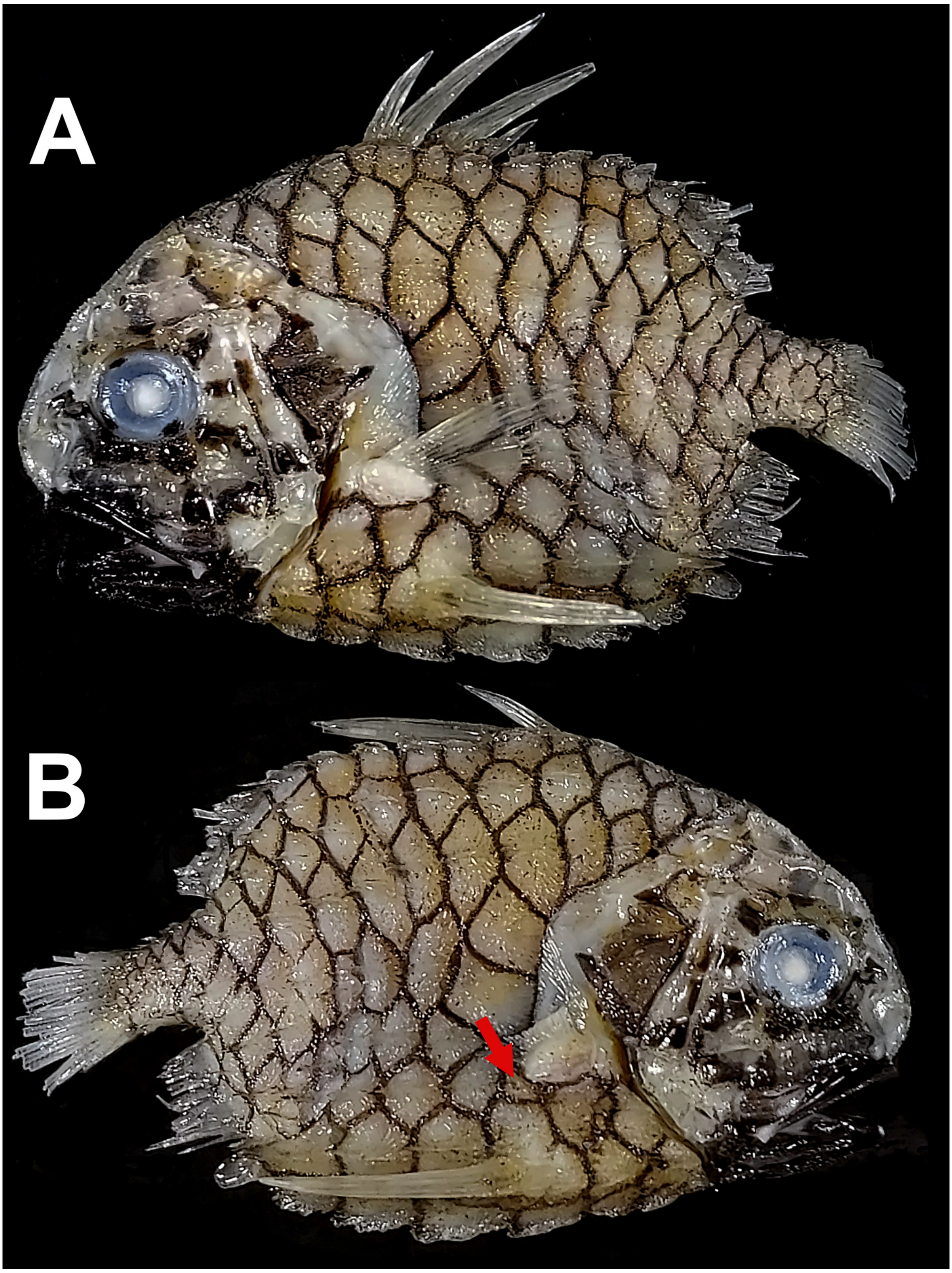

FIGURE 16. A potential hybrid individual of *M. chrysadamas* and *M. japonica*, NMMB-P36130, 80.7 mm SL, preserved. A. Left. B. Right with an extra scale below right pectoral-fin base (indicated by arrow).

Potential hybrid individuals

Among nearly 150 individuals collected from Taiwan, we found 6 specimens that are presumable hybrid descendants of *M. chrysadamas* and *M. japonica* (Fig. 16). All of these specimens possess the diagnostic character of both *M. japonica* and *M. chrysadamas*, e.g., LLA3 with 7 scales on one side and 8 on the other side (an extra small scale present) of body. The single retrieved COI sequence, together with a sequence obtained from BOLD system (voucher not available), suggested they may be *M. chrysadamas* but in a separated sub-clade (Fig. 10). The body depths of these specimens are somewhat narrower than those represented in sub-clade 2 and more similar to those of *M. japonica*. *Monocentris chrysadamas* and *M. japonica* were often collected together in western Taiwan suggesting overlapping habitats where hybridization may occur naturally. More investigation is needed to address this hypothesis.

Comparative materials. *Cleidopus gloriamaris*: AMS I.44777-001 (1, 114.9), 28°44'S, 153°40'E, off Ballina, New South Wales, Australia, 51–55 m, 20 Jan. 2008, demersal prawn trawl, coll. D. Johnson. AMS I.25636-001 (1, 95.4), FRS Kapala, st. K85-04-13, off Shoalhaven Bight, New South Wales, Australia, 18 Apr. 1985. AMS I.26784-002 (1, 100.4), FRV Kapala, st. K-86-33-04, 37°00–37°05'S, 149°59'–149°54'E, off Merimbula, New South Wales, Australia, twin prawn trawl, 60–62 m, 28 Nov. 1986. MNHN 1981-0022 (1, 124.7), Moreton Bay, Queensland, Australia, 140 m, Dec. 1978. MNHN 1981-0022 (1, 124.7), Moreton Bay, Queensland, Australia, 140 m, Dec. 1978.

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