



A review of the *Callogobius* (Teleostei: Gobiidae) from the Red Sea with the description of a new species

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Abstract

Five species of *Callogobius* Bleeker have been previously reported from the Red Sea: *C. amikami* Goren, Miroz & Baranes, *C. clarki* (Goren), *C. dori* Goren, *C. flavobrunneus* (Smith), and *C. maculipinnis* (Fowler). Records of *C. bifasciatus* (Smith) in the Red Sea are referable to *C. clarki*. *Callogobius amikami* has been previously known only from a single specimen, the holotype from the Red Sea, and two photographs, a live juvenile from Oman and a live specimen at an aquarium at Coral World, Eilat. We obtained a possible additional juvenile from the Red Sea, although we are unable to definitively determine its identity. Red Sea specimens previously identified as *C. maculipinnis* [or *C. irrasus* (Smith)] represent a new species, distinguished from the latter by normally having four sets of transverse mandibular rows on each side (rather than three); this species is described here as *Callogobius pilosimentum* sp. nov. Four specimens of an additional, undescribed species of *Callogobius*, *C. sp. A*, have been collected from the Red Sea, but we withhold a formal description because this species is currently under study by colleagues. *Callogobius sclateri* (Steindachner), previously known from the Indo-West Pacific, is reported from the Red Sea for the first time. A key to all seven species is provided. Each species is photographed, habitat is described and a brief description with detailed comparisons is provided. The new species and *C. clarki* are endemic to the Red Sea.

Key words: taxonomy, endemism, key

Introduction

Callogobius Bleeker 1874 is a genus of moderately small gobies characterized by distinctive raised ridges of papillae on the head and comprising more than 40 nominal species (Eschmeyer & Fricke 2016). It is widespread in Indo-Pacific shallow marine and brackish environments, including coral reefs and coral rubble, tidepools, and mangrove streams. Species are cryptic and rarely seen out of shelter, making them difficult to survey. Despite considerable collecting and research over almost 200 years, relatively few specimens and only five species have been reported from the Red Sea (Golani & Bogorodsky 2010). The first described Red Sea endemic *Callogobius* was *C. clarki* (Goren 1978); Goren (1980) reviewed four species of *Callogobius* in the Red Sea, *C. clarki*, *C. irrasus* (Smith 1959), *C. flavobrunneus* (Smith 1958), and described a new Red Sea endemic, *C. dori* Goren. *Callogobius irrasus* was considered a synonym of *C. maculipinnis* (Fowler 1918) by McKinney & Lachner (1984). Goren *et al.* (1991) described yet another Red Sea endemic species, *C. amikami* Goren, Miroz & Baranes. *Callogobius clarki* was synonymized with *C. bifasciatus* (Smith 1958) by Randall *et al.* (1994), a decision followed by other authors including Randall (1995) and Golani & Bogorodsky (2010), until *C. clarki* was resurrected as a valid species by Delventhal & Mooi (2014).

In this paper we report the first record of *Callogobius sclateri* (Steindachner 1879) for the Red Sea, a species with an otherwise widespread distribution in the Indo-West Pacific. In addition, we have identified four Red Sea

specimens that, though resembling *C. sclateri*, represent an undescribed species: BPBM 18213 (male, 38.3 mm SL and female, 34.5 mm SL), SMF 35772 (KAU 13-631; juvenile, 14.5 mm SL), and KAUMM 383 (KAU 13-32; juvenile, 17.0 mm SL). This species can be distinguished from *C. sclateri* and other Red Sea species by the lower lateral scale counts (22–25), partially united pelvic fins (about two-thirds of length in intact specimens), and the fifth pelvic-fin ray no more than four-fifths the length of the fourth. These appear to be representatives of a widespread species in the Indo-West Pacific that is presently under study by scientists at the Biological Laboratory of the Imperial Palace, Japan. We include this species in our key as *C. sp. A*, but do not provide a formal species description; one is forthcoming from these colleagues.

Our examination of the head papillae row patterns of Red Sea specimens identified as *Callogobius maculipinnis* revealed a subtle difference compared to specimens outside the Red Sea. With rare exception, specimens of members of the *C. maculipinnis* species complex collected outside the Red Sea have three sets of transverse mandibular rows on each side of the lower jaw. In contrast, almost all Red Sea specimens have four sets of transverse mandibular rows on each side of the lower jaw; we describe the Red Sea specimens as a new species.

We provide a key to all seven Red Sea *Callogobius* along with brief descriptions of each species, detailed comparisons, habitat descriptions, and photographs.

Materials and methods

Specimens from the Red Sea are listed in their respective species accounts. In addition, we examined type specimens of the *Callogobius* species listed in Delventhal & Mooi (2013), and representatives of *C. maculipinnis* as identified from other geographic localities are provided in the new species account. The full account of the new species is provided first, followed by the remaining Red Sea species summaries in alphabetical order.

Abbreviations for institutional codes follow Fricke & Eschmeyer (2015) and/or Sabaj Pérez (2014) excepting KAUMM (King Abdulaziz University Marine Museum, Jeddah, Saudi Arabia—specimens temporarily housed at SMF). Specimens that have been tissue-sampled are provided with a KAU number after the catalogue number. Methods for morphometrics and meristics follow Delventhal & Mooi (2013), with the following additions. Whenever possible, morphometric data were taken from specimens that had reached sexual maturity and that had not become compressed, folded or otherwise distorted during preservation and storage. Full collection data are provided for previously unreported material.

Scales. We recorded the anterior-most limits of ctenoid scales with appropriate landmarks (e.g., from the first spine of the second dorsal fin, meaning, from a vertical line drawn from the first spine of the second dorsal fin) or simply recorded a general pattern with its variation (e.g., ctenoid scales, if present, restricted to the caudal peduncle).

Sensory pores and papillae rows. The alphabetical naming system for the sensory pores follows Akihito & Meguro (1977) and descriptive names for pores and canals are modified from Takagi (1957). Figure 1 illustrates the sensory pores and canals found in the new species. Cyanine blue dye prepared by the method of Akihito *et al.* (1993) was applied when distinguishing between pores (which often end in short tubes) and pore replacement papillae, the latter normally located where pores would be positioned in pored species (see Delventhal & Mooi 2013). Terminology for sensory papillae rows follows Delventhal & Mooi (2013). We comment only on papillae rows whose length and orientation are variable among *Callogobius* species and generally consistent within a species (these rows are labeled in Fig. 1).

Color pattern. In each species account, we recorded a range in the number of dark bars (e.g. 4–5 bars). In general, each species has a specific number of possible bars in a distinct and consistent orientation, but the bars themselves may or may not be visible due to changes in contrast caused by the environment and behavioural response of the fish (e.g., Fig. 2). In addition, many *Callogobius* become increasingly dark and/or mottled as they age. In these species, juveniles tend to be distinctly bi-colored, but the barring pattern becomes obscured in larger fish. The color patterns of the pectoral and first dorsal fins are often useful in distinguishing species. Unfortunately, the first dorsal fin is usually compressed in preserved specimens. The pattern on the pectoral fin often changes with age. Photographs by the third author (SVB) are of live specimens usually under anesthetic; this can sometimes result in different color patterns than might be seen before collection, but are usually more representative than patterns in freshly dead specimens.

***Callogobius pilosimentum* sp. nov.**

Hairy-chinned Flapheaded Goby

(Figures 1–2, Table 1)

Drombus irrasus (non Smith)—Goren 1979: 36.

Callogobius irrasus (non Smith)—Goren 1980: 213; Dor 1984: 241.

Callogobius maculipinnis (non Fowler)—Goren *et al.* 1991: 299; Goren & Dor 1994: 53; Golani & Bogorodsky 2010: 46.

Material examined. All specimens collected from the Red Sea.

Holotype. SMF 35756 (KAU12-0224), female, 36.4 mm SL, Saudi Arabia, Farasan Island, N16°43.083' E42°03.934', isolated coral patch of lagoon, 3–5 m, S.V. Bogorodsky & T.J. Alpermann, 20 February 2012 (Figs. 1, 2A).

Paratypes (17 specimens, 25.5–67.0 mm SL). **Egypt:** BPBM 21518, male?, 41.5 mm SL, El Hameira, coral knoll in 12 m, J.E. Randall & O. Gon, 25 April 1977; **Saudi Arabia:** KAUMM 373, male, 47.1 mm SL, Maqna, N28°26'13.40" E034°45'47.80", steep slope, 7 m, S.V. Bogorodsky, 13 April 2011; KAUMM 374, female, 28.3 mm SL, Jeddah, Obhur (Sharm Obhur), N21°42'33.12" E39°05'48.26", base of rocky reef, 2 m, S.V. Bogorodsky, 19 April 2011; KAUMM 375 (KAU12-0220), male, 25.5 mm SL, collected with the holotype; KAUMM 376, male, 37.0 mm SL, Farasan Island, N16°43.083' E42°03.934', isolated coral patch of lagoon, 3–5 m, S.V. Bogorodsky & T.J. Alpermann, 20 February 2012; KAUMM 377 (KAU13-378), male, 28.5 mm SL, 30 km south of Al Wajh, N26°03'30.36" E36°38'34.98", fringing reef, 8 m, S.V. Bogorodsky & T.J. Alpermann, 14 June 2013; SMF 35757, 2 males, 29.7 mm SL (C&S) & 47.3 mm SL, Farasan Island, N16°54' 93.30" E41°50'76.10", lagoon, isolated small coral patch, 1 m, S.V. Bogorodsky, 01 April 2011; SMF 35758 (KAU12-0218), male, 38.4 mm SL, collected with the holotype; SMF 35759 (KAU12-0538), female, 35.8 mm SL, Farasan Island, N16°43.083' E42°03.934', isolated coral patch of lagoon, 3–5 m, S.V. Bogorodsky & T.J. Alpermann, 28 February 2012; SMF 35760, male, 67.0 mm SL and female, 55.8 mm SL (Fig. 2C), Jeddah, Obhur (Sharm Obhur), N21°42'32.28" E39°05'47.16", steep slope with patches of corals and small sandy flats, 14–16 m, S.V. Bogorodsky, 01 July 2013; **Sudan:** BMNH 1978.9.8.12-16, 5 specimens (4 females with 1 C&S, 1 male, 44.5–61.9 mm SL), Suakin, coral crevices in seawall, Manihine collections, 5 December 1950.

Other material. BMNH 1978.9.8.17-26, 10 specimens (6 females, 4 males, 36.9–70.7 mm SL), Sudan, Suakin Archipelago, around seawall and from crevices, Manihine collections, 12 January 1951.

Tentative identification: USNM 296956, female, 44.3 mm SL, Red Sea, Egypt, just north of Ras Burqa, V.G. Springer *et al.*, 23 July 1969.

Diagnosis. *Callogobius pilosimentum* is distinguished from all other known *Callogobius* species by the following combination of characters: interorbital canal normally containing pores B', C, D, E, F, G and H'; preopercular canal containing pores M', N, and O'; temporal canal containing pores K' and L'; scales in lateral series 21–25 (usually 24); normally four transverse mandibular papillae rows (Row 16) on each side.

Description. Holotype values indicated by an asterisk. Parentheses enclose number of type specimens with the particular value, counts made on both sides when applicable or possible. Dorsal fin VI + I,9(17*), VI + I,10(1); anal fin I,6(1), I,7(17*); pectoral-fin rays 15(2), 16(11), 17(15*), 18(5); pelvic-fin rays I,5(36*); segmented caudal-fin rays 9 + 8(1), i8 + 8(4*), i8 + 7i(12), ii7 + 8(1); procurrent rays 4 + 4(2), 5 + 4(15*), 5 + 5(1); scales in lateral series 21(1), 22(3*), 23(4), 24(20*), 25(5); predorsal scales 6(5), 7(13*); transverse scales 8(3), 9(13*), 10(2).

See Table 1 for selected morphometrics.

Body moderately robust for the genus (Fig. 2). Head depressed, broader than deep. Snout obtuse. Mouth slightly oblique, forming an angle of about 45° with body axis; lower jaw slightly beyond tip of upper jaw, posterior end of jaws at or just before vertical through anterior margin of orbit. Anterior nostril moderately long, slender tube, reaching halfway to anterior outer edge of upper lip; posterior nostril very short, upright tube. Eye moderately large; upper margin of orbit slightly elevated above profile of head. Interorbital narrow. Gill opening ending ventrally at lower edge of pectoral-fin base. Tongue broad, tip slightly bilobed. Urogenital papilla long, slender and darkly pigmented in males; broad and darkly pigmented in females, no lateral flaps. Vertebral count (based on two cleared and stained specimens) 10 precaudal + 16 caudal.

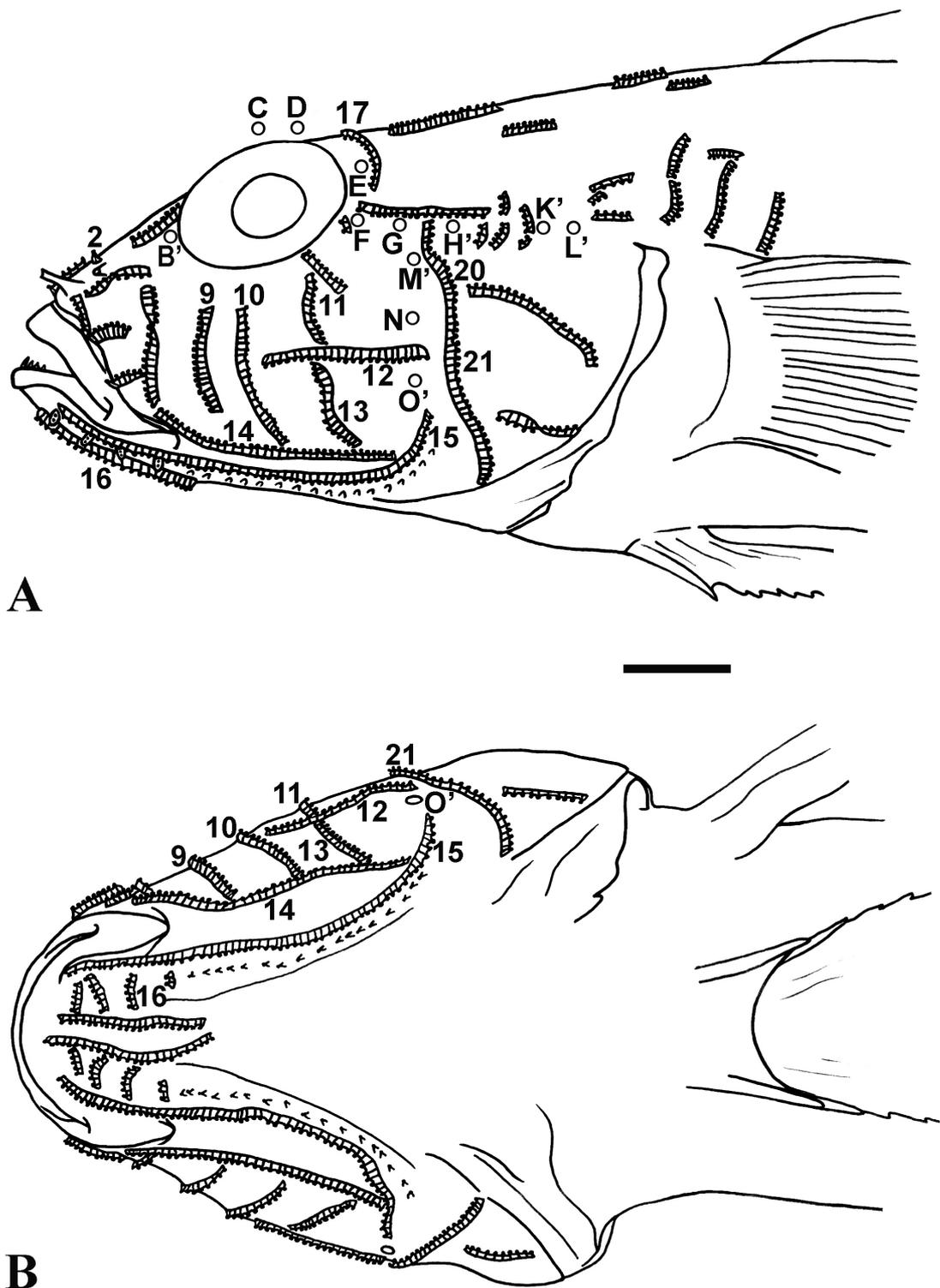


FIGURE 1. Sensory pore and papillae pattern on the head of *Callogobius pilosimentum* sp. nov., SMF 35756, holotype, female, 36.4 mm SL. **A.** Lateral view; **B.** Ventral view. Letter abbreviations of sensory pores follow Akihito & Meguro (1977) and descriptive names are modified from Takagi (1957). Papillae row numbering follows Akihito and Meguro and descriptive names are from Delventhal & Mooi (2013). Sensory pores: B = posterior nasal; C = anterior interorbital; D = posterior interorbital; E = supraotic; F = anterior otic; G = posterior otic; H = intertemporal; M, N, O = preopercular; K = anterior temporal; L = posterior temporal. Papillae rows: 2 = postnasal; 9 = anterior suborbital; 10 = mid suborbital; 11 = posterior suborbital; 12 = longitudinal cheek; 13 = transverse cheek; 14 = longitudinal maxillary; 15 = longitudinal mandibular; 16 = transverse mandibular; 17 = postorbital; 20 = preopercular; 21 = transverse opercular (rows 20 and 21 continuous). Scale bar = 2 mm. Illustration by RDM and NRD.



FIGURE 2. *Callogobius pilosimentum* sp. nov., live coloration: **A.** SMF 35756, holotype, female, 36.4 mm SL, Farasan Island, Saudi Arabia; **B.** Fresh coloration, uncatalogued, Farasan Island, Saudi Arabia, illustrating pattern frequently induced by stress; **C.** SMF 35760, paratype, female, 55.8 mm SL, Obhur, Jeddah, Saudi Arabia. Photos by SVB.

TABLE 1. Selected measurements of the holotype and paratypes of *C. pilosimentum* **sp. nov.**; standard length is provided in mm, values for other morphometrics are as percentage of standard length (SL) or head length (HL), as indicated. For paratypes, the range is followed by an average value for all types in parentheses. The two largest specimens (63 and 67 mm SL) were males (M), the next 3 largest specimens (55.8, 50.3, 49.3 mm SL) were females (F).

	Holotype	Paratypes
Gender	F	9M,8F
Standard Length (mm)	36.4	25.5–67.0 (42.8)
Head length (% of SL)	33.0	29.1–34.1 (32.3)
Head depth (% of HL)	59.2	50.6–64.6 (58.8)
Head width (% of HL)	73.3	64.6–75.8 (70.2)
Interorbital width (% of HL)	5.4	4.1–7.8 (5.7)
Predorsal fin distance (% of SL)	38.5	34.3–40.4 (37.0)
Preanal fin distance (% of SL)	59.6	57.8–62.8 (60.3)
Prepelvic fin distance (% of SL)	33.0	29.6–35.8 (32.8)
Pectoral-fin length (% of SL)	31.3	29.7–35.4 (32.6)
Pelvic-fin length (% of SL)	23.9	22.0–28.1 (24.9)
Caudal-fin length (% of SL)	32.4	26.4–37.3 (31.9)
Caudal peduncle depth (% of SL)	13.7	12.3–15.5 (13.8)

Dentition. Teeth in jaws conical and slender in rows; outer teeth slightly larger than inner teeth. Outer teeth present on anterior two-fifths of toothed portion of lower jaw; inner teeth of lower jaw tightly packed anteriorly, about 6 irregular rows merging to single row posteriorly. Outer teeth of upper jaw extend over entire toothed portion of upper jaw, about 5 irregular rows of inner teeth merging to single row parallel to row of outer teeth.

Fins. First dorsal-fin base short; anterior fin membranes incised, first three interspinous membranes incised with spine tips free up to one-fourth their length, occasionally more for second and third spine (particularly in males that have longer, filamentous fin spines), posterior interspinous membrane only slightly incised; second spine longest. Second dorsal-fin base about twice that of first dorsal; segmented rays branched, penultimate ray longest. Anal-fin base short; segmented rays branched, penultimate ray longest. Pectoral-fin rays branched except for dorsalmost one or two rays; fin reaching to level of second or third anal-fin ray. Pelvic fins fully united with membrane over entire length of medial rays; fourth segmented pelvic-fin ray barely shorter or subequal to fifth ray, fifth ray almost reaching to anus; all segmented pelvic-fin rays branched. Pelvic frenum present and well developed. Caudal fin rounded, length < 40% SL.

Squamation. All scales large and deciduous, with distinctly outlined centres. Scales cycloid on head and anterior half of body; cycloid scales present on nape to interorbital, in spaces between papillae rows on cheeks, preoperculum and operculum, on lateral side of pectoral-fin bases, prepelvic and predorsal areas, and belly. Scales ctenoid on posterior half of body from mid-flank region below first to third spines of first dorsal fin. Ctenii numerous, long, slender and pointed; no elongate ctenii on caudal peduncle. Most specimens with single large cycloid scale in centre of pelvic disc (visible under pelvic frenum).

Cephalic sensory systems. Pores present (Fig. 1). Interorbital canal with pair of posterior nasal pores (pore B), anterior interorbital pore (pore C), posterior interorbital pore (pore D), pair of supraotic pores (pore E), pair of anterior otic pores (pore F), pair of posterior otic pores (pore G), and pair of intertemporal pores (pore H); preopercular canal with three preopercular pores (pores M, N and O); each temporal canal with anterior and posterior temporal pore (pores K and L, respectively).

Papillae row configuration (Fig. 1): Postnasal rows (Row 2) long and joined across midline (16*) or overlapping (1). Anterior suborbital row (Row 9) short to moderately long, not reaching eye (34*). Mid suborbital row (Row 10) short to moderately long, not reaching eye (34*). Posterior suborbital rows (Row 11) long and overlapping (32*) or rarely short or irregular (2). Longitudinal maxillary row (Row 14) rarely irregular (1), normally continuous and extending posteriorly to below and beyond (33*) transverse cheek row (Row 13), latter short (31*) or rarely irregular (1). Longitudinal mandibular row (Row 15) continuous (21*) or irregular (3). With 4(31*), 5(2), or 2(1) transverse mandibular rows (Row 16) on each side of lower jaw, all but one specimen with 4

on at least one side; 15 of 17 type specimens with 4 on both sides. One specimen with 5 on one side and 4 on the other (SMF 35760, 67 mm SL), and one with 5 on one side and 2 on the other (SMF 35759, 35.8 mm SL); latter exhibits irregular patterns in several other papillae rows (Rows 13, 14, 15, 17, 20, 21). Postorbital rows (Row 17) short (less than two-thirds of distance from the dorsal mid-line to bony edge of cranium) (8) or medium (more than two-thirds of distance from dorsal mid-line to bony edge of the cranium) (24*), rarely irregular (1). Preopercular row (Row 20) continuous with the transverse opercular row (Row 21) (25*) or separate (5).

Color in life (Fig. 2). General color pattern brown to dark brown with paler patches (Fig. 2A), or pale grayish-brown with up to five dark brown mottled vertical bars on body and dark brown blotchy patterns with varying contrast on head. Body bars, when visible (e.g. Figs. 2B & C, but not Fig. 2A), appear as follows: irregular bar may extend dorsally over operculum and pectoral-fin base, slightly indented at first dorsal-fin spine; wide bar extends below first dorsal fin; two wide, slightly oblique bars extend below mid and posterior portions of second dorsal fin; narrow bar encircles posterior caudal peduncle, edge of hypural plate and proximal regions of the caudal fin. Underside of head light brown or dusky, papillae rows may show great color contrast. First dorsal fin with dark brown basal spot centered on fourth ray and continuous with dark body bar; may exhibit yellow markings on distal margin. First and second dorsal fins dark brown with irregular, oblique, pale bands or rows of spots, some individuals with irregular dark and pale pattern; caudal fin dark brown usually with pale spots forming irregular bars. Pelvic and anal fins dusky or dark brown with or without paler blotches. Pectoral fin with dark irregular bands or rows of spots and a dark medial mark at base. Urogenital papilla dark.

Color in preservative. As in life, although older specimens can be orange-brown with little pattern on body. Most museum specimens damaged (species with fragile skin and deciduous scales) and body color pattern often reduced to light brown or grey with dark outlines of scale pockets.

Etymology. The species name is derived from the Latin *pilosus* meaning “hairy” and *mentum* meaning “chin”, referring to the extra rows of papillae on the chin. Specific epithet to be treated as a noun in apposition. Suggested common name: hairy-chinned flapheaded goby.

Distribution and habitat. Restricted to the Red Sea. It is usually collected in shelters or close to shelters on small sand flats (about 0.5–1 m across) of steep slopes, sometimes at the base of coral reefs, in closed areas in bays and lagoons, at depths of 1–20 m.

Remarks. Goren (1980) listed *Drombus irrasus* Smith in the Red Sea as a first record. This species is considered a synonym of *Callogobius maculipinnis* by most authors (e.g. McKinney & Lachner 1984, Goren *et al.* 1991); Eschmeyer & Fricke (2016) incorrectly attributed Delventhal & Mooi (2013) as recognizing Smith’s species when the type was listed as comparative material. Although we have not examined Goren’s (1980) *C. irrasus* material, we suspect that these specimens will belong to *C. pilosimentum*. Two lots of specimens that we identify as *C. pilosimentum* (BMNH 1978.9.8.12-16 and BMNH 1978.9.8.17-26) were examined by Goren (1980) and identified as *C. irrasus*.

Callogobius pilosimentum belongs to a “*maculipinnis* species complex” including the following nominal species: *C. bauchotae* Goren 1979, *C. irrasus* (Smith 1959), *C. kuderer* (Herre 1943), *C. maculipinnis* (Fowler 1918), *C. nigromarginatus* Chen & Shao 2000, *C. shunkan* Takagi 1957, *C. snelli* Koumans 1953, and *C. vanaclevei* (Herre 1950). Species of this complex are characterized by having the temporal canal with pores K and L (absent in all other *Callogobius*) and normally four or fewer transverse mandibular rows on each side (all other *Callogobius* normally have more than 10). McKinney & Lachner (1984) synonymised *C. irrasus*, *C. kuderer*, *C. shunkan*, *C. snelli*, and *C. vanaclevei* with *C. maculipinnis*; they did not examine *C. bauchotae* (or *C. nigromarginatus* as it was described after their work). However, their synonymies should be considered questionable because all included species are poorly defined. Based on the first author’s examination of the types, we are confident that several, or even most, of these species will prove to be valid after complete investigation. Despite this, *C. pilosimentum* can readily be distinguished from the other members of this complex, all of which normally have three transverse mandibular rows on each side. We previously examined the types of all the above species in the *maculipinnis* complex except *C. nigromarginatus*. They all have three sets of transverse mandibular rows, except *C. shunkan* which has extra irregular rows and is easily differentiated by other characters (Y. Ikeda pers. comm.). These observations of the types were recently confirmed by Y. Ikeda (*C. bauchotae*, *C. snelli*, and *C. shunkan*), M. Sabaj Pérez (*C. maculipinnis*) and D. Catania (*C. kuderer*). L. Parenti re-examined the holotype of *C. vanaclevei*, a distorted specimen that appears to have no fourth transverse mandibular row on either side. The holotype of *C. nigromarginatus* was unavailable, but the illustration and text indicate that three transverse mandibular rows are present (Chen & Shao 2000).

We found only a single Red Sea specimen (USNM 296956, female, 44.3 mm SL) that has three transverse mandibular rows on each side. We tentatively identify it as *Callogobius pilosimentum*, but we have not designated it as a paratype. We presume that this is simply unusual variation in a species that normally has four on each side. To evaluate variation in transverse mandibular papillae rows (Row 16, Fig. 1) in specimens outside of the Red Sea, we examined 174 adult specimens identified in collections as *C. maculipinnis* ranging across the Indian Ocean eastward to Mangareva (Gambier Islands, French Polynesia) in the Pacific Ocean (listed in Comparative material below).

Of the 174 specimens examined from outside of the Red Sea, only three (< 1.7%) exhibited the condition of *C. pilosimentum* of having four transverse mandibular papillae rows on both sides of the jaw. Even among these, only one (WAM P27935-024) exhibited a normal, sequential four-row anatomy, and this specimen belongs to an Australian ‘population’ that has distinctly higher meristic counts than other members of the complex (D. Hoese pers. comm.). The other two specimens (USNM 332226 and ZRC 40669) have unusual morphologies where the fourth transverse mandibular row on one side follows a free papilla and/or the first row is a branch of the intermandibular row. An additional 11 specimens had four rows on only one side and three or fewer on the other (6.3% of all specimens). From localities with the largest representation, an Indonesian lot (USNM 241882) had three of 32 specimens having four transverse mandibular papillae rows on one side only and of 42 specimens in 11 lots from Fiji only two specimens had four such rows on one side. This is in contrast to the condition in *C. pilosimentum* in the Red Sea where all specimens exhibited four or more transverse mandibular rows on each side except one that had five on one side and two on the other, and one that had three on each side (USNM 296956).

In *Callogobius pilosimentum*, the anterior first dorsal-fin spines are usually free of membrane for one-fourth or more of the spine length, particularly the second spine. Although clearly evident on some live specimens (Fig. 2), this can be difficult to assess on preserved specimens. This feature is common to most, if not all, members of the *maculipinnis* species complex so is not diagnostic, but is potentially of value to distinguish live or particularly well-preserved specimens from Red Sea congeners.

Comparative material. *Callogobius maculipinnis* (listed west to east): Comoros—ROM 92691 (4); Oman—ROM 39895 (6); Chagos—ROM 55107 (4); Sri Lanka—USNM 220035 (5); Cocos-Keeling—WAM P29928-022 (4); Western Australia—WAM 27935-024 (3); Thailand—ROM 58036 (1), 68041 (4); Indonesia—USNM 241882 (32), WAM P33093-002 (2); Singapore—ZRC 40669 (1); Philippines—ROM 53339 (3), USNM 297102 (2); Taiwan—BPBM 23242 (1), USNM 298439 (8); Palau—BPBM 37767 (2), ROM 75955 (1); 76134 (1); Papua New Guinea—BPBM 32638 (1), 32674 (2), USNM 297051 (2); Australia—MPM 48365 (1), ROM 38903 (1), USNM 297048 (3); One Tree Island—BPBM 14432 (4); Lord Howe Island—BPBM 14862 (1); Coral Sea—BPBM 33517 (1), 33629 (3); New Caledonia—BPBM 34270 (1), ROM 64155 (1), 64160 (2), 64416 (3); Vanuatu—BPBM 5765 (1), MPM 32132 (1), 46721 (1); Marshall Islands—BPBM 8296 (1), 17739 (1), 22349 (1); Fiji—BPBM 39866 (1), 40082 (1), ROM 57700 (5), 57701 (1), 57703 (3), 57705 (6), 57707 (2), 57708 (1), 57709 (2), 57710 (1), USNM 332226 (19); Tonga—BPBM 38115 (3), USNM 339828 (7); Tahiti—BPBM 8315 (2); Rapa—BPBM 17317 (1); Mangareva—BPBM 13595 (3).

Comparisons to other described *Callogobius* species are based on our data from the available holotypes listed in Delventhal & Mooi (2013).

***Callogobius amikami* Goren, Miroz & Baranes 1991**

(Figure 3)

Callogobius amikami Goren, Miroz & Baranes 1991: 300 (Eilat, Israel, Gulf of Aqaba, Red Sea; holotype TAU P-10321).—Goren & Dor 1994: 63; Randall 1995: 329; Golani & Bogorodsky 2010: 46.

Diagnosis. *Callogobius amikami* is distinguished from congeners by the following combination of characters: interorbital pores B', D, E, F, G and H' present; preopercular canal absent; temporal canal absent; dorsal fin VI + I, 10; anal fin I, 8; scales in lateral series about 27; scales ctenoid from the first spine of the second dorsal fin to the caudal-fin base; preopercular papillae row (Row 20) continuous with transverse opercular row (Row 21); body coloration with strongly contrasting wide dark bars and narrow horizontal lines.

Brief description. Moderately stout-bodied species with slightly elongate and round-tipped caudal fin > 40% SL in length. Scales large, cycloid anteriorly, ctenoid from first spine of second dorsal fin to caudal-fin base, scales

in lateral series about 27. Dorsal-fin rays VI + I,10, anal-fin rays I,8, pectoral-fin rays 18; pelvic fins fully united with fifth ray equal to fourth (resulting in blunt-ended appearance), frenum weak. Anterior nostril slightly longer than posterior nostril. Head pores present with interorbital canal normally containing pores B', D, E, F, G, and H', preopercular and temporal canals absent. Preopercular papillae row (Row 20) continuous with transverse opercular row (Row 21), more than 10 transverse mandibular papillae rows (Row 16) on each side.

Body of adults pale grey with about nine narrow black stripes following scale rows, short broad black bar dorsally below posterior half of first dorsal fin, a slightly curved black bar below rear of second dorsal fin, and black bar at caudal-fin base. Head whitish with three dark bars radiating from eye, one oblique across side of snout anteriorly to chin, one across cheek and opercle, and one dorsoposteriorly across occiput. Broad irregular oblique black bar from origin of first dorsal fin to upper part of opercle. Two papillae rows on cheek below eye black. Both dorsal fins black, each with broad white dash anteriorly, oblique rows of white spots, and narrow white to hyaline border. Caudal fin with large central brown area crossed by rows of black spots, margin white and broadest dorso-posteriorly. Pectoral fin dark dorsally and basally, white ventrally. Presumed juveniles (see Remarks) white with four narrow black bars on body, one on nape, one dorsally extending into first dorsal fin, one posteriorly extending through anal fin and second dorsal, and one at caudal-fin base; bars in dorsal fins with orange spot; pelvic fin white; pectoral fin mostly white with broad black dorsal and posterior margin with orange submarginal band; caudal fin white with black bar in posterior third with orange bar within it.

Distribution and habitat. Confirmed only from the Red Sea. First reported by Goren *et al.* (1991) in the original description of a single specimen (TAU P-10321) from Eilat, Israel collected at 6 m among coral pieces and rocks away from the coral reef. A possible photographic record from Oman is discussed below.

Remarks. *Callogobius amikami* is most likely to be confused with *C. dori*. It differs in second dorsal- and anal-fin ray counts (D2 I,10 and A I,8 in the holotype of *C. amikami* vs. D2 I,9 and A I,7 in *C. dori*), and in adult color pattern (distinct vertical bars present vs. absent).

Our measurements and lateral scale counts taken from the holotype (Fig. 3A) differ slightly from those of Goren *et al.* (1991), who measured the holotype at 28.4 mm SL and counted 24 scales in lateral series. Our shorter SL measurement is likely due to stiffening of the specimen in preservation; our higher lateral scale count can be attributed to uneven scale distribution and individual researcher technique. Goren *et al.* (1991) stated that the holotype is a male; we found the gender to be ambiguous.

A second specimen of *C. amikami* was photographed by J.E. Randall in 1993 at Coral World in Eilat (Fig. 3B). We were unable to determine if the specimen was eventually preserved and added to a collection.

Debelius (1993: 263) provided a photograph of a single live juvenile *Callogobius* taken in Muscat, Oman (Western Indian Ocean) that he identified as *C. amikami*, but no specimens were taken. The photographed individual displays sharply contrasting narrow bars, with the bars having bright orange central markings on the pectoral, first and second dorsal fins, and caudal fins. Randall (1995) followed Debelius (1993) in listing *C. amikami* as occurring in Oman. We consider this identification to be uncertain. The color pattern of *C. amikami* differs slightly from the photograph (although some differences would be expected from developmental change); the holotype of *C. amikami* has much wider bars and darker fins. The live photograph of the holotype in Goren *et al.* (1991) does indicate orange on the first dorsal fin, supporting the identification of the Oman specimen as *C. amikami*, however, the latter appears to have an anal fin ray count of I,7 (as opposed to I,8 in the holotype *C. amikami*).

The third author collected and photographed a 7.2 mm juvenile from Al Wajh bank, Saudi Arabia (Fig. 3C) that resembles the specimen in Debelius's photograph. This individual was very secretive, hidden inside the base of dead coral in fringing seaward reefs at a depth of 3–5 m. Microscopic examination revealed that the lateral scales are not yet fully developed on this specimen and second dorsal- and anal-fin ray counts are I,9 and I,7 respectively, lower than the counts on the holotype of *C. amikami*. Instead, these counts match those of *C. dori*, although no tiny juveniles of the latter are known. We are uncertain that this specimen represents *C. amikami*.

Representative Red Sea Material (2 specimens, 7.2 & 26.2 mm SL). **Israel:** TAU P-1032, holotype, sex uncertain, 26.2 mm SL. **Saudi Arabia:** SMF 35770 (KAU13-142), juvenile (tentative identification), 7.2 mm SL, Al Wajh bank, N25°35'52.86" E36°41' 01.80", seaward slope of unnamed island, sediment with coral patches, 3–5 m, coll. S.V. Bogorodsky & T.J. Alpermann, 12 June 2013.



FIGURE 3. *Callogobius amikami* Goren, Miroz & Baranes: **A.** Preserved specimen, TAU P-10321, holotype, sex uncertain, 26.2 mm SL, Eilat, Israel; **B.** Aquarium specimen in 1993, Coral World, Eilat, about 40 mm TL, collected by A. Miroz. **C.** *Callogobius* cf. *amikami*, live coloration, SMF 35770, juvenile, 7.2 mm SL, Al Wajh bank, Saudi Arabia. Photos by NRD (A), J.E. Randall (B) used with permission, SVB (C).

Callogobius clarki (Goren 1978)

(Figure 4)

Drombus clarki Goren 1978: 200 (El-Tur, Sinai coast, Egypt, Gulf of Suez, Red Sea; holotype HUI 10065).—Goren 1979: 36.

Callogobius bifasciatus (non Smith)—Randall *et al.* 1994: 240; Randall 1995: 330; Golani & Bogorodsky 2010: 46.

Callogobius clarki—Goren 1980: 213; Dor 1984: 241; Goren *et al.* 1991: 300; Goren & Dor 1994: 63; Delventhal & Mooi 2014: 143.

Diagnosis. *Callogobius clarki* is distinguished from congeners by the following combination of characters: head pores absent; scales in lateral series 33–41; scales mostly cycloid except for ctenoid scales occasionally on caudal peduncle; preopercular papillae row (Row 20) not continuous with transverse opercular row (Row 21).

Brief description. Moderately stout-bodied with rounded caudal fin < 40% SL in length. Scales small, cycloid except for a few rows at caudal-fin base (larger specimens may lack ctenoid scales, although exceptionally long ctenii may be present on caudal peduncle scales), scales in lateral series 33–41. Dorsal-fin rays VI + I, 10–11 (rarely 11); anal-fin rays I, 8–9 (usually 9); pectoral-fin rays 15–17; pelvic fins united two-thirds of their length, with fifth ray shorter than fourth with weak frenum. Anterior nostril slightly longer than posterior nostril. Head pores absent. Preopercular papillae row (Row 20) not continuous with transverse opercular row (Row 21); more than 10 transverse mandibular papillae rows (Row 16) on each side.

Head, body and median fins finely mottled whitish and grey-brown with irregular broad, dark brown bar below first dorsal fin extending onto fin as one or two spots at base. Second broad, oblique, dark bar extending from mid to posterior base of second dorsal fin to posterior base of anal fin and anterior caudal peduncle. A dark bar posteriorly on caudal peduncle at caudal-fin base. Wide, diffuse brown bar or blotch present on ventral half of body below origin of second dorsal fin. Sensory papillae ridges on head with dark brown spots. Pectoral fin mostly translucent with diffuse vertical, narrow, brown bands and sometimes dense markings medially. Coloration of preserved material similar to fresh coloration.

Distribution and habitat. Reported only from the Red Sea. *Callogobius clarki* is often found under stones or at the base of corals in fringing seaward reefs and patches of corals in lagoons and bays at a depth of up to at least 12 m.

Remarks. *Callogobius clarki* differs from all other *Callogobius* species in the Red Sea in lacking head pores. Juvenile specimens of *C. flavobrunneus* and *C. sclateri* that have not yet developed head pores may be confused with *C. clarki*. Unlike *C. flavobrunneus*, *C. clarki* has ctenoid scales only on the caudal peduncle, pelvic fins united, and a weak frenum (vs. ctenoid scales on the posterior half of the body, separate pelvics or united by only a minute membrane, and no frenum). *Callogobius clarki* has higher lateral scale counts than *C. sclateri* (33–41 vs. 28–31) and pelvic fins partially united with a weak frenum (vs. separate with no frenum). Live *C. clarki* may closely resemble *C. flavobrunneus*, due to similar body shape and coloration (they may have *flavobrunneus*-like medial markings on the pectoral fins); examination with the aid of a microscope may be needed to distinguish them.

Representative Red Sea material (35 specimens, 16.8–52.0 mm SL). **Egypt:** BPBM 41226, female, 23.9 mm SL; BPBM 41243, male, 52.0 mm SL, Dahab, large coral block, 14 m, coll. S.V. Bogorodsky, 01 August 2015; HUI 10065, holotype, female, 36.5 mm SL; ROM 50227, male, 34.9 mm SL; USNM 220031, 11 specimens, 4 males, 3 females, 1 juvenile, and 3 specimens cleared and stained, 14.1–35.1 mm SL; USNM 220090, male, 43.7 mm SL; USNM 296954, 1 male and 1 juvenile, 16.8–24.2 mm SL; USNM 341181, male and female, 31.0–47.9 mm SL; USNM 300015, female?, 23.6 mm SL; **Eritrea:** USNM 220038, 2 males, 34.6–48.6 mm SL; **Saudi Arabia:** KAUMM 380 (KAU13-218), male, 25.2 mm SL, Al Wajh bank, fringing reef of small island, 5–8 m, coll. S.V. Bogorodsky & T.J. Alpermann, 12 June 2013; KAUMM 381 (KAU13-292), male, 29.4 mm SL, 25 km south of Al Wajh, fringing reef, 5–7 m, coll. S.V. Bogorodsky & T.J. Alpermann, 13 June 2013; KAUMM 382 (KAU13-491), female, 34.6 mm SL, 25 km south of Al Wajh, fringing reef, 11–14 m, coll. S.V. Bogorodsky & T.J. Alpermann, 16 June 2013; SMF 35755, male, 21.5 mm SL, Amaq, fringing reef, 7 m, coll. S.V. Bogorodsky & T.J. Alpermann, 31 March 2011; SMF 35763, female, 23.7 mm SL, Farasan Island, isolated coral patch of lagoon, 3–5 m, coll. S.V. Bogorodsky & T.J. Alpermann, 28 February 2012; SMF 35765 (KAU13-212), female, 36.4 mm SL, Al Wajh bank, sediment with coral patches, 3–5 m, coll. S.V. Bogorodsky & T.J. Alpermann, 12 June 2013; SMF 35766 (KAU13-291), female, 41.4 mm SL, 25 km south of Al Wajh, fringing reef, 5–7 m, coll. S.V. Bogorodsky & T.J. Alpermann, 13 June 2013 (Fig. 7); SMF 35767 (KAU13-217), male, 37.2 mm SL, Al Wajh bank, fringing reef

of small island, 5–8 m, coll. S.V. Bogorodsky & T.J. Alpermann, 12 June 2013; SMF 35768 (KAU13-381 & 382), 2 females, 31.6–33.6 mm SL, 30 km south of Al Wajh, fringing reef, 8 m, coll. S.V. Bogorodsky & T.J. Alpermann, 14 June 2013; SMF 35769 (KAU13-454), male, 42.3 mm SL, 25 km south of Al Wajh, fringing reef, 11–14 m, coll. S.V. Bogorodsky & T.J. Alpermann, 16 June 2013; **Sudan**: BMNH 1978.9.8.6, male, 38.8 mm SL.



FIGURE 4. *Callogobius clarki* (Goren), live coloration: **A.** SMF 35766, female, 41.4 mm SL, Al Wajh, Saudi Arabia; **B.** BPBM 41243, male, 52.0 mm SL, Dahab, Egypt. Photos by SVB.

***Callogobius dori* Goren 1980**

(Figure 5)

Callogobius dori Goren 1980: 210 (Suakin, Sudan, Red Sea; holotype BMNH 1978.9.8.7).

Callogobius dori—Dor 1984: 241; Goren *et al.* 1991: 299; Golani & Bogorodsky 2010: 46.

Diagnosis. *Callogobius dori* is distinguished from congeners by the following combination of characters: interorbital pores B', D, E, F, G and H' present; preopercular canal absent; temporal canal absent; dorsal fin VI + I,9; anal fin I,7; scales in lateral series 24–26; body tan to dark brown with narrow, dark longitudinal stripes; a large diffuse black spot dorsally in caudal fin.

Brief description. Moderately stout-bodied with elongate, broadly rounded, caudal fin > 40% SL in length.

Scales large, deciduous, cycloid anteriorly, ctenoid from first spine of second dorsal fin to caudal-fin base, scales in lateral series 24–26. Dorsal-fin rays usually VI + I,9, anal-fin rays usually I,7, pectoral-fin rays 17–18, pelvic fins fully united with moderate frenum. Anterior nostril longer than posterior nostril. Head pores present with interorbital canal normally containing pores B', D, E, F, G and H', preopercular and temporal canals absent. Preopercular papillae row (Row 20) continuous with transverse opercular row (Row 21), more than 10 transverse mandibular papillae rows (Row 16) on each side.

Head, body and fins tan to brown. About seven or eight narrow, dark, longitudinal stripes usually visible on body. First dorsal and pectoral fins dark. Our specimens very faded, unable to discern whether or not vertical bars or head markings present. Dark spot as large as eye on upper part of caudal fin often present, depending on the condition of the specimen. Coloration in preservation similar.



FIGURE 5. *Callogobius dori* Goren, live coloration, SMF 35762, male, 23.8 mm SL, Farasan Island, Saudi Arabia. Photo by SVB.

Distribution and habitat. Western Indian Ocean and Red Sea. *Callogobius dori* specimens have been collected from the base of coral patches on silty sand of a closed lagoon, depth 5–7 m, although one collection reached 21–27 m.

Remarks. In the Red Sea, *C. dori* is most likely to be confused with *C. amikami* and *C. pilosimentum*. *Callogobius dori* shares a similar body shape and usually dark coloration with *C. pilosimentum*; it differs from the latter in lacking preopercular and temporal canals (vs. present), dorsal-fin spines not prolonged (vs. dorsal-fin spines prolonged, the second spine occasionally as a short filament), caudal fin > 40% SL in length (vs. < 40% SL), and more than 10 transverse mandibular papillae rows on each side (vs. 4). *Callogobius dori* shares a similar body shape and proportions with *C. amikami*; it differs from the latter in having second dorsal- and anal-fin ray counts of I,9 and I,7 respectively (vs. I,10 and I,8 respectively in holotype of *C. amikami*) and in color pattern (cf. Figs. 3, 5).

McKinney (1980) in an unpublished Master's thesis refers to this species as *Callogobius* new species B. One lot of *C. dori* examined by McKinney (USNM 220030, Red Sea, Gulf of Aqaba, Bay at El Himeira, 4 specimens) was labeled as "*C. aquilus*"; this name was never published. *Callogobius dori* has been considered a Red Sea endemic, but we have located three specimens from the Seychelles (USNM 385746, Amirante Islands, St. Joseph Atoll, south of Ressource Island, 0–4 m, 7 March 1964), considerably expanding the known range of this species and suggesting it might be found elsewhere in the Western Indian Ocean.

Representative Red Sea material (24 specimens, 15.8–35.5 mm SL). **Egypt:** HUI 11092, male, 28.1 mm SL; ROM 43205, 1 male and 1 female, 17.0–20.5 mm SL; USNM 220030, 2 males, 2 females, and 1 specimen cleared and stained, 15.8–24.0 mm SL; USNM 220095, female?, 19.2 mm SL; USNM 220098, male, 28.7 mm SL; USNM 220929, 1 male and 2 females, 18.4–21.5 mm SL; **Eritrea:** USNM 220099, female, 24.0 mm SL; **Saudi Arabia,** Farasan Island: KAUMM 378 (KAU12-318), female, 23.9 mm SL, base of fringing reef of small island, 7 m, coll. S.V. Bogorodsky & T.J. Alpermann, 22 February 2012; SMF 35761 (KAU12-219), male, 24.6 mm SL, isolated coral patch of lagoon, 3–5 m, coll. S.V. Bogorodsky & T.J. Alpermann, 20 February 2012; SMF 35762, male, 23.8 mm SL (Fig. 5), collected with SMF 35761; **Sudan:** BMNH 1978.9.8.7, holotype, male, 33.5 mm SL; BMNH 1978.9.8.8–11, paratypes, 3 males and 1 female, 27.5–35.5 mm SL; BPBM 20387, male, 26.8 mm SL.

***Callogobius flavobrunneus* (Smith 1958)**

(Figure 6)

Mucogobius flavobrunneus Smith 1958: 145 (Pinda, Mozambique; holotype SAIAB 211).

Callogobius flavobrunneus—Goren 1980: 214; Dor 1984: 241; Goren *et al.* 1991: 300; Goren & Dor 1994: 63; Golani & Bogorodsky 2010: 46.

Diagnosis. *Callogobius flavobrunneus* is distinguished from congeners by the following combination of characters: interorbital pores present; preopercular canal absent; temporal canal absent; scales in lateral series 34–40; scales ctenoid posteriorly on body from below first spine of the second dorsal fin; preopercular papillae row (Row 20) not continuous with transverse opercular row (Row 21); pectoral fin densely pigmented medially.

Brief description. Moderately stout-bodied with rounded caudal fin < 40% SL in length. Scales medium-sized, cycloid anteriorly, ctenoid posteriorly on body from below first spine of second dorsal fin to the caudal-fin base (exceptionally long ctenii on caudal peduncle scales), scales in lateral series 34–40. Dorsal-fin rays VI + I, 9–10 (rarely 10), anal-fin rays I, 7–8 (usually 8), pectoral-fin rays 15–17, pelvic fins separate (or with very short connecting membrane) with fifth ray significantly shorter than fourth (only about three-fourths of length) and frenum absent. Anterior nostril longer than posterior nostril. Head pores present with interorbital canal normally containing pores B', D, E, F, G, and H' (rarely containing pore C), preopercular and temporal canals absent. Preopercular papillae row (Row 20) not continuous with transverse opercular row (Row 21), more than 10 transverse mandibular papillae rows (Row 16) on each side.

Head, body and fins densely mottled brown (sometimes pale and lightly mottled). Depending on intensity of mottling, up to four broad, diffuse, dark brown bars, frequently two being more obvious, one below first dorsal fin and one obliquely below second dorsal fin. Base of pectoral-fin rays darkly marked with a vertical bar, connecting anteriorly to a dark pectoral-fin base, resulting in an H or sideways T mark. First dorsal fin with irregular, dark basal spot. Caudal fin brown with vertical rows of white speckles, margin of fin usually pale. Coloration in preservation similar to color in life, although generally paler and barring more distinct.

Distribution and habitat. Widespread in the Indo-West Pacific. In the Red Sea, often found under stones or at the base of coral heads in fringing seaward reefs, depth 3–15 m.

Remarks. In the Red Sea, *C. flavobrunneus*, *C. sclateri*, and *C. clarki* are frequently confused, due to similarly-shaped moderately stout bodies, and color pattern of four wide bars. *Callogobius flavobrunneus* differs from *C. clarki* in having head pores in specimens at least 14 mm SL (vs. absent in specimens of any size), ctenoid scales from the origin of the second dorsal fin (vs. only on caudal peduncle), and pelvic-fin morphology (frenum absent and membrane uniting medial rays minute or absent vs. frenum present and fins united over most of length medial ray). *Callogobius flavobrunneus* differs from *C. sclateri* in having higher lateral series scale counts (34–40 vs. 27–32), fifth pelvic-fin ray significantly shorter than fourth (about three-fourths length of fourth ray vs. subequal), and pectoral-fin color pattern (medial dark markings vs. dark upper edge or diffuse vertical bands). *Callogobius flavobrunneus* differs from *C. sp. A* in having higher lateral series scale counts (34–40 vs. 22–25), and pelvic fins with connecting membrane very short or absent (fins separate vs. united along most of length of medial rays).

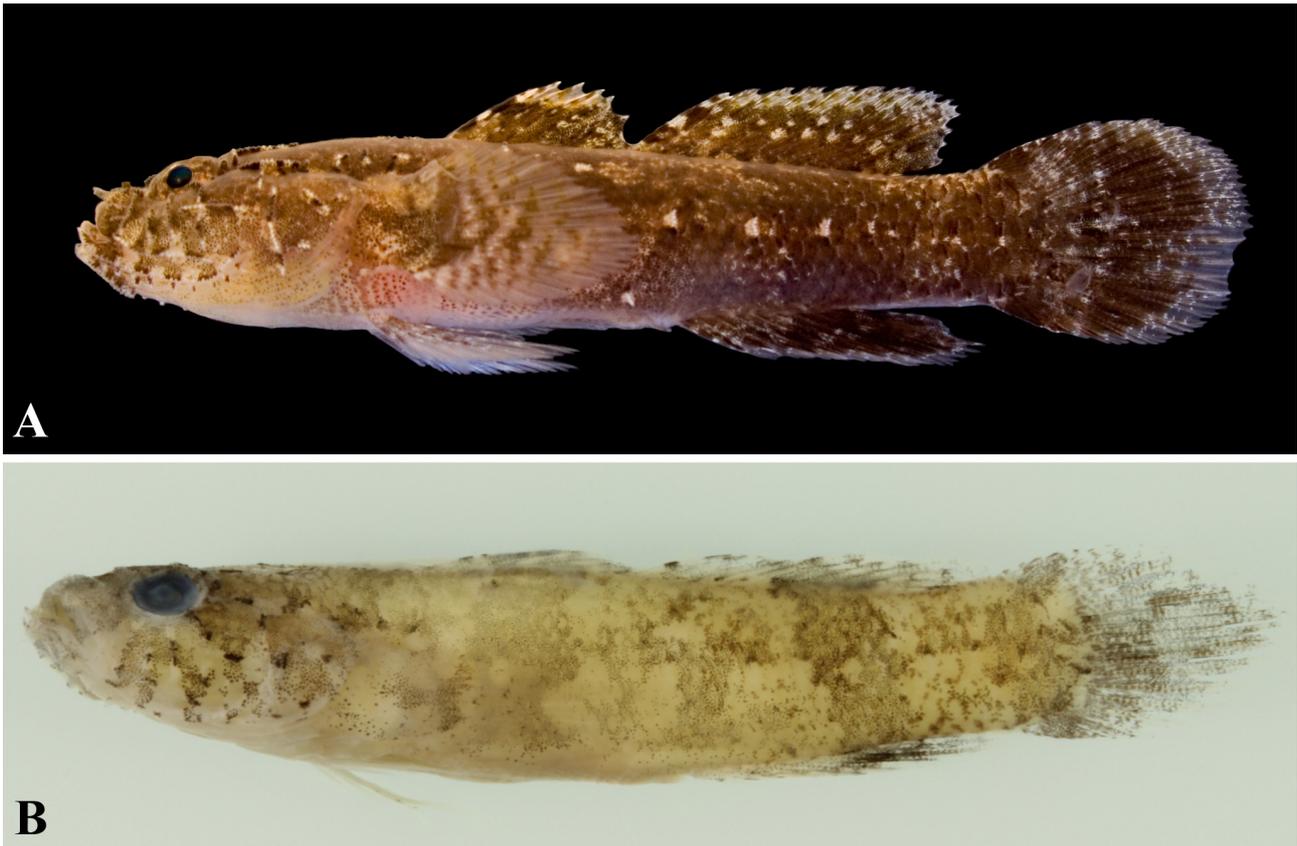


FIGURE 6. *Callogobius flavobrunneus* (Smith): **A.** Fresh coloration, uncatalogued, 36.0 mm SL, Shams Alam, southern Egypt; **B.** Preserved specimen, SMF 35771, female, 27.3 mm SL, Al Wajh, bank, Saudi Arabia. Photos by SVB (A), RDM (B).

Representative Red Sea material (5 specimens, 14.3–41.3 mm SL). **Egypt:** HUI 11564, male, 24.9 mm SL; USNM 298438, male, 31.8 mm SL; **Eritrea:** USNM 297159, female, 41.3 mm SL; USNM 300014, female, 14.3 mm SL; **Saudi Arabia:** SMF 35771 (KAU13-211), female, 27.3 mm SL, Saudi Arabia, Al Wajh bank, seaward slope of unnamed island, sediment with coral patches, 3–5 m, coll. S.V. Bogorodsky & T.J. Alpermann, 12 June 2013.

***Callogobius sclateri* (Steindachner 1879)**
(Figure 7A)

Eleotris sclateri Steindachner 1879: 157 (Society Islands; holotype NMW 30901).

Diagnosis. *Callogobius sclateri* is distinguished from congeners by the following combination of characters: interorbital pores present; preopercular canal absent; temporal canal absent; scales in lateral series 27–32; pelvic fins separate or with only a minute basal membrane, without frenum and with fifth ray subequal to fourth; preopercular papillae row (Row 20) not continuous with transverse opercular row (Row 21).

Brief description. Moderately stout-bodied with rounded caudal fin < 40% SL in length. Scales medium-sized, cycloid anteriorly, ctenoid from the first to third spine of the first dorsal fin to the caudal-fin base (exceptionally long ctenii on caudal peduncle scales), scales in lateral series 27–32. Dorsal-fin rays VI + I,9, anal-fin rays I,7; pelvic fins separate or joined by a minute basal membrane, fifth ray just slightly shorter or about equal to length of fourth and frenum absent. Anterior nostril slightly longer than posterior nostril. Head pores present with interorbital canal normally containing pores B', C, D, E, F, G and H' (pore C sometimes absent), preopercular and temporal canals absent. Preopercular papillae row (Row 20) not continuous with transverse opercular row (Row 21), more than 10 transverse mandibular papillae rows (Row 16) on each side.



FIGURE 7. A. *Callogobius sclateri* (Steindachner), preserved specimen, USNM 298419, female, 22.1 mm SL, Ras Burqa, Gulf of Aqaba, Egypt. **B.** *Callogobius* sp. A, live coloration, SMF 35772, juvenile, 14.5 mm SL, Yabua Island, Saudi Arabia. Photos by RDM (A), SVB (B).

Head, body and fins usually with fine speckling, particularly in larger specimens. Head with dark brown bars extending from eye, one oblique anteriorly to upper lip, one posteriorly to preopercular margin, and one ventral just posterior to gape. Body with up to four brown bars, one from base of first dorsal fin extending from basal fin spot and narrowing to below outer third of pectoral fin, an oblique brown bar linking posterior bases of second dorsal and anal fins extending irregularly into second dorsal-fin membranes, a broad dark brown bar at base of caudal fin, and another short bar on lower half of body below origin of second dorsal fin. First dorsal fin mostly dark, second dorsal fin mottled or broadly striped. Pectoral fin with dark diagonal marking along upper margins in juveniles, which can become broader, more vertical, curved and/or diffuse in larger specimens. Caudal fin with faint, fine barring to dark. Coloration in preservation similar to live coloration.

Distribution and habitat. *Callogobius sclateri* is distributed in the Indo-West Pacific and the Red Sea. Habitat information not recorded in the Red Sea, although capture depth ranges from 0–16 m.

Remarks. In the Red Sea, *Callogobius sclateri*, *C. flavobrunneus*, and *C. clarki* are frequently confused due to similarly-shaped moderately stout bodies, and color pattern of four wide bars. *Callogobius sclateri* differs from *C. clarki* by having head pores in specimens at least 14 mm SL (vs. none) and in having separate pelvic fins (vs. united at least two-thirds length). *Callogobius sclateri* shares the separate pelvic fins with *C. flavobrunneus*, but differs in having lower counts of scales in lateral series (27–32 vs. 34–40), fifth pelvic-fin ray subequal to fourth (vs. significantly shorter), and pectoral-fin color pattern (dark upper edge or diffuse vertical bands vs. medial dark markings). *Callogobius sclateri* has a similar color pattern to *C. sp. A* (Fig. 7B), but the latter has partially united pelvic fins and fewer scales in lateral series (22–25 vs. 27–32). These differences were confirmed through examination of the holotype of *C. sclateri* (NMW 30901) by NRD and SVB.

Representative Red Sea material (4 specimens, 14.0–21.8 mm SL). **Egypt:** USNM 298412, 1 male and 1 female, 14.0–20.5 mm SL; USNM 298419, sex uncertain, 1 specimen, 21.8 mm SL; USNM 296964, male, 21.4 mm SL.

Discussion

Of the seven species of *Callogobius* identified from the Red Sea, at least two have been found nowhere else: *C. clarki* and *C. pilosimentum*. Two others were originally described from the Red Sea and considered endemic. *Callogobius amikami* is known only from the holotype (Fig. 3A) and a possible juvenile specimen (Fig. 3C), both from the Red Sea. There are two photographic records, the only certainly identifiable image being a Red Sea specimen (Fig. 3B). The remaining photograph is of a tiny juvenile from Oman that has yet to attain characters that can confirm identification (Debelius 1993). If this latter record is of *C. amikami*, the species would lose its Red Sea endemic status. We found specimens of *C. dori* in a mixed lot with one *C. flavobrunneus* from the Seychelles of the Western Indian Ocean, removing it as a Red Sea endemic. The remaining *Callogobius* species found in the Red Sea are widespread across the Indo-Pacific; *C. sclateri* has not been previously reported from the Red Sea.

It is possible, even likely, that continued study of these species, particularly the widespread taxa, will reveal undiscovered diversity and geographic differentiation. Even so, the endemism of *Callogobius* in the Red Sea (28%) is higher than that reported for the region as a whole (13%; DiBattista *et al.* 2015), and is perhaps indicative of the tendency for demersal, egg-guarding species to have more restricted ranges. For example, *Pseudochromis* (Pseudochromidae) exhibits about 75% endemism in the Red Sea (Gill 2004; Golani & Bogorodsky 2010). Thorough sampling of *Callogobius* with techniques that result in intact specimens, color photographs and genetic material, along with monographic treatment will provide a much more complete picture of the taxonomy and biogeography of this difficult group.

Key to seven *Callogobius* species of the Red Sea

(To be used for specimens at least 15 mm SL. Counts of scales in lateral series can vary by ± 2 depending on the user or the condition of the specimen)

- 1a. Chin with 4 transverse mandibular papillae rows (Row 16) on each side; temporal canal present with 2 pores (K', L') above operculum; scales in lateral series 21–25, usually 24; in intact adult specimens, anterior first dorsal-fin spines free of membranes for about one-quarter or more of spine length *Callogobius pilosimentum* n. sp. (Fig. 2)
- 1b. Chin with more than 10 transverse mandibular papillae rows (Row 16) on each side (the rows extending posteriorly to the lower edge of the preoperculum); temporal canal absent (no pores above operculum); scales in lateral series 22–41, more than 24 in most species; in intact adult specimens, anterior first dorsal-fin spines free of membranes for less than one-quarter spine length. 2
- 2a. Pelvic fin united and frenum weak to moderately well-developed; preopercular row (Row 20) continuous with transverse opercular papillae row (Row 21) 3
- 2b. Pelvic fins separate or partially united and frenum weak or absent; preopercular papillae row (Row 20) not continuous with transverse opercular row (Row 21) 4
- 3a. Head with strongly contrasting markings including bars radiating from eye, body with dark bars and horizontal stripes; D VI + I,10; A I,8 *Callogobius amikami* (Fig. 3)
- 3b. Head, body and fins mostly dark with narrow dark horizontal stripes on body, dark vertical bars usually not obvious; D VI + I,9; A I,7 *Callogobius dori* (Fig. 5)
- 4a. Scales in lateral series 33–41 5
- 4b. Scales in lateral series 22–32 6
- 5a. Head pores absent; scales mostly cycloid, except for a few on caudal peduncle; pelvic fins united about two-thirds of length of medial rays, frenum weak *Callogobius clarki* (Fig. 4)
- 5b. Head pores present; scales ctenoid on posterior half of body; pelvic fins separate or with a minute membrane, frenum absent *Callogobius flavobrunneus* (Fig. 6)
- 6a. Scales in lateral series 27–32; pelvic fins separate or with a minute basal membrane *Callogobius sclateri* (Fig. 7A)
- 6b. Scales in lateral series 22–25; pelvic fins united about two-thirds of the length of pelvic fin *Callogobius* sp. A (Fig. 7B)

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