

# Redescriptions of *Chromis notata* (Temminck and Schlegel, 1843) and *C. kennensis* Whitley, 1964 with the Description of a New Species of *Chromis* (Perciformes: Pomacentridae)

Hiroki Iwatsubo<sup>1</sup> and Hiroyuki Motomura<sup>2,3</sup>

<sup>1</sup> Graduate School of Fisheries, Kagoshima University, 4-50-20 Shimoarata, Kagoshima 890-0056, Japan

<sup>2</sup> The Kagoshima University Museum, 1-21-30 Korimoto, Kagoshima 890-0065, Japan

E-mail: motomura@kaum.kagoshima-u.ac.jp

<sup>3</sup> Corresponding author

(Received 5 March 2013; Accepted 18 November 2013)

Two species of *Chromis*, *C. notata* (Temminck and Schlegel, 1843) and *C. kennensis* Whitley, 1964, are redescribed, and the description of a new species, *C. yamakawai* sp. nov., is provided. Two nominal species that were previously regarded as valid, *C. flavomaculata* Kamohara, 1960 and *C. miyakeensis* Moyer and Ida, 1976, are synonymized with *C. notata*. *Chromis villadolidi* Jordan and Tanaka, 1927 is confirmed as a junior synonym of *C. notata*. Geographic variation of *C. notata* is discussed. Two populations previously treated as *C. flavomaculata* (regarded as a junior synonym of *C. notata* in this study) include two geographically disjunct species: *C. kennensis*, previously regarded as a junior synonym of *C. flavomaculata*, from the southwestern Pacific Ocean, and *C. yamakawai* from the northwestern Pacific Ocean.

**Key Words:** Western Pacific Ocean, damselfishes, synonymy, taxonomy, *Chromis miyakeensis*, *Chromis villadolidi*, *Chromis flavomaculata*.

## Introduction

Fishes of the genus *Chromis* Cuvier, 1814, the most speciose genus in the family Pomacentridae, are common on coral and rocky reefs throughout tropical and warm temperate seas (Allen 1991). Eighty-eight species of *Chromis* are currently recognized as valid (Allen 1991; Randall and McCosker 1992; Randall 1994; de Moura 1995; Randall 2001; Allen and Randall 2004; Lecchini and Williams 2004; Allen and Erdmann 2005, 2008, 2009; Senou and Kudo 2007). The genus is characterized by having the following: an elliptical and moderately deep body, its depth 53–62% of standard length; a short snout; biserial teeth including an outer row of enlarged conical teeth; a fully scaled head, except for the tip of the snout and the area around the nasal openings; a dorsal fin with 12–15 spines and 10–15 soft rays; an anal fin with two spines and 10–14 soft rays; a caudal fin with 15 principal rays and five or six procurent rays, the first two or three of the latter being spiniform; and less than 30 scale rows in the longitudinal series (Randall *et al.* 1981; Allen 1991).

*Chromis notata notata* (Temminck and Schlegel, 1843), originally described as *Heliases notatus*, and *C. notata miyakeensis* Moyer and Ida, 1976, originally described as *C. miyakeensis*, have been regarded as two valid subspecies by many authors (e.g., Ida 1984; Aonuma and Yoshino 1993, 2000). Randall *et al.* (1981) were the first to treat *C. miyakeensis* as a subspecies, albeit somewhat tentatively.

They characterized it as having a deep body, but stated that more specimens should be examined to assess the validity of this feature. Since Randall *et al.* (1981), no taxonomic treatment of either *C. notata notata* or *C. notata miyakeensis* has been reported.

We examined a large number of specimens of *C. notata notata* from a wide distributional range and concluded that they represented three indistinct geographic populations, with *C. miyakeensis* being a junior synonym of *C. notata*. *Chromis villadolidi* Jordan and Tanaka, 1927 was also confirmed in this study to be a junior synonym of *C. notata*.

*Chromis flavomaculata* Kamohara, 1960 (type locality: Kochi, Japan), closely related to *C. notata* (see Randall *et al.* 1981), has been regarded as a valid species with an anti-equatorial distribution in the northwestern and southwestern Pacific Ocean (Randall *et al.* 1981, 1997; Randall 2005; Allen and Erdmann 2012). Examination of the holotype of *C. flavomaculata* in this study showed it to be identical with *C. notata*, and the two anti-equatorial populations were found to differ from each other in several morphological features. The northern population, previously identified as *C. flavomaculata*, is herein described as a new species. The name *Chromis kennensis* Whitley, 1964 (type locality: Kenn Reef, Coral Sea), previously regarded as a junior synonym of *C. flavomaculata* (e.g., Randall *et al.* 1981; Allen 1991; Randall 2005; Allen and Erdmann 2012), should be applied to the southern population.

This paper provides redescriptions of *C. notata* (as a senior synonym of *C. villadolidi*, *C. miyakeensis*, and *C.*

*flavomaculata*) from East Asia and *C. kennensis* (a resurrected name from the southwestern Pacific Ocean), and the description of *C. yamakawai* sp. nov. from the northwestern Pacific Ocean.

## Materials and Methods

Counts and measurements follow Hubbs and Lagler (1947); observations were made on the left side of the body if possible. Measurements of the basal widths of the pelvic fin axillary scale and the scale between the pelvic fin bases are shown in Fig. 1. Standard length is abbreviated as SL. Gill rakers were counted on the first gill arch. Osteological characters were confirmed from X-ray photographs (33 specimens of *C. notata*, five of *C. kennensis*, and nine of *C. yamakawai*). Counts and proportional measurements, as percentages of SL, of the specimens of *Chromis notata* are given in Tables 1, 2, and 5, and those of *C. kennensis* and *C. yamakawai* are given in Table 4. Frequency distributions of selected meristic characters of the three species are presented in Table 3.

The specimens examined in this study are deposited at the Australian Museum, Sydney (AMS); Bishop Museum, Honolulu (BPBM); Department of Biology, Faculty of Science, Kochi University, Kochi (BSKU); California Academy of Sciences, San Francisco (CAS); Kyoto University

Museum, Kyoto (FAKU); Fisheries Research Laboratory, Mie University, Shima (FRLM); Hiwa Museum for Natural History, Shobara (HMNH); Hokkaido University Museum, Hakodate (HUMZ); Kagoshima University Museum, Kagoshima (KAUM); Kanagawa Prefectural Museum of Natural History, Odawara (KPM); Kochi Prefectural Kochi Nishi Senior High School, Kochi (KSHS; currently deposited at NSMT); Division of Fisheries Sciences, University of Miyazaki, Miyazaki (MUFS); National Museum of Nature and Science, Tsukuba (NSMT); Osaka Museum of Natural History, Osaka (OMNH); Naturalis Biodiversity Center, Leiden (RMNH); Seikai National Fisheries Research Institute, Nagasaki (SNFR); Churashima Research Center, Okinawa Churashima Foundation, Motobu (formerly University of the Ryukyus: URM); Museum Support Center of the National Museum of Natural History, Smithsonian Institution, Suitland, MD (USNM); Western Australian Museum, Welshpool (WAM); Humboldt-Universität, Museum für Naturkunde, Zoologisches Museum, Berlin (ZMB); and University Museum, University of Tokyo, Tokyo (ZUMT).

### *Chromis notata* (Temminck and Schlegel, 1843)

[Standard Japanese name: Suzumedai]

[English name: Pearl-spot Chromis]

(Figs 2–4, 6, 7, 12A–D; Tables 1–3, 5)

*Heliastes notatus* Temminck and Schlegel, 1843: 66 (type locality: Nagasaki, Japan).

*Heliastes notatus*: Günther 1862: 63 (China; Sea of Japan).

*Chromis notatus*: Jordan and Snyder 1902: 599 (Tokyo; Misaki; Enoshima; Kobe; Wakanoura; Hiroshima; Tsushima; Nagasaki, Japan); Schmidt 1930: 66 (in part; Kominato and Daikuma, Amami-oshima island; Itoman, Okinawa); Okada 1938: 200 (in part; Honshu and Shikoku, Japan); Kamohara 1957: 38 (in part; middle part of Japan to Ryukyu Islands; Korea; China); Kamohara 1960: 4 (Chiba and Niigata, Japan; Korea; China); Masuda *et al.* 1975: 96, 285, fig. D on p. 96 (southern Japan).

*Chromis villadolidi* Jordan and Tanaka, 1927: 387, pl. 34, fig. 1 (type locality: Sea of Japan between Tsushima and Fukuoka).

*Chromis notata*: Kamohara 1930: 483 (Kashiwa-jima island, Kochi, Japan); Tanaka 1931: 31 (southern Japan); Boeseman 1947: 71 (Nagasaki, Japan); Kamohara 1963: 34, pl. 34, fig. 1 (Chiba and Niigata, Japan; Korea; East China Sea); Masuda *et al.* 1980: 96, 285, fig. D on p. 96 (southern Japan); Allen 1991: 77, 240, unnumbered fig. (southern Japan, including Ryukyu Islands; Taiwan; China); Kuitert and Debelius 2006: 530, unnumbered fig. (Japan); Yoshino and Senou 2008: 265, unnumbered figs (Akita and southwards in Japan, including Izu and Ryukyu islands; Korean Peninsula; China; Taiwan); Kato 2011b: 70 (Akita and southwards; Izu Islands; Ryukyu Islands; Korean Peninsula; China; Taiwan); Allen *et al.* 2012: 80, unnumbered fig. (southern Japan to Taiwan).

*Chromis flavomaculatus* Kamohara, 1960: 5, pl. 1, fig. 2 (type locality: Susaki, Kochi, Japan).

*Chromis miyakeensis* Moyer and Ida, 1976: 189, fig. 1 (type

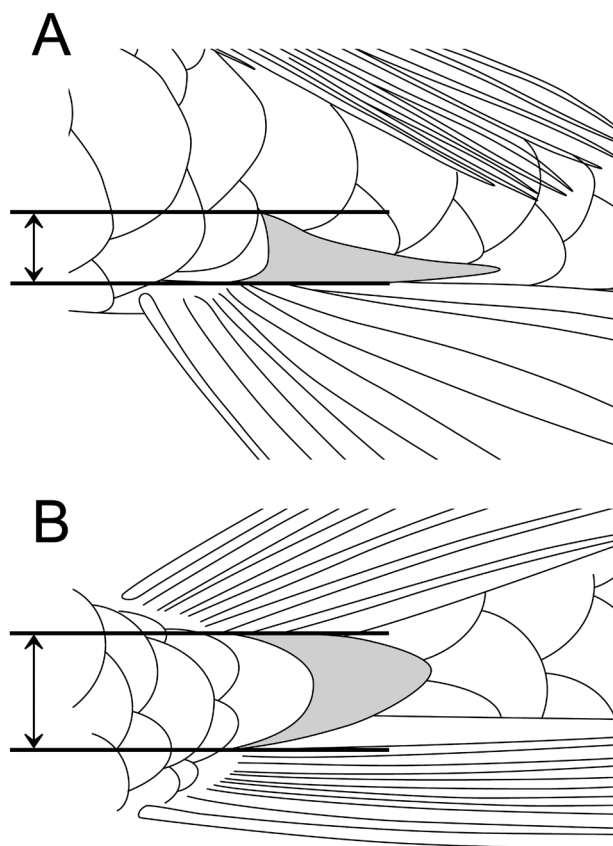


Fig. 1. Measurements of basal widths of scales. A, pelvic fin axillary scale, lateral view; B, scale between bases of pelvic fins, ventral view.

Table 1. Counts and measurements, expressed as percentages of standard length (SL), of type specimens now identified as *Chromis notata*.

	<i>C. notata</i>			<i>C. villadolidi</i>	<i>C. miyakeensis</i>
	Lectotype	Paralectotypes		Holotype	Holotype
	RMNH.PISC. 895	RMNH.PISC. 895 Nagasaki, Japan	ZMB 2792	FMNH 59185 Tsushima, Japan	ZUMT 53957 Miyake-jima, Japan
Standard length (mm)	86.8	69.2	88.8	100.8	126.3
Counts					
Dorsal fin rays	XIII, 13	XIII, 12	XIII, 13	XII, 12	XIII, 13
Anal fin rays	II, 10	II, 10	II, 10	II, 10	II, 11
Pectoral fin rays	19	19	19	19	20
Pelvic fin rays	I, 5	I, 5	I, 5	I, 5	I, 5
Spiniform caudal fin rays	2	2	2	2	2
Principal caudal fin rays	8+7	8+7	8+7	8+7	8+7
Tubed lateral line scales	18	18	18	18	18
Pored scales on caudal peduncle	9	9	9	8	8
Scale rows in longitudinal series	28	28	26	30	27
Scale rows above/below lateral line	4/12	4/11	4/11	5/11	4/11
Circumpeduncular scales	14	14	14	14	14
Gill rakers	8+23=31	8+22=30	9+21=30	9+23=32	—
Measurements (% SL)					
Head length	29.5	30.9	30.3	29.4	29.8
Snout length	7.4	8.4	7.9	7.9	9.3
Body depth	47.8	43.5	43.5	39.2	50.4
Body width	16.7	14.0	17.2	16.2	21.0
Orbit diameter	9.8	11.4	10.6	11.0	8.4
Interorbital width	10.6	10.5	10.0	10.4	11.3
Caudal peduncle depth	14.9	14.7	14.3	14.2	16.3
Caudal peduncle length	17.7	18.9	16.9	17.6	18.4
Upper jaw length	10.0	10.8	9.7	10.7	9.9
Pre-dorsal-fin length	35.9	40.0	37.3	37.7	38.2
Spinous dorsal fin base length	47.0	45.5	47.5	43.3	46.6
Soft-rayed dorsal fin base length	16.8	15.5	16.8	14.1	17.7
1st dorsal fin spine length	8.2	9.8	9.3	10.1	8.9
2nd dorsal fin spine length	12.0	—	12.2	12.4	11.2
3rd dorsal fin spine length	14.3	15.9	14.5	16.9	14.6
5th dorsal fin spine length	15.1	—	15.4	18.2	17.5
7th dorsal fin spine length	—	15.9	16.0	16.5	17.6
Last dorsal fin spine length	11.5	12.7	12.6	14.3	15.8
1st dorsal fin soft ray length	—	—	—	16.6	17.7
Longest dorsal fin soft ray length	—	—	23.5	21.7	27.6
Last dorsal fin soft ray length	10.6	9.2	9.6	6.9	7.4
Pre-anal-fin length	64.1	62.1	71.6	63.9	60.9
Anal fin base length	20.3	20.7	20.9	18.8	22.2
1st anal fin spine length	—	7.8	7.1	7.2	6.3
2nd anal fin spine length	—	18.5	17.1	18.3	19.0
1st anal fin soft ray length	—	18.8	—	20.2	22.4
Longest anal fin soft ray length	—	21.0	—	20.7	24.9
Last anal fin soft ray length	—	8.8	12.0	8.4	9.9
Caudal fin length	—	—	34.5	33.5	17.7
Caudal concavity	—	—	17.1	15.9	35.8
Pectoral fin length	33.3	31.5	—	32.8	29.9
Pre-pelvic-fin length	41.5	40.3	42.0	41.9	41.6
Pelvic fin spine length	14.1	17.1	16.0	16.1	15.0
1st pelvic fin soft ray length	31.7	31.4	28.5	29.2	24.7
Last pelvic fin soft ray length	13.9	15.0	15.2	15.9	15.6
Basal width of pelvic fin axillary scale	—	—	—	—	2.2
Basal width of scale between pelvic fin bases	—	—	—	—	3.5

Table 2. Counts and measurements, expressed as percentages of standard length (SL), of non-type specimens of *Chromis notata*. Modes or means in parentheses.

	<i>Chromis notata</i>							
	Sea of Japan	<i>n</i>	Seto Inland Sea plus East China Sea	<i>n</i>	Pacific coast of Japan plus southern China	<i>n</i>	Izu Islands	<i>n</i>
Standard length (mm)	20.4–113.8	44	33.7–110.5	82	26.7–122.3	71	65.9–128.8	5
Counts								
Dorsal fin rays	XIII–XIV (XIII), 12–14 (13)	42	XIII, 12–14 (13)	75	XIII, 11–14 (13)	70	XIII, 12–13 (12)	5
Anal fin rays	II, 10–12 (11)	42	II, 10–12 (11)	75	II, 10–12 (11)	71	II, 10–11 (11)	5
Pectoral fin rays	18–20 (19)	42	16–20 (19)	75	17–20 (19)	69	19	5
Pelvic fin rays	I, 5	42	I, 5	75	I, 5	71	I, 5	5
Spiniform caudal fin rays	2	42	2	75	2	71	2	5
Principal caudal fin rays	8+7	42	8+7	75	8+7	71	8+7	5
Tubed lateral line scales	16–19 (17)	35	16–19 (17)	73	16–21 (17)	68	17–18 (17)	5
Pored scales on caudal peduncle	8–9 (8)	23	7–10 (8)	61	7–10 (8)	61	8–9	4
Scale rows in longitudinal series	24–28 (26)	24	24–27 (26)	66	23–28 (26)	61	26–28 (27)	5
Scale rows above / below lateral line	4/11–12 (11)	33	4/11–12 (11)	70	4–5 (4)/11–12 (11)	64	4–5 (4)/11–12 (11)	5
Circumpeduncular scales	14	29	14	72	14	67	14	5
Gill rakers	7–9 (8)+20–24 (22)=28–33 (31)	33	7–10 (9)+20–24 (20)=27–33 (28)	74	7–10 (9)+19–24 (21)=27–33 (29)	62	8–9+21–22= 29–31	2
Measurements (% SL)								
Head length	28.9–33.9 (31.2)	40	28.3–33.3 (30.8)	73	28.5–37.3 (31.2)	71	30.0–32.3 (31.2)	5
Snout length	6.5–9.3 (7.7)	39	6.7–9.4 (8.0)	73	5.7–9.5 (7.9)	70	7.4–8.3 (7.8)	5
Body depth	37.8–49.9 (44.0)	43	41.1–50.7 (45.5)	82	42.0–51.5 (48.0)	70	45.8–52.3 (49.6)	5
Body width	14.1–24.6 (17.2)	43	15.4–23.4 (18.2)	73	15.4–23.4 (19.5)	70	17.0–20.0 (18.4)	5
Orbit diameter	8.9–13.2 (10.5)	39	8.4–11.6 (9.8)	73	8.4–11.3 (10.1)	69	9.0–12.1 (10.2)	5
Interorbital width	9.3–11.4 (10.4)	39	9.4–12.1 (10.6)	73	9.3–11.8 (10.6)	69	9.7–11.2 (10.5)	5
Caudal peduncle depth	12.5–15.7 (14.1)	42	13.3–15.9 (14.4)	73	11.2–15.8 (14.8)	71	14.4–15.9 (14.9)	5
Caudal peduncle length	9.5–20.6 (17.8)	39	11.5–20.4 (16.9)	73	9.8–20.0 (15.3)	69	12.1–19.5 (17.7)	5
Upper jaw length	8.8–12.1 (9.9)	39	8.4–11.3 (9.7)	73	8.0–11.1 (9.7)	67	8.9–10.6 (9.5)	5
Pre-dorsal-fin length	34.5–40.2 (37.7)	38	30.6–41.0 (37.3)	73	33.8–46.3 (38.4)	69	36.1–39.2 (38.3)	5
Spinous dorsal fin base length	41.1–49.0 (44.9)	38	41.9–51.9 (46.0)	73	43.9–51.9 (47.0)	69	36.8–51.3 (45.8)	5
Soft-rayed dorsal fin base length	11.3–18.0 (14.8)	38	12.8–20.3 (15.7)	73	12.6–20.4 (15.6)	69	14.6–16.5 (15.5)	5
1st dorsal fin spine length	7.4–12.5 (9.9)	37	7.0–12.0 (9.4)	72	4.4–12.5 (9.1)	69	8.8–11.4 (9.9)	5
2nd dorsal fin spine length	10.9–17.9 (14.4)	38	9.2–16.6 (13.6)	73	9.5–17.8 (13.3)	69	13.0–17.0 (14.5)	5
3rd dorsal fin spine length	12.4–19.7 (16.5)	38	12.7–18.9 (15.7)	72	11.9–18.2 (15.0)	69	15.0–18.5 (16.8)	5
5th dorsal fin spine length	14.5–21.0 (17.4)	38	14.0–19.5 (16.8)	71	13.3–20.1 (16.2)	69	17.0–19.7 (18.2)	5
7th dorsal fin spine length	13.6–19.7 (16.6)	38	13.7–19.3 (16.5)	72	11.2–19.2 (15.8)	69	16.9–18.7 (17.5)	5
Last dorsal fin spine length	9.7–16.1 (13.4)	35	11.1–18.0 (14.0)	73	9.4–18.8 (13.3)	67	13.6–15.9 (14.9)	5
1st dorsal fin soft ray length	10.7–18.0 (14.6)	28	12.2–21.3 (15.6)	69	10.5–22.2 (15.3)	65	15.6–21.2 (17.8)	3
Longest dorsal fin soft ray length	18.8–26.0 (22.3)	30	20.6–31.5 (24.0)	72	18.6–33.1 (24.1)	65	22.0–26.1 (24.4)	4
Last dorsal fin soft ray length	5.0–10.2 (7.4)	34	4.5–14.5 (7.6)	71	4.2–9.9 (7.1)	68	6.4–8.7 (7.5)	5
Pre-anal-fin length	58.5–71.5 (66.0)	38	58.0–74.8 (63.8)	73	59.0–73.4 (63.3)	70	58.5–64.1 (63.1)	5
Anal fin base length	16.3–21.9 (19.6)	39	17.3–22.4 (20.2)	73	16.6–23.6 (19.9)	65	19.1–22.1 (20.9)	5
1st anal fin spine length	5.2–11.3 (7.3)	36	4.9–8.5 (6.8)	73	4.5–10.2 (6.3)	67	5.9–8.5 (7.2)	5
2nd anal fin spine length	16.1–22.1 (18.4)	38	14.8–21.0 (18.2)	73	12.7–21.7 (17.6)	70	17.5–23.4 (20.1)	5
1st anal fin soft ray length	14.1–23.1 (18.6)	35	14.1–22.9 (19.3)	72	14.1–25.8 (18.6)	67	17.9–23.1 (20.2)	3
Longest anal fin soft ray length	15.6–24.5 (19.9)	35	17.2–28.1 (21.2)	70	17.3–26.1 (21.4)	64	19.7–25.2 (22.1)	4
Last anal fin soft ray length	5.8–10.8 (8.0)	36	5.0–12.5 (8.1)	72	4.5–11.0 (7.4)	67	6.4–9.1 (7.7)	4
Caudal fin length	28.7–38.4 (33.6)	28	14.0–40.6 (33.9)	71	28.4–43.9 (36.5)	63	33.6–36.1 (35.0)	3
Caudal concavity	12.0–21.5 (16.2)	26	12.7–39.4 (19.6)	70	10.8–26.1 (19.4)	61	11.5–17.6 (14.6)	4
Pectoral fin length	20.1–33.2 (29.2)	35	27.1–42.0 (31.1)	73	17.0–35.0 (30.7)	70	31.5–35.5 (32.9)	5
Pre-pelvic-fin length	38.1–47.6 (42.2)	39	28.1–48.1 (42.1)	72	38.2–49.9 (42.6)	70	40.5–45.6 (43.0)	5
Pelvic fin spine length	13.7–18.7 (16.2)	38	13.7–18.8 (16.1)	73	10.9–19.3 (16.2)	70	16.8–19.3 (17.6)	5
1st pelvic fin soft ray length	21.7–30.9 (26.9)	28	15.3–33.2 (29.1)	68	17.8–33.0 (28.9)	69	20.7–34.1 (27.9)	5
Last pelvic fin soft ray length	10.7–15.5 (13.0)	33	11.0–17.3 (13.3)	73	9.7–16.0 (12.6)	68	12.0–16.5 (13.8)	5
Basal width of pelvic fin axillary scale	1.5–2.6 (2.0)	22	1.5–3.2 (2.1)	31	1.5–2.6 (2.0)	44	1.9–2.5 (2.1)	4
Basal width of scale between pelvic fin bases	2.0–3.6 (2.7)	30	2.0–3.7 (2.7)	34	2.2–3.7 (2.8)	48	2.3–3.5 (2.8)	5



Table 3. Frequency distributions of selected counts of *Chromis notata*, *C. kennensis*, and *C. yamakawai* sp. nov.

	<i>n</i>	Dorsal fin soft rays				<i>n</i>	Anal fin soft rays		
		11	12	13	14		10	11	12
<i>C. notata</i>									
Sea of Japan	42	—	10	30	2	42	11	27	4
Seto Inland Sea plus East China Sea	78	—	10	61 <sup>L</sup>	7	78	7 <sup>L</sup>	65	6
Pacific coast of Japan plus southern China	70	1	12	54	3	71	2	56	13
Izu Islands	5	—	3	2	—	5	1	3	1
<i>C. kennensis</i>	22	5	16 <sup>H</sup>	1	—	22	6	15 <sup>H</sup>	1
<i>C. yamakawai</i> sp. nov.	105	24	80 <sup>H</sup>	1	—	105	13	89 <sup>H</sup>	3
	<i>n</i>	Pectoral fin rays							
		16	17	18	19	20	21		
<i>C. notata</i>									
Sea of Japan	42	—	—	9	32	1	—		
Seto Inland Sea plus East China Sea	78	2	3	10	59 <sup>L</sup>	4	—		
Pacific coast of Japan plus southern China	69	—	1	6	59	3	—		
Izu Islands	5	—	—	—	5	—	—		
<i>C. kennensis</i>	16	—	1	—	12 <sup>H</sup>	3	—		
<i>C. yamakawai</i> sp. nov.	96	—	2	4	67 <sup>H</sup>	22	1		
	<i>n</i>	Tubed lateral line scales							
		15	16	17	18	19	20	21	
<i>C. notata</i>									
Sea of Japan	35	—	4	19	9	3	—	—	
Seto Inland Sea plus East China Sea	75	—	7	40	25 <sup>L</sup>	3	—	—	
Pacific coast of Japan plus southern China	68	—	8	30	24	4	1	1	
Izu Islands	5	—	—	3	2	—	—	—	
<i>C. kennensis</i>	17	1	2	6 <sup>H</sup>	6	2	—	—	
<i>C. yamakawai</i> sp. nov.	78	—	2	14	26 <sup>H</sup>	33	2	1	
	<i>n</i>	Scale rows in longitudinal series							
		21	22	23	24	25	26	27	28
<i>C. notata</i>									
Sea of Japan	24	—	—	—	2	2	10	9	1
Seto Inland Sea plus East China Sea	68	—	—	—	3	8	37	18	2 <sup>L</sup>
Pacific coast of Japan plus southern China	61	—	—	1	1	15	34	6	4
Izu Islands	5	—	—	—	—	—	1	3	1
<i>C. kennensis</i>	12	—	—	—	—	2	9 <sup>H</sup>	1	—
<i>C. yamakawai</i> sp. nov.	35	4	—	2	1	4	16 <sup>H</sup>	8	—
	<i>n</i>	Scale rows above lateral line			<i>n</i>	Scale rows below lateral line			
		3	4	5		9	10	11	12
<i>C. notata</i>									
Sea of Japan	33	—	33	—	33	—	—	27	6
Seto Inland Sea plus East China Sea	72	—	72 <sup>L</sup>	—	72	—	—	57	15 <sup>L</sup>
Pacific coast of Japan plus southern China	64	—	61	3	64	—	—	63	1
Izu Islands	5	—	4	1	5	—	—	4	1
<i>C. kennensis</i>	14	14 <sup>H</sup>	—	—	14	13 <sup>H</sup>	1	—	—
<i>C. yamakawai</i> sp. nov.	94	94 <sup>H</sup>	—	—	91	83 <sup>H</sup>	8	—	—

Table 3. Continued

	<i>n</i>	Gill rakers on upper limb					Gill rakers on lower limb						
		6	7	8	9	10	19	20	21	22	23	24	25
<i>C. notata</i>													
Sea of Japan	33	—	5	17	11	—	1	8	8	7	9	—	—
Seto Inland Sea plus East China Sea	76	—	24	36 <sup>L</sup>	16	—	—	21	17	21	15 <sup>L</sup>	2	—
Pacific coast of Japan plus southern China	62	—	6	22	32	2	4	10	30	10	7	1	—
Izu Islands	2	—	—	1	1	—	—	—	1	1	—	—	—
<i>C. kennensis</i>	18	—	2	10	6 <sup>H</sup>	—	—	—	1	3	6 <sup>H</sup>	7	1
<i>C. yamakawai</i> sp. nov.	91	2	41	34 <sup>H</sup>	14	—	—	6	10	27	34 <sup>H</sup>	13	1
		Total gill rakers											
	<i>n</i>												
		27	28	29	30	31	32	33	34				
<i>C. notata</i>													
Sea of Japan	33	—	3	6	10	11	2	1	—				
Seto Inland Sea plus East China Sea	76	10	16	13	15	14 <sup>L</sup>	7	1	—				
Pacific coast of Japan plus southern China	62	4	8	20	16	5	7	2	—				
Izu Islands	2	—	—	1	—	1	—	—	—				
<i>C. kennensis</i>	18	—	—	1	3	4	8 <sup>H</sup>	1	1				
<i>C. yamakawai</i> sp. nov.	91	5	6	14	28	27 <sup>H</sup>	10	1	—				

<sup>H</sup> including data for holotypes of *Chromis kennensis* and *C. yamakawai*. <sup>L</sup> including data for lectotype of *Chromis notata*.

locality: Igaya Bay, Miyake-jima island, Japan).

*Chromis notata notata*: Randall *et al.* 1981: 231, fig. 15 (central Japan to Hong Kong); Kinoshita 1988: 561 (Akita and southwards in Sea of Japan; Chiba and southwards along Pacific coast of Japan; East China Sea); Aonuma and Yoshino 1993: 810, unnumbered fig. (Akita and southwards in Sea of Japan; Chiba and southwards along Pacific coast of Japan; East China Sea); Masuda and Kobayashi 1994: 222, fig. 1 (Akita and southwards in Sea of Japan; Chiba and southwards along Pacific coast of Japan; East China Sea); Allen 2000: 626 (South China Sea); Aonuma and Yoshino 2000: 925, unnumbered fig. (Akita and southwards in Sea of Japan; Chiba and southwards along Pacific coast of Japan; East China Sea); Hirata *et al.* 2001: 70, unnumbered fig. (Iburi, Kochi, Japan); Aonuma and Yoshino 2002: 925, unnumbered fig. (Akita and southwards in Sea of Japan; Chiba and southwards along Pacific coast of Japan; East China Sea); Konishi 2007: 238, unnumbered fig. (Akita and southwards in Sea of Japan; Chiba and southwards along Pacific coast of Japan; East China Sea); Nishida *et al.* 2007: 70 (Fukutsu, Fukuoka, Japan); Masuda 2008: 391 (Nagahama, Maizuru, Kyoto, Japan); Araga 2009: 440, unnumbered fig. (Akita and southwards in Sea of Japan; Chiba and southwards along Pacific coast of Japan; East China Sea); Motomura *et al.* 2010: 149 (Yaku-shima island, Kagoshima, Japan); Sakai *et al.* 2010: 12 (Osaki-kami-shima island, Hiroshima, Japan); Shimizu *et al.* 2010: 45 (off Kurahashi-jima island, Seto Inland Sea, Japan); Takagi *et al.* 2010: 78, unnumbered fig. (Ehime, Japan); Tsuji *et al.* 2010: 10 (Nanao Bay, Noto Peninsula, Japan).

*Chromis notatus notatus*: Ida 1984: 192, pl. 185, fig. D (Akita and southwards in Sea of Japan; Chiba and southwards along Pacific coast of Japan; East China Sea); Araga *et al.* 1985: 252, unnumbered fig. (Akita and southwards in Sea of Japan; Chiba and southwards along Pacific coast of

Japan; East China Sea); Kinoshita 1988: 559, 561, unnumbered fig. (Akita and southwards in Sea of Japan; Chiba and southwards along Pacific coast of Japan; East China Sea).

*Chromis notata miyakeensis*: Randall *et al.* 1981: 233, fig. 16 (Miyake-jima island, Izu Islands, Japan); Aonuma and Yoshino 1993: 810, unnumbered fig. (Miyake-jima island, Izu Islands, Japan); Masuda and Kobayashi 1994: 221, figs 7, 8 (Miyake-jima island, Izu Islands; Izu Peninsula, Japan); Aonuma and Yoshino 2000: 925, unnumbered fig. (Miyake-jima island, Izu Islands; Izu Peninsula, Japan); Aonuma and Yoshino 2002: 925, unnumbered fig. (Miyake-jima island, Izu Islands; Izu Peninsula, Japan).

*Chromis notatus miyakeensis*: Ida 1984: 192, pl. 185, fig. E (Izu Islands).

**Lectotype.** RMNH.PISC. 895 (1 of 2 specimens), 86.8 mm SL, Nagasaki, Japan, P. F. von Siebold [lectotype designated by Boeseman (1947)].

**Paralectotypes.** RMNH.PISC. 895 (1 of 2 specimens), 69.2 mm SL, ZMB 2792, 88.8 mm SL, same data as lectotype.

**Other type material examined.** BSKU 8482, holotype of *C. flavomaculata*, 84.8 mm SL, Susaki, Kochi, Japan, 19 May 1959; FMNH 59185, holotype of *C. villadolidi*, 101.0 mm SL, Sea of Japan between Tsushima and Fukuoka, D. Jordan and S. Tanaka; ZUMT 53957, holotype of *C. miyakeensis*, 126.3 mm SL, Igaya Bay, Miyake-jima island, Izu Islands, Japan, J. Moyer and H. Ida, October.

**Non-type material examined.** Most specimens from fishing ports were obtained from fishermen; although the site of capture of such specimens is unknown, in most cases it should not be far distant from the port. The geographical categorization adopted here reflects the distribution of morphologically distinct populations, as is discussed afterwards. **SEA OF JAPAN** (44 specimens, 20.4–113.8 mm SL)—**AKITA**: KAUM-I. 34909, 109.2 mm SL, KAUM-

Table 4. Counts and measurements, expressed as percentages of standard length (SL), of *Chromis kennensis* and *C. yamakawai* sp. nov. Modes or means in parentheses.

	<i>Chromis kennensis</i>			<i>Chromis yamakawai</i> sp. nov.		
	Holotype	Non-types		Holotype	Paratypes	
	AMS IB. 4973 Australia	Southwestern Pacific	<i>n</i>	NSMT-P 111948 Japan	Northwestern Pacific	<i>n</i>
Standard length (mm)	77.6	22.5–93.0	23	83.0	18.2–130.8	107
Counts						
Dorsal fin rays	XIII, 11	XIII–XIV (XIII), 11–13 (12)	21	XIII, 12	XIII–XIV (XIII), 11–13 (12)	104
Anal fin rays	II, 10	II, 10–12 (11)	21	II, 11	II, 10–12 (11)	104
Pectoral fin rays	20	17–20 (19)	15	19	17–21 (19)	95
Pelvic fin rays	I, 5	I, 5	19	I, 5	I, 5	101
Spiniform caudal fin rays	2	2	21	2	2	102
Principal caudal fin rays	8+7	8+7	21	8+7	8+7	102
Tubed lateral line scales	17	15–19 (18)	16	19	16–21 (19)	70
Pored scales on caudal peduncle	8	8–11 (8)	15	8	7–10 (8)	63
Scale rows in longitudinal series	24	25–27 (26)	11	26	21–27 (26)	34
Scale rows above / below lateral line	3/9	3/9–10 (9)	13	3/9	3/9–10 (9)	90
Circumpeduncular scales	14	14	17	14	14	67
Gill rakers	9+23=32	7–9 (8)+21–25 (24)= 29–34 (32)	17	8+23=31	6–9 (7)+20–25 (23)= 27–33 (30)	90
Measurements (% SL)						
Head length	22.6	28.2–37.3 (31.4)	19	23.8	23.7–36.0 (29.7)	97
Snout length	6.8	7.0–8.9 (7.5)	19	7.1	5.3–8.9 (7.4)	95
Body depth	45.1	39.0–47.7 (43.4)	19	44.5	36.3–50.6 (43.8)	97
Body width	16.9	12.2–20.6 (16.5)	19	18.1	12.0–26.4 (17.5)	95
Orbit diameter	9.0	9.0–13.4 (11.0)	19	9.4	7.9–14.3 (9.9)	95
Interorbital width	10.2	9.1–11.3 (10.3)	19	10.4	8.8–11.9 (10.1)	95
Caudal peduncle depth	14.3	13.3–15.5 (14.2)	20	14.1	12.7–15.4 (14.0)	101
Caudal peduncle length	17.5	12.9–20.3 (17.5)	19	19.2	10.8–21.2 (18.0)	95
Upper jaw length	9.4	9.1–12.2 (10.1)	19	9.3	7.8–11.4 (9.4)	87
Pre-dorsal-fin length	37.4	36.3–41.1 (38.9)	19	38.3	34.8–43.4 (38.2)	95
Spinous dorsal fin base length	45.7	39.3–46.9 (43.6)	16	47.6	34.4–48.2 (44.4)	95
Soft-rayed dorsal fin base length	14.3	11.7–15.8 (13.8)	16	15.1	10.7–17.6 (14.1)	95
1st dorsal fin spine length	7.9	6.4–10.2 (8.3)	16	6.6	5.3–13.3 (7.8)	93
2nd dorsal fin spine length	9.8	9.5–14.9 (12.1)	16	11.0	9.1–16.1 (11.8)	93
3rd dorsal fin spine length	11.6	11.6–17.3 (14.7)	16	14.2	9.7–18.2 (14.2)	94
5th dorsal fin spine length	14.8	10.5–17.8 (15.2)	15	15.9	11.4–18.7 (15.2)	95
7th dorsal fin spine length	15.2	8.8–17.9 (13.6)	16	15.7	11.4–18.7 (14.6)	92
Last dorsal fin spine length	11.1	6.0–12.7 (10.0)	16	11.6	7.6–14.6 (11.2)	94
1st dorsal fin soft ray length	14.9	7.4–17.7 (13.6)	15	12.8	8.3–20.5 (14.8)	81
Longest dorsal fin soft ray length	19.6	15.0–21.9 (19.1)	16	22.0	13.2–25.3 (20.6)	82
Last dorsal fin soft ray length	7.9	5.5–8.8 (7.6)	16	7.0	4.8–11.9 (7.9)	95
Pre-anal-fin length	61.9	59.3–72.8 (64.9)	16	68.0	56.3–73.6 (64.6)	94
Anal fin base length	20.6	17.9–20.8 (19.0)	19	20.0	14.4–21.2 (19.1)	93
1st anal fin spine length	4.8	4.8–7.4 (6.1)	18	5.8	3.4–8.6 (6.1)	95
2nd anal fin spine length	15.9	15.5–19.9 (18.3)	19	18.1	14.3–22.9 (18.1)	94
1st anal fin soft ray length	—	10.5–21.1 (17.4)	19	18.8	13.8–22.9 (18.7)	89
Longest anal fin soft ray length	—	14.2–21.1 (18.4)	19	18.8	13.4–22.9 (18.9)	82
Last anal fin soft ray length	7.3	6.1–9.1 (7.8)	17	7.1	4.3–10.4 (7.8)	94
Caudal fin length	11.1	11.4–23.1 (16.7)	14	38.4	27.9–44.8 (36.0)	83
Caudal concavity	33.4	24.0–41.5 (36.0)	14	22.0	11.8–25.9 (20.0)	82
Pectoral fin length	31.1	26.5–33.5 (30.2)	18	29.8	23.5–35.2 (30.2)	93
Pre-pelvic-fin length	40.1	37.0–44.8 (40.3)	16	39.3	32.1–48.6 (41.5)	95
Pelvic fin spine length	16.1	15.4–18.7 (16.5)	15	16.0	13.4–18.3 (15.9)	94
1st pelvic fin soft ray length	29.0	15.2–29.0 (26.3)	15	23.1	14.6–31.4 (25.7)	80
Last pelvic fin soft ray length	12.9	8.8–15.4 (12.3)	16	14.6	9.1–16.2 (12.8)	93
Basal width of pelvic fin axillary scale	1.8	0.6–1.8 (1.5)	15	2.1	1.7–2.8 (2.2)	58
Basal width of scale between pelvic fin bases	2.5	2.0–2.8 (2.6)	16	3.6	2.2–3.9 (3.0)	59

Table 5. Counts and measurements, expressed as percentages in standard length (SL), of Japanese specimens reported by Kamohara (1960).

Kamohara (1960) reported as:	<i>Chromis flavomaculatus</i>		<i>Chromis notata</i>	<i>Chromis notata</i>
Re-identified in this study as:	<i>Chromis notata</i>		<i>Chromis notata</i>	<i>Chromis yamakawai</i>
	Holotype BSKU 8482 Susaki, Kochi	Non-type BSKU 4944 Tachibana, Tokushima	Non-type BSKU 4946 Tachibana, Tokushima	Non-type BSKU 8513 Susaki, Kochi
Standard length (mm)	84.8	80.9	89.6	113.0
Counts				
Dorsal fin rays	XIII, 13	XIII, 13	XIII, 13	XIII, 12
Anal fin rays	II, 11	II, 11	II, 11	II, 12
Pectoral fin rays	18	19	19	19
Pelvic fin rays	I, 5	I, 5	I, 5	I, 5
Spiniform caudal fin rays	2	2	2	2
Principal caudal fin rays	8+7	8+7	8+7	8+7
Tubed lateral line scales	17	17	18	18
Pored scales on caudal peduncle	8	8	8	—
Scale rows in longitudinal series	26	26	25	—
Scale rows above / below lateral line	4/12	4/12	4/10	3/9
Circumpeduncular scales	14	14	14	14
Gill rakers	—	—	9+21=30	9+21=30
Measurements (% SL)				
Head length	30.5	31.5	34.4	28.7
Snout length	8.1	8.4	8.3	7.0
Body depth	50.0	46.7	45.2	42.4
Body width	20.3	17.4	39.5	15.9
Orbit diameter	10.0	10.3	10.5	8.7
Interorbital width	10.6	10.0	10.4	9.7
Caudal peduncle depth	14.5	14.2	14.3	12.7
Caudal peduncle length	17.6	18.5	19.7	1.2
Upper jaw length	10.4	9.9	10.2	7.8
Pre-dorsal-fin length	37.4	38.6	36.1	39.5
Spinous dorsal fin base length	44.5	45.5	43.6	45.2
Soft-rayed dorsal fin base length	16.9	14.7	15.3	13.1
1st dorsal fin spine length	9.2	9.5	11.0	7.3
2nd dorsal fin spine length	13.0	15.6	14.0	11.0
3rd dorsal fin spine length	15.1	17.1	17.1	13.9
5th dorsal fin spine length	16.5	17.1	16.6	15.5
7th dorsal fin spine length	15.6	16.1	16.7	15.1
Last dorsal fin spine length	14.4	14.7	14.7	12.2
1st dorsal fin soft ray length	14.7	16.4	16.0	—
Longest dorsal fin soft ray length	24.1	27.1	22.6	21.7
Last dorsal fin soft ray length	8.1	6.8	8.2	7.7
Pre-anal-fin length	60.0	61.3	63.4	61.2
Anal fin base length	18.8	20.4	19.8	19.5
1st anal fin spine length	6.3	6.7	8.2	6.6
2nd anal fin spine length	17.2	—	18.8	18.8
1st anal fin soft ray length	17.9	19.0	17.8	18.2
Longest anal fin soft ray length	19.1	—	18.2	18.2
Last anal fin soft ray length	6.1	7.7	8.1	8.3
Caudal fin length	36.0	38.7	—	—
Caudal concavity	17.0	17.1	—	—
Pectoral fin length	32.7	33.6	28.8	27.5
Pre-pelvic-fin length	40.3	43.8	45.8	41.7
Pelvic fin spine length	16.2	16.4	15.4	15.9
1st pelvic fin soft ray length	31.6	30.2	26.0	24.5
Last pelvic fin soft ray length	11.2	13.0	12.0	11.9
Basal width of pelvic fin axillary scale	—	1.6	1.9	2.2
Basal width of scale between pelvic fin bases	3.3	2.6	2.8	2.7

I. 34910, 113.8 mm SL, KAUM-I. 34911, 102.8 mm SL, Togashiohama, Oga, 16 October 2010, spear, S. Chiba. **YAMAGATA:** KAUM-I. 26534, 97.7 mm SL, Tobi-shima island, Sakata, 39°12'N, 139°30'E, 1996, 0–30 m depth, H. Motomura; KAUM-I. 31026, 34.0 mm SL, KAUM-I. 31027, 38.3 mm SL, KAUM-I. 31032, 39.4 mm SL, KAUM-I. 31033, 34.0 mm SL, KAUM-I. 31037, 37.6 mm SL, KAUM-I. 31038, 36.9 mm SL, KAUM-I. 31039, 38.1 mm SL, KAUM-I. 31040, 35.7 mm SL, 13 October 1996, H. Ida; NSMT-P 73365, 2 specimens, 82.9–84.5 mm SL, Tobi-shima island, 7–8 November 1936; NSMT-P 73464, 103.5 mm SL, Tobi-shima island, August 1936, H. Umemoto. **NIIGATA:** FAKU 86796, 107.7 mm SL, FAKU 86797, 96.0 mm SL, FAKU 86798, 105.8 mm SL, FAKU 86799, 102.4 mm SL, Tsutsuishi Fishing Port, Itoigawa, 6 June 2003; HUMZ 78484, 94.8 mm SL, Mano Bay, Sado Island, 25 November 1978. **ISHIKAWA:** KAUM-I. 31042, 56.7 mm SL, KAUM-I. 31043, 54.1 mm SL, KAUM-I. 31044, 61.0 mm SL, KAUM-I. 31045, 60.4 mm SL, Kanazawa, 14 October 1982, H. Ida. **KYOTO:** FAKU 60946, 83.4 mm SL, FAKU 60948, 86.2 mm SL, FAKU 60957, 92.3 mm SL, FAKU 90959, 85.6 mm SL, Wakasa Bay, 10 October 1994; FAKU 131446, 3 of 5 specimens, 89.3–92.1 mm SL, Mio, Kami, 11 July 1997, Hyogo Prefectural Fisheries Experiment Station; FAKU W 374, 78.5 mm SL, Nishi-maizuru Fish Market, 25 August 1978, I. Nakamura. **HYOGO:** OMNH-P 4332, 77.1 mm SL, Imagoura, Kasumi, Kinosaki, 22 July 1990, spear, H. Setoguchi; OMNH-P 7933, 20.4 mm SL, Oura, Takano, Kinosaki, 3 September 1994, hand net, T. Suzuki; OMNH-P 8098, 94.8 mm SL, Moroyose Fishing Port, Moroyose, Hamasaka, Mikata, 7 February 1996, set net, Uwa Fish Store. **SHIMANE:** FAKU 38334, 50.3 mm SL, FAKU 38349, 77.1 mm SL, FAKU 38350, 77.2 mm SL, FAKU 38351, 70.8 mm SL, FAKU 38484, 84.4 mm SL, FAKU 38485, 86.7 mm SL, FAKU 38487, 81.6 mm SL, Oki Islands, 1950s; KAUM-I. 31041, 97.6 mm SL, Oki-no-shima island, 23 July 1972, H. Ida. **YAMAGUCHI:** HMNH-P 5397, 71.9 mm SL, Susa Fishing Port, Susa, Hagi, 1 August 2002.

**SETO INLAND SEA plus EAST CHINA SEA (82 specimens, 33.7–110.5 mm SL).** **OSAKA:** OMNH-P 13704, 57.7 mm SL, Fuke Fishing Port, Fuke, Sennan-misaki, 4 November 1998, H. Ariyama. **WAKAYAMA:** KAUM-I. 28397, 84.7 mm SL, off Osaki Fishing Port, Shimotsu, Kainan, 34°08'01"N, 135°07'55"E, 6 November 2009, line-fishing, M. Hanano and Y. Yamana; OMNH-P 9601, 81.2 mm SL, Oi, Miyazaki, Arida, 8 June 1975, T. Kawasaki; OMNH-P 10512, 76.0 mm SL, OMNH-P 10513, 67.2 mm SL, OMNH-P 10514, 74.3 mm SL, Hama, Hatsushima, Arida, 29 August 1975, T. Kawasaki; OMNH-P 26833, 83.2 mm SL, Kada, 29 October 1961, K. Hatooka; OMNH-P 26834, 79.0 mm SL, OMNH-P 26835, 74.2 mm SL, Kada, 4 November 2004, K. Hatooka. **HYOGO:** OMNH-P 13800, 93.6 mm SL, OMNH-P 13801, 92.4 mm SL, Anaga Fishing Port, Anaga, Minami-awaji, 4 November 1999, line-fishing, K. Hatooka. **OKAYAMA:** HUMZ 44820, 85.0 mm SL, Seto, Oda. **HIROSHIMA:** HMNH-P 3671, 76.2 mm, HMNH-P 3672, 77.1 mm SL, HMNH-P 3673, 49.9 mm SL, Ta-shima island, Utsumi, Fukuyama, 15 September 2001; HUMZ 70681,

74.6 mm SL, off Onomichi, August 1930. **YAMAGUCHI:** HMNH-P 9839, 69.3 mm SL, HMNH-P 9840, 72.7 mm SL, Murotsu Fishing Port, Murotsu, Kaminoseki, 8 December 2006. **KAGAWA:** BSKU 65511, 79.5 mm, BSKU 65512, 88.9 mm, BSKU 65569, 73.9 mm SL, BSKU 65570, 75.6 mm SL, BSKU 65571, 76.8 mm SL, BSKU 65572, 84.9 mm SL, BSKU 65573, 83.7 mm SL, BSKU 65574, 83.2 mm SL, BSKU 65581, 85.1 mm SL, BSKU 65582, 82.4 mm SL, BSKU 65583, 78.6 mm SL, BSKU 65584, 75.4 mm SL, BSKU 65585, 75.4 mm SL, No Fishing Port, Sakaide, line-fishing, 26 June, 2003; **TOKUSHIMA:** BSKU 4944, 80.9 mm SL, Tachibana, 24 October 1955; BSKU 4946, 89.6 mm SL, Tachibana, 24 October 1955. **EHIME:** BSKU 38835, 97.3 mm SL, BSKU 38836, 99.7 mm SL, BSKU 38838, 92.7 mm SL, Yahatahama, 6 August 1983; BSKU 39015, 92.8 mm SL, Yahatahama, 8 August 1983; OMNH-P 11229, 92.4 mm SL, OMNH-P 11230, 91.0 mm SL, OMNH-P 11231, 81.6 mm SL, OMNH-P 11232, 76.8 mm SL, Okuura, Yoshida, Uwajima, 23 December 1997, line-fishing, K. Hatooka; OMNH-P 14077, 2 specimens, 82.0–86.9 mm SL, Sakashizu, Uwajima, 11 July 2001, net, Uwajima Fisheries High School; OMNH-P 14107, 2 specimens, 91.6–107.4 mm Uwajima Bay, 31 October 2000, line-fishing. **OITA:** KAUM-I. 32287, 74.3 mm SL, KAUM-I. 32288, 80.5 mm SL, KAUM-I. 32289, 85.6 mm SL, Hiji, Beppu, 33°21'N, 131°32'E, 28 July 2010, 3 m depth, line-fishing, S. Torigoe and H. Iwatsubo. **NAGASAKI:** BSKU 9863, 82.0 mm SL, Goto Islands, 1955; FAKU S 122, 101.8 mm SL, FAKU S 123, 100.1 mm SL, Shikoe, Tsushima, 1973; KAUM-I. 28139, 80.3 mm SL, Tachibana Bay, Ikanoura, 4 April 2010, line-fishing, M. Okamoto. **KUMAMOTO:** SNFR 12473, 4 specimens, 85.7–97.6 mm SL, Minamata, 23 March 1987. **KAGOSHIMA:** KAUM-I. 7576, 59.0 mm SL, east of Sakinoyama, Katura, Kasasa, Minami-satsuma, 31°25'44"N, 130°11'49"E, 24 February 2007, 27 m depth, set net, M. Ito; KAUM-I. 10753, 33.2 mm SL, Ohto Port, Kasasa, Minami-satsuma, 31°25'19"N, 130°10'27"E, 6 July 2008, 4–5 m depth, hand net, M. Ito; KAUM-I. 33715, 105.9 mm SL, off Ikara-jima island, Nagashima, Izumi, 32°13'N, 130°12'E, 20 October 2010, KAUM Fish Team; KAUM-I. 33770, 110.5 mm SL, Take-shima island, Nagashima, Izumi, 32°13'26"N, 130°10'51"E, 5–10 m depth, 24 October 2010, line-fishing, KAUM Fish Team; KAUM-I. 33801, 94.7 mm SL, KAUM-I. 33802, 95.3 mm SL, off Ikara-jima island, Nagashima, Izumi, 32°13'N, 130°12'E, 26 October 2010, KAUM Fish Team. **KOREA:** BSKU 101353, 89.0 mm SL, BSKU 101354, 108.4 mm SL, BSKU 101355, 110.0 mm SL, BSKU 101364, 108.4 mm SL, BSKU 101365, 110.0 mm SL, BSKU 101366, 104.2 mm SL, BSKU 101367, 97.3 mm SL, BSKU 101368, 93.1 mm SL, BSKU 101369, 69.5 mm SL, BSKU 103852, 93.6 mm SL, BSKU 103853, 84.4 mm SL, BSKU 103854, 98.4 mm SL, BSKU 103855, 100.5 mm SL, BSKU 103856, 94.3 mm SL, BSKU 103857, 96.3 mm SL, BSKU 103858, 104.9 mm SL, BSKU 103859, 94.6 mm SL, BSKU 103860, 102.5 mm SL, BSKU 103861, 102.3 mm SL, Jeju Market, Jeju Island, 5 August 2005, H. Endo.

**PACIFIC COAST OF JAPAN plus SOUTHERN CHINA (71 specimens, 26.7–122.3 mm SL).** **CHIBA:**



KAUM-I. 25873, 68.2 mm SL, off Tokyo University of Marine Science and Technology Field Science Center Tateyama Station, Banda, Tateyama, 34°58'37"N, 139°46'10"E, July 2009, 7 m depth, hand net, M. Watai; KPM-NI 21975, 26.7 mm SL, Banda, Tateyama, 4 October 2003, hand net, M. Honda; KPM-NI 25242, 92.6 mm SL, off Shiramazu, Chikura, Minamiboso, 23 m depth, 9 July 2009, H. Ishikawa. **KANAGAWA:** KPM-NI 2443, 103.0 mm, KPM-NI 2444, 105.8 mm SL, Hayakawa Fishing Port, Odawara, set net, 6 June 1996; KPM-NI 2555, 95.2 mm SL, Odawara Fish Market, Odawara, 6 June 1996, H. Senou; KPM-NI 2571, 100.6 mm SL, 22 June 1996; KPM-NI 2886, 103.8 mm SL, Odawara Fish Market, Odawara, 3 July 1996, H. Senou; KPM-NI 15137, 90.5 mm SL, KPM-NI 15769, 86.5 mm SL, Aburatsubo Bay, Koajiro, Misaki, Miura, 10 March 1996, Mochizuki *et al.*; KPM-NI 24878, 100.0 mm SL, off Enoshima island, Sagami Bay, Fujisawa, 20 m depth, 16 August 2009, H. Ishikawa. **SHIZUOKA:** KAUM-I. 31046, 90.5 mm SL, KAUM-I. 31047, 71.4 mm SL, Numazu, 4 January 1997, H. Ida; KPM-NI 13265, 81.1 mm SL, KPM-NI 13266, 99.4 mm SL, Heda Port, Heda, Tagata, 30 September 2003; NSMT-P 81233, 74.7 mm SL, Masaki breakwater, Shimizu Harbor, Miho Peninsula, 15 July 1982, gill net. **MI:** FAKU 24503, 98.9 mm SL, Washio, 25 October 1954, Y. Iwai; FRLM 2600, 110.7 mm SL, Wagu, Shima, 22 June 1980, S. Kimura *et al.*; FRLM 3052, 111.4 mm SL, Wagu, Shima, 31 May 1981, S. Kimura *et al.*; FRLM 3223, 95.5 mm SL, FRLM 3224, 99.5 mm SL, FRLM 3226, 106.8 mm SL, FRLM 3227, 102.5 mm SL, FRLM 3230, 97.7 mm SL, FRLM 3231, 96.0 mm SL, FRLM 3233, 103.4 mm SL, FRLM 3234, 110.2 mm SL, FRLM 3235, 86.0 mm SL, Wagu, Shima, 23 September 1981, S. Kimura *et al.*; FRLM 4085, 116.5 mm SL, Wagu, Shima, 31 July 1983, S. Kimura *et al.*; FRLM 4512, 98.1 mm SL, FRLM 4514, 83.7 mm SL, Ago Bay, Goza, Shima, 14 September 1984, S. Kimura *et al.*; FRLM 6669, 94.5 mm SL, Wagu, Shima, 8 September 1987, S. Kimura *et al.*; FRLM 6750, 69.1 mm SL, Wagu, Shima, 19 August 1987, S. Kimura *et al.*; FRLM 11050, 64.8 mm SL, Ago Bay, Goza, Shima, 29 June 1991, S. Kimura *et al.*; FRLM 20828, 42.8 mm, Shukutaso, Minami-ise, Watarai, 29 August 1997, S. Kimura *et al.* **KOCHI:** BSKU 56080, 122.3 mm SL, Okino-shima island, Sukumo, line-fishing, 9 July 2001; BSKU 7412, 83.1 mm SL, Kochi Fish Market, 16 August 1957; BSKU 3416, 74.2 mm SL, BSKU 3417, 72.3 mm SL, Mimase, 27 November 1953; BSKU 8559, 77.7 mm SL, BSKU 8560, 86.6 mm SL, Susaki, 7 July 1959; BSKU 52423, 93.4 mm SL, Kokadai, 16 April 1994; KSHS 8802, 80.6 mm SL, KSHS 8804, 97.9 mm SL, Kochi Central Fish Market, 4 November 1968; KSHS 18585, 96.9 mm SL, Sukumo Bay, Sukumo, 26 July 1979. **MIYAZAKI:** MUFS 30749, 99.1 mm SL, MUFS 30750, 96.8 mm SL, MUFS 30751, 94.3 mm SL, Iorigawa, Kadokawa, Higashiusuki, 14 September 2009. **CHINA:** CAS 55958, 5 specimens, 60.0–81.6 mm SL, CAS 55959, 11 specimens, 54.9–85.2 mm SL, Hong Kong, 27 February 1958, R. L. Bolin and D. Bromhall; KAUM-I. 31050, 91.9 mm SL, KAUM-I. 31051, 86.8 mm SL, KAUM-I. 31052, 86.9 mm SL, KAUM-I. 31053, 85.2 mm SL, KAUM-I. 31054, 84.8 mm SL, Cheung Chau Island, Hong Kong, 19 November 1995, H.

Ida. **TAIWAN:** USNM 14159, 87.9 mm SL, Soo Wan Bay, 3–9 m depth, 29 January 1910; USMN 270856, 85.8 mm SL, southwest of Yeh-liu, 25°12'N, 121°41'E, 8–11 m depth, 19 May 1968, V. Springer *et al.*

**IZU ISLANDS (5 specimens, 65.9–128.8 mm SL).** **TO-SHIMA ISLAND:** KPM-NI 25259, 128.8 mm SL, 35 m depth, 16 May 2009, Y. Ogawa. **MIYAKE-JIMA ISLAND:** KAUM-I. 31020, 88.3 mm SL, KAUM-I. 31021, 92.0 mm SL, 23 June 1972, H. Ida; KAUM-I. 31022, 122.4 mm SL, 25 July 1973; NSMT-P 30735, 65.9 mm SL, Igaya Bay, 30°06'N, 139°30'E, 22 September 1973.

**Diagnosis.** A species of *Chromis* with the following combination of characters: dorsal fin rays XIII–XIV, 11–14 (mode XIII, 13); anal fin rays II, 10–12 (11); pectoral fin rays 16–20 (19); principal caudal fin rays 15; spiniform caudal fin rays 2; scale rows in longitudinal series 23–28 (26); tubed lateral line scales 16–21 (17); scale rows above lateral line 4–5 (4), scale rows below lateral line 11–12 (11); gill rakers 7–10 (9)+19–24 (21)=27–33 (30); preopercular margin smooth; caudal fin deeply forked, without prolonged filaments; prominent black blotch covering upper two-thirds of pectoral fin base throughout life; indistinct white spot at end of dorsal fin base; caudal peduncle without distinct markings; broad dark band along each caudal fin lobe.

**Distribution.** *Chromis notata* is distributed only in East Asia, where it ranges from Akita Prefecture and southwards in the Sea of Japan, including southern Korea, from Chiba Prefecture to Kyushu along the Pacific coast of Japan, including the Izu Islands, and in southern China, including Taiwan and Hong Kong (Fig. 4). It does not occur in the Ryukyu Islands. Senou *et al.* (2006) reported *C. notata* from Ie-jima island, off Okinawa-jima island in the central Ryukyu Islands, on the basis of a single specimen (KPM-NI 4072). This specimen (35.6 mm SL, 15 m depth, 16 June 1997) is herein re-identified as *Chromis atripectoralis* Weiland and Schultz, 1951 (H. Senou, pers. comm.).

**Synonyms.** Bloch (1792) described *Perca japonica* as a new species on the basis of a single specimen from Japan. The dried holotype of *P. japonica* (ZMB 14630) has apparently been lost (Paepke 1999; this study). Bloch and Schneider (1801) proposed *Cichla macrolepidota* Bloch and Schneider, 1801 as a new replacement name for *P. japonica*, notwithstanding that *P. japonica* was an available name. However, *C. macrolepidota* is regarded here as an available name since it was described before 1931 (ICZN 1999: article 12.2.3); thus *C. macrolepidota* is a junior synonym of *P. japonica*. Although Paepke (1999) wrote, "*P. japonica* appears to be a senior synonym of *Chromis notatus*", examination of the original description of *P. japonica* and the drawing of the holotype (reproduced here as Fig. 5) showed that *P. japonica* differs from *C. notata* in having X, 10 dorsal fin rays, 8 anal fin soft rays, 3 scale rows above and 6 scale rows below the lateral line, and no black spot on the pectoral fin base or dark brown bands along the caudal fin lobes. Although the taxonomic status of *P. japonica* is still unknown, it is regarded here as a *nomen oblitum* because the name has never been used since its original description, except for Bloch and Schneider (1801) and Paepke (1999).

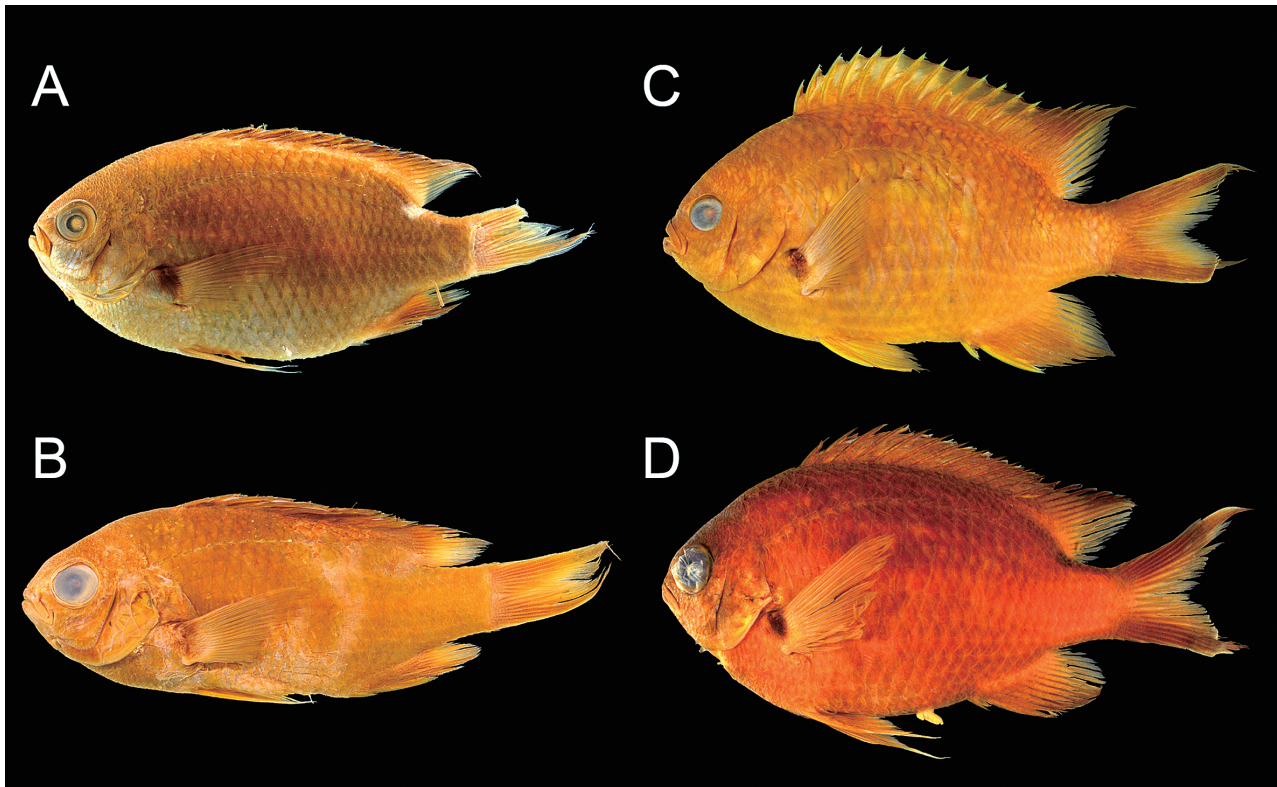


Fig. 2. Primary type specimens of nominal species regarded as *Chromis notata*. A, lectotype of *Heliases notatus* (RMNH.PISC. 895, 86.8 mm SL); B, holotype of *Chromis villadolidi* (FMNH 59185, 101.0 mm SL); C, holotype of *Chromis miyakeensis* (ZUMT 53957, 126.3 mm SL); D, holotype of *Chromis flavomaculatus* (BSKU 8482, 84.8 mm SL).

Jordan and Tanaka (1927) described *Chromis villadolidi* as a new species on the basis of five specimens from the Sea of Japan between Tsushima Island and Fukuoka, off northern Kyushu. Aoyagi (1941), Kamohara (1960), and Randall *et al.* (1981) regarded *C. villadolidi* as a junior synonym of *C. notata*. Examination of the holotype (FMNH 59185, 101.0 mm SL; Fig. 2B) of *C. villadolidi* showed it to be identical with *C. notata*, the former having five scale rows above the lateral line, 11 scale rows below, and a black blotch restricted to the upper two-thirds of the pectoral fin base (Fig. 2; Table 1). Therefore, the taxonomic status of *C. villadolidi* as a synonym of *C. notata* is confirmed in this study.

*Chromis miyakeensis* was originally described by Moyer and Ida (1976) on the basis of eight specimens from Miyake-jima island in the Izu Islands off central Honshu, Japan. Subsequently, Randall *et al.* (1981) regarded *C. miyakeensis* as a subspecies of *C. notata*, and its subspecies status, *i.e.*, as *C. notata miyakeensis*, was recognized as well by Ida (1984) and Aonuma and Yoshino (1993, 2000, 2002). *Chromis notata miyakeensis* was supposedly characterized by a deeper body, compared with *C. notata notata* (Randall *et al.* 1981; Aonuma and Yoshino 1993, 2000, 2002), but our examination of a large series of specimens of *C. notata* showed that body depth varies geographically (see 'Geographic variation of *Chromis notata*' below). The range of the body depths of specimens from Miyake-jima island (45.8–52.3% of SL), including the holotype of *C. miyakeensis* (50.4%; Fig. 2C), was almost within that of *C. notata* from other localities (37.8–51.5%; Tables 1, 2; Figs 6, 7). Thus, *C.*

*miyakeensis* is herein regarded as a junior synonym of *C. notata*. The synonymy of *C. flavomaculata* is discussed below (see 'Remarks' on *C. kennensis*).

**Geographic variation of *Chromis notata*.** Examination of a large series of specimens of *C. notata* from a wide area of East Asia showed it to have three morphologically distinct populations, *viz.*, in the Sea of Japan, in the Seto Inland Sea plus East China Sea, and along the Pacific coast of Japan plus southern China (Figs 3, 4, 6, 7; Table 2). The population of the Sea of Japan tends to have a shallower body depth (mean 44.0% of SL), a narrower body width (17.2%), and a shallower caudal peduncle depth (14.1%) than the population of the Pacific coast of Japan plus southern China (48.0%, 19.5%, and 14.8%, respectively; Figs 3, 6; Table 2). In addition, the dorsal fin spines of the former population tend to be longer (mean length of first spine 9.9% of SL) than those of the latter (9.1%) (Fig. 7; Table 2). The population of the Seto Inland Sea plus East China Sea has intermediate values of these morphometrics [*e.g.*, body depth 41.1–50.7% of SL (mean 45.5%), body width 15.4–23.4% (18.2%), and caudal peduncle depth 13.3–15.9 (14.4%); Figs 3, 6, 7; Table 2]. Despite these slight morphometric differences among the three populations, there are no differences in meristics, coloration, or other morphological features among them (Fig. 3; Tables 2, 3). Thus, the three are herein regarded as examples of geographic variation of a single species.

Specimens from the Izu Islands, including the holotype of *C. miyakeensis*, tend to have a relatively deep body and caudal peduncle, wide body width, and long dorsal fin spines



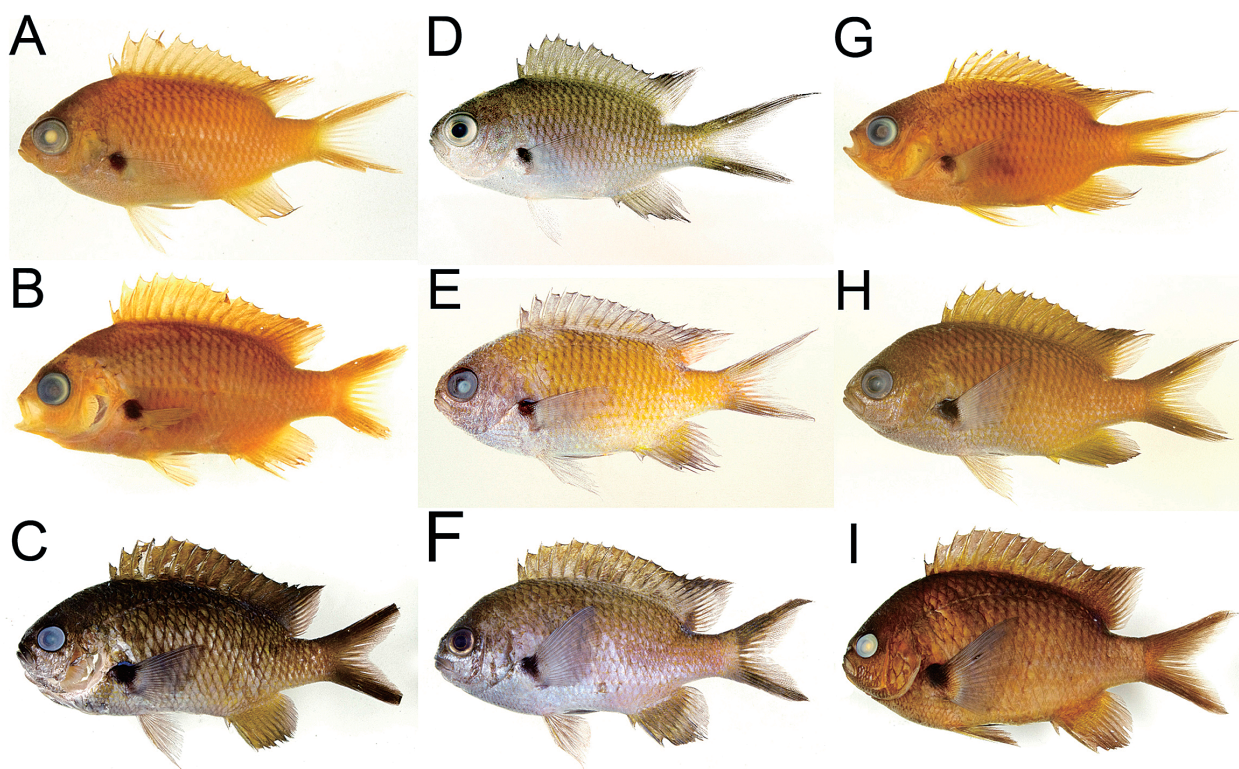


Fig. 3. Juveniles to adults of *Chromis notata* from different localities. A–C, specimens from the Sea of Japan (A, KAUM-I. 31033, 34.0 mm SL; B, KAUM-I. 31045, 60.4 mm SL; C, KAUM-I. 34910, 113.8 mm SL). D–F, specimens from the Seto Inland Sea and East China Sea (D, KAUM-I. 10753, 33.7 mm SL; E, KAUM-I. 7576, 59.0 mm SL; F, KAUM-I. 33715, 104.5 mm SL). G–I, specimens from the Pacific coast of Japan and southern China (G, KPM-NI 21975, 26.7 mm SL; H, KAUM-I. 25873, 68.2 mm SL; I, KPM-NI 25259, 122.3 mm SL).

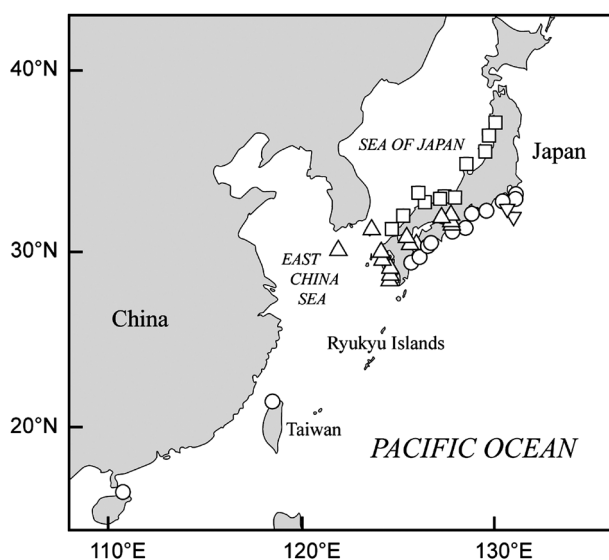


Fig. 4. Distributional records of *Chromis notata* on the basis of specimens examined in this study: populations of the Sea of Japan ( $\square$ ), the Seto Inland Sea plus East China Sea ( $\triangle$ ), the Pacific coast of Japan plus southern China ( $\circ$ ), and the Izu Islands ( $\nabla$ ). Some symbols include more than one specimen.

(Table 2), but these values are almost within those of the population of the Pacific coast of Japan plus southern China (Figs 6, 7; Table 2). This further supports our contention that *C. miyakeensis*, which was characterized only by having

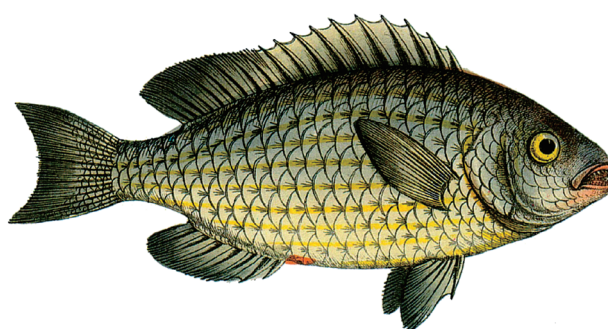


Fig. 5. Reproduction of original painting of *Perca japonica* (from Bloch 1792: pl. 311, fig. 1).

a deeper body, is identical to *C. notata*.

#### *Chromis kennensis* Whitley, 1964

[Australian English name: Yellow-spotted Chromis]

(Figs 8, 9, 11, 12E; Tables 3–4)

*Chromis kennensis* Whitley, 1964: 182, Fig. 12 (type locality: Kenn Reef, Coral Sea); Allen 1975: 81, 83, unnumbered fig. (Kenn Reef, Coral Sea; Lord Howe Island; Sydney, Australia; Ouvea Island, Loyalty Islands, New Caledonia). *Chromis flavomaculata* (not of Kamohara): Allen 1991: 68 (Ouvea Island, Loyalty Islands, New Caledonia; Lord Howe Island; Coral Sea; eastern Australia between south-

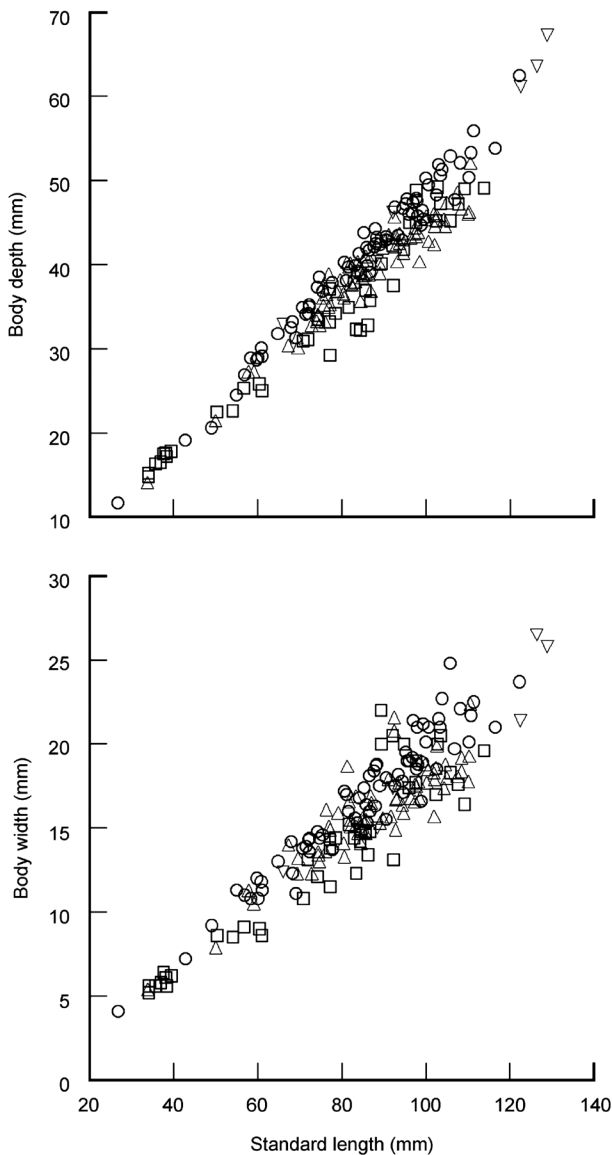


Fig. 6. Relationships of (A) body depth and (B) body width to standard length in *Chromis notata* populations of the Sea of Japan (□), the Seto Inland Sea plus East China Sea (△), the Pacific coast of Japan plus southern China (○), and the Izu Islands (▽).

ern Great Barrier Reef and Sydney); Kuiter 1993: 237, unnumbered fig. (Coral Sea to Montague Island; Lord Howe Island); Randall *et al.* 1997: 258, unnumbered fig. (Coral Sea; Lord Howe Island; New Caledonia); Randall 2005: 357, unnumbered fig. (southern Great Barrier Reef to New South Wales; Lord Howe Island; Norfolk Island; New Caledonia); Allen *et al.* 2006: 1449, (Lord Howe Island; Great Barrier Reef, Queensland to Montague Island, New South Wales, Australia); Kuiter and Debelius 2006: 530, unnumbered fig. (Australia); Kato 2011b: 58 (Great Barrier Reef; New Caledonia; Tonga); Allen *et al.* 2012: 80 (eastern Australia and Coral Sea); Allen and Erdmann 2012: 580 (eastern Australia; Coral Sea; New Caledonia; northern tip of New Zealand).

**Holotype.** AMS IB. 4973, 77.6 mm SL, Kenn Reef, Coral Sea, D. McMichael.

**Non-type material examined.** 23 specimens, 22.5–93.0 mm SL—**AUSTRALIA:** AMS I. 17357-023, 43.0 mm SL, off Phillip Point, Lord Howe Island, New South Wales, 31°05'S, 159°01'E, G. Allen *et al.*; AMS I. 17376-008, 4 specimens, 33.6–35.1 mm SL, Lord Howe Island, New South Wales, 31°50'S, 159°10'E, F. Talbot *et al.*; AMS I. 17380-006, 2 specimens, 22.5–23.8 mm SL, Lord Howe Island, New South Wales, 31°50'S, 159°10'E, AMS party; AMS I. 17737-001, 48.8 mm SL, Long Bay, Sydney, New South Wales, 33°07'S, 151°03'E, R. Kuiter; AMS I. 27139-024, 71.4 mm SL, Middleton Reef, Coral Sea, 29°48'67"S, 159°06'83"E, A. Gill *et al.*; AMS I. 27891-043, 2 specimens, 59.0–62.2 mm SL, Elizabeth Reef, Coral Sea, 29°09'S, 159°00'E, D. Williams *et al.*; BPBM 14766, 3 specimens, 30.0–33.0 mm SL, Lord Howe Island, New South Wales, 20–27 m depth, 6 February 1973, spear, J. Randall and G. Allen; BPBM 33664, 3 specimens, 79.0–82.0 mm SL, Coral Sea, 19°52'S, 158°19'E, 9 m depth, 24 August 1988, J. Randall *et al.* **NEW CALEDONIA:** BPBM 11438, 70.4 mm SL, 1 km northwest of Dumbae Pass, Nouméa, 15–18 m depth, J. Randall *et al.*; USNM 319941, 31.8 mm SL, Ouvea Island, Loyalty Islands, 20°39'30"S, 166°23'00"E, 18 m depth, 14 November 1991, J. Williams *et al.*; USNM 319942, 82.1 mm SL, Bagaat Islet, Ouvea Atoll, Loyalty Islands, 20°37'18"S, 166°16'08"E, 15–22 m depth, 16 November 1991, J. Williams, *et al.*; USNM 319943, 74.8 mm SL, Ouvea Island, Loyalty Islands, 20°34'12"S, 166°14'12"E, 5 m depth, 16 November 1991, J. Williams *et al.* **TONGA:** USNM 332432, 28.9 mm SL, Ha'atafu Beach, Tongatapu, 21°03'58"S, 175°20'03"W, 5.5–7.9 m depth, 21 October 1993, J. Williams, *et al.*

**Diagnosis.** A species of *Chromis* with the following combination of characters: dorsal fin rays XIII, 11–13 (mode XIII, 12); anal fin rays II, 10–12 (11); pectoral fin rays 17–21 (19); principal caudal fin rays 15; spiniform caudal fin rays 2; scale rows in longitudinal series 24–27 (26); tubed lateral line scales 15–19 (18); scale rows above lateral line 3, scale rows below lateral line 9–10 (9); gill rakers 7–9 (8) + 21–25 (24) = 29–34 (32); preopercular margin smooth; caudal fin deeply forked, without prolonged filaments; basal width of pelvic fin axillary scale 0.6–1.8% of SL; basal width of scale between pelvic fin bases 2.0–2.8% of SL; prominent black blotch covering entire pectoral fin base throughout life; no white spot at end of dorsal fin base; caudal peduncle without distinct markings; caudal fin yellowish with no dark band along each fin lobe.

**Distribution.** *Chromis kennensis* is known only from the southwestern Pacific Ocean: the Coral Sea (Ken Reef, Middleton Reef, and Elizabeth Reef), Lord Howe Island, eastern Australia (Sydney), New Caledonia (Ouvea Island), and Tonga (Tongatapu) (Fig. 9).

**Remarks.** Kamohara (1960) described *Chromis flavomaculata* (as *flavomaculatus*) as a new species on the basis of a single specimen (BSKU 8482; Fig. 2D) from Kochi, Japan, while also listing an additional non-type specimen (BSKU 4944) of the species from Tokushima, Japan. Examination of the holotype and non-type specimen showed them to be identical with *C. notata* in having four scale rows above the lateral line and 12 scale rows below, a black blotch



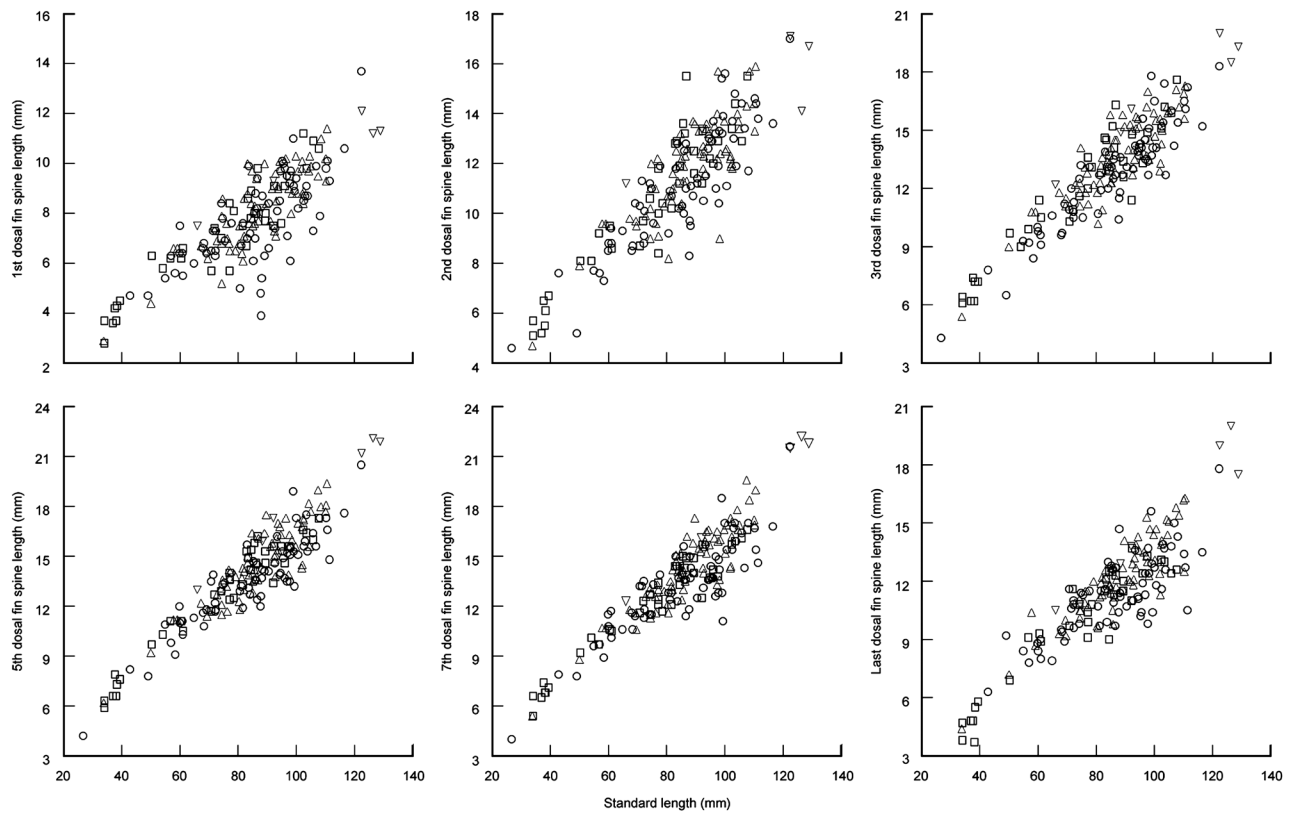


Fig. 7. Relationships of the dorsal fin spine lengths to standard length in *Chromis notata* populations. Symbols as in Fig. 6.

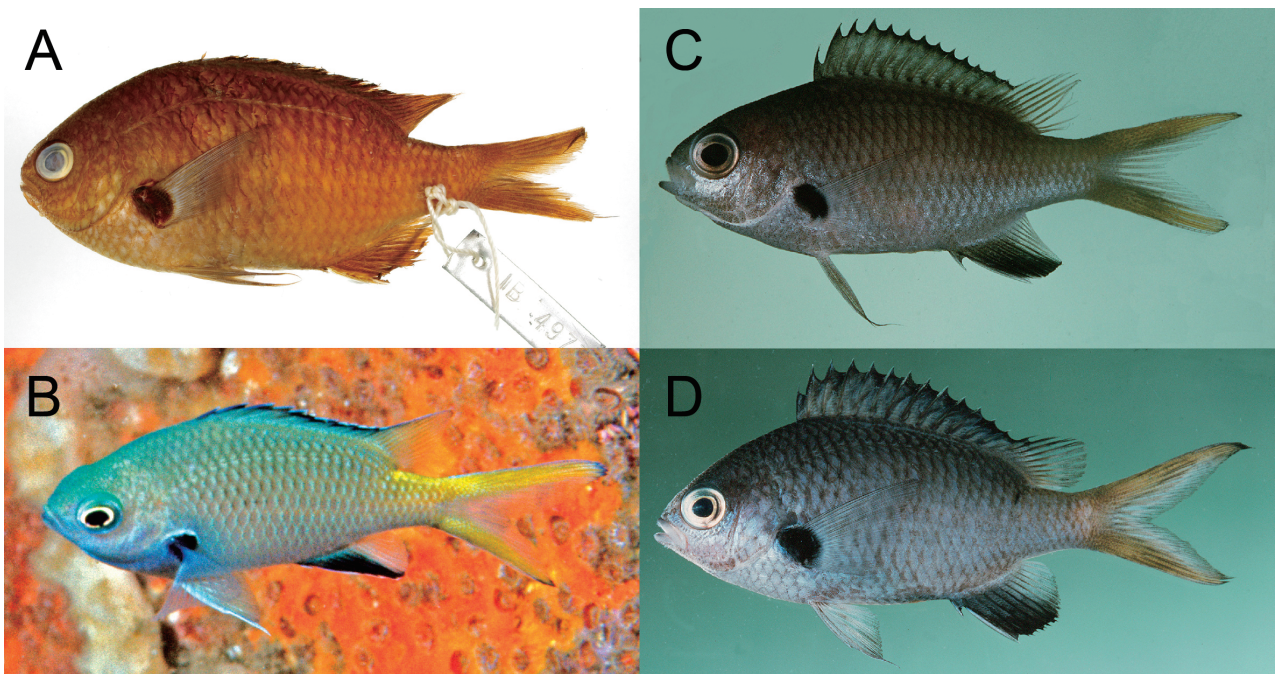


Fig. 8. Photographs of *Chromis kennensis*. A, AMS IB. 4973, holotype, 77.6 mm SL; B, juvenile, New South Wales, Australia (photo by R. Kuiter); C, BPBM 14766, juvenile, 31.6 mm SL, Lord Howe Island (photo by J. Randall); D, BPBM 11438, adult, 93.0 mm SL, New Caledonia (photo by J. Randall).



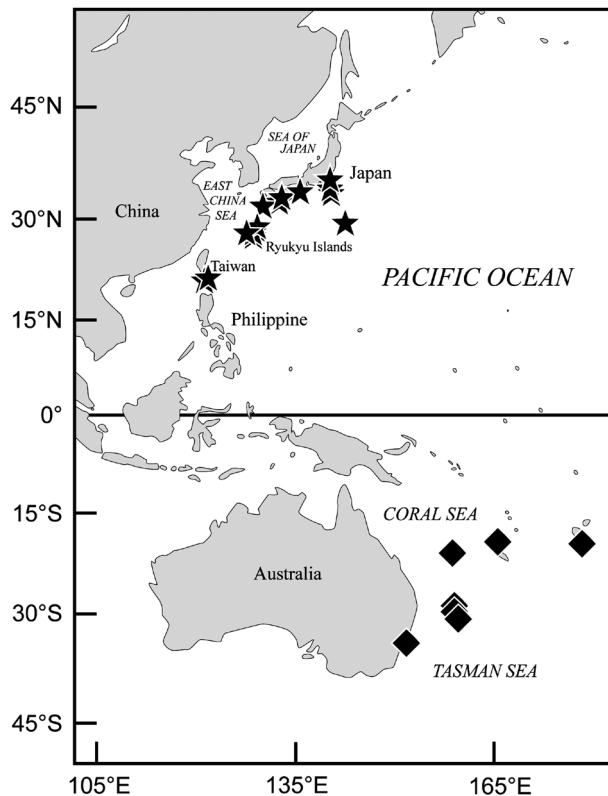


Fig. 9. Distributional records of *Chromis kennensis* (◆) and *C. yamakawai* sp. nov. (★) on the basis of specimens examined in this study. Some symbols include more than one specimen.

restricted to the upper two-thirds of the pectoral fin base, and black bands along the caudal fin lobes (Fig. 2; Tables 4, 5). Therefore, *C. flavomaculata* is herein regarded as a junior synonym of *C. notata*. In the same paper, Kamohara (1960) gave a description of two specimens of *C. notata*. These two specimens (BSKU 4946 and 8513) were examined and re-identified by us as *C. notata* and *C. yamakawai* sp. nov., respectively. Data for Kamohara's (1960) specimens are given in Table 5.

A species of *Chromis*, previously identified as *C. flavomaculata*, is herein regarded as comprising two geographically disjunct species: *C. yamakawai* sp. nov. from the northwestern Pacific Ocean and *C. kennensis* from the southwestern Pacific Ocean (Fig. 9). These two species can be distinguished from *C. notata* by having three scale rows above the lateral line and nine or 10 scale rows below (vs 4 or 5 and 11 or 12 in *C. notata*; Tables 1–5), a black blotch covering the entire pectoral fin base in adults (vs restricted to the upper two-thirds of the pectoral fin base), and a yellow caudal fin without black bands (vs a grayish caudal fin with black bands along the lobes) (Figs 3, 8, 10).

*Chromis kennensis*, previously regarded as a junior synonym of *C. flavomaculata* (e.g., Randall *et al.* 1997; Randall 2005; Allen *et al.* 2006), differs from *C. yamakawai* sp. nov. in coloration, meristics, and morphometrics. In young specimens, the dark blotch at the base of the pectoral fin is relatively large in *C. kennensis*, covering the entire fin base, whereas that of *C. yamakawai* is small, covering only the

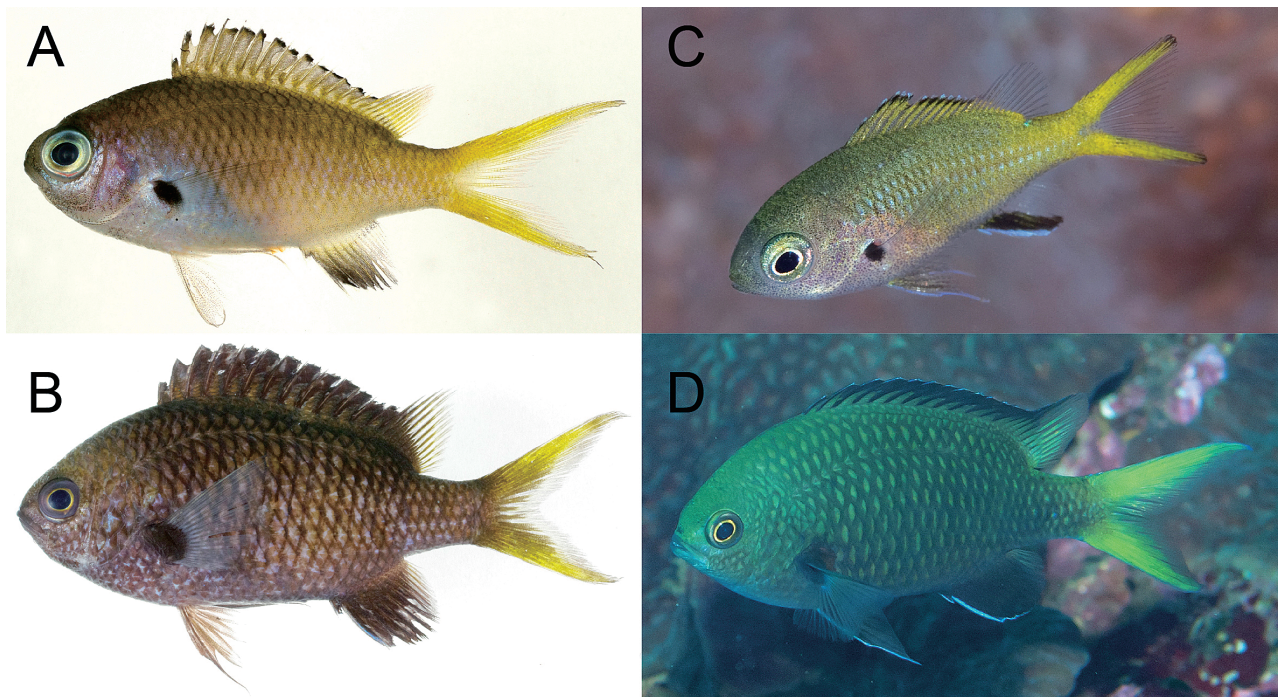


Fig. 10. Photographs of *Chromis yamakawai* sp. nov. A, KAUM-I. 40100, juvenile, 31.9 mm SL, Iou-jima island, Kagoshima, Japan; B, NSMT-P 111948, holotype, 83.0 mm SL, Yoron-jima island, Kagoshima, Japan; C, juvenile, Hachijo-jima island, Izu Islands, Japan (photo by S. Kato); D, adult, Hachijo-jima island, Izu Islands, Japan (photo by S. Kato).

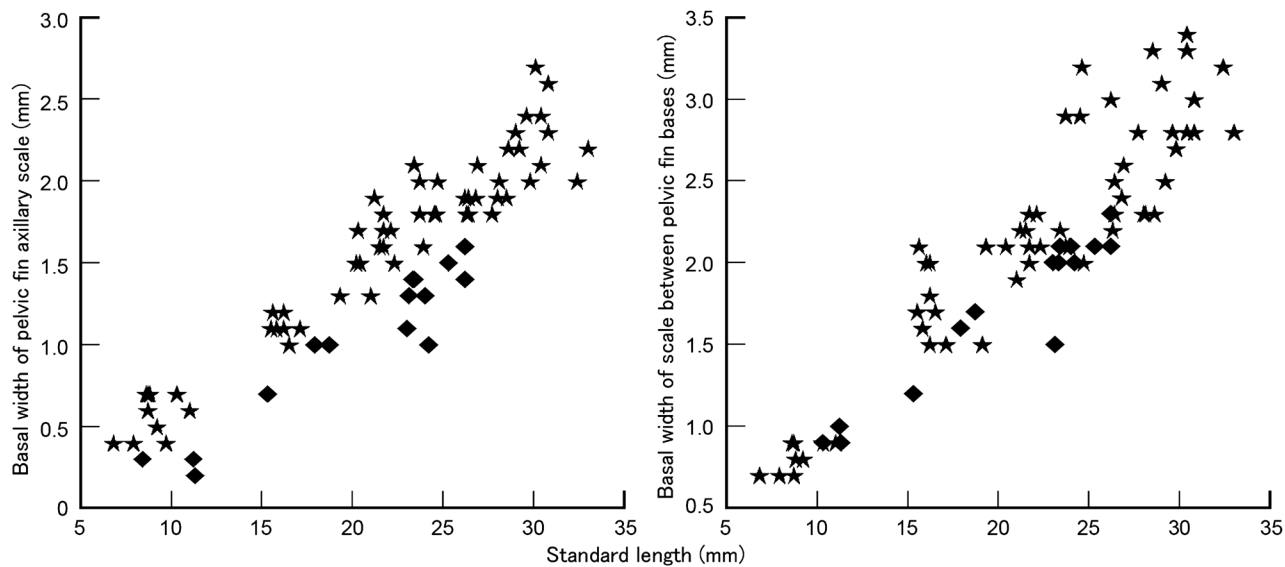


Fig. 11. Relationships of (A) basal width of pelvic fin axillary scale and (B) basal width of scale between bases of pelvic fins to standard length in *Chromis kennensis* (◆) and *C. yamakawai* sp. nov. (★).

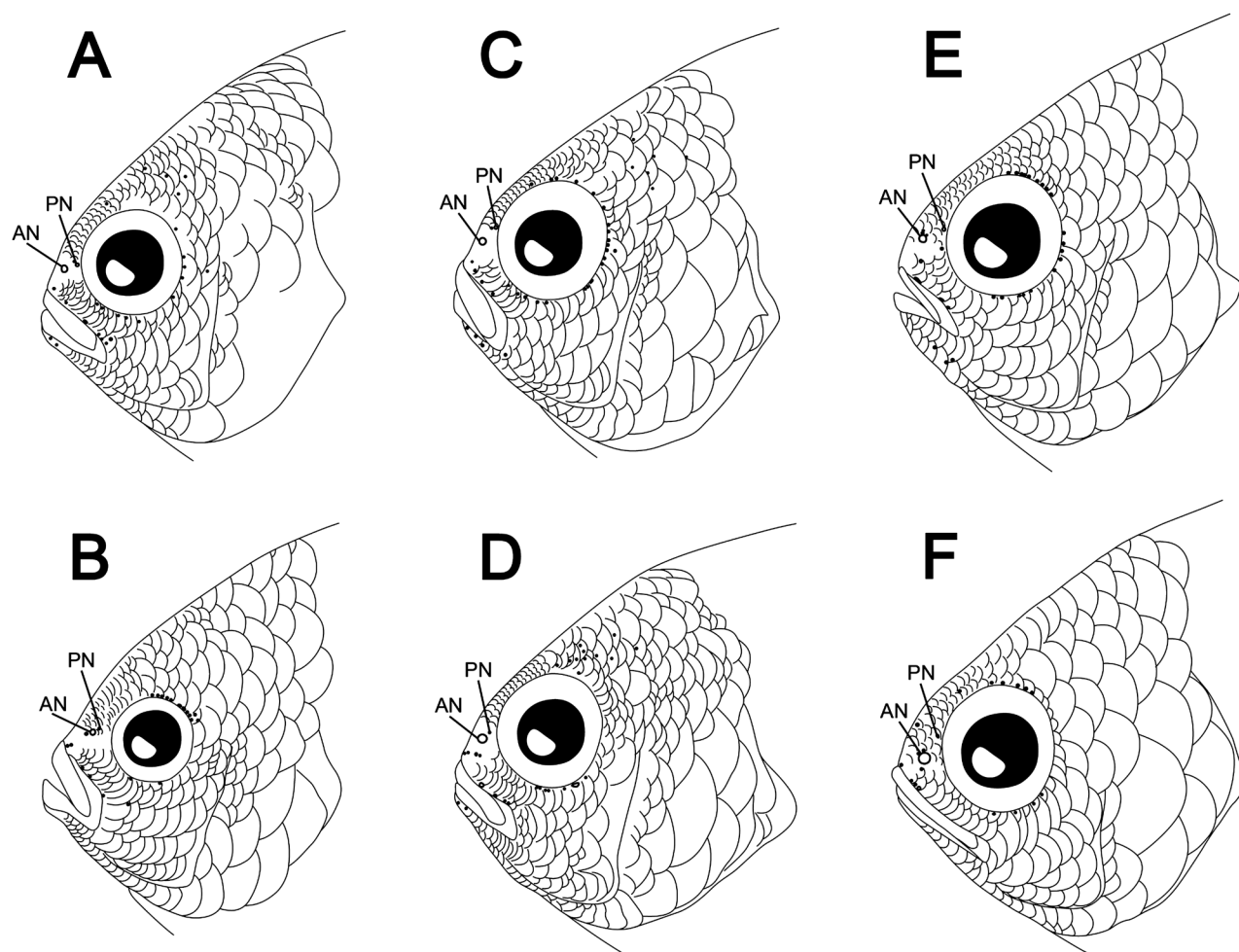


Fig. 12. Heads of three species of *Chromis*. A–D, *C. notata* (A, KAUM-I. 26534, 97.7 mm SL, Tobi-shima island, Yamagata, Japan; B, KAUM-I. 33715, 104.5 mm SL, Kagoshima, Japan; C, KPM-NI 24878, 100.0 mm SL, Enoshima island, Kanagawa, Japan; D, ZUMT 53957, 126.3 mm SL, Miyake-jima island, Izu Islands, Japan); E, *C. kennensis* (AMS IB. 4973, holotype, 77.6 mm SL, Kenn Reef, Coral Sea); F, *C. yamakawai* sp. nov. (NSMT-P 111948, holotype, 83.0 mm SL, Yoron-jima island, Kagoshima, Japan). AN, anterior nostril; PN, posterior nostril.

upper half of the fin base (the blotch becomes larger with growth in *C. yamakawai*) (Figs 8, 10). In meristics, *C. kennensis* differs slightly from *C. yamakawai* in having fewer tubed lateral line scales (15–19 vs 16–21 in *C. yamakawai*), and more gill rakers [21–25 (mode 24) lower gill rakers and 29–34 (32) total rakers vs 20–25 (23) and 27–33 (30), respectively] (Table 3). In morphometrics, the basal width of the pelvic fin axillary scale is 0.6–1.8% of SL (mean 1.5%) in *C. kennensis*, whereas that of *C. yamakawai* is 1.4–2.8% (2.2%) (Fig. 11; Table 4). The basal width of the scale between the pelvic fins in *C. kennensis* (2.0–2.8% of SL, mean 2.6%) also tends to be less than that of *C. yamakawai* (2.2–3.9%, 3.0%) (Fig. 11; Table 4). Moreover, *C. yamakawai* grows larger than *C. kennensis* (largest recorded size 130.8 mm vs 93.0 mm SL).

*Chromis kennensis* and *C. yamakawai* are similar to *C. pura* Allen and Randall, 2004, which is known only from the Alor Islands, Indonesia, in overall body appearance and general coloration, but *C. pura* has a yellowish caudal peduncle, darker yellow fins, and a smaller black blotch at the base of the pectoral fin (Allen and Randall 2004: figs. 2, 3). *Chromis pura* also differs from the former two species in having fewer gill rakers (25–27 in *C. pura* vs 29–34 in *C. kennensis* and 27–33 in *C. yamakawai*).

***Chromis yamakawai* sp. nov.**

[Standard Japanese name: Kihoshi-suzumedai]

[New English name: Northern Yellow-spotted Chromis]

(Figs 9–11, 12F; Tables 3–5)

*Chromis notatus* (not of Temminck and Schlegel): Aoyagi 1941: 181, fig. 11 (southern part of Japan); Kamohara 1960: 4 (Kochi, Japan).

*Chromis* sp.: Masuda *et al.* 1975: 96, 285, fig. E on p. 96 (southern Japan, including Ryukyu and Ogasawara islands).

*Chromis flavomaculatus* (not of Kamohara): Masuda *et al.* 1980: 96, 285, fig. E on p. 96 (southern Japan, including Ryukyu and Ogasawara Islands); Ida 1984: 192, pl. 185, fig. F (central Japan to Taiwan).

*Chromis flavomaculata* (not of Kamohara): Araga *et al.* 1985: 148, unnumbered fig. (Izu Peninsula and southwards along Pacific coast of Japan; Taiwan); Allen 1991: 68, unnumbered fig. (southern Japan, including Ryukyu Islands; Taiwan); Aonuma and Yoshino 1993: 809, unnumbered fig. (Ogasawara Islands, Izu Peninsula and southwards along Pacific coast of Japan; Taiwan); Masuda and Kobayashi 1994: 221, fig. 5 on p. 221 (southern Japan); Randall *et al.* 1997: 258 (Japan to Taiwan); Aonuma and Yoshino 2000: 925, unnumbered fig. (Ogasawara Islands, Izu Peninsula and southwards along Pacific coast of Japan; Taiwan); Randall 2005: 357 (southern Japan); Kuitert and Debelius 2006: 530, unnumbered fig. (Japan); Konishi 2007: 238, unnumbered fig. (Izu, Ogasawara, and Ryukyu islands, Japan; Taiwan); Yoshino and Senou 2008: 264, unnumbered figs

(Pacific coast of southern Japan; Hachijo-jima island, Izu Islands; Ryukyu and Ogasawara islands; Taiwan); Araga 2009: 440 (Ogasawara Islands, Izu Peninsula and southwards along Pacific coast of Japan; Taiwan); Motomura *et al.* 2010: 149 (Yaku-shima island, Kagoshima, Japan); Kato 2011a: 150, unnumbered figs (southern Japan; Hachijo-jima island; Ryukyu Islands; Ogasawara Islands; Taiwan); Kato 2011b: 58, unnumbered figs (Hachijo-jima island, Izu Islands; Taiwan); Allen *et al.* 2012: 80, unnumbered fig. (southwestern Japan to Philippines); Allen and Erdmann 2012: 580, unnumbered fig. (southern Japan, including Ryukyu Islands; Taiwan; northern Philippines).

**Holotype.** NSMT-P 111948 (formerly KAUM-I. 40160), 83.0 mm SL, off west coast of Yoron-jima island, Kagoshima, Japan, 27°03'21"N, 128°24'39"E, 10 m depth, 15 August 2011, drive fishing, H. Motomura, M. Yamashita, T. Yoshida, H. Nishiyama, and H. Iwatsubo.

**Paratypes.** 114 specimens, 18.2–130.8 mm SL—**JAPAN:** BPBM 6880, 92.2 mm SL, Ishigaki-jima island, Okinawa, May 1968, spear, J. Randall; BPBM 11989, 68.4 mm SL, Ishigaki-jima island, Okinawa, 22 May 1968, J. Randall and A. Banner; BPBM 35316, 53.5 mm SL, Tatsumi Bay, Chichi-jima island, Ogasawara Islands, 26 m depth, 7 June 1992, J. Randall and R. Pyle; BPBM 19073, 2 specimens, 68.4–92.2 mm SL, southeast coast of Sesoko Island, Okinawa, 26 May 1975, spear, J. Randall; BSKU 8513, 11.3 mm SL, Okino-shima island, Sukumo, Kochi, 8 June 1959; BSKU 65128, 114.2 mm SL, BSKU 65129, 120.0 mm SL, BSKU 65130, 109.3 mm SL, BSKU 69938, 130.8 mm SL, Okino-shima island, Sukumo, Kochi, line-fishing, 22 August 2002; FAKU 104285, 69.7 mm SL, FAKU 104420, 67.9 mm SL, Ankyaba, Amami-oshima island, 24 December 1958, T. Mashima; FAKU 61749, 90.7 mm SL, FAKU 61753, 88.7 mm SL, Shirahama, Wakayama, 1981–1982; FAKU 121418, 102.6 mm SL, Shirahama, Wakayama, 1984–1985; FRLM 10757, 77.6 mm SL, Naha, Okinawa, 17 May 1990, S. Kimura *et al.*; HMNH-P 3118, 80.9 mm SL, Okinawa, 17 August 2001; HMNH-P 3505, 26.4 mm SL, Seragaki, Onna, Okinawa, 18 August 2001; HMNH-P 4286, 97.9 mm SL, Manzano, Onna, Okinawa, 1 January 2002; HMNH-P 7485, 108.0 mm SL, HMNH-P 7486, 89.6 mm, Okinawa, 27 December 2003, Okinawa Federation of Fisheries Cooperatives; HUMZ 3455, 82.8 mm SL, HUMZ 3456, 73.3 mm SL, Okinawa; HUMZ 3457, 85.1 mm SL, Okinawa; HUMZ 3461, 79.0 mm SL, Okinawa; HUMZ 39070, 72.9 mm SL, Chinen, Okinawa, 6 March 1974; HUMZ 46754, 66.3 mm SL, HUMZ 46758, 66.6 mm SL, Naha Fish Market, Naha, Okinawa, 29 October 1975; HUMZ 48235, 76.4 mm SL, Naha, Okinawa, 13 April 1973; HUMZ 48567, 85.8 mm SL, Naha, Okinawa, 13 April 1973; HUMZ 48579, 83.0 mm SL, Naha, Okinawa, 13 April 1973; KAUM-I. 7211, 96.0 mm SL, KAUM-I. 7212, 103.0 mm SL, off Kakeroma-jima island, Setouchi, Amami Islands, Kagoshima, 13 November 2007, net, FV *Uehara-maru*; KAUM-I. 29581, 18.2 mm SL, off west coast of Iou-jima island, Mishima, Kagoshima, 30°15'42"N, 130°15'42"E, 5–20 m depth, 28 May 2010, hand net, KAUM Fish Team; KAUM-I. 31023, 96.3 mm SL, KAUM-I. 31024,



106.6 mm SL, KAUM-I. 31025, 104.4 mm SL, Miyake-jima island, 25 July 1973, H. Ida; KAUM-I. 40099, 26.2 mm SL, KAUM-I. 40100, 31.9 mm SL, KAUM-I. 40101, 26.8 mm SL, off southwest coast of Yoron-jima island, Kagoshima, 27°01'48"N, 128°24'37"E, 2–3 m depth, drive fishing, 14 August 2011, H. Motomura *et al.*; KAUM-I. 40161, 81.7 mm SL, KAUM-I. 40162, 86.4 mm SL, KAUM-I. 40163, 79.5 mm SL, KAUM-I. 40170, 91.8 mm SL, KAUM-I. 40175, 91.0 mm SL, KAUM-I. 40177, 95.3 mm SL, KAUM-I. 40178, 95.8 mm SL, KAUM-I. 40181, 50.5 mm SL, KAUM-I. 40183, 91.5 mm SL, KAUM-I. 40186, 96.1 mm SL, KAUM-I. 40194, 92.8 mm SL, KAUM-I. 40198, 80.5 mm SL, KAUM-I. 40213, 52.4 mm SL, KAUM-I. 40214, 55.2 mm SL, KAUM-I. 40216, 54.9 mm SL, KAUM-I. 40217, 54.6 mm SL, KAUM-I. 40129, 53.9 mm SL, KAUM-I. 40221, 53.7 mm SL, same data as holotype; KPM-NI 4686, 95.1 mm SL, KPM-NI 4687, 77.8 mm SL, Ishigaki-jima island, Okinawa, net, March 1998; KPM-NI 5065, 26.4 mm SL, KPM-NI 5105, 91.2 mm SL, KPM-NI 5106, 89.3 mm SL, Ie-jima island, Okinawa, 4 m depth, hand net, 19 June 1998, T. Nomura; KPM-NI 17973, 121.9 mm SL, Gunkan Dike, Kaminato Port, Kaminatohigashi, Hachijo-jima island, Tokyo, line-fishing, 16 August 2000, Y. Miyazaki; KPM-NI 18542, 112.7 mm SL, Futami Port, Chichi-jima island, Ogasawara Islands, Tokyo, line-fishing, 12 December 2006, Y. Miyazaki; KSHS 15340, 82.7 mm SL, KSHS 15341, 78.0 mm SL, Okinawa-jima island, March–April 1974; KSHS 16983, 85.3 mm SL, KSHS 16984, 85.6 mm SL, KSHS 16985, 77.9 mm SL, KSHS 16986, 79.2 mm SL, Naha Fish Market, Naha, Okinawa, 5 November 1975; NSMT-P 3246–004, 98.0 mm SL, Amami-oshima island, 21 November 1957; NSMT-P 29624, 77.2 mm SL, Miyako-jima island, Okinawa, 20 m depth, net, 21 July 1988, H. Senou and M. Aizawa; NSMT-P 30613, 55.4 mm SL, Igaya Bay, Miyake-jima island, Izu Islands, 34°06'N, 139°30'E, 17 November 1974; NSMT-P 30742, 67.6 mm SL, Igaya Bay, Miyake-jima island, Izu Islands, 34°06'N, 139°30'E, 19 November 1974; NSMT-P 30811, 79.2 mm SL, NSMT-P 30812, 76.5 mm SL, Igaya Bay, Miyake-jima island, Izu Islands, 30°06'N, 139°30'E, 10 m depth, 21 December 1976; NSMT-P 32798, 32.9 mm SL, Miyanojima Bay, Chichi-jima island, Ogasawara Islands, 27°06'N, 142°15'E, hand net, 10 June 1990, J. Okuno; NSMT-P 90966, 103.9 mm SL, NSMT-P 90967, 109.1 mm SL, Futami Bay, Chichi-jima island, Ogasawara Islands, 12 December 2006, Y. Miyazaki; NSMT-P 92979, 2 specimens, 98.6–98.9 mm SL, Keise-jima island, Okinawa, 6 July 2003, T. Kon; NSMT-P 32810, 2 specimens, 18.9–23.4 mm SL, Kominato beach, Chichi-jima Island, Ogasawara Islands, 27°03'N, 142°11'E, 3 m depth, 12 June 1990, K. Matsuura; NSMT-P 105526, 25.3 mm SL, Sokaru, Amami-oshima island, Kagoshima, 8 m depth, 11 June 1991, K. Matsuura and M. Aizawa; URM-P 907, 69.1 mm SL, URM-P 908, 67.0 mm SL, URM-P 909, 68.4 mm SL, URM-P 910, 73.3 mm SL, URM-P 911, 70.7 mm SL, Okinawa Island; URM-P 1182, 94.7 mm SL, Tomari Fish Market, Naha, Okinawa, 10 December 1981; URM-P 4598, 97.2 mm SL, Ishigaki Port, Ishigaki-jima island, Okinawa, 6 September 1982, H. Masuda; URM-P 11761, 77.1 mm SL, Okinawa, 9 September 1985, Y. Aonuma; URM-P 22905, 89.2 mm

SL, off Tropical Biosphere Research Center Sesoko Station, University of the Ryukyus, Sesoko-jima island, Okinawa, 13 July 1977, T. Yoshino; URM-P 27135, 68.9 mm SL, Amami-oshima island, Kagoshima, 27 March 1992, Y. Sakurai *et al.*; URM-P 30301, 88.5 mm SL, Okinawa, 17 September 1993, H. Yoshigou and Y. Sakurai; URM-P 31167, 66.4 mm SL, Okinawa, 12 February 1994, H. Yoshigou; URM-P 33815, 76.0 mm SL, Okinawa, 16 June 1995, H. Yoshigou; URM-P 37846, 100.0 mm SL, Maeda Cape, Okinawa, 11 April 1997, H. Yoshigou and M. Sekine; URM-P 37901, 92.5 mm SL, Okinawa, 19 April 1997, N. Takei and H. Yoshigou; URM-P 38096, 71.0 mm SL, Okinawa, 17 May 1997, H. Yoshigou *et al.*; URM-P 39899, 78.2 mm SL, URM-P 39900, 82.0 mm SL, Setouchi, Amami-oshima island, Kagoshima, 6 April 1998, Setouchi Fisheries Cooperative; WAM-P 25516–016, 74.7 mm SL, Okinawa. **PHILIPPINES:** USNM 314196, 2 specimens, 70.8–72.3 mm SL, Y'ami Island, Batan Islands, 21°07'35"N, 121°56'45"E, 15–20 m depth, 26 April 1987, D. Johnson *et al.*; USNM 364157, 79.4 mm SL, Sabatan Island, 9 November 1908.

**Diagnosis.** A species of *Chromis* with the following combination of characters: dorsal fin rays XIII–XIV, 11–13 (mode XIII, 12); anal fin rays II, 10–12 (11); pectoral fin rays 17–21 (19); principal caudal fin rays 15; spiniform caudal fin rays 2; scale rows in longitudinal series 21–27 (26); tubed lateral line scales 16–21 (19); scale rows above lateral line 3, scale rows below lateral line 9–10 (9); gill rakers 6–9 (7)+20–25 (23)=27–33 (30); preopercular margin smooth; caudal fin deeply forked, without prolonged filaments; basal width of pelvic fin axillary scale 1.7–2.8% of SL; basal width of scale between pelvic fin bases 2.2–3.9% of SL; prominent black blotch covering upper two-thirds of pectoral fin base in juveniles and covering entire fin base in adults; no white spot at end of dorsal fin base; caudal peduncle without distinct markings; caudal fin yellowish without dark band along each fin lobe.

**Description.** Proportional measurements as percentages of SL are given in Table 4. Frequency distributions of selected meristic characters are presented in Table 3. Features for the holotype are presented first, followed by paratype data in parentheses. Characters given in the diagnosis are not repeated here.

Body moderately deep, compressed. Dorsal profile of head slightly convex. Snout shorter than orbit diameter. Mouth terminal, small, oblique; posterior margin of maxilla just reaching (or not reaching) to vertical through anterior margin of pupil. Upper jaw with entire row of canine teeth, 2 or 3 irregular rows of smaller conical teeth anteriorly, 1 such row posteriorly. Lower jaw with row of canine teeth and anterior inner row of small conical teeth; no small posterior teeth. No teeth on vomer and palatines. Tongue obtuse triangular. Gill rakers long and slender, longest on lower limb near angle, about three-fourths as long as longest gill filaments. Nostril with fleshy rim, more protrusive on posterior edge, vertically situated at level of middle of pupil. Preopercular margin smooth; upper end not reaching level of upper margin of orbit. Suborbital with free lower margin. Opercular margin with small, flat spine projecting from be-

neath large scale. Body scales finely ctenoid. Scales covering head except for lips, tip of snout, and narrow zone from orbit to around nostrils. Anterior lateral line ending below soft-rayed portion of dorsal fin. Scaly sheath at base of dorsal fin, its width about one-half of pupil diameter at base of middle of dorsal fin. Scales covering basal parts of dorsal, pectoral, and anal fins. Small scales covering entire caudal fin, except for center and posterior margin. Small scales on bases of pectoral fins. One median scale process extending posteriorly from between bases of pelvic fins, its length about half that of pelvic spine. Axillary scale above base of pelvic spine more than one-third as long as that spine. Origin of dorsal fin above third (or fourth) tubed scale. Tip of pectoral fin not reaching vertical through origin of anal fin. Depressed pelvic fin reaching to (or just short of) origin of anal fin. Vertebrae  $11+15=26$ .

Color when fresh (based on color photographs of KAUM-I. 40100 and NSMT-P 111948; Fig. 10A, B): body olive-brown with dark-brown-margined body scales (more yellowish body in young). Upper head and nape greenish brown; suborbital and opercular scales sometimes bluish. Spinous portion of dorsal fin yellowish brown with dark margin in young, brownish without marginal marking in adults; posterior half of soft-rayed portion of dorsal fin transparent. Pectoral fin transparent. Pelvic fin yellowish to brownish anteriorly, transparent posteriorly. Anterior two-thirds of anal fin blackish, remaining portion transparent. Caudal fin lobes yellow in young, dark yellow in adults, and transparent centrally. Color of preserved specimens similar to that of fresh specimens, except for dusky brown caudal fin.

**Distribution.** *Chromis yamakawai* is known from the Izu Islands (recorded from Miyake-jima and Hachijo-jima islands), the Ogasawara Islands (Chichi-jima island), the Pacific coast of southern Japan (Wakayama and Okinoshima island, Kochi), the Ryukyu Islands (Iou-jima, Amami-oshima, Kakeroma-jima, Yoron-jima, Okinawa-jima, Ie-jima, Sesoko-jima, Keise-jima, and Ishigaki-jima islands), and the Philippines (Batan Islands) (Fig. 9).

**Etymology.** The species is named for Takeshi Yamakawa (Kochi, Japan), who first recognized this species as new and kindly made specimens available to the authors.

**Remarks.** *Chromis yamakawai* has previously been regarded as *C. flavomaculata*, the latter being regarded as a junior synonym of *C. notata* in this study (see Remarks for *C. kennensis*). Comparisons among *C. notata*, *C. kennensis*, *C. yamakawai*, and *C. pura* are made in the Remarks for *C. kennensis*. These four species can be distinguished from other members of *Chromis* by having a smooth preopercular margin, a large, black blotch at the base of the pectoral fin, a blackish or brownish caudal peduncle, and a caudal fin without filamentous rays. *Chromis westaustralis* Allen, 1976, endemic to Western Australia, is similar to *C. notata* in general coloration and morphology, but specimens of *C. westaustralis* were not available for this study; detailed comparisons between the two species are required to assess the taxonomic status of *C. westaustralis*.

The squamation and sensory pores on the heads of *C. no-*

*tata*, *C. kennensis*, and *C. yamakawai* are shown in Fig. 12. The distribution of sensory pores on the head varies individually and does not represent a species-specific pattern (Fig. 12).

## Acknowledgments

We thank M. McGrouther, A. Hay, and S. Reader (AMS), A. Suzumoto and L. O'Hara (BPBM), H. Endo (BSKU), D. Catania (CAS), Y. Kai (FAKU), S. Kimura (FRLM), H. Yoshigou (HMNH), M. Yabe, H. Imamura, and T. Kawai (HUMZ), Y. Iwatsuki (MUFS), K. Matsuura and G. Shinohara (NSMT), K. Hatooka (OMNH), M. van Oijen and R. de Ruiter (RMNH), K. Hoshino (SNFR), T. Yoshino, M. Toda, and K. Miyamoto (URM), J. Williams and S. Raredon (USNM), S. Morrison and G. Moore (WAM), P. Bartsch (ZMB), K. Sakamoto (ZUMT), and H. Ida (formerly Kitasato University) for opportunities to examine specimens of *Chromis*. We are grateful to T. Yamakawa (formerly Kochi Senior High School) for sharing his knowledge of the taxonomy of *Chromis*, M. Ito (Maruse Daikichi Fishery Cooperative), S. Chiba and E. Katayama (NSMT), M. Okamoto (SNFR), S. Dewa (Diving Services Umiannai), K. Furuta (Diving Services Umikobo), Y. Kaji and other staff of the Wakayama Prefectural Museum of Natural History, K. Hoshino, S. Torigoe, K. Imai, and other staff of the Oita Marine Palace Aquarium Umitamago, T. Kasedo and T. Ogami (Faculty of Fisheries, Kagoshima University), staff of the Azuma-cho Fishery Cooperative, H. Sato, H. Sato, K. Kajiwara, K. Tokuda, S. Hiwatari, and T. Yasunaga (Mishima, Kagoshima), H. Takahashi (Kagoshima University Activation Center for Yoron Island), K. Tatsuno and other staff of Yoron Town Hall, T. Takeshita (Yoron Diving Services), N. Iwamura and other staff of the Yoron Chamber of Commerce and Industry, and Y. Kimura (Graduate School of Biosphere Science of Hiroshima University) for their kind assistance with collecting specimens of *Chromis*. We also thank S. Kato (Regulus Diving) and R. Kuiter (Aquatic Photography) for kindly providing underwater photographs of *C. yamakawai* from Hachijo-jima island and *C. kennensis* from New South Wales, respectively, J. Randall for providing photographs of *C. kennensis*, T. Hashimoto (KAUM) for taking X-ray photographs, M. Matsunuma and G. Ogihara (KAUM) for examining the type specimens of *Chromis*, H. Senou (KPM) for information on *C. notata* from the Ryukyu Islands, and G. Yearsley (Ellipsis Editing) for checking an early version of this manuscript. We greatly appreciate Y. Haraguchi, volunteers, and students of KAUM for their curatorial assistance. This study was supported in part by Grants-in-Aid for Scientific Research (B, 24370041 and C, 23580259) from the Japan Society for the Promotion of Science, Tokyo, Japan (JSPS), a Grant-in-Aid for Young Scientists (B, 19770067) from the Ministry of Education, Science, Sports and Culture, Tokyo, Japan, the JSPS Asian Core Program, "Establishment of Research and Education Network on Coastal Marine Science in Southeast Asia", the JSPS International Training Program, "Protect Diversity of Biore-



sources in the Tropical Area”, and the Coastal Area Capability Enhancement in Southeast Asia Project of the Research Institute for Humanity and Nature, Kyoto, Japan.

## References

- Allen, G. R. 1975. *Damselfishes of the South Seas*. TFH Publications, Neptune, NJ, 330 pp.
- Allen, G. R. 1991. *Damselfishes of the World*. Mergus Publishers, Melle, Germany, 271 pp.
- Allen, G. R. 2000. Pomacentridae. In: Randall, J. E. and Lim, K. K. (Eds). A checklist of the fishes of the South China Sea. The Raffles Bulletin of Zoology, Supplement 8: 626–627.
- Allen, G. R., Cross, N. J. and Allen, C. J. 2006. Pomacentridae. Pp. 1439–1471. In: Beesley, P. L. and Wells, A. (Eds). *Zoological Catalogue of Australia, Volume 35, Fishes, Part 2*. CSIRO Publishing, Collingwood, Vic.
- Allen, G. R. and Erdmann, M. V. 2005. *Chromis xouthos*, a new species of damselfish (Pomacentridae) from the east Andaman Sea and central Indian Ocean. *Aqua. Journal of Ichthyology and Aquatic Biology* 10: 89–94.
- Allen, G. R. and Erdmann, M. V. 2008. A new species of damselfish (*Chromis*: Pomacentridae) from the Raja Ampat Islands, Papua Barat Province, Indonesia. *Aqua. International Journal of Ichthyology and Aquatic Biology* 14: 203–208.
- Allen, G. R. and Erdmann, M. V. 2009. Two new species of damselfishes (Pomacentridae: *Chromis*) from Indonesia. *Aqua. Journal of Ichthyology and Aquatic Biology* 15: 121–134.
- Allen, G. R. and Erdmann, M. V. 2012. *Reef Fishes of the East Indies*. Vol. 2. Tropical Reef Research, Perth, 425–856 pp.
- Allen, G. R. and Randall, J. E. 2004. Two new species of damselfishes (Pomacentridae: *Chromis*) from Indonesian seas. *Aqua. Journal of Ichthyology and Aquatic Biology* 9: 17–24.
- Allen, G. R., Steene, R., Humann, P. and DeLoach, N. 2012. *Reef Fish Identification, Tropical Pacific*. New World Publications, Jacksonville, 457 pp.
- Aonuma, Y. and Yoshino, T. 1993. Pomacentridae. Pp. 803–834, 1333. In: Nakabo, T. (Ed.). *Fishes of Japan with Pictorial Keys to the Species*. Tokai University Press, Tokyo. [In Japanese]
- Aonuma, Y. and Yoshino, T. 2000. Pomacentridae. Pp. 918–950, 1577. In: Nakabo, T. (Ed.). *Fishes of Japan with Pictorial Keys to the Species. Second Edition*. Tokai University Press, Tokyo. [In Japanese]
- Aonuma, Y. and Yoshino, T. 2002. Pomacentridae. Pp. 918–950, 1577. In: Nakabo, T. (Ed.). *Fishes of Japan with Pictorial Keys to the Species. English Edition*. Tokai University Press, Tokyo.
- Aoyagi, H. 1941. The damsel fishes found in the waters of Japan. *Transactions of the Biogeographical Society of Japan* 4: 157–279.
- Araga, C. 2009. Pomacentridae. Pp. 434–463. In: Okamura, O. and Amaoka, K. (Eds). *Sea Fishes of Japan*. Yama-kei Publishers, Tokyo. [In Japanese]
- Araga, C., Takamatsu, S., Mochizuki, K. and Konishi, K. 1985. *Sakana Daizukan [Atlas of Fishes]*. Weekly Sunday Fishing, Osaka, 447 pp. [In Japanese]
- Bloch, M. E. 1792. *Naturgeschichte der Ausländischen Fische*. Vol. 6. Buchhandlung der Realschule, Berlin, xii+126 pp. [In German]
- Bloch, M. E. and Schneider, J. G. 1801. *Systema Ichthyologiae Iconibus cx Illustratum. Post Obittum Auctoris Opus Inchoatum Absolvit, Correxerit, Interpolavit J. G. Schneider, Saxo. Berolini*. Berolini, Berlin, lx+584 pp.
- Boeseman, M. 1947. Revision of the fishes collected by Burger and Von Siebold in Japan. *Zoologische Mededeelingen* 28: 1–242.
- de Moura, R. L. 1995. A new species of *Chromis* (Perciformes: Pomacentridae) from the southeastern coast of Brazil, with comments on other species of the genus. *Revue Française d'Aquariologie Herpétologie* 21: 91–96.
- Günther, A. 1862. *Catalogue of the Acanthopterygii, Pharyngognathi and Anacanthini in the Collection of the British Museum*. Vol. 4. The British Museum, London, xxi+534 pp.
- Hirata, T., Yamaoka, K., Kanda, M. and Hirata, S. 2001. Atlas of fishes in life mode. Pp. 42–111. In: Nakabo, T., Machida, Y., Yamaoka, K. and Nishida, K. (Eds). *Fishes of the Kuroshio Current, Japan*. Osaka Aquarium Kaiyukan, Osaka. [In Japanese]
- Hubbs, C. L. and Lagler, K. F. 1947. Fishes of the Great Lakes region. *Cranbrook Institute of Science Bulletin* 26: i–xi+1–186.
- Ida, H. 1984. *Chromis notatus notatus, Chromis notatus miyakeensis, Chromis flavomaculata*. P. 192. In: Masuda, H., Amaoka, K., Araga, C., Uyeno, T. and Yoshino, T. (Eds). *The Fishes of Japanese Archipelago*. Tokai University Press, Tokyo. [In Japanese]
- ICZN (International Commission on Zoological Nomenclature) 1999. *International Code of Zoological Nomenclature, Fourth Edition*. International Trust for Zoological Nomenclature, London, xxix+306 pp.
- Jordan, D. S. and Snyder, J. O. 1902. A review of the labroid fishes and related forms found in the waters of Japan. *Proceedings of the United States National Museum* 24: 595–662.
- Jordan, D. S. and Tanaka, S. 1927. Notes on new and rare fishes of the fauna of Japan. *Annals of Carnegie Museum* 17 (12): 385–392, pl. 34.
- Kamohara, T. 1930. [Fishes collected from vicinity of Kashiwa-jima island, Kochi] *Dobutsugaku Zasshi* 42: 479–486. [In Japanese]
- Kamohara, T. 1957. A list of fishes from Amami-oshima and adjacent regions, Kagoshima Prefecture, Japan. *Reports of the Usa Marine Biological Station* 4: 1–65.
- Kamohara, T. 1960. On the fishes of the genus *Chromis* (family Amphiprionidae, Chromides, Pisces), found in the waters of Japan. *Reports of the Usa Marine Biological Station* 7: 1–10.
- Kamohara, T. 1963. *Coloured Illustrations of the Fishes of Japan (II)*. Hoikusha, Osaka, xi+168 pp., 68 pls. [In Japanese]
- Kato, S. 2011a. *Marine Fishes Illustrated*. Seibundo-Shinkosha, Tokyo, 303 pp. [In Japanese]
- Kato, S. 2011b. *Damselfishes Illustrated*. Seibundo-Shinkosha, Tokyo, 239 pp. [In Japanese]
- Kinoshita, I. 1988. Pomacentridae. Pp. 558–567. In: M. Okiyama (Ed.). *An Atlas of the Early Stage Fishes in Japan*. Tokai University Press, Tokyo. [In Japanese]
- Konishi, H. (Ed.) 2007. *Color Guide to the Japanese Fishes for Sport Fishermen*. Enterbrain, Tokyo, 400 pp. [In Japanese]
- Kuiter, R. H. 1993. *Coastal Fishes of South-eastern Australia*. Crawford House Press, Bathurst, NSW, 437 pp.
- Kuiter, R. H. and Debelius, H. 2006. *World Atlas of Marine Fishes*. IKAN-Unterwasserarchiv, Frankfurt, 720 pp.
- Lecchini, D. and Williams, J. T. 2004. Description of a new species of damselfish (Pomacentridae: *Chromis*) from Rapa Island, French Polynesia. *Aqua. Journal of Ichthyology and Aquatic Biology* 8: 97–102.
- Masuda, H., Araga, C. and Yoshino, T. 1975. *Coastal Fishes of Southern Japan*. Tokai University Press, Tokyo, 379 pp. [In Japanese]
- Masuda, H., Araga, C. and Yoshino, T. 1980. *Coastal Fishes of Southern Japan*. Tokai University Press, Tokyo, 382 pp. [In Japanese]
- Masuda, H. and Kobayashi, Y. 1994. *Grand Atlas of Fish Life Modes*. Tokai University Press, Tokyo, xlviii+435 pp. [In Japanese]
- Masuda, R. 2008. Seasonal and interannual variation of subtidal fish assemblages in Wakasa Bay with reference to the warming trend in the Sea of Japan. *Environmental Biology of Fishes* 82: 387–399.
- Motomura, H., Kuriwa, K., Katayama, E., Senou, H., Ogihara, G., Meguro, M., Matsunuma, M., Takata, Y., Yoshida, T., Yamashita,

- M., Kimura, S., Endo, H., Murase, A., Iwatsuki, Y., Sakurai, Y., Harazaki, S., Hidaka, K., Izumi, H. and Matsuura, K. 2010. Annotated checklist of marine and estuarine fishes of Yaku-shima Island, Kagoshima, southern Japan. Pp. 65–247. *In*: Motomura, H. and Matsuura, K. (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.
- Moyer, J. Y. and Ida, H. 1976. Description of a new damselfish, *Chromis miyakeensis*, from Miyake Island, Japan. *Japanese Journal of Ichthyology* 22: 189–194.
- Nishida, T., Nakazono, A., Onikura, N., Oikawa, S. and Matsui, S. 2007. Seasonal dynamics of fish fauna on the reef in the Tsushima Current, northern Kyushu, Japan. *Japanese Journal of Ichthyology* 54: 65–78. [In Japanese]
- Okada, Y. 1938. *A Catalogue of Vertebrates of Japan*. Maruzen, Tokyo, iv+412 pp. [In Japanese]
- Paepke, H. J. 1999. *Bloch's Fish Collection in the Museum für Naturkunde der Humboldt Universität zu Berlin: an Illustrated Catalog and Historical Account*. Koeltz Scientific Books, Königstein, 216 pp.
- Randall, J. E. 1994. Two new damselfishes (Perciformes: Pomacentridae) from Arabian waters. *Revue Française d'Aquariologie Herpétologie* 21: 39–48.
- Randall, J. E. 2001. Four new damselfishes (Perciformes: Pomacentridae) from the Marquesas Islands. *Copeia* 2001: 92–107.
- Randall, J. E. 2005. *Reef and Shore Fishes of the South Pacific: New Caledonia to Tahiti and the Pitcairn Islands*. University of Hawai'i Press, Honolulu, xii+507 pp.
- Randall, J. E., Allen, G. R. and Steene, R. C. 1997. *Fishes of the Great Barrier Reef and Coral Sea. Revised and Expanded Edition*. Crawford House Publishing, Bathurst, NSW, xx+557 pp.
- Randall, J. E., Ida, H. and Moyer, J. T. 1981. A review of the damselfishes of the genus *Chromis* from Japan and Taiwan, with description of a new species. *Japanese Journal of Ichthyology* 28: 203–242.
- Randall, J. E. and McCosker, J. E. 1992. Two new damselfishes of the genus *Chromis* (Perciformes: Pomacentridae) from the South Pacific. *Proceedings of the California Academy of Sciences* 47: 329–337.
- Sakai, Y., Ochi, Y., Tsuboi, M., Kadota, T., Shimizu, N., Shoji, J., Matsu-moto, K., Mabuchi, K., Kuniyoshi, H., Ohtsuka, S. and Hashimoto, H. 2010. Fish fauna of shallow waters of Aki Nada, Seto Inland Sea, Japan. *Biosphere Science, Journal of the Graduate School of Biosphere Science, Hiroshima University* 49: 7–20. [In Japanese]
- Schmidt, P. J. 1930. Fishes of the Riu-kiu Islands. *Transactions of the Pacific Committee of the Academy of Sciences of the Union of Soviet Socialist Republics* 1: 19–156.
- Senou, H., Kodato, H., Nomura, T. and Yunokawa, K. 2006. Coastal fishes of Ie-jima Island, the Ryukyu Islands, Okinawa, Japan. *Bulletin of the Kanagawa Prefectural Museum (Natural Science)* 35: 67–92.
- Senou, H. and Kudo, T. 2007. A new species of the genus *Chromis* (Perciformes: Pomacentridae) from Taiwan and Japan. *Bulletin of the National Museum of Nature and Science, Series A, Supplement* 1: 51–57.
- Shimizu, N., Kadota, T., Tsuboi, M. and Sakai, Y. 2010. Fish fauna in the coastal area of Kurahashi Island, Seto Inland Sea, Japan. *Bulletin of the Hiroshima University Museum* 2: 43–52. [In Japanese]
- Takagi, M., Hirata, T., Hirata, S. and Nakata, C. (Eds) 2010. *Fishes of Ainan Ehime*. Sofusha Shuppan, Matsuyama, 250 pp. [In Japanese]
- Tanaka, S. 1931. On the distribution of fishes in Japanese waters. *Journal of the Faculty of Science, Imperial University of Tokyo, Section 4. Zoology* 3: 1–90.
- Temminck, C. J. and Schlegel, H. 1843. Pisces, parts 2–3. Pp. 21–72. *In*: von Siebold, P. F. (Ed.). *Fauna Japonica, Sive Descriptio Animalium quae in Itinere per Japoniam Suscepto Annis 1823–30 Collegit, Notis Observationibus et Adumbrationibus Illustravit*. J. Müller & Co., Amsterdam.
- Tsuji, T., Hayase, S. and Oya, F. 2010. Occurrence of halfbeak *Hyporhamphus sajori*, larvae and juveniles in Nanao Bay, Noto Peninsula. *Bulletin of Ishikawa Prefecture Fisheries Research Center* 5: 7–12.
- Whitley, G. P. 1964. Fishes from the Coral Sea and the Swain Reefs. *Records of the Australian Museum* 26: 145–195.
- Yoshino, Y. and Senou, H. 2008. *Sea Fishes of Japan*. Yama-kei Publishers, Tokyo, 543 pp. [In Japanese]