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Taxonomic review and molecular phylogenetics of the reef gobiid genus *Fusigobius* from Taiwan with comments on a new species from South China Sea

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Abstract

A taxonomic review is given for the gobiid genus *Fusigobius,* known for its cryptic and inconspicuous body coloration, from the waters of Taiwan. Six species of *Fusigobius* have been formally confirmed from Taiwan, including four nominal species (*F. duospilus*, *F. humeralis*, *F. inframaculatus*, and *F. neophytus*), a newly recorded *F. melacron*, and a new species, *Fusigobius taipinensis* **n. sp.**, recently collected from the South China Sea and southern Taiwan. The new species is morphologically close to *F. duospilus,* but can be clearly distinguished by several important coloration features on the first dorsal fin or body. Phylogenetic analysis and species delimitation inferred from partial sequences of the mtDNA ND5 gene support *F. taipinensis* as a valid discrete species and *F. melacron* as the plesiomorphic state for *Fusigobius*.

Key words: Fish fauna, Marine goby, New species, *Fusigobius taipinensis*, Nansha, Taiping Island

Introduction

Gobioid fishes are a large family of marine teleost fish, accounting for 495 known (259 valid) genera and 2,962 known (1,984 valid) species (Fricke *et al.* 2023) worldwide. Among these, a medium-small sized benthic reef gobiid, genus *Fusigobius,* inhabits the sandy bottoms around reefs and coral reef areas in subtropical to tropical regions of the Indo-Pacific region. Due to its cryptic and inconspicuous body coloration, merely five Indo-Pacific species of *Fusigobius* had been described before 2000. These include *F. neophytus* (Günther, 1877), *F. longispinus* Goren, 1978, *F. duospilus* Hoese & Reader, 1985, *F. signipinnis* Hoese & Obika, 1988, *F. inframaculatus* Randall, 1994, and *F. aureus* Chen & Shao, 1997. Randall (2001) published five new species of *Fusigobius* under the genus *Coryphopterus,* however, all Asian ichthyologists still recognize *Fusigobius* as a valid genus (Randall 1995; Akihito in Nakabo 2000, 2002; Wu *et al.* 2009). These new species include *F. gracilis*, *F. humeralis*, *F. maximus*, *F. melacron*, and *F. pallidus.*

In the Taiwan Fish Database, there is some uncertainty regarding the categorization of several species, including *F. duospilus*, *F. humeralis*, *F. inframaculatus*, *F. longispinus*, *F. maximus*, *F. melacron*, *F. neophytus*, and *F. signipinnis* (Shao 2024). Of these, *F. longispinus,* a Red Sea species, should be reclassified as *F. inframaculatus,* according to

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Randall (2001) and Nakabo (2013). The classifications of *F. maximus* and *F. signipinnis* are not fully confirmed due to a lack of voucher specimens collected. During our SCUBA diving surveys around Taiwanese waters, including field expeditions in Dongsha and Nansha Taiping Island of the South China Sea, more species emerged, confirming the presence of *Fusigobius* diversity around the reef habitat. The aim of this paper is to document the diagnosis of whole species diversity, report a new species and a new record from the South China Sea and Taiwan. A key to all nominal species is provided, and the molecular phylogenetic insight of current species found in Taiwan is addressed and reported herein.

Materials and methods

Sample collections

Specimens of all nominal species of *Fusigobius* were collected by our team using a handnet while SCUBA diving. All counts and measurements were taken from specimens preserved in 10% formalin. Descriptions of the color patterns were based on fresh specimens. The terminology used for the pores of the cephalic sensory canals and the free neuromast organ (sensory papillae) is from Miller (1988), based on Sanzo (1911). Meristic characters were assessed following the methods of Masuda *et al.* (1984) and Chen and Shao (1997). Morphometric characters were measured based on Chen and Shao (1997). Type specimens of new *Fusigobius* species and other nominal species from Taiwan collected by our team are deposited at the fish collection of the National Taiwan Ocean University, Keelung (NTOUP). Meristic abbreviations include D1, D2 (first and second dorsal fins); A (anal fin); P (pectoral fins); V (pelvic/ventral fin); LR (longitudinal scale rows); SD1P (scale rows between first dorsal fin origin and upper pectoral fin base); and TR (transverse scale rows).

Molecular phylogenetics

The DNA samples of gobiid fishes were preserved in 95% ethanol before DNA extraction. All DNA extractions of the gobies were done according to the general protocols of the phenol-chloroform method (Sambrook *et al.* 1989; Chen *et al.* 2002). The partial mitochondrial NADH dehydrogenase subunit 5 (ND5) gene was selected as commonly used for other gobies (Mukai *et al.* 2005; Tang *et al.* 2010; Huang *et al.* 2013; Nabilsyafiq *et al.* 2019). The DNA fragments of about 1 Kbp of the mtDNA ND5 gene were amplified by the polymerase chain reaction (PCR) using primers based on the flanking region that were designed from the sequences of PGLeuD2 (5'-AGG AAC CAA AAA CTC TTG GTG CAA ATC CAA GT-3') and ND5mR (5'-CCT ATT TTK CGG ATG TCY TG-3'). PCR was done in a Model 9700 thermal cycler (Perkin-Elmer), and 30–40 cycles were carried out. The 25 μL reaction volume contained 14.4 μL of sterile distilled water, 2.5 μL of 10× PCR buffer (Takara), 2.0 μL of dNTP (2.5 mM each), 2.5 μL of each primer (5 μM), 0.1 μL of 0.5 unit Ex Taq (Takara), and 1.0 μL of template. The thermal cycle profile was as follows: denaturation at 94 °C for 15 seconds, annealing at 50° C for 15 seconds and extension at 72 ° C for 60 seconds. A negative control without template DNA was carried out for each run of PCR. The PCR products were run on a 1.0% L 03 agarose gel (Takara) and stained with ethidium bromide for band characterization under ultraviolet trans-illumination. Double-stranded PCR products were purified using a kit (Boehringer Mannheim, High Pure PCR Product Purification kit) before undergoing direct cycle sequencing with dye-labeled terminators (ABI Big-Dye kit). The sequencing primers used were either the same as those for PCR amplification or another two sequencing primers as Fu-ND5-F3 (5'-TAY GGS CGA GCM GAC GCA AA-3') and FND5-mR1 (5'-GTR TTT GCG TCD GCT CGB CC-3'). All sequencing reactions were performed according to the manufacturers' instructions. Labeled fragments were analyzed using an ABI Model 377-64 DNA sequencer (ABI). Nucleotide sequence alignment was done manually.

Phylogenetic trees were reconstructed using both Bayesian and maximum likelihood (ML) methods. The Bayesian method was applied using the program MrBayes 3.2.7 (Huelsenbeck & Ronquist 2001) with 1 million steps in a Monte Carlo Markov Chain (MCMC) simulation. The effective sample sizes (ESS) of parameters sampled from the MCMC were 1,064 (acceptable ESS is >200). Trees were sampled every 1,000 generations, with the initial 25% being discarded as burn-in to ensure that the Average Standard Deviation of Split Frequencies (ASDSF) is

<0.01. Additionally, the convergence diagnostic PSRF (Potential Scale Reduction Factor) should approach 1 as runs converge (Gelman & Rubin 1992). The ML method was applied using the program PhyML with 1,000 bootstraps. The best substitution model evaluated from MEGA11 (Tamura *et al.* 2021) with invariable sites (TN93+G+I, I=0.33, G=1.03, Ts/Tv ratio=2.49) was selected for constructing a PhyML tree, while GTR+G+I was selected for constructing a Bayesian tree with both phylogenetic trees using *Odontobutis sinensis* (GenBank accession numbers: NC022818), *Bathygobius fuscus* (AB429401), *Eleotris acanthopoma* (NC004415C), and *Eleotris oxycephala* (NC026902) as the outgroups. Nodes presenting a posterior probability ≥0.95 or with bootstrap values ≥70% were considered well supported. To identify the number of taxonomic entities within the dataset, species delimitation methods such as PTP (Zhang *et al.* 2013), bPTP (Zhang *et al.*, 2013), ABGD (Puillandre *et al.* 2012), and ASAP (Puillandre *et al.* 2021) were used. These methods are based on the maximum likelihood solution, the highest Bayesian supported solution, and genetic distances, which disregard phylogenetic relationships within the dataset and operate on Bayesian phylogenetic tree and sequences to build species partitions.

Systematics

Fusigobius duospilus Hoese & Reader, 1985

(Figs. 1A, 3A; Table 2)

Fusigobius duospilus Hoese & Reader 1985: 2 (in part) (Escape Reef, Great Barrier Reef, Australia); Hoese & Obika 1988: 286; Chen *et al.* 1997: 129; Chen & Shao 1997: 90; Akihito in Nakabo 2000: 1247; Mundy 2005: 475; Hiroshi *et al.* 2007: 67; Chen *et al.* 2010: 489; Shen 2011: 685.

Coryphopterus duospilus: Randall 1995: 797; Randall *et al.* 1997: 529; Randall & Earle 2000: 19; Randall 2001: 208; Greenfield & Randall 2004: 517; Randall 2005: 524.

Materials examined. NTOUP 2006-08-712, 22.1 mm SL, Chao-Jing Park, Keelung City, 15 m, coll. I-S Chen *et al.*, August 25, 2006; NTOUP 2006-09-733, 25.4 mm SL, Hongchaikeng, Kenting, Pingtung County, 15 m, coll. I-S Chen *et al.*, September 14, 2006; NTOUP 2006-09-734, 28.6 mm SL, Hongchaikeng, Kenting, Pingtung County, 15 m, coll. I-S Chen *et al.*, September 14, 2006; NTOUP 2006-09-735, 25.1 mm SL, Hongchaikeng, Kenting, Pingtung County, 15 m, coll. I-S Chen *et al.*, September 14, 2006; NTOUP 2006-09-739, 27.7 mm SL, Hongchaikeng, Kenting, Pingtung County, 15 m, coll. I-S Chen *et al.*, September 14, 2006; NTOUP 2008-06-398, 33.3 mm SL, Chao-Jing, Keelung City, 10 m, coll. I-S Chen *et al.*, June 26, 2008; NTOUP 2010-09-467, 28.9 mm SL, Nanwan, Kenting, Pingtung County, 20 m, coll. M-J Jiang *et al.*, May 26, 2010; NTOUP 2010-09-470, 24.6 mm SL, Nanwan, Kenting, Pingtung County, 20 m, coll. M-J Jiang *et al.*, May 27, 2010; NTOUP 2012-03-248, 28.1 mm SL, Longshiadong, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, August 12, 2010; NTOUP 2012-03-250, 31.0 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, August 13, 2010; NTOUP 2012-03-251, 28.6 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, August 13, 2010; NTOUP 2012-03-252, 16.7 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, August 13, 2010; NTOUP 2012-03-258, 25.5 mm SL, Houshih Fringing Reef, 20 m, Liouciou Township, Pingtung County, coll. I-S Chen *et al.*, August 13, 2010; NTOUP 2012-03-275, 16.1 mm SL, North-side of atoll, Dongsha Island, Kaohsiung City, 20 m K-T Chen, June 19, 2011; NTOUP 2012-06-503, 3: 20.9–21.9 mm SL, Outer-side of atoll, Dongsha Island, Kaohsiung City, 20 m K-T Chen, July7, 2011; NTOUP 2012-06-504, 2: 20.1–20.6 mm SL, Outer-side of atoll, Dongsha Island, Kaohsiung City, 20 m K-T Chen, July 7, 2011; NTOUP 2012-06-505, 28.4 mm SL, Outer-side of atoll, Dongsha Island, Kaohsiung City, 20 m K-T Chen, July 7, 2011; NTOUP 2012-06-506, 4: 20.2–27.8 mm SL, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, July 7, 2007; NTOUP 2012-06-507, 4: 17.8–32.6 mm SL, Huapingyan, Liouciou Township, Pingtung County, 10 m, coll. I-S Chen *et al.*, July 7, 2007; NTOUP 2012-06-508, 3: 24.2–36.2 mm SL, Meirendong, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, July 10, 2007; NTOUP 2012-06-509, 4: 12.0–27.6 mm SL, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, July 8, 2007; NTOUP 2012-06-510, 4: 27.6–31.6 mm SL, Shiangjieuwan, Kenting, Pingtung County, 20 m, coll. I-S Chen *et al.*, September 8, 2008; NTOUP 2012-06-511, 2: 25.2–28.4 mm SL, Hongchiakeng, Kenting, Pingtung County, 15 m, coll. I-S Chen *et al.*, September 9, 2008; NTOUP 2012-06-512, 30.8 mm SL, Hongchiakeng, Kenting, Pingtung County, 15 m, coll. I-S Chen *et al.*, September 5, 2009; NTOUP 2012-06-513, 33.8 mm SL, Shanhai, Kenting, Pingtung County, 15 m, coll. K-T Chen,

May 3, 2011; NTOUP 2012-06-514, 25.1 mm SL, Shanhai, Kenting, Pingtung County, 15 m, coll. K-T Chen, May 3, 2011; NTOUP 2012-06-515, 17.2 mm SL, Wanlitong, Kenting, Pingtung County, 15 m, coll. K-T Chen, May 3, 2011; NTOUP 2012-06-516, 23.8 mm SL, Hongchaikeng, Kenting, Pingtung County, 15 m, coll. K-T Chen, May 3, 2011; NTOUP 2012-06-517, 21.3 mm SL, Hongchaikeng, Kenting, Pingtung County, 15 m, coll. K-T Chen, May 3, 2011; NTOUP 2012-06-518, 3: 16.1–20.5 mm SL, Baisha, Kenting, Pingtung County, 15 m, coll. K-T Chen, May 4, 2011; NTOUP 2012-06-519, 17.2 mm SL, Hongchaikeng, Kenting, Pingtung County, 15 m, coll. K-T Chen, May 5, 2011; NTOUP 2012-06-520, 25.7 mm SL, Longshiadong, Liouciou Township, Pingtung County, 15 m, coll. K-T Chen, August 24, 2011; NTOUP 2012-06-521, 24.9 mm SL, Longshia dong, Liouciou Township, Pingtung County, 15 m, coll. K-T Chen, August 24, 2011; NTOUP 2012-06-522, 42.0 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. K-T Chen, August 24, 2011; NTOUP 2012-06-523, 2: 26.1–26.9 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. K-T Chen, August 24, 2011; NTOUP 2012-06-524, 2: 29.9–35.2 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. K-T Chen, August 24, 2011; NTOUP 2012-06-525, 6: 24.9–35.2 mm SL, Shanfu fish port, Liouciou Township, Pingtung County, 10 m, coll. K-T Chen, August 25, 2011; NTOUP 2012-06-526, 3: 23.5–28.8 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. K-T Chen, August 25, 2011; NTOUP 2012-06-527, 25.8 mm SL, Mianhua Islet, Keelung City, 20 m, coll. I-S Chen *et al.*, September 6, 2011; ASIZP0057529, 3: 25.8–34.6 mm SL, Tiaoshi, Kenting, Pingtung County, coll. J-P Chen, November 2, 1995.

Diagnosis. D1 VI; D2 I/9; A I/8; P modally 19; LR modally 25; TR7; SD1P 3. Pelvic fin with weak frenum. First dorsal fin with a large vertical black line in front of 3rd spinous ray; second black blotch around 5th to 6th spinous rays. Body with many small brown spots. Caudal fin base with a large triangular black mark.

Distribution. Widely distributed in the Indo-West Pacific region. It can be found in northern, eastern, southern Taiwan, as well as other islands.

Fusigobius humeralis (Randall, 2001)

(Fig. 1B; Table 2)

Coryphopterus humeralis Randall 2001: 212 (Embudu I., S. side, south Malé Atoll, Republic of Maldives); Randall 2005: 524. *Fusigobius humeralis*: Akihito *et al.* in Nakabo 2002: 1248; Hiroshi *et al.* 2007: 67; Chen *et al.* 2010: 490; Shen 2011: 685.

Materials examined. NTOUP 2006-09-744, 16.0 mm SL, Wanlitong, Kenting, Pingtung County, 15 m, coll. I-S Chen *et al.*, September 14, 2006; NTOUP 2006-09-756, 23.4 mm SL, Hongchaikeng, Kenting, Pingtung County, 15 m, coll. I-S Chen *et al.*, September 15, 2006; NTOUP 2006-09-757, 18.5 mm SL, Hongchaikeng, Kenting, Pingtung County, 15 m, coll. I-S Chen *et al.*, September 15, 2006; NTOUP 2010-09-469, 18.3 mm SL, Hongchaikeng, Kenting, Pingtung County, 15 m, coll. M-J Jiang *et al.*, May 26, 2010; NTOUP 2010-09-473, 23.7 mm SL, Dalaogoo, Kenting, Pingtung County, 20 m, coll. M-J Jiang *et al.*, May 27, 2010; NTOUP 2012-03-249, 19.2 mm SL, Sanbanwan, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, August 12, 2010; NTOUP 2012-03-253, 25.4 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, August 13, 2010; NTOUP 2012-03-254, 21.4 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, August 13, 2010; NTOUP 2012-03-255, 22.2 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, August 13, 2010; NTOUP 2012-03-256, 15.6 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, August 13, 2010; NTOUP 2012-03-259, 17.4 mm SL, Houshih Fringing Reef, Liouciou Township, Pingtung County, 20 m, coll. I-S Chen *et al.*, August 13, 2010; NTOUP 2012-03-260, 24.0 mm SL, Shanfu fish port, Liouciou Township, Pingtung County, Intertidal zone, coll. I-S Chen *et al.*, August 13, 2010; NTOUP 2012-06-501, 23.4 mm SL, Longdong, Gongliao, New Taipei City, 10 m, coll. I-S Chen and K-T Chen, June 14, 2011; NTOUP 2012-06-502, 22.6 mm SL, Longdong, Gongliao, New Taipei City, 10 m, coll. I-S Chen and K-T Chen, June 14, 2011; NTOUP 2012-06-528, 25.4 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, July 10, 2007; NTOUP 2012-06-529, 24.0 mm SL, Wanlitong, Kenting, Pingtung County, 15 m, coll. I-S Chen *et al.*, September 10, 2008; NTOUP 2012-06-530, 23.1 mm SL, Shirang, Green Island, Taitung, 15 m, coll. I-S Chen *et al.*, April 26, 2009; NTOUP 2012-06-531, 23.6 mm SL, Longmen port, Orchid Island, Taitung, 15 m, coll. M-J Jiang *et al.*, September 8, 2009; NTOUP 2012-06-532, 2: 20.0-22.2 mm SL, Hongchaikeng, Kenting, Pingtung, 15 m, coll. M-J Jiang *et al.*, September 5, 2009; NTOUP 2012-06-533, 29.2 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. K-T Chen and Y-H

Gong, August 24, 2011; NTOUP 2012-06-534, 2: 20.0–25.5 mm SL, Shanfu fish port, Liouciou Township, Pingtung County, 15 m, coll. K-T Chen and Y-H Gong, August 24, 2011; NTOUP 2012-06-535, 18.9 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m, coll. K-T Chen and Y-H Gong, August 25, 2011; ASIZP0056482, 29.0 mm SL, Tanziwan, Pingtung County, coll. J-P Chen, May 25, 1987.

Diagnosis. D1 VI; D2 I/9; A I/8; P modally 18; LR modally 25; TR 7; SD1P 3. Second and 3rd spinous rays longer in D1. Pelvic fin with frenum. Head and body with many yellowish brown round spots. A black round blotch above pectoral fin base about equal to width of pupil. Caudal fin base with similar black blotch.

Distribution. Widely distributed in the Indo-West Pacific region. It can be found in northern, eastern, southern Taiwan, as well as other islands.

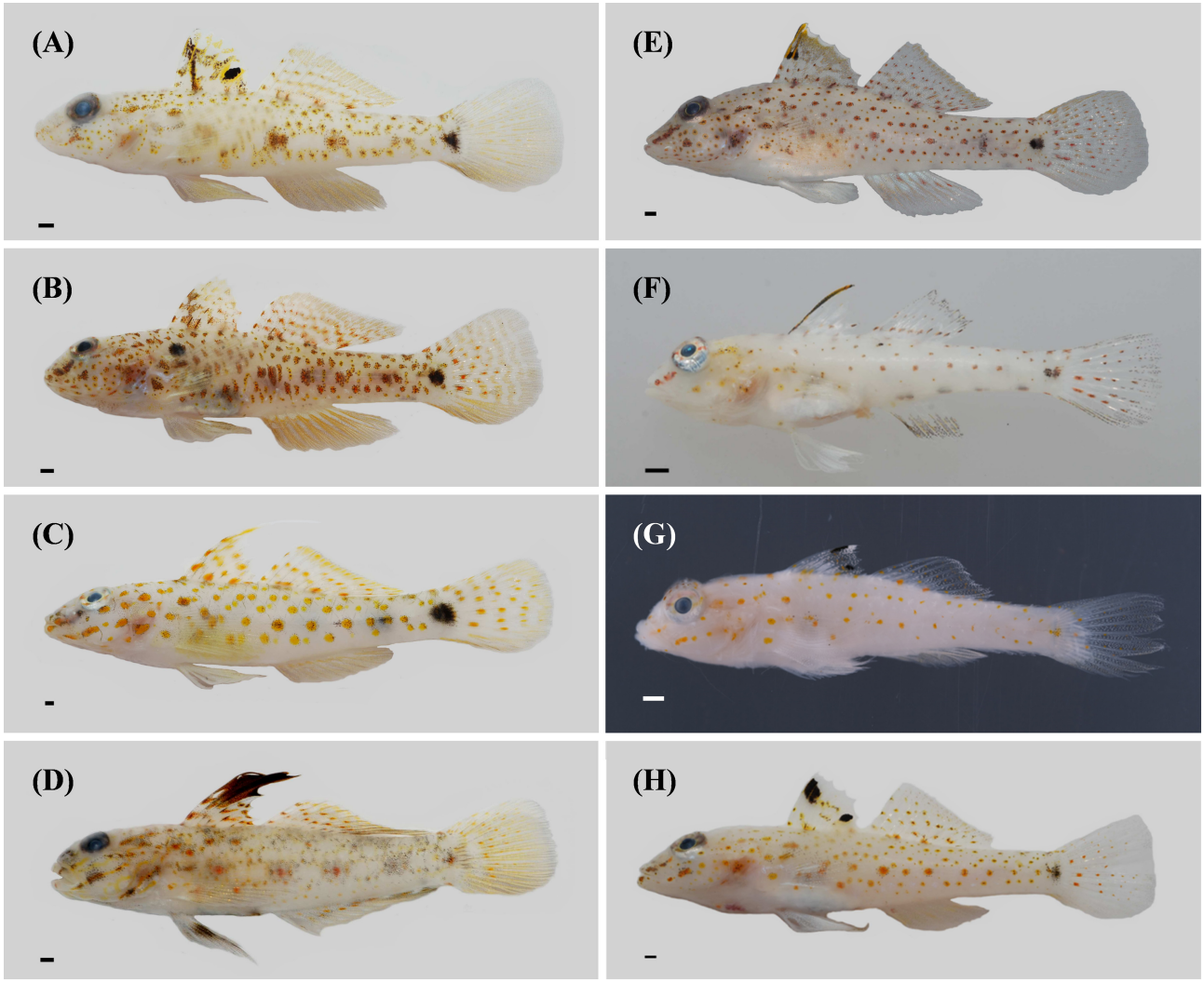

FIGURE 1. Specimen photos of nominal species of *Fusigobius* from Taiwan. **(A)** *Fusigobius duospilus*, NTOUP 2012-06-524, 28.8 mm SL, Huapingyan, Liouciou Township, Pingtung County, Taiwan. **(B)** *Fusigobius humeralis*, NTOUP 2012-06-533, 29.2 mm SL, Huapingyan, Liouciou Township, Pingtung County, Taiwan. **(C)** *Fusigobius inframaculatus*, NTOUP 2012-06-543, 45.9 mm SL, Longshiartong, Huapingyan, Liouciou Township, Pingtung County, Taiwan. **(D)** *Fusigobius melacron*, NTOUP 2010-09-472, 33.3 mm SL, Nanwan, Henchuen Township, Taiwan. **(E)** *Fusigobius neophytus*, NTOUP 2012-03-276, 34.8 mm SL, Northern Coast, Dongsha, Taiwan. **(F)** *Fusigobius neophytus*, NTOUP 2012-03-268, 19.0 mm SL, Northern Coast, Dongsha, Taiwan. **(G)** *Fusigobius taipinensis*, NTOUP 2022-07-201, holotype, 25.5 mm SL, Taiping Island, Nansha, South China Sea. **(H)** *Fusigobius taipinensis*, NTOUP 2012-06-555, paratype, 25.7 mm SL, Huapingyan, Liouciou Township, Pingtung County, Taiwan. (Bar = 1 mm).

Fusigobius inframaculatus (Randall, 1994)

(Fig. 1C; Table 2)

Coryphopterus inframaculatus Randall 1994: 331 (Base of drop-off, ne. side of Jana I., Persian Gulf, Saudi Arabia); Randall 1995: 332; Randall 2001: 207; Randall 2005: 524.

Fusigobius inframaculatus: Chen & Shao 1997: 90; Akihito *et al.* in Nakabo 2000: 1247; Akihito *et al.* in Nakabo 2002: 1247; Randall *et al.* 2004: 27; Hiroshi *et al.* 2007: 67; Chen *et al.* 2010: 490.

Fusigobius longispinus: Shen 1993: 957 (not Goren 1978); Chen *et al.* 1997: 143; Shen 2011: 686.

Materials examined. NTOUP 2006-09-742, 42.7 mm SL, Wanlitong, Kenting, Pingtung County, 15 m, coll. I-S Chen *et al.*, September 14, 2006; NTOUP 2006-09-743, 29.9 mm SL, Wanlitong, Kenting, Pingtung County, 15 m, coll. I-S Chen *et al.*, September 14, 2006; NTOUP 2010-09-462, 15.6 mm SL, Nanwan, Kenting, Pingtung County, 20 m, coll. M-J Jiang *et al.*, May 27, 2010; NTOUP 2010-09-466, 34.4 mm SL, Hongchaikeng, Kenting, Pingtung County, 15 m, coll. M-J Jiang *et al.*, May 26, 2010; NTOUP 2010-09-468, 26.9 mm SL, Hongchaikeng, Kenting, Pingtung County, 15 m, coll. M-J Jiang *et al.*, May 26, 2010; NTOUP 2010-09-474, 44.8 mm SL, Nanwan, Kenting, Pingtung County, 20 m, coll. M-J Jiang *et al.*, May 26, 2010; NTOUP 2010-09-475, 38.7 mm SL, Nanwan, Kenting, Pingtung County, 20 m, coll. M-J Jiang *et al.*, May 27, 2010; NTOUP 2010-09-476, 46.8 mm SL, Nanwan, Kenting, Pingtung County, 20 m, coll. M-J Jiang *et al.*, May 27, 2010; NTOUP 2010-09-477, 42.0 mm SL, Nanwan, Kenting, Pingtung County, 20 m, coll. M-J Jiang *et al.*, May 27, 2010; NTOUP 2012-03-257, 44.2 mm SL, Shanfu fish port, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, August 13, 2010; NTOUP 2012-06-536, 23.1 mm SL, Chenggong Township, Taitung County, 15 m, coll. I-S Chen *et al.*, April 05, 2007; NTOUP 2012-06-537, 21.1 mm SL, Chenggong Township, Taitung County, 15 m, coll. I-S Chen *et al.*, April 05, 2007; NTOUP 2012-06-538, 2: 21.8–22.5 mm SL, Chenggong Township, Taitung County, 15 m, coll. I-S Chen *et al.*, April 05, 2007; NTOUP 2012-06-539, 39.2 mm SL, Chenggong Township, Taitung County, 15 m, coll. I-S Chen *et al.*, April 06, 2007; NTOUP 2012-06-540, 45.9 mm SL, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, July 9, 2007; NTOUP 2012-06-541, 23.1 mm SL, Liouciou Township, Pingtung County, 15 m, coll. I-S Chen *et al.*, July 8, 2007; NTOUP 2012-06-542, 2: 36.9–45.8 mm SL, Longmen port, Orchid Island, Taitung, 15 m, coll. I-S Chen *et al.*, September 8, 2009; NTOUP 2012-06-543, 45.9 mm SL, Longshiadong, Liouciou Township, Pingtung County, 15 m, coll. Y-H Gong, August 24, 2011; ASIZP0056670, 27.1 mm SL, Shanhai, Pingtung County, 14 m, coll. K-T Shao, June 7, 1989; ASIZP0058777, 2: 33.0–51.0 mm SL, Guiwan, Green Island, Taitung County, 6 m, coll. J-P Chen, May 29, 1993.

Diagnosis. D1 VI; D2 I/9; A I/8; P modally 19; LR modally 26; SD1P 3. Anterior two spinous longest in D1. Body scattered with yellowish orange rounded spots. Caudal fin base with large, oblong black blotch about equal to eye diameter.

Distribution. Widely distributed in the Indo-West Pacific region. It can be found in southern Taiwan and other islands.

Fusigobius melacron (Randall, 2001)

(Fig. 1D; Table 2)

Coryphopterus melacron Randall 2001: 218 (Ne. coast at Tulamben, off wreck of U.S.S. "Liberty", Bali, Indonesia); Randall 2005: 525.

Fusigobius melacron: Akihito *et al.* in Nakabo 2002: 1247; Hoese & Larson 2006: 1652; Hiroshi *et al.* 2007: 67.

Materials examined. NTOUP 2010-09-471, 27.5 mm SL, Nanwan, Hengchun township, Pingtung county, 20 m, coll. M-J Chiang *et al.*, May 27, 2010; NTOUP 2010-09472, 33.3 mm SL, Nanwan, Hengchun township, Pingtung county, 20 m, coll. M-J Chiang *et al.*, May 27, 2010.

Diagnosis. D1 VI; D2 I/9; A I/8; P 19-21; LR 26-27; SD1P 4. Upper lip prominent. Second and 3rd spinous rays longer in D1. Pelvic fin without frenum, with low connecting membrane. Body scattered yellowish brown to grayish orange-red spots. First dorsal fin grayish-black on upper half.

Distribution. Widely distributed in the Indo-West Pacific region. A newly recorded species for all Taiwanese waters. In Taiwan, it can only be collected from the southern region (Kenting National Park). I-S Chen observed this species in Taiping Island, South China Sea, in 1995.

Remarks. I-S Chen first found and recorded this unusual, rare species during a SCUBA diving expedition in Maumere, Flores Island, Indonesia in 1993. He also found the species in Taiping Island, South China Sea at a depth of 20–35 m during a fish fauna survey expedition in 1995. However, first valid evidence of this species, confirmed by real specimens, was brought to light in southern Taiwan as part of the author's collection in 2010.

Fusigobius neophytus (Gunther, 1877)

(Figs. 1E–F; Table 2)

Gobius neophytus Günther 1877: 174 (Ponape, Micronesia; Apia, Upolu I., Western Samoa; Huahine and Tahiti, Society Islands).

Fusigobius neophytus: Goren 1979: 39; Hoese & Reader 1985: 7; Hoese 1986: 789; Hoese & Obika 1988: 286; Chen & Shao 1997: 90; Akihito *et al.* in Nakabo 2000: 1248; Akihito *et al.* in Nakabo 2002: 1248; Randall *et al.* 2004: 27; Hiroshi *et al.* 2007: 67; Chen *et al.* 2010: 492; Shen & Wu 2011: 686.

Fusigobius neophytus africanus: Smith 1959: 208.

Coryphopterus neophytus: Randall 1995: 797; Randall *et al.* 1997: 401; Randall 2001: 207; Greenfield & Randall 2004: 518; Randall 2005: 525.

Materials examined. NTOUP 2010-09-478, 16.9 mm SL, Nanwan, Kenting, Pingtung County, 20 m, coll. M-J Jiang *et al.*, May 27, 2010; NTOUP 2012-03-261, 30.2 mm SL, Nanwan, Kenting, Pingtung County, 20 m, coll. K-T Chen and Y-H Gong, December 20, 2010; NTOUP 2012-03-262, 36.5 mm SL, Nanwan, Kenting, Pingtung County, 20 m, coll. K-T Chen and Y-H Gong, December 20, 2010; NTOUP 2012-03-263,17.2 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5m, coll. K-T Chen and Y-H Gong, June 17, 2011; NTOUP 2012-03-264, 15:11.8–18.5 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. K-T Chen and Y-H Gong, June 17, 2011; NTOUP 2012-03-265, 16.6 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. K-T Chen and Y-H Gong, June 17, 2011; NTOUP 2012-03-266, 16.6 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. K-T Chen and Y-H Gong, June 17, 2011; NTOUP 2012-03-267, 16.6 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. K-T Chen and Y-H Gong, June 17, 2011; NTOUP 2012-03-268, 19.0 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. K-T Chen and Y-H Gong, June 17, 2011; NTOUP 2012-03-269, 20.1 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. K-T Chen and Y-H Gong, June 17, 2011; NTOUP 2012-03-270, 20.2 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. K-T Chen and Y-H Gong, June 17, 2011; NTOUP 2012-03-271, 27.0 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. K-T Chen and Y-H Gong, June 17, 2011; NTOUP 2012-03-272, 20.1 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. K-T Chen and Y-H Gong, June 18, 2011; NTOUP 2012-03-273, 2: 17.5–18.2 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. K-T Chen and Y-H Gong, June 18, 2011; NTOUP 2012-03-274, 57.0 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. K-T Chen and Y-H Gong, June 18, 2011; NTOUP 2012-03-276, 34.8 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. Y-H Gong, June 21, 2011; NTOUP 2012-03-277, 32.5 mm SL, Northwest of Inner Atoll, Dongsha Island, Kaohsiung City, 20m, coll. Y-H Gong, June 22, 2011; NTOUP 2012-06-544, 29.1 mm SL, Chenggong, Taitung, 15 m, coll. I-S Chen *et al.*, April 6, 2007; NTOUP 2012-06-545, 23.5 mm SL, Chenggong, Taitung, 15 m, coll. I-S Chen *et al.,* April 5, 2007; NTOUP 2012-06-546, 41.0 mm SL, Chenggong, Taitung, 15 m, coll. I-S Chen *et al.*, April 6, 2007; NTOUP 2012-06-547, 24.1 mm SL, Jihuei, Chenggong, Taitung, 15 m, coll. I-S Chen *et al.*, August 18, 2006; NTOUP 2012-06-548, 29.5 mm SL, Nanwan, Kenting, Pingtung County, 20 m, coll. K-T Chen and Y-H gong, May 4, 2011; NTOUP 2012-06-549, 16.2 mm SL, Lagoon, Dongsha Island, Kaohsiung City, 5 m, coll. I-S Chen *et al.,* September 21, 2011; NTOUP 2012-06-550, 6: 20.6–33.6 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. K-T Chen, September 21, 2011; NTOUP 2012-06-551, 4: 21.8–31.2 mm SL, North Coast, Dongsha Island, Kaohsiung City, 5 m, coll. K-T Chen, September 21, 2011; ASIZP00056483, 44.9 mm SL, Houbi Lack, Pingtung County, coll. J-P Chen, January 24, 1988; ASIZP0056785, 2: 49.0–53.0 mm SL, Maubitou, Pingtung County, Intertidal zone, coll. H-C Lee, June 19, 1975; ASIZP0058359, 7: 42.9–51.7 mm SL, Maubitou, Pingtung County, coll. H-C Lee, May 24, 1975.

Diagnosis. D1 VI; D2 I/9; A I/8; P modally 18; LR modally 25; TR7; SD1P 3. Pelvic fin with frenum with larger 5th branched ray. Body and head with orange to brown small dots. A brown stripe below eye to upper lip. A larger brown spot on cheek. First dorsal fin with a median small black spot in front 2rd spinous ray. Caudal peduncle with a median vertical bar. Caudal fin base with a small black spot about equal to pupil.

Distribution. Widely distributed in the Indo-West Pacific region. It can be found in northern, eastern, and southern Taiwan, as well as other islands.

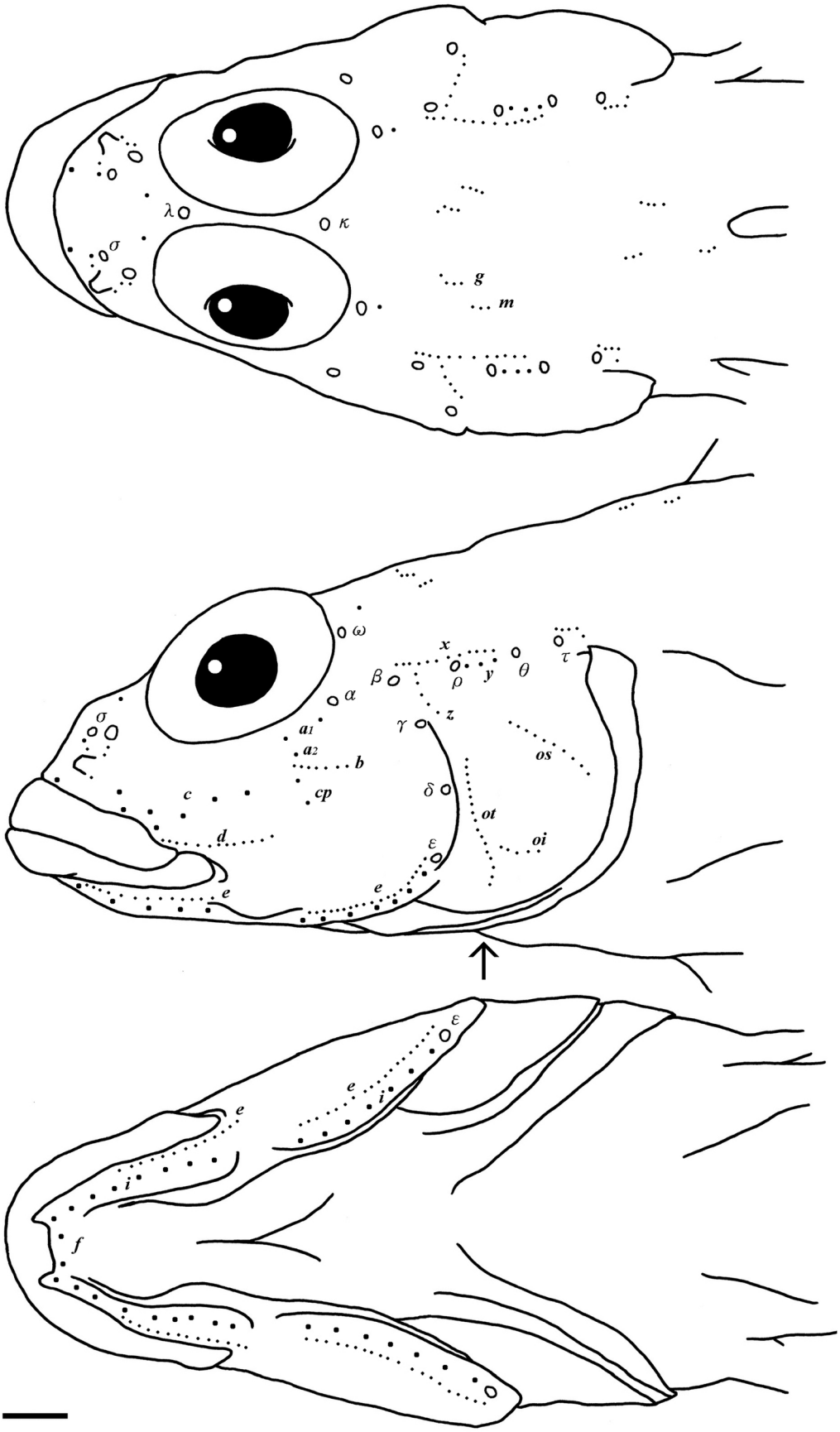

FIGURE 2. The head lateral line system of *Fusigobius taipinensis* **n. sp.** from NTOUP 2012-06-557, 28.4 mm SL, paratype, Huapingyan, Liouciou Township, Pingtung County, Taiwan. The arrow denotes the position of the gill opening. Illustration by Kuan-Ter Chen. (Bar = 1 mm).

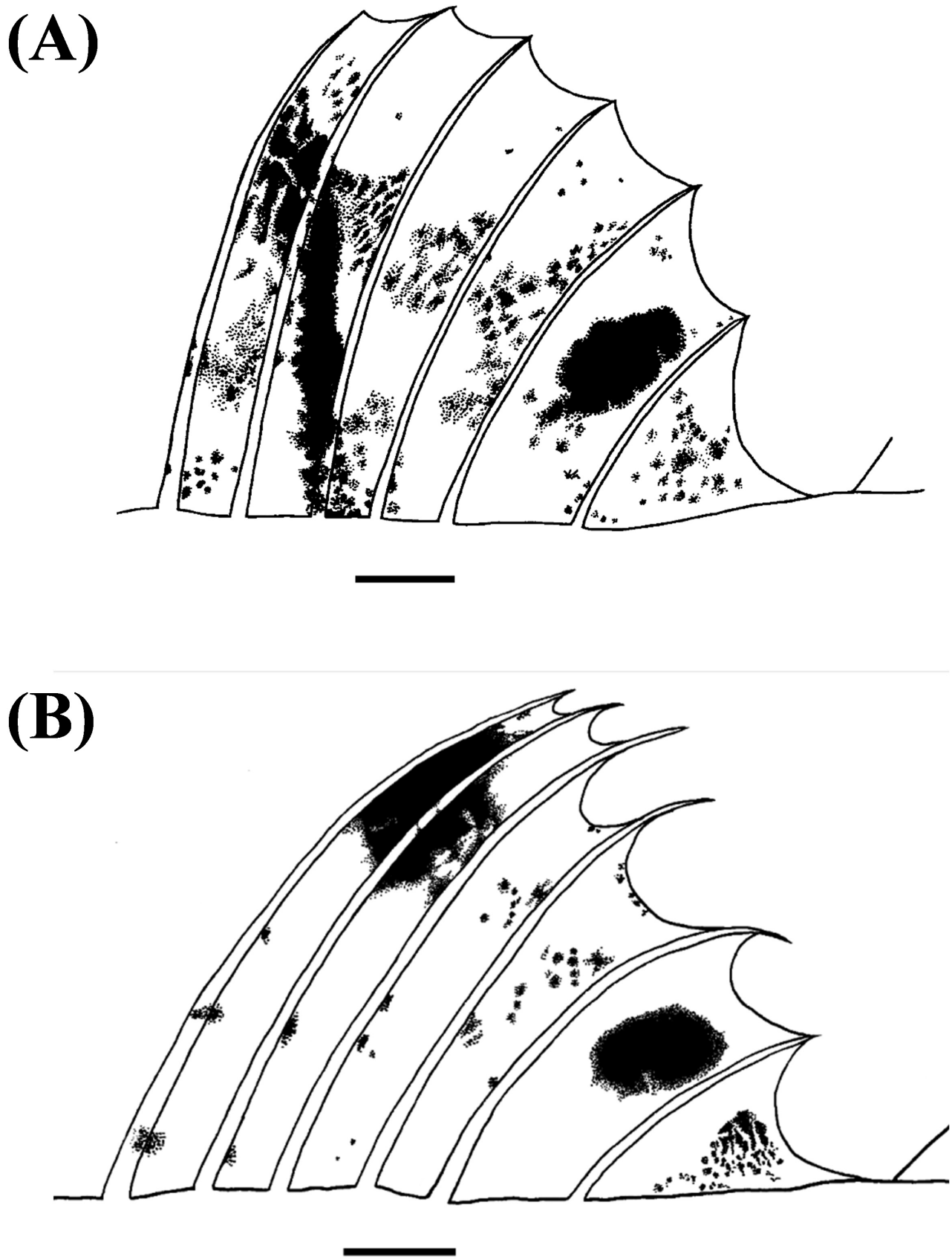

FIGURE 3. Pigmentation on the first dorsal fin from preserved specimens. **(A)** *Fusigobius duospilus*, NTOUP 2012-06-524, 29.9 mm SL, Huapingyan, Liouciou Township, Pingtung County, Taiwan. **(B)** *Fusigobius taipinensis*, NTOUP 2012-06-556, 28.8 mm SL, paratype, Huapingyan, Liouciou Township, Pingtung County, Taiwan. Illustration by Kuan-Ter Chen. (Bar = 1 mm).

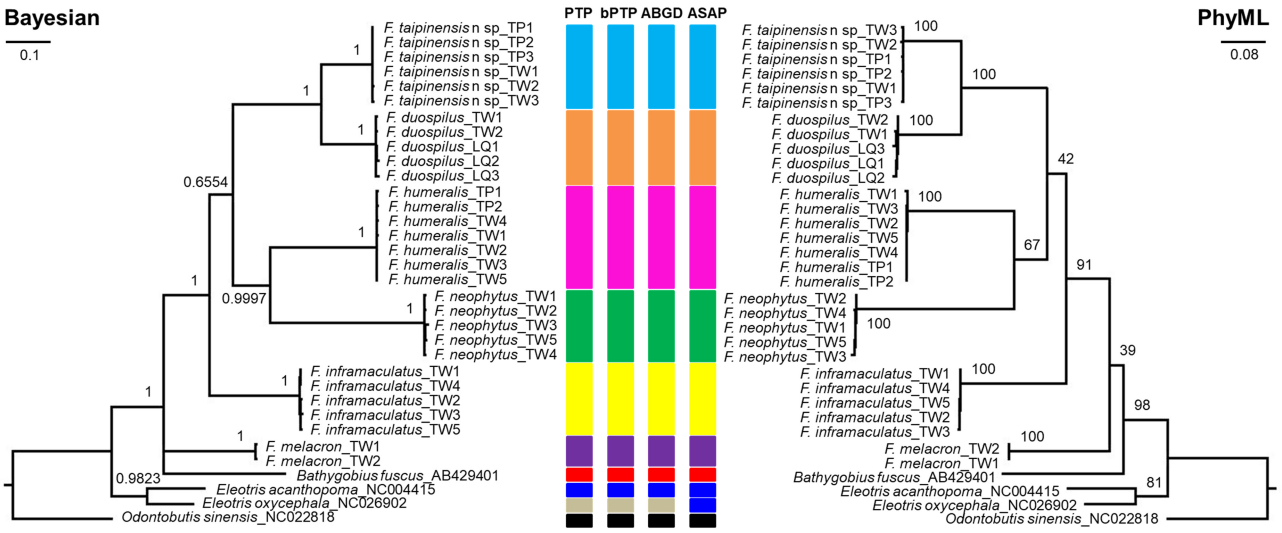

FIGURE 4. The Bayesian and PhyML phylogenetic trees of nominal species of *Fusigobius* from Taiwan inferred from the partial sequences of the mtDNA ND5 gene. The numbers were posterior probabilities and bootstrap values for Bayesian and PhyML trees, respectively. The species delimitation results by different methods (PTP, bPTP, ABDG, and ASAP) were shown in different colors.

Fusigobius taipinensis n. sp. Chen, Chen & Chang

(Figs. 1G–H, 2, 3B; Tables 1–2)

Materials examined. Holotype. NTOUP 2022-07-201, 25.5 mm SL, coll. DY Hong and YC Yang, Taiping Island, South China Sea, July 27, 2022. **Paratypes.** SOUTH CHINA SEA: NTOUP 2022-07-202, 7: 17.3–24.2 mm SL, coll. DY Hong and YC Yang, Taiping Island, South China Sea, July 27, 2022. NTOUP 2022-07-203, 2: 28.8–29.8 mm SL, coll. DY Hong and YC Yang, Taiping Island, South China Sea, July 27, 2022. NTOUP 2022-07-204, 2: 22.4–23.6 mm SL, coll. DY Hong and YC Yang, Taiping Island, South China Sea, July 29, 2022. TAIWAN: NTOUP 2012-06-552, 23.1 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m. coll. I-S Chen *et al.*, July 7, 2007. NTOUP 2012-06-553, 30.0 mm SL, Meirendong, Liouciou Township, Pingtung County, 15 m. coll. I-S Chen *et al.*, July 8, 2007. NTOUP 2012-06-554, 2: 17.8–23.1 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m. coll. I-S Chen *et al.*, July 10, 2007. NTOUP 2012-06-555, 25.7 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m. coll. K-T Chen and Y-H Gong, August 24, 2011. NTOUP 2012-06-556, 28.8 mm SL, Huapingyan, Liouciou Township, Pingtung County, 15 m. coll. K-T Chen and Y-H Gong, August 24, 2011. NTOUP 2012-06-557, 28.4 mm SL, Shanfu fish port, Liouciou Township, Pingtung County, 15 m. coll. K-T Chen and Y-H Gong, August 24, 2011.

Diagnosis. The new species can be distinguished from other congeners by the following unique combination of features: D1 VI; D2 I/9; A I/8; P 19; LR 25-26; SD1P 3. V with low frenum with lowest region about 1/10 of its spine; 4th branched rays longest. Head and body with small, bright yellow round spots and some tiny white dots. A row of discontinuous yellow spots running from lower origin of orbit to upper lip. Cheek with a similar parallel row of yellow marks. Lateral midline with a horizontal series of 8–9 bright yellow spots, with size smaller than pupil on trunk. Caudal fin base with a median, triangularly yellow to grayish-yellow mark. First dorsal fin with a deep black blotch on upper 1/4 region in front of 3rd spinous ray; a smaller oblong, deep black mark on upper half region in between 5th and 6th spinous rays. Second dorsal fin with 3–4 rows of tiny yellow round spots. Caudal fin translucent with three major radiated rows of small yellow spots.

Descriptions. Body proportions were listed in Table 1. Body slender and elongate, compressed posteriorly. Cross-section of anterior part of head triangular. Snout short, pointed, dorsal profile smooth. Maxillary reaching the vertical of anterior margin of orbit. Anterior nostril as a short tube. Gill-opening extending ventrally beyond vertical of midline of opercle. Posterior nostril as round hole. VC 10+16=26.

Fins.—D1 VI; D2 I/9; A I/8; P 18-20 (modally 19); V I/5. No distinct elongate spinous ray in D1, with anterior

three rays longer, rear tip extending to first branched ray of D2. An origin inserted below vertical of first branched ray of D2. P large, rear tip extending to vertical of second branched ray of D2. V with low frenum with lowest region about 1/10 of its spine length; 4th branched rays longest, and rear tip extending beyond the anus. C rounded.

Scales.—LR 25-26 (modally 26); TR 7; PreD 0; SD1P 3. Body with median large ctenoid scales. Head including cheek, snout, nape and operculum naked. Prepectoral and prepelvic region with cycloid scales.

TABLE 1. Morphometry of *Fusigobius taipinensis* **n. sp.**

	F. taipinensis	
	Male	Female
	n=3	n=4
Standard length (mm)	17.8–30.0 (25.5)	23.1–28.4 (25.3)
Percent of standard length (%)		
Head length	33.3–34.4 (33.8)	29.7–33.7 (31.9)
Predorsal length	37.2–39.5 (38.3)	34.4–40.3 (37.6)
Snout to 2nd dorsal length	58.3–59.9 (59.0)	53.0–59.6 (57.1)
Snout to anus	53.2–54.2 (53.8)	51.6–57.2 (54.3)
Snout to anal fin origin	55.2–55.9 (55.5)	56.2–59.2 (58.0)
Prepelvic length	31.5–33.2 (32.4)	30.1–34.6 (32.2)
Caudal peduncle length	24.3–27.2 (26.2)	23.8–26.8 (25.2)
Caudal peduncle depth	9.7–12.5 (11.3)	9.7–12.2 (11.1)
1st dorsal fin base	20.3–22.7 (21.5)	18.4–21.6 (19.4)
2nd dorsal fin base	22.4–22.5 (22.5)	20.1–22.1 (21.7)
Anal fin base	15.0–15.6 (15.4)	16.9–18.2 (17.4)
Caudal fin length	23.7–30.9 (27.4)	25.3–34.3 (30.3)
Pectoral fin length	29.1–31.9 (30.5)	28.1–32.8 (30.1)
Pelvic fin length	26.2–29.6 (27.4)	25.8–30.5 (28.2)
Body depth at pelvic fin origin	19.4–21.2 (20.1)	18.0–20.8 (19.6)
Body depth at anal fin origin	17.4–19.1 (18.1)	16.5–20.3 (18.4)
Body width at anal fin origin	11.9–13.9 (12.6)	12.2–12.9 (12.5)
Pelvic fin origin to anus	18.6–21.2 (20.1)	20.1–24.5 (22.6)
Head width in maximum	18.5–19.8 (19.3)	18.4–20.6 (19.3)
Head width in upper gill	10.6–11.6 (11.1)	9.9–12.4 (11.1)
Percent of head length (%)		
Head width in maximum	55.7–64.4 (59.2)	59.6–61.7 (60.4)
Head width in upper gill	32.0–36.4 (34.1)	31.6–36.9 (34.8)
Snout length	30.6–31.6 (31.1)	30.6–34.0 (32.2)
Eye diameter	30.3–31.8 (31.3)	29.9–34.6 (31.7)
Cheek depth	23.7–26.1 (25.1)	25.2–28.0 (26.6)
Postorbital length	47.5–50.8 (49.6)	31.6–36.9 (34.8)
Low jaw length	34.7–39.8 (37.5)	32.89–39.7 (35.8)
Bony interorbital width	1.7–3.1 (2.5)	1.8–3.2 (2.6)
Fleshy interorbital width	9.5–12.7 (11.5)	12.9–14.3 (13.5)
Percent of Caudal peduncle length (%)		
Caudal peduncle depth	36.3–50.7 (43.2)	37.5–50.1 (44.3)

TABLE 2. Distribution pattern of different species of *Fusigobius* found in Taiwanese waters.

	N Taiwan	E Taiwan	S Taiwan	Liuciou	Lanyu/Green Is.	Donsha Is.	Taiping Is.
Fusigobius duospilus	V		V	V		V	
Fusigobius humeralis	W	W	V	V	V		V
Fusigobius inframaculatus		V	V	V	V		
Fusigobius melacron			V				W
Fusigobius neophytus	W	V	V	V	W	V	
Fusigobius taipinensis **n. sp.**				V			V

V: voucher specimen collected.

W: witness by author's SCUBA diving.

Head lateral-line system

Head canals: Three major canals comprise anterior oculoscapular canal, posterior oculoscapular canal, and preopercular canal. Head pores on anterior oculoscapular canal with a posterior nasal pore σ near each posterior nostril; a single median interorbital pore λ and posterior pore κ; a posterior pore ω just behind orbit; an infraorbital pore α below the posterior pore; a lateral canal pore β above preoperculum; a terminal lateral canal pore ρ above ear vertical of preoperculum. Pores θ and τ as two ends on posterior oculoscapular canal. Three pores γ, δ and ε on preopercular canal.

Sensory papillae: Cheek with four main longitudinal rows *a*, *b*, *c*, *d*. Row *cp* singular. More papillae in rows *b* and *d*. Row *a* divided into *a1* (2 papillae), and a single *a2*. Operculum with rows *ot* and *oi* closely arranged; but well separated from row *os*. Row *z* vertically present. Rows *x* and *y* horizontally present. Nape with longitudinal rows *g* and *m*. Row *f* paired. Other papillae shown in Fig. 2.

Coloration while fresh. Body and head semi-translucent, head and body with small bright yellow round spots and some tiny white dots. A row of discontinuous yellow spots running from lower origin of orbit to the upper lip. Cheek with a similar parallel row of yellow marks. Pectoral fin base with two bright yellow round spots with a median white bar. Lateral midline with a horizontal series of 8–9 bright yellow spots with size smaller than pupil on trunk. Other part of trunk scattered with smaller yellow round spots. Caudal fin base with a median, triangularly yellow to grayish-yellow mark. First dorsal fin with a deep black blotch on upper 1/4 region in front of 3rd spinous ray; a smaller oblong, deep black mark on upper half region in between 5th and 6th spinous rays; and its membrane with some smaller yellow spots and some grayish to black dots. Second dorsal fin with 3–4 rows of tiny yellow round spots. Pelvic somewhat translucent with tiny white dots. Anal fin with some small yellow spots on outer 2/3 region and some tiny white spots basally. Caudal fin translucent with three major radiated rows of small yellow spots.

Coloration in preservation. After 10% formalin preservation, all bright yellow spots and marks faded. Only the diagnostic feature of the first dorsal fin, along with separate black marks, remained.

Distribution. This new species is mainly found in Taiping Island in the South China Sea, with some populations also in southern Taiwan. Its presence may extend the known range of new species to other regions of the South China Sea, southern Japan, or the tropical Indian Ocean.

Etymology. The specific name, *taipinensis,* refers to its type locality, Taiping Island, which is the largest island belonging to Taiwan ROC, located around the Nansha Islands in the South China Sea. The new species identified is more dominant than any other *Fusigobius* species collected from the island. This region may also serve as an important habitat for the current species. In contrast, although the species is also found in southern Taiwan, it is actually a very rare species compared to all other species observed among the members of its congeners.

Remarks. The new species herein is rather similar to the typical *F. duospilus* in terms of its meristic features. However, it can be well distinguished from *F. duospilus* from the type locality of the holotype by (1) the different pigmentation in anterior half of first dorsal fin as higher black blotch vs. vertical black stripe (Fig. 3); (2) body coloration: a series of bright yellow spots vs. 4 main grayish brown blotches; (3) great differentiation in mitogenetic comparison (Fig. 4). Hoese and Reader (1985) describe specimens of fish not from Australia exhibiting a similar dorsal fin pattern, which could possibly be identical to those in our studies.

Phylogenetic insights into *Fusigobius* species in Taiwan. The phylogenetic analysis of all Taiwanese species of *Fusigobius* was inferred from the partial sequences of the mtDNA ND5 gene represented in Fig. 4. Both phylogenetic trees showed similar topologies, except the divergence time of *Bathygobius* was different between the trees. In the PhyML tree, *Bathygobius* separated from the common ancestor with all analyzed *Fusigobius* species, and *Fusigobius* formed a monophyletic group. As for the Bayesian tree, *Bathygobius* separated from the common ancestor with *F. melacron* and other *Fusigobius* species. All these scenarios could explain the plesiomorphic state of *F. melacron* and the monophyletic group of remaining *Fusigobius* that shares the synapomorphic feature of separated pelvic fins. All recognized Taiwanese species, including *F. humeralis*, *F. inframaculatus*, *F. melacron*, and *F. neophytus,* were very well separated by long branches with rather high posterior probability and bootstrap value support. The intraspecific genetic divergence of all *Fusigobius* species was very low. The phylogenetic trees were also well supported by the fact that *F. taipinensis* **n. sp.** was different from its closely related *F. duospilus* with a high posterior probability and bootstraps value. All the species delimitations also supported that these two lineages were distinct species; even the ASAP method assigned *E. acanthopoma* and *E. oxycephala* as the same species, irrespective of which substitution models were selected.

With the new species *Fusigobius taipinensis* and the new record *Fusigobius melacron* documented in this study, a total of six species of *Fusigobius* have been formally recorded from Taiwan. These reef gobiids were morphologically and genetically distinguished.

Diagnostic key to all nominal species of *Fusigobius* (Whitely) from Taiwanese waters (including Dongsha and Taiping Island)

1. D2 I/10; A I/9, pelvic fin well separated without frenum. . . . . *F. melacron*
- D2 I/9; A I/8, pelvic fin united with frenum. 2
2. Anterior 2 spines as elongate extension . . . . . *F. inframaculatus*
- Anterior 2 spines not elongate 3
3. A conspicuous grayish-black mark on upper origin of pectoral fin . . . . . *F. humeralis*
- No such black mark 4
4. Lateral extension of canal with 3 pores . . . . . *F. neophytus*
- Lateral extension of canal with 2 pores 5
5. First dorsal fin with a vertical black mark in front of 3rd spine; lateral side with 4 major grayish brown blotches. . . . . *F. duospilus*
- First dorsal fin with a round black spot on upper 1/3 region; lateral side with a series of small, bright yellow rounded marks. . . . . ***F. taipinensis* n. sp.**

Acknowledgments

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