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Records of the Orange Goatfish, *Mulloidichthys pflugeri* (Teleostei: Mullidae), from Amami-oshima and Yonaguni-jima islands in the Ryukyu Archipelago, southern Japan

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Abstract

Specimens of the Orange Goatfish, *Mulloidichthys pflugeri*, were collected from off Amami-oshima and Yonaguni-jima islands in the Ryukyu Archipelago, Japan. Previously *M. pflugeri* has been recorded in Japanese waters only from Okinawa-jima island and the Ogasawara Islands. Therefore, the present specimens are the first distributional records from each of Amami-oshima and Yonaguni-jima islands. Additionally, the specimen collected from Amami-oshima island represents the northernmost record of the species.

Key words: *Mulloidichthys flavolineatus*, *Mulloidichthys vanicolensis*, distribution, Amami Islands, Yaeyama Islands

Introduction

Seven species have been recognized as valid in the genus *Mulloidichthys*: *M. ayliffe* Uiblein, 2010 from the western Indian Ocean, *M. flavolineatus* (Lacepède, 1801), *M. pflugeri* (Steindachner, 1900), and *M. vanicolensis* (Valenciennes, 1831) from the Indo-Pacific, *M. mimicus* Randall and Guézé, 1980 from the southern Pacific, *M. dentatus*, Gill 1862 from the eastern Pacific, and *M. martinicus* (Valenciennes in Cuvier and Valenciennes, 1837) from the Atlantic Ocean (GILL 1862, ALLEN and ROBERTSON 1994, UIBLEIN 2010). Three species, *M. flavolineatus* “Montsuki-akahimeji”, *M. pflugeri* “Ryukyu-akahimeji”, and *M. vanicolensis* “Akahimeji”, are known from Japan (HATOOKA and DOIUCHI 2013).

The genus *Mulloidichthys* is defined as lacking teeth on the vomer or palatines and scales on the second dorsal fin, and having small conical teeth forming two or more rows on the jaws, 33-42 pored lateral-line scales, and five scale rows between the dorsal fins (RANDALL 1984, UIBLEIN 2010).

A single specimen of *M. pflugeri* was collected off Amami-oshima island in the Amami Islands, and landed at Naze Fishing Port. In addition, another specimen of *M. pflugeri* was collected off Yonaguni-jima island in the Yaeyama Islands. The species was previously recorded from off the Molucca, Mariana, Marshall, Tonga, Hawaiian, Society, Marquesas, Mascarene, and Ogasawara islands, and Okinawa-jima island (HATOOKA and DOIUCHI 2013), with the northernmost record on the basis of voucher specimens being from the Ogasawara Islands, Japan (RANDALL *et al.* 1997). The present specimens are the first distributional records of *M. pflugeri* from the Amami and Yaeyama islands, and the specimen collected from Amami-oshima island now represents the northernmost record of the species.

Materials and Methods

Counts, measurements, and abbreviations of characters follow UIBLEIN (2010). Measurements were made to the nearest 0.1 mm with digital calipers. The description is based on specimens from the Amami and Yaeyama islands (KAUM-I. 72443 and MUFS 47000). Counts and measurements of MUFS 47000 are shown in parentheses if data differ between the two specimens. The coloration is described on the basis of color photographs of two specimens. The specimens are deposited at the Kagoshima University Museum, Kagoshima, Japan (KAUM) and Division of Fisheries Science, University of Miyazaki, Japan (MUFS). Curatorial procedures for the collected specimens followed MOTOMURA and ISHIKAWA (2013).

Results and Discussion

Mulloidichthys pflugeri (Steindachner, 1900)

Standard Japanese name: Ryukyu-akahimeji

Figs. 1–3

Materials examined. KAUM-I. 72443, 348.2 mm SL, off Amami-oshima island (28°18'N, 129°20'E), Amami Islands, Kagoshima Prefecture, Japan, line fishing, Nov. 2015, landed at Naze Fishing Port, purchased by T. MAEAWA; MUFS 47000, 189.0 mm SL, north of Yonaguni-jima island (24°28'N, 122°57'E), Yaeyama Islands, Okinawa Prefecture, Japan, line fishing, 30 m, 22 Sept. 2015, collected by H. WADA.

Description. Pectoral-fin rays 18, upper 2 and lower 1 unbranched; rudimentary gill rakers on upper limb 3 (2); developed gill rakers on upper limb 5 (6); developed gill rakers on lower limb 14 (14); rudimentary gill rakers on lower limb 5 (5); total gill rakers on upper

limb 8 (8); total gill rakers on lower limb 19 (19); total gill rakers 27 (27); scales along lateral line to caudal-fin base 41 (39).

Following measurement characters expressed as percentages of SL: body depth at first dorsal-fin origin 32.3 (26.2) %; body depth at anal-fin origin 27.2 (22.0) %; half body depth at first dorsal-fin origin 23.9 (21.9) %; half body depth at anal-fin origin 17.9 (17.0) %; caudal-peduncle depth 9.4 (8.3) %; caudal-peduncle width at position of caudal-peduncle depth measurement 5.7 (5.6) %; maximum head depth 25.0 (22.3) %; head depth across a vertical midline through eye 21.4 (19.5) %; suborbital depth 13.2 (11.3) %; interorbital length 10.3 (8.7) %; head length 31.2 (30.6) %; snout length 15.3 (14.6) %; postorbital length 11.5 (10.5) %; orbit length 5.2 (6.8) %; orbit depth 4.9 (5.9) %; upper-jaw length 12.7 (12.0) %; lower-jaw length 12.5 (12.1) %; snout width 11.8% (10.5); barbell length 20.6 (16.8) %; maximum barbell width 1.3 (1.4) %; first pre-dorsal-fin length 40.4 (39.4) %; second pre-dorsal-fin length 68.6 (66.6) %; inter-dorsal-fin distance 17.8 (16.6) %; caudal-peduncle length 21.6 (21.1) %; pre-anal-fin length 67.2 (66.2) %; pre-pelvic-fin length 30.3 (31.0) %; pre-pectoral-fin length 31.6 (32.4) %; second dorsal-fin depth 27.6 (22.6) %; pelvic-fin depth 31.9 (27.0) %; pectoral-fin depth 19.5 (17.1) %; length of first dorsal-fin base 18.6 (16.5) %; length of second dorsal-fin base 14.0 (12.7) %; distance between dorsal caudal-fin origin and upper caudal-lobe tip 32.3 (29.0) %; length of anal-fin base 11.5 (10.6) %; distance between anal-fin origin and anal-fin anterior tip 13.6 (12.1) %; distance between pelvic-fin origin and pelvic-fin tip 24.4 (22.8) %; distance between pectoral-fin dorsal origin and pectoral-fin tip 22.5 (21.3) %; width of pectoral-fin base 6.6 (6.2) %; first dorsal-fin height 21.4 (19.9) %; second dorsal-fin height 12.5 (12.2) %.

Body elongate, deepest at origin of first dorsal fin; depth of caudal peduncle slightly less than $\frac{1}{3}$ of body depth at origin of first dorsal fin; head rounded; dorsal profile straight to anterior of eye, slightly bent horizontal to origin of first dorsal fin.

Mouth small, axilla not reach vertical at front of orbit, upper-jaw length 12.0–12.7% SL; small conical teeth on both jaws, placed in one outer row and more irregularly behind in the front of jaws, and on a single row more posteriorly; no teeth on roof of mouth; anterior nostril a small vertically elliptical opening about $\frac{2}{3}$ orbit diameter in front of eye; posterior nostril a narrow slit covered by a membrane next to edge of upper orbit; longest gill filaments on first gill arch about $\frac{2}{3}$ orbit diameter; longest gill raker on first arch about $\frac{2}{3}$ of longest gill filament; a single flat spine at posterior edge of operculum at mid-eye level.

Scales very finely ctenoid; head fully scaled; fins naked except base of caudal fin; origin of first and second dorsal fin vertical at 4th and 18th lateral line scale, respectively; origin of anal fin vertical at origin of second dorsal fin; origin of pectoral fin posterior to vertical at origin of pelvic fin; pectoral fin reaches vertical at posterior margin of first dorsal fin base; pelvic fin does not reach to anus; lateral line following contour of back; pored scales of lateral line with many branched tubules.

Color when fresh (Figs. 1–2a) — Body rose, ventrally white; dorsal half of body red becoming more intense further dorsally; body scales margined by faint yellow; single, very faint yellowish longitudinal stripe from upper margin of gill opening to caudal peduncle in MUFS 47000; anterior part of head yellowish-red; first dorsal fin rose and anteriorly



Fig. 1. Fresh specimen of *Mulloidichthys pflugeri* (KAUM-I. 72443), 348.2 mm SL, off Amami-oshima island, Amami Islands, Kagoshima Prefecture, Japan, line fishing, Nov. 2015, landed at Naze Fishing Port.



Fig. 2. Fresh specimen (A) and live specimen just removed from water (B) of *Mulloidichthys pflugeri* (MUFS 47000), 189.0 mm SL, off north of Yonaguni-jima island, Yaeyama Islands, Okinawa Prefecture, Japan, line fishing, 30 m, 22 Sept. 2015.

reddish-orange; second dorsal fin and anal fin rose with whitish outer margin; pectoral fin rose in KAUM-I. 72443, but translucent in MUFS 47000; pelvic fin rose; caudal fin reddish-orange; barbell pink becoming white on tip.

Color when alive (Fig. 2b) — Body faint orange and ventrally white; four wide bright red lateral bands on body to caudal-peduncle; head reddish-orange.

Color in alcohol — Body pale brown with some red or orange pigments remaining; fins pale brown; barbell white; peritoneum pale brown without pigments.

Distribution. The species known from the Indo-Pacific Ocean, and has currently been recorded from the following insular localities in the Pacific Ocean; the Marquesas Islands, the Society Islands, Tonga, the Molucca Islands, the Marshall Islands, the Hawaiian Islands, the Mariana Islands, the Ogasawara Islands, Yonaguni-jima island, Okinawa-jima island, and Amami-oshima island (YAMAKAWA 1984, RANDALL 1984, ALLEN and ROBERTSON 1994, RANDALL *et al.* 1997, HOOVER 2008, UIBLEIN 2010, HATOOKA and DOIUCHI 2013, present study; Fig. 3).

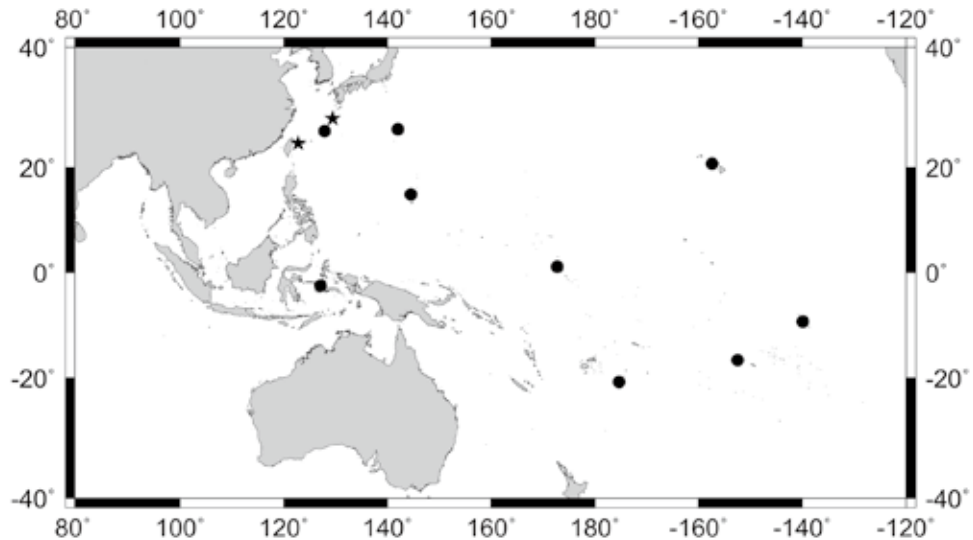


Fig. 3. Distributional records of *Mulloidichthys pflugeri* in the Pacific Ocean. Stars and circles indicate records by the present study and literature respectively.

Remarks. Characters of the present specimens are consistent with the diagnostic characters of *M. pflugeri* given by RANDALL (1984), UIBLEIN (2010), and HATOOKA and DOIUCHI (2013); *i.e.*, second dorsal-fin height 12.2–12.5% SL, caudal-peduncle depth 29.3–31.7% in body depth at first dorsal-fin origin, caudal-peduncle width 60.6–67.5% in caudal-peduncle depth, total gill rakers 27, a rose body when fresh without distinct yellow stripes, and white peritoneum. *Mulloidichthys pflugeri* is clearly distinguishable from its two congeners in the western Pacific Ocean by its rose body without distinct stripes (vs. yellow longitudinal stripes in *M. flavolineatus* and *M. vanicolensis*), white peritoneum (vs. dark brown to black), no black spot on the body (vs. single black spot on body side in *M. flavolineatus*), body depth at first dorsal-fin origin 26.2–32.3% SL (vs. 21.0–30.0% in

M. flavolineatus), and total gill rakers 27 (vs. 29–36 in *M. vanicolensis*) (RANDALL 1984, UIBLEIN 2010, HATOOKA and DOIUCHI 2013).

Mulloidichthys pflugeri was originally described by STEINDACHNER (1900) on the basis of a specimen from Oahu Island in the Hawaiian Islands. AOYAGI (1943) firstly used the Japanese name “Ryukyu-akahimeji” for *M. vanicolensis*, and MATSUBARA (1955) followed this example. GUSHIKEN (1972) reported a photograph of species of *Mulloidichthys* with the Japanese standard name “Ryukyu-akahimeji” and Okinawan local name “yū-aka-jinbā” with the scientific name *M. vanicolensis*, but the photograph is herein reidentified as *M. pflugeri*. This represents the first reliable record of the species. MASUDA *et al.* (1975) challenged the identification of AOYAGI (1943), and readjusted the Japanese standard name “Ryukyu-akahimeji” to *M. pflugeri* with a description based on the specimen. MASUDA *et al.* (1975) also readjusted the Japanese names “Akahimeji” and “Montsuki-Akahimeji” to *M. vanicolensis* and *M. flavolineatus*, respectively, and subsequent Japanese publications have followed them (e.g. YAMAKAWA 1984, HATOOKA 1993, HATOOKA 2000, HATOOKA and DOIUCHI 2013).

YOKOI (1989) and WANG (2011) also reported this species from Okinawa-jima island and Taiwan, respectively, but their photographs are herein reidentified as *Parupeneus cyclostomus* (Lacepède, 1801) from the body coloration and the long barbells.

The northernmost record of *M. pflugeri* has previously been the Ogasawara Islands (27°04'N, 142°11'E), Japan (RANDALL *et al.* 1997; Fig. 3; see above). Therefore, the present specimen, the first record from the Amami-oshima islands, becomes the northernmost record of the species. In addition, we also report here a single specimen collected from Yonaguni-jima island which is the westernmost island in Ryukyu Archipelago. These two records indicate that *M. pflugeri* is widely distributed in the central to southern Ryukyu Archipelago.

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