

Two New Species of the Gobiid Fish Genus *Trimma* (Actinopterygii: Perciformes: Gobiidae) from Japan and Palau

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Abstract Two new species of the gobiid fish genus *Trimma*, *T. fasciatum* and *T. matsunoi* are described based on specimens from Japan and Palau. *Trimma fasciatum* (three specimens, 12.4–21.9 mm SL, Kume-jima Island, Japan and Ngis Island, Palau) differs from all other congeners in having 8 predorsal scales; no elongate and filamentous spine in first dorsal fin; all pectoral-fin rays unbranched; height of basal membrane between innermost pelvic-fin rays about 23% of length of fifth ray; shallow to moderate interorbital groove; interorbital space narrow and bony width 18–26% of pupil diameter; and body with 4 broad bright yellow bands when freshly collected and when alive. *Trimma matsunoi* (two specimens, 16.8–26.4 mm SL, near Kashiwa-jima Island, Shikoku, Japan) differs from all other congeners in having 6 predorsal scales; no elongate and filamentous spine in first dorsal fin; fifth pelvic-fin ray unbranched, basal membrane reduced; interorbital groove shallow; no opercle scales; interorbital space wide and bony width 75–77% of pupil diameter; scale pockets with deep orange margins when fresh; 8 to 9 yellowish orange saddles over the dorsal midline and six saddles on the ventral midline when alive.

Key words: *Trimma*, new species, Gobiidae, Japan, Palau.

Trimma is an Indo-Pacific gobiid fish genus, comprising cryptic, tiny (less than 40 mm SL), colorful, tropical species found on coral and rocky reefs, usually at depths shallower than 80 m. According to Winterbottom (2011), *Trimma* can be recognized by having the following combination of characters: lack of cephalic sensory canal pores; much reduced cephalic sensory papillae pattern; wide gill opening extending to below the vertical limb of the preopercle or anterior to this; lack of bony spicules on the outer gill rakers of the first gill arch; fewer than 12 dorsal- and anal-fin segmented rays; and a fifth pelvic-fin ray that is equal to or more than 40% the length of the fourth pelvic-fin ray.

Trimma, established by Jordan and Seale (1906), may contain about 100 species (Winterbottom, 2011). Of these, 71 described species are

currently recognized as valid (Hagiwara and Winterbottom, 2007; Hoese *et al.*, 2011; Suzuki and Senou, 2007, 2008, 2009; Winterbottom and Southcott, 2007; Winterbottom and Zur, 2007; Winterbottom, 2009, 2011), while the others are still unnamed (R. Winterbottom pers. comm.: *T. capostriatum* (Goren, 1981) is a valid species).

Following 25 valid species of *Trimma* have been reported so far from Japan, as well as 4 undescribed species of Suzuki and Shibukawa in Senou (2004): *Trimma anaima* Winterbottom, 2000, *T. annosum* Winterbottom, 2003, *T. benjamini* Winterbottom, 1996, *T. caesiura* Jordan and Seale, 1906, *T. caudipunctatum* Suzuki and Senou, 2009, *T. caudomaculata* Yoshino and Araga, 1975, *T. emeryi* Winterbottom, 1985, *T. flavatrum* Hagiwara and Winterbottom, 2007, *T. grammistes* (Tomiyama, 1936), *T. halonevum*

Winterbottom, 2000, *T. hayashii* Hagiwara and Winterbottom, 2007, *T. imaii* Suzuki and Senou, 2009, *T. kudoui* Suzuki and Senou, 2008, *T. macrophthalmum* (Tomiyama, 1936), *T. maiandros* Hoese, Winterbottom and Reader, 2011, *T. marinae* Winterbottom, 2005, *T. milta* Winterbottom, 2002, *T. naudei* Smith, 1956, *T. nomurai* Suzuki and Senou, 2007, *T. okinawae* (Aoyagi, 1949), *T. sheppardi* Winterbottom, 1984, *T. taylori* Lobel, 1979, *T. winchi* Winterbottom, 1984, *T. yanagitai* Suzuki and Senou, 2007 and *T. yanoi* Suzuki and Senou, 2008 (Hagiwara and Winterbottom, 2007; Hoese *et al.*, 2011; Suzuki and Senou, 2007, 2008, 2009; Suzuki and Shibukawa in Senou, 2004; Suzuki *et al.*, 2007a, 2007b, 2008; Winterbottom, 2005a, 2005b, 2011).

In this paper, we describe 2 new species of *Trimma* collected from Japan and Palau. One of these was first reported by Suzuki and Shibukawa in Senou (2004) as "*Trimma* sp. 13." The other one was recently collected from near Kashiwa-jima Island, Shikoku, Japan.

Materials and Methods

Type specimens of the new species are deposited in Kanagawa Prefectural Museum of Natural History (KPM), the National Museum of Nature and Science, Tsukuba (NSMT) and the Osaka Natural History Museum, Osaka (ONHM).

Methods of counting and measurements follow Suzuki and Senou (2007). Pectoral- and pelvic-fin ray branching, squamation, and groove around orbit were described from preserved materials stained with a cyanine blue solution. The methods of Akihito (1984) were used in describing the pattern of the interdigitation of the dorsal-fin pterygiophores between the neural spines ("P-V"). The P-V and vertebrae counts were obtained from radiographs. Cephalic sensory papillae were observed on holotype stained with cyanine blue, and notations follow Miller (1986), Iwata *et al.* (2007) and Winterbottom (2011). Information about tooth morphology and gill-raker counts were obtained from a paratype stained with alizarin red. Description of the color

when fresh was based on color slides of each species. Color descriptions when alive were based on the underwater photographs in Yano in Senou (2004), and/or the Image Database of Fishes in the Kanagawa Prefectural Museum of Natural History (KPM-NR). The names of colors follow the recommendations of the Japan Color Research Institute (1995). Measurements are given in Table 1. In each description, data for the holotype are given first, followed by data for the paratype(s) in parentheses where different. Specimens from Palau were collected under permit RE09-02 (2009) and exported to Japan under an export permit 47710-B (2009).

Trimma fasciatum sp. nov.

(New Japanese name: Dokutsu-shima-beni-haze)

(Figs. 1 and 2)

Trimma sp.: Hayashi and Shiratori, 2003: 45 (No. 074 underwater photograph, Saipan Island, 4m depth, photo by H. Kimura).

Trimma sp. 13: Suzuki and Shibukawa in Senou, 2004: 116 (underwater photograph, Kume-jima Island, the Ryukyu Islands, Japan, 25m depth, photo by T. Kawamoto).

Holotype. OMNH-P 35167, male, 21.9mm SL, Ngemlis Reef, Ngis Island, Palau, 07°08'17.0"N, 134°13'18.5"E, 30m depth, 8 May 2009.

Paratypes. NSMT 106482 (ex OMNH-P 34795), male, 20.0mm SL, cleared and stained, 12 Jan. 2008, same locality and collector as the holotype. KPM-NI 10995, juvenile, 12.4mm SL, Kume-jima Island, the Ryukyu Islands, Japan, 25m depth, 22 Nov. 2001.

Photograph Records from Image Database of Fishes. Ngemlis Reef, Ngis Island, Palau, N 07°08'17.0", E 134°13'18.5", 30m depth, Jiro Sakaue, 18 Jan. 2008: KPM-NR 44892 and 44893. Kume-jima Island, Okinawa Islands, the Ryukyu Islands, Japan: KPM-NR 16411, 30m depth, Arimasa Sakamoto, 2 June 1997; KPM-NR 54680, a fresh specimen of KPM-NI 10995, Hiroshi Senou; KPM-NR 63439, 28m depth, Tsuyoshi Kawamoto, 24 Oct. 2001.

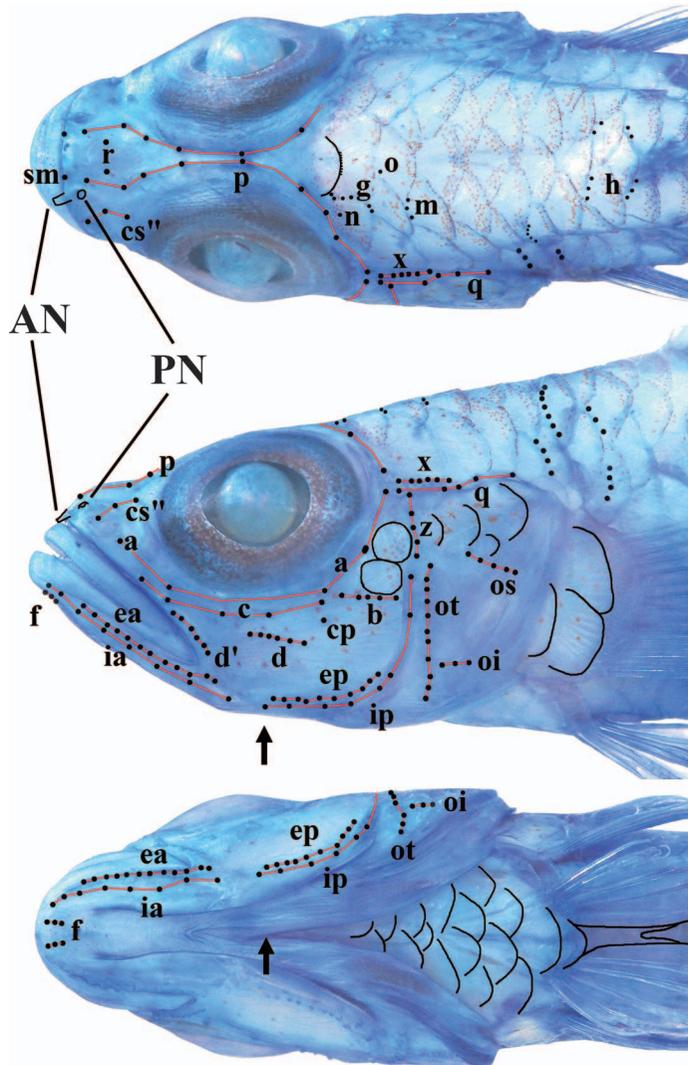


Fig. 1. The cephalic sensory papillae and squamation of head, and basal membrane of pelvic fins in *Trimma fasciatum*, holotype, OMNH-P 35167, male, 21.9 mm SL. Dorsal (top), lateral (middle) and ventral (bottom) views of head. Dots represent the sensory papillae. AN and PN indicate anterior and posterior nares, respectively. Arrows show position where gill membrane is attached to isthmus.

Diagnosis. *Trimma fasciatum* differs from the other described species of the genus in the following combination of characters: 8 predorsal scales; no elongate and filamentous spine of first dorsal fin; all pectoral-fin rays unbranched; height of basal membrane between innermost pelvic-fin rays about 23% of length of fifth ray; shallow to moderate interorbital groove; interorbital space narrow and bony width 18–26% of

pupil diameter; nape with 1 or 2, and body with 4 broad bright yellow bands when fresh and when alive.

Description. Dorsal-fin rays VI-I, 8; anal-fin rays I, 8; pectoral-fin rays 16 (14 in one; 15 in one); pelvic-fin rays I, 5; segmented caudal-fin rays 8 + 7 (9 + 8 in one), branched caudal-fin rays 6 + 5; longitudinal scales 24 (23 in two); anterior transverse scales 7; posterior transverse

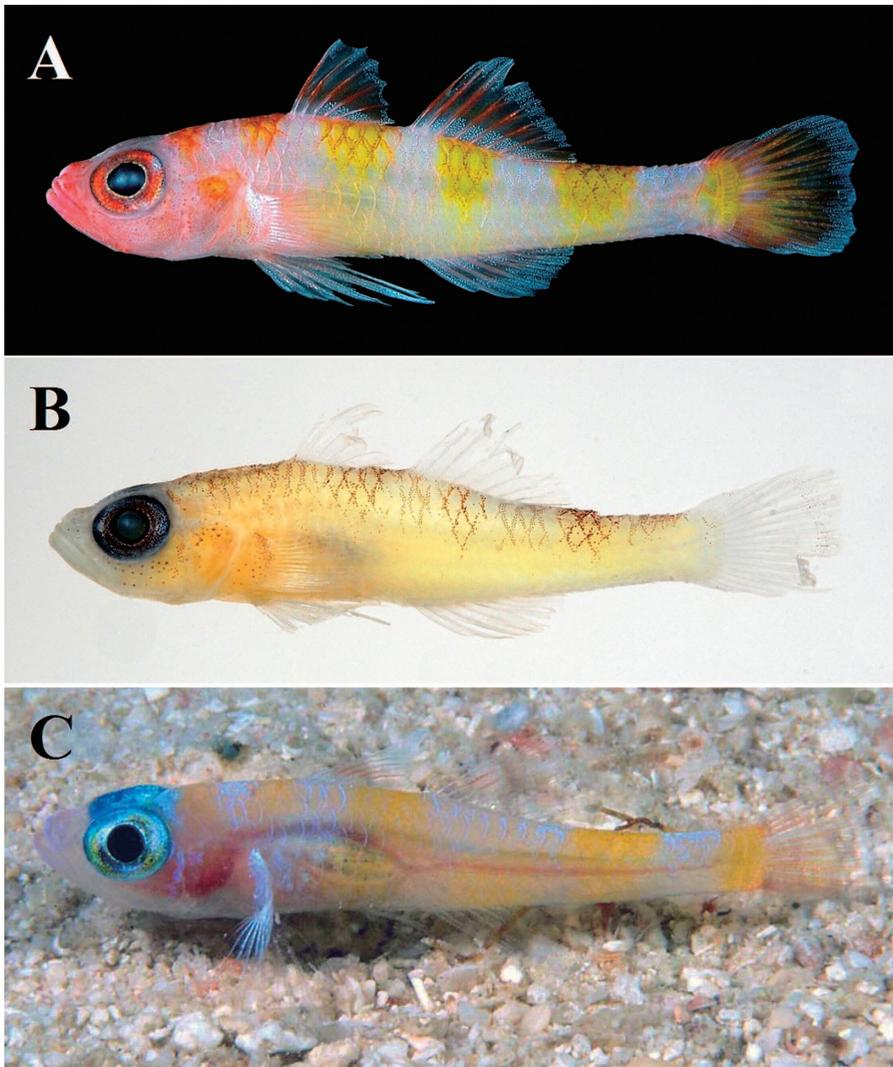


Fig. 2. *Trimma fasciatum*, Ngemlis Reef, Ngis Island, Palau. A: fresh specimen, holotype, photo by J. Sakaue. B: alcohol preserved specimen, holotype, photo by T. Suzuki. C: KPM-NR 44892, live (not preserved), 30m depth, photo by J. Sakaue, 18 Jan. 2008.

scales 6; predorsal scales 8; P-V 3 /II II I I 0 / 9; vertebrae 10 + 16 = 26.

Second and third spines of first dorsal fin longest (second spine in one; third spine in one), but not elongate and filamentous, not reaching posteriorly to second dorsal-fin origin when adpressed (reaching to first segmented ray base of second dorsal fin in one juvenile paratype); first dorsal fin separate from second dorsal fin. All pectoral-fin rays unbranched; fin not reaching posteriorly

to above anal-fin origin. All pelvic-fin rays each with two terminal tips; fifth ray 53% (48% in one; 59% in one) of fourth ray in length; fourth ray longest, reaching posteriorly to base of third segmented ray of anal fin when adpressed (anal-fin origin in one juvenile; fourth segmented ray base of anal fin in one). No pelvic-fin frenum. Basal membrane between innermost pelvic-fin rays about 23% of length of fifth ray (broken in two) (Fig. 1).

Cheek with two embedded cycloid scales dorsally (absent in two). Opercle with 5 embedded cycloid scales dorsally (2 in one; absent in one juvenile). Pectoral-fin base with 3 cycloid scales in 2 vertical and 2 horizontal rows (2 scales in 1 vertical and 2 horizontal in two), preplevic area scaled in 8 longitudinal and 4 transverse rows of cycloid scales (5 longitudinal rows in one; absent in one juvenile), and anterior half of midline of belly with small cycloid scales (cycloid scales on midline in one; absent on midline in one juvenile). Nape with ctenoid scales, extending anteriorly to orbit. Other parts of body with large ctenoid scales. Gill opening extending below a vertical line just slightly posterior to the middle of the pupil (middle of pupil in one; between anterior edge and middle of eye in one). Anterior naris with a short tube; posterior nasal opening a simple pore, 2 naris diameter from anterior naris and 9 naris diameter from eye. Interorbital groove shallow (moderate in one), postorbital groove absent. Interorbital space narrow and bony width 18% of pupil diameter (26% in one juvenile) (Fig. 1). The cephalic sensory papillae are depicted of the holotype in Fig. 1.

Inwardly curved conical teeth in both jaws. Upper jaw with two-three irregular inner rows of small teeth, grading to a single row on center and posterior parts; an anterior part with an outermost row of 4 large, spaced teeth; center and posterior parts with an outermost row of medium teeth. Lower jaw with 2–3 irregular medial rows of small teeth, grading to a single row on center and posterior parts; anterior part with an outermost row of 7 large, spaced teeth; center part with a single innermost row of 12 medium, spaced teeth.

Color of holotype when fresh (Fig. 2A). Background color of head and body white. Scale pockets of nape and dorsal sides of body with beige margins. Nape with 2 bright orange saddles. Body with 4 broad bright yellow bands. The first band below the first dorsal fin, the second below the second dorsal fin, the third on anterior part of caudal peduncle, the last on posterior part of caudal peduncle and anterior part of caudal

fin. Anterior parts of head pinkish. Dorsal part of opercle with a bright orange round mark. Iris bright red and surrounding of purple gold. Snout, cheek, opercle, pectoral-fin base with many minute reddish brown dots. Fins hyaline. Dorsal fins with a bright orange, broad, longitudinal, medial stripe. Caudal fin with a large bright yellow and bright orange mark. Anal and pelvic fins pinkish medially. Base and anterior part of pectoral fin white.

Color of holotype in alcohol (Fig. 2B). Pink, red, white and yellow colors faded. Head and body pale yellow. Scale pockets of nape and dorsal sides of body outlined with reddish brown.

Color when alive. Similar to fresh coloration, except as follows: head and body semi-translucent; the scale pockets on the dorsum lack dark margins; gill and aorta deep red; snout, base and anterior part of pectoral fin, interspaces of yellow bands on dorsal side of body pale sky blue; iris and interorbital space bright blue; lacks the yellow bar below the middle of the second dorsal fin, and the bars across the nape are yellowish in Fig. 2C, but the bar below the middle of the second dorsal fin present, and the bars across the body are reddish in Figure of Yano in Senou (2004).

Distribution. Kume-jima Island, the Ryukyu Islands, Japan; Ngis Island, Palau; Saipan Island (photograph only, Hayashi and Shiratori, 2003).

Etymology. The specific name is the Latin *fasciatum* meaning “bands”, in allusion to the yellow bands of body of the new species.

Comparisons. *Trimma fasciatum* is most similar to *T. flavatrum* and *T. randalli* Winterbottom and Zur, 2007. It differs from *T. flavatrum* in having: height of basal membrane between innermost pelvic-fin rays about 23% of length of fifth ray (vs. no basal membrane in *T. flavatrum*); and 4 broad bright yellow bands on body (vs. usually no band but sometimes 2 white bands and one saddle when alive, see Hagiwara and Winterbottom, 2007). *Trimma fasciatum* differs from *T. randalli* in having: no elongated spine of the first dorsal fin (vs. second spine elongated in *T. randalli*); and 4 broad bright yellow bands on body

Table 1. Measurements (% SL) for *Trimma fasciatum* and *T. matsunoi*.

	<i>T. fasciatum</i>			<i>T. matsunoi</i>	
	Holotype	Paratypes		Holotype	Paratype
	OMNH-P 35167	NSMT-P 106482	KPM-NI 10995	NSMT-P 106483	OMNH-P 23885
Sex	male	male	juvenile	female	male
Standard length (mm)	21.9	20.0	12.4	26.4	16.8
Head length (exclude gill membrane)	30.3	broken	31.9	28.8	broken
Snout to first dorsal-fin origin	37.7	40.0	39.2	36.0	38.4
Snout to second dorsal-fin origin	55.0	55.7	55.4	55.8	57.1
Snout to anal-fin origin	56.7	58.1	63.1	59.0	58.8
Caudal peduncle length	30.3	29.5	24.2	28.8	27.1
Caudal peduncle depth	11.3	9.5	10.0	14.0	13.6
Snout length	7.8	7.1	7.5	5.8	7.9
Upper jaw length	11.9	12.4	12.8	11.9	12.7
Eye diameter	11.5	12.9	13.1	9.4	10.5
Bony interorbital width	1.5	1.7	1.8	3.6	4.2
Pupil diameter	8.2	9.5	6.9	4.7	5.6
Longest first dorsal spine length	14.5 (II & III)	12.6 (III)	16.2 (II)	19.4 (II)	20.3 (II)
4th pelvic-fin ray length	26.0	29.5	26.9	25.2	28.5
5th pelvic-fin ray length	13.9	14.3	15.9	11.5	16.9
Pelvic connecting membrane length	3.2	broken	broken	reduced	reduced

(vs. one white band on caudal peduncle, see Winterbottom and Zur, 2007).

Trimma matsunoi sp. nov.

(New Japanese name: Kashiwa-benihaze)

(Figs. 3–5)

Holotype. NSMT 106483, female, 26.4 mm SL, near Kashiwa-jima Island, Itsusai, Otsuki-cho, Kouchi Prefecture, Shikoku, Japan, 56 m depth, Jiro Sakaue, 19 Aug. 2010.

Paratype. OMNH-P 23885, male, 16.8 mm SL, cleared and stained, near Kashiwa-jima Island, Tsutomezaki, Otsuki-cho, Kouchi Prefecture, Island, Shikoku, Japan, 53 m depth, 20 Aug. 2010.

Photograph Records from Image Database of Fishes. KPM-NR 44894, same data as the holotype; KPM-NR 44895, same data as the paratype.

Diagnosis. *Trimma matsunoi* differs from the other described species of the genus in the following combination of characters: 6 predorsal scales; no elongate and filamentous spine of first

dorsal fin; fifth pelvic-fin ray unbranched, basal membrane reduced; interorbital groove shallow; interorbital space wide and bony width 75–77% of pupil diameter; no opercle scales; scale pockets with deep orange margins when fresh; 8 yellowish orange saddles over the dorsal midline and 6 saddles on the ventral midline when alive.

Description. Dorsal-fin rays VI–I, 8; anal-fin rays I, 8; pectoral-fin rays 17; pelvic-fin rays I, 5; segmented caudal-fin rays 8 + 7 (9 + 8); branched caudal-fin rays 6 + 6 (6 + 5); longitudinal scales 22 (23); anterior transverse scales 7; posterior transverse scales 7; predorsal scales 6 (0, see the remarks); gill rakers (2 + 11, stained paratype only). P–V 3 / II II I I 0 / 9; vertebrae 10 + 16 = 26 (10 + 15 = 25).

Second spine of first dorsal fin longest but not elongate and filamentous, not reaching posteriorly to second dorsal-fin origin when adpressed; sixth spine reaching posteriorly to second dorsal-fin origin when adpressed; first dorsal fin attached to second dorsal fin via low membrane. Pectoral-fin rays unbranched except eighth ray

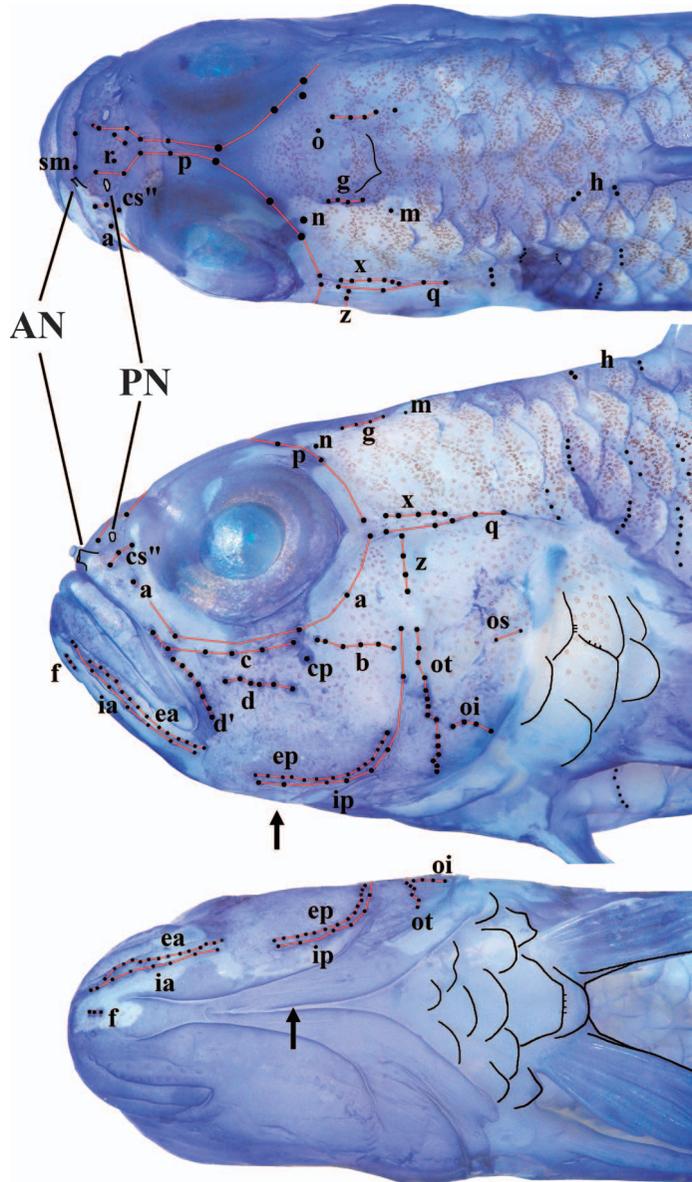


Fig. 3. The cephalic sensory papillae and squamation of head, and basal membrane of pelvic fins in *Trimma matsunoi*, NSMT 106483, holotype, female, 26.4 mm SL. Dorsal (top), lateral (middle) and ventral (bottom) views of head. Dots represent the sensory papillae. AN and PN indicate anterior and posterior nares, respectively. Arrows show position where gill membrane is attached to isthmus.

(all rays unbranched); fin not reaching posteriorly to above anal-fin origin. First four pelvic-fin rays each with 2 terminal tips; fifth ray unbranched and 46% (59%) of fourth ray in length; fourth ray longest, not reaching posteriorly to anal-fin origin when adpressed (reaching

base of first segmented ray). No pelvic frenum; basal membrane reduced but present, hidden under the posteriormost scale between pelvic fins (Fig. 3).

Cheek and opercle without scales. Pectoral-fin base with 2 weak ctenoid scales and 5 cycloid

scales (six cycloid scales) in 2–3 (2) vertical and 2–3 (4) horizontal rows, preplevic area with a weak ctenoid scale and 12 cycloid scales in 5 longitudinal and 5 transverse rows (damaged), and anterior belly with small cycloid scales. Nape with ctenoid scales, extending anteriorly to

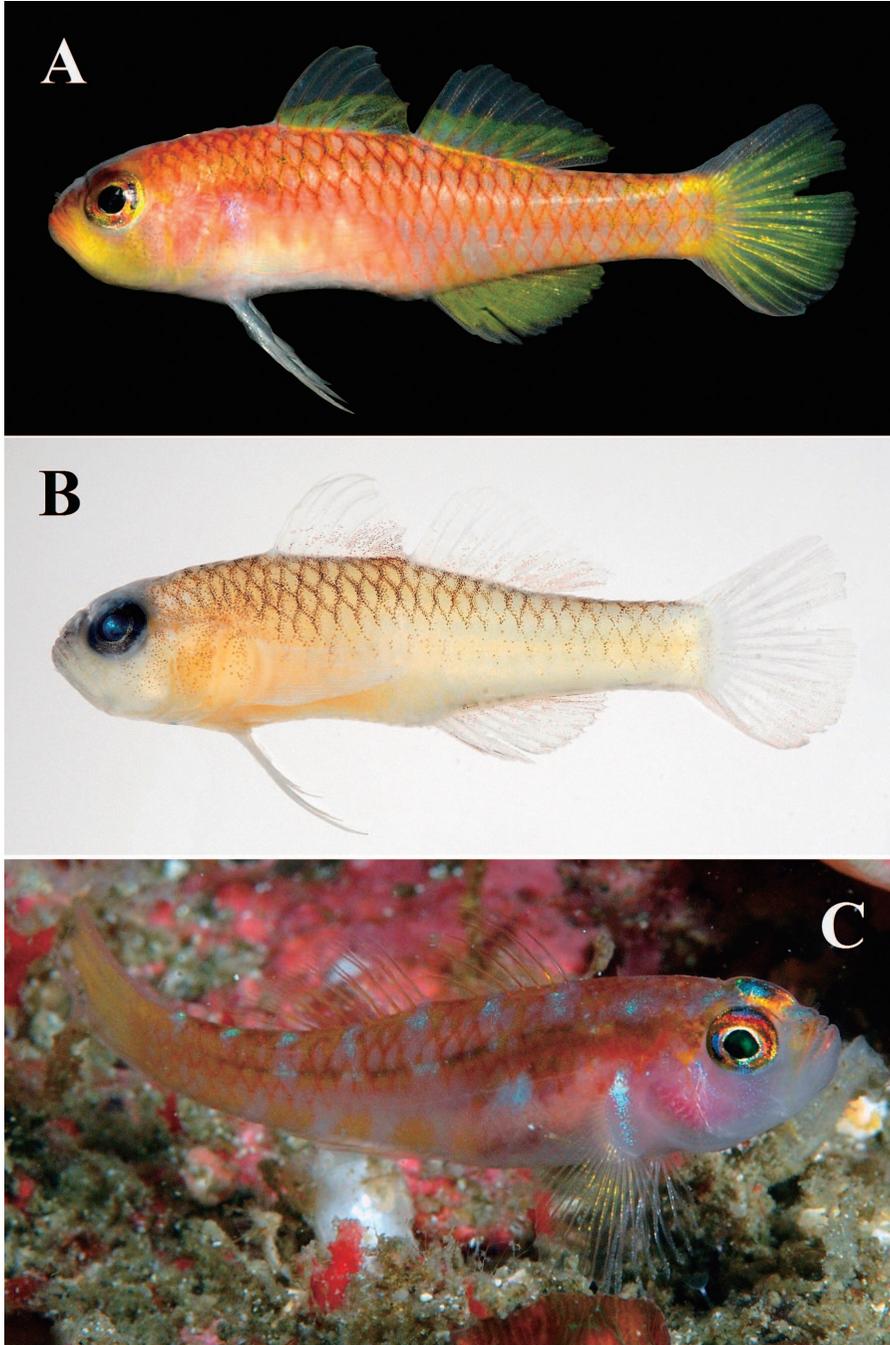


Fig. 4. *Trimma matsunoi*, holotype. A: fresh specimen, photo by J. Sakaue. B: alcohol preserved specimen, photo by T. Suzuki. C: KPM-NR 44894, live, 56 m depth, photo by J. Sakaue, 19 Aug. 2010.

orbit (no scales on predorsal midline and left side base of the first dorsal fin: see the remarks). Remainder of body with large ctenoid scales. Gill opening extending below a vertical line just slightly posterior to the middle of the pupil. Anterior naris with a short tube; posterior nasal

opening a simple pore, 3.3 naris diameter from anterior naris and 8 naris diameter from eye. Interorbital groove shallow (absent), postorbital groove absent. Interorbital space wide and bony width 78% of pupil diameter (77%) (Fig. 3). The cephalic sensory papillae of the holotype are

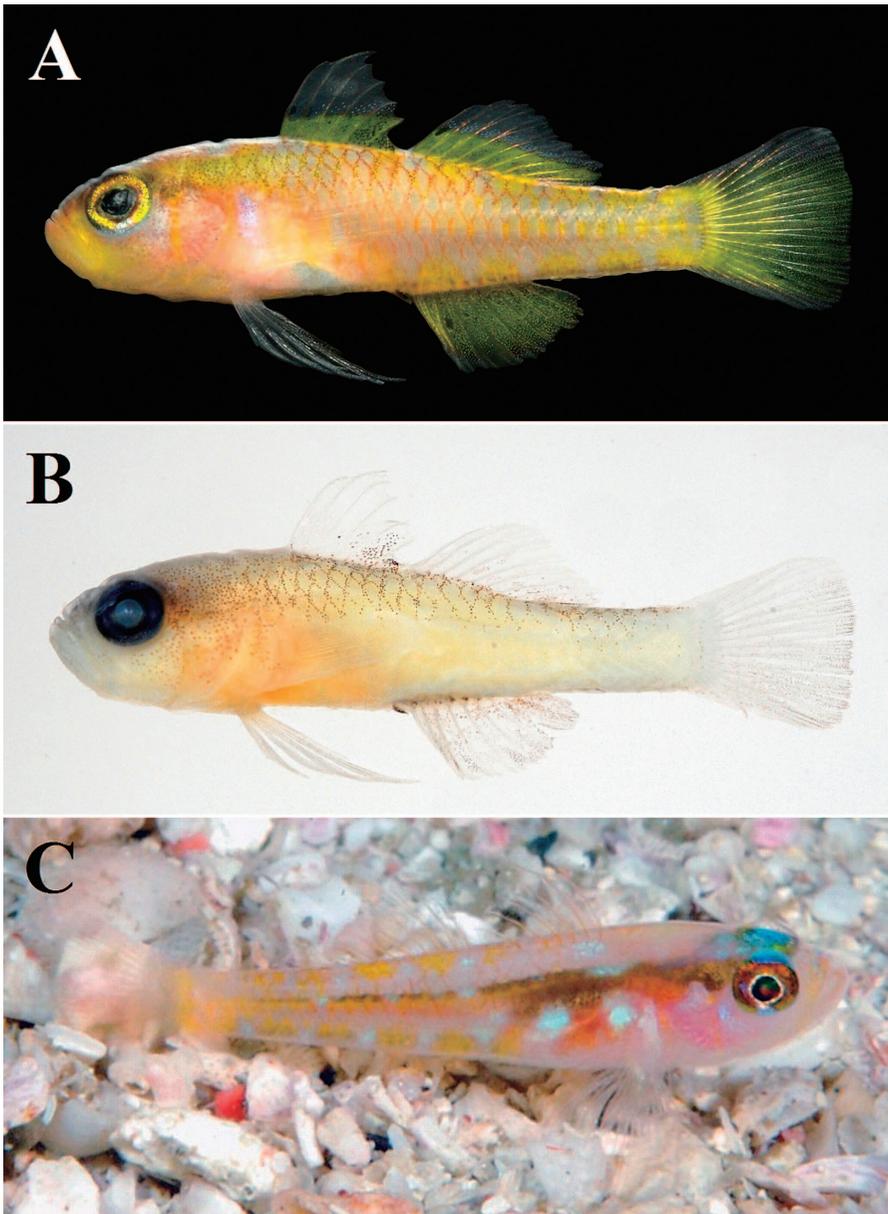


Fig. 5. *Trimma matsunoi*, paratype, OMNH-P 23885, male, 16.8 mm SL, Tsutomezaki, Otsuki-cho, Kochi Pref., Shikoku, Japan. A: fresh specimen, photo by J. Sakaue. B: alcohol preserved specimen, photo by T. Suzuki. C: KPM-NR 44895, live, 53 m depth, photo by J. Sakaue, 20 Aug. 2010.

depicted in Fig. 3.

Inwardly curved conical teeth in both jaws. Upper jaw with 2 irregular inner rows of small teeth, grading to single posterior row; anterior and center parts with outermost row of 7 large, spaced teeth. Lower jaw with 3 irregular inner rows of small teeth, grading to single posterior row; anterior part with an outermost row of 6 large teeth; center part with a single innermost row of 5 large teeth.

Color of types when fresh (Figs. 4A and 5A). Background color of head and body grayish white. Belly white. Scale pockets with deep orange margins (pale brown) except for those on belly. Dorsal and ventral most part of body and posterior most part of tail yellowish (nape with 2, the dorsal midline of body with 7, and the ventral midline of belly and tail with 6 light yellow saddles). Snout and interorbital space grayish, and nape orange. Lower half of head and posterior margin of eye light yellow. Iris with red, yellow, and black marks (iris yellow). Cheek, opercle and pectoral-fin base with many minute yellowish brown dots. Fins hyaline. Dorsal fins with a light yellow, broad, longitudinal, basal stripe. Pectoral and anal fins light yellow except margins. Anterior part of pelvic fin and pectoral-fin base grayish white. Caudal fin light yellow except upper and lower margins (a yellow band on base of the fin).

Color of types in alcohol (Figs. 4B and 5B). Red, orange, white and yellow colors faded. Head and body yellowish white. Scale pockets outlined with yellowish brown. Lower half of dorsal fins, anal and caudal fins with many minute yellowish brown dots.

Color of types when alive (Figs. 4C and 5C). Similar to fresh coloration except as follows: head and body semi-translucent; nape with 1 (2) and the dorsal midline of body with 7 bright yellowish orange saddles; interspaces of those saddles pale sky blue; a broad, light yellowish orange stripe from snout to caudal peduncle; this orange stripe interrupted by 3 pale sky blue marks below the second dorsal fin; a dark gray stripe along upper margin of orange stripe; dorsal

part of belly with 2 pale sky blue marks; the ventral midline of belly and tail with 6 light yellowish orange saddles; iris vivid orange with three strong blue marks (upper part of eye and interorbital space bright greenish blue); upper and lower margins of caudal fin with a pale pink stripe respectively (a light yellow band on base of the fin).

Distribution. Near Kashiwa-jima Island, Otsuki-cho, Kouchi Prefecture, Island, Shikoku, Japan

Etymology. The specific name, *matsunoi*, honors Mr. Kazushi Matsuno, who first discovered the new species.

Remarks. The paratype lacks scales on the predorsal midline and on the left side of the base of the first dorsal fin, and has the malformation of some of the neural spines beneath the first dorsal fin.

Comparisons. *Trimma matsunoi* is most similar to *T. caudipunctatum* and *T. maiandros* in overall morphology. However, *T. matsunoi* differs from *T. caudipunctatum*, in having: no opercle scales (vs. some cycloid scales dorsally in *T. caudipunctatum*); interorbital space wide and bony width 75–77% of pupil diameter (30–36%); 8 saddles over the dorsal midline and six saddles on the ventral midline when alive (vs. no saddles, see Suzuki and Senou, 2009). The new species differs from *T. maiandros*, in having: 5 predorsal scales in midline (vs. usually naked in *T. maiandros*); no blue zigzag line on semi-translucent body (vs. a blue zigzag line on red body, see Hoese *et al.*, 2011).

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