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REDESCRIPTION OF *Gobius gastrospilos* BLEEKER, 1853 WITH COMMENTS ON FOUR NEWLY RECORDED SPECIES OF BRACKISH GOBIES FROM TAIWAN

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Key words: *Pseudogobius*, *Mugilogobius*, Gobiidae.

ABSTRACT

A re-examination of the holotype of *Gobius gastrospilos* Bleeker, 1853 confirmed thatthis species belongs to the genus *Pseudogobius* Popta, 1922. The detailed redescription of *Pseudogobius gastrospilos* (Bleeker, 1853) would be provided in this paper. Furthermore, a series of field surveys of the gobioid fauna in brackish habitats of Taiwan revealed and summarized the following four newly recorded gobiid species: *Pseudogobius gastrospilos* (Bleeker, 1853), *Mugilogobius chulae* (Smith, 1932), *Mugilogobius mertoni* (Weber, 1911) and *Mugilogobius myxodermus* (Herre, 1935). The diagnosis of these newly recorded species of Taiwan would be also provided herein.

I. INTRODUCTION

The genus *Pseudogobius* was erected by Popta in 1922 [38] based on *Pseudogobius javanicus* (Bleeker, 1856) [9]. This group of gobiid fishes mainly lives in mangrove and estuarine brackish water habitats in the Indo-west Pacific region [10, 51]. Previous taxonomic studies, mainly achieved by Larson, have shown *Pseudogobius* comprises at least 6 nominal species: *Pseudogobius poicilosoma* (Bleeker, 1849), *Pseudogobius javanicus* (Bleeker, 1856), *Pseudogobius melanostictus* (Day, 1876), *Pseudogobius olorum* (Sauvage, 1880), *Pseudogobius masago* (Tomiyama, 1936) and *Pseudogobius avicennia* (Herre, 1940) [6, 9, 17, 23, 24, 32, 41, 47].

Bleeker (1853) [8], described *Gobius gastrospilos* on the basis of one specimen from Batavia [Jakarta], Java. Since the description of the species, its generic status has not been studied. Our examination of the holotype of *G. gastrospilos*, showed that based on its common generic features including the squamation pattern, the head canal pores restricted to the anterior oculoscapular region, and the absence of a posterior oculoscapular and a preopercular canal, *G. gastrospilos* belongs to the genus *Pseudogobius*. In order to clarify the taxonomic status of *P. gastrospilos*, it was compared with all our recent collections of *Pseudogobius* species.

Recently, a series of intensive survey of freshwater and brackish gobioid fishes of Taiwan bythe team of the last author (ISC) has yielded some new records of genera and species of diadromous gobiid fishes [14, 28] including: *Lentipes armatus* Sakai and Nakamura, 1979 [39] and *Bunaka gyrinoides* (Bleeker, 1853) [7]. So far, in studies of brackish gobioid fauna, only *P. javanicus* (Bleeker, 1856), *P. masago* (Tomiyama, 1936), *M. abei* (Jordan and Snyder, 1901) and *M. cavifrons* (Weber, 1909) [9, 17, 22, 30, 35, 43, 47-49] have been formally recorded in Taiwan [10, 42]. Oshima (1919) described *M. parvus* as a new species collected from Yilan County, northeast Taiwan. However, Larson regarded *M. parvus* as a junior synonym of *M. cavifrons* [32].

The aim of this paper is not only to verify the specific status of *P. gastrospilos*, but also to document four newly recorded gobiid fishes from Taiwanese waters including species of *Pseudogobius* and *Mugilogobius*.

II. MATERIALS AND METHODS

All specimens were collected by handnet from estuary or mangrove habitats in Taiwan, the Philippines, Singapore, Malaysia, Palau and Hong Kong. All counts and measurements were made from specimens preserved in 70% ethanol. Morphometric methods follow Miller (1988) [34] and meristic

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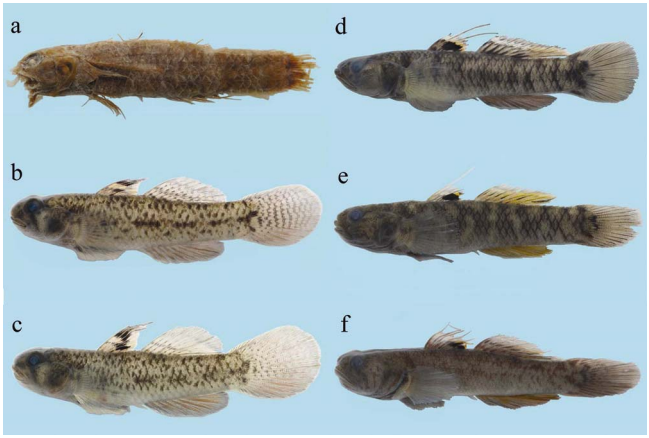

Fig. 1. Specimen photos of *Pseudogobius gastrospilos*. a, Holotype of *Pseudogobius gastrospilos* (= *Gobius gastrospilos*), LEIDEN 4676, 29.7 mm SL, Batavia, Java, Indonesia; b, fresh specimen of *Pseudogobius gastrospilos*, NTOUP 201211-168, male, 30.3 mm SL, Sai Yuan, Phuket Island, Thailand; c, *Pseudogobius gastrospilos*, NTOUP 201105-050, male, 29.3 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan; d, *Mugilogobius chulae*, NTOUP 201008-430, male, 29.5 mm SL; e, *Mugilogobius mertoni*, NTOUP 201008-434, male, 26.0 mm SL; f, *Mugilogobius myxodermus*, NTOUP 201008-435, male, 32.9 mm SL.

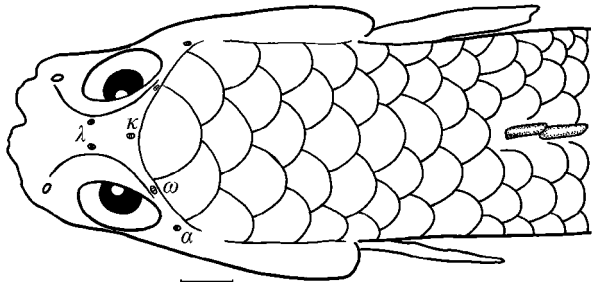

Fig. 2. The distribution of scale and head pores of *Pseudogobius gastrospilos*, LEIDEN 4676, 29.7 mm SL. Bar = 1 mm. Drawing by Shih-Pin Huang.

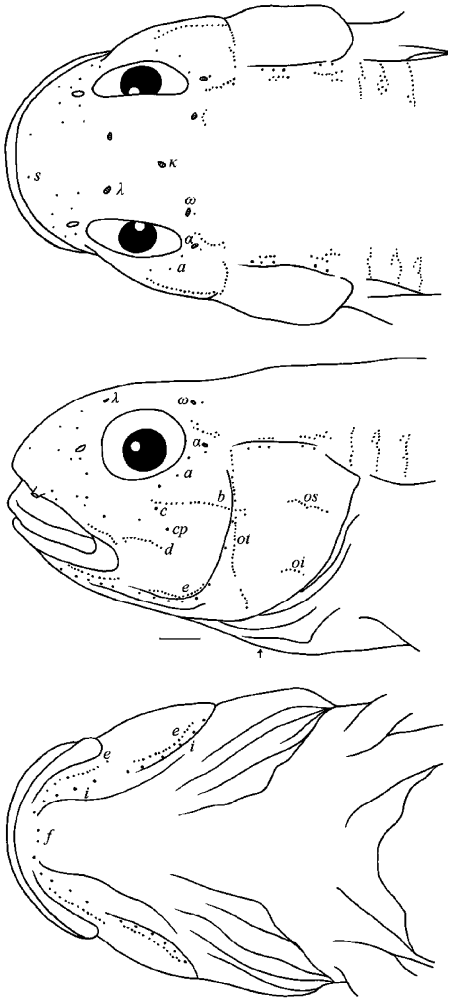

Fig. 3. Head lateral-line system of *Pseudogobius gastrospilos*, NTOUP 201105-050, male, 34.1 mm SL. Bar = 1 mm. Drawing by Shih-Pin Huang.

methods follow Akihito *et al*. (1984), Chen and Shao (1996), Chen *et al*. (1999), Chen and Kottelat (2003), Chen and Miller (2008) and Huang and Chen (2007) [1, 11-13, 15, 29]. Terminology of cephalic sensory canals and free neuromast organs (sensory papillae) is from Wongrat and Miller (1991) [50], based on Sanzo (1911) [40]. The holotype of *Pseudogobius gastrospilos* (= *Gobius gastrospilos*) is deposited at Naturalis Biodiversity Center, Leiden, the Netherlands (RMNH). Other fish specimens, used for comparisons as well as assigned type material, are deposited at the Institute of Marine Biology, National Taiwan Ocean University, Keelung (NTOUP).

Meristic abbreviations are as follows: A, anal fin; C, caudal fin; D1 and D2, first and second dorsal fins, respectively; LR, longitudinal scale series; P, pectoral fin; PreD, predorsal scales; SDP, scale series from origin of first dorsal fin to upper pectoral origin; TR, transverse scale series from second dorsal to anal fin; VC, vertebral count. All fish lengths are standard length (SL).

III. SYSTEMATICS

Redescription of *Pseudogobius gastrospilos* (Bleeker, 1853)

***Pseudogobius gastrospilos* (Bleeker, 1853)**

(Figs. 1a, 1b, 1c, 2, 3)

Gobius gastrospilos Bleeker, 1853b: 477 (Batavia, Java, Indonesia) [8].

Gobius melanostictus Day, 1876: 290 (Madras, India) [17].

Vaimosa serangoonensis Herre, in Herre and Myers, 1937: 40 (creek at Serangoon, Singapore) [27].

Vaimosa adyari Herre, 1945a: 402 (Adyar River, India) [24].

Pseudogobius melanostictus: Larson, 2001: 203 [32]; Larson and Lim, 2005: 142 [33].

Material examined:

Holotype.-RMNH.PISC.4676, 29.7 mm SL, Batavia, Java, Indonesia.

Other non-type materials. NTOUP 201105-049, 20 specimens, 16.8-33.3 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang and H. M. Huang, 15 January, 2010; NTOUP 201105-050, 15 specimens, 21.5-34.6 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang and H. M. Huang, 22 March, 2010; NTOUP 201105-051, 11 specimens, 26.0-37.0 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang and H. M. Huang, 13 May, 2010; NTOUP 201202-120, 15 specimens, 28.3-36.2 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang, 22 April, 2010. NTOUP 201202-121, 8 specimens, 23.7-33.0 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang, 15 July, 2010; NTOUP 201202-123, 10 specimens, 20.1-30.5 mm SL, mangrove of Palau, coll. I-S. Chen and J. T. Chen, 17 November, 2006; NTOUP 201211-165, 3 specimens, 18.6-32.4 mm SL, Sai Yuan, Phuket Island, Thailand, coll. S. P. Huang, 23 November, 2012; NTOUP 201211-168, 8 specimens, 18.3-30.3 mm SL, Cherngtalay, Phuket Island, Thailand, coll. S. P. Huang, 23 November, 2012.

Other comparative materials of congeners

***Pseudogobius avicennia* (Herre, 1940)**

NTOUP 201105-020, 12 specimens, 22.0-25.9 mm SL, Matang mangrove, Malaysia, coll. I-S. Chen and S. P. Huang, 21 April, 2011.

***Pseudogobius javanicus* (Bleeker, 1856)**

NTOUP 201105-052, 12 specimens, 20.8-32.1 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang and H. M. Huang, 29 October, 2009; NTOUP 201105-054, 18 specimens, 19.3-29.1 mm SL, Beimen Township, Tainan County, Taiwan, coll. S. P. Huang and H. M. Huang, 2 March, 2010; NTOUP 201202-126, 20 specimens, 19.9-26.6 mm SL, mangrove of Liehyu Island, Taiwan, coll. S. P. Huang and N. H. Jang-Liaw, 24 November, 2011; NTOUP 201202-127, 8 specimens, 14.6-23.7 mm SL, mangrove of Hong Kong, coll. I-S. Chen, 22 November, 2011; NTOUP 201105-055, 4 specimens, 25.2-30.1 mm SL, San Fernando City, Luzon Island, the Philippines, coll. S. P. Huang, 18 April, 2010; NTOUP 201105-056, 52 specimens, 15.9-32.4 mm SL, Sungei Buloh mangroves, Singapore, coll. I-S. Chen, July, 2001; NTOUP 201211-164, 22.7 mm SL, Sai Yuan, Phuket Island, Thailand, coll. S. P. Huang, 23 November, 2012.

***Pseudogobius masago* (Tomiyama, 1936)**

NTOUP 201011-568, 28 specimens, 17.1-21.0 mm SL, estuary of Puzi River, Dongshi Township, Chiayi County, Taiwan, coll. S. P. Huang and H. M. Huang, 2 March, 2010; NTOUP 201011-595, 30 specimens, 14.0-18.6 mm SL, estuary of Xiaofanli River, Guanyin Township, Taoyuan County, Taiwan, coll. S. P. Huang and H. M. Huang, 9 July, 2010; NTOUP 201202-119, 5 specimens, 21.9-24.5 mm SL, estuary of Jinsha River, Kinmen Island, Taiwan, coll. S. P. Huang, 19 May, 2010.

Diagnosis

Pseudogobius gastrospilos can be well distinguished from its congeners by the unique combinations of the following features: (1) fins: D2 I/7, A I/7, P 14-16 (modally 15), shape of first dorsal triangular, second and third spine extended into a short filament in adult males; (2) squamation: lateral body with large ctenoid scales, longitudinal scale rows 27-28, predorsal scales 7; (3) specific coloration: first dorsal fin with two large vertically aligned black spots, caudal fin base with two vertically aligned blackish brown spots; a lachrymal blackish brown stripe below eye.

Description

Body elongate, slightly compressed. Head large. Snout more prominent than tip of mouth. Eyes rather large. Mouth medium, maxillary extending to the vertical of anterior margin of pupil in males, but maxillary extending to the vertical of anterior margin of eye in females. Anterior nasal as a short tube, posterior nasal as a round hole. Gill-opening restricted, ventrally extending beyond the midline of vertical of operculum. VC 10 + 16 = 26 (in 11).

Fins.-D1 VI; D2 I/7; A I/7; P 14-16 (modally 15). Shape of first dorsal triangular, second and third spine extended into a short filament in adult males, but never filamentous in females. Anal fin originates below first branched ray of second dorsal fin. Pelvic fin large and rounded. Caudal fin of males larger than that of females, posterior margin rounded.

Scales.-LR 27-28 (modally 27); TR 8-9 (modally 8); PreD 7; SDP 5-6 (modally 5). Body covered with rather large ctenoid scales. Predorsal region with cycloid scales. Belly with smaller cycloid scales. Cheek naked. Opercle covered with few cycloid scales.

Head lateral-line system

Canals- Anterior oculoscapular canal present, anterior termination with paired pores λ, single median interorbital pore κ; paired postorbital pores ω, lateral termination with paired pores α. Posterior oculoscapular and preopercular canals entirely absent.

Sensory papillae- Row *a* short, about two third of eye diameter. Row *b* long with densely-set papillae, equal to eye diameter, starting from the vertical of center of pupil. Row *c* with 3 papillae. Row *d* long, equal to eye diameter, starting from the vertical from posterior nasal, extending to posterior margin of pupil. Single *cp* papilla. Opercular rows with rows

Table 1. Morphometric measurements of the holotype of *Pseudogobius gastrospilos* and other fresh specimens from Taiwan.

	Pseudogobius gastrospilos									
Characters	holotype	Male				Female				
n	1	6				6				
Percent standard length (%)										
Head length	26.5	26.4	–	26.8	(26.6)	24.4	–	25.0	(24.8)	
Predorsal length	35.9	34.4	–	36.5	(35.6)	35.5	–	36.6	(36.0)	
Snout to 2nd dorsal origin	55.9	53.9	–	55.3	(54.4)	55.1	–	56.2	(55.8)	
Snout to anus	51.7	49.2	–	49.8	(49.5)	50.5	–	52.5	(51.4)	
Snout to anal fin origin	54.7	54.8	–	55.2	(55.0)	57.1	–	58.5	(57.9)	
Prepelvic length	27.2	27.0	–	27.8	(27.3)	26.5	–	27.9	(27.2)	
Caudal peduncle length	32.1	31.8	–	33.1	(32.5)	31.8	–	32.7	(32.2)	
Caudal peduncle depth	15.2	14.5	–	16.5	(15.2)	15.4	–	15.7	(15.5)	
1st dorsal fin base	14.9	13.0	–	13.9	(13.4)	12.9	–	14.8	(13.7)	
2nd dorsal fin base	16.9	15.6	–	17.3	(16.6)	14.7	–	15.4	(15.1)	
Anal fin base	17.1	16.2	–	16.9	(16.6)	15.0	–	15.9	(15.4)	
Caudal fin length	–	29.1	–	31.6	(30.7)	27.1	–	28.7	(27.8)	
Pectoral fin length	–	22.4	–	25.0	(23.7)	21.5	–	23.4	(22.2)	
Pelvic fin length	21.1	20.9	–	21.8	(21.4)	20.6	–	22.9	(22.0)	
Body depth at pelvic fin origin	18.8	18.5	–	20.4	(19.6)	18.5	–	19.9	(19.0)	
Body depth at anal fin origin	20.8	19.8	–	21.4	(20.5)	20.8	–	22.6	(21.7)	
Body width at anal fin origin	10.8	13.4	–	15.6	(14.8)	14.8	–	15.3	(14.9)	
Pelvic fin origin to anus	25.0	22.1	–	24.6	(23.2)	24.5	–	25.7	(25.2)	
Percent head length (%)										
Snout length	33.5	33.7	–	37.3	(35.8)	29.3	–	31.9	(30.9)	
Eye diameter	29.6	27.0	–	29.3	(28.4)	32.4	–	34.5	(33.5)	
Cheek depth	29.6	28.4	–	30.6	(29.2)	25.8	–	27.8	(27.1)	
Postorbital length	47.9	44.7	–	46.6	(45.9)	45.1	–	46.3	(45.8)	
Head width in maximum	72.6	73.5	–	80.0	(76.2)	81.9	–	83.1	(82.5)	
Head width in upper gill	52.5	52.3	–	57.7	(54.7)	59.1	–	59.5	(59.3)	
Bony interorbital width	13.6	12.2	–	12.5	(12.3)	12.8	–	13.5	(13.2)	
Fleshy interorbital width	25.7	25.1	–	26.1	(25.5)	26.1	–	28.1	(27.2)	
Lower jaw length	–	44.2	–	49.2	(46.1)	36.5	–	40.6	(38.6)	

os, *oi* and *ot*. Rows *oi* and *ot* well separated. Row *f* with a pair of papillae.

Coloration in fresh specimens

Head and body generally pale yellowish brown, flank with 5 broken blackish brown blotches. Lateral scales with blackish brown margin. Belly creamy white. A lachrymal blackish brown stripe below eye.. First dorsal fin with two large vertically aligned black spots, their rear margins usually joined. Second dorsal fin with two longitudinal gray stripes. Pectoral fin base with a blackish brown blotch, pectoral fin membrane translucent and lacking any dark brown marks. Anal fin pale orange to pale red in adult males, but merely pale grayish white in females. Caudal fin base with 2 vertically aligned blackish brown spots, usually joined together, caudal fin membrane pale orange to pale red in adult males, but merely grayish white in females, and membrane with 4-6 row vertical black lines.

Morphological comparison of congeneric species

Pseudogobius melanosticus Day, 1876 has been used and considered as valid species for a while [32, 33]. However, our re-examined the holotype of *Gobius gastropilos* Bleeker, 1853 seems to conclude and be agree that they are the same species in the Indo-West Pacific region. It should be used the first priority for *Pseudogobius gastropilos* Bleeker, 1853 to replace the junior synonymy of *Pseudogobius melanosticus*.

Although it resembles the remaining 5 nominal, valid species of *Pseudogobius* in the Indo-West Pacific region [32], *P. gastrospilos* can be distinguished from *P. poicilosomus* by its higher number of pectoral fin rays 14-16 (modally 15) *vs.* 12, and second dorsal fin rays I/7 *vs.* I/8. *P. gastrospilos* can be distinguished from *P. olorum* by its lower number of anal fin rays I/7 *vs.* I/8, and lower number of longitudinal scales 27-28

Table 2. Morphometry of three newly recorded of *Mugilogobius* species from Taiwan.

	Mugilogobius chulae		*Mugilogobius mertoni*		*Mugilogobius myxodermus*	
Characters	Male	Female	Male	Female	Male	Female
n	6	6	2	2	5	5
Body length						
Percent standard length (%)						
Head length	28.8 – 30.5 (29.6)	24.9 – 26.9 (26.2)	27.3 – 29.2 (28.2)	25.8 – 26.6 (26.2)	29.5 – 31.6 (30.3)	27.3 – 29.3 (28.6)
Predorsal length	36.3 – 39.4 (38.0)	35.2 – 37.8 (37.0)	36.6 – 38.4 (37.5)	36.8 – 36.9 (36.9)	39.0 – 41.1 (40.1)	37.3 – 39.7 (38.2)
Snout to 2nd dorsal origin	55.1 – 57.5 (56.2)	57.5 – 59.8 (58.8)	55.6 – 56.3 (55.9)	55.4 – 55.5 (55.5)	57.0 – 59.7 (58.4)	55.8 – 57.3 (56.6)
Snout to anus	52.9 – 56.3 (54.5)	54.8 – 57.0 (56.7)	50.6 – 52.7 (51.6)	50.8 – 52.6 (51.7)	55.1 – 57.5 (56.2)	54.5 – 54.7 (54.6)
Snout to anal fin origin	56.7 – 58.9 (58.2)	58.1 – 61.8 (60.1)	56.7 – 59.2 (57.9)	56.8 – 59.7 (58.3)	59.1 – 59.6 (59.4)	59.8 – 60.6 (60.1)
Prepelvic length	29.9 – 33.7 (31.9)	27.2 – 28.9 (28.2)	29.5 – 31.7 (30.6)	28.8 – 30.3 (29.6)	29.2 – 31.1 (30.2)	27.3 – 29.8 (28.4)
Caudal peduncle length	28.6 – 31.9 (29.4)	27.7 – 31.6 (29.8)	31.0 – 33.7 (32.4)	31.1 – 32.4 (31.8)	25.2 – 27.8 (26.4)	26.2 – 27.9 (27.3)
Caudal peduncle depth	13.0 – 14.5 (13.7)	12.0 – 13.4 (12.8)	13.0 – 14.8 (13.9)	12.5 – 13.2 (12.9)	12.2 – 13.9 (12.8)	11.3 – 13.4 (12.2)
1st dorsal fin base	14.3 – 16.9 (15.6)	12.7 – 14.5 (13.7)	11.3 – 13.9 (12.6)	11.6 – 12.0 (11.8)	16.7 – 17.5 (17.0)	13.9 – 15.9 (15.2)
2nd dorsal fin base	18.4 – 19.8 (19.3)	15.9 – 17.5 (16.8)	17.5 – 20.7 (19.1)	17.1 – 19.0 (18.0)	20.5 – 22.1 (21.1)	19.0 – 20.2 (19.6)
Anal fin base	15.9 – 17.2 (16.5)	11.9 – 14.6 (13.3)	15.7 – 16.4 (16.1)	14.4 – 15.5 (14.9)	18.0 – 19.7 (18.8)	15.9 – 17.5 (16.5)
Caudal fin length	23.1 – 24.4 (23.7)	22.0 – 23.9 (23.1)	20.3 – 23.0 (21.6)	21.4 – 22.1 (21.7)	26.1 – 29.0 (27.2)	22.9 – 24.0 (23.4)
Pectoral fin length	21.0 – 23.7 (21.9)	19.6 – 22.0 (20.8)	21.9 – 22.8 (22.4)	20.4 – 22.3 (21.3)	20.9 – 22.6 (21.8)	21.3 – 22.4 (21.7)
Pelvic fin length	16.4 – 20.9 (18.2)	18.2 – 20.5 (19.3)	18.2 – 18.6 (18.4)	17.2 – 18.0 (17.6)	20.4 – 21.2 (20.8)	17.6 – 19.1 (18.4)
Body depth at pelvic fin origin	17.9 – 19.0 (18.5)	17.2 – 20.2 (18.5)	18.0 – 18.2 (18.1)	17.5 – 18.9 (18.2)	18.2 – 19.1 (18.5)	18.0 – 18.1 (18.0)
Body depth at anal fin origin	15.9 – 17.8 (17.1)	16.6 – 18.9 (17.4)	17.4 – 17.5 (17.4)	17.5 – 19.6 (18.6)	16.5 – 17.8 (16.9)	15.7 – 17.3 (16.4)
Body width at anal fin origin	10.7 – 12.9 (11.8)	10.5 – 12.5 (11.3)	13.9 – 15.5 (14.7)	13.9 – 14.0 (13.9)	11.1 – 12.5 (11.7)	12.3 – 14.7 (13.2)
Pelvic fin origin to anus	22.2 – 25.4 (24.3)	27.1 – 30.9 (29.3)	24.6 – 24.7 (24.7)	25.8 – 26.0 (25.9)	23.1 – 26.5 (24.3)	26.0 – 27.9 (27.2)
Percent head length (%)						
Snout length	31.1 – 35.8 (32.8)	30.4 – 32.1 (31.2)	27.4 – 28.0 (27.7)	26.3 – 27.3 (26.8)	25.0 – 27.4 (26.5)	29.0 – 30.7 (29.8)
Eye diameter	24.4 – 28.4 (26.5)	26.4 – 31.5 (28.8)	27.2 – 28.7 (27.9)	29.7 – 31.6 (30.7)	26.4 – 28.2 (27.0)	24.2 – 26.4 (25.3)
Cheek depth	18.6 – 21.2 (19.4)	17.6 – 18.9 (18.1)	23.9 – 26.1 (25.0)	22.4 – 22.6 (22.5)	20.5 – 22.4 (21.2)	18.3 – 20.9 (19.3)
Postorbital length	50.5 – 53.3 (52.1)	48.7 – 53.8 (51.6)	53.1 – 54.5 (53.8)	57.5 – 57.6 (57.5)	56.1 – 57.2 (56.2)	55.8 – 57.7 (56.5)
Head width in maximum	68.6 – 73.0 (70.6)	68.0 – 72.8 (71.4)	74.1 – 75.8 (74.9)	80.6 – 81.0 (80.8)	68.5 – 80.4 (72.7)	67.3 – 77.1 (70.9)
Head width in upper gill	50.8 – 54.4 (52.7)	56.8 – 61.2 (59.0)	58.6 – 60.2 (59.4)	62.3 – 64.1 (63.2)	50.8 – 55.0 (52.5)	47.9 – 53.8 (50.8)
Bony interorbital width	14.1 – 15.8 (14.8)	12.1 – 14.5 (13.8)	19.8 – 21.1 (20.5)	18.6 – 20.1 (19.4)	15.2 – 17.2 (16.1)	14.7 – 16.0 (15.4)
Fleshy interorbital width	34.7 – 38.3 (36.7)	34.7 – 38.5 (36.0)	33.3 – 35.5 (34.4)	34.7 – 35.3 (35.0)	29.6 – 32.2 (30.6)	28.5 – 31.2 (30.3)
Lower jaw length	47.8 – 52.6 (50.7)	40.0 – 44.0 (41.7)	41.5 – 44.2 (42.9)	39.5 – 40.6 (40.1)	41.9 – 48.2 (44.1)	35.3 – 44.1 (38.6)

(modally 27) *vs.* 32. *P. gastrospilos* can be distinguished from *P. javanicus* by its lower number of longitudinal scales 27-28 (modally 27) *vs.* 28-29; the deeper position of its gill opening: ventrally extending to two fifth of vertical line of operculum *vs.* ventrally extending to the center of vertical line of operculum. *P. gastrospilos* can be distinguished from *P. avicennia* by its lower number of predorsal scales 7 *vs.* 8-9, and transverse scales 8 *vs.* 10; *P. gastrospilos* first dorsal fin spine extended into a filament- in adult males, the *P. avicennia* males never have a filament on the the first spine. *P. gastrospilos* can be well distinguished from *P. masago* as it has fewer predorsal scales 7 *vs.* 8-10, and fewer longitudinal scale series 27-28 (modally 27) *vs.* 28-29 (modally 28); and first dorsal fin spine extended into a filament in adult males *vs.* no filament.

The redescription of three newly recorded species of *Mugilogobius*

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

(Figs. 1d, 4)

Vaimosa chulae Smith, 1932: 260 (Koh Samui, Gulf of Thailand); Fowler, 1937: 251; Koumans, 1953: 125; Suvatti, 1981: 306 [20, 31, 43, 46].

Vaimosa valigouva Deraniyagala, 1936: 219 (Pt. Pedro, Ceylon) [18].

Vaimosa zebra Aurich, 1938: 171 (Boloang, north Celebes); Koumans, 1953: 125 [4, 31].

Mugilogobius chulae: Hayashi and Itoh, 1978: 71; Akihito *et al*., 1988: 268; Larson, 2001: 109; Wu and Zhong, 2008: 497 [2, 21, 32, 51].

Materials examined:

NTOUP 201008-425, 35 specimens, 16.2-30.0 mm SL,

Table 3. Frequency distribution of meristic features of the *Pseudogobius gastrospilos* and other compared species from Taiwan, Palau, Phuket, Singapore and Malaysia.

	D1			D2			A				P				
	V	VI	x	I/7	I/8	x	I/6	I/7	I/8	x	14	15	16	17	x
Holotype of *P. gastrospilos*	–	1	6.0	1	–	7.0	–	1	–	7.0	1	1	–	–	14.5
P. gastrospilos (Phuket)	–	11	6.0	11	–	7.0	–	11	–	7.0	2	18	–	–	14.9
P. gastrospilos (Taiwan)	–	20	6.0	20	–	7.0	–	20	–	7.0	3	31	4	–	15.0
P. avicennia	–	12	6.0	12	–	7.0	1	11	–	6.9	–	2	16	4	16.1
P. masago	1	19	6.0	19	1	7.1	–	18	2	7.1	2	24	13	1	15.3
P. javanicus	–	28	6.0	28	–	7.0	–	28	–	7.0	–	35	27	1	15.5

	LR				TR				PreD					
	27	28	29	x	8	9	10	x	6	7	8	9	10	x
Holotype of *P. gastrospilos*	2	–	–	27.0	1	–	–	8.0	–	1	–	–	–	7.0
P. gastrospilos (Phuket)	14	8	–	27.4	9	2	–	8.2	–	11	–	–	–	7.0
P. gastrospilos (Taiwan)	22	18	–	27.5	13	7	–	8.4	–	20	–	–	–	7.0
P. avicennia	–	19	5	28.2	–	–	12	10.0	–	–	–	11	1	9.1
P. masago	–	31	8	28.2	20	–	–	8.0	–	–	3	16	1	8.9
P. javanicus	–	41	25	28.4	17	16	–	8.5	4	24	4	–	–	7.0

	SDP					VC		
	5	6	7	8	x	25	26	x
Holotype of *P. gastrospilos*	1	–	–	–	5.0	–	1	26.0
P. gastrospilos (Phuket)	9	2	–	–	5.2	–	3	26.0
P. gastrospilos (Taiwan)	2	18	–	–	5.9	–	11	26.0
P. avicennia	–	–	12	–	7.0	–	3	26.0
P. masago	–	3	11	6	7.2	4	2	25.3
P. javanicus	1	23	9	–	6.2	1	7	25.9

estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang and H. M. Huang, 15 January, 2010; NTOUP 201008-427, 19 specimens, 17.4-30.6 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang and H.M. Huang, 22 March, 2010; NTOUP 201008-428, 35 specimens, 20.7-30.6 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang and H. M. Huang, 22 April, 2010; NTOUP 201008-429, 21 specimens, 20.3-29.5 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang and H. M. Huang, 13 May, 2010; NTOUP 201008-430, 12 specimens, 26.0-30.1 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang and H. M. Huang, 28 June, 2010; NTOUP 201008-431, 26 specimens, 20.5-31.9 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang and H. M. Huang, 15 July, 2010; NTOUP 201202-112, 6 specimens, 18.3-21.3 mm SL, estuary of Chienpu River, Kinmen County, Taiwan, coll. S. P. Huang, 22 November, 2011; NTOUP 201202-113, 3 specimens, 13.3-17.6 mm SL, Chingyuan Lake, Lieyu Island, Kinmen County, Taiwan, coll. S. P. Huang, 24 November, 2011.

Diagnosis

Mugilogobius chulae can be distinguished from its congeners by the unique combination of the following features: (1) fin rays: D2 I/6-8 (modally 7), A I/6-7 (modally 7); P 13-15 (modally 14); second to fourth spines of first dorsal fin always extended into a filament, second and third spines longest; (2) squamation: longitudinal scale rows 28-30 (modally 29), predorsal scales 11-14 (modally 12-13); (3) specific coloration: parallel oblique broad stripes on both neck and on dorsum below first dorsal fin. Two black round or elliptical spots vertically aligned on caudal fin base.

Description

Body elongate, sub-cylindrical anteriorly and compressed posteriorly. Head large. Snout rounded. Eye rather large. Mouth medium sized, maxillary extending to the vertical of center of pupil in males, but maxillary extending to the vertical of anterior margin of orbit in females. Anterior nasal opening as a short tube, posterior nasal opening as a round hole. Gill-opening extending ventrally forward to the middle vertical line of the operculum. VC 10 + 16 = 26 (in 6).

Fins.-D1 VI; D2 I/6-8 (modally 7); A I/6-7 (modally 7); P 13-15 (modally 14). Second to fourth spines of first dorsal fin always filamentous, and second and third spines longest, in males when pressed down maximally extending to fifth ray of second dorsal fin; when pressed down in females merely

Table 4. Frequency distribution of meristic features of the three newly recorded *Mugilogobius* species and other compared species from Taiwan.

	D1			D2					A				P					
	VI	VII	x	I/6	I/7	I/8	I/9	x	I/6	I/7	I/8	x	13	14	15	16	17	x
M. abei	15	–	6.0	–	–	15	–	8.0	–	–	15	8.0	–	–	2	19	9	16.2
M. cavifrons	9	1	6.1	–	–	9	1	8.1	–	1	9	7.9	–	–	5	13	1	15.8
M. chulae	25	–	6.0	2	22	1	–	7.0	1	24	–	7.0	2	38	10	–	–	14.2
M. mertoni	10	–	6.0	–	10	–	–	7.0	–	10	–	7.0	–	2	12	3	–	15.6
M. myxodermus	9	1	6.1	–	1	9	–	7.9	–	2	8	7.8	–	–	14	3	1	15.3

	LR																
	28	29	30	31	32	33	34	35	36	37	~	44	45	46	47	48	x
M. abei	–	–	–	–	–	–	–	18	9	3	–	–	–	–	–	–	35.5
M. cavifrons	–	–	–	–	–	–	–	–	–	–	–	2	7	8	2	1	45.7
M. chulae	9	28	13	–	–	–	–	–	–	–	–	–	–	–	–	–	29.1
M. mertoni	–	–	12	8	–	–	–	–	–	–	–	–	–	–	–	–	30.4
M. myxodermus	–	–	–	–	–	8	10	2	–	–	–	–	–	–	–	–	33.7

	TR									PreD													
	8	9	10	11	12	13	14	15	x	11	12	13	14	15	16	17	18	19	20	21	22	23	x
M. abei	–	–	15	–	–	–	–	–	10.0	–	–	–	2	1	5	5	1	1	–	–	–	–	16.3
M. cavifrons	–	–	–	–	–	–	7	3	14.3	–	–	–	–	–	–	–	–	1	–	4	3	2	21.5
M. chulae	3	22	–	–	–	–	–	–	8.9	3	10	10	2	–	–	–	–	–	–	–	–	–	12.4
M. mertoni	–	3	7	–	–	–	–	–	9.7	–	2	4	3	1	–	–	–	–	–	–	–	–	13.3
M. myxodermus	–	–	10	–	–	–	–	–	10.0	–	–	–	2	1	4	3	–	–	–	–	–	–	15.8

	SDP								VC			
	7	8	9	10	11	12	13	x	25	26	27	x
M. abei	–	–	7	8	–	–	–	9.5	1	5	–	25.8
M. cavifrons	–	–	–	–	3	5	2	11.9	–	6	–	26.0
M. chulae	5	20	–	–	–	–	–	7.8	–	6	–	26.0
M. mertoni	–	5	5	–	–	–	–	8.5	–	4	–	26.0
M. myxodermus	–	–	10	–	–	–	–	9.0	–	9	1	26.1

reaching the first ray. Anal fin inserted below first branched ray of second dorsal fin. Pelvic fin large and rounded. Caudal fin rounded.

Scales.-LR 28-30 (modally 29); TR 8-9 (modally 9); PreD 11-14 (modally 12-13); SDP 7-8 (modally 8). Body covered with ctenoid scales. Predorsal region covered with cycloid scales. Belly covered with smaller cycloid scales. Cheek naked. Operculum covered with many small cycloid scales.

Head lateral-line system

Head canals- Head pores absent.

Sensory papillae- Row *a* short, about half of orbit diameter. Row *b* with densely-set papillae, starting from vertical of rear margin of pupil, and extending backward to rear margin of preoperculum. Row *c* short, about half of pupil diameter, Row *c1* short, about two-thirds of pupil diameter, starting from vertical of rear margin of orbit. Row *cp* and Row *d* longer than eye diameter. Row *s* with three rows of papillae. Row *p* completed. Opercular rows with rows *os*, *oi* and *ot*. Rows *oi* and *ot* closed. Row *f* with a pair of papillae.

Coloration in life.-Head and body with pale grayish brown or pale yellowish brown background, flank with about 7 irregular blackish brown stripes. Dorsum below first dorsal fin and neck both with a broad oblique stripe. Scales with dark margin, belly pale yellowish-white. Cheek with a horizontal stripe, starting from lower margin of eye, and extending to rear margin of preoperculum; operculum with a horizontal stripe starting from anterior margin extending to rear margin of

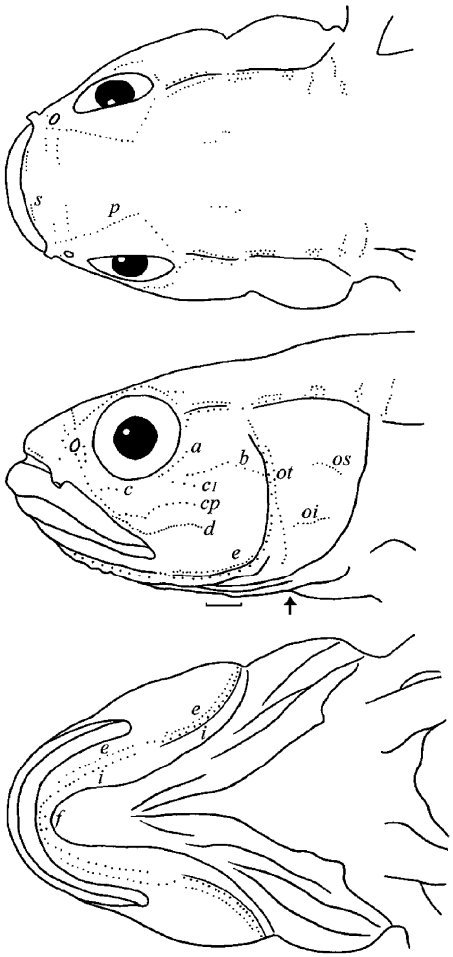

Fig. 4. Head lateral-line system of *Mugilogobius chulae*, NTOUP 201008-430, male, 29.5 mm SL. Bar = 1 mm. Drawing by Shih-Pin Huang.

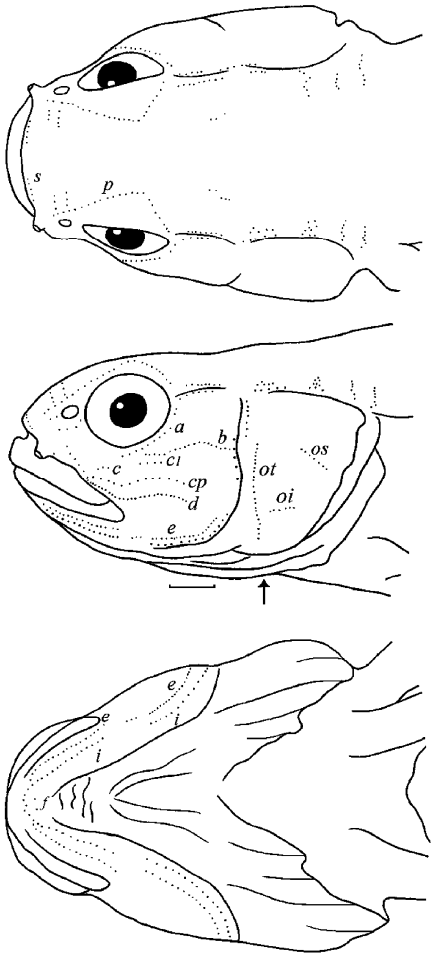

Fig. 5. Head lateral-line system of *Mugilogobius mertoni*, NTOUP 201008-434, male, 26.0 mm SL. Bar = 1 mm. Drawing by Shih-Pin Huang.

operculum. Pectoral fin base with a blackish brown spot. First dorsal fin with a big black spot starting from third spine, extending to rear margin, membrane in outer margin of black spot usually yellow in adult males, and merely grayish white in females. Anal fin usually red orange in adult males, and grayish-white in females. Two black round or elliptical spots vertically aligned on caudal fin base, behind the spots, with a vertical bar. Caudal fin membrane pale grayish black in males, and pale grayish white in females.

Distribution in Taiwan:
This species is merely known from Yilan County, Kouhsiung County, Kinmen County, Taiwan.

Mugilogobius mertoni (Weber, 1911)
(Figs. 1e, 5)

Gobius mertoni Weber, 1911: 37 (Panua Bori River near Sungei Manumbai, Aru Island, Indonesia) [49].
Gobius durbanensis Barnard, 1927: 70 (Durban Bay, South Africa) [5].
Tamanka mindora Herre, 1945b: 75 (Hacienda Waterous, Mangarin, Mindoro, Philippines) [25].
Vaimosa layia Herre, 1953: 13 (Layia, Batangas Province, Luzon, Philippines) [26].
Tamanka mertoni: Koumans, 1953: 160 [31].
Stigmatogobius inhacae Smith, 1959: 198 (Inhaca, Mozambique) [45].
Mugilogobius inhacae: Smith and Heemstra, 1986: 795 [44].
Mugilogobius mertoni: Larson, 2001: 109; Larson and Lim, 2005: 119 [32, 33].

Materials examined:
Taiwan: NTOUP 201008-432, 2 specimens, 19.3-21.8 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang and H. M. Huang, 25 February, 2010; NTOUP 201008-433, 24.5 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang and H. M. Huang, 22 March, 2010; NTOUP 201008-434, 26.0 mm SL, estuary of Zhuan River, Toucheng Township, Yilan

County, Taiwan, coll. S. P. Huang and H. M. Huang, 22 April, 2010; NTOUP 201202-101, 5 specimens, 18.3-19.6 mm SL, estuary of Zhuan River, Toucheng Township, Yilan County, Taiwan, coll. S. P. Huang and Y. H. Kung, 15 February, 2010.

Palau: NTOUP 201202-102, 3 specimens, 12.9-17.0 mm SL, Mangrove of Palau, coll. I-S. Chen and J. T. Chen, 17 November, 2006.

Diagnosis

Mugilogobius mertoni can be distinguished from its congeners by the unique combination of the following features: (1) fin rays: D2 I/7, A I/7, P 14-16 (modally 15); First dorsal fin first spine elongated and filamentous in adult male; (2) squamation: longitudinal scale rows 30-31 (modally 30), predorsal scales 12-15 (modally 13); (3) specific coloration: First dorsal fin with a big black spot starting from third spine, extending to rear margin; caudal fin base with a vertical black bar, the front of the bar, with two vertically aligned yellow spots.

Description

Body elongate, subcylindrical anteriorly and compressed posteriorly. Head large. Snout rounded. Eye rather large. Mouth medium sized, maxillary extending to the vertical of anterior margin of pupil in males, but maxillary extending to the vertical of anterior margin of orbit in females. Anterior nasal opening as a short tube, posterior nasal opening as a round hole. Gill-opening extending ventrally forward to the middle vertical line of operculum. VC 10 + 16 = 26 (in 4).

Fins.-D1 VI; D2 I/7; A I/7; P 14-16 (modally 15). First spine of first dorsal fin extended into a filament in adult males, maximally extending to first branched ray of second dorsal fin when pressed down; never elongated and filamently extended in females. Anal fin inserted below first branched rays of second dorsal fin. Pelvic fin large and rounded. Caudal fin rounded.

Scales.-LR 30-31 (modally 30); TR 9-10 (modally 10); PreD 12-15 (modally 13)；SDP 8-9 (modally 8-9). Body covered with ctenoid scales. Predorsal region covered with cycloid scales. Belly covered with smaller cycloid scales. Cheek naked. Operculum covered with many small cycloid scales.

Head lateral-line system

Head canals- Head pores absent.

Sensory papillae- Row *a* short, about two-thirds of orbit diameter, and starting from anterior margin of pupil. Row *b* with densely-set papillae, starting from vertical of rear margin of pupil, and extending backward to rear margin of preoperculum. Row *c* short, about one-thirds of pupil diameter, Row *c1* short, about two-thirds of pupil diameter, starting from vertical of center of orbit. Row *cp* and Row *d* longer than eye diameter. Row *s* with three rows of papillae. Row *p* complete. Opercular rows with rows *os*, *oi* and *ot*. Rows *oi* and *ot* slightly separated. Row *f* with a pair of papillae.

Coloration in life.-Head and body with pale yellowish brown background, flank with about 7 irregular blackish brown stripes. Scales with dark margin, belly pale yellowish white. Cheek with a horizontal stripe, starting from rear margin of upper lip, and extending to rear margin of operculum. Pectoral fin base with a blackish brown spot. First dorsal fin with a big black spot starting from third spine, extending to rear margin, membrane in outer margin of black spot usually yellow in adult males, and merely grayish white in females. Second dorsal fin membrane yellow in males, and pale gray in females. Pelvic fin membrane grayish black in males, and pale gray in females. Anal fin membrane yellow in male, and pale grayish brown in females. Caudal fin base with a vertical black bar, the front of the bar, with two vertically aligned yellow spots. Caudal fin membrane pale grayish brown in males, and pale grayish white in females.

Distribution in Taiwan:
So far, this species merely known from Tainan County, Yilan County in Taiwan.

Mugilogobius myxodermus (Herre, 1935)

(Figs. 1f, 6)

Ctenogobius myxodermus Herre, 1935: 395 (Lingnan University, Honam Island,Canton, China); Chu and Wu, 1965: 130 [16, 22].
Gobius myxodermus: Nichols, 1943: 264 [36].
Rhinogobius myxodermus: Anonymous, 1976: 209 [3].
Mugilogobius myxodermus: Zheng and Wu, 1985: 327; Ding, 1994: 519; Wu and Zhong, 2008: 499 [19, 51, 52].

Materials examined:
Taiwan: NTOUP 201008-435, 32.9 mm SL, lower reach of Yangliao River, Xinwu Township, Taoyuan County, Taiwan, coll. S. P. Huang and H. M. Huang, 9 July, 2010; NTOUP 201008-436, 29.6 mm SL, lower reach of Xinwu River, Xinwu Township, Taoyuan County, Taiwan, coll. S. P. Huang and H. M. Huang, 28 July, 2010; NTOUP 201008-437, 8 specimens, 17.0-19.6 mm SL, a pond near Zhongli City, Taoyuan County, Taiwan, coll. S. P. Huang and H. M. Huang, 28 July, 2010; NTOUP 201202-110, 32.1 mm SL, lower reach of Chienpu River, Kinmen Island, Taiwan, coll. S. P. Huang, 19 May, 2010; NTOUP 201202-111, 2 specimens, 21.6-27.1 mm SL, Shuangli Lake, Kinmen Island, Taiwan, coll. S. P. Huang, 20 May, 2010.

China: NTOUP 201008-438, 1 specimen, 24.3 mm SL, a stream near Meizhou City, Guangdong Province, Western drainage of the Hanjiang River basin, China, coll. S. P. Huang and M. Chang, 27 July, 2005.

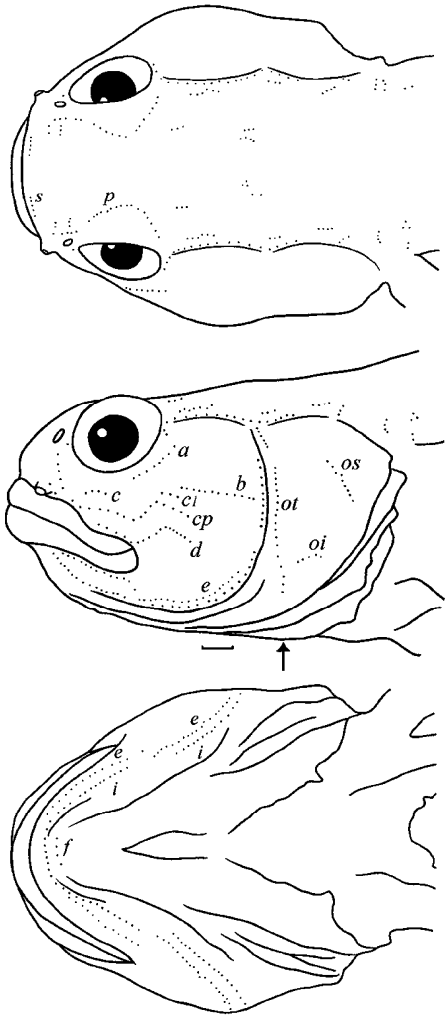

Fig. 6. Head lateral-line system of *Mugilogobius myxodermus*, NTOUP 201008-435, male, 32.9 mm SL. Bar = 1 mm. Drawing by Shih-Pin Huang.

Diagnosis

Mugilogobius myxodermus can be distinguished from its congeners by the unique combination of the following features: (1) fin rays: D2 I/7-8 (modally 8), A I/7-8 (modally 8), P 15-17 (modally 15); all spines of the first dorsal fin always elongated and filamentous in adult males; (2) squamation: longitudinal scale rows 33-35 (modally 34), predorsal scales 14-17 (modally 16); (3) specific coloration: flank with many irregular thin oblique orange or brown stripes when joined forming indistinct X or V shapes; cheek with five irregular oblique stripes, starting from lower margin of eye, and extending to lower margin of cheek; two vertically aligned black bars on caudal fin base.

Description

Body elongate, subcylindrical anteriorly and compressed posteriorly. Head large. Snout rounded. Eye rather large. Mouth medium sized, maxillary extending to the to posterior margin of pupil in males, but maxillary extending to the vertical of anterior margin of orbit in females. Anterior nasal opening as a short tube, posterior nasal opening as a round hole. Gill-opening extending ventrally forward to the middle vertical line of operculum. VC 10 + 16 = 26 (in 9) and 10 + 17 = 27(in 1).

Fins.-D1 VI-VII (modally VI), D2 I/7-8 (modally 8), A I/7-8 (modally 8), P 15-17 (modally 15). All spines of first dorsal fin always elongated and filamentous in adult males, and third and fourth spines longest, maximally extending to first branched ray of second dorsal fin when pressed, but never filamentous in female. Anal fin inserted below first branched rays of second dorsal fin. Pelvic fin large and rounded. Caudal fin rounded.

Scales.-LR 33-35 (modally 34); TR 10; PreD 14-17 (modally 16); SDP 9. Body covered with ctenoid scales. Predorsal region covered with cycloid scales. Belly covered with smaller cycloid scales. Cheek naked. Operculum covered with many small cycloid scales.

Head lateral-line system

Head canals- Head pores absent.
Sensory papillae- Row *a* short, about half of orbit diameter, and starting from rear margin of pupil. Row *b* with densely-set papillae, starting from vertical of rear margin of pupil, and extending backwards to rear margin of preoperculum. Row *c* short, about half of pupil diameter, Row *c1* short, about half of pupil diameter, starting from vertical of rear margin of orbit. Row *cp* and Row *d* longer than eye diameter. Row *s* with three rows of papillae. Row *p* complete. Opercular rows with rows *os*, *oi* and *ot*. Rows *oi* and *ot* slightly separated. Row *f* with two pairs of papillae.

Coloration in life.-Head and body with pale yellowish brown or pale grayish brown background, flank with many irregular thin joined oblique orange or brown stripes forming indistinct X or V shapes. Scales with dark margin, belly pale yellowish white. Cheek with five irregular oblique stripes, starting from lower margin of eye, and extending to lower margin of cheek. First dorsal fin with a horizontal grayish black stripe, and with a big black spot starting from fifth spine extending to rear margin of first dorsal fin, membrane in outer margin of black spot usually yellow in adult males, and usually grayish white in females. Pectoral fin base with a blackish brown spot. Anal fin usually red orange in adult males, and yellowish brown in females. Two vertically aligned black bars on caudal fin base. Caudal fin membrane pale gray in males, and pale grayish white in females. Caudal fin membrane usually with 1-2 vertical lines in males, and with 3-4 vertical lines in females.

Distribution in Taiwan:
So far, this species is merely known from Taoyuan County and Kinmen County in Taiwan.

ACKNOWLEDGMENTS

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