

Apogonid fishes (Teleostei: Perciformes) of Yaku-shima Island, Kagoshima Prefecture, southern Japan

Tomohiro Yoshida^{1*}, Shigeru Harazaki² and Hiroyuki Motomura¹

¹Kagoshima University Museum, 1-21-30 Korimoto, Kagoshima 890-0065, Japan

²Diving Service Mori to Umi, 1559-1 Miyanoura, Yakushima, Kumage, Kagoshima 891-4205, Japan

*Corresponding author: e-mail: k5299534@kadai.jp

Abstract Forty five species of apogonid fishes were confirmed to occur at Yaku-shima Island, Kagoshima Prefecture, Kyushu, southern Japan. Of these, 27 species represent the first records from the island, including the first Japanese record of *Apogon chrysotaenia*. A new Japanese name, Akafuji-tenjukudai, is proposed for *Apogon crassiceps*. Each species account provides a synonym list, material examined, descriptions based on collected specimens, distribution in Japanese waters, taxonomic and nomenclatural remarks, and ecological notes from Yaku-shima Island.

Key words: Apogonidae, cardinalfishes, distribution, Yaku-shima Island, Japan.

Introduction

The family Apogonidae, characterized by having two separated dorsal fins, the first with 6–8 spines and the second with 1 spine and 8–14 soft rays, anal fin with 2 spines and 8–18 soft rays, and usually 24 vertebrae, consists of about 23 genera and roughly 273 species (Nelson, 2006). Of these, about 15 genera and 94 species have been recorded from Japanese waters (Matsuura and Tachikawa, 1994; Hayashi, 2002, 2004; Mabuchi et al., 2003, 2004; Yoshigou and Yoshino, 2004; Miyahara et al., 2005; Shibukawa et al., 2007; Fraser and Allen, 2010).

The first apogonid fish reported from Yaku-shima Island was *Apogon notatus* in 1906. Jordan and Starks (1906) gave an illustration of this species (as *Amia notata*) by Mr. W. S. Atkinson on the basis of a single specimen from the island. The specimen is now missing from collections of the California Academy of Sciences, San Francisco, or the Museum Support Center of the Smithsonian Institution National Museum of Natural History, Suitland. Subsequently, Arai and Ida (1975) reported two genera with four species of the family

from Kusugawa on the northeast coast of Yaku-shima Island on the basis of collected specimens, which are deposited at the National Museum of Nature and Science, Tokyo. Ichikawa et al. (1992) listed three genera with 10 species from the island, and Kuniyasu (1999) listed two genera with 12 species from Kurio on the southwest coast, both being based only on underwater observations.

In addition to the previous records, our Yaku-shima Island ichthyofaunal surveys in 2008–2009 (see Motomura et al., 2010) and the second author's underwater observations over the last six years resulted in 11 genera with 45 species of apogonid fishes occurring off Yaku-shima Island. This paper provides an annotated checklist of these species, along with color photographs if available.

Materials and methods

Counts and measurements generally follow Fraser (2005). Counts of longitudinal stripes on the lateral surface of the body begin with the uppermost stripe, including a stripe running along the dorsal-fin bases. Measurements were made to

the nearest 0.1 mm. Unless specified otherwise, the length of specimens listed throughout this paper is the standard length (abbreviated as SL). Identifications are generally based on Allen et al. (2005), Greenfield, (2001, 2007a, b), Gon (1993), Gon and Randall (2003), Fraser (2005, 2008), Fraser and Allen (2010), Hayashi (2000, 2002), Mabuchi et al. (2003, 2004), Randall (2005), and Randall et al. (1997a). Randall (2005) reclassified the genus *Apogon* and divided it into four genera, *Apogon*, *Ostorhinchus*, *Pristiapogon*, and *Zoramia*, but we use *Apogon* rather than these generic names. Scientific names are arranged alphabetically for each genus. The synonym lists contain only the original description citation and papers related to Yaku-shima Island, viz., Jordan and Starks (1906), Arai and Ida (1975), Ichikawa et al. (1992), Kuniyasu (1999), and Yoshida and Motomura (2009). Descriptions are based on specimens collected from Yaku-shima Island during ichthyofaunal surveys of the island (Motomura et al., 2010) and four specimens of *A. taeniophorus* reported by Arai and Ida (1975).

A photograph of *A. indicus* is based on a preserved specimen; other specimen photographs were taken when fresh. Underwater photographs were taken by the second author (SH) and I. Takaku (Yakushima-Diving-Life) around the island. Underwater observations have been made by SH for more than six years, and ecological notes on each species at Yaku-shima Island are given on the basis of his observations.

Acronyms of the following institutions are used in the text: Australian Museum, Sydney (AMS); Bernice Pauahi Bishop Museum, Honolulu (BPBM); Laboratory of Marine Biology, Kochi University, Kochi (BSKU); Fisheries Research Laboratory, Mie University, Shima (FRLM); Institute of Oceanic Research and Development, Tokai University, Shimizu (IORD); Kagoshima University Museum, Kagoshima (KAUM); Kanagawa Prefectural Museum of Natural History, Odawara (KPM); Department of Plant and Animal Sciences, Faculty of Agriculture, University of Miyazaki, Miyazaki (MUFS); and National Museum of Nature and Science, Tokyo (NSMT). Color photographs of fresh specimens are deposited at BSKU, KAUM, and KPM.

List of species of Apogonidae

Apogon amboinensis Bleeker, 1853

[Japanese name: Amami-ishimochi]

(Figs. 1A, B)

Apogon amboinensis Bleeker, 1853: 329 (type locality: Ambon, Moluccas, Indonesia); Yoshida and Motomura, 2009: 96, fig. 1 (mouth of Ambo River, Yaku-shima Island).

Material examined. KAUM–I. 21588, 53.5 mm SL, mouth of Ambo River; KAUM–I. 21589, 49.0 mm SL, mouth of Ambo River.

Description. Dorsal-fin rays VI–I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 7; circumpeduncular scales 12; total gill rakers 21–22, developed gill rakers 19–20; body light brown, with two black stripes, one from snout to opercular margin through eye, and the other on anterior portion of lateral line; anterior part of first dorsal fin blackish; and a distinct black spot on caudal-fin base.

Remarks. Yoshida and Motomura (2009) reported two specimens (KAUM–I. 21588, 21589) of *A. amboinensis* as the first records from Yaku-shima Island and the northernmost records of the species. They considered *A. amboinensis* to reproduce in the mouth of the Ambo River on Yaku-shima Island because one of the two specimens (KAUM–I. 21588) had about 3,000 eggs in his mouth. Subsequently, this species was also confirmed by the second author to occur in the mouth of the Isso River on the northern coast of the island on 24 Oct. 2009 and the mouth of the Ambo River on 8 Jan. 2010 (Fig. 1B).

Apogon amboinensis is distributed in the western Pacific, from Papua New Guinea to Japan (Allen et al., 2005). In Japanese waters, this species has been reported from Yaku-shima Island (Yoshida and Motomura, 2009; this study) and the Ryukyu Islands [Amami-oshima Island (Schmidt, 1930; Okada, 1938; Matsubara, 1963; Yoshigou et al., 2001), Okinawa Island (Yoshigou et al., 2005), Kume-jima Island (Yoshigou and Nakamura, 2003; Yoshigou, 2007), Miyako-jima Island (Yoshigou et al., 2005), Ishigaki-jima Island (Sakai

et al., 2001), Iriomote-jima Island (Hayashi and Kishimoto, 1983; Yoshigou et al., 2001), and Yonaguni-jima Island (Sakai et al., 2001)]. At Yaku-shima Island, the species inhabits river mouths on substrates mixed with mud and deciduous leaves in depths of 1–2 m.

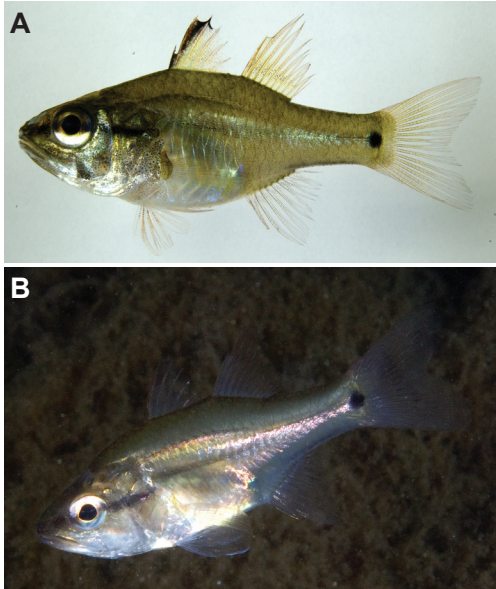


Fig. 1. *Apogon amboinensis*. **A**, KAUM-I. 21589, 49.0 mm SL, mouth of Ambo River; **B**, mouth of Ambo River, 1 m, 8 Jan. 2010, S. Harazaki.

Apogon angustatus (Smith and Radcliffe, 1911)
[Japanese name: Usujima-ishimochi]
(Fig. 2)

Amia angustata Smith and Radcliffe in Radcliffe, 1911: 253, fig.1 (type locality: Malanipa Island, east of Zamboanga in Mindanao, Philippines).

Material examined. KAUM-I. 20268, 17.8 mm SL, Kurio; KAUM-I. 21721, 14.3 mm SL, Kurio.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 4; circumpeduncular scales 12; total gill rakers 19, developed gill rakers 14; white body, with five poorly defined dark brown stripes on lateral surface of body, posterior end of third stripe (middle

stripe) reaching a black spot on caudal-fin base; and caudal-fin base spot subequal in size to pupil.

Remarks. *Apogon angustatus* is widely distributed in the Indo-West Pacific where it ranges from the Red Sea to Australia and Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from Hachijo-jima Island (Senou et al., 2002) and the Ryukyu Islands [Amami-oshima Island (Hayashi, 2002), Okinoerabu-jima Island (Yoshigou et al., 2005), Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou et al., 2005), Sesoko-jima Island (Hayashi, 2002), Tokashiki-jima Island (Watai et al., 2009), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Yoshigou et al., 2001; Yoshigou and Nakamura, 2002)].

At Yaku-shima Island, specimens of *A. angustatus* were collected only from Kurio, representing the first reliable records of *A. angustatus* from the island. This solitary species (not forming schools) lives in the shade of rocky reefs at depths of less than 15 m at Yaku-shima Island; it can be observed in coastal areas of the island throughout the year.



Fig. 2. *Apogon angustatus*. Off Issu, 15 m, 16 Oct. 2009, S. Harazaki.

Apogon apogonides (Bleeker, 1856)
[Japanese name: Aohana-tenjikudai]
(Fig. 3)

Cheilodipterus apogonides Bleeker, 1856a: 37
[type locality: Manado, Sulawesi (Celebes), Indonesia].

Remarks. The photographed individual (Fig. 3) is herein identified as *Apogon apogonides* on the basis of the following combination of characters: pinkish orange body, with brassy yellow abdomen; two blue lines from front of snout to opercular margin; bluish spots in three rows on mid-lateral surface of body; and no black markings on caudal peduncle. Specimens have not been collected from Yaku-shima Island.

Apogon apogonides is widely distributed in the Indo-Pacific where it ranges from the Red Sea east to the Society Islands, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from the Izu Islands [Miyake-jima Island (Hayashi, 2002) and Hachijo-jima Island (Senou et al., 2002)], the Sagami Sea (Senou et al., 2006b), Shikoku [Oshima Island (Aizawa and Senou, 1991) and Kashiwa-jima Island (Hirata et al., 1996)], and the Ryukyu Islands [Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Hayashi, 2002), and Miyako Group (Senou et al., 2007)].

Figure 3 represents the first confirmed record of *A. apogonides* from Yaku-shima Island. This species is always observed in aggregations with *Apogon notatus* throughout the year around a wreck at a depth of 15 m off Isso, Yaku-shima Island; it was not observed elsewhere around the island. Off Isso, the spawning period of the species is from July to August.



Fig. 3. *Apogon apogonides*. Off Isso, 18 m, 15 Sept. 2009, S. Harazaki.

Apogon aureus (Lacepède, 1802)
[Japanese name: Aosuji-tenjikudai]
(Figs. 4A, B)

Centropomus aureus Lacepède, 1802: 253, 273
(type locality: Mauritius).

Apogon aureus; Ichikawa et al., 1992: 9 (Yaku-shima Island, Japan).

Material examined. BSKU 96634, 63.3 mm SL, Isso.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 25; predorsal scales 5; circumpeduncular scales 12; total gill rakers 24, developed gill rakers 21; no oblique dark bars on cheek; yellowish orange body, with two blue stripes from snout to opercle through eye; and a broad, black band, its width subequal to pupil diameter, on caudal-fin base.

Remarks. *Apogon aureus* is widely distributed in the Indo-West Pacific where it ranges from the east coast of Africa east to Tonga, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from the Izu Islands [Miyake-jima Island (Ida and Moyer, 1974; Hayashi, 2002) and Hachijo-jima Island (Senou et al., 2002)], the Sagami Sea (Senou et al., 2006b), Shikoku [Oshima Island (Aizawa and Senou, 1991) and Kashiwa-jima Island (Hirata et al., 1996)], Yaku-shima Island (Ichikawa et al., 1992), and the Ryukyu Islands [Ie-jima Island (Senou et al., 2006a), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Hayashi and Kishimoto, 1983)].

At Yaku-shima Island, only a single specimen of *A. aureus* was collected off Isso, but it has also been observed at depths of 6–30 m off the island throughout the year, sheltering among rocky reefs. At Yaku-shima Island, spawning of *A. aureus* begins in early June and ends in July. Although juveniles aggregate, adults usually behave as a pair at the island.

Apogon caudicinctus Randall and Smith, 1988
[Japanese name: Koyari-ishimochi]
(Fig. 5)

Apogon caudicinctus Randall and Smith, 1988: 2, fig.1 (type locality: south side of Mei Point, Rapa).

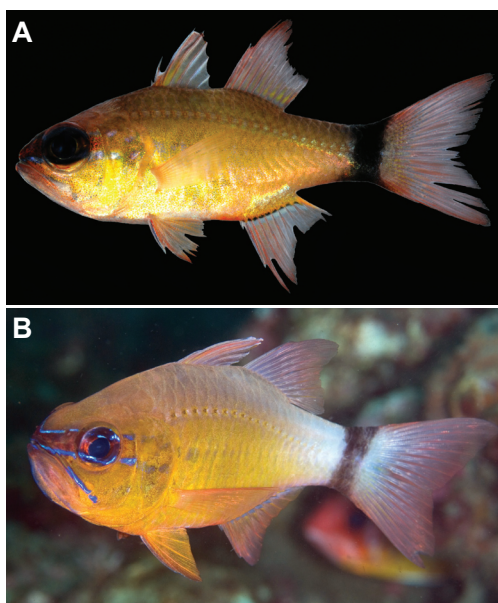


Fig. 4. *Apogon aureus*. A, BSKU 96634, 63.3 mm SL, Isso; B, off Isso, 18 m, 22 Apr. 2005, S. Harazaki.

Material examined. KAUM-I. 21765, 33.8 mm SL, Kurio.

Description. Dorsal-fin rays VI-I, 9; anal-fin rays II, 8; pectoral-fin rays 12; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 7; circumpeduncular scales 12; total gill rakers 16, developed gill rakers 10; second spine length of first dorsal fin 1.8 in head length; reddish body, with a broad, black circumpeduncular bar, its width greater than orbit diameter; and edges of scales on dorsal body dark.

Remarks. *Apogon caudicinctus* has been known from Réunion, the Marquesas Islands, the Pitcairn Islands, Rapa, Fiji, and the Ryukyu Islands (Randall, 2005). In Japanese waters, this species has been reported from the Ogasawara Islands (Randall et al., 1997b; Hayashi, 2002) and the Ryukyu Islands [Amami-oshima Island (Hayashi, 2002), Ie-jima Island (Senou et al., 2006a), Kume-jima Island (Yoshigou and Nakamura, 2003), and Ishigaki-jima Island (Hayashi, 2002)].

At Yaku-shima Island, a single specimen of *A. caudicinctus* was collected at a depth of less than 3 m in Kurio, representing the first reliable records of *A. caudicinctus* from the island and the northernmost record for the species. Ecological

information on *A. caudicinctus* at Yaku-shima Island is unknown since it is difficult to distinguish the species from other small reddish species of *Apogon* during underwater observation.



Fig. 5. *Apogon caudicinctus*. KAUM-I. 21765, 33.8 mm SL, Kurio.

Apogon chrysotaenia Bleeker, 1851

[Japanese name: None]

(Fig. 6)

Apogon chrysotaenia Bleeker 1851: 168 [type locality: Jakarta (Batavia), Java, Indonesia].

Remarks. The photographed individual (taken off Isso) is identified as *Apogon chrysotaenia* on the basis of the following characters reported for adults of the species: a yellowish orange body, with several faint brownish stripes dorsally; 6 fluorescent blue stripes radiating from front of head; and tip of second dorsal fin elongated.

Apogon chrysotaenia has been reported only from the South China Sea, Indonesia, Papua New Guinea, and Australia (Allen, 2000; Allen et al., 2005), and no records of the species have been published from Japanese waters. Thus, the photographed individual represents the first record of the species from Japan. Specimens of the species from Yaku-shima Island are required to confirm this new record.

The second author (SH) first observed a single individual of the species at a depth of 20 m off Isso, Yaku-shima Island, on 5 July 2004, and he photographed that individual on 11 July 2004 (Fig. 6). Subsequently, SH found a pair of adult and subadult individuals at a depth of 30 m off Isso on 21 November 2009. These individuals usually shelter under or behind large rocks but are often forced into open water by strong unidirectional currents around the rocks.



Fig. 6. *Apogon chrysotaenia*. Off Isso, 20 m, 11 July 2004, S. Harazaki.

Apogon cookii Macleay, 1881

[Japanese name: Suji-ishimochi]

(Figs. 7A–C)

Apogon cookii Macleay, 1881: 344 (type locality: Endeavour River and Darnley Island, Australia).

Material examined. KAUM–I. 11207, 27.3 mm SL, Kurio; KAUM–I. 21714, 31.0 mm SL, Kurio; KAUM–I. 21715, 28.0 mm SL, Kurio; KAUM–I. 21716, 22.0 mm SL, Kurio; KAUM–I. 21717, 18.0 mm SL, Kurio; NSMT–P 91664, 76.0 mm SL, Kurio.

Description. Dorsal-fin rays VII–I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 3–4; circumpeduncular scales 12; total gill rakers 18–20, developed gill rakers 12–13; body white, with six dark brown stripes on lateral surface of body; third stripe beginning from upper eye, ending at middle of body (below second dorsal-fin origin); fourth stripe (middle stripe) posteriorly reaching to a black spot on caudal-fin base; and caudal-fin base spot subequal in size to pupil diameter.

Remarks. *Apogon cookii* is similar to *A. nigrofasciatus*, but the former differs in having 12–13 (vs. 15–19 in the latter) developed gill rakers, 15 (vs. usually 14) pectoral-fin rays, and a postocular stripe (vs. no stripe) (Gon and Randall, 2003).

Apogon cookii is widely distributed in the Indo-West Pacific where it ranges from the Red Sea and east coast of Africa east to New Caledonia and Japan (Allen et al., 2005; Randall, 2005).

In Japanese waters, this species has been reported from the Sagami Sea (Senou et al., 2006b) and the Ryukyu Islands [Amami-oshima Island (Yoshigou et al., 2001), Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou and Nakamura, 2002, 2003; Yoshigou et al., 2005), Sesoko-jima Island (Yoshigou and Nakamura, 2003), Ou-jima Island (Yoshigou et al., 2005), Kume-jima Island (Yoshigou and Nakamura, 2003), Tokashiki-jima Island (Watai et al., 2009), Minamidaitou-jima Island (Yoshigou et al., 2005), Shimoji-shima Island (Yoshigou et al., 2005), Miyako Group (Senou et al., 2007), Iriomote-jima Island (Hayashi and Kishimoto, 1983), and Yonaguni-jima Island (Yoshigou et al., 2001)].

At Yaku-shima Island, specimens of *A. cookii* were collected only from Kurio and these specimens represent the first reliable records of *A. cookii* from the island. This solitary species (not forming schools) lives in the shade of rocky reefs at depths of less than 5 m at Yaku-shima Island; it can be observed in coastal areas of the island throughout the year.

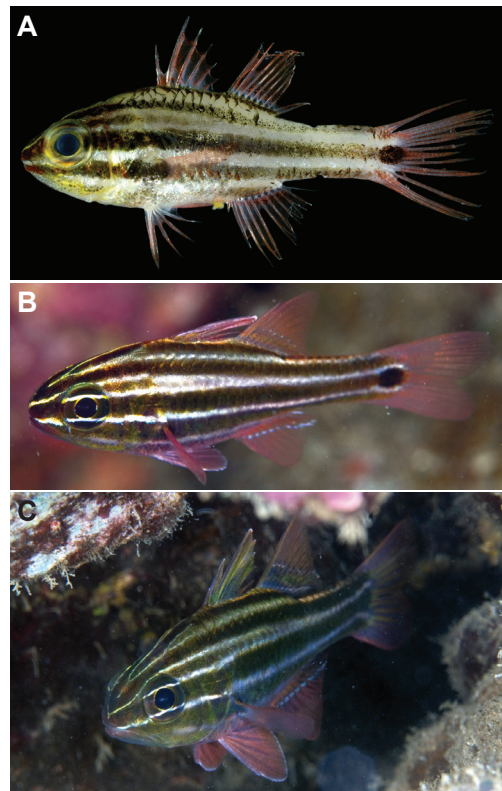


Fig. 7. *Apogon cookii*. A, KAUM–I. 11207, 27.3 mm SL, Kurio; B, off Isso, 5 m, 22 May 2007, S. Harazaki; C, off Isso, 3 m, 14 Apr. 2005, S. Harazaki.

Apogon crassiceps Garman, 1903

[New Japanese name: Akafuji-tenjikudai]

(Figs. 8A, B)

Apogon crassiceps Garman, 1903: 230 (type locality: Suva Reef, Viti Levu, Fiji).

Material examined. BSKU 96552, 27.2 mm SL, Yudomari; KAUM-I. 11445, 37.4 mm SL, Isso; KAUM-I. 20159, 20.3 mm SL, Yudomari; KAUM-I. 20196, 42.5 mm SL, Yudomari; KAUM-I. 20205, 22.8 mm SL, Yudomari; KAUM-I. 20206, 17.0 mm SL, Yudomari; KAUM-I. 20249, 24.9 mm SL, Kurio; KAUM-I. 20331, 34.3 mm SL, Isso; KAUM-I. 21767, 29.2 mm SL, Kurio; KAUM-I. 21768, 27.2 mm SL, Kurio; KPM-NI 22513, 24.4 mm SL, Yudomari; KPM-NI 22546, 28.4 mm SL, Kurio.

Description. Dorsal-fin rays VI-I, 9; anal-fin rays II, 8; pectoral-fin rays 13; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 5–6; large scale between first dorsal fin and lateral line 1 (often with a smaller second scale at base of dorsal fin); circumpeduncular scales 12; total gill rakers 15–16, developed gill rakers 8–9; full scale between the first dorsal fin and the lateral line 1, often with a smaller second scale; a free edge of skin near the anterior nasal opening; and body semitransparent red, with a thin, dark red stripe on mid-lateral surface of body when alive.

Remarks. The *Apogon coccineus* complex, comprising *A. campbelli* Smith 1949, *A. coccineus* Rüppell 1838, *A. crassiceps* Garman 1903, *A. kautamea* Greenfield and Randall 2004, and *A. kominatoensis* Ebina, 1935 (see Greenfield, 2001; Greenfield and Randall, 2004), was defined by Greenfield (2001) as having a free edge of skin near the anterior nasal opening, and a single, large, full scale (often a smaller second scale) between the lateral line and the dorsal fin. Our specimens from Yaku-shima Island is herein identified as *A. crassiceps* of the *A. coccineus* complex and differ from *A. campbelli* and *A. kautamea* in having 13 pectoral-fin rays (vs. 14 rays in the latter two species; Greenfield and Randall, 2004) and from *A. kominatoensis* in lacking numerous small brownish spots scattered on the body (vs. having the spots in *A. kominatoensis*; Ebina, 1935).

Apogon coccineus is an Indian Ocean species (Randall, 2005).

All previous records of *A. crassiceps* “Akane-tenjikudai” in Japanese waters (e.g., Masuda et al., 1984; Hayashi, 2000, 2002) were based on misidentifications of a species of the *A. talboti* group (sensu Greenfield, 2007b). Comparisons of *A. crassiceps* from Yaku-shima Island with “Akane-tenjikudai” (= *A. crassiceps* in Japanese literature) from Ie-jima and Iriomote-jima Islands revealed that the former differs from the latter in having a semitransparent red body (vs. opaque dark red), a thin, dark red stripe on the mid-lateral surface of the body (vs. stripe absent), 15 or 16 total gill rakers (vs. 18 or 19), and a single full scale (often with a smaller second scale) between the first dorsal fin and lateral line (vs. 2 large full scales, with 1 smaller third scale) (this study; Hayashi, 2000, 2002). In addition, *A. crassiceps* attains 5 cm SL (Randall, 2005), whereas “Akane-tenjikudai” reaches 12 cm SL (Hayashi, 2000, 2002).

“Akane-tenjikudai” is most similar to *A. talboti* Smith, 1961 in overall body appearance and sharing the following characters (“Akane-tenjikudai” vs. *A. talboti*): dorsal-fin rays VI-I, 9 (vs. VI-I, 9); anal-fin rays II, 8 (II, 8); pectoral-fin rays 13 or 14 (13); pored lateral-line scales 24 (24); total gill rakers 19 (20 or 21), developed rakers 18 (16–19); and supraneural bones 3 (3) [data for “Akane-tenjikudai” were based on KPM-NI 2524 (79.9 mm SL, Ie-jima Island, Japan, 16 m depth, coll. by H. Senou et al., 17 Jan. 1996), Masuda et al. (1984), and/or Hayashi (2000, 2002), and data for *A. talboti* were based on Gon and Randall (2003), Greenfield and Randall (2004), and Greenfield (2007b)]. Accordingly, we tentatively identify “Akane-tenjikudai” as *A. talboti*, and propose a new standard Japanese name, Akafuji-tenjikudai, for *A. crassiceps*.

Apogon crassiceps is widely distributed in the western Pacific where it ranges from the Line Islands and Tuamotu east to Australia, and north to Japan (Allen et al., 2005; Randall, 2005; this study). At Yaku-shima Island, specimens of *A. crassiceps* were collected from Isso, Kurio, and Yudomari in depths of less than 5 m, representing the first reliable records of *A. crassiceps* from the island. The photographed individual (Fig. 8B)

is herein identified as *A. crassiceps* by having a body semitransparent red, with a thin, dark red stripe on the mid-lateral surface of the body.

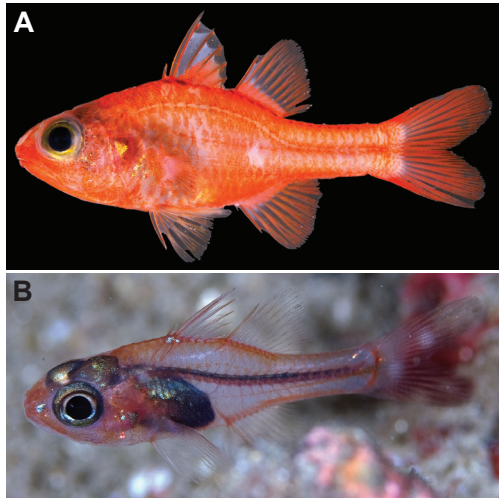


Fig. 8. *Apogon crassiceps*. **A**, KAUM-I. 20331, 34.3 mm SL, Isso; **B**, off Isso, 8 m, 22 Oct. 2009, S. Harazaki.

Apogon doederleini Jordan and Snyder, 1901
[Japanese name: Osuji-ishimochi]
(Figs. 9A, B)

Apogon doederleini Jordan and Snyder, 1901:
901, fig. 6 (type locality: Nagasaki, Japan);
Ichikawa et al., 1992: 9 (Yaku-shima Island,
Japan); Kuniyasu, 1999: 12 (Kurio, Yaku-
shima Island, Japan).

Material examined. FRLM 34706, 103.7 mm SL, Yudomari; KAUM-I. 11124, 99.2 mm SL, Ambo; KAUM-I. 11440, 46.5 mm SL, Isso; KAUM-I. 11441, 47.5 mm SL, Isso; KAUM-I. 11442, 46.5 mm SL, Isso; KAUM-I. 11443, 52.7 mm SL, Isso; KAUM-I. 11444, 44.5 mm SL, Isso; KAUM-I. 11446, 48.7 mm SL, Isso; KAUM-I. 11447, 43.9 mm SL, Isso; KAUM-I. 11448, 41.2 mm SL, Isso; KAUM-I. 11449, 41.5 mm SL, Isso; KAUM-I. 11450, 51.6 mm SL, Isso; KAUM-I. 11451, 52.1 mm SL, Isso; KAUM-I. 11452, 51.9 mm SL, Isso; KAUM-I. 20071, 85.7 mm SL, Yudomari; KAUM-I. 20072, 62 mm SL, Yudomari; KAUM-I. 20343, 56 mm SL, Isso; KAUM-I. 21751, 91.9 mm SL, Ambo;

KAUM-I. 25234, 78.1 mm SL, Ambo; MUFS 25446, 92.7 mm SL, Ambo; MUFS 25447, 85.4 mm SL, Ambo; MUFS 25448, 70.9 mm SL, Ambo; MUFS 25449, 69.2 mm SL, Ambo; MUFS 25450, 69.4 mm SL, Ambo.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 15; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 3; circumpeduncular scales 12; total gill rakers 18, developed gill rakers 12; body pinkish brown, with four dark brown stripes on lateral surface of body; third stripe (middle stripe) posteriorly not reaching to a black spot on caudal-fin base; and caudal-fin base spot subequal in size to pupil diameter.

Remarks. *Apogon doederleini* is distributed in the Indo-West Pacific where it ranges from Western Australia east to the Kermadec Islands, and north to Japan, but no records from Indonesia or New Guinea (Randall et al., 1997a; Randall, 2005). In Japanese waters, this species has been reported from the Izu Islands [Hachijo-jima Island (Senou et al., 2002)], the Ogasawara Islands (Kuwamura et al., 1983; Sato, 1991; Randall et al., 1997b), Tateyama Bay (Hagiwara and Kimura, 2005), the Sagami Sea (Senou et al., 2006b), Shikoku [Oshima Island (Aizawa and Senou, 1991), Kochi (Kamohara, 1964), and Kashiwa-jima Island (Hirata et al., 1996)], Nagasaki (Jordan and Snyder, 1901), Yaku-shima Island (Ichikawa et al., 1992; Kuniyasu, 1999), and the Ryukyu Islands [Amami-oshima Island (Yamakawa, 1969), Yagaji-shima Island (Yoshigou and Nakamura, 2002; Yoshigou et al., 2005), Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou et al., 2001; Yoshigou et al., 2005), and Iriomote-jima Island (Hayashi and Kishimoto, 1983)].

At Yaku-shima Island, specimens of *A. doederleini* were collected from Ambo, Isso, Kurio and Yudomari. The species has been observed at depths of less than 10 m in coastal areas of the island throughout the year, usually sheltering among rocky reefs in the daytime. Although juveniles form small aggregations, the adults are usually solitary.

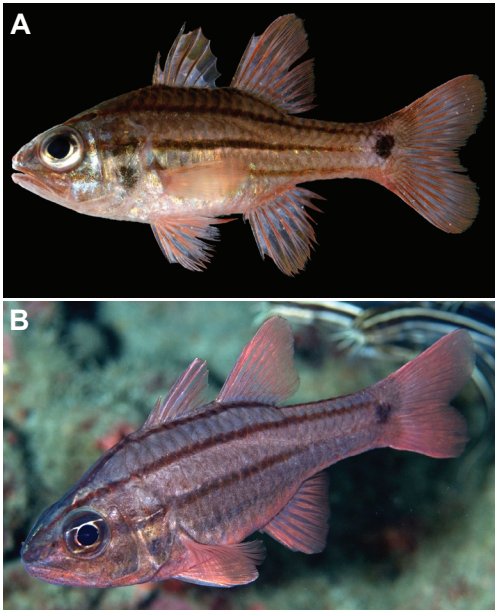


Fig. 9. *Apogon doederleini*. A, KAUM-I. 11124, 99.2 mm SL, Ambo; B, off Isso, 5 m, 26 Jan. 2005, S. Harazaki.

Apogon endekataenia Bleeker, 1852

[Japanese name: Kosuji-ishimochi]

(Figs. 10A, B)

Apogon endekataenia Bleeker, 1852: 449 [type locality: Bangka (Banka) or Lepar Island, Indonesia]; Arai and Ida, 1975: 192 (Kusugawa, Yaku-shima Island, Japan); Ichikawa et al., 1992: 9 (Yaku-shima Island, Japan); Kuniyasu, 1999: 12 (Kurio, Yaku-shima Island, Japan).

Material examined. KAUM-I. 21786, 26.8 mm SL, Isso.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 3; circumpeduncular scales 12; total gill rakers 17, developed gill rakers 12; body white, with about seven yellowish brown stripes on lateral surface of body; fifth stripe (middle stripe) posteriorly reaching to a black spot on caudal-fin base; caudal-fin base spot subequal in size to pupil diameter.

Remarks. *Apogon endekataenia* is widely distributed in the western Pacific (Randall et al., 1997a; Hayashi, 2002). In Japanese waters, this

species has been reported from the Ogasawara Islands (Randall et al., 1997b), Tateyama Bay (Hagiwara and Kimura, 2005), Sagami Bay (Senou, 1999), the Sagami Sea (Senou et al., 2006b), Shikoku [Kochi (Kamohara, 1964) and Kashiwajima Island (Hirata et al., 1996)], Yaku-shima Island (Arai and Ida, 1975; Ichikawa et al., 1992; Kuniyasu, 1999), and the Ryukyu Islands [Amami-oshima Island (Kamohara and Yamakawa, 1965) and the Kerama Islands (Hayashi, 2002)].

At Yaku-shima Island, specimens of *A. endekataenia* were collected only from Isso. This species is always observed in aggregations of about 10 individuals in depths of 25–30 m off Isso throughout the year; not observed elsewhere around the island.

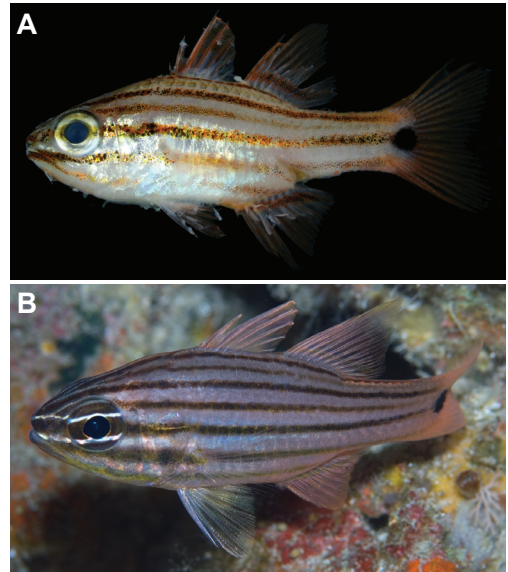


Fig. 10. *Apogon endekataenia*. A, KAUM-I. 21786, 26.8 mm SL, Isso; B, off Isso, 30 m, 16 Sept. 2009, S. Harazaki.

Apogon exostigma (Jordan and Starks, 1906)

[Japanese name: Yukata-ishimochi]

(Figs. 11A, B)

Amia exostigma Jordan and Starks, 1906: 238, fig. 31 (type locality: Apia, Upolu Island, Western Samoa).

Material examined. BSKU 96553, 45.8 mm SL, Yudomari; KPM-NI 22551, 28.1 mm SL, Kurio.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 23; predorsal scales 4; circumpeduncular scales 12; total gill rakers 16–17, developed gill rakers 10–12; no dark saddle on body below second dorsal-fin base; body depth 3.0–3.4 in SL; body whitish silver, with a middle stripe extending from front of snout to a black spot, smaller than pupil diameter, at caudal-fin base; and lower margin of caudal-fin base spot on lateral line.

Remarks. *Apogon exostigma* is widely distributed in the Indo-West Pacific where it ranges from the Red Sea east to the Line and Pitcairn Islands, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported only from the Ryukyu Islands [Amami-oshima Island (Kamohara and Yamakawa, 1968), Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou and Nakamura, 2002), Tokashiki-jima Island (Watai et al., 2009), Miyako Group (Senou et al., 2007), Ishigaki-jima Island (Yoshigou et al., 2001), and Iriomote-jima Island (Hayashi and Kishimoto, 1983)].

Two specimens of *A. exostigma*, collected from Kurio and Yudomari, represent the first reliable records of the species from Yaku-shima Island and the northernmost records for the species. This solitary species lives in the shade of rocky reefs in depths of less than 10 m at Yaku-shima Island; it can be observed in coastal areas of the island throughout the year (relatively common).

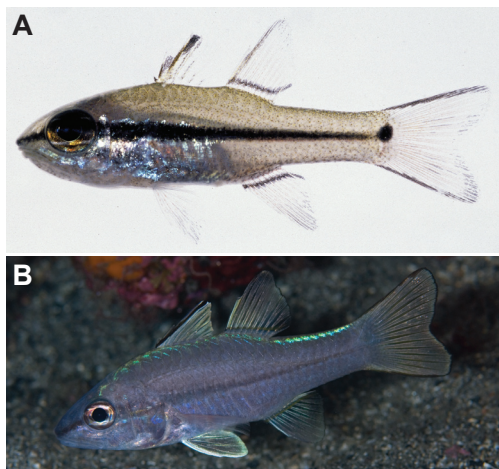


Fig. 11. *Apogon exostigma*. A, KPM-NI 22551, 28.1 mm SL, Kurio; B, off Isso, 12 m, 21 Sept. 2009, S. Harazaki.

Apogon fasciatus (White, 1790)
[Japanese name: Furai-ishimochi]
(Fig. 12)

Mullus fasciatus White, 1790: 268, pl. 53, fig. 1 (type locality: Port Jackson, New South Wales, Australia).

Remarks. Many Japanese authors (e.g., Hayashi, 2000, 2002; Senou et al., 2006b) have used a name, *Apogon quadrifasciatus* Cuvier, 1828, for this species. However, Randall and Lachner (1986) and Fraser (2005) regarded *A. quadrifasciatus* as a junior synonym of *A. fasciatus*.

The photographed individual (Fig. 12) is identified as *Apogon fasciatus* on the basis of the following combination of characters: a semitransparent body, with two black stripes on the lateral surface of the body, the upper stripe extending from the snout to the dorsal portion of the caudal-fin base via above the eye, the lower stripe from the snout to the caudal-fin margin via the middle of the eye; and two whitish stripes (or dotted stripes) running above and below each black stripe.

Apogon fasciatus is widely distributed in the Indo-West Pacific where it ranges from the Red Sea east to Australia, and north to Japan (Allen et al., 2005; Fraser, 2005). In Japanese waters, this species has been reported as *A. quadrifasciatus* from the Sagami Sea (Senou et al., 2006b), Nagasaki Prefecture and southward (Hayashi, 2002), including the Ryukyu Islands [Okinawa-jima Island (Yoshigou and Nakamura, 2003) and Iriomote-jima Island (Hayashi and Kishimoto, 1983)].

Figure 12 represents the first confirmed record of *A. fasciatus* from Yaku-shima Island. The second author observed this species forming a school with five or six individuals behind a big piece of driftwood over a sandy bottom at a depth of 20–25 m off Isso, Yaku-shima Island. No other individuals have recently been confirmed around Yaku-shima Island; it seems to be very rare in the island. Specimens have not been collected from Yaku-shima Island.



Fig. 12. *Apogon fasciatus*. Off Isso, 20 m, 10 Sept. 2005, S. Harazaki.

Apogon fraenatus Valenciennes, 1832

[Japanese name: Hitosuji-ishimochi]

(Figs. 13A, B)

Apogon fraenatus Valenciennes, 1832: 57, pl. 4, fig. 4 (type locality: New Guinea).

Remarks. Photographed individuals (Figs. 13A, B) are identified as *A. fraenatus* on the basis of the following combination of characters: a pinkish silver body with a dark black stripe on lateral surface of body, middle stripe posteriorly reaching to a black spot on caudal-fin base; and caudal-fin base spot subequal in size to pupil diameter. Specimens have not been collected from Yaku-shima Island.

Apogon fraenatus is widely distributed in the Indo-West Pacific where it ranges from the Red Sea and Gulf of Oman east to the Line Islands and Tuamotu Archipelago, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from the Izu Islands [Miyake-jima Island (Hayashi, 2002) and Hachijo-jima Island (Senou et al., 2002)], Wakayama Prefecture (Hayashi, 2002), Kashiwa-jima Island (Hirata et al., 1996), and the Ryukyu Islands [Amami-oshima Island (Kamohara and Yamakawa, 1965), Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou et al., 2005), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Hayashi and Kishimoto, 1983; Yoshigou et al., 2001; Yoshigou and Nakamura, 2002)].

Figure 13 represents the first confirmed record of *A. fraenatus* from Yaku-shima Island. This species is always observed in aggregations, sheltering among rocky reefs, throughout the year around Yaku-shima Island at depths of less than 20 m.

Although juveniles ca. 3–4 cm SL are common in the island, adults over ca. 10 cm SL are relatively rare.

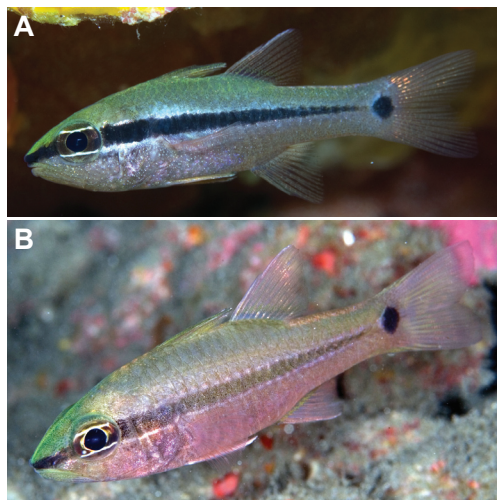


Fig. 13. *Apogon fraenatus*. A, off Isso, 25 m, 15 Sept. 2009, S. Harazaki; B, off Isso, 10 m, 14 Jan. 2010, S. Harazaki.

Apogon indicus Greenfield, 2001

[Japanese name: Ryukyu-ishimochi]

(Fig. 14)

Apogon indicus Greenfield, 2001: 465, figs. 2B, C (type locality: off le Morne, passe de l'Ambulante, southwestern coast of Mauritius).

Material examined. NSMT-P 95448, 32.9 mm SL, Haruo.

Description. Dorsal-fin rays VI-I, 9; anal-fin rays II, 8; pectoral-fin rays 13; pelvic-fin rays I, 5; pored lateral-line scales 23; predorsal scales 6; large scales between first dorsal fin and lateral line 2, with a smaller third scale at base of dorsal fin; circumpeduncular scales 14; total gill rakers 15, developed gill rakers 7; no free edge of skin near anterior nasal opening; and body whitish, with black pigments scattered on anterodorsal portion of body and caudal-fin base when preserved.

Remarks. Many Japanese authors (e.g., Hayashi, 2000, 2002) have used a name, *Apogon erythrinus* Snyder, 1904, for this species. However, Greenfield (2001) reviewed the *Apogon*

erythrinus complex and reclassified “*A. erythrinus*” into four species: *A. erythrinus*, endemic to the Hawaiian Islands and Johnston Atoll; *A. marquesensis* Greenfield, 2001, endemic to the Marquesas Islands; *A. indicus*, widespread in the Indo-Pacific; and *A. susanae* Greenfield, 2001, restricted to the Pacific Ocean. The *A. erythrinus* complex is characterized by the following two characters: skin at the end of the snout covering the nasal bones and over the ascending processes of the premaxilla smooth with no free edge near the anterior nasal opening, and two large full scales (often a smaller third scales at base of first dorsal fin) between the lateral line and the third spine of the first dorsal fin (Greenfield, 2001). *Apogon indicus* is distinguished from other members of the complex by having 12 or 13 pectoral-fin rays (vs. usually 14 rays in the latter; Greenfield, 2001). Yoshigou et al. (2005) reported eight specimens of the species (2 specimens from Okinoerabu-jima Island, 1 specimen from Irabu-jima Island, and 5 specimens from Okinawa-jima Island) from Japan as *A. indicus* (instead of *A. erythrinus*) for the first time.

Apogon indicus has been known from Mauritius, Vietnam, Philippines, Palau, Mariana Islands, New Caledonia, Tonga, and American Samoa (Randall, 2005). In Japanese waters, this species has been reported as *A. erythrinus* [except for Yoshigou et al. (2005, as *A. indicus*)] from Hachijo-jima Island (Senou et al., 2002), Kashiwa-jima Island (Hirata et al., 1996), and the Ryukyu Islands [Okinoerabu-jima Island (Yoshigou et al., 2005), Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou and Nakamura, 2002, 2003; Yoshigou et al., 2005), Tokashiki-jima Island (Watai et al., 2009), Irabu-jima Island (Yoshigou et al., 2005), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Hayashi and Kishimoto, 1983; Yoshigou et al., 2001)].

At Yaku-shima Island, a single specimen of *A. indicus* was collected at a depth of 4 m off Haruo, representing the first reliable record of *A. indicus* from the island. Ecological information on *A. indicus* at Yaku-shima Island is unknown since it is difficult for us to distinguish it from other reddish species of *Apogon* during underwater observation.

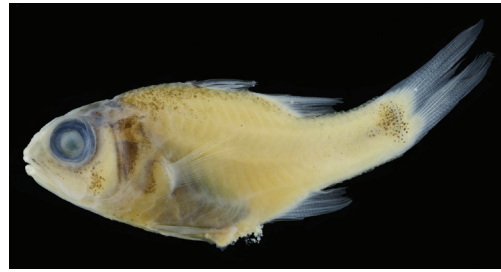


Fig. 14. *Apogon indicus*. NSMT-P 95448, 32.9 mm SL, Haruo.

***Apogon kallopterus* Bleeker, 1856**

[Japanese name: Kasuri-ishimochi]

(Fig. 15)

Apogon kallopterus Bleeker, 1856a: 33 [type locality: Manado, Sulawesi (Celebes), Indonesia]; Kuniyasu, 1999: 12 (Kurio, Yaku-shima Island, Japan).

Remarks. The photographed individual (Fig. 15) is identified as *Apogon kallopterus* on the basis of the following combination of characters: a pale pinkish brown body, with an indistinct, broad, black stripe on lateral surface of body; anterior part of first dorsal fin yellowish; and poorly defined black spot, its size greater than pupil diameter, above middle of caudal-fin base.

Apogon kallopterus is widely distributed in the Indo-Pacific where it ranges from the Red Sea and the east coast of Africa to the Hawaiian and Pitcairn Islands, including Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from Hachijo-jima Island (Senou et al., 2002), the Ogasawara Islands (Randall et al., 1997b; Hayashi, 2002), Wakayama Prefecture and southward (Hayashi, 2002), including Yaku-shima Island (Kuniyasu, 1999), and the Ryukyu Islands [Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou and Nakamura, 2003; Yoshigou et al., 2005), Tokashiki-jima Island (Watai et al., 2009), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Hayashi and Kishimoto, 1983)].

Apogon kallopterus lives solitarily (not forming schools) in the shade of rocky reefs at depths of less than 10 m at Yaku-shima Island; it can be

observed in coastal areas of the island throughout the year. Although it is common around the island, no specimens were collected during this study.



Fig. 15. *Apogon kallopterus*. Off Isso, 6 m, 11 Sept. 2009, S. Harazaki.

Apogon kominatoensis Ebina, 1935
[Japanese name: Kominato-tenjikudai]
(Fig. 16)

Apogon kominatoensis Ebina, 1935: 212, fig. 1
[type locality: tidepools at Kominato, Chiba, (Toba-ken: probably Chiba-ken), Japan].

Material examined. BSKU 96655, 29.7 mm SL, Isso; FRLM 34709, 38.3 mm SL, Yudomari; KAUM-I. 11133, 29.0 mm SL, Kurio; KAUM-I. 11290, 37.7 mm SL, Yudomari; KAUM-I. 11291, 42.3 mm SL, Yudomari; KAUM-I. 11652, 27.9 mm SL, Ambo; KAUM-I. 20041, 40.2 mm SL, Yudomari; KAUM-I. 20248, 39.3 mm SL, Kurio; KAUM-I. 20259, 41.3 mm SL, Kurio; KAUM-I. 20260, 41.2 mm SL, Kurio; KAUM-I. 20261, 32.7 mm SL, Kurio; KAUM-I. 20332, 35.4 mm SL, Isso; KAUM-I. 21766, 27.1 mm SL, Kurio; NSMT-P 91356, 40 mm SL, Yudomari; NSMT-P 91357, 37 mm SL, Yudomari; NSMT-P 95461, 36.7 mm SL, Haruo.

Description. Dorsal-fin rays VI-I, 9; anal-fin rays II, 8; pectoral-fin rays 13; pelvic-fin rays I, 5; pored lateral-line scales 22; predorsal scales 5–6; large full scale between first dorsal fin and lateral line 1, often with a smaller second scale at base of dorsal fin; circumpeduncular scales 12; total gill rakers 15–16, developed gill rakers 8; a free edge of skin near the anterior nasal opening; body semitransparent red, with numerous brown-

ish spots scattered on head and body when alive, and without a thin, dark red stripe on mid-lateral surface of body; and no black mark on caudal peduncle or lower lobe of caudal fin.

Remarks. Many Japanese authors (e.g., Hayashi, 2000, 2002) have used a name, *Apogon coccineus* Rüppell, 1838, for this species. However, Randall (2005) has recently regarded that *A. coccineus* is distributed only in the western Indian Ocean. Our specimens from Yaku-shima Island appear to be identical with *A. kominatoensis*, a species of the *A. coccineus* complex (see Remarks of *A. crassiceps*). Because previous Japanese records of “*A. coccineus*” may include more than one species, the reliable distributional range of *A. kominatoensis* in Japan is unknown.

At Yaku-shima Island, specimens of *A. kominatoensis* were collected from Isso, Ambo, Haruo, Yudomari, and Kurio, at depths of less than 5 m.



Fig. 16. *Apogon kominatoensis*. KAUM-I. 20332, 35.4 mm SL, Isso.

Apogon moluccensis Valenciennes, 1832
[Japanese name: Sehoshi-tenjikudai]
(Figs. 17A, B)

Apogon moluccensis Valenciennes, 1832: 54 [type locality: Ambon, Moluccas, Indonesia].

Material examined. BSKU 96640, 46.8 mm SL, Isso; KAUM-I. 20378, 43.1 mm SL, Isso.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 3; circumpeduncular scales 12; total gill rakers 22–23, developed gill rakers 19–21; body yellowish brown, with 2 reddish stripes, upper narrower stripe along anterior portion of lateral line, and

lower broader stripe from snout to opercular margin through eye; about 7 vertical, brownish bars on lateral surface of lower body, a small white spot at posterior end of second dorsal-fin base; and no black spot on caudal peduncle.

Remarks. Many Japanese authors (e.g., Hayashi, 2000, 2002) have used a name, *Apogon ventrifasciatus* Allen, Kuitert and Randall, 1994, for this species. However, Fraser et al. (2002) regarded *A. ventrifasciatus* as a junior synonym of *A. moluccensis*.

Apogon moluccensis is widely distributed in the western Pacific, from Australia to Japan (Hayashi, 2002; Randall et al., 1997a). In Japanese waters, this species has been reported as *A. ventrifasciatus* from the Ryukyu-Islands [Okinawa-jima Island (Hayashi, 2002) and Iriomote-jima Island (Hayashi and Yano, 1996; Hayashi, 2002)].

At Yaku-shima Island, two specimens of *A. moluccensis* were collected from Isso, representing the first reliable records of *A. moluccensis* from the island and the northernmost records for the species. This species is always observed in aggregations (ca. 20 individuals) throughout the year around a wreck at a depth of 4 m off Isso, Yaku-shima Island; no other localities confirmed from the island.

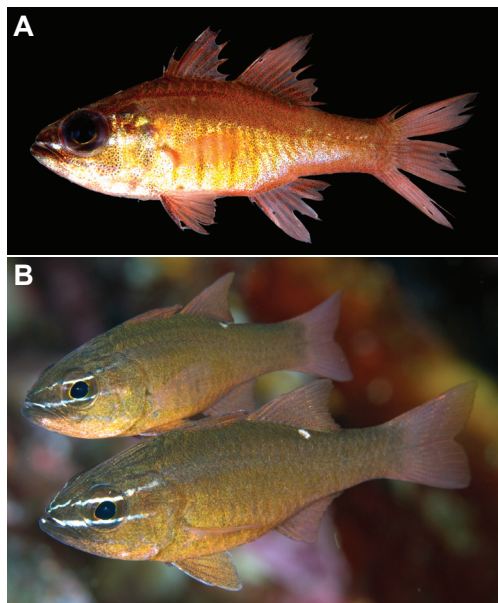


Fig. 17. *Apogon moluccensis*. **A**, KAUM-I. 20378, 43.1 mm SL, Isso; **B**, off Isso, 20 m, 18 Sept. 2007, S. Harazaki.

***Apogon nigrofasciatus* Lachner, 1953**

[Japanese name: Minami-futosuji-ishimochi]

(Figs. 18A, B)

Apogon nigrofasciatus Lachner, 1953: 466, fig. 81, pl. 37C, D (type locality: Yuro Island, Bikini Atoll, Marshall Islands); Kuniyasu, 1999: 12 (Kurio, Yaku-shima, Japan).

Apogon aroubiensis (not of Hombron and Jacquinet); Ichikawa et al., 1992: 9 (Yaku-shima Island, Japan).

Material examined. BSKU 96605, 58.9 mm SL, Kurio.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 4; circumpeduncular scales 12; total gill rakers 24, developed gill rakers 18; snout pointed; body white, with 5 broad, dark reddish brown stripes on lateral surface of body; middle stripes broader than pale interspace; and stripes not extending onto caudal fin.

Remarks. *Apogon nigrofasciatus* is widely distributed in the Indo-West Pacific where it ranges from the Red Sea and Gulf of Aden east to the Marshall Islands and Tuamotu Archipelago, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species (as *A. aroubiensis* or *A. nigrofasciatus*) has been reported from Hachijo-jima Island (Senou et al., 2002), the Ogasawara Islands (Randall et al., 1997b), the Sagami Sea (Senou et al., 2006b), Kashiwa-jima Island (Hirata et al., 1996), Yaku-shima Island (Ichikawa et al., 1992; Kuniyasu, 1999), and the Ryukyu Islands [Amami-oshima Island (Kamohara and Yamakawa, 1965; Yoshigou et al., 2001), Okinawa-jima Island (Yoshigou et al., 2005), Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou and Nakamura, 2002, 2003; Yoshigou et al., 2005), Tokashiki-jima Island (Watai et al., 2009), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Hayashi and Kishimoto, 1983)].

At Yaku-shima Island, only a single specimen of *A. nigrofasciatus* was collected off Kurio, but it has been observed at depths of 10–30 m throughout the year, sheltering among rocky reefs. At

Yaku-shima Island, spawning of *A. nigrofasciatus* begins in early April and ends in May.



Fig. 18. *Apogon nigrofasciatus*. A, BSKU 96605, 58.9 mm SL, Kurio; B, off Isso, 15 m, 11 Sept. 2009, S. Harazaki.

Apogon notatus (Houttuyn, 1782)
[Japanese name: Kurohoshi-ishimochi]
(Fig. 19)

Sparus notatus Houttuyn, 1782: 320 (type locality: Japan)

Amia notata: Jordan and Starks, 1906: 698, fig. 4 (Yaku-shima Island, Japan).

Apogon notatus: Ichikawa et al., 1992: 9 (Yaku-shima Island, Japan).

Remarks. Although the specimen's whereabouts is unknown, Jordan and Starks' figure (fig. 4 as *Amia notata*) clearly shows it to be identified as *Apogon notatus* in having a black band from the snout to the eye, a distinct spot on the nape, a black spot on the caudal-fin base, a black blotch on the first dorsal fin distally, and blackish bands along the bases of second dorsal and anal fins. The photographed individual (Fig. 19) is also herein identified as *A. notatus*.

Apogon notatus is widely distributed in the Indo-West Pacific, from Australia to Japan (Al-

len et al., 2005; Randall et al., 1997a). In Japanese waters, this species has been reported from Hachijo-jima Island (Senou et al., 2002), Sagami Bay (Senou, 1999), the Sagami Sea (Senou et al., 2006b), Shikoku [Oshima Island, (Aizawa and Senou, 1991) and Kashiwa-jima Island (Hirata et al., 1996)], Yaku-shima Island (Jordan and Starks, 1906; Ichikawa et al., 1992), and the Ryukyu Islands [Ie-jima Island (Senou et al., 2006a), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Hayashi and Kishimoto, 1983)].

Apogon notatus has been observed only at two diving spots at a depth of 20 m off Isso. A single school usually comprises more than 1,000 individuals, the number of individuals decreasing to ca. 100 in winter. At Yaku-shima Island, the spawning period of the species is from May to July.



Fig. 19. *Apogon notatus*. Off Isso, 20 m, 20 June 2005, S. Harazaki.

Apogon novemfasciatus Cuvier, 1828
[Japanese name: Tasuji-ishimochi]
(Fig. 20)

Apogon novemfasciatus Cuvier in Cuvier and Valenciennes, 1828: 154 (type locality: Timor and Guam); Kuniyasu, 1999: 12 (Kurio, Yaku-shima Island, Japan).

Material examined. KAUM-I. 21759, 33.7 mm SL, Ambo.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 4; circumpeduncular scales 12; total gill rakers

20, developed gill rakers 16; snout pointed; body white, with five poorly defined dark brown to black stripes on lateral surface of body; and third stripe (middle stripe) uneven in width, reaching caudal fin, but not ending a spot.

Remarks. *Apogon novemfasciatus* is widely distributed in the Indo-West Pacific where it ranges from the Cocos Keeling Islands east to the Line Islands, and the islands of Micronesia, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from the Ogasawara Islands (Randall et al., 1997b), the Sagami Sea (Senou et al., 2006b), Shikoku [Kochi (Kamohara, 1964) and Kashiwa-jima Island (Hirata et al., 1996)], Yaku-shima Island (Kuniyasu, 1999), and the Ryukyu Islands [Amami-oshima Island (Kamohara and Yamakawa, 1965; Yoshigou et al., 2001), Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou et al., 2001; Yoshigou and Nakamura, 2002, 2003), Sesoko-jima Island (Yoshigou and Nakamura, 2003), Tokashiki-jima Island (Watai et al., 2009), Miyako Group (Senou et al., 2007), Ishigaki-jima Island (Yoshigou et al., 2001), Iriomote-jima Island (Hayashi and Kishimoto, 1983), and Yonaguni-jima Island (Yoshigou et al., 2001)].

At Yaku-shima Island, a single specimen of *A. novemfasciatus* was collected off Ambo. This species lives solitarily in the shade of rocky reefs (not forming schools) at depths of less than 1 m at Yaku-shima Island; it can be observed in coastal areas of the island throughout the year.



Fig. 20. *Apogon novemfasciatus*. KAUM-I. 21759, 33.7 mm SL, Ambo.

Apogon parvulus (Smith and Radcliffe, 1912)
[Japanese name: Neon-tenjikudai]

Amia parvula Smith and Radcliffe in Radcliffe, 1912: 432, pl. 34, fig. 2 (type locality: Tataan Pass, Tawi Tawi Group, Philippines).

Apogon parvulus: Ichikawa et al., 1992: 9 (Yaku-shima Island, Japan).

Remarks. The identification of Ichikawa et al.'s (1992) *Apogon parvulus* is uncertain. The second author has dived to observe fishes around Yaku-shima Island almost everyday for six years, but has never seen this species. *Apogon parvulus* is distributed in the western Pacific, from Kalimantan to Japan (Allen et al., 2005); known only from Iriomote-jima Island (Hayashi and Kishimoto, 1983) in Japanese waters.

Apogon cf properuptus (Whitley, 1964), dotted type
[Japanese name: "kinsen-ishimochi, dotto-gata"]
(Figs. 21A, B)

Lovamia properupta Whitley, 1964: 167, pl. 10
(type locality: Frederick Reef, Coral Sea).

Material examined. KAUM-I. 21789, 37.8 mm SL, Isso; KAUM-I. 21790, 40.2 mm SL, Isso; KAUM-I. 21791, 36.6 mm SL, Isso; KAUM-I. 21792, 35.1 mm SL, Isso.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 3; circumpeduncular scales 12; total gill rakers 21, developed gill rakers 18; white body, with 6 yellowish brown stripes on lateral surface of body, posterior end of fourth stripe (middle stripe) reaching to caudal-fin margin; and a whitish interspace, between fifth and sixth stripes, on cheek and flank, with a series of white spots.

Remarks. In Japanese waters, "Kinsen-ishimochi, *A. properuptus*" has long been regarded to exhibit two color forms (e.g., Masuda and Kobayashi, 1996; Hayashi, 1997). Recently, Mabuchi et al. (2003) verified that "Kinsen-ishimochi, *A. properuptus*" in Japanese waters contained two distinct species, named as dotted and lined types, on the basis of examination of nucleotide

sequence data of approximately 650 bp from the anterior half of the mitochondrial 16S rRNA gene. Their “dotted type” is characterized by a series of white spots on a whitish interspace, between the fifth and sixth body stripes, and on the cheek and flank, whereas the “lined type” has a narrow stripe on a whitish interspace on the cheek and flank. Twelve specimens of “dotted type of Kinsen-ishimochi, *A. properuptus*” were reported by Mabuchi et al. (2003) from Japan: 3 specimens from Ajiro, Kochi; 3 from Okinoshima Island, Fukuoka; 3 from Tatsunokuchi, Nagasaki; and 3 from Bonotsu, Kagoshima). Senou (1999) reported the dotted type as *A. properuptus* from Sagami Bay. Kuitert and Kozawa (1999) published underwater photographs of this species as *Apogon* sp. 9 from Shizuoka, Mie, Kochi, and Kagoshima Prefectures. Hagiwara and Kimura (2005) listed this species as “*A. properuptus* (dotted type)” from Tateyama Bay. Although Ichikawa et al. (1992) and Arai and Ida (1975) listed “Kinsen-ishimochi” as *A. cyanosoma* from Yaku-shima Island, and Kuniyasu (1999) listed it as *A. properuptus* from the island, the taxonomic status of each of their “Kinsen-ishimochi” is unknown.

Mabuchi et al. (2003) suggested that the name *A. properuptus* cannot be applied to either dotted or lined types because *A. properuptus* (type locality: Frederick Reef, Coral Sea) is most likely to be restricted to the southwestern Pacific, as Randall et al. (1997a) stated. We tentatively identified here the “dotted type of Kinsen-ishimochi” in Japanese waters as “*A. cf properuptus*, dotted type”.

Comparisons of underwater photographs of “*A. cf properuptus*, dotted type” from Yaku-shima Island and published underwater photographs of *A. holotaenia* Regan, 1905 (e.g., Kuitert and Kozawa, 1999) showed that their overall body appearance and color pattern, including lines and spots, were indistinguishable. However, comparison of the preserved specimens from Yaku-shima Island with a specimen of *A. holotaenia* from its type locality (BPBM34498, 37.6 mm SL, Muscat, Oman, coll. by J. E. Randall, 13 May 1990) shows that the pigmentation of the fourth stripe on the caudal-fin membrane is different (barely remained faint stripe in the former vs. distinct black stripe in the latter), suggesting that the two may be distinct

species.

At Yaku-shima Island, only four specimens of “*A. cf properuptus*, dotted type” were collected off Isso, but it has been observed in depths of more than 25 m throughout the year, usually sheltering among rocky reefs. At Yaku-shima Island, spawning of this species begins in early summer.

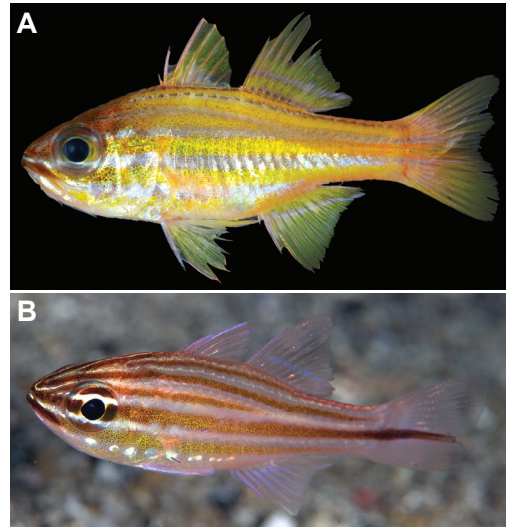


Fig. 21. *Apogon cf properuptus*, dotted type. A, KAUM-I. 21790, 40.2 mm SL, Isso; B, off Isso, 30 m, 13 Dec. 2004, S. Harazaki.

Apogon cf properuptus (Whitley, 1964), lined type [Japanese name: “kinsen-ishimochi, rain-gata”] (Figs. 22A, B)

Lovamia properupta Whitley, 1964: 167, pl. 10 (type locality: Frederick Reef, Coral Sea).

Material examined. KAUM-I. 20112, 32.3 mm SL, Yudomari; KAUM-I. 20207, 31.7 mm SL, Yudomari; KPM-NI 22506, 41.1 mm SL, Yudomari.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 3; circumpeduncular scales 12; total gill rakers 22–23, developed gill rakers 19; white body with 6 yellow stripes on lateral surface of body, posterior end of forth stripe (middle stripe) reaching on caudal fin margin; a narrow stripe on whitish interspace on cheek and flank.

Remarks. Taxonomic remarks are given under species account of “*A. cf properuptus*, dotted type”. Nine specimens of “lined type of Kinsen-ishimochi, *A. properuptus*,” were reported by Mabuchi et al. (2003) from Japan: 3 specimens from Ajiro, Kochi; 3 from Kuchinoerabu-jima Island; and 3 from Iriomote-jima Island. Aizawa and Senou’s (1991: pl. 8, C) *A. cyanosoma* from Oshima Island, Tokushima Prefecture is herein identified as “*A. cf properuptus*, lined type” in having a narrow stripe on the cheek and flank. Kuitert and Kozawa (1999) published underwater photographs of this species as *Apogon* sp. 12 from Iriomote-jima Island. Although Ichikawa et al. (1992) and Arai and Ida (1975) listed “Kinsen-ishimochi” as *A. cyanosoma* from Yaku-shima Island, and Kuniyasu (1999) listed it as *A. properuptus* from the island, taxonomic status of their “Kinsen-ishimochi” are unknown.

“*Apogon cf properuptus*, lined type” is similar to *A. properuptus* in overall appearance. However, although *A. properuptus* from the southwestern Pacific (see e.g., Randall et al., 1997a: 145) has a white line below the eye not extending beyond the opercular margin, the Japanese population of “*A. cf properuptus*, lined type” has the white line extending onto near the anal-fin base.

At Yaku-shima Island, three specimens of “*A. cf properuptus*, lined type” were collected off Yudomari, but it has been observed at depths of less than 25 m (vs. more than 25 m in “*A. cf properuptus*, dotted type”) throughout the year, usually sheltering among rocky reefs. At Yaku-shima Island, spawning of this species begins in early summer.

Apogon selas Randall and Hayashi, 1990
[Japanese name: Nagareboshi]

Apogon selas Randall and Hayashi, 1990: 399, figs. 1–2 (type locality: Tripod Reef, off Nagada Harbor, Madang, Papua New Guinea); Kuniyasu, 1999: 12 (Kurio, Yaku-shima, Japan).

Remarks. *Apogon selas* was originally described by Randall and Hayashi (1990) on the basis of 25 specimens, including 18 paratypes

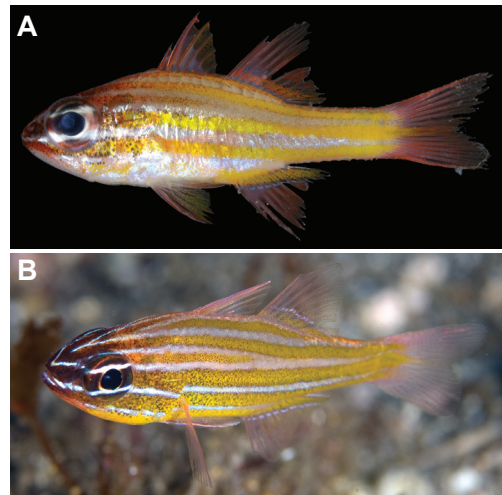


Fig. 22. *Apogon cf properuptus*, lined type. A, KAUM-I. 20112, 32.3 mm SL, Yudomari; B, off Isso, 20 m, 13 Dec. 2004, S. Harazaki.

(19.4–25.7 mm SL) from Japan (Iriomote-jima Island in the Ryukyu Islands). *Apogon selas* has been known from Japan, Indonesia, Papua New Guinea, the Solomon Islands, and New Caledonia (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported only from the Ryukyu Islands [Amami-oshima Island (Hayashi, 2002), Miyako Group (Senou et al., 2007) and Iriomote-jima Island (Hayashi and Kishimoto, 1983, as *Apogon* sp.; Randall and Hayashi, 1990; Hayashi, 2002)].

Identification of Kuniyasu’s (1999) *A. selas* is uncertain as the second author has dived to observe fishes around Yaku-shima Island almost every day for six years, but has never seen this distinct species.

Apogon seminigracaudus Greenfield, 2007
[Japanese name: Oguro-tenjikudai]
(Fig. 23)

Apogon seminigracaudus Greenfield, 2007a: 362, figs. 1–4 (type locality: north shore of Vanua Levu, Fiji).

Material examined. KAUM-I. 21785, 26.8 mm SL, Isso.

Description. Dorsal-fin rays VI–I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I,

5; pored lateral-line scales 24 ; predorsal scales 6; circumpeduncular scales 12; total gill rakers 17, developed gill rakers 10; body reddish; and lower caudal-fin lobe blackish distally.

Remarks. The Yaku-shima Island specimen and other Japanese specimens, previously identified as *Apogon fuscus* Quoy and Gaimard, 1825 (or *Nectamia fusca*), agree with *A. seminigracaudus* (see Greenfield, 2007a), with the exception of the number of pectoral-fin rays (14 in Yaku-shima Island specimen vs. 13 rays in type specimens; Greenfield, 2007a). *Apogon fuscus* is currently considered to be a valid species of the *A. bandanensis* group (T. Fraser, pers. comm. in Greenfield, 2007a).

Apogon seminigracaudus is widely distributed in the western Pacific where it ranges from the Fiji and Tonga Islands north to Japan (Greenfield, 2007a). In Japanese waters, this species has been reported as *A. fuscus* from Tateyama Bay (Hagiwara and Kimura, 2005), the Sagami Sea (Senou et al., 2006b), Shizuoka Prefecture (Hayashi, 2002), Shikoku [Ehime Prefecture (Hayashi, 2002) and Kashiwa-jima Island (Hirata et al., 1996)], and the Ryukyu Islands [Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou and Nakamura, 2003; Yoshigou et al., 2005), and Iriomote-jima Island (Yoshigou et al., 2001)].

At Yaku-shima Island, a single specimen of *A. seminigracaudus* was collected from Isso, representing the first reliable records of the species from the island. This species lives solitarily (not forming schools) in the shade of rocky reefs at a depth of 20 m off Isso, Yaku-shima Island; no other localities confirmed from the island.



Fig. 23. *Apogon seminigracaudus*. KAUM-I. 21785, 26.8 mm SL, Isso.

Apogon semiornatus Peters, 1876

[Japanese name: Yami-tenjikudai]

(Fig. 24)

Apogon semiornatus Peters, 1876: 436 (type locality: Mauritius).

Remarks. The photographed individual (Fig. 24) is herein identified as *Apogon semiornatus* on the basis of the following characters: transparent pinkish body, with a broad reddish brown band from the snout to the anal-fin base, and a broad dark brown band at the middle of the body surface.

Apogon semiornatus is widely distributed in the Indo-West Pacific where it ranges from the Red Sea and Gulf of Oman east to Australia and Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from the Izu Islands [Miyake-jima Island (Ida and Moyer, 1974; Hayashi, 2002) and Hachijo-jima Island (Senou et al., 2002)], Chiba Prefecture and southward (Hayashi, 2002), including Tateyama Bay (Hagiwara and Kimura, 2005), the Sagami Sea (Senou et al., 2006b), Kashiwa-jima Island (Hirata et al., 1996), and Ie-jima Island (Senou et al., 2006a).

Figure 24 represents the first confirmed record of *A. semiornatus* from Yaku-shima Island, but no specimens have been collected from the island. This species has usually been found hiding in a crack or hole on a large rock at depths of 10–20 m at Yaku-shima Island.



Fig. 24. *Apogon semiornatus*. Off Isso, 15 m, 21 July 2006, S. Harazaki.

***Apogon taeniophorus* Regan, 1908**

[Japanese name: Misuji-tenjikudai]

(Figs. 25A, B)

Apogon taeniophorus Regan, 1908: 226 (type locality: Maldives, Indian Ocean).*Apogon endekataenia* (not of Bleeker): Arai and Ida, 1975: 192 (Kusugawa, Yaku-shima Island, Japan).

Material examined. BSKU 96641, 37.8 mm SL, Isso; FRLM 34677, 47.2 mm SL, Kurio; KAUM-I. 11171, 59.3 mm SL, Kurio; KAUM-I. 11358, 76.9 mm SL, Kurio; KAUM-I. 11359, 76.1 mm SL, Kurio; KAUM-I. 20208, 28.2 mm SL, Yudomari; KAUM-I. 20240, 76.8 mm SL, Kurio; KAUM-I. 20341, 90.4 mm SL, Isso; KAUM-I. 20344, 88.8 mm SL, Isso; KAUM-I. 21718, 15.5 mm SL, Kurio; KAUM-I. 21719, 16.6 mm SL, Kurio; KAUM-I. 21720, 14.8 mm SL, Kurio; KAUM-I. 25227, 87.4 mm SL, Nagata; KPM-NI 22577, 21.8 mm SL, Isso; KPM-NI 22578, 25.8 mm SL, Isso; MUFS 25595, 57.7 mm SL, Kurio; MUFS 25596, 56.6 mm SL, Kurio; MUFS 25597, 63.1 mm SL, Kurio; NSMT-P 17846, 4 specimens: 28.8–68.0 mm SL, Kusugawa; NSMT-P 91351, 45.9 mm SL, Yudomari; NSMT-P 91682, 3 specimens: 58.4–69.3 mm SL, Kurio; NSMT-P 95459, 2 specimens: 32.6–84.6 mm SL, Haruo; NSMT-P 95463, 87.8 mm SL, Hirauchi.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 3–4; circumpeduncular scales 12; total gill rakers 18–20, developed gill rakers 11–13; body white, with 6 distinct dark brown stripes on lateral surface of body; posterior portion of third stripe not reaching to second stripe at below first dorsal fin; posterior end of fourth stripe (middle stripe) forming a poorly defined black spot, less than pupil diameter, at caudal-fin base; and fourth stripe not extending onto caudal-fin membrane.

Remarks. Matsuura and Tachikawa (1994) reported *A. taeniophorus* from Chichi-jima Island, the Ogasawara Islands, as the first record of the species from Japan, on the basis of a single specimen (NSMT-P 35302, 60.8 mm SL), and

proposed a new Japanese name, Misuji-tenjikudai, for the species. Subsequently, Mabuchi et al. (2004) recognized two distinct species in specimens previously identified as *A. taeniophorus* from Japan on the basis of analysis of nucleotide sequence data of approximately 610 bp from the anterior half of the mitochondrial 16S rRNA gene. The two species were named by Mabuchi et al. (2004) as “Lined type of Misuji-tenjikudai, *A. taeniophorus*” and “Spotted type of Misuji-tenjikudai, *A. taeniophorus*”. The two can be easily distinguished by color patterns on the body and caudal fin (Mabuchi et al., 2004; this study, see Description of each species account).

Judging from numerous underwater photographs and published data for *A. taeniophorus* from the Indo-Pacific, Mabuchi et al.’s (2004) “Spotted type of Misuji-tenjikudai” is herein identified as *A. taeniophorus*. However, the taxonomic status of “Lined type of Misuji-tenjikudai” is still unknown. Two syntypes of *Amia fasciata stevensi* McCulloch, 1915 (AMS I. 4247, 48.3 mm SL, Fiji; AMS I. 13461, 59.9 mm SL, Vanuatu) were examined during this study and we confirmed that *A. fasciata stevensi* is a junior synonym of *A. taeniophorus* (= “Spotted type of Misuji-tenjikudai”) in having 14 pectoral-fin rays; white body with six dark brown stripes on lateral surface of body; posterior portion of third stripe not reaching to second stripe below first dorsal fin; posterior end of fourth stripe forming a black spot, less than pupil diameter, at caudal-fin base; and fourth stripe not extending onto caudal-fin membrane.

Because Matsuura and Tachikawa’s (1994) specimen (NSMT-P 35302) from Chichi-jima Island is in very poor condition (lacking most body scales and stripes), it cannot be reliably identified as either *A. taeniophorus* or “Lined type of Misuji-tenjikudai”. However, in their checklist of fishes of the Ogasawara Islands, Randall et al. (1997b) regarded Kuwamura et al.’s (1983) *A. robusta* (Smith and Radcliffe, 1911) (currently regarded as a junior synonym of *A. cookii*) and Sato’s (1991) *A. cookii* (both listed from the Ogasawara Islands) as *A. taeniophorus*. Sato’s (1991: fig. 11) *A. cookii* is also herein identified as *A. taeniophorus*. In addition, Randall et al. (1997b) listed four newly collected specimens of *A. taeniophorus* (BPBM

35092; BPBM 35125, 2 specimens; BPBM 35297) suggesting that *A. taeniophorus* is common in the Ogasawara Islands. Accordingly, we regard here that Matsuura and Tachikawa's (1994) specimen is *A. taeniophorus* (not Mabuchi et al.'s "Lined type of Misuji-tenjikudai") and the Japanese name proposed by Matsuura and Tachikawa (1994) is applied to *A. taeniophorus*.

At Yaku-shima Island, *A. taeniophorus* is most similar to *A. cookii*, but differs in having 14 pectoral-fin rays (vs. 15 rays in *A. cookii*) and an indistinct, smaller caudal-fin base spot (vs. a distinct, larger spot) (Gon, 1987; this study).

Apogon taeniophorus is widely distributed in the Indo-West Pacific where it ranges from the east coast of Africa east to the islands of Micronesia, the Line Islands, French Polynesia, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from the Ogasawara Islands (Matsuura and Tachikawa, 1994; Randall et al., 1997b; Mabuchi et al., 2004), Tateyama Bay (Hagiwara and Kimura, 2005), the Sagami Sea (Senou et al., 2006b), and the Ryukyu Islands [Kuchinoerabu-jima Island (Mabuchi et al., 2004), Okinoerabu-jima Island (Yoshigou et al., 2005), and Tokashiki-jima Island (Watai et al., 2009)].

At Yaku-shima Island, specimens of *A. taeniophorus* were collected from Hirauchi, Isso, Kurio, Kusugawa, Nagata, and Yudomari, representing the first records of the species from the island. This solitary species lives in the shade of rocky reefs at depths of less than 15 m at Yaku-shima Island; it can be observed in coastal areas of the island throughout the year. This species spawns in the early summer at the island.

Apogon cf taeniophorus Regan, 1908, lined type [Japanese name: "misuji-tenjikudai, rain-gata"] (Figs. 26A, B)

Apogon taeniophorus Regan, 1908: 226 (type locality: Maldives, Indian Ocean).

Material examined. KPM-NI 22579, 25.1 mm SL, Isso.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays

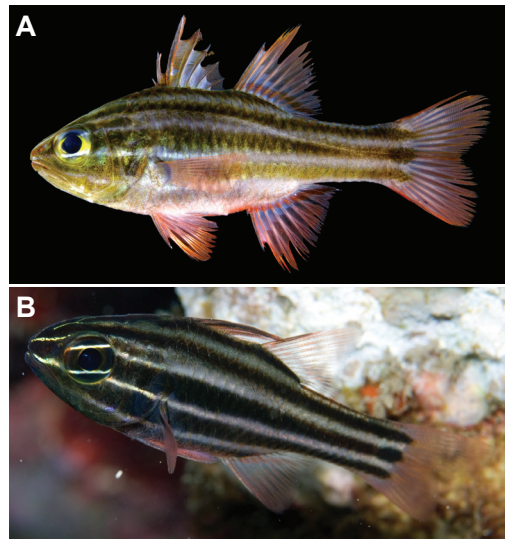


Fig. 25. *Apogon taeniophorus*. A, KAUM-I. 11359, 76.1 mm SL, Kurio; B, off Kurio, 2 m, 17 Dec. 2009, S. Harazaki.

I, 5; pored lateral-line scales 24; predorsal scales 4; circumpeduncular scales 12; total gill rakers 18, developed gill rakers 12; body white, with 6 dark brown stripes on lateral surface of body; posterior portion of third stripe curving upwardly and reaching to second stripe at below first dorsal fin; posterior end of fourth stripe (middle stripe) reaching on caudal-fin margin.

Remarks. The Yaku-shima Island specimen (Fig. 26A) and a photographed individual (Fig. 26B) are herein identified as Mabuchi et al.'s (2004) "Lined type of Misuji-tenjikudai, *A. taeniophorus*" on the basis of the following combination of characters: a white body, with six dark brown stripes on the lateral surface of the body, the posterior portion of the third stripe curving upwardly and reaching to the second stripe below the first dorsal fin, and the posterior end of the fourth stripe (middle stripe) reaching to the caudal-fin margin. Mabuchi et al. (2004) reported four specimens of the species (2 specimens from Misho, Ehime Prefecture, and 2 specimens from Kuchinoerabu-jima Island, Kagoshima Prefecture) from Japan as *A. taeniophorus* (lined type).

The Yaku-shima Island specimen was collected at a depth of 4 m off Isso. Another individual of the species was observed by the second author at a depth of 15 m off Isso.

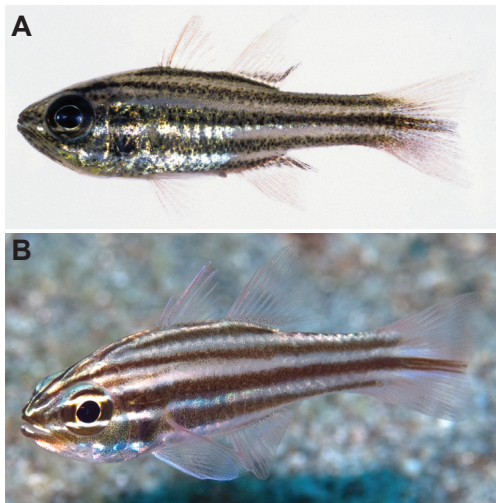


Fig. 26. *Apogon cf. taeniophorus*, lined type. **A**, KPM-NI 22579, 25.1 mm SL, Isso; **B**, off Isso, 20 m, 14 Sept. 2009, S. Harazaki.

***Apogonichthyoides timorensis* (Bleeker, 1854)**

[Japanese name: Kakure-ishimochi]

(Fig. 27)

Apogon timorensis Bleeker, 1854b: 207 (type locality: Kupang, Timor, Indonesia).

Material examined. KAUM-I. 20076, 59.9 mm SL, Yudomari; KPM-NI 22542, 29.0 mm SL, Yudomari; KPM-NI 22580, 21.9 mm SL, Isso.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 16; pelvic-fin rays I, 5; pored lateral-line scales 23–24; predorsal scales 3; circumpeduncular scales 12; total gill rakers 15, developed gill rakers 8–9; posterior tip of depressed pelvic fin extending beyond origin of anal fin; body yellowish brown, with four broad, vertical, dark brown bands on lateral surface of body, first band from anterior portion of first dorsal fin to pectoral fin, second band between bases of second dorsal and anal fins, third band on middle of caudal peduncle, and fourth band at caudal-fin base; and head with a broad brownish band from posterior margin of orbit to opercular margin, and a narrow brown stripe across cheek.

Remarks. Fraser and Allen (2010) allocated this species to the genus *Apogonichthyoides*. *Apogonichthyoides timorensis* is widely distributed in the Indo-West Pacific where it ranges from

the east coast of Africa and the Red Sea east to Australia and Japan (Allen et al., 2005; Randall et al., 1997a). In Japanese waters, this species (mostly as *Apogon timorensis*) has been reported from the Sagami Sea (Senou et al., 2006b), Shizuoka Prefecture (Hayashi, 2002), Shikoku [Ehime Prefecture (Hayashi, 2002) and Kashiwa-jima Island (Hirata et al., 1996)], and the Ryukyu Islands [Okinawa-jima Island (Yoshigou et al., 2005), Tokashiki-jima Island (Watai et al., 2009), and Iriomote-jima Island (Hayashi and Kishimoto, 1983, as *A. fraxineus*)].

At Yaku-shima Island, three specimens of *A. timorensis* were collected in less than 3 m depths off Isso and Yudomari, representing the first reliable records of *A. timorensis* from the island.



Fig. 27. *Apogonichthyoides timorensis*. KAUM-I. 20076, 59.9 mm SL, Yudomari.

***Archamia fucata* (Cantor, 1849)**

[Japanese name: Sumitsuki-atohiki-tenjikudai]

(Figs. 28A, B)

Apogon fucata Cantor, 1849: 986 [type locality: Sea of Pinang (Penang), Malaysia].

Material examined. BSKU 96549, 50.6 mm SL, Yudomari; KAUM-I. 20044, 49.5 mm SL, Yudomari; KAUM-I. 20074, 53.3 mm SL, Yudomari; KAUM-I. 20075, 73.5 mm SL, Yudomari.

Description. Dorsal-fin rays VI-I, 9; anal-fin rays II, 16; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 25; predorsal scales 6; circumpeduncular scales 12; total gill rakers 20–23, developed gill rakers 20; body pinkish, with numerous narrow, vertical or oblique reddish

orange bars; an indistinct reddish black spot behind opercle; and no black band on cheek;.

Remarks. *Archamia dispilus* Lachner, 1951 was recently synonymized with *A. fucata* by Gon and Randall (2003). Although the former (with an elongate spot behind head) is likely to be a valid species, we tentatively follow Gon and Randall's (2003) taxonomic decision.

Archamia fucata is widely distributed in the Indo-West Pacific where it ranges from the Red Sea and the east coast of Africa east to the Marshall Islands, the Samoa Islands, and Tonga, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species (as *A. dispilus*) has been reported from Hachijo-jima Island (Senou et al., 2002), the Ogasawara Islands (Sato, 1991; Randall et al., 1997b), Miyazaki Prefecture (Motomura et al., 2001), Kagoshima Prefecture (Yamada, 2007), and the Ryukyu Islands [Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou et al., 2001; Yoshigou and Nakamura, 2002; 2003; Yoshigou et al., 2005), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Hayashi and Kishimoto, 1983)].

At Yaku-shima Island, specimens of *A. fucata* were collected only from Yudomari, representing the first reliable records of the species from the island. This species forms schools in less than 5 m on muddy substrates in river mouths and fishing ports of Yaku-shima Island; it can be observed there in aggregations throughout the year.

***Cheilodipterus artus* Smith, 1961**

[Japanese name: Kasumi-yarai-ishimochi]
(Fig. 29)

Cheilodipterus artus Smith, 1961: 409, pl. 50, fig. F (type locality: Mahé, Seychelles)

Remarks. Hayashi (2002) reviewed the genus *Cheilodipterus* in Japanese waters and regarded four species as valid (Japanese names in parentheses), i.e., *C. artus* Smith, 1961 (Sudare-yarai-ishimochi), *C. macrodon* Lacépède, 1802 (Ryukyu-yarai-ishimochi), *C. quinquelineatus* Cuvier, 1828 (Yarai-ishimochi), and *C. subulatus* Weber, 1909 (Kasumi-yarai-ishimochi). Incidentally, although Gon (1993) regarded *C. subulatus* as a junior

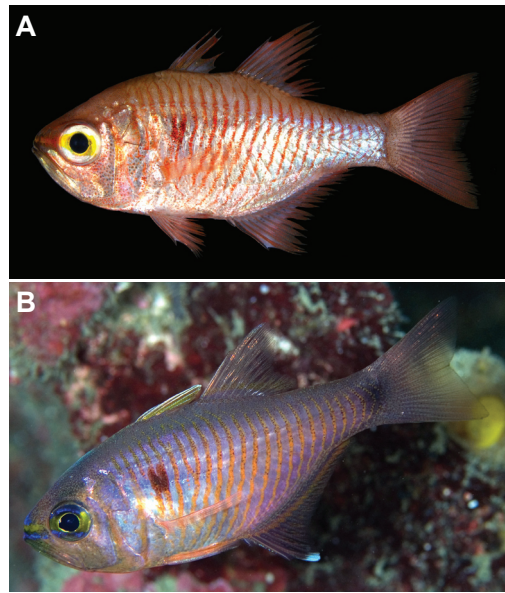


Fig. 28. *Archamia fucata*. A, KAUM-I, 20075, 73.5 mm SL, Yudomari; B, off Issu, 4 m, 26 Aug. 2006, S. Harazaki.

synonym of *C. singaporensis* Bleeker, 1859–60, Hayashi (2002) overlooked Gon's (1993) taxonomic decision.

Hayashi and Kishimoto's (1983: pl. 3, figs. 10a–b; IORD 77-748, 77-20) *Cheilodipterus* sp., type A, and Hayashi's (2002) 'Sudare-yarai-ishimochi, *C. artus*' are herein identified as *C. intermedius* Gon, 1993 (see Gon, 1993: pl. 1, fig. B). In addition, Hayashi and Kishimoto's (1983: pl. 3, fig. 9; IORD 76-435) *C. subulatus*, and Hayashi's (2002) 'Kasumi-yarai-ishimochi, *C. subulatus*' are herein identified as *C. artus* (see Gon, 1993: pl. 4, fig. C). Thus, the Japanese names 'Kasumi-yarai-ishimochi' and 'Sudare-yarai-ishimochi' correspond to *C. artus* and *C. intermedius* respectively (Senou et al., 2006a, 2007; this study).

Although *C. artus* is very similar to *C. intermedius* in juvenile coloration, *C. artus* differs from the latter in ontogenetic color changes of the caudal peduncle. Black pigments around a black spot at the caudal-fin base of *C. artus* increase with growth and the posterior portion of the caudal peduncle finally becomes black, whereas no black pigments usually occur around the caudal-fin base spot of *C. intermedius* and the posterior portion of the caudal peduncle usually becomes whitish (Gon, 1993; H. Senou, pers. comm.). The

figured individual (Fig. 29) may be an adult of *C. intermedius* (rather than *C. artus*); at this life stage, specimens are required for accurate identification.

Cheilodipterus artus is widely distributed in the Indo-West Pacific where it ranges from the east coast of Africa east to the Marshall Islands and Tuamotu Archipelago, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, reliable records of the species are from Yaku-shima Island (this study) and the Ryukyu Islands [Ie-jima Island (Senou et al., 2006a), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Hayashi and Kishimoto, 1983, as *C. subulatus*)].

This species inhabits rocky and coral reefs at depths of less than 20 m at Yaku-shima Island; common in the island and can be observed throughout the year.



Fig. 29. *Cheilodipterus cf. artus*. Off Issu, 8 m, 11 June 2005, S. Harazaki.

Cheilodipterus intermedius Gon, 1993

[Japanese name: Sudare-yarai-ishimochi]

(Figs. 30A, B)

Cheilodipterus intermedius Gon, 1993: 19, pl. 1, figs. 3B, 8 (type locality: east side of Marine lab., Sesoko-jima Island, Okinawa, Ryukyu Islands, Japan).

Remarks. Photographed individuals (Figs. 30A, B) are identified as *C. intermedius* on the basis of the following combination of characters: nine blackish brown broad and narrow stripes on lateral surface of body; a black spot, surrounded by yellow, at midbase of caudal fin in young (Fig. 30A); and no black vertical bar or distinct black

spot at caudal fin base in adults (Fig. 30B) (see Remarks of *C. artus*).

Cheilodipterus intermedius is widely distributed in the western Pacific where it ranges from the Solomon Islands to the South China Sea and Japan (Allen et al., 2005). In Japanese waters, this species has been reported from the Sagami Sea (Senou et al., 2006b, as *C. artus*) and the Ryukyu Islands [Sesoko-jima Island (Gon, 1993), Ie-jima Island (Senou et al., 2006a), and Miyako Group (Senou et al., 2007)].

This species is solitary on rocky and coral reefs at depths of less than 20 m at Yaku-shima Island; common in the island throughout the year.

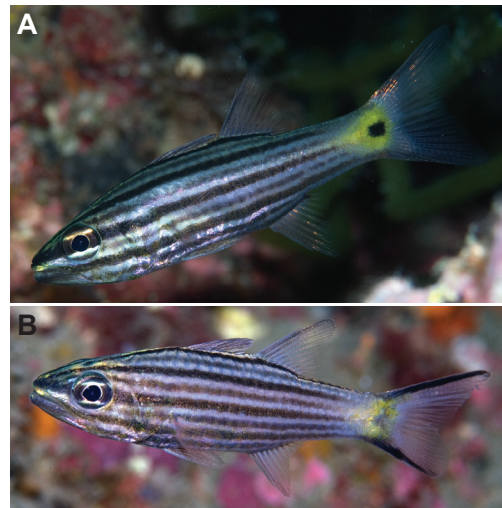


Fig. 30. *Cheilodipterus intermedius*. A, off Issu, 10 m, 5 Nov. 2005, S. Harazaki; B, off Issu, 10 m, 5 Nov. 2005, S. Harazaki.

Cheilodipterus macrodon (Lacepède, 1802)

[Japanese name: Ryukyu-yarai-ishimochi]

(Figs. 31A, B)

Centropomus macrodon Lacepède, 1802: 252, 273 (type locality: Mauritius or Réunion Island).

Cheilodipterus lineatus; Arai and Ida, 1975: 184, pl. 17, fig. 1 (Kusugawa, Yaku-shima Island, Japan).

Cheilodipterus macrodon; Ichikawa et al., 1992: 9 (Yaku-shima Island, Japan); Kuniyasu, 1999: 12 (Kurio, Yaku-shima Island, Japan).

Material examined. BSKU 96548, 58.7 mm SL, Yudomari; KAUM-I. 11453, 70.5 mm SL, Isso.

Description. Dorsal-fin rays VI-I, 9; anal-fin rays II, 8; pectoral-fin rays 12; pelvic-fin rays I, 5; pored lateral-line scales 25; predorsal scales 6; circumpeduncular scales 12; total gill rakers 20, developed gill rakers 9; large canine-like teeth on jaws; preopercular margin serrated; body white, with nine poorly defined dark brown stripes on lateral surface of body; a broad, black band on caudal-fin base in young.

Remarks. *Cheilodipterus macrodon* is widely distributed in the Indo-West Pacific where it ranges from the Red Sea and east coast of Africa east to French Polynesia (except for the Marquesas Islands), and the Pitcairn Islands, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from the Izu Islands [Hachijo-jima Island (Senou et al., 2002)], the Ogasawara Islands (Kuwamura et al., 1983; Sato, 1991; Randall et al., 1997b), Tateyama Bay (Hagiwara and Kimura, 2005), the Sagami Sea (Senou et al., 2006b), Shikoku [Kochi (Kamohara, 1964, as *Jadamga quinquelineatus*) and Kashiwa-jima Island (Hirata et al., 1996)], Yaku-shima Island (Ichikawa et al., 1992; Kuniyasu, 1999), and the Ryukyu Islands [Amami-oshima Island (Kamohara and Yamakawa, 1968), Ie-jima Island (Senou et al., 2006a), and Tokashiki-jima Island (Watai et al., 2009)].

At Yaku-shima Island, two specimens of *C. macrodon* were collected from Isso and Yudomari. This species occurs in less than 20 m at rocky or coral reefs at Yaku-shima Island throughout the year.

Cheilodipterus quinquelineatus Cuvier, 1828
[Japanese name: Yarai-ishimochi]
(Figs. 32A, B)

Cheilodipterus quinquelineatus Cuvier in Cuvier and Valenciennes, 1828: 167 (type locality: Bora Bora, Society Islands); Ichikawa et al., 1992: 9 (Yaku-shima Island, Japan); Kuniyasu, 1999: 12 (Kurio, Yaku-shima Island, Japan).

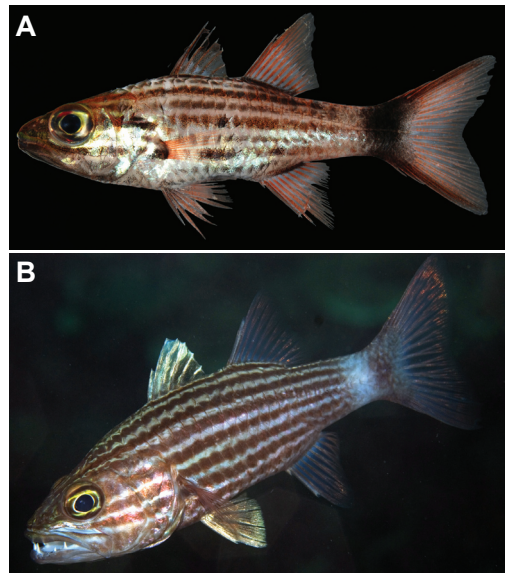


Fig. 31. *Cheilodipterus macrodon*. A, BSKU 96548, 58.7 mm SL, Yudomari; B, off Isso, 8 m, 22 June 2004, S. Harazaki.

Material examined. KAUM-I. 11289, 50.0 mm SL, Yudomari; KAUM-I. 20049, 80.3 mm SL, Yudomari; KAUM-I. 20068, 101.9 mm SL, Yudomari; KAUM-I. 20070, 85.8 mm SL, Yudomari; KAUM-I. 20073, 42.0 mm SL, Yudomari; KAUM-I. 20535, 65.5 mm SL, Yudomari; KPM-NI 22511, 40.0 mm SL, Yudomari.

Description. Dorsal-fin rays VI-I, 9; anal-fin rays II, 8; pectoral-fin rays 12; pelvic-fin rays I, 5; pored lateral-line scales 24–25; predorsal scales 6; circumpeduncular scales 12; total gill rakers 18, developed gill rakers 12; large canine-like teeth on jaws; preopercular margin serrated; body white, with five black stripes on lateral surface of body, posterior end of third stripe (middle stripe) reaching a black spot on caudal-fin base; and a caudal-fin base spot, less than pupil diameter, surrounded by poorly defined yellow blotch.

Remarks. *Cheilodipterus quinquelineatus* is widely distributed in the Indo-Pacific, except for the Persian Gulf and Hawaiian Islands (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from the Izu Islands [Miyake-jima Island (Ida and Moyer, 1974) and Hachijo-jima Island (Senou et al., 2002)], the Ogasawara Islands (Kuwamura et al., 1983; Sato, 1991; Matsuura and Tachikawa, 1994; Randall et

al., 1997b), the Sagami Sea (Senou et al., 2006b), Shikoku [Kochi (Kamohara, 1964) and Kashiwa-jima Island (Hirata et al., 1996)], Yaku-shima Island (Ichikawa et al., 1992; Kuniyasu, 1999), and the Ryukyu Islands [Yagaji-shima Island (Yoshigou et al., 2005), Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou et al., 2001; Yoshigou and Nakamura, 2002; Yoshigou et al., 2005), Tokashiki-jima Island (Watai et al., 2009), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Hayashi and Kishimoto, 1983; Yoshigou et al., 2001)].

At Yaku-shima Island, specimens of *C. quinquelineatus* were collected from Kurio and Yudomari. This species occurs in less than 20 m on rocky or coral reefs at Yaku-shima Island throughout the year. The population of *C. quinquelineatus* at Yaku-shima Island is the largest among the four species of *Cheilodipterus* occurring around the island.

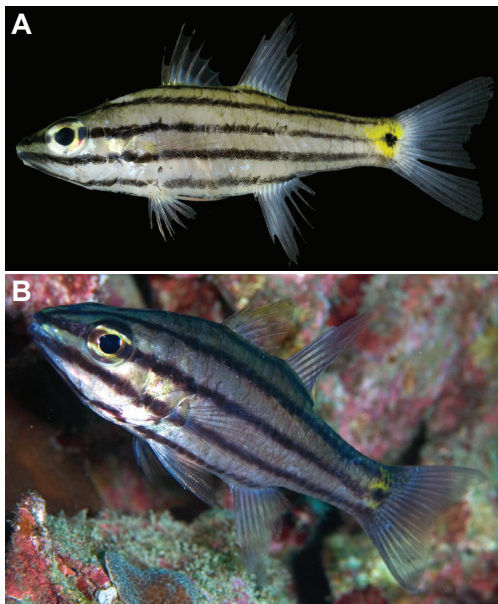


Fig. 32. *Cheilodipterus quinquelineatus*. **A**, KAUM-I. 11289, 50.0 mm SL, Yudomari; **B**, off Isso, 8 m, 26 Jan. 2005, S. Harazaki.

***Foa brachygramma* (Jenkins, 1903)**

[Japanese name: Taiwan-mato-ishimochi]

(Fig. 33)

Fowleria brachygrammus Jenkins, 1903: 447, fig.

20 (type locality: Honolulu, Oahu Island, Hawaiian Islands).

Remarks. The photographed individual (Fig. 33) is herein identified as *Foa brachygramma* on the basis of the following combination of characters: lateral line incomplete; no large black blotch on opercle; body blackish brown, with numerous small white blotches on head and caudal-fin base; and no vertical bands on lateral surface of body.

Foa brachygramma is widely distributed in the Indo-West Pacific where it ranges from the east coast of Africa east to the Hawaiian Islands, and north to Japan (Hayashi, 2002; Randall, 1997a). In Japanese waters, this species has been reported from Shimoda Bay, Shizuoka (Masuda et al., 1984) to the Ryukyu Islands [Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou et al., 2005), Tokashiki-jima Island (Watai et al., 2009), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Hayashi and Kishimoto, 1983; Yoshigou et al., 2001)].

Figure 33 represents the first confirmed record of *F. brachygramma* from Yaku-shima Island. This species can be observed in aggregations, each with about 20 individuals, on sandy substrates in less than 20 m off Isso, Yaku-shima Island, throughout the year; no other localities confirmed from the island.



Fig. 33. *Foa brachygramma*. Off Isso, 20 m, 15 Sept. 2009, S. Harazaki.

Fowleria isostigma (Jordan and Seale, 1906)

[Japanese name: Naha-mato-ishimochi]

(Fig. 34)

Apogonichthys isostigma Jordan and Seale, 1906: 251, fig. 45 (type locality: Apia, Upolu Island, Western Samoa).

Material examined. BSKU 96573, 17.0 mm SL, Yudomari.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 11; predorsal scales 6; circumpeduncular scales 12; total gill rakers 4, developed gill rakers 4; palatine without teeth; lateral line incomplete; body whitish brown, without small white blotches; a large ocellated black blotch on opercle; no vertical bands on lateral surface of body; and no spots or lines on fins.

Remarks. Two color variations of *F. isostigma* are known in Japanese waters: one has a round black spot basally on each scale of the lateral surface of the body, the spots forming several longitudinal stripes; the other lacks the spots (Hayashi, 2002). The Yaku-shima Island specimen is identified as Hayashi's (2002) "unmarked form".

Fowleria isostigma is widely distributed in the western Pacific where it ranges from Australia east to Mangareva and the islands of Micronesia, and north to Japan (Randall, 2005). In Japanese waters, this species has been reported from Wakayama Prefecture and southward (Hayashi, 2002), including Kashiwa-jima Island (Hirata et al., 1996) and the Ryukyu Islands [Amami-oshima Island (Kamohara and Yamakawa, 1968), Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou and Nakamura, 2003; Yoshigou et al., 2005), Ishigaki-jima Island (Yoshigou et al., 2001), and Iriomote-jima Island (Hayashi and Kishimoto, 1983)].

At Yaku-shima Island, a single specimen of *F. isostigma* was collected from Yudomari, representing the first reliable record of *F. isostigma* from the island. Ecological information on the species at Yaku-shima Island is unknown.



Fig. 34. *Fowleria isostigma*. BSKU 96573, 17.0 mm SL, Yudomari.

Fowleria cf marmorata (Alleyne and Macleay, 1877)

[Japanese name: Obi-shibori]

(Fig. 35)

Apogonichthys marmorata Alleyne and Macleay, 1877: 268, pl. 5, fig. 2 (type locality: Cape Grenville, Queensland, Australia).

Material examined. KAUM-I. 21784, 39.8 mm SL, Issu.

Description. Dorsal-fin rays VII-I, 9; anal-fin rays II, 8; pectoral-fin rays 14; pelvic-fin rays I, 5; pored lateral-line scales 6 (7 on right side of body); predorsal scales 6; circumpeduncular scales 12; total gill rakers 13, developed gill rakers 4; palatine without teeth; lateral line incomplete; body red, with several vertical dark red bars on lateral surface of body; 3 black bands radiating from posterior margin of eye; and a large ocellated black spot on opercle.

Remarks. The Yaku-shima Island specimen is herein identified as *F. marmorata* in having an incomplete lateral line; red body, with several vertical dark red bars on lateral surface of body and a large ocellated black spot on the opercle. However, the number of pored lateral-line scales in the Yaku-shima Island specimen is six (seven on right side of body), whereas those described by Hayashi (2002) and Randall (2005) are 12 and 10–13 respectively. In addition, the number of developed gill rakers in the Yaku-shima Island specimen is four, whereas those described by Hayashi (2002) is seven. More Yaku-shima Island specimens are required to determine whether these characters represent intraspecific variations or distinct species.

Fowleria marmorata is widely distributed in the Indo-West Pacific where it ranges from the Red Sea east to the Line, Society, and Marquesas Islands, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from Kashiwa-jima Island (Hirata et al., 1996) and the Ryukyu Islands [Okinawa-jima Island (Yoshigou et al., 2005) and Sesoko-jima Island (Hayashi, 2002)]. At Yaku-shima Island, a single specimen was collected from Isso at a depth of 30 m.



Fig. 35. *Fowleria cf. marmorata*. KAUM-I. 21784, 39.8 mm SL, Isso.

Fowleria variegata (Valenciennes, 1832)

[Japanese name: Shibori]

(Fig. 36)

Apogon variegata Valenciennes, 1832: 55 (type locality: Mauritius).

Material examined. BSKU 96547, 33.8 mm SL, Yudomari; KPM-NI 22505, 28.8 mm SL, Yudomari.

Description. Dorsal-fin rays VI-I, 9; anal-fin rays II, 8; pectoral-fin rays 13; pelvic-fin rays I, 5; pored lateral-line scales 10; predorsal scales 4–5; circumpeduncular scales 12; total gill rakers 14–15, developed gill rakers 6–8; palatine without teeth; lateral line incomplete; body blackish brown, with numerous black spots and blotches on lateral surface of body; a large dark ocellated spot on opercle; fins brown, with numerous white spots.

Remarks. *Fowleria variegata* is widely distributed in the Indo-West Pacific where it ranges from the Red Sea and the east coast of Africa, east to the Mariana and Samoa Islands, and north

to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from the Ogasawara Islands (Sato, 1991; Matsura and Tachikawa, 1994; Randall et al., 1997b) and the Ryukyu Islands [Amami-oshima Island (Yamakawa, 1971; Yoshigou et al., 2001), Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou et al., 2001; Yoshigou and Nakamura, 2003; Yoshigou et al., 2005), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Hayashi and Kishimoto, 1983; Yoshigou et al., 2001; Yoshigou and Nakamura, 2002)].

At Yaku-shima Island, two specimens of *F. variegata* were collected from Yudomari, representing the first reliable records of *F. variegata* from the island. Ecological information on the species at Yaku-shima Island is unknown.



Fig. 36. *Fowleria variegata*. KPM-NI 22505, 28.8 mm SL, Yudomari.

Neamia octospina Smith and Radcliffe, 1912

[Japanese name: Yatsutoge-tenjikudai]

(Figs. 37A, B)

Neamia octospina Smith and Radcliffe in Radcliffe, 1912: 441, pl. 36, fig. 2 (type locality: Rasa Island, off Mantaguin Bay, Palawan, Philippines).

Remarks. Photographed individuals (Figs. 37A, B) are herein identified as *N. octospina* on the basis of the following combination of characters: a semitranslucent white body, with numerous small reddish spots on the body and fins, and three indistinct reddish bands radiating from the posterior margin of the eye. Specimens have not been collected from Yaku-shima Island.

Neamia octospina is widely distributed in

the Indo-West Pacific where it ranges from the Red Sea east to Fiji, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from the Ryukyu Islands [Okinawa-jima Island (Yoshigou et al., 2005) and Ishigaki-jima Island (Ida and Moyer, 1974)].

Figures 37A, B represent the first confirmed records of *N. octospina* from Yaku-shima Island and the northernmost records for the species in the western Pacific. The photographed individuals were found among branches of the Alcyonacea, *Cladiella digitulata*, at a depth of 2 m off Motoura Beach, Isso, Yaku-shima Island on 23 Oct. 2006. These individual disappeared after *C. digitulata*' death confirmed by the second author; no other individuals have been observed at the island.

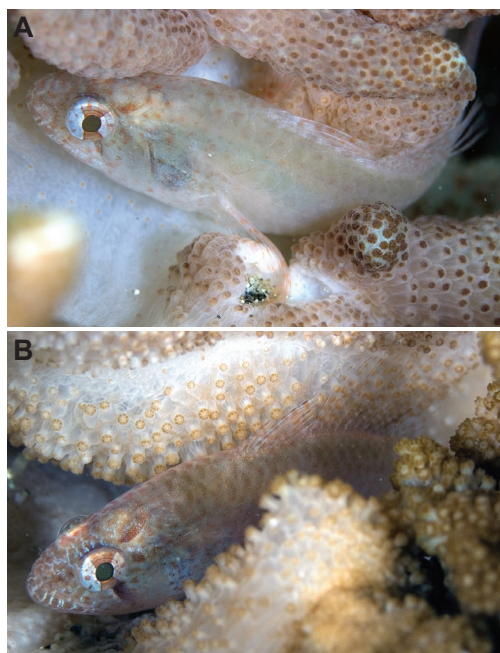


Fig. 37. *Neamia octospina*. A and B, off Isso, 5 m, 23 Oct. 2006, S. Harazaki.

Nectamia bandanensis (Bleeker, 1854)

[Japanese name: Banda-ishimochi]

(Figs. 38A, B)

Apogon bandanensis Bleeker, 1854a: 95 (type locality: Banda Neira, Banda Islands, Indonesia).

Material examined. BSKU 96538, 66.0 mm SL, Yudomari; KAUM-I. 20069, 67.8 mm SL, Yudomari.

Description. Dorsal-fin rays VII-I, 9 (one specimen with VII-II, 9); anal-fin rays II, 8; pectoral-fin rays 13; pelvic-fin rays I, 5; pored lateral-line scales 24; predorsal scales 3–4; circumpeduncular scales 12; total gill rakers 25–26, developed gill rakers 23; body depth 43.2–43.7 % of SL; body silvery brown, with 3 dark brown bands, widths subequal to pupil diameter, on lateral surface of body; and an oblique, straight, brownish bar from posteroventral margin of eye.

Remarks. Fraser (2008) recently allocated this species to *Nectamia* from *Apogon*. *Nectamia bandanensis* has been known from the western Pacific from Japan to American Samoa (Randall, 2005). In Japanese waters, this species has been reported from the Ogasawara Islands (Matsuura and Tachikawa, 1994, as *A. bandaensis*; Randall et al., 1997b, as *A. bandaensis*) and the Ryukyu Islands [Amami-oshima Island (Kamohara and Yamakawa, 1968, as *A. bandaensis*), Ie-jima Island (Senou et al., 2006a, as *A. bandaensis*), Okinawa-jima Island (Hayashi, 2002, as *A. bandaensis*), Sesoko-jima Island (Fraser, 2008), Tokashiki-jima Island (Watai et al., 2009), Miyako Group (Senou et al., 2007, as *A. bandaensis*), and Iriomote-jima Island (Hayashi and Kishimoto, 1983; Hayashi, 2002, as *A. bandaensis*)].

At Yaku-shima Island, two specimens of *N. bandanensis* were collected from Isso and Yudomari, representing the first reliable records of the species from the island and the northernmost records for the species. This species is observed in the shade of rocky reefs in the daytime and around the reefs at night; it can be observed in less than 10 m at Yaku-shima Island throughout the year.

Pseudamia gelatinosa Smith, 1956

[Japanese name: Numeri-tenjikudai]

(Figs. 39A, B)

Pseudamia gelatinosa Smith, 1956: 690, pl. 18, fig. A (type locality: Aldabra Islands).

Material examined. BSKU 96540, 42.9 mm SL, Yudomari; KAUM-I. 20120, 31.2 mm

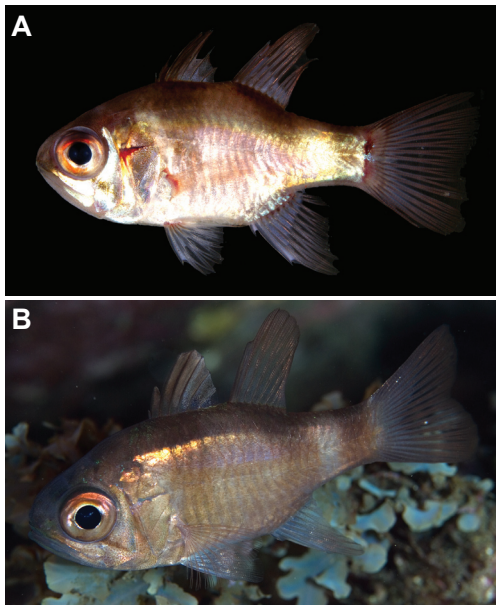


Fig. 38. *Nectamia bandanensis*. A, KAUM-I. 20069, 67.8 mm SL, Yudomari; B, off Isso, 10 m, 22 Oct. 2009, S. Harazaki.

SL, Yudomari; KAUM-I. 20163, 16.4 mm SL, Yudomari; KAUM-I. 20164, 21.0 mm SL, Yudomari; KAUM-I. 20165, 14.9 mm SL, Yudomari; KAUM-I. 20166, 16.5 mm SL, Yudomari; KPM-NI 22529, 18.7 mm SL, Yudomari.

Description. Dorsal-fin rays VI-I, 9; anal-fin rays II, 8; pectoral-fin rays 15; pelvic-fin rays I, 5; pored lateral-line scales 35; predorsal scales 5–6; circumpeduncular scales 12; total gill rakers 11, developed gill rakers 8; caudal fin lanceolate; anterior nostril with a long flap; semitranslucent slender body, with numerous small blackish spots forming several longitudinal stripes; caudal fin with a large black blotch dorsally; and a black blotch on caudal-fin base.

Remarks. *Pseudamia gelatinosa* differs from its close relative, *P. amblyuroptera*, in having 8 developed gill rakers and 8 anal-fin rays (vs. 11 rakers and usually 9 rays; Yoshigou and Yoshino, 2004).

Pseudamia gelatinosa is widely distributed in the Indo-West Pacific where it ranges from the Red Sea and east coast of Africa, east to the Line Islands, Society Islands and Rapa, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from

the Izu Islands [Hachijo-jima Island (Senou et al., 2002)], the Sagami Sea (Hayashi, 2002; Senou et al., 2006b), and the Ryukyu Islands [Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou et al., 2005), Miyako Group (Senou et al., 2007), Ishigaki-jima Island (Ida and Moyer, 1974), and Iriomote-jima Island (Yoshigou et al., 2001)].

At Yaku-shima Island, specimens of *P. gelatinosa* were collected from Yudomari, representing the first reliable records of the species from the island. This species is solitary in the shade of rocky reefs (not forming schools) at depths of less than of 10 m off Isso and Yudomari, Yaku-shima Island; no other localities confirmed from the island.

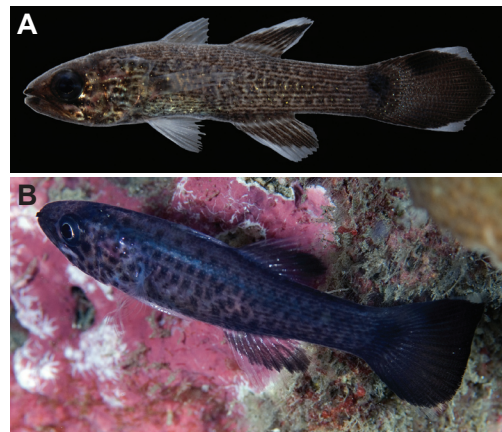


Fig. 39. *Pseudamia gelatinosa*. A, BSKU 96540, 42.9 mm SL, Yudomari; B, off Isso, 10 m, 16 Oct. 2009, I. Takaku.

Rhabdamia gracilis (Bleeker, 1856)

[Japanese name: Sukashi-tenjikudai]

(Figs. 40A, B)

Apogonichthys gracilis Bleeker, 1856b: 371 (type locality: Ternate, Moluccas, Indonesia).

Remarks. Photographed individuals (Figs. 40A, B) are identified as *R. gracilis* by having a translucent silvery body, with a bluish longitudinal stripe on the middle of the body. No specimens have been collected from Yaku-shima Island.

Mabuchi (2001) regarded that *R. gracilis* contained two distinct species: one has a black spot

on the posteroventral caudal peduncle, and the other lacks the spot. However, because these two have been observed as members of a school (see Fig. 40A) and the second author confirmed that they have often paired with each other at Yaku-shima Island, we tentatively treat them as conspecific in this study.

Rhabdamia gracilis is widely distributed in the Indo-West Pacific where it ranges from the east coast of Africa east to the Marshall Islands, Caroline Islands and Fiji, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from the Sagami Sea (Senou et al., 2006b), Wakayama Prefecture and southward (Hayashi, 2002), including the Ryukyu Islands [Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Ida and Moyer, 1974; Yoshigou et al., 2005), Tokashiki-jima Island (Watai et al., 2009), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Ida and Moyer, 1974; Hayashi and Kishimoto, 1983; Yoshigou and Nakamura, 2002)]. Figures 40 represent the first confirmed record of *R. gracilis* from Yaku-shima Island.

Rhabdamia gracilis, forming a school of ca. 50 individuals, lives sympatrically with *A. notatus* in depths of 20–25 m at two diving spots off Isso, Yaku-shima Island; no other localities confirmed from the island. At Yaku-shima Island, the spawning period of the species is in July and August.

Siphamia majimai Matsubara and Iwai, 1958
[Japanese name: Majimakuro-ishimochi]
(Figs. 41A–C)

Siphamia majimai Matsubara and Iwai, 1958:
603, fig.1 (type locality: Urasokari, Amami-oshima Island, Japan, ca. 28°07'N, 129°20'E).

Material examined. BSKU 96557, 16.9 mm SL, Yudomari; KAUM–I. 20158, 20.3 mm SL, Yudomari; KAUM–I. 20211, 19.3 mm SL, Yudomari; KPM–NI 22582, 16.9 mm SL, Isso.

Description. Dorsal-fin rays VI–I, 9; anal-fin rays II, 8; pectoral-fin rays 15; pelvic-fin rays I, 5; pored lateral-line scales 23; predorsal scales 6; circumpeduncular scales 12; total gill rakers 13–14, developed gill rakers 7–8; luminous organ

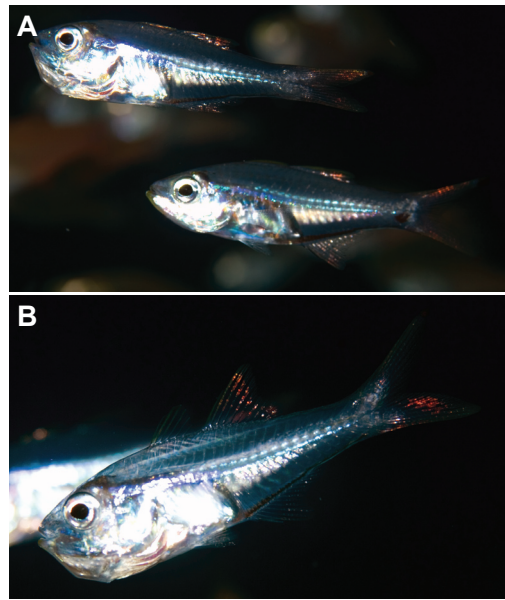


Fig. 40. *Rhabdamia gracilis*. **A**, off Isso, 20 m, 15 Sept. 2009, S. Harazaki; **B**, off Isso, 20 m, 15 Sept. 2009, S. Harazaki.

inside translucent muscles of ventral body from throat to caudal peduncle; and blackish silver body, with numerous small red spots on body and fins when fresh.

Remarks. *Siphamia majimai* is distributed in the western Pacific from Australia to Japan (Randall et al., 1997a). In Japanese waters, this species has been reported from the Ogasawara Islands (Randall et al., 1997b), Kashiwa-jima Island (Hirata et al., 1996), and the Ryukyu Islands [Amami-oshima Island (Matsubara and Iwai, 1958; Hayashi, 2002), Tokashiki-jima Island (Watai et al., 2009), Miyako Group (Senou et al., 2007), and Iriomote-jima Island (Hayashi and Kishimoto, 1983; Hayashi, 2002)].

At Yaku-shima Island, specimens of *S. majimai* were collected from Isso and Yudomari, representing the first reliable records of the species from the island. *Siphamia majimai* usually forms a school with five or six individuals and lives among spines of *Diadema setosum* at depths of less than 15 m at Yaku-shima Island. This species spawns in July and juveniles are observed in the middle of summer at the island.

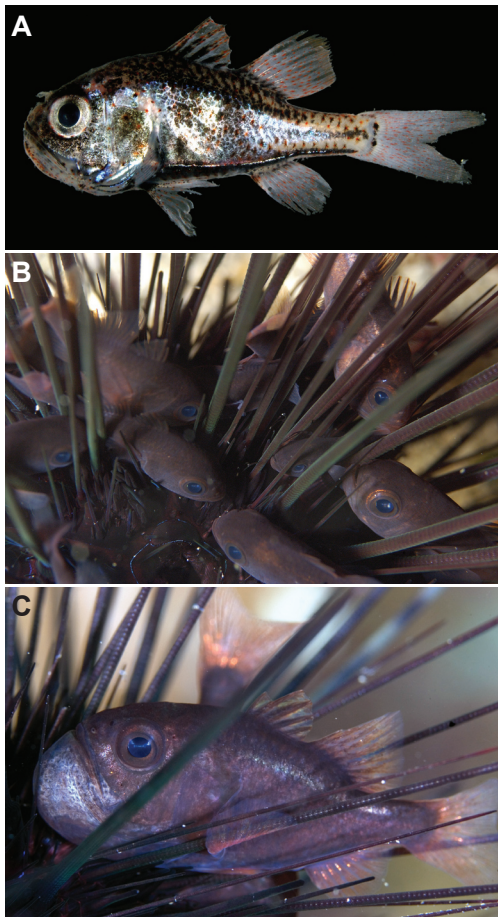


Fig. 41. *Siphamia majimai*. **A**, KAUM-I. 20158, 20.3 mm SL, Yudomari; **B**, off Isso, 5 m, 6 June 2005, S. Harazaki; **C**, off Isso, 5 m, 3 June 2006, S. Harazaki.

Siphamia tubulata (Weber, 1909)

[Japanese name: Inazuma-hikari-ishimochi]

(Fig. 42)

Apogon tubulatus Weber 1909: 160 (type locality: Sapeh Strait, Sumbawa Island, Lesser Sunda Islands, Indonesia).

Remarks. The photographed individual (Fig. 42) is herein identified as *Siphamia tubulata* on the basis of the unique coloration, viz., body silvery, mottled with reddish brown blotches. Specimens have not been collected from Yaku-shima Island.

Siphamia tubulata is distributed in the western Pacific, from Indonesia and Australia to Japan (Hayashi, 2002). In Japanese waters, this species

has been reported from Kashiwa-jima Island (Hirata et al., 1996; Hayashi, 2002).

Figure 42 represents the first confirmed record of *S. tubulata* from Yaku-shima Island. *Siphamia tubulata* is usually solitary in the shade of rocky reefs at depths of 25–30 m at Yaku-shima Island. A school with five or six young individuals was observed around *Padina arborescens* at depths of 25–30 m only once over the last six years of underwater observations.



Fig. 42. *Siphamia tubulata*. Off Isso, 25 m, 28 Oct. 2005, S. Harazaki.

Siphamia versicolor (Smith and Radcliffe, 1911)

[Japanese name: Hikari-ishimochi]

Amia versicolor Smith and Radcliffe in Radcliffe, 1911: 257, fig. 3 (type locality: Cataingan Bay, Masbate, Philippines).

Siphamia versicolor: Ichikawa et al., 1992: 9 (Yaku-shima Island, Japan).

Remarks. Identification of Ichikawa et al.'s (1992) *S. versicolor* is uncertain. The second author has dived for fish watching around Yaku-shima Island almost everyday for six years, but has never found the species.

Siphamia versicolor is widely distributed in the Indo-West Pacific where it ranges from the Gulf of Oman and Maldives Islands east to the Caroline Islands, and north to Japan (Allen et al., 2005; Randall, 2005). In Japanese waters, this species has been reported from the Izu Islands [Hachijo-jima Island (Senou et al., 2002)], the Ogasawara Islands (Kuwamura et al., 1983; Randall et al., 1997b; Yoshigou and Nakamura, 2002),

and the Ryukyu Islands [Yagaji-shima Island (Yoshigou and Nakamura, 2002; Yoshigou et al., 2005), Ie-jima Island (Senou et al., 2006a), Okinawa-jima Island (Yoshigou et al., 2005), Tokashiki-jima Island (Watai et al., 2009), and Iriomote-jima Island (Hayashi and Kishimoto, 1983)].

Conclusion

Fifteen genera with 94 species of the family Apogonidae have been recorded from Japanese waters (see Introduction). During this study, 45 species of the family were confirmed to occur around Yaku-shima Island, representing nearly half of all known Japanese species. Three species, *Apogon parvulus*, *A. selas* and *Siphamia versicolor*, previously reported by Ichikawa et al. (1992) and Kuniyasu (1999) from the island on the basis of underwater observations, were not observed or collected during this study (2004–2010). Thirteen of the 45 species, *Apogon apogonides*, *A. chrysotaenia*, *A. fasciatus*, *A. fraenatus*, *A. kallopterus*, *A. notatus*, *A. semiornatus*, *Cheilodipterus artus*, *C. intermedius*, *Foa brachygramma*, *Neamia octospina*, *Rhabdamia gracilis*, and *Siphamia tubulata*, were herein recorded only on the basis of underwater photographs, and records of the remaining species were based on collected specimens. Twenty-seven species represent the first records from Yaku-shima Island.

Recently, Yoshida and Motomura (2009) considered the northernmost recorded range of *Apogon amboinensis* to be Yaku-shima Island. In addition, our survey revealed that the northward distributional range of the following six species extended to Yaku-shima Island: *Apogon caudicinctus*, *A. chrysotaenia*, *A. exostigma*, *A. moluccensis*, *Neamia octospina*, and *Nectamia bandanensis*. Of these, *A. chrysotaenia* was recorded from Japanese waters for the first time. Although no specimens of three species, *A. chrysotaenia*, *A. exostigma*, and *N. octospina*, were collected during this study, underwater photographs facilitated their accurate identification. *Siphamia tubulata*, reported only from Kashiwa-jima Island (Hirata et al., 1996; Hayashi, 2002) in Japanese waters, was found at Yaku-shima Island. Incidentally, none of the 45 species found at Yaku-shima Island represents the southernmost record of the species.

Most of the 45 species found at Yaku-shima Island have been observed throughout the year at various life stages by scuba diving, with the exception of the following four: *Apogon fasciatus*, *A. cf. taeniophorus*, *Neamia octospina*, and *Siphamia tubulata*. Only a single, small specimen of *A. cf. taeniophorus* was collected and no adults of the species have been observed or collected at the island. The remaining three species have never been collected and have been observed by scuba diving only once for each species during the last six years. This suggests that the four species were most likely transported from around Taiwan or China by the Kuroshio Current, which normally flows well west of the Ryukyu Islands. It is highly unlikely that these species reproduce around Yaku-shima Island.

Although the second author has confirmed by underwater observations for the last six years that the following three species occur at Yaku-shima Island, no specimens or photographs of these species were taken from the island: *Apogon fukuii* Hayashi, 1990 (Futasuji-ishimochi), *A. rubrimacula* Randall and Kulbicki, 1998 (Akaoshikinsen-ishimochi), and *Pseudamia hayashii* Randall, Lachner, and Fraser, 1985 (Sabikudari-bouzugisumodoki). These species may be collected from the island in future.

Acknowledgments

We would like to thank M. Yamada (Kagoshima Aquarium, Japan), K. Hidaka, K. Miyamoto, S. Yoshinaga, and K. Kudo (formerly MUFS), H. Endo, E. Katayama, M. Nakayama, and M. Yamamura (BSKU), K. Matsuura, G. Shinohara, K. Kuriwa, T. Sato, Y. Takata, and M. Nakae (NSMT), S. Kimura (FRLM), H. Senou (KPM), Y. Iwatsuki and H. Izumi (MUFS), and G. Ogihara, M. Matsunuma, M. Meguro and M. Yamashita (KAUM) for their assistance with collecting apogonid fishes from Yaku-shima Island during this study. We are grateful to H. Senou (KPM) for providing valuable information on taxonomy of apogonids, M. McGrouther (AMS) for opportunity to examine two syntypes of *Amia fasciata stevensi*, A. Y. Suzumoto (BPBM) for a specimen loan, T. Yoshino (Department of Chemistry, Biology and Marine Science, Faculty of Science, Uni-

versity of the Ryukyus, Japan) and A. Yamane and M. Kawakami (MUFS) for providing literature, I. Takaku (Yakushima-Diving-Life, Japan) for providing an underwater photograph of Figure 39B, T. Hashimoto (KAUM) for X-ray photographs, G. Yearsley (Hobart, Australia) for checking our manuscript, and Y. Haraguchi (KAUM) and H. Iwatsubo and T. Haraguchi (Kagoshima University, Japan) for their curatorial assistance. This study was supported in part by a Grant-in-Aid for Scientific Research (A) (19208019) from the Japan Society for the Promotion of Science, Tokyo, Japan, and a Grant-in-Aid for Young Scientists (B) (19770067) from the Ministry of Education, Science, Sports and Culture, Japan.

Literature cited

- Aizawa, M. and H. Senou. 1991. An annotated list of the coastal fishes from Oshima Island and the adjacent region, Tokushima Prefecture, Japan. *Bulletin of the Tokushima Prefectural Museum*, (1):73–208.
- Allen, G. R. 2000. Apogonidae. Pages 612–614 in J. E. Randall and K. K. P. Lim (eds.). *A checklist of the fishes of the South China Sea*. The Raffles Bulletin of Zoology, Supplement, (8):569–667.
- Allen, G., R. C. Steene, P. Humann and N. Deloach. 2005. *Reef fish identification - tropical Pacific*. New World Publications Inc., Jacksonville. 457 pp.
- Alleyne, H. G. and W. Macleay. 1877. The ichthyology of the Chevert expedition. *Proceedings of the Linnean Society of New South Wales*, 1 (part 3):261–281, pls. 3–9.
- Arai, R. and H. Ida. 1975. The sea fishes of Yakushima and Tanegashima Islands, southern Kyushu, Japan. *Memoirs of the National Science Museum*, (8):183–204.
- Bleeker, P. 1851. Nieuwe bijdrage tot de kennis der Percoïdei, Scleroparei, Sciaenoïdei, Maenoïdei, Chaetodontoïdei en Scomberoïdei van den Soenda-Molukschen Archipel. *Natuurkundig Tijdschrift voor Nederlandsch Indië*, 2:163–179.
- Bleeker, P. 1852. Bijdrage tot de kennis der ichthyologische fauna van het eiland Banka. *Natuurkundig Tijdschrift voor Nederlandsch Indië*, 3: 443–460.
- Bleeker, P. 1853. Vierde bijdrage tot de kennis der ichthyologische fauna van Amboina. *Natuurkundig Tijdschrift voor Nederlandsch Indië*, 5:317–352.
- Bleeker, P. 1854a. Derde bijdrage tot de kennis der ichthyologische fauna van de Banda-eilanden. *Natuurkundig Tijdschrift voor Nederlandsch Indië*, 6:89–114.
- Bleeker, P. 1854b. Nieuwe bijdrage tot de kennis der ichthyologische fauna van Timor. *Natuurkundig Tijdschrift voor Nederlandsch Indië*, 6:203–214.
- Bleeker, P. 1856a. Beschrijvingen van nieuwe of weinig bekende vischsoorten van Manado en Makassar, grotendeels verzameld op eene reis naar den Molukschen Archipel in het gevolg van den Gouverneur Generaal Duymaer van Twist. *Acta Societatis Regiae Scientiarum Indo-Néerlandicae*, 1:1–80.
- Bleeker, P. 1856b. Zevende bijdrage tot de kennis der ichthyologische fauna van ternate. *Natuurkundig Tijdschrift voor Nederlandsch Indië*, 10:357–386.
- Cantor, T. E. 1849. *Catalogue of Malayan fishes*. *Journal and Proceedings of the Asiatic Society of Bengal*, 18 (part 2):i–xii + 983–1443, pls. 1–14.
- Cuvier, G. and A. Valenciennes. 1828. *Histoire naturelle des poissons*, Vol. 2. F. G. Levrault, Paris. xxi + 490 pp, pls. 9–40.
- Ebina, K. 1935. Descriptions of two new fishes from Kominato, Prov. Bôsyû. *Journal of the Imperial Fisheries Institute*, 30(2):211–217.
- Fraser, T. H. 2005. A review of the species in the *Apogon fasciatus* group with a description of a new species of cardinalfish from the Indo-West Pacific (Perciformes: Apogonidae). *Zootaxa*, 924:1–30.
- Fraser, T. H. 2008. Cardinalfishes of the genus *Nectamia* (Apogonidae, Perciformes) from the Indo-Pacific region with descriptions of four new species. *Zootaxa*, 1691:1–52.
- Fraser, T. H. and G. R. Allen. 2010. Cardinalfish of the genus *Apogonichthyoides* Smith, 1949 (Apogonidae) with a description of a new species from the West-Pacific region. *Zootaxa*, 2348: 40–56.
- Fraser, T. H., J. E. Randall and G. R. Allen. 2002. Clarification of the cardinalfishes (Apogonidae) previously confused with *Apogon moluccensis* Valenciennes, with a description of a related new species. *The Raffles Bulletin of Zoology*, 50(1):175–184.
- Garman, S. 1903. Some fishes from Australia. *Bulletin of the Museum of Comparative Zoology*, 39(8):229–241, pls. 1–5.
- Gon, O. 1987. The cardinal fishes (Perciformes; Apogonidae) collected in the Maldiv Islands during the Xarifa expedition (1957/58). *J. L. B. Smith Institute of Ichthyology Special Publication*, 42:1–18.
- Gon, O. 1993. Revision of the cardinalfish genus *Cheilodipterus* (Perciformes: Apogonidae), with description of five new species. *Indo-Pacific Fishes*, (22):1–59, pls. 1–5.

- Gon, O. and J. E. Randall. 2003. A review of the cardinalfishes (Perciformes: Apogonidae) of the Red Sea. *Smithiana*, 1:1–48.
- Greenfield, D. W. 2001. Revision of the *Apogon erythrinus* complex (Teleostei: Apogonidae). *Copeia*, 2001(2):459–472.
- Greenfield, D. W. 2007a. *Apogon seminigracaudus*, a new cardinalfish species previously misidentified as *Apogon fuscus* (Teleostei: Apogonidae). *Proceedings of the California Academy of Sciences*, 58(17):361–366.
- Greenfield, D. W. 2007b. Geographic variation in a cardinalfish, *Apogon dianthus* (Teleostei: Apogonidae). *Proceedings of the California Academy of Sciences*, 58(30):601–605.
- Greenfield, D. W. and J. E. Randall. 2004. Two new cardinalfish species of the genus *Apogon* from Easter Island. *Proceedings of the California Academy of Sciences*, 55(29):561–567.
- Hagiwara, K. and K. Kimura. 2005. Catalogue of fishes of the Yokosuka City Museum (IV). Sagami-Bay Marine Biological Research Club's fish collection of Hasama, Tateyama-Bay. Miscellaneous Report of the Yokosuka City Museum, (29):1–34.
- Hayashi, M. 1997. Apogonidae. Pages 288–307 in O. Okamura and K. Amaoka (eds.). *Sea fishes of Japan*. Yama-kei, Tokyo.
- Hayashi, M. 2000. Apogonidae. Pages 750–779, 1551–1553 in T. Nakabo (ed.). *Fishes of Japan with pictorial keys to the species*. Tokai University Press, Tokyo.
- Hayashi, M. 2002. Apogonidae. Pages 750–779, 1544–1545 in T. Nakabo (ed.). *Fishes of Japan with pictorial keys to the species*, English edition. Tokai University Press, Tokyo.
- Hayashi, M. 2004. First record of apogonid fish, *Apogon albomarginatus* (Pisces: Apogonidae) from Ryukyu Islands, southwestern Japan. *Science Report of the Yokosuka City Museum*, 51:46–52.
- Hayashi, M. and H. Kishimoto. 1983. Fish fauna of Iriomote-Island, Ryukyu Islands III. Apogonidae (Apogoninae). *Science Report of the Yokosuka City Museum*, 31:15–46, pls. 2–8.
- Hayashi, M. and K. Yano. 1996. First record of *Apogon ventrifasciatus* (Pisces: Apogonidae) from Ryukyu Islands, southern Japan. *Science Report of the Yokosuka City Museum*, 44:47–53.
- Hirata, T., T. Yamakawa, A. Iwata, S. Manabe, W. Hiramatsu and N. Ohnishi. 1996. Fish fauna of Kashiwa-jima Island, Kochi Prefecture, Japan. *Bulletin of Marine Science and Fisheries*, Kochi University, (16):1–177.
- Houttuyn, M. 1782. Beschryving van eenige Japanse visschen, en andere zee-schepzelen. *Verhandelingen der Hollandsche Maatschappij der Wetenschappen*, Haarlem, 20(2):311–350.
- Ichikawa, S., S. Sunagawa and T. Matsumoto. 1992. A general view of fishes of Yaku-shima Island [original title in Japanese: Yakushima san gyorui no gaikan]. Pages 19–46 in Team for Marine Organism Survey in Inshore of Yaku-shima Island [Yakushima engan kaiyou seibutsu chousadan] (eds.). *Report on scientific survey of marine organisms from inshore of Yaku-shima Island* [Yakushima engan kaiyou seibutsu gakujuutsu chousa houkokusyo].
- Ida, H. and J. T. Moyer. 1974. Apogonid fishes of Miyake-jima and Ishigaki-jima, Japan, with description of a new species. *Japanese Journal of Ichthyology*, 21(3):113–128.
- Jenkins, O. P. 1903. Report on collections of fishes made in the Hawaiian Islands, with descriptions of new species. *Bulletin of the United States Fish Commission*, 22:415–511, pls. 1–4.
- Jordan, D. S. and A. Seale. 1906. The fishes of Samoa. Description of species found in the Archipelago with a provisional checklist of the fishes of Oceania. *Bulletin of the Bureau of Fisheries*, 25:173–455, pls. 33–53.
- Jordan, D. S. and J. O. Snyder. 1901. A review of the cardinal fish of Japan. *Proceedings of the United States National Museum*, 23(1240):891–913, pls. 43–44.
- Jordan, D. S. and E. C. Starks. 1906. List of fishes collected on Tanaga and Yaku, offshore islands of southern Japan, by Robert van Vleck Anderson, with descriptions of seven new species. *Proceedings of the United States National Museum*, 30(1462):695–706.
- Kamohara, T. 1964. Revised catalogue of fishes of Kochi Prefecture, Japan. *Reports of the Usa Marine Biological Station*, 11(1):1–99.
- Kamohara, T. and T. Yamakawa. 1965. Fishes from Amami-oshima and adjacent regions. *Reports of the Usa Marine Biological Station*, 12(2):1–17.
- Kamohara, T. and T. Yamakawa. 1968. Additional records of marine fishes from Amami. *Reports of the Usa Marine Biological Station*, 15(1):1–25.
- Kuiter, R. H. and T. Kozawa. 1999. Fishes of the Indo-West Pacific. Pictorial guide. Apogonidae. *Zoonetics*, Seaford. 133 pp.
- Kuniyasu, T. (ed.). 1999. Report on regional survey of ecosystem diversity (inshore of Yaku-shima Island) [original title in Japanese: Seitaikei tayousei chiiiki chousa (Yakushima engan kaiiki)]. *Nature Conservation Bureau, Ministry of Environment and Kagoshima Nature Conservation Association* [Kankyou-chou shizenhogo-kyoku · Kagoshima-ken shizenaigo-kyoukai]. 64 pp.

- Kuwamura, T., R. Fukao, T. Nakabo, M. Nishida, T. Yanagisawa and Y. Yanagisawa. 1983. Inshore fishes of the Ogasawara (Bonin) Islands, Japan. *Galaxea*, 2:83–94.
- Lacepède, B. G. E. 1802. Histoire naturelle des poissons. Vol. 4. Plassan, Paris. xlv + 728 pp. 16 pls.
- Lachner, E. A. 1953. Family Apogonidae: cardinal fishes. Pages 412–498 in L. P. Schultz, E. S. Herald, E. A. Lachner, A. D. Welander and L. P. Woods (eds.). Fishes of the Marshall and Marianas Islands. Bulletin of the United States National Museum, No. 202, Vol. 1.
- Mabuchi, K. 2001. Apogonidae. Pages 51–54, 185–189 in T. Nakabo, Y. Machida, K. Yamaoka and K. Nishida (eds.). Fishes of the Kuroshio Current, Japan. Osaka Aquarium Kaiyukan, Osaka.
- Mabuchi, K., N. Okuda, T. Kokita and M. Nishida. 2003. Genetic comparison of two color-morphs of *Apogon properuptus* from southern Japan. *Ichthyological Research*, 50(3):293–296.
- Mabuchi, K., N. Okuda and M. Nishida. 2004. Genetic differentiation between two color morphs of *Apogon taeniophorus* from southern Japan. *Ichthyological Research*, 51(2):180–183.
- Macleay, W. J. 1881. Descriptive catalogue of the fishes of Australia. Part I. Proceedings of the Linnean Society of New South Wales, 5(part 3):302–344.
- Masuda, H., K. Amaoka, C. Araga, T. Uyeno and T. Yoshino. 1984. The fishes of the Japanese Archipelago. Tokai University Press, Tokyo. Text: xxii + 437 pp., 370 pls.
- Masuda, H. and Y. Kobayashi. 1996. Grand atlas of fish life modes. Color variation in Japanese fish. Tokai University Press, Tokyo. xlviii + 465 pp.
- Matsubara, K. 1963. Fish morphology and hierarchy, part 1, second edition. Ishizaki-shoten, Tokyo. xi + 789 pp.
- Matsubara, K. and T. Iwai. 1958. Results of the Amami Islands Expedition, No. 2. A new apogonid fish, *Siphamia majimai*. *Annals and Magazine of Natural History* (Series 13), 1(9):603–608.
- Matsuura, K. and H. Tachikawa. 1994. Fishes washed up on beaches in Chichi-jima, Ogasawara Islands. *Bulletin of the National Science Museum, Series A, Zoology*, 20(3):131–147.
- Miyahara, H., T. Yoshino and K. Nakaya. 2005. First record of an apogonid fish, *Apogon rhodopterus*, from Iriomote Island, Japan. *Japanese Journal of Ichthyology*, 52(2):147–151.
- Motomura, H., K. Hidaka and Y. Iwatsuki. 2001. A cardinalfish, *Archamia dispilus*, from Miyazaki waters, southern Japan (Perciformes: Apogonidae). *Izu Oceanic Park Diving News*, 12(2):5–7.
- Motomura, H., K. Kuriwa, E. Katayama, H. Senou, G. Ogihara, M. Meguro, M. Matsunuma, Y. Takata, T. Yoshida, M. Yamashita, S. Kimura, H. Endo, A. Murase, Y. Iwatsuki, Y. Sakurai, S. Harazaki, K. Hidaka, H. Izumi and K. Matsuura. 2010. Annotated checklist of marine and estuarine fishes of Yaku-shima Island, Kagoshima, southern Japan. Pages 65–247 in H. Motomura and K. Matsuura (eds.). Fishes of Yaku-shima Island – A World Heritage island in the Osumi Group, Kagoshima Prefecture, southern Japan. National Museum of Nature and Science, Tokyo.
- Nelson, J. S. 2006. Fishes of the world. Fourth edition. John Wiley & Sons, Inc., New Jersey. xv + 601 pp.
- Okada, Y. 1938. A catalogue of vertebrates of Japan. Maruzen, Tokyo. iv + 412 pp.
- Peters, W. 1876. Übersicht der von Hrn. Prof. Dr. K. Möbius in Mauritius und bei den Seychellen gesammelten fische. *Monatsberichte der Akademie der Wissenschaft zu Berlin*, 1876:435–447.
- Radcliffe, L. 1911. Notes on some fishes of the genus *Amia*, family of Cheilodipteridae, with descriptions of four new species from the Philippine Islands. *Proceedings of the United States National Museum*, 41(1853):245–261, pls. 20–25.
- Radcliffe, L. 1912. Descriptions of fifteen new fishes of the family Cheilodipteridae, from the Philippine Islands and contiguous waters. *Proceedings of the United States National Museum*, 41(1868):431–446, pls. 34–38.
- Randall, J. E. 2005. Reef and shore fishes of the South Pacific. New Caledonia to Tahiti and Pitcairn Islands. University of Hawai'i Press, Honolulu. xii + 707 pp.
- Randall, J. E., G. R. Allen and R. C. Steene. 1997a. Fishes of the Great Barrier Reef and Coral Sea. Second edition. University of Hawaii Press, Honolulu. xx + 557 pp.
- Randall, J. E. and M. Hayashi. 1990. *Apogon selas*, a new cardinalfish from the western Pacific. *Japanese Journal of Ichthyology*, 36(4):399–403.
- Randall, J. E., H. Ida, K. Kato, R. L. Pyle and J. L. Earle. 1997b. Annotated checklist of the inshore fishes of the Ogasawara Islands. *National Science Museum of Nature and Science Monographs*, (11):1–74, pls. 1–19.
- Randall, J. E. and E. A. Lachner. 1986. The status of the Indo-West Pacific cardinalfishes *Apogon aroubiensis* and *A. nigrofasciatus*. *Proceedings of the Biological Society of Washington*, 99(1):110–120.
- Randall, J. E. and C. L. Smith. 1988. Two new species and a new genus of cardinalfishes (Perciformes: Apogonidae) from Rapa, South Pacific Ocean. *American Museum Novitates*, 2926:1–9.

- Regan, C. T. 1908. Report on the marine fishes collected by Mr. J. Stanley Gardiner in the Indian Ocean. The Transactions of the Linnean Society of London, Second Series, Zoology, 12(3):217–255, pls. 23–32.
- Sakai, H., M. Sato and M. Nakamura. 2001. Annotated checklist of fishes collected from the rivers in the Ryukyu Archipelago. Bulletin of the National Science Museum of Nature and Science, Series A (Zoology), 27(2):81–139.
- Sato, T. 1991. Inshore fishes of the Ogasawara (Bonin) Islands observed during research trips made in 1990 and 1991. Pages 309–326 in M. Ono, M. Kimura, K. Miyashita and M. Nogami (eds.). Report of the second general survey on natural environment of the Ogasawara (Bonin) Islands, 1990–1991. Tokyo Metropolitan University, Tokyo.
- Schmidt, P. J. 1930. Fishes of the Riukiu Islands. Transactions of the Pacific Committee of the Academy of Sciences of the Union of Soviet Socialist Republics, 1:19–156, pls. 1–6.
- Senou, H. 1999. The Akazawa Sea: cardinalfishes [original title in Japanese: Akazawa no umi: ten-jikudai no nakama tachi]. I. O. P. Diving News, 10(2):7.
- Senou, H., Y. Kobayashi and N. Kobayashi. 2007. Coastal fishes of the Miyako Group, the Ryukyu Islands, Japan. Bulletin of the Kanagawa Prefectural Museum (Natural Sciences), 36:47–74.
- Senou, H., H. Kodato, T. Nomura and K. Yunokawa. 2006a. Coastal fishes of Ie-jima Island, the Ryukyu Islands, Okinawa, Japan. Bulletin of the Kanagawa Prefectural Museum (Natural Sciences), 35:67–92.
- Senou, H., K. Matsuura and G. Shinohara. 2006b. Checklist of fishes in the Sagami Sea with zoogeographical comments on shallow water fishes occurring along the coastlines under the influence of the Kuroshio Current. Memoirs of the National Science Museum, (41):389–542.
- Senou, H., G. Shinohara, K. Matsuura, K. Furuse, S. Kato and T. Kikuchi. 2002. Fishes of Hachijo-jima Island, Izu Islands Group, Tokyo, Japan. Memoirs of the National Science Museum, (38):195–237.
- Shibukawa, K., Y. Takata and G. Shinohara. 2007. First record of a cardinalfish *Neamia articycla* (Perciformes: Apogonidae) from Amami-oshima Island, Ryukyu Islands, Japan. Japanese Journal of Ichthyology, 54(2):219–223.
- Smith, J. L. B. 1956. The fishes of Aldabra. Part II. Annals and Magazine of Natural History (Series 12), 8 (93):689–697, pls. 1–8.
- Smith, J. L. B. 1961. Fishes of the family Apogonidae of the western Indian Ocean and the Red Sea. Ichthyological Bulletin of the J. L. B. Smith Institute of Ichthyology, 22:378–418, pls. 46–52.
- Valenciennes, A. 1832. Descriptions de plusieurs espèces nouvelles de poissons du genre *Apogon*. Nouvelles Annales du Muséum d'Histoire Naturelle (Paris), 1:51–60, pls. 1–4.
- Watai, M., Y. Miyazaki, A. Murase and H. Senou. 2009. Fish fauna of Tokashiku Bay, Tokashiki Island, the Kerama Islands, Okinawa Prefecture. Bulletin of the Kanagawa Prefectural Museum (Natural Sciences), 38:119–132.
- Weber, M. 1909. Diagnosen neuer fische Siboga-Expedition. Notes from the Leyden Museum, 31(note 4):143–169.
- Whitley, G. P. 1964. Fishes from the Coral Sea and the Swain Reefs. Records of the Australian Museum, 26(5):145–195, pls. 8–10.
- White, J., 1790. Journal of a voyage to New South Wales with sixty-five plates of non descript animals, birds, lizards, serpents, curious cones of trees and other natural productions. I. Debrett, London. 297 pp., 65 pls.
- Yamada, M. 2007. *Archamia fucata*. The Kagoshima University Museum Newsletter, (16):6.
- Yamakawa, T. 1969. Additional records of marine fishes from Amami (III). Reports of the Usa Marine Biological Station, 16(2):1–16.
- Yamakawa, T. 1971. Additional records of marine fishes from Amami (IV). Reports of the Usa Marine Biological Station, 18(2):1–21.
- Yoshida, T. and H. Motomura. 2009. Northernmost records of *Apogon amboinensis* (Teleostei, Perciformes, Apogonidae) from Yaku-shima Island, Kagoshima, southern Japan. Nanki-seibutsu, 51(2):96–98.
- Yoshigou, H. 2007. Inland water fishes of the Kume Island, Ryukyu Islands, Japan. Miscellaneous Reports of Hiwa Museum for Natural History, (48):25–51, pls. 1–4.
- Yoshigou, H., M. Ichikawa and S. Nakamura. 2005. Catalogue of fish specimens preserved in Hiwa Museum for Natural History (IV). Hiwa Museum for Natural History Material Reports, (5):1–51, pl. 1.
- Yoshigou, H., J. Naito and S. Nakamura. 2001. Catalogue of fish specimens preserved in Hiwa Museum for Natural History. Hiwa Museum for Natural History Material Reports, (2):119–168.
- Yoshigou, H. and S. Nakamura. 2002. Catalogue of fish specimens preserved in Hiwa Museum for Natural History (II). Hiwa Museum for Natural History Material Reports, (3):85–136, pl. 1.

- Yoshigou, H. and S. Nakamura. 2003. Catalogue of fish specimens preserved in Hiwa Museum for Natural History (III). Hiwa Museum for Natural History Material Reports, (4):29–73, pl. 1.
- Yoshigou, H. and T. Yoshino. 2004. First record of *Pseudamia amblyuroptera* (Perciformes: Apogonidae) from Japan. Izu Oceanic Park Diving News, 15(2):2–5.