

Trimma novemstriatum, a new species of marine goby fish (Teleostei: Gobiidae) from Taiwan

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Abstract

A new species of pygmy goby of the genus *Trimma* Jordan & Seale, 1906 was described based on the specimens collected from the coastal water of northern and southeastern Taiwan. *Trimma novemstriatum* **sp. nov.**, can be distinguished from its congeners by the following unique combination of features: (1) fin ray counts of second dorsal fin I/9, anal fin I/8, and pectoral fin 17, with the pectoral fin rays and 5th pelvic fin ray unbranched; (2) squamation including longitudinal scale rows 22–23, transverse scale rows 6–7, scales between first dorsal fin to upper margin of pectoral fin base 3, no scales on the cheek and operculum, side area of predorsal scales usually present; (3) number of papillae on cheek rows b and d usually 4–5; and (4) distinctive colouration with the dorsum crossed by 9 yellowish-orange stripes or saddles, the midside of the body with 9 vertical stripes connected to lower spot of the belly to caudal peduncle, 1st to 3rd of which separated from dorsal but all others partly or fully connected to saddles.

Key words: new species, pygmy goby, taxonomy, fish fauna, Taiwan

Introduction

The marine benthic gobiid genus *Trimma* Jordan & Seale, 1906 contains small-sized (<30 mm SL), colourful fishes that are found widely in the Indo-Pacific Ocean associated with coral and rocky reefs in both shallow and deep waters (Winterbottom & Chen 2004; Suzuki & Senou 2007; Allen 2015; Winterbottom 2019, 2023; Winterbottom & Pyle 2022). The genus was established in 1906 based on the single specimen of the type species, *Trimma caesiura* Jordan & Seale, 1906, collected from Apia, Samoa Islands, in the South Pacific Ocean. At present, the genus contains at least 113 recognized valid species and constitutes the second largest marine genus in the family Gobiidae (Hoese *et al.* 2015; Winterbottom *et al.* 2014, 2015, 2024; Chen and Harefa 2024). The genus *Trimma* can be distinguished from other gobiid genera by the lack of any cephalic sensory canals and pores; a rather wide gill opening that extends to below the vertical limb of the preopercle or, more usually, anterior to this; the lack of spicules (odontoids) on the outer gill rakers of the first gill arch; usually fewer than 12 rays each in the second dorsal and anal fins; and the 5th pelvic fin ray length being at least 40% as long as the 4th pelvic fin ray (Winterbottom, 1984; Winterbottom & Hoese 2015).

In Taiwan, 10 nominal species of *Trimma* have been recorded: *T. annosum* Winterbottom, 2003, *T. anaima* Winterbottom, 2000, *T. caesiura*, *T. grammistes* (Tomiya, 1936), *T. caudomaculatum* Yoshino & Araga, 1975, *T. macrophthalmus* (Tomiya, 1936), *T. milta* Winterbottom, 2002, *T. naudei* Smith, 1957, *T. okinawae* (Aoyagi 1949), and recently published—*T. tigrinum* Chen & Harefa, 2024 (Shen 1993; Chen *et al.* 1997; Wu *et al.* 2009; Chen *et al.* 2010; Chen & Harefa 2024).

During our recent explorations of the coastal fishes in Taiwan employing SCUBA diving, we discovered an undescribed species of *Trimma*. We therefore describe the new goby formally. A brief comparison of this new species with congeneric species will be provided.

Materials and methods

Fish were collected by hand-net while SCUBA diving. Fresh specimens were directly photographed then preserved in 10% formalin and later transferred to 70% ethanol for long term storage. Measurements follow Miller (1988) and are expressed as percentage of standard length (SL) and head length (HL). Meristic counts follow Chen & Shao (1996) and Chen & Harefa (2024). The terminology of cephalic sensory canals and free neuromast organs (sensory papillae) follows Wongrat & Miller (1991), modified on the basis of Sanzo (1911). The type specimens have been deposited in the Pisces collections of National Taiwan Ocean University, Keelung (NTOUP).

The following abbreviation are used herein: A = anal fin; C = caudal fin; D1 = first dorsal fin; D2 = second dorsal fin; P = pectoral-fin; V = pelvic fin; LR = longitudinal scale rows, TR = transverse scale rows; SDP = scales between first dorsal fin and upper margin of pectoral fin base.

Other materials examined of 10 nominal species of *Trimma* from Taiwan was all listed in Chen & Harefa (2024).

Systematics

Trimma novemstriatum sp. nov.

(九帶磨鰕虎)

(Figures 1–3)

Material examined

Holotype

NTOUP- 2021-08-062, male, 21.1 mm SL, Maoao, Gongliao District, New Taipei City, Taiwan, depth 8–12 m, coll. T. Harefa and D.Y. Hong, 9 August 2021.

Paratypes

NTOUP-2020-09-084, 3 specimens, 14.2–16.5 mm SL; Jihue, Chenggong Township, Taitung County, Taiwan, depth 6–7 m, coll. T. Harefa and I-S. Chen, 29 September 2020.

NTOUP-2021-08-063, female, 18.4 mm SL, same data as holotype.

NTOUP-2021-09-226, female, 20.6 mm SL, Jihue, Chenggong Township, Taitung County, Taiwan, depth 5–6 m. coll. T. Harefa *et al.*, 24 September 2021.

NTOUP-2021-09-227, female, 20.1 mm SL, Jihue, Chenggong Township, Taitung County, Taiwan, depth 5–6 m. coll. T. Harefa *et al.*, 24 September 2021.

Non-types

NTOUP-2021-06-282, female, 12.5 mm SL, Maoao, Gongliao District, New Taipei City, Taiwan, Depth 8–12 m, coll. T. Harefa and D.Y. Hong, 11 June 2021.

NTOUP-2021-08-225, 3 specimens, 13.5–17.5 mm SL, Jihue, Chenggong Township, Taitung County, Taiwan; depth 5–6 m. coll. T. Harefa *et al.*, 24 September 2021. NTOUP-2021-12-184, female, 13.7 mm SL, Jihue, Chenggong Township, Taitung County, Taiwan, depth 6–8 m, coll. T. Harefa *et al.*, 21 December 2021.

NTOUP-2022-11-156, 3 specimens, 15.6–16.5 mm SL, Jihue, Chenggong Township, Taitung County, Taiwan, depth 5–6 m, coll. T. Harefa and D.Y. Hong, 17 November 2022.

NTOUP-2023-01-098, 2 specimens, 12.9–17.2 mm SL, Jihue, Chenggong Township, Taitung County, Taiwan, depth 5–6 m, coll. T. Harefa *et al.*, 12 January 2023.

Diagnosis

The new species of *Trimma novemstriatum* can be well distinguished from other congeners by following unique combination of features: (1) fin ray counts D2 I/9, A I/8, P 17, with pectoral fin rays and 5th pelvic fin ray unbranched; (2) squamation including LR 22–23, TR 6–7, SDP 3, no scales on the cheek and operculum, lateral side area of predorsal scales usually present; (3) number of papillae on cheek rows *b* and *d* usually 4–5; and (4) distinctive colouration with dorsum crossed by 9 yellowish-orange stripes or saddles, the midside of the body with 9 vertical stripe connect to the lower spot of the belly to caudal peduncle, 1st to 3rd of which separated from dorsal saddles, all others partly or fully connected to saddles.

Description

Body proportion in Table 1. Body moderately elongated, slightly compressed posteriorly. Head slightly depressed anteriorly. Mouth oblique, maxilla extending posteriorly to slightly beyond vertical drawn through anterior margin of orbit. Lower jaw protruding slightly beyond tip upper jaw. Anterior nasal with a short tapering tube reaching anteriorly to above anterior margin of upper lip, posterior opening pore-like with low raised rim. Eyes large, dorsolateral. Interorbital narrow, with shallow trench and postorbital trench with slightly groove. Cheek slightly fleshy. Gill opening on each side large, extending anteroventrally to vertical drawn through posterior edge of mid-pupil. VC =26.

TABLE 1. Morphometric measurements of *Trimma novemstriatum* sp. nov.

Gender	Male	Female		
Type	Holotype	Paratypes (<i>N</i> = 9)		
Size (mm SL)	21.1	min	max	average
		12.5	20.6	
% in SL				
Head length	27.9	26.7	29.3	27.9
Snout to 1st dorsal fin origin	36.3	34.5	36.4	35.5
Snout to 2nd dorsal fin origin	55.5	53.7	56.9	55.4
Snout to anus	52.0	51.1	54.1	52.3
Snout to anal fin origin	56.4	55.3	58.6	57.0
Prepelvic length	27.5	25.6	29.8	27.5
Caudal peduncle length	22.2	22.4	26.4	24.2
Caudal peduncle depth	12.3	11.7	12.8	12.5
First dorsal fin base	13.8	13.4	16.4	14.5
Second dorsal fin base	17.0	17.5	20.7	19.5
Anal fin base	16.1	15.2	18.5	16.5
Caudal fin length	23.7	22.3	26.5	23.9
Pectoral fin length	23.5	21.7	26.3	24.3
Pelvic fin length	32.5	31.6	38.1	35.2
Body depth at pelvic fin origin	21.1	20.9	22.8	21.7
Body depth at anal fin origin	19.9	17.3	21.5	19.6
Body width at anal fin origin	12.0	11.5	13.1	12.3
Pelvic fin origin to anus	21.6	21.7	23.8	22.6
% in HL				
Snout length	9.9	9.3	11.5	10.5
Eye diameter	40.3	37.2	39.8	38.1
Postorbital length	39.3	36.8	41.2	39.2
Cheek depth	18.9	18	19.5	18.5
Head width at upper gill opening	45.7	47.2	51.4	48.9
Head width (maximum)	68.4	66.6	72.5	69.9
Fleshy interorbital width	13.9	13.2	17.2	14.8
Bony interorbital width	2.0	1.8	3.0	2.2
Lower jaw length	34.5	32.0	35.0	33.6

Fins.—D1 VI, D2 I/9, A I/8, V I/5, P 17. First dorsal fin with no filamentous rays, all spinous rays about equal except sixth spinous ray shorter and rather distance from others, its rear tip extending to origin of second dorsal fin when depressed. 1st segmented ray of second dorsal-fin usually unbranched, remaining rays branched, most posterior

element with two rays. 1st segmented ray of anal-fin usually unbranched, 2nd segmented ray branched except in two specimens, remaining rays all branched, most posterior element with two rays. Rear margins of second dorsal fin and anal fin not reaching the precurrent rays of caudal fin when depressed. Pectoral fin rays not branched. Pelvic fin with no frenum and basal membrane, its first 4 rays each branching once, 5th ray shorter, unbranched and only 41–48% as long as 4th ray, latter posteriorly reaching spine or 2nd ray of anal-fin. Caudal fin rounded.

Scales.—LR 22–23 (modally 23), TR 6–7 (modally 6), SDP 3. No scales on cheek and operculum. Predorsal midline flanked by 6–7 cycloid scales, but midline itself usually not scaled or, if scaled, with 1–5 rows. Pectoral base with 2–3 vertical row of cycloid scales. Prepelvic area with 5–6 rows of cycloid scales, body otherwise covered with ctenoid scales.

Head lateral-line system.—(Figure 1)

Canals: No canal pore on head.

Sensory papillae: Sensory papillae or free neuromast distributed as follows, with counts and ranges shown in parentheses: row *a* (6) long, extending from posterior to anterior of orbit; rows *b* and *d* (4–5 and 4–5 respectively) short; row *c* (6) present longitudinally below infraorbital; single *cp* papilla (1); rows *e* and *i* (26–27 and 14–15, respectively) on preoperculo-mandibular; row *f* (3 paired papillae) on rostral mandibular; rows *g* and *n* (1 and 4–5, respectively) anteriodorsal; row *h* (4) posteriodorsal; rows *ot*, *oi* and *os* (13–14, 3–4, and 4–5, respectively) on opercular; *p* papillae (6, paired) flanking midline on interorbital; rows *r* and *s* (3 and 1, respectively, all paired) flanking midline in preorbital area; rows *u*, *x* and *z* (5, 4–5, and 6, respectively) on oculoscapular.

Colouration while fresh.—(Figures 2–3)

Head and body gray to light gray. Yellowish-orange stripe on upperlip either continuous with or separate from small, yellowish-orange spot on the cheek. Vertical yellowish-orange bar on preopercle, broad yellowish-orange bar on posterior end of operculum and elongated yellowish-orange bar behind each eye. Pectoral-fin base with 2 small yellowish-orange spots on middle and lower margin respectively. Dorsum crossed by 9 yellowish-orange saddles: 1st of these situated behind the eyes; 2nd above pectoral fin base; 3rd at base of spine 1–4 of first dorsal fin; 4th at base of spine 6 of first dorsal fin; 5th at bases of spine 1 and rays 1–3 of second dorsal fin; 6th at bases of rays 4–8 of second dorsal fin; 7th and 8th on caudal peduncle; and 9th on dorsal precurrent caudal fin. Nine vertical stripes along mid-side of body, starting from before first dorsal fin to caudal peduncle, 1st to 3rd of which separated from dorsal saddles, remainder partly or fully connected to saddles. Dorsal fin translucent, with yellowish-orange stripe near base; caudal fin mostly yellowish-orange.

Colouration in preserved

Broad dense fields of black melanophores present on cheek below the eyes and in non scaled mid-predorsal area. Black melanophores present on former yellowish-orange bars on upper lip and preopercle. Pectoral fin base with light black melanophores, lower base also with some black spots. Scale margins of the anterior body with dense melanophores, but such scales becoming light on caudal peduncle. Dorsal fin and anal fin translucent, with black melanophores on tips of rays and near bases of fins. Caudal fin translucent.

Distribution

Currently known from coastal regions of northern and southeastern Taiwan.

Etymology

The specific name *novemstriatum*, a declineable compound participle with a neuter ending to match the gender of *Trimma*, is derived from the Latin “*novem*” meaning nine, and “*striatus*, -a, -um”, meaning striped with reference to the colouration pattern.

Remarks

Among all the valid species of *Trimma*, nine species have 17 or more unbranched pectoral fin rays and an unbranched 5th pelvic fin: *T. albicaudatum* Wada, Takase & Senou, 2023, *T. anaima*, *T. bathum* Winterbottom, 2017, *T. erwani* Viviani, Williams & Planes, 2016, *T. grammistes*, *T. kadium* Winterbottom, Erdmann & Cahyani, 2015, *T. matsunoi* Suzuki *et al.*, 2012, *T. meityae* Winterbottom & Erdmann, 2018, and *T. sanguinellum* Winterbottom &

Southcott, 2007. Of these, only *T. grammistes* and *T. matsunoi* share similarities with *T. novemstriatum* **sp. nov.** in not having scales on the opercle. However, the new species *T. novemstriatum* can be distinguished from *T. matsunoi* by having fewer rays in the second dorsal fin (8 vs 9). It also differs from *T. grammistes* in having fewer rays in the first dorsal fin (8 vs 10–11), fewer rays of pectoral fin (17 vs 18–20), and fewer lateral scales rows (22–23 vs 26–28).

Among the species members of genus *Trimma*, the new species *T. novemstriatum* **sp. nov.** sharing many similarities to *T. maiandros* (type located in Queensland, Australia) in having equal number of scales and fin rays. However, according to Winterbottom's key (Winterbottom 2019), the new species differs from *T. maiandros* in having no branched pectoral fin rays (vs some rays branched). Moreover, it can be well distinguished from *T. maiandros* (type located in Queensland, Australia) (Hoesé *et al.* 2013) by having fewer number of papillae on the cheek in rows *b* and *d* (4–5 vs 5–6), and in colouration having nine yellowish-orange vertical stripes on the midside of the body (vs irregular, yellow to reddish-orange bands). In the type specimen of *T. maiandros*, these bands are barely connected to the lower spot of the belly to caudal peduncle, whereas in *T. novemstriatum* **sp. nov.**, all the vertical stripes are fully connected along the ventral midline (Fig. 2, 3).

Hoesé *et al.* (2011) noted the differences in colouration between live specimens of *T. maiandros* from the Great Barrier Reef (paratypes) and other specimens from Chesterfield Bank, the Coral Sea, Enewetak, Palau, Fiji, Samoa, New Caledonia, Guam and Saipan that were excluded from type series. In the present study, not only the molecular evidence but also distinctive morphological features support the conclusion that *T. novemstriatum* **sp. nov.** and *T. maiandros* are good discrete species.

TABLE 2. Distribution frequency of fin-rays counts of 11 *Trimma* species from Taiwan.

Species	D2 I/						A I/					
	7	8	9	10	11	Av	7	8	9	10	11	Av
<i>T. novemstriatum</i> sp. nov.	-	-	16	-	-	9	-	16	-	-	-	8
<i>T. anaima</i>	-	3	-	-	-	8	-	3	-	-	-	8
<i>T. annosum</i>	5	47	1	-	-	8	3	49	1	-	-	8
<i>T. caesiura</i>	-	40	-	-	-	8	-	40	-	-	-	8
<i>T. caudomaculatum</i>	-	1	-	-	-	8	-	1	-	-	-	8
<i>T. grammistes</i>	-	-	-	15	2	10	-	-	2	14	1	10
<i>T. macrophthalmus</i>	-	2	17	-	-	9	-	5	14	-	-	9
<i>T. milta</i>	-	-	1	-	-	9	-	1	-	-	-	8
<i>T. naudei</i>	1	9	-	-	-	8	1	9	-	-	-	8
<i>T. okinawae</i>	-	-	64	2	-	9	3	57	3	-	-	8
<i>T. tigrinum</i>	-	-	43	-	-	9	-	-	43	-	-	9

.....continued below

TABLE 2. (Continued)

Species	P							
	14	15	16	17	18	19	20	Av
<i>T. novemstriatum</i> sp. nov.	-	-	-	15	1	-	-	17
<i>T. anaima</i>	-	-	3	-	-	-	-	16
<i>T. annosum</i>	-	-	-	7	42	4	-	18
<i>T. caesiura</i>	-	-	11	25	4	-	-	17
<i>T. caudomaculatum</i>	1	-	-	-	-	-	-	14
<i>T. grammistes</i>	-	-	-	-	10	6	1	18
<i>T. macrophthalmus</i>	-	-	-	6	10	3	-	18
<i>T. milta</i>	-	-	-	1	-	-	-	17
<i>T. naudei</i>	-	-	3	6	1	-	-	17
<i>T. okinawae</i>	-	-	-	9	50	7	-	18
<i>T. tigrinum</i>	-	-	2	4	34	3	-	18

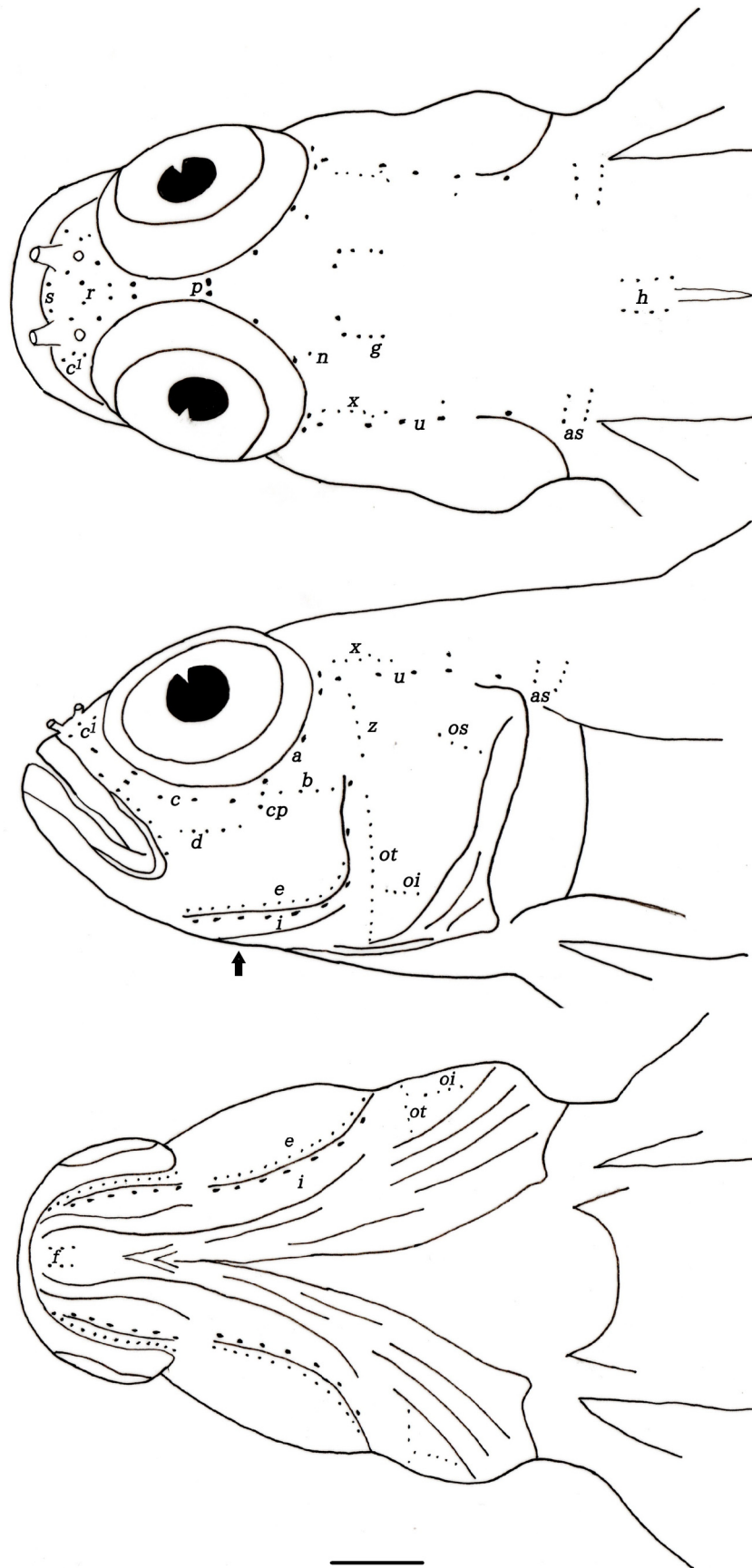


FIGURE 1. Head lateral system of *Trimma novemstriatum* **sp. nov.**, holotype, NTOUP-2021-08-062, 21.1 mm SL. Maoao, New Taipei City, Taiwan. Bar = 1 mm. An arrow denotes the position of the gill opening

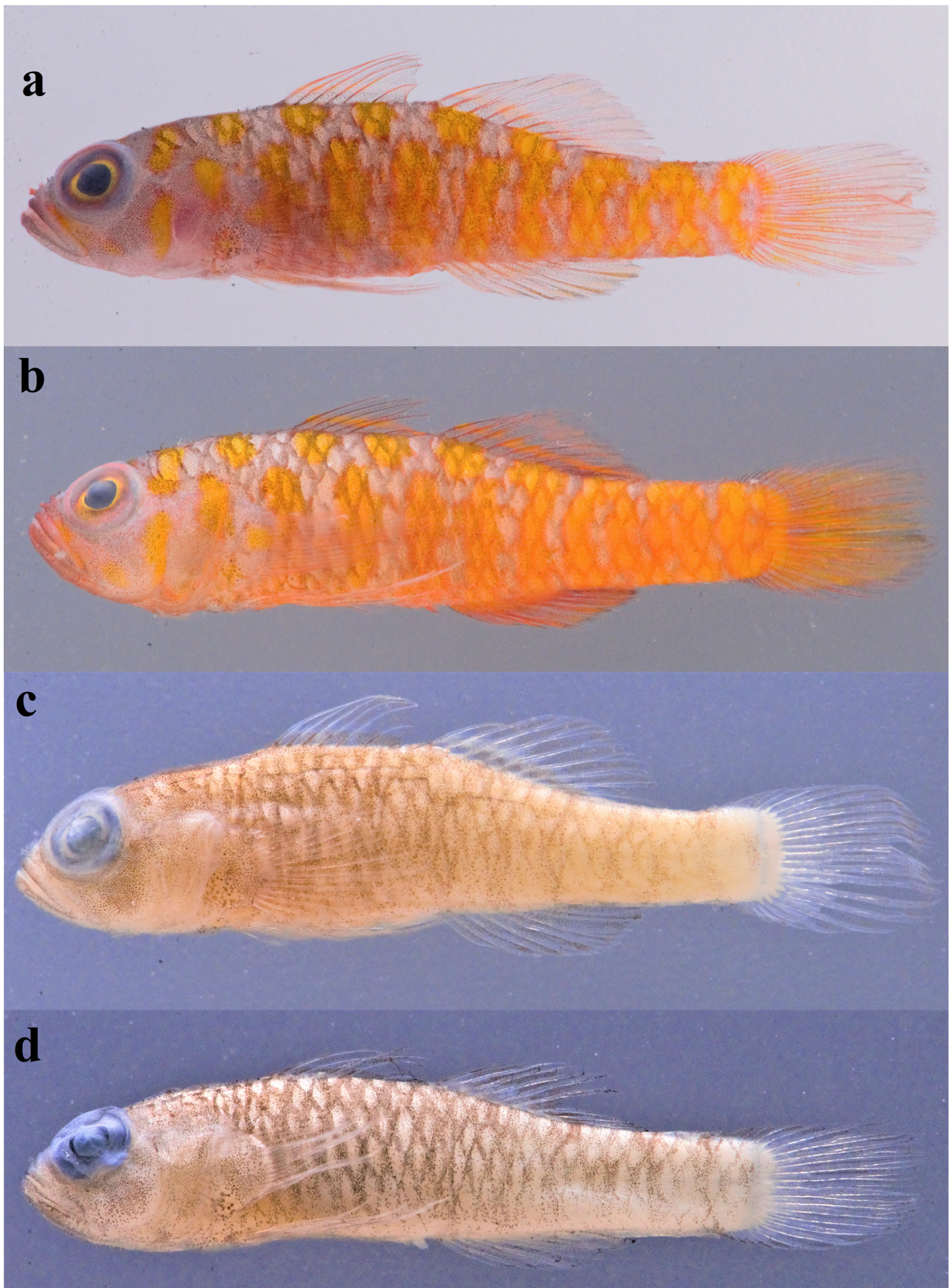


FIGURE 2. Specimen photographs of *Trimma novemstriatum* **sp. nov.**: (a) and (c). Male, holotype, NTOUP-2021-08-062, 21.1 mm SL, Maoao, New Taipei City, Taiwan; (b) and (d). Female, paratype, NTOUP-2021-09-226 20.6 mm SL, Jihue, Taitung County, Taiwan.

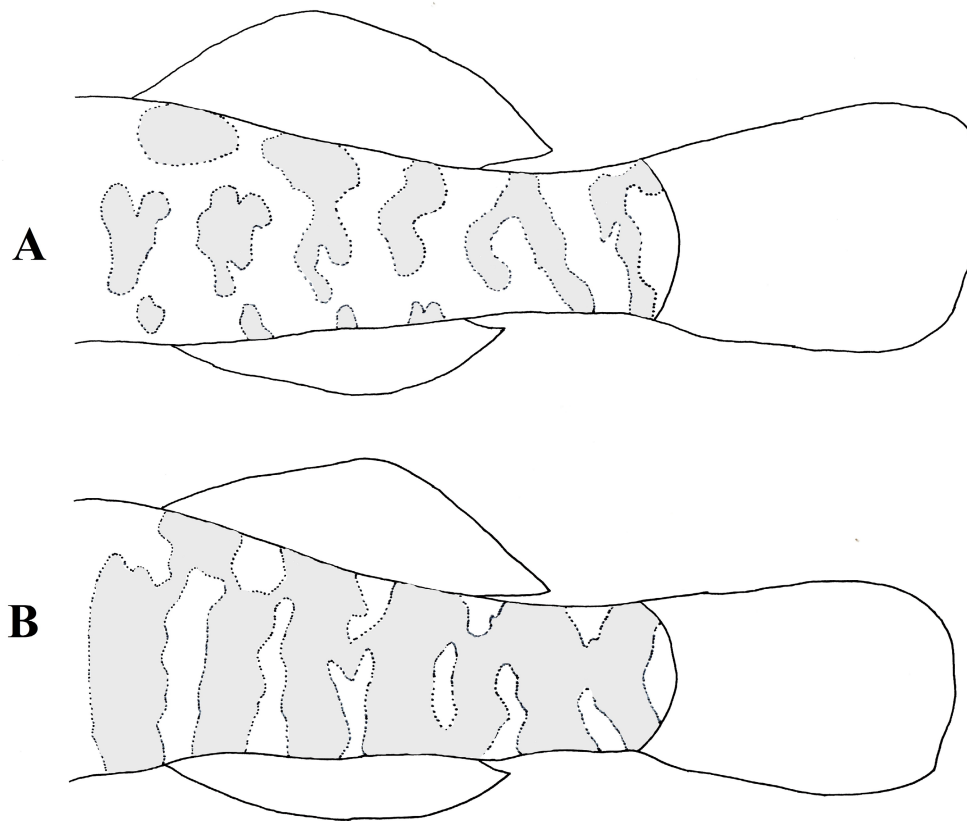


FIGURE 3. Schematic pattern of vertical stripes on posterior part of the body: A. *Trimma maiandros*, redraw from holotype image (Hoesé *et al.* 2011: fig. 1), 20.7 mm SL; B. *Trimma novemstriatum* **sp. nov.**, holotype, NTOUP-2021-08-062, 21.1 mm SL.

Diagnostic key to all nominal species of *Trimma* from Taiwan

- 1a. Predorsal midline scaleless. 2
- 1b. Predorsal midline with some scales or fully scaled 4
- 2a. Lateral side of body with dark stripe *T. grammistes*
- 2b. Lateral side of body without dark stripe. 3
- 3a. P 17–19; TR 8–9; P base with three dark spots *T. macrophthalmus*
- 3b. P 16; TR 7; P base without dark spot *T. anaima*
- 4a. P rays some branched. 5
- 4b. P rays unbranched. 9
- 5a. Interorbital with trench between and posterodorsal to the eyes 6
- 5b. No trench or groove between and posterodorsal to the eyes *T. milta*
- 6a. Opercle with 1–3 cycloid scales. 7
- 6b. Scale on upper opercle absent 8
- 7a. Second spine of D1 elongated; P base with dark bar *T. naudei*
- 7b. Second spine of D1 not elongated; P base without dark bar *T. caesiura*
- 8a. PredS 7–9; 6, 8–9 and 8–9 papillae in row *c*, *b* and *d*, respectively; spines of dorsal-fin with black spots surrounded reddish margin. *T. tigrinum*
- 8b. PredS 2–6; 5, 5–6 and 5–6 papillae in row *c*, *b* and *d*, respectively; spines and rays with yellowish-orange spots *T. okinawae*
- 9a. Cheek with scale rows, large black-reddish blotch on C base *T. caudomaculatum*
- 9b. Cheek without scale; P 17–19; no such blotch on C base 10
- 10a. D2 I/7–8, V unbranched, body with reddish-range spots *T. annosum*
- 10b. D2 I/9, V branched, body with nine vertical stripes *T. novemstriatum* **n. sp.**

TABLE 3. Distribution frequency of scale counts of 11 *Trimma* species from Taiwan.

	LR								Av
	22	23	24	25	26	27	28	29	
<i>T. novemstriatum</i> sp. nov.	1	14	1	-	-	-	-	-	23
<i>T. anaima</i>	-	3	-	-	-	-	-	-	23
<i>T. annosum</i>	1	10	25	17	-	-	-	-	24
<i>T. caesiura</i>	-	29	9	1	1	-	-	-	23
<i>T. caudomaculatum</i>	-	1	-	-	-	-	-	-	23
<i>T. grammistes</i>	-	-	-	-	7	3	4	3	26
<i>T. macrophthalmus</i>	1	6	12	-	-	-	-	-	24
<i>T. milta</i>	-	1	-	-	-	-	-	-	23
<i>T. naudei</i>	1	6	3	-	-	-	-	-	23
<i>T. okinawae</i>	1	40	25	2	-	-	-	-	23
<i>T. tigrinum</i>	-	17	24	2	-	-	-	-	24

.....continued below

TABLE 3. (Continued)

	TR						SDP						
	6	7	8	9	10	Av	0	1	2	3	4	5	Av
<i>T. novemstriatum</i> sp. nov.	12	4	-	-	-	6	-	-	-	16	-	-	3
<i>T. anaima</i>	-	3	-	-	-	7	-	-	-	3	-	-	3
<i>T. annosum</i>	16	37	-	-	-	7	-	-	-	6	47	-	4
<i>T. caesiura</i>	4	28	5	-	-	7	-	-	-	1	34	5	4
<i>T. caudomaculatum</i>	-	1	-	-	-	7	-	-	-	1	-	-	3
<i>T. grammistes</i>	-	1	5	10	1	9	17	-	-	-	-	-	0
<i>T. macrophthalmus</i>	-	-	13	6	-	8	19	-	-	-	-	-	0
<i>T. milta</i>	1	-	-	-	-	6	-	-	-	-	1	-	4
<i>T. naudei</i>	3	6	1	-	-	7	-	-	-	-	8	2	4
<i>T. okinawae</i>	-	23	43	2	-	8	-	-	-	30	38	-	4
<i>T. tigrinum</i>	6	37	-	-	-	7	-	-	-	-	43	-	4

.....continued below

TABLE 3. (Continued)

	PreD												
	0	1	2	3	4	5	6	7	8	9	10	11	AV
<i>T. novemstriatum</i> sp. nov.	13	2	-	-	-	3	-	-	-	-	-	-	0
<i>T. anaima</i>	3	-	-	-	-	-	-	-	-	-	-	-	0
<i>T. annosum</i>	-	-	-	-	-	30	19	4	-	-	-	-	5
<i>T. caesiura</i>	-	-	-	-	-	-	-	9	19	12	-	-	8
<i>T. caudomaculatum</i>	-	-	-	-	-	-	-	-	-	-	-	1	11
<i>T. grammistes</i>	12	-	-	-	-	-	-	-	-	-	-	-	0
<i>T. macrophthalmus</i>	19	-	-	-	-	-	-	-	-	-	-	-	0
<i>T. milta</i>	-	-	-	-	-	-	-	1	-	-	-	-	7
<i>T. naudei</i>	-	-	-	-	-	-	2	2	6	-	-	-	7
<i>T. okinawae</i>	6	-	7	28	6	14	3	-	-	-	-	-	3
<i>T. tigrinum</i>	-	-	-	-	-	-	-	26	16	-	-	-	7

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