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A new species of deep-water tonguefish (Pleuronectiformes: Cynoglossidae: *Symphurus*) from the western North Pacific Ocean

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Abstract

A new species of symphurine tonguefish, *Symphurus oxyrhynchus* **sp. nov.**, is described from two specimens captured in deep waters (718–852 m) off Taiwan and Japan. This new species is distinguished from congeners by the following combination of characters: predominant 1–2–2–1–2 pattern of interdigitation of dorsal pterygiophores and neural spines, 14 caudal-fin rays, 93 dorsal-fin rays, 80–81 anal-fin rays, 9 abdominal and 52 total vertebrae, 5 hypurals, small eye (7.5–8.0 % HL) with relatively large pupil (78–85% ED), moderately large scales (87–89 scales in longitudinal series, 31 scales in transverse row), snout square and projecting anteriorly, ocular side uniformly yellow to dark brown with intense pigmentation on body areas overlying dorsal- and anal-fin pterygiophores, outer surface of opercle on both sides bluish black, general background coloration shared the same coloration in blind side, including more intense on body areas overlying dorsal and anal pterygiophores. *Symphurus oxyrhynchus* **sp. nov.** is a rare species, only two specimens were retrieved by research vessels. This study provides formal description of this unique new species based on these two specimens. Further investigations and expeditions are necessary for better understanding of the biodiversity of tonguefishes in the western Pacific.

Key words: *Symphurus oxyrhynchus*, new tonguefish, taxonomy, Deep-Sea, Japan, Taiwan

Introduction

Symphurine tonguefishes are small-sized, sinistral flatfishes belonging to the genus *Symphurus* Rafinesque (family Cynoglossidae). Approximately 86 species are considered valid in *Symphurus*, with 36 species distributed in the Indo-Pacific region (Bleeker 1879; Alcock 1889; Alcock 1891; Alcock 1894; Alcock 1899; Gilbert 1905; Fowler 1934; Chabanaud 1954; Chabanaud 1955a; Chabanaud 1955b; Chabanaud 1955c; Chabanaud 1956; Munroe 1992; 1998; 2006; Munroe & Marsh 1997; Munroe & Amaoka 1998; Munroe & Hashimoto, 2008; Lee *et al.*, 2009a; 2009b; Munroe *et al.*, 2011; Lee *et al.*, 2013; 2014; 2017; Lee & Munroe 2021). Most of these tonguefishes are deep-water species inhabiting depths between 200 and 1500 m; only 10 of these species are recorded from shallow waters (Munroe 2006; Lee & Munroe 2021).

Munroe (1992) considered that the numbers of proximal dorsal-fin pterygiophores in each of the most anterior five interneural spaces (ID patterns) is a distinguishable feature for identifying species of *Symphurus*. Furthermore, the combination of ID patterns, numbers of abdominal vertebrae and caudal-fin rays are helpful in classifying species of *Symphurus* into different phenetic species groups (Munroe 1992, Lee *et al.* 2009a, Munroe *et al.* 2011).

During a journey visiting fish collections in Japan (BSKU and NSMT) and Taiwan (ASIZP, NMMBA), two specimens of an unidentified species of *Symphurus* featuring a 1–2–2–1–2 ID pattern, 3+6 abdominal vertebrae and 14 caudal-fin rays were examined. Among Indo-Pacific *Symphurus*, only three species have been recorded sharing this combination of characters, *S. fuscus* Brauer, 1906, *S. macrophthalmus* Norman, 1939, and *S. schultzi* Chabanaud, 1955. After detailed comparisons of these two specimens with specimens of *S. fuscus*, *S. macrophthalmus*, and *S. schultzi*, distinct differences revealed in several meristic and morphometric features, which indicated they belong to an undescribed species. The purpose of this paper is to describe this new species formally.

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Materials and methods

The two specimens examined were deposited in the ichthyological collections of the ASIZP and NSMT-P, respectively. Institutional abbreviations follow those listed in Fricke and Eschmeyer (2022). Additional information for comparative materials of all other Indo-Pacific species of *Symphurus* included in this study are listed in Munroe (1992), Shen *et al.* (1993), Munroe & Marsh (1997), Munroe & Amaoka (1998), Krabbenhoft & Munroe (2003), Munroe (2006), Munroe & Hashimoto (2008), Lee *et al.* (2009a; 2009b; 2013; 2014; 2017; 2021), and Munroe *et al.* (2011).

Methods for counting meristic characters, measuring morphometric features, general terminology, and morphological features distinguishing species follow Munroe (1998), body thickness (TH) follows that of Lee & Munroe (2021).

Two specimens were radiographed. Terminology and formulae for interdigitation patterns of proximal dorsal pterygiophores and vertebral neural spines (ID pattern) follow Munroe (1992). Morphometric characters were measured to the nearest 0.1 mm using either dial calipers or dissecting microscope fitted with an ocular micrometer. Morphometric features are expressed either as percent of standard length (SL), percent head length (HL), or percent body depth (BD).

Description of pigmentation features is based on specimens preserved in 75% ethanol. Maturity was estimated by macroscopic examination of extent of posterior elongation of the ovaries and presence of developing ova in the ovaries (both observed using light transmitted through the body). In species of *Symphurus*, no obvious differences are apparent in testis size between mature and immature males (Munroe 1998); therefore, macroscopic estimates of maturity are based entirely on females.

Symphurus oxyrhynchus sp. nov.

(English name: Sharpnose tonguefish)
(Figs. 1–4; Table 1)

Holotype. NSMT-P 57352, mature female, 101.3 mm SL, off Kochi, Tosa Bay, Japan, 744–786 m, 33º10.63'–33º11.36' N, 133º53.79'–133º55.35'E, 11 December 1998.

Paratype. ASIZP0061780, male, 87.4 mm SL, South China Sea, off SW Taiwan, otter trawl, 718–852 m, 22º05.16'–22º10.73' N, 120º14.10' E, *Ocean Researcher I*, CD 139, 23 November 2001.

Diagnosis. *Symphurus oxyrhynchus* **sp. nov.** is distinguished from all congeners by the combination of: 1–2–2–1–2 ID pattern, 14 caudal-fin rays, 9 abdominal vertebrae, 52 total vertebrae, 5 hypurals, 93 dorsal-fin rays, 80–81 anal-fin rays, 87–89 longitudinal scale rows, 31 transverse scales, 18 scale rows on head posterior to lower orbit, small eye (7.5–8.0% HL) with relatively large pupil (78–85% ED), square snout, projecting anteriorly, with the ocular side uniformly yellow to dark brown with intense pigmentation on body areas overlying dorsal- and anal-fin pterygiophores, outer surface of opercle bluish-black, and with the blind side sharing the same coloration and also the same intensity overlying the pterygiophore areas.

Description. Meristic characters and proportions of morphometric features are summarized in Table 1. *Symphurus oxyrhynchus* **sp. nov.** is a medium-sized species; reaching sizes to at least 101.3 mm SL. Predominant ID pattern 1–2–2–1–2 (2/2 specimens) (Fig. 1). Caudal-fin rays 14 (one specimen with 15 caudal-fin rays). Dorsal-fin rays 93. Anal-fin rays 80–81. Pelvic-fin rays 4. Total vertebrae 52; abdominal vertebrae 9 (3 + 6) (Fig. 1). Hypurals 5. Longitudinal scale rows 87–89. Scale rows on head posterior to lower orbit 18. Transverse scale rows 31.

Body moderately deep; maximum depth in anterior one-third of body; body depth tapering gradually from anterior to posterior. Preanal length smaller than body depth. Head wide; head width slightly greater than head length (HW/HL 1.01–1.03). Upper head lobe narrower than lower head lobe and shorter than postorbital length (UHL/LHL= 0.94–0.98). Lower opercular lobe of ocular-side slightly narrower than upper opercular lobe. Snout square and projecting anteriorly, its length much greater than eye diameter (SNL/ED 2.84–2.87). Dermal papillae well developed, present on blind side snout and lower part of chin. Ocular-side anterior nostril tubular and short, usually not reaching anterior margin of lower eye when depressed posteriorly. Ocular-side posterior nostril a small rounded tube located between upper and lower eye. Blind-side anterior nostril tubular and elongate, easily distinguishable from dermal papillae; blind-side posterior nostril a shorter posteriorly-directed tube situated posterior to vertical at rear margin of jaws. Jaws short; posterior margin of upper jaw usually reaching point between verticals through

anterior margin and midpoint of lower eye. Eyes separate, round and extremely small; with two to three rows of small ctenoid scales in interorbital space, and with some small scales covering upper aspects of eye. Pupillary operculum absent. Dorsal-fin origin located at point between verticals through anterior margin and midpoint of upper eye. No scales present on dorsal- and anal-fin rays on either side. Caudal fin short, with several rows of ctenoid scales on base of fin.

TABLE 1. Meristic and morphometric characters for the holotype and paratype of *Symphurus oxyrhynchus* **sp. nov.**, abnormal character indicated by asterisk.

	Holotype	Paratype
Standard length (SL, mm)	101.3	87.4
Meristic features		
Dorsal-fin rays	93	93
Anal-fin rays	81	80
Caudal-fin rays	14	15*
Abdominal vertebrae	3+6	3+6
Total vertebrae	52	52
Hypurals	5	5
ID pattern	1-2-2-1-2	1-2-2-1-2
Longitudinal Scale Counts	89	87
Head Scale Counts	18	18
Lateral Scales counts	31	31
Morphometric features (% of SL)		
Body depth (BD)	26.5	25.2
Trunk length (TKL)	85.2	84.2
Predorsal length (PDL)	4.5	5.3
Preanal length (PAL)	24.4	24.9
Dorsal-fin length (DBL)	95.5	94.7
Anal-fin length (ABL)	76.0	75.1
Pelvic-fin length (PL)	6.3	8.1
Pelvic to anal length (PA)	3.2	4.3
Caudal-fin length (CFL)	12.0	10.0
Head length (HL)	20.2	20.4
Head width (HW)	20.5	21.0
Postorbital head length (POL)	14.0	14.4
Upper head lobe width (UHL)	10.3	10.2
Lower head lobe width (LHL)	10.5	10.9
In % of HL		
Predorsal length (PDL)	22.1	25.8
Postorbital head length (POL)	68.4	70.3
Snout length (SNL)	20.2	21.3
Upper jaw length (UJL)	19.1	19.6
Eye diameter (ED)	8.0	7.5
Chin depth (CD)	21.7	16.0
Lower opercular lobe (OPLL)	24.6	20.6
Upper opercular lobe (OPUL)	26.4	21.7
In % of BD		
Body thickness (TH)	17.1	15.8
Proportions		
HL/HW	1.01	1.03
Pupil/ED	0.78	0.85

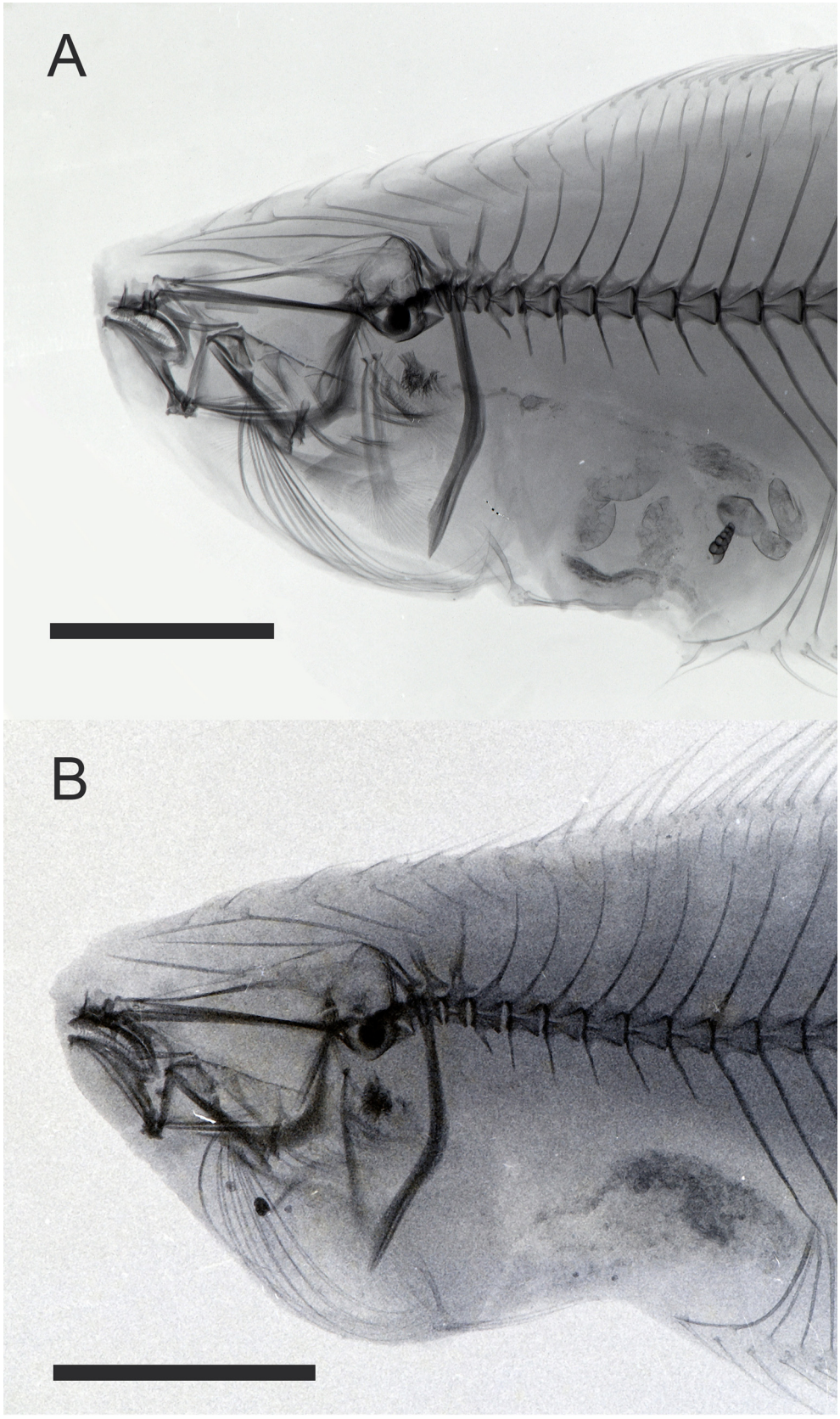

FIGURE 1. Radiographs depicting interdigitation patterns (ID patterns) of proximal dorsal-fin pterygiophores and neural spines and numbers of abdominal vertebrae for *Symphurus oxyrhynchus* **sp. nov.** A. holotype, NSMT-P 57352. B. paratype, ASIZP0061780.

FIGURE 2. *Symphurus oxyrhynchus* **sp. nov.**, holotype, NSMT-P 57352, mature female, 101.3 mm SL, collected at 744–786 m in Tosa Bay (33°10.63'–33°11.36' N, 133°53.79'–133°55.35'E), Japan. A. Ocular-side coloration. B. Blind-side coloration.

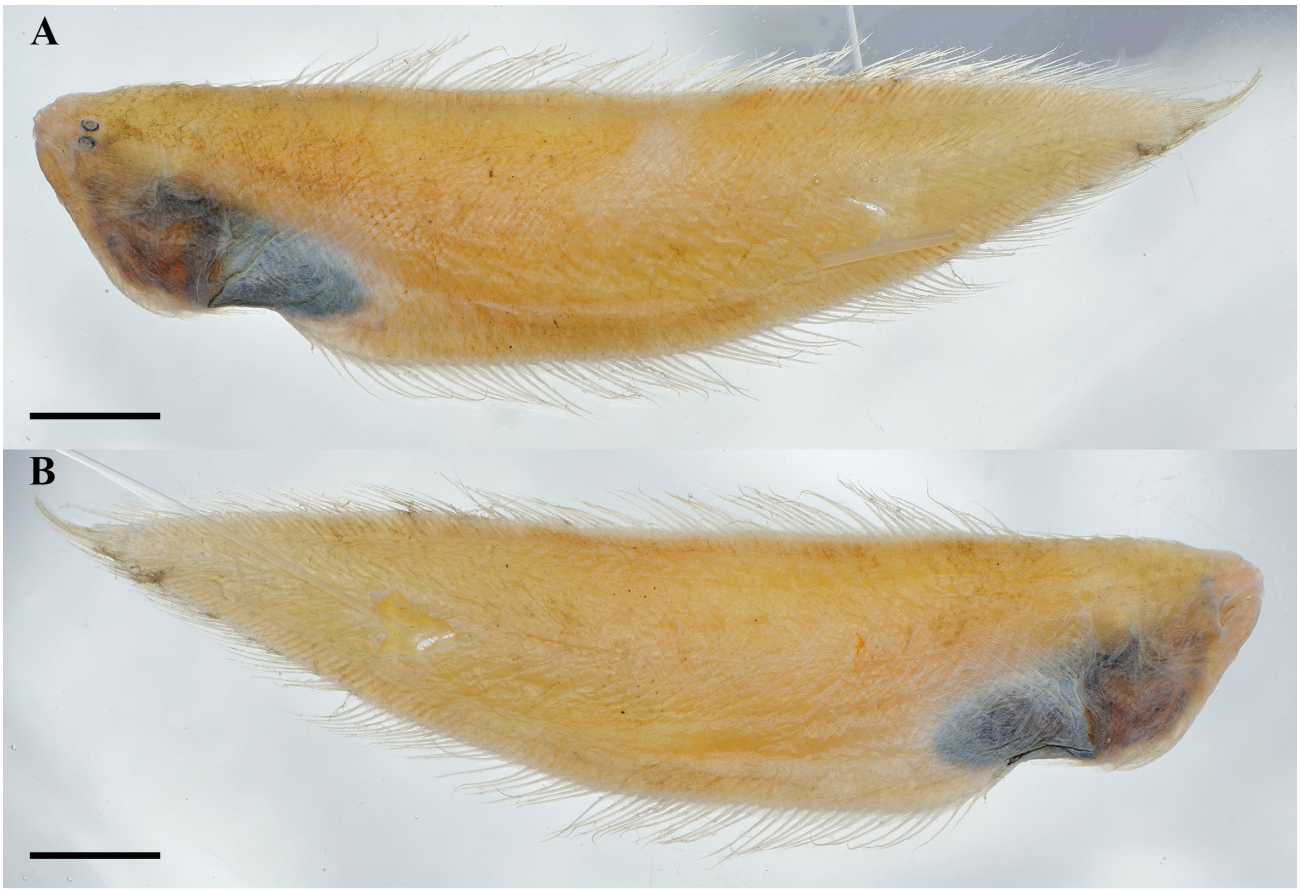

FIGURE 3. *Symphurus oxyrhynchus* **sp. nov.**, paratype, ASIZP0061780, male, 87.4 mm SL, collected at 718-852 m off SW Taiwan (22°05.16'–22°10.73' N, 120°14.10' E), South China Sea. A. Ocular-side coloration. B. Blind-side coloration.

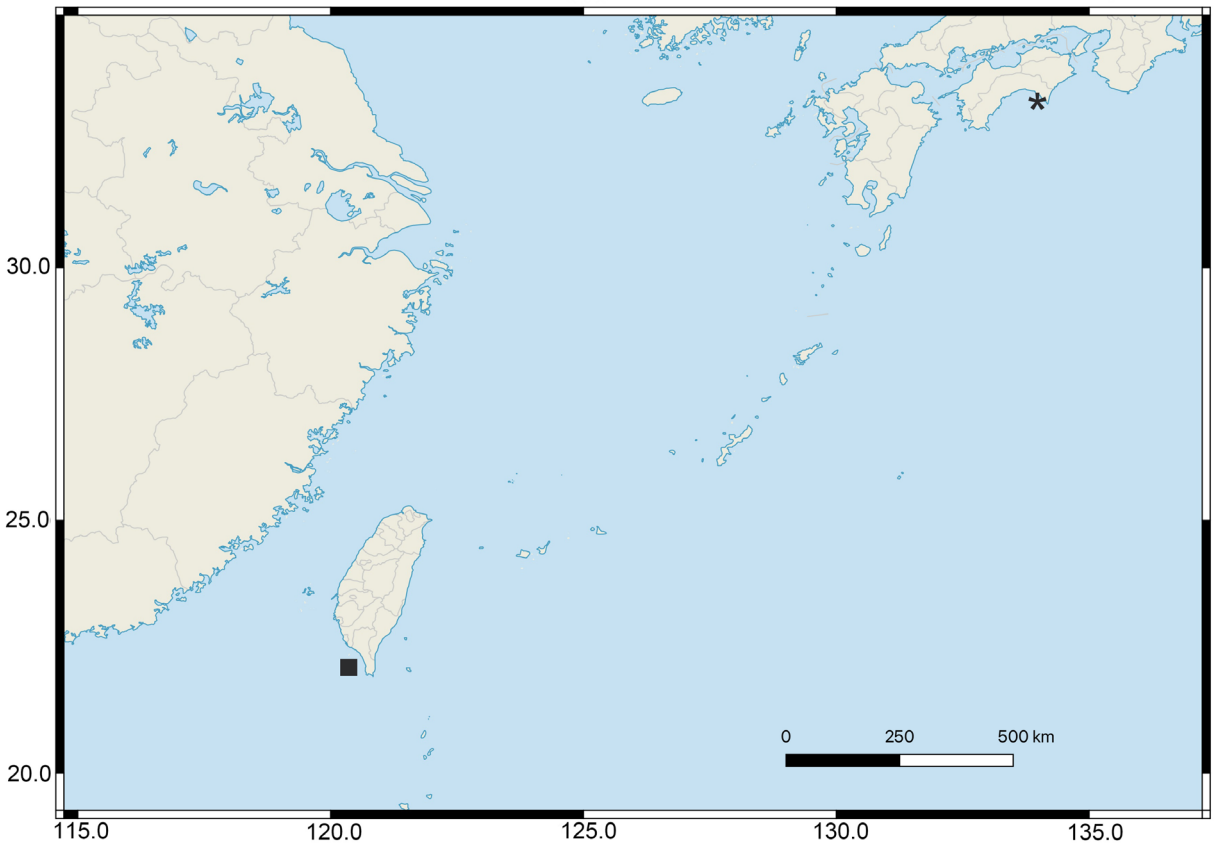

FIGURE 4. Geographic distribution of *Symphurus oxyrhynchus* **sp. nov.**, capture location of holotype indicated by asterisk. Capture location of paratype indicated by solid square.

Four to five rows of well-developed teeth on blind-side dentary; two to three rows of well-developed teeth on blind-side premaxilla. One row of sharply, pointed, well-developed teeth on both ocular-side dentary and premaxilla.

Pigmentation (Figs. 2–3). Ocular-side background coloration generally yellow to dark brown with greatest intensity on body areas overlying dorsal- and anal-fin pterygiophores. Head coloration similar to that on body. Outer surface of both opercles bluish-black. Posterior margin of opercle darker, black and easily distinguishable from bluish-black regions of opercle. Inner surfaces of opercles with small dark-brown or black dots. Lips and chin region yellow to light brown, margins of lips unpigmented. Ocular-side anterior nostril light yellow. Upper aspects of eyes, and eye socket bluish, pupil light bluish. Blind side background coloration the same as the ocular-side background coloration, uniformly yellow to dark brown with darker, with greater intensity on the area overlying dorsal- and anal-fin pterygiophores. Peritoneum bluish-black, clearly observed through abdominal wall on both sides.

Fin rays of dorsal, anal, and pelvic fins uniformly yellow to dark brown with black margins; basal regions of fin rays brown. Fin membrane usually faded, and transparent in whole membrane area. Coloration of blind-side fin rays yellow to dark brown, with darker coloration covering their basal margins.

Size and sexual maturity. Of two specimens examined, one is a male of 87.4 mm SL, while the other is a mature female of 101.3 mm SL with elongate, but not gravid, ovaries.

Distribution & Ecology. *Symphurus oxyrhynchus* is currently known from only two specimens, one collected from Tosa Bay, Japan; and the other collected from off Siao-Liouciou, South China Sea, Taiwan (Fig. 4). These specimens were collected from deep waters between 718 and 852 m depths. It is expected that this species has wider distributions, horizontally and vertically.

Small crustaceans, snails and bivalves were observed in the digestive systems of the holotype (Fig. 1A). Little else is known regarding the biology of this species.

Etymology. The name *oxyrhynchus*, derived from the Greek, *oxy* meaning sharp, and *rhynchus*, meaning snout, in reference to the relatively sharp, pointed snout of this species compared with those of congeners.

Comparisons. *Symphurus oxyrhynchus* is easily distinguished from all other congeners, except *S. fuscus* Brauer, *S. macrophthalmus* Norman, and *S. schultzi* Chabanaud, by the combination of a 1–2–2–1–2 ID pattern (Fig. 1), 9 abdominal vertebrae, and 14 caudal-fin rays. *Symphurus oxyrhynchus* is easily separated from *S. fuscus* by having fewer dorsal- (93 vs. 105 in *S. fuscus*) and anal-fin rays (80–81 vs. 93 in *S. fuscus*), and fewer total vertebrae (52 vs. 58 in *S. fuscus*) than are found in *S. fuscus*. These species, known from limited specimens, are actually distributed in different oceans, with *S. oxyrhynchus* currently known from off Taiwan and Japan, western Pacifc, while *S. fuscus* was collected from off east Africa, western Indian Ocean. Both of these need further investigation for more precise species definitions and understanding the range of morphological variation of the species. Compared with *S. macrophthalmus* and *S. schultzi*, *S. oxyrhynchus* has similar but slightly higher counts of dorsal- (93 vs. 87 in *S. macrophthalmus*, and 85–88 in *S. schultzi*) and anal-fin rays (80–81 vs. 75 in *S. macrophthalmus*, and 72–75 in *S. schultzi*), and total vertebrae (52 vs. 48 in *S. macrophthalmus*, and 48–50 in *S. schultzi*). *Symphurus oxyrhynchus* also differs from both species in having an obviously smaller eye (7.5–8.0% HL vs. 21.1% HL in *S. macrophthalmus*, and 13.3–18.9% HL in *S. schultzi*) with a larger pupil (pupil diameter/eye diameter 78–85% vs. 54% in *S. macrophthalmus*, and 61.9–68.4% in *S. schultzi)*.

Symphurus oxyrhynchus is also similar to *S. bathyspilus* Krabbenhoft and Munroe, *S. multimaculatus* Lee, Munroe and Chen, and *S. thermophilus* Munroe and Hashimoto in sharing similar meristic features, but is easily distinguished from these species by its 1–2–2–1–2 ID pattern (vs. 1–2–2–2–2 in these others). In morphometric measurements, *S. oxyrhynchus* differs from these other species in having a much smaller eye (7.5–8.0% HL vs. 12.2–16.3% HL in *S. bathyspilus*, 9.1–10.1% HL in *S. multimaculatus*, and 10.2–16.3% in *S. thermophilus*), and by its generally yellow to dark-brown coloration with intense coloration on body areas overlying the dorsal- and anal-fin pterygiophores on both sides (vs. uniformly lighter and white blind side in these other three species, and with pepper-dots present in *S. bathyspilus* and *S. multimaculatus*, and the ocular side of both in *S. bathyspilus* and *S. thermophilus* usually has crossbands, and do not have intense coloration overlying the pterygiophore regions). *Symphurus oxyrhynchus* also differs from *S. bathyspilus* in having a longer snout (20.2–21.3% HL vs. 12.9–19.7% HL in *S. bathyspilus*) and a much shorter anterior nostril, not reaching the lower eye when depressed (vs. elongate anterior nostril, usually reaching the lower eye when depressed). *Symphurus oxyrhynchus* is further distinguished from *S. multimaculatus* in having fewer scale rows on the head posterior to the lower orbit (18 vs. 21–24 in *S. multimaculatus*), fewer transverse rows of scales (31 vs. 45–48 in *S. multimaculatus*), and fewer longitudinal scales (87–89 vs. 102–108 in *S. multimaculatus*), a more slender body (25.2–26.5% SL vs. 28.6–35.1% SL in *S. multimaculatus*), narrower head (20.5–21.0% SL vs. 24.5–30.2% SL in *S. multimaculatus*), a with a smaller ratio of HW/HL (HW/HL=1.01–1.03 vs. HW/HL=1.26–1.50 in *S. multimaculatus*), a longer predorsal length (22.1–25.8% HL vs. 15.2–19.3% HL in *S. multimaculatus*), narrower upper head lobe (10.2–10.3% SL vs. 14.4–18.8% SL in *S. multimaculatus*) that is shorter than the lower head lobe (vs. bigger than lower head lobe in *S. multimaculatus*),the snout much longer than the eye (SNL/ED=2.84–2.87 vs. SNL/ED=1.54–1.90 in *S. multimaculatus*), and in *S. oxyrhynchus* the pupil is also larger (pupil diameter/eye diameter 78–85% vs 61–72% in *S. multimaculatus*).

Symphurus oxyrhynchus also differs from *S. thermophilus* in having fewer scale rows on the head posterior to the lower orbit (18 vs. 20–24 in *S. thermophilus*), fewer transverse scale rows (31 vs. 47–56 in *S. thermophilus*), and fewer longitudinal scales (87–89 vs. 100–112 in *S. thermophilus*), a more slender body (25.2–26.5% SL vs. 28.4–33.1% SL in *S. thermophilus*), narrower head (20.5–21.0% SL vs. 26.2–29.3% SL in *S. thermophilus*) that is much smaller than its length (HW/HL=1.01–1.03 vs. HW/HL=1.18–1.30 in *S. thermophilus*), narrower upper head lobe (10.2–10.3% SL vs. 13.8–17.1% SL in *S. thermophilus*), a narrower lower head lobe (10.5–10.9% SL vs. 11.7–15.9% SL in *S. thermophilus*), and with upper head narrower than the lower head lobe (vs. upper lobe wider than lower head lobe in *S. thermophilus*), narrower lower lobe of opercle (20.6–24.6% HL vs. 26.9–36.4% HL in *S. thermophilus*), and upper opercular lobe wider than the lower (vs. lower opercular lobe wider than the upper in *S. thermophilus*), and larger pupil (pupil diameter/eye diameter 78–85% vs. 55–68% in *S. thermophilus*).

Symphurus oxyrhynchus is also similar to *S. fallax* Chabanaud, *S. orientalis* (Bleeker), and *S. septemstriatus* (Alcock) in having similar or overlapping dorsal- and anal-fin rays, and counts for abdominal and total vertebrae. *Symphurus oxyrhynchus* differs distinctly from these species in having 14 caudal-fin rays and five hypurals (vs. 12 caudal-fin rays and four hypurals in those species), and a 1–2–2–1–2 ID pattern (vs. 1–2–2–2–2 in those species).

Discussion

Study of the taxonomy of deep-sea fishes is usually restricted by the limited number of specimens available (Lee *et al.* 2019; Wong *et al.* 2021), and in some cases, descriptions are based on specimens in poor condition which poses difficulties when species have overall similarities in their phenetic characters (Munroe 1992; Munroe & Amaoka 1998; Lee *et al.* 2013). Integrative taxonomy usually resolves this situation by considering phylogenetic, species delimitation analysis and morphological comparisons as comprehensive evidence, especially in nominal species with subtle differences (Lee *et al.* 2019; Wong *et al.* 2021; Lee & Munroe 2021). However, *S. oxyrhynchus* is only known from two preserved specimens. Therefore, examination of morphological characters and discovering diagnostic features are the only evidence available for recognizing these specimens as belonging to an undescribed species. Fortunately, the unique combination of their morphological characters, especially their ID patterns, provides the robust evidence to support recognizing these two specimens as a species, *S. oxyrhynchus*, distinct among congeners.

The paratype of S. *oxyrhynchus* has anomalies associated with its caudal-fin rays as reflected in both the number of fin rays and their relationship with the hypurals. Usually species of *Symphurus* with five hypurals also have 14 caudal-fin rays. In this case, ASIZP0061780 possesses 15 caudal-fin rays, probably a kind of abnormality, and commonly observed in specimens of *Symphurus* (Munroe, 1992; Lee *et al.* 2009b). Figuring out these variant/abnormal patterns (e.g. numbers of hypurals and caudal-fin rays, ID patterns, presence of fused vertebrae) is important when identifying species of tonguefishes, especially to avoid overestimating the species diversity of these fishes.

The bathymetric distribution of *S. oxyrhynchus* is another evidence for considering these specimens as a new species. *Symphurus oxyrhynchus* inhabits depths between 718 and 853 m, other deep-sea species of *Symphurus* occurring sympatrically in the geographic area are usually distributed between 200 and 600 m (Lee *et al.* 2009a, 2009b; Lee *et al.* 2013), only *S. hondoensis* (390–1040 m, M.-Y. Lee, unpubl. data) shares a similar bathymetric distribution with that of *S. oxyrhynchus*. These two species are easily distinguished by non-overlapping differences in morphology, which support recognizing them as different species.

Further investigations and expeditions in the western Pacific off NW Asia are needed to capture additional specimens that will provide molecular information helpful in understanding the phylogenetic relationships between *S. oxyrhynchus* and other deep-sea tonguefishes. Additional specimens will also provide the data necessary to construct a better morphological definition of *S. oxyrhynchus.* The biodiversity of members of the genus *Symphurus* is still currently underestimated (Lee *et al.* 2009a, 2009b; 2013; 2014; 2017; Lee & Munroe 2021). Increasing efforts in investigations conducted in the western Pacific, especially at deep-sea areas, will provide better understanding of the biodiversity of these tonguefishes.

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