



## *Cirrhilabrus greeni*, a new species of wrasse (Pisces: Labridae) from the Timor Sea, northern Australia

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### Abstract

A new species of labrid fish, the Sunset Fairy-wrasse, *Cirrhilabrus greeni* n. sp., is described from seven specimens, 39.4–47.3 mm SL, collected from the eastern Timor Sea, Northern Territory, Australia. The species is clearly distinguished by its terminal-phase male color pattern, consisting of pink to reddish hues on the upper half of the head and body and yellow on the lower half, in combination with a mainly yellow-orange dorsal fin and a scarlet-red anal fin. The caudal fin of the male is particularly distinctive, being emarginate but appearing lunate due to a clear central portion and tapering red bands along dorsal and ventral margins. Females can be distinguished from sympatric congeners by having a large black spot on the upper caudal peduncle. Sequencing of the mtDNA-barcode marker COI reveals that the new species has identical sequences to *C. rubripinnis* and *C. aff. tonozukai* from the Philippines, which have very different color patterns and tail shapes from the new species, indicating the new species has diverged recently and/or there is historic or episodic hybridization within the species complex.

**Key words:** taxonomy, systematics, ichthyology, coral-reef fishes, Indo-Pacific Ocean, fairy wrasse, DNA barcoding.

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## Introduction

The labrid genus *Cirrhilabrus* Temminck & Schlegel, 1845 of the tropical Indo-west Pacific is among the most colorful groups of coral-reef fishes, highlighted by the gaudy nuptial displays of terminal-phase (TP) males occurring daily 1–2 hours prior to sunset. The rate of new species descriptions for this genus is among the highest for reef fishes, thanks to numerous discoveries of new species by scuba-diving researchers over the past several decades. The genus currently contains 57 valid species (Eschmeyer *et al.* 2017), including 33 species described since 1990. As in most other groups of reef fishes, the genus is most strongly represented in the East Indian region, where at least 25 species are presently known (Allen & Erdmann 2012).

Meristic and morphological differences between species are usually subtle and of limited value, although the shape of the dorsal, caudal, and pelvic fins can vary and are often useful for distinguishing species. One of the most valuable diagnostic features is the remarkable TP-male color pattern, which is especially intensified during courtship and spawning.

In contrast to the widespread geographic ranges of many other labrid fishes associated with coral reefs, the species of *Cirrhilabrus* frequently have restricted regional distributions, including 5 previously described species apparently limited to northern Australian seas. The present paper describes the fifty-eighth member of the genus and the third species known only from the Timor Sea, after *C. morrisoni* Allen, 1999 and *C. hygroxerus* Allen & Hammer, 2016.

## Materials and Methods

Type specimens are deposited at the Australian Museum, Sydney (AMS); Museum and Art Gallery of the Northern Territory, Darwin, Australia (NTM); and Western Australian Museum, Perth (WAM).

Lengths of specimens are given as standard length (SL), the straight-line measurement from the front of the upper lip to the base of the caudal fin (end of hypural plate). Head length is the distance from the front of the upper lip to the posterior end of the opercular membrane. Body depth is the greatest depth to the base of the dorsal fin (adjusting for any malformation of the abdomen due to preservation). Body width is measured just posterior to the opercular flap. Snout length is taken from the front of the upper lip to the fleshy edge of the orbit (if the upper jaw is protruded, it is pressed back to the nonprotractile position before the measurement is taken). Orbit diameter is the greatest fleshy diameter. Interorbital width is the least bony width. Caudal-peduncle depth is the least depth; caudal-peduncle length is the horizontal measurement between verticals at the rear base of the anal fin and the caudal-fin base. Measurements of the fin spines and rays are taken to the extreme base of these elements. Pectoral-fin length is taken from the tip of the longest ray to the base of this ray. Pelvic-fin length is measured from the base of the spine to the tip of the longest ray. Caudal concavity is the horizontal distance between verticals at the tips of the shortest and longest rays.

Tissues from specimens of the new species were sequenced for the mtDNA-barcode marker COI, following the procedure recently detailed in Allen & Erdmann (2017). The tissues were processed, sequenced, and the data collated and compared using the Barcode of Life Data Systems (BOLD) database of the Centre for Biodiversity Genomics at the University of Guelph, Canada. Comparison mtDNA COI sequences for *C. rubripinnis* from the Philippines were provided in the BOLD database by Jeffrey T. Williams of the National Museum of Natural History of the Smithsonian Institution (USNM), collected in collaboration with the Department of Agriculture, Bureau of Fisheries and Aquatic Resources-National Fisheries Research and Development Institute (BFAR-NFRDI), Department of Agriculture, Philippines. Relevant COI sequences were submitted to the GenBank database and are publically available.

Measurements in Table 1 are given as percentages of the standard length. Data in parentheses in the descriptions refer to the range for paratypes, if different from the holotype.

## *Cirrhilabrus greeni*, n. sp.

Sunset Fairy-wrasse

urn:lsid:zoobank.org:act:6288E913-6AAC-49B8-97BA-493378F4E3DA

BOLD mtDNA barcode lineage BIN BOLD:ACU6080

Figures 1–4; Table 1.

**Holotype.** NTM S.18119-001, TP male, 47.3 mm SL, Australia, Northern Territory, eastern Timor Sea, approx.  $-10.70^{\circ}$ ,  $129.31^{\circ}$ , T. Green, 7 October 2016.

**Paratypes.** (same location and collector as holotype) AMS I.47790-001, TP male, 43.3 mm SL; NTM S.18120-001, 2 TP males, 42.5–43.8 mm SL and female, 39.9 mm SL; WAM P.34808-001, TP male, 41.1 SL, 7 October 2016; WAM P.34815-001, female, 39.4 mm SL, 27 April 2017.

**Diagnosis.** Dorsal-fin elements XI,9; anal-fin elements III,9; pectoral-fin rays 15; lateral-line scales 16–17 + 6–7; median predorsal scales 5; single horizontal scale rows on cheek below eye; gill rakers 13; body depth 3.6–3.7 in SL; head length 2.9–3.0 in SL; snout length 3.5–4.3 in HL; dorsal fin mostly uniform height; pelvic fins of TP male moderately elongate, reaching posteriorly to about base of first soft anal-fin ray, 2.7–3.9 in SL; caudal fin distinctly emarginate, appearing lunate in males due to tapering red bands along dorsal and ventral margins. TP male in life mainly reddish on upper half of body and bright yellow below; dorsal fin mainly yellow orange, grading to reddish basally with dark-edged white or clear bands on basal half of soft rays; anal fin scarlet red; caudal fin translucent medially with tapering red bands along dorsal and ventral margins; pelvic fins pinkish; pectoral fins translucent with brilliant red triangular mark immediately above base. Female in life rosy pink on upper two-thirds of head and body, grading to whitish ventrally; body with 4–5 narrow reddish stripes on upper half; dorsal fin pinkish yellow with faint red bands and dark brown first spine; anal fin pink with faint red bands; caudal fin with numerous transverse rows of faint red spots, except darker red along edge of lower lobe; black spot, about one-third to half pupil size, on upper side of caudal peduncle.

**Description.** Dorsal-fin elements XI,9; anal-fin elements III,9; dorsal and anal-fin soft rays branched, last to base, except first dorsal and anal ray unbranched; pectoral-fin rays 15, upper two unbranched (including rudimentary splint-like uppermost ray); pelvic-fin rays I,5; principal caudal-fin rays 13, uppermost and lowermost rays unbranched; upper and lower procurrent caudal-fin rays 4 (5–6), posteriormost segmented; lateral-line interrupted, pored scales 16 + 6 (16–17 + 6–7); scales above lateral line to origin of dorsal fin 2; scales below lateral line to anus 6; median predorsal scales 5; median preventral scales 5; single horizontal scale row on



**Figure 1.** *Cirrhilabrus greeni*, freshly collected male holotype, NTM S.18119-001, 47.3 mm SL, eastern Timor Sea (M.P. Hammer).



**Figure 2.** *Cirrhilabrus greeni*, freshly collected female paratype, NTM S.18120-001, 39.9 mm SL, eastern Timor Sea (M.P. Hammer).

cheek; circumpeduncular scales 14; gill rakers 13 (13–14); pseudobranchial filaments 11; branchiostegal rays 5; vertebrae 24 (25).

Greatest body depth 3.6 (3.6–3.7) in SL; body compressed, width 2.0 (1.8–2.1) in depth; dorsal profile of head nearly straight, becoming slightly convex on nape; head length 3.0 (2.9–3.0) in SL; snout length 4.0 (3.5–4.3) in HL; orbit diameter 3.9 (3.3–3.9) in HL; interorbital width 4.5 (4.3–4.6) in HL; caudal-peduncle depth 2.4 (2.2–2.5) in HL; caudal-peduncle length 2.0 (1.9–2.8) in HL.

Mouth small, terminal and oblique, maxilla reaching vertical at anterior nostril, upper-jaw length 4.3 (4.5–4.9) in HL; dentition typical of the genus with three pairs of enlarged canine teeth at front of upper jaw, gradually longer and more laterally recurved proceeding posteriorly; series of about 25–30 tiny conical teeth on each side of upper jaw, medial to anterior canines and continuing on side of jaw; lower jaw with a single stout pair of canines anteriorly, protruding obliquely outward and slightly lateral to medial pair of upper jaw; inner series of about 16–20 small conical teeth on each side of lower jaw; tongue short with rounded anterior edge; gill rakers small, longest on first arch about one-third length of longest gill filaments of holotype.

Posterior margin of preopercle with about 28 (24–28) tiny serrae (often difficult to detect due to overlying soft tissue); upper posterior edge of preopercle free to level of middle of pupil; anterior ventral edge of preopercle free to below about anterior margin of pupil; anterior nostril very small, in short membranous tube with posterior flap, located anterior to upper edge of eye and closer to eye than to snout tip; aperture of posterior nostril much larger than pores, with a slightly elevated rim, located posterior and slightly dorsal to anterior nostril on a vertical with anterior margin of eye; pores of cephalic lateralis system adjacent to eye from behind middle of orbit to below front of orbit 13 (10–14); pores on side of snout anterior to eye 3; pores on posterior and ventral edges of preopercle 8 (8–10), continuing as a series of 4 pores on mandible to front of chin; mid-interorbital pores 2 (3–4); pores adjacent to upper edge of eye to above posterior nostril 5 (4–6); pores from upper margin of preopercle to upper rear corner of eye 5 (4–5); series of 5 (4–5) small pores on side of nape from anterior end of lateral line to front of most anterior predorsal scale; pores across front of anterior predorsal scale 8 (8–10).

Scales cycloid; head scaled except snout, interorbital region, lips, and chin, also broad naked flange (maximum width about equal to half width of adjacent cheek scale) on posterior and ventral edges of preopercle; cheek with a single row of large cycloid scales; base of dorsal and anal fins with a row of large, pointed, elongate scales, one per inter-radial, tallest more than one-half length of adjacent dorsal-fin spines (scales progressively shorter posteriorly on membranes of soft portion of fin); base of caudal fin with three greatly enlarged scales (middle and largest about 4 times larger than body scales), middle one overlapping those above and below, almost reaching one-half distance to posterior margin of fin; pectoral fins naked; pelvic fins with a median ventral process of two elongate scales, their combined length about 85–88% length of pelvic spine and about equal in length to slender axillary scale above each pelvic fin.

Origin of dorsal fin above second lateral-line scale; dorsal fin gradually increasing in height to fourth spine,

TABLE 1

Proportional measurements of type specimens of *Cirrhilabrus greeni*, n. sp.  
as percentages of the standard length

|  | holotype        |                 | paratypes       |                 |                 |                 |                 |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|  | NTM S.<br>18119 | NTM S.<br>18120 | AMS I.<br>47790 | NTM S.<br>18120 | WAM P.<br>34808 | NTM S.<br>18120 | WAM P.<br>34815 |
|  | male            | male            | male            | male            | male            | female          | female          |
| Standard length (mm)                       | 47.3            | 43.8            | 43.3            | 42.5            | 41.1            | 39.9            | 39.4            |
| Body depth                                 | 27.9            | 27.5            | 27.7            | 27.4            | 27.5            | 26.7            | 27.5            |
| Body width                                 | 13.9            | 14.3            | 15.2            | 13.7            | 13.4            | 14.2            | 12.9            |
| Head length                                | 33.6            | 34.0            | 34.1            | 33.7            | 34.6            | 33.6            | 34.4            |
| Snout length                               | 8.4             | 9.0             | 9.8             | 8.2             | 9.1             | 7.8             | 8.7             |
| Orbit diameter                             | 8.7             | 8.8             | 9.4             | 9.1             | 9.3             | 9.5             | 10.5            |
| Interorbital width                         | 7.5             | 7.7             | 7.8             | 7.3             | 7.7             | 7.9             | 8.0             |
| Upper jaw                                  | 7.8             | 7.0             | 7.2             | 7.5             | 7.6             | 7.1             | 7.2             |
| Depth of caudal peduncle                   | 14.2            | 13.8            | 15.2            | 14.2            | 14.8            | 14.0            | 15.6            |
| Length of caudal peduncle                  | 17.2            | 16.7            | 16.7            | 17.4            | 18.0            | 12.7            | 12.2            |
| Predorsal distance                         | 34.4            | 34.7            | 35.0            | 34.3            | 35.7            | 35.5            | 33.9            |
| Preanal distance                           | 61.3            | 60.6            | 60.2            | 60.6            | 61.6            | 59.4            | 59.5            |
| Prepelvic distance                         | 34.9            | 35.6            | 34.3            | 34.9            | 36.6            | 33.4            | 34.7            |
| Length of dorsal-fin base                  | 56.8            | 58.1            | 56.7            | 57.1            | 57.1            | 57.2            | 59.7            |
| 1 <sup>st</sup> dorsal-fin spine           | 9.0             | 7.4             | 6.6             | 6.9             | 7.9             | 7.1             | 8.1             |
| 3 <sup>rd</sup> dorsal-fin spine           | 12.7            | 13.4            | 11.5            | 13.3            | 12.5            | 11.5            | 11.5            |
| Last dorsal-fin spine                      | 15.9            | 18.0            | 14.5            | 16.0            | 16.0            | 15.3            | 13.9            |
| Longest (1 <sup>st</sup> ) soft-dorsal ray | 15.7            | 17.2            | 15.6            | 17.4            | 14.4            | 15.3            | 14.9            |
| Length of anal-fin base                    | 25.8            | 26.1            | 27.0            | 25.9            | 26.6            | 26.0            | 27.7            |
| 1 <sup>st</sup> anal-fin spine             | 5.9             | 6.3             | 6.0             | 6.3             | 7.1             | 6.5             | 6.1             |
| 2 <sup>nd</sup> anal-fin spine             | 9.4             | 9.0             | 8.1             | 8.9             | 9.0             | 10.0            | 8.4             |
| 3 <sup>rd</sup> anal-fin spine             | 10.8            | 10.1            | 9.9             | 10.5            | 10.1            | 11.6            | 10.7            |
| Longest (8 <sup>th</sup> ) soft-anal ray   | 15.1            | 16.0            | 14.8            | 14.5            | 16.0            | 14.7            | 14.3            |
| Caudal-fin length                          | 37.1            | 31.6            | 32.3            | 34.6            | 38.7            | 26.1            | 27.8            |
| Caudal concavity                           | 10.4            | 6.3             | 6.4             | 7.6             | 9.4             | -               | -               |
| Pectoral-fin length                        | 20.7            | 19.2            | 20.4            | 22.0            | 22.8            | 20.7            | 23.1            |
| Pelvic-fin-spine length                    | 13.1            | 12.5            | 12.7            | 13.2            | 13.3            | 11.7            | 12.4            |
| Pelvic-fin length                          | 29.3            | 36.4            | 25.7            | 30.7            | 34.9            | 20.1            | 20.6            |

remaining spines and soft rays about subequal; first dorsal-fin spine 3.7 (4.3–5.2), third dorsal-fin spine 2.7 (2.5–3.0), last dorsal-fin spine 2.1 (1.9–2.5), all in HL; interspinous membranes extending well above spine tips, supported by a terminal cirrus projecting dorsally or posteriorly from behind each spine tip, cirrus of longest spines about one-half spine length in adult males and slightly shorter in females; longest (first or second) dorsal-fin soft ray 2.1 (1.9–2.4) in HL; origin of anal fin vertical with base of penultimate dorsal-fin spine; first anal-fin spine 5.7 (4.9–5.7), second anal-fin spine 3.6 (3.4–4.2), third anal-fin spine 3.1 (2.9–3.4), all in HL; penultimate anal-fin soft rays usually longest, 2.2 (2.1–2.4) in HL; caudal fin emarginate, 2.7 (3.6–4.3) in SL; fourth and fifth pectoral rays longest, 1.6 (1.5–1.8) in HL; origin of pelvic fins level with upper pectoral-fin base, slightly behind origin of dorsal fin; pelvic fins of males moderately elongate, reaching at least anal-fin origin or as far as base of second soft ray of anal fin, 3.4 (2.7–3.9 in male paratypes); pelvic fins of females shorter, not reaching anal-fin origin, 4.8–5.0 in SL.

**Color of TP male in life and fresh.** (Figs. 1 & 3) Upper half of body, i.e. area above line connecting upper rear edge of gill cover and middle of caudal-fin base, pink to reddish brown, ventral half of body bright yellow; head above level of lower edge of eye scarlet red, below level abruptly yellow, narrow elongated patch of blue



**Figure 3.** *Cirrhilabrus greeni*, aquarium photographs of live male holotype, 47.3 mm SL, eastern Timor Sea (M.P. Hammer).

along ventral aspect from chin to pelvic-fin base; eye with red iris and thin yellow ring around pupil; dorsal fin yellow orange, except first spine dark brown and brownish area on basal part of posterior half of fin, also series of translucent spots of variable size (sometimes merged), just above brownish area; anal fin scarlet red with fine black outer margin and 1–2 rows of brown spots or ocelli markings at base of posterior half of fin; caudal fin translucent medially with tapering red bands along dorsal and ventral margins; pelvic fins red; pectoral fins translucent with red base, also red area immediately above pectoral-fin base, confluent with red color of head. Nuptial-display changes in coloration are unknown.

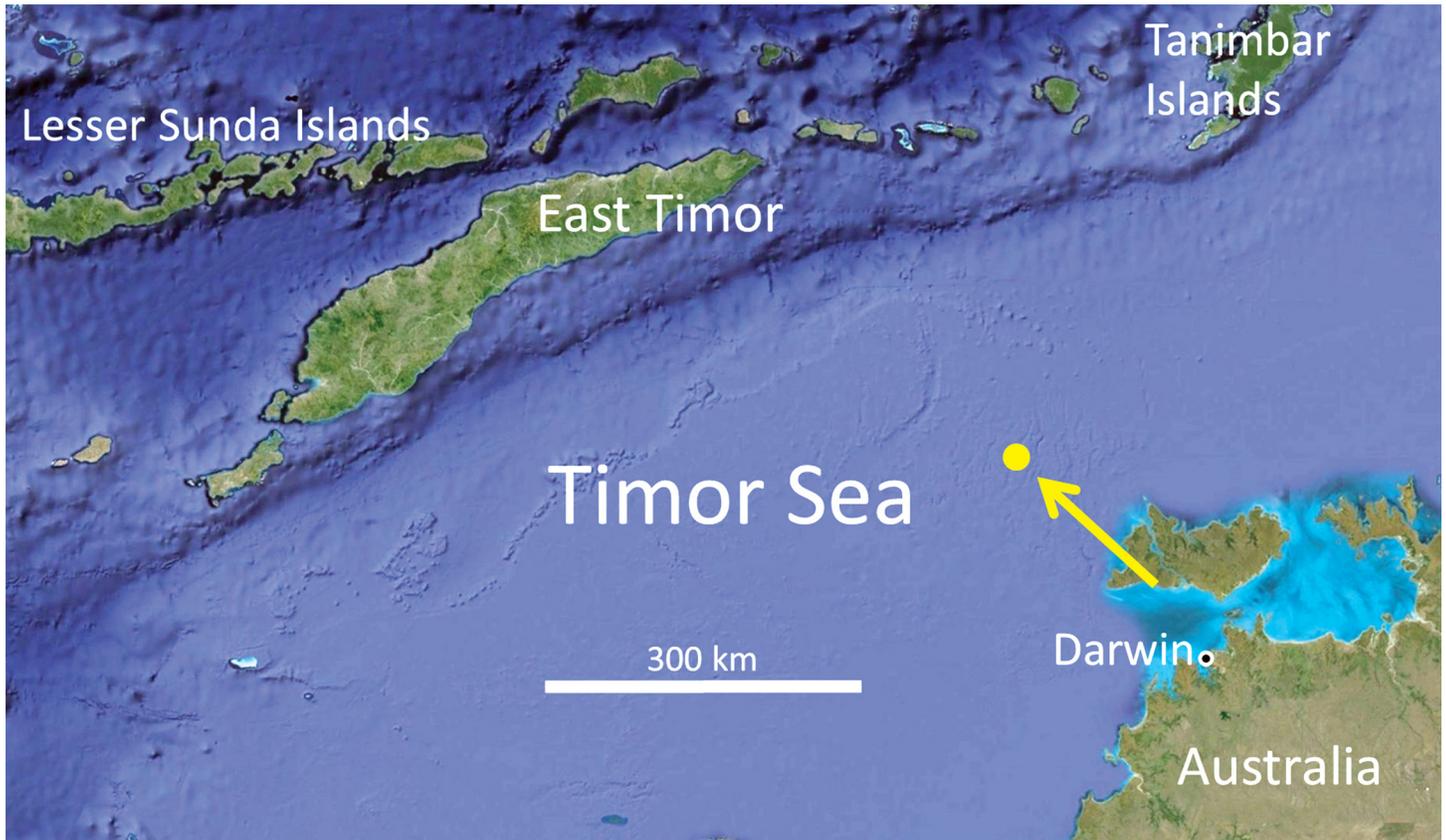
**Color of fresh female** (Fig. 2) Upper two-thirds of head and body pinkish red, with faint red to lavender stripe on each horizontal scale row, grading to slightly yellowish or whitish ventrally; a black spot, about one-third to half pupil size, on upper side of caudal peduncle; eye with pale yellow to whitish iris; dorsal fin yellowish with brown first dorsal-fin spine and oblique dark-edged translucent bands; anal fin pinkish with similar oblique bands as those on dorsal fin; caudal fin pinkish red basally, grading to translucent with faint reddish bands (and intense red “checkering” on basal part of dorsal and ventral margins; pelvic fins pale pinkish; pectoral fins translucent with conspicuous yellow base.

**Color in alcohol.** (Fig. 4) TP male with head mainly yellowish tan, except lower jaw and lowermost portion of cheek and opercle brownish; upper half of body and thoracic area brown, grading to yellowish tan on lower half of side; fins semi-translucent whitish. Female generally yellowish tan, except slightly dusky brown on upper back below middle of dorsal fin, and a small black spot on side of upper caudal peduncle; fins semi-translucent whitish.

**Etymology.** The species is named in honor of Tim Green of Monsoon Aquatics (Darwin, Australia), who collected the type specimens.



**Figure 4.** *Cirrhilabrus greeni*, preserved holotype (upper), 47.3 mm SL, and female paratype (lower), 39.9 mm SL, eastern Timor Sea (G.R. Allen).



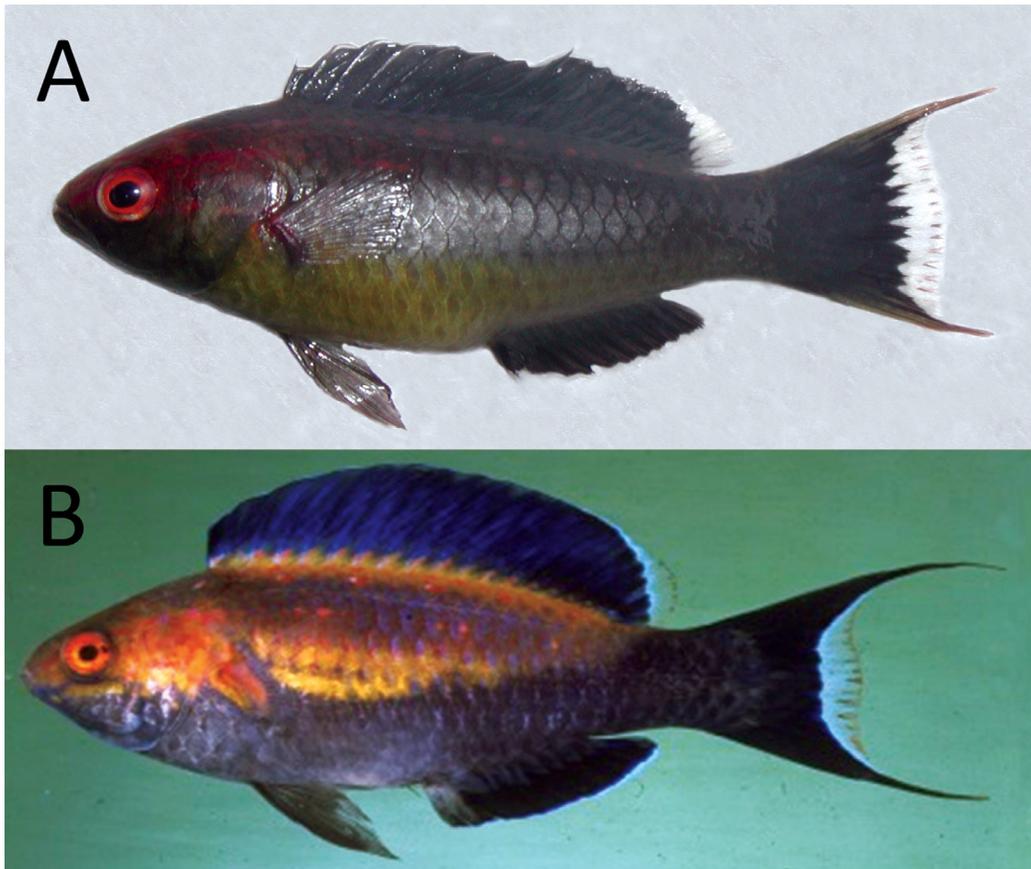
**Figure 5.** Map of Timor Sea showing collection locality (yellow spot) for type specimens of *Cirrhilabrus greeni*.

**Distribution and habitat.** The new species is currently known only from the eastern Timor Sea (Fig. 5), approximately 300 km northwest of Darwin, Australia and 300 km southwest of the Tanimbar Islands of Indonesia. It was collected and observed in depths of about 18–40 m. The habitat consists of sloping rubble bottoms with scattered low outcrops of rock or coral and occasional large coral outcrops. It co-occurs with several other members of the genus including *C. hygroxerus* and four species of undetermined status that are related to *C. cyanopleura* (Bleeker, 1851); *C. exquisitus* Smith, 1957; *C. punctatus* Randall & Kuitert, 1989; and *C. temminckii* Bleeker, 1853.

**Comparisons.** The new species exhibits a distinctive TP-male color pattern that is not likely to be confused with any other congener. The tapering red bands along dorsal and ventral margins of the caudal fin, giving the fin a lunate appearance, are particularly diagnostic. Only two other species, *C. brunneus* Allen, 2006 (Fig. 6A) from the Indo-Malayan region and *C. lunatus* Randall & Masuda, 1991 (Fig. 6B) from Japan, possess a strongly emarginate to lunate caudal fin, but they differ substantially in color pattern. The bicolor pattern with red above the lateral midline and bright yellow below is also unique among *Cirrhilabrus* species.

Females of many *Cirrhilabrus* species look similar, nevertheless the position and size of the black spot on the caudal peduncle high on the body and about one scale width proved a ready means of distinguishing the new species from specimens of sympatric congeners, especially the common *C. hygroxerus* (with a tiny spot), from the collection site.

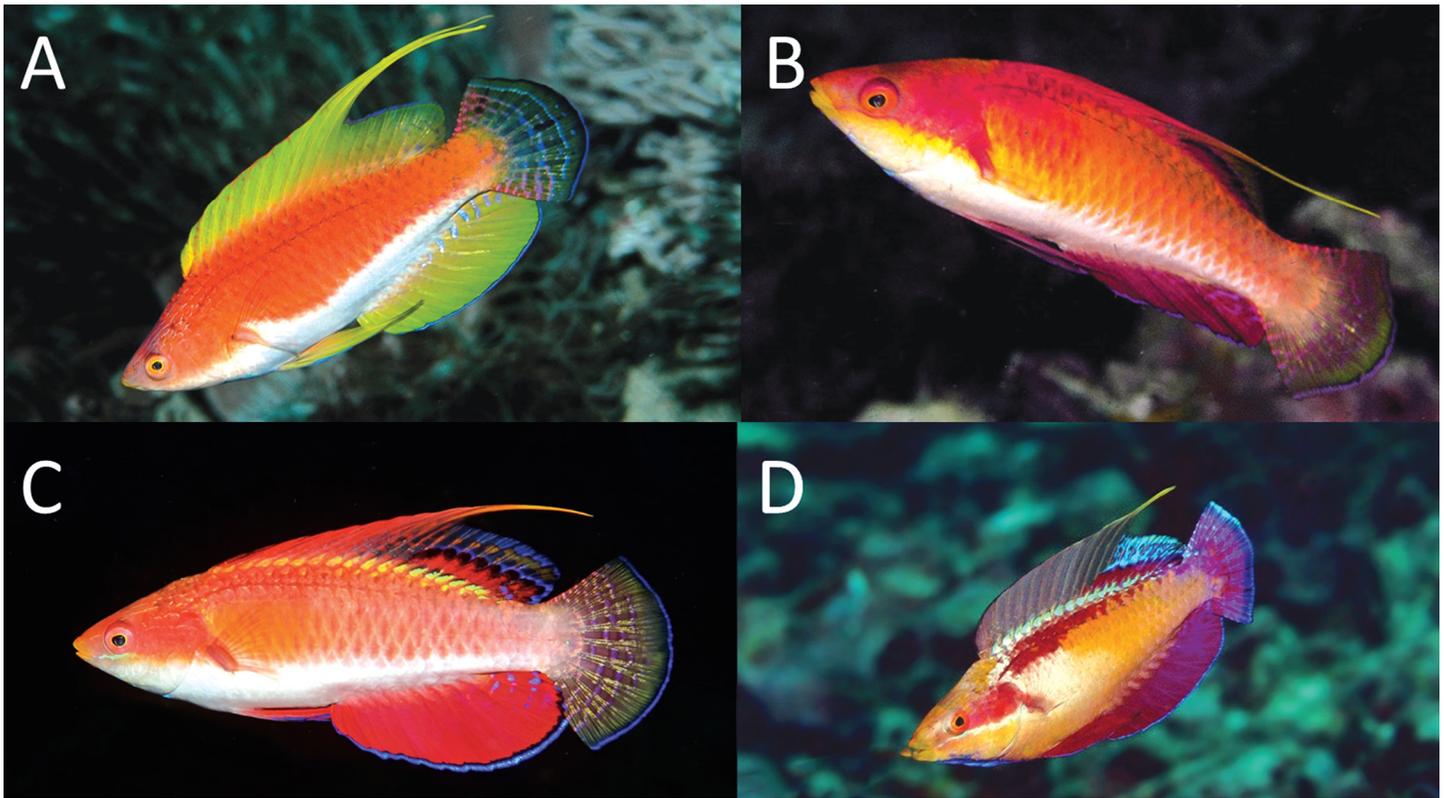
**DNA Comparisons.** The results of sequencing the mtDNA-barcode marker COI for the new species reveals that they share haplotypes with *C. rubripinnis* Randall & Carpenter 1980 (Fig. 7) from the central Philippines and *C. aff. tonozukai*, from the northern Philippines (to be described by Tea *et al.*). The other two members of the *C. rubripinnis* complex, *C. filamentosus* (Klausewitz, 1976; Fig. 8A) and *C. tonozukai* Allen & Kuitert, 1999 (Fig. 8B-D), also from the East Indian region, have not been sampled, but likely share the same mtDNA lineage as well. These species all have complex patterns based on reddish or orange color dorsally and often pale ventrally on both the head and body, but, notably, all of these allied species can be distinguished by having rounded caudal fins vs. the emarginate and lunate-appearing caudal fin of the new species.



**Figure 6.** *Cirrhilabrus brunneus*, (A) freshly collected male holotype, 43.6 mm SL, East Kalimantan, Indonesia (G.R. Allen); (B) *C. lunatus*, freshly collected male holotype, 67.7 mm SL, Ryukyu Islands (J.E. Randall).



**Figure 7.** *Cirrhilabrus rubripinnis*, underwater photos of adult males, approx. 60 mm SL, including the male nuptial display (lower right), Batangas Province, Luzon, Philippines (G.R. Allen).



**Figure 8.** *Cirrhilabrus filamentosus*, (A), underwater photo of adult male, approx. 60 mm SL, Nusa Penida, Lesser Sunda Islands, Indonesia and *C. tonozukai* (B–D), underwater photos of adult males, approx. 60 mm SL, including male nuptial display (D), West Papua Province, Indonesia (G.R. Allen).

Several other species complexes of *Cirrhilabrus* have members that share mtDNA haplotypes, despite having quite different male-display color patterns (Allen *et al.* 2015, Allen & Hammer 2016, Tea *et al.* 2016, Victor 2016, Walsh *et al.* 2017) and, in one case, also caudal-fin shapes (Tea *et al.* 2016). These “phenovariant” species likely represent recent radiations of sibling species that either have not had sufficient time to accumulate neutral mutations in the relevant genetic marker, or share mtDNA due to historic or occasional hybridization, or both (Victor 2015).

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