

A new species of *Amphictene* (Annelida, Polychaeta, Pectinariidae) from off Kushiro, Hokkaido, Japan

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Abstract: We describe here a new species of *Amphictene* (Annelida, Polychaeta, Pectinariidae) from a depth of 1160 m off Kushiro, East Hokkaido, Japan. *Amphictene hokkaido* sp. nov. is characterized by the presence of following characters: a pair of ventral lappets in segment 1; ventro-median lobes in segments 2–4; anterior conical or rounded lappets on ventro-lateral lobe of segment 2; dorso-lateral pads in segments 3 and 4; 17 segments with chaetae on notopodia, 13 segments with uncini on neuropodia; notopodia in segment 21 with notopodial lappets beneath chaetal tuft; neuropodial uncini with 4–5 main teeth and subrostral process on basal prow; 7–9 pairs of scaphal hooks; scaphe with anterior median lobe and four pairs of lateral lobes; anal lobe with an anal cirrus and a row of postero-ventral minute cirri. We provide a diagnostic key to species of the genus.

Key words: Terebellomorpha, taxonomy, uncini, ultrastructure

Introduction

Pectinariidae de Quatrefages, 1866, also known as “ice-cream cone worms”, is a group of marine annelids distributed worldwide (Rouse et al. 2022). This family, part of the Terebelliformia group, is unique among group members because it possesses a fused prostomium and peristomium that form a cephalic veil with a row of paleae at the anterior end, while the posterior end modified into a sucker-like scaphe (Hutchings et al. 2021). The family’s taxonomic history dates to Pallas (1766), who described the first pectinid, now known as *Pectinaria belgica*, as *Nereis cylindrarica* var. *belgica* from the Dutch North Sea (Ton van Haaren 2021; Hutchings et al. 2021). The family comprises

five genera (Fauchald 1977; Parapar et al. 2020; Read & Fauchald 2023b), and 73 species are currently considered valid (Read & Fauchald 2023b).

A total of nine species of Pectinariidae have been recorded from Japanese waters: *Amphictene japonica* (Nilsson, 1928), *Cistenides granulata* (Linnaeus, 1767), *C. hyperborea* Malmgren, 1866, *Lagis bocki* (Hessle, 1917), *L. koreni* Malmgren, 1866, *Pectinaria okudai* Imajima & Hartman, 1964, *Pec. aegyptia* (Savigny, 1822), *Pec. belgica* (Pallas, 1766), and *Pec. hiuchiensis* Kitamori, 1965 (Marenzeller 1879; Hessle 1917; Nilsson 1928; Okuda 1934, 1936, 1937, 1938; Imajima & Hartman 1964; Kitamori 1965; Okuda & Imajima 1965; Uchida 1968; Imajima 1972, 2009; Sato et al. 2014; Nishi et al. 2014; Tomioka & Nishi 2022). Among them, *L. bocki*, *Pec. okudai*, *Pec. hiuchiensis* have been found in intertidal to shallow subtidal sandy or muddy sediments (see Nishi et al. 2012,

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2013, 2014; Orita et al. 2019).

Data on the worldwide pectinariid distribution on the continental shelf and in the deep sea are scant (Hutchings et al. 2021). Only four species have been reported from the lower bathyal and upper abyssal zone (2000–4000 m): *Petta assimilis* McIntosh, 1885 (2926 m deep); *Pet. investigatoris* Zhang, Hutchings & Kupriyanova, 2019 (2338–2820 m deep); *Pet. williamsonae* Zhang, Hutchings & Kupriyanova, 2019 (2760–2692 m deep); *A. moorei* (Annenkova, 1929) (2000–3000 m deep). Three species have been reported from the upper bathyal zone (200–2000 m): *A. undulata* Zhang & Hutchings, 2019 (ca. 700 m deep); *Pec. ningalooensis* Zhang & Hutchings, 2019 (ca. 650–750 m deep); *A. japonica* (ca. 1700 m deep).

The genus *Amphictene* Lamarck, 1818 has 17 species worldwide (Read & Fauchald 2023a), and four species are known from the temperate western Pacific around Japan: *A. japonica* from Japanese waters, *A. moorei* from the Russian waters of the Sea of Japan, *A. alata* Zhang, Zhang & Qiu, 2015 and *A. jianqingi* Zhang, Hutchings & Qiu, 2022 from off Chinese coasts (Nilsson 1928; Okuda 1934; Imajima & Hartman 1964; Imajima 2009; Annenkova 1929; Zhang et al. 2015, 2022). Zhang et al. (2022) reported two undetermined species of *Amphictene*, i.e., *A. sp. 1* and *A. sp. 2* from the Yellow Sea. Here we report the second species of the genus from Japanese waters, the fifth species in the temperate Pacific area, and the 18th species in the world. We provide here a diagnostic key to species of the genus.

Materials and methods

The specimens were collected by Deep Tow camera dive DT#DTV-13 from muddy bathyal sediments at a depth of 1160 m, off Kushiro, East Hokkaido, during the RV *Kaiyo* cruise KY97-11. The distinct pectinariid tubes were picked from the mud sample, fixed in 10% neutralized formalin and preserved in 70% ethanol.

The holotype and paratypes have been deposited in the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Yokosuka, Japan.

To highlight features that are inconspicuous in alcohol-preserved colorless specimens, the bodies of pectinariid specimens were stained with methyl green. The staining methods followed Tomioka et al. (2013). Digital photographs of the body and tube were taken using a Sony α 77D (=SLT-A77V) camera with a Minolta Macro-Zoom 3x-1x lens. Photographs of parapodia and chaetae were taken with an iPhone 7[®] (Apple Inc.) connected to either an Olympus SZX-7 stereomicroscope or a Leica CM-E compound microscope. An iPhone 7 camera, inserted into eyepiece tube of the stereo and compound light microscopes through the microscope adapter i-NTER LENS, and using the Micronet “i-NTER SHOT” software, produced optimal images. The microscope adapter and associated application software were from MeCan Imaging Co. Ltd., Saitama, Japan. Digital images were edited with[®] Adobe Photoshop

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Taxonomic character terminology adhered to Hutchings & Peart (2002), Zhang & Hutchings (2019), and Zhang et al. (2022). Uncinal morphology terminology followed Parapar et al. (2020).

For scanning electron microscopy (SEM), specimens were dehydrated through a gradual series of ethanol for 10 min each and finally washed with 100% ethanol for 10 min. The samples were then washed with a 1 : 1 and 1.5 : 0.5 mixture of 100% ethanol and hexamethyldisilazane (HMDS) for 10 min each, and finally washed with 100% HMDS for 10 min as per Nation (1983) and Nishi et al. (2022). Specimens were left overnight to ensure HMDS evaporation, then coated with platinum and viewed under the Hitachi FE SU8010 at the Instrumental Analysis Center of Yokohama National University.

Results

Systematics

Family Pectinariidae de Quatrefages, 1866

Genus *Amphictene* Lamarck, 1818

Amphictene hokkaido sp. nov.

[new Japanese name Ezo-umi-isagomushi]

(Figures 1–4)

Material examined. HOLOTYPE: a specimen with tube (JAMSTEC RK6-A-3, 008703); off Kushiro, Hokkaido, Japan, 42°10.500'N, 144°10.500'E; muddy sediments, 1160 m; 23 October 1997; leg. Fujiwara, Y.; dredge manipulated by Deep Tow camera dive DT#DTV-13; fixed in 10% formalin, preserved in 70% ethanol.

PARATYPES: three specimens with tube (JAMSTEC RK6-A-3, 008704–008706); data as for holotype; RK6-A-3, 008704–008706 fixed in 10% formalin, preserved in 70% ethanol; RK6-A-3, 008706 subsequently prepared for SEM.

NON-TYPES: Five empty tubes (JAMSTEC RK6-A-3, 008707–11); data as for holotype; fixed in 10% formalin, preserved in 70% ethanol.

Description (based on holotype and paratypes, paratype data in brackets).

Color of preserved specimens pale grey. Body robust and solid (Fig. 1B), 26.0 mm long (32.0–38.0 mm), width at operculum 5.0 mm (5.5–6.0 mm), width at scaphe 3.0 mm (2.6–3.0 mm) (Fig. 1B–D, J, M).

Methyl green staining distinct on cirri of cephalic veil, opercular rim, ventral lobes of segments 2–6, ventral lappets on segment 1, dorso-lateral pads of segments 3–4, glandular area of segments 7–15, glandular areas between segment 21 and scaphe, and margins of scaphe (Fig. 1B–M).

Operculum with 9/12 in left/right (10/11, 9/8) long golden paleae (Figs. 1 and 2), slightly curved medially, with extended acute tips (Figs 1B–I; 2A, B); raised opercular rim well developed, crenulated with 18 (18–20) triangular

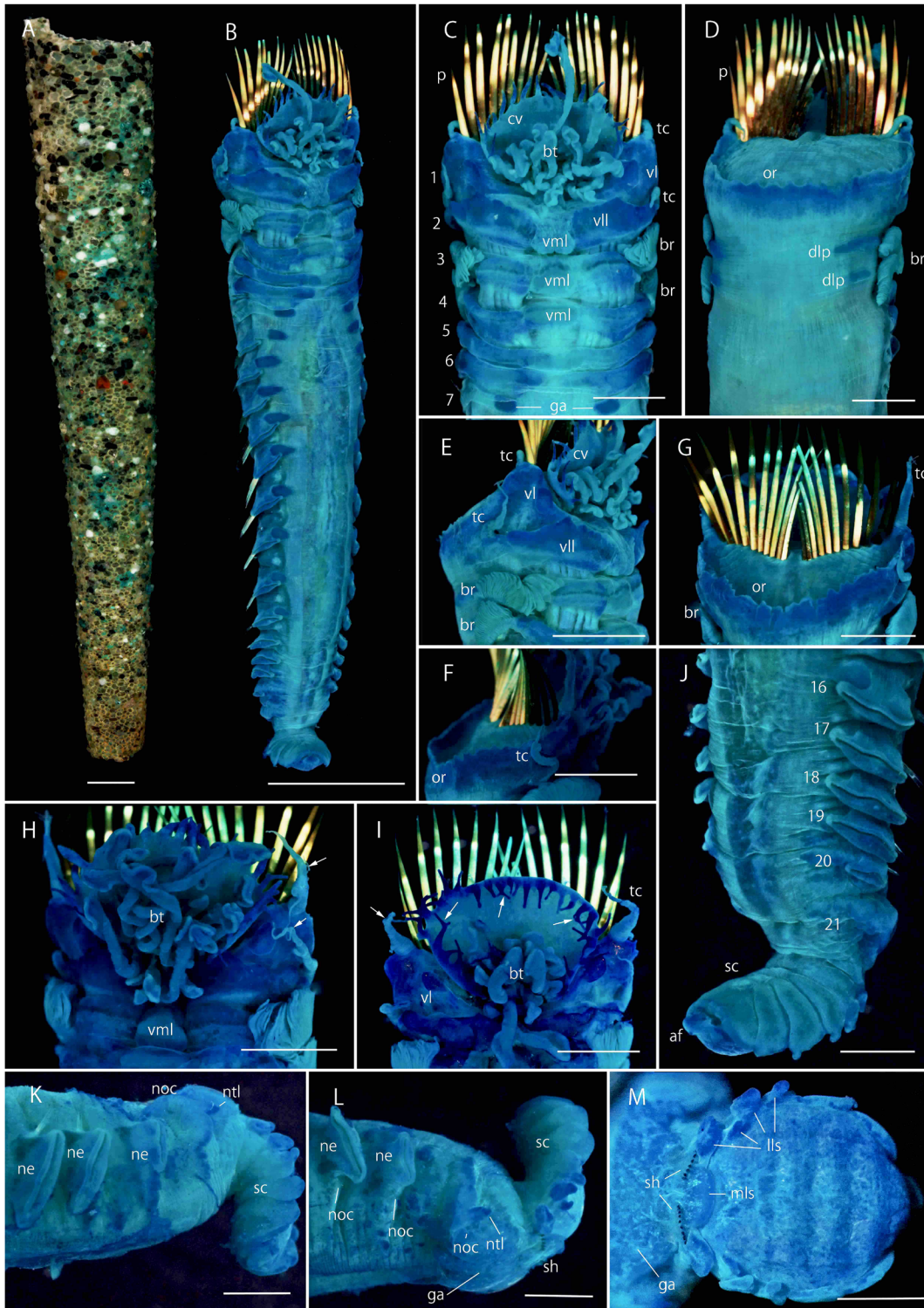


Fig. 1. *Amphitene hokkaido* sp. nov. A–E, J, M, holotype RK6-A-3, 008703; F, H, paratype RK6-A-3, 008705; G, I, paratype RK6-A-3, 008706; K, L, paratype RK6-A-3, 008705. A, tube; B, ventro-lateral view of whole worm; C, ventral view from head to segment 7; D, dorsal view of anterior segments; E, lateral view from head to branchiate segments; F, close-up view of lateral part of segments 1 and 2; G, dorsal view of paleae, from head to segments 4; H, close-up ventral view of segments 1–3; arrow shows branched cirri; I, close-up ventral view from head to segment 2; arrows show branched cirri; J, ventro-lateral view from posterior segments to scaphe; K, L, lateral view of most posterior segments and scaphe; M, dorsal view of scaphe. The numerals 1–7 and 16–21 in C and J show segments number. Abbreviations: af anal flap; br branchiae; bt buccal tentacle; cv cephalic veil; dlp dorso-lateral pad; ga glandular area; mls median lobe of schaphe; lls lateral lobe of schaphe; ne neuropodium; noc notochaetae; ntl notopodial lappets; or opercular rim; p paleae; sc scaphe; sh scaphal hook; tc tentacular cirrus; vml ventro-median lobe; vl ventral lappet; vll ventro-lateral lobe. Scales: 2.0 mm in A, C–J, 5.0 mm in B, 1.0 mm in K–M.

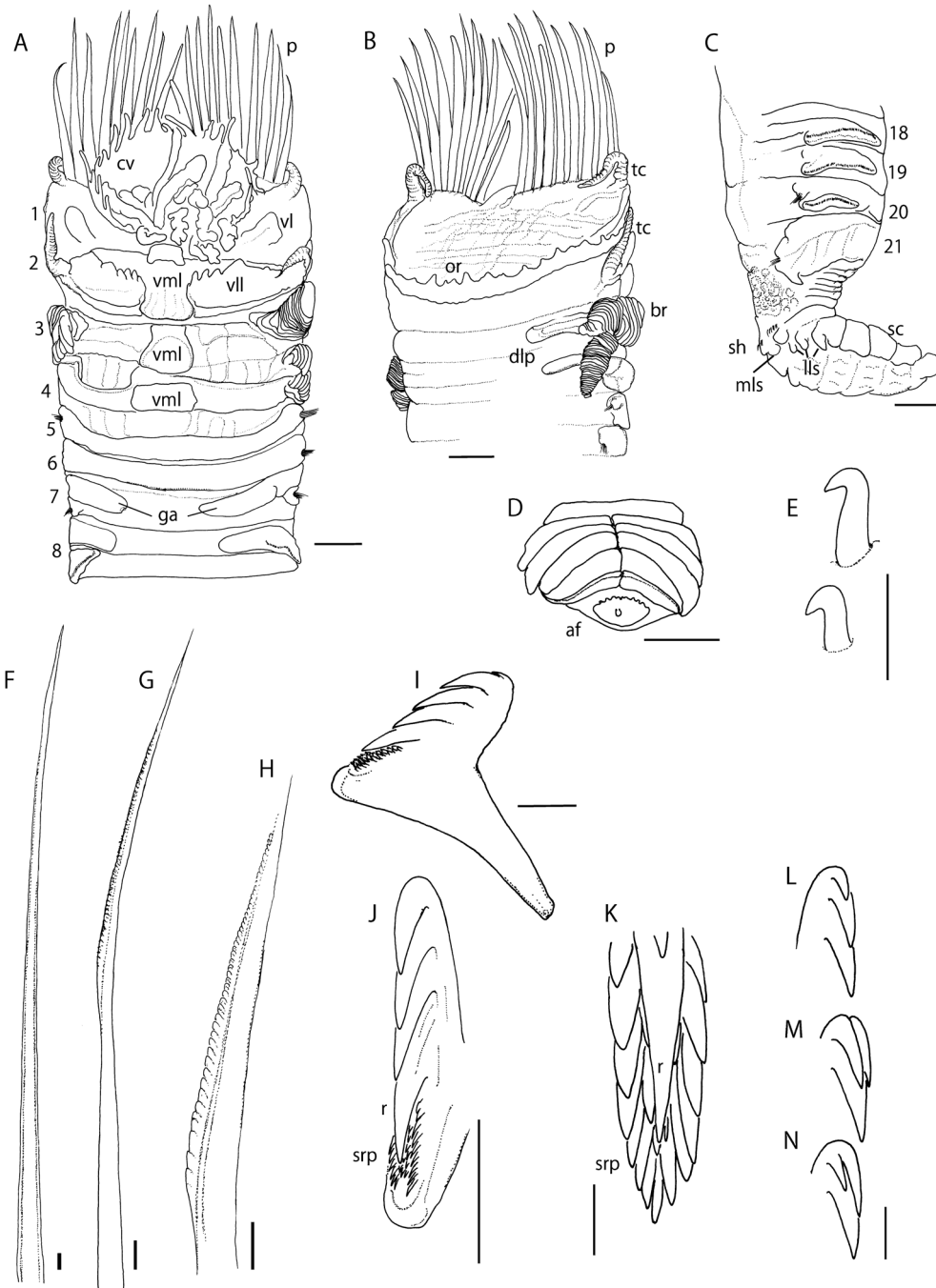


Fig. 2. *Amphictene hokkaido* sp. nov. A–D, holotype RK6-A-3, 008703; E–M, paratype RK6-A-3, 008706 (partly drawn from SEM images). A, ventral view from head to segment 8. B, dorsal view from head to segment 6. C, lateral view of posterior segments and scaphe. D, posterior view of scaphe. E, lateral view of scaphal hooks. F, G, H, distal part of two types of notochoetae: straight type with acute tip (F) and geniculate winged type (G, H). I, lateral view of an uncinus. J, ventral view of an uncinus. K, close-up view of lower part of uncini, showing rostrum and subrostral process. L–N, three types of uppermost major uncinal teeth: (L) single small tooth situated at top; (M) pair of small teeth with same size situated at top; (N) pair of small teeth with different size situated at top. The numerals 1–8 and 18–21 in A and C show segments number. Abbreviations: af anal flap; br branchiae; cv cephalic veil; dlp dorso-lateral pad; ga glandular area; lls lateral lobe of scaphe; mls median lobe of scaphe; ne neuropodium; or opercular rim; p palea; r rostrum; sc scaphe; sh scaphal hook; srp subrostral process; tc tentacular cirrus; vml ventro-median lobe; vl ventral lappet; vll ventro-lateral lobe. Scales: 1.0 mm in A–D, 50 μ m in E, 10 μ m in F–N.

lappets (Figs 1D, G; 2B).

Rim of cephalic veil with 23 (25–30) slender cirri, each cirrus tapering to thread-like terminal filament (Fig. 1H,

I); some of cirri bi- or tri-branched (Fig. 1C, E, H, I). Cephalic veil covering base of buccal tentacle tufts (Figs 1C, H, I; 2A), cephalic veil completely free from operculum.

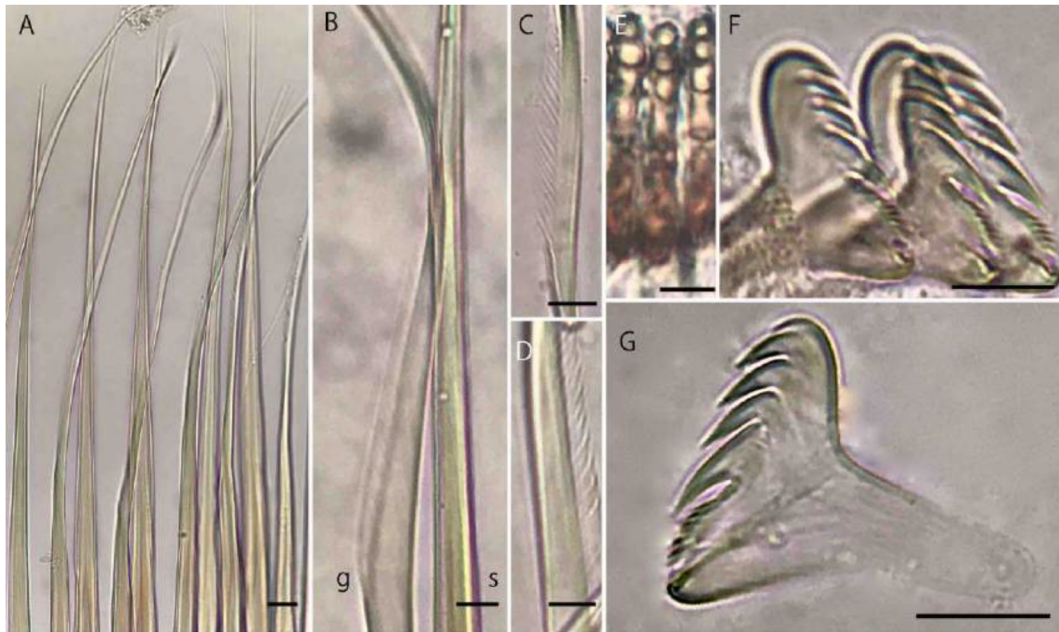


Fig. 3. *Amphictene hokkaido* sp. nov. A, tuft of notochaetae, paratype RK6-A-3, 008706. B, close-up view of notochaetae showing geniculate, winged type (g) and straight type (s). C, D, close-up view of geniculate type chaetae. E, lateral view of uncini. F, G, lateral view of uncini. Scales: 10 μ m.

First pair of tentacular cirri arising from connection of opercular rim and paleal ridge (Figs 1C, D, E, G–I; 2A); pair of ventral lappets present behind tentacular cirri near cephalic veil on segment 1 (Figs 1C, E; 2A). Second pair of tentacular cirri on latero-median connecting ridge on segment 2, running to ventro-lateral lobe (Fig. 1C, D; 2A, B). Anterior margin of ventro-lateral lobe of segment 2 with contiguous conical or rounded lappets, one conical and three or four rounded lappets present proximally in holotype, three rounded lappets present proximally in paratypes (Figs 1C, E, H, I; 2A).

Ventro-lateral lobe of segment 2–4 connected to quadrangular ventro-median lobe (Figs 1B, C, H; 2A); segments 5 and 6 without ventro-median lobes, ventral side of segment 7 and following ones with elongated oval-shaped glandular area (Figs 1C; 2A).

Two pairs of comb-like branchiae situated laterally on segments 3 and 4, anterior pair positioned more ventrally than posterior one (Figs 1D, E; 2B). Dorsal side of segments 3 and 4 with pair of dorso-lateral pads each, anterior pair longer than posterior one (Figs 1D; 2B).

Notopodia with chaetae on segments 5–21 (17 pairs), each bearing two kinds of notochaetae (Fig. 3A, B): geniculate, winged, bordered with distal serrations (Figs 2G, H; 3B, C, D; 4I–L) and stout, long and straight, tapering to acute tips (Fig. 2F; 3B; 4K). First to third and posterior five notopodia reduced (Figs 1J–L; 2C). Notopodia on segment 21 with short dorsal cirri posterior to notochaetal tuft (Figs 1K, L; 2C).

Neuropodia 13 pairs on segments 8–20, with transverse row of uncini, each uncinus with slightly inflated U-shaped

anterior peg (basal prow), several rows of minor teeth or subrostral processes beneath rostrum, four to five major teeth in row (Figs 2I–N; 3E–G; 4M, N); distal major teeth usually arranged in row (Figs 2I, J, L; 3E, F, G), rarely in two rows (Fig. 2M), or distal tooth with associated small tooth situated laterally (Fig. 2N).

Scaphe ovoid, divided into five horizontal sections dorsally and ventrally, each ventral section separated medially (Figs 1J–M; 2C, D; 4C, D), with anterior median lobe between scaphal hooks (Figs 1M; 4C, D); four pairs of lateral lobes, second ones situated more medially than others (Figs 1M; 4C, D). Anal flap circular, with smooth margin, bearing short anal cirrus (Figs 2D; 4C, D, G, H). Anal flap with row of minute cirri on proximal edge of ventral surface (Figs 2D; 4G, H). Scaphal hooks seven to nine pairs, curved dorso-medially, with blunt tips (Figs 1M; 2E; 4E, F).

Tube almost straight, only slightly curving, 36.0 (38.0–48.0) mm in length. Anterior opening 6.5 (7.0–8.0) mm wide; posterior opening 2.5 (2.0–3.0) mm wide. Fragile tube wall made of sand granules and shell fragments (Fig. 1A).

Etymology. The species is named after the type locality, Hokkaido, Japan.

Taxonomic remarks

Amphictene hokkaido sp. nov. can be distinguished from all other valid species of the genus by the combination of the following nine characteristics: (1) presence of a pair of lateral lappets on the segment 1 lateral to the cephalic veil (Figs 1C, E; 2A); (2) ventro-lateral lobe on segment 2 with anterior lappets; (3) dorso-lateral pads on branchi-

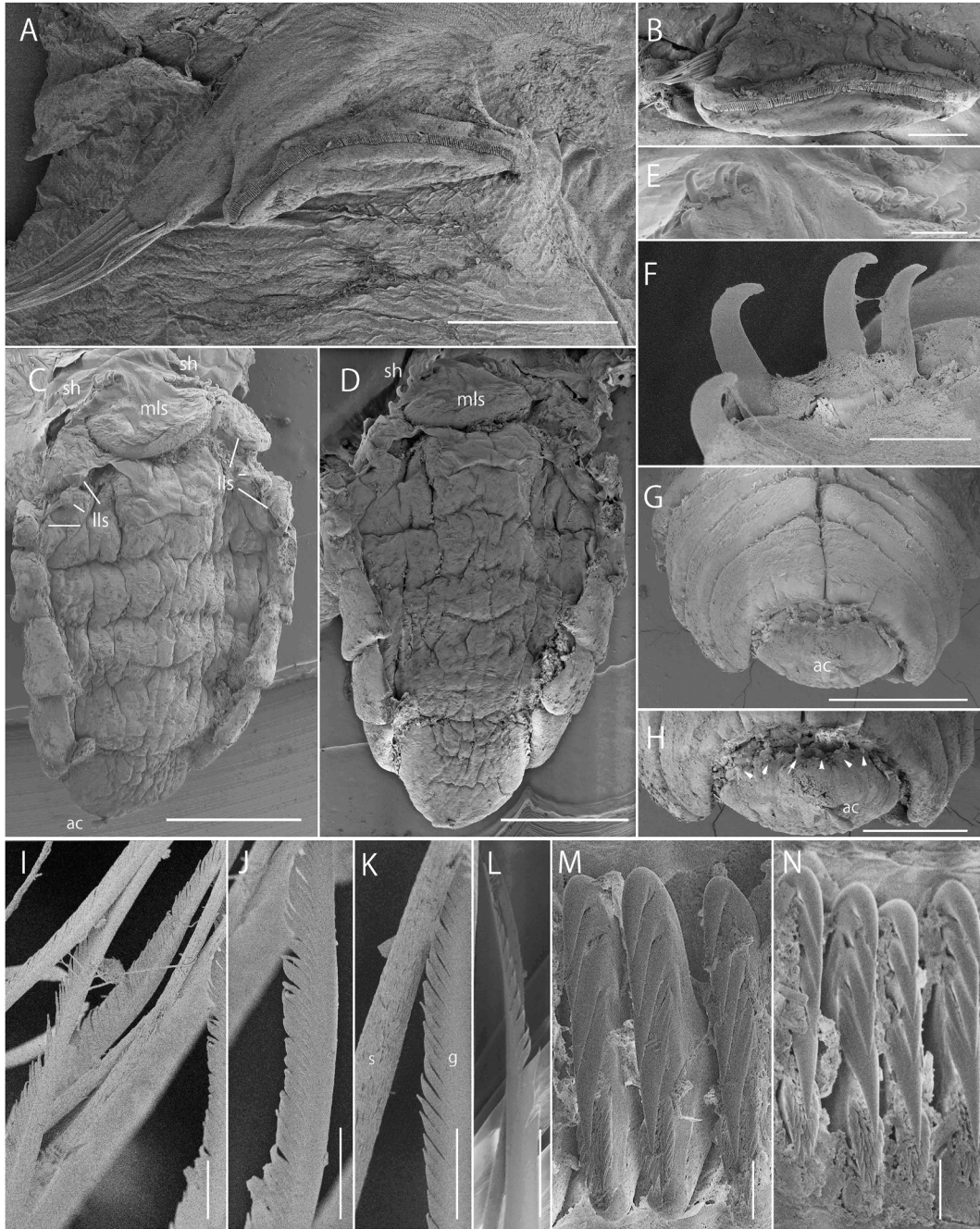


Fig. 4. Scanning electron microscopy image of notopodium and parapodium, hooks and chaetae of *Amphictene hokkaido* sp. nov., paratype RK6-A-3, 008706. A, parapodium of segment 10; B, notopodium and neuropodium of segment 15; C, D, dorsal view of scaphe; E, row of scaphal hooks; F, close-up view of hooks; G, postero-ventral view of scaphe; H, close-up view of anal flap showing anal cirri and a row of small cirri (arrow); I–L, notochaetae; M, N, uncini. Abbreviations: ac anal cirri; g geniculate, winged notochaetae; mls median lobe of scaphe; lls lateral lobe of scaphe; s straight, with acute tip notochaetae; sh scaphal hook. Scales: 0.5 mm in A, C, D, G; 0.2 mm in B, H; 0.1 mm in E; 50 μm in F; 10 μm in I, J, K; 20 μm in L; 5 μm in M, N.

ate segments; (4) 17 segments with notopodial chaetae; (5) notopodia of segment 21 with notopodial lappet located posterior to the chaetal tuft (Fig. 2C); (6) a strongly bent scaphal hook with a blunt distal tip (Fig. 4E, F); (7) an anterior median lobe situated between the scaphal hook rows (Fig. 1M, 4C, D); (8) a row of small cirri on the ventral side of anal cirri (Figs 2D; 4G, H); (9) uncini with a single row

of 4 to 5 major teeth (Figs 2I–N; 3E, F, G; 4M, N).

Discussion

We provide the third deepest record of an *Amphictene* species in the temperate Pacific Ocean, following the deepest *A. moorei* from continental shelf of Russian Far-Eastern

Seas, ca. 2900 m (Uschakov 1950, 1955) and the second deepest *A. japonica*, ca. 1700 m deep off Tohoku (Imajima 2009).

Amphictene hokkaido sp. nov. is the second species of the genus, after *A. japonica*, described from the Japanese region. This new species differs from *A. japonica* by having 17 notopodia with chaetae (*A. japonica* has 16 notopodia with chaetae), lateral lappets in segment 1 (*A. japonica* has no lateral lappets), cephalic veil with 23–30 cirri (*A. japonica* has 12–14 cirri), uncini with a single row of four to five major teeth (*A. japonica* has uncini with two rows of eight columns of major teeth), semi-circular scaphe with anterior cirri (*A. japonica* has tongue-like scaphe broadly divided into three lobes and bearing small lateral cirriform papillae), and seven to nine pairs of bent scaphal hooks with blunt distal tips (*A. japonica* has 19–24 pairs of almost straight hooks) (Okuda 1938, Nishi et al. 2014).

Amphictene hokkaido sp. nov. is very similar to *A. moorei* recorded from the northern part of the Sea of Japan. Both species have uncini with a single row of four to five major teeth, 17 notopodia with chaetae, and ca. nine to 10 pairs of scaphal hooks that are strongly curved (Annenkova 1929; Uschakov 1950, 1956). However, the new species have no cirri or lappets on the anterior ventro-lateral lobe of segment 6 (Figs 1C, E; 2A), unlike those present on segment 6 in *A. moorei* (Annenkova 1929: fig. 8 of plate 37, p. 503). *Amphictene hokkaido* sp. nov. also has a lower number of cephalic veil cirri (23–30) in comparison to that in *A. moorei* (35–40). Furthermore, the new species features a row of small cirri on the ventral margin of its anal flap (Fig. 2D), whereas *A. moorei* has a smooth margin.

Zhang et al. (2022) reported two undetermined species of *Amphictene*, *A. sp. 1* and *2* from 20–22 m deep muddy bottoms of the Yellow Sea. Our new species can be distinguished from those Yellow Sea species as follows. *Amphictene sp. 1 sensu* Zhang et al. 2022 has dorso-lateral pads on segment 3, those are absent in segment 4 (*A. hokkaido* sp. nov. has dorso-lateral pads in segments 3 and 4); *A. sp. 1* has 4–5 longitudinal rows of major teeth, each row with 6–8 teeth on uncini (*A. hokkaido* sp. nov. has a single row of major teeth, each row with 4–5 teeth on uncini). *Amphictene sp. 2 sensu* Zhang et al. 2022 has smooth narrow and elongated dorso-lateral pads on segment 3, dorso-lateral pad is absent in segment 4 (*A. hokkaido* sp. nov. has elongated oval dorso-lateral pads on segments 3 and 4); *A. sp. 2* has two longitudinal rows of major teeth on uncini, each row with 7–8 teeth (*A. hokkaido* sp. nov. has a single row of major teeth, each row with 4–5 teeth).

The number of segments with notochaetae and neurochaetae is an important character for delineating the *Amphictene* species. The members of this genus can be classified into three groups. The first group includes three species displaying capillary notochaetae on segments 5–19 and neurochaetae on segments 8–19, these species are from North and South America, viz. Brazil, Guatemala, and Mexico: *A. catharinensis* (Grube, 1870), *A. guatemalensis*

(Nilsson, 1928), and *A. helenae* García-Garza & de Leon-Gonzalez, 2014. The second group comprises five species with notochaetae on segments 5–20 and neurochaetae on segments 8–20: two from Chinese waters, *A. alata* and *A. jianqingi*, two from Africa, *A. capensis* (Pallas, 1766) and *A. souriei* (Fauvel, 1949), and *A. japonica* from Japan. The third group contains 10 species with notochaetae on segments 5–21 and neurochaetae on segments 8–20: *A. auricoma* (O. F. Müller, 1776) from Northern Europe (Denmark) and 9 from Pacific Ocean: *A. cercusa* Zhang & Hutchings, 2019, *A. crassa* (Grube, 1870), *A. favona* Hutchings & Peart, 2002, *A. leioscappha* (Caullery, 1944), *A. lizardensis* Wong & Hutchings, 2015, *A. moorei* (Annenkova, 1929), *A. undulata* Zhang & Hutchings, 2019, *A. uniloba* Hutchings & Peart, 2002 and our new species from Hokkaido, Japan.

The number and morphology of scaphal hooks and uncinal teeth distribution patterns are important taxonomical characters in the genus. Six species of the genus have almost straight hooks, four species are with slightly curved hooks, and five species, including our new species, are with strongly curved hooks (see Zhang & Hutchings 2019, Zhang et al. 2022, and this study). *Amphictene hokkaido* sp. nov. and *A. moorei* have a single row of major teeth on uncini, while other species have 2 to 4 rows of such teeth.

The scaphal morphology is also important in the classification of Pectinariidae. Within the genus *Amphictene*, *A. cercusa* and *A. jianqingi* are the only species with dorsal cirri located near the lateral margin of scaphe (Zhang & Hutchings 2019, Zhang et al. 2011), all other congeners lack such cirri. The anal flap in *A. favona* and *A. uniloba* possesses lappets, whereas in *A. helenae*, *A. guatemalensis*, and the new species it bears cirri; all other species lack either cirri or lappets on the anal flap.

Based on the above diagnostic characters, we provide a key to the species of the genus. Morphological characters of each species compiled from Hutchings & Peart (2002), Nishi et al. (2014), García-Garza & de Leon-Gonzalez (2014), Wong & Hutchings (2015), Zhang et al. (2015, 2022) and Zhang & Hutchings (2019).

Character key to species of *Amphictene*

- | | | |
|----|---|-------------------------|
| 1a | 15 notopodia with chaetae, 12 neuropodia with uncini | 2 |
| 1b | 16 notopodia with chaetae, 13 neuropodia with uncini | 3 |
| 1c | 17 notopodia with chaetae, 13 neuropodia with uncini | 6 |
| 2a | With eight pairs of glandular cirri on segment 2, six glandular lobes on segment 4 | <i>A. helenae</i> |
| 2b | With six pairs of glandular cirri on segment 2, two pairs of subtriangular glandular lobes on segment 2 | <i>A. guatemalensis</i> |
| 2c | With 17 or 18 glandular cirri on segment 2, a central lobe and two pairs of broad glandular lobes on segment 4 | |

-*A. catharinensis*
- 3a Scaphal hooks strongly curved.*A. capensis*
- 3b Scaphal hooks almost straight 4
- 3c Scaphal hooks slightly curved 5
- 4a Without dorsal cirri on scaphe*A. japonica*
- 4b With dorsal cirri on lateral margin of scaphe
.....*A. jianqiangi*
- 5a With a pair of dorso-lateral pads in segment 3
.....*A. alata*
- 5b With two pairs of dorso-lateral pads in segment 3
.....*A. sourieri*
- 6a No cirri or lappets on ventro-lateral lobe of segment 2
..... 9
- 6b Lappets on ventro-lateral lobe of segment 2
.....*A. hokkaido* n. sp.
- 6C Lappets on ventro-lateral lobe of segment 6 7
- 7a Uncini with a single row of major teeth*A. moorei*
- 7b Uncini with two rows of major teeth 8
- 8a Anal flap semicircular, margin crenulated. . .*A. crassa*
- 8b Anal flap long tongue-like, margin with lappets
.....*A. favona*
- 9a Scaphal hooks straight 10
- 9b Scaphal hooks slightly curved 11
- 9c Scaphal hooks strongly curved. 12
- 10a With a dorsal cirrus on scaphe*A. cercusa*
- 10b Without a dorsal cirrus on scaphe*A. leioscapha*
- 11a Uncini with three–six rows and six–nine columns
of teeth*A. lizardensis*
- 11b Uncini with two rows and about seven columns of
major teeth and a single large tooth (rostrum) above
subrostral process*A. undulata*
- 12a Opercular rim with cirri*A. auricoma*
- 12b Opercular rim with triangular lappets*A. uniloba*

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