
FAUNISTICS

Holothurians of the Genus *Molpadia* Risso, 1826 (Molpadiida: Molpadiidae) from the Shelf of Kamchatka and the Kurile Islands

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Abstract—Two species of holothurians of the order Molpadiida were found on the shelf of Kamchatka and the Kurile Islands: *Molpadia orientalis* (Saveljeva, 1933) comb. nov. and *M. roretzi* (von Marenzeller, 1877). Molpadiid holothurians were not previously recorded in waters near Kamchatka and the Kurile Islands. Brief descriptions of the morphology of the two species, distribution and ecology data, as well as figures depicting calcareous rings and body skin ossicles, are provided.

Keywords: Kamchatka, Kurile Islands, holothurians, Holothuroidea, Molpadiida, Molpadiidae, *Molpadia*, morphology, distribution, ecology

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INTRODUCTION

The order Molpadiida Haeckel, 1896 includes three families: Caudinidae Heding, 1931, Eupyrgidae Semper, 1868, and Molpadiidae J. Müller, 1850.

The species *Paracaudina chilensis* (Müller, 1850) belonging to the family Caudinidae was first reported by Saveljeva [8] as *Caudina chilensis* found in the Sea of Japan (to the south of Cape Peshchurov; in Patrokl Bay; in an area with coordinates 43°42' N, 135°02' E; at the entrance to Vladimir Bay) and in coastal waters of Sakhalin. In addition, this species was found in Busse Bay (Sakhalin Island), in storm casts at Petrov Island in Sokolovskaya Bay, in Vladimir Bay, and Peter the Great Bay (Kitovy Inlet). In the Russian-language literature, it is given under different names: *Paracaudina ransonnetii* (von Marenzeller, 1881) and *P. ransonetii* (von Marenzeller, 1881) [2–6, 9], which are synonyms of *Paracaudina chilensis*.

The second species *Eupyrgus pacificus* Ostergren, 1905 (family Eupyrgidae) was first found by Saveljeva [8] in Peter the Great Bay and in the northern Sea of Japan. It is also known from Sokolovskaya Bay and from coastal waters near Antonovo and Kholmsk (southwestern coast of southern Sakhalin) [2–4].

The third species *Molpadia roretzi* (von Marenzeller, 1877) belonging to the family Molpadiidae was recorded in the Tatar Strait and in the southern

Sea of Japan. It is given in the Russian literature as *Ankyroderma roretzii* (see [3, 4, 8]).

The fourth species *Molpadia orientalis* (Saveljeva, 1933) was described as *Trochostoma orientale* (the genus *Trochostoma* is a junior synonym of the genus *Molpadia* [14, 17, 18, 28]) from the Sea of Japan (Peter the Great Bay; Grossevich Bay; 50°30' N, 141°00' E). It was also recorded in the Tatar Strait to about 50° N [1, 3–5, 7, 8].

Molpadia musculus Risso, 1826, whose presence in Russian waters is doubted, was not found by Russian investigators and was only recorded by Ohshima [27] at the eastern coast of southern Sakhalin.

No representative of the order Molpadiida was recorded in the literature for the shelf of Kamchatka and the Kurile Islands. We found two species of molpadiids in this region for the first time: *Molpadia roretzi* (off southwestern and northeastern Kamchatka) and *M. orientalis* (off southern Kurile Islands).

MATERIALS AND METHODS

Material was collected during expeditions of the Zhirmunsky Institute of Marine Biology (IMB) of the Far East Branch, Russian Academy of Sciences (FEB RAS), Pacific Institute of Bioorganic Chemistry (PIBOC), Far East Branch, Russian Academy of Sci-

ences, Pacific Fisheries Research Center (PFRC), and Kamchatka Research Institute of Fisheries and Oceanography (KRIFO) (Fig. 1). Material is deposited at the Kamchatka Branch of the Pacific Institute of Geography, Far East Branch, Russian Academy of Sciences.

Samples of holothurians were photographed, their shapes and colors (natural and/or in alcohol-preserved specimens) were assessed, and their lengths and maximum diameters were measured.

Ossicles were prepared according to the standard protocol. Tissue samples were dissolved in tubes with Javelle water. Ossicles that precipitated on the tube bottom were washed, placed on a slide, and after drying embedded in Canada balsam. Slides were examined under a microscope. The image of ossicles was displayed on the screen of the computer using a Mikromed-2 light microscope and a DCM130 digital camera and recorded on the hard disk as a graphic file using the ScopePhoto software (v. 2.0.12.146).

In order to describe the calcareous ring, its elements were measured; the shape of the ring and characteristic features were drawn. A map of the distribution of holothurians was plotted using the CardMaster software (v. 4.1).

RESULTS AND DISCUSSION

Herein, *Trochostoma orientale* Saveljeva, 1933 is given as *Molpadia orientalis* (Saveljeva, 1933).

The genus *Trochostoma* was described in 1879 in the report of the results of the Norwegian polar expedition in the Norwegian language [15]. In 1882, among the expedition reports an issue dealing with holothurians was published that had parallel Norwegian and English texts and color tables [16].

Clark ([14], pp. 18–20) synonymized this genus, as well as the genus *Ankyroderma* that was described by Danielssen and Koren [15], with the genus *Molpadia* Cuvier, 1817. The genus *Ankyroderma* was erected for species that had anchors in the body skin. Clark, who investigated a large number of specimens, thought this feature not to be genus-specific and even species-specific. Therefore, he decided that *Ankyroderma* is a synonym of *Trochostoma*. The latter genus, in his opinion, is a synonym of the genus *Molpadia* Cuvier, 1817.

This point of view was accepted by subsequent investigators; however, in the early 1930s Heding [20] attempted a revision of molpadiids. In that preliminary publication, he subdivided molpadiids into three families: Molpadiidae J. Müller, 1850; Eupyrgidae Semper, 1868; and Caudinidae Heding, 1931. The author recognized five genera within the family Molpadiidae: *Molpadia* Cuvier, 1817; *Ankyroderma*

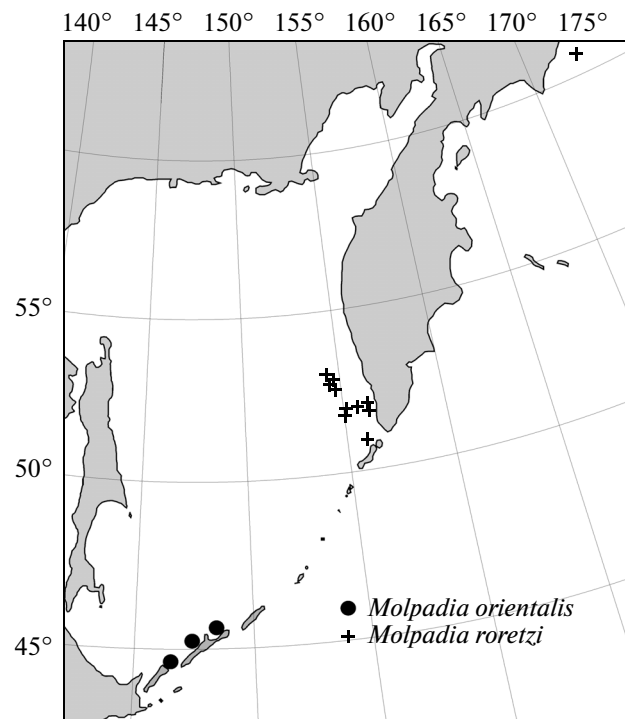


Fig. 1. A scheme of the stations where holothurians of the genus *Molpadia* were found.

Danielssen et Koren, 1879; *Pseudomolpadia* Heding, 1931 (since this name was preoccupied, in the following year it was substituted with *Paramolpadia* Heding, 1932 [21] and in 1935 lowered in rank to a subgenus within the genus *Molpadia* [22]); *Haplodactyla* Grube, 1840; and *Trochostoma* Danielssen et Koren, 1878. Heding finally published his system of Molpadioidea in 1935. In that work, he provided diagnoses of the genera based mainly on the structure of the pharyngeal ring and sclerites and described a new genus *Eumolpadia* Heding, 1935 within this family. The genus *Paramolpadia* was suggested to be considered as a subgenus of *Molpadia*, and the genus *Haplodactyla* was placed in the family Caudinidae.

Saveljeva [8] was familiar with the works by Heding and accepted his view on the system of molpadiids; therefore, the description of *Trochostoma orientale* Saveljeva, 1933 a new species within the genus *Trochostoma* was quite understandable.

A criticism of the Heding's system was put forward by Deichmann [17], who shared the view of Clark and considered all genera proposed by Heding to be synonyms of the genus *Molpadia*. In an account on Antarctic molpadiids, Pawson [28] accepted the viewpoint of Clark and Deichmann but without any argu-

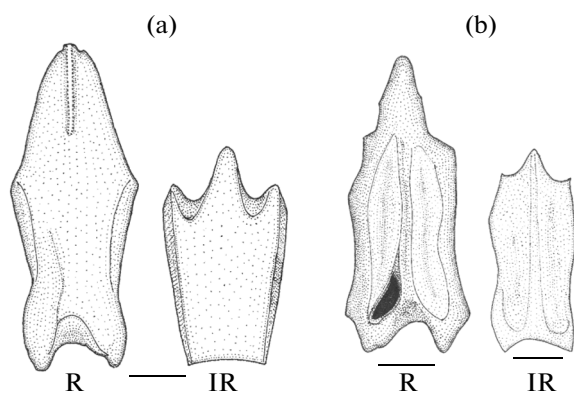


Fig. 2. A calcareous pharyngeal ring. (a) *Molpadia orientalis*; (b) *Molpadia roretzi*. R, radial plate; IR, interradiat plate. Scale 1 mm.

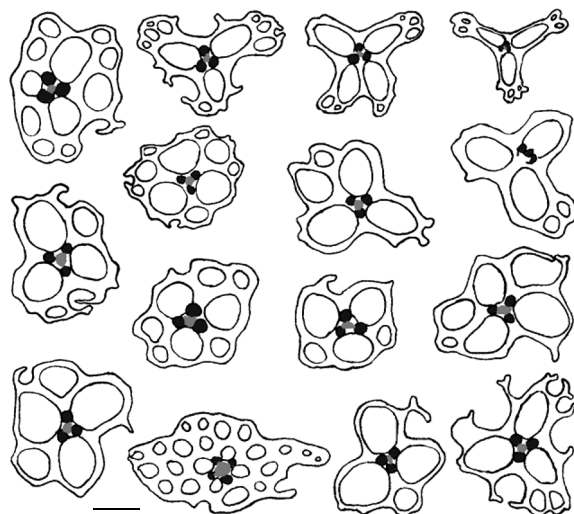


Fig. 3. *Molpadia orientalis*. “Tables” of body skin, top view. Scale 100 μ m.

ments for it. After that, Clark’s viewpoint eventually triumphed.

Below are descriptions of the species of molpadiids we found. The structure of skeletal elements is analyzed in greater detail, because the previous descriptions do not allow a complete representation of the composition and structure of the ossicles, as well as the structure of the calcareous ring.

Molpadia orientalis (Saveljeva, 1933) comb. nov.

Trochostoma orientale [8]: 41–43, Figs. 8–11; [3]: 76–77, Figs. 121, 122; [7]: 183–185; [4]: 376; [1]: 118; [5]: 26, Fig. 2.

Material. July 7, 2011, R/V *Akademik Oparin*, 41st cruise, trawl haul no. 1, stn. 3, Kurile Islands, 44°36.62′–44°36.6′ N, 146°26.35′–146°25.9′ E, depth 180–200 m, sand, gravel, coll. V.I. Kharlamenko and K. Minin (three specimens). July 10, 2011, R/V *Akademik Oparin*, 41st cruise, trawl haul no. 7, stn. 11, Kurile Islands, 45°14.58′–45°15.0′ N, 147°24.69′–147°24.96′ E, depth 490–242 m, coll. K. Minin (one specimen). July 24, 2011, R/V *Akademik Oparin*, 41st cruise, trawl haul no. 46, stn. 53, Kurile Islands, 45°38.35′–45°39.15′ N, 148°23.9′–148°24.1′ E, depth 450 m, silty sand, coll. K. Minin (one specimen).

Description. The body is barrel-shaped, up to 135 mm long, with a well-defined tail. The color is gray with red speckles. Tentacles, 15.

The sculpture of the outer surface of the calcareous ring is indistinct, only the canals of ampoules are visible (Fig. 2a). Skin ossicles of the body appear as tables, whose disk usually has three large loops in the middle and a large number of small loops at the periphery (branching is very plentiful). The disk carries in its center a fairly high spire consisting of three pillars connected by crossbeams (Figs. 3, 4a). Skin ossicles of the tail are usually fusiform rods, generally with a moderately broadened middle part and openings, of which the third and the fourth are larger than the others. In the center of the plate, there are, in most cases, three projections merging into a short pillar. Sometimes, the projections are absent or do not form a pillar (Figs. 4b, 5). Red phosphatic bodies in the skin are few. Anchors and rosettes are absent.

Geographical distribution. *M. orientalis* is known from the Sea of Japan (Peter the Great Bay; Grosse-ich Bay; 50°30′ N, 141°00′ E) and from the Tatar Strait to about 50° N; we found it was first off the Kurile Islands (Fig. 1).

Vertical distribution. It is a subtidal-bathyal species, previously recorded from 17 to 340 m, we found at depths to 450 m.

Distribution by substrates. Predominantly silty substrates, including clayey silts; sometimes, sands and gravel.

Temperature and salinity. In Peter the Great Bay, this species was recorded at temperatures from –1.13 to 5.07°C (optimum from –1.01 to 3.42°C) and at a salinity of 33.71–34.11 vol ‰ [7].

Molpadia roretzi (von Marenzeller, 1877)

Haplodactyla roretzii [24]: 29, Taf. IV, Fig. 1.

Ankyroderma roretzii [25]: 124–126, Taf. IV, Fig. 4; [30]: 49; [11]: 41; [26]: 267, pl. VIII, Fig. 78, textfig. 55; [20]: 248; [8]: 40–41; [3]: 76, Fig. 119; [4]: 376.

Ankyroderma simile [30]: 40–41, pl. 2, Fig. 5, pl. 11, Fig. 2.

Molpadia similis [14]: 163, pl. 10, Fig. 6.

Molpadia roretzii [14]: 163; [27]: 249; [19]: 155–190.

Molpadia chinensis [12]: 26, text Figs. 13, 14, pl. 3, Fig. 2.

Molpadia roretzi [12]: 23, text Figs. 11, 12, pl. 3, Fig. 1; [13]: 44; [29]: 374; [23]: 523–524, Fig. 320.

Material. 13.10.1987, R/V *Tikhookeanskiy*, stn. 483, sample no. 1344, Shumshu Island, dredge, Okhotsk Sea coast, 50°58.5' N, 156°04' E, depth 200 m, sand, shell debris, coll. V.I. Lukin and Grebelnyi (one specimen). September 25, 1998, R/V *Ametist*, Sea of Okhotsk, 52°46'–52°41' N, 154°32'–154°40' E, depth 310 m, coll. P.S. Vasilyev (one specimen). July 19, 2008, R/V *TINRO*, 29th cruise, trawl haul no. 11, Bering Sea, 60°40.3'–60°35.0' N, 173°28.0'–173°30.5' E, depth 544 m, coarse sand, small pebbles, coll. V.G. Stevanov (one specimen). July 26, 2009, R/V *Professor Kizevetter*, 27th cruise, trawl haul no. 27, Sea of Okhotsk, 51°49.3'–51°50.1' N, 156°19.8'–156°17.9' E, depth 60–61 m, sand, coll. T.B. Morozov (one specimen). July 27, 2009, R/V *Professor Kizevetter*, 27th cruise, trawl haul no. 31, Sea of Okhotsk, 51°59.1'–52°00.7' N, 156°14.7'–156°13.4' E, depth 51 m, coarse sand, coll. T.B. Morozov (1 specimen). July 27, 2009, R/V *Professor Kizevetter*, 27th cruise, trawl haul no. 34, Sea of Okhotsk, 52°00.2'–51°58.8' N, 155°44.5'–155°45.7' E, depth 92–93 m, pebbles, coll. T.B. Morozov (six specimens). July 27, 2009, R/V *Professor Kizevetter*, 27th cruise, dredge haul no. 9, Sea of Okhotsk, 51°57.05'–51°59.06' N, 155°08.47'–155°08.46' E, depth 250 m, shell debris, silty sand, coll. T.B. Morozov (one specimen). August 3, 2009, R/V *Professor Kizevetter*, 27th cruise, dredge haul no. 25, Sea of Okhotsk, 53°03.2'–53°03.3' N, 154°25.4' E, depth 296 m, silt, coll. T.B. Morozov (17 specimens). March 26, 2010, *Sapfir-1*, trawl haul no. 151, Sea of Okhotsk, 52°35.4' N, 154°40.2' E, depth 300 m, coll. V.G. Stepanov (1 specimen). March 29, 2010, *Sapfir-1*, trawl haul no. 165, Sea of Okhotsk, 52°54.7'–52°45.2' N, 154°40.5'–154°45.6' E, depth 420 m, coll. V.G. Stepanov (two specimens). April 7, 2010, *Sapfir-1*, trawl haul no. 202, Sea of Okhotsk, 52°46.4'–52°57.0' N, 154°44.1'–154°37.9' E, depth 240 m, coll. V.G. Stepanov (one specimen). April 10, 2010, *Sapfir-1*, trawl haul no. 208, Sea of Okhotsk, 52°53.6'–52°47.0' N, 154°36.8'–154°40.0' E, depth 260 m, coll. V.G. Stepanov (one specimen). April 24, 2010, *Sapfir-1*, trawl haul no. 254, Sea of Okhotsk, 51°48.9'–51°46.4' N, 155°07.9' E, depth 307 m, coll. V.G. Stepanov (one specimen). August 7, 2011, R/V *TINRO*, trawl haul no. 192, Sea of Okhotsk,

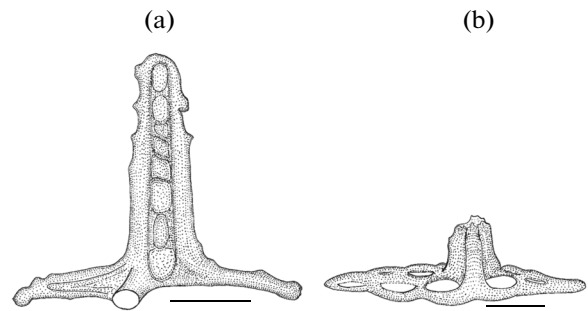


Fig. 4. *Molpadia orientalis*. (a) “table” of body skin, side view; (b) “table” of tail skin, side view. Scale 100 µm.

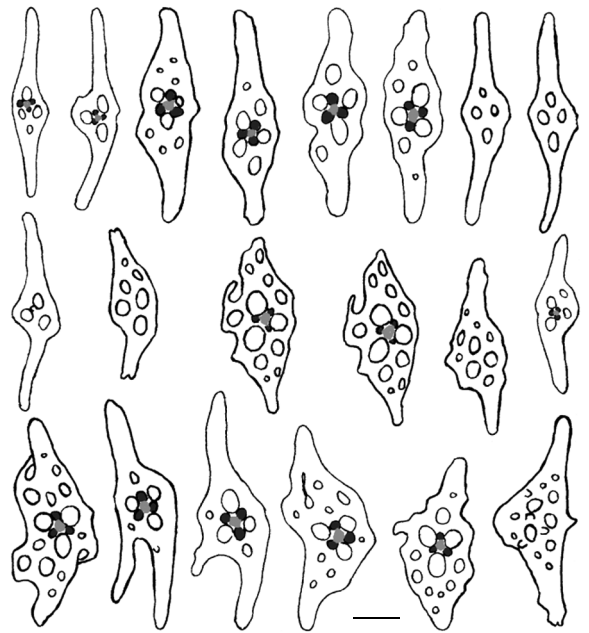


Fig. 5. *Molpadia orientalis*. Tail skin ossicles, top view. Scale 100 µm.

52°46.9'–52°44.5' N, 154°37.5'–154°37.9' E, depth 291 m, sand, coll. T.B. Morozov (one specimen).

Description. The body is fusiform, up to 135 mm long, usually with a well-defined tail. The color is dark violet or gray, with numerous red speckles. Tentacles 15.

The outer surface of the calcareous ring has a deep and rough structure (Fig. 2b). There are four types of body skin ossicles. The predominant type resembles tables, whose disk has branched curved processes often joining at the periphery and a high spire in the center (Figs. 6a, 7a). Large reticulated plates with numerous openings are infrequently found (Fig. 6b). In addition,

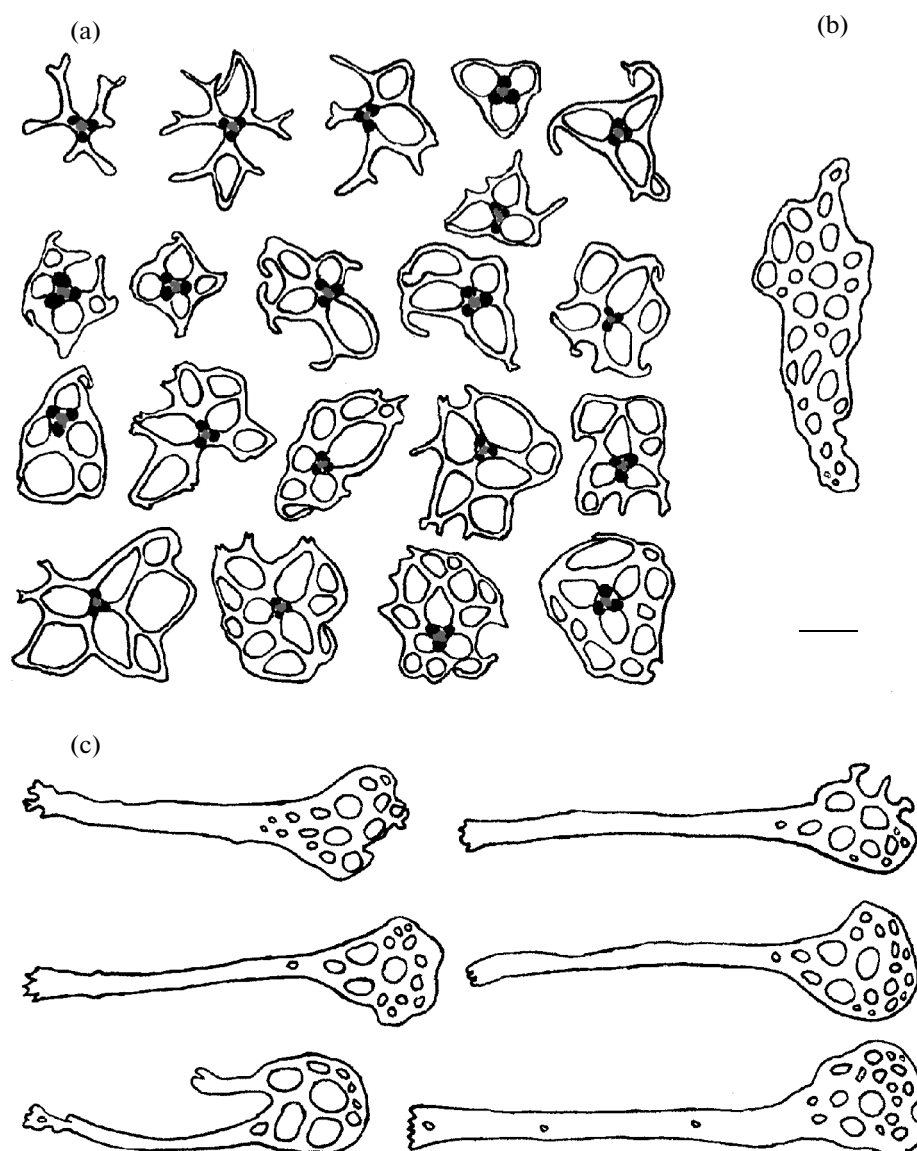


Fig. 6. *Molpadia roretzi*. Body skin ossicles. (a) "Tables", top view; (b) reticulated plate; (c) racquet-shaped plates. Scale 100 μ m.

there sometimes may be anchors (which we did not find) set on the rosettes consisting of five to six elongated racket-shaped ossicles (Fig. 6c). Skin ossicles of the tail are fusiform rods or their derivatives, with a greatly broadened middle part and openings, of which three to four are larger than the others. A high central spire consisting of three to four pillars is present (Figs. 7b, 8). Numerous red phosphatic bodies are present in the body skin.

Geographical distribution. Previously, *M. roretzi* was known from the southern coast of Japan to the South China Sea as far as Philippines. In Russian water, it was found in the Tatar Strait. We first recorded

this species off the southwestern and northeastern coast of Kamchatka (Fig. 1).

Vertical distribution. Subtidal–bathyal, from 44 to 620 m.

Distribution by substrates. It is an euryedaphic species but prefers silty and sandy substrates.

The finding of representatives of the order Molpadata in waters off Kamchatka and the Kurile Islands significantly contributes to the data on their distribution in the Russian Far Eastern seas. Representatives of the genus *Molpadia* were also found in Avacha Bay (southeastern coast of Kamchatka); however, because

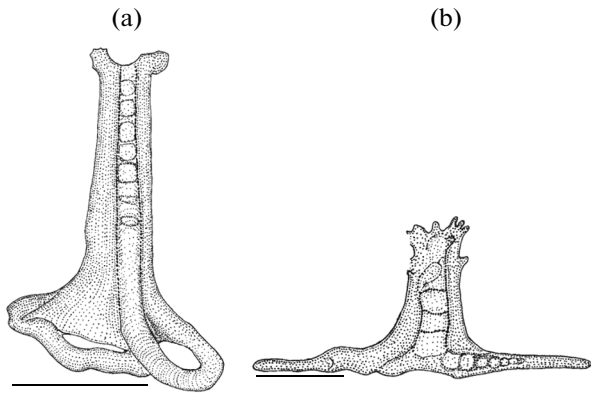


Fig. 7. *Molpadia roretzi*. (a) "table" of body skin, side view; (b) "table" of tail skin, side view. Scale 100 μ m.

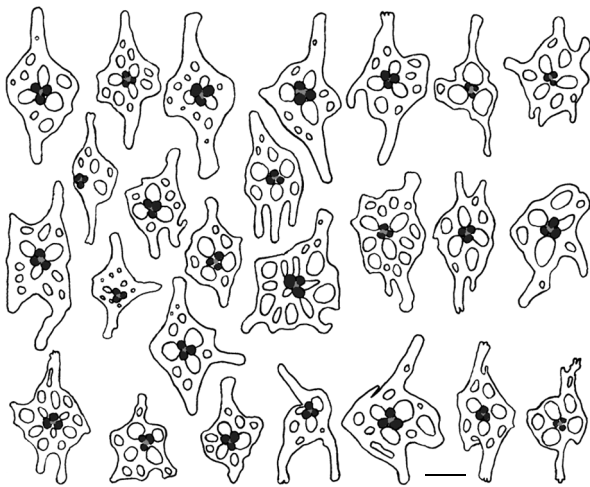


Fig. 8. *Molpadia roretzi*. "Tables" of tail skin, top view. Scale 100 μ m.

of the poor preservation of the material their identification was impossible [10].

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