

A New Species of Deep-sea Solenogastres (Mollusca) from the Sea of Japan

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Abstract: A new species of deep-sea Solenogastres-Amphimeniidae, *Alexandromenia marisjaponica*, is described from the Sea of Japan at 300–600 m depth. This new species attains a size of 16 × 1.7 cm, exhibits a reddish coloration and shows up to 26 pedal folds. Internally, it is characterized among others, by the shape of the monoserial radula consisting of teeth provided with a pair of long horn-like lateral denticles and by the configuration of the spawning ducts. The organisation of the new species is displayed and compared with known congeneric representatives. This record enlarges the poorly known biodiversity of Solenogastres in Japanese waters.

Key words: Solenogastres, Amphimeniidae, *Alexandromenia*, new species, taxonomy, Sea of Japan.

Introduction

The Solenogastres is a small group of shell-less laterally narrowed mollusks, which is characterized by a mantle that produces a chitinous cuticle throughout, as well as unicellularly formed aragonitic sclerites, and by a midventral groove which houses a pedal fold or folds with cilia for gliding locomotion. The Solenogastres are exclusively marine animals, occurring at the depth from 1 to 6850 m (Salvini-Plawen and Schwabe, 2012). They are free living animals, predominantly feeding on Cnidaria. At present, 275 nominal species have become known (Gil-Manzillo *et al.*, 2011, 2012; Salvini-Plawen and Schwabe, 2012; Zamarro *et al.*, 2012), which are classified into four orders (two subclasses) mainly based on the features of the cuticle and the sclerites (Salvini-Plawen, 1978).

During the course of a deep-sea research project, “Research on Deep-Sea Fauna of the Sea of Japan, 2009–2013” conducted by the National Museum of Nature and Science (NSMT), five specimens of large Solenogastres were collected from the Sea of Japan at the depth from 300 to 600 m, that is the transitional zone extending between the margin of continental shelf and the upper bathyal zone, thus already belonging to the deep-sea. Examination of those specimens together with two additional specimens deposited in the NSMT, which were collected from the same zone of the Sea of Japan, revealed that those specimens are conspecific, and belong to the genus *Alexandromenia* of the family Amphimeniidae. To date, ten species of *Alexandromenia* are known: four species from the Antarctic, four species from the North Atlantic, two species from the East Pacific. Taxonomic comparisons between the present species and those ten congeners revealed sufficient differences, which warrant the present species to be new to science.

Materials and Methods

The localities of the seven examined specimens are shown in Fig. 1. Among them, the holotype and another specimen were incidentally collected together by a fishing trawl, which was operated off Shin-minato, Toyoma Bay, at the depth of *ca.* 300 m; the remaining five specimens were collected during the research project “Research on Deep-Sea Fauna of the Sea of Japan”. All specimens were fixed in 10% neutral formalin, and preserved in 70–80% ethanol.

Among seven specimens examined in total, three specimens were investigated histologically, four specimens were dissected to observe general morphology of the internal organization.

For examination of mantle sclerites, pieces of mantle cuticle were dissected, macerated in diluted household bleach (hypochloride), and rinsed, and sclerites were then removed from the cuticle in a drop of 80% ethanol on slide glass using needles. Those removed sclerites were air dried and permanently mounted in ENTELLAN[®] neu (Merck & Co. Inc.). Identification, measurement, and drawing of sclerites were made by using a light microscope equipped with an ocular micrometer and a camera lucida.

For observation of the radula, the radula area of the foregut was isolated by dissection and macerated in diluted household bleach. The dislodged radula was transferred into distilled water by a pipet for washing, then to ethanol series and DMP (2,2-dimethoxy propane) for dehydration in small dimples on a slide glass. Subsequently, the radula was transferred into a drop of xylene on a slide glass and mounted in the same medium with the sclerites.

For histological study, both terminal portions of specimens were decalcified in Bouin’s solution. Then, these portions were rinsed with 70% ethanol with drops of ammonium solution, dehydrated with DMP, embedded in paraffin, serially cross sectioned in 10 μ m thickness by a microtome, and stained with Mayer’s hematoxyline and eosin B.

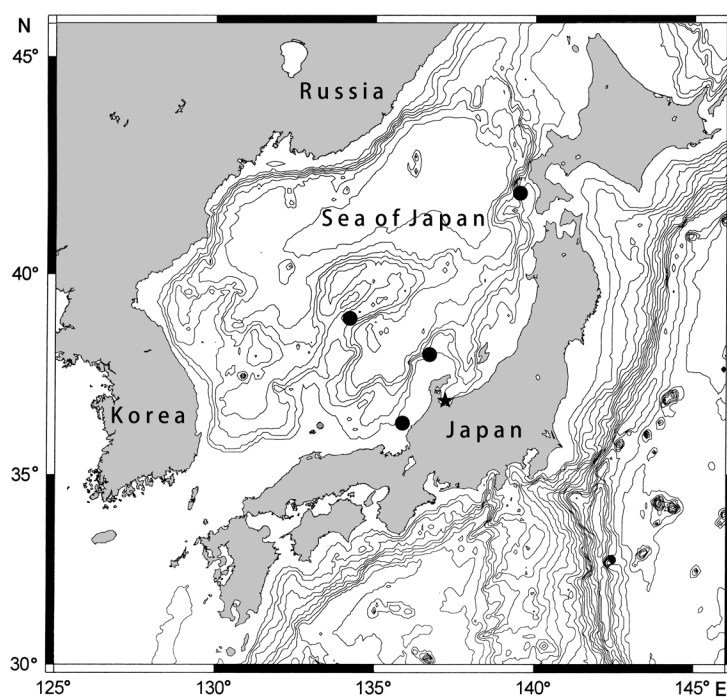


Fig. 1. Localities of specimens. Asterisk indicates the type locality.

Reconstruction of the body organization was made manually by the conservative method, plotting on millimeter-scaled paper.

All specimens are deposited in the molluscan collection in the Department of Zoology, National Museum of Nature and Science, at Tsukuba.

Description is made based on the holotype specimen. When additional information from the paratypes was given, it was indicated in parenthesis with the registration number of the source specimen.

Abbreviations: a, anus; ac, anterior caecum of midgut; at, atrium; au, heart auricle; bg, buccal ganglion; bw, "spongy" body wall; c, cone of out-leading duct of latero-ventral foregut glandular organ; cg, cerebral ganglion; d, ductule of latero-ventral foregut glandular organ; dp, diverticula of pallial cavity; dts, dorsoterminal sense organ; e, esophagus; eg, esophageal glands; fg, packages of latero-ventral foregut glandular organ; fgd, out-leading duct of latero-ventral foregut glandular organ; fn, frontal nerve; g, gonad; gp, gonopericardioduct; gpi, ganglia posteriora inferiora; gps, ganglia posteriora superiora; h, heart; hg, hindgut; lg, (1st) lateral ganglion; m, mouth; ma, mantle; mg, midgut; oe, opening of esophagus; ofg, opening of out-leading duct of latero-ventral foregut glandular organ; og, glands of the spawning duct outlet; op, beginning (proximal opening) of pericardioduct; osd, opening of spawning duct; p, pericardium; pc, pallial cavity; pd, pericardioduct; pf, pedal fold; pg, pedal glandular organ; phg, pharyngeal glands; ph, pharynx; pp, pedal pit; r, radula; rf, respiratory folds; sc, suprarectal commissure; sd, spawning duct; sdo, spawning duct outlet; sdg, spawning duct glands; sp, sensory papillae; spg, suprapallial gland; sr, seminal receptacle; vn, heart ventricle; vg, (1st) ventral ganglion.

Systematic Account

Class Solenogastres Gegenbaur, 1878 (*sensu* Simroth, 1893)

Order Cavibelonia Salvini-Plawen, 1978

Diagnosis. Mantle cuticle generally thick, mostly with multiple layers of hollow spicules and long epidermal papillae.

Family Amphimeniidae Salvini-Plawen, 1972

Diagnosis. Solenogastres with thick mantle cuticle, sclerites acicular as hollow spicules (needles). Radula monoserial (or lacking); antero-ventral radula sack (when present) unpaired. Foregut glandular organs opening pre-radular, typically as ramified ducts with terminally arranged packages of gland cells (= type D). Spawning ducts with subepithelially arranged, intercellularly opening glands. Ten genera recognized.

Genus *Alexandromenia* Heath, 1911

Type species. *Alexandromenia agassizi* Heath, 1911

Diagnosis. Epidermal papillae present. Sclerites in two main sizes. Mouth within common atrio-buccal cavity. Radula present. Pre-radular outlet of latero-ventral foregut glandular organs into pouch with cone. Midgut with constrictions. Secondary genital opening unpaired. Without copulatory stylets. Dorsoterminal sense organ and respiratory organs present.

***Alexandromenia marisjaponica* n. sp.**

(Figures 1–11)

Material examined. Holotype – NSMT-Mo 73240, 82 mm long $\times$ 13 mm wide, anterior body in cross sections on 161 slides, posterior body in cross sections on 152 slides, mid body preserved in 75% ethanol; off Shin-minato, Toyama Bay, Sea of Japan, approximately 36°50'N, 137°10'E, ca. 300 m, fishing trawl; coll. H. Numanami, 31 March 2003. Paratypes – NSMT-Mo 73241, 1 specimen, 58 mm long $\times$ 8.8 mm wide, anterior part in cross sections on 83 slides, posterior part in cross sections on 42 slides, same lot as holotype. NSMT-Mo 78543, 1 specimen, 164 mm long $\times$ 17 mm wide, dissected; T/S *Tanshu-maru* St. TS09-T105, 36°06.43'N, 135°43.39'E–36°05.13'N, 135°42.46'E, 292–291 m; coll. T. Kubodera, 31 May 2009. NSMT-Mo 78544, 1 specimen, 120 mm long $\times$ 10 mm, dissected; same lot with NSMT-Mo 78543. NSMT-Mo 78545, 1 specimen, 54 mm long $\times$ 10 mm wide, anterior part in cross sections on 108 slides, posterior part in cross sections on 62 slides; R/V *Tansei-maru* St. KT-11-09-E2, 41°50.26'N, 139°34.03'E–41°48.70'N, 139°34.18'E, 388–538 m; coll. H. Saito, 29 May 2011. NSMT-Mo 78546, 1 specimen, 20 mm long $\times$ 4 mm wide, dissected; R/V *Tansei-maru* St. KT-11-09-N4, 38°08.04'N, 136°49.64'E–38°09.00'N, 136°51.20'E, 617–604 m; coll. H. Saito, 1 June 2011. NSMT-Mo 78547, 1 specimen, 69 mm long $\times$ 8 mm wide, dissected; T/S *Tanshu-maru* St. TS13-S01, 38°01.30'N, 134°07.90'E–38°01.04'N, 134°07.38'E, 414–428 m; coll. K. Hasegawa, 24 August 2013.

Etymology. The name refers to the record of the present species in the Sea of Japan.

Diagnosis. Animals up to 164 mm $\times$ 17 mm. Body narrowly elongate, reddish, often with numerous transverse wrinkles, neither dorsal keel nor warts. Mantle sclerites as two types of hollow needles, epidermal papillae stout and densely arranged. Up to 26 pedal folds, three entering pallial cavity. Pallial cavity with radially arranged numerous respiratory folds and with anterior pouch. Atrial papillae single, arranged among ciliated folds. Single dorso-terminal sense organ located above anterior to middle pallial cavity. With three sets of foregut glands: subepithelial multicellular pharyngeal glands and esophageal glands, as well as paired latero-ventral glandular organs with ramified duct, opening far pre-radularly through pouch provided with ductile-less cone. Radula apparatus with distinct support of turgescient cells. Radula teeth with two long horn-like lateral denticles. Anterior midgut caecum short. Heart running freely. Distal-most portion of pericardioduct with single small sacculum (receptacula seminis?). Paired spawning duct repeatedly winding, opening terminally united by single, narrow outleading duct.

Description. Animal large, elongate, 82 mm long $\times$ 13 mm wide at mid-body (Fig. 2A) (164 mm $\times$ 17 mm in NSMT-Mo 78543), without warts or dorsal keel, often with transverse wrinkles, rounded at both ends; mid-body almost round in cross-section. Pedal groove distinct, extending to the mantle cavity. Color in life dark reddish brown (brown with reddish tint in larger specimens: NSMT-Mo 78543, 78544; reddish orange in smaller specimens: NSMT-Mo 78545, 78546) (Fig. 2). Color in preserved specimen uniformly beige.

Cuticle thick, 290–330 μ m at dorsum, 220–270 μ m ventral of anterior body, densely penetrated by long stout epidermal papillae. Epidermis low, 7–10 μ m, underlain by 250–700 μ m “spongy” layer of lacunate connective tissue provided with scattered circular muscle fibres; it is followed medially by more compacted circular musculature and a not very prominent longitudinal muscle layer. Sclerites in mantle cuticle of two types of hollow needles (Fig. 3): (1) small, slightly S-shaped needle, 125–130 μ m in length $\times$ ca. 7 μ m in diameter (Fig. 3C) rather sparsely arranged tangentially to obliquely in several irregular, not intercrossing layers; (2) large, straight

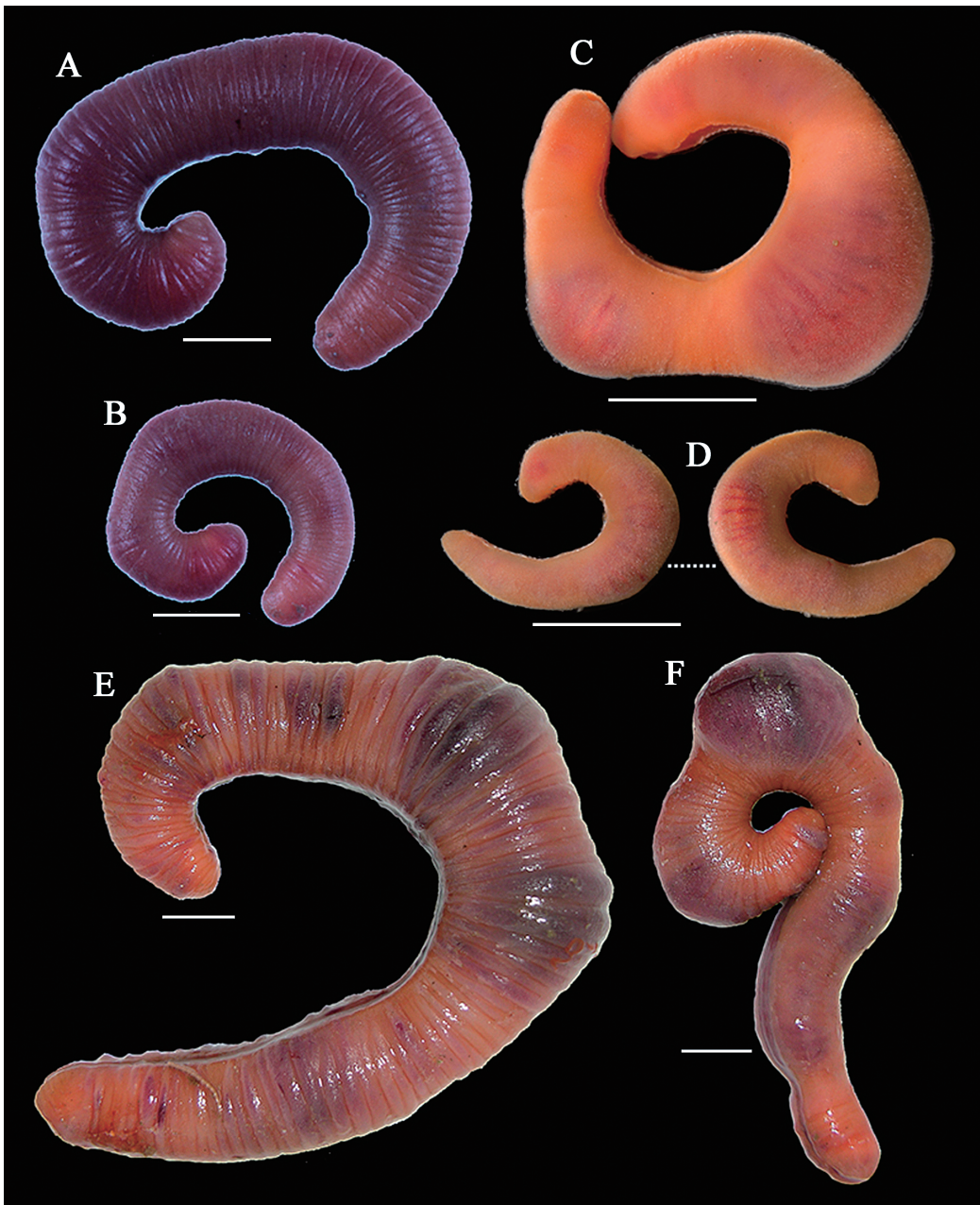


Fig. 2. *Alexandromenia marisjaponica* n. sp. Habitus in life or just after the death. A, holotype, NSMT-Mo 73240; B-F, paratypes: B, NSMT-Mo 73241; C, NSMT-Mo 78545; D, NSMT-Mo 78546; E, NSMT-Mo 78543; F, NSMT-Mo 78544. All scales: 10 mm.

to distally slightly curved needles, $260\text{--}315\mu\text{m}$ in length $\times$ $18\text{--}20\mu\text{m}$ in diameter (Fig. 3A, B) arranged in fairly radial orientation. Sclerites along pedal groove similar to small needles, but slightly thicker, *ca.* $9.5\mu\text{m}$ in diameter and smaller hollow (*ca.* 60% of entire sclerite length) (Fig. 3D).

Ciliary pedal pit anteriorly elongate (Figs. 4, 5B) with 24–26 heavily ciliated pedal folds

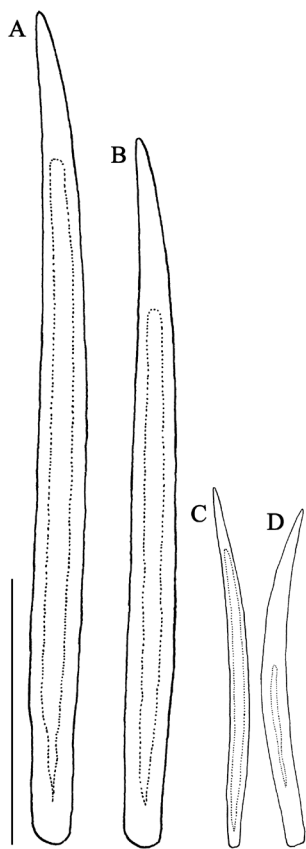


Fig. 3. *Alexandromenia marisjaponica* n. sp. Mantle sclerites, holotype. A, B, large dorsal sclerites; C, small dorsal sclerites; D, ventral sclerites, along pedal groove. Scale: 100 μ m.

which enter the pedal groove. Pedal folds then decreasing to 19 in posterior body at portion below anterior pericardium, among which three folds enter the pallial cavity (splitting here to five folds). Pedal glandular organ of a mass of irregularly arranged, fairly small packages of gland cells with dense, finely granulated content (Fig. 7A). Sole glands with same histological structure as pedal glandular organ, which are arranged in paired latero-dorsal mass above the pedal groove (sparing the differently-shaped ventral sinus) but open in all parts of the foot.

Dorso-posterior end of pallial cavity drawn out, forming extended pallial cavity roof, thus cavity opening located obliquely towards ventral (Fig. 9). Dorso-anteriorly pallial cavity at both sides of hindgut extended and forming some diverticula up to pericardium. Dorsal, central and posterior walls with numerous, radially arranged respiratory folds, which are 1.6–1.7 mm in height, 90–96 in number in middle portion of dorsal area (Figs. 9, 10, 11D: rf). Hindgut opening into pallial cavity from dorso-frontal. Unpaired secondary genital opening (unpaired outlet of spawning duct) (Figs. 9, 10: sdo) emptying centrally into pallial cavity above beginning of cavity opening. All space between dorsal body wall and respiratory folds, as well as anteriorly as far as behind pericardium, filled with dense mass of suprapallial glands (Figs. 9, 10B, 11D: spg).

Circular and longitudinal musculature of body wall indistinct, medially of “spongy” layer about equal thickness (35–50 μ m), but longitudinal layer pairedly thickened to ca. 900 μ m at ventral wall (Figs. 5B, 6A: bw). Paired dorso-ventral muscle bundles fairly prominent, outer ones intercrossing each other midventrally above longitudinal muscle bundles of ventral wall, providing deep midgut constrictions (Figs. 5A). Foregut with thin inner circular muscle and outer longitudinal muscle layers in pharynx, which increase in thickness toward radula region, then decreasing thickness towards posterior end of the esophagus. No distinct sphincter around opening of esophagus into midgut. Unpaired portion (outlet) of spawning duct with thick layer of circular musculature.

Atrium located in front of but laterally flanking mouth area (Fig. 4: at). Sensory area of atrium as usual bordered by horseshoe-shaped ciliated tract, of which the anterior-most ventral tracts, however, do not unite frontally; they rather form a pair of folds intruding the cavity. Antero-dorsally, in addition to middorsal ciliated fold which diminishes posteriorly, horseshoe-shaped tract beginning as pair of folds; the atrium itself is thus frontally subdivided by five ciliated folds; the two dorsal folds posteriorly delimit the lateral atrial pouches which are subdivided

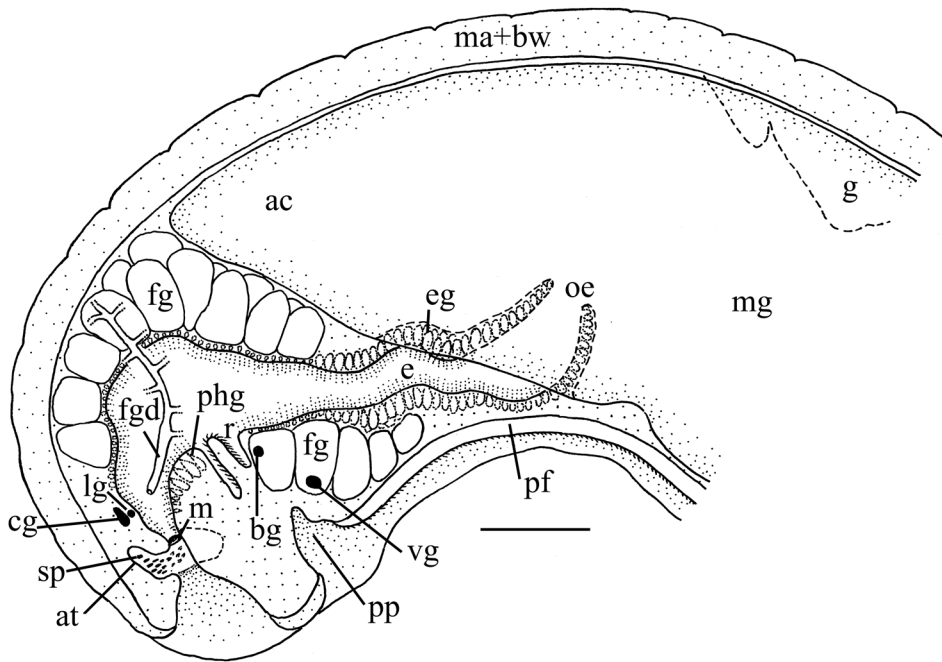


Fig. 4. *Alexandromenia marisjaponica* n. sp. Reconstructed organization of the anterior body from the left, holotype. Scale: 5 mm.

by another ventro-posterior fold; the middorsal area between the folds leads to the fairly separated mouth opening. Numerous atrial papillae almost single (*ca.* 150 μ m long, 50 μ m in diameter). All common atrio-buccal area surrounded by wide zone of ciliated epithelium.

Single dorsoterminal sense organ small, located either above anterior-most or middle region of pallial cavity (Figs. 9, 10B, 11C: dts). Several pit- to tube-like infoldings in terminal body epithelium, which may resemble dorsoterminal sense organs, but are covered with cuticle.

Unpaired cerebral ganglion small compared to body size, positioned above anterior pharynx (1000 μ m in width, 250 μ m in thickness, 570 μ m in length) (Figs. 4, 5B, 6A, B). Cerebral connectives (lateral and ventral cords) emerging separately but closely adjoining each other from both sides of cerebral ganglion, running together posteriorly along pharyngeal wall: in distance of 1.2–1.3 mm from cerebral ganglion, lateral cords forming first ganglia (*ca.* 190 μ m in width, 160 μ m in thickness, 100 μ m in length); ventral cords getting distance from lateral cords behind first lateral ganglia, directing ventrally in pedal glandular organ, and forming behind pedal pit first ventral ganglia (*ca.* 350 μ m $\times$ 150 μ m across, 300 μ m in length). Buccal connectives emerging at dorso-lateral portion of cerebral ganglion and extending to radula region, forming single pair of buccal ganglia behind radula sheath (*ca.* 180 μ m $\times$ 120 μ m across, 150 μ m in length); they are interconnected by a *ca.* 150 μ m long commissure behind the radula apparatus. Two pairs of frontal nerves rising from ventral side of cerebral ganglion extending towards atrium.

All larger tracks (lateral and ventral cords) more or less medullary, though with serial arrangement of fairly distinct lateral and ventral swellings with nuclei; latero-ventral connectives and ventral commissures likewise possess nuclei. Posterior-most ganglia of lateral cords (ganglia posteriora superiora: gps; *ca.* 300 $\times$ 190 μ m in maximum size) located adjacent to opening of pericardium into pericardioducts (holotype). Medullar, long suprarenal commissure (5 mm $\times$ 120 μ m in diameter) emerging from gps, extending along dorsal wall of terminal pericardium

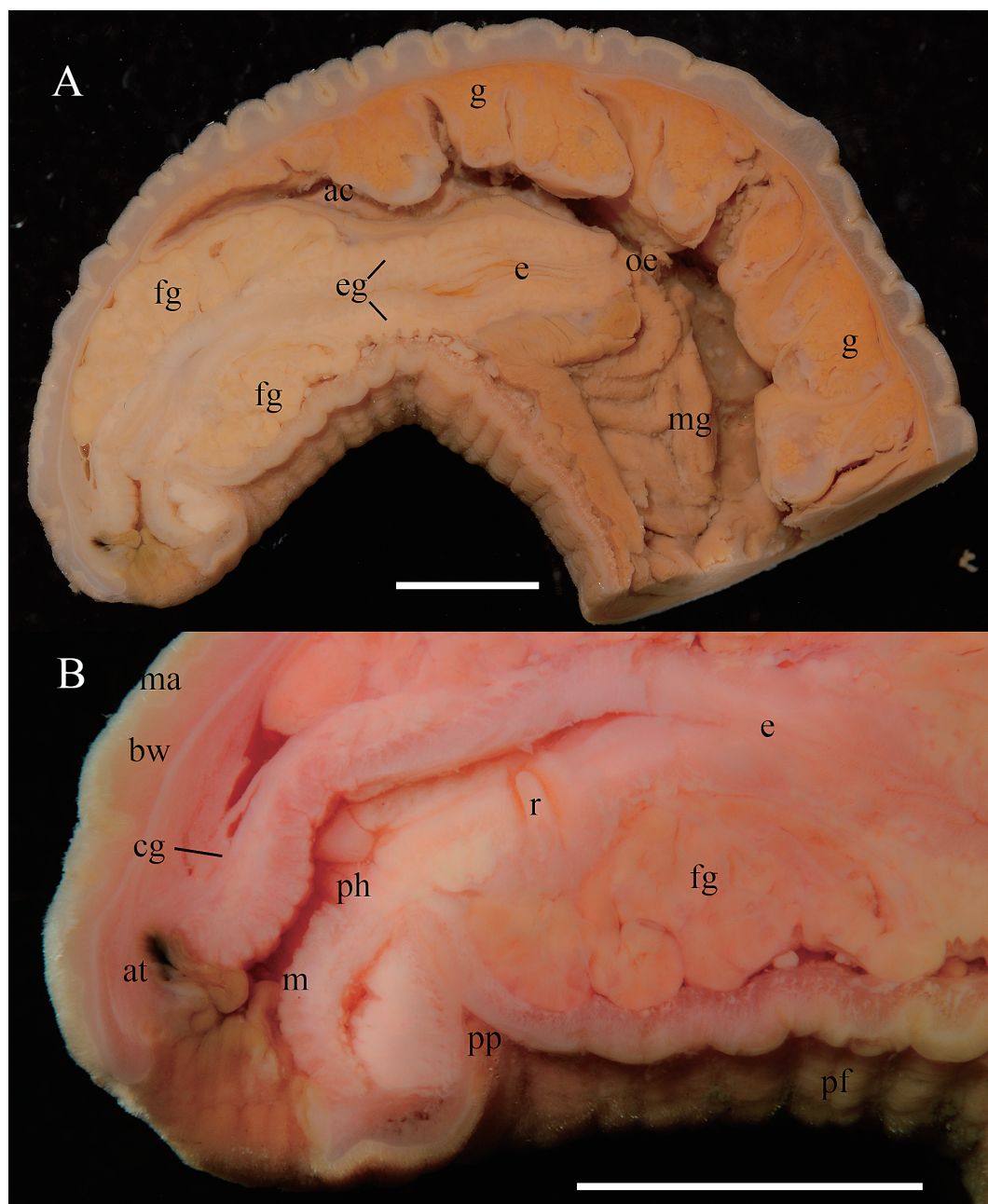


Fig. 5. *Alexandromenia marisjaponica* n. sp. A, dissected anterior body, NSMT-Mo 78543; B, close up of pharynx, slightly dyed with Safranin. Scales: 5 mm.

(Fig. 9: sc), rather than above hindgut below pericardium (below pericardium above beginning of pallial cavity in NSMT-Mo 78545). Posterior-most ganglia of ventral cords (ganglia posteriora inferiora: gpi; ca. $350 \times 300 \mu\text{m}$ in maximum diameter, $400 \mu\text{m}$ in length) located at both sides of outlet of spawning duct and interconnected by ventral as well as dorsal strong commissure. Shortly behind gpi, another pair of smaller swellings formed likewise at both sides of unpaired spawning duct.

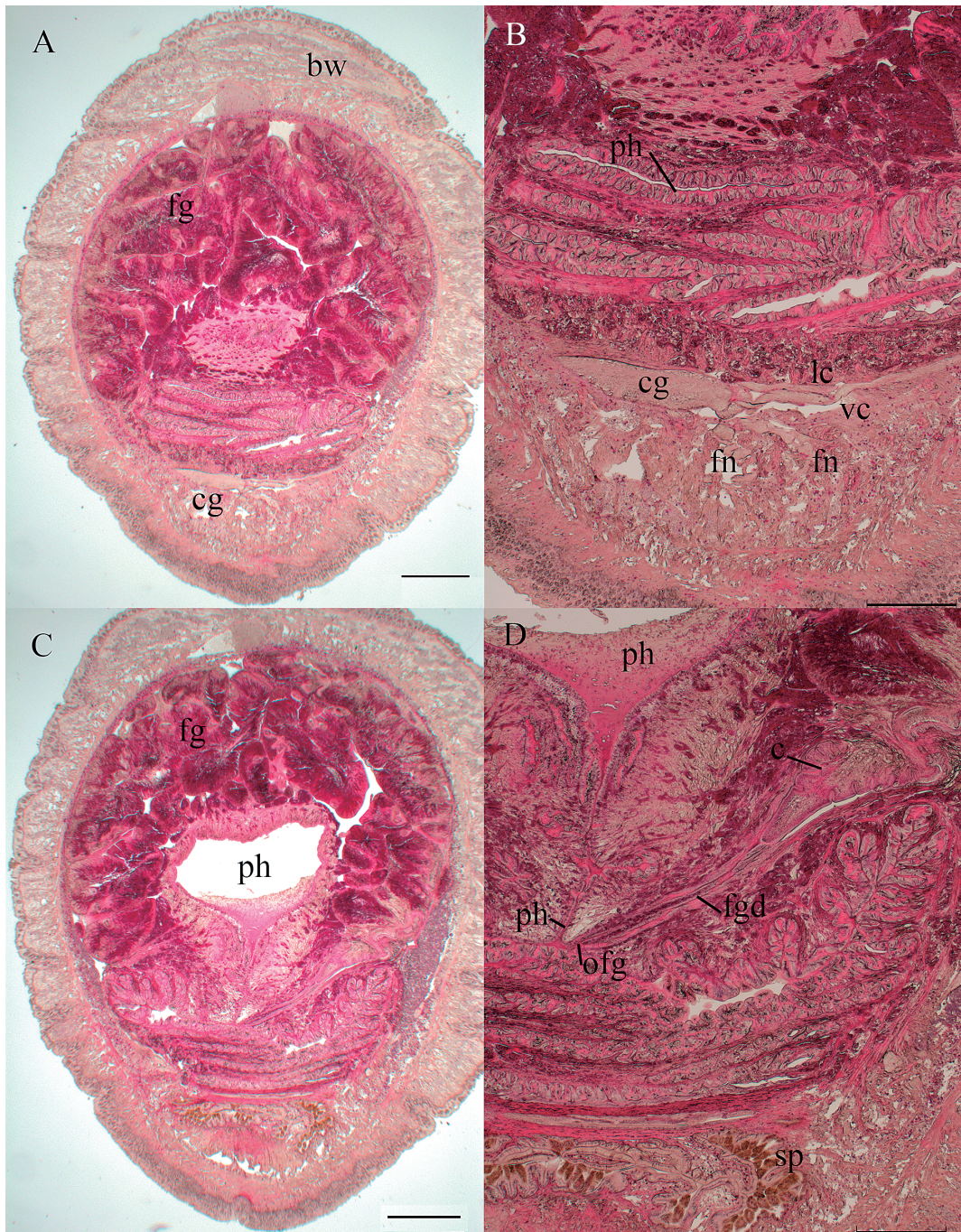


Fig. 6. *Alexandromenia marisjaponica* n. sp. Cross sections of anterior body, holotype. A, region of anterior foregut, showing cerebral ganglion; B, close up of A; C, slightly posterior to section A; D, close up of C, showing outlet duct of ventro-lateral foregut glandular organ, and the cone. Scales: 1 mm for A and C, 100 μ m for B and D.

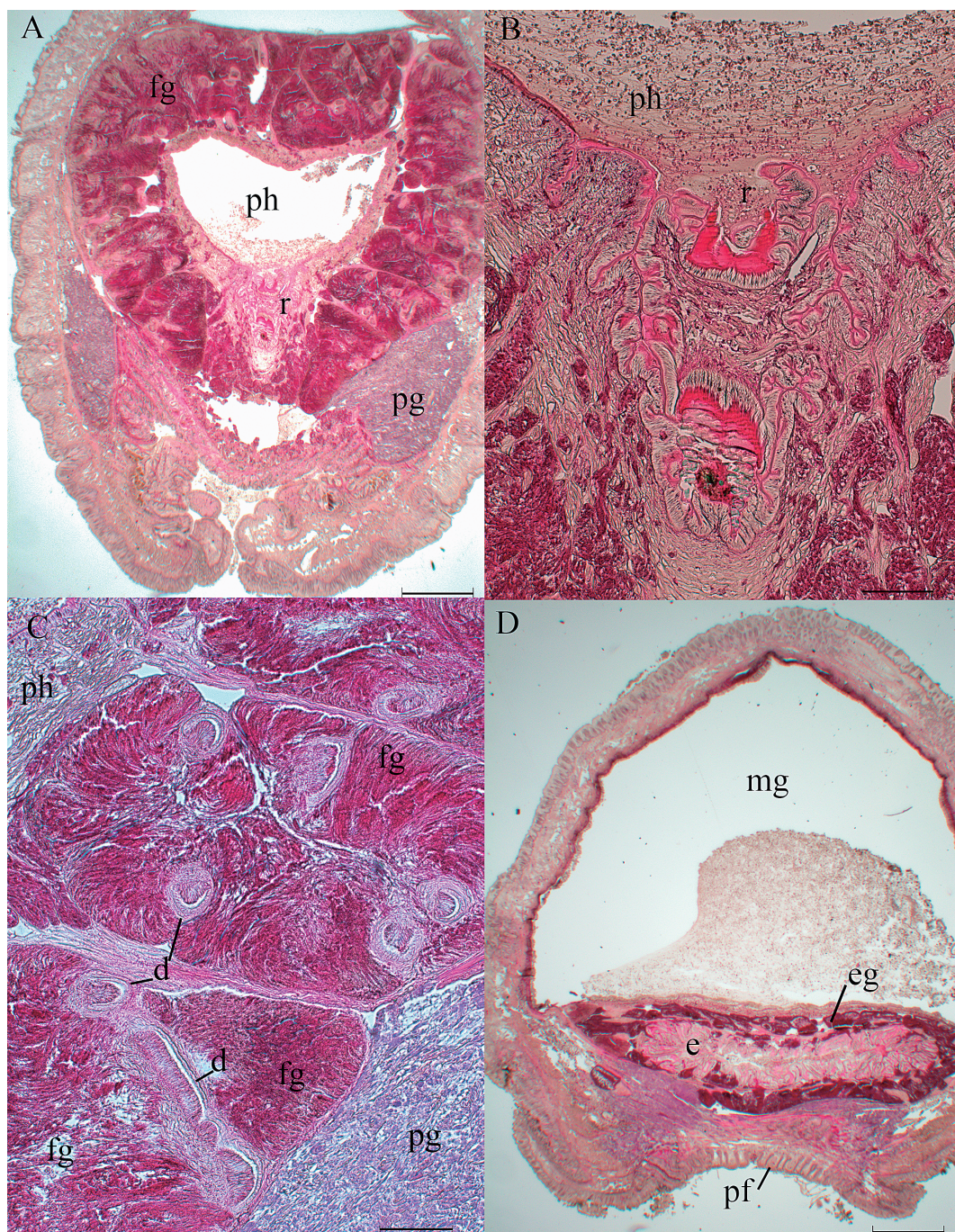


Fig. 7. *Alexandromenia marisjaponica* n. sp. Cross sections of anterior body, holotype. A, region of radula apparatus; B, close up of A, showing radula; C, packages of latero-ventral foregut glandular organ with ductules encircled by musculature; D, esophagus surrounded by pharyngeal glands. Scales: 1 mm for A and D, 200 μ m for C, 100 μ m for B.

Mouth opening and atrium forming common atrio-buccal cavity (Figs. 4, 5). Mouth opening located immediately behind folded dorsal tract of peri-atrial ridge. Inner surface of anterior pharynx with numerous, irregular transverse folds, that of posterior pharynx with thick longitudinal folds; both with scattered, subepithelially arranged pharyngeal glands. Inner surface of esophagus with finer longitudinal folds provided with numerous minute sub-folds, thus forming villous appearance. Posterior-most part of esophagus protruding into midgut ventro-frontally as free tube. Paired latero-ventral foregut glandular organs opening laterally far anterior to radula apparatus (Figs. 4, 6C, D), as it typical for Amphimeniidae (type D in Salvini-Plawen, 1978 or *Amphimenia* type according to Handl and Todt, 2005). Out-leading duct of paired organ and all their ramifications with median ridge encircled by musculature (Fig. 7C). Anterior-most portion of each out-leading duct curving medially and widening into pouch where the median ridge is enlarged to form a cone protruding into the pouch (Fig. 6D). No ductule within cone and no opening papilla (as described and figured for *Alexandromenia gulaglandulata* Salvini-Plawen, 2008: Fig. 20A); rather, the pouch at each side distally connecting directly to the lateral wall just behind the area of irregular transverse folds of the anterior pharynx. Each lateral out-leading duct continuous with dorsally curved collecting duct (Fig. 4). This duct receiving from anterior ductules which have the openings of the glands in their package; posteriorly, the opening ductules of the gland packages are ramified. All together extending from region of out-leading duct opening to middle portion of esophagus. These globular to egg-shaped packages (up to $1300\mu\text{m}$ in height, $700\text{--}1300\mu\text{m}$ in diameter) arranged more or less circularly



Fig. 8. *Alexandromenia marisjaponica* n. sp. Radula tooth, NSMT-Mo 78547. Scale: 1 mm.

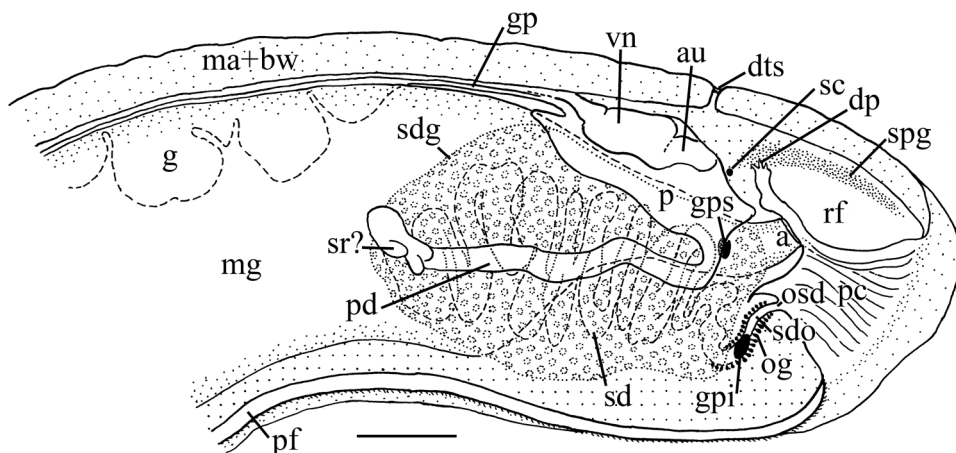


Fig. 9. *Alexandromenia marisjaponica* n. sp. Reconstructed organization of the posterior body from the left, holotype. Scale: 5 mm.

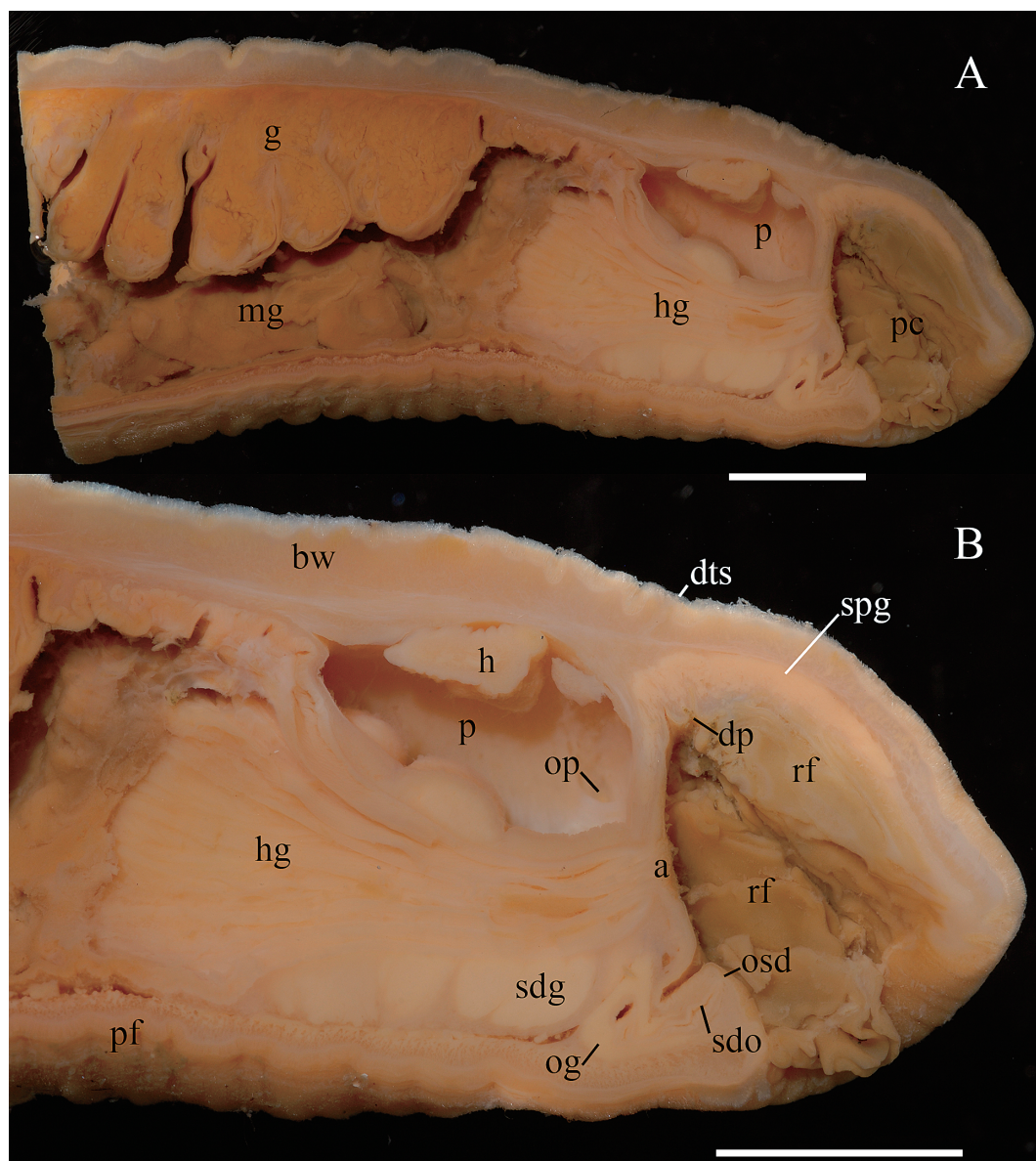


Fig. 10. *Alexandromenia marisjaponica* n. sp. A, dissected posterior body, NSMT-Mo 78543; B, close up of posterior most part. Scales: 5 mm.

around foregut (Fig. 7A); each package is surrounded by a thin layer of musculature. Esophagus behind latero-ventral glandular organs surrounded by a 300–500 μm thick layer of subepithelial multicellular glands (Figs. 4, 7D) which open intercellularly (esophageal glands) and are of similar structure as pharyngeal glands.

Monoserial radula (Fig. 7B) with distinct support of many turgescient (“chondroid”) cells, located almost perpendicularly to foregut. At least 28 transverse rows of teeth counted (NSMT-Mo 78543). Each tooth with horn-like denticle at both lateral borders, measuring 234 μm in width and 215 μm in height (NSMT-Mo 78547), being somewhat larger with longer denticles

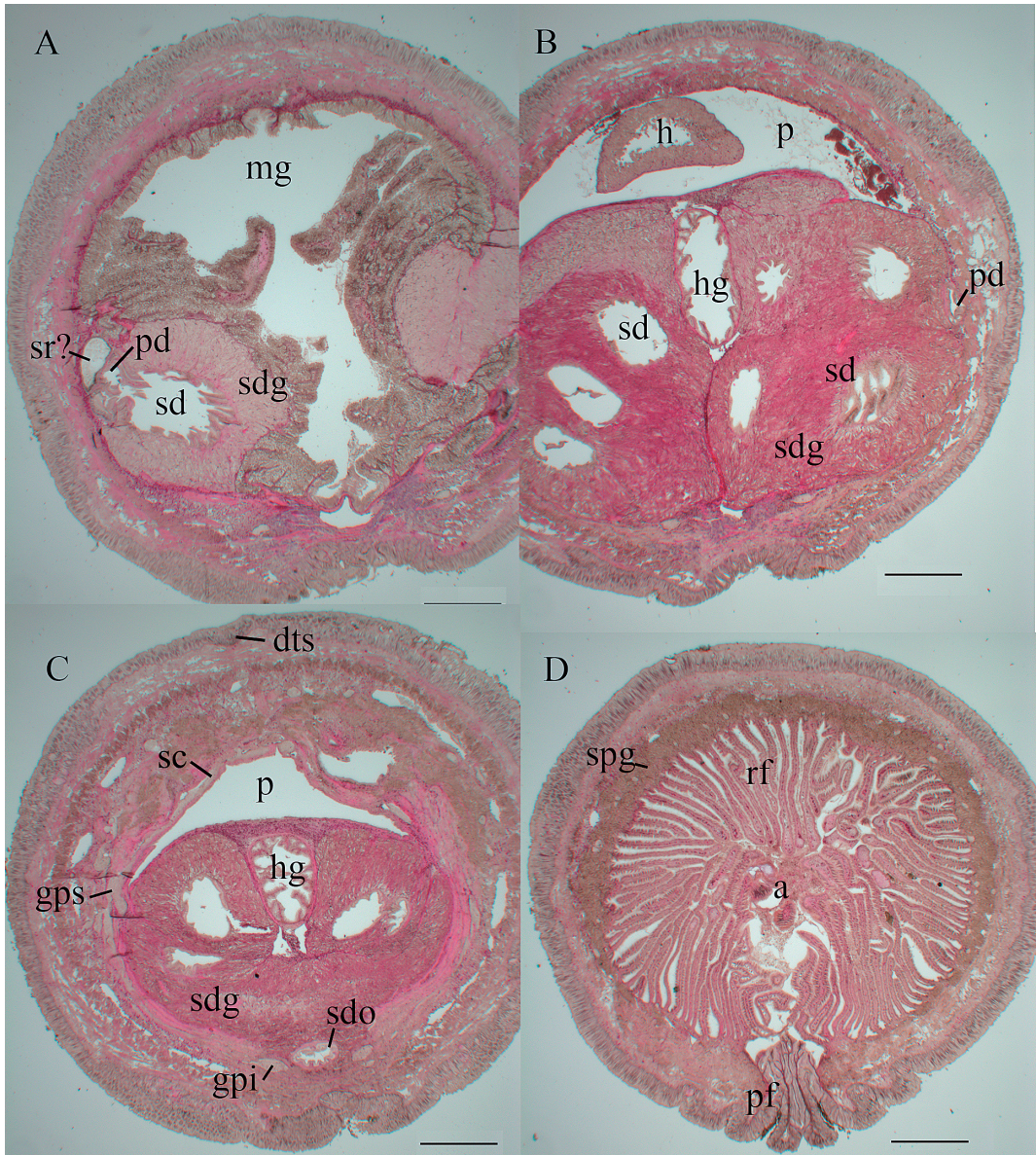


Fig. 11. *Alexandromenia marisjaponica* n. sp. Cross sections of posterior body, holotype. A, section through joining portion of pericardioduct and spawning duct; B, section through pericardium and spawning duct; C, section through unpaired part of spawning duct, and suprarectal commissure; D, pallial cavity, showing respiratory folds and suprapallial glands. Scales: 1 mm for A and C, 100 μ m for B and D.

posteriorly (Fig. 8). In radula sheath, median edge between two denticles with weak interconnection.

Midgut with anterior dorsal caecum extending to area above radula. Posteriorly, midgut increasing in volume, encompassing posterior esophagus and its subepithelial multicellular glands, thus protruding into midgut lumen (Figs. 4, 5). Midgut epithelium 100–200 μ m thick and fairly uniform. It strongly creased by up to 3 mm long folds towards lumen, resulting in enormous surface enlargement. Gonadal pouches dorsally intruding midgut. Hindgut opening,

accompanied by some irregular anterior sacculations of mantle cavity, in dorso-frontal wall of pallial cavity.

Anteriorly, paired gonad extending up to opening of esophagus to above midgut (up to anterior esophagus in NSMT-Mo 78543). Paired gonad voluminous, forming ventral pouches intruding midgut (Figs. 5A, 9, 10A). Eggs up to diameter of $250\mu\text{m}$ (same diameter in NSMT-Mo 78543). Gonad tapering in posterior body, continued by about 3 mm long gonopericardioducts, which have a high, folded ciliary epithelium and open into antero-dorsal portion of the pericardium with distance of $580\mu\text{m}$ between the ducts. Paired lateral ciliary tracts extending along entire length of pericardium. Heart, with ventricle and unpaired atrium/auricle, extending freely within pericardial cavity; atrium invaginated ventral side of pericardium.

Each pericardioduct emerging from ventro-lateral wall near posterior end of pericardium (Fig. 9) and lined by somewhat folded, ciliated epithelium surrounded by circular musculature. Near distal end of pericardioducts with small sacculation (seminal receptacle?) (Fig. 9, 11A: sr); pericardioducts then bending ventrally, connected within short distance with spawning ducts. Each spawning duct lacking circular musculature and sinuously wound in entire length. Both ducts surrounded by dense mass of spawning duct glands packed into slender groups of up to $1500\mu\text{m}$ in length (Fig. 9, 11B). Glands occupying entire lateral body space, from proximal pericardioducts to distal end of pericardioducts. In region below suprarectal commissure or gps, both terminal spawning ducts passing over to short medially joined common portion which opens ventrally into unpaired out-leading duct (Fig. 9, 11C: sd, sdo). These bends, as well as unpaired out-leading duct, receiving distinctly different type of small, subepithelially arranged glands, which are packed into dense groups (Fig. 9: og). Unpaired outlet itself surrounded by circular musculature and opening, accompanied by a short pouch, below anus centrally into pallial cavity, already in midst of respiratory papillae. No copulatory stylets or other accessory genital organs present.

Biological Remarks. The present species appears to feed on a hexacorallian sea anemone. In the midgut contents scattered nematocysts including spirocysts are present. Dr. Hisanori Kotsuka, a staff of Misaki Marine Biological Station, University of Tokyo kindly informed us that he had found a large, approximately 10 cm long, reddish solenogastres clung to a sea anemone, which was incidentally caught by a gillnet operated near the type locality of the present species, at the depth from 400–500 m off Noto Peninsula, the Sea of Japan (personal observation). In the genus *Alexandromenia*, highly possible feeding on a hexacorallian sea anemone, *Glyphoperidium bursa* Roule, 1909 (Anthozoa: Hexacorallia: Actiniidae) has been reported for *A. heteroglandulata* by Salvini-Plawen and Schwabe (2012). Hexacorallia are prey for quite a number of different Solenogastres (see Salvini-Plawen, 1981), such as Sasaki and Saito (1999) reported in Japanese waters the feeding habit on a sea anemone for a giant solenogastres, *Neomenia yamamotoi* Baba, 1975.

Comparison. In the genus *Alexandromenia*, ten valid species have been recognized to date (Salvini-Plawen, 2008 and present paper) among which four species were described from Antarctic/Subantarctic waters: *A. acuminata* Salvini-Plawen, 1978; *A. antarctica* Salvini-Plawen, 1978; *A. latosoleata* Salvini-Plawen, 1978; *A. heteroglandulata* Salvini-Plawen and Schwabe, 2012, four species from the North Atlantic: *A. crassa* Odhner, 1921; *A. grimaldii* Leloup, 1946; *A. pilosa* Handl and Salvini-Plawen, 2002; *A. gulaglandulata* Salvini-Plawen, 2008, two from the East Pacific: *A. agassizi* Heath, 1911; *A. valida* Heath, 1911. The poorly described *A. crassa* Odhner, 1921 has been doubted as concerns the generic assignment because it was described with a “pair of small salivary glands opening into the radula sac” (Salvini-Plawen, 2008: 895).

In comparison, the present species collected from the Northwest Pacific differs in its zoogeographical provenance from all other species. Among these, the present species most resembles *A. heteroglandulata* described from off Queen Maud Land, Antarctica, 2084–2163 m, by its large body size and the internal organization, especially by the ductule-less cone of the out-leading ducts of the latero-ventral foregut glandular organs, by the configuration of the atrium, which extends posteriorly around the pharynx, and by the arrangements of alimentary tract and the gonopericardial organs with a separate set of glands associated to the outlet. However, it differs from this species by having a larger number of pedal folds, by much larger radula teeth with longer denticles, by a shorter anterior midgut caecum which encompasses smaller part of alimentary tract and its glandular organs, by the beginning of pericardi ducts (lateral, not at posterior extension or “horn” of the pericardium), and by less developed diverticula of the pallial cavity.

The present species also differs from the other two North Pacific species, *A. agassizi* and *A. valida*. *A. agassizi* described from near Revillagigedo Islands, East Pacific, Mexico, at 840 m, has a smaller size (25 mm in length), no “spongy” body wall, larger number of radula teeth (45–53), a prominent and different set of pharyngeal glands, as well as the common origin of the cerebral connectives. *A. valida* described from off California at 1100–2500 m has a smaller size (32 mm in length) and smaller spicules, no “spongy” body wall, a thick sheath of pharyngeal glands, as well as a radula with tall basal plate with denticles which are re-curved somewhat outwardly near the tips.

The differences between the present species and the remaining six species are as follows: *A. acuminata* from the Scotia Sea, Antarctica, 2886–3040 m, has a smaller size (40 mm in length), which is rather rapidly narrowing towards both ends, fewer pedal folds (maximum eight), cone of foregut glandular organ opening with ductule, different configuration of the pallial cavity. *A. antarctica* from the Bransfield Strait, Antarctica, at 662–1120 m also has a smaller size (20 mm in length), and smaller number of pedal folds (seven), which do not enter the pallial cavity, radula teeth with several small denticles at the inner edge between the horn-like denticles, and the cone with a ductule of the out-leading ducts of the latero-ventral foregut glandular organs. *A. latosoleata* from the South Pacific at 459 m has a smaller size (35 mm in length), pallial cavity with fewer respiratory folds (16–18), cone of foregut glandular organ opening with ductule and short but palmular seminal receptacle. *A. grimaldii* from off the Azores Islands 1250 m, has a smaller size (20 mm in body length), thicker layer of the pharyngeal glands, U-shaped radula plates with one pair of latero-medial denticles (Salvini-Plawen, 1972), and a straight paired portion of the spawning ducts which lack seminal receptacle. *A. pilosa* from the Trondheimsfjord, Norway, at 180–240 m, has a much smaller size (9 mm in length), a second pair of small denticles on the inner edge between the horn-like radula denticles, and the out-leading ducts of the latero-ventral foregut glandular organs open fairly close to the radula. *A. gulaglandulata* from the West European Basin at 1050 m has a smaller size (21 mm in length), an additional set of foregut glands, high radula base with thinner horn-like denticles and a simple outlet of the straight, terminally fused spawning ducts.

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