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Review of the labrid fishes of the Indo-Pacific Genus *Pseudocoris*, with a description of two new species

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Abstract

The Indo-Pacific labrid fish genus *Pseudocoris* Bleeker is represented by nine species: three pairs of sibling species that split between the Indian and Pacific Oceans and three endemic to various parts of the Pacific Ocean. Two of the species pairs include a new species for the Indian Ocean sibling. *Pseudocoris heteroptera* (Bleeker) is now considered limited to the Pacific Ocean, ranging from the Line Islands to Indonesia, north to Taiwan and southern Japan, and south to the Great Barrier Reef, while *Pseudocoris occidentalis* n. sp. is from the western Indian Ocean. The terminal male of both species have a large dark bar anteriorly on the body, followed by a series of irregular black bars; the Indian Ocean species differs by having shorter bars, a bright yellow anal fin in the terminal male, and the juveniles blue becoming yellow posteriorly. *Pseudocoris yamashiroi* (Schmidt) is now considered limited to the Pacific Ocean, wide-ranging from Japan, Taiwan, and the Marshall Islands, south to Samoa and New Caledonia, while *Pseudocoris hemichrysos* n. sp. is from the islands of the western Indian Ocean, including Maldives, Mascarenes, and Chagos; the terminal males of the new species differ by having a bright yellow-orange area on the rear upper body and soft dorsal fin. The third sibling-species pair had already been split; comprising the Pacific *Pseudocoris bleekeri* (Hubrecht) from Indonesia north to Ryukyu Islands, the terminal male with a broad bright yellow bar on midside of body, flanked by numerous dark bars and ovals, and *Pseudocoris petila* Allen & Erdmann, named for its slender body. The latter was described from two initial-phase specimens from the Andaman Islands, and an underwater photograph of the terminal male from NW Sumatra (the range is extended southwest to the island of Réunion and South Africa based on underwater photographs of terminal males); the terminal male of *P. petila* differs by having two yellow bars on the midside of the body. The three endemic Pacific species comprise *Pseudocoris aequalis* Randall & Walsh from the Coral Sea and southern Queensland, the terminal male bright blue without elongate anterior dorsal spines; *Pseudocoris aurantiofasciata* Fourmanoir, wide-ranging in the Pacific (with records in the eastern Indian Ocean at Christmas and Cocos-Keeling Islands), the largest species (to 193 mm SL), with the greatest body depth (to 2.9 in SL), the adult male with a

narrow white bar on the side and with two long caudal-fin filaments; and *Pseudocoris ocellata* Chen & Shao from Taiwan and Japan, the terminal male with a large, irregular, blue-edged black spot on midside. Sequences of the barcode mtDNA COI marker for all but one species of the genus (*P. ocellata* is unavailable) show the eight species to be distinct monophyletic lineages, with the sibling-species pairs from different oceans diverging 0.63% in *P. heteroptera*/*P. occidentalis*, 2.51% in *P. yamashiroi*/*P. hemichrysos*, and 1.08% in *P. bleekeri*/*P. petila*.

Key words: coral reef fishes, wrasses, Labridae, Julidinae, taxonomy, systematics, DNA barcoding, biogeography.

Introduction

The species of the Indo-Pacific labrid fish genus *Pseudocoris* are called torpedo wrasses, a fitting name for the speed at which they are able to swim. They form small aggregations from one to several meters above the substratum to feed on zooplankton. If a diver tries to swim close enough to either photograph or collect one of these fishes, it usually swims quickly away. The smaller plankton-feeding fishes, such as most of the species of *Cirrhilabrus* and *Pseudanthias*, typically take cover on the bottom when approached (where they are more easily collected). The first author has at times resorted to shooting an explosive-tipped spear to strike hard bottom when an individual of the genus *Pseudocoris* is nearby (an event not appreciated by fellow divers, even if forewarned). Another method of collecting these elusive fishes is to set a barrier net. To be successful, this generally requires two or more divers. The paucity of adult specimens of the genus *Pseudocoris* in fish collections is testimony to the difficulty of capturing them. The U.S. National Museum of Natural History has only ten lots of the genus, and the California Academy of Sciences only five.

Bleeker (1862) proposed the genus *Pseudocoris* for a species of labrid fish he first described in 1857 as *Julis (Halichoeres) heteropterus*, type locality Ambon, Molucca Islands. Günther (1862: 195) did not recognize Bleeker's genus and reclassified *heteropterus* in the genus *Coris* Lacepède. Some authors followed Günther, such as Fowler (1928: 349), Fowler & Bean (1928: 309), and Norman (1957: 345), while others such as de Beaufort (1940: 238), Herre (1953: 686), and Randall (1973: 197) reverted to Bleeker's genus.

Pseudocoris is clearly an evolutionary offshoot of the genus *Coris* adapted to feed on zooplankton in the water column. The species of *Coris* are benthic feeders on hard-shelled invertebrates. They have strong canine teeth anteriorly in the jaws and large molariform pharyngeal teeth. In contrast, the species of *Pseudocoris* have much smaller anterior canines, have lost the canine posteriorly on the upper jaw, and the pharyngeal dentition lacks large molariform teeth. The mouth is smaller, and the snout shorter, so the eyes can converge on the small animals of the plankton. The eyes are nearer the center of the head so that predators can be seen below, as well as above. Unlike in most planktivores, where the premaxilla is usually protractile and the gill rakers longer and more numerous, the species of *Pseudocoris* have remained like *Coris* for these characters. There are other examples of zooplankton-feeding fishes derived from benthic-feeding ancestors that have been considered to be distinct at the generic level (Davis & Birdsong 1973). Two examples confirmed by recent phylogenetic studies are the serranid genus *Paranthias*, type species *P. furcifer* (Valenciennes), which has arisen from benthic grouper stock of the genus *Cephalopholis* Bloch & Schneider (Craig & Hastings 2007), and the plankton-feeding chub *Sectator ocyurus* (Jordan & Gilbert), which has evolved recently from herbivorous *Kyphosus* stock (Knudson 2013); note that both works question the validity of the two derived genera based on paraphyly.

Species of *Pseudocoris* also differ from those of *Coris* in their mode of reproduction. Those of *Coris* are monandric; males are the result of sex change, attain larger size, maintain a harem, and spawn individually with their females. The species of *Pseudocoris* are diandric; there are both mature males and females in the initial color phase. Although we have not seen spawning, we may infer from more observable diandric labrids, such as those of the genus *Thalassoma*, that initial-phase *Pseudocoris* spawn in aggregations. Terminal-phase males of *Pseudocoris* probably pair spawn with initial-phase females. Our lack of information on the biology of species of *Pseudocoris* is due largely to the difficulty in observing them closely and collecting them.

Hubrecht (1876: 214) described the second species of the genus *Pseudocoris* as *Coris bleekeri*, type locality Ceram, Molucca Islands. De Beaufort (1940: 239) mistakenly treated it as a synonym of *Pseudocoris heteroptera*. Fowler & Bean (1928: 309) named a third species of *Pseudocoris* as *Coris philippina*. Schmidt (1930: 85–88)

described three more as *Julis yamashiroi*, *J. awayai*, and *J. albolumbata*, all from Okinawa. Fourmanoir (1971) described the fourth species *P. aurantiofasciatus* from the Tuamotu Archipelago. Araga in Masuda *et al.* (1984: 210) correctly linked *P. awayai* (Schmidt) as the male of *P. yamashiroi* and listed the three species of the genus from Japan as *P. heteropterus*, *P. philippina*, and *P. yamashiroi*. Gomon in Fischer & Bianchi (1984: 10) recorded *P. heteroptera* and *P. yamashiroi* in a list of labrid fishes of the western Indian Ocean, and Winterbottom *et al.* (1989: 55) reported and illustrated the same two species from the Chagos Archipelago. Chen & Shao (1995) added a fifth species, *P. ocellata*, from Taiwan. Parenti & Randall (2000: 36) included five species of *Pseudocoris* in a checklist of labroid fishes; *P. philippina* and *P. albolumbata* were considered synonyms of *P. bleekeri*. Randall & Walsh (2008) described the sixth species, *P. aequalis*, from Holmes Reef in the Coral Sea, and Allen & Erdmann (2012) described the seventh, *P. petila*, from two initial-phase specimens from the Andaman Islands and an underwater photograph of a terminal male from Pulau Weh off the NW tip of Sumatra. Taquet & Diringer (2012: 494) illustrated a male from an underwater photograph taken at the island of Réunion as *Pseudocoris* cf. *bleekeri*, which is clearly a terminal-phase *P. petila*.

Materials and Methods

Specimens of the genus *Pseudocoris* were examined at or obtained from the Australian Museum, Sydney (AMS); Museum of the Research Center for Biodiversity, Academia Sinica, Taipei (ASIZP); The Natural History Museum, London (BMNH); Bernice P. Bishop Museum, Honolulu (BPBM); Muséum national d'Histoire naturelle, Paris (MNHN); Queensland Museum, South Brisbane (QM); Nationaal Natuurhistorische Museum, Leiden (RMNH); Royal Ontario Museum, Toronto (ROM); South African Institute for Aquatic Biodiversity, Grahamstown (SAIAB); United States National Museum of Natural History, Washington, D.C. (USNM); and the Zoological Museum, Amsterdam (ZMA).

Lengths of specimens are given as standard length (SL), measured from the base of the caudal fin (posterior end of hypural plate) to the median end of the upper lip or canine tooth, whichever is most anterior; head length is measured from the same anterior point to the posterior end of the opercular flap, and upper-jaw length from the same anterior point to the posterior end of the maxilla; body depth is the greatest depth from the base of the dorsal spines to the ventral margin of the abdomen (correcting for any obvious malformation of preservation); body width is taken just posterior to the gill opening; orbit diameter is the greatest fleshy diameter; interorbital width the least bony width; caudal-peduncle depth is the least depth, and caudal-peduncle length the horizontal distance between verticals at the rear base of the anal fin and base of the caudal fin; lengths of spines and rays of median fins are measured to their extreme bases; caudal concavity is the horizontal distance between tips of the longest and shortest rays; pectoral-fin length is the length of the longest ray; pelvic-fin length is measured from the base of the pelvic spine to the tip of the longest ray.

Counts of pectoral-fin rays include the rudimentary upper ray. Lateral-line scale counts do not include the one or two pored scales on the base of the caudal fin. Scales above the lateral line are counted in an oblique row below the last dorsal spine, not including dorsalmost scales less than half diameter of adjacent lower scale. If the dorsalmost scale is more than half the lower scale size, it is included in the count. Some scale counts could not be made due to spear damage of specimens. Gill-raker counts include rudiments. Vertical bands in color descriptions are referred to as bars, and horizontal ones as stripes. In descriptions of new species, data in parentheses refer to paratypes. Proportional measurements in the text are rounded to the nearest 0.05.

DNA extractions were performed with the NucleoSpin96 (Machery-Nagel) kit according to manufacturer specifications under automation with a Biomek NX liquid-handling station (Beckman-Coulter) equipped with a filtration manifold. A 652-bp segment was amplified from the 5' region of the mitochondrial COI gene using a variety of primers (Ivanova *et al.* 2007). PCR amplifications were performed in 12.5 µl volume including 6.25 µl of 10% trehalose, 2 µl of ultra pure water, 1.25 µl of 10× PCR buffer (10mM KCl, 10mM (NH₄)₂SO₄, 20mM Tris-HCl (pH8.8), 2mM MgSO₄, 0.1% Triton X-100), 0.625 µl of MgCl₂ (50mM), 0.125 µl of each primer (0.01mM), 0.0625 µl of each dNTP (10mM), 0.0625 µl of *Taq* DNA polymerase (New England Biolabs), and 2 µl of template DNA. The PCR conditions consisted of 94°C for 2 min., 35 cycles of 94°C for 30 sec., 52°C for 40 sec., and 72°C for 1 min., with a final extension at 72°C for 10 min. Specimen information and barcode sequence data from

this study were compiled using the Barcode of Life Data Systems (Ratnasingham & Hebert 2007). The sequence data is publicly accessible on BOLD and GenBank. Sequence divergences were calculated using BOLD with the Kimura 2-parameter (K2P) model generating a mid-point rooted neighbor-joining (NJ) phenogram to provide a graphic representation of the species' sequence divergence. Genetic distances were calculated by the BOLD algorithm both as uncorrected p-distances and as K2P distances.

Genus *Pseudocoris* Bleeker

Pseudocoris Bleeker 1862: 411 [type species, *Julis (Halichoeres) heteropterus* Bleeker, by original designation].

Diagnosis. Dorsal-fin rays IX,12; anal-fin rays III,12 or 13; principal caudal rays 14, the middle 12 branched; pectoral-fin rays 12–15 (13 with rare exceptions in all but one species; modally 14 in *P. ocellata*), the uppermost rudimentary; pelvic rays I,5; lateral line continuous, deflected downward below posterior part of dorsal fin, the pored scales 64–81; scales small and cycloid; head naked; no scales on base of dorsal and anal fins; small scales basally on caudal fin; gill rakers 15–23; branchiostegal rays 5; vertebrae 9 + 16; body depth 2.9–5.0 in SL; body moderately compressed, the width 1.6–2.3 in body depth; head length 3.1–3.7 in SL; snout short, 3.3–4.4 in head length; eye nearly midlateral on head; mouth terminal, oblique, and small, the maxilla not reaching posterior to anterior edge of orbit; a single pair of protruding, slightly recurved and laterally curving, canine teeth anteriorly in jaws, the lower pair fitting between upper pair when mouth closed; side of jaws with a single row of strong conical teeth, the largest about one-half length of anterior canines; no canine at corner of mouth; very small low nodular teeth in a dense band medial to teeth on side of jaws; pharyngeal teeth small, most bluntly conical, a few peripheral teeth sharper, none molariform as seen in species of *Coris*; lips thin; dorsal spines flexible, the first two closer together than remaining spines, at least in adults; first dorsal spine of males prolonged (except one species), and the second spine may also be longer than remaining spines; caudal fin varying from slightly rounded to emarginate or double emarginate, the terminal male of one species with very long filamentous upper and lower principal caudal rays; pelvic fins short. Color changing greatly with growth and with sex change.

Remarks. The species of *Pseudocoris* are known only from the Indo-Pacific region, ranging from the east coast of Africa to the Line Islands and Tuamotu Archipelago. None are reported from the Red Sea, Hawaiian Islands, or eastern Pacific Ocean. Because of the importance of color to separate the species of this genus and the variation in color with growth and sex change, many color figures are provided. Confirmation of zooplankton-feeding was provided for the following three species by Randall & Walsh (2008): *P. aurantiofasciata*, *P. heteroptera*, and *P. yamashiroi* from analysis of stomach contents (i.e. copepods, appendicularian tunicates, echinoid larvae, pteropods, foraminiferans, heteropods, amphipods, and unidentified crustacean fragments).

TABLE 1
Range of lateral-line scale counts for species of *Pseudocoris*
(both sides counted separately)

	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
<i>P. aequalis</i>												2			1			
<i>P. aurantiofasciata</i>										3	2	3	1	1			1	
<i>P. ocellata</i>	1		2		3	2												
<i>P. bleekeri</i>					1	1		2	1		1		1		1			
<i>P. petila</i>									1			1						
<i>P. yamashiroi</i>	2	1		2	2	1	4	6	5	4	3							
<i>P. hemichrysos</i> , n. sp.			1	1	1		1		2	1			1	2				
<i>P. heteroptera</i>								3	1	8	7	4	2	1	1			
<i>P. occidentalis</i> , n. sp.						1			2	7	6	5	5	2	4	2	1	1

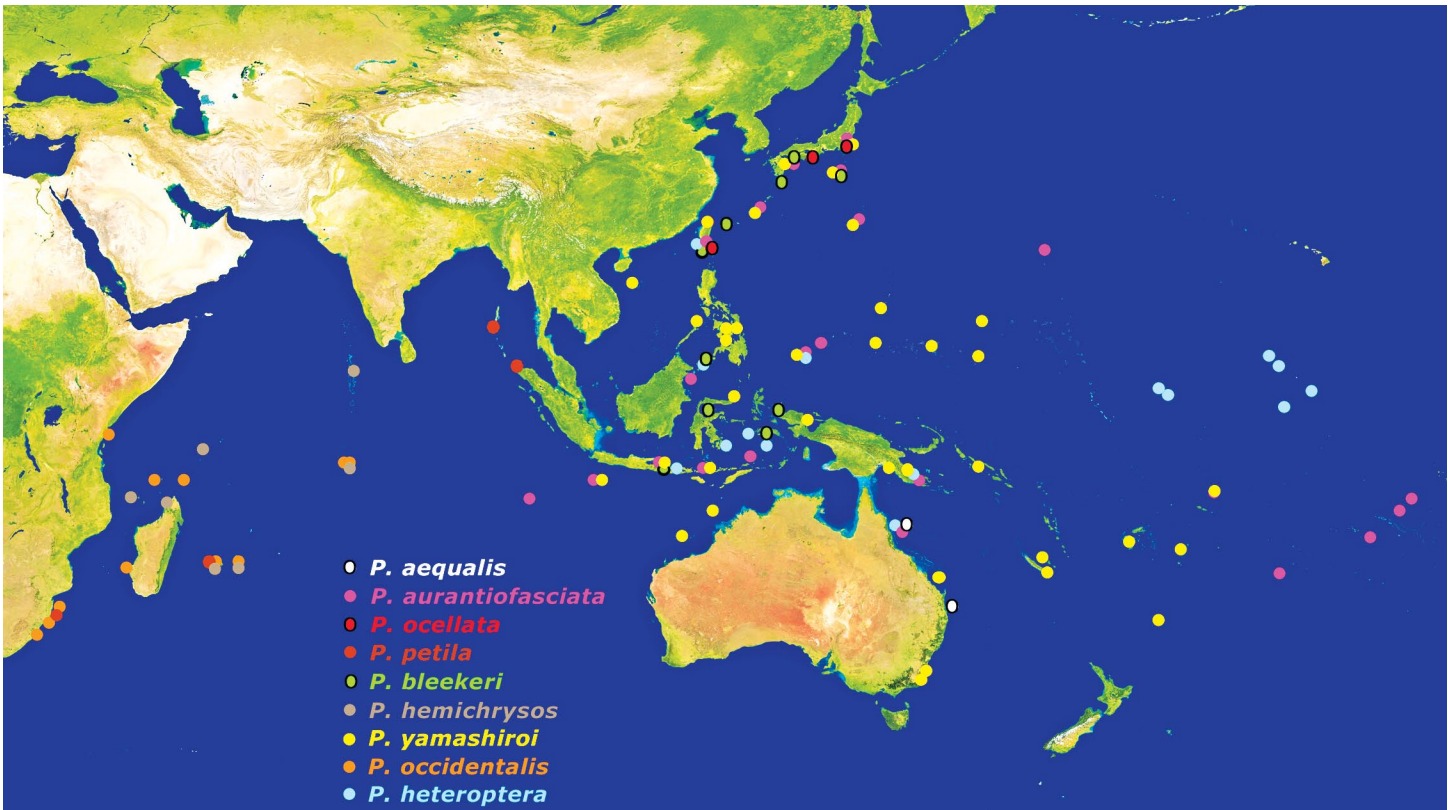


Figure 1. Known distributions of species of the genus *Pseudocoris*; symbols represent either specific collection data or, when a species is known for a large continental area such as Western Australia or a large island such as Sumatra, but without any specific localities within these areas, a single central coastal location is designated or an area where heaviest collecting would be expected is denoted.

Key to the Species of the Genus *Pseudocoris*

- 1a. Pectoral-fin rays 14 (occasional 13 or rare 15); lateral-line scales 64–69; body width of adults 1.8–2.0 in body depth; scales above lateral line 4; initial phase yellowish to coppery with thin dark stripes across the operculum and a round black spot slightly smaller than the eye at the base of the caudal fin above the lateral midline; terminal male with a large, irregular, blue-edged black spot or two on side of body and irregular blue stripes on head (Taiwan and Japan)***P. ocellata*** (p.46)
- 1b. Pectoral-fin rays 13 (rarely 12 or 14); lateral-line scales 64–81; body width of adults 1.9–2.7 in body depth (except *P. petila*, with width 1.6–1.8 in depth); scales above lateral line 4 or 5; color not as in 1a.2
- 2a. Dorsal fin of terminal male not elevated anteriorly; scales above lateral line 5; upper half of body of terminal males blue, lower half of body abruptly white; several thin dark stripes from behind upper eye to end of opercular flap; larger IP with upper half of body dusky orange to violet to blue-green, abruptly paler on lower half, with a darker wide band from front of snout through eye, ending in a dark spot on opercular flap; smaller fish orangish with two white stripes on the head above and below the eye; iris reddish orange (Coral Sea to southern Queensland)***P. aequalis*** (p.39)
- 2b. Dorsal fin of terminal males with extensions of first two spines; scales above lateral line 4 (except for *P. heteroptera* and *P. occidentalis*); color not as in 2a3

- 3a. Adults wide-bodied, body depth 2.9–3.1 in SL; terminal male with a long filament from upper and lower corners of caudal fin; juvenile prominently striped with three broad dark stripes from snout to tail; initial phase mostly unmarked and mainly blue-green to gray or brownish red with yellow lips; terminal males light blue to dark blue to brown or purplish black, with several narrow orange and dark alternating bars on anterior body, usually ending with a more prominent white narrow bar; attains 18.9 cm SL (Indonesia and Cocos-Keeling Islands to Tuamotu Archipelago) ***P. aurantiofasciata*** (p.41)
- 3b. Body depth of adults 3.15–5.0 in SL; no long filament from upper and lower corners of caudal fin of adult male (except some *P. heteroptera* and *P. occidentalis*); color not as in 3a4
- 4a. Initial phase with dark spot about eye size on upper caudal-fin base, terminal male with yellow midbody bar.....5
- 4b. Initial phase without dark spot on upper caudal-fin base, terminal male without midbody yellow bar.....6
- 5a. Initial phase body uniformly pinkish, fins yellowish; terminal male with a midlateral row of short dark bars and dark ovals on upper body, a single midbody yellow bar, dorsal fin mostly orange-yellow (East Indies north to southern Japan) ***P. bleekeri*** (p.31)
- 5b. Initial phase with prominent salmon and blue-gray bands along body and small blue spots on dorsal fin; terminal male with broad black midlateral band underlined with a wavy blue stripe, two midbody yellow bars, dorsal fin dark with blue base and edge (Andaman Islands, NW Sumatra, Réunion, and South Africa)..... ***P. petila*** (p.36)
- 6a. Scales above lateral line at base of ninth dorsal spine 4; no dark spot on opercular flap; terminal males with dark upper two thirds of head and body, abruptly white below, dark body with numerous irregular short dark bars and spots7
- 6b. Scales above lateral line at base of ninth dorsal spine 5 or 5.5; a dark spot on opercular flap in both IP and TP; terminal males with 4–9 prominent irregular black bars and ovals on rear half of body8
- 7a. Terminal males with uniformly dark spinous and soft dorsal fin, upper rear body greenish yellow and almost obscured by numerous small dark bars and spots (Japan, Taiwan, Marshall Islands, south to Samoa and New Caledonia) ***P. yamashiroyi*** (p.21)
- 7b. Terminal males with bright yellow-orange soft dorsal fin and unobscured yellow-orange patch on upper rear body (Maldives, Mauritius, and Chagos Archipelago) ***P. hemichrysos*, n. sp.** (p.26)
- 8a. Juveniles usually white with two dark brown stripes; terminal males with 4–7 dark bars on the rear body, extending the full body depth and touching the bases of the median fins, and a dark blue to black anal fin with a basal yellow band; gill rakers 18–21, modally 20 (Line Islands to western Pacific) ***P. heteroptera*** (p.7)
- 8b. Juveniles blue and orange with two dark brown stripes; terminal males with 7–9 short dark bars and ovals on the rear body, not extending to the fin bases, anal fin yellow without a dark edge; gill rakers 17–20, modally 19 (western Indian Ocean) ***P. occidentalis*, n. sp.** (p.13)

Pseudocoris heteroptera (Bleeker)

Figures 1–7, Table 1.

mtDNA COI barcode-lineage BIN number: BOLD:AAH8268 (in part)

Julis (Halichoeres) heteropterus Bleeker 1857: 78 (Ambon, Molucca Islands).

Pseudocoris heteroptera Bleeker 1861: 411 (Ambon); Bleeker 1862: 90, pl. 19, fig. 1 (Ambon); Myers 1999: 200, pl. 127 F, G (Palau in Micronesia); Parenti & Randall 2000: 36 (western Pacific); Kuitert 2002: 177, figs. A–H (northeast Australia); Allen & Adrim 2003: 50 (Indonesia); Allen *et al.* 2003: 226, lower 2 figs. (southern Japan and Papua New Guinea); Kuitert & Tonozuka 2004: 505, 8 figs. (Flores and Bali, Indonesia); Allen *et al.* in Hoese *et al.* 2006: 1407 (northwest Australia); Randall & Walsh 2008: 49, figs. 8–11 (Kiritimati, Line Islands to western Pacific); Mundy *et al.* 2010: 36 (Howland & Baker in the Phoenix Islands; Jarvis, Palmyra, & Kingman Reef in Line Islands); Kuitert 2010: 323, figs. A, C–F (Bali, Flores, and Queensland); Allen & Erdmann 2012: 713, 3 figs. (western Pacific).

Coris heteroptera Günther 1862: 206 (Ambon); Fowler 1928: 349 (Ambon).

Pseudocoris heteropterus Fowler & Bean 1928: 686 (Ambon); Herre, (1953: 686 (Philippines); Westneat in Randall & Lim 2000: 629 (South China Sea); Motomura & Matsuura 2010: 171 (Yaku-shima Island).

Pseudocoris bleekeri (*non* Hubrecht 1876) Fricke & Kulbicki 2006: 343 (New Caledonia); Fricke & Kulbicki 2007: 387 (New Caledonia).

Diagnosis. Dorsal-fin rays IX,12; anal-fin rays III,12; pectoral-fin rays 13 (rare 12); lateral-line scales 71–78; scales above lateral line at base of ninth dorsal spine 5; gill rakers 5–6 + 12–15, total 18–21 (modally 20); body depth varying from 4.2–4.8 in SL of juveniles to 3.15 in large adults; body compressed, the width 2.3–2.5 in body depth; dorsal profile of head a slight sinuous curve (slightly concave above eye, becoming convex on nape); head length 3.3–3.5 in SL; snout short, 3.8–4.0 in head length; orbit diameter varying from 4.8 in head length of a 60-mm subadult to 6.5 in a 160-mm adult; first dorsal spine of initial phase short, about 2.5–3.0 in head length, to 1.7 in large terminal male; second dorsal spine about three-fourths length of first spine; caudal fin of juveniles slightly rounded to truncate, emarginate in adults, the lobes prolonged and attenuate in large terminal males, the caudal concavity up to 2.0 in head length; pelvic fins short, 1.9–2.4 in head length. Largest specimen, the holotype, a terminal male 169.5 mm SL. Largest female examined, 137 mm SL, from Madang, Papua New Guinea.

Color in alcohol. Juveniles yellowish white with two dark brown stripes, both commencing at tip of snout, one middorsal ending at rear base of dorsal fin, the other enclosing upper two-thirds of eye, passing along side of body above base of pectoral fin, and ending narrowly on base of caudal fin above end of lateral line.

Initial phase medium brown, a little darker on opercular flap; dorsal and anal fins orangish brown; caudal fin with dark brown lobes, broadly joined in dark brown across base, with a large hemispherical centroposterior translucent area with pale yellow rays; paired fins translucent with pale yellow rays.

Body of terminal males dark brown anteriorly, becoming abruptly lighter brown posterior to tip of pectoral fin, with a series of irregular dark brown bars that typically extend from the base of the dorsal fin to the base of the anal fin. Anal fin with dark distal stripe.

Color in life. Juveniles have two dark lateral stripes (vs. three in the similarly striped juvenile of *P. aurantiofasciata*). The background color is white to bluish with a dark brown mid-lateral stripe from front of

snout, enclosing upper two-thirds of eye, passing along side of body equal or wider than orbit diameter, a second brown stripe from middorsally on front of snout, continuing below base of dorsal fin, narrowing and ending at rear base of fin; median fins mostly whitish to yellow to orange, dorsal fin with one or more rows of bluish white spots on the membranes (Fig. 2). Larger juveniles lose the orange band on the lower rear body and develop dark upper and lower margins of the caudal fin. An 80-mm individual with the two lateral stripes (Fig. 2, bottom), initially considered to be a subadult from its color and small size, proved to be a mature female on internal examination.

Initial-phase fish range from greenish yellow to brownish orange, with orangish median fins. The two dark



Figure 2. *Pseudocoris heteroptera*, initial phase; **top:** BPBM 34200, 31 mm SL, Tukanbesi Islands, Indonesia (J.E. Randall); **middle:** BPBM 34202, 60 mm SL, Lombok, Indonesia (J.E. Randall); **bottom:** BPBM 15851, 80 mm SL, Madang, Papua New Guinea (J.E. Randall).

stripes along the body can persist into larger initial-phase females (Fig. 3, bottom & Fig. 4, top). As the initial-phase fish become larger, the stripes become less distinct and the color becomes more uniform greenish to bluish yellow; the rows of bluish white spots on the dorsal-fin membranes fade; the anal fin develops a distinct bicolor pattern with a basal yellow band and a distal dark band; and the black stripes on the upper and lower margins of the caudal fin become more intense and contrasting (Fig. 5). As the lateral stripe disappears, an irregular dark blotch remains on the opercular flap. The iris changes from dark, as part of the mid-lateral stripe, to orange or reddish.

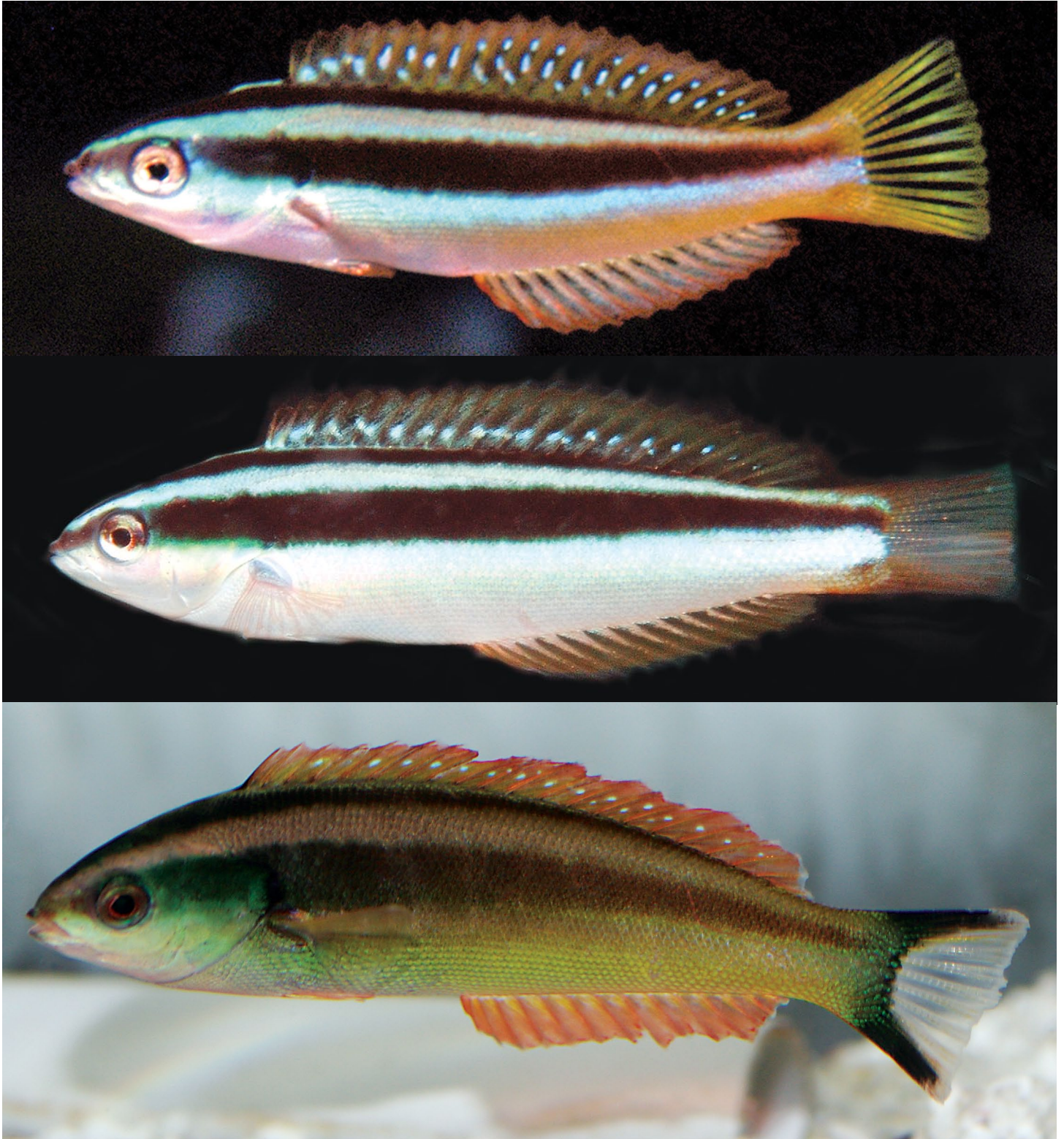


Figure 3. *Pseudocoris heteroptera*, initial phase; **top:** Ulithi, Micronesia (G.R. Allen); **middle:** Papua New Guinea (G.R. Allen); **bottom:** Holmes Reef, Coral Sea (F. Walsh).

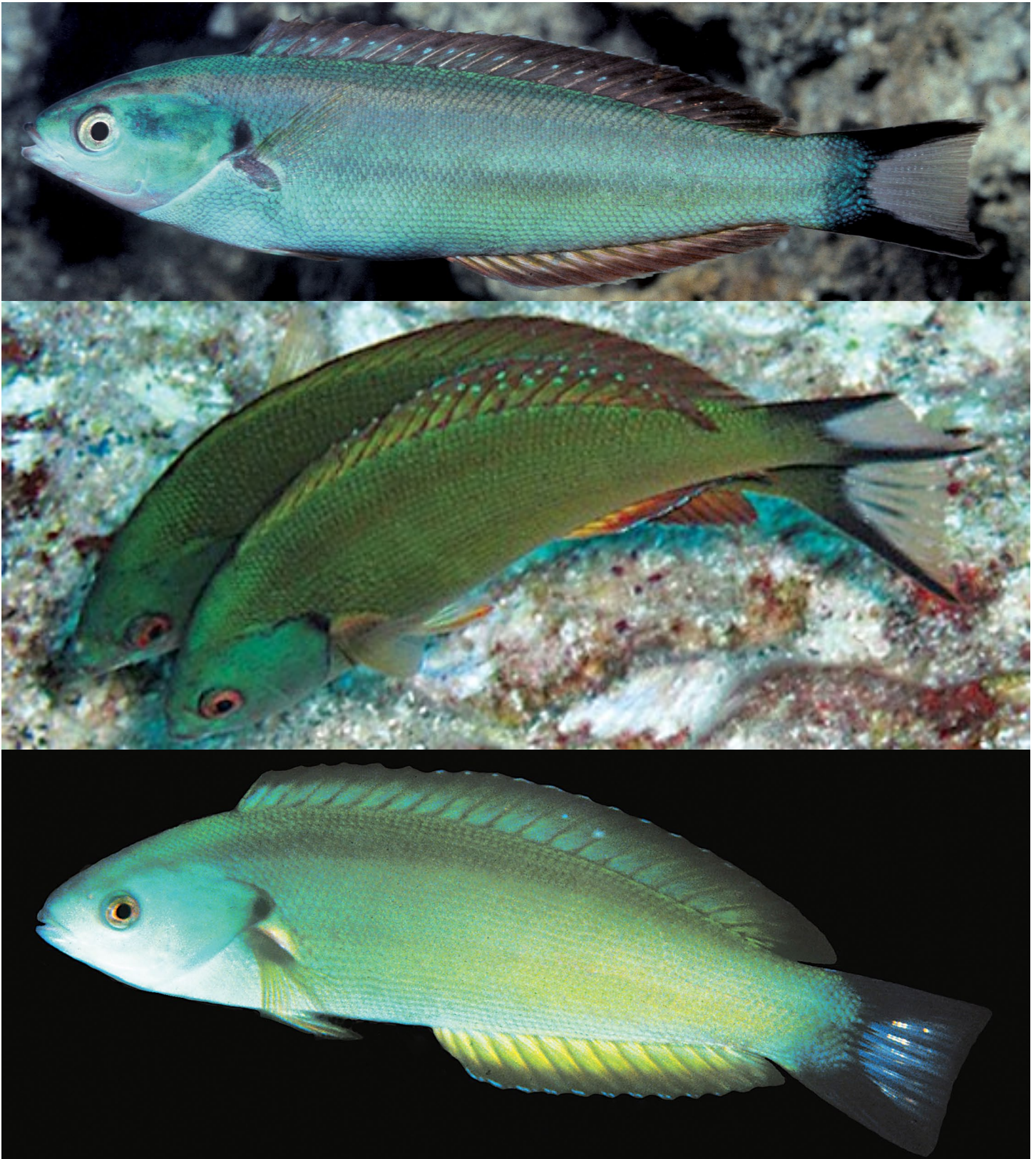


Figure 4. *Pseudocoris heteroptera*, initial phase; **top:** aquarium photograph, estimated 110 mm TL, Kiritimati, Line Islands (J.E. Randall); **middle:** Palau (cruisecontrol.jp); **bottom:** estimated 120 mm TL, Bali, Indonesia (J.E. Randall).

Terminal males range from blue-green to turquoise to dark blue on the head and forebody, grading to greenish yellow to bright yellow on the rear body, with a wide black bar anteriorly on body behind the pectoral-fin base, followed by four to seven narrower irregular black bars that typically extend the full depth of the body and onto the dorsal and sometimes the anal-fin membranes; a distinct small black rounded spot on opercular flap; dorsal fin mostly dark with yellow basal extensions of the light body bars; anal fin either bicolored with a broad basal

yellow stripe and dark distal stripe or all black with basal patches of yellow under the light bars of the rear body; caudal fin with black base and upper and lower margins (Fig. 5); larger mature males with long black filamentous extensions on the upper and lower caudal-fin lobes (Figs. 6 & 7).

Remarks. Previously considered a single pan-Indo-Pacific species, the western Indian Ocean population is described here (section below) as a new species. The two sibling species differ slightly in the number of lateral-line scales (Table 1) and in the number of gill rakers, as well as in the coloration of juveniles and the terminal-phase male. There is, in addition, a 0.63% sequence difference in the mtDNA COI barcode gene (minimum interspecific difference by K2P & uncorrected pairwise). The present distribution of *P. heteroptera* is unusual. For the western Pacific, Allen & Erdmann (2012: 713) included Indonesia, Malaysia, Papua New Guinea, Philippines, and Solomon Islands, as well as Christmas Island (the specific identity of this far eastern Indian Ocean island population near Indonesia is uncertain). Their record from the Philippines is based on the high probability of its occurring there because it is known to the north and south. Allen (pers. comm.) has sight records of four individuals for the Solomon Islands. Fricke *et al.* (2011) extend the reported range south to multiple locations in New Caledonia. Masuda & Kobayashi (1994: 275, fig. 4) illustrated a subadult from Kochi Prefecture that appears to be the only published record for Japan, none were observed by Nishiyama & Motomura (2012) in their extensive photographic survey of the wrasses of Japan. The first author speared a specimen in southern Taiwan (BPBM 23444: 48 mm SL) for the first record for the island. For Micronesia, Myers (1999: 200, pl. 127, figs. F, G) reported the species from Palau and Allen photographed a juvenile at Ulithi (Fig. 3, top). The only other localities for Oceania are Howland and Baker in the Phoenix Islands and the Line Islands, far to the east, with no records between these low islands and Micronesia. The Equatorial Counter Current could account for the eastward distribution, but one would expect to find localities between Palau and the Phoenix and Line Islands, such as the



Figure 5. *Pseudocoris heteroptera*, terminal males; **upper:** Ribbon Reef, GBR, Australia (F. Walsh); **lower:** estimated 150 mm TL, Kiritimati, Line Islands (J.E. Randall).



Figure 6. *Pseudocoris heteroptera*, terminal male, aquarium trade (wavichian, Bangkok, internet photograph).

Marshall Islands and Mariana Islands, where this species should be found, but there are no records, despite the fact that these two archipelagos are among the most extensively collected for fishes in the Pacific Ocean. Randall & Walsh (2008) reported a specimen from Holmes Reef in the Coral Sea. The most southern record for the Pacific is Ribbon Reef in the northern Great Barrier Reef (Fig. 5 upper).

Bishop Museum specimens of *P. heteroptera* have been collected from the depth range of 7–27 m. Myers (1999: 200) gave the depth range as 2–54 m. This species is typically found in outer-reef areas of moderate to strong current where it forms small aggregations to feed on zooplankton well above the substratum (to 10 m above, as reported by Myers [1999]), hence higher than the usual plankton feeders of such genera as *Cirrhilabrus* and *Chromis*. Smaller initial-phase individuals have been observed to join aggregations of the similarly-colored initial-phase individuals of the labrid *Thalassoma amblycephalum* (Bleeker), another example of social mimicry (Randall & McCosker 1993).

Material Examined: INDONESIA: Molucca Islands, Ambon, BMNH 1864.5.15.30, 169.5 mm SL (holotype), BPBM 18521, 2: 55–61 mm SL; Banda Islands, BPBM 36575, 109 mm SL; Penyu Islands, BPBM 36562, 66 mm SL; Sulawesi, Tukanbesi Islands, BPBM 34200, 31 mm SL, BPBM 34202, 4: 59–100 mm SL; Lombok, BPBM 30039, 137 mm SL. PAPUA NEW GUINEA: Madang, BPBM 15825, 111 mm SL, BPBM 15851, 3: 80–150 mm SL. CORAL SEA: Holmes Reef, BPBM 40875, 61.5 mm SL. TAIWAN: Nan Wan, BPBM 23444, 48 mm SL. LINE ISLANDS: Kiritimati Atoll, BPBM 37587, 2: 42–68 mm SL.



Figure 7. *Pseudocoris heteroptera*, terminal male, Bali, Indonesia (W. White, CSIRO, Australian National Fish Collection).

***Pseudocoris occidentalis*, n. sp.**

Figures 1, 8–14, Tables 1 & 2.

mtDNA COI barcode-lineage BIN number: BOLD:AAH8268 (in part)

Pseudocoris heteroptera [non Bleeker] Gomon in Fischer & Bianchi 1984: 10 (WIO fish list); Winterbottom *et al.* 1989: 55, pl. 8 B (Chagos Archipelago); Randall & Van Egmond 1994: 58 (St. Joseph & Poivre Atolls, Seychelles); Kuitert 2010: 323, fig. B (South Africa); Taquet & Diringer 2012: 495, fig. (Réunion).

Pseudocoris sp. Kuitert 2002: 178, figs. A–C (KwaZulu-Natal).

Pseudocoris cf. *heteroptera* Taquet & Diringer 2012: 494 (South Africa and Madagascar to Seychelles).

Holotype. BPBM 41222, male, 154 mm SL, near Mombasa, Kenya, aquarium collectors, June 1, 2014.

Paratypes. USNM 233569, 68.5 mm SL, Indian Ocean, Seychelles, Aldabra Atoll, 9°23'54" S, 46°12'36" E, just south of La Passe Du Bois, 0–3 m, rotenone, H.A. Fehlmann, Aug. 19, 1967; BPBM 21079, 10: 67–120 mm SL, Aldabra, mouth of Passe Gionnet, 27.5 m, and mouth of Passe Dubois, 6 m, spear, D.R. Robertson, Aug. 26, 1975; ROM 36644, 39.5 mm SL, Chagos Archipelago, Salomen Atoll, between Isle Anglaise and Isle Diabole, drop-off, 15–24 m, rotenone, R. Winterbottom *et al.*, March 19, 1979; ROM 36643, 2: 33–36 mm SL, Chagos Archipelago, Peros Banhos Atoll, pass between Isle Anglaise and Isle Montpatre, drop-off, 15–24 m, rotenone, R. Winterbottom *et al.*, March 30, 1979; SAIAB 51991, 65 mm SL, Mauritius, Flic en Flac, 20°20' S, 57°33' E, D. Pelicier, Jan. 1, 1988; BPBM 35544, 2: 50–53 mm SL, Seychelles, Amirantes, St. Joseph Atoll, south side, 13–15 m, quinaldine & spear, J.E. Randall, Dec. 28, 1992; SAIAB 55785, 66 mm SL, South Africa, KwaZulu-Natal, Tiger Reef (3 km south of Protea Banks), 30.867°S, 30.450°E, M. Fraser, P.C. Heemstra, and D.R. King, Feb. 2, 1998; SAIAB 57382, 38 mm SL, KwaZulu-Natal, Tiger Reef, D.R. King, Feb. 2, 1998; SAIAB 58491, 55 mm SL, Mauritius, Flic en Flac, 20°20' S, 57°33.3' E, D. Pelicier, June 1, 1998; SAIAB 60273, 45 mm SL, KwaZulu-Natal, Aliwal Shoal off Scottburgh, 30.299°S, 30.816°E, P.H. Heemstra & W. Holleman, April 23, 1999; SAIAB 187899, 130 mm SL, KwaZulu-Natal, Cape Vidal, 28°9.68' S, 32°33.65' E, multiprong spear, A. D. Connell, Jan. 15, 2010; SAIAB 188276, 39 mm SL, KwaZulu-Natal, Cape Vidal, 28°09.682' S, 32°33.649' E, A.D. Connell, Jan. 15, 2010; SAIAB 188936, 7: 119–164 mm SL, Mozambique, Techobanine, coral reef & adjacent sand, 26°40.2' S, 32°54.65' E, 16–24 m, multiprong spear, A.D. Connell, March 14, 2013; BPBM 41151, gravid female, 124 mm SL, KwaZulu-Natal, Sodwana Bay, reef in 20 m, multiprong spear, A.D. Connell, April 26, 2013; BPBM 41152, 64.5 mm SL, KwaZulu-Natal, Cape Vidal, wreck of DAR barge, 28°9'19" S, 32°32'44" E, 28 m, multiprong spear, A.D. Connell, April 27, 2013; BPBM 41223, IP female, 81 mm SL, Kenya, near Mombasa, aquarium collectors, Feb. 1, 2015.

Diagnosis. Dorsal-fin rays IX,12; anal-fin rays III,12; pectoral-fin rays 13; lateral-line scales 69–81; scales above lateral line at base of ninth dorsal spine 5; head naked; no median predorsal scales; scales on nape progressively smaller and more embedded anteriorly, extending forward nearly to rear edge of orbit; gill rakers 17–20 (modally 19); body depth 3.3–4.4 in SL; body width 1.9–2.3 in body depth; head length 3.2–3.45 in SL; dorsal profile of head of juvenile and initial phase nearly smoothly convex, of terminal males nearly straight to above eye, then convex; snout short, 3.6–4.4 in head length; orbit diameter varying from 4.75 in head length of a 72-mm subadult to 7.15 in the 164-mm adult male; first dorsal spine of adult males moderately elongate, 1.6–2.35 in head length, the second spine 52–60% length of first spine; third to ninth dorsal spines progressively longer, the ninth spine 2.65–3.1 in head length; caudal fin of juveniles slightly rounded to truncate, emarginate in adults, the lobes prolonged and attenuate in large terminal males, the caudal concavity up to 1.2 in head length; pelvic fins short, not reaching anus. Largest specimen, 164 mm SL.

Description. Dorsal-fin rays IX,12; anal-fin rays III,12; dorsal and anal soft rays branched, the last to base; pectoral-fin rays 13, the uppermost short and splint-like, the second unbranched; pelvic rays I,5, the soft rays branched; caudal fin with 14 principal rays, the middle 12 branched; upper and lower unbranched rays nearly as long as middle branched rays; upper and lower procurrent caudal rays 6 or 7, the most posterior segmented; lateral-line continuous, deflected sharply downward below posterior part of dorsal fin to straight midlateral portion, the pored scales 74-75 (69–81), not including one or two pored scales on base of caudal fin; scales above lateral line at base of ninth dorsal spine 5; head naked; no median predorsal scales; scales on nape progressively smaller and more embedded anteriorly, extending forward nearly to rear edge of orbit; no scales on fins except basally on caudal fin and extending a short distance in very small size on lobes of fin; gill rakers 5 +12 (5 or 6 + 12–14), total 17 (17–20, modally 19); branchiostegal rays 6; vertebrae 9 + 16.

Body moderately elongate, the depth 3.3 (3.45–4.4) in SL; body width 2.2 (1.9–2.3) in body depth; head length 3.2 (3.25–3.45) in SL; dorsal profile of head of juvenile and initial phase nearly smoothly convex, of terminal males nearly straight to above eye, then convex; snout short, 4.4 (3.6–4.2) in head length; orbit diameter 6.7 (4.75–7.15) in head length; interorbital width 3.8 (4.25–5.1) in head length; caudal-peduncle depth 2.4 (2.4–2.7) in head length; caudal-peduncle length 3.1 (2.85–3.3) in head length.

Mouth terminal, oblique (forming an angle of about 45° to horizontal axis of body), and small, the maxilla reaching a vertical through posterior nostril; upper-jaw length 5.3 (4.3–5.3) in head length; front of upper jaw with a pair of moderately large canine teeth that are slightly recurved and outflaring; side of upper jaw of holotype with a single row of up to 18 close-set, strong, conical teeth, progressively smaller posteriorly; no large canine tooth posteriorly on upper jaw at corner of mouth; pair of canine teeth anteriorly in lower jaw, smaller than upper pair and fitting inside upper pair when mouth closed; side of lower jaw with up to 15 conical teeth, progressively smaller posteriorly; a medial band of close-set, small, low nodular teeth adjacent to large teeth on side of both jaws (probably serving to buttress the larger outer teeth); lips thin; broadest depth of labial flap on side of lower jaw one-half orbit diameter; tongue triangular with finely pointed tip, attached ventrally to tip (hence seems immobile), the dorsal surface with conspicuous papillae. Opercular flap well-developed, the broadly rounded posterior end extending slightly beyond anterior end of pectoral-fin base; preopercular margin thin and smooth, the corner broadly rounded; upper end of preopercular margin ventral to level of lower edge of orbit, the anterior free end nearly reaching a vertical at posterior edge of maxilla.

Nostrils very small, only slightly larger than largest cephalic sensory pore, anterior to upper edge of eye, the internarial distance about half pupil diameter; anterior nostril with a slightly elevated rim, the posterior nostril with a flap that nearly covers aperture.

A series of six prominent cephalic sensory pores from in front of anterior nostril to interorbital; another series of six to 12 sensory pores from below last interorbital pore, encircling the posterior and ventral part of orbit, and ending on a vertical with first sensory pore dorsally on snout; a third series of sensory pores along margin of embedded scales anteriorly on nape, continuing to join anterior end of pores of lateral-line scales, with a branch that leads to about 13 pores of the preopercular-mandibular series.

Scales on body small and cycloid; progressively smaller scales extending forward on nape to above upper end of preopercular margin; no median predorsal scales; no scales on head, and none on midventral line of prepelvic area; dorsal and anal fins naked except for two rows of small scales on base of dorsal fin and one to two rows on base of anal fin; small scales on about basal third of caudal fin; no scales on base of paired fins; a midventral, pointed, fleshy process at base of pelvic fins, its length nearly as great as pupil diameter; lateral line following dorsal contour of body to below ninth dorsal soft ray, then deflected obliquely downward to continue midlaterally to base of caudal fin; last pored scale on base of caudal fin a little larger and more pointed than previous scales.

Origin of dorsal fin above upper end of gill opening, the predorsal length 3.55 (3.5–3.8) in SL; spines of dorsal and anal fins flexible; membranes of spinous portion of dorsal and anal fins not incised; spine tips continuing as a slender, tapering, flexible rod that reinforces fin margin more than half way to next spine; anterior part of dorsal fin not elevated in initial phase; first dorsal spine of initial phase 3.05–4.8 in head length, of terminal males 2.35 (1.6–1.65) in head length; ninth dorsal spine longest, 3.1 (2.65–3.05) in head length; sixth to eleventh dorsal soft rays subequal, 2.7 (2.35–2.65) in head length; first anal spine slender and short, 15.2 (4.2–10.6) in head length; third anal spine longest, 4.0 (2.4–3.75) in head length; second to ninth anal soft rays subequal, 2.9 (2.1–2.6)

TABLE 2

Proportional measurements of type specimens of *Pseudocoris occidentalis*, n. sp.
as percentages of the standard length

	holotype	paratypes							
	BPBM	SAIAB	SAIAB	SAIAB	SAIAB	BPBM	BPBM	BPBM	BPBM
	41222	188936	188936	188936	188936	21079	21079	41223	21079
	male	male	male	female	female	male	female	IP	IP
Standard length (mm)	154	164	163	135	122	115	111	81	72
Body depth	30.2	28.1	27.7	26.1	25.3	25.2	24.8	24.2	22.6
Body width	13.6	13.6	12.2	13.7	13.5	11.3	10.9	11.6	10.6
Head length	31.5	30.6	30.7	29.0	29.4	29.5	29.8	30.0	29.9
Snout length	7.1	8.5	8.4	8.0	8.1	7.1	8.0	7.2	7.6
Orbit diameter	4.7	4.3	4.3	4.3	4.8	5.1	5.0	5.6	6.3
Interorbital width	8.4	7.5	7.6	6.2	6.3	6.9	6.4	5.9	6.3
Caudal-peduncle depth	13.1	12.0	11.7	11.8	10.9	11.0	11.3	12.6	11.1
Caudal-peduncle length	10.2	9.8	9.3	9.8	10.3	10.1	9.5	10.1	9.4
Predorsal length	28.3	28.3	28.5	26.2	26.2	26.1	27.0	28.6	26.2
Preanal length	55.0	53.3	56.5	52.5	52.3	53.0	53.7	53.8	51.5
Prepelvic length	37.1	36.9	36.0	31.2	31.3	34.7	33.4	33.0	30.2
Upper jaw length	6.0	6.7	6.8	6.5	6.6	6.6	6.9	5.7	6.4
Base of dorsal fin	69.9	64.0	64.7	65.0	63.7	64.6	64.8	63.7	64.5
First dorsal spine	13.4	15.9	18.4	9.5	9.2	18.3	9.4	6.3	7.0
Second dorsal spine	9.1	9.5	9.6	9.9	10.0	10.7	9.0	6.8	8.8
Third dorsal spine	8.8	10.5	10.1	10.3	11.2	9.8	10.7	7.9	9.9
Ninth dorsal spine	10.2	11.6	12.0	11.1	12.7	12.1	11.8	10.2	12.3
Longest dorsal ray	11.8	14.4	13.9	13.7	14.2	13.8	13.8	12.7	13.9
Base of anal fin	35.5	37.3	37.4	38.3	36.6	37.2	37.0	37.7	38.2
First anal spine	2.1	7.4	7.1	6.9	5.6	5.4	5.9	2.8	4.2
Third anal spine	8.0	12.4	11.8	11.8	12.2	11.1	11.5	8.0	11.6
Longest anal ray	10.9	13.7	13.2	13.0	12.8	13.9	11.9	11.5	11.6
Caudal-fin length	21.2	37.5	41.7	22.7	22.5	26.9	22.4	20.5	19.5
Caudal concavity	3.6	6.5	25.1	3.4	3.1	10.4	2.3	none	none
Pectoral-fin length	21.4	23.8	24.5	23.4	23.4	23.5	23.9	20.2	23.5
Pelvic-spine length	9.0	9.9	9.6	9.7	9.9	10.5	10.2	8.3	10.0
Pelvic-fin length	12.4	14.7	13.8	13.4	13.0	14.3	13.5	11.1	13.7

in head length; caudal fin of juveniles very slightly rounded to truncate, of initial phase truncate to slightly emarginate, of terminal males slightly to deeply emarginate, the fin length 4.7 (2.4–5.15) in SL; caudal concavity 8.85 (1.2–12.95; when present) in head length; pectoral fins pointed, the fourth ray longest (but third and fifth nearly equal), 4.7 (4.1–4.95) in SL; pelvic spine 3.5 (2.8–3.65) in HL, first and second pelvic soft rays longest and subequal 2.55 (2.05–2.7) in head length.

Color in alcohol. Small juveniles pale yellowish with a middorsal black stripe anteriorly on head, dividing on nape, passing to each side along base of dorsal fin, narrowing and disappearing before end of fin; a broad black stripe from front of snout through eye, continuing along side between lateral line and pectoral fin, narrowing



Figure 8. *Pseudocoris occidentalis*, paratypes, juveniles and initial phase; **top:** SAIAB 60273, 45 mm SL, Aliwal Shoal, KwaZulu-Natal, South Africa (P.C. Heemstra); **middle:** SAIAB 58491, 55 mm SL, Mauritius (D. Pelicier); **bottom:** SAIAB 55785, 66 mm SL, Tiger Reef, KwaZulu-Natal (P.C. Heemstra).

posteriorly and ending at base of caudal fin above lateral line. There is relatively little change in color in alcohol with growth until the initial phase develops black stripes along the upper and lower edges of the caudal fin and a dark bar across the caudal-fin base, leaving a large hemispherical posterior area on the fin with transparent membranes and pale yellowish rays. Larger initial-phase fish develop a diffuse blackish spot on the opercular flap.

Terminal males are dark brown anteriorly, becoming abruptly lighter brown posterior to tip of pectoral fin, with a series of short irregular dark brown bars and oval spots that are limited to the midlateral area and do not extend to the bases of the dorsal and anal fins. Anal fin without a dark distal band.

Color in life. Juveniles bluish white grading to bright yellow-orange on the rear body with two dark midlateral stripes (Figs. 8 & 9)(vs. three in *P. aurantiofasciata*, Figs. 41 & 42); a middorsal black stripe splitting and running along the base of the dorsal fin and a mid-lateral black stripe from snout through eye, narrowing to base of caudal fin just above lateral midline, varying in width, but usually wider than the eye at midpoint (Fig. 9). Median fins orange-yellow, the dorsal fin with rows of pale blue spots on proximal membranes. Larger juveniles develop a black bar at the base of the caudal fin with black stripes at the upper and lower margins of the fin. The iris is dark or orange.

Initial-phase fish vary from brownish orange to bluish green (Figs. 10 & 11), remaining light or pinkish on the ventral part; the black lateral stripe fades and the black upper and lower borders and base of the caudal fin become more intense. The dorsal fin darkens, but retains two rows of pale blue spots on each of the membranes between fin elements; the anal fin becomes bright orange-red with no distal dark stripe. A dark smudgy spot develops on the opercular flap. The iris is reddish.



Figure 9. *Pseudocoris occidentalis*, juveniles; **upper:** paratype, ROM 36643, 33 mm SL, Peros Banhos Atoll, Chagos Archipelago (R. Winterbottom); **lower:** Protea Bank, KwaZulu-Natal (D.R. King).



Figure 10. *Pseudocoris occidentalis*, paratype, BPBM 41223, initial phase, 81 mm SL, Mombasa, Kenya (B.C. Victor).

Terminal males are bright blue-green on the head and abdomen, grading to yellowish green on the rear body (Figs. 12–14), with a broad dark area anteriorly on body behind the pectoral-fin base, usually not extending below the level of the pectoral fin; in some individuals a dark triangular mark extends behind the eye to join the dark anterior body. Behind the pectoral-fin base, there are seven to nine narrow short irregular black bars and ovals centered on the lateral midline, not extending the full body depth and not reaching the dorsal and anal fin bases; dorsal fin mostly dark or blue, with a greenish yellow stripe at the base; anal fin bright yellow without a distal dark stripe; caudal fin (and paired fins) colored like initial phase, with black upper and lower borders, sometimes extended as dark filaments from the upper and lower lobes; a distinct small black rounded spot on opercular flap.

Remarks. The much larger size of terminal males collected from the coast of KwaZulu-Natal and southern Mozambique compared to those from Aldabra was perplexing, first suggesting to us the possibility of two species.



Figure 11. *Pseudocoris occidentalis*, initial phase; **upper:** Sodwana Bay, KwaZulu-Natal (J.E. Randall); **lower:** paratype, BPBM 41151, gravid female, 124 mm SL, Sodwana Bay, KwaZulu-Natal, 20 m (A.D. Connell).



Figure 12. *Pseudocoris occidentalis*, holotype, BPBM 41222, terminal male, 155 mm SL, Mombasa, Kenya (B.C. Victor).

When it was realized that Aldabra is an atoll with clear water and far less plankton than along continental shores of Africa, the difference in maximum size was then readily understood (similar to the explanation discussed for *P. yamashiroi* below).

The new species *P. occidentalis* is distinguished from its Pacific sibling species, *P. heteroptera*, by the

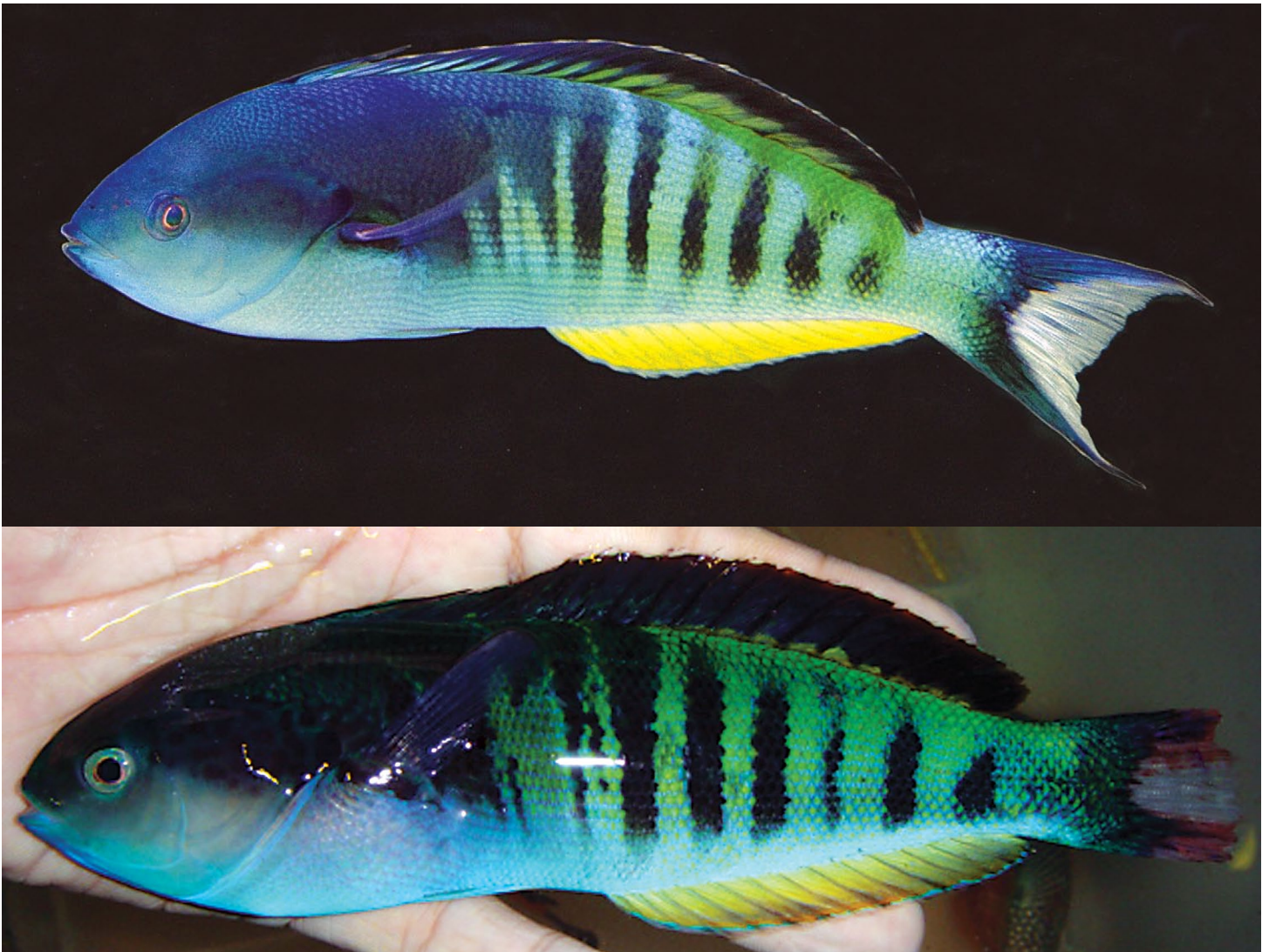


Figure 13. *Pseudocoris occidentalis*, terminal males, aquarium photographs; **upper:** (J.M.B. Edward); **lower:** Kenya aquarium trade (Sealife Hong Kong Ltd., internet photograph).

different color pattern primarily of the terminal male; the color patterns of the juveniles and initial phase are only subtly different and need to be better documented. The juveniles differ in the background color, being more bluish and orange in *P. occidentalis* vs. white and yellow in *P. heteroptera* (note exception in Fig. 3, top; from Ulithi in Micronesia). The primary difference in the terminal males is the shorter dark bars and ovals on the rear body that do not extend to the fin bases and a fully yellow anal fin in *P. occidentalis* vs. fewer dark bars on the rear body, extending the full body depth and touching or extending onto the bases of the median fins, and a dark blue to black anal fin with a basal yellow stripe or yellow patches in *P. heteroptera*. The two species have mutually exclusive monophyletic clades in the barcode mtDNA COI gene with a divergence of 0.63% (minimum interspecific difference by K2P & uncorrected pairwise).

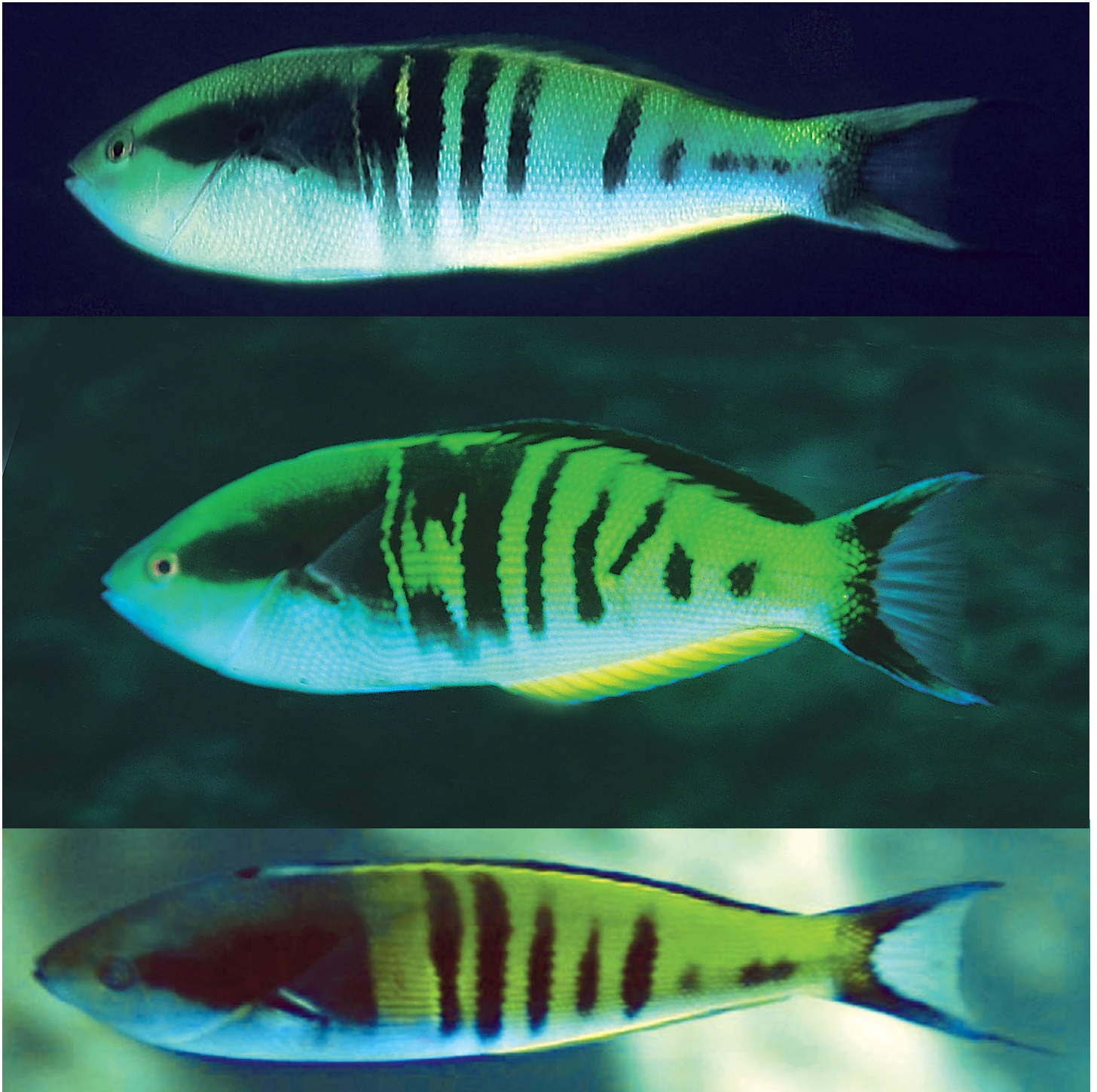


Figure 14. *Pseudocoris occidentalis*, terminal males; **upper:** Seychelles (J.E. Randall); **middle:** estimated 120 mm SL, Sodwana Bay, KwaZulu-Natal (D.R. King); **bottom:** KwaZulu-Natal (J.E. Randall).

Pseudocoris yamashiroi (Schmidt)

Figures 1, 15–21, Table 1.

mtDNA COI barcode-lineage BIN number: BOLD:AAF6951

Julis yamashiroi Schmidt 1930: 85, fig. 5 (type locality, Okinawa).

Julis awayae Schmidt 1930: 86, figs. 6, 7 (type locality, Okinawa).

Coris yamashiroi Araga in Masuda *et al.* 1975: 304, pl. 110 C (Kochi Prefecture to Okinawa Islands).

Pseudocoris yamashiroi Araga in Masuda *et al.* 1984: 210, pl. 295 K, I (Kochi Prefecture to Okinawa; *Julis awayae* Schmidt is a junior synonym); Randall 1986: 225, fig. 63 (Marshall Islands); Paulin *et al.* 1989: 207, fig. 140.6b (New Zealand); Randall *et al.* 1990: 331, 2 figs. (Great Barrier Reef); Francis 1993: 65 (Kermadec Islands); Kuitert 1993: 301 (New South Wales); Shen *et al.* 1993: 464, pl. 152, fig. 4 (Taiwan); Myers 1999: 200 (Micronesia); Parenti & Randall 2000: 36 (Indo-Pacific); Allen 2000: 114 (Calamian Islands, Palawan); Westneat in Randall & Lim 2000: 629 (South China Sea); Hutchins 2001: 269 (Western Australia); Kuitert 2002: 175, figs. A–J (Indo-Pacific); Nakabo 2002: 999 (southern Japan, Ryukyu Islands); Allen *et al.* 2003: 192, middle figs. (Indo-Pacific); Myers & Donaldson 2003: 636 (Mariana Islands); Allen & Adrim 2003: 50 (Papua to Sumatra); Kuitert & Tonzuka 2004: 507, 4 figs. (Flores and Bali, Indonesia); Randall *et al.* 2004: 22 (Tonga); Randall 2005: 432, upper 3 figs. (Indo-Pacific); Fricke & Kulbicki 2006: 343 (New Caledonia); Senou *et al.* 2006: 481 (Sagami Bay); Allen *et al.* 2006: 1407 (Queensland, New South Wales, Western Aus-



Figure 15. *Pseudocoris yamashiroi*, juvenile, Japan (Kei Morishita).

tralia); Fricke & Kulbicki 2007: 387 (New Caledonia); Randall & Walsh 2008: 46, figs. 15–17 (Indo-Pacific); Chen *et al.* 2010: 392, figs. E–G (Taiwan); Kuiter 2010: 326, figs. A–G (Japan, Bali, Queensland and NSW Australia); Motomura & Matsuura 2010: 171 (Yaku-shima Island); Fricke *et al.* 2011: 418 (New Caledonia); Allen & Erdmann 2012: 714, 2 figs. (Indo-Pacific); Nishiyama & Motomura 2012: 196, 12 figs. (Ryukyu, Ogasawara, Izu Islands, and Pacific coast of southern Japan).

Diagnosis. Dorsal-fin rays IX,12; anal-fin rays III,12; pectoral-fin rays 13; lateral-line scales 64–74; scales above lateral line below ninth dorsal spine 4; gill rakers 5 or 6 + 13–17; body depth varying from 5.2 in SL in a small juvenile to 3.7 in SL in a large terminal male; body compressed, the width 2.0–3.0 in body depth; dorsal profile of head to above eye of adults straight to slightly concave, then convex on nape; head length 3.35–3.55 in SL; snout length 3.5–3.7 in head length; orbit diameter varying from 4.2 in head length of a 43-mm juvenile to 7.1 in a 138-mm terminal male; first dorsal spine of terminal male filamentous and prolonged, 1.4–1.5 in head length; remaining dorsal spines progressively longer, the ninth 2.7–3.0 in head length; caudal fin truncate to slightly emarginate, 1.45–1.65 in head length; pelvic fins varying from 2.8 in head length of a 48-mm juvenile to 1.8 in head length of a 136-mm terminal male, the largest specimen examined.

Color in alcohol. Juveniles and initial-phase fish are light beige without dark markings, including juveniles as large as 70 mm and even a mature 95-mm female from the Philippines. One lot from the Loyalty Islands included an initial-phase, fully ripe male 70 mm SL and an intersex initial-phase fish 90 mm SL with no trace of melanin. Terminal males are dark on the upper two-thirds of the body and head and pale ventrally. The caudal fin has a dark base with dark bands along the upper and lower edges of the fin, dorsal fin is dusky, remaining fins translucent.

Color in life. Juveniles are orangish brown grading to lemon-yellow on the caudal fin (Fig. 15), with a midlateral dark orange stripe from the snout through the eye across the operculum, splitting into two lateral brown stripes, flanked above by two more brown stripes and below by another faint stripe, all stripes fading near the yellowish tail; the dark stripes alternate with thin light streaks along the side of the body; a particularly dark patch overlies the cranium, split by a middorsal white line. Juvenile *P. bleekeri* are very similar, but have fewer lateral stripes (see Fig. 26 with one juvenile *P. yamashiroi* among a set of juvenile *P. bleekeri*, from the same school collected in Bali, Indonesia and identified to species by mtDNA barcoding).



Figure 16. *Pseudocoris yamashiroi*, initial phase, Bunaken, Indonesia (G.R. Allen).



Figure 17. *Pseudocoris yamashiroi*, transitional and initial phase, Hachijo-jima, Japan (Shoichi Kato).

Initial-phase fish are orangish brown with bluish or yellowish scale centers, shading to pale bluish or yellowish ventrally (Figs. 16 & 17); head light iridescent blue with lighter bluish white stripes above and below the eye, the lower stripe extending rearward and curving over a bright pink oval at the base of the pectoral fin; blue iridescent reticulations behind eye and on upper operculum; lips and iris bright red.

The following color note was made of a 93-mm mature female from the Enewetak Atoll, Marshall Islands: upper three-fourths of body olive-green, the edges of scales brownish orange, the lower fourth greenish white; a broad maroon band from upper half of eye to front of snout; opercular flap and upper margin of operculum broadly bright blue; dorsal fin with transparent light orange membranes, the rays darker, with irregular green markings on basal three-fifths of fin; anal and caudal fins similar but paler; pectoral fins pale orangish with a large bright



Figure 18. *Pseudocoris yamashiroi*, terminal male, Palau (J.E. Randall).



Figure 19. *Pseudocoris yamashiroi*, terminal male, Okinawa, Japan (Takeru Tsuhako).

red spot at base and axil, and a blue marking behind in axil; pelvic fins bluish white basally, light orange distally.

The shading of the initial phase can vary from lavender to orange to bluish, although always with the characteristic bright pink pectoral base and axillary spot, the basis of the common name Red Spot Torpedo Wrasse. Nishiyama & Motumura (2012: 196) were well aware of the great variation in color of this species; they published 12 color illustrations. Transitional male individuals can develop the extended first dorsal fin spine while still in the uniform greenish yellow phase with the red pectoral-fin base (e.g. Fig. 17).

Terminal males are less brightly colored; the upper two-thirds of body blue-green to pale yellow, overlain with a dense pattern of black spots or short bars, usually made up of darkened scale edges, but sometimes rows of larger irregular dark blotches (Figs. 18–20); the white or light greenish ventral third of body with many yellow scales posterior to abdomen; head mainly blue-green to purplish blue, lighter ventrally; the red pectoral-base spot of females is dark in terminal males; caudal fin translucent with a prominent dark stripe along the dorsal and ventral margins.



Figure 20. *Pseudocoris yamashiroi*, terminal male, Hachijo-jima, Japan (Shoichi Kato).



Figure 21. *Pseudocoris yamashiroi*, possible hybrid, terminal male, Japan (Kazuhiko Nishiyama).

A variant terminal-male color phase photographed in the Izu region of Japan has the dark markings on the sides forming three rows of mostly oval black blotches (Fig. 21); Nishiyama & Motomura (2012) suggest this male may represent a hybrid of *P. yamashiroi* and *P. bleekeri*.

Remarks. *P. yamashiroi* is the most common species of the genus. Fortunately, the authors have been able to examine enough specimens and photographs to document the unusual large variation in color of the initial phase of this species and the unexpected variability in size at which maturity is attained by both sexes in the initial phase, as well as by terminal males. We suspect that the size difference is related to nutrition. Fishes collected from a lagoon rich in plankton, such as those from Enewetak Atoll, were larger, in general, than ones from clear outer-reef areas, such as those from Uvea Atoll, Loyalty Islands (see Material Examined).

Previously considered a single pan-Indo-Pacific species, we describe the Indian Ocean population as a new species (see below), based on a conspicuous difference in the terminal-phase male color pattern and a 2.51% sequence divergence in the barcode mtDNA COI gene (minimum interspecific difference by K2P; 2.46% uncorrected pairwise). *P. yamashiroi* in the Pacific Ocean has a broad distribution, ranging from Japan and Taiwan eastward to the Marshall Islands and south to Philippines, Indonesia, Tonga, Fiji, New Caledonia, GBR, and the Kermadec Islands off New Zealand.

The species of *Pseudocoris* with enough specimens to show a range in lateral-line scale counts all exhibit relatively wide variation. *P. yamashiroi* has a broad range, with 64–74 lateral-line scales. There is an indication that sea temperature is a factor in the large variation in the number of lateral-line scales. Specimens of *P. yamashiroi* from the warm seas of Palau and Bali have counts of 63, 66, 67, and 69 scales, whereas those from the cooler seas of Okinawa have 71, 72, and 73 scales. More data are needed to support this conclusion.

The depth was recorded for 21 of the 22 Bishop Museum collections of *Pseudocoris yamashiroi*, with a range of 7–42.5 m, with 11 lots taken in 20 m or more. Individuals at a pinnacle reef in the lagoon of Enewetak Atoll were seen between depths of 7 and 33 m.

Material Examined: TONGA: Vava’u, BPBM 38144, 138 mm SL. FIJI: Viti Levu, BPBM 40126, 28 mm SL. MARSHALL ISLANDS: Enewetak Atoll, BPBM 12174: 93 mm SL, BPBM 12184, 2: 96–98 mm SL, BPBM 29158, 115 mm SL. LOYALTY ISLANDS: Uvea Atoll, BPBM 22552, 2: 70–90 mm SL. SOLOMON ISLANDS: Florida Island, BPBM 16144, 51 mm SL, BPBM 16239, 33 mm SL. PALAU: BPBM 9481, 83 mm SL, BPBM 10883, 46 mm SL, BPBM 31458, 28 mm SL. PAPUA NEW GUINEA: Horseshoe Reef (S of Motupore Island), BPBM 32452, 49 mm SL; Madang, Rausch Pass, BPBM 15825, 111 mm SL. INDONESIA: Bali, BPBM 30185, 122 mm SL, BPBM 41224, 15.1 mm SL (DNA identification). PHILIPPINES: Cebu, Sumilon Island, BPBM 24449, 2: 95–131 mm SL; Leyte, ZMA 112.282, 123 mm SL. JAPAN: Ogasawara Islands, Chichi-jima, BPBM 35243, 66 mm SL; Ryukyu Islands, Okinawa, BPBM 19168, 110 mm SL.



Figure 22. *Pseudocoris hemichrysos*, n. sp., holotype, BPBM 41219 terminal male, 74 mm SL, Maldives (B.C. Victor).

***Pseudocoris hemichrysos*, n. sp.**

Figures 1, 22–25, Tables 1 & 3.

mtDNA COI barcode-lineage BIN number: BOLD:ACL3892

Pseudocoris yamashiroi [non Schmidt] Winterbottom *et al.* 1989: 56, pl. 8, fig. C (Chagos Archipelago); Kuitert 1998: 159, 2 figs. (Maldives); Fricke 1999: 428 (Mauritius); Kuitert & Debelius 2006: 600, 1 fig. (Maldives); Fricke *et al.* 2009: 88 (Réunion & Mauritius); Kuitert 2010: 325, figs. H & I (Maldives); Taquet & Diringer 2012: 495, 3 figs. (Réunion).

Holotype. BPBM 41219, male, 74 mm SL, Maldives, aquarium collectors, Dec. 1, 2014.

Paratypes. BPBM 16371, 3: 19–45 mm SL, Mauritius, W. coast, off Wolmar, 14 m, J.E. Randall & D. Pelicier, Dec. 4, 1974; BPBM 18930, 86 mm SL, Maldives, North Malé Atoll, 25 m, J.E. Randall, March 23, 1975; BPBM 20326, 2: 76–81 mm SL, Mauritius, P. Jauffret, 1975; BPBM 32980, 38 mm SL, Maldives, North Malé Atoll, 15 m, J.E. Randall & R.C. Anderson, March 19, 1988; BPBM 34690, 3: 20–32 mm SL, Maldives, North Malé



Figure 23. *Pseudocoris hemichrysos*, n. sp., terminal male, Maldives (R.H. Kuitert).

Atoll, 48 m, J.E. Randall & R.C. Anderson, Oct. 20, 1988; BPBM 41220, male, 66 mm SL, Maldives, aquarium collectors, Dec. 1, 2014; BPBM 41221, 32 mm SL, Mauritius, aquarium collectors, Jan. 1, 2014.

Diagnosis. Dorsal-fin rays IX,12; anal-fin rays III,12; pectoral-fin rays 13; lateral-line scales 66–77; scales above lateral line at base of ninth dorsal spine 4; head naked; no median predorsal scales; scales on nape progressively smaller and more embedded anteriorly, extending forward nearly to rear edge of orbit; gill rakers 14, anomalous (17–19); body depth 4.35 (4.05–4.35) in SL; body width 2.0 (2.25–2.5) in body depth; head length 3.35 (3.3–3.45) in SL; dorsal profile of head of juvenile and initial phase nearly smoothly convex, of terminal males nearly straight to above eye, then convex; snout short, 4.15 (3.85–4.25) in head length; orbit diameter 5.65 (4.6–5.8) in HL; first dorsal spine of adult males moderately elongate, 2.3 (1.75–2.3) in head length, the second spine 84% (60–77%) length of first spine; third to ninth dorsal spines progressively longer, ninth spine 2.95 (2.8–3.05) in head length; pelvic fins short, not reaching anus. Terminal males have a dark blue spinous dorsal fin followed by a bright orange-yellow soft dorsal fin, typically upper rear quadrant of body with a large patch of orange-yellow. Largest specimen, 86 mm SL.

Description. Dorsal-fin rays IX,12; anal-fin rays III,12; dorsal and anal soft rays branched, the last to base; pectoral-fin rays 13, the uppermost short and splint-like, the second unbranched; pelvic rays I,5, the soft rays branched; caudal fin with 14 principal rays, the middle 12 branched; upper and lower unbranched rays nearly as long as middle branched rays; upper and lower procurrent caudal rays 6 or 7, the most posterior segmented; lateral line continuous, deflected sharply downward below posterior part of dorsal fin to straight midlateral portion, the pored scales 76–77 (66–77), not including one or two pored scales on base of caudal fin; scales above lateral line at base of ninth dorsal spine 4; head naked; no median predorsal scales; scales on nape progressively smaller and more embedded anteriorly, extending forward nearly to rear edge of orbit; no scales on fins except basally on caudal fin; gill rakers 6 + 8 anomalous (5 or 6 + 12–14); branchiostegal rays 6; vertebrae 9 + 16.

Body moderately elongate, body depth 4.35 (4.05–4.35) in SL; body width 2.0 (2.25–2.5) in body depth; head length 3.35 (3.3–3.45) in SL; dorsal profile of head of juvenile and initial phase nearly smoothly convex, of terminal males nearly straight to above eye, then convex; snout short, 4.15 (3.85–4.25) in head length; orbit diameter 5.65 (4.6–5.8) in HL; interorbital width 4.7 (4.55–5.0) in head length; caudal-peduncle depth 2.6 (2.45–2.65) in head length; caudal-peduncle length 2.95 (2.35–2.75) in head length. Mouth terminal, oblique (forming an angle of about 45° to horizontal axis of body), and small, the maxilla reaching a vertical through posterior nostril; front of upper jaw with a pair of moderately large canine teeth that are recurved and outflaring; side of upper jaw of holotype with a single row of 6–8 conical teeth, progressively smaller posteriorly; no large canine tooth posteriorly on upper jaw at corner of mouth; pair of canine teeth anteriorly in lower jaw, slightly recurved and inclined forward, smaller than upper pair and fitting inside upper pair when mouth closed; side of lower jaw with 9–12 conical teeth.



Figure 24. *Pseudocoris hemichrysos*, n. sp., terminal male, Maldives (S. Michael).

TABLE 3

Proportional measurements of type specimens of *Pseudocoris hemichrysos*, n. sp.
as percentages of the standard length

	holotype	paratypes			
	BPBM	BPBM	BPBM	BPBM	BPBM
	41219	41220	20326	20326	18930
	male	male	male	male	male
Standard length (mm)	74	66	76	81	86
Body depth	23.0	22.9	23.2	24.1	24.6
Body width	11.4	9.2	10.2	10.3	10.5
Head length	29.7	29.7	29.0	30.2	29.5
Snout length	7.2	7.0	7.5	7.5	7.6
Orbit diameter	5.3	6.2	6.3	5.6	5.1
Interorbital width	6.4	6.5	5.8	6.2	5.9
Caudal-peduncle depth	11.4	11.4	11.9	11.5	11.6
Caudal-peduncle length	10.1	12.7	10.5	11.2	11.8
Predorsal length	27.2	28.0	27.1	27.7	27.0
Preanal length	54.5	50.3	52.3	53.0	53.5
Prepelvic length	31.8	29.4	29.5	30.8	29.3
Upper jaw length	4.7	6.1	6.1	6.2	6.3
Base of dorsal fin	63.0	65.8	64.5	64.7	64.5
First dorsal spine	12.8	13.0	13.2	broken	16.9
Second dorsal spine	10.8	7.9	10.2	broken	10.6
Third dorsal spine	9.6	8.2	9.5	broken	10.8
Ninth dorsal spine	10.1	10.6	10.0	10.1	9.6
Longest dorsal ray	13.0	12.0	13.1	12.6	13.2
Base of anal fin	37.3	37.9	36.1	38.1	37.8
First anal spine	1.5	2.3	2.5	2.7	2.6
Third anal spine	7.2	7.3	8.2	7.7	8.1
Longest anal ray	13.0	10.6	12.3	broken	12.8
Caudal-fin length	18.9	19.2	18.7	broken	19.8
Caudal-fin concavity	none	1.5	4.7	NA	5.2
Pectoral-fin length	19.6	19.5	broken	broken	23.2
Pelvic-spine length	8.5	8.9	9.1	8.6	9.5
Pelvic-fin length	12.4	12.0	13.2	broken	12.5

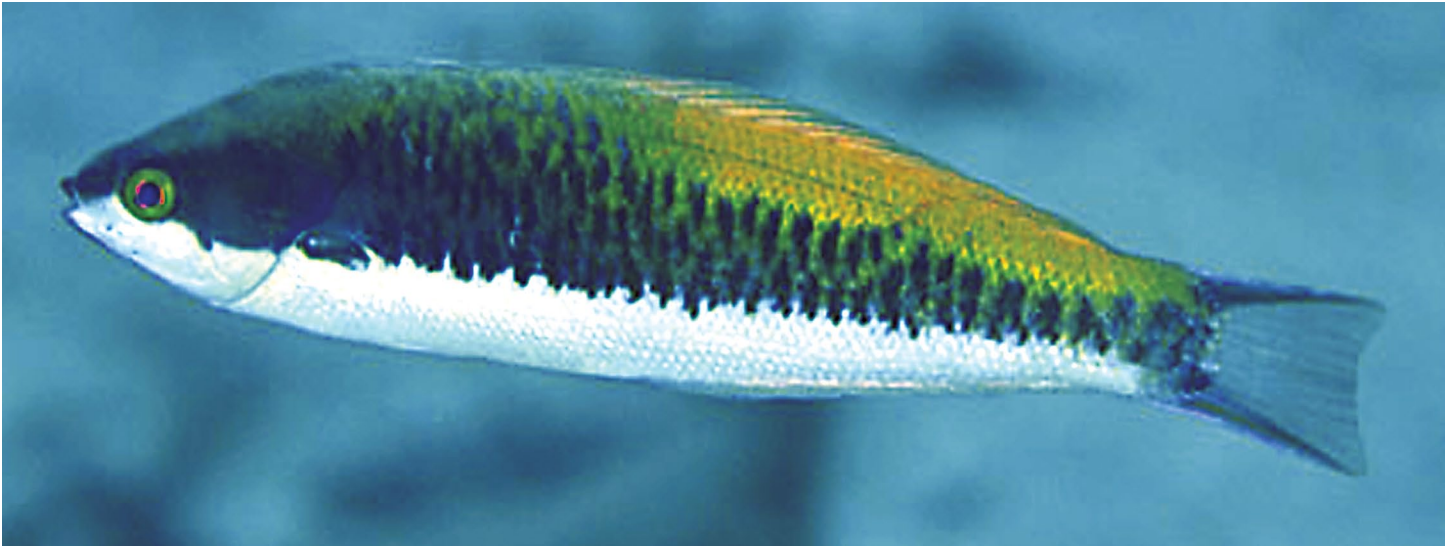


Figure 25. *Pseudocoris hemichrysos*, n. sp., terminal male, Maldives (Kei Morishita).

Opercular flap well-developed, the broadly rounded posterior end extending slightly beyond anterior end of pectoral-fin base; preopercular margin thin and smooth, the corner broadly rounded; upper end of preopercular margin ventral to level of lower edge of orbit, the anterior free end nearly reaching a vertical at posterior edge of maxilla. Nostrils very small, only slightly larger than largest cephalic sensory pore, anterior to upper edge of eye, the internarial distance about half pupil diameter; anterior nostril with a slightly elevated rim, the posterior nostril with a flap that nearly covers aperture. Pores on lower half of head comprising one over rear maxilla, two anterior to orbit, followed by 4–5 in a curving single suborbital series to rear mid-eye level; preopercular pores in a curved series, with two anterior to free margin, 7–9 along free margin.

Scales on body small and cycloid; progressively smaller scales extending forward on nape to above upper end of preopercular margin; no median predorsal scales; no scales on head, and none on midventral line of prepelvic area; dorsal and anal fins naked except for two rows of small scales on base of dorsal fin and one to two rows on base of anal fin; small scales on about basal third of caudal fin; no scales on base of paired fins; a midventral, pointed, fleshy process at base of pelvic fins, its length nearly as great as pupil diameter; lateral line following dorsal contour of body to below ninth dorsal soft ray, then deflected obliquely downward to continue midlaterally to base of caudal fin; last pored scale on base of caudal fin a little larger and more pointed than previous scales.

Origin of dorsal fin above upper end of gill opening, the predorsal length 3.7 (3.55–3.7) in SL; spines of dorsal and anal fins flexible; membranes of spinous portion of dorsal and anal fins not incised; anterior part of dorsal fin not elevated in initial phase, in terminal males 2.3 (1.75–2.3) in head length; ninth dorsal spine longest, 2.95 (2.8–3.05) in head length; sixth to eleventh dorsal soft rays subequal, 2.3 (2.2–2.5) in head length; first anal spine slender and very short, 20 (11.2–13) in head length; third anal spine longest, 4.15 (3.55–4.1) in head length; second to ninth anal soft rays subequal, 2.3 (2.3–2.8) in head length; caudal fin of juveniles very slightly rounded to truncate, of initial phase truncate to slightly emarginate, of terminal males slightly emarginate, the fin length 5.3 (5.05–5.35) in SL; pectoral fins pointed, the fourth ray longest (but third and fifth nearly equal), 5.1 (4.3–5.1) in SL; pelvic spine 3.5 (3.1–3.5) in head length, first and second pelvic soft rays longest and subequal 2.4 (2.2–2.5) in head length.

Color in alcohol. Small juveniles are pale beige in alcohol with translucent fins. Adult females are dark on the upper half of the head, light brown on the upper body grading to beige ventrally, otherwise unmarked. Terminal males are dark on the upper two-thirds of the head and body and abruptly pale ventrally. The caudal fin has a dark base with dark bands along the upper and lower edges of the fin, dorsal fin is dusky on the spinous portion, translucent on the soft dorsal and on the remaining fins.

Color in life. Based on a photograph from Maldives, females closely resemble *P. yamashiroi*, with a dark bluish head with fine light blue reticulations and a white streak above the eye, an orange pink body with greenish hues, and the characteristic oval pink spot at the pectoral base.

Terminal males are dark bluish green to purplish over the upper two thirds of the head and anterior body, abruptly white or pale on the lower third and bright yellow to orange over the upper back below the soft dorsal fin (Figs. 22–25). The upper two-thirds of the body has an array of short dark bars, fading or absent in the yellow-orange patch under the soft dorsal fin, the dark bars are longer and darker in a prominent row along the lateral mid-body. There is a dark oval at the outer base of the pectoral fin, one underwater photographs shows bright red in the pectoral axil. The dorsal fin is prominently bicolored, with the spinous portion dark blue to bluish yellow and the soft dorsal fin bright yellow to orange, sometimes with a thin blue rim. The caudal fin has a dark base and thick black stripes on the upper and lower margins, sometimes edged in white or blue; remaining fins translucent. Iris is yellowish to red.

Remarks. Terminal males were observed in courtship with an initial-phase female at North Malé Atoll in the Maldives by the first author in 1975, but spawning was not seen. There were about twenty times more initial-phase fish than terminal males. A lot of two mature male fish from Mauritius included a 74-mm male in the initial phase and an 81-mm male in the terminal phase, although the latter showed no lengthening of the first two dorsal spines, as is present in the holotype (and is characteristic of terminal males of *P. yamashiroi*).

P. hemichrysos is distinguished from its Pacific sibling species, *P. yamashiroi* by the different color pattern of the terminal-phase male, notably the prominent yellow-orange markings on the rear upper body and soft dorsal fin. There is insufficient material to assess female and juvenile coloration for the new species. Lateral-line scale counts broadly overlap, with 66–77 for the new species and 64–74 for *P. yamashiroi* from the Pacific Ocean. The two species have mutually exclusive monophyletic clades in the barcode mtDNA COI gene with a divergence of 2.51% (minimum interspecific difference by K2P; 2.46% uncorrected pairwise).

Pseudocoris bleekeri (Hubrecht)

Figures 1, 26–32, Table 1.

mtDNA COI barcode-lineage BIN number: BOLD:ACF6952 (in part)

Coris Bleekeri Hubrecht 1876: 214 (Ceram, Molucca Islands).

Coris philippina Fowler & Bean 1928: 309 (Sulade Island, Philippines).

Julis albolumbata Schmidt 1930: 87, fig. 8 (Itoman, Okinawa).

Pseudocoris heteroptera [non Bleeker] de Beaufort 1940: 239, fig. 35.

Coris philippina Kamohara 1957: 47 (Ushuku, Kagoshima Prefecture).

Pseudocoris philippina Araga in Masuda *et al.* 1984: 210, pl. 205 M (Amamiôshima to Philippines); Okamura & Amaoka 1997: 502, upper 3 figs. (Iriomoti Island); Masuda & Kobayashi 1994: 274, figs. 7 & 8 (Kochi Prefecture and to south); Nakabo 2002: 999, fig. (Hachijo-jima, Ryukyu Islands); Motomura & Matsuura 2010: 171, fig. 379 (Yaku-shima Island).

Pseudocoris bleekeri Parenti & Randall 2000: 35 (Ryukyu Islands to Indonesia); Kuitert 2002: 176, 7 figs. (Bali and Moluccas to southern Japan); Allen & Adrim 2003: 50 (Papua to Bali and Togean Islands); Allen *et al.* 2003, upper right fig. (Indonesia to Japan); Kuitert & Tonozuka 2004: 506, 3 figs. (Bali, Indonesia); Chen *et al.* 2010: 391, figs. g, h, i (Kenting National Park, Taiwan); Kuitert 2010: 324, 7 figs. (Kerama Islands, Japan, and Bali and Flores, Indonesia); Allen & Erdmann 2012: 712, 2 figs. (western Pacific); Nishiyama & Motomura 2012: 194, 6 figs. (Ryukyu Islands, Izu Islands, and Pacific coast of southern Japan).

Diagnosis. Dorsal-fin rays IX,12; anal-fin rays III,12; pectoral-fin rays 13; lateral-line scales 68–78; scales above lateral line below base of ninth dorsal spine 4; gill rakers 5 + 12 or 13; body depth varying from about 5.0 in SL in juveniles and small initial phase to 3.7 in SL in large initial phase and 3.55 in SL of large adult males; body width 2.0–2.5 in body depth; head length varying from 3.0 in SL in juveniles to 3.75 in SL in adults; dorsal profile of snout convex anteriorly, soon becoming straight to well above eye, then straight to very slightly convex on nape; snout length 3.75–4.15 in head length; orbit diameter varying from 5.0 in head length in juvenile to 5.7 in large IP and 5.8 in large adult male; first dorsal spine elongate in terminal male, 1.6–1.8 in head length; second dorsal spine about half length of first spine; third to ninth dorsal spines progressively longer, the ninth 2.4–3.8 in head length of adults; caudal fin slightly rounded to truncate in juveniles and initial-phase adults, truncate to slightly double emarginate in adult terminal males, the fin length, about 4.4 in SL in initial phase to 6.2 in terminal males; pelvic fins short, 1.85–2.5 in head length of adults. Largest specimen, the holotype, 118 mm SL.

Color in alcohol. Juveniles light beige with a dark stripe on head from snout through eye to operculum and another running above eye to mid-body. Initial phase light beige, the head more yellowish; an elliptical brown spot on opercular flap; a variable brown spot of about half orbit diameter on base of caudal fin just above end of lateral line; fins with translucent whitish membranes and pale yellowish rays. Terminal male yellowish brown with an elliptical pale yellowish bar two orbit diameters in maximum width beneath the fourth and fifth dorsal soft rays, preceded by an adjacent dark brown bar, followed and preceded by numerous brown bars, often broken into short ovals.



Figure 26. *Pseudocoris bleekeri*, juveniles, BPBM 41217, Bali, Indonesia; identified by mtDNA barcoding; **note** that the different-looking juvenile at bottom center is a juvenile *P. yamashiroi*, BPBM 41224, by DNA identification (B.C. Victor).

Color in life. Juveniles in life light yellowish brown to orange, grading to lemon yellow on caudal fin (Fig. 26), with a dark midlateral stripe, intense on snout and fading rearward, about three faint darker lateral stripes on body, a white lateral stripe from below eye along body, shorter white stripe above eye; no opercular or caudal black spots (only a subtle difference from *P. yamashiroi* juveniles, which have additional faint stripes on the body [Figs. 15 & 26]).

Initial-phase fish yellowish brown to pink or greenish to blue with a rounded brown to black spot slightly less than eye size on opercular flap and an irregular dark spot the same size or smaller on base of caudal fin just above lateral midline (Figs. 27 & 28, top); irregular white to pale yellow stripes on head, one middorsal and two passing from front of snout above and below eye and across postorbital head; axil of pectoral fin with an oval orange-pink spot.

Terminal male blue to bluish or yellowish green or purple dorsally, white to light blue-green ventrally, with a row of dark to black short bars or ovals along lateral midline with a similar shorter array of ovals above the lateral row (Figs. 28–32); a broad bright yellow bar midway along side of body with a contrasting prominent narrow black bar (or two) just anterior; front of lips blue or purple, continuing as a blue stripe midventrally on head. Elevated portion of anterior dorsal fin usually black or blue; dorsal and anal fins with a wide orange-yellow stripe rimmed above and below with blue; iris bright yellow-orange to red.



Figure 27. *Pseudocoris bleekeri*, initial phase, estimated 90 mm TL, Bali, Indonesia (J.E. Randall).



Figure 28. *Pseudocoris bleekeri*; **top:** initial phase, estimated 90 mm TL, Bali, Indonesia (J.E. Randall); **middle:** terminal male, 108 mm SL, Mactan Island, Cebu, Philippines (J.E. Randall); **bottom:** terminal male, Izu region, Japan (Kazuhiko Nishiyama).

Remarks. *Pseudocoris bleekeri* is known from relatively few specimens and photographs from Indonesia north to the Philippines, Taiwan, Ryukyu Islands, and Kochi Prefecture, Japan. It is apparently replaced by its sibling species, *P. petila*, in the Indian Ocean (see below), which differs in color pattern (initial phase more vividly colored and with a larger caudal spot and terminal-phase male with two yellow bars and a black midlateral band and very elongate first dorsal-fin spine) and 1.08% in the barcode mtDNA COI sequence (minimum interspecific distance by K2P & uncorrected pairwise).



Figure 29. *Pseudocoris bleekeri*, terminal male, Hachijo-jima, Japan (Shoichi Kato).

The holotype was examined and x-rayed at the Nationaal Natuurhistorische Museum in Leiden. The Bishop Museum has only three lots, one of two specimens collected by the first author in 12 m at Mactan Island near Cebu, ten juveniles from Bali collected by the third author (BV), which were identified as *P. bleekeri* by mtDNA barcode sequencing, and two aquarium-trade specimens from Indonesia.

Fowler & Bean (1928: 309) described *Coris philippina* from two specimens, the holotype from Sulade Island near Jolo, and the paratype from Balicasag Island. The holotype is reidentified as *Pseudocoris bleekeri* (Fowler & Bean's color description clearly matches this species), and the paratype as *P. yamashiroi* (it has 64 lateral-line scales, equal to the lowest count for *P. yamashiroi*, see Table 1). De Beaufort (1940: 238, fig. 35) caused

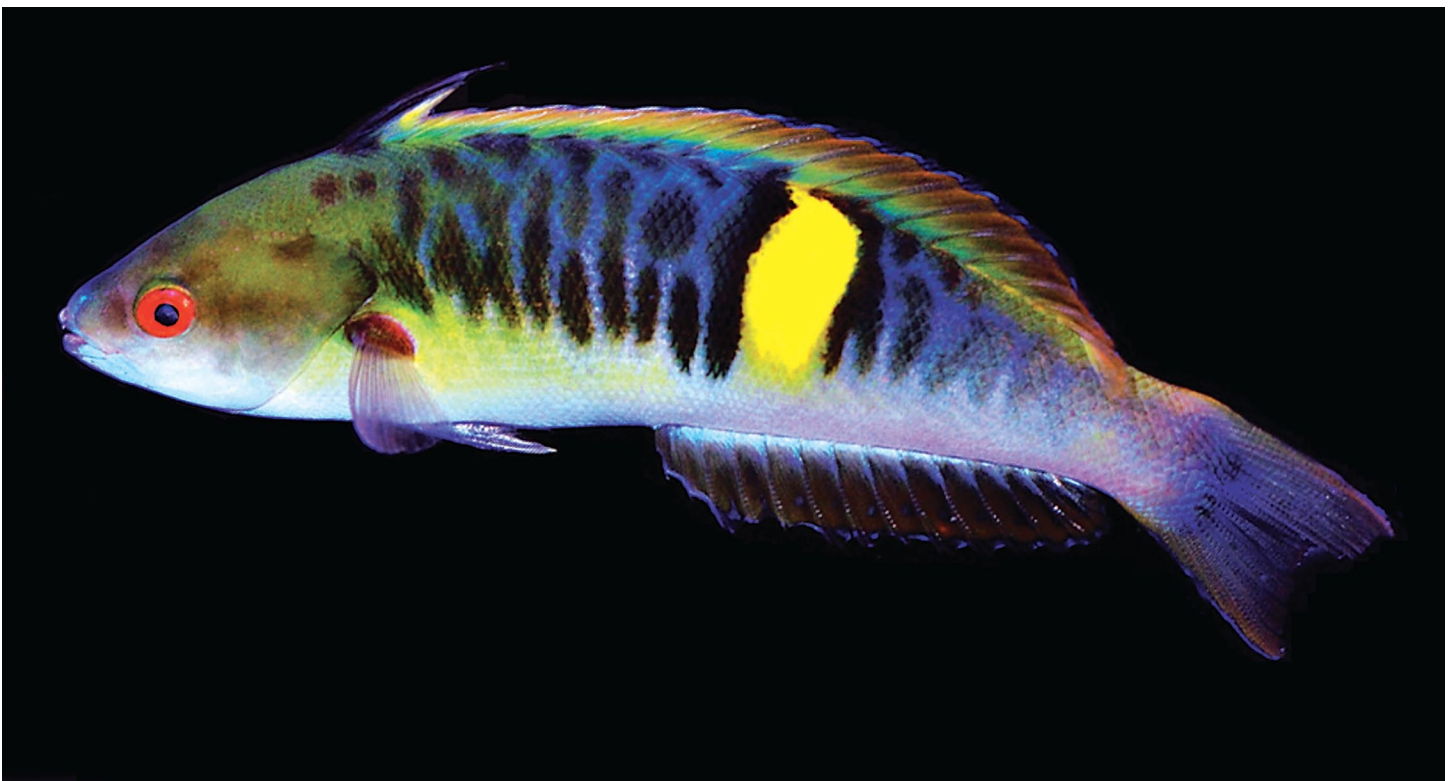


Figure 30. *Pseudocoris bleekeri*, terminal male, aquarium trade (Tea Yi-Kai).



Figure 31. *Pseudocoris bleekeri*, terminal male, aquarium trade (Tea Yi-Kai).

confusion by illustrating the holotype of *P. bleekeri* to represent *P. heteroptera*. Araga in Masuda *et al.* (1984: 210) misidentified *P. bleekeri* as *P. philippina*, and he was followed by some subsequent authors. Fricke & Kulbicki (2006: 343) reported *P. bleekeri* from New Caledonia, potentially a large range extension, but later corrected their identification to *P. heteroptera* (Fricke *et al.* 2011). Nishiyama & Motomura (2012: 198) published four color illustrations of what they believe to be the hybrid *Pseudocoris bleekeri* x *P. yamashiroi*. It was photographed in 32 m at Kashiwa-jima, Kochi Prefecture, Shikoku, Japan.

Material Examined: INDONESIA: Molucca Islands, Ceram, RMNH 2168, 118 mm SL (holotype); Bali, BPBM 41217, 10: 15.4–26 mm SL; “Indonesia” per aquarium trade, BPBM 41218, 2: 66–84 mm SL. PHILIPPINES: Sulade Island, USNM 93519, 87 mm SL (paratype of *Coris philippina* Fowler & Bean); Cebu, Mactan Island, BPBM 26837, 2: 68–108 mm SL. TAIWAN: north end, ASIZP 65351, 117 mm SL.



Figure 32. *Pseudocoris bleekeri*, terminal male, Kashiwajima, Kochi, Japan (Kenyu Nakajima).



Figure 33. *Pseudocoris petila*, initial phase, estimated 65 mm SL, South Cinque Island, Andaman Islands (G.R. Allen).

***Pseudocoris petila* Allen & Erdmann**

Figures 1, 33–36, Table 1.

mtDNA COI barcode-lineage BIN number: BOLD:ACF6952 (in part)

Pseudocoris cf. *bleekeri* Kuitert 2010: 325, 1 fig. (Pulau Weh, Sumatra); Taquet & Diringer 2012: 494 (Réunion)

Pseudocoris petila Allen & Erdmann 2012: 713, 2 Figs. & 1146, figs.1–5 (type locality, South Cinque Island, Andaman Islands).



Figure 34. *Pseudocoris petila*, initial phase, estimated 50-65 mm SL, South Cinque Island, Andaman Islands (G.R. Allen).



Figure 35. *Pseudocoris petila*, terminal male, estimated 80 mm SL, Pulau Weh, NW Sumatra (G.R. Allen).

Diagnosis. Dorsal-fin rays IX,12; anal-fin rays III,12; pectoral-fin rays 13; lateral-line scales 72–75; scales above lateral line below base of ninth dorsal spine 5; total gill rakers 15 or 16; body elongate, depth 4.6–5.5 in SL; body not strongly compressed, the width 1.6–1.8 in body depth; head length 3.2–3.3 in SL; dorsal profile of head of initial phase progressively less convex, the nape nearly straight; dorsal profile of terminal male convex above snout, flat above eye and slightly convex on nape; snout length about 4.0 in head length; orbit diameter 4.7–5.3 in head length; first dorsal spine very long in terminal male, to about 1.3 in head length; second dorsal spine slightly prolonged, about 1.7 in length of first spine; remaining dorsal spines progressively longer, the ninth about 2.8 in head length; membranes of dorsal and anal fins not incised; spine tips continuing as slender, tapering, flexible rods that reinforce the membrane margin; dorsal soft rays equal in length, except last two shorter; caudal fin truncate in all phases, the fin length about 5.4 in SL in initial phase to about 6.4 in terminal males; pelvic fins short, 2.9 in head length in subadults, 2.6 in adults. Estimated standard length of terminal male, 80 mm.

Color in alcohol. Body of initial-phase fish pale yellowish; a narrow blackish stripe on side of snout, broadening behind eye to an indistinct blackish stripe that narrows posteriorly, ending in a blackish spot at caudal-fin base; a narrow blackish bar dorsally on tip of snout, passing above lateral line, and ending diffusely below soft portion of dorsal fin; fins yellowish white. No terminal-phase fish have been collected.

Color in life. Initial-phase fish with a broad band of orange-pink to salmon above level of upper end of gill opening and dorsal edge of eye (Figs. 33 & 34), bisected by a thin blue-edged blackish stripe (pigment on scale edges); an intense blue band behind the eye ending in a smudgy black spot larger than the eye on the opercular flap, continuing along the lateral midline body as a broad blue to gray band, ending in an irregular black blotch, often horizontally elongated, up to about eye size on the caudal-fin base just above the lateral midline; ventral part of head and chest pale blue-green to white; ventral part of body pink to orange; median fins mainly orange, dorsal and anal fins with prominent rows of iridescent blue spots.

Terminal male green to bluish green dorsally, greenish yellow ventrally, with a very broad black stripe along upper side (Figs. 35 & 36), bordered ventrally by a wavy blue band; two yellowish bars at midbody interrupt the black stripe leaving a black bar of about equal width between them; head yellowish green, becoming blue-green dorsally or on opercle, except for bright blue lips and a broad blue band ventrally on head; iris orange; dorsal fin

blackish with blue margin and blue along base, the first two membranes purplish black; caudal fin translucent, with bright blue streaks and blue upper and lower margins; anal fin yellowish with a blue margin.

Remarks. *Pseudocoris petila* was described by Allen & Erdmann (2012) from two initial-phase specimens collected in the Andaman Islands, three underwater photographs of this phase, and underwater photographs of a terminal male taken at Pulau Weh off the northwestern tip of Sumatra (Fig. 35). A specimen photograph of the initial-phase holotype was also provided. Allen & Erdmann described the habitat of this species as sand, rubble, and weed bottom with scattered rock boulders. They gave the depth for their two specimens as 10–16 m. Unknown to the authors at the time of their description, an underwater photograph taken at Réunion was published in the book on Indian Ocean fishes by Taquet & Diringer (2012: 494), identified as *Pseudocoris* cf. *bleekeri*, clearly a terminal male of *P. petila*, showing the same markings and an even longer first dorsal spine. Taquet & Diringer (2012) recorded the species from the depth range of 15–35 m. More recently, an additional photograph of a terminal male was taken at Sodwana Bay, South Africa (Fig. 36). This suggests a broad range for the species in the Indian Ocean.

The color pattern of *P. petila* is generally similar to *P. bleekeri*, sharing the caudal-fin base spot in the initial phase and the yellow midbody bar in the terminal phase. Initial-phase *P. bleekeri* are less vividly colored than *P. petila* and have the opercular spot and caudal fin base spot smaller and rounder, while terminal males of *P. bleekeri* are distinctly different, with prominent lateral rows of black bars and ovals, no pale bar in front of the yellow bar, and most of the dorsal fin being yellow-orange. The two photographs of terminal male *P. petila* both show much longer first dorsal-fin spines than the typical *P. bleekeri*, but at least one *P. bleekeri* photograph shows a similarly long spine. The two species are an example of an interoceanic sibling-species pair, in this case with different color patterns in both the initial phase and in terminal-phase males, as well as a 1.08% sequence difference in the mtDNA COI barcode gene (minimum interspecific distance by K2P & uncorrected pairwise).



Figure 36. *Pseudocoris petila*, terminal male, Sodwana Bay, KwaZulu-Natal, South Africa (D.R. King).

Pseudocoris aequalis Randall & Walsh

Figures 1, 37–39, Table 1.

mtDNA COI barcode-lineage BIN number: BOLD:ACL4075

Pseudocoris aequalis Randall & Walsh 2008: 53 (type locality, Holmes Reef, Coral Sea); Kuitert 2010: 327, 5 figs. (Holmes Reef & Sydney, NSW, Australia).

Diagnosis. Dorsal-fin rays IX,12; anal-fin rays III,12 or 13 (rarely 12); pectoral-fin rays 13; lateral-line scales 75–78; scales above lateral line at base of ninth dorsal spine 5; gill rakers 5–6 + 12–14; body depth 3.6–4.35 in SL; body compressed, the width 2.0–2.3 in body depth; dorsal profile of head evenly convex; head length 3.1–3.35 in SL; snout short, 3.8–3.9 in head length; orbit diameter 4.9–6.1 in head length; first two dorsal spines of terminal-phase male not extended; ninth dorsal spine longest, 2.65–3.05 in head length; caudal fin truncate to slightly emarginate, 1.45–1.65 in head length.

Color in alcohol. Initial phase gray-brown, with a broad dark brown stripe from behind eye, narrowing as it passes across body to caudal peduncle, then expanding on base of caudal fin. Terminal male dark purplish gray dorsal to a demarcation at level of upper edge of pectoral-fin base, abruptly beige below; head with the same demarcation except anteriorly on opercle where the dark coloration extends ventrally behind preopercular margin;



Figure 37. *Pseudocoris aequalis*, initial phase, aquarium photos; **upper:** 82 mm SL, Holmes Reef, Coral Sea (L. Squire); **lower:** 89 mm SL, Holmes Reef, Coral Sea (F. Walsh).

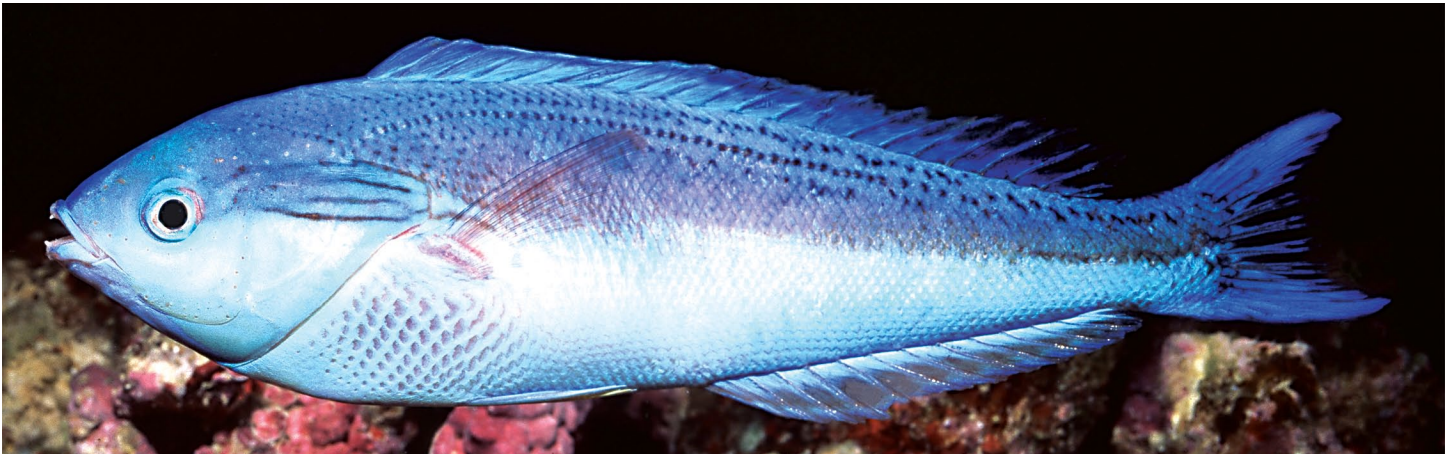


Figure 38. *Pseudocoris aequalis*, terminal male, 112 mm SL, aquarium photo, Holmes Reef, Coral Sea (F. Walsh).

dark stripe expanding on base of caudal fin, the lobes dusky; fins otherwise translucent.

Color in life. Juveniles orangish grading to yellow posteriorly, head darker with two white stripes above and below the eye and one on dorsal midline, fading rearward on body; iris reddish orange (similar appearance to juveniles of *P. yamashiroi*, *P. occidentalis*, *P. bleekeri*, and *P. petila*). Larger initial-phase fish uniform orangish to lavender to violet on upper half of body, pale below; dark band about eye-width runs from snout across eye ending in a darker spot on opercular flap, fins translucent (Fig. 37).

Terminal male with dorsal half of head and body bright blue to violet-blue, the ventral half abruptly white to pale blue, often darker lateral band at junction, extending onto caudal-fin base; scale centers on chest with darker violet-blue spot; several thin dark stripes along upper body formed by deep-violet scale rows, most prominent along lateral-line scales and anteriorly; 3–4 parallel thin black lines passing from behind dorsal half of eye to opercular flap; median fins mainly blue (Figs. 38 & 39).

Remarks. This species was named *aequalis*, meaning equal or uniform, in reference to the near-uniform height of the dorsal fin of the male (mature terminal males of other species of the genus have elongate anterior two dorsal spines, especially the first). The species was described from five specimens collected with a barrier net from depths of 8–15 m over rubble bottom at Holmes Reef (16°27.0' S, 147°51.50' E), 150 km east of the Great Barrier Reef, slightly north of the latitude of Cairns. The first author received a color slide in 1982 of a species of *Pseudocoris* collected by John Van Ruth at Nine-Mile Reef (28°11.8' S, 153° 37.8' E) about 4.5 miles off Danger Point, southern Queensland (Fig. 39); it is clearly the terminal male of *P. aequalis*, and was the first record. This slide was overlooked when *P. aequalis* was described in 2008. Kuitert (2010) has photographed juvenile *P. aequalis* as far south as Sydney, NSW.

Material Examined: CORAL SEA: Holmes Reef, QM I.38118, 112 mm SL (holotype), AMS I.44510-001, 100 mm SL, BPBM 40659, 105 mm SL, BMNH 2007.10.23.2, 89 mm SL, USNM 384193, 104 mm SL (all paratypes).



Figure 39. *Pseudocoris aequalis*, terminal male, Nine-Mile Reef, S. Queensland (J. Van Ruth).

Pseudocoris aurantiofasciata Fourmanoir

Figures 1, 40–46, Table 1.

mtDNA COI barcode-lineage BIN number: BOLD:ACX6997

Coris heteroptera [*non* Bleeker] Günther 1909: 283 (Tahiti).

Pseudocoris aurantiofasciatus Fourmanoir 1971: 130, fig. 2 (type locality, Rangiroa, Tuamotu Archipelago); Randall 1973: 197 (Tahiti); Allen & Smith-Vaniz 1994: 14 (Cocos-Keeling Islands); Allen *et al.* 2003: 192, fig. upper left.

Pseudocoris heteropterus [*non* Bleeker] Masuda *et al.* 1975: 305, pl. 110 J (Kochi Prefecture, Japan, southward); Araga in Masuda *et al.* 1984: 210, pl. 206 A (Kochi Pref. southward); Masuda & Kobayashi 1994: 275: figs. 1–4 (Kochi Pref. southward); Okamura & Amaoka 1997: 502, 3 figs. (Ogasawara Islands).

Pseudocoris aurantiofasciata Allen & Steene 1988: 103, lower fig. (Christmas Island); Senou & Morita 1993: 1 (Ogasawara Islands); Myers 1999: 200, pl. 127 E (only Palau in Micronesia); Parenti & Randall 2000: 35 (central and western Pacific); Westneat in Carpenter & Niem 2001: 3402 (as “*aurantifasciata*”, western central Pacific); Kuitert 2002: 178, lower 3 figs. (West Pacific); Nakabo 2002: 999 (Kochi Pref. to Ryukyu and Ogasawara Islands); Allen & Adrim 2003: 50 (western central Pacific, Flores); Kuitert & Tonzuka 2004: 506, 3 figs. (Flores, Indonesia); Lobel & Lobel 2004: 74 (Wake Island); Randall 2005: 431, lower 2 figs. (Tuamotu Archipelago, Society Islands, and Rarotonga to Banda Sea); Senou *et al.* 2006: 481 (Izu-oshima Island, Sagami Sea); Chen *et al.* 2010: 391 (Kenting National Park, Taiwan); Allen *et al.* 2010: 183 (Christmas Island); Kuitert 2010: 325, 6 figs. (Flores, Indonesia and Izu, Japan); Allen & Erdmann 2012: 712, middle fig. (NE Kalimantan and Java to West Papua, Philippines, and NE Papua New Guinea); Nishiyama & Motomura 2012: 192, 3 figs. (Ogasawara Islands, Ryukyu Islands, Izu Islands, and Pacific coast of southern Japan).

Diagnosis. Dorsal-fin rays IX,12; anal-fin rays III,12; pectoral-fin rays 13 (rare 14); lateral-line scales 73–79; scales above lateral line below ninth dorsal spine 5; gill rakers 5–6 + 12–14; body depth varying from 4.7 in SL of juveniles to 2.9 in large adults; body compressed, the width 2.5–2.7 in body depth; dorsal profile of head a slight sinuous curve (slightly concave above eye, becoming convex on nape); head length 3.4–3.6 in SL; snout short, 3.35 in head length in juveniles to 4.4 in large adults; orbit diameter varying from 4.7 in head length of a 76-mm juvenile to 7.0 in a 193-mm adult; first dorsal spine of initial phase short, about equal to snout length, of terminal male 1.65–1.9 in head length; second dorsal spine also prolonged but clearly shorter; third to ninth dorsal spines progressively longer, the last four progressively shorter; caudal fin of juveniles truncate to slightly emarginate, of initial phase slightly emarginate to lunate with filamentous lobe tips, the caudal concavity up to one-half head length; terminal male with a long trailing filament from each lobe tip, the total fin length one-half SL, the filaments alone can be longer than body depth. Largest species of the genus, the terminal male reaching a standard length of 193 mm and a total length of 300 mm, including caudal filaments.

Color in alcohol. Juveniles pale beige with three dark brown stripes, one from dorsally on side of nape, narrowing as it passes posteriorly below base of dorsal fin, ending at rear base of fin; second stripe from upper half of eye, ending narrowly on base of caudal fin just above end of lateral line; third stripe from cheek below eye, passing below pectoral fin, and ending in dark lower lobe of caudal fin; dorsal fin yellowish brown, darker basally, with a row of white spots, one per membrane.

Initial phase an uninspiring uniform dark brown, though some may have a slightly paler snout (often yellow in



Figure 40. *Pseudocoris aurantiofasciata*, juvenile, Japan (Kazuhiko Nishiyama).

life). Terminal males medium to dark brown, lighter on head and chest, with a series of narrow pale bars in middle of body, generally one about twice as broad as others; posterior margin of caudal fin narrowly pale yellowish, the trailing filaments brown.

Color in life. Juveniles pale yellowish gray to white, prominently striped with three broad red-brown to black stripes from the snout to the base of the caudal fin (Figs. 40 & 41), stripes often suffused with orange-red as they converge on the snout, where there is sometimes a bright yellow patch; dorsal fin with one basal row or two rows of blue spots, one per membrane (similarly striped juvenile of *P. heteroptera* and *P. occidentalis* have only two dark lateral stripes).

Initial-phase females are mostly unmarked, usually uniform bluish green to gray or brownish red with yellow around the lips and a reddish orange iris (Fig. 42). The following color note was made by the first author of a 150-mm female immediately after the fish was speared at Takaroa Atoll in the Tuamotus: dark olive, shading ventrally to purplish olive; ventral part of head iridescent blue; snout yellowish; dorsal and anal fins dark olive green; basal

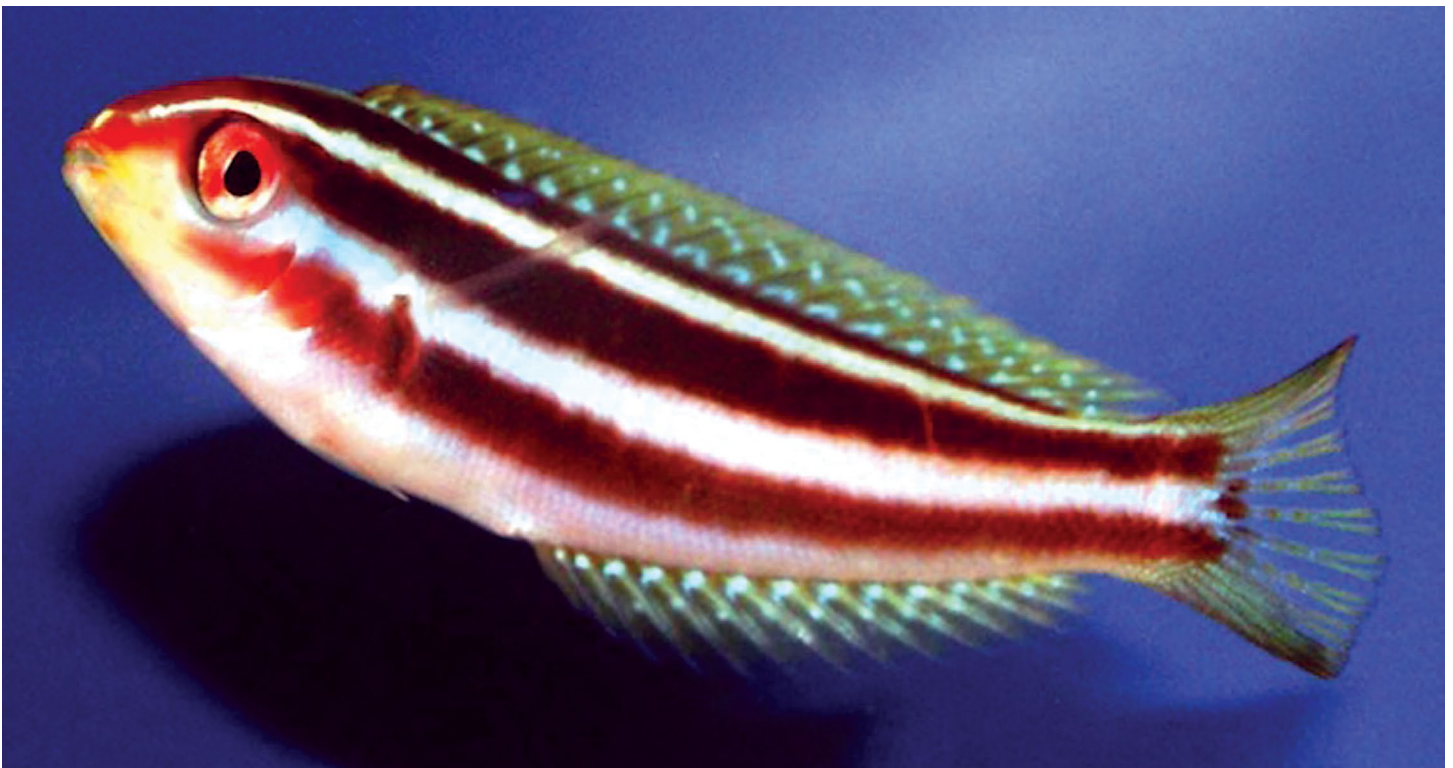


Figure 41. *Pseudocoris aurantiofasciata*, juvenile, aquarium trade, Marshall Islands (anon, reefbuilders.com).

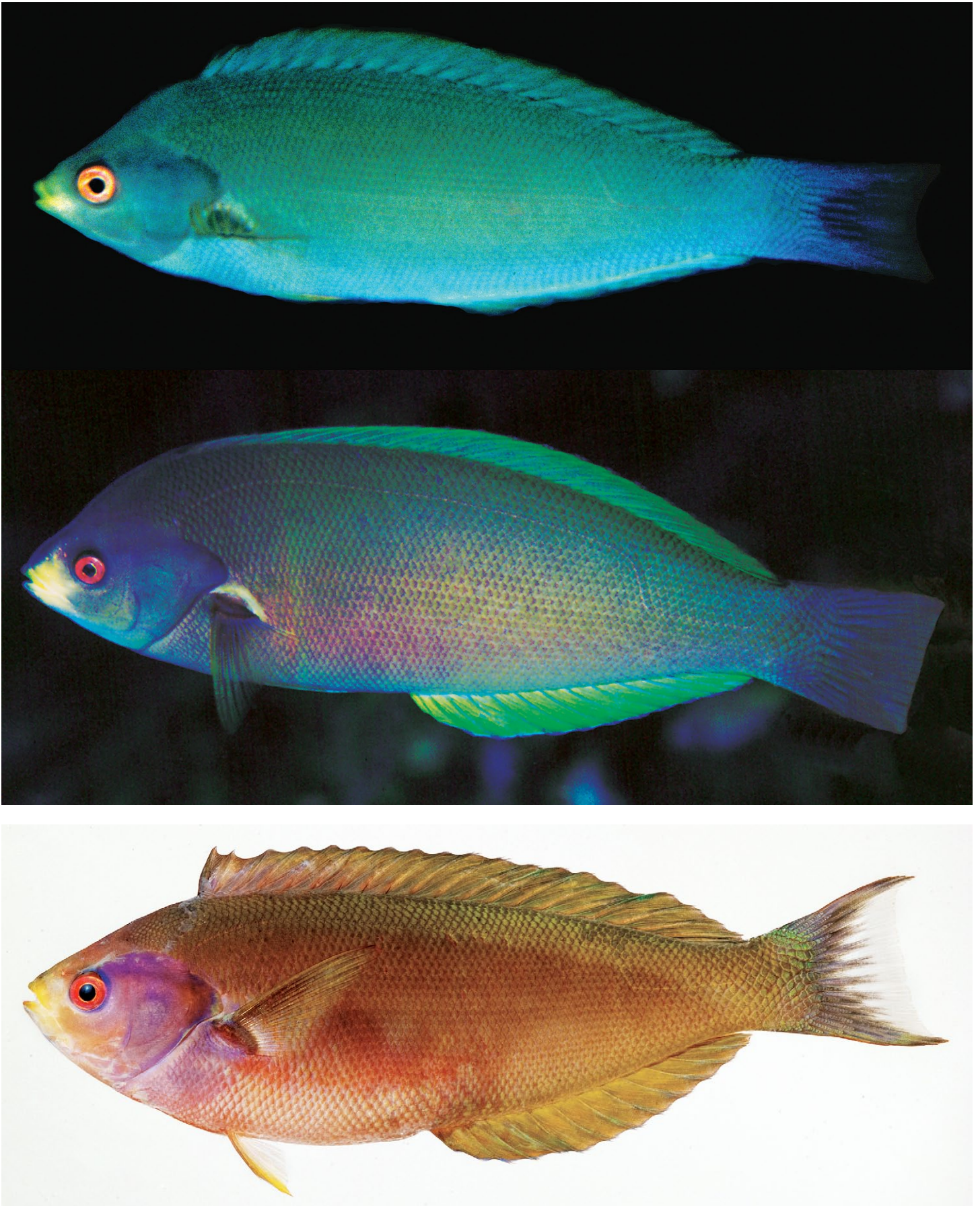


Figure 42. *Pseudocoris aurantiofasciata*, initial phase, probably females; **top:** estimated 110 mm TL, Gunung Api, Banda Sea (J.E. Randall); **middle:** Chichi-jima, Ogasawara Islands, Japan (Y. Morita); **bottom:** MBI01626, 144 mm SL, Moorea, French Polynesia (J.T. Williams).



Figure 43. *Pseudocoris aurantiofasciata*, terminal male, aquarium photo, Herald Reef, Coral Sea (F. Walsh).

two-thirds of caudal fin and caudal lobes blackish, the outer one-third with clear membranes and blackish rays; pectoral fins hyaline with dusky yellow rays; pelvic fins purplish blue-green, shading to yellowish at tips; iris red; pupil iridescent blue-green. Initial-phase fish soon fade to drab brown before a specimen photo can be taken (Fig. 42, bottom).

Terminal males lose much of their life color before they can be photographed as specimens (e.g. Fig. 45). Underwater photographs of live fish show a wide range of colors, from light blue to dark blue to brown or purplish black (Figs. 43, 44, & 46), with several narrow alternating orange and dark bars on the anterior body, usually ending with a more prominent white bar at the level of the mid-anal fin. The narrow bars can sometimes show only the orange series, or only the black series and the final white bar is sometimes reduced to a short oval. One specimen collected by the first author from Rarotonga was blue-green dorsally, grading to purplish blue ventrally (centers of scales blue, the edges violet), with narrow bars on the body that varied in width and in color from orange to blackish, ending with one short vertically elliptical yellow bar. A terminal male from Flores, Indonesia



Figure 44. *Pseudocoris aurantiofasciata*, terminal male, Japan; note unusual black mark on anal fin (Kazuhiko Nishiyama).



Figure 45. *Pseudocoris aurantiofasciata*, terminal male, BPBM 14987, 163 mm SL, Tetiaroa Atoll, Society Islands (J.E. Randall).

photographed underwater by R. Kuitert (Allen & Erdmann 2012: 712) has conspicuous parallel rows of scales with pale centers that are bordered above and below by black on the body immediately behind the pectoral fin, as in Figs. 43 & 44.

Remarks. *Pseudocoris aurantiofasciata* is known from scattered localities, from the eastern Indian Ocean (Christmas Island and Cocos-Keeling Islands), Papua New Guinea, Indonesia, Philippines Micronesia, and Marshall Islands, north to the Pacific coast of southern Japan and Wake Island, south to the Coral Sea, and eastward to the Cook Islands, Tuamotu Archipelago, and the Line Islands. It is typically seen in small aggregations well above the substratum, often off escarpments, and usually at depths greater than 20 m. Senou *et al.* (2006: 481) reported it from Izu-oshima Island in the Sagami Sea from a photograph taken in 36 m; Senou & Morita (1993: 1) from 45 m in the Ogasawara Islands; Randall & Walsh (2008: 49) from 49 m at Gunung Api in the Banda Sea, 82 m from Palau, and 91 m from Fais Island near Yap in the Caroline Islands (from Brian D. Greene). A juvenile specimen has been collected (and photographed) from the Marshall Islands for the aquarium trade (Fig. 41).

Material Examined: TUAMOTU ARCHIPELAGO: Rangiroa Atoll, MNHN 1970-32 167 mm SL (holotype); Tikehau Atoll, BPBM 9102, 161 mm SL; Takarua Atoll, BPBM 9097, 154 mm SL. SOCIETY ISLANDS: Tetiaroa Atoll, BPBM 14987, 163 mm SL, BPBM 14991, 3: 94–189 mm SL. COOK ISLANDS: Rarotonga, BPBM 13084, 193 mm SL. WAKE ISLAND: BPBM 38772, 4: 160–177 mm SL. PALAU: BPBM 37700, 76 mm SL.



Figure 46. *Pseudocoris aurantiofasciata*, terminal male, Rangiroa, French Polynesia (with permission, nangokulife.net)

Pseudocoris ocellata Chen & Shao

Figures 1, 47–51, Table 1.

Pseudocoris ocellatus Chen & Shao 1995: 690, fig. 1 (type locality, Wanlitung, southern Taiwan); Randall & Lim 2000: 629; Ho & Shao 2011: 50.

Pseudocoris ocellata Parenti & Randall 2000: 36 (Taiwan); Senou *et al.* 2006: 481, fig. 6 (Izu-Oshima Island, Sagami Bay); Chen *et al.* 2010: 392, 4 figs. (Kenting National Park, Taiwan) Kuitert 2010: 327, 3 figs. (Oshima, Japan and Taiwan); Nishiyama & Motomura 2012: 193, 2 figs. (Izu-Oshima Island and Wakayama Prefecture).

Diagnosis. Dorsal-fin rays IX,12; anal-fin rays III,12; pectoral-fin rays 13–15 (usually 14, rare 15); lateral-line scales 64–69; scales above lateral line below base of ninth dorsal spine 4; total gill rakers 14–18; body depth 4.1–5.3 in SL; body width 1.8–2.0 in body depth; dorsal profile of head convex above snout, flat above eye and slightly convex on nape; snout length 3.7–4.4 in head length; orbit diameter varying from 5.1 in head length of a 48-mm juvenile to 5.6 in a 100-mm male; first dorsal spine moderately elongate in terminal male, about 2.2 in head length; second dorsal spine slightly prolonged, about 1.7 in length of first spine; remaining dorsal spines progressively longer, the ninth about 2.8 in head length; dorsal soft rays equal in length, except last two shorter; anal-fin base 2.9–3.0 in SL; caudal fin truncate in all phases, the fin length about 4.8 in SL in subadults to 5.6 in terminal males; pelvic fins short, 2.9 in head length in subadults, 2.6 in adults.

Color in alcohol. Subadult and initial phase orangish brown above a midlateral darker brown line, about one scale in width, pale yellowish below; a pupil-size dark brown spot on base of caudal fin above last lateral-line scale; snout orangish brown; a lateral brown stripe extending from behind eye, progressively broader posteriorly, ending on opercular flap; head above line orangish brown, pale yellowish below; fins pale yellowish, the dorsal with a small dark brown spot at base of each spine and ray; first membrane of dorsal fin of large transitional initial-phase paratype in Fig. 48 largely dark brown. Terminal male similar in color in alcohol except for an irregular, very dark brown spot centered on side of midbody below last dorsal spine.

Color in life. Juveniles and initial phase uniformly yellowish brown to coppery (Fig. 47), paler ventrally, with two parallel thin dark stripes bordering a slightly paler lateral band, the upper stripe darkest, from the eye to the caudal-fin base intensifying and wider on the operculum (notably not expanding to form a blotch on



Figure 47. *Pseudocoris ocellata*, paratype, BPBM 35752, initial phase, 40 mm SL, NE Taiwan (J.-P. Chen).



Figure 48. *Pseudocoris ocellata*, paratype, BPBM 35751, transitional male, 101 mm SL, Wanlitung, Taiwan (J.-P. Chen & K.-T. Shao).

the opercular flap), the lower paler stripe running from the cheek, across the pectoral-fin base, fading near the tail; a black rounded spot slightly larger than the pupil of the eye on the caudal-fin base just above the lateral midline; a prominent row of small black spots at the base of each dorsal spine and ray in life; dorsal and caudal fins translucent brownish yellow; anal fin translucent dull orange. One underwater photo from Japan shows an initial phase color variation with numerous contrasting wide dark bars. The transitional initial-phase paratype of Fig. 48 is a mature male beginning the change to the terminal-male color pattern; the orange and blue markings are nearly developed on the head, the first dorsal-fin spine membrane is dark, but not extended, and the blackish midbody blotch is beginning to show. The spot on the base of the caudal fin characteristic of the initial phase is still prominent.

Terminal males are brightly colored, ranging from yellow-orange to blue-green or lavender with prominent blue stripes on the head and more irregular thin blue reticulations on the anterior body (Figs. 49–51); they have a large irregular black blotch or two (often overlapping) at midbody, edged in blue (sometimes with similar smaller satellite spots), just forward of the level of the origin of the anal fin, often followed by a large brighter patch of yellow or orange; first elevated anterior dorsal spine membrane dark blue to black; broad yellow-orange to red distal stripes along dorsal and anal fins.

Remarks. The holotype of *Pseudocoris ocellata* (originally described as *Pseudocoris ocellatus*, but the genus is feminine) is a 111-mm terminal male, caught in 1992 from an isolated reef in 15 m off southern Taiwan by J.-P.



Figure 49. *Pseudocoris ocellata*, holotype, terminal male, ASIZP 056678, 111 mm SL, Wanlitung, Taiwan (J.-P. Chen & K.-T. Shao).



Figure 50. *Pseudocoris ocellata*, terminal male, Izu region, Japan (Kazuhiko Nishiyama).

Chen (ASIZP 056678)(Fig. 49). A second specimen taken at the same station (Fig. 48) was given as a paratype to the Bishop Museum. J.-P. Chen also collected nine small specimens off Yenliao, Taipei, northeastern Taiwan, on sloping reef in 4–5 m. These were divided into three lots as paratypes for the Museum of the Institute of Zoology of Academia Sinica, the Bishop Museum, and the Museum of the Department of Zoology of National Taiwan University. Additional specimens have been collected and photographed in Taiwan (Fig. 51; courtesy of the Taiwan Fisheries Research Institute Digital Archives, Council of Agriculture, Keelung, Taiwan).

Chen *et al.* (2010: 392. 4 figs) illustrated the species from Kenting National Park, southern Taiwan. Other records of the species include photographs from Japan by Senou *et al.* (2006: 481), from Sagami Bay; Kuitert (2010), from Izu-Oshima Island (both near the Izu Peninsula); and Nishiyama & Motomura (2012: 194), from Oshima Island and farther south in Wakayama Prefecture (as juveniles). Despite the many available photographs, no specimens have been collected in Japanese waters (H. Motomura, pers. comm.).

Material Examined: TAIWAN: Wanlitung, BPBM 35751, 101 mm SL (paratype); Yenliao, BPBM 35752, 3: 32–40 mm SL (paratypes).



Figure 51. *Pseudocoris ocellata*, terminal male, FRIP22191, Fish Database of Taiwan (K.-T. Shao).

DNA Comparisons. The mtDNA COI sequence (DNA barcode) was obtained for all species of *Pseudocoris* (except *P. ocellata*). Mitochondrial DNA sequences can assist in assessing the distinctiveness of populations, however it should be noted that there is no consistent threshold degree of divergence, and, in some cases, reef fish species can share DNA sequences (phenovariant species) or populations with divergent DNA lineages can be otherwise indistinguishable (genovariant populations)(Victor 2015). Nonetheless, divergent mtDNA lineages do generally indicate that populations are no longer breeding together and the degree of divergence should be proportional to the time since the populations were isolated from each other. The absence of successful interbreeding is a feature of species-level differentiation, although clearly not sufficient, depending on which species definition is followed. When genetically divergent lineages persist in sympatry and maintain a different phenotype (however slight), few could argue the divergence is not species-level. The fact that many closely related Indian and Pacific Ocean sibling species are found to co-occur on reefs at some sites of overlap, such as Bali, supports the argument for species-level designation for inter-oceanic divergent DNA lineages with small color differences.

The neighbor-joining phenetic tree based on the COI mtDNA sequences of eight of the nine known species of *Pseudocoris* species, following the Kimura two-parameter model (K2P) generated by BOLD (Barcode of Life Database), shows mostly deep divergences between species and much smaller differences within species, except for a small overlap, where one interocean sibling-species pair has a lower divergence than the maximum intraspecific divergence within two of the more variable species (Fig. 52 & Table 4). Divergences between *Pseudocoris*

TABLE 4
**K2P distances for mtDNA COI sequences
of species of *Pseudocoris***

Minimum Interspecific and Maximum Intraspecific distances (%)

	<i>aeq</i>	<i>aur</i>	<i>yam</i>	<i>hem</i>	<i>het</i>	<i>occ</i>	<i>pet</i>	<i>ble</i>
<i>P. aequalis</i>	NA							
<i>P. aurantiofasciata</i>	8.93	NA						
<i>P. yamashiroi</i>	10.37	8.25	0.93					
<i>P. hemichrysos</i> , n. sp.	9.26	8.25	2.51	0.31				
<i>P. heteroptera</i>	7.79	3.73	7.07	6.72	0.16			
<i>P. occidentalis</i> , n. sp.	8.03	4.32	7.16	7.17	0.63	0.95		
<i>P. petila</i>	9.25	8.22	6.77	6.81	7.05	7.51	NA	
<i>P. bleekeri</i>	8.91	8.24	6.26	6.30	6.44	6.83	1.08	0.31

**P-distances (uncorrected pairwise) for mtDNA COI sequences
of species of *Pseudocoris***

Minimum Interspecific and Maximum Intraspecific distances (%)

	<i>aeq</i>	<i>aur</i>	<i>yam</i>	<i>hem</i>	<i>het</i>	<i>occ</i>	<i>pet</i>	<i>ble</i>
<i>P. aequalis</i>	NA							
<i>P. aurantiofasciata</i>	8.29	NA						
<i>P. yamashiroi</i>	9.52	7.67	0.92					
<i>P. hemichrysos</i> , n. sp.	8.60	7.68	2.46	0.31				
<i>P. heteroptera</i>	7.32	3.60	6.64	6.34	0.16			
<i>P. occidentalis</i> , n. sp.	7.53	4.15	6.73	6.75	0.63	0.94		
<i>P. petila</i>	8.60	7.68	6.42	6.45	6.67	7.07	NA	
<i>P. bleekeri</i>	8.29	7.68	5.95	5.99	6.10	6.45	1.08	0.31

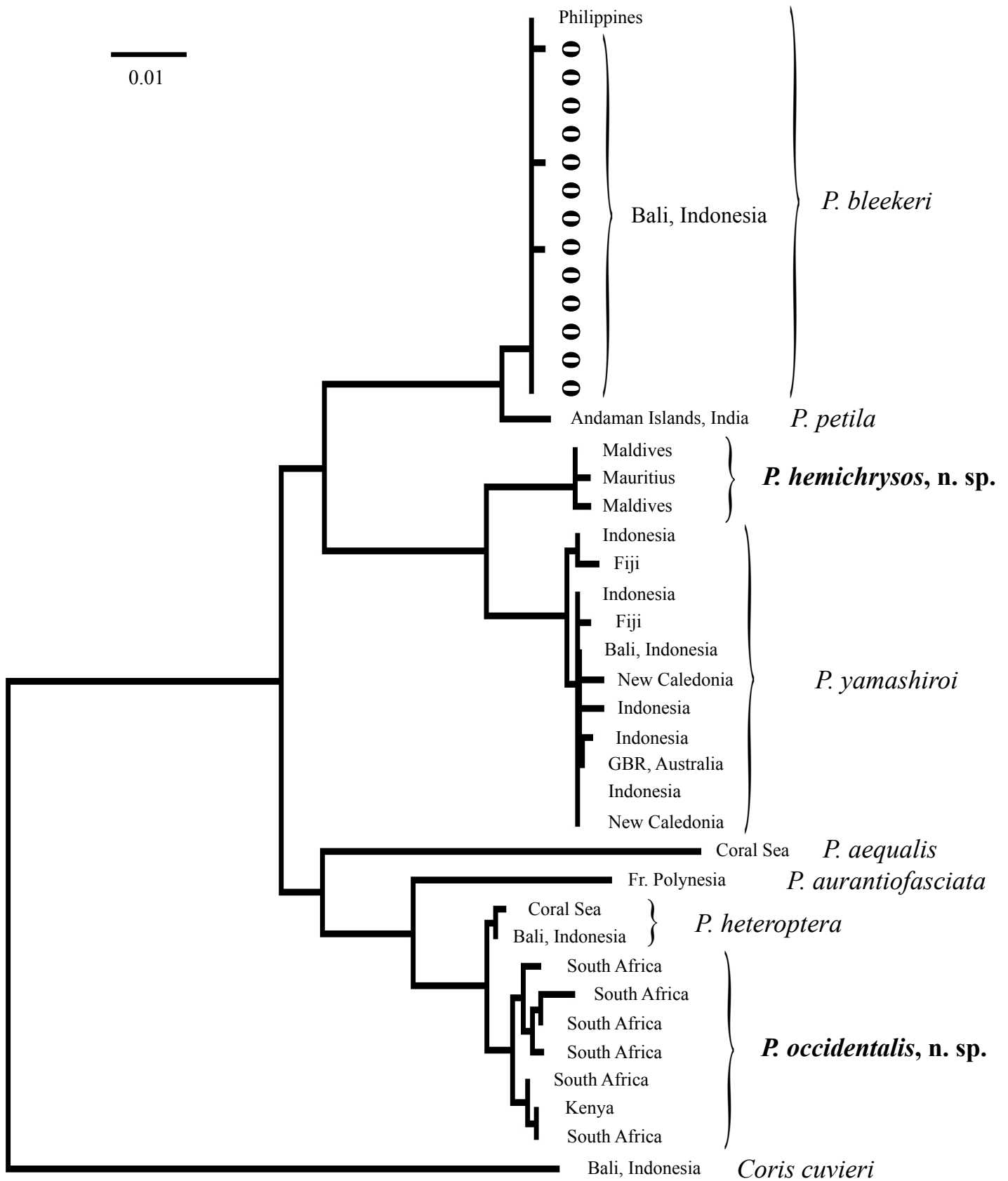


Figure 52. The neighbor-joining phenetic tree of mtDNA COI sequences for *Pseudocoris* species following the Kimura two-parameter model (K2P) generated by BOLD (Barcode of Life Database). The scale bar at left represents a 1% sequence difference. Collection locations for specimens are indicated, and *Coris cuvieri* is used as an outgroup. GenBank accession numbers and collection data for the sequences in the tree are listed in Appendix 1.

species range as high as 10.37% (minimum interspecific distance by K2P; 9.52% uncorrected pairwise) between *P. yamashiroi* and *P. aequalis* down to 0.63% (0.63% uncorrected pairwise) between the sibling-species pair of *P. heteroptera* and *P. occidentalis*. The three interocean sibling-species pairs do have the three lowest divergences in the genus, but these pairs are not all “cryptic species”, in the sense of being discovered only after a genetic analysis: *P. petila* was recognized and described well before it was sequenced and it has the second smallest genetic divergence.

In the case of *Pseudocoris*, some of the broad generalizations of the Barcode Project are not supported: the minimum interspecific distance between congeners is not an order of magnitude greater than the maximum intraspecific distance, nor is the “threshold” barcode divergence of about 2% between species supported (Steinke *et al.* 2009, Ward *et al.* 2009). Two of the three interocean sibling-species pairs are divergent below the 2% threshold, while the other is well over the threshold at 2.51% divergence (*P. yamashiroi/hemichrysos*). This result argues against any simple dichotomy between interocean sibling-species pairs and “normal” species, since divergences below 2.5% are frequently found between well-established reef fish species (Victor 2015). Similarly, there is no support for a defining degree of genetic divergence for subspecies vs. species level categories, and that taxonomic decision remains somewhat subjective. Furthermore, the lack of concordance between the degree of genotypic and phenotypic divergence is well illustrated here: the sibling-species pair with the greatest divergence differs only by coloration of the dorsal fin of the terminal-phase male, while the other sibling-species pairs show more pronounced differences in markings. This lack of a fine degree of concordance in the degree of genotypic and phenotypic divergence is typical for closely related reef fish species complexes (Victor 2015).

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Appendix 1. Specimen data and GenBank accession numbers for the barcode mtDNA COI sequences used to generate the phenogram in Fig. 52, following the order in the tree. Holotypes in bold.

Genus	species	Collection site	Voucher	GenBank #	Collector/Source
<i>Pseudocoris</i>	<i>bleekeri</i>	Philippines	BPBM 41218 dej14	KP975979	A. DeJong/aq. trade
<i>Pseudocoris</i>	<i>bleekeri</i>	Bali, Indonesia	BPBM 41217 bali11800py225	KP976007	B. Victor
<i>Pseudocoris</i>	<i>bleekeri</i>	Bali, Indonesia	BPBM 41217 bali11700py154	KP975991	B. Victor
<i>Pseudocoris</i>	<i>bleekeri</i>	Bali, Indonesia	BPBM 41217 bali118005py160	JQ839564	B. Victor
<i>Pseudocoris</i>	<i>bleekeri</i>	Bali, Indonesia	BPBM 41217 bal11800py202	JQ839566	B. Victor
<i>Pseudocoris</i>	<i>bleekeri</i>	Bali, Indonesia	BPBM 41217 bali11700py161	KP975992	B. Victor
<i>Pseudocoris</i>	<i>bleekeri</i>	Bali, Indonesia	BPBM 41217 bali11800py210	KP975987	B. Victor
<i>Pseudocoris</i>	<i>bleekeri</i>	Bali, Indonesia	BPBM 41217 bali11700py164	KP975981	B. Victor
<i>Pseudocoris</i>	<i>bleekeri</i>	Bali, Indonesia	BPBM 41217 bali11700py160	KP976009	B. Victor
<i>Pseudocoris</i>	<i>bleekeri</i>	Bali, Indonesia	BPBM 41217 bali11800py260	KP975976	B. Victor
<i>Pseudocoris</i>	<i>bleekeri</i>	Bali, Indonesia	BPBM 41217 bali11800py154	KP975972	B. Victor
<i>Pseudocoris</i>	<i>bleekeri</i>	Bali, Indonesia	BPBM 41217 bali11700py191	KP975995	B. Victor
<i>Pseudocoris</i>	<i>bleekeri</i>	Bali, Indonesia	BPBM 41217 bali11800py230	KP975973	B. Victor
<i>Pseudocoris</i>	<i>bleekeri</i>	Bali, Indonesia	BPBM 41217 bali118005py230	JQ839567	B. Victor
<i>Pseudocoris</i>	<i>petila</i>	Andaman Islands	me13pp	KP975980	G. Allen/M. Erdmann
<i>Pseudocoris</i>	<i>hemichrysos</i>	Maldives	BPBM 41219 je315ph	KP976008	J. Edward/aq. trade
<i>Pseudocoris</i>	<i>hemichrysos</i>	Mauritius	BPBM 41221 dej14py325	KP975984	A. DeJong/aq. trade
<i>Pseudocoris</i>	<i>hemichrysos</i>	Maldives	BPBM 41220 je14pm680	KP975994	J. Edward/aq. trade
<i>Pseudocoris</i>	<i>yamashiroi</i>	Indonesia	je14py2	KP975990	J. Edward/aq. trade
<i>Pseudocoris</i>	<i>yamashiroi</i>	Fiji	qm14fpy2	KP975982	QM/aq. trade
<i>Pseudocoris</i>	<i>yamashiroi</i>	Indonesia	je13py	KP975983	J. Edward/aq. trade
<i>Pseudocoris</i>	<i>yamashiroi</i>	Fiji	qm14fpy1	KP975988	QM/aq. trade
<i>Pseudocoris</i>	<i>yamashiroi</i>	Bali, Indonesia	BPBM 41224 bal11800py151	JQ839565	B. Victor
<i>Pseudocoris</i>	<i>yamashiroi</i>	New Caledonia	qm14py1	KP976000	J. Edward/aq. trade
<i>Pseudocoris</i>	<i>yamashiroi</i>	Indonesia	je14py1	KP976003	D. Carlon/A. Faucci
<i>Pseudocoris</i>	<i>yamashiroi</i>	Indonesia	je14py3	KP975997	B. Victor
<i>Pseudocoris</i>	<i>yamashiroi</i>	GBR, Australia	Appendix A (B & B 2005)	AY850766	Barber & Bellwood 2005
<i>Pseudocoris</i>	<i>yamashiroi</i>	Indonesia	dej14py740	KP976002	A. DeJong/aq. trade
<i>Pseudocoris</i>	<i>yamashiroi</i>	New Caledonia	qm14py2	KP975969	QM/aq. trade
<i>Pseudocoris</i>	<i>aequalis</i>	Coral Sea	fw13pa	KP975993	F. Walsh
<i>Pseudocoris</i>	<i>aurantiofasciata</i>	French Polynesia	MBIO1626	JF435148	S. Planes/J. Williams
<i>Pseudocoris</i>	<i>heteroptera</i>	Coral Sea	Appendix A (B & B 2005)	AY850765	Barber & Bellwood 2005
<i>Pseudocoris</i>	<i>heteroptera</i>	Bali, Indonesia	BW-A11270	KR861514	B. Ward/W. White CSIRO
<i>Pseudocoris</i>	<i>occidentalis</i>	South Africa	DSFSG613-11	KF489718	A. Connell/ SAIAB
<i>Pseudocoris</i>	<i>occidentalis</i>	South Africa	SAIAB 188936 DSFSG957-13	KP975965	A. Connell/ SAIAB
<i>Pseudocoris</i>	<i>occidentalis</i>	South Africa	SAIAB 188936 DSFSG998-13	KP975963	A. Connell/ SAIAB
<i>Pseudocoris</i>	<i>occidentalis</i>	South Africa	SAIAB 188936 DSFSG965-13	KP976004	A. Connell/ SAIAB
<i>Pseudocoris</i>	<i>occidentalis</i>	South Africa	SAIAB 187899 DSFSG112-10	HQ561460	A. Connell/ SAIAB
<i>Pseudocoris</i>	<i>occidentalis</i>	Kenya	BPBM 41222	KP975977	J. Edward/aq. trade
<i>Pseudocoris</i>	<i>occidentalis</i>	South Africa	SAIAB 188936 DSFSG917-13	KP975971	A. Connell/ SAIAB
<i>Coris</i>	<i>cuvieri</i>	Bali, Indonesia	bali11400cg170	JQ839416	B. Victor