Zootaxa 5032 (1): 136–142
https://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.5032.1.8
http://zoobank.org/urn:lsid:zoobank.org:pub:FB5CA2AF-B3E9-4A19-AB31-33BFB7D24885

Osteodiscus abyssicola, a new snailfish (Cottoidei: Liparidae) collected off the Pacific coast of northern Japan

KENTA MURASAKI[1*], YOSHIAKI KAI[2], HIROMITSU ENDO[3] & ATSUSHI FUKUI[4]
[1]*Institute of Oceanic Research and Development, Tokai University, 3-20-1 Orido, Shimizu-ku, Shizuoka 424-8610, Japan*
[2]*Maizuru Fisheries Research Station, Field Science Education and Research Center, Kyoto University, Nagahama, Maizuru, Kyoto 625-0086, Japan.* *kai.yoshiaki.4c@kyoto-u.ac.jp;* *https://orcid.org/0000-0002-0991-5173*
[3]*Laboratory of Marine Biology, Faculty of Science and Technology, Kochi University, 2-5-1 Akebono-cho, Kochi 780-8520, Japan*
endoh@kochi-u.ac.jp; *https://orcid.org/0000-0001-6916-6322*
[4]*School of Marine Science and Technology, Tokai University, 3-20-1 Orido, Shimizu-ku, Shizuoka 424-8610, Japan*
afukui@scc.u-tokai.ac.jp; *https://orcid.org/0000-0001-5195-9068*
[*]*Corresponding author.* *murasaki-619@hope.tokai-u.jp;* *https://orcid.org/0000-0002-3433-5795*

Abstract

The snailfish *Osteodiscus abyssicola* **sp. nov.** is described from a single specimen collected off the Pacific coast of Hokkaido, northern Japan, at a depth of 4,671–4,744 m. It is distinguished from all currently recognized congeners by the following combination of characters: vertebrae 49; dorsal-fin rays 44; anal-fin rays 39; principal caudal-fin rays 8; pyloric caeca 5; mouth horizontal; teeth on both jaws simple and sharp, without cusps; upper and lower jaw symphyses without diastema; cephalic pore sizes moderate, similar to or slightly larger than nostril; gill slit extending ventrally to 2nd pectoral-fin ray base; pectoral fin notched; mandibular symphysis to center of anus 101.6% head length (HL); posterior edge of pelvic disk to center of anus 15.5% HL; epural 1, reduced; epipleural ribs absent. An emended diagnosis and key to the species of *Osteodiscus* are provided.

Key words: Actinopterygii, new species, *Osteodiscus cascadiae*, *Osteodiscus andriashevi*, *Osteodiscus rhepostomias*

Introduction

Snailfishes in the family Liparidae (Scorpaeniformes: Cottoidei) are a morphologically diverse group of marine fishes, currently comprising about 32 genera with over 430 species worldwide (Chernova *et al*. 2004; Orr *et al*. 2019), with new species still being frequently described (e.g., Stein 2012; Orr 2016; Murasaki *et al*. 2019; Chernova *et al*. 2020; Kai *et al*. 2020). Occupying an unusually wide vertical habitat range, they are known from tidal pools to over 8,000 m depth (Chernova *et al*. 2004; Gerringer *et al*. 2017). Members of Liparidae can be recognized by the following morphological characters: body tadpole-like in shape, caudal region elongate; skin soft, including a thick or thin subdermal gelatinous layer; scales absent, but small prickles in some species; cephalic pore system well developed, but lacking a complete lateral line and pores; third infraorbital needle-like, posterior tip almost reaching to preopercle; only third pharyngobranchial present; dorsal and anal fins single, frequently connected to caudal fin by membrane; caudal-fin rays unbranched; pelvic fins modified into a variously shaped disk or completely lost (Kido 1988; Chernova *et al*. 2004; Smith & Busby 2014; Nelson *et al*. 2016). While many genera have been proposed, their phylogenetic relationships are so far largely uncertain (see Kido 1988; Orr *et al*. 2019).

The deep-sea snailfish group *Osteodiscus* Stein, 1978, is primarily distinguished from other genera by its unique pelvic disk skeleton (Stein 1978, 2012; Pitruk & Fedorov 1990; Murasaki *et al*. 2021) and currently comprises three species: *Osteodiscus andriashevi* Pitruk & Fedorov, 1990; *Osteodiscus cascadiae* Stein, 1978; *Osteodiscus rhepostomias* Stein, 2012. During our ongoing taxonomic study of Japanese snailfishes, we discovered a single specimen of *Osteodiscus* collected from the abyssal zone off the Pacific coast of Hokkaido, neighboring the most southern part of the Kuril-Kamchatka Trench. Because the specimen clearly differed from all currently recognized congeners, it is described herein as a new species, and an emended diagnosis and key to the species of *Osteodiscus* are provided.

 Accepted by B. Frable: 17 Aug. 2021; published: 6 Sept. 2021

Materials and methods

The specimen was collected by a small Sigsby-Agassiz type beam trawl (2 m span), and preserved in 70% ethanol. Counts, measurements, and descriptive terminology followed Andriashev & Stein (1998), with the exceptions of cephalic pore terminology, which follows Stein *et al*. (2001), and osteological terminology of the pelvic girdle, which follows Kido (1988). Vertebral and median-fin ray counts were made from radiographs. Cephalic pores were examined after staining with Aniline Blue (Wako Chemicals). Colors of the peritoneum, stomach, and pyloric caeca were noted following abdominal dissection. However, dissection and staining of the holotype for observation of the pectoral girdle were not attempted due to the possibility of resulting damage. Standard length and head length are abbreviated as SL and HL, respectively. Specimens examined in this study are deposited in the National Museum of Nature and Science, Japan (NSMT) and Zoological Institute of the Russian Academy of Sciences, Russia (ZIN).

Osteodiscus Stein, 1978

Standard Japanese name: Hariban-kusauo-zoku

Osteodiscus Stein, 1978: 24 (original designation, type species *Osteodiscus cascadiae* Stein, 1978 by monotypy).

Diagnosis. *Osteodiscus* is distinguished from all other genera by the following combination of characters: nostril single on each side; cephalic pore sizes ranging in size from similar to and much larger than nostril; branchiostegal rays six; pelvic disk present, skeletal, fleshly margin absent, basipterygia and pelvic rays covered only by thin skin, pelvic rays webbed between tips, webbing attenuated posteriorly; pleural ribs absent.

Species included. Four species: *Osteodiscus abyssicola* **sp. nov.**; *Osteodiscus andriashevi* Pitruk & Fedorov, 1990; *Osteodiscus cascadiae* Stein, 1978; *Osteodiscus rhepostomias* Stein, 2012.

Distribution. All known species are from the Pacific Ocean: *O. abyssicola* **sp. nov.** from the western North Pacific, off the Pacific coast of northern Japan, in 4,671–4,744 m depth; *O. andriashevi* from the western North Pacific, southern Sea of Okhotsk and off the Pacific coast of northern Japan, in 1,745–2,108 m depth; *O. cascadiae* from the eastern North Pacific, off southern British Columbia to central California, in 2,195–3,500 m depth; *O. rhepostomias* from the western South Pacific, off southeastern New Zealand, in 2,786–2,821 m depth (Stein 1978, 2012; Pitruk & Fedorov 1990; Stein *et al*. 2006; Murasaki *et al*. 2021; this study).

Comments. *Osteodiscus* was diagnosed in part by a deeply notched pectoral fin (Stein 1978, 2012). However, this character is removed from the emended diagnosis of the genus because *O. andriashevi* has an unnotched pectoral fin (see Pitruk & Fedorov 1990; Murasaki *et al*. 2021). Kido (1988) proposed three autapomorphies of *Osteodiscus* (proximal pectoral radials two; second and third pelvic rays widely spaced; epipleural ribs absent), based on his morphological phylogenetic analysis. However, *O. andriashevi*, described two years later, has three or four proximal pectoral radials, and epipleural ribs (Pitruk & Fedorov 1990; Murasaki *et al*. 2021). While *O. rhepostomias* has two proximal pectoral radials, the first radial is oddly shaped (an inverted triangle) and unusually large compared to other snailfishes (Stein 2012). Additionally, it appears that the second and third pelvic rays of *O. rhepostomias* are not widely spaced (see Stein 2012: fig. 16). Accordingly, the three characters proposed by Kido (1988) have also been deleted from the generic diagnosis.

Although species of *Osteodiscus* can be clearly diagnosed from all other snailfishes by the emended diagnosis given above, the phylogenetic position of the genus is essentially unknown and its monophyly unproven. Kido (1988) placed *Osteodiscus* in a basal position to *Careproctus* Krøyer, 1862 and *Paraliparis* Collett, 1879, but his analysis included only a single species of the former, *O. cascadiae*. In a recent molecular phylogenetic study by Orr *et al*. (2019), although *Osteodiscus* recovered a monophyletic group with species of *Careproctus* from the Southern Ocean, the authors conservatively proposed the informal name "Osteocareprocta" for the monophyletic group, since their analysis was also based only on *O. cascadiae*. Subsequently, *Careproctus laperousei* Chernova, Thiel & Eidus, 2020, characterized by reduced musculature on the pelvic disk (similar to the condition in species of *Osteodiscus*), was described from a single specimen collected from the northern slope of the Kuril-Kamchatka Trench, western North Pacific. However, *C. laperousei* clearly differed from species of *Osteodiscus* in having a fleshly margin on the pelvic disk and two paired pleural ribs on each posterior abdominal vertebra (Stein 1978, 2012; Kido 1988; Pitruk & Fedorov 1990; Chernova *et al*. 2020; Murasaki *et al*. 2021; this study). Apart from *O. cascadiae*, specimens of

Osteodiscus are very rare, being known only from the types or very limited additional specimens, and no genetic data are available. Clarification of the phylogenetic position and monophyly of *Osteodiscus* is dependent upon the collection of additional specimens, including those of *C. laperousei*.

Key to species of *Osteodiscus*

1a. Mouth distinctly oblique, principal caudal-fin rays 9 . . . . . *O. rhepostomias*
1b. Mouth horizontal, principal caudal-fin rays 6–8 2
2a. Pectoral fin unnotched, teeth blunt, anal-fin rays 46–49 . . . . . *O. andriashevi*
2b. Pectoral fin notched, teeth sharp, anal-fin rays 39–44 3
3a. Pelvic disk to anus about 1–4 % HL, pyloric caeca absent . . . . . *O. cascadiae*
3b. Pelvic disk to anus about 16% HL, pyloric caeca present . . . . . *O. abyssicola* **sp. nov.**

Osteodiscus abyssicola sp. nov.

New Japanese name: Tsugomori-hariban-kusauo
Figs. 1, 2; Table 1
urn:lsid:zoobank.org:act: D12C0636-D7A4-463A-A173-92E234C1D6E5

Holotype. NSMT-P 109986, 94.7 mm SL, immature female, south-southwest of Kushiro, Hokkaido, northern Japan; 41° 43.46′ N, 144° 53.63′ E–41° 42.24′ N, 144° 52.12′ E; 4,671–4,744 m depth, 4 Aug. 1992, R/V *Hakuho-maru*.

Diagnosis. A species of *Osteodiscus* distinguished from all currently recognized congeners by the following combination of characters: vertebrae 49; dorsal-fin rays 44; anal-fin rays 39; principal caudal-fin rays 8; pyloric caeca 5; mouth horizontal; teeth on both jaws simple and sharp, without cusps; upper and lower jaw symphyses without diastema; cephalic pore sizes moderate, similar to or slightly larger than nostril; gill slit extending ventrally to 2nd pectoral-fin ray base; pectoral fin notched; mandibular symphysis to center of anus 101.6% HL; posterior edge of pelvic disk to center of anus 15.5% HL; epural 1, reduced; epipleural ribs absent.

Description. Counts and measurements given in Table 1. Body slender, anteriorly oval in cross section, tapering gradually and becoming strongly compressed posteriorly, deepest at nape (= vertical depth through center of pelvic disk) (Fig. 1A, B). Skin thin, fragile (partly damaged); thin subdermal gelatinous layer present; prickles apparently absent. Head large, dorsal profile rounded from nape to snout. Snout blunt and deep, slightly projecting. Mouth subterminal, horizontal when closed, oral cleft extending to below center of orbit; outer margin of premaxilla completely covered by upper lip; posterior margin of maxilla slightly beyond to vertically below posterior margin of orbit. Lower jaw slightly inferior, anterior part of premaxillary tooth plates visible from ventral aspect of head; posterior half of outer margin of mandible covered by lower lip, anterior tip of lip slightly angled ventrally. Teeth on both jaws simple, sharp, without cusps, in about 20 oblique rows of 5–9 teeth forming bands, inner teeth larger than outer teeth (Fig. 2A). Upper and lower jaw symphyses without diastema. Single nostril tube-like, horizontally level with center of orbit. Eye and orbit small, dorsal contour of orbit below dorsal profile of head; pupil round. Cephalic pore sizes moderate, similar to or slightly larger than nostril: nasal pores 2, maxillary pores 6? [6th (= supraorbital) pore apparently present as shown in Fig. 1A, but difficult to discern due to poor skin condition], preoperculo-mandibular pores 7, suprabranchial pore 1; pore pattern 2-6?-7-1. Coronal pore absent. Chin pores (= anteriormost preoperculo-mandibular pores) paired, opening directly on skin surface, well separated from each other. Free neuromasts not apparent in damaged skin. Gill slit relatively short, upper margin horizontally level with lower margin of orbit, lower margin extending ventrally to 2nd pectoral-fin ray base. Opercular flap angular, pointing posteroventrally, supported by two spines: upper spine (from opercle) and lower spine (from subopercle) extending posterior to vertical through dorsal-fin origin.

Dorsal- and anal-fin rays not buried in gelatinous layer. Anteriormost and 2nd pterygiophores of dorsal fin without rays, inserted between 3rd and 4th, and 4th and 5th neural spines, respectively. Anal-fin origin below 8th dorsal-fin ray base. Hypural plates fused with terminal vertebral centrum, upper and lower plates separated by a narrow slit. Single reduced epural present. Pleural ribs and epipleural ribs absent.

Pectoral fin moderately or deeply notched (condition unclear due to damage to some rays in notch and lower lobe, as shown in Fig. 1A). Upper lobe rays slightly protruding from membrane at tip; 2nd and 3rd uppermost rays

longest, reaching to 4th anal-fin ray base. Notch and lower lobe rays filamentous, nearly completely free from membrane. Uppermost pectoral-fin base just below level of posterior margin of maxilla; lowermost pectoral-fin base below anterior margin of orbit.

TABLE 1 Counts and measurements of *Osteodiscus abyssicola* **sp. nov.**, holotype, NSMT-P 109986

Character	Counts	In % of measurements	
		Standard length	Head length
		94.7 mm	24.5 mm
Vertebrae (abdominal + caudal)	49 (10 + 39)		
Dorsal-fin rays	44		
Anal-fin rays	39		
Pectoral-fin rays	21		
Caudal-fin rays	9		
Principal caudal-fin rays (upper + lower)	8 (4 + 4)		
Procurrent caudal-fin rays (upper + lower)	1 (1 + 0)		
Branchiostegal rays	6		
Pyloric caeca	5		
Head length		25.9	
Head width		15.2	58.8
Maximum body depth		22.6	87.3
Body depth at anal-fin origin		14.3	55.1
Snout length		10.0	38.8
Maxilla length		13.5	52.2
Mandible length		13.4	51.8
Mouth width		13.6	52.7
Orbit length		4.0	15.5
Eye diameter		4.0	15.5
Interorbital width		10.8	41.6
Bony interorbital width		4.4	17.1
Suborbital depth to maxilla		5.4	20.8
Gill slit length		9.6	37.1
Pectoral-fin ray length in upper lobe		20.9	80.8
Pectoral-fin ray length in lower lobe		-	-
Pectoral-fin ray length at notch		-	-
Pelvic disk length		11.6	44.9
Pelvic disk width		9.6	37.1
Caudal fin length		-	-
Predorsal fin length		27.5	106.1
Snout to anterior edge of pelvic disk		12.9	49.8
Mandibular symphysis to anterior edge of pelvic disk		11.5	44.5
Snout to center of anus		27.7	106.9
Mandibular symphysis to center of anus		26.3	101.6
Posterior edge of pelvic disk to center of anus		4.0	15.5
Preanal fin length		36.7	142.0
Center of anus to anal-fin origin		10.9	42.0
Dorsal-fin origin to anal-fin origin		23.0	89.0

Pelvic disk large, longer than wide, moderately upturned at posterior part; skeletal, musculature greatly reduced, fleshly margin absent (Fig. 2B). Basipterygia and six paired pelvic rays (anteriormost spine, posterior five soft rays) covered only by thin skin, internal structures visible through skin. Bases of anteriormost and 2nd pelvic rays more widely spaced than bases of other rays; anteriormost ray supported by subpelvic process (= part of anterior half of basipterygium), posterior five rays supported by posterior half of basipterygium. Pelvic rays webbed between tips; webs somewhat attenuated posteriorly on disk. Anus well separated from posterior edge of pelvic disk, vertically below dorsal-fin origin. Minute genital papilla-like process at posterior of anus. Stomach and short pyloric caeca located on left side of visceral cavity.

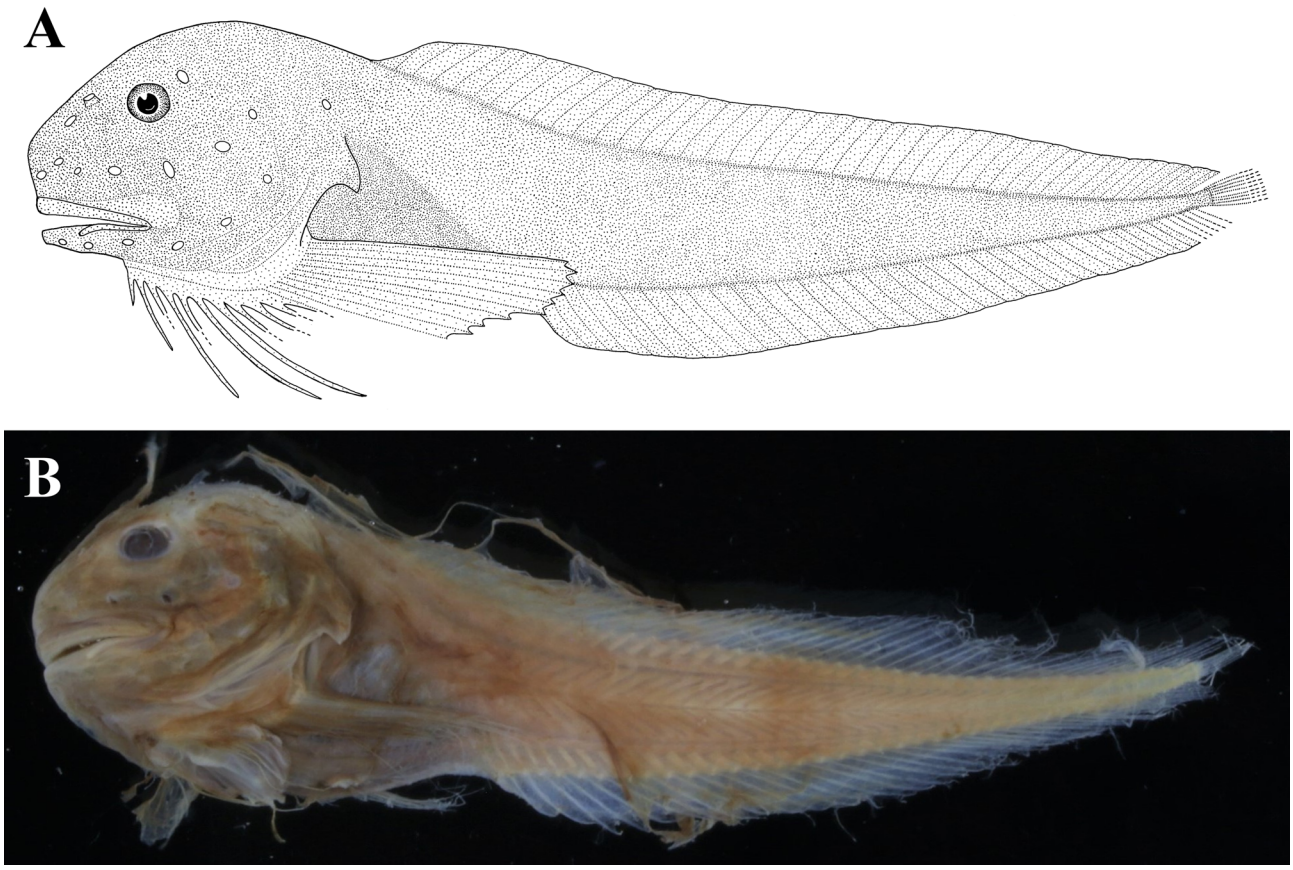

FIGURE 1. *Osteodiscus abyssicola* **sp. nov.**, holotype, NSMT-P 109986, 94.7 mm SL. (A) drawing; (B) photograph of preserved specimen.

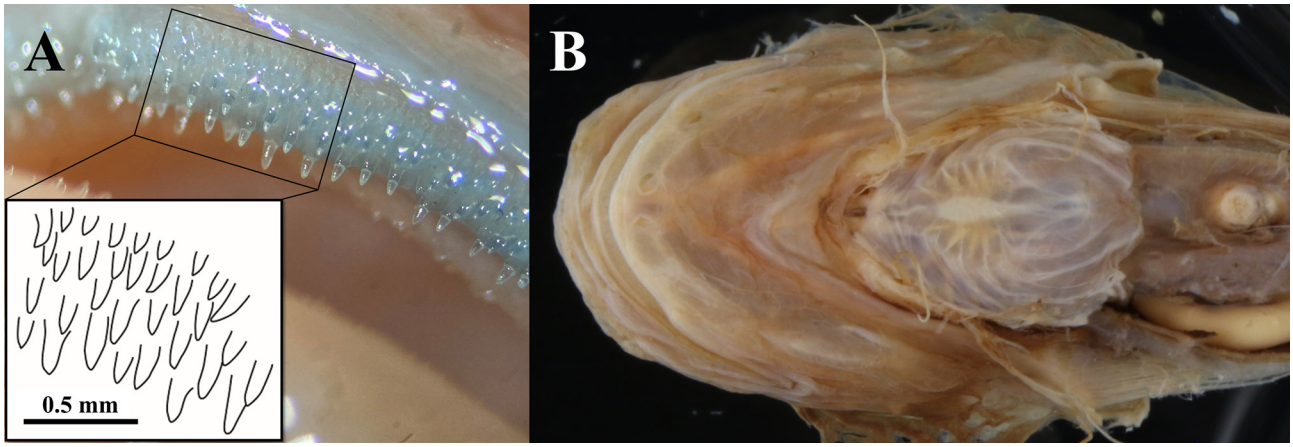

FIGURE 2. Teeth on right side of premaxilla (A) and ventral view of head and abdominal region (B) of *Osteodiscus abyssicola* **sp. nov.**, holotype, NSMT-P 109986, 94.7 mm SL.

Color in alcohol. Body and fins brown, head somewhat darker (Fig. 1B). Eye and peritoneum black. Gill cavity dark brown. Stomach, pyloric caeca, and genital papilla-like process pale.

Distribution. Western North Pacific, south-southwest of Kushiro, Hokkaido, northern Japan, at a depth of 4,671–4,744 m.

Etymology. The specific name "*abyssicola*", a noun in apposition, is derived from Latin "abyssus" (abyss) and "cola" (dweller), referring to the deeper habitat of this species compared to congeners. The Japanese name "Tsugomori" is an archaic term in Japanese, modified from "tsuki-gomori" (hiding moon), and refers to a dark night.

Comparisons. *Osteodiscus abyssicola* **sp. nov.** shares a horizontal mouth with two congeners, *O. cascadiae* and *O. andriashevi* (Stein 1978; Pitruk & Fedorov 1990; Murasaki *et al*. 2021; this study). However, *O. abyssicola* **sp. nov.** clearly differs from *O. cascadiae* in having 8 principal caudal-fin rays (vs. 6–7), 5 pyloric caeca (vs. 0), the anus well separated from the pelvic disk posterior edge (15.5% HL vs. immediately posterior to or slightly further from disk, 1–4 % HL), moderate-sized cephalic pores, similar to or slightly larger than nostril (vs. notably larger than nostril), absence of diastemata at both jaw symphyses (vs. present), and presence of a reduced epural (vs. absent) (Stein 1978, 2012; Kido 1988; this study). It also differs from *O. andriashevi* in having 49 vertebrae (vs. 55–60), 44 dorsal-fin rays (vs. 52–54), 39 anal-fin rays (vs. 46–49), 8 principal caudal-fin rays (vs. 7), sharp teeth without cusps (vs. blunt, some with lateral cusps), a notched pectoral fin (vs. unnotched), and the absence of epipleural ribs (vs. present) (Pitruk & Fedorov 1990; Murasaki *et al*. 2021; this study). Additionally, the space between the 1st and 2nd pelvic-fin ray bases is greater than between the other fin ray bases in *O. abyssicola* **sp. nov.** (vs. space between 2nd and 3rd ray bases greater than between others in *O. cascadiae* and *O. andriashevi*) (Stein 1978; Kido 1988; Pitruk & Fedorov 1990; this study). The remaining species, *O. rhepostomias*, has a distinctly oblique mouth (vs. horizontal in *O. abyssicola* **sp. nov.**), 9 principal caudal-fin rays (vs. 8), a shorter distance from mandible to anus, 68.2% HL (vs. 101.6% HL), a clear diastema at the lower jaw symphysis (vs. absent), and a large gill slit, extending ventrally to about 9th pectoral-fin ray base (vs. small, extending to 2nd pectoral-fin ray base) (Stein 2012; this study).

Comparative material

Osteodiscus andriashevi: paratype, ZIN 49565, one of two specimens with the same registration number, photographs and radiographs only, 165 mm SL, female, Sea of Okhotsk, 48° 07′ N, 146° 59′ E, 1,766–1,745 m depth, 22 May 1989, Freezer fishing trawler *Darwin* (trawl 38), otter trawl; NSMT-P 97212, 150.3 mm SL, female, off Iwate, Japan, 38° 39.9′ N, 143° 7.5′ E–38° 38.4′ N, 143° 8.9′ E, 1,997–2,108 m depth, 31 May 1989, R/V *Tansei-maru* (KT-89-07, SR103), beam trawl.

Acknowledgments

We are grateful to G. Shinohara and M. Nakae (NSMT) for access to the collections of the museum, and N. V. Chernova (ZIN) for providing photographs and radiographs of the paratype of *Osteodiscus andriashevi*, and acknowledge the roles of the captain and crew of R/V *Hakuho-maru* in collecting the holotype of the new species. G. S. Hardy (Ngunguru, New Zealand) reviewed the manuscript, and members of the Laboratory of Marine Biology, Faculty of Science and Technology, Kochi University (BSKU) assisted in taking radiographs of the holotype of the new species. This study was supported in part by Grants-in-Aid for the Promotion of Scientific Research (C) (no. 18K05792) from the Ministry of Education, Culture, Sports, Science and Technology, Japan to the last author.

References

Andriashev, A.P. & Stein, D.L. (1998) Review of the snailfish genus *Careproctus* (Liparidae, Scorpaeniformes) in Antarctic and adjacent waters. *Contributions in Science, Los Angeles*, 470, 1–63.

Chernova, N.V., Stein, D.L. & Andriashev, A.P. (2004) Family Liparidae Scopoli 1777—snailfishes. *California Academy of Sciences Annotated Checklists of Fishes*, 31, 1–72.

Chernova, N., Thiel, R. & Eidus, I. (2020) Four new species of *Careproctus* (Cottoidei: Liparidae) from the deep-water vicinity of the southern Kuril Islands (Western North Pacific). *Zootaxa*, 4821 (1), 71–87.

https://doi.org/10.11646/zootaxa.4821.1.3
Collett, R. (1879) Fiske fra Nordhavs-Expeditionens sidste Togt, Sommeren 1878. *Forhandlinger I Videnskabs-Selskabet i Christiania*, 14, 1–106. [for 1878]
Gerringer, M.E., Linley, T.D., Jamieson, A.J., Goetze, E. & Drazen, J.C. (2017) *Pseudoliparis swirei* sp. nov.: a newly-discovered hadal snailfish (Scorpaeniformes: Liparidae) from the Mariana Trench. *Zootaxa*, 4358 (1), 161–177.
https://doi.org/10.11646/zootaxa.4358.1.7
Kai, Y., Murasaki, K., Misawa, R., Fukui, A., Morikawa, E. & Narimatsu, Y. (2020) A new species of snailfish of the genus *Paraliparis* (Liparidae) from the western North Pacific, with a redescription of the poorly known species *Paraliparis mandibularis*. *ZooKeys*, 968, 143–159.
https://doi.org/10.3897/zookeys.968.56057
Kido, K. (1988) Phylogeny of the family Liparididae, with the taxonomy of the species found around Japan. *Memoirs of the Faculty of Fisheries, Hokkaido University*, 35, 125–256.
Krøyer, H.N. (1862) Nogle Bidrag til Nordisk ichthyologi. *Naturhistorisk Tidsskrift, Kjøbenhavn*, Series 3, 1, 233–310.
Murasaki, K., Kai, Y., Endo, H. & Fukui, A. (2021) First Japanese record of the snailfish *Osteodiscus andriashevi* (Liparidae), collected off Iwate, Japan. *Japanese Journal of Ichthyology*. [10 May 2021, online first, in Japanese]
https://doi.org/10.11369/jji.20-044
Murasaki, K., Takami, M. & Fukui, A. (2019) *Paraliparis variabilidens*, a new snailfish (Liparidae) from the Suruga Trough, Japan. *Ichthyological Research*, 66, 509–514.
https://doi.org/10.1007/s10228-019-00692-y
Nelson, J.S., Grande, T.C. & Wilson, M.V.H. (2016) *Fishes of the world*. *5th Edition*. John Wiley and Sons, Hoboken, New Jersey, xli + 707 pp.
Orr, J.W. (2016) Two new species of snailfishes of the genus *Careproctus* (Liparidae) from the Aleutian Islands, Alaska. *Copeia*, 104, 890–896.
https://doi.org/10.1643/CI-15-378
Orr, J.W., Spies, I., Stevenson, D.E., Longo, G.C., Kai, Y., Ghods, S. & Hollowed, M. (2019) Molecular phylogenetics of snailfishes (Liparidae: Cottoidei) based on mtDNA and RADseq genomic analyses, with comments on selected morphological characters. *Zootaxa*, 4642 (1), 1–79.
https://doi.org/10.11646/zootaxa.4642.1.1
Pitruk, D.L. & Fedorov, V.V. (1990) A new species of the genus *Osteodiscus* Stein (Liparididae) from the Sea of Okhotsk. *Voprosy Ikhtiologii*, 30 (5), 856–860. [in Russian, English translation in *Journal of Ichthyology*, 30 (8), 112–118]
Smith, W.L. & Busby, M.S. (2014) Phylogeny and taxonomy of sculpins, sandfishes, and snailfishes (Perciformes: Cottoidei) with comments of the phylogenetic significance of their early-life-history specializations. *Molecular Phylogenetics and Evolution*, 79, 332–352.
https://doi.org/10.1016/j.ympev.2014.06.028
Stein, D.L. (1978) A review of the deepwater Liparidae (Pisces) from the coast of Oregon and adjacent waters. *Occasional Papers of the California Academy of Sciences*, 127, 1–55.
Stein, D.L. (2012) A review of the snailfishes (Liparidae, Scorpaeniformes) of New Zealand, including descriptions of a new genus and sixteen new species. *Zootaxa*, 3588 (1), 1–54.
https://doi.org/10.11646/zootaxa.3588.1.1
Stein, D.L., Chernova, N.V. & Andriashev, A.P. (2001) Snailfishes (Pisces: Liparidae) of Australia, including descriptions of thirty new species. *Records of the Australian Museum*, 53, 341–406.
https://doi.org/10.3853/j.0067-1975.53.2001.1351
Stein, D.L., Drazen, J.C., Schlining, K.L., Barry, J.P. & Kuhnz, L. (2006) Snailfishes of the central California coast: video, photographic and morphological observations. *Journal of Fish Biology*, 69, 970–986.
https://doi.org/10.1111/j.1095-8649.2006.01167.x