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First regional record of two *Mugilogobius* Smitt (Gobiiformes: Gobiidae) from Penghu (Pescadores Islands), Formosan Strait

HSIEN-EN LI[1,4], ZHI-XIANG LUO[2,5#], BAO-YANG LIN[2,6], JHY-YUN SHY[2,7*] & I-SHIUNG CHEN[1,3,8*]
[1]*Institute of Marine Biology, National Taiwan Ocean University, Keelung, 202301, Taiwan, R.O.C.*
[2]*Department of Aquaculture National Penghu University of Science and Technology, Taiwan, R.O.C.*
[3]*Center for Excellence of the Oceans, National Taiwan Ocean University, Keelung, 202301, Taiwan, R.O.C.*
[4] *seanlee22@hotmail.com; https://orcid.org/0000-0002-5964-3292*
[5] *ffff99056@gmail.com; https://orcid.org/0009-0003-5728-1181*
[6] *linbaoyang188@gmail.com; https://orcid.org/0009-0008-6375-9475*
[7] *jyshy@npu.edu.tw; https://orcid.org/0000-0003-3998-4046*
[8] *iscfish@gmail.com; https://orcid.org/0000-0002-4190-7720*
#The author shares equal contribution of first author
**Correponding authors*

Abstract

During an investigation of the freshwater crustacean fauna of Penghu Island, we collected *Mugilogobius cavifrons* (Weber, 1909) and *Mugilogobius chulae* (Smith, 1932). These species represent the second and third additions of *Mugilogobius* species diversity in Penghu and an addendum to their respective species distribution in the Formosan Strait. Herein, we give detailed descriptions of their morphology, sensory canal and papillae patterns, and fresh colorations and comparisons of the two species with their relatives on the adjacent island of Taiwan.

Key words: *Mugilogobius*, new records, Penghu, species diversity.

Introduction

As part of the western Pacific biogeographic region, Taiwan supports a highly diverse ichthyofauna. Beyond Taiwan itself, the surrounding islands also support rich marine ichthyofaunas, largely shaped by regional ocean currents that facilitate dispersal and speciation (Shao *et al.* 1997). Such as the archipelago of Penghu, also known as the Pescadores, which had always been known as an ichthyofaunal hot spot for the Formosan Strait (Chen 2021), with a total count of 165 families and 919 genera recorded in the first comprehensive field guide by Chun-Hui Chen (2003), and a checklist was also published afterwards (Chen 2004) with 172 families and 1230 genera recorded.

The teleostean family Gobiidae, commonly known as gobies, is one of the most important and diverse groups of vertebrates, and for Taiwan, about 77 genera and more than 270 species were recorded (Chen *et al.* 2007). One of the first gobiid-related studies of the Pescadores was by Liao (1960), with 3 goby species recorded, *viz. Asterropteryx semipunctatus*, *Acentrogobius campbelli* (=*Istigobius campbelli*), and *Ctenogobius abei* (=*Mugilogobius abei*). After the publication of the comprehensive checklist by Chen (2004), a total of 26 genera and 56 species of gobiids were recorded, and many more shall be uncovered with extensive surveys continued to be carried out (Chen 2021).

Recently, we had an unexpected encounter with a limited brackish fish fauna formed by reservoir and pond outlets while carrying out a survey of the crustacean fauna of Penghu. After a short period of collection, a total of two species of *Mugilogobius* Smitt, 1900 were collected and identified as a new record for the Penghu Islands; they were *M. cavifrons* (Weber, 1909) and *M. chulae* (Smith, 1932). The taxonomy of *Mugilogobius* was summarised by Huang *et al.* (2016) with a total count of 8 species, *viz. M. abei* (Jordan & Snyder, 1901), *M. cavifrons*, *M. mertoni* (Weber, 1911), *M. chulae*, *M. myxodermus* (Herre, 1935), and *M. flavomaculatus* Huang, Chen, Yung & Shao, 2016. The current two new *Mugilogobius* records represent corresponding species distributional addenda in the Formosan Strait, and descriptions of their external morphology are also given in this paper.

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Materials and Methods

Samples were collected with kick nets and baited traps. Collected specimens were taken back alive to the Lab of crustacean and aquatic ecology situated at the National Penghu University of Science and Technology (NPU). After live photo record, specimens were preserved in 10% formalin and juvenile individuals preserved in 95% EtOH for future applications in molecular biology research. Measurements of every collected individual were carried out by electronic calipers and scales to the nearest 0.01 mm under dissecting microscope following the methods of Miller (1988) and Chen *et al.* (2024). Osteological characters were observed with radiographs and identified following Birdsong *et al.* (1988), and the naming system for cephalic sensory papillae and pore system followed Sanzo (1911) and Wongrat and Miller (1991).

Abbreviations for meristic characters shown as follows: D, dorsal fin elements; D1, first dorsal fin elements; D2, second dorsal fin elements; A, anal fin elements; P1, pectoral fin elements; P2, pelvic fin elements; LR, longitudinal scale rows; TR, transverse scale rows; D-P, scale rows between D1 origin and upper P1 base; Pred, predorsal scales; V, vertebral counts; P-V, dorsal pterygiophore formula; AP, anal pterygiophores anterior to the first haemal spine; SL, standard length.

Taxonomy

Mugilogobius cavifrons (Weber, 1909)

Figures 1A, 2A, 3

Materials Examined

NTOUP-2025-11-012, 4 ind., 32.7–46.8 mm SL, outlet of PHU brackish pond, coll. B.-Y. Lin, 19 April 2025.

Diagnosis

D2. I, 8; A. I, 8; P1 15–16; LR. 45–47; TR. 14; Pred. 21–23.

Body with lightning-like dark transverse bands. D1 with an oval shaped blotch, third spine longest.

Redescription

Morphometric percentages shown in table 2. Body robust, slightly slender in female individuals. Head bulbous (distinct in males). Mouth slightly oblique, gape larger in males. Anterior nostril with a tubular opening while the posterior nostril is merely an oval-shaped hole. Vertebrae count 10+16=26 (4).

Fins. See table 1 for meristic frequencies. D1 VI (4); D2 I, 8 (4); A I, 8 (4); P1 15 (1)–16 (3); P2 I, 5 (4). First dorsal fin in rounded rectangular shape, with the third spine only slightly longest. Second dorsal fin origin slightly anterior to the anal fin origin. Pelvic fin oval shaped. Caudal fin rounded.

Squamation. See table 1 for meristic frequencies. LR 45 (1), 46 (1) or 47 (2); TR 14; Pred 21 (1), 22 (2) or 23; D-P 11 (1)–12 (3). Body covered in both ctenoid and cycloid scales. Predorsal region mostly covered in rather large cycloid scales until the vertical of preopercle, and thoracic region with small cycloid scales. Cheeks naked. dorsal regions of operculum with patches of small cycloid scales.

Cephalic sensory organs. See figure 3 for detailed sensory organ patterns. All canal pores absent. Sensory papillae in longitudinal pattern. For the infraorbital papillae rows: row *a* short, about the same length as orbit; row *b* extends until the posterior edge of preopercle; row *cp* and *d* in almost equal length. Opercle rows all separated. The chin row *f* in a pair of 2 papillae.

Live coloration. See figure 1A. Body in brownish yellow while male individuals express dark colorations under stress. Body lined with about 7 diamond-like dark blotches, and caudal peduncle with 2 to 3 rows of lightning-like transverse bands. Head with numerous cloud-like blotches. D1 with a dusky margin and a transparent band, possessing metallic shade. Centre of D1 with a smear of dark blotch. D2 with a dusky margin with whitish band, posterior tip with a yellowish dash; a series of elliptical blotch lined up along D2. Anal fin yellowish thoroughly with a dark margin. Pectoral fins and pelvic fins dusky without pigmentations. Caudal fin with wavy brown stripes.

Coloration in preservatives. See figure 2A. All bright colours fade away; whole body turn blackish and almost all body blotches become vague and indistinct.

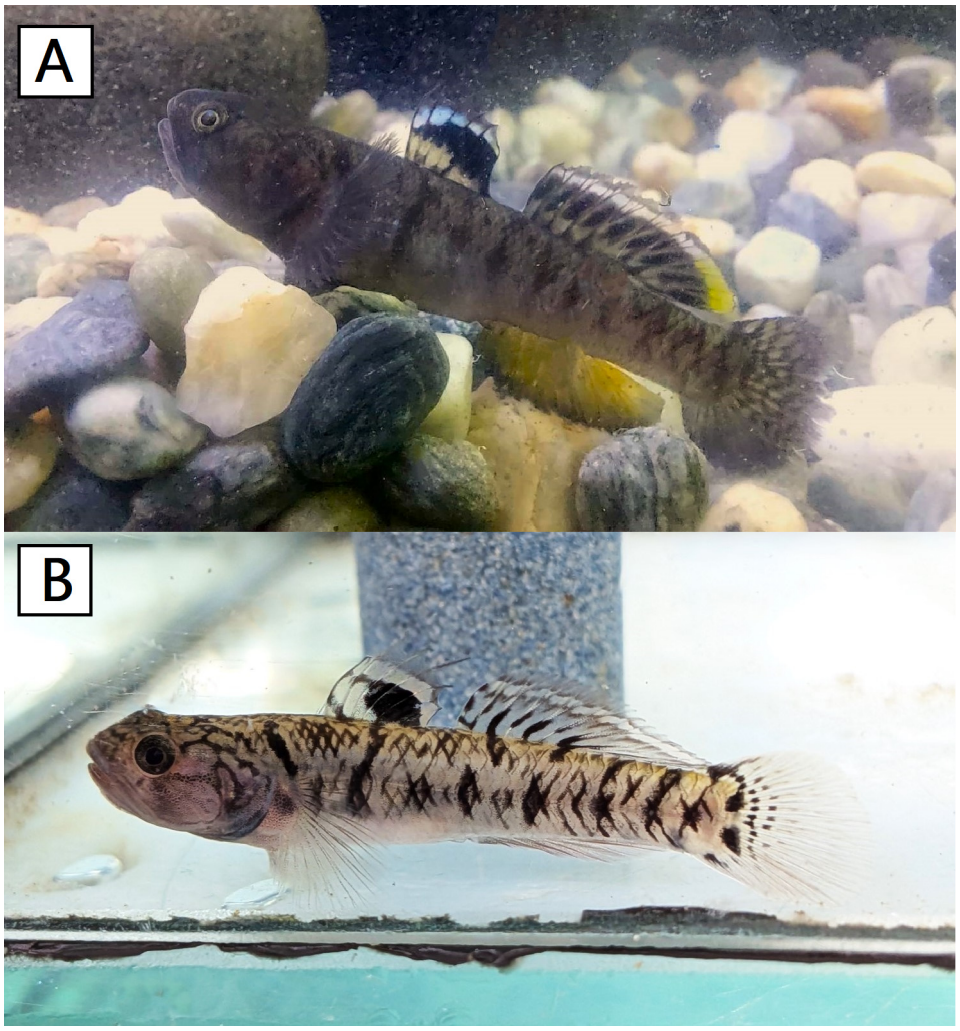

FIGURE 1. *In situ* colorations of the newly recorded *Mugilogobius* from Penghu. A. *Mugilogobius cavifrons* (NTOUP-2025-11-002, 46.8 mm SL); B. *Mugilogobius chulae* (NTOUP-2025-11-003, 28.0 mm SL).

Distribution and habitat

The species was collected near the coastal outlet pool of the NPU brackish pond, the substrates were rubble and the pool will be flooded with sea water during spring tide. The sympatric species being *Metopograpsus thukuhar* (Owen, 1839), *Ligia exotica* Roux, 1828, *Platorchestia* spp., Mugilidae spp., *Scatophagus argus* (Linnaeus, 1766) and *Lutjanus argentimaculatus* (Forsskål, 1775).

***Mugilogobius chulae* (Smith, 1932)**

Figures 1B, 2B, 4

Materials Examined

NTOUP-2025-11-013, 3 ind., 21.5–28.0 mm SL, water way of Hu-Xi ditch, coll. Z.-X. Luo, 26 September 2025.

Diagnosis

D2. I, 7; A. I, 7; P1 14; LR. 29–30; TR. 9; Pred. 12–14.

D1 with a distinct black spot. Nape with a dark stripe extending downwardly to the pectoral fin bases. Caudal fin base with a pair of small black spots.

FIGURE 2. Preserved condition of the newly recorded *Mugilogobius* from Penghu A. *Mugilogobius cavifrons* (NTOUP-2025-11-002, 40.1 mm SL); B. *Mugilogobius chulae* (NTOUP-2025-11-003, 21.5 mm SL).

Redescription

Morphometric percentages shown in table 2. Body slightly elongated. Head not distinctly bulbous in both sexes. Mouth slightly oblique, gape distinctly larger in males. Anterior nostril with a tubular opening while the posterior nostril is merely an oval-shaped hole. Vertebrae count 10+16=26 (4).

Fins. See table 1 for meristic frequencies. D1 VI (3); D2 I, 7 (3); A I, 7 (3); P1 14 (3); P2 I, 5 (4). First dorsal fin almost rounded in shape, with 2nd till 4th spine elongated, 4th spin elongation longest. D1 elongation is seen in both sexes while distinct in male. Second dorsal fin origin slightly anterior to the anal fin origin. Pelvic fin oval shaped. Caudal fin rounded.

Squamation. See table 1 for meristic frequencies. LR 29 (2)–30 (1); TR 9; Pred 12 (1), 13 (2) or 14; D-P 8 (3). Body covered in both ctenoid and cycloid scales. Predorsal region mostly covered in rather large cycloid scales until the vertical of preopercle, and thoracic region with small cycloid scales. Cheeks naked. Dorsal regions of operculum with patches of small cycloid scales.

Cephalic sensory organs. See figure 4 for detailed sensory organ patterns. All canal pores absent. Sensory papillae in longitudinal pattern. For the infraorbital papillae rows: row *a* short, only about 1/3 of orbit; row *b* extends until the posterior edge of preopercle; row *cp* slightly shorter that row *d*. Opercle rows all separated. The chin row *f* in a pair of 2 transverse rows.

Live coloration. See figure 1B. Body almost transparent or slightly dusky. Lateral side with 7 diamond-like spots lines medially. Scales with distinct dark margin. Head with lattice-like markings. Nape with a distinct transverse stripe extending obliquely backwards to pectoral fin base. Another transverse stripe running from middle of D1 base

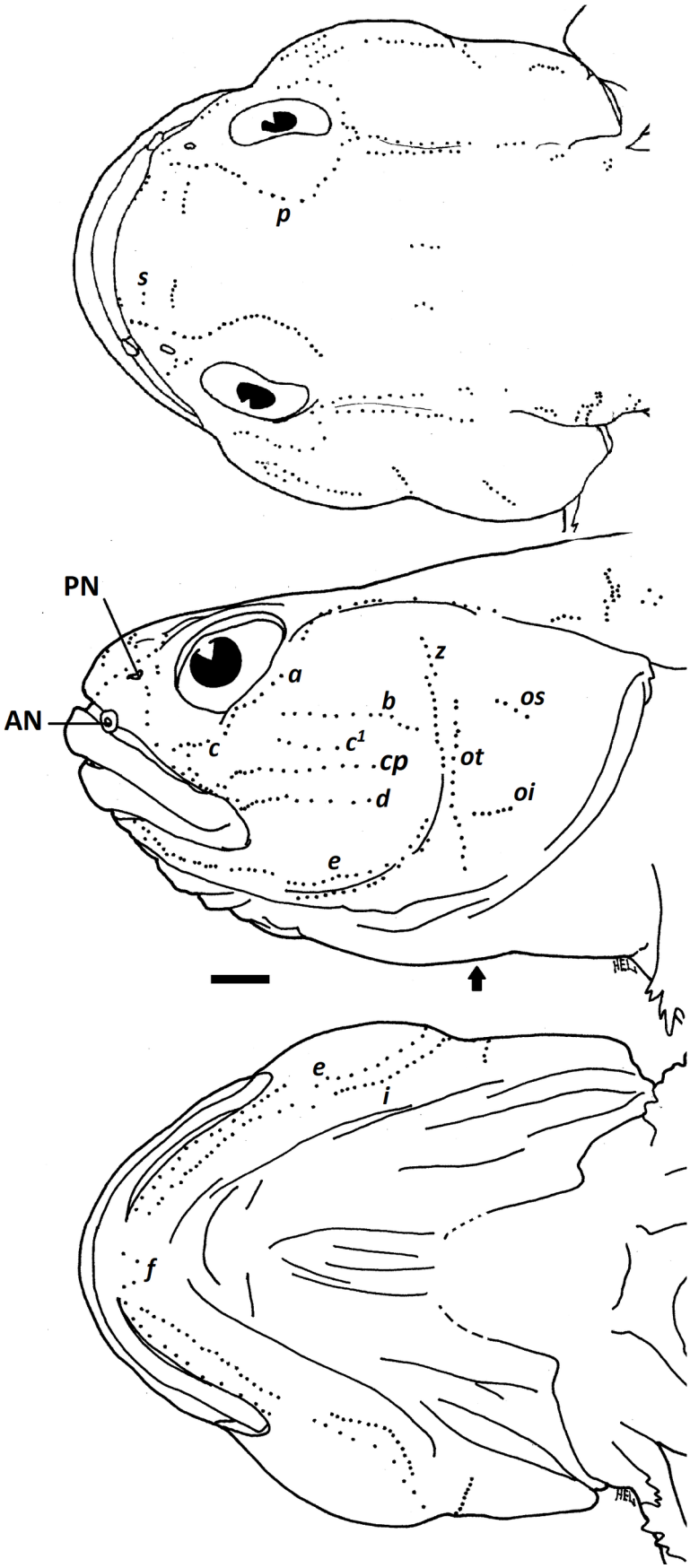

FIGURE 3. Head canal and sensory papillae arrangements of *Mugilogobius cavifrons* (NTOUP-2025-11-002, 40.1 mm SL). AN, anterior nostril; PN, posterior nostril. Arrows showing the anterior edge of gill slits. Scale bar = 1 mm.

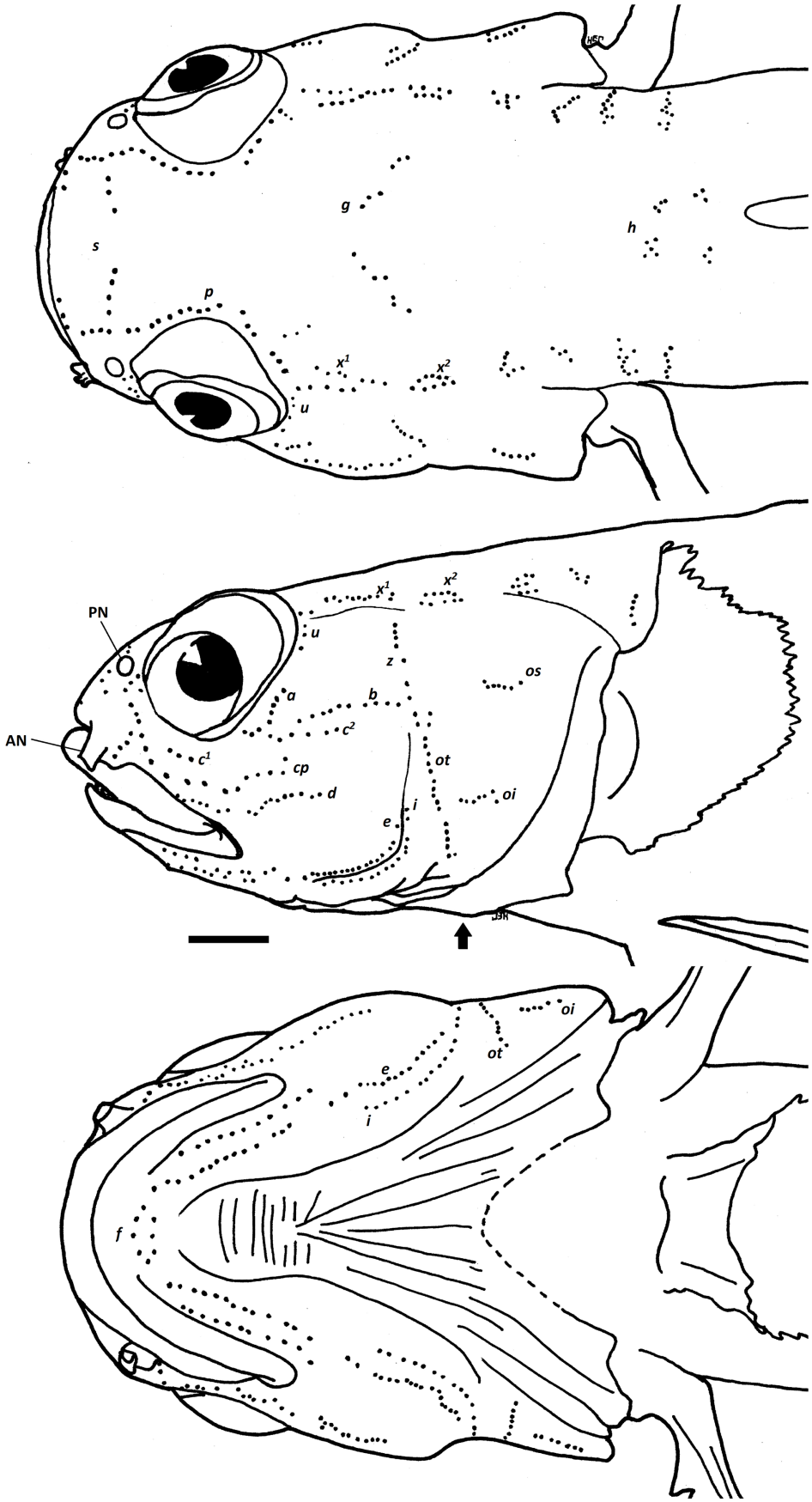

FIGURE 4. Head canal and sensory papillae arrangements of *Mugilogobius chulae* (NTOUP-2025-11-003, 21.5 mm SL). AN, anterior nostril; PN, posterior nostril. Arrows showing the anterior edge of gill slits. Scale bar = 1 mm.

TABLE 1. Meristic frequencies of the two *Mugilogobius* species newly recorded from Penghu in this study. Comparative data of Taiwanese population were derived from Huang (2014). Average values were rounded to the first decimal.

Species/characters	D2 ray					A ray				P1 ray						LR									
	6	7	8	9	x	6	7	8	x	13	14	15	16	17	x	28	29	30	…	44	45	46	47	48	x
M. cavifrons (Penghu)	-	-	4		8.0	-	-	4	8.0	-	-	1	3	-	15.8	-	-	-	-	-	1	1	2	-	46.3
M. cavifrons (Taiwan)	-	-	9	1	8.1	-	1	9	7.9	-	-	5	13	1	15.8	-	-	-	-	2	7	8	2	1	45.7
M. chulae (Penghu)	-	3	-	-	7.0	-	3	-	7.0	-	3	-	-	-	14.0	-	2	1	-	-	-	-	-	-	29.3
M. chulae (Taiwan)	2	22	1	-	7.0	1	24	-	7.0	2	38	10	-	-	14.2	9	28	13	-	-	-	-	-	-	29.1

.....continued below

TABLE 1. (Continued)

Species/characters	TR						Pred											D-P					
	8	9	…	14	15	x	11	12	13	14	…	19	…	21	22	23	x	7	8	11	12	13	x
M. cavifrons (Penghu)	-	-	-	4	-	14.0	-	-	-	-	-	-	-	1	2	1	22.0	-	-	1	3	-	11.8
M. cavifrons (Taiwan)	-	-	-	7	3	14.3	-	-	-	-	-	1	-	4	3	2	21.5	-	-	3	5	2	11.9
M. chulae (Penghu)	-	3	-	-	-	9	-	1	1	1	-	-	-	-	-	-	13.0	-	3	-	-	-	8
M. chulae (Taiwan)	3	22	-	-	-	8.9	3	10	10	2	-	-	-	-	-	-	12.4	5	20	-	-	-	7.8

TABLE 2. Morphometric percentages of the two *Mugilogobius* species newly recorded from Penghu in this study. Comparative data of Taiwanese population were derived from Huang (2014). Average values were rounded to the first decimal.

Species	*Mugilogobius cavifrons*		*Mugilogobius chulae*	
Sex	♂	♀	♂	♀
n	3	1	2	1
% in SL				
Head length	29.0–29.7 (29.4)	27.0	25.2–29.2 (27.2)	29.22
Predorsal length	36.7–39.3 (38.0)	42.2	37.1–38.3 (37.7)	37.08
Snout to 2nd dorsal origin	57.4–59.3 (58.2)	59.3	58.2–56.7 (59.0)	58.20
Snout to anus	54.9–57.9 (56.7)	59.0	53.8–56.7 (55.2)	56.66
Snout to anal fin origin	61.0–62.7 (61.9)	62.8	60.6–60.8 (60.7)	60.59
Prepelvic length	30.1–31.1 (30.5)	31.4	29.5–33.8 (31.6)	33.76
Caudal peduncle length	21.9–26.4 (23.9)	21.7	23.2–23.7 (23.5)	23.19
Caudal peduncle depth	12.9–14.6 (13.7)	12.9	12.3–13.8 (13.0)	13.83
1st dorsal fin base length	10.3–15.5 (12.7)	10.8	14.7–15.4 (15.1)	15.36
2nd dorsal fin base length	19.0–19.5 (19.2)	13.6	15.0–18.0 (16.5)	18.04
Anal fin base length	18.9–19.5 (19.2)	16.0	15.5–15.9 (15.7)	15.93
Caudal fin length	18.7–23.2 (20.6)	19.3	20.6–25.6 (23.1)	20.61
Pectoral fin length	18.1–22.6 (20.2)	19.6	20.9–25.6 (23.1)	20.94
Pelvic fin length	17.6–18.2 (17.8)	13.6	18.0–18.3 (18.1)	17.97
Body depth at pelvic fin base	19.4–20.6 (20.0)	18.0	16.5–17.7 (17.1)	17.68
Body depth at anal fin base	16.0–17.9 (16.7)	15.2	14.0–16.1 (15.1)	16.15
Body width at anal fin base	8.9–11.7 (9.8)	9.0	7.3–7.4 (7.3)	7.29
Pelvic fin origin to anus	26.2–29.3 (28.0)	29.0	25.6–26.4 (26.0)	26.44
% in HL				
Head width in maximum	76.0–82.5 (79.3)	77.8	67.8–69.3 (68.6)	69.32
Head width at upper gill	47.6–69.7 (56.7)	65.2	44.4–53.8 (49.1)	44.38
Eye diameter	18.9–22.0 (20.0)	27.1	24.0–28.6 (26.3)	23.96
Bony interorbital width	23.8–31.7 (26.7)	19.4	22.5–31.5 (27.0)	31.54
Fleshy interorbital width	48.0–57.4 (52.5)	50.2	47.7–49.6 (48.6)	47.68
Snout length	22.2–68.1 (38.3)	21.1	18.6–22.6 (20.6)	22.62
Lower jaw length	23.0–24.4 (23.8)	25.6	18.5–19.8 (19.1)	18.46
Cheek depth	34.6–38.2 (36.2)	19.6	27.3–33.9 (30.6)	33.86
Postorbital length	57.1–64.1 (59.5)	59.9	50.2–56.6 (53.4)	50.24

to mid-lateral of trunk. D1 with dusky margin, a distinct oval spot can be seen locating at the posterior 2/3. D2 with dusky margin and a greyish white longitudinal band. Anal fin, pectoral fins and pelvic fins blotchless, anal fin dusky. Caudal fin base with 2 black spots and 2–3 transverse bands near posterior edge of caudal peduncle.

Coloration in preservatives. Body turns pale and opaque. All dark blotches remained consistent.

Distribution and habitat

The species was collected at an artificial waterway that was part of the Hu-Xi ditch (湖西大排). The waterway was connected to the sea, and substrates were mainly composed by dead coral rubbles and mud. Sympatric species being *Macrobrachium nipponense* De Haan, 1849, *Rhinogobius similis* Gill, 1859, *Terapon jarbua* (Forsskål, 1775), *Oreochromis* spp. and *Cyprinus carpio* Linnaeus, 1758.

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