

A new species of solitary Entoprocta (Loxosomatidae) from the Laptev Sea with notes on entoproct epibionts of polychaetes

A.O. Borisanova

Faculty of Biology, Moscow State University, Moscow, 119991 Russia.
E-mail: borisanovaaao@mail.ru

ABSTRACT: A new solitary entoproct species, *Loxosomella apicalis* sp.n., is described from the Laptev Sea from the depths of 72–90 m. *L. apicalis* sp.n. is a small species with a body length of 158–323 µm and with an extremely short stalk. Calyx bears 8 tentacles, buds emerge from a frontal budding area. The species is an epibiont of polychaete worms *Aglaophamus malmgreni* (Nephtyidae). Specimens of *L. apicalis* sp.n. are attached to the tips of the dorsal cirri or the tips of the gills of the parapodia. The base of the stalk of *L. apicalis* sp.n. grasps tightly the tip of the cirris or the gill. The list of all entoproct species associated with nephtyid polychaetes is given as well as the list of all polychaete families hosted solitary entoprocts, with indication of loxosomatid species.

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KEY WORDS: *Aglaophamus malmgreni*, Kamptozoa, Loxosomatidae, *Loxosomella*, Arctic, epibiont.

Новый вид одиночных Entoprocta (Loxosomatidae) из моря Лаптевых с замечаниями о внутрипорошицевых — эпибionтах полихет

A.O. Борисанова

Биологический факультет Московского государственного университета, Москва, 119991, Россия. E-mail: borisanovaaao@mail.ru

РЕЗЮМЕ: Описан новый вид одиночных внутрипорошицевых, *Loxosomella apicalis* sp.n. из моря Лаптевых, найденный на глубинах 72–90 м. Мелкий вид с длиной тела 158–323 мкм, с очень короткой ножкой. Чашечка несет 8 щупалец, почки отходят от фронтальной зоны чашечки. Особи *L. apicalis* обитают на параподиях многощетинковых червей *Aglaophamus malmgreni* (Nephtyidae), прикрепляясь к кончикам дорсальных усиков или жабр параподий с помощью основания ножки, которое плотно охватывает апикальную часть усика или жаберы. В статье приведен список всех видов Entoprocta, обитающих на многощетинковых червях семейства Nephtyidae (Phyllodocida), и перечислены все семейства полихет, являющиеся хозяевами для одиночных внутрипорошицевых, с указанием обитающих на них видов Entoprocta. Как цитировать эту статью: Borisanova A.O. 2018. A new species of solitary Entoprocta (Loxosomatidae) from the Laptev Sea with notes on entoproct epibionts of polychaetes // Invert. Zool. Vol.15. No.4. P.373–382. doi: 10.15298/invertzool.15.4.06

КЛЮЧЕВЫЕ СЛОВА: *Aglaophamus malmgreni*, Kamptozoa, Loxosomatidae, *Loxosomella*, Арктика, эпибионты.

Introduction

Entoprocta (Kamptozoa) is a small phylum, which includes about 180 species of miniature, mostly marine, colonial and solitary animals. Fauna of Entoprocta of the World Ocean remains poorly investigated. In the seas of Russia Entoprocta is one of the less studied groups of invertebrate animals. At present only about 30 species were described from the seas of Russia (Nilus, 1909; Derjugin, 1928; Kluge, 1946; Krylova, 1986; Bagrov, Slyusarev, 2002; Borisanova, Krylova, 2014; Borisanova, 2016a, b; Borisanova, Potanina, 2016; Borisanova *et al.*, 2018). Most of the described species are known from the White Sea. The information on the fauna of entoprocts in other seas is extremely limited. But the studies of the last few years have shown that the diversity of Entoprocta in the seas of Russia is richer than it was previously believed. New species have been described, including species from the Kara Sea (Borisanova, 2016a) and the Sea of Okhotsk (Borisanova, Potanina, 2016; Borisanova *et al.*, 2018), where there were no records of Entoprocta before. In this study a new species of solitary Entoprocta from the Laptev Sea is described, where only two entoproct species were previously known, solitary *Loxosoma cingulata* Kluge, 1946 and colonial *Barentsia discreta* (Busk, 1886) (Kluge, 1946). The new species was found living on the polychaete *Aglaophamus malmgreni* (Théel, 1879) (Nephtyidae), so a list of all known Entoprocta species associated with polychaetes of the Nephtyidae family (Phyllococida) is given.

Materials and Methods

The material was collected in the Laptev Sea during the 63-rd cruise of RV Akademik Mstislav Keldysh in September–October 2015. Specimens of *Loxosomella apicalis* sp.n. were found on the tips of the gills and dorsal cirri of parapodia of *Aglaophamus malmgreni* (Polychaeta: Nephtyidae) collected at two stations (Fig. 1).

The material was fixed in 4% formalin, and then transferred to 96% alcohol for storage.

Holotype and paratypes were imaged and drawn using Leica DM2500 microscope. The body parameters were measured from photographs using the ImageJ software package.

The type material is deposited in the Zoological Museum of Moscow State University (ZMMU), Moscow.

Description

Family Loxosomatidae Hincks, 1880

Genus *Loxosomella* Mortensen, 1911

Loxosomella apicalis sp.n.

Fig. 2, 3.

Type material: ZMMU Uk-25 (holotype); ZMMU Uk-26 (3 paratypes)

Type locality: Laptev Sea, station 5228 (77.6547° N, 130.4743° E), 90 m, 14.09.2015, on the polychaete *Aglaophamus malmgreni*.

Additional material: ZMMU Uk-27 (5 specimens). Laptev Sea, station “seep” (76.7715° N, 125.8418° E), 72 m, 16.09.2015; on the polychaete *Aglaophamus malmgreni*.

ETYMOLOGY: The species’ name “apicalis” means “apical” in Latin and refers to localization of specimens on the tips of gills and cirri.

DIAGNOSIS:

Small species with total body length from 158 to 323 µm (length of holotype 208 µm), average body length 235 µm (Table 1). Calyx slightly flattened laterally, with 8 tentacles, directed distally in contracted state. Lateral sensory organs absent. Stomach roundish. Stalk very short, from 26 to 62 µm, average length 36 µm. Foot absent in adults. Base of stalk tightly grasps apex of notopodial cirri or gill, so that specimen of *L. apicalis* sp.n. looks like cap on tip. Specimens of *L. apicalis* sp.n. can be easily detached from tips of cirri or gills without damaging tissues of host or epibiont, so it can be assumed that fixation on host’s body provided only by musculature of stalk, without using secretion of attachment glands.



Fig. 1. Map of the sampling sites.
Рис. 1. Карта точек сбора материала.

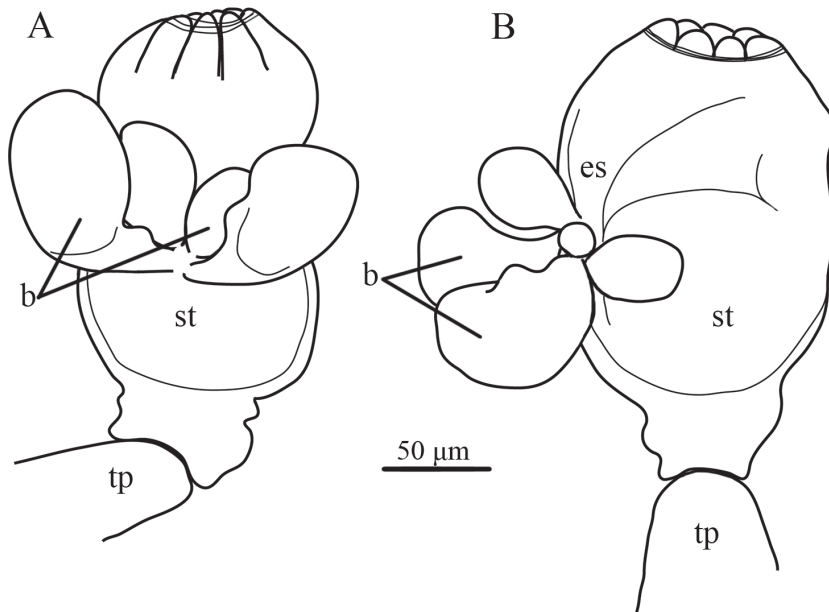


Fig. 2. *Loxosomella apicalis* sp.n., drawing of holotype. A — frontal view; B — lateral view.
Abbreviations: b — bud; es — esophagus; st — stomach; tp — tip of the dorsal cirri of notopodia.
Рис. 2. *Loxosomella apicalis* sp.n., рисунок голотипа. А — фронтальный вид; В — латеральный вид.
Обозначения: b — почка; es — пищевод; st — желудок; tp — кончик дорсального усика нотоподии.

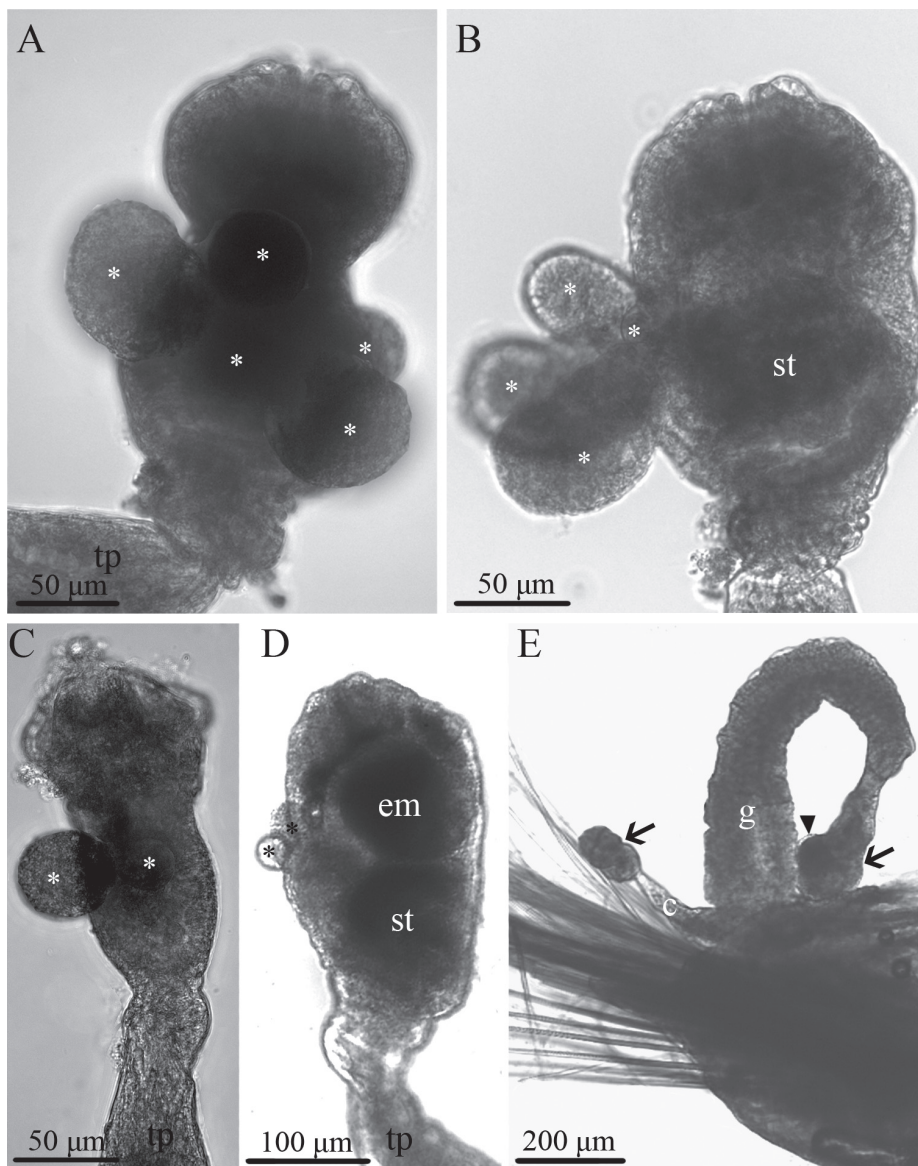


Fig. 3. Specimens of *Loxosomella apicalis* sp.n., light microscopy. A — holotype, frontal view; B — holotype, lateral view; C — paratype, latero-frontal view; D — specimen with developing larvae in the brood chamber; E — part of parapodia with specimens on the tip of the dorsal cirrus and on the tip of the gill (arrows indicate the location of specimens of *L. apicalis* sp.n., arrowhead indicates embryo in the brood chamber). Abbreviations: c — dorsal cirri of notopodia; em — developing embryo; g — notopodial gill; st — stomach; tp — tip of the dorsal cirri of notopodia. Asterisks indicate buds.

Рис. 3. Особи *Loxosomella apicalis* sp.n., микрофотографии. А — голотип фронтально; В — голотип латерально; С — паратип латеро-фронтально; D — особь с развивающейся личинкой в выводковой камере; E — участок параподии с двумя особями — на верхушке дорсального усика и жабры (стрелки указывают на место расположения особей *Loxosomella apicalis*, наконечник стрелки указывает на выводковую камеру с развивающимся эмбрионом).

Обозначения: с — дорсальный усик нотоподии; em — развивающаяся личинка; g — жабра нотоподии; st — желудок; tp — верхушка дорсального усика нотоподии. Звездочками отмечены почки.

Table 1. Measurements of holotype (*), three paratypes (**) and five specimens (5–9) of *Loxosomella apicalis* sp.n. from another sampling site (μm).Таблица 1. *Loxosomella apicalis* sp.n. Размеры тела и число почек голотипа (*), трех паратипов (**) и пяти особей (5–9) из другой точки сбора (мкм).

Specimen	1*	2**	3**	4**	5	6	7	8	9
Total length	208	158	187	226	216	223	267	312	323
Calyx length	172	126	149	200	189	185	230	283	261
Calyx width in lateral view	116	89	78	149	125	103	134	203	144
Calyx width in frontal view	99	73	68	–	109	84	139	159	152
Stalk length	36	32	38	26	27	38	37	29	62
Stalk width	57	39	40	72	60	45	62	105	65
Amount of buds	5	2	2	6	5	3	1	0	3

Reproduction: Frontal budding area with 1–6 buds. Large buds with well-developed foot. Some specimens with prominent ovaries with several large oocytes. Some specimens with embryos developing in lateral brood chambers (Fig. 3D). Specimens with brood chambers have large roundish protrusions on each side of calyx (Fig. 3E, arrowhead). Brood chamber can be present only on one side of calyx, or two chambers can be located symmetrically on both sides. One embryo develops in each chamber.

Ecology: large number of entoproct specimens may occur on one host, so that they attached to tips of almost all dorsal cirri. Localization on tips of gills is less common. Two specimens of *L. apicalis* sp.n. can be present simultaneously on same parapodium: one on cirris, and one on gill (Fig. 3E). *L. apicalis* sp.n. occurs exclusively on tips of cirri and gills, and never were found on lateral surfaces of these organs or on any other parts of parapodia.

DIFFERENTIAL DIAGNOSIS:

Loxosomella apicalis sp.n. is the second solitary entoproct species described from the Laptev Sea. The first species was *Loxosoma cingulata* Kluge, 1946. Although this species was originally described in the genus *Loxosoma*, the description is insufficient to ascertain its

generic affinities, so Nielsen (1996) assumed its probable belonging to the genus *Loxosomella*. Considering this supposition the comparison between *L. apicalis* sp.n. and *L. cingulata* is reasonable. *L. cingulata* differs from *L. apicalis* sp.n. by larger body length (361 μm in average) and larger stalk (up to 102 μm , 81 μm in average), by number of tentacles (8–10) and by the presence of lateral wings with gland cells on the calyx. These two species also have different host animals, *L. cingulata* is an epibiont of bryozoan *Rhizophostomella costata* Lorenz, 1886, while *L. apicalis* sp.n. is associated with nephtyid polychaete *Aglaophamus malmgreni*.

Five species of Loxosomatidae besides *L. apicalis* sp.n. are epibionts of polychaetes from the family Nephtyidae (Table 2). Four species belong to genus *Loxosomella*. *Loxosomella scaura* Nielsen, 1964 differs from *L. apicalis* sp.n. by a larger body size (up to 900 μm), number of tentacles (10–14 tentacles), relatively long stalk, and the way of the attachment to the substrate. *Loxosomella brachystipes* Franzén, 1973 has larger body size (up to 500 μm), 6 to 12 tentacles, and two lateral budding areas on the calyx. *Loxosomella varians* Nielsen, 1964 is similar to *L. apicalis* sp.n. by morphology, although the specimens of *L. varians* can reach

Table 2. List of Loxosomatidae reported from Nephthyidae (Phyllozoa).

Таблица 2. Список видов Loxosomatidae, обитающих на многощетинковых червях семейства Nephthyidae (Phyllozoa).

Species	Total length (µm)	No. of tentacles	Budding area	Attachment structure	Host species	Localization on the host animal	Distribution, depths (m)	References
<i>Emschermannia ramificata</i>	165–335	8–10	frontal	basal plate with pseudostolons	<i>Aglaophamus malmgreni</i>	parapodia; groove between the notopodia and the neuropodia	Kara Sea, 25–472	Borisanova, 2016
<i>Loxosomella brachystipes</i>	426	6–12	lateral	Attachment disk	<i>Aglaophamus virginis</i>	parapodial gills	South Georgia, Cumberland Bay, 250	Franzén, 1973
<i>Loxosomella malakhovi</i>	160–225	8	frontal	roundish concaved disk	<i>Aglaophamus</i> sp.	parapodial gills	Sea of Okhotsk, 3296–3366	Borisanova et al., 2018
<i>Loxosomella scaura</i>	till 900	10–14	lateral	foot-like posterior expansion	<i>Nephtys paradoxa</i> , <i>N. incisa</i> , <i>N. hombergi</i>	parapodial setae	Skagerrak, Kattegat, 28–190	Nielsen, 1964, 1989
<i>Loxosomella varians</i>	300–750	8	frontal	Variable in shape, sometimes as expended attachment area	<i>Aglaophamus rubella</i> , <i>A. foliosus</i> , different species of <i>Nephtys</i>	parapodia; parapodial gills	Baltic Sea, North Sea, Weddell Sea, Bransfield Strait, 10–400	Nielsen, 1964, 1989; Emschermann, 1993
<i>Loxosomella apicalis</i> sp.n.	158–323	8	frontal	roundish disk, enclose the tip of the cirrus or the gill	<i>Aglaophamus malmgreni</i>	tips of the dorsal cirri or the gills за parapodia	Laptev Sea, 72–90	Our data

length of 750 μm and have a variable structure of the attachment organs. Morphology of *Loxosomella malakhovi* Borisanova, Chernyshev et Ekimova, 2017 is almost identical to morphology of *L. apicalis* sp.n. Both species are small, with 8 tentacles, frontal budding area and short stalk, although in *L. malakhovi* the stalk is slightly longer (in *L. malakhovi* stalk length varies from 30 to 60 μm , in average 46 μm ; in *L. apicalis* it varies from 26 to 62 μm , in average 36 μm). Both species are associated with polychaetes of the genus *Aglaophamus* Kinberg, 1865, but location on host's body is different in these two species. All the investigated *L. malakhovi* specimens were attached to the lateral surfaces of the gills, grasping the soft tissue of the gill with its attachment disk. *L. apicalis* sp.n. was never found on the surface of the gills, only on the tips of the gills and cirri. The geographical distribution of these species also differs: *L. apicalis* sp.n. lives in the shelf zone of the Laptev Sea, *L. malakhovi* is a deep-water species from the Sea of Okhotsk, described from the depths of 3296–3366 m.

Discussion

A unique feature of *L. apicalis* sp.n., which does not occur in any other described species of Entoprocta, is the location on the host's body. *L. apicalis* sp.n. attaches to the very tips of the gills and dorsal cirri of parapodia, grasping them with the base of the stalk. Other entoproct species can attach to the surface of parapodia as *Loxosomella akkeshiensis* (Yamada, 1956) or *L. aripes* Nielsen, 1964 or to parapodial gills, as for example, *Loxosomella perezi* (Bobin et Prenant, 1953), *L. varians* to the body surface of the polychaete, as *Loxosoma pectinaricola* Franzén, 1962, *L. rhodinicola* Franzén, 1962, *Loxosomella fagei* Bobin et Prenant, 1953. *Loxosomella* species living as epibionts of Polynoidae and Aphroditidae polychaetes, can attach to elytra (*L. obesa* (Atkins, 1932), *L. pseudocompressa* Konno, 1977). Some species attach to parapodial chaetae (*Loxosomella antis* Krylova, 1985, *L. scaura*). But *L. apicalis* sp.n. is the only species which attaches to the tips of the gills and cirri.

Polychaeta is one of the main groups of host animals for solitary entoprocts. More than 60 species of Loxosomatidae (42 species of *Loxosomella*, 24 species of *Loxosoma* and the only species of *Emschermannia*, *E. ramificata* Borisanova, 2016) are associated with polychaetes. Entoprocts can be found in tubes and on the body surface of both sessile and errant polychaetes from 15 families (Table 3). Species from the family Maldanidae are hosts for the largest number of loxosomatids. Twelve species of genus *Loxosoma* and six species of genus *Loxosomella* are epibionts of maldanid polychaetes, and most of them attach to the tubes of the host species. Relatively large number of species are also associated with polychaetes from family Terebellidae (one *Loxosoma* species and nine *Loxosomella* species), and only three of them are attached to the body surface, other live in tubes of the host animals. In general, most of epibiotic entoproct species are associated with sessile polychaetes (53 species). The host animals apparently provide loxosomatids with a safe environment and with water currents that bring suspended food particles (Nielsen, 1964; Iseto, 2005). Entoprocts, which associated with errant polychaetes, are most frequently attached to the parapodia, and apparently use water currents created by parapodia movement. The epibionts of the sedentary polychaetes obviously use the water current passing through the tubes. Probably, the current, created by sessile worms, is optimal for entoprocts. It is also necessary to take into account the physical opportunity for entoproct larvae to find a host and attach to it. It can be assumed that it is easier for the larva to get inside tubes of the sedentary polychaetes with water currents generated by host than try to attach themselves to the body of the errant worms.

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Table 3. List of families of Polychaeta, with which solitary Euprocta (family Loxosomatidae) are associated.
Таблица 3. Список семейств полихет, на которых обитают одиночные Euprocta семейства Loxosomatidae.

Family of Polychaeta	Species of Loxosomatidae	Localization on the host	References
Acoetidae	<i>Loxosomella bilocata</i> , <i>L. glandulifera</i> , <i>L. worki</i>	Chaetae, tubes	Franzén, 1962; Nielsen, 1966
Ampharetidae	<i>Loxosomella tonsoria</i>	Anterior segments and gills	Emschermann, 1993
Aphroditidae	<i>Loxosomella antedonis</i> , <i>L. claviformis</i> , <i>L. fagei</i> , <i>L. fauvei</i> , <i>L. globosa</i> , <i>L. obesa</i>	Body surface, chaetae, parapodia, ventral side of elytra	Bobin, Prenant, 1953b; Nielsen 1989; Emschermann, 1993
Capitellidae	<i>Loxosoma clapparedei</i> , <i>L. poculi</i> , <i>L. singulare</i> , <i>L. tetracheir</i> , <i>L. vatilli</i>	Body surface, tubes	Bobin, Prenant, 1953a; Nielsen 1996
Chaetopteridae	<i>Loxosomella neapolitana</i> , <i>L. marsypos</i>	Tubes	Kowalevsky, 1866; Nielsen, Ryland, 1961
Eunicidae	<i>Loxosomella marsypos</i> , <i>L. pistilli</i>	Tubes	Nielsen, Ryland, 1961; Konno, 1975
Maldanidae	<i>Loxosoma agile</i> , <i>L. annelidicola</i> , <i>L. axisadversum</i> , <i>L. davenporti</i> , <i>L. loxalina</i> , <i>L. monilis</i> , <i>L. nilseni</i> , <i>L. rhodinicola</i> , <i>L. saltans</i> , <i>L. significans</i> , <i>L. sam</i> , <i>L. spathula</i> , <i>Loxosomella decorata</i> , <i>L. elegans</i> , <i>L. kindai</i> , <i>L. polita</i> , <i>L. similis</i> , <i>L. triangularis</i>	Body surface, tubes	Franzén, 1962; Nielsen 1964, 1966, 1989, 1996, 2017; Konno, 1972, 1973; Krylova, 1985; Ppirc, 2001
Nephtyidae	<i>Emschermannia ramificata</i> , <i>Loxosomella brachystipes</i> , <i>L. malakhovi</i> , <i>L. scaura</i> , <i>L. varians</i> , <i>L. apicalis</i> sp.n.	Chaetae, parapodia surface, parapodial gills and cirri	Nielsen, 1964, 1989; Franzén, 1973; Emschermann, 1993; Borisanova, 2016; Borisanova <i>et al.</i> , 2018; our data
Onuphidae	<i>Loxosomella diopatricola</i>	Gills, dorsal body surface, notopodia	Williams, 2000
Pectinariidae	<i>Loxosoma fishelsoni</i> , <i>L. nung</i> , <i>L. pectinaticola</i> , <i>L. song</i> , <i>Loxosomella murmanica</i>	Body surface, gills, tubes	Bobin 1970; Nielsen, 1989, 1996
Polynoidea	<i>Loxosomella antis</i> , <i>L. compressa</i> , <i>L. harmeri</i> , <i>L. pseudocompressa</i>	Chaetae, cirri, elytra, parapodia	Konno, 1977; Krylova, 1985; Nielsen, 1989
Scalibregmatidae	<i>Loxosoma okudai</i>	Body surface	Yamada, 1956
Sigalionidae	<i>Loxosomella perezi</i>	Gills	Bobin, Prenant, 1953a
Spionidae	<i>Loxosomella aripes</i> , <i>L. sextentaculata</i>	Parapodia	Nielsen, 1964; Borisanova <i>et al.</i> , 2018
Terebellidae	<i>Loxosoma cubitus</i> , <i>Loxosomella akkeshiense</i> , <i>L. ampullae</i> , <i>L. bifida</i> , <i>L. collumnodi</i> , <i>L. diffigurata</i> , <i>L. follicicola</i> , <i>L. ornata</i> , <i>L. spiropedis</i> , <i>L. umeri</i>	Body surface, tubes	Yamada, 1956; Nielsen, 1964, 1966; Konno, 1972, 1974, 1976

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