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Abstract Three species of the gobiid genus *Cristatogobius* found in Japan are reviewed with description of a new species. They are *C. aurimaculatus* sp. nov. (Japanese name: Hime-tosakahaze), *C. lophius* (Japanese name: Tosakahaze), and *C. nonatoae* (Japanese name: Kuro-tosakahaze). Tosakahaze, which had not previously been identified, can now be identified as *C. lophius*. The three species are clearly distinguishable by the difference in coloration. A key to species is provided.

Key words. — *Cristatogobius aurimaculatus*; new species; Gobiidae; Japan.

The genus *Cristatogobius* was established by Herre (1927) with *C. lophius* from the Philippines as the sole species. Later *C. albius* Chen, 1959 from Taiwan was added to the genus. *C. albius* is listed in this paper as a junior synonym of *C. nonatoae* (Alban, 1940) from the Philippines, which was originally described as a species of *Lophogobius*. These are the nominal species that have hitherto been described in the genus.

The first report on the collection of a species of the genus from Japan was made by Hayashi (1980) as *C.* sp. (Japanese name: Tosakahaze) with a life colour photograph. Then Hayashi et al. (1981) reported that this species was quite similar to *C. lophius* Herre, 1927, but could not be identified as *C. lophius* because of the difference in the number of dorsal soft rays and the number of dark brown transverse bands on the lateral side of the body. Later two species were added from Japan to the previous species as *C.* sp. 1 by Akihito (1984). They were the above-mentioned *C. nonatoae* (Ablan, 1940) (Japanese name: Kuro-tosakahaze) and *C.* sp. 2 (Japanese name: Hime-tosakahaze). This paper reviews the three species of the genus from Japan with *C.* sp. 2 described as a new species.

Recently there were two reports on the collection of unidentified species of the genus: one from Indonesia with a photograph (Kottelat et al., 1993) and the other from the Northern Territory, Australia without a photograph (Larson and Williams, 1997).

Materials and Methods

Examined specimens are listed in each section in the following order: institutional catalogue number, total number of specimens (in parentheses), standard length (SL), collection locality, collection date, and collector.

In addition, specimens of *Lophogobius cyprinoides*, BLIH 1957003, (4), 23.3–50.0 mm SL, near Tahiti Beach, Dade County, Florida, U.S.A., 8 May 1957, collected by C. R. Robins, were also examined as the type species of *Lophogobius* in which genus *C. nonatoae* was originally placed.

Institutional abbreviations are as follows: AMS, Australian Museum, Sydney, N.S.W., Australia; BLIH, Biological Laboratory, Imperial Household, Tokyo, Japan; NSMT, National Science Museum, Department of Zoology, Tokyo, Japan; ROM, Royal Ontario Museum, Toronto, Ontario, Canada; TFRI, Taiwan Fishery Research Institute, Chilung, Taiwan; URM, University of the Ryukyus, Nishihara, Okinawa, Japan; WAM, Western Australian Museum, Perth, Western Australia, Australia; YCM, Yokosuka City Museum, Yokosuka, Kanagawa, Japan; ZUMT, Department of Zoology, University Museum, University of Tokyo, Tokyo, Japan.

The method of counting and the formula for the relation between the pterygiophores of the dorsal fins and vertebrae follow those of Akihito (1984), except for the predorsal scales, which were counted on a scale row close to the left side of the nuchal crest. In-

stitutional abbreviations follow Eschmeyer (1998).

Cristatogobius Herre, 1927
(Japanese name: Tosakahaze zoku)

Cristatogobius Herre, 1927: 170 (type species: *C. lophius* Herre, 1927, by original designation and monotypy).

Diagnosis. Nuchal crest with thin rounded margin from above eye to origin of first dorsal fin and with height greater than half the eye diameter. Enlarged teeth in outer row from anterior to middle part on lower jaw, posteriormost tooth distinctly enlarged. Rows of sensory papillae on cheek running longitudinally and two rows on anterior part elevated onto ridges. Scapula unossified.

Description. The characters common to the species of the genus except for young specimens are as follows. Head and body compressed. Thin nuchal crest with rounded margin from above eye to origin of first dorsal fin; its height from base to uppermost edge greater than half the eye diameter. Mouth vertically oblique, lower jaw projecting. Pluriserial teeth on upper jaw, enlarged teeth in outer row; pluriserial teeth on lower jaw, enlarged teeth in outer row from anterior to middle part, posteriormost tooth or rarely two teeth distinctly enlarged. Anterior nostril at end of a tube and posterior nostril without a tube. Arrangement of sensory canal pores and sensory papillae on head illustrated in Akihito (1984) and Akihito et al. (1993b); rows of sensory papillae on cheek running longitudinally; and the following rows of sensory papillae elevated onto ridges: i.e., anterior part of two rows on cheek, longitudinal row running close to lower lip, anterior part of longitudinal row behind upper posterior part of eye, and transverse row running close to anterior margin of opercle. No scales on head except for nape. Body covered with cycloid scales anteriorly and ctenoid scales posteriorly, beginning from below first dorsal fin. First dorsal fin not connected by membrane with second dorsal fin. Caudal fin somewhat lanceolate; segmented fin rays 9+8=17. Pelvic fins united to form a longitudinally elongate cup-shaped disk with frenum between spines and with membrane between innermost soft rays; fin rays I,5; soft rays multibranched; distal margin of frenum smooth, extending to tips of spines; distal margin of membrane between innermost rays not notched. Relation between pterygiophores of dorsal fins and vertebrae 3/II II I I 0/9. Number of vertebrae 10+16=26. Male urogenital papilla slender and pointed, that of female round; width of that of male less than 2/3 that of female of same size. Scapula unossified.

Remarks. Herre (1927) and Koumans (1931) thought that this genus was closely allied to *Lophogobius* Gill, 1862, because the type species of *Lophogobius*, *Gobius cristagalli* Valenciennes, 1837, which was later synonymized with *L. cyprinoides* (Pallas, 1770) by Koumans (1931), has a nuchal crest as high as that of *Cristatogobius*. However, as another species of the genus, *L. cristulatus* Ginsburg, 1939 has, unlike *Cristatogobius*, only a low ridgelike crest (Dawson, 1972), the high nuchal crest is not regarded as a generic diagnosis of *Lophogobius*. The two genera differ in the following characters: *Cristatogobius* has the posteriormost tooth distinctly enlarged in the outer row on the middle part of the lower jaw, whereas *Lophogobius* lacks such a distinctly enlarged tooth; *Cristatogobius* has only longitudinal rows of sensory papillae on the cheek and the the anterior part of two of them is elevated, whereas *Lophogobius* has transverse rows of sensory papillae in addition to longitudinal rows on the cheek, but they are not elevated; *Cristatogobius* has an unossified scapula, whereas *L. cyprinoides* has an ossified scapula which surrounds the scapula foramen incompletely and whose lower margin is broken by the foramen. The scapula of *C. nonatoae* (as *C. albius*) and *L. cyprinoides* was reported by Akihito (1967). The scapula of *L. cristulatus* has not been examined, but it is considered to be the same type of scapula as found in *L. cyprinoides*, because the type of the scapula is usually the same within the genus (Akihito, 1986).

The species of this genus have been found in the southern islands of Okinawa Prefecture, Japan; Taiwan, the Philippines, Thailand, Indonesia, Papua New Guinea, Fiji, and the Northern Territory, Australia.

Cristatogobius aurimaculatus sp. nov.
(Japanese name: Hime-tosakahaze)
(Figs. 1, 2)

Cristatogobius sp. 2: Akihito, 1984: 257, pl. 242-N (Ishigakijima, Okinawa Pref., Japan).

Cristatogobius sp. 2: Akihito et al., 1993a: 1035 (Ishigakijima, Okinawa Pref., Japan).

Cristatogobius sp. 2: Masuda and Kobayashi, 1994: 344, pl. 5 (Yaeyama Is., Okinawa Pref., Japan).

Holotype. NSMT-P 47066, 26.5 mm SL, male, mouth of Miyara River, Ishigakijima, Okinawa Pref., Japan, 8 Oct. 1987, collected by A. Iwata and Y. Ikeda.

Paratypes. NSMT-P 47067, (2), males, 21.2–22.9 mm SL, same data as holotype. NSMT-P 47068, (2), males, 22.4–22.5 mm SL, same locality as holotype, 16 Oct. 1989, collected by T.

Kamisato, A. Iwata, and K. Sakamoto. URM-P 3148, (1), male, 30.0 mm SL, same locality as holotype, 29 May 1982, collected by T. Yoshino, H. Senou, K. Hatooka, and A. Ono. URM-P 3840, (5), males, 28.0–32.0 mm SL, (5), females, 23.2–26.7 mm SL, same data as URM-P 3148.

Other specimens. AMS-I 16671-069, (8), 21.6–38.9 mm SL, Madang Harbour, opposite end of Sek Is., Papua New Guinea, 31 July 1969, collected by F. Talbot. AMS-I 24395-001, (8), 16.2–29.5 mm SL, Nagara Is., Viti Levu, Fiji, collected by V.G. Springer et al. BLIH 1987558, (2), 11.8–19.4 mm SL, same data as holotype. BLIH 19891132, (8), 12.9–20.7 mm SL, same data as NSMT-P 47068 (paratypes). BLIH 1993041–43, (3), 24.8–27.3 mm SL, same locality as holotype, 16 Sept. 1993, collected by A. Iwata, K. Sakamoto, and Y. Ikeda. BLIH 1995030, (1), 35.2 mm SL, mouth of Nakama River, Iriomotejima, Okinawa Pref., Japan, 3 Sept. 1995, collected by A. Iwata, K. Sakamoto, and Y. Ikeda. URM-P 3840, (21), 20.9–31.3 mm SL, same data as URM-P 3148 (paratype).

Diagnosis. *Colour in life.* — Iridescent blue or green spots surrounded with red or reddish tinge scattered on head and upper anterior part of body, with two posteriormost large spots positioned transversely below middle part of first dorsal fin. Yellow spots scattered on purple dorsal and caudal fins. Anal fin grey to dark grey, proximally lighter with reddish tinge without separation of colour.

Colour in preservation. — Two brown bands below nuchal crest: anterior one running downward from below middle part and posterior one slanting forward from below posterior part. Darker areas on light brown body below middle part of first dorsal fin corresponding to two transversely positioned large iridescent blue or green spots in life.

Description. The counts of meristic characters were taken from specimens collected in Japan including the types. The number of specimens examined is shown in the parentheses. Second dorsal fin rays I,9–10 (35), holotype I,9, paratypes (15) I,9–10; anal fin rays I,8–10 (35), holotype I,9, paratypes (15) I,8–9; pectoral fin rays 15–17 (35), holotype 16, paratypes (15) 15–17; scales in a longitudinal row 24–33 (35), holotype 29, paratypes (15) 27–31; scales in a transverse row 9–13 (35), holotype 12, paratypes (15) 9–12; predorsal scales 5–15 (33), holotype 7, paratypes (15) 5–15.

Dorsal profile sloping upward slightly from nape to origin of first dorsal fin and gradually downward posteriorly. Body depth of larger specimens greater than that of young specimens: body depth at origin of pelvic fins in percent of standard length of four young specimens (11.8–19.4 mm SL) 20.1–22.9%, that of five larger males (30.0–34.1 mm SL) 23.1–25.6%, and that of six larger females (30.7–32.6 mm SL) 23.3–24.8%.

Shape of membranous part of first dorsal fin somewhat triangular, with longest spine (usually the fourth) at the apex; spines distally connected by membranes except for longest spine, its tip filamentous. The tip of the longest spine of males (21.2–30.0 mm SL) reaches the base of the fifth to seventh soft ray of the second dorsal fin when depressed, and that of females (23.2–26.7 mm SL) reaches the base of the second to fifth soft ray of the second dorsal fin. A male of 18.3 mm SL (BLIH 19891132-11) is the largest specimen without a filamentous spine and a male of 19.4 mm SL (BLIH 1987558-1) is the smallest specimen with a filamentous spine.

Colour in life. — The description is based on the original of the photograph taken in life and printed in Masuda and Kobayashi (1994) and the photographs taken immediately after fixation of the holotype (male, 26.5 mm SL, Fig. 1) and five paratypes (males, 21.2–30.0 mm SL), one of which (male, 30.0 mm SL, paratype, URM-P 3148) is the original of the photograph shown in Akihito (1984: pl. 242-N, 3.1 cm SL). Head brown with scattered iridescent blue or green spots surrounded with red or reddish tinge (reddish tinge indistinct around some spots) as well as red streaks and spots. Nuchal crest brown with obscure light brown areas on lower part. Posterior part of upper lip yellow. A narrow blackish band behind upper lip. Two dark brown bands below nuchal crest: anterior one from middle part running downward and posterior one from posterior part slanting forward and tapering; an iridescent blue or green spot surrounded with red or reddish tinge before anterior dark brown band; an elongate iridescent blue or green spot surrounded with red or reddish tinge on posterior dark brown band. Body brown with several short light brown transverse bands dorsally; upper anterior part with scattered iridescent blue or green spots surrounded with red or reddish tinge, with the two posteriormost large spots positioned transversely below middle part of first dorsal fin, the upper one slanting downward posteriorly and the lower one slanting downward anteriorly; iridescent bluish white, greenish white, or brownish white spots scattered on body below posterior part of second dorsal fin to caudal peduncle. First dorsal fin purple with scattered yellow spots; an iridescent blue or green spot behind first dorsal spine on lower middle part; a darker purple or grey band running longitudinally on lower middle part, posteriorly darker and closer to base with two iridescent blue or green spots; below grey band dark yellow. Second dorsal fin purple with scattered yellow spots, spotted on upper margin as well; blackish spots present or absent on posterior lobe. Anal fin grey to

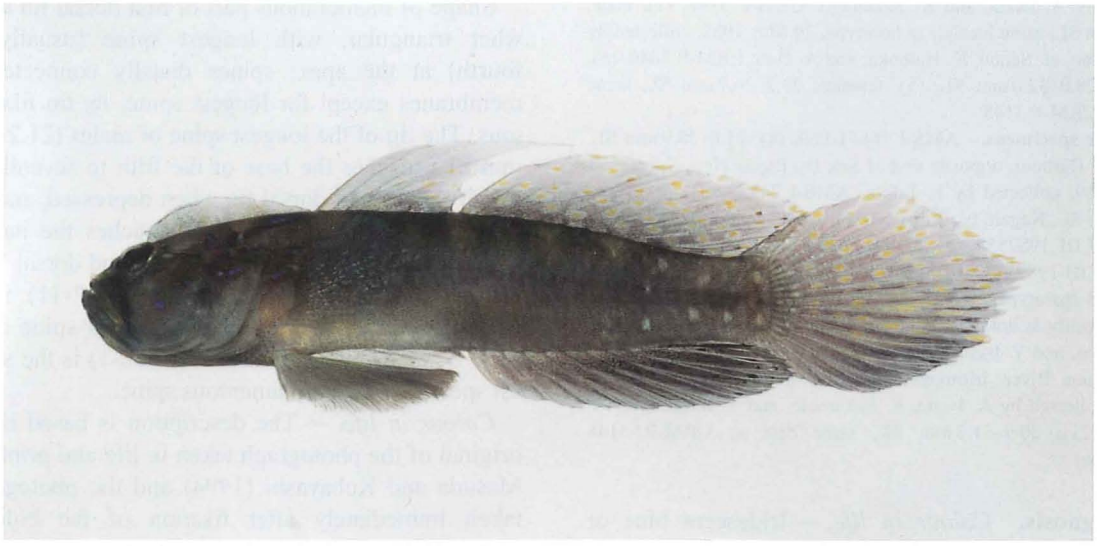

Fig. 1. *Cristatogobius aurimaculatus* sp. nov., holotype, NSMT-P 47066, male, 26.5 mm SL, mouth of Miyara River, Ishigakijima, Okinawa Pref., Japan. Photograph by A. Iwata.

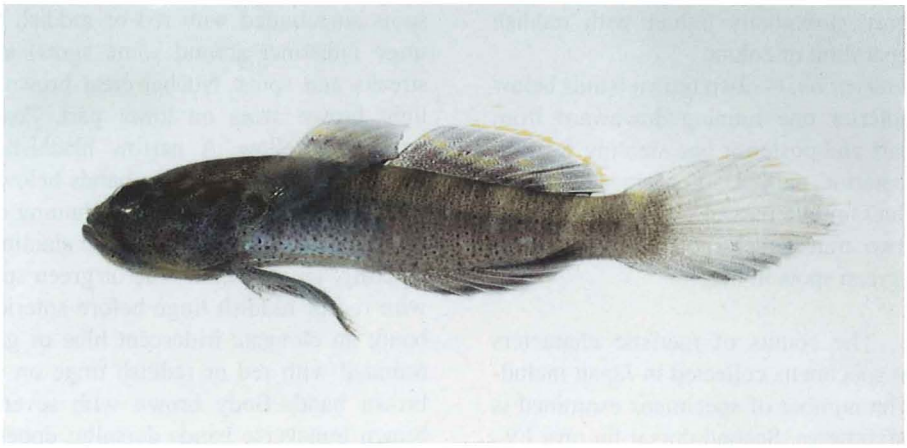

Fig. 2. A young specimen of *Cristatogobius aurimaculatus* sp. nov., BLIH 1987558-5, male, 11.8 mm SL, same locality as holotype. Photograph by A. Iwata.

dark grey, proximally lighter with reddish tinge without separation of colour; blackish spots present or absent on posterior lobe. Caudal fin purple, grey to dark grey on lower part; yellow spots scattered on upper and middle parts. One or two iridescent blue or green spots with red or reddish tinge on upper part of pectoral fin base; a short red streak on lower part. Pectoral fin finely mottled with brownish white and grey to dark grey. Pelvic fins light brown to brown.

Colour of holotype and paratypes in preservation. — Head light brown. Two brown bands below nuchal crest: anterior one running downward from below middle part and posterior one slanting forward from below posterior part. Darker areas on light brown body below middle part of first dorsal fin corresponding to two transversely positioned iridescent blue or green spots seen in life. Fins faded; lower posterior part of first dorsal fin in most specimens brown to dark brown; posteriormost part of second dorsal and anal fins brown to dark brown, but such colour not seen in photographs taken immediately after fixation; most specimens without blackish spots on posterior lobe of second dorsal and anal fins.

Colour of young specimens of 11.8 mm SL (Fig. 2, BLIH 1987558-5), 12.9 mm SL (BLIH 19891132-7), and 13.0 mm SL (BLIH 19891132-6) photographed

immediately after fixation. — Diagnostic characters different from larger specimens are as follows. No clearly outlined iridescent blue or green spots on head. Body sprinkled with blackish dots; among iridescent blue or green spots scattered on anterior part of body seen in larger specimens, three spots including two transversely positioned spots below first dorsal fin noticeable in the two larger young specimens, but without surrounding red tinge; bluish white spots scattered on body behind two transversely positioned spots to caudal peduncle: transversely elongate spots anteriorly and roundish spots posteriorly. Purple second dorsal fin with yellow upper margin and with irregular row of yellow spots running longitudinally on middle part.

Ontogenetic changes in coloration. — Noticeable changes are as follows: increase in number and size of clearly outlined iridescent blue spots on head and upper anterior part of body and development of red tinge surrounding these spots; disappearance of transversely elongate iridescent bluish white spots scattered on middle part of body, while roundish spots remain on posterior part; sprinkled blackish dots on body becoming indistinct; yellow spots on second dorsal fin scattering and increasing in number.

Distribution. Known from Ishigakijima and Iriomotejima, Okinawa Prefecture, Japan; Papua New Guinea and Fiji.

Habitat. The specimens were collected in inlets of river mouths where the water depth is 10–50 cm at the lowest tide. The bottom consists of an accumulation of mud, and is affected by the inflow of eroded topsoil. They were collected with *C. lophius* (A. Iwata, K. Sakamoto, and Y. Ikeda, pers. comm.).

Etymology. From yellow spots on the dorsal and caudal fins.

Remarks. Akihito (1984) pointed out that *C. aurimaculatus* (as *C.* sp. 2) has the spines of the first dorsal fin elongated into filaments, but our examination revealed that only the longest spine is filamentous, and other spines are not filamentous.

Akihito et al. (1993a) pointed out in the key that *C. aurimaculatus* (as *C.* sp. 2) is distinguishable from *C. nonatoae* in the following characters: *C. aurimaculatus* has no rise in the dorsal profile centred on the area on the base of the first dorsal fin, whereas *C. nonatoae* has a slight rise in this area; *C. aurimaculatus* has light coloured spots on the second dorsal fin scattered irregularly, whereas *C. nonatoae* has those spots arranged regularly. In this paper the former character is not presented in the diagnosis or the key, and the latter character is revised. The reason for the correction is set forth in the remarks for *C. nonatoae*.

Cristatogobius lophius Herre, 1927
(Japanese name: Tosakahaze)
(Figs. 3, 4)

Cristatogobius lophius Herre, 1927: 170 (in part), pl. 13, fig.1 (Sulu Prov., Philippines).
Cristatogobius sp.: Hayashi, 1980: a colour photo (Iriomotejima, Okinawa Pref., Japan).
Cristatogobius sp.: Hayashi et al., 1981: 9, pl. 5, fig. 121 (Iriomotejima I., Okinawa Pref., Japan).
Cristatogobius sp.: Suzuki and Senou, 1983: 49, pl. 1, fig. 1 (Yaeyama Is., Okinawa Pref., Japan)
Cristatogobius sp. 1: Akihito, 1984: 256, pl. 242-M (Ishigakijima and Iriomotejima, Okinawa Pref., Japan).
Cristatogobius sp. 1: Akihito et al., 1993a: 1035 (Ishigakijima and Iriomotejima, Okinawa Pref., Japan).
Cristatogobius sp. 1: Masuda and Kobayashi, 1994: 344, pls. 3–4 (Yaeyama Is., Okinawa Pref., Japan).

Specimens. BLIH 1960017, (1), 33.0 mm SL, Rayong Province, Gulf of Thailand, 29 Apr. 1960, collected by A. Fehlmann et al. BLIH 1978077, (16), 13.0–29.0 mm SL, Otomi, Nakama River, Iriomotejima, Okinawa Pref., Japan, 9 Aug. 1978, collected by T. Suzuki. BLIH 1980043, (1), 30.9 mm SL, mouth of Fukido River, Ishigakijima, Okinawa Pref., Japan, 30 May 1980, collected by K. Meguro et al. BLIH 1986396, (3), 31.7–31.9 mm SL, mouth of Nakama River, Iriomotejima, Okinawa Pref., Japan, 3 Nov. 1986, collected by M. Hayashi, K. Sakamoto and A. Iwata. BLIH 1989917, (204), 13.2–32.6 mm SL and (10), stained with alizarin red S, 22.5–32.9 mm SL, same locality as BLIH 1986396, 11 Oct. 1989, collected by Y. Yanohara, T. Kamisato, A. Iwata, and K. Sakamoto. BLIH 19891129, (10), 25.0–33.7 mm SL, same locality as BLIH 1986396, 11 Oct. 1989, collected by T. Kamisato, A. Iwata, and K. Sakamoto. BLIH 19891130, (3), 13.4–15.6 mm SL, same locality as BLIH 1986396, 16 Oct. 1989. BLIH 1993030-40, (11), 24.8–40.2 mm SL, same locality as BLIH 1986396, 14 Sept. 1993, collected by A. Iwata, K. Sakamoto, and Y. Ikeda. ROM 48586, (3), 16.1–22.7 mm SL, Philippines, Sept. 1985, collected by R. Winterbottom. URM-P 3243, (1), 27.1 mm SL, Amitori Bay, Iriomotejima, Okinawa Pref., Japan, 5 June 1982. URM-P 3285, (2), 33.9–35.6 mm SL, Yonada River, Iriomotejima, Okinawa Pref., Japan, 7 June 1982. WAM-P 30721-003, (1), 42.4 mm SL, Sangalakki Is., Indonesia, Aug. 1993, collected by Tomascik. WAM-P 30803-007, (7), 43.0–51.0 mm SL, Kakaban Is., Kalimantan, Indonesia, 17 May 1994, collected by G. Allen. YCM-P 6644, (45), 21.2–33.0 mm SL, same locality as BLIH 1986396, 30 Apr. 1979, collected by M. Hayashi et al. YCM-SSP 9055, (2), 26.8–40.4 mm SL, same locality as BLIH 1986396, 13 July 1980, collected by T. Suzuki and H. Senou. ZUMT-P 58026, (1), 40.9 mm SL, same locality as BLIH 1986396, 8 July 1988, collected by H. Senou and M. Aizawa. ZUMT-P 58391-3, (3), 39.3–40.9 mm SL, mouth of Yonada River, Iriomotejima, Okinawa Pref., Japan, 13 July 1988, collected by H. Senou and M. Aizawa. ZUMT-P 58400, (12), 32.6–40.8 mm SL, same data as ZUMT-P 58391. ZUMT-P 58396, (1), 40.1 mm SL, same data as ZUMT-P 58391.

Diagnosis. *Colour in life.* — Black spots on head, body, and pectoral fin base. Larger round to elongate iridescent blue or green spots scattered on head and upper anterior part of body, those on upper anterior part of body surrounded both above and below with elongate and inwardly curved or roundish dark brown spots. Several brown transverse bands from dorsal to ventral sides of body. Second dorsal fin mottled with red, yellow, and grey with black spots usually present. Anal fin separated into proximal red and distal black areas with a yellow line on red area close to black area.

Colour in preservation. — Black spots on head, body, and pectoral fin base. A dark brown band running downward and forward, from below posterior part of nuchal crest (conspicuous in preserved specimens). Several brown transverse bands from dorsal to ventral sides of body. Pairs of longitudinally elongate and inwardly curved dark brown spots on upper anterior part of body (iridescent blue or green spots between them in life).

Description. The counts of meristic characters were taken from specimens collected in Japan. The number of specimens examined is shown in the parentheses. Second dorsal fin rays I,9–10 (28); anal fin rays I,8–9 (28); pectoral fin rays 14–16 (28); scales in a longitudinal row 28–32 (28); scales in a transverse row 11–13 (28); predorsal scales 0–14 (36).

Dorsal profile sloping upward slightly from nape to origin of first dorsal fin and gradually sloping downward posteriorly. Body depth of larger specimens greater than that of young specimens: body depth at origin of pelvic fins in percent of standard length of six young specimens (13.4–19.6 mm SL) 20.2–22.5%, that of six larger males (31.7–51.0 mm SL) 22.1–25.5%, and that of seven larger females (35.3–47.4 mm SL) 23.6–25.6%.

Shape of membranous part of first dorsal fin somewhat round or quadrate; third or fourth spine, third and fourth spines, or third, fourth, and fifth spines sometimes filamentous; fourth spine usually longest. The tip of the longest spine of males (21.1–40.8 mm SL) reaches the base of the first to second soft ray of the second dorsal fin when depressed; that of females (23.4–35.3 mm SL) reaches the base of the first soft ray of the second dorsal fin. However, there are two exceptional specimens. One of them is a male (37.3 mm SL, ZUMT-P 58400-3) whose membranous part is somewhat triangular with the longest spine, the fourth spine, at the apex; the longest spine is the only filamentous spine and reaches beyond the base of the fifth soft ray of the second dorsal fin when depressed. The other is a female (34.4 mm SL, ZUMT-P 58400-12) whose longest spine, the fourth spine, reaches the base of the third soft ray of the second dorsal fin; but as the other spines and interradial membranes are damaged, it is not clear whether the shape of the fin is similar to that of the above specimen. No filamentous spine is found in the three males and four females of 43.0 to 51.0 mm SL (WAM-P 30803-007) from Indonesia. Development of a filamentous spine or spines is not connected with the size of the specimens except for young specimens which have no filamentous spines.

Colour in life. — The description is based on the photographs of specimens taken in life including the original photograph printed in Hayashi (1980) as well as those taken immediately after fixation, one of which is shown in Fig. 3. Head mottled with light brown and brown, having scattered black spots and iridescent blue or green spots, and with reddish tinge. A narrow blackish band behind upper lip. Nuchal crest with transversely alternating brownish red areas and light brown areas. Ventral side of head behind mouth yellow. A dark brown band, not always conspicuous, running downward and forward on body from below posterior part of nuchal crest; an iridescent blue or green elongate spot or two spots on it and a round spot at its lower tip. A light brown band from anterior part of first dorsal fin running downward and forward towards upper posterior margin of opercle along dark brown band. Upper half of body below first dorsal fin brown with conspicuous or inconspicuous light brown areas, its lower half transversely banded with brown and yellowish light brown; body below second dorsal fin with three yellowish light brown bands from dorsal to ventral sides alternating with three brown bands; a yellowish light brown band crossing body between last rays of second dorsal and anal fins; two brown bands from dorsal to ventral sides of caudal peduncle and a yellowish light brown band slanting forward between them; an obscure lighter band between base of upper and lower procurrent rays and posterior end brown. Upper anterior part of body with scattered iridescent blue or green spots surrounded both above and below with elongate and inwardly curved dark brown spots or roundish spots or having such spots only below or rarely above; black spots scattered mostly on middle to lower anterior parts; a few iridescent bluish or greenish white spots sometimes on caudal peduncle. First dorsal fin mottled with red and yellow with or without black spots; an iridescent blue or green spot behind first spine on middle part (indistinct in Fig. 3); a reddish

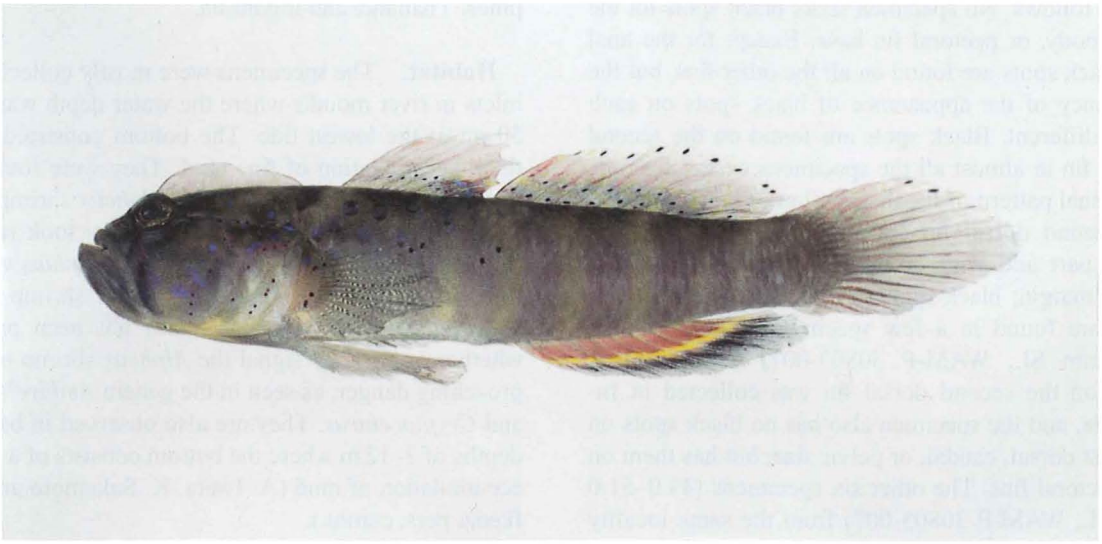

Fig. 3. *Cristatogobius lophius*, BLIH 1986396-3, male, 31.9 mm SL, mouth of Nakama River, Iriomotejima, Okinawa Pref., Japan. Photograph by A. Iwata.

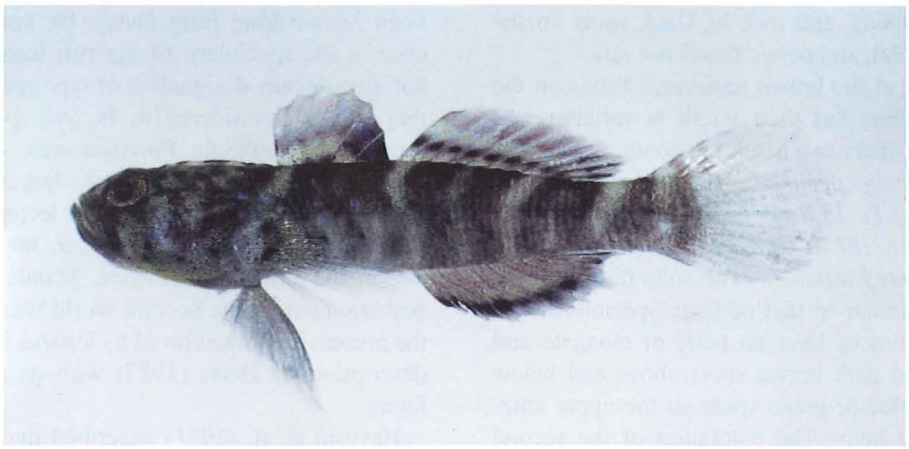

Fig. 4. A young specimen of *Cristatogobius lophius*, BLIH 19891130-1, sex unknown, 13.4 mm SL, mouth of Nakama River, Iriomotejima, Okinawa Pref., Japan. Photograph by A. Iwata.

dark brown area with two iridescent blue or green spots on lower posterior part. Upper margin of second dorsal fin yellow with or without black spots; upper and middle parts of fin mottled with red and yellow; lower part mottled with grey, yellow, and red with black spots in two rows. Anal fin separated into proximal red and distal black areas with a yellow line on red area close to black area. Upper part of caudal fin with broken red stripes on interradial membranes; middle to lower parts with unbroken dark red stripes on interradial membranes; rays and spaces between broken stripes yellow; black spots, when present, on upper half. Pectoral fin base with a black spot or spots, round or elongate, or two connected spots each on upper and lower parts; an iridescent blue or green spot on upper part. Pectoral fin finely mottled with brownish white and grey to blackish; proximal part usually with smaller black spots than those on pectoral fin base. Pelvic fins light brown.

Colour in preservation. — Brown to black markings in life colour remain noticeable in the unfaded specimens. Among these markings a dark brown band from below the posterior part of the nuchal crest running downward and forward on the body is conspicuous in preserved specimens.

Variations found in the distribution of black spots

are as follows. No specimen lacks black spots on the head, body, or pectoral fin base. Except for the anal fin, black spots are found on all the other fins, but the frequency of the appearance of black spots on each fin is different. Black spots are found on the second dorsal fin in almost all the specimens except for one. The usual pattern of the distribution of black spots on the second dorsal fin appears as two rows on the lower part and with or without black spots on the upper margin; black spots in one row instead of two rows are found in a few specimens. The specimen (47.9 mm SL, WAM-P 30803-007) without black spots on the second dorsal fin was collected in Indonesia, and the specimen also has no black spots on the first dorsal, caudal, or pelvic fins, but has them on the pectoral fins. The other six specimens (43.0–51.0 mm SL, WAM-P 30803-007) from the same locality have black spots on the second dorsal fin: four specimens with a row of black spots on the lower part and two specimens with two rows there, and all of them without black spots on the upper margin. Lack of black spots on both sides of the pectoral fins is found in a few specimens, and lack of black spots on the first dorsal, caudal, and pelvic fins is not rare.

The position of the brown transverse bands on the body is invariable, but their width is variable, and there are cases where two bands are connected.

Colour of young specimens of 13.4 mm SL (Fig. 4, BLIH 19891130-1), 13.8 mm SL (BLIH 19891131-3), and 14.2 mm SL (BLIH 19891130-2) photographed immediately after fixation. — The coloration of these specimens is similar to that of large specimens. But the young specimens have no pairs of elongate and inwardly curved dark brown spots above and below the iridescent blue or green spots on the upper anterior part of the body. The coloration of the second dorsal fin also differs to some degree from that of large specimens. The second dorsal fin has a reddish purple area between the yellow upper margin and a yellow spotted longitudinal line on the middle part; on the lower part a row of black spots in the grey area with reddish tinge; basally with yellowish tinge.

Ontogenetic changes in coloration. — Noticeable changes are as follows: appearance of pairs of elongate and inwardly curved dark brown spots surrounding iridescent blue or green spots above and below on upper anterior part of body; development of red and yellow mottling from a yellow spotted longitudinal line and a reddish purple area above it on second dorsal fin.

Distribution. Known from Ishigakijima and Iriomotejima, Okinawa Prefecture, Japan; the Philippines, Thailand, and Indonesia.

Habitat. The specimens were mostly collected in inlets in river mouths where the water depth was 10–50 cm at the lowest tide. The bottom consisted of a thick accumulation of fine mud. They were found in the entrance of burrows dug by *Alpheus* shrimp and other invertebrates. When alarmed they took refuge in the burrows. Three specimens of *C. lophius* which lived in the burrows with the *Alpheus* shrimp were observed while diving, but it has not been proved whether or not they signal the *Alpheus* shrimp of approaching danger, as seen in the genera *Amblyeleotris* and *Cryptocentrus*. They are also observed in bays at depths of 3–12 m where the bottom consists of a thick accumulation of mud (A. Iwata, K. Sakamoto and, Y. Ikeda, pers. comm.).

Remarks. Herre (1927) described *C. lophius* as a new species with three specimens from the Philippines: two specimens of 25 and 22 mm in length without the caudal fin from Sulu Province and a specimen 36 mm long from Panay. He noted the difference in the specimens of the two localities, but did not mention any designation of type specimens. Thus, they are all considered to be syntypes. Later two specimens from Sulu Province were designated by Koumans (1940) as the type (the larger one) and cotype, so they were regarded as the lectotype and paralectotype of *C. lophius*. However, these types were lost in the Bureau of Science, Manila, when it was destroyed during the Second World War. Accordingly, the present identification of *C. lophius* is based on the description by Herre (1927) with its accompanying figure.

Hayashi et al. (1981) described the specimens of Tosakahaze collected at Iriomotejima as *Cristatogobius* sp., stating that they could not be identified as *C. lophius*, because of the difference in the number of dorsal soft rays and the number of dark brown transverse bands on the lateral side of the body: Tosakahaze has VI-I,9 and seven to eight bands, whereas *C. lophius* has VI-I,10 and five to six bands. Regarding the number of soft rays, there were found some specimens of Tosakahaze which had ten soft rays, so that Tosakahaze and *C. lophius* are not distinguishable by this character. Concerning the number of bands, there is a difference in the bands which Herre (1927) and Hayashi et al. (1981) counted. The description of the bands by Herre (1927) is as follows: 'The color in alcohol dark brown, with five or six paler cross-bands on sides'. He did not mention the dark brown bands which Hayashi et al. (1981) counted. As mentioned

above in the life colour of Tosakahaze, the body behind the first dorsal fin is banded alternately with yellowish light brown bands and brown bands from the dorsal to ventral sides, but the body below the first dorsal fin is banded on the lower half, and the upper half is brown with conspicuous or inconspicuous light brown areas. Consequently the brown bands below the first dorsal fin are continuous with the brown upper half of the body, but the yellowish light brown bands below the first dorsal fin do not extend over the upper half of the body. Because of such a difference in the pattern of yellowish light brown bands below the first dorsal fin and those below the second dorsal fin, there is a possibility that the bands below the first dorsal fin were not counted by Herre (1927). If so, the number of paler cross-bands of Tosakahaze coincides well with that of *C. lophius*. Still, the position of bands between Tosakahaze and *C. lophius* in the figure is different: *C. lophius* has a paler cross-band from the dorsal side below the posterior half of the first dorsal fin and two paler cross-bands below the second dorsal fin, whereas Tosakahaze has no paler cross-bands from the dorsal to ventral sides below the first dorsal fin and three paler cross-bands below the second dorsal fin. On the whole the number of bands which Hayashi et al. (1981) mentioned as a character distinguishing Tosakahaze and *C. lophius* is not considered decisive for identification.

As for the other diagnostic characters presented in this paper, the black spots of Tosakahaze are well shown in the following description of *C. lophius* by Herre (1927): 'on base of pectoral are two large black spots, and scattered thinly over sides of head and forward half of body are black dots'. However, black spots on the fins are not mentioned in the description or figure of *C. lophius* except for a small black spot on the proximal part of the pectoral fin in the figure (Herre, 1927: pl. 13, fig. 1). In this respect the aforementioned specimen from Indonesia without black spots on the dorsal and caudal fins but with them on the pectoral fins is the sole specimen which agrees well with the description and figure. Pairs of longitudinally elongate and inwardly curved dark brown spots, which are another diagnostic character of Tosakahaze, are indicated in the figure of *C. lophius* as two pairs of black spots on the body below the second dorsal fin. Though Herre (1927) did not mention that there are two kinds of black spots on the body, the figure clearly distinguishes the paired spots from single spots: paired spots are semicircular and single spots are round. As two diagnostic characters of Tosakahaze agree well with the description by Herre (1927), it is reasonable to assume that Tosakahaze is identical with *C. lophius*.

Akihito (1984) pointed out as a diagnostic character of *C. lophius* the lack of filamentous spines in the first dorsal fin. Our further examination of many specimens revealed that specimens with a filamentous spine or spines are also found, and that the first dorsal fin without a filamentous spine or spines is not a diagnostic character of *C. lophius*. However, the shape of the membranous part of the first dorsal fin and the length of the longest spine of *C. lophius* are usually different from those of *C. aurimaculatus* and *C. nonatoae*. The shape of the membranous part of *C. lophius* is somewhat round or quadrate whereas that of *C. aurimaculatus* and *C. nonatoae* is somewhat triangular with the longest spine at the apex. The tip of the longest spine of most males of *C. lophius* reaches the base of the first to second soft ray of the second dorsal fin when depressed, whereas that of *C. aurimaculatus* reaches the second to seventh soft ray and that of *C. nonatoae* reaches the sixth to beyond the ninth soft ray. Thus, the aforementioned specimen of *C. lophius* (37.3 mm SL, ZUMT-P 58400-3) in which the first dorsal fin is somewhat triangular, with a filamentous longest fourth spine at the apex, is exceptional for *C. lophius*, as it is not possible to distinguish the fin shape from that of *C. aurimaculatus* and *C. nonatoae*. But its coloration completely agrees with that of *C. lophius*. Because of the existence of such a specimen whose first dorsal fin is indistinguishable from that of the other species, this feature is not mentioned in the diagnosis.

Cristatogobius nonatoae (Ablan, 1940)
(Japanese name: Kuro-tosakahaze)
(Fig. 5)

Cristatogobius lophius Herre, 1927 (in part):170 (Panay, Philippines).

Lophogobius nonatoae Ablan, 1940: 376, pl. 2 (Luzon, Philippines).

Cristatogobius albius Chen, 1959: 209, fig. 1 (Tong-Kang, Taiwan).

Cristatogobius nonatoae: Akihito, 1984: 256, pl. 242-L, fig. 101 (Ishigakijima, Okinawa Pref., Japan).

Cristatogobius nonatoae: Akihito et al., 1993: 1035 (Iriomotejima, Okinawa Pref., Japan).

Specimens. BLIH 1955010, (2), 39.7–42.3 mm SL, Dagatdagatan, Malabon, Philippines, 24 Apr. 1955, collected by I. A. Ronquillo. ROM 68203, (2), 33.4–39.4 mm SL, Phuket, Thailand, 22 Nov. 1993, collected by R. Winterbottom et al. TFRI 3929, holotype of *Cristatogobius albius*, 36.5 mm SL, Tong-Kang, Taiwan, Jan. 1959, collected by Y. H. Chia. URM-P 3284, (1), 25.7 mm SL, mouth of Yonada River, Iriomotejima, Okinawa Pref., Japan, 7 June

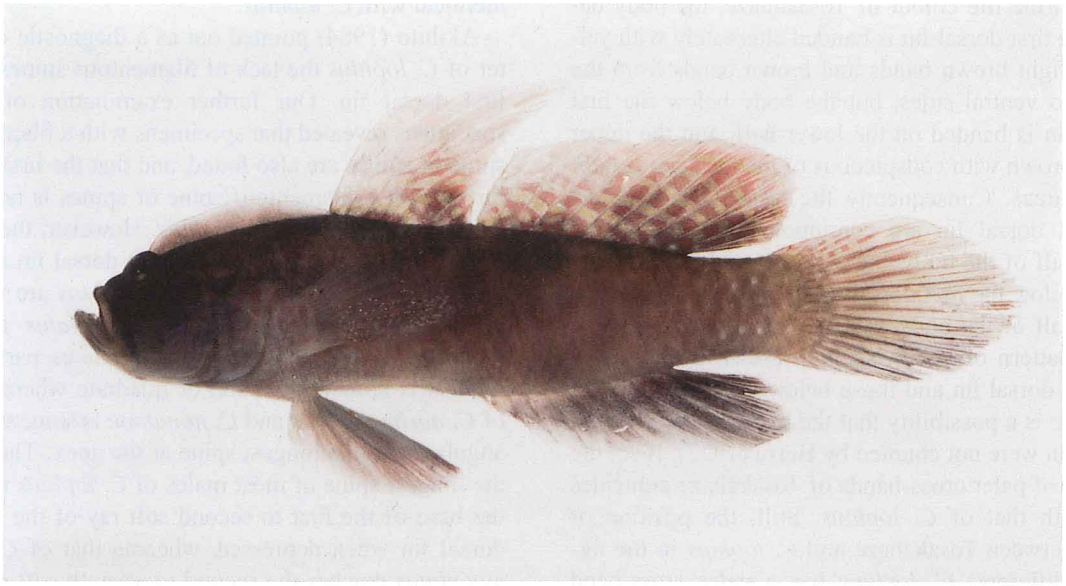

Fig. 5. *Cristatogobius nonatoae*, URM-P 12690, male, 43.,6 mm SL, Phuket Is., Thailand. Photograph by H. Senou.

1982, collected by H. Senou and A. Ono. URM-P 4540, (2), 15.0–17.7 mm SL, mouth of Miyara River, Ishigaki-jima, Okinawa Pref., Japan, 5 Sept. 1982, collected by H. Senou and A. Ono. URM-P 12676, (17), 24.6–40.0 mm SL, same locality as ROM 68203, 2 Nov. 1983, collected by H. Senou. URM-P 12690, (1), 43.6 mm SL, same data as URM-P 12676. YCM-SSP 10375, (1), 27.3 mm SL, mouth of Yonada River, Iriomotejima, Okinawa Pref., Japan, 29 Oct. 1981, collected by H. Senou.

Diagnosis. Colour of specimens immediately after fixation. Head and upper anterior part of body variously streaked with red. Second dorsal fin with several irregular longitudinal rows of red blotches from basal to upper part which are interspaced with yellowish tinge. A red streak on upper and on lower parts of pectoral fin base. Anal fin dark grey with proximal reddish tinge, or black.

Colour in preservation. — Head and body faded without distinct markings.

Description. The counts of meristic characters were taken from specimens collected in Japan. The number of specimens examined is shown in the parentheses. Second dorsal fin rays I, 9 (4); anal fin rays I, 9 (4); pectoral fin rays 16 (4); scales in a longitudinal row 27–29 (4); scales in a transverse row 11–12 (4); predorsal scales 10–12 (4).

Dorsal profile sloping upward from nape to origin of first dorsal fin and sloping downward posteriorly. Body depth of larger specimens greater than that of young specimens: body depth at origin of pelvic fins in percent of standard length of two young specimens (15.0 and 17.7 mm SL) 22.6–24.0%, that of four larger males (32.0–43.6 mm SL) 24.0–26.5%, and that of three larger females (34.0–42.3 mm SL) 25.9–27.2%.

Shape of membranous part of first dorsal fin somewhat triangular with longest spine (usually the fourth spine) at the apex; spines distally connected by membranes except for longest spine which has a filamentous tip. The tip of the longest spine of males (27.4–38.4 mm SL) reaches the base of the sixth to beyond the ninth and the last soft ray of the second dorsal fin when depressed, and that of females (28.3–34.0 mm SL) reaches the base of the third to sixth soft ray of the second dorsal fin. All the specimens including the smallest female (15.0 mm SL, URM-P 4540-2) have a filamentous spine.

Colour of specimens immediately after fixation. — The description is based on the original photograph of a specimen (25.7 mm SL, URM-P 3284) from Japan shown in Akihito (1984: pl. 242-L, 2.8 cm SL) and the photographs of two specimens (39.4 mm SL, ROM 68203 and 43.6 mm SL, URM-P 12690) from Thailand. The larger specimen from Thailand was in good condition when the photograph was taken and is shown in Fig. 5 (43.6 mm SL, URM-P 12690), but the smaller specimen was damaged and its scales were mostly lost when it was photographed. Head

dark brown, variously streaked and spotted with red as well as spotted with blue. Narrow blackish band behind upper lip. Nuchal crest reddish brown with obscure greenish brown blotches. Body brown with dark brown mottling (Fig. 5) or dark brown with obscure darker bands slanting downward posteriorly on upper half (specimen from Japan); upper anterior part variously streaked with red; iridescent bluish white spots scattered on caudal peduncle. First dorsal fin mottled with red and yellow; lower posterior area darker with two blue spots; blue spots with dark red area not seen in specimen in Fig. 5. Second dorsal fin with several irregular longitudinal rows of red blotches from basal to upper part which are interspaced with yellowish tinge; upper margin red. Anal fin dark grey with proximal reddish tinge, or black. Upper part of caudal fin with broken red stripes on interradial membranes and spaces between broken stripes with yellowish tinge; middle to lower parts with dark red stripes on interradial membranes. A red streak each on upper and lower parts of pectoral fin base. Pectoral fin finely mottled with brownish white and grey to blackish. Pelvic fins light brown or black.

The specimens in preservation have the colour of the head and body faded, and no definite colour marks are present. Fins are coloured as follows: a brown to blackish spot on lower posterior part of first dorsal fin; anal fin brown to black; pelvic fins light brown to blackish; colour of other fins lighter.

Distribution. Known from Ishigakijima and Iriomotejima, Okinawa Prefecture, Japan; Taiwan, the Philippines, and Phuket, Thailand.

Habitat. In Iriomotejima, the specimens were collected in river mouths at depths of 1 m or less in hollows 20–30 m in diameter, which become tide pools at low tide. They were collected with *C. lophius*, *Oxyurichthys ophthalmonema*, and *Taenioides limicola* (H. Senou, pers. comm.).

Remarks. *C. nonatoae* was originally described as *Lophogobius nonatoae* by Ablan (1940). He discussed the difference between the genera *Cristatogobius* and *Lophogobius*, and referred to *Cristatogobius* as having a pointed caudal and canines. But this statement is contradictory to his assignment of *nonatoae* to *Lophogobius*, because he described *L. nonatoae* as having a pointed caudal and a posterior lateral pair of large backward-curved canines in the outer row of the lower jaw. He should have assigned it to *Cristatogobius* in view of his discussion of the two genera and his description of *Lophogobius*.

Ablan's (1940) type specimens were all lost during the Second World War. The specimens described in this paper can be identified as *C. nonatoae* through comparison with the original description and figure of Ablan (1940) with such characters as 'reddish streaks on base of pectoral' and 'second dorsal cross-barred with reddish bars in four rows' in addition to the rise in dorsal profile. However, Ablan's figure shows that the first dorsal fin has three filamentous spines instead of one.

Herre (1927) wrote about a fine adult male specimen 36 mm long from Panay, the Philippines, which he had received shortly before and in which he found some differences from the two specimens from Sulu Province, the Philippines. He reported that this specimen had 'the color bluish slate' and 'no black spots on sides or pectoral base'. These characters indicate it to be *C. nonatoae*.

C. albius Chen, 1959 is identified as *C. nonatoae* by the original description and figure with such diagnostic characters as 'uniformly grey without any mark on the sides' and 'the color of the anal and ventrals are (sic) very dark, almost blackish' in addition to the rise in dorsal profile. However, the description and figure show the first dorsal fin has three filamentous spines instead of one.

C. nonatoae is distinguished from *C. aurimaculatus* (as *C.* sp. 2) by Akihito et al. (1993a) by the following characters: the slight rise in the dorsal profile centred on the area below the first dorsal fin and the light coloured spots on the second dorsal fin which are regularly arranged. The dorsal profile of *C. nonatoae* looks higher in the area below the first dorsal fin than in the other two species, and the measurement of the body depth at the origin of the pelvic fins of *C. nonatoae* indicates such a tendency, but the values of *C. nonatoae* and the other two species overlap and are not clearly distinguishable. Thus, the character of the dorsal profile is not considered to be appropriate for diagnosis. With respect to the coloration of the second dorsal fin, *C. nonatoae* has several irregular longitudinal rows of red blotches interspaced with yellowish tinge, and as light coloured markings are not arranged in regular rows and do not form spots, the character of the second dorsal fin is revised.

Key to the Species of the Genus *Cristatogobius* (based on the adult life colour*)

1a. Black spots on head, body, and pectoral fin base; several brown transverse bands from dorsal to ventral sides of body; anal fin separated into

proximal red and distal black areas with a yellow line on red area close to black area
.....*C. lophius*

1b. No black spots on head, body, or pectoral fin base; no transverse bands from dorsal to ventral sides of body; anal fin without separated colour patterns 2

2a. Second dorsal fin purple scattered with yellow spots; two brown bands below nuchal crest**
.....*C. aurimaculatus* sp. nov.

2b. Second dorsal fin with several irregular longitudinal rows of red blotches from basal to upper part which are interspaced with yellowish tinge; no bands below nuchal crest .....*C. nonatoae*

* Brown to black marks remain in the specimens in preservation.

** Two brown bands are conspicuous in the specimens in preservation.

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