Zootaxa 4337 (4): 563–572
http://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4337.4.7
http://zoobank.org/urn:lsid:zoobank.org:pub:DDD0CDFE-C748-4FCD-9065-E643E16261BF

Scoliorhapis stepanovi—new species of sea cucumber from the North-West Pacific (Holothuroidea: Synaptida: Chiridotidae: Taeniogyrinae) and some remarks on the genus *Scoliorhapis*

ALEXEY V. SMIRNOV[1,3], ELENA G. PANINA[2], NADEZHDA P. SANAMYAN[2] & KAREN E. SANAMYAN[2]

[1]*Zoological Institute Russian Academy of Sciences, Universitetskaya nab., 1, St. Petersburg, 199034, Russia. E-mail: sav_11@inbox.ru*

[2]*Kamchatka Branch of Pacific Geographical Institute, Far-Eastern Branch of Russian Academy of Sciences, Partizanskaya str., 6, Petropavlovsk-Kamchatsky, 683000, Russia. E-mail: panina1968@mail.ru; nadya@sanamyan.com; ascidiacea@sanamyan.com*

[3]*Correspondence author*

Abstract

New species *Scoliorhapis stepanovi* has been collected from depths of 10–23 m on the sandy bottom of Avacha Bay (east coast of Kamchatka), Paramushir Island (North Kuril Islands), and Matua Island (Middle Kuril Islands). It is unique in having sigmoid ossicles in the body wall with points at both ends (without an open-eye, and with the two points lying in a perpendicular plane). Such sigmoids do not occur in any other taeniogyrinid species. The two-pointed sigmoids are 80–115 μm in length, and are scattered in the body wall and not clustered. Probably the two-pointed sigmoids are underdeveloped typical sigmoid with open-eye. In the tentacles there are straight and C-shaped rods, sometimes branched at the ends, 70–90 *μ*m in length. It is assumed that atypical two-pointed sigmoid ossicles may have been originated due to deviating from the usual course of sigmoid development in the middle stages. *Scoliorhapis stepanovi* resembles *S. lindbergi*. A key for species of *Scoliorhapis* is provided.

Key words: Avacha Bay, Kamchatka Peninsula, Paramushir Is., Matua Is., Kuril Is., key, map

Резюме

Описан новый вид голотурий *Scoliorhapis stepanovi* (отряд Synaptida, подотряд Synaptina, семейство Chiridotidae, подсемейство Taeniogyrinae) из Авачинского залива (восточная Камчатка), острова Парамушир (северные Курильские острова) и острова Матуа (средние Курильские острова). Вид обнаружен на глубинах 10–23 м, на песчанистом грунте. Новый вид отличается от всех остальных видов подсемейства Taeniogyrinae строением склеритов кожи тела в виде сигмоидов, имеющих жала на обоих концах (незамкнутое кольцо на одном из концов отсутствует, а вместо него сигмоид имеет второе жало; оба жала расположены в перпендикулярных друг другу плоскостях). Двузаостренные сигмоиды длиной 80–115 мкм лежат в стенке тела поодиночке и не собраны в группы. Скорее всего, двузаостренные сигмоиды являются видоизмененными типичными сигмоидами. Возможно, что атипичные двузаостренные сигмоиды могли возникнуть из-за отклонения от обычного хода развития, характерного для типичных сигмоидов, на средних стадиях. В щупальцах прямые или С-образные палочки, иногда ветвящиеся на концах, длиной 70–90 мкм. Новый вид наиболее близок к виду *S. lindbergi.* Приведен ключ для определения видов рода *Scoliorhapis.*

Ключевые слова: Авачинский залив, Камчатский полуостров, о. Парамушир, о. Матуа, Курильские о-ва, определительный ключ, карта

Accepted by M. Eleaume: 4 Sept. 2017; published: 20 Oct. 2017

Introduction

In recent years the Kamchatka Branch of the Pacific Geographical Institute of the Far-Eastern Branch of the Russian Academy of Sciences (Petropavlovsk-Kamchatsky) has investigated the benthic fauna of Avacha Bay and Matua Is. (Middle Kurile Is.) by scuba diving. Among the samples collected during these surveys were some small synaptid holothurians with distinctive two-pointed sigmoid-like ossicles in the body wall. The ossicles have the typical sigmoid hook shape with ends lying in a perpendicular plane, but instead of an open-eye at one end, they have a second point. Typical sigmoid hooks were not found in the body wall. Many specimens with two-pointed sigmoids in the body wall were found, confirming it as a new species described below. All other morphological and anatomical characters, including the form of the tentacles, ciliated funnels and the absence of wheel ossicles in the body wall indicate that the new species belongs to the genus *Scoliorhapis* of the subfamily Taeniogyrinae (family Chiridotidae) (Smirnov, 1998; 2012). Two additional specimens from Paramushir Is. (North Kuril Is.) belonging to the new species have been found in the collection of the Zoological Institute of the Russian Academy of Sciences (St. Petersburg).

Methods

Photos of living specimens were taken by Karen Sanamyan. Ossicles obtained from specimens were firstly cleared from associated soft tissue with bleach. They were then washed using distilled water and 70% ethanol, air-dried, and mounted on a microscope slide in Canada balsam. Ossicles were photographed through a "Micromed 2" microscope with a Scopetek DCM130E digital camera. The specimens are deposited in the collections of the Zoological Institute of the Russian Academy of Sciences (St Petesburg) (ZIN).

Systematic account

Suborder Synaptina Al. Smirnov, 1998

Diagnosis (after Smirnov, 2012). Segments of calcareous ring lacking large anterior processes; excavations for tentacular ampullae occurring on the external side of the ring. Madreporite is situated at the end of a long stone canal far from the ambulacral ring. Ciliated funnels present. One to many Polian vesicles. Five pairs of statocysts located at the place where radial nerves extend from the neural ring. Ossicles: chiridotid wheels and/or sigmoids or anchors and anchor plates; wheels of larvae and juveniles with flat hub and large number of spokes.

Family Chiridotidae Östergren, 1898

Diagnosis (after Smirnov, 2012). Synaptina with 10, 12 or 18 peltato-digitate, pinnate, or secondarily simple tentacles with single pair of digits on the tip. Ossicles: chiridotid wheels and/or sigmoids; chiridotid wheels with six spokes, numerous small denticles on the inner rim and complex hub; the lower side of each spoke branches toward the lower side of the egg-shaped hub to form a star-shaped structure in the centre; the tentacles and the body wall also contain rod-like ossicles with branching ends.

Subfamily Taeniogyrinae Al. Smirnov, 1998

Diagnosis (after Smirnov, 2012). Chiridotidae with 10 or 12 tentacles. Radial segments of calcareous ring lacking perforations for the nerve but sometimes with notch on anterior (upper) surface. Ossicles: chiridotid wheels and/or only sigmoids.

Genus *Scoliorhapis* H.L. Clark, 1946

Scoliorhapis H. L. Clark, 1946: 461.—Rowe in Rowe and Gates, 1995: 267.—Smirnov, 1998: 519.—O'Loughlin and VandenSpiegel, 2010: 76.—Solis-Marin *et al.*, 2014: 324.
Scoliodotella Oguro, 1961: 2.
Scoliodota Heding, 1928: 319 (junior homonym of *Scoliodota* H. L. Clark, 1908).

Diagnosis (after H. L. Clark, 1946 and O'Loughlin and VandenSpiegel, 2010, emended here).

Taeniogyrinae with 10 or 12 peltato-digitate tentacles, each with up to 8 pairs of digits. Single polian vesicle. Intestine without loop. Ossicles: body wall ossicles sigmoid hooks or two-pointed sigmoids only; sigmoid hooks and two-pointed sigmoids scattered but some clastered or aligned; wheels lacking in body wall; tentacle ossicles bracket-shaped or rods.

Type species. Scoliodota theelii Heding, 1928 (Eastern Australia, from Port Denison (North Queensland) till Port Davis Creek (Spencer Gulf, South Australia), Tasmania, Rottnest Is. (Western Australia), 0–5 m..

Other species. Scoliorhapis biopearli O'Loughlin and VandenSpiegel, 2010 (Scotia Sea, South Shetland Is., 1544 m); *Scoliorhapis dianthus* Solis-Marin *et al.*, 2014 (Sea of Japan, Sado Is., 0.5–1 m); *Scoliodota lindbergi* Djakonov in Djakonov, Baranova and Saveleva, 1958 (North Japan Sea, Hokkaido, South Sakhalin, South Kurile Is, 0–65 m); *Scoliorhapis massini* O'Loughlin and VandenSpiegel, 2010 (Scotia Sea, Shag Rocks, 206 m; Falkland Islands, 118 m,); *Scoliorhapis stepanovi* sp. nov. (East Kamchatka, Avacha Bay, North Kuril Is., Paramushir Is., Middle Kurile Is., Matua Is., 10–24 m).

Remarks. H. L. Clark (1908) established the new monotypic genus *Scoliodota* for *Chiridota japonica* v. Marenzeller, 1881, described from Japan. According to v. Marenzeller (1881) description this species had only sigmoid hooks that were clustered in the papillae. Clark used the following characters to diagnose the new genus *Scoliodota*: "Tentacles 10. Digits 10 or more. Wheels wanting; calcareous particles sigmoid bodies only, commonly arranged in groups" (Clark, 1908: 125). Clark had no Japanese specimens on hand but following Théel (1886) assigned a specimen from Port Jackson, Australia that he had studied to this species: "There is a single specimen in the collection, one of those taken by the "Challenger" at Port Jackson, New South Wales, and already described by Théel. There can be no doubt that wheels are entirely wanting" (Clark, 1908: 30).

Ohshima (1913, 1914) studied synaptids from Misaki, near the type locality of *Chiridota japonica* v. Marenzeller, 1881, and found that synaptids with sigmoid hooks clustered in papillae as described for *Scoliodota japonica* (v. Marenzeller, 1881) also had wheels in the body wall, which "…are extremely infrequent, though near the base of tentacles they can be found without much difficulty" (Ohshima, 1914: 480; see drawings of the wheels in Ohshima, 1913: 260, text-figs. C, D; pl. 6, fig. 1). Ohshima thus concluded that this species could be transferred to *Trochodota* and *Scoliodota* Clark, 1908 thus was synonymized with *Trochodota* Ludwig, 1892. Clark agreed (Oguro, 1961), and the final list of holothurians collected by the "Albatross" in the Northwestern Pacific during the summer 1906 included *Trochodota japonica* (v. Marenzeller, 1881) (Ohshima, 1919: 149).

Clark (1921: 164) continued the synonymization of his genus *Scoliodota* with *Trochodota*.

Rowe (1976) transferred *Trochodota japonica* to *Taeniogyrus* Semper, 1867, so *Scoliodota* became a synonym of *Taeniogyrus*.

Heding (1928) studied specimens from Port Jackson, Australia, determined earlier as *Chiridota/Scoliodota japonica* by Théel (1886) and Clark (1908), but found no wheels in the body wall. He described these as a new species, *Scoliodota theeli*, characterized by the presence in the body wall of sigmoid hooks only, clustered in body wall papillae. Heding resurrected *Scoliodota* Clark and designated *S. theeli* as the type species of the restored genus. Heding's (1928: 319) diagnosis was: "Tentacles ten, peltated, digitate. Wheels wanting; calcareous deposits in the skin sigmoid bodies only. In the tentacles rods may occur. Calcareous ring bilaterally symmetrical. Polian vesicle and stone-canal single". He did not refer to the arrangement of the sigmoid hooks, whether scattered or clustered. Because *Scoliodota* was already typified through monotypy by Clark (1908), Heding's type designation was not valid. Clark (1946) suggested a new genus name *Scoliorhapis* for *Scoliodota* sensu Heding, 1928 (non Clark, 1908) with the type species *Scoliodota theeli* Heding, 1928.

Djakonov (in Djakonov, Baranova and Saveljeva, 1958) described *Scoliodota lindbergi* from the South Sakhalin and South Kuril Islands, with only scattered sigmoid hooks in the body wall. Evidently Djakonov was unaware of Clark's 1946 monograph, and used Heding's interpretation of *Scoliodota*.

Three years later Oguro (1961) described the new genus and species *Scoliodotella uchidai* from Hokkaido,

with sigmoids hooks only in the body wall, scattered and not clustered. He also appeared to have been unaware of Clark's 1946 monograph and did not refer to *Scoliorhapis*. He also was unaware of Djakonov's paper published in Russian and did not compare his new species with Djakonov's. Oguro (1961) differentiated his new genus *Scoliodotella* from *Scoliodota* (sensu Heding, 1928) in having scattered rather than clustered sigmoid hooks, although Heding did not mention the arrangement of hooks in diagnosis of *Scoliodota.*

Levin (1982) synonymized *Scoliodotella uchidae* with *Scoliodota lindbergi*. He followed Oguro's opinion that the arrangement of sigmoid hooks in the body wall (scattered or clustered) is a character of the genus level, which distinguishes *Scoliodotella* and *Scoliodota* sensu Heding, 1928. Levin referred *Scoliodota lindbergi* to the *Scoliodotella*.

O'Loughlin & VandenSpiegel (2010) described two new species of *Scoliorhapis* from the Scotia Sea—*S. biopearli* and a 12-tentacled species *S. massini*. Unfortunately, poor preservation of specimens precluded detailed study of the internal anatomy and calcareous ring structure of these species. These authors considered that scattering or clustering of sigmoid hooks is not a genus level character and synonymized *Scoliodotella* with *Scoliorhapis*. They emended the diagnosis *Scoliorhapis* to include species with scattered as well as those with grouped sigmoid hooks, and with 10 and 12 tentacles.

Inoue & Kajihara (2012) re-described *Scoliorhapis* specimens from Akkeshi Bay, Hokkaido, Japan (the type locality of *Scoliodotella uchidai*) and confirmed Levin's synonymization of this species with *Scoliorhapis lindbergi*.

Solis-Marin *et al.* (2014) described a new *Scoliorhapis* species, *S. dianthus*, from the side of Niigata, Honshu Is., Sea of Japan.

Together with *Scoliorhapis stepanovi*, n. sp. described below, *Scoliorhapis* now contains 6 valid species.

O'Loughlin & VandenSpiegel (2010: 76) emended the diagnosis of *Scoliorhapis*, to include species with 12 tentacles. However, the same authors, distinguished two genera of Taeniogyrinae, *Taeniogyrus* Semper, 1867 and *Sigmodota* Studer, 1876, based on tentacle number and correspondingly the structure of the calcareous ring: 10 in *Taeniogyrus* and 12 in *Scoliodota*. In our opinion, the number of tentacles in the Synaptida is a "good" character at the genus level, although reduction from 12 to 10 may have taken place independently in different clades (Smirnov, 2015). Thus we retain the 12-tentacled species *Scoliorhapis massini* to *Scoliorhapis* with reservation. Future study may show this species should be referred to a new genus or perhaps *Sigmodota* pending a latter revision.

***Scoliorhapis stepanovi* Al. Smirnov and Panina sp. nov.**

Fig. 1, A–G, I; Fig. 2; Fig. 3, A–C; Fig. 4 (map); key.

Taeniogyrinae gen. sp.—Stepanov *et al.*, 2012: 15, fig. 1, 2.

Material examined. Holotype—13.09.2010, East Kamchatka, Avacha Bay, Is. Starichkov, 52.7793, 158.6225, depth 10–11 m, bottom—boulders, stones, muddy gravel with shells, bottom temperature 6°C, diving collection by Sanamyan NP, ZIN No. 1/23624.

Paratypes—7 specimens, collected together with holotype, ZIN No. 2/23625.

Other investigated samples—11.09.2008, East Kamchatka, Avacha Bay, Viluchinskaya Bay, La Pérouse Stones, [52.6160, 158.5055], 20 m, sand sample, t 13°C, diving collection by Sanamyan NP, 1 specimen; 18.10.2008, East Kamchatka, Avacha Bay, Is. Starichkov, 52.7727, 158.6154, 21–23 m, t 6°C, diving collection by Sanamyan NP, 1 specimen; 18.07.2010, East Kamchatka, Avacha Bay, Viluchinskaya Bay, La Pérouse Stones, 52.6160, 158.5055, 10 m, sand with shells, boulders, t 9°C, diving collection by Sanamyan NP, 1 specimen; 13.09.2010, East Kamchatka, Avacha Bay, Is. Starichkov, 52.7793, 158.6225, 10–11 m, muddy gravel, stones, boulders, diving collection by Sanamyan NP, 1 specimen; 13.09.2010, East Kamchatka, Avacha Bay, Is. Starichkov, 52.7746, 158.6115, 20 m, gravel with shells, stones, boulders, t 1°C, diving collection by Sanamyan NP, 1 specimen; 26.09.2010, East Kamchatka, Avacha Bay, Is. Starichkov, 52.7737, 158.6198, 24 m, gravel and sand with shells, stones, boulders, t 8°C, diving collection by Sanamyan NP, 1 specimen; 21.07.2011, East Kamchatka, Is. Starichkov, 52.7747, 158.7108, 24 m, sand with shells, stones, boulders, rock, t 2°C, sand sample, diving collection by Sanamyan NP, 1 specimen; 16.07.2014, East Kamchatka, Avacha Bay, Listvinichnaya Bay,

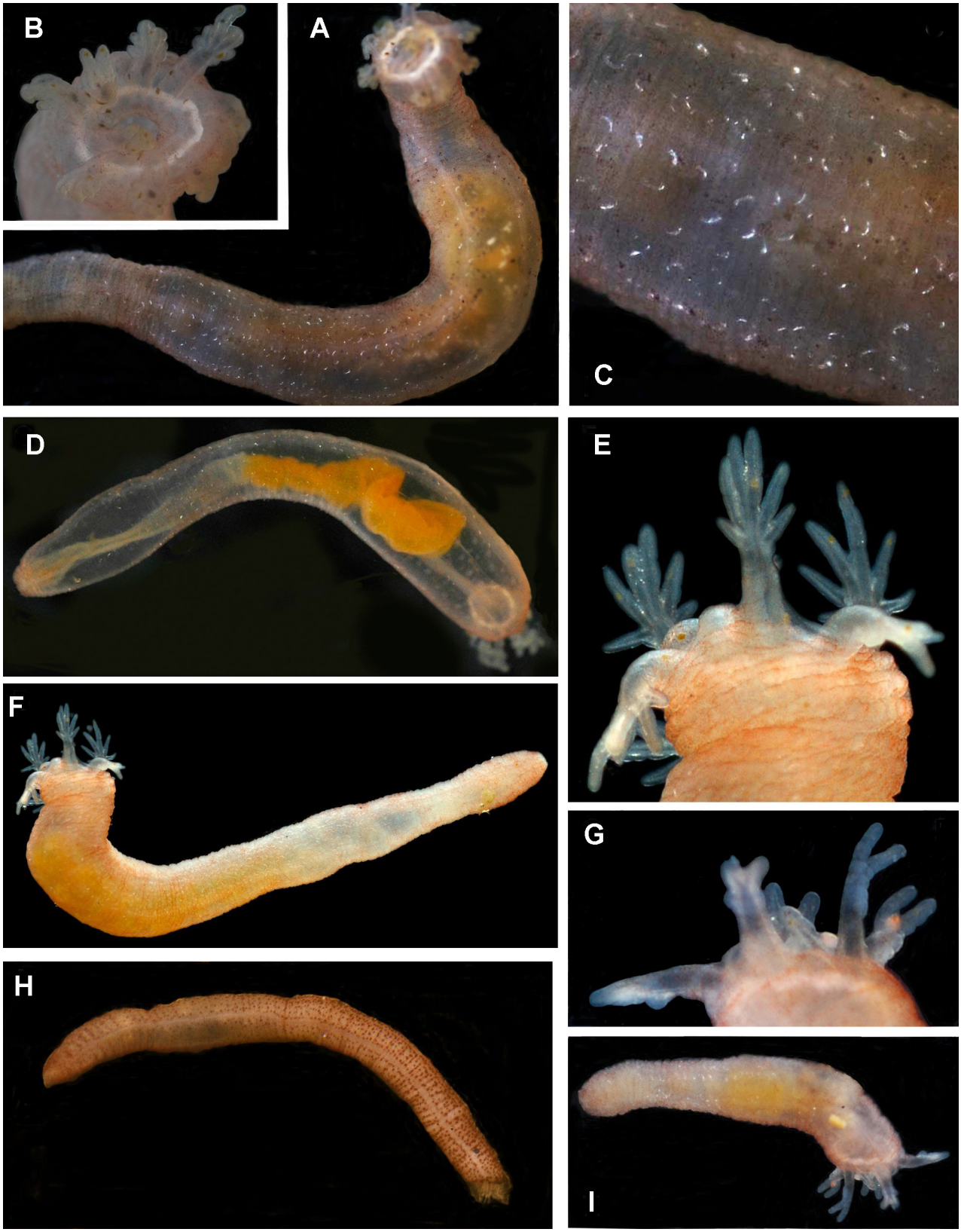

FIGURE 1. *Scoliorhapis stepanovi* **n. sp.** (A–G, I, photos by K.E. Sanamyan) and *S. lindbergi* (H, photo by A.V. Smirnov). A—*S. stepanovi*, external view, with clearly visible arrangement of sigmoids in the body wall and calcareous ring; B—*S. stepanovi*, head part of the body (tentacles and calcareous ring); C—*S. stepanovi*, arrangement of the sclerites in the body wall; D—*S. stepanovi*, small relaxed specimen; with intestine without loops clearly visible through the body wall; E—*S. stepanovi*, tentacles (detail F); F—*S. stepanovi*, external view; G—*S. stepanovi*, tentacles of a juveniles specimen with one pair of digits (detail I); H—*S. lindbergi*, external view; I—*S. stepanovi*, juvenile specimen.

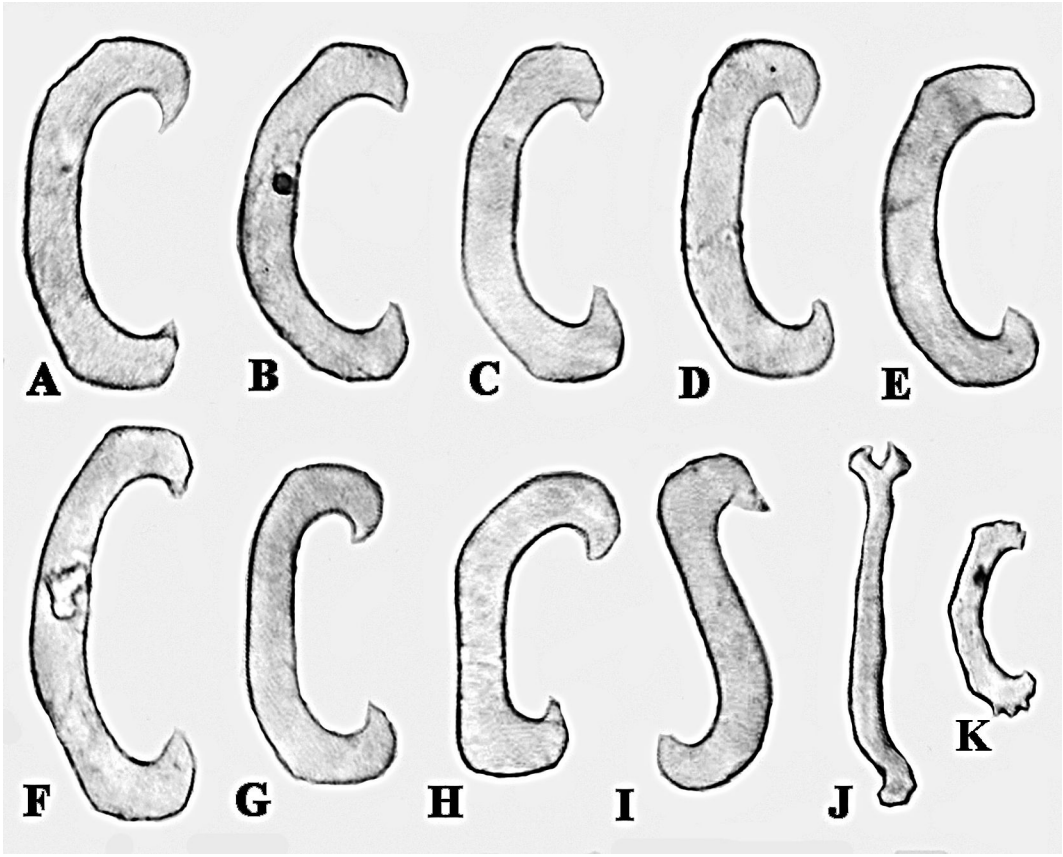

FIGURE 2. *S. stepanovi* **n. sp.**, ossicles. A–I—two-pointed sigmoids from the body wall (A–H sinistral sigmoids, I—dextral sigmoids; J, K—rods from tentacles.

Pyramidny Cape, 52.3814, 158.5737, 21 m, sand, boulders, rocks, t 1°C, diving collection by Sanamyan NP, 1 specimen; 06.07.1955, North Kurile Is., Is. Paramushir, Sea of Okhotsk shore, Shelikhovo, coll. Khlebovich VV., 2 specimens; 20.08.16, Middle Kurile Is., Is. Matua, Cape Crocodile, 15 m, t 3°C, diving collection by Sanamyan NP, 2 specimens.

Diagnosis. *Scoliorhapis* species with 10 peltate-digitate tentacles with up to 5 pairs of narrow elongate digits. Calcareous ring bead-like, with 10 segments; medioventral Polian vessel single, large, connected to ring vessel by narrow duct. Intestine without loop, attached for most of its length by mediodorsal mesentery. Rectal intestine fixed by two mesenteries: mediodorsal mesentery fixed to body wall near right dorsal muscle band, and left ventral mesentery fixed in left ventral interradius near medioventral muscle band. Two series of ciliated funnels: near the middorsal mesentery and in the left dorsal interradius near left ventral radial muscle. Body wall with scattered two-pointed sigmoids only, 80–115 μm in length. Tentacles with straight or C-like rods, sometimes branched at the ends, 70–90 μm in length.

Description. Body wormlike, cylindrical, slightly tapering to posterior end, up to 50 mm in length. Color in life pink-orange (Fig. 1F), whitish after fixation. Body wall with crowded small warts when compressed, thin and translucent when stretched, when internal organs easily seen (Fig. 1D). Body wall sigmoids noticeable in reflected light (Fig. 1A, C). Ten peltate-digitate tentacles with up to five pairs of narrow elongated comparatively large to tentacle size digits (Fig. 1E). Terminal digits longest. Juveniles terminating with single pair of digits on the tip (Fig. 1G, I). Intestine without loop (Fig. 1D), attached for most of its length by the mediodorsal mesentery in the middle of the interradius. Rectal intestine is approximately 1/5 length of the entire elementary canal length, fixed by two mesenteries: mediodorsal fixed to body wall near right dorsal muscle band and left ventral fixed in left ventral interradius near medioventral muscle band. Two series of crowded ciliated funnels: near middorsal mesentery and in left dorsal interradius near left edge of left ventral radial muscle. Funnels situated singly, wide funnel with thin collar and narrow stalk that is ~ 1.5 times longer than height of funnel (Fig. 3B).

Single, very large, ovoid, midventral Polian vessel connected to water ring by thin short duct (Fig. 3A).

The gonad is slightly branched.

Calcareous ring bead-like, with 10 segments; comparatively small relative to local body width (Fig. 1A, B, D, G, I).

Body wall ossicles two-pointed sigmoids, 80–115 μm in length, scattered throughout body wall, slightly more abundant over muscle bands. Sigmoids are oriented at an angle to longitudinal body axis (Fig. 1A, C). Sigmoid bodies end in hooks on both end, oriented perpendicular to each other. The second hook is likely derived from the eye-like ending of sigmoid hooks in resembles species. The majority of the sigmoids are "sinistral" (Fig. 2A–H) but a few are "dextral" (Fig. 2).Tentacles with straight or C-shaped rods, some with slightly branched , 70–90 μm in length (Fig. 2J, K; 3C).

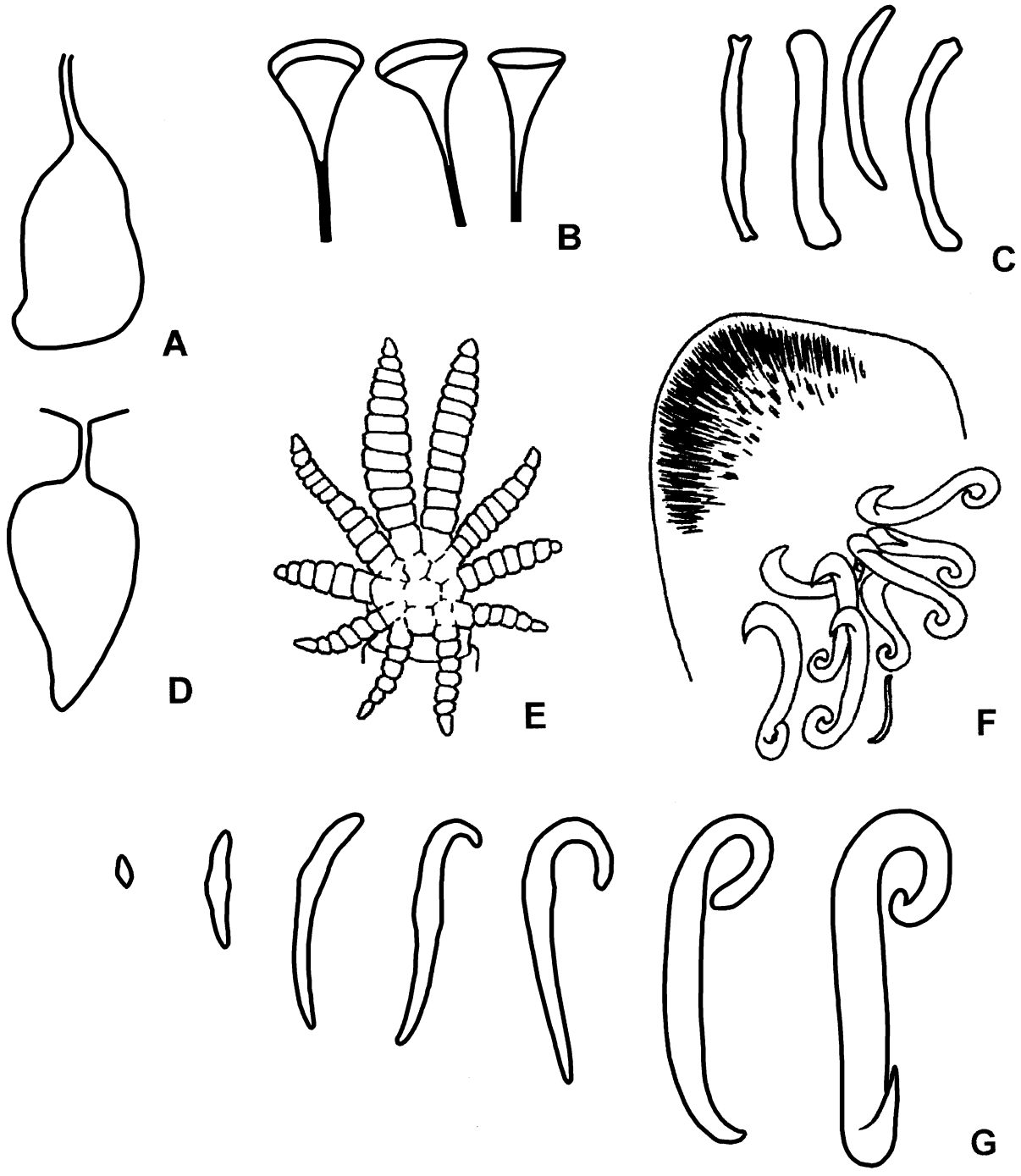

FIGURE 3. Details of the structure of some species of the genus *Scoliorhapis.* A–C—*S. stepanovi* **n. sp.** A—Polian vessel; B—ciliated funnels; C—rods from tentacles; D, E—*S. lindbergi.* D—Polian vessel (after Oguro, 1965); E—tentacle (from Levin, 1982); F—*S. theeli,* papillae with the group of sigmoid hooks (from Heding, 1928); G—*Taeniogyrus dunedinensis,* series of developmental stages of sigmoids (after Mortensen, 1925).

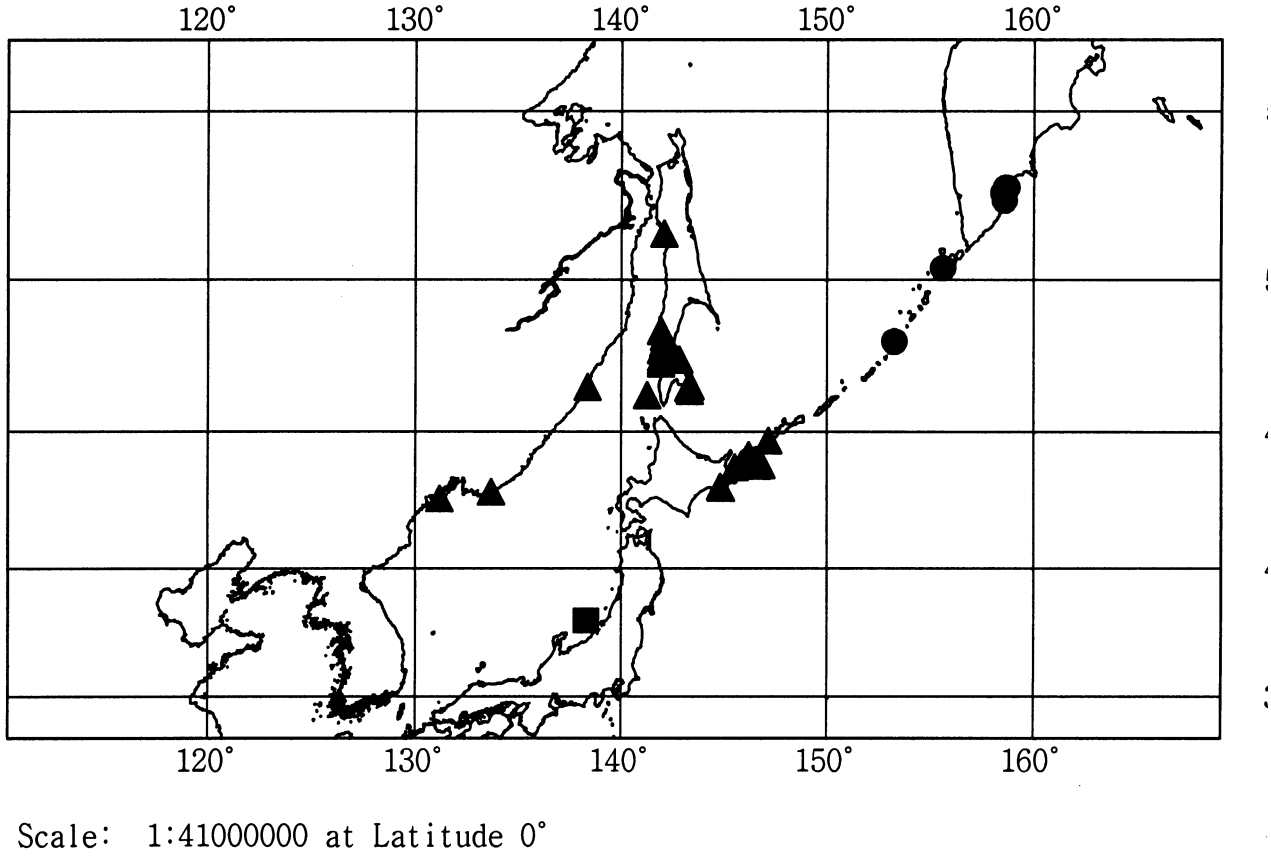

FIGURE 4. Distribution of the boreal species of the genus *Scoliorhapis*. ●—*S. stepanovi*; ▲—*S. lindbergi*; ■—*S. dianthus.*

Distribution. East Kamchatka, Avacha Bay, at 10–24 m depth, on sand bottom with bottom temperature 1–13°C, in North Kurile Is., Paramushir Is., Sea of Okhotsk shore, Shelikhovo, and in Middle Kurile Is., Matua Is. at 15 m depth (Fig. 4).

Remarks. The main character separating *S. stepanovi* from other *Scoliorhapis* species is the shape of the sigmoids that are pointed at both ends. All other species have sigmoid hooks with a point on one end and open-eye on the other. The new species differs from the genotype, *S. theeli* by the arrangement of the sigmoids in the body wall—scattered in *S. stepanovi* and clustered in papillae in *S. theeli* (Théel, 1868 Pl. 2, fig. 3; Heding, 1928, Fig. 69, 1–2) (Fig. 3F).

The new species resembles *S. lindbergi* (see Djakonov *et al.*, 1958; Oguro, 1961; 1965; Levin, 1982; Inoue & Kajihara, 2012). These species share the following characters: similar arrangement and orientation of body wall ossicles (cf. Fig. 1E, I in *S. stepanovi* and Oguro, 1961, Fig. 2 in *S. lindbergi*); tentacles with narrow elongated and comparatively large to tentacle size digits (cf. Fig. 1 F in *S. stepanovi* and Fig. 3E and Inoue, Kajihara, 2012, Fig. 1B, C in *S. lindbergi*); intestine with rectal part fixed to same mesenteries; large ovoid midventral Polian vessel connected with the water ring by narrow short duct (cf. Fig. 3A in *S. stepanovi* and Oguro, 1961, Fig. 3D in *S. lindbergi*).

The two-pointed sigmoid of *S. stepanovi* may have been originated by deviating from the usual course of development of sigmoid in the middle stages (cf. two-pointed sigmoids of *S. stepanovi* (Fig. 2A–I) and developmental stages of sigmoids in *Taeniogyrus dunedinensis* (Fig., 3G). The reduced calcareous ring without radial nerve notch, the medioventral position of the Polian vessel, and, perhaps, intestine without loop are probably paedomorphic characters (Smirnov, 2015).

Scoliorhapis dianthus[1] recently described from the area of Sado, Japan is very close to *S. lindbergi* on a number of characters: external appearance, color and body wall structure with crowded small warts when compressed (cf. Solis-Marin *et al.*, 2014, Fig. 1A in *S. dianthus* and Fig. 1H in *S. lindbergi*); the structure of tentacles (cf. Solis-Marin *et al.*, 2014, Fig. 1B, C in *S. dianthus* and Fig. 3E in *S. lindbergi*) and number of digits on tentacles (6 pairs of appendages in *S. dianthus* and 3-6 pairs in *S. lindbergi*); sigmoids size is 75 ± 5μm on average in *S. dianthus* (Solis-Marin et al, 2014) and 70–100μm (80μm on average) in *S. lindbergi* (Oguro, 1961; Levin, 1982; Inoue & Kajihara, 2012). Thus *S. dianthus* is very close to *S. lindbergi*, and may be synonymous. We note that both species inhabit the Manchurian subregion of the Pacific Boreal (Steller) region (Kusakin 1979, 1990)—*S. dianthus* at its southern borders, and *S. lindbergi* at the northern.

Etymology. Named for Dr. Vadim Stepanov, Kamchatka branch of the Pacific Geographical Institute, Far-Eastern Branch of the Russian Academy of Sciences, with appreciation for his contribution to systematic and faunistic studies of the sea cucumbers of the Far Eastern Seas.

Key to species of genus *Scoliorhapis* H.L. Clark, 1946

1.	Tentacles 12	*Scoliorhapis massini* O'Loughlin et VandenSpiegel, 2010
-	Tentacles 10	
2.	Body wall with two-pointed sigmoids	*Scoliorhapis stepanovi* **sp. n.**
-	Body wall typical sigmoids with open-eye on one end and point on the other end	3
3.	Sigmoids grouped in papillae	*Scoliorhapis theeli* (Heding, 1928)
-	Sigmoids scattered in the body wall	4
4.	Rods absent in tentacles	*Scoliorhapis dianthus* Solis-Marin *et al.*, 2014
-	Rods present in tentacles	5
5.	Sigmoid 70–100 μm (mean ~ 80 μm) long	*Scoliorhapis lindbergi* (Djakonov in Djakonov, Baranova et Saveljeva, 1958)
-	Sigmoid 158–184 μm long	*Scoliorhapis biopearli* O'Loughlin et VandenSpiegel, 2010

Remark. Solis-Marin *et al.* (2014) used the number of tentacle digits as one of the main diagnostic characters in their key to *Scoliorhapis*. In our view this feature may be considered only when the limits of its variability are clarified. Thus in *S. lindbergi* hundreds of specimens were studied and it was determined that the number of digits on the tentacles in this species varies from 3 to 6, with 4 to 5 being average. In the only three specimens of *S. dianthus* examined the tentacle number is 6. The actual variability of this character in *S. dianthus* is not yet clear.

Acknowledgments

We are particularly grateful to Peter Mark O'Loughlin from Marine Biology Section, Museum Victoria, Melbourne, Australia for reading and improving our manuscript. This work was supported by All-Russian non-governmental organization "Russian Geographical Society".

References

Clark, H.L. (1908) The Apodous Holothurians: A monograph of the Synaptidae and Molpadiidae, including a report on the representatives of these families in the collections of the United National Museum. *Smithsonian Contributions Knowledge* 35, 1–231, 14 pls.

Clark, H.L. (1921) The echinoderm fauna of Torres Strait: its composition and its origin. *Carnegie Institution of Washington Publication* 214 (*Papers from the Department of Marine Biology of the Carnegie Institution of Washington* 10), 233 pp., 10 pls.

Clark, H.L. (1946) The echinoderm fauna of Australia. Its composition and its origin. *Carnegie Institution of Washington Publication,* 566, 567 pp.

1. Solis-Marin *et al.* (2014) writes that «Tentacles devoid of any kind of ossicles» (p. 324), and this feature is used as a diagnostic character in their key of the genus *Scoliorhapis* (p. 326). At the same page 324 authors stated «Tentacles with sigmoid deposits similar to those in body wall but slightly smaller (55-59 μm) (Fig. 2C)», which is repeated in the figure caption (p. 326). So the question of the presence or absence of the sigmoids in the tentacles in *S. dianthus* remain open, although, apparently, authors did not found ossicles in the tentacles in *S. dianthus*.

Djakonov, A.M., Baranova, Z.I. & Saveljeva, T.S. (1958) Zametka o goloturiiakh (Holothurioidea) rayona uzhnogo Sakhalina i uzhnykh Kuril'skikh ostrovov. *Issledovaniya dal'nevostochnykh morei SSSR* [Note on the holothurians (Holothurioidea) from South Sakhalin and South Kurile Islands. *Explorations of the Far-Eastern Seas of the USSR*], 5, 358–380. [in Russian]

Heding, S.G. (1928) Synaptidae. Papers from Dr. Th. Mortensen's Pacific Expedition 1914-16. XLVI. *Videnskabelige Meddelelser fra Dansk naturhistorisk Forening i København*, 85, 105–323, pls. 2, 3.

Inoue, J. & Kajihara, H. (2012) Redescription of *Scoliorhapis lindbergi* comb. nov. (Echinodermata: Holothuroidea: Apodida: Chiridotidae), with special reference to the ultrastructure of sigmoid bodies. *Species diversity*, 71, 15–20.

Kusakin, O.G. (1979) Morskie i solonovatovodnye ravnonogie rakoobraznye (Isopoda) kholodnykh i umerennykh vod severnogo polushariya. Podotr. Flabellifera [Marine and brackish isopods (Isopoda) of cold and temperate waters of the northern hemisphere. Suborder Flabellifera]. (Keys to the Fauna of the USSR, 122). Leningrad: "Nauka". 472 pp. [in Russian]

Kussakin, O.G. (1990) Biogeography of isopod Crustaceans in the Boreal Pacific. *Bulletin of Marine Science*, 46 (3), 620–639.

Levin, V.S. (1982) Novye dannye o goloturii *Scoliodotella lindbergi* (Apoda, Chiridotidae) *Zoologicheskii Zhurnal* [New data on a sea cucumber *Scoliodotella lindbergi* (Apoda, Chiridotidae) *Zoological Journal*], 61 (12), 1916–1920. [in Russian with brief English summary].

Marenzeller, E. von. (1881) Neue Holothurien von Japan und China. *Verhandlungen Kaiserlich-Königlichen Zoologisch-Botanischen Gesellschaft, Wien*, 31, 121–140, Tafl. 4, 5.

Mortensen, Th. (1925) Echinoderms of new Zealand and the Auckland Campbell Islands. III-V. Asteroidea, Holothuroidea and Crinoidea. Papers from Dr. Th. Mortensen's Pacific Expedition 1914-16. XXIX. *Videnskabelige Meddelelser fra Dansk naturhistorisk Forening i København*, 7, 261–420, pls. 12–14.

Oguro, C. (1961) The fauna of Akkeshi Bay XXVI. Holothuroidea. *Publications from the Akkeshi Marine Biological Station*, 11, 1–4.

Oguro, C. (1965) Notes on the morphology of an apodian holothurian, *Scoliodotella uchidai*. *Publication from the Akkeshi Marine Biological Station*, 15, 1–8.

Ohshima, H. (1913) Synaptiden von Misaki. *Dobutsugaku zasshi* [*Zoological Magazine*], 25, 253–262. [in Japanese with German summary].

Ohshima, H. (1914) The Synaptidae of Japan. *Nihon dobutsugaku iho* [*Annotationes Zoologicae Japonenses*], 8: 467–482, 1 pl.

Ohshima, H. (1919) Holothurians collected by the "Albatross" in the Northwestern Pacific. *Dobutsugaku zasshi* [*Zoological Magazine*], 31, 139–149. [in Japan].

O'Loughlin, P.M. & VandenSpiegel, D. (2010) A revision of Antarctic and some Indo-Pacific apodid sea cucumbers (Echinodermata: Holothuroidea: Apodida). *Memoirs of Museum Victoria*, 67, 61–95.

Rowe, F.W.E. (1976) Restriction of the chiridotid genus *Trochodota* Ludwig (1891) (Holothurioidea: Apodida), with the description of a new species from South Australia. *Transactions of the Royal Society of South Australia*, 100 (4), 203–206.

Rowe, F. W. E. & Gates, J. (1995) Echinodermata. *In*: Wells, A. (ed.). *Zoological Catalogue of Australia.* Vol. 33. CSIRO, Melbourne, i–xiii + 510 pp.

Semper C. (1867–8). *Reisen im Archipel der Philippinen. Zweiter Theil. Wissenschaftliche Resultate. Erster Band. Holothurien*. Verlag von Wilhelm Engelmann, Leipzig, 288 S.

Smirnov, A.V. (1998) On the classification of the apodid holothurians. *In*: Mooi, R. & Telford, M. (eds). *"Echinoderms: San Francisco". Proceedings of the ninth international echinoderm conference, San Francisco, California, USA, 5-9 August 1996.* A. A. Balkema, Rotterdam, Brookfield, 517–522.

Smirnov, A.V. (2012) System of the Class Holothuroidea. *Paleontological Journal*, 46 (8), 793–832. http://dx.doi.org/10.1134/S0031030112080126

Smirnov, A.V. (2015) Paedomorphosis and heterochrony in the origin and evolution of the class Holothuroidea. *Paleontological Journal*, 49 (14), 1597–1615. http://dx.doi.org/10.1134/S003103011514018X

Solis-Marin, F.A., Komatsu, M., Soliman, T., Uchida, K., Shimotani, T. & Nozaki, M. (2014) *Scoliorhapis dianthus*, a new species of sea cucumber (Apodida: Chiridotidae) from the Sea of Japan. *Proceedings of the Biological Society of Washington*, 127 (2), 323–327. http://dx.doi.org/10.2988/0006-324X-127.2.323

Stepanov, V.G., Panina, E.G. & Morozov, T.B. (2012) Fauna goloturiy Avachinskogo zaliva (severo-vostochnaia chast' Tikhogo okeana). *Issledovaniya vodnykh biologicheskikh resursov Kamchatki i severo-zapadnoi chasti Tikhogo okeana: Sbornik nauchnykh trudov.* [A holothurian fauna of the Avacha gulf (North-West part of Pacific Ocean). *Investigation of the Studies of water biological resources of Kamchatka and the North-West Pacific: Proceedings*]. KamchatNIRO, Petropavlovsk-Kamchatsky, 26 (1), 12–32.

Studer, T. (1876) Über Echinodermen aus dem antarkischen Meere und zwei neue Seeigel von den Papua–Inseln, gesammelt auf der Reise SMS Gazelle um die Erde. *Monatsberichte der königlich Preussichen Akademie der Wissenschaften zu Berlin* aus dem Jahre 1876, 452–465.

Théel, H. (1886) Report on the Holothurioidea dredged by HMS. *Challenger* during the years 1873–1876. Part II. *Scientific Results of HMS* Challenger *1873–1876. Zoology.* Vol. 4, (no. 34), 290 pp., 16 pls.