



A new species of the genus *Osteodiscus* (Cottoidei: Liparidae) from the Kuril Basin (Sea of Okhotsk, western North Pacific)

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ABSTRACT

A new species of liparid fish from the genus *Osteodiscus* Stein, 1978 is described. The genus is primarily distinguished from *Careproctus* Krøyer, 1862 in the reduction of soft tissues of the pelvic disk. Three specimens of *Osteodiscus lindbergi* sp. nov. were caught during the international expedition SokhoBio (“Sea of Okhotsk Biodiversity Studies”, 2015) in the Kuril Basin of the Sea of Okhotsk at an abyssal depth of 3306–3348 m. The new species differs from four other congeners in the number of vertebrae (53) and rays in the dorsal (51) and anal (42) fins, a notched pectoral fin with a moderately elongated lower lobe (that is 67–76% of the length of upper pectoral-lobe), a horizontal mouth, and lack of prickles on the skin. Color of head and body brown, peritoneum black. This abyssobenthic species is presumably endemic to the deep-sea Kuril Basin.

Key words: Kuril Basin, Liparidae, *Osteodiscus*, Sea of Okhotsk

Новый вид рода *Osteodiscus* (Cottoidei: Liparidae) из Курильской котловины Охотского моря (северо-западная Пацифика)

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РЕЗЮМЕ

Описан новый вид липаровых рыб из рода *Osteodiscus* Stein, 1978, представители которого отличаются от *Careproctus* Krøyer, 1862 редукцией мягких тканей в брюшной присоске. Три экземпляра *Osteodiscus lindbergi* sp. nov. были пойманы в ходе международной экспедиции СохоБио («Sea of Okhotsk Biodiversity Studies», 2015 г.) в Курильской котловине Охотского моря на абиссальных глубинах (3306–3348 м). От четырех других представителей рода новый вид отличается числом позвонков (53) и лучей в спинном (51) и анальном (42) плавниках, выемчатым грудным плавником с умеренно удлиненной нижней лопастью (составляющей 67–76% длины его верхней лопасти), горизонтальным ртом, отсутствием шипиков на коже. Окраска головы и тела коричневая, перитонеум черный. Этот абиссобоентальный вид, по-видимому, эндемичен для Курильской глубоководной котловины.

Ключевые слова: Курильская котловина, Liparidae, *Osteodiscus*, Охотское море

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INTRODUCTION

Snailfishes were present among the ichthyological material collected by the Russian-German expedition SokhoBio (“Sea of Okhotsk Biodiversity Studies”, July–August 2015) in the area of the Kuril Islands (Malyutina et al. 2018). They were sampled at a depth of more than three thousand meters. Of the great interest are three specimens from the deep-sea Kuril Basin (southern part of the Sea of Okhotsk), assigned to the genus *Osteodiscus* Stein, 1978. The genus is close to *Careproctus* Krøyer, 1862 but characterized by a significant reduction of the soft tissues of the pelvic disk, in which the leathery marginal part and muscles are absent, the rays supporting the disk are covered only with thin skin. The ends of the longest rays of the disk are obviously erectile: when all the rays are raised, the disk takes on a concave shape.

The genus includes four species. The type, *O. cascadiae* Stein, 1978, is described from the Cascadia Abyssal Plain (off Oregon), depth 2850 m; *O. andriashevi* Pitruk et Fedorov, 1990 from the Sea of Okhotsk (1945–1930 m); *O. rhepostomias* Stein, 2012 from the Bounty Trench (New Zealand region, 2786–2821 m); and *O. abyssicola* Murasaki, Kai, Endo et Fukui, 2021 from waters east of Hokkaido at depths 4671–4744 m (Stein 1978; Pitruk and Fedorov 1990; Stein 2012; Murasaki et al. 2021a). All these deep-water species occur in the Pacific Ocean; *O. rhepostomias* is found in the southern part, *O. cascadiae* in the northeastern area, and two, *O. andriashevi* and *O. abyssicola*, in the northwestern region of the Pacific Ocean.

An overview of *Osteodiscus* species and a key for their identification was recently presented (Murasaki et al. 2021a), making it easier for us to identify our specimens. We assign them to the new species *O. lindbergi* sp. nov., according to a complex of meristic and morphological characters. This new species is described below.

MATERIAL AND METHODS

Gear. The specimens were collected using an Agassiz trawl (AGT) with a frame of 350 × 70 cm and a mesh size of 10 mm. After deploying to the bottom and stopping the winch, trawling was carried out for 10 to 20 minutes at a vessel speed of 1 knot. Full data for cruise details see in Malyutina et al. (2018).

Environmental conditions. Water temperature and salinity measured by CTD at 10 stations during the cruise were stable between 1.9 to 2.1°C (mean 1.91) and 34.5 to 34.6 (34.59) PSU.

Preservation. The catch was removed from the trawl, immediately placed in chilled seawater, and then fixed in 4% formaldehyde solution. One month later the specimens were transferred into 70% ethanol at the laboratory. The holotype (ZMH 28701) and the larger paratype (ZMH 28702) were photographed with an Olympus Tough TG-6 Compact Digital Camera. Images of the smaller paratype (ZMH 28671) were taken with a Digital BK Plus imaging system (Dun, Inc.), equipped with a Canon EOS 5DS DSRL camera with a 100-mm macro lens. Image stacking was performed using Zerene Stacker v.1.04 (Zerene Systems LLC).

The specimens are deposited in the collection of Zoological Museum Hamburg (ZMH), at present belonging to Leibniz Institute for the Analysis of Biodiversity Change, Museum of Nature, Hamburg, Germany (LIB).

Methods of fish study. We used traditional methods to study liparids (Burke 1930; Stein 1978; Andriashev 2003; Chernova et al. 2020). Descriptions and measurements were carried out on fixed specimens. Vertebrae and ray numbers in vertical fins were counted from radiographs. Vertebral number includes the urostyle. Pectoral girdle, which is useful for species identification in snailfishes, was not extracted for study to avoid damaging the specimens of a rare species. The specimen ZMH 28702 was checked for pyloric caeca. Unfortunately no samples were taken on board for molecular genetic studies.

For the cephalic pores of the sensory system, we give Burke’s (1930) pore formula, traditionally used in snailfish descriptions, which includes the number of pores on the snout (nasal), near the eye (infraorbital + postorbital), preoperculo-mandibular pores, and that above the gill opening (suprabranchial pore).

Photographs of the other two *Osteodiscus* species were taken during earlier studies (NC).

Osteodiscus andriashevi, non type ZIN 49360, 151 mm SL; Sea of Okhotsk, 48°10′03″ N, 148°01′05″ E, 1950–1930 m, Fishing trawler “Novodrutsk”, 10.07.1987, trawl 82, collector V.V. Fedorov.

Osteodiscus cascadiae, paratype OSIC 012771, 79 mm SL; off Oregon (eastern North Pacific), 44°06′12″ N, 125°22′42″ W, depth 2850 m.

Fish collection codes: OSIC – The Oregon State Ichthyology Collection, Corvallis, Oregon, USA; ZIN – Zoological Institute, Russian Academy of Sciences, Saint Petersburg, Russia.

Abbreviations: dorsal (D), anal (A), pectoral (P) and caudal (C) fins and ray numbers; total length (TL), standard length (SL), and head length (HL).

SYSTEMATICS

Family Liparidae Gill, 1861

Genus *Osteodiscus* Stein, 1978

Osteodiscus lindbergi sp. nov.

(Figs 1–2, 3A, B)

Holotype. ZMH 28701, female 92.6 mm SL, – TL; Kuril Basin (southern part of the Sea of Okhotsk), 46°57.0' N 151°00.4' E, 3306 m depth, 21.07.2015, RV “Akademik M.A. Lavrentyev”, cruise 71, station 7–11, Agassiz trawl; collector I. Eidus. Condition: end of caudal fin missing; skin on posterior part of body lost.

Paratypes (2). ZMH 28702, female ca. 79 mm SL, – TL; same collection data as holotype. Condition: skin on head and body lost; end of tail (obviously 2 or 3 vertebrae) and caudal fin missing. ZMH 28671, juvenile 50.9 mm SL, 57.3 mm TL; Kuril Basin, 48°03.0'N, 150°00.3'E, 3348 m depth, 21.07.2015, RV “Akademik M.A. Lavrentyev”, cruise 71, Station 6–9, Agassiz trawl; collector I. Eidus.

Etymology. The species is named after the Russian ichthyologist G.U. Lindberg (1894–1976), initiator and author of the fundamental series “Fishes of the Sea of Japan and the adjacent parts of the Sea of Okhotsk and the Yellow Sea” in seven volumes (Lindberg and Legeza 1959, 1965; Lindberg and Krasnyukova 1969, 1975, 1987; Lindberg and Fedorov 1993; Lindberg et al. 1997).

Diagnosis. A snailfish with soft tissues of pelvic disk reduced. Vertebrae 53, D 51, A 42. Pectoral fin with 20–22 rays, notched; lower fin-lobe shorter than upper lobe. Mouth horizontal. Cephalic pores 2–6–7–1. Pyloric caeca absent. Prickles on skin absent. Skin on head and body (where present) dark brown; peritoneum and branchial cavity black.

Description of the holotype. Counts provided in Table 1. Body deepest at nape, slim and gradually thinning towards the end. Head massive and rather large (length 3.8 in SL), deeper than it is wide (71.4 and 60.6% HL respectively). Occiput deep and

swollen (Fig. 1); dorsal contour depressed above eye. Snout blunt, not protruding, its length 1.8 times eye diameter. Orbit one-fourth of head length; eye 0.8 of orbit diameter, pupil round. Interocular 1.2 diameter of orbit. Nostril in front of lower half of orbit. Mouth horizontal, terminal; lower jaw not included. Maxillary reaching posteriorly to below center of eye. Teeth simple, not numerous (Table 1), in 4 oblique rows at each half of jaws, 5 and 4 teeth in a full oblique rows anteriorly on upper and lower jaw. Gill slit about one-third HL, longer than orbit and reaching ventrally to eighth pectoral fin ray. Opercular flap large, tip levels with pupil. Cephalic pores: 2 nasal, 6 infraorbital, 7 preoperculo-mandibular, and 1 suprabranchial. Preoperculo-mandibular pores large. Chin pores small and close together, but separate.

Precaudal part of body 2.7 in SL. Pleural ribs absent, epipleural ribs indistinguishable on radiographs. Pectoral fins not long (60% HL) and notched, right 22, left 20 rays. Upper pectoral lobes include 16 and 15 rays, lower lobes 6 and 5 rays accordingly. The upper pectoral ray about levels with mouth cleft; the longest rays reaching to sixth anal-fin ray. The lower fin-lobe not much long, reaching to 76% of the upper lobe length; tips of rays free of fin membrane. Disk skeletal, four pairs of pelvic rays are set apart, which is clearly visible through skin (Fig. 1, 3B) and on radiogram. Disk large, 29% HL. Anus posterior to disk at a short distance, about one-fourth of disk length. Body not gelatinous. Skin thin, not prickled. Caudal fin broken. Color of skin on head and body (where present) is brown. Branchial cavity and peritoneum black.

Variability. Basic characters of paratypes are similar to those described (Table 1). Pyloric caeca absent (paratype ZMH 28702). The juvenile (ZMH 28671, about twice smaller than the holotype), has head and body lower and more compressed, predorsal and precaudal parts of body shorter, eye and orbit smaller; mandible to disk and to anus longer, but length from disk (and anus) to anal-fin origin shorter than larger specimen.

Morphometry. Holotype 92.6 mm SL (paratype ZMH 28671, 50.9 mm SL), in % SL: head length 26.0 (25.0), head depth 18.6 (13.9) and width 15.8 (12.2); maximum body depth 15.6 (11.6) and depth above anal-fin origin 9.1 (7.5); predorsal 26.1 (23.4) and pre-anal-fin length 36.5 (31.4); eye diameter 5.1 (3.5), gill slit 8.0 (7.7), mandible to pectoral-fin symphysis 8.0 (11.2); mandible to disk 13.1 (13.9) and

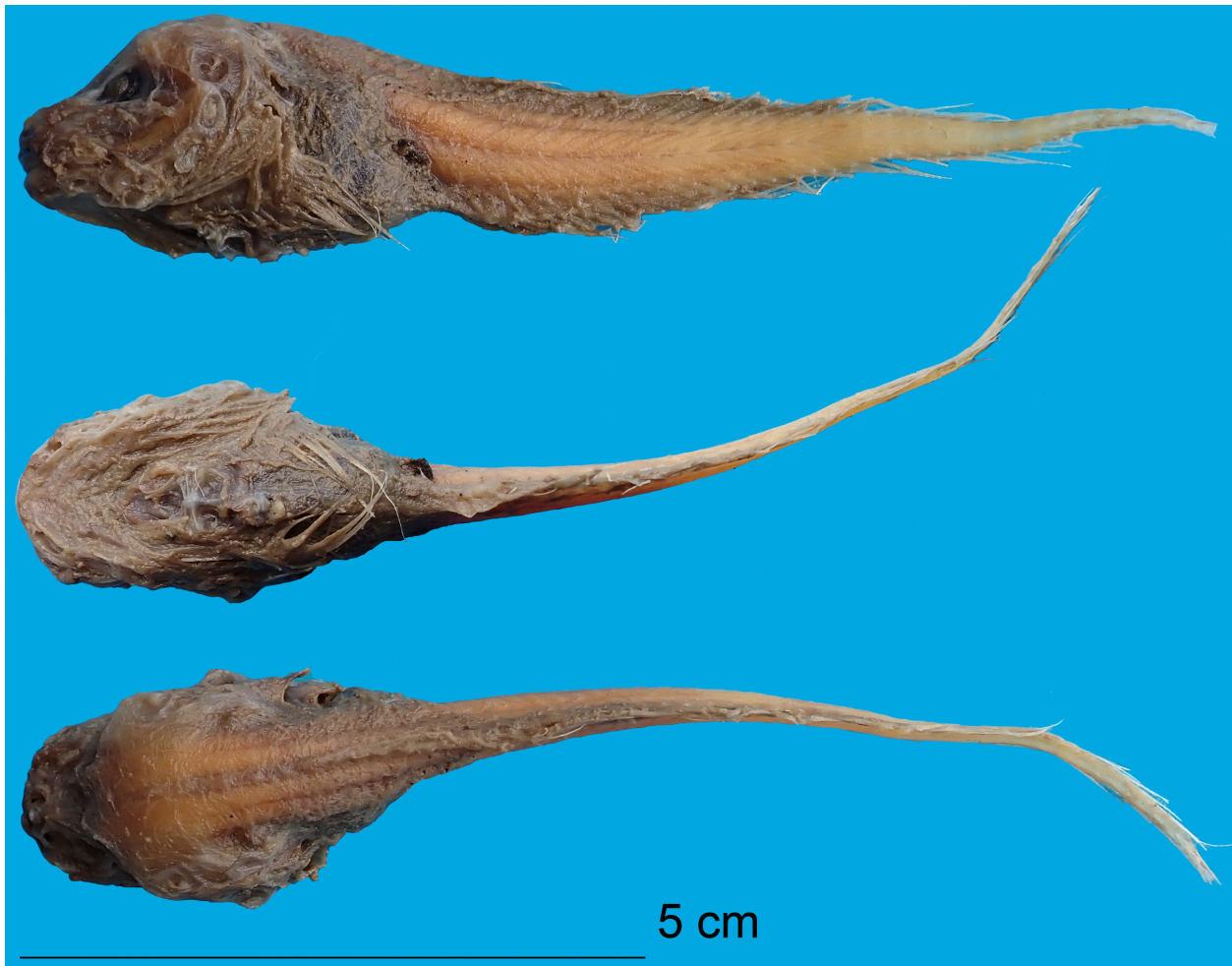


Fig. 1. *Osteodiscus lindbergi* sp. nov. Holotype ZMH 28701, female 92.6 mm SL, in lateral (top), ventral (middle) and dorsal view (bottom).

to anus 21.6 (22.2); disk length 7.6 (9.4) and width 6.3 (5.7); disk to anus 1.9 (1.8) and to anal-fin origin 15.8 (9.8); anus to anal-fin origin 13.9 (8.1); length of upper pectoral lobe 15.7 (15.5), pectoral notch ray 5.2 (3.5) and lower pectoral lobe 11.9 (12.6); pectoral symphysis to anal-fin origin 25.2 (18.3). We cannot give measurements for paratype ZMH 28702 which is missing the last two or three vertebrae (SL 79+ mm).

Holotype (paratypes ZMH 28702 and ZMH 28671), in % HL: head depth 71.4 (65.1; 55.9) and width 60.6 (59.6; 48.8); maximum body depth 59.8 (56.0; 46.5) and depth above anal-fin origin 34.9 (39.4; 29.9); predorsal 100.4 (109.2; 93.7) and pre-anal-fin length 140.2 (130.7; 126.0); snout length 34.4 (35.3; 33.9), eye 19.5 (20.2; 14.2) and orbit diameter 24.5 (29.4; 22.0); postorbital length 46.1 (44.5;

53.5); interocular 28.6 (39.0; 27.6) and interorbital (bony) width 14.9 (13.3; –); upper jaw 43.6 (50.0; 44.9) and lower jaw length 53.5 (54.1; 56.7); width between corners of mouth 36.5 (52.3; 37.0), gill slit 30.7 (26.1; 30.7), disk length 29.0 (35.3; 37.8); upper pectoral lobe 60.2 (61.5; 62.2) and lower lobe 45.6 (41.3; 50.4).

Distribution. Type specimens are found in the Kuril Basin, an isolated abyssal plain in the southern part of the Sea of Okhotsk, at a depth of 3306 and 3348 m.

Comparisons. Three of the four species of the genus *Osteodiscus* live in regions remote from the place where the new species was captured, but one, *O. andriashevi*, described from the Sea of Okhotsk (Pitruk and Fedorov 1990; Chernova et al. 2020, fig. 3) and



Fig. 2. *Osteodiscus lindbergi* sp. nov., paratype ZMH 28671, juvenile 50.9 mm SL, in lateral (top), ventral (middle) and dorsal view (bottom).

recorded recently from Pacific waters of Japan (Iwate Prefecture), depth 1997–2108 m (Murasaki et al. 2021b). *Osteodiscus lindbergi* differs from *O. andria-shevi* in a notched pectoral fin (vs. fin almost unnotched, with rays gradually decreasing in length), in lower number of total vertebrae (53 vs. 55–60), dorsal and anal fin rays (51 vs. 52–54 and 42 vs. 46–49) (Table 2), and head color (brown, including underside vs. ink black, Figs 3B, C).

Osteodiscus lindbergi differs from *O. abyssicola* described off Hokkaido in the following different counts: total vertebrae 53 (vs. 49), dorsal fin rays 51 (vs. 44) and anal fin rays 42 (vs. 39). Gill slit is shorter in length (26–31% HL vs. 37%), but reaching to eighth pectoral ray (vs. to second ray); pelvic disk to anus shorter (1.8–7.5 vs. 15.5% HL) (Murasaki et al. 2021a).

In *O. cascadiae*, described from Oregon waters (Stein 1978), the first soft ray of pelvic disk is shifted forward close to the spine of subpelvic process and widely separated from remaining four soft rays, occu-

pying the normal position (Kido, 1988: 151, fig. 14B). Disk of *O. lindbergi* similarly has only four pairs of rays together (Fig. 3B). *Osteodiscus lindbergi* is also close to *O. cascadiae* in meristic counts (Table 2), but differs in having body lower (depth 15.4–15.5 vs. 15.9–23.3 % SL), pectoral-fin lower rays shorter (67–76 vs. 86–137% of upper-lobe length) and includes 5–6 rays forming a lobe (in *O. cascadiae* 3–5 rays closely set, with two of them threat-like – Fig. 4), prickles on skin absent (vs. present in males and females of all size, sitting in radiating clumps); teeth are fewer, forming 4 oblique rows at each half of jaws (vs. in narrow band of 18–24 oblique rows) (Stein 1978: 25).

Osteodiscus lindbergi differs from *O. rhepostomias* (Bounty Trough, New Zealand vicinity) in having a horizontal (vs. oblique) mouth, numerous dorsal fin rays (51 vs. 46–47), a lower number of pectoral fin rays (20–22 vs. 24), and posterior position of anus (mandible to anus 80–83% HL vs. 68%) (Stein 2012).



Fig. 3. Head region of *Osteodiscus lindbergi* sp. nov. (paratype ZMH 28671, juvenile 50.9 mm SL) in lateral (A) and ventral (B) views, and *O. andriashevi* (non type ZIN 49360, 151 mm SL) in ventral view (C). Pelvic disk with reduced soft tissue visible.

Table 1. Counts of *Osteodiscus lindbergi* sp. nov., holotype and paratypes.

Counts	Holotype ZMH 28701	Paratype ZMH 28702*	Paratype ZMH 28671	Limits
Total vertebrae	53	49+		53
Precaudal vertebrae	9	8		8–9
Caudal vertebrae	44	41+		44
Dorsal rays number	51	48+		51
Anal rays number	42	40+		42
Pectoral rays number, right; left	22; 20	21; 22	20	20–22
Pectoral upper-lobe rays	16; 15	16; 16	15	15–16
Pectoral lower-lobe rays	6; 5	5; 6	5	5–6
Cephalic pore pattern	2–6–7–1	2–6–7–1	2–6–7–1	2–6–7–1
Teeth on upper (lower) jaw				
Teeth number in a full oblique row anteriorly	5(4)	5(4)	5(4)	5(4)
Number of teeth oblique rows near jaw symphysis	4(4)	4(3)	3–4(3)	3–4(3–4)
Number of teeth oblique rows along a half of jaw	4(4)	3(3)	3–4(3–4)	3–4(3–4)

* The last vertebrae (two or three, including the urostyle) are lost.

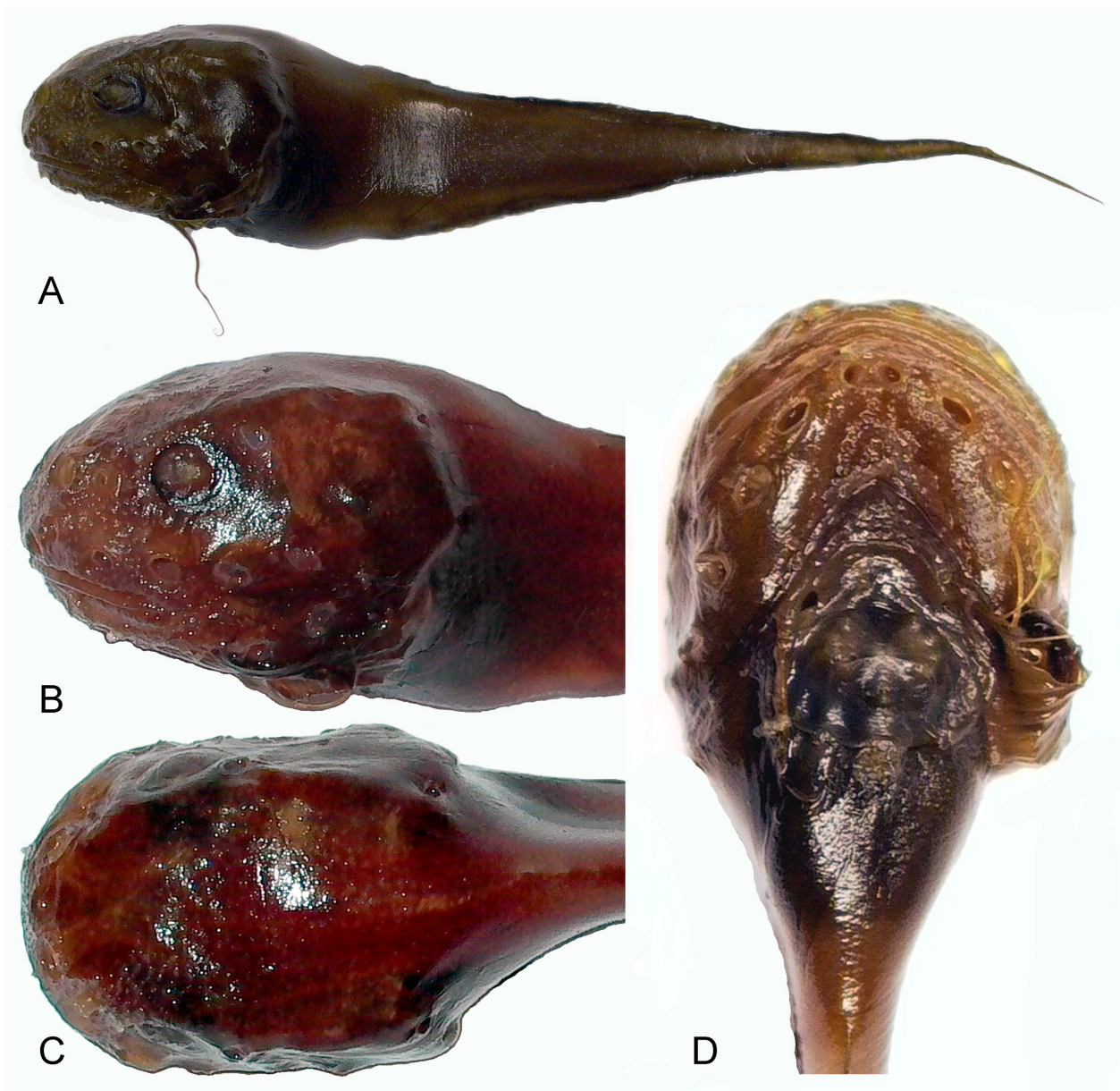


Fig. 4. *Osteodiscus cascadiae* (paratype OSIC 012771, 79 mm SL, off Oregon, depth 2850 m) in lateral (A, B), upper (C) and ventral (D) views.

DISCUSSION

Depths below 3000 m are regarded as the upper abyssal zone (Sheiko and Fedorov 2000), therefore *O. lindbergi* sp. nov. is an abyssobenthic species. The Kuril Basin is an isolated abyssal plain (Fig. 5), separated from the Pacific Ocean not only by the chain of the Kuril Islands (with the deepest straits about

1800 and 2200 m), but also by ultra-abyssal depth of the Kuril-Kamchatka Trench (Malyutina et al. 2018). This allows to expect that *O. lindbergi* sp. nov. is more likely an endemic species of the isolated depression of the Kuril Basin.

In contrast, the congener from the Sea of Okhotsk, *O. andriashevi*, described from the Academy of Sciences Rise, depth of 1945–1930 m, is a bathybenthal

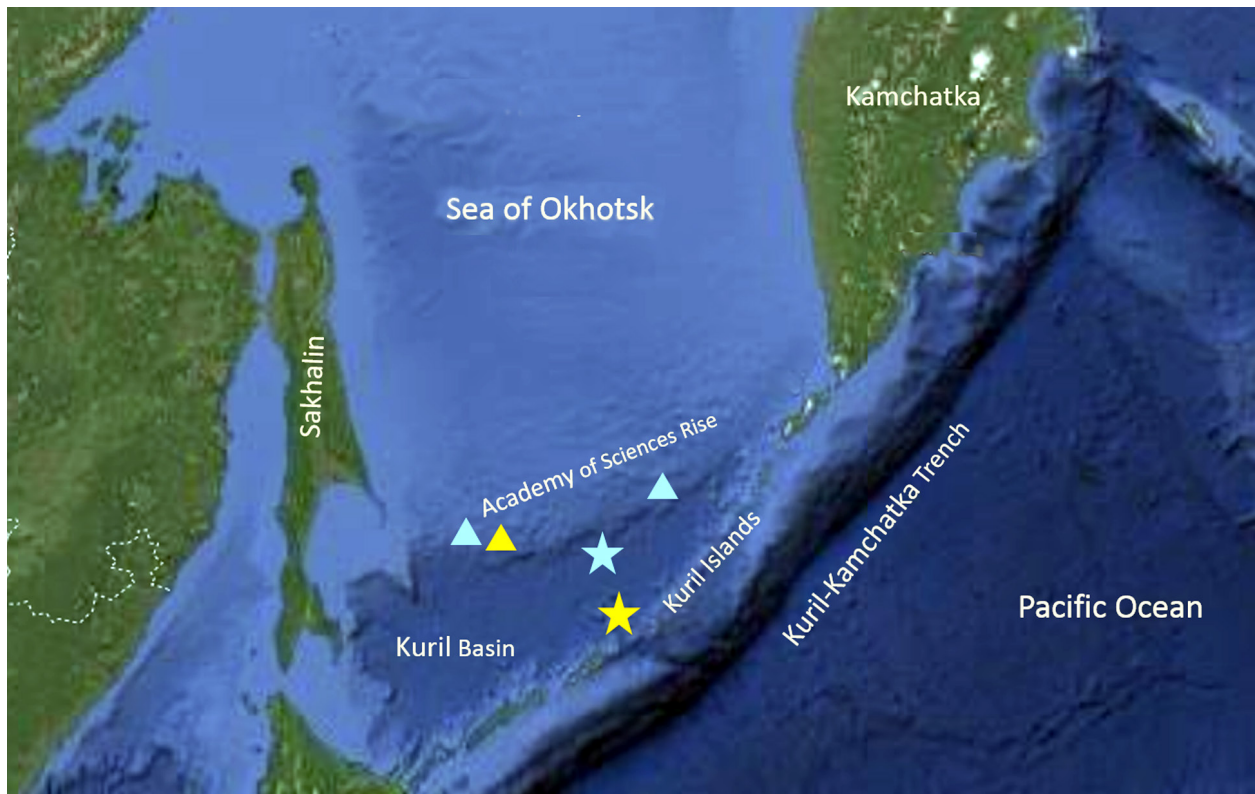


Fig. 5. Map showing the catch locations of *Osteodiscus lindbergi* sp. nov. (holotype and paratype ZMH 28702 – yellow star, paratype ZMH 28671 – blue star) and *Osteodiscus andriashevi* (holotype – yellow triangle, paratypes – blue triangles). Map: <https://www.google.com/maps/place>.

Table 2. Basic characters of five *Osteodiscus* species; differences between *O. lindbergi* sp. nov. and congeners in bold.

Species	<i>O. cascadiae</i>	<i>O. andriashevi</i>	<i>O. rhepostomias</i>	<i>O. abyssicola</i>	<i>O. lindbergi</i> sp. nov.
References	Stein 1978	Pitruk, Fedorov 1990; Murasaki et al. 2021	Stein 2012	Murasaki et al. 2021	Present paper
Vertebrae, total	51–56	55–60	51–55	49	53
Vertebrae, precaudal	–	8–9	–	10	8–9
Dorsal fin rays	47–52	52–54	46–47	44	51
Anal fin rays	40–44	46–49	41–44	39	42
Caudal fin rays, total	6–7	7–8	10	8–9	–
Pectoral fin rays	20–25	21–23	24	21	20–22
Pores pattern	2–6–7–1	2–6–7–1	–	2–6?–7–1	2–6–7–1
Mouth cleft	horizontal	horizontal	oblique	horizontal	horizontal
Teeth shape	simple, sharp	simple (blunt), or with shoulders	sharp canines	simple, sharp	simple
Gill slit reaching to pectoral-fin ray	3–12 (in average 6–7)	1	9	2	8
Pectoral-fin notch	present	absent	present	present	present
Prickles on skin	present	absent	absent	present	absent
Color of head and body	black or dark brown	head black, body lighter	brown, tail unpigmented	brown	brown
Color of peritoneum	black	black	black	black	black

fish (Sheiko and Fedorov 2000). Type specimens of *O. andriashevi* were collected close to the northern margin of the Kuril Basin (Fig. 5). The bathymetric map of the area allows suggesting that *O. andriashevi* can obviously be distributed wider than *O. lindbergi*, as the bathyal depths have a wider spread in the Sea of Okhotsk as well along the Japanese Islands. A supporting fact for this assumption is the recent record of *O. andriashevi* at the Pacific side of Japan (off Iwate, 38°39.9' N, 143°7.5' E–38°38.4' N, 143°8.9' E) at a depth of 1997–2108 m (Murasaki et al. 2021b).

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