

Deep-Sea Sipunculans (Sipuncula) of the Northwestern Pacific

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Abstract—Based on the available literature data, museum collections, and our own material, a review is presented on sipunculan species of the northwestern Pacific that occur at depths greater than 500 m. Brief morphological descriptions showing the main characters used in taxonomy and a key for the identification of deep-sea sipunculans of the northwestern Pacific to species level are proposed. The key includes 22 valid species representing 7 genera and 5 families of Sipuncula.

Keywords: sipunculans, biodiversity, northwestern Pacific

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INTRODUCTION

Sipunculans are a well-separated monophyletic group of marine coelomic worms representing a phylum of the animal kingdom, Sipuncula [13, 29]. The world's deep-sea sipunculan fauna has been studied insufficiently. The most recent revision listed only 22 species of sipunculans from depths greater than 500 m [30]. This also largely applies to the northwestern Pacific. Most of the available collections, including those from the Kuril–Kamchatka Trench area, were made by trawling during a series of expeditions on the renowned R/V *Vityaz* in the 1950s–1960s [3–7]. The greatest contribution to the description of the museum material and the inventory of the northwestern Pacific sipunculan fauna was made by V.V. Murina, who published a fairly detailed key to sipunculans of the arctic and boreal waters of Eurasia [9]. All data on the world's sipunculan fauna available at that time were reviewed by Stephen and Edmonds [31].

Despite the efforts of researchers, detailed descriptions of live worms are absent because of the poor condition of the bottom-trawl material. Moreover, the degree of intactness and the quality of the preserved material do not allow genetic methods to be used for ascertaining the taxonomic status of some close species, which is important in the case of the variability of many morphological characters even within one species.

Many revisions of individual taxa of sipunculans undertaken in the 1980s have substantially hampered the use of the previously published taxonomic keys [14–19, 22]. In 1994, Cutler [13] published a new overall review of this group and a new key to sipunculans of the world, in which he reduced many species,

among them those described by Murina, to synonymy and the total number of species from 300 to 149. Unfortunately, this very valuable and important book lacks illustrations of most species, thus hindering its use as a field guide. Nevertheless, well-illustrated papers on the sipunculan fauna of some areas of the western Pacific appeared later, which substantially helped the identification of common species of peanut worms [1, 2, 12, 21, 23, 26–28].

In recent years, interest in the northwestern Pacific sipunculan fauna has increased in connection with a series of deep-sea expeditions that have been conducted in this region using the state-of-the-art technologies for the collection of biological material, including underwater robotic vehicles [10, 11]. These investigations showed that even at relatively low species richness the sipunculans are an abundant group of deep-sea benthos in all seas of the Russian Far East, including abyssal and ultraabyssal depths [25–27]. Up-to-date illustrated guides allowing identification of this material to the species level have become a necessity.

The aim of the present work is to review the data accumulated to date on the deep-sea sipunculan fauna of the northwestern Pacific and to provide brief descriptions and keys for the identification of all species recorded in the region at depths greater than 500 m. By the northwestern Pacific we mean a part of the Pacific Ocean bounded by the Asiatic coast from the Bering Strait to 30° N and 180° E.

Analysis of our own and museum material from deep-water samples showed that 22 valid species of sipunculans are reliable records from depths below 500 m

in the northwestern Pacific. Some species were also known from less deep waters of the Pacific Ocean. We earlier recorded *Nephasoma wodjanizkii* for the Sea of Japan [26]; however, subsequent examination of the material questioned the taxonomic identity of our find; we consequently do not put *N. wodjanizkii* in the list of species reliably occurring below 500 m in the northwestern Pacific. The absence of true endemics in the abyssal and even hadal fauna evidently indicates the relative youngness of the deep-water biota. Supposedly, this fauna might have formed as a result of the migration of shallow-water and eurybathic species of sipunculans colonizing new ecological niches in oceanic depths. The presence of free-swimming and long-lived planktotrophic larvae able to travel huge distances via oceanic currents could have led to the formation of cosmopolitan species and could have allowed some sipunculan species to colonize the entire depth range from the intertidal zone to the abyssal plains and deep-sea trenches.

SYSTEMATICS

Phylum Sipuncula Linnaeus, 1766

Class Sipunculidea E. Cutler et Gibbs, 1985

Order Sipunculiformes E. Cutler et Gibbs, 1985

Family Sipunculidae Rafinesque, 1814

Genus *Sipunculus* Linnaeus, 1766

Subgenus *Sipunculus* (*Sipunculus*) Linnaeus, 1766

Sipunculus norvegicus Danielssen, 1869

Material: Cutler et al., 1984.

Description. Trunk up to 10 cm long (TL), light gray. Introvert shorter than trunk, approximately one quarter of TL. Tentacular apparatus with 8–12 leaflike lobes. Skin may have swollen rectangular minipillows. Body walls translucent. Longitudinal musculature gathered in 20–24 longitudinal bands. Intestine with approximately 16 coils. Nephridia unattached. Nephridiopores open anterior to anus. Spindle muscle present, not attached at posterior end of trunk. Wing muscles present.

Distribution. A cold-water species, widespread in the Atlantic and Pacific oceans. It is found to depths of 3000 m [9, 13, 20].

Sipunculus nudus Linnaeus, 1766 (Fig. 1a)

Material: Cutler et al., 1984.

Description. Trunk up to 15 cm long (TL), gray to brown. Tentacular apparatus lobe-shaped, with two dorsal lobes markedly larger than the rest. Skin may have swollen rectangular minipillows. Longitudinal musculature gathered in 24–34 longitudinal bands. Intestine with up to 20 coils. Nephridia attached to body wall for one third of their length. Nephridiopores open anterior to anus. Wing muscles present.

Distribution. A cosmopolitan species found at depths to 2275 m [9, 20]. Recorded in the Sea of Japan.

Order Golfingiiformes E. Cutler et Gibbs, 1985

Family Golfingiidae Stephen et Edmonds, 1972

Genus *Golfingia* Lankester, 1885

Subgenus *Golfingia* (*Golfingia*) Lankester, 1885

Golfingia anderssoni (Theel, 1911)

Material: Cutler et al., 1984.

Description. TL 3–4 cm. The posterior end of the trunk may have the form of a caudal appendage up to 8 mm long. Introvert length equal to trunk length. Trunk color from yellow–gray to brown. Hooks present only in juvenile specimens, lacking in adult worms. Posterior end of trunk at tail base is covered with large finger-shaped anteriorly-directed papillae, which, in turn, may carry small cylindrical papillae. Ventral retractors originating almost in mid-region or in second half of trunk (with caudal appendage). Dorsal retractors originating at anteriormost end of trunk. Intestine with up to 30 coils. Nephridiopores open at anus level.

Distribution. A deep-water species common in the Atlantic and Pacific oceans. In the northwestern Pacific, it is found to depths of 6135 m [13].

Golfingia elongata (Keferstein, 1862)

Material: Mirina, 1977; Cutler et al., 1984.

Description. TL up to 9 cm. Introvert almost two times shorter than trunk. Hooks almost straight (up to 70 μm), arranged in 8–10 rings. Skin smooth, lustrous. Vertical retractor muscles originating at border of first one-third of trunk; dorsal retractors just posterior to anus. Intestine with 30 to 60 coils. Nephridiopores open at or slightly anterior to anus.

Distribution. Found in the Atlantic and Pacific oceans, usually from the intertidal zone to 400 m depth. In the East China Sea, it was recorded to depths of 590 m [6, 13, 20].

Golfingia margaritacea (Sars, 1851) (Fig. 1b)

Material: Maiorova, Adrianov, 2013.

Description. Trunk from 3 to 9 cm long (TL) and from 6 to 10 mm wide. Introvert shorter or almost equal to TL. Skin gray, semitransparent, lustrous. Hooks (25–35 μm) present only in juvenile individuals, lacking in mature worms. Ventral retractors originating at 30% of TL toward posterior end of trunk; dorsal retractors in anterior half of trunk (approximately 5–6% of TL). Intestine with up to 35 coils. Wing muscles present. Nephridia approximately 10–15% of TL. Nephridiopores open at anus level.

Distribution. This is a cosmopolitan species widespread in the northwestern Pacific, where it is found to depths of 5740 m [9].

Golfingia muricaudata (Southern, 1913) (Fig. 1c)

Material: Maiorova, Adrianov, 2015.

Description. Trunk up to 7 cm long (TL) and up to 9 mm wide, yellowish-gray, translucent. Introvert equal to trunk length. Hooks small (20 μm), present only in juvenile (up to 5 mm) individuals. A pair of

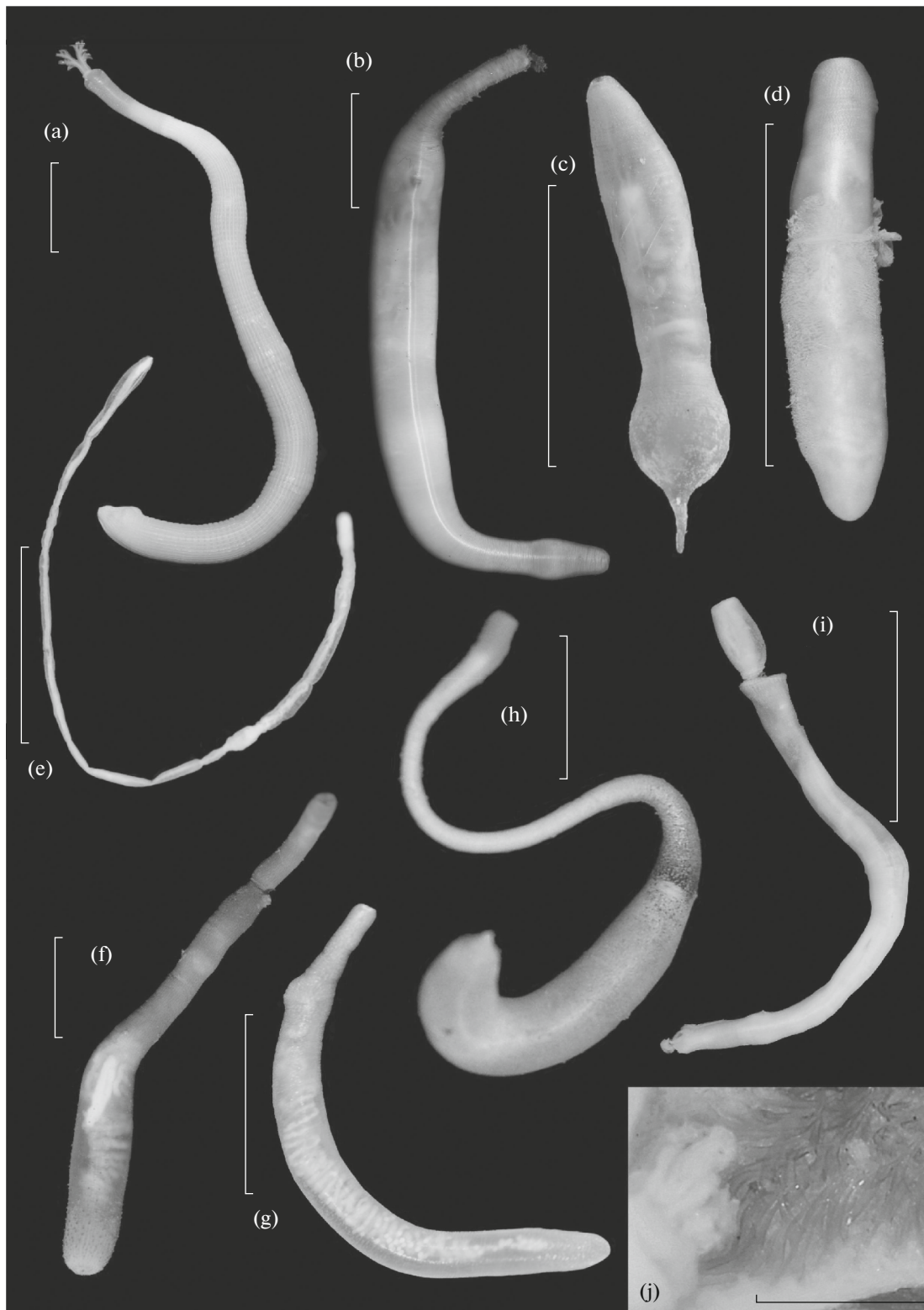


Fig. 1. (a) *Sipunculus nudus*, dorsal view of worm, introvert is everted; (b) *Golfingia margaritacea* (station A2-8), lateral view of worm, introvert is retracted; (c) *G. muricaudata* (station 28), ventral view of worm, with introvert completely retracted; (d) *Nephasoma abyssorum* (stations 2–4), lateral view of worm, with introvert completely retracted; (e) *N. capilleforme*, lateral view of type specimen (1/38749), with introvert everted; (f) *N. corrugatum* (stations 7–10), lateral view of worm, introvert half everted; (g) *N. diaphanes* (stations 7–10), lateral view of worm, introvert is half everted; (h) *N. eremita*, dorsal view of worm, introvert is retracted; (i) *N. vitjazi*, lateral view of type specimen (1/38734), introvert is half everted; (j) *N. vitjazi*, hooks at introvert base. Scale: (a–d) 20 mm; (e, f, h) 10 mm; (g, i) 5 mm; (j) 0.5 mm.

reddish eyespots well visible. Posterior end of trunk with longitudinal rugae and a long (up to 20–30% of TL) caudal appendage. Large cylindrical papillae may be located on posterior part of trunk. Ventral retractors originating at 20–21% of TL, dorsals at 8–9% of TL toward posterior end of trunk. Intestine with 12–20 coils. Spindle muscle present, not attached to posterior end of trunk. Nephridia 9–13% of TL, unattached. Nephridiopores open posterior to or at anus level.

Distribution. A deep-water species widespread in all oceans, occurring to depths of 6860 m. In the northwestern Pacific, it is found from the Bering Sea to Japan [6, 9, 13, 27].

Golfingia vulgaris (de Blainville, 1827)

Material: Murina, 1977; Cutler et al., 1984.

Description. TL up to 20 cm. Introvert shorter than TL. Trunk for most part smooth, pale gray to yellow–brown. Anterior and posterior ends of trunk dark brown, with large papillae. Introvert shorter than trunk. Hooks (up to 150 μm) irregularly arranged. Ventral retractors originating from body wall at 30% of TL toward posterior end of trunk, dorsal retractors at 12% of TL. Intestine with approximately 20 coils. Spindle muscle present. Wing muscles present. Nephridia approximately 6% of TL. Nephridiopores open anterior to anus.

Distribution. A cosmopolitan species found from the Kuril–Kamchatka Trench to the Japan Islands at depths down to 5853 m [9, 20].

Genus *Nephasoma* Pergament, 1940

Subgenus *Nephasoma* (*Nephasoma*) Pergament, 1940

Nephasoma abyssorum (Koren et Danielssen, 1875) (Fig. 1d)

Material: Maiorova, Adrianov, 2015.

Description. Trunk up to 3 cm (TL). Introvert shorter than trunk, 1/3 to 1/2 of TL. Skin smooth, opaque, gray. Pseudoshield as an aggregation of closely packed large papillae present at anterior end of trunk. Hooks (100–150 μm) arranged generally irregularly, sometimes in spiral. Ventral retractors originating in mid-trunk (50–55% of TL toward posterior end of trunk). Intestine with 16–18 coils. Spindle muscle weakly developed. Nephridia approximately 15–20% of TL, unattached. Nephridiopores open at anus level.

Distribution. A deep-water species, widespread in all oceans, recorded to depths of 5300 m [13, 27].

Nephasoma capilleforme (Murina, 1973) (Fig. 1e)

Material: type specimens from the collection of Zoological Institute, Russian Academy of Sciences (1/38749, 2/44334, Pacific Ocean, 56°09'9" N, 139°12'6" W, depth 3350 m).

Description. Trunk filiform, approximately 1.2 cm in length (TL), approximately 0.5 mm in diameter. Papillae on anterior and posterior ends of trunk.

Introvert equal to or somewhat longer than trunk. Hooks small (20–25 μm), scattered. Ventral retractors originating from body wall at 60% of TL toward posterior end of trunk. Intestine with 12–15 coils. Nephridia approximately 15% of TL, unattached.

Distribution. A deep-water species found in the Atlantic and Pacific oceans to depths of 3450 m [8, 9, 13]. Recorded in the Sea of Japan at depths to 300 m [26].

Nephasoma corrugatum N. Cutler et Cutler, 1986 (Fig. 1f)

Material: Maiorova, Adrianov, 2015.

Description. Trunk up to 1.5 cm in length (TL) and up to 3 mm in diameter, gray, semi-transparent, often pear-shaped. Introvert equal to trunk length. Zigzag-like longitudinal ridges present at introvert base and at anterior and posterior ends of trunk. Hooks small (30 μm), scattered. Body wall muscles continuous. Ventral retractors originating from body wall at 50–70% of TL toward posterior trunk. Intestine with 15–20 coils. Spindle muscle absent. Nephridia approximately 9–10% of TL, unattached. Nephridiopores open at anus level.

Distribution. This species is widespread in the Atlantic and Pacific oceans, found to depths of 5900 m. Recorded in the Kurile–Kamchatka Trench area [27].

Nephasoma diaphanes (Gerould, 1913) (Fig. 1g)

Material: Maiorova, Adrianov, 2015.

Description. Trunk up to 3 cm in length (TL) and up to 4 mm in diameter, smooth, pale gray to almost brown. Introvert equal to trunk length. Specimens from foraminiferal tubes have few brown papillae on the trunk. Hooks small (25–30 μm), scattered. Body wall musculature continuous. Ventral retractors originating from body wall at 50–70% of TL toward posterior end of trunk. Intestine with 15–30 coils. Spindle muscle absent. Nephridia approximately 10% of TL, unattached. Nephridiopores open at anus level.

Distribution. A deep-water cosmopolitan species occurring at depths to 5300 m. Found in the Kurile–Kamchatka Trench and at the adjacent abyssal plain [9, 27].

Nephasoma eremita (Sars, 1851) (Fig. 1h)

Material: Murina, 1977; Cutler et al., 1984.

Description. Trunk up to 6 cm in length (TL) and up to 6 mm in diameter, grayish-yellowish to dark brown. Trunk surface often rugose, with transverse grooves. Papillae finger-shaped, more numerous at anterior and posterior ends of trunk. Introvert equal to or shorter than trunk. Hooks absent. Body wall musculature continuous. Ventral retractors originating at 50–60% of TL toward posterior end of trunk. Intestine with 20–40 coils. Spindle muscle present. Nephridiopores open at anus level.

Distribution. A cosmopolitan species found at depths to 3867 m. Records from the Sea of Okhotsk, off eastern Kamchatka, and off the Aleutian Islands [9].

Nephasoma vijazi (Murina, 1964) (Figs. 1i and 1j)

Material: Type specimen from the collection of the Zoological Institute of the Russian Academy of Sciences (1/38734, Pacific Ocean, R/V *Vityaz*, station 3520, depth 4150 m, 28°57'5" N, 137°21' E).

Description. Trunk approximately 2.1 cm in length and approximately 1.2 mm in diameter, smooth, pale brown. Anterior end of trunk with 30–35 parallel, longitudinal ridges radiating out from introvert base to form a pseudoshield. Introvert longer than trunk. Hooks large (210–280 µm), rings indistinct. Body wall musculature continuous. Ventral retractor muscles originating from body wall in anterior one-third of trunk. Intestine with 15 coils. Nephridiopores open at anus level.

Distribution. This species was described from the Japan Trench from 4150 m depth [6].

Family Phascolionidae E. Cutler et Gibbs, 1985

Genus *Phascolion* Theel, 1875

Subgenus *Phascolion* (*Phascolion*) Theel, 1875

Phascolion strombus (Montagu, 1804) (Fig. 2a)

Material: Maiorova, Adrianov, 2013.

Description. Trunk up to 3.5 cm long (TL), gray to dark brown. Introvert almost twice as long as trunk. Hooks (80–85 µm) scattered. Anterior end of trunk bears an aggregation of large papillae, posterior trunk with large V-shaped holdfast papillae (approximately 200 µm). Body wall musculature continuous. Retractor muscles originating at 80–90% of TL toward posterior end of trunk. Spindle muscle present. Gut loops usually forming no spiral. Nephridium approximately 25% of TL, attached to body wall for almost all of length. Nephridiopore opens at anus level.

Distribution. A widespread species, occupying gastropod shells and polychaete tubes. Found to depths of 4030 m, from the northern Bering Sea to the southern Sea of Japan [13, 26].

Subgenus *Phascolion* (*Isomya*) E. Cutler et Cutler, 1985

Phascolion tuberculosum Theel, 1875

Material: Murina, 1977; Cutler et al., 1984.

Description. TL up to 5 cm. Trunk yellow–brown, with introvert shorter than trunk. Anterior and posterior ends of trunk carry an aggregation of large (200–250 µm) conical papillae with one or several nipples on tip. Holdfast papillae rounded and flattened (up to 300 µm in diameter). Hooks scattered, varying in size from 40 to 220 µm among specimens. Retractors originating in posteriormost part of trunk (ventral retractor slightly anterior to dorsal one). Intestine helix ill-defined. Nephridiopore opens markedly posterior to anus.

Distribution. This species is widespread in the Atlantic and Pacific oceans, occurring at depths down to 2700 m [13]. Recorded from off Japan, often found in mollusk shells and polychaete tubes [9, 20].

Subgenus *Phascolion* (*Lesenka*) Gibbs, 1985

Phascolion rectum Ikeda, 1904

Material: Murina, 1977; Cutler et al., 1984.

Description. Trunk up to 2 cm long (TL), yellowish–gray. Introvert usually shorter than trunk. An aggregation of tall (sometimes club-shaped) papillae at introvert base, mid-region of trunk with flattened papillae, no holdfast papillae. Retractor muscles originating in posteriormost part of trunk. Spindle muscle absent. Intestine with approximately 20 coils. Nephridiopore opens markedly posterior to anus.

Distribution. This species was described from the Pacific side of the Japan Islands. Recorded to depths of 2600 m [9, 13, 20, 24]. Found in mollusk shells.

Subgenus *Phascolion* (*Montuga*) Gibbs, 1985

Phascolion lutense Selenka, 1885 (Fig. 2b)

Material: Maiorova, Adrianov, 2015.

Description. Trunk up to 5 cm (TL), yellowish–gray. Worms often build thick brown tubes from silt and mucus. Introvert equal to or longer than trunk. Hooks (commonly 50–70 µm, sometimes up to 150 µm) scattered, sometimes weakly visible in cuticular grooves. Anterior and posterior ends of trunk with aggregations of tall finger-shaped brown papillae; mid-region of trunk with rounded and flattened papillae. Body wall musculature continuous. Retractor muscles originating at 95% of TL toward posterior end of trunk. Spindle muscle present. Nephridia unattached. Nephridiopores open at anus level.

Distribution. A deep-water species, widespread in the Atlantic and Pacific oceans. Recorded to depths of 6860 m. Found from the Bering Sea to the Japan Islands [9, 27].

Phascolion pacificum Murina, 1957 (Fig. 2c)

Material: Maiorova, Adrianov, 2015.

Description. TL up to 2.5 cm. Introvert usually equal to trunk length. Aggregations of tall conically-shaped brown papillae present at introvert base and at anterior and posterior ends of trunk; holdfast papillae in mid-region of trunk. Hooks (30–35 µm) scattered. Body wall musculature continuous. Retractor muscles originating in posteriormost part of trunk at 95% of TL. Spindle muscle present. Intestine usually with no more than 10–12 coils, loops sometimes not in helix. Nephridium approximately 30% of TL, unattached. Nephridiopore opens at anus level.

Distribution. A deep-water species, widespread in all oceans, occurring to depths of 6860 m. Recorded for the Kuril–Kamchatka and Japan trenches [9, 13, 27]; often found in foraminiferan and polychaete tubes and in empty gastropod or scaphopod shells.

Genus *Onchnesoma* Koren et Danielssen, 1875

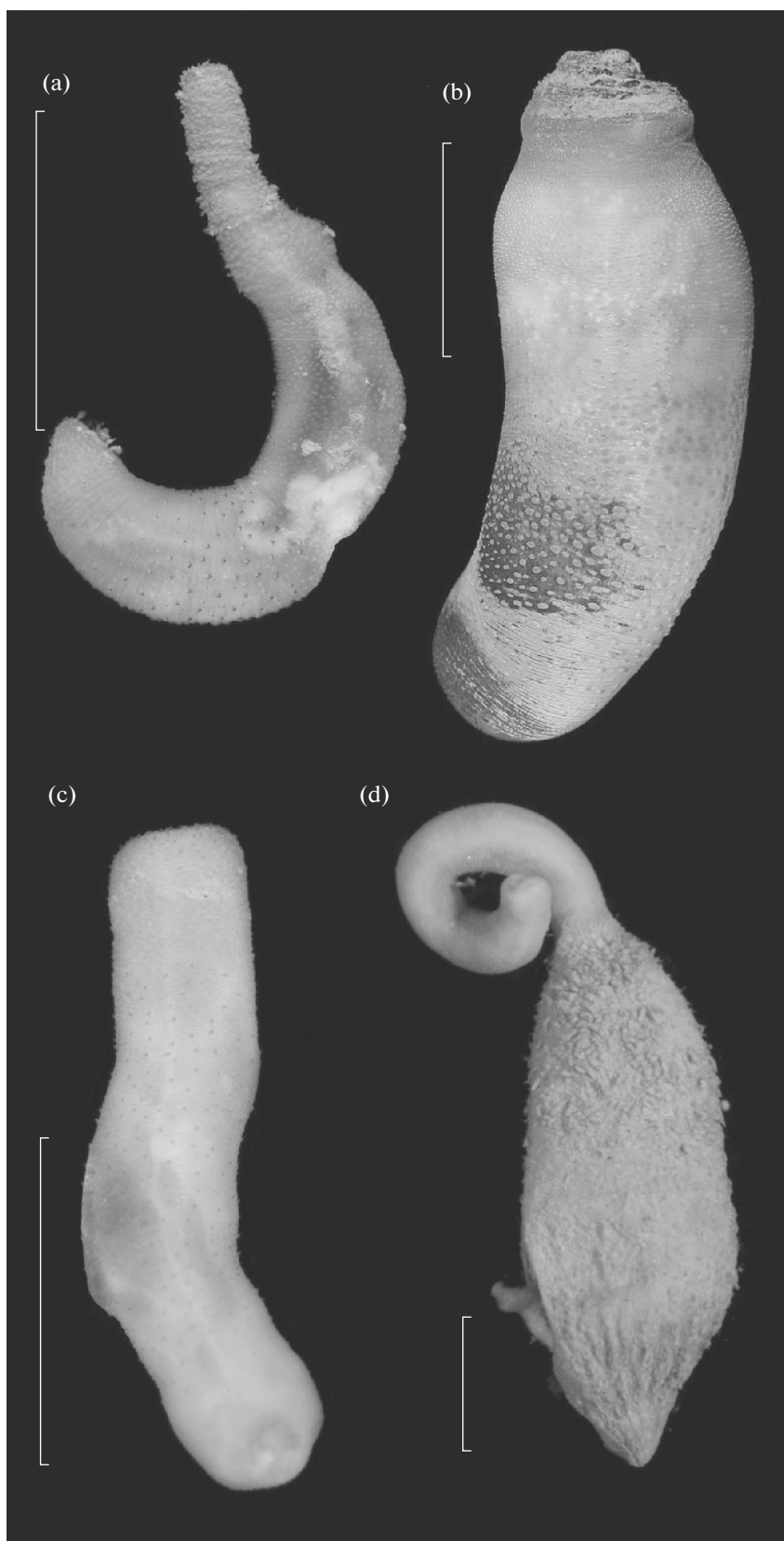


Fig. 2. (a) *Phascolion strombus* (station A2-8), lateral view of worm, introvert is half everted; (b) *P. lutense* (stations 3–10), lateral view of worm, introvert is retracted; (c) *P. pacificum* (stations 1–12), ventral view of worm, introvert is retracted; (d) *Onchnesoma intermedium*, lateral view of type specimen (1/38746), introvert half everted. Scale: (a–c) 10 mm; (d) 2 mm.

Onchnesoma intermedium Murina, 1976 (Fig. 2d)

Material: Type specimens from the collection of the Zoological Institute of the Russian Academy of Sciences (1/38746, 2/40278, East China Sea, R/V *Vityaz*, station 3540, depth 500 m, 30°48'5" N, 128°04'8" E).

Description. TL up to 1.5 cm. Trunk pale gray to brown. Introvert 2–3 times as long as trunk. Anterior half of trunk densely covered with large cuticular scales. Posterior region nonpapillated, with longitudinal ridges and furrows (up to 20). Retractor muscle originating in posteriormost part of trunk. Intestine with no more than 20 coils. Anus opens in mid-introvert. Nephridium short (approximately 2 mm). Nephridiopore opens far posterior to anus.

Distribution. This species was described from the East China Sea from 500 m depth [9].

Onchnesoma steenstrupii Koren et Danielssen, 1875

Material: Murina, 1977; Cutler et al., 1984.

Description. Trunk approximately 4 mm long (TL), spherical or pear-shaped, gray. Introvert very thin and long, 5–10 times as long as trunk. Posterior of trunk with radiating keels (up to 30). Retractor muscle originating in posteriormost part of trunk. Anus opens in distal region of introvert.

Distribution. A deep-water species found in all oceans to depths of 3362 m. Recorded at high latitudes of the Northwestern Pacific [9, 13, 20].

Class Phascolosomatidea E. Cutler et Gibbs, 1985

Order Phascolosomatiformes E. Cutler et Gibbs, 1985

Family Phascolosomatidae Stephen et Edmonds, 1972

Genus *Apionsoma* Sluiter, 1902

Subgenus *Apionsoma* (*Apionsoma*) Sluiter, 1902

Apionsoma murinae (E. Cutler, 1969)

Material: Murina, 1977; Cutler et al., 1984.

Description. Trunk up to 1.5 cm long (TL), gray to brown. Large mammiform papillae on posterior of trunk. Introvert very thin and long, 5–10 times as long as trunk. Hooks with basal spinelets arranged in rings. Body wall musculature splits into longitudinal bands in anterior and posterior parts of trunk. Ventral retractors originating in anterior trunk, while dorsal retractors even anterior to anus. Intestine with up to 30 coils. Nephridiopores open anterior to anus.

Distribution. This species is widespread in the Atlantic and Pacific oceans, found at depths to 5260 m. Recorded for the Bering Sea [9, 13, 20].

Order Aspidosiphoniformes E. Cutler et Gibbs, 1985

Family Aspidosiphonidae Baird, 1868

Genus *Aspidosiphon* Diesing, 1851

Subgenus *Aspidosiphon* (*Aspidosiphon*) Diesing, 1851

Aspidosiphon muelleri Diesing, 1851

Material: Murina, 1977; Cutler et al., 1984.

Description. Trunk 0.5–1.2 cm long (TL) and 2.0–2.5 mm in diameter, gray. Introvert 2–3 times as long as trunk. Hooks (20–30 µm) arranged in rings on distal part of introvert, scattered proximally. Anal shield yellow–brown, composed of small plates arranged into various-size units separated by longitudinal furrows dorsally and by transverse furrows in anterior part of shield. Caudal shield yellow–brown, with 15–20 radial grooves. Retractor muscles originating from body wall at 10% of TL from caudal shield. Spindle muscle attached to posterior end of trunk. Nephridia approximately 70% of TL.

Distribution. A widespread eurybathic species found to depths of 2900 m. It often occupies gastropod shells. Recorded from off the Japan Islands [9, 20].

A Key to Sipunculan Species

1. Tentacular crown around mouth present, dorsal crown (arc) present or absent; introvert hooks (if present) scattered.....class Sipunculidea (2)
 - Tentacular crown around mouth absent, only dorsal crown (arc) present; introvert hooks (if present) arranged in rings.....class Phascolosomatidea (21)
2. Longitudinal body wall musculature in separate or anastomosing bands.....order Sipunculiformes, family Sipunculidae (3)
 - Longitudinal body wall musculature in continuous layer.....order Golfingiiformes (4)
3. 20–24 longitudinal muscle bands, nephridia free....
 -*Sipunculus norvegicus*
 - 24–34 longitudinal muscle bands, nephridia attached to body wall by 10–40%.....*Sipunculus nudus*
4. Two nephridia.....family Golfingiidae (5)
 - A single nephridium.....family Phascolionidae (15)
5. Four retractor muscles of introvert.....
 -genus *Golfingia* (6)
 - Only 2 retractor muscles of introvert.....
 -genus *Nephasoma* (10)
6. Posterior end of trunk with a distinct caudal appendage (up to 20–30% of TL).....(7)
 - Posterior end of trunk without caudal appendage.....(8)
7. Ventral retractors originating almost in mid-region or in second half of trunk; posterior end of trunk at tail base with large finger-shaped or ovate anteriorly-directed papillae, on which small cylindrical or mammiform papillae may be present.....
 -*Golfingia anderssoni*
 - Ventral retractors originating only at 20–21% of TL; posterior end of trunk with otherwise structured papillae.....*Golfingia muricaudata*

8. Introvert hooks arranged in distinct rings.....
.....*Golfingia elongata*
– Introvert hooks (if present) scattered.....(9)
9. Hooks (25–35 μm) present only in juvenile specimens, absent in adult animals; dorsal retractors originating from body wall at 5–6% of TL.....
.....*Golfingia margaritacea*
– Hooks (up to 150 μm) present in adult specimens also; dorsal retractors originating from body wall at 12% of TL.....*Golfingia vulgaris*
10. A cuticular pseudoshield present at introvert base; introvert hooks large, usually more than 50 μm).....(11)
– Pseudoshield at introvert base not distinct, only closely-arranged papillae present on trunk; introvert hooks small (20–30 μm).....(12)
11. Pseudoshield as an aggregation of closely packed papillae present at introvert base; small hooks (50–150 μm) arranged irregularly or in spiral.....*Nephasoma abyssorum*
– Pseudoshield of 30–35 longitudinal ridges radiating out from introvert base; hooks very large (210–280 μm), scattered.....*Nephasoma vitjazi*
12. Introvert hooks lacking; trunk surface rugose, with transverse grooves.....*Nephasoma eremita*
– Introvert hooks present; trunk surface without distinct transverse grooves.....(13)
13. Trunk filiform.....*Nephasoma capilleforme*
– Trunk not filiform.....(14)
14. Zigzag-shaped longitudinal wrinkles in skin present at anterior and posterior ends of trunk.....
.....*Nephasoma corrugatum*
– Trunk lacking zigzag-shaped wrinkles.....
.....*Nephasoma diaphanes*
15. Retractor muscles not fused into single column; anus in anterior part of trunk.....
.....genus *Phascolion* (16)
– Retractor muscles fused into single column; anus in distal part of introvert.....genus *Onchnesoma* (20)
16. V-shaped holdfast papillae in posterior part of trunk.....*Phascolion strombus*
– Holdfast papillae shaped otherwise or absent.....(17)
17. Nephridiopores open markedly posterior to anus.....(18)
– Nephridiopores open at anus level.....(19)
18. Introvert hooks absent; an aggregation of club-shaped papillae at introvert base, no holdfast papillae.....*Phascolion rectum*
– Introvert hooks present, otherwise-shaped papillae at introvert base, holdfast papillae present.....
.....*Phascolion tuberculosum*
19. Introvert hooks small (30–35 μm), nephridia length approximately 30% of TL.....
.....*Phascolion pacificum*
– Introvert hooks large (50–150 μm), nephridia length approximately 50% of TL.....
.....*Phascolion lutense*
20. Introvert 2–3 times as long as trunk; anterior trunk with scale-like papillae; anus opens on introvert 50–80% of its length toward mouth.....
.....*Onchnesoma intermedium*
– Introvert 5–10 times as long as trunk; scale-like papillae absent; anus opens on introvert 90% of its length toward mouth.....
.....*Onchnesoma steenstrupii*
21. Anal shield absent from anterior end of trunk; introvert 5–10 times as long as trunk.....
.....order Phascolosomatiformes, family Phascolosomatidae, *Apionsoma murinae*
– Anal shield present at anterior end of trunk; introvert 2–3 times as long as trunk.....
.....order Aspidosiphoniformes, family Aspidosiphonidae, *Aspidosiphon muelleri*.

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