

Cynoglossus ochiaii, a New Tongue Sole from Japan (Pleuronectiformes: Cynoglossidae)

Kōji Yokogawa¹, Hiromitsu Endo² and Hideo Sakaji³

¹ 13–5 Higashihama, Tadotsu-cho, Nakatado-gun, Kagawa 764–0016, Japan
E-mail: gargariscus@ybb.ne.jp

² Laboratory of Marine Biology, Faculty of Science, Kochi University, 2–5–1
Akebono-cho, Kochi 780–8520, Japan

E-mail: endoh@kochi-u.ac.jp

³ National Research Institute of Fisheries Science, Fisheries Research Agency,
2–12–4 Fukuura, Kanazawa, Yokohama, Kanagawa 236–8648, Japan
E-mail: hidekun@fra.affrc.go.jp

Abstract *Cynoglossus ochiaii* sp. nov. is described on the basis of 28 specimens from Tosa Bay, off Kochi, and Kagoshima Bay, southern Japan. Formerly regarded as a variation of *C. interruptus*, the latter being originally diagnosed as having 2 lateral lines, the new species differs from its congeners by the following combination of characters: 3 continuous ocular side lateral lines; 2 nostrils on each side; eyes large, without interorbital space; dorsal-fin rays 104–112; anal-fin rays 83–88; pored scales on dorsolateral line 66–79, midlateral line 67–73, ventrolateral line 38–62, mandibulo-opercular line 15–20 and cephalodorsal line 6–9; scales above dorsolateral line 3–4; scales between dorsolateral and midlateral lines 11–12; supraorbital and midlateral lines present; posterior marginal flap of each pored lateral-line scale blackish; body uniformly brown; dorsal and anal fins dark brown to blackish, with dappled marks on ocular side, uniformly dense pigmentation on blind side; maximum size about 180 mm in standard length. A bottom-dweller, the new species is found in depths of ca. 50–220 m around the southern half of Honshu, Shikoku and Kyushu Islands (Japan), and in the East China Sea.

Key words: Cynoglossidae, *Cynoglossus*, new species, southern Japan, 3 lateral lines

The cynoglossid genus *Cynoglossus* Hamilton, 1822, including about 50 species, is distributed from off the Atlantic coast of Africa to Indo-West Pacific waters (Menon, 1977). Among the 11 species recorded from Japan (Yamada, 2002), the genko sole, *Cynoglossus interruptus* Günther, 1880, was recognized on the basis of 2 specimens collected from a Yokohama market (located along Tokyo Bay) (Menon, 1977: 46), and diagnosed by having 2 lateral lines dorsally and medially on the ocular side, the dorsal line being short, undulating and partly interrupted (Menon, 1977). However, Jordan and Starks (1906) recorded Japanese “*C. interruptus*” on the basis of specimens with 3 lateral lines (dorsolateral, midlateral and ventrolateral; being a supposed variation), and transferred the species to the

genus *Areliscus* Jordan and Snyder, 1900 (type species: *Cynoglossus joyneri* Günther, 1878), diagnosed by having 3 lateral lines. Although Wu (1932) recognized 2 lateral lines as distinguishing *C. interruptus* from other Chinese cynoglossids, Ochiai (1959, 1963) and Menon (1977) followed Jordan and Starks’s view that the 3 lateral-line condition was an intra-specific variation. Subsequently, most ichthyologists have accepted 3 lateral lines as characteristic of *C. interruptus* (Ochiai, 1965; Yamada, 1986; Amaoka *et al.*, 1995), such being an important character distinguishing the species from other Japanese cynoglossids (e.g., Matsubara, 1955; Yamada, 1993, 2002). On the other hand, Sakamoto (1997) and Sanada (1997) recognized only 2 lateral lines as being diagnostic of *C. interruptus*.

Furthermore, Shimizu and Watanabe (1997) questioned the taxonomic treatment of *C. interruptus* sensu Jordan and Starks (1906), and suggested that the difference in lateral-line numbers had specific significance.

A recent isozymic analysis by Yokogawa *et al.* (2008) revealed that the 2 forms of "*C. interruptus*" were genetically distinct at the specific level. Because 1 of the 2 syntypes (BMNH 1879.5.14.92 and 1890.2.26.146) clearly has 2 lateral lines (Menon, 1977: the former is shown as "holotype" in fig. 21), we herein describe the form with 3 lateral lines as a new species.

Materials and Methods

Specimens examined in this study are deposited in the following institutions: Laboratory of Marine Biology, Faculty of Science, Kochi University (BSKU); Faculty of Agriculture, Kyoto University (FAKU); Laboratory of Marine Zoology, Hokkaido University (HUMZ); Kagoshima University Museum (KAUM); National Museum of Nature and Science (NSMT, formerly National Science Museum, Tokyo).

Specimens were collected by the R/V *Kotakamaru* using an otter trawl in Tosa Bay, Kochi, during a sampling planned and operated by H. Honda (FSF: National Research Institute of Far Sea Fisheries, Fisheries Research Agency), and H. Sakaji and K. Nashida (NRIFS: National Research Institute of Fisheries Science, Fisheries Research Agency), under a joint research venture of NRIFS, NSMT and BSKU from 1997 to 2000 (Shinohara *et al.*, 2001).

Counts and measurements follow Ochiai (1963) and Hubbs and Lagler (1970), in addition to the following: distance from tip of fleshy snout to angle of mouth (DSM); distance from tip of lower jaw to angle of mouth (DLM); last 2 rays of dorsal and anal fins counted separately. Lateral line terminology follows Ochiai (1966). Cephalic lateral lines and measurements are shown in Fig. 1. Counts of pored scales and scale rows are as follows: cephalodorsal line (CDL), dorsolateral line (DLL) and midlateral line (MLL) excluding

scales on the supraorbital commissure (SOC); all pored scales on the ventrolateral (VLL) and mandibulo-opercular lines (MOL) were counted; SOC scales were counted from the uppermost (between CDL and DLL) to the lowermost [between SOL and preopercular line (POL)], and POL scales from the uppermost (next to connecting scale between SOL and POL); scales above DLL (SADLL), between DLL and MLL (DLL-MLL), between MLL and VLL (MLL-VLL), and below VLL (SBVLL) were counted at the maximum body depth, excluding each lateral line scale. Standard length and head length are abbreviated as SL and HL, respectively. Fin rays and vertebrae were counted from radiographs.

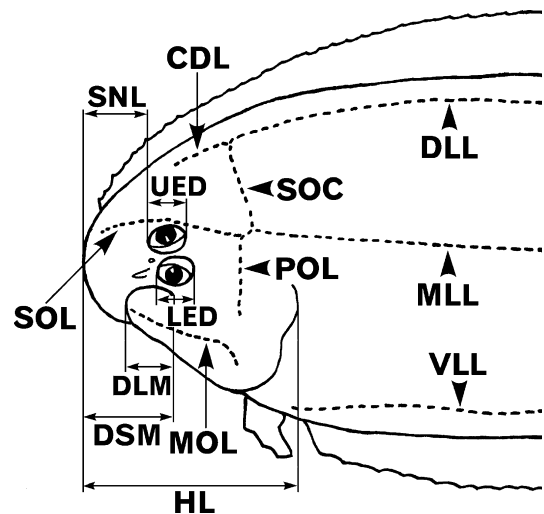


Fig. 1. Head measurements and lateral-line descriptions for *Cynoglossus ochiaii*. DLL: Dorsolateral line; MLL: Midlateral line; VLL: Ventrolateral line; CDL: Cephalodorsal line; SOL: Supraorbital line; MOL: Mandibulo-opercular line (modified term from Ochiai, 1966); SOC: Supraorbital commissure; POL: Preopercular line; HL: Head length; SNL: Snout length; UED: Upper eye diameter; LED: Lower eye diameter; DSM: distance from tip of fleshy snout to angle of mouth; DLM, distance from tip of lower jaw to angle of mouth.

Cynoglossus ochiaii sp. nov.

(New Japanese name: Oki-genko)

(Figs. 2–4, 6A, 6C, 7, Tables 1–3)

Areliscus interruptus (not of Günther): Jordan and Starks, 1906: 240 (in part; description); Hubbs, 1915: 494 (list); Jordan and Hubbs, 1925: 302 (list); Okada and Matsubara, 1938: 438 (in part; key); Kuroda, 1951: 390 (in part; list); Matsubara, 1955: 1286 (key); Tomiyama *et al.*, 1958: 32, pl. 89 (brief description and illustration); Kuroda, 1962: 5 (Izu Peninsula, off Ida and Toi, depths around 150 and 180 m; brief description).

Cynoglossus interruptus (not of Günther): Ochiai, 1959: 202 [in part; South China Sea to Japan (south of Muro-ran, Hokkaido), depths around 100 m; description]; Ochiai, 1963: 82, pl. XVIII [in part; Japan (south of Muro-ran) to Korea, Phillipines, around 100 m; description and illustration]; Ochiai, 1965: 498, pl. 1402 (in part; brief description); Menon, 1977: 45 (in part; description and synonymy); Ochiai, 1984: 341, pl. 320-G (in part; brief description); Kamohara and Okamura, 1985: 63, pl. 134–667 (in part; brief description); Ya-

mada, 1986: 412 (in part; brief description and color photograph); Ochiai, 1987: 929, pl. 3714 (in part; brief description); Ochiai, 1988: 341, pl. 320-G (in part; brief description); Abe and Ochiai, 1989: 220 (brief description and illustration); Yamada, 1993: 1194 (pictorial key; illustration with 3 lateral lines); Yamada *et al.*, 1995: 213, pl. 301 (brief description and illustration with 3 lateral lines); Yamada, 2000: 1391 (pictorial key; illustration with 3 lateral lines); Shinohara *et al.*, 2001: 336 (list; noted that all specimens have 3 lateral lines; central Tosa Bay, ca. 100–150 m); Kim *et al.*, 2001: 290 (in part; brief description); Choi *et al.*, 2002: 551 (brief description); Yamada, 2002: 1391 (pictorial key; illustration with 3 lateral lines); Youn, 2002: 442, 688 (in part; pictorial key); Kim *et al.*, 2005: 488 (in part; brief description); Ochiai, 2005: 929 (in part; brief description); Yamada *et al.*, 2007: 1158 (in part; brief description and illustration).

Cynoglossus sp.: Yokogawa *et al.*, 2008: 81 (trilinear form with 3 lateral lines).

Holotype. NSMT-P 76853 (formerly BSKU 74196), 132 mm SL, Tosa Bay, 33°17.2'N, 133°36.6'E–33°15.5'N,



Fig. 2. *Cynoglossus ochiaii*, holotype in preserved condition, NSMT-P 76853, 132 mm SL, ocular side (above) and blind side (below). Photographed by H. Endo.

133°36.9'E, 129–152 m, R/V *Kotaka-maru*, 17 Jan. 2005.

Paratypes. 27 specimens from Tosa Bay and Kagoshima Bay: BSKU 51502, 159 mm SL, Mimase fish market (bottom trawl), Kochi City, Kochi Prefecture, 8 Mar. 2000; BSKU 51840, 136 mm SL, 33°25.4'N, 133°34.9'E–33°24.8'N, 133°34.5'E, 56–59 m, R/V *Kotaka-maru*, 25 Aug. 2000; BSKU 54387, 179 mm SL, Saga fishing port, Kuroshio Town, Kochi Prefecture, 25 Apr. 2002; BSKU 75148, 112 mm SL, BSKU 75149, 111 mm SL, Kami-kawaguchi fishing port, Kuroshio Town, Kochi Prefecture, 3 July 2000; BSKU 75580, 116 mm SL, BSKU 75582, 122 mm SL, 33°20.1'N, 133°35.7'E–33°19.7'N, 133°34.8'E, 100 m, R/V *Kotaka-maru*, 23 Aug. 2004; BSKU 75979, 132 mm SL, 33°20.6' N, 133°35.6'E–33°19.4'N, 133°35.0'E, 96–105 m, R/V *Kotaka-maru*, 17 Jan. 2005; BSKU 78261, 84 mm SL, 33°18.4'N, 133°31.9'E–33°17.6'N, 133°30.4'E, 99–100 m, R/V *Kotaka-maru*, 17 June 2004; BSKU 82848, 146 mm SL, Mimase fish market (bottom trawl), Kochi City, Kochi Prefecture, 14 Dec. 1996; BSKU 82958, 157 mm SL, Mimase fish market (bottom trawl), Kochi City, Kochi Prefecture, 5 Oct. 1996; BSKU 85665, 148 mm SL, 33°19.3'N, 133°33.3'E–33°18.8'N, 133°33.0'E, 97–99 m, R/V *Kotaka-maru*, 7 Sep. 1998; BSKU 85981, 124 mm SL, Mimase fish market (bottom trawl), Kochi City, Kochi Prefecture, 17 Dec. 1998; BSKU 89766, 155 mm SL, BSKU 89767, 163 mm SL, BSKU 89771, 125 mm SL, BSKU 89772, 151 mm SL, BSKU 89773, 133 mm SL, Kami-kawaguchi fishing port, Kuroshio Town, Kochi Prefecture, 27 Apr. 2006; KAUM-I. 5870, 143 mm SL, KAUM-I. 6028, 164 mm SL, KAUM-I. 6031, 133 mm SL, KAUM-I. 6035, 139 mm SL, KAUM-I. 6036, 153 mm SL, KAUM-I. 6037, 145 mm SL, 31°37.46'N, 130°37.11'E, 140 m, off west coast of Sakurajima, Kagoshima Bay, Kagoshima Prefecture, bottom trawl, coll. by Isao Hidaka, 28 July 2007; NSMT-P 57366, 126 mm SL, 33°18.08'N, 133°36.76'E–33°17.83'N, 133°37.19'E, 123–127 m, R/V *Kotaka-maru*, 17 Jan. 1998; NSMT-P 76854 (144 mm SL, formerly BSKU 89769), Kami-kawaguchi fishing port, Kuroshio Town, Kochi Prefecture, 27 Apr. 2006; NSMT-P 76855 (103 mm SL, formerly BSKU 89784), Mimase fish market (bottom trawl), Kochi City, Kochi Prefecture, 5 Apr. 2007.

Non-types. 38 specimens from Tosa Bay, Kagoshima Bay, and off Shimabara: BSKU 51503, 127 mm SL, Mimase fish market (bottom trawl), Kochi City, Kochi Prefecture, 8 Mar. 2000; BSKU 58738 and 58739, 90–122 mm SL, 33°22.8'N, 133°33.9'E–33°22.7'N, 133°34.4'E, 74–77 m, R/V *Kotaka-maru*, 12 Jan. 2001; BSKU 81360 (6 specimens), 76–147 mm SL, 33°21.81'N, 133°35.85'E–33°20.89'N, 133°34.81'E, 86–90 m, R/V *Toyohata-maru*, 15 Dec. 1992; BSKU 86269–86277, 103–177 mm SL, collected with the paratype of BSKU 85665; BSKU 91030, 78 mm SL, 33°26.01'N, 133°33.62'E–33°25.

57'N, 133°32.29'E, 46–47 m, R/V *Toyohata-maru*, 15 Dec. 1992; BSKU 91031–91032, 77–80 mm SL, 33°24.51'N, 133°34.47'E–33°23.95'N, 133°33.21'E, 63–64 m, R/V *Toyohata-maru*, 15 Dec. 1992; NSMT-P 57493, 147 mm SL, 33°16.80'N, 133°38.76'E–33°16.55'N, 133°39.11'E, 144–154 m, R/V *Kotaka-maru*, 8 Dec. 1998; FAKU 4119, 131 mm SL, Kumano Sea, off Kii Peninsula, Jan. 1937; FAKU M8888, 121 mm SL, Kanaiwa, Ishikawa Prefecture, 26 Oct. 1942; FAKU 11444 and 11445, 142–151 mm SL, Okinoshima Islands, Shimane Prefecture, Nov. 1948; FAKU 13735, 126 mm SL, Kasumi, Hyogo Prefecture, 17 Aug. 1950; FAKU 13938, 127 mm SL, Owase, Mie Prefecture, 20 Sep. 1950; FAKU 19438, 111 mm SL, FAKU 19446, 111 mm SL, Nobeoka, Miyazaki Prefecture, 10 Dec. 1952; KAUM-I. 464, 131 mm SL, 31°28.13'N, 130°37.82'E–31°28.32'N, 130°38.31'E, 220 m, off Tarumizu, Kagoshima Bay, Kagoshima Prefecture, bottom trawl, coll. by Katsumi Nakahata, 15 Mar. 2006; KAUM-I. 5874, 6027, 6029, 6030, 6032, 6034, 121–156 mm SL, collected with the paratypes of KAUM; uncatalogued specimen of Nagasaki University, 122 mm SL, off Shimabara, Nagasaki Prefecture, ca. 50 m, 20 Dec. 2007.

Diagnosis. A relatively small species of *Cynoglossus* with the following combination of characters: 3 lateral lines (dorsolateral, midlateral and ventrolateral) on ocular side; no lateral line on blind side; cephalodorsal line scales 6–9; dorsolateral line scales 66–79; midlateral line scales 67–73; ventrolateral line scales 38–62; scales above dorsolateral line 3–4; scales between dorsolateral and midlateral lines 11–12; pored scales with well developed blackish posterior flap present on dorsolateral, midlateral, cephalodorsal and mandibulo-opercular lines; eyes contiguous; mouth without fringe, reaching posteriorly to vertical line at middle of lower eye; 2 nostrils on ocular side; anterior nostrils developed, tubular; dorsal and anal fins with dark brown to blackish dapples; dorsal-fin rays 104–112; anal-fin rays 83–88; caudal-fin rays 10; vertebrae 8–9+43–45=52–54.

Description. Proportional characters and counts are shown in Table 1. Body elongate, extremely depressed, highest point at anterior one-third of body length, 27.9–32.2% SL. Entire body covered with small ctenoid scales. Eyes on left side of head, moderately large, diameter about 12.3–17.6% HL. Upper eye slightly anteri-

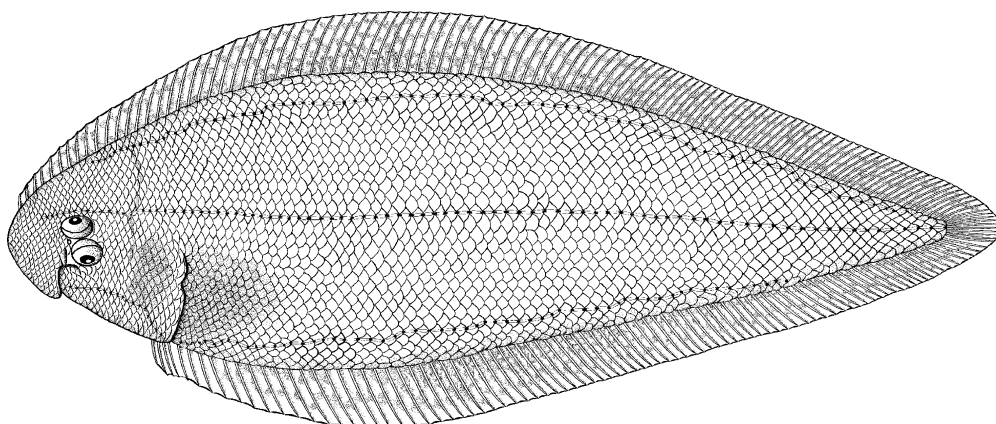


Fig. 3. *Cynoglossus ochiaii*, paratype, BSKU 85665, 148 mm SL. Drawn by K. Yokogawa.

or to lower eye. No interorbital space. Snout rounded, covered with fine scales. Two widely-spaced nostrils on each side: anterior nostril tubular, in front of lower eye, posterior nostril lacking tube or flap, immediately between eyes. Nasal tube on ocular side larger than that on blind side. Mouth moderately large, upper jaw mostly covered by large rostral hook. Narrow bands of small conical teeth on jaws on blind side, teeth absent on ocular side. Posterior margin of operculum almost vertical, with slight indentation on middle portion. Both gill membranes united ventrally, forming shallow fold, free from isthmus. Gill arches lacking rakers. Anus located near anal-fin origin, opening somewhat posterior to pelvic fin on blind side.

All fins continuous, comprising unbranched soft rays. Both pectoral fins absent. Unpaired pelvic fin with 4 rays, located just below preopercular angle. Dorsal- and anal-fin bases very long. Dorsal-fin origin at middle of snout, anal-fin origin just posterior to vent.

Lateral-line system on ocular side includes cephalodorsal, supraorbital, preopercular and mandibulo-opercular lines, and supraorbital commissure on head, and dorsolateral, midlateral and ventrolateral lines on trunk (Figs. 1–3). Cephalodorsal line short, comprising 6–9 pored scales. Supraorbital and mandibulo-opercular lines somewhat longer than cephalodorsal line. Dorsolateral line undulating, running posteriorly

along dorsal margin of body to near caudal base. Midlateral line running almost straight across center of trunk to caudal base. Ventrolateral line undulating, running posteriorly along ventral margin of body and terminating at about 3-quarters length of anal-fin base (Fig. 3). Each pored scale on dorsolateral, midlateral, cephalodorsal and mandibulo-opercular lines with a well developed, dark colored (almost black) flap on posterior margin (Fig. 6A, C). No scale row between rows connected with SOL and MLL (Fig. 7A). Scales above dorsolateral line 3–4, below ventrolateral line 2–3. No lateral-line systems on blind side.

Color when fresh (Fig. 4). On ocular side, head and body almost uniformly brown to dark brown with blackish to dark blueish opercular and abdominal regions, vertical fins dark brown to blackish with dappled marks. On blind side, head and body uniformly pale white, vertical fins uniformly dark brown to blackish. Dorsal fin rays on anterior of head whitish, pelvic fin pale.

Color in alcohol (Fig. 2). On ocular side, head, body and vertical fins more yellowish than fresh condition. On blind side, head and body uniformly tan with blackish opercular and abdominal region, vertical fins brown to darkish brown, uniformly and densely pigmented. Peritoneum dark.

Distribution and habitat. *Cynoglossus ochiaii* has been recorded from the Pacific coasts

Table 1. Proportional measurements and counts of *Cynoglossus ochiaii*, *C. interruptus* and *C. nigropinnatus*. Abbreviations of characters given in text and Fig. 1.

	<i>C. ochiaii</i>		<i>C. interruptus</i>	<i>C. nigropinnatus</i>
	Holotype NSMT-P76853	Paratypes 27 specimens	BSKU 56 specimens	BSKU 15 specimens
SL (mm)	132	84–179	63–153	90–206
As % of SL		Range (Mean)	Range (Mean)	Range (Mean)
Body depth	30.9	27.9–32.2 (30.4)	23.7–30.4 (27.2)	31.5–36.2 (33.7)
Dorsal-fin ray length	7.1	6.6–10.0 (8.3)	5.9–10.7 (7.7)	9.6–11.2 (10.3)
Anal-fin ray length	7	6.5–9.8 (8.4)	6.1–10.6 (7.9)	9.7–11.1 (10.6)
Pelvic-fin ray length	6.5	5.2–7.5 (6.2)	4.0–7.6 (6.0)	5.6–6.9 (6.2)
Head length (HL)	20.2	18.8–22.5 (20.8)	17.3–22.1 (20.2)	18.0–21.6 (19.7)
As % of HL				
Snout length	31.6	28.6–36.7 (32.1)	25.7–40.0 (31.3)	24.6–28.4 (26.4)
Upper eye diameter	15.8	12.3–17.6 (14.7)	11.6–20.5 (15.3)	15.2–17.8 (16.0)
Lower eye diameter	16.5	13.4–16.5 (14.8)	12.0–20.4 (15.3)	15.1–18.2 (17.2)
DSM	48.5	39.6–50.5 (46.6)	35.0–53.2 (42.6)	38.2–46.7 (43.6)
DLM	20.7	19.0–23.6 (20.8)	18.6–26.8 (22.0)	21.4–29.4 (25.1)
Counts				
Dorsal-fin rays	108	104–112 (108.4)	105–114 (108.9)	107–112 (109.7)
Anal-fin rays	85	83–88 (85.3)	81–91 (84.4)	86–90 (87.7)
Caudal-fin rays	10	10 (10.0)	9–10 (9.9)	9–10 (9.9)
Abdominal vertebrae	9	8–9 (9.0)	8–10 (8.9)	9 (9.0)
Caudal vertebrae	44	43–45 (43.8)	42–45 (43.9)	44–46 (45.0)
Total vertebrae	53	52–54 (52.8)	51–55 (52.8)	53–55 (54.0)
Pored scales on				
CDL	7	6–9	0–7	14–15
MOL	6+	15–20	12–18	18–21
SOC	11	10–11	9–16	10–11
POL	4+	4–7	4–7	6–10
DLL	70	66–79	18–38	99–113
MLL	69	67–73	60–75	69–75
VLL	41	38–62	none	98–104
SADLL	3	3–4	2–3	7–8
DLL-MLL	12	11–12	10–12	11
MLL-VLL	12	10–13		11–12
SBVLL	3	2–3		6–7

of Honshu, Shikoku and Kyushu Islands, including Owase (Mie), Kumano Sea (off the East of Kii Peninsula), Tosa Bay (off Kochi), Nobeoka (Miyazaki), Kagoshima Bay (Kagoshima), Shimabara (Nagasaki), and from the Sea of Japan, including Kanaiwa (Ishikawa), Kasumi (Hyogo) and Okinoshima Islands (Shimane). It is apparently distributed from southern Japan, southward to the East China Sea, in depths of ca. 50–220 m (Ochiai, 1959, 1963; Kuroda, 1962; Shinohara *et al.*, 2001; Yamada *et al.*, 2007; this study). In Tosa Bay, specimens were trawled from sandy or mud-sandy bottoms in depths of 46–154 m. In Kagoshima Bay, 1 specimen was collected from 220 m deep.

Etymology. The new species is named after Dr. Akira Ochiai, Emeritus Professor of Kochi University, for his great contributions to the taxonomy of Japanese cynoglossids. On the other hand, the new Japanese name “Oki-genko” indicates its deeper range (“oki” meaning “offshore”) in comparison with that of “Genko” (Japanese name of *C. interruptus*, occurring near shore).

Remarks. In his systematic monograph of *Cynoglossus*, Menon (1977) included “*C. interruptus*”, including *Cynoglossus nigropinnatus* Ochiai, 1963 as a junior synonym [although now considered a valid species (Yamada, 2002)] and specimens with 3 lateral lines (now *C. ochiaii*) as an intra-specific variation, in the *kopsii* complex

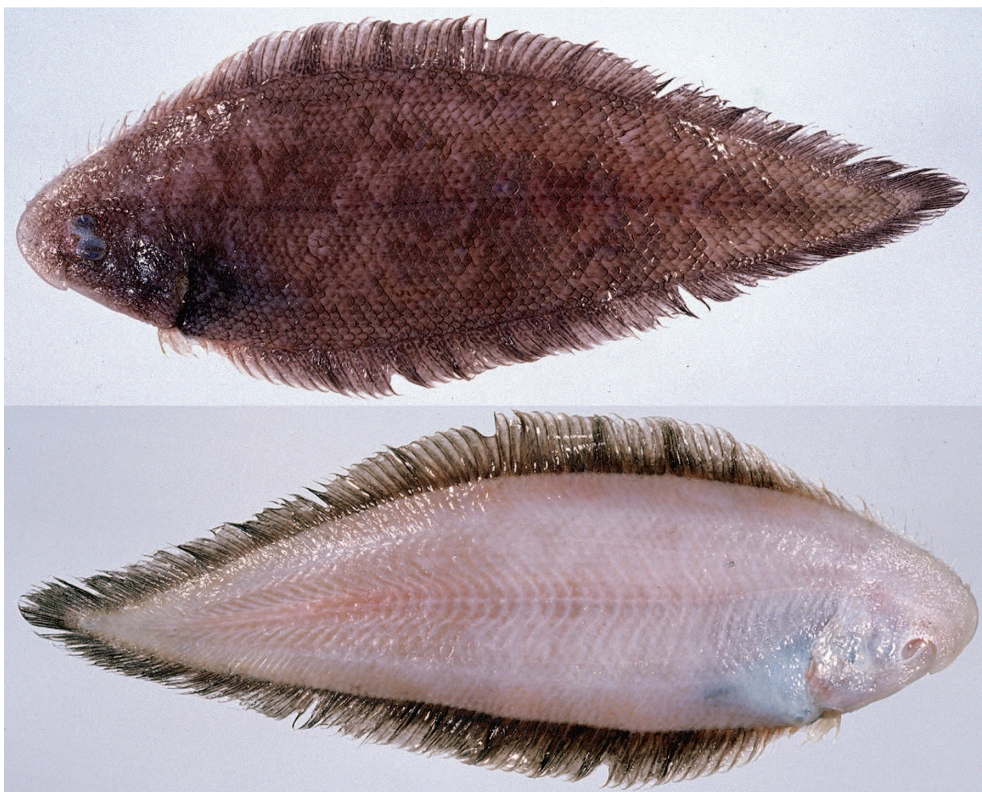


Fig. 4. *Cynoglossus ochiaii*, paratype in fresh condition, BSKU 85665, 148 mm SL, ocular side (above) and blind side (below). Photographed by H. Endo.

of the *kopsii* group, together with *Cynoglossus kopsii* (Bleeker, 1851) and *Cynoglossus joyneri* Günther, 1878 (the original spelling of “*kopsii*”, rather than “*kopsi*”, is used here as the group-name).

The *kopsii* group, including 5 species' complexes [*kopsii* (3 species), *itinus* (1), *ogilbyi* (3), *ecaudatus* (4) and *sealarki* (4)], shares “smaller adult size, large eyes, either contiguous or with a very narrow interorbital space, 2 nostrils, the posterior one occasionally hidden under scales or absent, short obtusely pointed snout with the angle of the mouth situated nearer to tip of snout than to branchial opening, 1 to 3 lateral lines on ocular side, the dorsolateral and ventrolateral either absent or incomplete, no lateral line on blind side, 10 or 8 rays in the caudal fin, and large scales” (Menon, 1977: 42). The *kopsii* complex, however, differs from other species of the *kopsii*

group by having the following combination of characters: 10 caudal-fin rays, 7–12 interlinear scale rows, 2 nostrils on each side and “the dorsolateral line extending to varying distances along the dorsal contour (when the ventrolateral line is absent) or with an uninterrupted dorsolateral line (when the ventrolateral line is present)”. We follow Menon's classification for these subgroups in *Cynoglossus*, because the *kopsii* group and complex are easily separable from the other groups and species' complexes, respectively.

Among the *kopsii* complex, *C. ochiaii* closely resembles *C. interruptus* in general appearance, but clearly differs in having a long and continuous DLL with 66–76 pored scales (short and interrupted with 18–38 pored scales in *C. interruptus*: see “holotype” illustration in Menon, 1977: Fig. 21), VLL present (absent), usually 3 SADLL (usually 2) (Table 2), no scale row be-

tween rows connected with SOL and MLL (one row) (Fig. 7), 6–9 (mean 7.2, $n=14$) CDL scales (0–7, mean 2.7, $n=22$), 15–20 MOL scales (12–18), posterior margin of pored scales on DLL, MLL, CDL and MOL with blackish, well-developed flap (without flap) (Fig. 6), body uniformly dark brown on ocular side (usually light brown with brown dapples), uniformly whitish on blind side (usually white with somewhat orange regions near dorsal and anal-fin bases when fresh), dorsal and anal fins dark brown to blackish with dappled marks on ocular side and fin membranes uniformly densely pigmented on blind side (blackish marks on fin rays, fin membranes mostly translucent on ocular side, blind side pigmentation sparse or absent) (Figs. 4, 5). In addition, the body depth of *C. ochiaii* is somewhat greater than that of *C. interruptus* (27.9–32.2 vs. 23.7–30.4% SL) and scales of the former seemed to be the more deciduous.

On the other hand, *C. ochiaii* is easily separable from *C. nigropinnatus*, as follows: lower

body depth 27.9–32.2% SL (31.5–36.2 in *C. nigropinnatus*), anterior nostril on blind side tubular and well developed (rudimentary), snout moderately long, its length 28.6–36.7% HL (short, 24.6–28.4), 3–4 SADLL (7–8), body brown (blackish-brown), dorsal and anal fins dark brown with dappled marks (uniformly blackish).

Cynoglossus ochiaii is also clearly distinguished from *C. kopsii* by having a long and continuous VLL (if present, extending to a varying degree in *C. kopsii*; lacking in NSMT-P 68318) and the body uniformly colored on the ocular side (with irregular darker spots), and from *C. joyneri* by having large eyes (diameter

Table 2. Scale counts above dorsolateral line of 2 *Cynoglossus* species.

Scales	2	3	4
<i>C. ochiaii</i>		45	3
<i>C. interruptus</i>	41	6	



Fig. 5. *Cynoglossus interruptus* in fresh condition, BSKU 93226, 114 mm SL, ocular side (above) and blind side (below). Photographed by H. Endo.

12.3–16.7% HL) without an interorbital space (small with narrow interorbital space in *C. joyneri*; upper and lower eyes 6.4 and 7.3% HL, respectively, in BSKU 62474), and the mouth angle on the ocular side reaching posteriorly to a vertical through the middle of the lower eye (to a vertical through the posterior eye margin).

In some *Cynoglossus* species, differences in lateral-line numbers and conditions on the ocular side have been regarded as intra-specific variations (Ochiai, 1959, 1963, 1966; Menon, 1977). However, in the *kopsii* complex, the present example of “*C. interruptus*” suggests that *C. kopsii*, which has similar lateral-line variations, may also involve more than 1 species (Menon, 1977: fig. 20).

Most previous records and descriptions of “*C. interruptus*” have included those of material now referable to *C. ochiaii* (e.g., Ochiai, 1963, 1984; Yamada, 2002). Among them, some have included diagnostic characters of both species, in addition to a color photograph or illustration of *C. interruptus* (Ochiai, 1984, 2005; Amaoka *et al.*, 1995; Yamada *et al.*, 2007). Thus, the distribution of each species based on such reports is uncertain. Our reexamination of some FAKU specimens of “*C. interruptus*” used by Ochiai (1959, 1963), excluding those from Tosa Bay, revealed that *C. ochiaii* has also been collected from off the Pacific coasts of Honshu and Kyushu Islands [Owase (Mie), Kumano Sea (off the east of Kii Peninsula) and Nobeoka (Miyazaki)], and from the Sea of Japan [Kanaiwa (Ishikawa), Kasumi (Hyogo), and Okinoshima Islands (Shimane)]. However, Ochiai’s specimens from Muroran (Southern-east of Hokkaido) are now missing (Y. Kai, pers. com.). On the other hand, the localities of Ochiai’s specimens re-identified here as *C. interruptus* were as follows: Pacific coasts of Honshu [Choshi (Chiba), Miya (Aichi), and Daiozaki and Owase (Mie)], and the Sea of Japan [Maizuru, (Kyoto) and Hofu (Yamaguchi)]. Although Yamada *et al.* (2007) gathered various biological and fisheries research data for “*C. interruptus*”, including *C. ochiaii*, in the East China Sea, Tosa Bay and Seto Inland Sea off Yam-

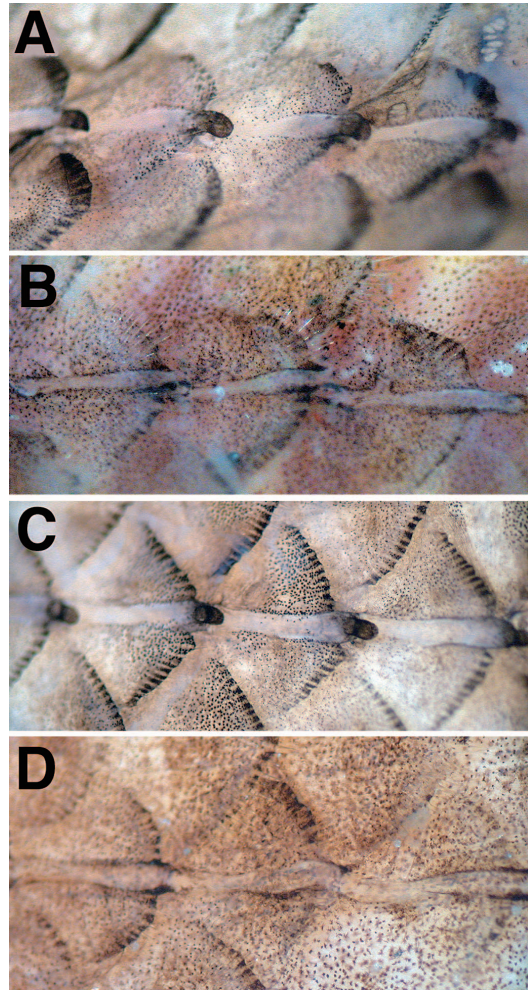


Fig. 6. Pored scales on dorsolateral line (DLL, A, B) and midlateral line (MLL, C, D) of two *Cynoglossus* species. A, C: *C. ochiaii*, holotype, NSMT-P 76853; B, D: *C. interruptus*, BSKU 39265. Photographed by H. Endo.

aguchi, and noted that “*C. interruptus*” was distributed widely on the continental shelf of the East China Sea, precise localities and ranges of *C. ochiaii* could not be determined from their data. One specimen (HUMZ 108928) of *C. interruptus* collected from 105 m in the East China Sea was the deepest record for the species.

Kim and Choi (1994) reported “*C. interruptus*” from Korean waters, on the basis of collected specimens, noting that the dorsolateral line was interrupted at mid-body and that the ventro-

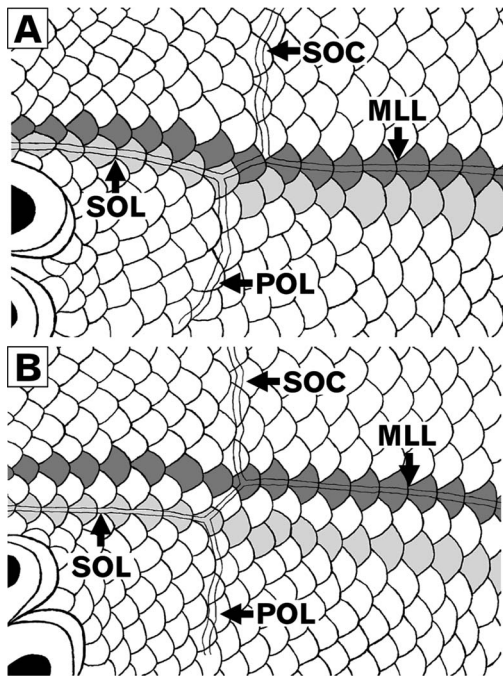


Fig. 7. Squamation of scale rows connected with supraorbital line (SOL, light gray) and midlateral line (MLL, dark gray). A: *C. ochiaii*; B: *C. interruptus*. Drawn by K. Yokogawa.

lateral line was unclear. Kim *et al.* (2001) also described "*C. interruptus*" from Korean waters, having 3–4 SADLL, a color photograph of 1 specimen confirming its identity as true *C. interruptus*. However, it remains unclear as to whether or not these specimens also included *C. ochiaii*. Although the latter probably abounds in the East China Sea (Yamada *et al.*, 2007), its occurrence in Korean waters needs confirmation.

Concerning the occurrence of *C. ochiaii* around Taiwan, we were unable to find any published records of "*C. interruptus*" with 3 lateral lines (e.g., Chen and Weng, 1965; Shen, 1967, 1993). Among 3 HUMZ specimens collected from Ta-Shih, northern-east part of Taiwan, HUMZ 10771 may be an example of *C. ochiaii*, having 3 lateral lines and a darkish body and fins, but its very poor condition prevented conclusive identification.

According to research data held by NRIFS, "*C. interruptus*" has been collected from depths

Table 3. *Cynoglossus* specimens collected from central Tosa Bay during 4 tows of the RV *Toyohata-maru* on 15 December 1992 and 1 tow (*) of the RV *Kotaka-maru* on 12 January 2001.

Depths (m)	29–30	46–47	63–64	74–77*	86–90
<i>C. ochiaii</i>		1	2	2	6
<i>C. interruptus</i>	5	7	7	1	

of 10–145 m in Tosa Bay, off Kochi (Yamada *et al.*, 2007). On the basis of the specimens examined herein, *C. ochiaii* occurs between depths of 46–154 m, being plentiful around 100 m. On the other hand, *C. interruptus* was generally obtained from shallower than 50 m depth (ca. 10–50 m), although a single specimen was caught between 74–77 m (BSKU 58740: together with 2 of *C. ochiaii*: BSKU 58738 and 58739) and 7 between 63–64 m (BSKU 81378) (Table 3). These indicate that the ranges of the 2 species overlap in depths of about 45–80 m in Tosa Bay. Other reliable data of the present materials indicates that *C. interruptus* also inhabits shallower ranges in the Seto Inland Sea and Tokyo Bay (ca. 20–30 m). In the East China Sea, Yamada *et al.* (2007) noted that "*C. interruptus*" was trawled in depths between 50–147 m. Although 1 specimen of *C. interruptus* (HUMZ 108923) was collected at 105 m (north of the Okinawa Trough), any overlap of the ranges of these 2 species in the East China Sea is still uncertain. However, *C. ochiaii* in that area probably occurs over a deeper range than *C. interruptus*, as it does in Tosa Bay, the difference in preferred habitats likely being related to the ecological divergence of the two species.

Comparative materials. *Cynoglossus interruptus* (95 specimens): BSKU 39265, 115 mm SL, Tosa Bay; BSKU 58740, 101 mm SL, same data as BSKU 58738–58739 (*C. ochiaii*); BSKU 81378 (7), 89–102 mm SL, same data as BSKU 91031–91032 (*C. ochiaii*); BSKU 81379 (7), 84–100 mm SL, same data as BSKU 91030 (*C. ochiaii*); BSKU 89574–89578 (5), 106–139 mm SL, Tokyo Bay, off Yokohama; BSKU 89579–89590 (12), 99–142 mm SL, Tokyo Bay, off Yokohama; BSKU 89739–89744 (6), 62–149 mm SL, Seto Inland Sea, off Marugame, Kagawa; BSKU 89877–89910 (34), 65–116 mm SL, Tosa Bay; BSKU 91029 (5), 84–103 mm

SL, 33°27.03'N, 133°32.21'E–33°27.66'N, 133°33.53'E, 30–29 m, R/V *Toyohata-maru*, 15 Dec. 1992; BSKU 93226, 114 mm SL, Seto Inland Sea, off Marugame, Kagawa; FAKU M7895, 25570, 25572, 116–134 mm SL, Choshi, Chiba; FAKU 12589, 12623, 100 mm SL, Hofu, Yamaguchi; FAKU 12722, 108 mm SL, Maizuru, Kyoto; FAKU 13943, 97 mm SL, Owase, Mie; FAKU 16826, 16827, 16837, 65–110 mm SL, Osaka Bay; FAKU 17265, 20540, 83–92 mm SL, Miya, Aichi; FAKU 19764, 103 mm SL, Daio-zaki, Mie; HUMZ 107802, 107803, 89–114 mm SL, Ta-Shih, Taiwan; HUMZ 108928, 91 mm SL, East China Sea, 30°30.30'N, 127°09.32'E, 105 m, 21 Nov. 1985. *Cynoglossus joyneri* (1): BSKU 62474, 209 mm SL, Tosa Bay. *Cynoglossus nigropinnatus* (18, all from Tosa Bay): BSKU 11796, 36895, 39423, 39583, 39969, 51810, 53877, 53878, 53879, 63645, 67392–67394 (3), 74840–74841 (2), 75628, 78263, 90–206 mm SL. *Cynoglossus kopsii* (2): NSMT-P 68318, 104 mm SL, Vietnam. *Cynoglossus* sp.: HUMZ 10771, 117 mm SL, Ta-Shih, Taiwan.

Acknowledgments

We are most grateful to Dr. Akira Ochiai (Professor Emeritus, Kochi University) for supporting our study and Drs. Keiichi Matsuura (NSMT) and Seishi Kimura (Fisheries Research Laboratory, Mie University) for their efforts in preparing this supplement. We also give special thanks to the following: Dr. Hitoshi Honda (FSF), Mr. Kazuya Nashida, and the captain and crews of R/V *Kotaka-maru* (NRIFS), Drs. Atsuko Yamaguchi and Gen Kume (Faculty of Fisheries, Nagasaki University), Drs. Yoshihiko Machida and Kunio Sasaki (BSKU), and Osamu Okamura (Professor Emeritus, Kochi University) for assistance in collecting specimens; Drs. Gento Shinohara and Masanori Nakae (NSMT), Hisashi Imaura (HUMZ), Yoshiaki Kai (FAKU) and Hiroyuki Motomura (KAUM) for specimen loans; Drs. Koichi Hoshino (Seikai National Fisheries Research Institute), Yohko Takata (NSMT) and Chung-Bae Kang (Pukyong National University, Korea) for providing literature; and Mr. Naohide Nakayama and Ms. Eri Katayama (BSKU) for preparing many radiographs. We also thank Dr. Graham S. Hardy (Ngunguru, New Zealand) for checking the English text.

Literature Cited

- Abe, T. and A. Ochiai. 1989. Keys to the Japanese Fishes Fully Illustrated in Colors. Vol. 3. Hokuryukan, Tokyo. 315 pp. (In Japanese.)
- Amaoka, K., K. Nakaya and M. Yabe. 1995. The Fishes of Northern Japan. North Japan Ocean Center, Sapporo. 391 pp. (In Japanese.)
- Bleeker, P. 1851. Bijdrage tot de kennis der ichthyologische fauna van Riouw. *Natuurkundig Tijdschrift voor Nederlandsch-Indië*, 2: 469–497.
- Chen, J. T. F. and H. T. C. Wang. 1965. A review of the flatfishes of Taiwan. *Tunghai University, Biological Bulletin*, 25, 27: 1–103.
- Choi, Y., J.-H. Kim and J.-Y. Park. 2002. Marine Fishes of Korea. Kyo-Hak Publishing, Seoul. 647 pp. (In Korean.)
- Günther, A. 1878. Notes on a collection of Japanese sea-fishes. *Annals and Magazin of Natural History*, Ser. 5, 1(6): 485–487.
- Günther, A. 1880. Report on the Shore Fishes Procured during the Voyage of H.M.S. “Challenger.” Report on the Scientific Results of the Voyage of H.M.S. “Challenger” in the Years, *Zoology*, 1(6): 1–82, pls. 1–32.
- Hamilton, F. 1822. An Account of the Fishes Found in the River Ganges and its Branches. Fishes Ganges, Edinburgh. i–vii+405 pp., pls. 1–39.
- Hubbs, C. L. 1915. Flounders and soles from Japan collected by the United States Bureau of Fisheries steamer “Albatross” in 1906. *Proceedings of the United States National Museum*, 48 (2082): 449–496, pls. 25–27.
- Hubbs, C. L. and K. F. Lagler. 1970. Fishes of the Great Lakes Region, 3rd edition. University of Michigan Press, Ann Arbor. 213 pp.
- Jordan, D. S. and C. L. Hubbs. 1925. Record of fishes obtained by David Starr Jordan in Japan, 1922. *Memoirs of Carnegie Museum*, 10(2): 93–346, pls. 5–12.
- Jordan, D. S. and O. Snyder. 1900. A list of fishes collected in Japan by Keinosuke Otaki and by the United States steamer Albatross. *Proceedings of the United States National Museum*, 23(1213): 335–380, pls. 9–20.
- Jordan, D. S. and E. C. Starks. 1906. A review of the flounders and soles of Japan. *Proceedings of the United States National Museum*, 31(1484): 161–246.
- Kamohara, T. and O. Okamura. 1985. Colored Illustrations of the Marine Fishes of Japan. Vol. II. Hoikusha Publishing, Osaka. 161 pp.
- Kim, I.-S. and Y. Choi. 1994. A taxonomic revision of the family Cynoglossidae (Pisces, Pleuronectiformes) from Korea. *Bulletin of the Korean Fisheries Society*, 27: 803–813.
- Kim, Y.-U., J.-G. Myoung, Y.-S. Kim, K.-H. Han, C.-B. Kang and J.-G. Kim. 2001. The Marine Fishes of

- Korea. Hanguel, Pusan. 382 pp. (In Korean)
- Kim, I.-S., Y. Choi, C.-Y. Lee, Y.-J. Lee, B.-J. Kim and J.-H. Kim. 2005. Illustrated Book of Korean Fishes. Kyo-Hak Publishig, Seoul. 616 pp. (In Korean.)
- Kuroda, N. 1951. A nominal list with distribution of the fish of Suruga Bay, inclusive of the fresh waters species found near the coast. *Japanese Journal of Ichthyology*, 1: 314–338; 376–394.
- Kuroda, N. 1962. On the life colors of some fishes -XIV. *Japanese Journal of Ichthyology*, 10: 1–5.
- Matsubara, K. 1955. Fish Morphology and Hierarchy. Ishizaki Shoten, Tokyo. Part II, i–v+790–1605. (In Japanese.)
- Menon, A. G. K. 1977. A systematic monograph of the tongue soles of the genus *Cynoglossus* Hamilton-Buchanan (Pisces: Cynoglossidae). *Smithsonian Contributions to Zoology*, (238): i–iv+1–129.
- Ochiai, A. 1959. Morphology, Taxonomy and Ecology of Soles of Japan. Laboratory of Fisheries, Faculty of Science, Kyoto University, Kyoto. 236 pp., 2 pls. (In Japanese.)
- Ochiai, A. 1963. Fauna Japonica Soleina (Pisces). Biogeographical Society of Japan, Tokyo. 115 pp., 24 pls.
- Ochiai, A. 1965. Genko, *Cynoglossus interruptus*. Page 498 in K. Okada, K. Uchida and T. Uchida, eds. New Illustrated Encyclopedia of the Fauna of Japan. Part 3. Hokuryukan, Tokyo. (In Japanese.)
- Ochiai, A. 1966. Studies on the comparative morphology and ecology of the Japanese soles. *Misaki Marine Biological Institute, Kyoto University, Special Report*, (3): 1–97, 2 pls. (In Japanese.)
- Ochiai, A. 1984. Cynoglossidae. Pages 341–342 in H. Masuda, K. Amaoka, C. Araga, T. Uyeno and T. Yoshino, eds. The Fishes of the Japanese Archipelago. English text. Tokai University Press, Tokyo.
- Ochiai, A. 1987. Family Cynoglossidae. Pages 927–931 in T. Abe, ed. Illustrated Fishes of the World in Colour. Hokuryukan, Tokyo. (In Japanese.)
- Ochiai, A. 1988. Cynoglossidae. Pages 341–342 in H. Masuda, K. Amaoka, C. Araga, T. Uyeno and T. Yoshino, eds. The Fishes of the Japanese Archipelago. 2nd edition. English text. Tokai University Press, Tokyo.
- Ochiai, A. 2005. Family Cynoglossidae. Pages 927–931 in Y. Taki, H. Kohno, K. Sakamoto and K. Hosoya, eds. Illustrated Fishes of the World in Colour. Revised edition. Hokuryukan, Tokyo. (In Japanese.)
- Okada, Y. and K. Matsubara. 1938. Key to the Fishes and Fish-like Animals of Japan. Sanseido, Tokyo. ixl+585 pp. (In Japanese.)
- Sakamoto, K. 1997. Genko, *Cynoglossus interruptus*. Page 684 in O. Okamura and K. Amaoka, eds. Sea Fishes of Japan. Yama-Kei Publishers, Tokyo. (In Japanese.)
- Sanada, Y. 1997. Genko, *Cynoglossus interruptus*. Page 75 in K. Ikehara, ed. Fishes of the Seto Inland Sea. Fisheries Developing Committee of the Seto Inland Sea, Kobe. (In Japanese.)
- Shen, S.-C. 1967. Studies on flat-fishes (Pleuronectiformes or Heterosomata) in the adjacent waters of Hong Kong. *Quaternary Journal of the Taiwan Museum*, 20(1, 2): 150–281.
- Shen, S.-C. 1993. Pleuronectiformes. Pages 565–585 in S.-C. Shen, ed. Fishes of Taiwan. The National Taiwan University, Taipei.
- Shimizu, T. and A. Watanabe. 1997. Seasonal fluctuation of the benthic fish communities in Iyonada, Japan. *Bulletin of Ehime Prefectural Fisheries Experimental Station*, (6): 11–39. (In Japanese with English abstract.)
- Shinohara, G., H. Endo, K. Matsuura, Y. Machida and H. Honda. 2001. Annotated checklist of the deepwater fishes from Tosa Bay, Japan. Pages 283–343 in T. Fujita, H. Saito and M. Takeda, eds. Deep-sea Fauna and Pollutants in Tosa Bay. National Science Museum Monographs, No. 20.
- Tomiyama, I., T. Abe and T. Tokioka. 1958. Encyclopedia Zoologica Illustrated in Colours. Vol. 2. Hokuryukan, Tokyo. ixviii+394+87 pp.
- Wu, H.-W. 1932. Contribution à l'étude morphologique, biologique et systématique des poissons hétérosomes (Pisces, Heterosomata) de le Chine. Theses, Université de Paris, Paris. 244 pp.
- Yamada, U. 1986. Genko, *Cynoglossus interruptus* Günther. Page 412 in O. Okamura, ed. Fishes of the East China Sea and the Yellow Sea. Seikai Regional Fisheries Research Laboratory, Nagasaki. (In Japanese.)
- Yamada, U. 1993. Cynoglossidae. Pages 1191–1195, 1374 in T. Nakabo, ed. Fishes of Japan with Pictorial Keys to the Species. Tokai University Press, Tokyo. (In Japanese.)
- Yamada, U. 2000. Cynoglossidae. Pages 1388–1392, 1639 in T. Nakabo, ed. Fishes of Japan with Pictorial Keys to the species. 2nd edition. Tokai University Press, Tokyo. (In Japanese.)
- Yamada, U. 2002. Cynoglossidae. Pages 1388–1392, 1630 in T. Nakabo, ed. Fishes of Japan with Pictorial Keys to the Species. English edition. Tokai University Press, Tokyo.
- Yamada, U., S. Shirai, T. Irie, M. Tokimura, S. Deng, Y. Zheng, C. Li, Y.-U. Kim and Y.-S. Kim. 1995. Names and Illustrations of Fishes from the East China Sea and the Yellow Sea. Oversea Fishery Cooperation Foundation, Tokyo. 288 pp.
- Yamada, U., M. Tokimura, H. Horikawa and T. Nakabo. 2007. Fishes and Fisheries of the East China and Yellow Seas. Tokai University Press, Tokyo. i–Ixxiv+1263 pp. (In Japanese.)
- Yokogawa, K., H. Sakaji, H. Endo and A. Yamaguchi.

2008. Genetic divergence between two forms of a tongue sole, *Cynoglossus interruptus*. *Ichthyological Research*, 55(1): 78–81.

Youn, C.-H. 2002. Fishes of Korea with Pictorial Key and Systematic List. Academic Seojeok, Seoul. 747 pp. (In

Korean.)

Manuscript received 27 September 2007; revised 31 January 2008; accepted 15 February 2008.

Associate editor: S. Kimura.