

## Taxonomic review and DNA barcoding of the fish genus *Peristedion* (Scorpaeniformes: Peristediidae) in Taiwan

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### Abstract

The peristiid fishes of genus *Peristedion* are commonly collected using bottom trawls in Taiwan, yet only three species have been previously reported from Taiwan. A survey on the taxonomy and DNA barcoding revealed that four species are present in Taiwanese waters, namely *Peristedion liorhynchus*, *P. nierstraszi*, and *P. orientale*, as well as a new record, *P. amblygenys*. Diagnosis and color photos of each species are provided along with a key for distinguishing these four species.

**Key words:** Taxonomy, *Peristedion*, Armored searobins, new record, Taiwan

### Introduction

The fish family Peristediidae, previously placed under Triglidae, is a small group of armored fishes generally known as sea

robins with 37 recognized species in five genera (Kawaii, 2008; Pogoreutz et al., 2013). Of them, the genus *Peristedion* is the largest in the family, comprising 22

valid species, and is characterized by no upper-jaw teeth, lateral margin of head smooth, lacking strong posteriorly projected spine, all barbells branched (except for one species), and posterior pairs of bony plates in lower lateral rows sutured along midline, not separated by those on ventral row .

In Taiwan, two species of *Peristedion* were commonly reported: *Peristedion nierstraszi* Weber, 1913 and *P. orientale* Temminck & Schlegel 1843 (e.g. Shen, 1984, Shen et al., 1993). A third species, *P. liorhynchus* (Günther 1872) had also recorded occasionally (Shao et al., 2008).

Recently, intensive collections targeted on the demersal fishes of southwestern Taiwan have revealed an additional, fourth *Peristedion* species present. The purposes of this study was to document all four *Peristedion* species collected from Taiwanese waters, to provide a detailed description for each species, and to provide a revised key for identifying the species in Taiwan. DNA barcoding was conducted to provide better support for identifying the species due to the general similarity of appearance among these species.

## Materials and Methods

Methods for taking counts and measurements and terminology generally followed Kawai (2004a). Standard length (SL), measured from upper jaw symphysis to base of caudal fin, and head length

(HL), measured from upper jaw symphysis to posterior end of opercle, were used throughout. Predorsal and prepelvic lengths, measured from upper jaw symphysis to the fin origins; body depth, measured at origin of dorsal fin and body width measured at base of pectoral fin; snout length, measured from symphysis of upper jaw to anterior margin of orbit; eye diameter (ED), length of longest horizontal distance of bony margin; interorbital width, measured from least distance of upper bony margins of orbit; post-orbital length, measured from posterior bony margin to posterior end of opercle; upper-jaw length, measured from symphysis of upper jaw to posterior end of maxilla; pelvic-fin length, measured from origin of the fin to tip of the longest ray; barbel length, measured from base to tip of the posterior-most barbel; first dorsal-fin height, measured from the longest ray. Four additional measurements were taken: rostral projection length, measured from the inner base to the tip of the right projection; rostral projection width, the width of the base of the projection; rostral concave width at base, measured from the distance between the inner base of both rostral projections; rostral concave width at tip, the distance of both tips of rostral projections. Measurements were not recorded from damaged anatomy. Specimens were deposited in National Museum of Marine Biology & Aquarium (NMMB-P).

A sample of fin or muscle tissue was collected for DNA extraction, and DNA samples were obtained by using a Quick Gene DNA tissue Kit S (Fujifilm, Tokyo, Japan). A barcode fragment of the mitochondrial cytochrome c oxidase subunit I gene (COI) gene was amplified by exploiting the primer FishF2 (5' TCG ACT AAT CAT AAA GAT ATC GGC AC 3') and FishR2 (5' ACT TCA GGG TGA CCG AAG AAT CAG AA 3') by polymerase chain reaction (PCR) as described by Ward et al. (2005). Each 25 µl PCR reaction contains 100 ng template DNA, 12.5 µmol of each specific primer, 12.5 µL of Fast-Run™ Advanced Taq Master Mix (ProTech, Taipei, Taiwan), and distilled water. Thermal cycling started with one cycle of 94°C for 3 min, and subsequent 35 cycles of 94°C for 30 s, annealing at 50°C for 30 s, and extension at 72°C for 30 s. Finally, a single extension step at 72°C for 5 min. Reaction products were sequenced bi-directionally and analyzed on an ABI3730XL model automated sequencer (Applied Biosystems, USA). Sequences (597 bp) were aligned using CLUSTAL X version 1.81 (Thompson et al., 1997). A neighbor-joining (NJ) phylogenetic tree of the Kimura two-parameter distance (K2P) with 10,000 bootstrapping replications was constructed using MEGA 5 (Tamura et al., 2011).

## Results

### Key to species of *Peristedion* occurred in Taiwan

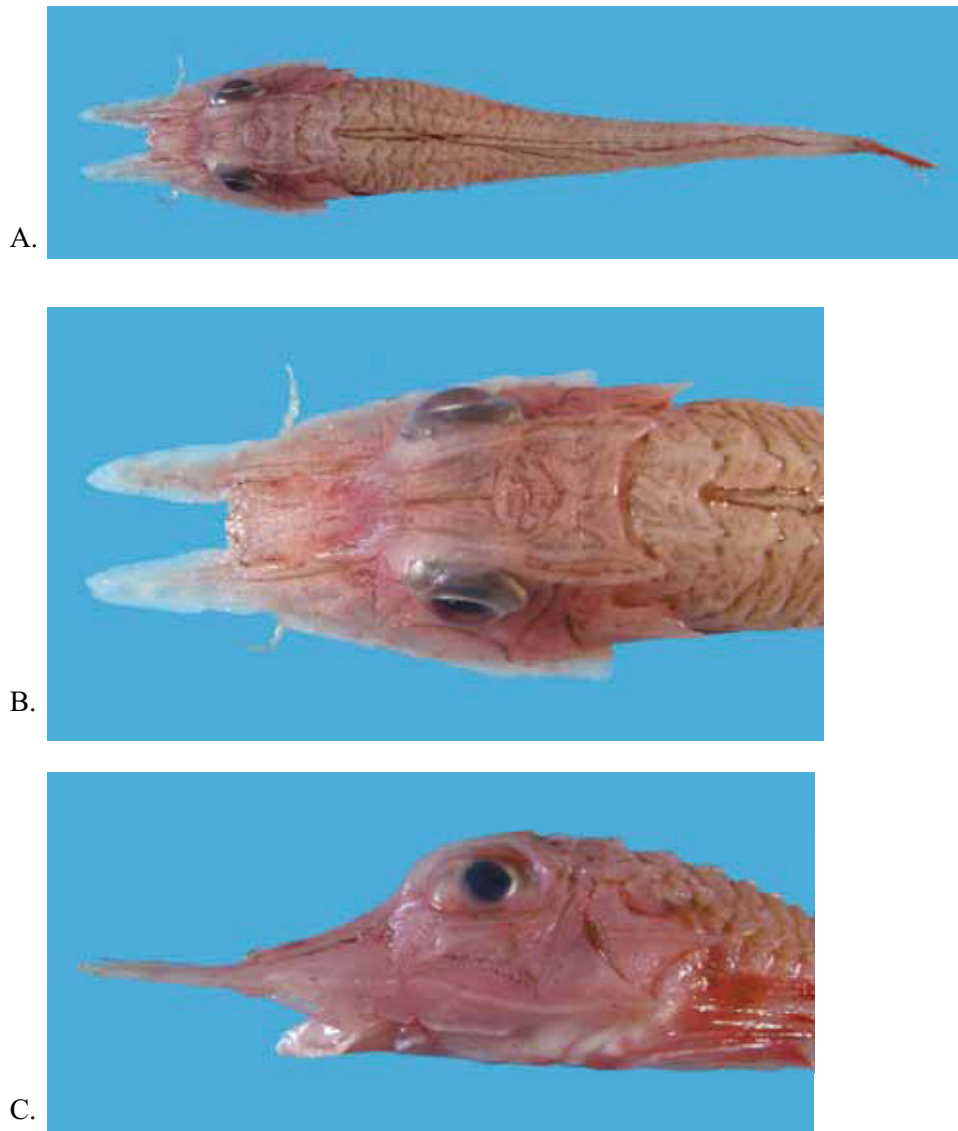
- 1A. Rostral projection short, usually <10% SL; tip of rostral projection broad and spatulate, middle portion of the projection narrower than all other parts.....  
.....*P. liorhynchus*
- 1B. Rostral projection long, usually >9 % SL; tip of rostral projection pointed anteriorly.....2
- 2A. Rostral projections long triangular with a very broad base; pectoral fin usually uniform in color.....*P. amblygenys*
- 2B. Rostral projections uniformly narrow; black bands usually present on pectoral fin.....3
- 3A. Body covered by brown vermiculate; mainly 30-31 bony plates on dorsal row; 24-26 bony plates on ventral row.....  
.....*P. orientale*
- 3B. Body light pinkish, without brown vermiculate; mainly 32-33 bony plates on dorsal row; 26-28 bony plates on ventral row.....*P. nierstraszi*

### *Peristedion amblygenys* Fowler, 1938

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Figures 1A-C; Tables 1-2

*Peristedion amblygenys* Fowler 1938:122 (type locality: western coast of Luzon Island, Philippines). Kawai 2008:24.



**Fig. 1.** *Peristedion amblygenys* Fowler, 1938, NMMB-P 17021, 1 of 5, 180 mm SL, fresh. A. Dorsal view of whole fish. B. Dorsal view of head. C. Lateral view of head.

**Table 1.** Morphometric data of four *Peristedion* species occurred in Taiwan.

SL	<i>P. amblygenys</i>		<i>P. liorhynchus</i>		<i>P. nierstraszi</i>		<i>P. orientale</i>	
	107-195 mm (n=27)	66-183 mm (n=15)	136-163 mm (n=27)	79-183 mm (n=26)	Mean (Range)	SD	Mean (Range)	SD
%SL	Mean (Range)	SD	Mean (Range)	SD	Mean (Range)	SD	Mean (Range)	SD
Body depth	13.6 (11.9-14.9)	0.7	13.9 (11.9-15.0)	1.0	13.8 (12.2-16.0)	1.0	15.1 (13.2-16.9)	0.9
Body width	11.6 (10-13.9)	1.2	12.0 (10.1-13.7)	1.3	11.4 (9.5-13.1)	0.8	11.1 (9.5-12.7)	0.9
Head length	30.2 (28.0-32.4)	1.1	33.8 (30.9-37.7)	1.6	30.6 (28.3-32.2)	1.0	33.4 (31.5-35.2)	0.8
Head depth	12.5 (11.1-13.9)	0.8	13.8 (12.6-14.6)	0.7	13.8 (12.4-15.1)	0.7	14.6 (12.9-16.2)	0.9
Head width	18.5 (17.0-21.5)	0.9	19.3 (16.8-21.8)	1.8	17.6 (16.2-19.9)	1.0	18.5 (16.1-20.9)	1.5
Pre-dorsal length	29.7 (28.0-31.9)	1.1	32.4 (30.2-34.5)	1.4	30.7 (29.2-32.1)	0.8	32.4 (30.4-34.4)	1.1
Pre-anal length	43.5 (40.9-46.7)	1.7	44.3 (41.4-46.1)	1.4	44.4 (41.4-47.4)	1.6	45.6 (43.1-48.0)	1.4
Pre-anus length	39.2 (37.0-41.5)	1.3	40.7 (38.5-42.9)	1.4	40.3 (37.8-43.5)	1.5	42.1 (39.3-44.9)	1.4
Snout length	13.1 (11.8-14.8)	0.8	15.1 (14.0-16.4)	0.8	13.4 (12.2-14.9)	0.7	15.9 (15.0-16.9)	0.4
Rostral projection length	10.0 (8.6-11.9)	0.9	8.2 (6.3-10.9)	1.7	11.9 (11.0-13.7)	0.7	13.1 (10.8-15.4)	1.3
Rostral projection width	4.5 (3.8-5.0)	0.3	3.8 (3.4-4.3)	0.3	4.2 (3.6-4.8)	0.3	3.8 (3.4-4.2)	0.3
Width of rostral concave base	3.0 (2.4-4.1)	0.4	6.1 (4.6-7.7)	1.0	3.7 (2.6-5.6)	0.8	4.6 (3.5-5.6)	0.5
Width of rostral concave opening	8.7 (7.2-11.6)	1.3	11.4 (9.0-13.2)	1.5	13.2 (10.2-17.5)	1.9	15.7 (13.0-18.4)	1.8
Longest barbel length	8.9 (6.9-11.5)	1.2	10.6 (9.3-13.4)	1.2	10.9 (8.0-13.0)	1.3	10.0 (7.7-12.3)	1.2
Upper jaw length	11.5 (10.8-12.5)	0.5	12.6 (11.1-13.7)	0.6	12.0 (10.9-12.8)	0.5	12.3 (11.0-13.5)	0.6
Lower jaw length	8.7 (8.0-9.5)	0.4	9.3 (8.3-9.9)	0.5	9.3 (8.6-9.8)	0.3	9.5 (8.7-10.4)	0.4
Orbital diameter	6.7 (5.4-8.1)	0.8	6.7 (5.0-8.4)	1.1	7.0 (5.6-8.1)	0.7	7.2 (5.6-8.7)	0.7
Interorbital width	6.8 (5.5-8.0)	0.8	6.8 (5.1-8.2)	1.1	7.3 (5.6-8.4)	0.8	7.6 (6.2-8.9)	0.6
Pectoral fin length	14.6 (12.9-16.5)	1.1	14.4 (11.7-16.2)	1.4	15.0 (12.4-16.5)	1.1	15.1 (13.1-17.1)	1.1
Length of upper detached pectoral fin ray	16.6 (14.8-19.6)	1.2	18.3 (16.0-20.7)	1.5	18.7 (16.8-20.3)	0.9	19.8 (17.8-21.8)	1.1
Length of lower detached pectoral fin ray	13.0 (11.3-15.9)	1.1	14.7 (13.1-16.9)	1.0	14.2 (11.9-16.1)	1.1	15.3 (12.7-18.0)	1.3
Pelvic fin length	14.7 (12.9-16.5)	1.0	14.9 (13.7-16.9)	1.0	15.1 (13.6-16.9)	0.9	15.5 (13.9-17.1)	0.9
Caudal peduncle length	7.5 (5.1-9.4)	1.2	7.3 (5.5-9.7)	1.3	7.9 (4.7-10.0)	1.4	7.0 (4.8-9.3)	1.1
Caudal peduncle depth	1.9 (1.7-2.3)	0.1	2.1 (1.9-2.4)	0.2	2.0 (1.9-2.3)	0.1	2.1 (1.8-2.4)	0.1

**Table 2.** Distribution of select meristic data of four *Peristedion* species found in Taiwan.

	n	Bony plates on dorsal row					Bony plates on ventral row							
		30	31	32	33	34	18	19	20	21	22	23	24	25
<i>P. amblygenys</i>	27	1	4	12	10			1	1	1	12	7	5	
<i>P. liorhynchus</i>	14	1	10	3						6	7	1		
<i>P. nierstraszi</i>	27		4	16	6	1			3	4	15	4	1	
<i>P. orientale</i>	26	6	17	3			2	1	10	6	4	3		
	n	Bony plates on upper lateral row					Bony plate on lower lateral row							
	n	34	35	36	37	38	25	26	27	28	29	30	31	
<i>P. amblygenys</i>	27		5	11	5	6				4	5	12	6	
<i>P. liorhynchus</i>	14		3	9	1	1	2	8		3	1			
<i>P. nierstraszi</i>	27			10	13	4	1		6	6	7	7		
<i>P. orientale</i>	26	1	4	13	8			5	4	11	6			
	n	Gill rakers on upper limb				Gill rakers on lower limb								
	n	5	6	7	8	15	16	17	18	19	20	21	22	23
<i>P. amblygenys</i>	27		14	11	2					3	7	11	5	1
<i>P. liorhynchus</i>	15	1	14						7	3	2	2	1	
<i>P. nierstraszi</i>	27	1	22	4				6	9	11	1			
<i>P. orientale</i>	26	3	22	1		1	2	6	9	7	1			
	n	Total gill rakers												
	n	20	22	23	24	25	26	27	28	29	30			
<i>P. amblygenys</i>	27					2	6	7	6	5	1			
<i>P. liorhynchus</i>	15				7	4	1	2	1					
<i>P. nierstraszi</i>	27		1	5	7	12	1	1						
<i>P. orientale</i>	26	2	3	5	9	7	1							
	n	Dorsal-fin rays						Anal-fin rays						
	n	17	18	19	20	21	22	23	18	19	20	21	22	23
<i>P. amblygenys</i>	27				4	7	14	2	1	1	8	5	12	
<i>P. liorhynchus</i>	15					11	4				5	9	1	
<i>P. nierstraszi</i>	27				3	9	13	2		1	8	15	2	1
<i>P. orientale</i>	26	1			8	14	3			1	13	11	1	
	n	Pectoral fin rays		Principal caudal-fin rays		Barbels (lip+chin)								
	n	11	12	11	12	3+5	3+6	3+7						
<i>P. amblygenys</i>	27	2	25	4	23	4	22	1						
<i>P. liorhynchus</i>	15	1	14	2	10		15							
<i>P. nierstraszi</i>	27	1	26		26	1	26							
<i>P. orientale</i>	26		26		26	17	9							

**Specimen examined.** NMMB-P2854 (1, 120 mm), Tongkang, 100 m, 8 Nov. 2001. NMMB-P4735 (1, 120 mm), Tainan, 16 Mar. 1964. NMMB-P4736 (1, 165 mm), Tongkang, 21 Mar. 1979. NMMB-P4737 (4, 160-189 mm), Tongkang, 29 Mar. 1964. NMMB-P7626 (1, 169 mm), Kaohsiung, 4 Jul. 2004. NMMB-P7910 (1, 148 mm), Tongkang, 11 Jun. 2004. NMMB-P9214 (1, 147 mm), Tongkang, 18 Sep. 2008. NMMB-P11320 (1, 117 mm), Tongkang, 5 Jul. 2007. NMMB-P11322 (1, 159 mm), Tongkang, 16 Sep. 2009. NMMB-P11328 (1, 126 mm), Tongkang, 15 Dec. 2009. NMMB-P13680 (1, 171 mm), Tongkang, 2 Jul. 2011. NMMB-P13691 (4, 159-190 mm), Tongkang, 19 May 2011. NMMB-P14383 (3, 107-120 mm), Fongkang, 200 m, 8 Nov. 2001. NMMB-P14487 (1, 107 mm), Tongkang, 8 Nov. 2001. NMMB-P17021 (5, 150-195 mm), Tongkang, 8 Aug. 2012.

**Diagnosis.** Rostral projections long, triangle in shape, parallel, with a broad base and a bluntly pointed tip, its length 8.6-11.9% SL. Rostral projection concave and narrow, rectangular in shape, the width at base smaller than eye diameter. Total gill rakers 25-30. Head relatively short, 3.1-3.6 in SL. Snout relatively short, 6.8-8.5 in HL. All spines on head blunt. Body uniformly pinkish, sometimes with light pinkish vermiculate pattern on dorsal surface; dorsal-fin margin black; light greenish bands on pectoral fin.

**Description.** Morphometric and meristic

data are provided in Tables 1-2.

Dorsal fin rays VIII-IX, 20-23 (mainly VIII, 21-22); anal fin rays 18-22 (20-22); pectoral fin rays 11-12+2=13-14 (14); pelvic fin rays I, 5; principal caudal fin rays 11-12 (12). Gill rakers 6-8+19-23=25-30.

Body depth 6.7-8.4 times in SL; body width 7.2-10.0; head length 3.1-3.6; head depth 7.2-9.0; head width 4.7-5.9; predorsal length 3.1-3.6; preanal length 2.1-2.4; preanus length 2.4-2.7; snout length 6.8-8.5. Head width 1.4-1.8 in HL; head depth 2.2-2.7; snout length 2.1-2.6; orbital diameter 3.7-5.9; rostral projection length 2.7-3.5; longest barbel length 2.7-4.2; upper jaw length 2.4-2.9; lower jaw length 3.2-3.8.

Bony plate covered on entire body, each with a posterior-directed spines; dorsal row with 30-33 (mainly 32-33) bony plates; 35-38 (36) on upper lateral row; 28-31 (30) on lower lateral row; 19-24 (22) on ventral row.

Head small, relatively depressed; infraorbital bones relatively broad; rostral projections long, narrow triangular, its length 1.1-1.6 times of eye diameter (ED); both projections parallel; width of projection base 0.5-0.6 ED; rostral concave narrow, long rectangular in outline, width at base 0.3-0.5 ED, width at opening 0.9-1.5 ED. Interorbital a narrow concave, without distinct ridges, its width about equal to ED. Frontal, parietal, posttemporal, and opercular spines

present on head. All spines blunt, except for opercular spine. Spine on first three bony plates of dorsal row blunt. Upper margin of orbital smooth, a horizontal ridge below the eye.

Mouth large and inferior, posterior tip of upper jaw not reaching point below anterior margin of eye; posterior end of lower jaw reaching anterior half of eye. Teeth absent from both jaws, vomer and palatines. Three barbels on lower lip; 5-6 barbels on chin, all multiple branched.

Coloration. When fresh, uniformly light pinkish with light greenish or orange vermiculation on dorsal surface; dorsal fin with black margin; very light reddish bands may present on pectoral fin; caudal fin red. When preserved, uniformly creamy white with grayish margin on dorsal fin.

**Distribution.** Known from the type locality, the Philippines, and newly recorded from southern Taiwan. In Taiwan, this species is commonly collected using bottom trawls at depth around 200-300 m.

**Remark.** Fowler (1938) described the species based on 25 specimens collected from the Philippines. Richards (1999) listed the species in the western central Pacific Ocean and again listed the species in the South China Sea (Richards in Randall and Lim, 2000). However, no additional information was provided in these subsequent publications. Recent collections indicate that this species is commonly collected by bottom trawls and

was often misidentified as *P. nierstraszi* in Taiwan. The species differs from *P. nierstraszi* in having the rostral projections very broad at base (vs. uniformly narrow from the base to near the tip), rostral concave very narrow, the width at base less than eye diameter (vs. wider), and 25-29 total gill rakers on first gill arch (vs. 23-26).

***Peristedion liorhynchus* (Günther 1872)**

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Figures 2A-C; Tables 1-2

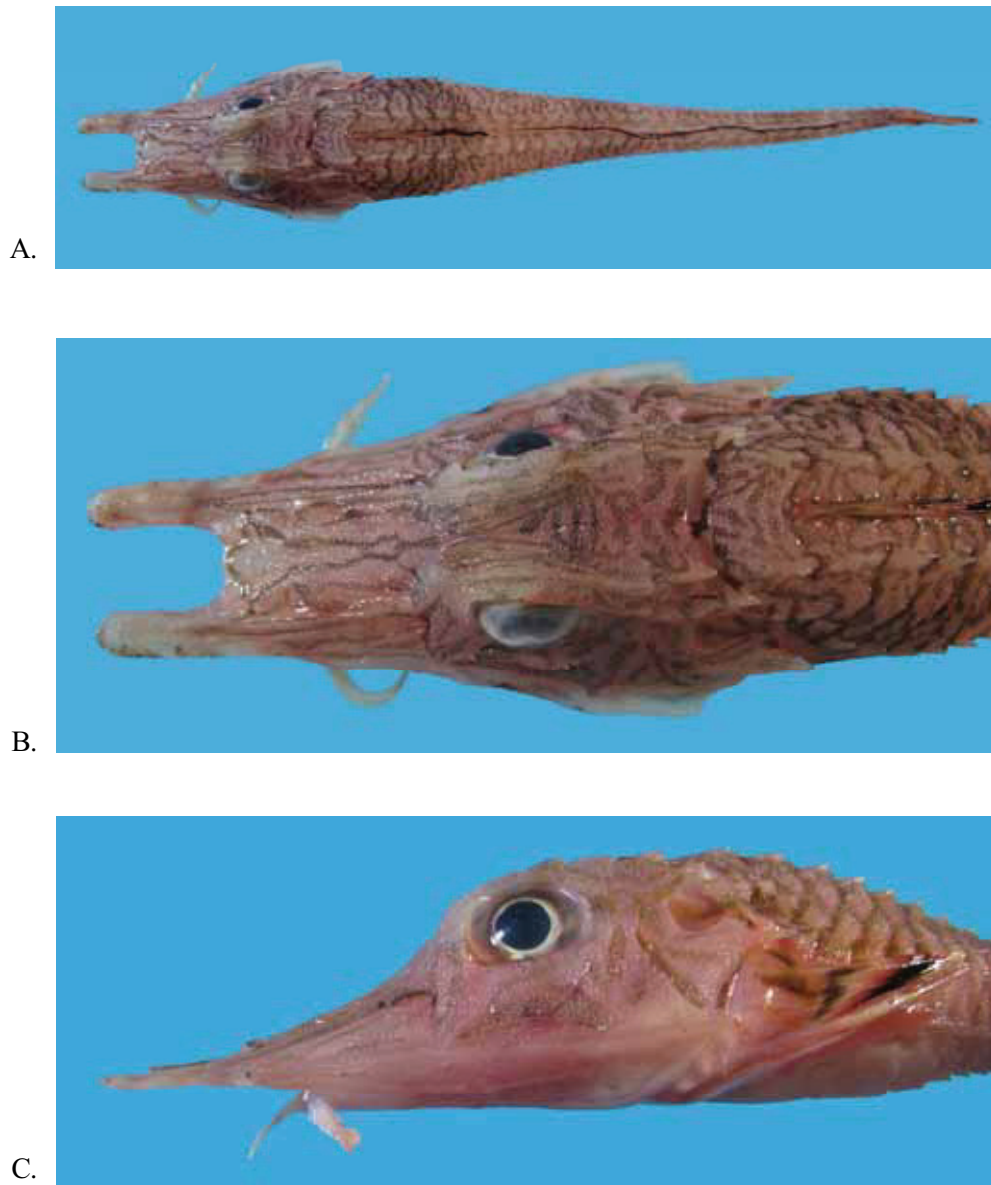
*Peristethus liorhynchus* Günther 1872:663 (Type locality: Manado, Sulawesi, Indonesia).

*Peristedion liorhynchus* (Günther 1872): Kawai 2008:24. Shen & Wu, 2011: 340

**Specimen examined.** NMMB-P5801 (3, 66-131 mm), Tongkang, Taiwan, 13 Mar. 2003. NMMB-P12027 (2, 153-175 mm), Tongkang, Taiwan, 15 Feb. 2011. NMMB-P12168 (1, 162 mm), Tongkang, Taiwan, 31 Dec. 2010. NMMB-P13934 (3, 92-112 mm), Fongkang, 200 m, Taiwan, 25 May 2002. NMMB-P15702 (3, 139-144 mm), Tongkang, Taiwan, 29 Sep. 2010. NMMB-P17019 (3, 157-183 mm), Tongkang, Taiwan, 8 Aug. 2012.

**Diagnosis.** Rostral projections short, 6.3-10.9% SL, parallel; tip of rostral projection broad and spatulate, middle portion of the projection narrower than all other parts. Rostral projection concave oblong in shape, its base about as wide as eye diameter. Head relatively long, its





**Fig. 2.** *Peristedion liorhynchus* (Günther 1872), NMMB-P17019,1 of 3, 183 mm SL, fresh. A. Dorsal view of whole fish. B. Dorsal view of head. C. Lateral view of head.

length 2.7-3.2 in SL. Snout relatively long, 6.1-7.2 in HL. Total gill rakers 24-28. Body pinkish orange with irregular greenish brown vermiculate pattern on dorsal surface, two black bands on pectoral fin.

**Description.** Morphometric and meristic data are provided in Tables 1-2.

Dorsal fin rays VIII, 21-22; anal fin rays 20-22; pectoral fin rays 11-12+2=13-14 (mainly 14); pelvic fin rays I, 5; principal caudal fin rays 11-12 (mainly 12). Gill rakers 5-6+18-22=24-28.

Body depth 6.6-8.4 times in SL; body width 7.3-9.9; head length 2.7-3.2; head depth 6.8-7.9; head width 4.6-6.0; predorsal length 2.9-3.3; preanal length 2.2-2.4; preanus length 2.3-2.6; snout length 6.1-7.2. Head width 1.5-2.0 in HL; head depth 6.8-7.9; snout length 2.0-2.5; orbital diameter 3.9-6.9; rostral projection length 3.2-5.3; longest barbel length 2.5-3.7; upper jaw length 2.4-2.8; lower jaw length 3.3-4.1.

Bony plate covered on entire body, each with a posterior-directed spines; dorsal row with 30-32 bony plates; 35-38 on upper lateral row; 25-29 on lower lateral row; 22-24 on ventral row.

Head large, less depressed and preopercle; rostral projections short, its length 1.0-1.8 times of ED, both projections parallel, never expanded; width of projection base 0.5-0.7 ED; rostral concave narrow, nearly oblong in outline, width at base about 0.7-1.2 ED,

width at opening 1.5-2.1 ED. Interorbital a narrow concave, without distinct ridges, its width about equal to ED. No other spines on head besides frontal, parietal, posttemporal, and opercular spines. All spines, except for opercular spine, blunt. Spine on first three bony plates on dorsal row relatively sharp. Upper margin of orbital smooth, a horizontal ridge below the eye.

**Coloration.** When fresh, background pinkish orange, with greenish or brownish vermiculate pattern on dorsal surface of head and body; dorsal fins with black margin; four broad dark brown blotches on body; bands on pectoral fin, anterior one deep greenish and posterior black. When preserved, creamy white background with grayish vermiculate pattern on dorsal surface, black margins on dorsal fins.

**Distribution.** Western Pacific off Japan, Taiwan, Philippines and Australia. In Taiwan, this species is commonly collected from southwestern coast off Tongkang region at depths around 200-300 meters.

**Remarks.** The species can be easily distinguished from other three congeners in Taiwan by having a relatively short and spatulate rostral projection, which are parallel and never expanded, and the rostral concave base relatively wide, which is about equal to eye diameter.

***Peristedion nierstraszi* Weber 1913**

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Figure 3A-D; Tables 1-2

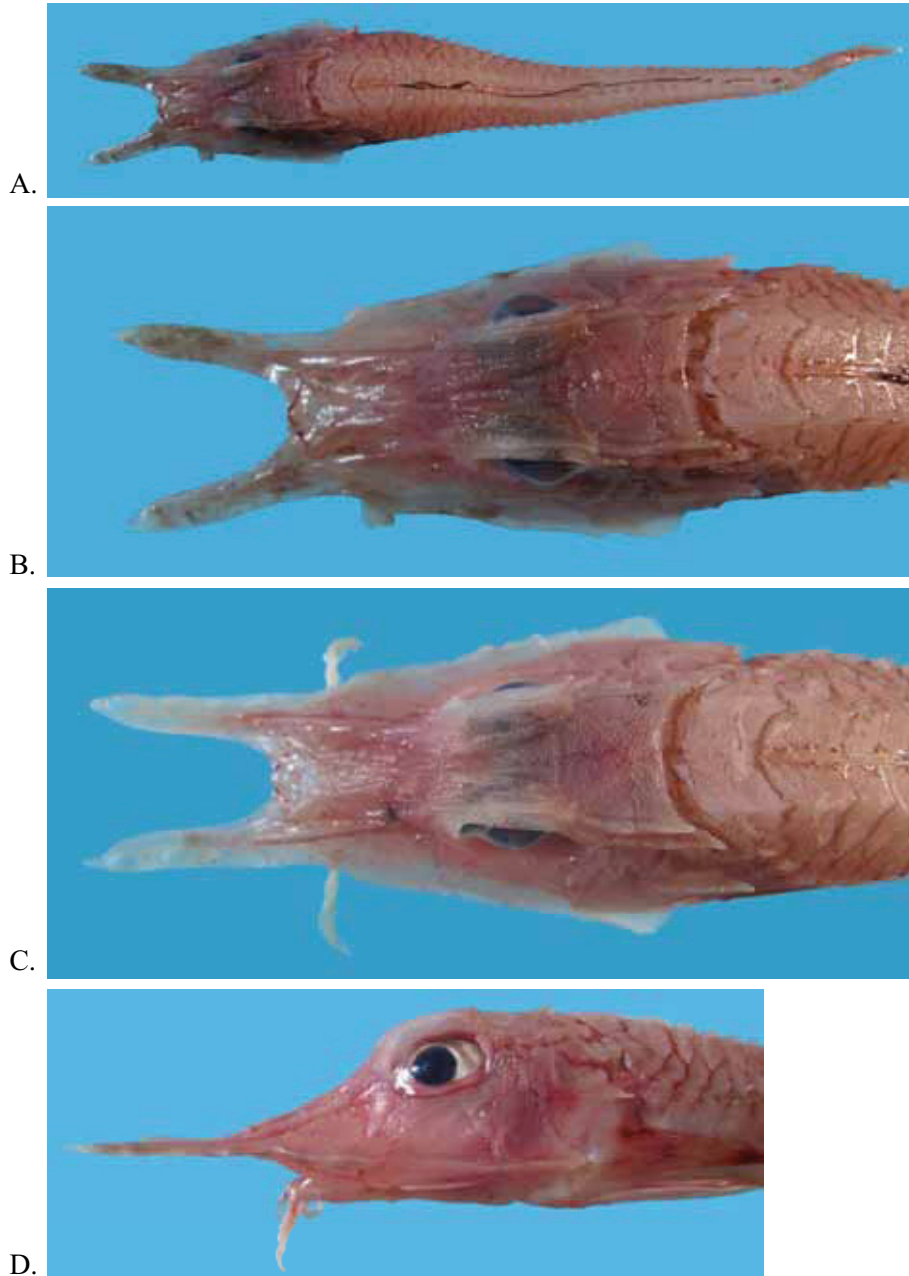
*Peristedion nierstraszi* Weber, 1913: 514

(Type locality: Flores Sea, 521-538 m).

Shen 1984a:201. Shen 1984b:33. Chen &

Yu, 1986:434. Shen et al., 1993: 252.

Kawai 2008:24. Shen & Wu, 2011: 340.



**Fig. 3.** *Peristedion nierstraszi* Weber 1913, NMMB-P17018, 2 of 62, fresh. A. Dorsal view of whole fish. B. Dorsal view of head. C. Dorsal view of head. D. Lateral view of head. A-B. 168 mm SL. C-D. 172 mm SL.

**Specimen examined.** NMMB-P9214 (2, 139-147 mm), Tongkang, Taiwan, 18 Sep. 2008. NMMB-P8415 (1, 138 mm), Tongkang, Taiwan, 17 Mar. 2005. NMMB-P17018 (62, 142-173 mm), Tongkang, Taiwan, 8 Aug. 2012.

**Diagnosis.** Rostral projection uniformly narrow and long, 11.0-13.7% SL; the projections parallel to broadly expanded. Total gill rakers 22-27. Rostral concave rectangular to trapezoidal in outline, its base narrower than eye diameter. Head small and narrow, its length 3.1-3.5 in SL. Snout relatively short, 2.2-2.5 in HL. Body usually uniformly pinkish, dorsal-fin margin black, two black bars on pectoral fin.

**Description.** Morphometric and meristic data are provided in Tables 1-2.

Dorsal fin rays VII-IX, 20-23 (mainly VIII, 21-22); anal fin rays 19-23 (mainly 20-21); pectoral fin rays 11-12+2=13-14 (mainly 14); pelvic fin rays I, 5; principal caudal fin rays 12. Gill rakers 5-7+17-20=22-27.

Body depth 6.2-8.2 times in SL; body width 7.3-10.5; head length 3.1-3.5; head depth 6.6-8.1; head width 5.0-6.5; snout length 6.4-8.2; predorsal length 3.1-3.4; preanal length 2.1-2.4; preanus length 2.3-2.6. Head width 1.5-2.0 in HL; head depth 2.0-2.4; snout length 2.2-2.5; orbital diameter 3.9-5.1; rostral projection length 2.3-2.9; longest barbel length 2.3-3.8; upper jaw length 2.2-2.9; lower jaw length 2.9-3.6.

Bony plate covered on entire body, each with a posterior-directed spines; dorsal row of body with 31-34 (mainly 32-33) bony plates; 36-38 on upper lateral row; 25-30 on lower lateral row; 21-25 (mainly 22-24) on ventral row.

Head small, less depressed and preopercle and infraorbital bones less expanded laterally; rostral projections long triangular, its length 1.8-2.2 ED, both projections nearly parallel to broadly expanded; width of projection base 0.6-0.8 ED; rostral concave narrow to very wide, rectangular to trapezoidal in outline, width at base 0.4-0.9 ED, width at opening 1.6-2.8 ED. Interorbital narrow concave, without distinct ridges, its width about equal to ED. Frontal, parietal, posttemporal, and opercular spines present on head. All spines, except for opercular spine, blunt. Spine on first three bony plates of dorsal row blunt.

**Coloration.** When fresh, uniformly pinkish, sometimes with light brownish vermiculate pattern on dorsal surface; margins of dorsal and anal fins blackish; two reddish brown bands on pectoral fin. When preserved, uniformly creamy white; margins of dorsal and anal fins blackish; bands on pectoral fin strongly faded.

**Distribution.** Western Pacific Ocean off Japan, Hongkang, Taiwan and the Philippines. In Taiwan, the specimens are usually collected from around 100-300 m.

**Remark.** This species is easily confused with *P. amblygenys* in general appearance

and coloration. It differs from *P. amblygenys* in the rostral projections uniformly narrow (vs. broad at base), the projections parallel to very broadly expanded (vs. parallel), and 20-26 gill rakers on first gill arch (vs. 25-30).

*Peristedion nierstraszi* is also similar to *P. orientale* in having uniformly narrow rostral projections. Nakabo (2002) distinguished this species from *P. proentale* by the rostral projections are broadly expanded and the numbers of bony plates on upper lateral row. However, based on our examination, the rostral projections of *P. orientale* are always broadly expanded whereas *P. nierstraszi* can be parallel to broadly expanded. The numbers of bony plates on upper lateral row are overlap. Thus, these two characters can not be used to separate these two species. Based on our study, *P. nierstraszi* can be readily distinguished from *P. orientale* by having dorsal surface usually uniformly pinkish or at most light vermicular pattern (vs. heavily covered by deep vermiculate pattern); majority of bony plates on dorsal row and ventral slightly more than those of *P. orientale* (see Table 2).

***Peristedion orientale* Temminck & Schlegel 1843**

東方黃魴鯉

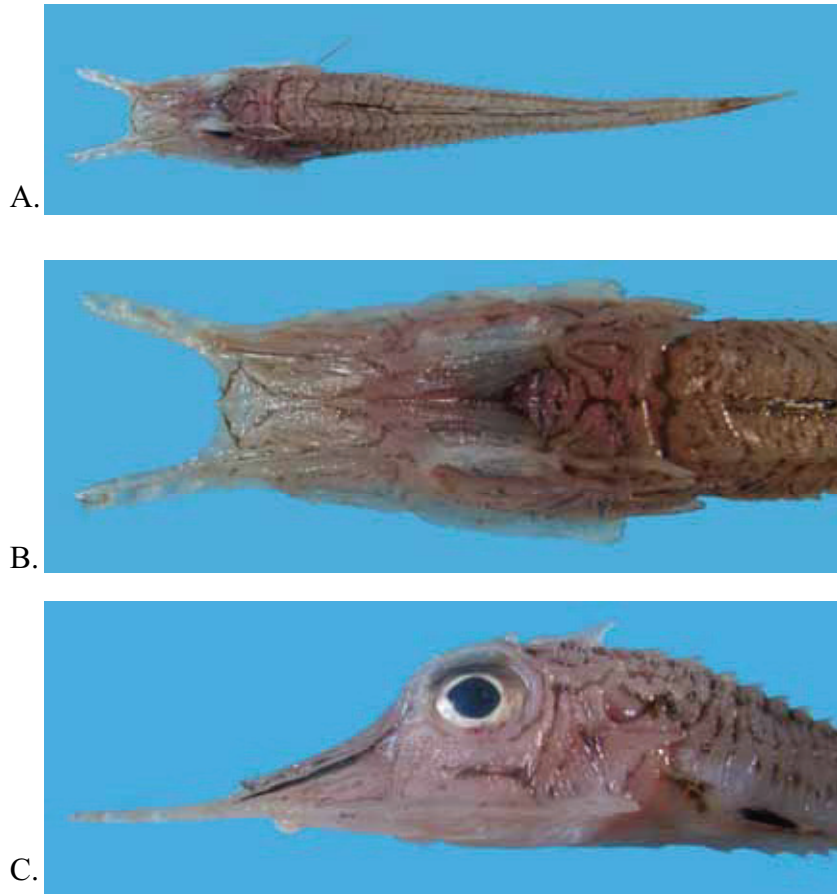
Figure 4A-C; Tables 1-2

*Peristedion orientale* Temminck &

Schlegel, 1843:37 (Type locality: Japan). Shen Shen, 1984a:201. Chen & Yu, 1986:434. Shen et al., 1993:252. Kawai 2008:24. Shen & Wu, 2011: 340 (figured is *Satyrichthys rieffeli*).

**Specimens examined.** NMMB-P2832 (1, 103 mm), Tongkang, 100 m, Taiwan, 8 Nov. 2001. NMMB-P3072 (1, 138 mm), Wan-li-tung, Taiwan, Nov. 1984. NMMB-P3791 (1, 100 mm), Fongkang, 300 m, Taiwan, 2 Aug. 2001. NMMB-P3832 (1, 112 mm), Fongkang, Taiwan, 23 Aug. 2001. NMMB-P4024 (1, 110 mm), Tongkang, Taiwan, 5 Aug. 1986. NMMB-P5751 (3, 98-110 mm), Tongkang, Taiwan, 13 Mar. 2003. NMMB-P5801 (1, 108 mm), Tongkang, Taiwan, 13 Mar. 2003. NMMB-P7626 (1, 79 mm), Kaohsiung, Taiwan, 4 Jul. 2004. NMMB-P8415 (1, 105 mm), Tongkang, Taiwan, 17 Mar. 2005. NMMB-P12026 (2, 97-101 mm), Tongkang, Taiwan, 28 Jan. 2011. NMMB-P12027 (3, 92-101 mm), Tongkang, Taiwan, 15 Feb. 2011. NMMB-P14459 (1, 100 mm), Tongkang, 300 m, Taiwan, 28 Feb. 2001. NMMB-P15702 (3, 98-116 mm), Tongkang, Taiwan, 29 Sep. 2010. NMMB-P17020 (7, 92-183 mm), Tongkang, Taiwan, 8 Aug. 2012.

**Diagnosis.** Rostral projection uniformly narrow and elongated, 10.8-15.4% SL; the projections well expanded and deeply forked. Parietal spine and spine on first bony plate of dorsal row sharp. Rostral concave trapezoidal in outline, base narrower



**Fig. 4.** *Peristedion orientale* Temminck & Schlegel 1843, NMMB-P17020, 1 of 7, 170 mm SL, fresh. A. Dorsal view of whole fish. B. Dorsal view of head. C. Lateral view of head.

than eye diameter. Head long and deep, its length 2.8-3.2 in SL, its depth 2.0-2.6 in HL. Snout relatively long, 5.9-6.7 in SL. Total gill rakers 20-26. Body pinkish with dense greenish brown vermiculate pattern, dorsal-fin margin black.

**Description.** Morphometric and meristic data are provided in Tables 1-2.

Dorsal fin rays VIII, 20-21; anal fin

rays 19-22 (mainly 20-21); pectoral fin rays 12+2=14; pelvic fin rays I, 5; principal caudal fin rays 12. Gill rakers 5-7+16-19=20-26.

Body depth 5.9-7.6 times in SL; body width 7.9-10.5; head length 2.8-3.2; head depth 6.2-7.7; head width 4.8-6.2; predorsal length 2.9-3.2; preanal length 2.1-2.3; preanus length 2.2-2.5; snout



length 5.9-6.7. Head width 1.5-2.1 times in HL; head depth 2.0-2.6; snout length 2.0-2.2; orbital diameter 3.8-5.4; rostral projection length 2.2-3.0; longest barbel length 2.7-4.1; upper jaw length 2.4-3.0; lower jaw length 3.2-3.7.

Bony plate covered on entire body, each with a posterior-directed spines; dorsal row of body with 30-32 bony plates; 34-37 on upper lateral row; 26-29 on lower lateral row; 18-23 on ventral row.

Head small, less depressed; rostral projections uniformly marrow and slender, its length 1.4-2.0 times of ED, both projections well-expanded; width of projection base 0.4-0.7 ED; rostral concave with a very broad opening, trapezoidal in outline, width at base about 0.5-0.7 ED, width at opening 1.7-2.6 ED. Interorbital narrow concave, without distinct ridges, its width about equal to ED. Frontal, parietal, posttemporal, and opercular spines present on head, all spines relatively sharp. Spine on first three bony plates of dorsal row sharp. Upper margin of orbital smooth, a horizontal ridge below the eye.

**Coloration.** When fresh, background pale brown, dorsal surface heavily covered by greenish brown vermiculate pattern; two bands on pectoral fin, anterior one deep green and posterior one black; black margins on dorsal and anal fins. When preserved, yellowish gray background with dorsal surface covered by deep gray vermiculate pattern; two backs bands on

pectoral fin and dorsal and anal fin with black margins.

**Distribution.** Northwestern Pacific Ocean off China, Korea, Japan and Taiwan. In Taiwan, this species is commonly collected using bottom trawls at depths not more than 400 m.

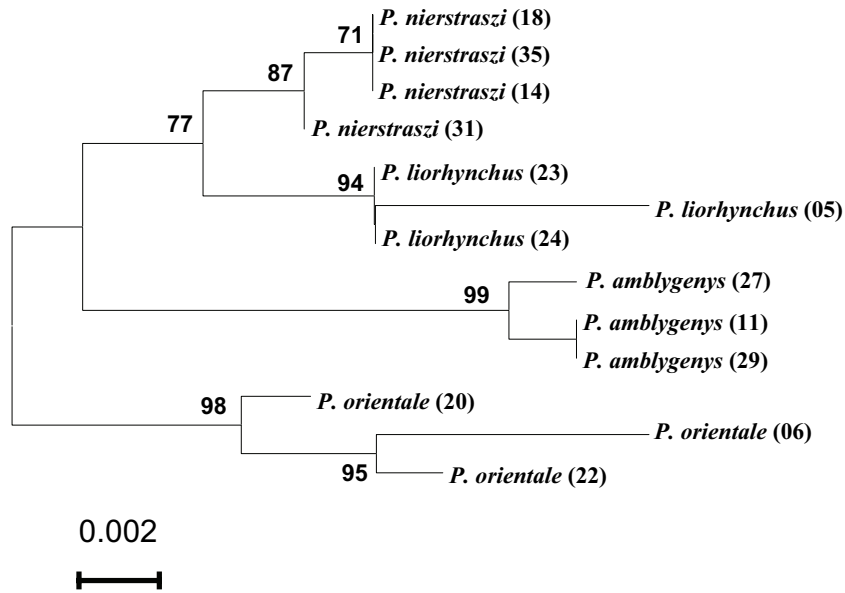
**Remark.** *Peristedion orientale* can be also distinguished from other three congeners in Taiwan by having relatively sharp spines on head and first bony plate on dorsal row and the dense vermiculate pattern on dorsal body.

#### **DNA barcoding**

The NJ analysis of barcode sequences of the four *Peristedion* species demonstrates that each species is a monophyletic group with high statistic support (Fig. 5). The K2P distance between *P. orientale* and *P. liorhynchus* is  $2.17 \pm 0.52\%$ , between *P. orientale* and *P. nierstraszi* is  $2.06 \pm 0.40\%$ , between *P. amblygenys* and *P. nierstraszi* is  $1.85 \pm 0.10\%$ , between *P. amblygenys* and *P. liorhynchus* is  $2.23 \pm 0.35\%$ , and between *P. liorhynchus* and *P. nierstraszi* is  $1.01 \pm 0.35\%$ .

#### **Discussion**

Although most morphometric and meristic are similar or overlapped, several of them can be used to distinguish the species. The numbers of body bony plates often overlap among species, but some differences were observed. The majority of the number of bony plates on the dorsal row are 31 in *P. liorhynchus* and *P. orientale*,



**Fig. 5.** Neighbour-joining tree of four *Peristedion* species inferred from COI gene sequences with 10000 bootstrap replicates. Bootstrap values > 50% are indicated.

32 in *P. nierstraszi* and 32-33 in *P. amblygenys*. The majority of the number of bony plates on lower row of lateral body is 30 in *P. amblygenys*, 26 in *P. liorhynchus*, 28 in *P. orientale* and 27-30 in *P. nierstraszi*. The majority of bony plates on ventral row is 22-23 in *P. liorhynchus* and *P. amblygenys*, 20-21 in *P. orientale* and 23 in *P. nierstraszi*.

There were relatively more total gill raker numbers are in *P. amblygenys* (24-28) and *P. liorhynchus* (25-30) and relatively fewer in *P. orientale* (20-26) and *P. nierstraszi* (22-27).

The head is relatively long in *P. liorhynchus* (30.9-37.7% SL) and *P. orientale*

(31.5-35.2% SL), whereas the head is relatively short in *P. amblygenys* (28.0-32.4% SL) and *P. nierstraszi* (28.3-32.2% SL). The head is relatively depressed in *P. amblygenys* (11.1-13.9% SL) and relatively high in *P. orientale* (12.9-16.2% SL), whereas the other two congeners are moderately high. The pre-dorsal length is relatively small in *P. amblygenys* (28.0-31.9% SL) and *P. nierstraszi* (29.2-32.1% SL) and relatively long in *P. liorhynchus* (30.2-34.5% SL) and *P. orientale* (30.4-34.4% SL). The snout is relatively short in *P. amblygenys* (28.0-31.9% SL) and *P. nierstraszi* (29.2-32.1% SL) and relatively long in *P.*



*liorhynchus* (30.2-34.5% SL and *P. orientale* (30.4-34.4% SL).

The rostral projection is short in *P. liorhynchus* (6.3-10.9% SL), relatively long in *P. orientale* (10.8-15.4% SL) and moderately long in other two species. The base of rostral concave is relatively wide in *P. liorhynchus* (4.6-7.7% SL), whereas other congeners are relatively narrow. The opening of the rostral concave is narrow in *P. amblygenys* (7.2-11.6% SL), relatively wide in *P. orientale* (13.0-18.4% SL), and moderately wide in two other congeners.

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## 台灣產黃魴魮屬(魴形目：黃魴魮科)之分類及分子研究

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### 摘 要

魴魮科下之黃魴魮屬物種為台灣底拖常見魚種。過去僅記錄有三個種。本研究針對分類及分子鑑定，共計確認有四種台灣產黃魴魮，包含光黃魴魮、尼氏黃魴魮、東方黃魴魮以及一新紀錄種鈍頰黃魴魮。本文並提供各種之鑑別特徵及彩色圖片，以及台灣產四種之檢索資料。

**關鍵詞：**分類、黃魴魮屬、新紀錄、台灣