THE RAFFLES BULLETIN OF ZOOLOGY 2008 Supplement No. **19**: 183–201
Date of Publication: 15 Dec.2008

TAXONOMIC REVIEW AND MOLECULAR PHYLOGENY OF THE TRIPLEFIN GENUS *ENNEAPTERYGIUS* (TELEOSTEI: TRIPTERYGIIDAE) FROM TAIWAN, WITH DESCRIPTIONS OF TWO NEW SPECIES

Min-Chia Chiang and I-Shiung Chen
Institute of Marine Biology, National Taiwan Ocean University, Keelung 202, Taiwan, Republic of China
Email: isc@mail.ntou.edu.tw (Corresponding author)

***ABSTRACT*. –** The triplefin genus *Enneapterygius* Rüppell, 1835, recorded from the coastal waters of Taiwan is reviewed. There are eighteen valid species and eleven of these species have been collected for both molecular and morphological studies. A molecular phylogenetic analysis based on the partial sequence of mtDNA ND5 gene (about 1,000 bp) supports the validity of each examined species of *Enneapterygius* and some groups shared similar branch lengths with varied bootstrap support, the possibility of rapid evolutionary radiation within *Enneapterygius* is suggested. The combination of morphological and molecular analyses confirm that some synonymies occur and that the validity of specific names should be reconsidered. *Enneapterygius rubicauda* Shen & Wu, is a junior synonym of *E. flavoccipitis* Shen & Wu. Three recently-described species: *E. erythrosomus* Shen & Wu, *E. hsiojenae* Shen & Wu, and *E. leucopunctatus* Shen & Wu are considered to be valid species. Two new species, *E. shaoi* and *E. sheni*, are described herein. A diagnostic key to all recorded species of *Enneapterygius* in Taiwan is provided.

***KEYWORDS*. –** New coral-reef fishes, *Enneapterygius*, fish taxonomy, molecular phylogeny, Taiwan.

INTRODUCTION

The genus *Enneapterygius* Rüppell, 1835, is the most speciose of the tripterygiid fishes and is widely distributed through the Indo-Pacific Ocean. *Enneapterygius* is distinguished from other genera of Tripterygiidae by the following characters: the first dorsal fin of three spines, the second of 9–16 spines, and the third of 7–12 soft rays; lateral line discontinuous, with an anterior series of 6–22 pored scales and a posterior series of 13–37 notched scales extending to caudal fin base; anal fin with 1 spines; pelvic fin with 1 spine and 2 soft rays. Body with ctenoid scales. Head and operculum naked; abdomen and pectoral fin base usually naked but with cycloid scales in some species (Holleman, 1982; Shen & Wu, 1994; Fricke, 1994b; Wang et al., 1996; Fricke, 1997).

Shen & Wu (1994) studied seven species of *Enneapterygius* from Taiwan. Five these were described as new, including *E. erythrosomus*, *E. flavoccipitis*, *E. hsiojenae*, *E. leucopunctatus*, and *E. rubicauda*. In the same year, Fricke (1994b) reported a total of 18 species of this genus from Australia and the southwest Pacific, and regarded *E. erythrosomus* and *E. rubicauda* as synonyms, and both *E. hsiojenae* and *E. leucopunctatus* as junior synonyms of *E. vexillarius* Fowler, 1946. Wang et al. (1996) described a further new species, *Enneapterygius cheni*, from the eastern coastal waters of Taiwan, and Fricke (1997) reported 37 *Enneapterygius* species of the western and central Pacific, in which 16 species were recorded from Taiwan (Fricke, 1997) and considered *E. cheni* to be a junior synonym of *E. niger* Fricke, 1994. However, Shibukawa (2004) subsequently supported the validity of *E. cheni* Wang et al., 1996. Several conflicting synonymies of other Taiwanese *Enneapterygius* species were still unresolved and it became necessary to gather more morphological and molecular data.

While collecting in the coastal waters of Taiwan, we discovered two more undescribed species. The first aim of this paper is to describe these new species and to summarize the taxonomic status of the other species previously collected from Taiwan. The second aim of this paper is to obtain a preliminary molecular phylogenetic perspective of the *Enneapterygius* species of Taiwan. The molecular phylogenetic analysis of mtDNA sequences has been successfully employed for the systematics and phylogeographical research of fishes (Chen et al., 2002; Hickey et al., 2004; Carreras-Carbonell et al., Chen & Chang, 2007; Wu et al., 2007; Domingues et al., 2007). In our study we used the mitochondrial NADH dehydrogenase subunit 5 (ND5) gene, a protein-coding gene with good phylogenetic performance (Miya & Nishida, 2000; Miya et al., 2006; Loh et al., 2008) as a genetic marker. A comparison between out morphological and molecular data has given us fresh insight into the relationships of the various *Enneapterygius*

species from Taiwan, and allowed us to resolve synonymy problems.

MATERIALS AND METHODS

***Sample collection.* –** All specimens examined in this study were collected since 2006 from the coastal waters of Taiwan, using either hand-nets in tide pools or while SCUBA diving. *Norfolkia brachylepis* (Schultz, 1960), was also collected and assigned as outgroup for molecular phylogenetic analysis. *Norfolkia* belongs to the same family but it distinctly differs from *Enneapterygius* by first dorsal fin with four spines and anal fin with two spines. Specimens used for morphological studies were preserved in 10% formalin before being transferred into 70% ethanol for long-term preservation. Fresh specimens or fin tissue used for molecular analysis were directly preserved in 95% ethanol after capture and, after preservation, transferred frozen in the laboratory.

All type and comparative specimens have been deposited at the Institute of Marine Biology, National Taiwan Ocean University, Keelung (NTOU P).

***Molecular phylogenetic analysis.* -** All DNA extraction was performed using the High Pure PCR Template Preparation Kit (Roche). DNA fragments of the partial mitochondrial NADH dehydrogenase subunit 5 (ND5) gene (about 1000 bp) were amplified by polymerase chain reaction (PCR), using primers based on the flanking region (ND5-LEU: 5'–GGT CTT AGG AAC CAA AAA CTC TTG GTG CAA–3' and ND5-MR: 5'–CCT ATT TTK CGG ATG TCY TG–3') designed from the conserved sequence of the tRNA-LEU and the middle region of ND5. The PCR was carried out using an ABI 2720 thermal cycler, and 35 cycles were completed. The 50 µL reaction volume contained 33.5 µL of sterile distilled water, 5 µL of 10× reaction buffer (Takara), 4 µL of dNTP (2.5 mM each), 3µL of $MgCl^2$ (2.5mM), 1 µL of each primer (10 pmole), 0.1 µL of 2 unit Super-therm DNA polymerase and 1 µL of template. The thermal cycler profile was as follows: denaturation at 94°C for 60 seconds, annealing at 50°C for 60 seconds and extension at 72°C for 90 seconds. A negative control without template was carried out for each PCR run. The PCR products were run on a 1.0% agarose gel and stained with ethidium bromide for band characterization under ultraviolet trans-illumination.

Double-strained PCR products were purified using a kit (Roche, High Pure Product Purification kit), before undergoing direct cycle sequencing with dye-labelled terminators (ABI Big-Dye kit). The sequencing primers used were either same as those for PCR or following two primers: ND5-TL: 5'–AAY ACW GCW GCY CTN CAA GC–3' and ND5-TR: 5'–AAR ATY TGY TGT ATC TCY CAG GAG TT–3', specifically designed for triplefins. All sequencing reactions were performed according to the manufacturer's instructions. Labelled fragments were analyzed using ABI Model 3700 DNA Automated sequencer.

Nucleotide sequence alignment was verified manually after running BIOEDIT version 5.9 software (Hall, 2001) and corrected by eye. Parsimony (MP) analysis was carried out using PAUP* version 4.0 b10 (Swofford, 2003), using heuristic search. Branch support was established via bootstrap analysis (2000 replications). For the Bayesian (BI) analysis, the best-fitting model for sequence evolution was determined for mtDNA ND5 sequences using MrModeltest version 2.2 (Nylander, 2005). The BI analyses were performed using MrBayes 3.0 (Ronquist & Huelsenbeck, 2003). The posterior probabilities of each node were computed from the remaining 75% of all sampled trees.

***Morphological studies.* –** Morphometric methods generally follow those described by Randall & Clark (1958) and by Fricke (1997). Proportional measurements given in the text are in relation to standard length (SL), head length and eye diameter. Meristic abbreviations are as follows: A: anal-fin rays; D: dorsal-fin rays; P1: pectoral-fin rays; P2: pelvic-fin rays; and C: caudal-fin rays. Supraoccipital sensory canal definition, mandibular pore counts and vertebral counts follow Holleman (1982, 2006).

SYSTEMATICS

Diagnostic key to all valid species of *Enneapterygius* in Taiwan

1 Anterior lateral-line less than 13 scales 2
– Anterior lateral-line more than 14 scales 4
2 First dorsal fin higher than second dorsal fin; mandibular pores 2+2+2, U-shaped curve of supraoccipital sensory canal anterior to first dorsal fin ..... *E. tutuilae*
– First dorsal fin lower than second dorsal fin; symphyseal mandibular pores 1, flattened curve of supraoccipital sensory canal anterior to first dorsal fin 3
3 Mandibular pores 2+1+2; body white or translucent in both sexes ..... *E. nanus*
– Mandibular pores 3+1+3; body reddish-brown in male, light red or yellow in female ..... *E. philippinus*
4 Second dorsal fin always more than 14 spines, anal fin rays always more than 20 rays 5
– Second dorsal fin always less than 14 spines, anal fin rays always less than 20 rays 6
5 Mandibular pores 4+1+4; nasal cirrus forked; first dorsal fin equal to or higher than second dorsal fin ..... *E. etheostomus*
– Mandibular pores 3+1+3; nasal cirrus simple; first dorsal fin lower than second dorsal fin ..... *E. hsiojenae*
6 Caudal fin black in male 7
– Caudal fin pale, membrane translucent or white in male . 10
7 Body dark brown, anal fin black in male 8
– Body reddish, anal fin pale in male 9
8 Male with a black head mask, a short blue suborbital mark; pyramid-shaped blackish blotches along the ventral sides of body. Notched scales usually 16-17 ..... *E. fuscoventer*
– Male without a black head mask. Head yellowish with two vertical suborbital brown streaks; body sides with two rows of white blotches. Notched scales usually 19 .... *E. pallidoserialis*
9 Caudal peduncle blackish in male; body with brownish saddles on back ..... *E. bahasa*

– Caudal peduncle pale in male; body without any markings .. .. *E. nigricauda*
10 Second dorsal fin grayish-black in male, first dorsal fin equal to or higher than second dorsal fin ..... *E. sheni* new species
– Second dorsal fin pale in male, first dorsal fin lower than second dorsal fin 11
11 Caudal fin with vertical rows of reddish or brownish markings on rays 12
– Caudal fin with whitish or yellowish or reddish rays in male 14
12 Mandibular pores 3+1+3; second dorsal fin spines usually 13; pored scales usually 14, notched scales usually 18 .... *E. unimaculatus*
– Mandibular pores 4+1+4; second dorsal fin spines usually 12; pored scales usually 18, notched scales usually 16 13
13 Caudal fin with a brownish-black bar on rays near the distal margin; caudal peduncle with a brownish-black bar near the end and extending to the caudal fin base .... *E. shaoi* new species
– Caudal fin with several bars of discontinuous reddish markings on rays; caudal peduncle with a black hourglass marking ..... *E. elegans*
14 Anal fin rays usually 17; supraorbital cirrus broad or lobate 15
– Anal fin rays usually 18; supraorbital cirrus thin or slender 16
15 Nasal cirrus simple and slender; third dorsal fin rays usually 9; notched scales usually 16 ..... *E. cheni*
– Nasal cirrus trifid; third dorsal fin rays usually 8; notched scales usually 18 ..... *E. fasciatus*
16 Mandibular pores 3+1+3. Nape yellowish in male ..... *E. flavoccipitis*
– Mandibular pores 4+1+4. Nape not yellowish in male 17
17 Nasal cirrus slender; body with vague bands, anterior- red and posterior- orange or yellow; three red to blackish-brown blotches arranged triangularly on base of pectoral fin .... *E. erythrosomus*
– Nasal cirrus lobate; body with ambiguous reddish-brown or blackish-brown markings; pectoral fin base brownish-black with three to four white spotted lines on base of pectoral fin ..... *E. leucopunctatus*

Enneapterygius sheni, new species
(Fig. 1a, b, 2)

Holotype. – NTOU-P 2008-06-366, 1 male, 23.0 mm SL, Feng-chui-sha, Hengchun Township, Pingtung County, Taiwan, 3–12 m depth, coll. M. C. Chiang et al., 20 Jul.2007.

Paratypes. – NTOU-P 2008-06-359, 1 female, 20.8 mm SL; NTOU-P 2008-06-361, 1 female, 20.8 mm SL; NTOU-P 2008-06-363, 1 female, 15.6 mm SL; NTOU-P 2008-06-367, 1 male, 21.3 mm SL; NTOU-P 2008-06-368, 1 male, 23.2 mm SL; NTOU-P 2008-06-369, 1 male, 21.5 mm SL. All specimens listed above with the same collecting data as the holotype.

Diagnosis. – The new species can be distinguished from other congeners by the following combination of characters: dorsal fins III, XII, 9; anal fin I, 17; lateral line with 16–18 pored scales and 16–18 notched scales; mandibular pore system 4+1+4; supraorbital cirrus simple and broad; nasal cirrus simple and slender; first dorsal fin equal to or higher than second; head with a black mask, and first, second dorsal and anal fins entirely blackish in male; second dorsal fin with four black blotches and anal fin with 8-9 basal blackish-brown streaks in female; opercle grayish-black; a black streak on caudal peduncle.

Description. – D. III, XII, 9; A. I, 17; P1. 2–3+4–6+7; P2. I, 2. C. 2+9+2. Scale rows 33-34. Lateral line with 17–18 pored scales and 16–18 notched scales, pored scales ending below last membrane of second dorsal fin, notched scale following last pored scale but two rows lower. Transverse scale rows 3+1+6-7, three rows of scales between origin of second dorsal fin and anterior lateral line series, six to seven rows of scales between anterior lateral line series and origin of anal fin. A single symphyseal mandibular pore, mandibular pore pattern 4+1+4; supraoccipital sensory canal forms a flattened curve anterior to first dorsal fin (Fig. 2). Vertebrae 10+24.

Body moderately elongated and compressed. Head moderately large, dorsal profile triangular. Body covered with ctenoid scales. Head, nape, base of pectoral fin and ventral abdomen naked. Snout pointed, maxilla ending below or slightly posterior to front border of eye. Eye moderately large and slightly oriented dorsally. Supraorbital cirrus simple and broad. Nasal cirrus simple and slender. First dorsal fin equal to or higher than second dorsal fin in both sexes; anal fin

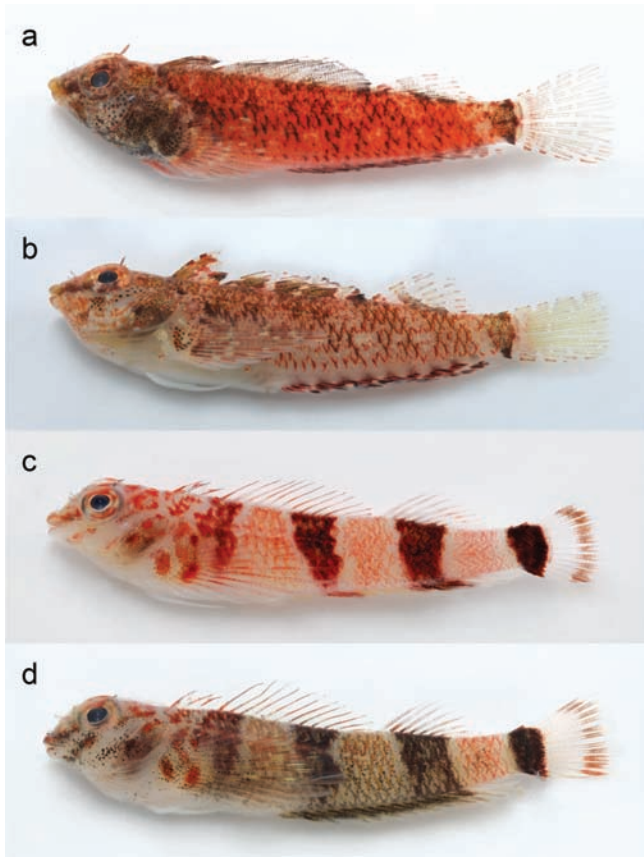

Fig. 1. Specimen photographs of: a, *Enneapterygius sheni*, new species, holotype, male, NTOU-P 2008-06-366, 23.0 mm SL; b, *Enneapterygius sheni*, new species, paratype, female, NTOU-P 2008-06-359, 20.8 mm SL; c, *Enneapterygius shaoi*, new species, holotype, female, NTOU-P 2008-06-304, 21.9 mm SL; d, *Enneapterygius shaoi*, new species, paratype, male, NTOU-P 2008-06-302, 23.4 mm SL.

Table 1. Frequency distribution of fin-ray counts of 18 species of the *Enneapterygius* from Taiwan.

Species	Second dorsal fin spines							Third dorsal fin rays							Anal fin rays							
	11	12	13	14	15	16	Av	7	8	9	10	11	12	Av	15	16	17	18	19	20	21	Av
E. sheni, new species	–	7	–	–	–	–	12.0	–	–	7	–	–	–	9.0	–	–	7	–	–	–	–	17.0
E. shaoi, new species	–	6	–	–	–	–	12.0	–	–	–	6	–	–	10.0	–	–	–	6	–	–	–	18.0
*E. bahasa**	17	29	10	4	–	–	12.0	8	27	18	6	1	–	8.4	–	5	27	21	6	1	–	17.5
E. cheni	1	8	1	–	–	–	12.0	–	3	6	1	–	–	8.8	–	2	7	1	–	–	–	16.9
E. elegans	–	1		–	–	–	12.0	–	–	1	–	–	–	9.0	–	–	1	–	–	–	–	17.0
E. erythrosomus	–	3	6	1	–	–	12.8	–	–	4	5	1	–	9.7	–	–	–	8	2	–	–	18.2
E. etheostomus	–		1	7	2	–	14.1	–	–	2	7	1	–	9.9	–	–	–	–	1	5	4	20.3
*E. fasciatus***	5	15	–	–	–	–	11.8	4	10	3	2	1	–	8.3	–	1	10	6	3	–	–	17.6
E. flavoccipitis	–	9	2	–	–	–	12.2	–	–	7	4	–	–	9.4	–	–	2	9	–	–	–	17.8
*E. fuscoventer**	2	13	8	3	–	–	12.5	–	3	14	9	–	–	9.2	4	11	10	1	–	–	–	16.3
E. hsiojenae	–		–	4	–	–	14.0	–	–	–	4	–	–	10.0	–	–	–	–	1	3	–	19.8
E. leucopunctatus	–		6	–	–	–	13.0	–	–	4	5	1	–	9.7	–	–	–	6	–	–	–	18.0
*E. nanus**	11	20	22	7	–	–	11.4	4	14	24	15	3	–	9.0	–	7	15	21	14	3	–	17.8
*E. nigricauda***	9	5	6	–	–	–	11.8	1	6	7	6	–	–	8.9	–	5	7	6	2	–	–	17.2
*E. pallidoserialis***	6	10	4	–	–	–	11.9	–	2	12	6	–	–	9.2	–	6	9	4	1	–	–	17.0
E. philippinus	6	4	–	–	–	–	11.4	–	3	7	–	–	–	8.7	4	5	1	–	–	–	–	15.7
E. tutuilae	3	7	–	–	–	–	11.7	–	1	8	1	–	–	9.0	–	2	7	1	–	–	–	16.9
*E. unimaculatus**	–	14	44	8	–	–	12.9	–	9	36	21	–	–	9.2	–	11	28	19	8	–	–	17.4

*data from Fricke (1997).
**data merely including type locality from Fricke (1997).

Table 2. Frequency distribution of scale counts of 18 species of the *Enneapterygius* from Taiwan.

Species	Pored scales														Notched scales										
	8	9	10	11	12	13	14	15	16	17	18	19	20	Av	13	14	15	16	17	18	19	20	21	22	Av
E. sheni, new species	–	–	–	–	–	–	–	–	1	4	2	–	–	17.1	–	–	–	1	2	4	–	–	–	–	17.4
E. shaoi, new species	–	–	–	–	–	–	–	–	1	1	4	–	–	17.5	–	–	1	4	1	–	–	–	–	–	16.0
*E. bahasa**	–	–	–	–	–	1	3	12	16	42	33	9	4	17.1	1	2	4	9	41	43	13	5	2	–	17.5
E. cheni	–	–	–	–	–	–	–	6	4	–	–	–	–	15.4	–	–	–	5	3	2	–	–	–	–	16.7
E. elegans	–	–	–	–	–	–	–	–	–	–	1	–	–	18.0	–	–	–	1	–	–	–	–	–	–	16.0
E. erythrosomus	–	–	–	–	–	–	–	2	2	4	2	–	–	16.6	–	–	–	1	2	4	2	1	–	–	18.0
E. etheostomus	–	–	–	–	–	–	–	–	–	2	5	1	2	18.3	–	–	–	1	3	4	1	1	–	–	17.8
*E. fasciatus***	–	–	–	–	1	3	17	8	10	1	–	–	–	14.6	–	–	1	2	9	15	11	2	–	–	18.0
E. flavoccipitis	–	–	–	–	–	–	–	3	7	1	–	–	–	15.8	–	–	–	–	3	6	2	–	–	–	17.9
*E. fuscoventer**	–	–	–	–	–	–	–	7	17	16	8	4	–	16.7	–	2	5	16	14	11	4	–	–	–	16.8
E. hsiojenae	–	–	–	–	–	–	–	–	–	–	2	1	1	18.8	–	–	–	–	1	2	1	–	–	–	18.0
E. leucopunctatus	–	–	–	–	–	–	–	–	–	2	4	–	–	17.7	–	–	–	–	6	–	–	–	–	–	17.0
*E. nanus**	–	–	11	29	35	33	11	1	–	–	–	–	–	12.1	–	–	–	–	–	9	23	47	25	7	19.9
*E. nigricauda***	–	–	–	–	–	–	–	3	11	11	10	4	1	17.1	–	–	–	5	16	11	6	2	–	–	17.6
*E. pallidoserialis***	–	–	–	–	–	–	–	12	12	10	3	2	1	16.4	–	–	1	2	4	7	17	8	1	–	18.6
E. philippinus	–	–	–	–	9	1	–	–	–	–	–	–	–	12.1	–	–	–	–	2	2	3	3	–	–	18.7
E. tutuilae	1	4	2	1	2	–	–	–	–	–	–	–	–	9.9	–	–	–	–	–	3	3	–	3	1	19.6
*E. unimaculatus**	–	–	–	–	–	28	80	40	14	–	–	–	–	14.3	–	–	–	11	29	35	32	18	7	–	18.3

*data from Fricke (1997).
**data merely including type locality from Fricke (1997).

Table 3. Morphometry of *Enneapterygius sheni*, new species, and *Enneapterygius shaoi*, new species. All values in parentheses are mean values.

Species	*Enneapterygius sheni*, new species		*Enneapterygius shaoi*, new species	
	Holotype	Holotype + Paratype n = 7	Holotype	Holotype + Paratype n = 6
Standard length (mm)	23.0	15.6–23.2	21.9	18.7–23.8
In % of standard length				
Head length	29.0	27.8–31.8 (30.0)	28.1	27.4–31.0 (28.6)
Body depth of anal fin origin	19.3	19.0–20.6 (19.7)	18.3	17.2–20.5 (19.2)
Body width of anal fin origin	15.1	13.5–15.2 (14.6)	15.4	13.3–16.7 (15.4)
Head width in maximum	20.7	19.6–23.5 (21.4)	21.1	20.1–23.6 (21.8)
Predorsal(1) length	23.3	23.2–28.2 (25.2)	26.6	25.2–28.3 (26.9)
Predorsal(2) length	36.1	36.1–37.7 (37.0)	35.5	33.7–36.8 (35.2)
Predorsal(3) length	69.4	69.0–71.9 (70.1)	68.4	68.2–71.7 (69.2)
Prepectoral fin length	33.8	32.8–36.0 (33.9)	32.5	31.6–34.1 (32.8)
Prepelvic fin length	25.3	24.2–29.1 (26.2)	21.9	21.9–25.4 (24.2)
Preanal fin length	52.2	51.3–54.4 (52.7)	50.9	48.7–52.1 (50.6)
Caudal peduncle length	8.7	8.7–11.7 (10.0)	11.6	9.2–12.9 (11.2)
Caudal peduncle depth	9.7	8.8–9.9 (9.4)	9.6	8.6–9.6 (9.1)
Pectoral fin length	31.9	29.5–34.1 (31.9)	32.3	29.9–33.4 (32.2)
Pelvic fin length	22.6	21.5–25.5 (23.2)	23.4	21.7–23.4 (22.6)
Caudal fin length	21.2	21.2–25.5 (22.8)	17.9	17.9–19.2 (18.4)
D1 fin base	10.0	9.4–13.0 (11.1)	9.4	7.9–10.8 (9.4)
D2 fin base	33.5	32.0–36.4 (33.6)	30.4	30.0–34.8 (32.0)
D3 fin base	20.2	17.4–22.0 (20.1)	19.9	15.8–19.9 (17.7)
A fin base	41.5	39.6–42.4 (41.0)	40.1	40–42.9 (41.3)
D1 1st spine length	13.6	12.3–14.9 (13.6)	7.3	6.2–9.6 (7.6)
D2 1st spine length	12.2	10.8–14.2 (12.4)	9.8	9.8–13.2 (11.3
In % of head length				
Head width in maximum	71.6	61.7–78.8 (71.5)	75.2	70.0–84.6 (76.5)
Eye diameter	32.9	28.4–34.7 (32.5)	33.9	32.9–35.9 (34.9)
Interorbital width	10.1	8.6–11.5 (10.0)	12.2	12.2–15.6 (14.0)
upper jaw length	44.7	35.0–44.7(40.8)	34.4	32.0–38.3 (34.6)
Snout length	29.2	29.2–32.6 (30.6)	30.5	29.5–33.9 (31.5)
In % of orbit diameter				
Nasal tentacle length	15.5	15.5–19.8 (18.0)	16.8	12.0–22.7 (17.3)
Orbital tentacle length	27.9	25.1–28.2 (27.2)	20.7	14.0–20.7 (17.7)

origin below vertical through base of 8th second dorsal fin; pectoral fins large and pointed, ending below last membrane of second dorsal fin; caudal fin truncate to slightly rounded. Morphometric data are listed in Table 3.

Colouration when fresh. **–** Males with a black mask on lower three-quarters of head; body blood red with irregular black marks, which black pigment mainly along margins of scales; first, second dorsal and anal fins dusky gray to deep black, third dorsal fin with oblique grayish bands, and other fins rays reddish to yellowish-brown; a black streak on caudal peduncle.

Females with paler head, ventral part whitish, operculum dusky gray, lower part of pectoral fin base densely spotted with melanophores, a brown streak from suborbital to jaw and a vertical band beneath the eye; body pale orange with irregular orange or brown marks; four brownish blotches on second dorsal fin; a grayish-black oblique band on third dorsal fin; 8-9 blackish-brown streaks on anal fin; pelvic white; pectoral and caudal fin reddish; a brown to black streak on caudal peduncle.

Distribution. **–** To date this new species has been found only from the southern tip of Taiwan. It seems to prefer the shallow sub-tidal habitat at depths of 3–12 m.

Etymology. **–** The species is named after Prof. S. C. Shen in recognition of his great contribution to the systematics of marine fishes, including the triplefins in Taiwan.

Remarks. **–** In comparison with its congeners, this species most resembles *Enneapterygius larsonae* Fricke, 1994, and *Enneapterygius triserialis* Fricke, 1994, by possessing a pored lateral line with more than 14 scales, a mandibular pore pattern 4+1+4, a pale caudal fin and a black anal fin in the male. However, it can be distinguished from *E. larsonae* by its second dorsal fin with four brown blotches in female and overall dusky black in male (vs. basally brown in both sexes in *E. larsonae*), and anal fin with 8–9 streaks

in female (vs. without streak). *E. triserialis* has the same meristic characters and has a overall dusky black second dorsal fin in the male, but its colour pattern is completely different in both sexes.

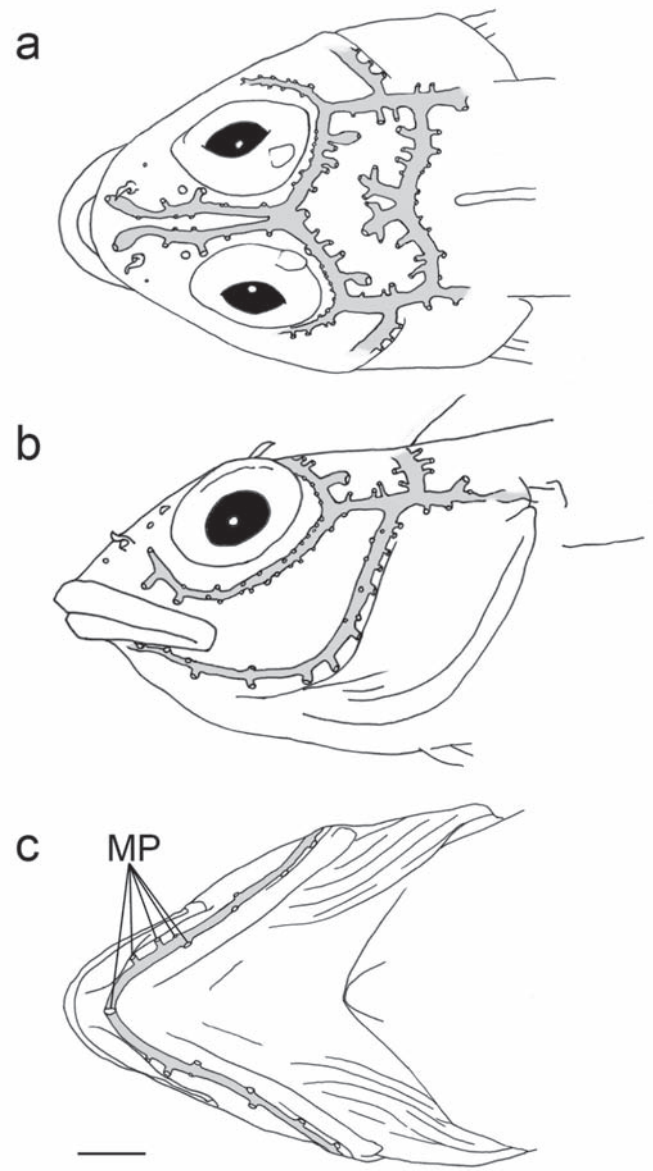

Fig. 2. Cephalic sensory canal of *Enneapterygius sheni*, new species, paratype, female, NTOU-P 2008-06-359, 23.2 mm SL: a, dorsal view; b, lateral view; c, ventral view. Canal indicated by gray shading. MP, mandibular pores. Scale bar = 1 mm.

Enneapterygius shaoi, new species
(Fig. 1c, d, 3)

Holotype. **–** NTOU-P 2008-06-304, 21.9 mm SL, Feng-chui-sha, Hengchun Township, Pingtung County, Taiwan, 3–12 m depth, coll. M. C. Chiang et al., 21 Jul.2007.

Paratypes. **–** NTOU-P 2008-06-299, 19.4 mm SL, Chenggong Township, Taitung County, coll. M. C. Chiang et al., 19 Aug.2006. Four lots of specimens with same collecting data as holotype listed as follows. NTOU-P 2008-06-300, 19.6 mm SL; NTOU-P 2008-06-301, 18.7 mm SL; NTOU-P 2008-06-302, 23.4 mm SL; NTOU-P 2008-06-303, 23.8 mm SL.

Diagnosis. **–** The new species can be distinguished from other congeners by the following combination of characters: dorsal fins III, XII, 10; anal fin I, 18; lateral line with 16–18 pored scales and 15–17 notched scales; mandibular pore pattern 4+1+4; supraorbital cirrus simple and slender; nasal cirrus short and broad; first dorsal fin lower than second; body pink to light orange with four vertical or slightly oblique deep brown bars from behind pectoral fin base to caudal fin base, each broad bar edged with whitish border; caudal fin pale with a brownish-black streak near the distal margin. Sexual dichromatism indistinct, spawning males with blackish anal fin and spotted with melanophores on body, head, dorsal and pectoral fin rays.

Description. **–** D. III, XII, 10; A. I, 18; P1. 2–3+6+7; P2. I, 2. C. 2+9+2. Scale rows 33–35. Lateral line with 16–18 pored scales and 15–17 notched scales, pored scales ending below the 1st spine of third dorsal fin, continuing one row lower with a posterior series of notched scales. Transverse scale rows 3+1+6, three rows of scales between origin of second dorsal fin and anterior lateral line series, six rows of scales between anterior lateral line series and origin of anal fin. A single symphyseal mandibular pore, mandibular pore pattern 4+1+4; supraoccipital sensory canal forms a flattened curve anterior to first dorsal fin (Fig. 3). Vertebrae 10+25.

Body moderately elongated and compressed. Head moderately large, dorsal profile triangular. Body covered with ctenoid scales. Head, nape, base of pectoral fin and ventral abdomen naked. Mouth pointed, maxilla ending below or slightly posterior to front border of eye. Eye moderately large and slightly oriented dorsally. Supraorbital cirrus simple and slender. Nasal cirrus short and broad. First dorsal fin lower than second dorsal fin in both sexes; anal fin beginning below vertical through base of 7^{th}–8^{th} second dorsal fin; pectoral fin large and pointed, ending below last spine of second dorsal fin; caudal fin truncate to slightly rounded. Morphometric data are listed in Table 3.

Colouration when fresh. **–** Body pink to light orange with four vertical or slightly oblique deep brown or blackish bars, each broad bar edged with whitish border. The first bar behind pectoral fin base, second bar below the last half of second dorsal fin, third bar below the third dorsal fin, the last on caudal peduncle and extending to caudal fin base. A pre-orbital reddish-brown streak and an infra-orbital orange or red streak from eye to mouth. Operculum reddish to brown. Three red blotches on pectoral fin base, lower one red to brownish-red. Caudal fin pale with a brownish-black streak near the distal margin. Dorsal and pectoral fin membrane translucent, fin rays reddish. Anal fin white or light yellowish with two deep brown bands connected from second and third bars on body.

Sexual dichromatism indistinct, spawning males with blackish anal fin and spotted with melanophores on body, operculum, pre-orbital streak and infra-orbital streak, pectoral fin base, pectoral fin and dorsal fin rays.

Distribution. **–** To date this new species has been found only

on the eastern coast and southern tip of Taiwan. It appears to prefer the shallow sub-tidal habitat at depths of 3–12 m.

***Etymology.* –** The species is named after Prof. K. T. Shao in recognition of his excellent contribution to the systematics and the ecology of fishes in Taiwan.

***Remarks.* –** In comparison of meristic data and in colouration pattern, this new species most resembles its congener *Enneapterygius rhabdotus* Fricke, 1994. However, it can be distinguished from *E. rhabdotus* by the following features: (1) mandibular pore pattern 4+1+4 (vs. 3–4+3–4+3–4); (2) no scale gap or merely with one row between two lateral line sections (vs. two rows between two lateral line sections); (3) body with pink or light orange color background with deep brown streaks (vs. brown background with black streaks); and (4) dorsal fin membrane translucent with fin rays reddish in both sexes (vs. dorsal fin entirely black in male).

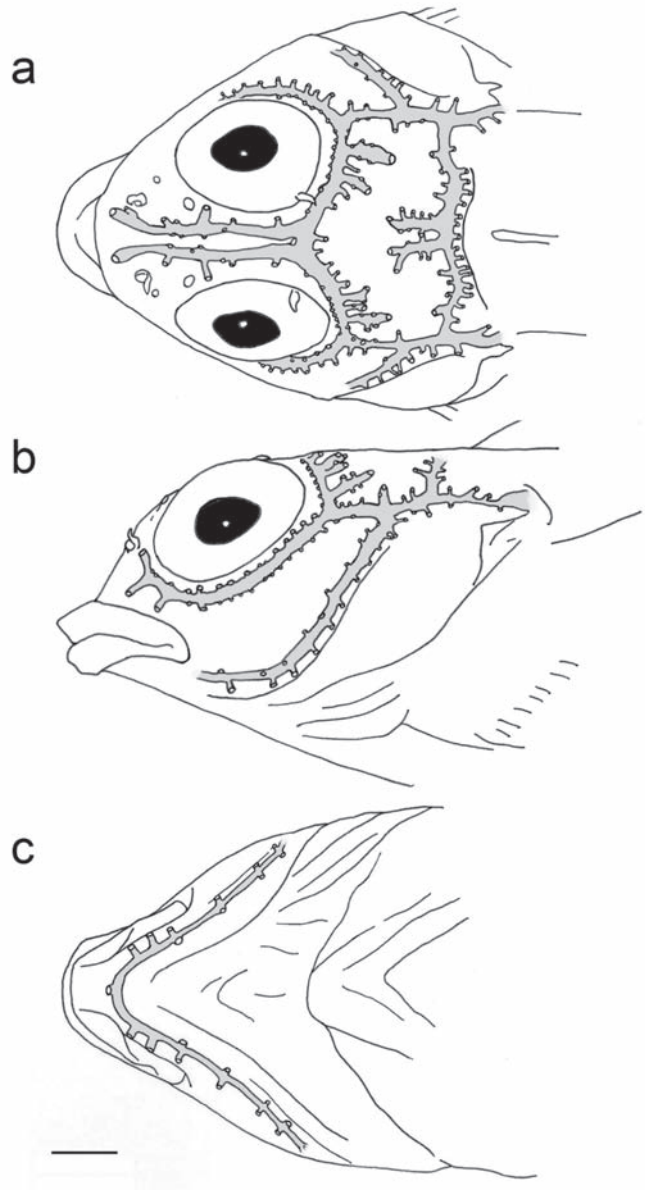

Fig. 3. Cephalic sensory canal of *Enneapterygius shaoi*, new species, paratype, female, NTOU-P 2008-06-304, 21.9 mm SL: a, dorsal view; b, lateral view; c, ventral view. Canal indicated by gray shading. Scale bar = 1 mm.

Enneapterygius bahasa Fricke, 1997

Enneapterygius bahasa Fricke, 1997: 170 (Type locality: Heron Island, Queensland, Australian).

***Diagnosis.* –** D. III, XI–XV (modally XIII), 7–11 (modally 11). A. I, 16–20 (modally 19). Lateral line with 13–20 pored scales and 13–22 notched scales. Mandibular pore pattern 3–6+2–8+3–6 (modally 4+6+5). Supraorbital cirrus short. The first dorsal fin lower than second dorsal fin in both sexes. Males with a black mask on its lower two-thirds of head, a bright blue suborbital streak, and the caudal peduncle and caudal fin black. Dorsal and anal fins pale.

***Distribution.* –** This species has been recorded in the depth of 0.1–18 m, from the southern tip of Taiwan and from Japan, the Philippines, Indonesia, Papua New Guinea, Palau, Guam and Queensland (Australia) (Fricke, 1997).

Enneapterygius cheni Wang, Shao & Shen, 1996
(Fig. 4a)

Enneapterygius cheni Wang, Shao & Shen, 1996: 80 (Type locality: Chenggong (Cheng-Kung), Taitung County, Taiwan).
Enneapterygius niger – Fricke, 1997: 248.
Enneapterygius cheni – Shibukawa et al., 2004: 2.

***Material examined.* –** Seven specimens collected from Chenggong Township, Taitung County, 3–10 m depth, coll. M. C. Chiang et al.: NTOU-P 2008-06-319, 1 male, 22.9 mm SL, 19 Aug.2006; NTOU-P 2008-06-320, 1 female, 19.0 mm SL, 5 Apr.2007; NTOU-P 2008-06-321, 1 male and 1 female, 22.8 and 19.3 mm SL, 5 Apr.2007; NTOU-P 2008-06-322, 1 Female, 23.8 mm SL, 6 Apr.2007; NTOU-P 2008-06-323, 1 male and 1 female, 19.0 and 18.2 mm SL. NTOU-P 2008-06-324, 1 female, 23.5 mm SL, Nan-ren-Road Ferry, Pingtung County, Taiwan, 5–10 m depth, coll. M. C. Chiang et al., 19 Jul.2007; NTOU-P 2008-06-325, 1 male and 1 female, 25.5 and 20.1 mm SL, Feng-chui-sha, Hengchun Township, Pingtung County, Taiwan, 3-12 m depth, coll. M. C. Chiang et al., 21 Jul.2007.

***Diagnosis.* –** D. III, XI–XIII (modally XII), 8–10 (modally 9). A. I, 16–18 (modally 17). Lateral line with 15–16 pored scales and 16–18 notched scales. Mandibular pore pattern 4+1+4. Supraorbital cirrus simple and broad. Nasal cirrus simple and slender. The first dorsal fin lower than second in both sexes. A vertical whitish streak on the cheek. Five white oblique streaks on body. Males overall deep brown, with oblique streaks on body reduced to two distinct whitish bars; caudal peduncle with a narrow vertical black streak. Supraoccipital sensory canal forms a flattened curve anterior to first dorsal fin.

***Distribution.* –** The samples were collected by us from depths of 0–12 m at the northeastern, eastern coast and southern tip of Taiwan. This species has been previously recorded from the eastern coast of Taiwan (Wang et al., 1996) and the Ryukyu Island (Shibukawa et al., 2004).

***Remarks.* –** Fricke (1997) concluded that *Enneapterygius cheni* was a junior synonym of *Enneapterygius niger*

Fig. 4. Specimen photographs of: a, *Enneapterygius cheni*, new species, NTOU-P 2008-06-324, 23.5 mm SL; b, *Enneapterygius elegans*, NTOU-P 2008-06-370, 24.1 mm SL; c, *Enneapterygius erythrosomus*, NTOU-P 2008-06-341, 21.9 mm SL; d, *Enneapterygius etheostomus*, NTOU-P 2008-06-333, male, 44.3 mm SL; e, *Enneapterygius etheostomus*, NTOU-P 2008-06-374, female, 31.2 mm SL; f, *Enneapterygius. flavoccipitis*, male, NTOU-P 2008-06-354, 20.6 mm SL; g, *Enneapterygius flavoccipitis*, female, NTOU-P 2008-06-358, 21.3 mm SL; h, *Enneapterygius hsiojenae*, NTOU-P 2008-06-373, 23.1 mm SL; i, *Enneapterygius leucopunctatus*, NTOU-P 2008-06-308, 26.8 mm SL; j, *Enneapterygius philippinus*, male, NTOU-P 2008-06-344, 20.8 mm SL; k, *Enneapterygius philippinu*s, female, NTOU-P 2008-06-348, 17.8 mm SL; and l) *Enneapterygius tutuilae*, NTOU-P 2008-06-318, 15.1 mm SL.

Table 4. Morphometry of *Enneapterygius* species from Taiwan. All values in parentheses are mean values.

Species	*E. cheni*	*E. elegans*	*E. erythrosomus*	*E. etheostomus*	*E. flavoccipitis*
	n = 10	n = 1	n = 10	n = 10	n = 11
Standard length (mm)	18.2–25.5	24.1	20.0–30.0	30.0–48.0	20.6–25.0
In % of standard length					
Head length	27.9–30.5 (29.3)	30.6	26.2–30.8 (28.0)	25.2–28.4 (26.5)	24.1–29.9 (27.6)
Body depth of anal fin origin	19.8–22.9 (21.5)	24.8	19.7–23.5 (21.5)	18.0–20.1 (19.1)	18.0–21.2 (19.6)
Body width of anal fin origin	11.0–16.3 (13.6)	18.3	11.8–16.1 (15.0)	13.6–15.6 (14.6)	12.9–16.3 (14.4)
Head width in maximum	19.1–24.9 (21.8)	23.7	19.0–23.6 (20.8)	18.7–22.1 (20.5)	18.2–21.8 (20.4)
Predorsal(1) length	25.7–28.1 (26.8)	27.8	24.8–27.7 (26.3)	23.0–26.0 (24.3)	25.5–28.6 (26.7)
Predorsal(2) length	33.3–38.9 (36.7)	38.5	29.3–37.4 (34.9)	31.6–37.4 (34.9)	33.4–37.2 (36.0)
Predorsal(3) length	66.5–73.0 (69.1)	71.1	68.4–72.6 (70.7)	69.1–72.4 (70.9)	67.0–72.3 (70.3)
Prepectoral fin length	32.1–35.4 (33.4)	33.7	31.7–34.9 (32.8)	30.7–33.2 (31.8)	32.1–34.2 (33.0)
Prepelvic fin length	21.1–26.9 (24.0)	25.2	19.9–26.7 (23.1)	20.2–23.5 (22.0)	21.3–28.3 (25.3)
Preanal fin length	49.5–55.5 (52.8)	52.7	47.7–54.5 (50.5)	44.6–50.0 (47.4)	46.7–52.5 (50.1)
Caudal peduncle length	8.5–11.9 (10.4)	9.5	9.4–12.3 (11.0)	8.1–11.8 (10.4)	9.2–13.1 (11.0)
Caudal peduncle depth	8.4–10.1 (9.2)	10.9	9.0–10.7 (9.7)	8.1–10.3 (9.0)	7.8–9.5 (8.7)
Pectoral fin length	29.5–35.6 (32.2)	33.0	27.7–34.1 (30.9)	27.7–34.9 (31.8)	28.9–34.1 (31.9)
Pelvic fin length	21.8–26.5 (24.7)	24.9	21.8–26.8 (24.0)	18.9–25.4 (22.0)	20.2–25.3 (22.5)
Caudal fin length	19.7–23.9 (22.1)	23.8	19.1–22.1 (21.1)	18.1–22.5 (20.1)	18.4–22.0 (20.5)
D1 fin base	8.8–11.9 (10.4)	9.7	8.1–10.8 (9.6)	7.6–12.2 (11.2)	7.7–10.2 (9.2)
D2 fin base	27.4–39.3 (30.3)	37.0	30.7–35.7 (33.1)	32.3–42.8 (37.1)	26.7–35.8 (31.1)
D3 fin base	16.5–20.5 (17.9)	19.2	17.0–21.0 (19.0)	18.1–23.2 (19.7)	16.4–19.7 (18.3)
A fin base	35.3–42.9 (39.5)	44.3	39.3–44.6 (41.9)	41.0–46.5 (43.8)	40.2–45.2 (42.4)
D1 1st spine length	10.8–14.1 (12.1)	9.7	8.9–12.5 (11.0)	10.1–17.4 (13.2)	9.0–11.7 (9.9)
D2 1st spine length	12.6–16.9 (14.7)	13.1	12.2–16.3 (14.5)	9.5–14.9 (11.7)	11.7–14.6 (13.4)
In % of head length					
Head width in maximum	64.9–87.4 (74.6)	77.5	68.3–83.2 (74.3)	68.3–82.6 (77.2)	64.4–84.4 (74.0)
Eye diameter	33.5–39.2 (35.5)	32.0	29.7–40.8 (35.1)	29.0–39.6 (33.3)	32.5–38.0 (35.4)
Interorbital width	10.2–13.9 (12.0)	13.0	10.4–16.7 (12.7)	8.5–17.7 (13.0)	9.4–14.9 (11.7)
Upper jaw length	36.0–41.8 (39.7)	37.0	35.7–41.0 (38.8)	36.5–44.1 (40.8)	33.1–42.7 (38.2)
Snout length	26.7–33.5 (29.7)	33.6	27.5–34.5 (31.1)	28.1–38.7 (34.7)	27.2–39.7 (32.6)
In % of orbit diameter					
Nasal tentacle length	10.4–16.8 (14.5)	20.3	10.7–21.1 (15.8)	14.0–19.7 (16.6)	11.6–19.1 (14.1)
Orbital tentacle length	16.1–22.7 (19.2)	5.1	12.1–19.6 (15.7)	13.2–23.7 (17.8)	14.9–24.5 (19.0)

Table 4. (continued).

Species	*E. hsiojenae*	*E. leucopunctatus*	*E. philippinus*	*E. tutuilae*
	n = 4	n = 6	n = 10	n = 10
Standard length (mm)	18.5–29.9	23.7–29.1	17.8–24.5	15.1–18.2
In % of standard length				
Head length	25.4–27.8 (26.8)	27.3–31.0 (29.1)	22.8–27.7 (25.7)	23.3–32.1 (27.9)
Body depth of anal fin origin	15.3–18.1 (16.7)	20.6–22.4 (21.3)	18.5–21.7 (20.0)	18.6–22.0 (20.7)
Body width of anal fin origin	11.6–14.4 (13.4)	12.8–17.4 (15.1)	12.0–15.8 (13.7)	10.7–14.0 (12.6)
Head width in maximum	16.4–21.4 (19.2)	20.4–21.6 (20.8)	16.9–22.9 (19.5)	16.9–20.6 (19.4)
Predorsal(1) length	25.0–26.5 (25.5)	24.9–28.0 (26.4)	22.6–27.3 (25.3)	21.8–25.4 (24.1)
Predorsal(2) length	32.3–34.9 (34.1)	35.2–38.0 (37.1)	32.9–38.3 (35.1)	33.1–37.6 (35.6)
Predorsal(3) length	69.5–70.0 (69.9)	70.9–74.1 (72.6)	67.6–73.3 (70.3)	66.7–71.3 (68.7)
Prepectoral fin length	31.0–32.5 (31.7)	32.3–35.2 (33.5)	29.2–33.4 (31.4)	31.9–35.1 (33.4)
Prepelvic fin length	20.7–26.3 (24.1)	23.2–26.3 (25.2)	21.7–26.4 (23.8)	21.9–28.7 (25.5)
Preanal fin length	45.9–50.7 (47.8)	49.7–56.4 (53.2)	46.0–60.3 (51.6)	48.8–52.0 (50.5)
Caudal peduncle length	9.0–10.8 (10.1)	8.9–12.8 (10.1)	10.9–14.1 (12.8)	9.3–11.2 (10.5)
Caudal peduncle depth	7.8–9.4 (8.6)	8.7–10.3 (9.4)	8.7–10.2 (9.4)	8.1–10.8 (9.5)
Pectoral fin length	31.7–32.7 (32.2)	28.8–32.8 (30.8)	28.2–35.7 (32.0)	27.5–33.8 (30.3)
Pelvic fin length	22.1–24.8 (23.2)	22.2–25.4 (23.7)	22.2–26.6 (23.9)	22.3–30.4 (24.9)
Caudal fin length	20.1–22.3 (21.0)	22.0–23.7 (22.8)	20.0–25.7 (22.3)	21.4–26.8 (24.3)
D1 fin base	8.3–10.3 (9.2)	7.8–11.3 (9.7)	6.9–12.4 (10.0)	9.9–13.2 (11.0)
D2 fin base	31.0–36.1 (33.8)	32.1–35.0 (33.5)	31.9–38.3 (34.7)	26.6–34.7 (31.9)
D3 fin base	17.9–19.5 (18.7)	16.0–19.5 (18.7)	17.3–20.8 (19.3)	17.2–21.8 (20.6)
A fin base	42.7–47.9 (44.8)	37.2–45.3 (41.4)	37.6–45.2 (41.5)	39.3–47.4 (43.6)
D1 1st spine length	10.2–12.6 (11.7)	8.7–10.9 (9.8)	8.1–11.6 (9.4)	17.5–20.1 (18.8)
D2 1st spine length	12.2–13.6 (13.1)	13.1–15.5 (14.2)	11.6–16.0 (13.8)	11.7–15.4 (13.8)
In % of head length				
Head width in maximum	64.3–77.2 (71.4)	67.3–78.9 (71.6)	47.1–86.4 (74.3)	62.0–82.0 (69.7)
Eye diameter	36.7–42.3 (38.4)	29.5–34.7 (31.6)	33.2–41.0 (36.2)	32.9–41.8 (37.1)
Interorbital width	11.5–13.3 (12.6)	10.1–13.4 (11.3)	12.8–36.6 (18.1)	7.4–36.6 (17.8)
Upper jaw length	36.8–40.4 (38.3)	34.4–38.2 (36.4)	31.3–42.3 (36.9)	35.8–50.4 (40.8)
Snout length	28.0–34.4 (31.3)	25.4–33.2 (30.1)	28.2–34.7 (32.2)	27.2–38.8 (31.8)
In % of orbit diameter				
Nasal tentacle length	14.7–22.4 (17.8)	12.9–21.8 (16.9)	12.7–19.4 (15.8)	17.4–32.6 (24.2)
Orbital tentacle length	13.3–21.7 (18.3)	16.8–21.2 (18.2)	12.6–24.3 (16.4)	21.7–28.0 (25.1)

Fricke, 1994, based on a few male specimens from New Caledonia and Vanuatu that possesses the vertical streak on the cheek. However, Shibukawa et al. (2004) recognized that both *E. cheni* and *E. niger* are valid because the former may be clearly distinguished from the latter by having the following features: occipital branch of cephalic sensory canals moderately complex (vs. usually simple), mandibular pore pattern usually 4+1+4 (vs. 3-4+1-2+3), obvious alternative black and white oblique-barred pattern on body in both sexes (vs. body with very indistinct oblique-barred pattern or overall blackish in male); anal fin entirely dusky in male (vs. whitish or, possibly, grayish).

Enneapterygius elegans (Peters, 1877)
(Fig. 4b)

Tripterygium elegans Peters, 1877: 441 (Type locality: Mauritius).
Enneapterygius elegans – Fricke, 1997: 179.

Material examined. – NTOU-P 2008-06-370, 1 male, 24.1 mm SL, Nan-ren-Road Ferry, Pingtung County, Taiwan, 5–10 m depth, coll. I-S. Chen et al., 19 Jul.2007.

Diagnosis. – D. III, XII, 9. A. I, 17. Lateral line with 18 pored scales and 16 notched scales. Mandibular pore pattern 4+1+4. Supraorbital cirrus simple and small. Nasal cirrus simple and slender. First dorsal fin lower than second dorsal fin. Caudal peduncle with a black hourglass marking. Lower three-fourths of head black with a white spot under eye. Anal, pectoral and pelvic fin reddish; dorsal and caudal-fin rays with discontinuous reddish marks. Supraoccipital sensory canal forms a flattened curve anterior to first dorsal fin.

Distribution. – This sample was collected at a depth of 9 m at the southern tip of Taiwan. This species has been previously recorded in the depths of 0.1–12 m from the eastern shore and southern tip of Taiwan, from Indonesia, the Cocos Keeling Islands, Christmas Island, Papua New Guinea, Solomon Island, Vanuatu, Fiji, Tonga, American Samoa, Western and Central Indian Ocean to Sri Lanka and Queensland (Australia) (Fricke, 1997).

Enneapterygius erythrosomus Shen & Wu, 1994
(Fig. 4c)

Enneapterygius erythrosoma Shen & Wu, 1994: 7 (Type locality: Wen-zi-keng (Wen-tz-keng), Gongliao Township, Taipei County, Taiwan).
Enneapterygius rubicauda – Fricke, 1997: 310.

Materials examined. – NTOU-P 2008-06-336, 1 specimen, 22.5 mm SL, Ma-gang, Taipei County, Taiwan, 5–8 m depth, coll. M. C. Chiang et al., 1 Sep.2006; NTOU-P 2008-06-337, 1 specimen, 28.6 mm SL, same collection data as NTOU-P 2008-06-336; NTOU-P 2008-06-338, 1 specimen, 26.0 mm SL, same data as NTOU-P 2008-06-336; NTOU-P 2008-06-339, 2 specimens, 22.2 and 30.0 mm SL, NW shore of Liouciou Township, Pingtung County, Taiwan, 5–12 m depth, coll. M. C. Chiang et al., 8 Jul.2007; NTOU-P 2008-06-340, 1 specimen, 29.3, E shore of Liouciou, Pingtung County, 3–6 m depth, Taiwan, coll. M. C. Chiang et al., 9 Jul.2007; NTOU-P 2008-06-341, 2 specimens, 20.4 and 21.9 mm SL, Nan-ren-Road Ferry, Pingtung County, Taiwan, 5–10 m depth, coll. M. C. Chiang et al., I-S. Chen et al., 19 Jul.2007.

Diagnosis. – D. III, XII–XIV (modally XIII), 9–11 (usually 10). A. I, 18–19 (modally 18). Lateral line with 15–18 (usually 17) pored scales and 16–20 (usually 18) notched scales. Mandibular pore pattern 4+1+4. Supraorbital cirrus simple and slender. Nasal cirrus simple and slender. First dorsal fin lower than second dorsal fin. Body with vague bands, anterior- red, and posterior- orange or yellow. Pectoral and dorsal fins red; anal and caudal fins orange or yellow. Three red or brown or blackish-brown blotches arranged triangularly on base of pectoral fin, the lowermost more distinct and darker. Supraoccipital sensory canal forms a flattened curve anterior to first dorsal fin.

Distribution. – The samples were collected by us at depths of 1–12 m from the north-eastern coast and southern tip of Taiwan; also from Liouciou Island (off the south-western shore of Taiwan). This species has been previously recorded from the north-eastern coast of Taiwan, from Penghou Island (off the western shore of Taiwan) and Liouciou Island (Shen & Wu, 1994).

Remarks. – Fricke (1997) considered *Enneapterygius erythrosomus* and *Enneapterygius rubicauda* to be synonymous. However, these two species have different mandibular pore pattern (*E. erythrosomus*: 4+1+4; *E. rubicauda*: 3+1+3) and the caudal peduncle of *E. rubicauda* has a wide red bar of which the posterior border is blackish-brown, and an obvious white interspace before the red bar on the caudal peduncle (*E. erythrosomus*: interspace between bands on body narrower, indistinct or even absent). However, *E. rubicauda* is actually the junior synonym of *E. flavoccipitis* Shen & Wu (see below in *E. flavoccipitis*).

Enneapterygius etheostomus (Jordan & Snyder, 1903)
(Fig. 4d, e)

Tripterygion etheostoma Jordan & Snyder, 1903: 444 (Type locality: Misaki, Japan).
Enneapterygius etheostomus – Fricke, 1997: 185.
Rosenblatella etheostoma – Shen & Wu, 1994: 25.

Material examined. – NTOU-P 2008-06-326, 1 male, 39.0 mm SL, Ba-dou-zi, Keelung City, Taiwan, intertidal pools, coll. M. C. Chiang et al., 29 Aug.2005; NTOU-P 2008-06-327, 1 female, 31.2 mm SL, same collection data as NTOU-P 2008-06-326; NTOU-P 2008-06-328, 1 female, 36.4 mm SL, Ba-dou-zi, Keelung City, Taiwan, intertidal pools, coll. M. C. Chiang et al., 27 Sep.2005; NTOU-P 2008-06-329, 1 female, 30.0 mm SL, same data as 2008-06-328; NTOU-P 2008-06-330, 1 male, 44.4 mm SL, Ba-dou-zi, Keelung City, Taiwan, intertidal pools, coll. M. C. Chiang et al., 18 Apr.2006; NTOU-P 2008-06-331, 1 female, 40.3 mm SL, same data as NTOU-P 2008-06-330; NTOU-P 2008-06-332, 1 male, 48.0 mm SL, Bian-fu-dong, Rueifang Township, Taipei County, Taiwan, intertidal pools, coll. M. C. Chiang et al., 10 Jun.2006; NTOU-P 2008-06-333, 1 male, 44.3 mm SL, same collection data as NTOU-P 2008-06-332; NTOU-P 2008-06-334, 1 female, 30.0

mm SL, Ye-liu, Taipei County, Taiwan, intertidal pools, coll. M. C. Chiang et al., 21 Jun.2006; NTOU-P 2008-06-335, 1 male, 44.3 mm SL, Ao-di, Gongliao Township, Taipei County, Taiwan, 0–3 m depth, coll. M. C. Chiang et al., 19 Apr.2007.

***Diagnosis.* –** D. III, XIII–XV (modally XIV), 9–11 (modally 10). A. I, 19–21 (rarely 19). Lateral line with 17–20 (usually 18) pored scales and 16–20 (usually 18) notched scales. Mandibular pore pattern 4+1+4. Supraorbital cirrus lobate. Nasal cirrus with forked tips. The first dorsal fin equal to or higher than second dorsal fin. Females body white with 4-5 brownish-red H-bars in females. Males body black with two white bars below junction of second and third dorsal fins with caudal peduncle. Caudal-fin rays with alternating white and reddish-brown marks. Supraoccipital sensory canal forms a flattened curve anterior to first dorsal fin.

***Distribution.* –** The samples were collected by us in tide pools and shallow waters of 0–2 m depth from the north-eastern and northern coast of Taiwan. This species has previously been recorded at depths of 0–21m from the northeast and northern shore of Taiwan, Japan, Korea, China, Ryukyu Island, Hong Kong, Vietnam (Fricke, 1997).

***Remarks.* –** Shen &Wu (1994) placed this species in the genus *Rosenblatella* Shen & Wu, 1994, by the nasal cirrus unserrated with short stem and forked tip; anterior lateral line series slightly curving downward behind pectoral fin base; no scale between the junction of pored and notched scales. However, it is still grouped with other *Enneapterygius* species by molecular phylogenetic analyses based on mitochondrial ND5 gene (Fig. 5). We considered that those characters defining genus *Rosenblatella* are autapomorphies.

Enneapterygius fasciatus (Weber, 1909)

Tripterygium fasciatum Weber, 1909: 148 (Type locality: Savu, Karakelang, Indonesia).
Tripterygium fasciatum – Lal Mohan, 1968: 116.
Enneapterygius fasciatus – Fricke, 1997: 193.

***Diagnosis.* –** D. III, XI–XII (modally XII), 7–11 (usually 8). A. I, 16–19 (usually 17). Lateral line with 12–17 pored scales and 15–20 notched scales. Mandibular pore pattern 3–5+1+3–5. Supraorbital cirrus broad and lobular with three shallow depressions. Nasal cirrus trifid. First dorsal fin lower than second dorsal fin. The body with five irregular greenish cross-bars. Males with a blackish-brown mask on lower two-thirds of head; females with irregular brown pigment around eye, a brown blotch on lower part of opercle. A dusky blotch on first dorsal fin between first and second spine; a reddish blotch on pectoral fin base; six to seven deep blue spots on the base of anal fin.

***Distribution.* –** This species has been recorded in shallow waters of 0–7 m depth, at southern tip of Taiwan, the Philippines, India, Thailand, Indonesia, Papua New Guinea, Solomon Islands, East Africa to Sri Lanka (Fricke, 1997).

Enneappterygius flavoccipitis Shen & Wu, 1994
(Fig. 4f, g)

Enneapterygius flavoccipitis Shen & Wu, 1994: 8 (Type locality: Hou-bi-hu (Ho-bi-hou), Pintung County, Taiwan).
Enneapterygius rubicauda Shen & Wu, 1994: 17 (Type locality: Liouciou Township, Pintung County, Taiwan).
Enneapterygius bichrous Fricke, 1994b: 195. (Type locality: New Year Island, Northern Territory, Australia)
Enneapterygius flavoccipitis Fricke, 1997: 199.

***Materials examined.* –** NTOU-P 2008-06-352, 1 male, 23.2 mm SL, Wan-li-tong, Pingtung County, Taiwan, 5–8 m depth, coll. M. C. Chiang et al., 15 Sep.2006; NTOU-P 2008-06-353, 1 male, 21.8 mm SL, Su-ao, Yilan County, Taiwan, 5–7 m depth, coll. M. C. Chiang et al., 4 May 2007; NTOU-P 2008-06-354, 1 male, 20.6 mm SL, Nan-ren-Road Ferry, Pingtung County, Taiwan, 5–10 m depth, coll. M. C. Chiang et al., 19 Jul.2007; NTOU-P 2008-06-355, 1 female and 1 male, 21.9 and 24.0 mm SL, SE shore of Liouciou Township, Pingtung County, Taiwan, 6–8 m depth, coll. M. C. Chiang et al., 9 Nov.2007; NTOU-P 2008-06-356, 1 female and 1 male, 24.3 and 22.1 mm SL, same collection data as above; NTOU-P 2008-06-357, 1 female and 1 male, 22.1and 25.0 mm SL, same collection data as above; NTOU-P 2008-06-358, 1 female and 1 male, 23.4 and 21.3 mm SL, E shore of Liouciou Township, Pingtung County, Taiwan, 12–20 m depth, coll. M. C. Chiang et al., 10 Nov.2007.

***Diagnosis.* –** D. III, XII–XIII (modally XII), 9–10. A. I, 17–18 (usually 18). Lateral line with 15–17 (usually 16) pored scales and 17–19 (usually 18) notched scales. Mandibular pore pattern 3+1+3. Supraorbital and nasal cirrus simple and slender. First dorsal fin about half height of second dorsal fin. Males with lower portion of head black or densely spotted with melanophores, pectoral fin and area from nasal and interorbital to base of first dorsal fin yellow, body deep red or brown to blackish-brown. Females with whitish lower portion of head, body light red, caudal peduncle with wide red bar of which posterior border is blackish-brown. Supraoccipital sensory canal forms a flattened curve anterior to first dorsal fin.

***Distribution.* –** The samples were collected by us from depths of 1–20 m from the north-eastern coast and the southern tip of Taiwan, and from Liouciou Island of Taiwan (off the south-western coast of Taiwan). This species has been previously recorded at depths of 0.3–22 m from the southern tip of Taiwan and from Liouciou Island, the Philippines, Ryukyu Islands, Indonesia, Timor Sea, Papua New Guinea, Vanuatu, western Coral Sea (Australia), New Caledonia, and northern Australia (Fricke, 1997).

***Remarks.* –** *Enneapterygius rubicauda* described by Shen & Wu (1994) is actually the female colour morph of *E. flavoccipitis* Shen & Wu, 1994. Apart from the blackish lower portion of head, yellowish upper portion of head and pectoral fin, and deep red or brownish body, *E. flavoccipitis* has the same pattern of meristic characters as *E. rubicauda*. During observation in their sub-tidal habitat they have been found existing in pairs. Based on the page priority of *E. flavoccipitis* in Shen & Wu (1994), we concluded that *E. rubicauda* is a junior synonym of *E. flavoccipitis*.

Enneapterygius fuscoventer Fricke, 1997

Enneapterygius fuscoventer Fricke, 1997: 210 (Type locality: Cuyo Island, the Philippines).

***Diagnosis.* –** D. III, XI–XIV (modally XIII), 8–10 (modally 9). A. I, 15–18 (modally 17). Lateral line with 15–19 (usually 16–17) pored scales and 14–19 (usually 16–18) notched scales. Mandibular pore pattern 3–5+1+3–5 (modally 4+1+4). First dorsal fin lower than second dorsal fin in both sexes. The male with a black head mask, a short blue suborbital streak; pyramid-shaped blackish blotches along the ventral sides of the body; dorsal-fin rays spotted with melanophores; pectoral and pelvic fins brownish; anal fin blackish; caudal fin black, central part and distal margin lighter.

***Distribution.* –** This species has been recorded in shallow waters of 0.0–4.5 m depth, at southern tip of Taiwan, the Philippines, Papua New Guinea, Fiji, American Samoa, and Society Islands (Fricke, 1997).

Enneapterygius hsiojenae Shen & Wu, 1994
(Fig. 4h)

Enneapterygius hsiojenae Shen & Wu, 1994: 11 (Type locality: Wen-zi-keng (Wen-tz-keng), Gongliao Township, Taipei County, Taiwan)
Enneapterygius vexillarius – Fricke, 1997: 355.

***Material examined.* –** NTOU-P 2008-06-371, 1 specimen, 25.4 mm SL, Ba-dou-zi, Keelung City, Taiwan, 1–3 m depth, coll. M. C. Chiang et al., 15 Feb. 2006; NTOU-P 2008-06-372, 1 specimen, 18.5 mm SL, Ba-dou-zi, Keelung City, Taiwan, 1–5 m depth, coll. M. C. Chiang et al., 25 Aug.2006; NTOU-P 2008-06-373, 1 specimen, 23.1 mm SL, Nan-fang-ao, Yilan County, Taiwan, 5–6 m depth, coll. M. C. Chiang et al., 4 May 2007. NTOU-P 2008-06-374, 1 specimen, 29.9 mm SL, Ba-dou-zi, Keelung City, Taiwan, 1–5 m depth, coll. J. H. Huang, 27 Jun.2008.

***Diagnosis.* –** D. III, XIV, 10. A. I, 19–20. Lateral line with 18–20 pored scales and 17–19 notched scales. Mandibular pore pattern 3+1+3. Supraorbital and nasal cirrus slender and long. First dorsal fin lower than second dorsal fin. Body pale or light yellowish with four brownish-yellow or reddish-brown bars below second dorsal fin, third dorsal fin and caudal peduncle. A brownish-black or black saddle mark behind the base of pectoral fin. Head pale with scattered melanophores, some males densely spotted resembling a black mask on overall head. Dorsal-fin rays reddish to orange, second dorsal fin membrane dusky near the base; other fins pale yellow to yellow. Supraoccipital sensory canal forms a flattened curve anterior to first dorsal fin.

***Distribution.* –** The samples were collected by us from the depths of 1–6 m from the north-eastern coast of Taiwan. This species has been previously recorded from the northeast of Taiwan and from Penghou Island, off the western shore of Taiwan (Shen & Wu, 1994).

***Remarks.* –** Fricke (1994b) considered *Enneapterygius hsiojenae* a junior synonym of *Enneapterygius vexillarius* Fowler, 1946. However, *E. hsiojenae* can be distinguished from *E. vexillarius* by its colour pattern as there are five transverse cross bands on body (vs. eight), pored scales reaching about below last spine of second dorsal fin (vs. 10^{th}–11^{th}), and scale rows about 36–38 (vs. 30).

Enneapterygius leucopunctatus Shen & Wu, 1994
(Fig. 4i)

Enneapterygius leucopunctatus Shen & Wu, 1994: 12 (Type locality: Wen-zi-keng (Wen-tz-keng), Gongliao Township, Taipei County, Taiwan).
Enneapterygius vexillarius – Fricke, 1997: 355.

***Materials examined.* –** NTOU-P 2008-06-305, 1 female and 1 male, 27.9 and 23.7 mm SL, Chenggong Township, Taitung County, Taiwan, 2–5 m depth, coll. M. C. Chiang et al., 19 Aug.2007; NTOU-P 2008-06-306, 1 specimen, 29.1 mm SL, Chenggong Township, Taitung County, Taiwan, 2–4 m depth, coll. M. C. Chiang et al., 7 Apr.2007; NTOU-P 2008-06-307, 1 specimen, 25.5 mm SL, as same collection data as above; NTOU-P 2008-06-308, 1 specimen, 26.8 mm SL, Feng-chui-sha, Hengchun Township, Pingtung County, Taiwan, 3–12 m depth, coll. M. C. Chiang et al., 20 Jul.2007; NTOU-P 2008-06-309, 1 specimen, 24.0 mm SL, as the same data as above.

***Diagnosis.* –** D. III, XIII, 9–11 (rarely 11). A. I, 18. Lateral line with 17–18 pored scales and 17 notched scales. Mandibular pore pattern 4+1+4. Supraorbital cirrus thin. Nasal cirrus broad or lobate. First dorsal fin lower than second dorsal fin. Body light red or yellow to orange with several ambiguous reddish-brown or blackish-brown bars, the colours along back and lateral line contrasting, resembling black saddles on back with marbled whitish yellow blotches. Two to three white lines or spots spreading from eye to cheek. Pectoral fin base brownish-black with three to four white lines or whitish spotted lines. A vertical black streak on caudal peduncle. Dorsal fin and anal fin rays reddish. Pectoral fin rays reddish with three whitish cross lines. Caudal fin rays red or yellow to orange with a median whitish cross line. Supraoccipital sensory canal forms a flattened curve anterior to first dorsal fin.

***Distribution.* –** The samples were collected by us from the depths of 2–12 m at the eastern coast and southern tip of Taiwan. This species has been previously recorded in north-east of Taiwan (Shen & Wu, 1994).

***Remarks.* –** Fricke (1997) regarded *Enneapterygius leucopunctatus* and *Enneapterygius hsiojenae* as the females and males of *Enneapterygius vexillarius* Fowler, 1946. When preserved the band behind pectoral fin base is usually a dark blackish-brown in these three nominal species. However, their fresh colouration is distinct, the mandibular pore pattern (*E. leucopunctatus*: 4+1+4; *E. hsiojenae*, *E. vexillarius*: 3+1+3) and the counts for the second dorsal fin (*E. hsiojenae*: XIV; *E. leucopunctatus*: XIII; *E. vexillarius*: XVI) are also different.

Enneapterygius nanus (Schultz, 1960)

Tripterygion nanus Schultz, 1960: 288 (Type locality: Marshall Islands).
Enneapterygius nanus – Shen & Wu, 1994: 16.
Enneapterygius nanus – Fricke, 1997: 242.

Diagnosis. – D. III, XI–XIV (modally XII), 7–11 (modally 9). A. I, 16-20. Lateral line with 10–15 (modally 12) pored scales and 18–22 (modally 19) notched scales. Mandibular pore pattern 2+1+2. Supraorbital and nasal cirrus simple and slender. First dorsal fin lower than second dorsal fin in both sexes. Males with a brownish mask on lower part of head; pectoral and pelvic fin base brownish; caudal fin with faint dusky bars of grayish pigment. Females are everywhere plain pale, without melanophores on head.

Distribution. – This species has been recorded in intertidal pools to the depth of 30 m, at southern tip of Taiwan, Thailand, Indonesia, Papua New Guinea, Solomon Islands, western Coral Sea (Australia), New Caledonia, Marshall Islands, Federated States of Micronesia, Palau, and Commonwealth of the Northern Marianas (Fricke, 1997).

Enneapterygius nigricauda Fricke, 1997

Enneapterygius nigricauda Fricke, 1997: 255 (Type locality: Tonga).

Diagnosis. – D. III, XI-XIII (modally XIII), 7–10 (modally 9). A. I, 16–19 (modally 17). Lateral line with 15–20 pored scales and 16–20 notched scales. Mandibular pore pattern 3–4+1+3–4 (modally 3+1+3). Supraorbital cirrus short. First dorsal fin lower than second dorsal fin in both sexes. Males with a black mask on lower sides of head; caudal fin black, remaining parts of the body and fins pale.

Distribution. – This species has been recorded in shallow waters of 2–12 m depth, at northern, eastern, and southern tip of Taiwan, the Philippines, Vanuatu, Tonga, American Samoa, Society Islands, Kiribati, Jarvis Island, Howland Island, Wake Island, Marshall Islands, Federated States of Micronesia, Guam, and Bonin Islands (Fricke, 1997).

Enneapterygius pallidoserialis Fricke, 1997

Enneapterygius pallidoserialis Fricke, 1997: 264 (Type locality: Cuyo Island, the Philippines).

Diagnosis. – D. III, XI–XIII (modally XII), 8–10 (modally 9). A. I, 16–19 (modally 17). Lateral line with 14–20 (modally 17) pored scales and 14–21 (modally 20) notched scales. Mandibular pore pattern 3–4+1–2+3–4 (modally 4+2+4). Supraorbital cirrus long and simple. First dorsal fin lower than second dorsal fin in both sexes. Head yellowish with two vertical suborbital brown streaks. Males body blackish-brown, with two horizontal series of white spots; dorsal, anal and caudal fins blackish.

Distribution. – This species has been recorded in shallow waters of 0–8 m depth, at southern tip and eastern shore of Taiwan, the Philippines, Japan, Malaysia, Vanuatu, and Federated States of Micronesia (Fricke, 1997).

Enneapterygius philippinus (Peters, 1869)
(Fig. 4j, k)

Tripterygium philippium Peters, 1869: 269 (Type locality: Paracali, Luzon, the Philippines).
Enneapterygius minutus (non Günther, 1877) – Shen & Wu, 1994: 14.
Enneapterygius philippinus – Fricke, 1997: 274.

Material examined. – All specimens collected from tide pools, Chenggong Township, Taitung County, Taiwan, coll. M. C. Chiang et al.: NTOU-P 2008-06-343, 1 male, 19.2 mm SL, 18 Aug.2006; NTOU-P 2008-06-344, 1 male, 20.8 mm SL, 18 Aug.2006; NTOU-P 2008-06-345, 2 males, 20.6 and 20.6mm SL, 19 Aug.2006; NTOU-P 2008-06-346, 1 male, 20.0 mm SL, 31 May 2008; NTOU-P 2008-06-347, 1 female, 20.3 mm SL, 18 Aug.2006; NTOU-P 2008-06-348, 1 female, 17.8 mm SL, 18 Aug.2006; NTOU-P 2008-06-349, 1 female, 20.2 mm SL, 19 Aug.2006; NTOU-P 2008-06-350, 1 female, 22.3 mm SL, 17 Apr.2007; NTOU-P 2008-06-351, 1 female, 24.5 mm SL, 31 May 2008.

Diagnosis. – D. III, XI-XII, 8–9. A. I, 15–17 (rarely 17). Lateral line with 12–13 pored scales and 17–20 notched scales. Mandibular pore pattern 3+1+3. Supraorbital cirrus short. Nasal cirrus lobate. First dorsal fin lower than second dorsal fin. Males with a black mask, body densely spotted with deep brown melanophores on yellow or reddish-brown background, anal fin and caudal fin blackish, pectoral fin and pelvic fin gray or black, dorsal fin yellowish to reddish-brown. Females with light red or yellow background, sides of body with several irregular brown bars and with a few whitish spots; pectoral, anal and caudal fins with several vertical black streaks or rows of black spots. Supraoccipital sensory canal forms a flattened curve anterior to first dorsal fin.

Distribution. – The samples were all collected from tide pools by us from the eastern coast of Taiwan. This species has been previously recorded from the depths of 0.1–8 m at the eastern and southern coast of Taiwan and from Liouciou Island (off south-western shore of Taiwan), the Philippines, Ryukyu Islands, China, Indonesia, Christmas Island, Papua New Guinea, Solomon Islands, Vanuatu, New Caledonia, Fiji, Niue, Western Samoa, American Samoa, Kiribati, Marshall Islands, Federated States of Micronesia, Palau, Commonwealth of the Northern Marianas, Western Indian Ocean to the northern half of Australia (Fricke, 1997).

Enneapterygius tutuilae Jordan & Seale, 1906
(Fig. 4l)

Enneapterygius tutuilae Jordan & Seale, 1906: 418 (Type locality: Pago Pago, American Samoa).
Enneapterygius tutuilae – Fricke, 1997: 337.

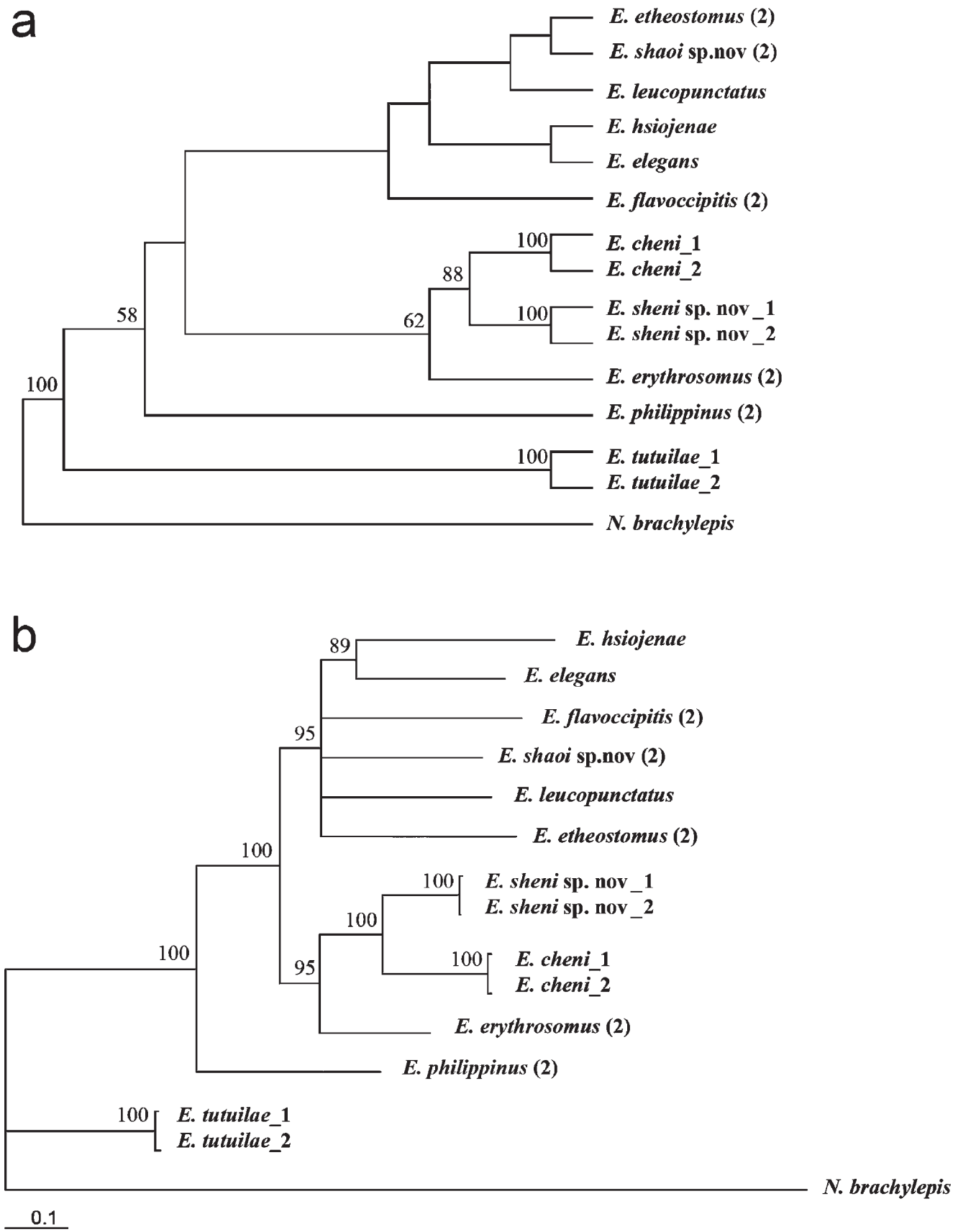

Fig. 5. Molecular phylogenetic tree of *Enneapterygius* from Taiwan: a, the topology by MP method, the values (shown only > 50) of 2,000 bootstrap replications are shown above each branch; b, the topology by BI method, the values of posterior probability are shown above each branch.

Material examined. **–** NTOU-P 2008-06-310, 2 specimens, 15.7 and 17.8 mm SL, Chenggong Township, Taitung County, Taiwan, 5–10 m depth, coll. M. C. Chiang et al., 19 Aug.2006; NTOU-P 2008-06-311, 1 specimen, 18.2 mm SL, Hong-chai-keng, Pingtung County, Taiwan, 8–15 m depth, coll. M. C. Chiang et al., 14 Sep.2006; NTOU-P 2008-06-312, 1 specimen, 17.4 mm SL, as the same collection as above; NTOU-P 2008-06-313, 1 specimen, 16.8 mm SL, N shore of Liouciou Township, Pingtung County, Taiwan, 10–12 m depth, coll. M. C. Chiang et al., 10 Jul.2007; NTOU-P 2008-06-314, 1 specimen, 16.9 mm SL, NE shore of Liouciou Township, Pingtung County, Taiwan, 12–20 m depth, coll. M. C. Chiang et al., 9 Nov.2007; NTOU-P 2008-06-315, 1 specimen, 15.2 mm SL, NW shore of Liouciou Township, Pingtung County, Taiwan, 15–25 m depth, coll. M. C. Chiang et al., 11 Nov.2007; NTOU-P 2008-06-316, 1 specimen, 15.4 mm SL, as the collection data as above; NTOU-P 2008-06-317, 1 specimen, 15.9 mm SL, Chenggong Township, Pingtung County, Taiwan, 5–10 m depth, coll. M. C. Chiang et al., 31 May 2008; NTOU-P 2008-06-318, 1 specimen, 15.1 mm SL, Wan-li-tong, Pingtung County, Taiwan, 6–8 m depth, coll. M. C. Chiang et al., 1 Jun.2008.

Diagnosis. **–** D. III, XI–XII, 8–10 (mostly 9). A. I, 16–18 (mostly 17). Lateral line with 8–12 pored scales and 18–22 notched scales. Mandibular pore pattern 2+2+2. Supraorbital cirrus simple and broad. Nasal cirrus simple and slender. First dorsal fin higher than second dorsal fin. Body yellow to green or yellow to yellowish-brown with 5 yellowish-brown to blackish-brown bars that branch above anal fin base. Lower head and snout red. First dorsal fin yellowish-brown, fin-rays red with a large black blotch on the second dorsal fin; pelvic fin black; anal fin with 6–7 streaks or blotches. Supraoccipital sensory canal forms an U-shaped curve anterior to first dorsal fin.

Distribution. **–** The samples were collected by us from the depths of 5–25 m, at the southern tip of Taiwan and Liouciou Island (off the south-western shore of Taiwan).This species has been previously recorded from the north-western and southern coast of Taiwan, the Philippines, Thailand, Indonesia, Cocos-Keeling Islands, Christmas Island, Timor Sea, Papua New Guinea, Solomon Islands, western Coral Sea (Australia), New Caledonia, Vanuatu, Fiji, American Samoa, Society Islands, Federated States of Micronesia, Palau, Guam, Commonwealth of the Northern Marianas, Western and Central Indian Ocean and Red Sea to tropical Australia (Fricke, 1997).

Enneapterygius unimaculatus Fricke, 1994

Enneapterygius unimaculatus Fricke, 1994a: 5 (Type locality: Bali, Indonesia).
Enneapterygius unimaculatus – Fricke, 1997: 352.

Diagnosis. **–** D. III, XI–XIV, 8–10. A. I, 16–19. Lateral line with 13–16 pored scales and 16–21 notched scales. Mandibular pore pattern 3+1+3. Supraorbital cirrus short, lobate. First dorsal fin lower than second dorsal fin in both sexes. The caudal fin with vertical black streak. Body with numerous narrow deep brown saddles. The male with a black mask on the lower side of head; a large blotch on the pectoral fin base.

Distribution. **–** This species has been recorded in tide pools and shallow waters of 0–6 m depth, at southern tip of Taiwan, the Philippines, Malaysia, Indonesia, Papua New Guinea, and Republic of Palau (Fricke, 1997).

MOLECULAR PHYLOGENETIC ANALYSIS

The aligned ND5 dataset consists of 14 different haplotypes from 11 *Enneapterygius* species with 19 individuals and one outgroup with a total length of 1,029 bp. This alignment contained 563 divergent sites with 464 parsimony informative sites. Maximum parsimony analysis has yielded three MP trees of 1910 steps with a global consistency index (CI) of 0.49, retention index (RI) of 0.50 and rescaled consistency index (RC) of 0.23. The consensus trees are shown in Fig. 5a. *Enneatpterygius tutuilae* was first diverged as plesiomorphic OTU from other taxa, and then *E. philippinus*. The phylogenetic result can be divided into two clades: one clade clearly resolved including *E. erythrosomus* and a pair sister species of *E. cheni* and *E. sheni*; the other clade with low resolution and bootstrap including *E. flavoccipitis*, a pair sister group of *E. elegans* and *E. hsiojenae*, and a group of *E. leucopunctatus*, *E. shaoi*, *E. etheostomus*.

Using Bayesian analysis, a tree was constructed using a general time-reversible model of molecular evolution with invariants and gamma-approximated site-specific rate heterogeneity (GTR + I + G). The topology of this BI tree is similar to the MP tree in Fig. 5b, apart from the poorly-resolved group of *E. etheostomus*, *E. flavoccipitis*, *E. leucopunctatus*, and *E. shaoi*. The branching of *E. philippinus*, *E. tutuilae* and the monophyly of *E. erythrosomus*, *E. cheni* and *E. sheni* are strongly supported.

DISCUSSION

The meristic data of different species usually overlap. This is also true for their morphometric data (Table 1–4). Some species' meristic frequency and morphometric data is highly similar; it is difficult to distinguish these species using this data alone (e.g. *E. erythrosomus* and *E. flavoccipitis*). Most species of *Enneapterygius* exhibit very conspicuous sexual dichromatism with the male usually having a black mask on the head (e.g. *E. elegans* and *E. sheni*) or even possessing a deeper or brighter colours than those of the female (e.g. *E. cheni*). To obtain valid identifications of morphological species using character sets it is essential to record their colouration when fresh. Reconfirmation of species pairs by molecular identification is sometimes required. Molecular analysis can also be used to identify individuals of distinct species, synonymous species, and species complexes.

Fricke (1994b) concluded that both *E. rubicauda* and *E. erythrosomus* belonged to a single species, *E. rubicauda*. However, after examining the combined morphological and molecular evidence, we have found that *E. rubicauda* is actually the female of *E. flavoccipitis* (no pairwise difference between them in this study), and so *E. erythrosomus* remains

a valid name. The phylogenetic tree we have obtained indicates that *E. erythrosomus* is genetically distant from *E. flavoccipitis*, although these two species always occupy a similar habitat and are frequently in proximity. Fricke (1994b; 1997) considered that *E. hsiojenae* and *E. leucopunctatus* were the male and female of one species, *E. vexillarius* Fowler, 1946. In our current study using molecular sequences, we have concluded that *E. hsiojenae* and *E. leucopunctatus* are distinct; they also differ in their morphology from *E. vexillarius*. Therefore, *E. hsiojenae* and *E. leucopunctatus* should be recognised as two valid species.

Shen & Wu (1994) created a new genus, *Rosenblatella*, characterized by forked nasal cirrus and no scale being between the junction of the pored and notched scales, and replaced *Enneapterygius etheostomus* in the genus. However, in our phylogenetic tree, *E. etheostomus* is grouped with other *Enneapterygius* species. The characters previously used in its diagnosis may be homoplaseous or autapomorphic and we suggest that *Rosenblatella* should be lumped into *Enneapterygius*.

In our phylogenetic analysis based on molecular data, *Enneapterygius tutuilae* represents an early branch, well-separated from other congeneric species. This species differs from other examined species of *Enneapterygius* in Taiwan by morphological differentiation of possessing a very high first dorsal fin, the lowest count of pored scales, two symphyseal pores, and U-shaped of supraoccipital sensory canal anterior to first dorsal fin. *E. tutuilae* may have diverged early in the evolutionary history of *Enneapterygius* and evolved independently. The low resolution of some branches probably represent a rapid evolutionary radiation in the coral-reef habitat, *Enneapterygius* becoming adapted and filling many cryptic, species-specific niches. The further employment of more than one genetic marker may help in gathering a better resolution of species of *Enneapterygius*.

ACKNOWLEDGMENTS

The authors are very grateful to the postgraduate students of the Laboratory of Ichthyology, NTOU including Mr. J. H. Huang, J. T. Chen, S. H. Su, & S. P. Huang. They gave their assistance with collections while SCUBA diving. Our research has been partly supported by the research grants to the last author - (ISC) from NSC (2006), Taipei and CMBB research grant (2006-2007) from NTOU.

LITERATURE CITED

Carreras-Carbonell J., M. Pascual & E. Macpherson, 2007. A review of the *Tripterygion tripteronotus* (Risso, 1810) complex, with description of a new species from the Mediterranean Sea (Teleostei: Tripterygiidae). *Scientia Marina*, **71:** 75–86.

Chen, I-S. & Y. C. Chang, 2007. Taxonomic revision and mitochondrial sequence evolution of the cyprinid genus *Squalidus* (Teleostei: Cyprinidae) in Taiwan with description of a new species. *The Raffles Bulletin of Zoology*, Supplement, **14:** 69–76.

Chen, I-S., P. J. Miller, H. L. Wu & L. S. Fang, 2002. Taxonomy and mitochondrial sequence evolution in non-diadromous species of *Rhinogobius* (Teleostei: Gobiidae) of Hainan island, southern China. *Marine & Freshwater Research*, **53:** 259–273.

Domingues, V. S., V. C. Almada, R. S. Santos, A. Brito & G. Bernardi, 2007. Phylogeography and evolution of the triplefin *Tripterygion delaisi* (Pisces, Blennioidei). *Marine Biology*, **150:** 509–519

Fowler, H. W., 1946. A collection of fishes obtained in the Riu Kiu Islands by Captain Ernest R. Tinkham, A.U.S. *Proceedings of the Academy of Natural Sciences of Philadelphia*, **98:** 123–218.

Fricke, R., 1994a. Tripterygiid fishes of the genus *Enneapterygius* from Bali, Indonesia, with descriptions of two new species (Teleostei: Blennioidei). *Stuttgarter Beiträge zur Naturkunde. Serie A (Biologie).* **512:** 1–13.

Fricke, R., 1994b. Tripterygiid fishes of Australia, New Zealand and the southwest Pacific Ocean (Teleostei). *Theses Zoologicae*, **24:** 1–585.

Fricke, R., 1997. Tripterygiid fishes of the western and central Pacific, with descriptions of 15 new species, including an annotated checklist of world Tripterygiidae (Teleostei). *Theses Zoologicae*, **29:** 1–607.

Hall, T. A., 2001. Bioedit: a user-friendly biological sequence alignment editor and analysis, version 5.09. Raleigh, North Carolina: Department of Microbiology, North Carolina State University.

Hickey, A. J. R., S. D. Lavery, S. R. Eyton & K. D. Clements, 2004. Verifying invasive marine fish species using molecular techniques: a model example using triplefin fishes. *New Zealand Journal of Marine and Freshwater Research*, **38:** 439–446.

Holleman, W., 1982. Three new species and a new genus of tripterygiid fishes (Blennioidei) from the Indo-West Pacific Ocean. *Annals of the Cape Provincial Museums (Natural History), Grahamstown, South Africa,* **14:** 109–137.

Holleman, W., 2006. Fishes of the *Helcogramma steinitzi* species group (Blennioidei: Tripterygiidae) from the India Ocean, with descriptions of two new species. *Aqua, Journal of Ichthyology and Aquatic Biology*, **11:** 89–104.

Jordan, D. S. & J. O. Snyder, 1903. A review of the blennioid fishes of Japan. *Proceedings of the United States National Museum*, **25:** 441–504.

Jordan, D. S. & A. Seale, 1906. The fishes of Samoa. Description of the species found in the archipelago, with a provisional check-list of the fishes of Oceania. *Bulletin of the Bureau of Fisheries*, **25:** 173–455.

Loh, K.-H, I.-S. Chen, J. E. Randall & H.-M. Chen, 2008. A review and molecular phylogeny of the moray eel subfamily Uropteryginae (Anguilliformes: Muraenidae) from Taiwan, with a description of a new species. *The Raffles Bulletin of Zoology*, Supplement No. **19**: 135–150.

Lol Mohan, R. S., 1968. On the occurrence of the blennioid fishes *Blennius semifasciatus* Rüppell (family: Blenniidae) and *Tripterygium fasciatum* (Weber) (family: Clinidae) along the India coast. *Journal of the Marine Biological Association of India*, **10:** 114–117.

Miya, M. & M. Nishida, 2000. Use of mitogenomic information in teleostean molecular phylogenetics: a tree-based exploration under the maximum-parsimony optimality criterion. *Molecular Phylogenetics and Evolution*, **17:** 437–455.

Miya, M., K. Saitoh, R. Wood, M. Nishida & R. L. Mayden, 2006. New primers for amplifying and sequencing the mitochondrial

ND4/ND5 gene region of the Cypriniformes (Actinopterygii: Ostariophysi). *Ichthyological Research*, **53:** 75–81.

Nylander, J. A. A., 2005. *MrModeltest V 2.2*. Evolutionary Biology Centre, Uppsala University. Uppsala, Sweden.

Peters, W. C. H. 1869. Über die von Hrn. Dr. F. Jagor in dem ostindischen Archipel gesammelten und dem Königl. *Zoologischen Museum übergebenen Fische. Monatsberichte der Akademie der Wissenschaft zu Berlin*, **1868:** 254–281.

Peters, W. C. H., 1877. Übersicht der von Hrn. Prof. Dr. K. Möbius in Mauritius und bei den Seychellen gesammelten Fische. *Monatsberichte der Akademie der Wissenschaft zu Berlin*, **1876:** 435–447.

Randall, J. E. & E. Clark, 1993. *Helcogramma vulcana*, a new triplefin fish (Blennioidei: Tripterygiidae) from the Banda Sea, Indonesia. *Revue Français d'Aquariologie*, **20:** 27–32.

Ronquist, F. & J. P. Huelsenbeck, 2003. MrBayes 3: Baysian phylogenetic inference under mixed models. *Bioinformatics*, **19**: 1572–1574.

Rüppell, E., 1835. *Neue wirbelthiere zu der fauna von Abyssinien gehörig., Fische des Rothen Meeres.* Frankfurt am Main.

Schultz, L. P., 1960. *Family Clinidae: Scaled Blennise. Subfamily Tripterygiinae*. In: Schultz, L.P., W. M. Chapman, E. A. Lachner & L. P. Woods (eds), Fishes of the Marshall and Marianas Islands. Volume 2. Families from Mullidae through Stromateidae. *Bulletin of the United States National Museum, Washington D.C.*, pp. 281–300.

Shen, S. C. & K. Y. Wu, 1994. A revision of the tripterygiid fishes from coastal waters of Taiwan with descriptions of two new genera and five new species. *Acta Zoologica Taiwanica*, **5:** 1–32.

Shibukawa, K., T. Suzuki & M. Hosokawa, 2004. First record of a triplefin, *Enneapterygius cheni*, from Japan (Perciformes: Tripterygidae). *Izu Oceanic Park Diving News*, **15:** 2–6. (In Japanese).

Swofford, D. L., 2003. *PAUP*. Phylogenetic Analysis Using Parsimony (*and Other Methods), Version 4*. Sinaur Associates. Sunderland, Massachusetts.

Wang, S. C., K. T. Shao & S. C. Shen, 1996. *Enneapterygius cheni*, a new triplefin fish (Pisces: Tripterygiidae) from Taiwan. *Acta Zoologica Taiwanica*, **7:** 79–83.

Wu, J. H., C. H. Hsu, L. S. Fang & I-S. Chen, 2007. The molecular phylogeography of *Candidia barbata* species complex (Teleostei: Cyprinidae) from Taiwan. *The Raffles Bulletin of Zoology*, Supplement 14: 61–67.

Weber, M., 1909. Diagnosen neuer Fische der Siboga-Expedition. *Notes from the Leyden Museum*, **31:** 143–169.