

First equatorial records of four marine fishes (Actinopterygii) caught off Lembeh Island, northern Sulawesi, Indonesia

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Abstract

This study reports the first equatorial records of four demersal marine fish species, *Plectranthias yamakawai* Yoshino, 1972, *Aulacocephalus temminckii* Bleeker, 1855, *Iniistius geisha* (Araga et Yoshino, 1986), and *Randallichthys filamentosus* (Fourmanoir, 1970), collected off Lembeh Island, northern Sulawesi, Indonesia. All these species had been previously reported only from higher latitudes in the Northern and Southern Hemispheres, leading to their classification as anti-equatorial. Their presence in equatorial Indonesian waters at 1.4°N latitude suggests that their distributions extend beyond those usually regarded as anti-equatorial and that a re-evaluation of their biogeographical classification would be in order. In particular, the need for further research on deep-sea fish diversity in extremely low latitude regions is highlighted.

Keywords

Anti-equatorial, distribution, ichthyofauna, line fishing, morphology

Introduction

Lembeh Island is located off the northeastern coast of Sulawesi, Indonesia, separated from the mainland by the narrow Lembeh Strait and lies within the Coral Triangle, one of the world's most biologically diverse marine regions. Additionally, the waters around Lembeh Island and Tomini Bay, northern Sulawesi are part of a hotspot of reef fish endemism in the East Indian region, with 16 endemic species recorded (Allen and Erdmann 2024).

Apart from being a popular diving destination (Ambo-Rappe and Moore 2019), the Lembeh Strait and the surrounding area are important for local fisheries,

including a traditional deep-sea line fishing method practiced for many years by fishermen from Lembeh Island and the mainland. Such fishing typically targets large deeper-water pelagic species, including tuna, groupers, and snappers, which are abundant around the island (Chen and Dirhamsyah 2019).

Specimens of demersal fishes, caught by fishermen using the above technique near Lembeh Island at depths of 100–150 m and now housed in the collection of the Research Center for Oceanography in Bitung, northern Sulawesi, have been recently identified as *Plectranthias yamakawai* Yoshino, 1972, *Aulacocephalus temminckii* Bleeker, 1855, *Iniistius geisha* (Araga et Yoshino, 1986),

and *Randallichthys filamentosus* (Fourmanoir, 1970). These species have previously been reported as having a widespread distribution across the Indo–Pacific region or the western Pacific Ocean (Baldwin and Smith 1998; Fricke et al. 2024), although none has been reported from equatorial or Indonesian waters. Notably, Randall (1982), Springer (1982), and Fricke et al. (2009) recognized both *A. temminckii* and *R. filamentosus* as exhibiting an anti-equatorial distribution, their presence having been observed exclusively at higher latitudes, both north and south of the equatorial zone. Consequently, the discovery of *P. yamakawai*, *A. temminckii*, *I. geisha*, and *R. filamentosus* off Lembeh Island significantly extends the known geographical range of these species, in addition to being the first records of each in equatorial and Indonesian waters.

Materials and methods

The five specimens of the four species reported herein, collected from the northern tip of Sulawesi Island, Indonesia (Fig. 1), using vertical hooked lines at depths varying between 100–150 m (based on information provided by the fishermen), were purchased between 2008 and 2012 from local fishermen at the Girian Fish Market, Bitung, northern Sulawesi, Indonesia. Fresh specimens were photographed, fixed in 4% formalin, and then preserved in 70% ethanol. Counts and measurements for *P. yamakawai* and *A. temminckii* followed Randall

(1980); for *I. geisha*, Araga and Yoshino (1986); and for *R. filamentosus*, Anderson et al. (1977). All measurements were taken using digital calipers to the nearest 0.01 mm. Standard and head lengths are abbreviated as SL and HL, respectively. Cyanine blue was used to examine scale counts. The last two soft rays of the dorsal and anal fins were counted as single rays, each pair being associated with a single pterygiophore. Classification followed Van der Laan et al. (2024) and the English common names, Froese and Pauly (2024). All specimens examined were deposited in the fish collection of the Research Center for Oceanography (LBRC-F), National Research and Innovation Agency, Bitung, northern Sulawesi, Indonesia.

Results

Family Anthiadidae Poey, 1861 Genus *Plectranthias* Bleeker, 1873

Plectranthias yamakawai Yoshino, 1972

Fig. 2A

Plectranthias yamakawai Yoshino, 1972.—Yoshino (1972): 53, fig. 3 (type locality Ryukyu Islands, southern Japan).—Randall (1980): 184 (southern Japan).—Wass (1984): 12 (Samoa Islands).—Chen and Shao (2002): 64 (Taiwan).—Motomura and Matsuura (2010): 99 (southern Japan).—Wada et al. (2020): 305 (southern Japan).—Cabebe–Barnuevo et al. (2022): 300 (Luzon, Philippines).

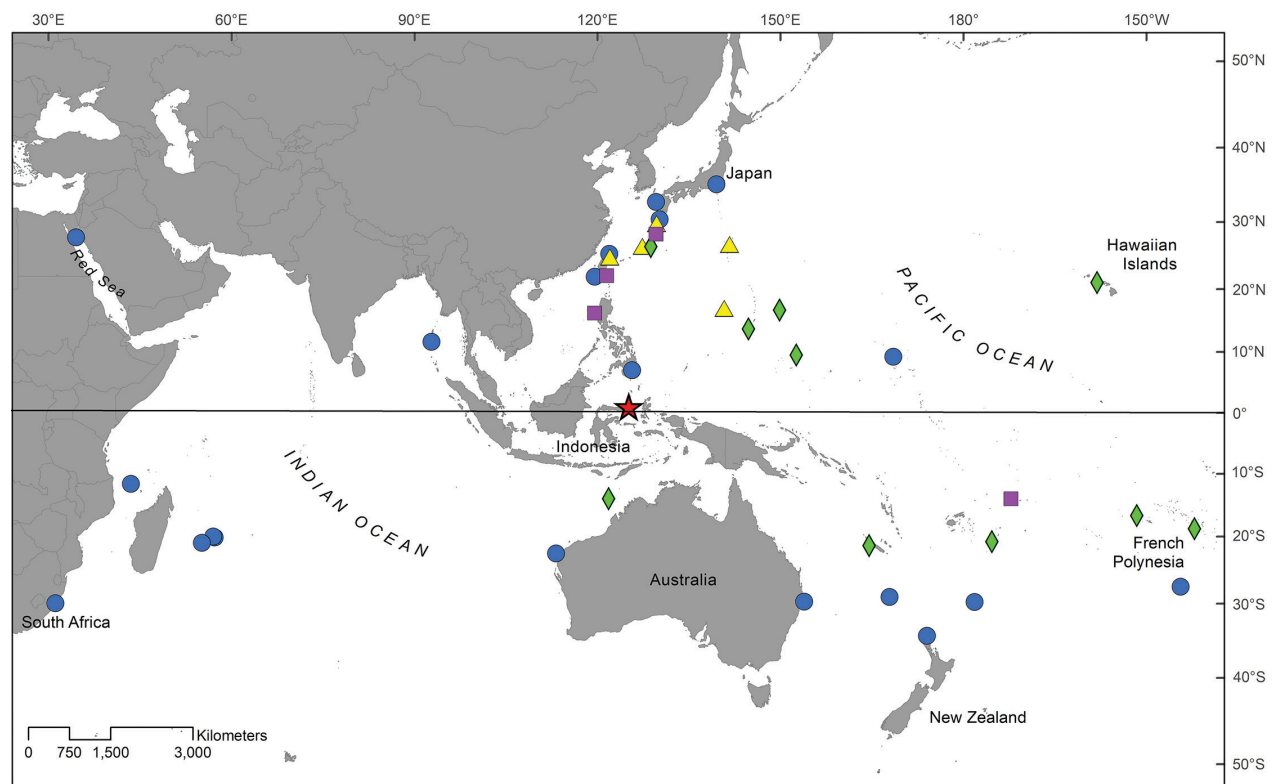


Figure 1. Distributional records of *Plectranthias yamakawai* (squares), *Aulacocephalus temminckii* (dots), *Iniistius geisha* (triangles), and *Randallichthys filamentosus* (diamonds), based on previous studies. Lembeh Island, northern Sulawesi, Indonesia (the collection site of presently reported specimens) is marked by a star.

Material examined. LBRC-F 3002, 182.5 mm SL, off Lembah Island, Bitung, Indonesia, hook and line, 100–150 m depth (purchased at Girian Fish Market, Bitung, northern Sulawesi by T. Peristiwady, 22 December 2012).

Description. Dorsal fin with 10 spines and 16 soft rays; anal fin with 3 spines and 7 soft rays; pectoral fin with 13 rays, uppermost unbranched; pored lateral-line scales 32; scales above lateral line 5; scales below lateral line 16; gill rakers on upper limb of first gill arch 6, lower limb 12, total 18; body compressed, its depth 2.3 in SL; body width 2.2 in body depth; head length 2.3 in SL; snout length 3.9 in HL; orbit diameter 4.4 in HL; upper jaw length 2.2 in HL; interorbital width 7.3 in HL; caudal peduncle depth 2.3 in HL; caudal peduncle length 3.3 in HL; dorsal profile of head forming angle of about 30° to horizontal axis of head and body, mouth terminal, oblique; vomer and palatine with teeth; posterior margin of maxilla just reaching vertical through midline of pupil; pre-opercle with two antrorse spines on ventral margin; opercle with three flat spines, uppermost blunt, middle largest; fourth dorsal-fin spine longest, fifth to last spines becoming progressively shorter; origin of first anal-fin spine about level with origin of third dorsal-fin soft ray, second anal-fin spine longest, second anal-fin soft ray longest; pectoral-fin ray long, its tip beyond base of first anal-fin spine; pelvic fin short, posterior tip not reaching anus when depressed; caudal fin weakly emarginate, some upper and lower rays somewhat filamentous.

Color when fresh. Body orange dorsally and rosy ventrally; dorsum of head and body, including dorsal and caudal fin bases, with numerous small distinctive, yellow-fringed dark greenish spots; large red spot just below lateral line at center of body; dorsal, anal and caudal fins yellowish; pectoral and pelvic fins reddish (Fig. 2A).

Remarks. The Lembah Island specimen agreed closely with the diagnostic characters of *P. yamakawai* given by Yoshino (1972), Randall (1980, 1996), Wada et al. (2020), and Cabebe-Barnuevo et al. (2022), viz. dorsal-fin soft rays 16; pectoral fin rays 13; pored lateral-line scales 32; pre-opercle with two antrorse spines on ventral margin; fourth dorsal-fin spine longest; dorsum of head and body, including dorsal and caudal fin bases, with numerous small distinctive yellow-fringed dark greenish spots; large red spot below lateral line at center of body. In addition, the specimen also matched the figure of the holotype of the species (see Randall 1980: 32) and the color photographs provided by Motomura et al. (2018: 97) and Cabebe-Barnuevo et al. (2022: fig. 1A).

Plectranthias yamakawai has previously been reported only from southern Japan, Taiwan, the Philippines and Samoa, at latitudes of 15–30°N and 13°S (Wass 1984; Motomura and Matsuura 2010; Wada et al. 2020; Cabebe-Barnuevo et al. 2022; fig. 3). The presently reported specimen, collected off Lembah Island at a latitude of 1.4°N, represents the first record of *P. yamakawai* in equatorial and Indonesian waters.

Family Liopropomatidae Poey, 1867

Genus *Aulacocephalus* Temminck et Schlegel, 1843

Aulacocephalus temminckii Bleeker, 1855

Fig. 2B

Aulacocephalus temminckii Bleeker, 1855.—Bleeker (1855): 12 (type locality Nagasaki, Japan).—Randall et al. (1971): 173 [Natal coast (South Africa), Mauritius, Thailand, northeast China, Taiwan, Korea, Japan, New Zealand, Kermadec Islands].—Randall (1982): 201 (Rapa, French Polynesia).—Katayama (1984): 139 (southern Japan).—Francis (1993): 160 (Eastern Australia, Norfolk Island, New Zealand, Kermadec Islands).—Goren and Dor (1994): 24 (Red Sea).—Kuitert (1997): 122 (Australia).—Fricke (1999): 210 (Mascarene Islands).—Hutchins (2001): 30 (Western Australia).—Senou (2002): 726 (Japan).—Randall et al. (2005): 119 (Marshall Islands).—Kuitert and Debelius (2007): 313 (South Africa).—Khalaf and Zajonz (2007): 427 (Gulf of Aqaba).—Fricke et al. (2009): 43 (La Réunion, Mauritius, and Comores).—Randall and Schraml (2010): 170 (Japan; Norfolk Island).—Bos and Gumanao (2013): 3 (Philippines).—Duffy and Ahyong (2015): 113 (Australia, New Zealand).—Stewart (2015): 1201 (New Zealand).—Golani and Fricke (2018): 60 (Red Sea).—Akhilesh et al. (2021): 49 (India).—Heemstra (2022): 79 (western Indian Ocean).

Material examined. LBRC-F 367, 190.7 mm SL, LBRC-F 402, 152.1 mm SL, off Lembah Island, hook and line, 100–150 m (both purchased at Girian Fish Market, Bitung, northern Sulawesi, T. Peristiwady, 18 August and 13 December 2008, respectively).

Description. Dorsal fin with 9 spines and 12 soft rays, fourth spine longest, its length 3.2–3.3 in HL, first and last dorsal spines subequal, their lengths about half length of fourth spine; anal fin with 3 spines and 9 soft rays, third or fourth ray longest, its length 2.5–2.8 in HL; pectoral fin with 15 rays; pored lateral-line scales 74–79; scales above lateral line 13; scales below lateral line 44; gill rakers on upper limb of first gill arch 9, lower limb 18, total 27; body depth 2.8–2.9 in SL; body width behind gill opening 2.8–3.0 in body depth; head length 2.4–2.5 in SL; snout relatively long, its length 6.6–6.9 in HL; mouth slightly oblique; pre-opercle coarsely serrated; subopercle and interopercle serrated; interorbital width 6.6–7.6 in HL; origin of pelvic fin just below origin of pectoral fin, pelvic fin short, its length 9.2–9.7 in HL, posterior tip not reaching anus when depressed; caudal peduncle depth 3.1–3.2 in HL; caudal peduncle length 2.1–2.3 in HL; head (except snout, interorbital, and maxillary) and body covered with ctenoid scales.

Color when fresh. Body bluish grey, a bright yellow band running from near snout tip through eye, along upper part of back and dorsal fin base to upper and lower bases of caudal fin; a yellow streak along upper margin of upper jaw; soft portions of median fins with blackish rays and translucent membranes; pectoral and pelvic fin membranes translucent (Fig 2B).

Remarks. The following diagnostic features of the presently reported specimens closely matched those of *A. temminckii* given by Heemstra and Randall (1999): for

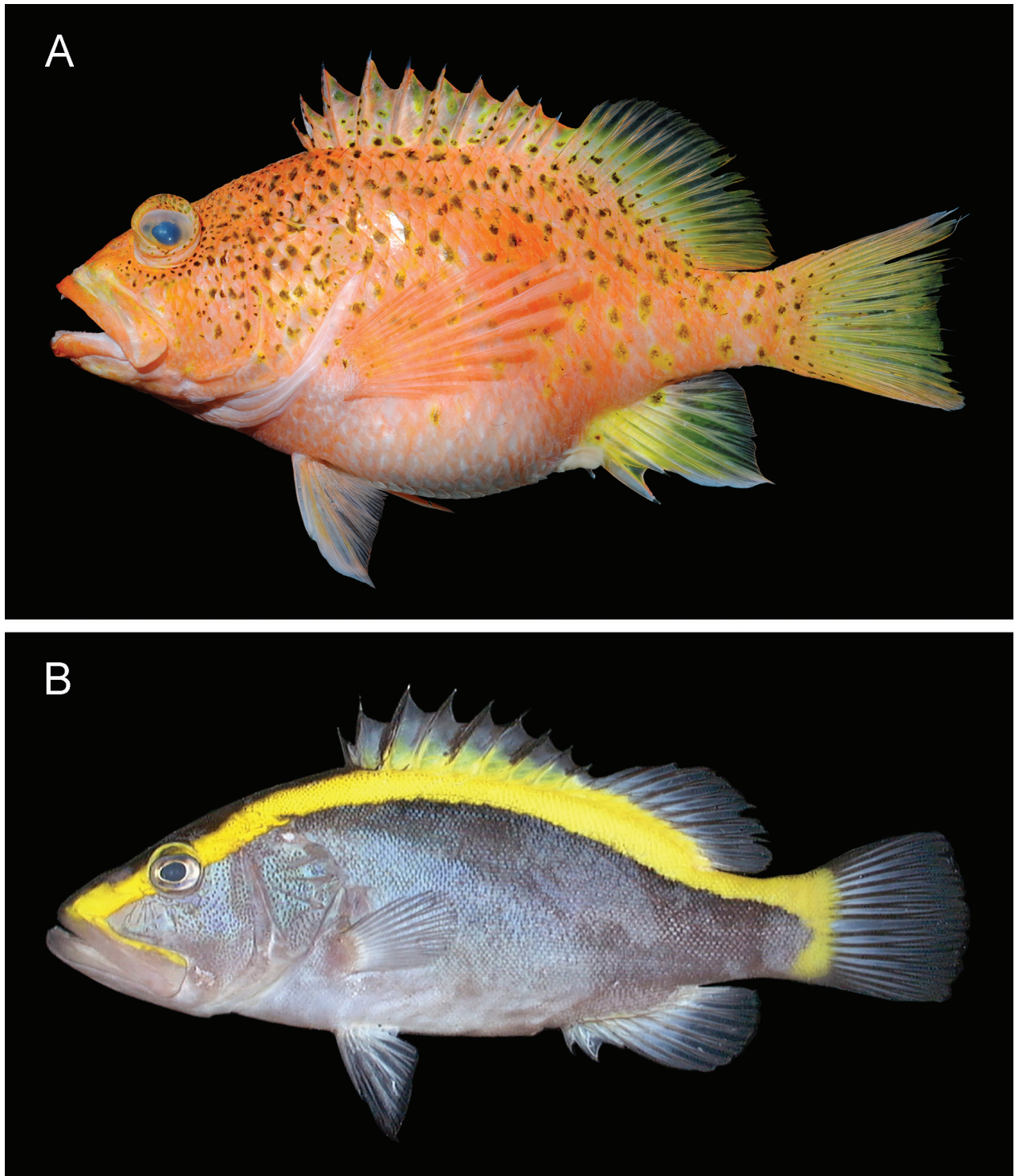


Figure 2. Photographs of fresh specimens of (A) *Plectranthias yamakawai*, LBRC-F 3002, 182.5 mm SL and (B) *Aulacocephalus temminckii*, LBRC-F 402, 152.1 SL, collected off Lembbeh Island, northern Sulawesi, Indonesia.

example, dorsal fin single, with 9 spines and 12 soft rays, last two spines subequal; anal fin with 3 spines and 9 soft rays; body depth less than head length 2.8–2.9 in SL; caudal fin rounded; pelvic fin short, its posterior tip not reaching anus when depressed; posterior margin of pre-opercle, subopercle and interopercle serrated; head and body scales ctenoid; body bluish-grey, with a bright yellow band from near front of upper jaw through eye, along upper part of back and dorsal fin base to caudal fin base.

There appears to be variation in the coloration of the posterior end of the yellow band running along the upper part of the body. Specimens of *A. temminckii* collected from the Red Sea and Japanese waters exhibit the band terminating at the upper caudal fin base, accompanied by a yellow blotch on the lower caudal fin base (see Khalaf and Zajonz 2007: 427; Randall and Schraml 2010: fig. 4). In contrast, specimens from Norfolk Island show the band ending at the upper caudal fin base without a blotch

on the lower base (see Randall and Schraml 2010: fig. 5). Meanwhile, specimens from the Philippines and Lembah Island waters show the band extending posteriorly to form a vertical band across both the upper and lower bases of the caudal fin (see Bos and Gumanao 2013: fig. 4A; this study: Fig. 2B).

Although *A. temminckii* is widely distributed in the Red Sea and Indo–west Pacific, except for the Hawaiian Islands (Fig. 1); it is relatively rare in collections (Baldwin and Smith 1998). The distribution of *A. temminckii* in Southeast Asia was previously reported as limited to the Philippines (Bos and Gumanao 2013), the presently reported specimens being the first recorded from Indonesia.

Aulacocephalus temminckii is common in subtropical waters between 20 and 36°N or S (Randall et al. 1971) but has not previously been reported in equatorial waters (Randall 1982). Prior to the presently reported account, the lowest latitudes reported for *A. temminckii* were 11°N (Port Blair, Andaman Islands) (Rangarajan 1969) and 11°S (Comoros, eastern Africa) (Fricke et al. 2009), considered as evidence of an anti-equatorial distribution (Randall 1982; Springer 1982; Fricke et al. 2009). However, Bos and Gumanao (2013) reported the first record of the species from the Philippines, based on a specimen collected at Peñaplata Public Market, southern Mindanao (caught latitude ca. 7°N in Samal Island, Davao Gulf). The presently reported specimen, collected off Lembah Island (latitude 1.4°N) indicates that the anti-equatorial distribution, recognized by Randall (1982), Springer (1982), and Fricke et al. (2009), is no longer valid.

Family Labridae Cuvier, 1816

Genus *Iniistius* Gill, 1862

Iniistius geisha (Araga et Yoshino, 1986)

Fig. 3A

Xyrichtys geisha Araga et Yoshino, 1986.—Araga and Yoshino (1986): 75 (type locality Okinawa Islands, Japan).—Shimada (2002): 1011 (Okinawa Islands, Japan).

Iniistius geisha (Araga et Yoshino, 1986).—Myers and Donaldson (2003): 631 (Mariana Islands).—Parenti and Randall (2010): 35.—Akaike et al. (2021): 45 (Amami, Okinawa, and Ogasawara islands, Japan).—Furuhashi and Motomura (2022): 16 (Tokara Islands, Japan).

Material examined. LBRC-F 1681, 236.5 mm SL, off Lembah Island, Bitung, Indonesia, hook and line, 100–150 m (purchased at Girian Fish Market, Bitung, northern Sulawesi, T. Peristiwady, 2 April 2012).

Description. Dorsal fin with 9 spines and 12 soft rays, second and third dorsal fin spines connected by low membrane; anal fin with 3 spines and 14 soft rays; pectoral fin with 12 rays; lateral line interrupted on posterior half of body, with 19 + 6 pores; scales above lateral line 3.5; scales below lateral line 12; gill rakers on upper limb of first gill arch 7, lower limb 11, total 18; body relatively deep, its depth 2.9 in SL; body strongly compressed, its width 3.1

in depth; head rounded, long, its length 2.9 in SL; anterior profile of head steep; interorbital space convex, its width 4.8 in HL; snout length 2.0 in HL; eye diameter 6.3 in HL; depth of caudal peduncle 2.3 in HL, its length 1.4 in caudal peduncle depth; mouth terminal, gape horizontal, posterior end of maxilla not reaching to vertical through anterior margin of orbit; pair of large, slightly recurved canine teeth projecting from tip of each jaw, lower pair inserted into space between somewhat separated upper canine teeth when mouth closed; 8 to 10 conical teeth in single row along sides of each jaw; cheeks with several scales, without grooves or ridges; origin of dorsal fin just above posterior margin of orbit; caudal fin short, its length 1.9 in HL, posterior margin slightly rounded; pectoral fin relatively long, its length 1.5 in HL; pelvic fin length 1.5 in HL, origin of pelvic fin just below pectoral fin base.

Color when fresh. Snout and ventral surface of head whitish-grey, dorsal and ventral surface of body black, remainder of head and body yellowish red; dorsal, anal and pelvic fins entirely black; upper and lower half of caudal fin whitish and blackish, respectively; pectoral fin white, with black base (Fig. 3A).

Remarks. *Iniistius geisha* is easily distinguishable from other congeners due to its distinctive coloration (see Araga and Yoshino 1986: fig. 1; Akaike et al. 2021: fig. 1F; Furuhashi and Motomura 2022: fig. 5F; vs. Fig. 3A of this study).

A relatively rare species, *I. geisha* has been reported (based on several specimens) as having a limited Northern Hemisphere distribution, including southern Japan, Taiwan, and the Mariana Islands, ranging from 16 to 30°N (Shimada 2002; Myers and Donaldson 2003; Akaike et al. 2021; Furuhashi and Motomura 2022). The discovery of *I. geisha* off Lembah Island significantly extends the known geographical range of the species, being the first record of the species in equatorial waters and the southernmost occurrence reported to date (Fig. 1).

Family Lutjanidae Gill, 1861

Genus *Randallichthys* Anderson, Kami et Johnson, 1977

Randallichthys filamentosus (Fourmanoir, 1970)

English vernacular name: Randall's snapper

Fig. 3B

Etelis filamentosus Fourmanoir, 1970.—Fourmanoir (1970): 28 (type locality New Caledonia).

Etelis nudimaxillaris Yoshino et Araga, 1975.—Yoshino and Araga (1975): 236 (type locality southern Japan).

Randallichthys filamentosus (Fourmanoir, 1970).—Anderson et al. (1977): 89 (Hawaiian Islands and New Caledonia).—Yoshino (1984): 167 (southern Japan, Hawaiian Islands, Guam and New Caledonia).—Allen (1985): 156 (southern Japan, Hawaiian Islands and New Caledonia).—Anderson and Allen (2001): 2916 (western central Pacific).—Shimada (2002): 827 (southern Japan).—Randall et al. (2002): 158 (Society and Tuamotu islands).—Myers and

Donaldson (2003): 626 (Mariana Islands).—Randall et al. (2004): 16 (Tonga).—Leis (2005): 58 (Caroline Islands); Mundy (2005): 385 (Hawaiian Islands).—Randall et al. (2005): 123 (Marshall Islands).—Randall (2007): 251 (Hawaiian Islands).—Newman (2009): 1514 (Scott Reef, northwestern Australia).

Material examined. LBRC-F 2425, 175.0 mm SL, off Lembah Island, Bitung, Indonesia, hook and line, more than 100 m depth (purchased at Girian Fish Market, Bitung, northern Sulawesi, T. Peristiwady, 20 December 2011).

Description. Dorsal fin with 10 spines (third longest) and 11 soft rays (fourth longest), penultimate ray simple, not filamentous; anal fin with 3 spines and 9 soft rays; pectoral fin with 16 rays; pelvic fin with 1 spine and 5 rays;

lateral line scales complete, with 50 pores; scales above lateral line 8; scales below lateral line 13; gill rakers (not including rudiments) on upper limb of first gill arch 5, lower limb 11, total 16; head relatively long, its length 2.9 in SL; body depth about equal to HL; body width 2.2 in body depth; dorsal-fin base length almost half of SL, 2.1 in SL; pectoral fin short, its length 1.8 in HL, base covered with scales, tip reaching vertical line through base of seventh dorsal-fin spine; pelvic fin short, its length 1.5 in HL, posterior tip not reaching anus when depressed; caudal fin lunate, scaly, its length 1.1 in HL, lower lobe with some filamentous rays; body covered with ctenoid scales; snout, interorbital, maxillary and dorsal and anal fin bases scaleless; head blunt, with flat interorbital space; lateral

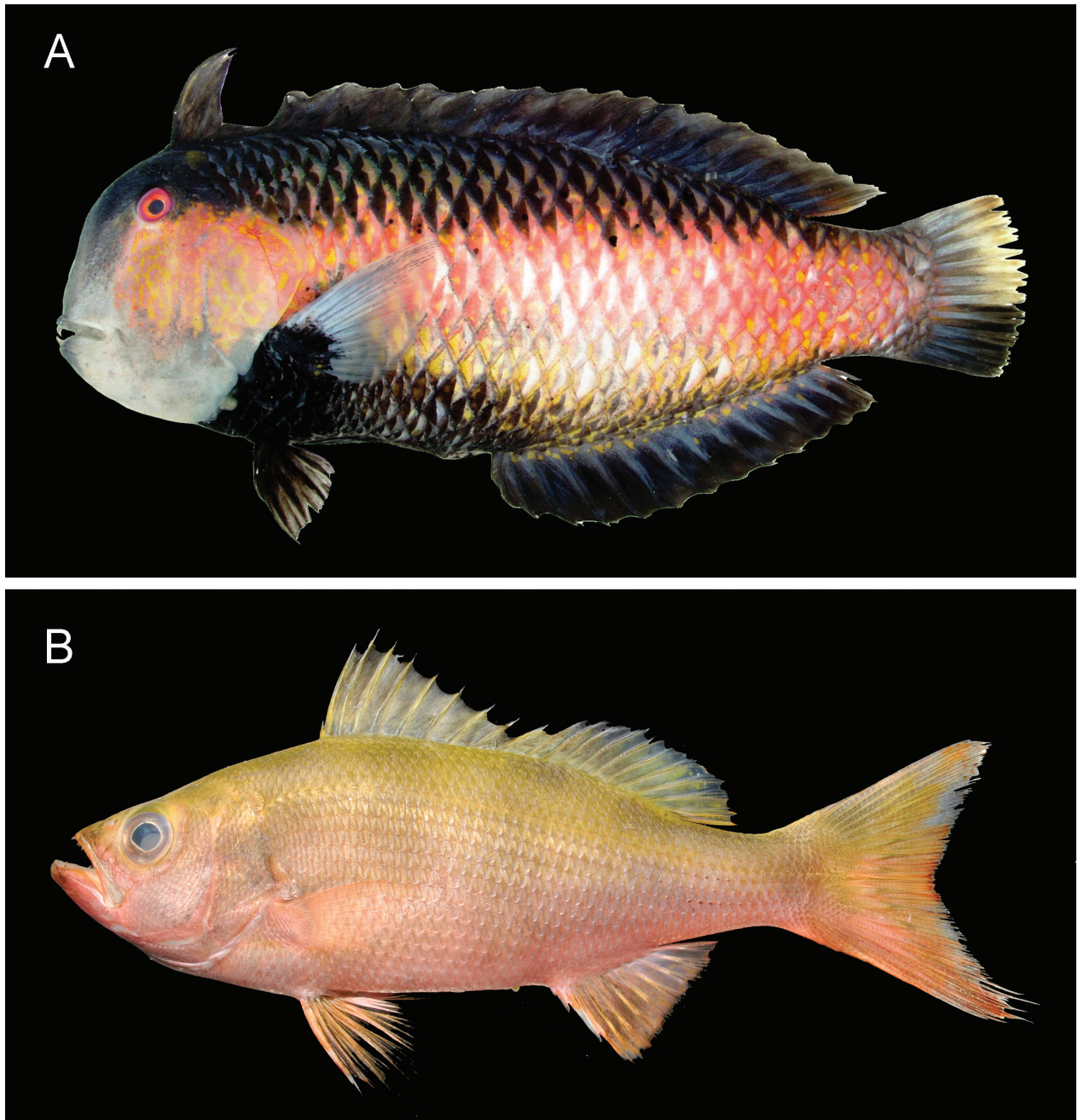


Figure 3. Photographs of fresh specimens of (A) *Iniiustus geisha* LBRC-F 1681, 236.5 mm SL and (B) *Randallichthys filamentosus* LBRC-F 2425, 175.0 mm SL, collected off Lembah Island, northern Sulawesi, Indonesia.

surface of maxilla with longitudinal ridges; posterior end of maxilla level of anterior margin of orbit; premaxillae not protrusible; lower jaw protruding; horizontal level of snout tip approximately through mid-orbit.

Color when fresh. Head and body rosy red ventrally, yellowish tinge dorsally; body with four indistinct blackish bands; all fins rosy reddish or yellowish, with outer edge of spinous dorsal and pelvic fins black (Fig. 3B).

Remarks. Characters of the presently reported specimen followed those of *R. filamentosus* given by Anderson et al. (1977), Yoshino (1984), Allen (1985), and Anderson and Allen (2001). The species can be easily distinguished from all other lutjanids by the following combination of characters: dorsal fin with 10 spines and 11 soft rays; maxilla and dorsal and anal-fin bases without scales; premaxillae not protrusible; lateral surface of maxilla with longitudinal ridges; vomer with teeth; pectoral-fin length less than HL (Anderson and Allen 2001; this study).

Randallichthys filamentosus has previously been recorded across a broad range of oceanic islands in the western and central Pacific, including those of southern Japan and Hawaii and the Mariana, Society, Tuamotu, Tonga and Marshall Islands, as well as Scott Reef (north-western Australia), in latitudes of 8–27°N and 16–21°S (Fig. 1). Such a distribution has thus far supported Randall's (1982) categorization of *R. filamentosus* as an anti-equatorial species. However, the presently reported specimen, collected off Lembeh Island (latitude 1.4°N), is the first record of *R. filamentosus* from equatorial Indonesian waters, prompting a reconsideration of Randall's (1982) anti-equatorial classification.

Discussion

The presence of *Plectranthias yamakawai*, *Aulacocephalus temminckii*, *Iniistius geisha*, and *Randallichthys filamentosus* in the equatorial waters off Lembeh Island represents a significant finding, as these species were previously known only from higher latitudes in the Northern or Southern Hemispheres (Fig. 1) (see also Remarks section for each species). A similar occurrence was reported by Motomura and Peristiwady (2012) for two scorpionfish species, *Neosebastes entaxis* Jordan et Starks, 1904 and *Neosebastes longirostris* Motomura, 2004, recorded in this region despite their previously known distribution being restricted to the north-western coast of Western Australia at latitudes of 14–20°S.

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Motomura and Peristiwady (2012) indicated the presence of *N. longirostris* in northern Sulawesi as that of a relict species, emerging during the Pleistocene. However, the occurrence of the four species is more likely explained by the isothermal submergence pattern, reflecting ecological adaptation to temperature gradients in tropical ocean depths. The four species were found at depths corresponding to the tropical thermocline, approximately 100–150 m, where temperatures remain stable and resemble their native habitat conditions. *Plectranthias yamakawai* is known to inhabit depths of 100–300 m (Motomura and Harazaki 2017; Wada et al. 2020), *I. geisha* at 95–100 m (Araga and Yoshino 1986; Furuhashi and Motomura 2022), and *R. filamentosus* at 150–380 m (Allen 1985; Mundy 2005), indicating tolerance for cold, deep-sea habitats. *Aulacocephalus temminckii*, inhabiting at depths of 20–350 m (Khalaf and Zajonz 2007), demonstrates flexibility in occupying both thermocline zones and shallower waters.

This finding highlights the significance of the waters surrounding Lembeh Island, northern Sulawesi, not only as a hotspot of biodiversity and endemism but also as an important distribution zone for non-endemic species reliant on thermal adaptation. Further research is particularly needed to explore deep-sea fish diversity in equatorial regions at very low latitudes.

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