Revised Diagnosis and First Northern Hemisphere Records of the Rare Clingfish *Lepadichthys akiko* (Gobiesocidae: Diademichthyinae)

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*Lepadichthys akiko* Allen and Erdmann, 2012, previously known only from the holotype from West Papua, Indonesia, is recorded from Japan and Palau for the first time, based on underwater photographs and two specimens, respectively. The latter (12.3 and 14.0 mm standard length) revealed new diagnostic characters of the species: viz., 3 of 5 gill arches with 2 filaments and 4 or 5 gill rakers on each arch; single nasal and postocular canal pores; and no lacrimal, preopercular or mandibular canal pores. The new specimens are described in detail, including a revised diagnosis and comparisons made with congeners.

**Key Words:** Teleostei, range extension, distribution, Japan, Palau, northernmost record.

**Introduction**

In his review of the family Gobiesocidae, Briggs (1955) defined *Lepadichthys* Waite, 1904 (with four valid species) as characterized by the following combination of characters: snout comparatively short and broad, its length 3.1–4.2 in head length; small single disc, its length 4.9–6.5 in standard length; a row of conical lower-jaw teeth; 3 of 5 gill arches with 2 filaments; and gill membranes attached to the isthmus. Although several new species of *Lepadichthys* have been described subsequently, the characters of some did not match the diagnosis of *Lepadichthys sensu* Briggs (1955) [e.g., *Lepadichthys bolini* Briggs, 1962 with a very small single disc, its length 8.2 in standard length; *Lepadichthys caritius* Briggs, 1969 with incisor teeth in each jaw]. Hence a re-assessment of the generic diagnosis is necessary.

During a taxonomic study of *Lepadichthys* by the authors, two clingfish specimens from Palau, deposited at the Bishop Museum, Honolulu and underwater photographs taken at Okinawa Island, Japan have been identified as *Lepadichthys akiko* Allen and Erdmann, 2012, based on meristics, morphometrics and coloration. The species was originally described from a single specimen collected from West Papua, Indonesia, no additional examples of the species having been recorded since. The Palauan specimens and underwater photographs from Okinawa Island, representing the first Northern Hemisphere records of *L. akiko*, are described in detail and a revised diagnosis is provided.

**Materials and Methods**

Counts and measurements follow Hubbs and Lagler (1958) and Briggs (1955), with the following additions: head depth—vertical height at most posterior point of orbit; body width—width at pectoral-fin base; gill-opening depth—vertical height from upper end of gill membrane to disc base; snout depth—vertical height at most anterior point of orbit; anterior and posterior interorbital widths—bony interorbital distance between anterior and posterior margins of orbits, respectively; disc width—width at widest point of disc; pre-disc and pre-anus lengths—distance from anterior tip of upper jaw to anterior margin of disc and anus, respectively; disc to anal-fin origin and anus lengths—distance from posterior margin of disc to anal-fin origin and anus, respectively; pre-anal-fin length—distance from anterior tip of upper jaw to anal-fin origin; anal-caudal length—distance from anal-fin origin to mid-caudal-fin base. Measurements were made to the nearest 0.01 mm, except for standard length (nearest 0.1 mm), with needle-point calipers under a dissecting microscope. Standard and head lengths are abbreviated as SL and HL, respectively.

Disc and head sensory pore terminology follow Briggs (1955: Fig. 1) and Shiogaki and Dotsu (1983), respectively, those regions having been observed using versatile staining with Cyanine Blue (Saruwatari et al. 1997). The distribution map was preparing using GMT 5.3.1, with data from GSHHG (Wessel and Smith 1996). Institutional codes used in this study are as follows: Bishop Museum, Honolulu, USA (BPBM); Kagoshima University Museum, Kagoshima, Japan (KAUM); and Kanagawa Prefectural Museum of Natural History, Odawara, Japan (KPM).
**Lepadichthys akiko** Allen and Erdmann, 2012 [English name: Minute Clingfish; new standard Japanese name: Akasuji-ubauo] (Figs 1–5; Tables 1, 2)

**Lepadichthys akiko** Allen and Erdmann, 2012: 1164, figs 1–3 (type locality: east of Point Mangguar, Cenderawasih Bay, West Papua, Indonesia).

**Material examined.** BPBM 37695, 14.0 mm SL, Au-gulpelu Reef, Palau, 07º16'24.6"N, 134º31'26.4"E, ca. 90 m depth, coll. by J. Earle, 10 May 1997; BPBM 37705, 12.3 mm SL, same locality as BPBM 37695, ca. 90 m depth, coll. by R. Pyle and J. Earle, 12 May 1997.

**Diagnosis.** A species of *Lepadichthys* distinguished from all congeners by the following combination of characters: 11–12 dorsal-fin rays; 9–10 anal-fin rays; 16–18 pecto-

### Table 1. Counts and proportional measurements of Palauan specimens of *Lepadichthys akiko*.

|                      | BPBM 37695 | BPBM 37705 |
|----------------------|------------|------------|
| **Counts**           |            |            |
| Dorsal-fin rays      | 11         | 12         |
| Anal-fin rays        | 9          | 10         |
| Pectoral-fin rays    | 18         | 18         |
| Caudal-fin rays      | 18         | 17         |
| Gill rakers (1st arch) | 4        | —          |
| Gill rakers (2nd arch) | 5        | 4          |
| Gill rakers (3rd arch) | 5        | 5          |
| Nasal canal pores    | 1          | 1          |
| Lacrimal canal pores | 0          | 0          |
| Postocular canal pores | 1        | 1          |
| Preopercular canal pores | 0     | 0          |
| Mandibular canal pores | 0        | 0          |
| **Measurements**     | % SL       | % HL       |
| Head length (HL)     | 32.4       | —          |
| Postorbital length   | 15.7       | 48.5       |
| Head depth           | 9.4        | 28.9       |
| Head width           | 14.4       | 44.5       |
| Body depth           | 12.9       | 39.9       |
| Body width           | 12.2       | 37.7       |
| Gill-opening depth   | 3.3        | 10.1       |
| Snout length         | 9.9        | 30.4       |
| Snout depth          | 6.4        | 19.8       |
| Upper-jaw length     | 7.3        | 22.5       |
| Orbit diameter       | 6.2        | 19.2       |
| Least interorbital width | 2.9     | 8.8        |
| Anterior interorbital width | 7.8   | 24.0       |
| Posterior interorbital width | 12.7  | 39.2       |
| Disc length          | 9.9        | 30.6       |
| Disc width           | 8.9        | 27.5       |
| Caudal-peduncle length | 3.4      | 10.6       |
| Caudal-peduncle depth | 6.0      | 18.5       |
| Pre-disc length      | 30.6       | 94.3       |
| Pre-anus length      | 69.4       | 214.1      |
| Disc to anal-fin origin length | 41.6 | 128.2     |
| Disc to anus length  | 27.6       | 85.2       |
| Pre-dorsal-fin length | 76.1     | 234.8      |
| Pre-anal-fin length  | 81.8       | 252.2      |
| Dorsal-caudal length | 22.3       | 68.7       |
| Post-dorsal-caudal length | 5.8    | 17.8       |
| Anal-caudal length   | 18.2       | 56.2       |
| Dorsal-fin base length | 14.3     | 44.1       |
| Anal-fin base length | 12.4       | 38.3       |
| Pectoral-fin length  | 11.0       | 33.9       |
| Caudal-fin length    | 8.1        | 24.9       |
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Ralf-fin rays; 17–18 caudal-fin rays; head length 32.4–36.1% SL; very small single disc, its length 9.8–11.1% SL; anus much closer to anal-fin origin than to posterior margin of disc, distance from posterior margin of disc to anus 65.5–66.5% of distance from posterior margin of disc to anal-fin origin; gill opening small, upper end of gill membrane level with tenth or eleventh pectoral-fin ray base in lateral view; 3 of 5 gill arches with 2 filaments and 4 or 5 gill rakers on each arch; dorsal, anal, and caudal fins connected with membranes; single nasal and postocular canal pores; no lacrimal, preopercular or mandibular canal pores; head and body white with two longitudinal red stripes, upper and lower stripes along dorsal profile of body and mid-lateral body, respectively, stripes connected on snout.

**Description.** Characters included in diagnosis not repeated here. Counts and measurements given in Table 1. Body slender, cylindrical, compressed at caudal peduncle (Fig. 1). Head large, depressed anteriorly. Snout bluntly pointed in lateral view, duck beak-shaped in dorsal view; dorsal profile of snout slightly concave anteriorly. Upper jaw longer than lower jaw, posterior margin of former not reaching to anterior margin of orbit. Upper-jaw lip slightly thickened. Single row of small conical teeth in both jaws. Anterior nostril with long membranous tube; posterior nostril small, circular opening, without distinct membranous tube. Posterior nostril located at front of anterodorsal margin of orbit; anterior nostril located between posterior nostril and nasal canal pore. Eye large, diameter less than snout length, upper margin protruding above dorsal contour of head. Interorbital region narrow, flattened.

Gill rakers short, somewhat pointed. Gill membranes attached to isthmus. All soft fin rays unbranched. Dorsal and anal fins located posteriorly on body. Origin of dorsal fin vertically above origin of anal fin. First dorsal- and anal-fin soft rays very short. Dorsal- and anal-fin heights increasing posteriorly. Pectoral- and caudal-fin margins rounded. Uppermost pectoral-fin ray minute; eighth or ninth pectoral-fin ray longest. Pelvic fin circular adhesive disc without posterior cavity. Disc regions A and B with flattened papillae (observed in BPBM 37705, not in BPBM 37695; see Remarks), disc region A with 2 or 3 rows of papillae across center, disc region B with 4 or 5 rows (Fig. 2). Disc region C without papillae. Inner rows of papillae larger than outer rows. Lowermost pectoral-fin ray base attached to disc base by membrane. Posterior margin of disc with narrow fringe.

Head sensory canal pores poorly developed, postocular canal pores larger than nasal canal pores (Fig. 3); all pores with minute membranous tube; nasal canal pores located in front of anterior nostrils in dorsal view, postocular canal pores behind posterior margins of orbits.

**Coloration.** Although color photographs of the two Palauan specimens were not taken, life coloration was detailed on the collection data label accompanying BPBM 37695: “Pale pink with a narrow red stripe from tip of snout.

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Fig. 1. Preserved specimens of *Lepadichthys akiko* from Palau (A, BPBM 37705, 12.3 mm SL; B–D, BPBM, 37695, 14.0 mm SL). A, B, lateral view; C, dorsal view; D, ventral view.
through eye, alongside of body where it becomes dark brown, changing to orange-red posteriorly and extending into caudal fin; a narrow orange-red stripe extending posteriorly from upper edge of eye, joining one of other side dorsally on caudal peduncle and fin; 2 faint longitudinal orange lines ventrally on head, and blackish orange midventral line on body, continuing narrowly on lower edge of caudal fin'. Life coloration is shown in Fig. 4. Preserved specimens are uniformly yellowish-white.

**Distribution and habitat.** Currently known only from West Papua, Indonesia (type locality; Allen and Erdmann 2012), Palau (2 specimens; this study), and Okinawa Island, Japan (underwater photographs; this study) (Fig. 5). The holotype of *L. akiko* was collected at a depth of 70 m (Allen and Erdmann 2012) and the Palauan specimens from ca. 90 m. The underwater photographs were taken near a sea urchin, *Echinothrix diadema* (Linnaeus, 1758), in 42–52 m off Okinawa Island, Japan (Fig. 4B).

**Remarks.** The characters of the two specimens from Palau agreed with those given in the original description of *Lepadichthys akiko* Allen and Erdmann, 2012, including: a very small single disc, its length 9.8–9.9% SL; anus much closer to anal-fin origin than to posterior margin of disc; and upper end of gill membrane level with tenth pectoral-fin ray base in lateral view. Life coloration given for a Palauan specimen (above) agreed closely with that given by Allen and Erdmann (2012). Examination of the Palauan specimens revealed range extensions of the following characters, compared with the holotype: 11 dorsal-fin rays (12 in holotype); 9 anal-fin rays (10); 17 caudal-fin rays (18); 18 pectoral-fin rays (16–17); and disc length 9.8–9.9% SL (11.1% SL) (Allen and Erdmann 2012; this study).

Head lengths (32.6–32.8% SL) of the Palauan specimens (12.3–14.0 mm SL) are significantly less than that (36.1% SL) of the holotype (10.8 mm SL) (Allen and Erdmann 2012; this study), apparently resulting from ontogenetic change, similar changes with growth having been noted in other gobiesocids, including species of *Kopua* Hardy, 1984 (Fujiwara et al. 2018) and *Lepadichthys frenatus* Waite, 1904 (authors, unpub. data).

Although BPBM 37705 possessed flattened disc papillae (Fig. 2), such papillae were not evident in BPBM 37695, probably due to abrasion during collection, a well-known occurrence in clingfishes (Hayashi and Hayashi 1985).

Two underwater photographs of a clingfish, taken off Okinawa Island (registered as KPM-NR 73666, 7 August 2010 and KPM-NR 176523, 11 August 2016; Fig. 4), were identified as *L. akiko* from the following identifiable characters: ca. 12 dorsal-fin rays; ca. 10 anal-fin rays; ca. 18 caudal-fin rays; very small disc; body and head white with two longitudinal red stripes, upper and lower stripes along dorsal profile of body and mid-lateral body, respectively, stripes connected at snout. Although a third (narrower) red stripe ventrolaterally on the head was distinct in the holotype (Allen and Erdmann 2012), it was indistinct in KPM-NR 73666 and 176523 (Fig. 4). Such presence or absence of this stripe may represent geographic variation or a change in the physical condition of individuals.

Twelve valid Indo-Pacific species are regarded as members of *Lepadichthys* (Table 2), *L. akiko* being easily distinguished from all congeners by having 16–18 pectoral-fin rays (vs. 23–30 in the latter; Table 2). Among the 12 species,
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Head sensory canal pores have been described only in five, viz., *L. akiko*, *L. bolini* Briggs, 1962, *L. erythraeus* Briggs and Link, 1963, *L. frenatus* Wæte, 1904, and *L. lineatus* Briggs, 1966 (Hayashi and Hayashi 1985; Craig et al. 2015; this study), the lowest known number of such pores being in *L. akiko* thus far (Table 2). The habitat of *L. akiko* is considerably deeper than those of other congeners (42–90 m in *L. akiko* vs. < 23 m in the latter; Table 2).

Although most like *L. bolini* (Fig. 6), *L. akiko* differs in having the upper end of the gill membrane located level with the tenth or eleventh pectoral-fin ray base in lateral view (vs. fifteenth pectoral-fin ray base in *L. bolini*), and a duck beak-shaped snout in dorsal view (vs. triangular shape) (Allen and Erdmann 2012; this study: Figs 1, 6) [in addition to numbers of pectoral-fin rays, head sensory canal pores and habitat depth (above)].

The holotype of *L. akiko* was attached to a sponge when it was collected (Allen and Erdmann 2012). However, judging from the underwater photographs (Fig. 4) and very small disc in the species, *L. akiko* may be epibenthic.

The Palauan specimens and underwater photographs from Okinawa Island represent the first records of *L. akiko* north of the equator (Fig. 5), the latitudinal range from West Papua to Okinawa Island suggesting that the species is likely to be widely distributed in the western Pacific Ocean.

The new standard Japanese name "Akasuji-ubauo" is proposed for *Lepadichthys akiko* (based on BPBM 37695). "Akasuji" means red stripe (coloration of *L. akiko*) in Japanese.

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Fig. 4. Underwater photographs of *Lepadichthys akiko* from Okinawa Island, Japan (A, KPM-NR 73666; B, KPM-NR 176523). Specimens not collected. Photos by Y. Terada.
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and “Ubauo” is the common Japanese name for clingfishes.

Comparative material examined. Lepadichthys bolini: BPBM 9219, 28.1 mm SL, Palau, 0.6–0.9 m depth, coll. by J. Randall and E. Helfman, 5 June 1968.

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