



A new species of *Trimma* (Teleostei: Gobiidae) from Indonesia and Timor-Leste

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Abstract

A new species of gobiid fish, *Trimma putrai*, is described from 4 localities in Indonesia and Timor-Leste (Bali, Flores, Raja Ampat Islands, as well as Atauro Island in Timor-Leste). It shares a combination of features with three other species: scales present on the predorsal midline and upper opercle; no scales on the cheek; the second spine of the first dorsal fin elongate and reaching beyond the origin of the second dorsal fin when adpressed; at least some branched pectoral-fin rays; a branched fifth pelvic-fin ray; and the absence of deep narrow trenches between and behind the eyes. It differs from the three species primarily in color pattern, having yellow, orange, or red bars on the cheek and yellow-to-red spots on the anterior body that lack discrete dark centers.

Key words: taxonomy, ichthyology, goby, coral-reef fishes, Indo-Pacific Ocean, COI mtDNA

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Introduction

The genus *Trimma* Jordan & Seale, 1906 (type species: *T. caesiura* Jordan & Seale, 1906) currently contains 104 valid described species of small (<30 mm SL), often colorful gobiid fishes, primarily associated with Indo-Pacific coral reefs. Members of the genus may be recognized by the lack of cephalic sensory-canal pores; a much reduced cephalic-sensory-papillae pattern; a wide gill opening extending anteriorly to below the vertical limb of the preopercle or, more usually, farther anterior; a lack of spicules (odontoids) 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 ray (Winterbottom 2011).

Winterbottom (2011), citing unpublished data, estimated that there were, at that time, about 35 known but undescribed species in the genus, for a total count in the vicinity of 110 species. However, recent sequencing surveys of the mtDNA COI marker suggests that there may be a plethora of cryptic species in the genus that could double this number (Winterbottom *et al.* 2014), depending, in part, on the significance of divergences in the COI marker sequence and whether any correlated morphological, meristic, marking, or color characters can be found. In addition, collections made below normal scuba-diving depths (ca. 50 m) almost always contain previously unknown species. A further complication is that populations that appear to be identical in the field may prove to be distinct species when live colors are documented with underwater macro-photography and morphology is closely examined.

Materials and Methods

Type specimens are deposited at the Royal Ontario Museum, Toronto, Canada (ROM) and the Western Australian Museum, Perth, Australia (WAM).

All specimens were collected using regular scuba gear and clove oil (anesthetic). The methods of counting and measuring and general format of the new species description follow those of Winterbottom (2016 and references cited therein). Naming of the cephalic-sensory-papillae rows follows Winterbottom (2011), as modified by Winterbottom *et al.* (2015). Specimens were stained with Cyanine Blue 5R solution, which greatly facilitated examination of branching patterns of the pectoral- and pelvic-fin rays, as well as highlighting cephalic sensory papillae rows. Standard length, the measurement from the tip of the snout to the end of the hypural plate, is abbreviated as SL and head length, tip of snout to posterior limit of opercular flap (or membrane), as HL. Counts and measurements, if variable, are given for the range of types with the holotype value in bold, followed in parentheses by the mean value and sample size for specimens examined, if appropriate. Counts and measurements were input directly into an Excel file with Mitutoyo digital calipers using WinWedge 3.01™ software. Photographs other than the portraits of fresh or live specimens were produced from multiple digital images taken with a Canon EOS Rebel XS camera attached to a Zeiss SV-12 dissecting microscope using Zeiss AxioVision 4.8™ software and automatic increments. The image stack was then collated into a single image using Helicon Focus 5.1™ (HeliconSoft) and edited in Adobe LightRoom 4™ and Adobe PhotoShop CS6™. DNA sequencing methods and materials follow those described in Winterbottom *et al.* (2014).

Trimma putrai, n. sp.

Putra's Pygmygoby

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Figures 1–3B.

Holotype. ROM 93350, 20.4 mm SL, male, Indonesia, West Papua, Raja Ampat Islands, Batanta, -0.9133°, 130.5584°, 35 m, clove oil, M.V. Erdmann, 18 February 2012.

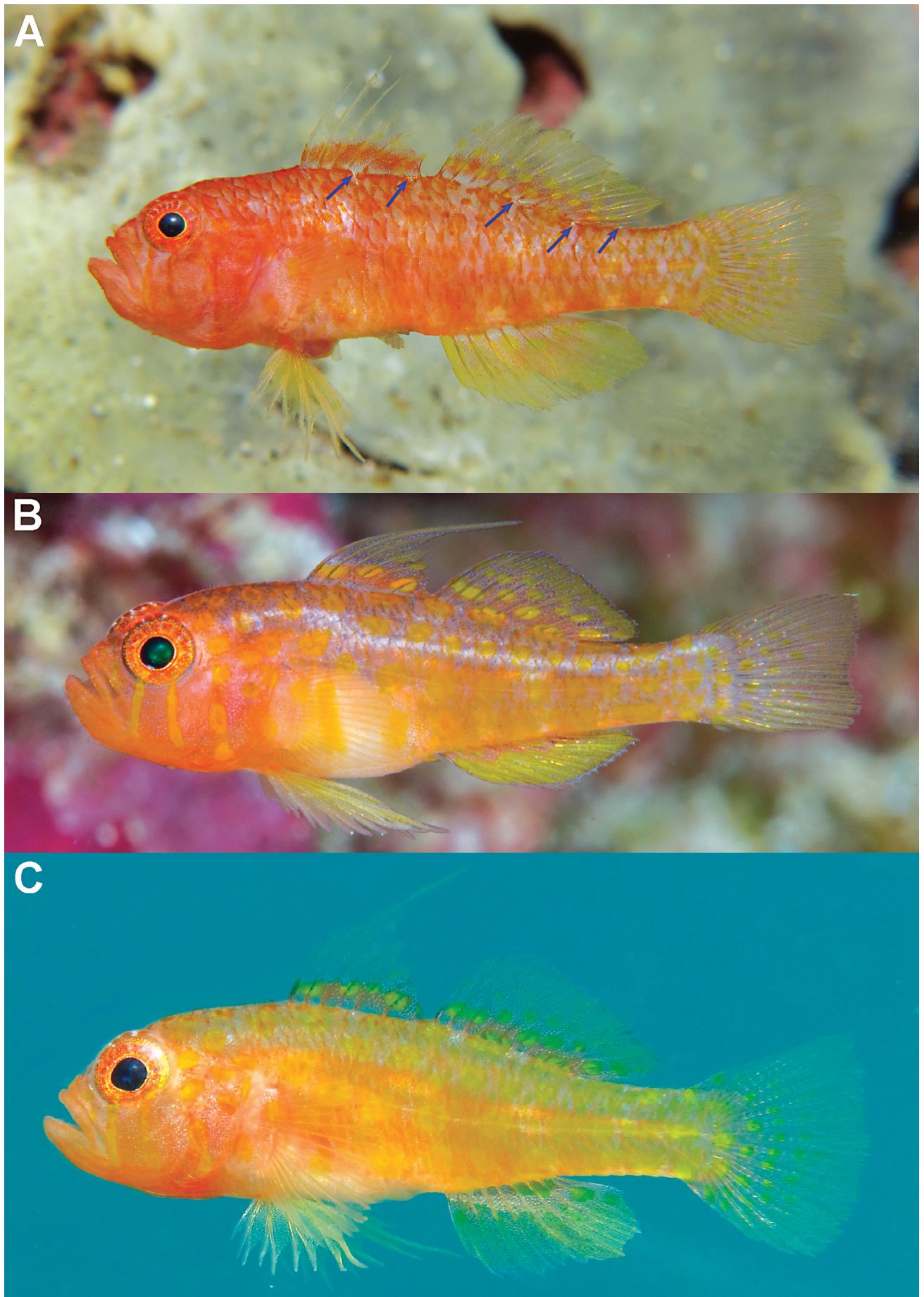


Figure 1. *Trimma putrai*, A: female paratype ROM T12727, 22.1 mm SL, Raja Ampat Islands, Indonesia (blue arrows point to tiny white saddles on the dorsum; image reversed); B: male paratype, ROM 101303, 13.9 mm SL, Flores, Indonesia; C: male paratype, WAM P.33475-008, 16.5 mm SL, Bali (image reversed) (M.V. Erdmann).

Paratypes. ROM 101302, 13.9 mm SL, Timor-Leste, Atauro Island, Fatúu, -8.1404°, 125.6123°, 65 m, MVE-16-031, clove oil, M.V. Erdmann, 25 June 2016; ROM 101303, 14.6 mm SL, Indonesia, East Nusa Tenggara, Flores, Pomana Kecil Island, -8.3487°, 122.3447°, 55 m, MVE-16-054, clove oil, M.V. Erdmann, 13 August 2016; WAM P.33475-008, 13.9 mm SL, Indonesia, Lesser Sunda Islands, Bali, Taka Pemuteran, -8.1296°, 144.6668°, 40 m, clove oil, M.V. Erdmann, 8 May 2011; WAM P.33825-001, 10.5 mm SL, Indonesia, Raja Ampat Islands, Miosging, -0.8799°, 129.7308°, 70 m, IND-13-009, M.V. Erdmann & M. Mambrasar, 5 February 2013; **Tissues for DNA:** ROM T12727, 22.1 mm SL, collected with holotype; ROM T12765, 10.1 mm SL, collected with WAM P.33825-001.

Diagnosis. A species of *Trimma* with scales present on predorsal midline and in a single row of two or three scales on upper opercle; no scales on cheek; second spine of first dorsal fin elongate and reaching to bases of second to sixth rays of second dorsal fin when adpressed; middle pectoral-fin rays branched; a branched fifth pelvic-fin ray with a vestigial basal membrane; and absence of deep narrow trenches between and behind eyes. Color in life and when fresh includes yellow, orange, or red bars on the cheek and yellow-to-red spots on anterior body that lack discrete dark centers.

Description. (based on up to 7 specimens, 10.1–22.1 mm SL) Dorsal-fin VI+I,9, second dorsal-fin spine usually somewhat elongated (Figs. 1 & 3), to base of second to sixth segmented dorsal-fin ray (mean fifth) when adpressed; first ray of second dorsal fin branched, remaining fin rays branched except for posterior element of last ray, fin reaches posteriorly to 76–80–90% (84%, 5) of distance between base of last ray and first exposed dorsal procurrent caudal-fin ray; anal-fin elements I,8, first ray branched (unbranched in 1, 4), fin reaches posteriorly to 71–90% (84%, 5) of distance between base of last ray and first exposed ventral procurrent caudal-fin ray; pectoral-fin 18 or 19 (18.6, 5), 3 or 4 (3.3) dorsal and 5 or 6 (5.5) ventral rays unbranched, with 9–11 (10.0) branched rays in between, fin reaching posteriorly to **region above anal-fin spine** to base of first anal-fin ray; pelvic-fin elements I,5, fifth ray with single dichotomous branch and 64–75% (70%) length of fourth ray, which reaches posteriorly to between bases of **first** to fifth anal-fin rays, first four rays with a single sequential branch point, basal membrane vestigial, joined in midline just dorsal to last midline scale on pelvic-fin base or attached to side of abdomen just lateral to this; no frenum. Lateral scales 23; anterior transverse scales 9 or 10 (9.3, 4); posterior transverse scales 8 or 9 (8.3, 4); cheek scaleless; opercle with one dorsal row of 2 or 3 scales; midline of predorsal with 7 or 8 (7.8, 4) scales, anterior row or rows may be cycloid, remainder ctenoid; anteriormost scales on sides and top of nape (may be ctenoid or cycloid) reaching anteriorly to one scale-width of posterior margin of pupil; 3 vertical rows of cycloid scales on pectoral-fin base with 2 in anteriormost row and 3 in middle row and 4 in posterior row; 6 or 7 (6.5, 4) cycloid scales on midline anterior to pelvic fin base; area between pelvic-fin spine and ventral margin of pectoral-fin base with cycloid scales; anterior few rows of scales on midline of belly cycloid; circumpeduncular scales 12; 8 scale rows on midline between base of last anal-fin ray and first ventral procurrent caudal-fin ray. Upper jaw with 4–6 outer enlarged curved canines, several rows of small conical teeth at symphysis grading posteriorly to a single row at end of premaxilla. Lower jaw with 4–6 outer enlarged curved canines, several irregular rows of small conical teeth grading to one row at base of coronoid process of dentary, innermost teeth at symphysis twice height of other inner teeth, and recurved, reaching posteriorly to coronoid process. Tongue broadly truncate, once with central notch. Gill opening extending anteroventrally to below mid pupil; gill rakers 3–4+13–14=17–18 (3.8+13.8=17.5, 4). Nasal apparatus well developed, situated on anterior 75% of snout, anterior naris a short tapering tube reaching anteriorly to above anterior margin of upper lip, posterior opening pore-like with a raised rim, transverse width of pore about 65% length of nasal capsule, posterior margin of posterior naris separated from bony front of orbit by about 1.5 times its transverse width, nasal sac raised above surrounding area of snout (Fig. 2B). Bony interorbital width 32–43–55% (41.6, 4) of pupil diameter; broad shallow U-shaped depression between eyes (primarily between third and fourth papillae of row *p*); slight postorbital groove ending at last (sixth) papilla in row *p*; epaxialis reaching anteriorly in midline to vertical above mid-pupil; no narrow ridge of skin in midline of nape extending anteriorly from origin of first dorsal fin.

Measurements: (based on 4 specimens 13.9–20.4 mm SL) Caudal-peduncle depth 48–59% (53.1%) of caudal-peduncle length; head length 31–34% SL (32.9%); horizontal eye-diameter 33–37% HL (34.9); snout length 21–25% HL (23.2%); cheek depth 23–31% HL (28.1%).

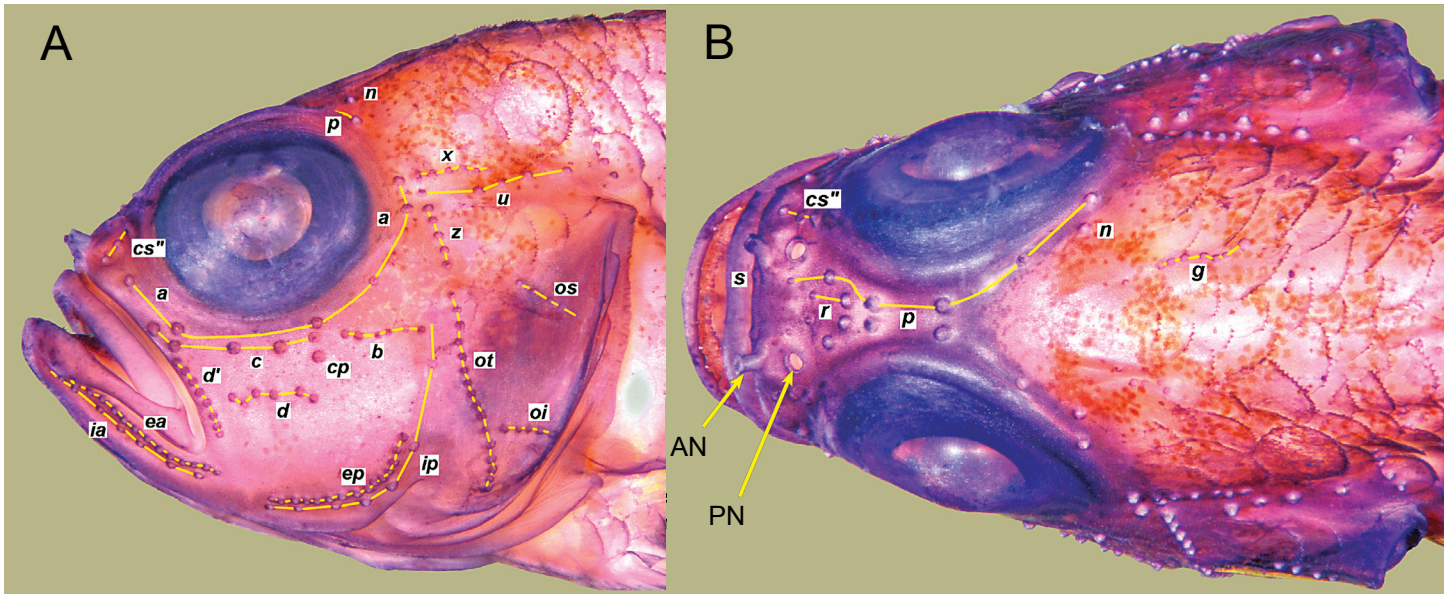


Figure 2. *Trimma putrai*, preserved male holotype, ROM 93350, 20.4 mm SL, left lateral (A) and dorsal (B) view of head: Papillae in a given row connected by dashed yellow lines; AN=anterior naris; PN=posterior naris. Specimen stained with Cyanine Blue (R. Winterbottom).

Cephalic sensory papillae as in Fig. 2. Number of papillae in each row (based on 4 specimens unless noted otherwise): $a=6$; $b=6-7-8$ (6.8); $c=5$; $cp=1$; $d=6-7$ (6.5); $d'=7-9$ (8.0); e -anterior=14–15 (14.5); e -posterior=14–16 (15.0); i -anterior=8; i -posterior=8; $p=6$; $r=2$; $f=3$; $cs''=3$; $g=4-7$ (6.0, 3); $n=1$; $x=6$; $u=5$; $z=5-6$ (5.3); $ot=14-16$ (14.8); $os=5-7$ (5.7, 3); $oi=3-5$ (4.0). Abdominal/caudal vertebral transition not examined.

Color when fresh. (Figs. 1 & 3A, based on images of 7 specimens) Female 22.1 mm SL paratype (Fig. 1A): background of body semi-translucent, scale pockets mostly diffusely outlined with dark orange/red, scattered and apparently random orange-red spots up to pupil diameter in width; about 6 tiny white saddles across dorsal midline, first just anterior to first spine of first dorsal fin (not visible in Fig. 1A), second at base of fourth spine, third just behind sixth spine, fourth at base of fifth ray, fifth at base of ninth ray, and sixth on peduncle; 5 large diffuse orange-red saddles across ventrum, decreasing in size posteriorly, first at urogenital papilla, second centered on second anal-fin-ray base, third at seventh ray, and two on peduncle. Head overall red with two prominent darker red or orange bars across cheek, first below anterior edge of eye, second below mid-pupil; a third bar from upper cheek to branchiostegal membrane in line with posterior margin of vertical limb of preopercle; a short bar below posterior naris in front of eye; iris with thin yellow margin around pupil, then orange red, outer two-thirds diffuse grey (especially dorsally), dorsal third with dark red radii alternating with grey. Dorsal fins with clear basal stripe about one third pupil diameter in height, followed by dark-red, pupil-width stripe (with scattered yellow half-pupil width spots centered on fin rays in second dorsal fin), membranes of fins above basal stripe with a diffuse mix of melanophores, xanthophores, and iridocytes. Anal fin with similar clear basal stripe, rest of fin mainly yellow (diffusely concentrated into vague yellow spots on posterior two-thirds), with some red pigmentation in posterior basal half. Caudal fin basally reddish with some diffuse yellow-and-grey pigmentation in distal half with some very diffuse yellow spots. Pectoral fin with reddish rays and lighter red membranes; pelvic fin with light yellow membranes.

Male 13.9 mm SL paratype (Fig. 1B, ROM 101303) from Flores with darker background dorsally on body and yellow below mid-lateral scale row (especially posterior to anal-fin origin). Discrete row of 7 yellow spots, two-thirds pupil diameter in width, along middle of dorsum, with diffuse yellow spots/blotches just lateral to dorsal-fin bases which continue anteriorly onto nape, where spots have slightly darker centers. Snout and head below eye diffusely light red, anterior two cheek bars bright yellow, bar posterior to preopercle vertical limb consisting of 4 ovoid yellow spots with dorsalmost behind mid-orbit, a very short yellow bar from anteroventral orbit to mid-maxilla. Iris similar to above, but dorsal radii less discrete, grey part of radii on top of right orbit appear as white lines. First dorsal fin with narrow light basal stripe, with three large yellow spots in the red stripe (first between spines 1–3, second on fourth spine and last centered on sixth spine), light mixture of iridocytes and melanophores distally with diffuse yellow pigment near tips of spines 5 and 6. Pale basal stripe in second dorsal fin only evident

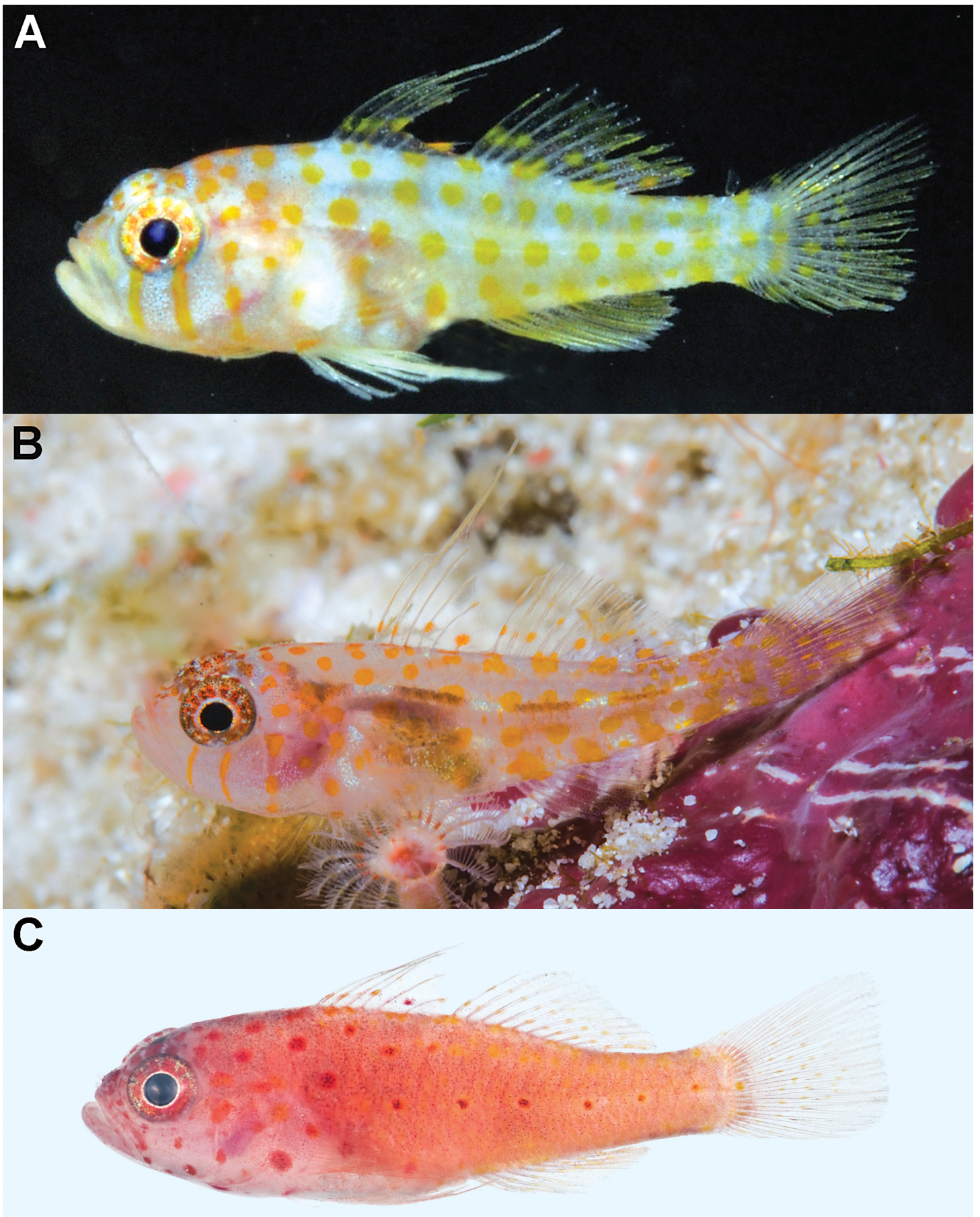


Figure 3. *Trimma putrai*, A: fresh juvenile paratype, WAM P.33825.001, 10.5 mm SL, Raja Ampat Islands, Indonesia (image reversed); B: uncollected live juvenile, Flores, Indonesia (M.V. Erdmann); C) *T. halonevum*, ROM 85251, 16.4 mm SL female, Walo Island, Raja Ampat Islands, Indonesia (R. Winterbottom).

anteriorly, red stripe less defined, containing yellow ovoid spots, between spine and second ray and another at bases of rays 3 and 4, with a yellow spot just distal to base of fifth ray, and ovoid yellow spot covering bases of seventh to eighth rays; an irregular row of smaller yellow spots above basal stripe, fin membranes diffusely red basally and yellow distally with scattered melanophores and iridocytes, thin grey distal margin to second dorsal fin. Anal fin mostly yellow, with some diffuse red pigmentation basally, and light-grey thin distal stripe. Caudal fin similar to above, but lacking proximal red pigmentation. Pectoral-fin membranes translucent; pelvic-fin membranes of mixed melanophores, iridocytes, and xanthophores.

Male 16.5 mm SL paratype from Bali (Fig. 1C, WAM P.33475-008) similar to Flores specimen, but yellower with less red pigment, yellow cheek stripes fainter, streak of melanophores/iridocytes in anal fin from base of spine, widening posteriorly at increasing distance from base of fin, round spots in basal half of caudal better defined and more obvious. A freshly collected 10.5 mm SL juvenile from Raja Ampat (Fig. 3A, WAM P.33825.001) with largely white body and head with orange (on head) to yellow (on body) spots and bars. Three equally spaced rows of yellow spots on body, middle row centered on mid-lateral septum. Spots on dorsal part of nape orange, bars on cheek and opercle yellow to orange. Base of dorsal fins clear, with a row of small yellow spots about pupil diameter distal to surface of dorsum. Anal fin with dense melanophores and iridocytes, with yellowish tinge. Vague yellow bar over bases of caudal-fin rays, followed by two vertical rows of yellow spots. Pectoral and pelvic fin membranes apparently hyaline.

Color in life. Based on an uncollected juvenile from Flores (Fig. 3B), body and head translucent but faintly pink; spots and bars orange; radii on dorsal part of iris a mix of red and black with grey interspaces, ring around pupil off-white with some highlights of orange immediately adjacent to pupil; neural canal with alternating dark and light stripes, with dark below first and second dorsal fins, and on peduncle, starting at last ray of second dorsal fin. Anal fin translucent with scattered iridocytes.

Color of holotype in alcohol. Pale straw-yellow overall, with scattered melanophores on head, (especially nape and dorsal part of opercle above papilla line *os*) and anterior body, most scales with exposed edges outlined with a single row of small round melanophores (may be absent in other specimens); tiny white saddles across dorsum in life replaced by concentrations of melanophores; pectoral-fin base with scattered amorphous melanophores; some other specimens with faint clear spots among melanophores on nape, others with two tiny black bars (white when fresh) over peduncle, one just posterior to last ray of dorsal fin, other at mid-peduncle. A few scattered melanophores on cheek, but no pattern discernible; skin covering top of orbit with a few short dark bands separated by much wider clear interstices. Some scattered melanophores (either amorphous or as tiny dark spots) on first-dorsal-fin membranes, more concentrated on second dorsal fin, where traces of clear round spots remain (yellow in fresh material); anal-, caudal-, and pelvic-fin membranes similar to first dorsal fin, pectoral-fin membranes hyaline.

Etymology. The new species is named *putrai* in honor of Ketut Sarjana Putra, head of Conservation International Indonesia and one of Indonesia's foremost marine conservationists. Ketut's work over the past three decades has ranged from sea-turtle conservation to pioneering large-scale marine-protected-area network development, and has focused on both the Lesser Sunda Islands and West Papua—precisely the range of this new species. The species has been informally referred to as *Trimma* RW sp 102.

Distribution and habitat. The new species is currently recorded from the Lesser Sunda Islands (including Bali, Flores, and Timor-Leste), as well as the Raja Ampat Islands in West Papua, Indonesia. It appears to be a rare and relatively deepwater species, with specimens collected between 35–70 m. It is apparently a solitary species, with only 1 or 2 specimens collected from each site. Three of the collection sites consisted of steep reef walls exposed to significant current, with individual specimens observed perched upright in small crevices in the coralline-algae-encrusted wall. The other two collection sites were in the mixed coral rubble and sand at the base of steep reef slopes in 35 m depth, with individuals resting on top of medium-sized rubble pieces and disappearing under the rubble when approached closely.

Comparisons. Three other species of *Trimma* share the combination of scales present on the predorsal midline and upper opercle; no scales on the cheek; the second spine of the first dorsal fin elongate and reaching beyond the origin of the second dorsal fin when adpressed; at least some branched pectoral-fin rays; a branched fifth pelvic-fin ray; and the absence of deep narrow trenches between and behind the eyes: *T. cheni* Winterbottom, 2011; *T. halonevum* Winterbottom, 2000; and *T. nomurai* (Suzuki & Senou, 2007). Of these, *T. nomurai* has fewer gill

rakers (total of 14 or 15 vs. 17 or 18 in *T. putrai*); 6 papillae in row *c* (vs. 5); 2 (vs. 1) branches in the fifth pelvic-fin ray; a dark, pupil-sized spot on the dorsum below the origin of the first dorsal fin (vs. spot absent); and no red/orange bars on the cheek (vs. bars present). *Trimma cheni* generally has a lower pectoral-fin-ray count, and fewer are branched (16–18 and 3–9 vs. 18–19 and 9–11, respectively, in *T. putrai*), and also has a shorter fifth pelvic-fin ray (48–56% length of fourth ray vs. 64–75%). It also tends to have three yellowish stripes along the body (vs. rows of spots), and never has spots on the nape (vs. spots usually present). *Trimma halonevum* is extremely similar to *T. putrai* morphologically, but differs significantly in color: the red/orange spots on the anterior part of the body and the nape, as well as the spot on the sixth dorsal-fin spine, invariably have black centers in *T. halonevum* (see Fig. 3C; vs. no black centers in *T. putrai*, although the centers of the spots may be a little darker than the surroundings in some specimens); and there is a prominent such spot at the anteroventral base of the pectoral and pelvic fins (vs. spots absent). In addition, *T. halonevum* virtually never has yellow, orange, or red bars across the cheek, and this area is usually plain (vs. two prominent yellow, orange, or red bars on the cheek).

Discussion. Two specimens of *T. putrai* were available for COI analysis, both from the Raja Ampat Islands. The results (Fig. 4) suggest that this species is distinct from, but phenetically closest to, *T. halonevum*, differing minimally from it by 10.35% of the COI base pairs. Variation within the former species was less than 0.2%, while that in *T. halonevum*, based on 26 specimens ranging from the Maldives across the western Pacific to the Solomon Islands, was 0.7%. These two species formed a grade with three other recognized species: *T. trioculatum*, *T. cheni* and *T. zurae*, with latter two slightly more similar in COI. We note with interest that the 5 samples identified as *T. cheni* appear to form two distinct haplogroups separated by about 3.9% of the COI gene, with one group from Rabaul, New Britain, and the other in north-eastern Indonesia (Raja Ampat, Cendrawasih Bay, and Maluku Islands). More genetic samples of *T. cheni* throughout its range, and morphological comparisons, are needed to confirm whether this difference in COI is also reflected in other attributes of these fishes. A similar situation

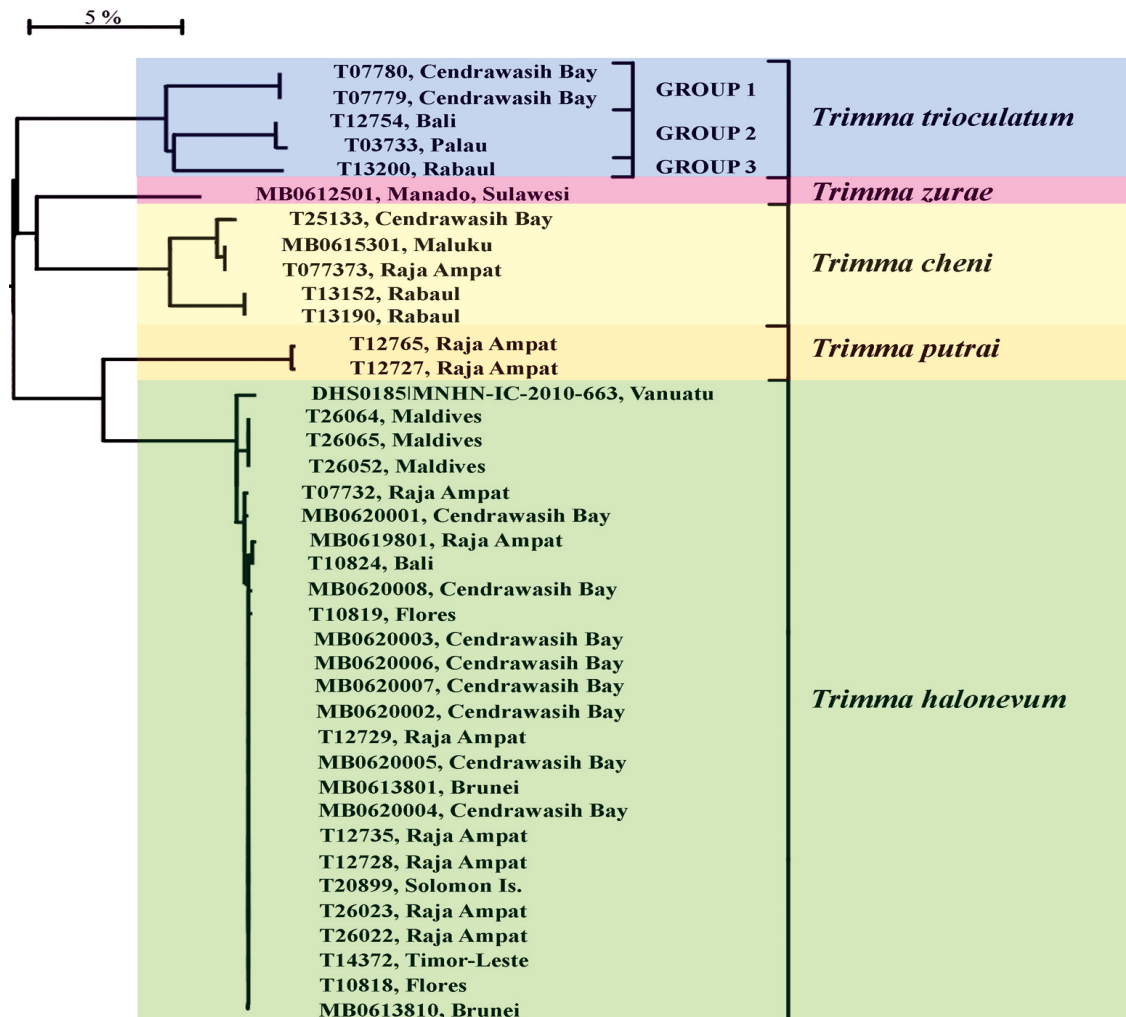


Figure 4. *Trimma* haplogroups associated with *T. putrai* (Neighbor Joining network derived from BOLD analysis of the COI marker with 835 samples).

pertains to specimens identified as *T. trioculatum*, where three haplogroups are apparent (Fig. 4, labelled as Groups 1–3). Winterbottom *et al.* (2015, fig. 18), in their description of this species, recognized these three haplogroups. The record from Bali was based on formalin-fixed specimens (designated “unknown haplogroup”). No specimens from Bali were available for sequencing at that time. A specimen was subsequently collected and analyzed, and the result suggests the Bali specimens are members of Group 2, along with the sample from the main islands of Palau.

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