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Shallow-water Ascidians from Matua Island (central Kuril Islands, NW Pacific), part 2

KAREN SANAMYAN & NADYA SANAMYAN
Kamchatka Branch of Pacific Geographical Institute, Far-Eastern Branch of the Russian Academy of Sciences, Partizanskaya 6, Petropavlovsk-Kamchatsky, 683000, Russia. E-mail: ascidiacea@sanamyan.com

Abstract

The paper reports several ascidians, previously not known from central group of Kurile Islands, including two new species, *Synoicum polyzoinum* **n. sp.** and *Aplidium matua* **n. sp.** In order to systematize our knowledge on numerous members of these genera, reported from NW Pacific, we provide an overview of all *Synoicum* and *Aplidium* species, known from Far Eastern Seas of Russia, including comments on the species erroneously identified in the past.

Key words: Tunicata, Ascidiacea, *Aplidium*, *Synoicum*, Kuril Islands, Matua Island, NW Pacific

Introduction

In August 2016 and August 2017 one of us (N. Sanamyan) took part in 20-th and 21-th Kuril-Kamchatka Expedition of Russian Geographic Society to Matua Island, which belongs to central group of Kuril Islands, and collected samples of marine invertebrates, with a special attention to several groups including ascidians. In our previous paper (Sanamyan & Sanamyan, 2017) we reported 15 species of ascidians collected around Matua Island in 2016, two of which were described as new. Ascidians from the central Kuril Islands were almost totally not known before that publication. The material collected in 2017 is less abundant but contains three species not reported previously for central Kuril Islands (*Aplidium spitzbergense*, *Distaplia* sp. and *Styela coriacea*) and also two new species described in the present paper (*Aplidium matua* **n. sp.** and *Synoicum polyzoinum* **n. sp.**). For general information about the region and map showing location of Matua Island see Sanamyan & Sanamyan (2017).

Material and methods

The samples reported in the present paper were collected by SCUBA, to 14 m depth and preserved in 4% seawater formalin on the surfacing. Most specimens were photographed in vivo to document colour, form and structure of colonies. All described specimens are deposited in the Kamchatka Branch of the Pacific Geographical Institute (KBPGI). All underwater photos were taken by N. Sanamyan. All specimens, if not stated otherwise, were collected by N. Sanamyan.

Descriptions

Synoicum polyzoinum n. sp.

(Figures 1, 2)

Material examined. Matua Island, Point Kluv, 14 m, 16.08.2017, one colony (#400). Holotype KBPGI 1454/1.

Description. The species forms extensive (about 10 см in extent) colonies composed of several groups of

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short, sometimes partially fused, sometimes completely separated from each other lobes of various shape and size (Figure 1D and 2A, B). Smaller lobes, containing only one system of zooids, may be described as short upright cylinders fused with each other at their basal part and along about a half or more of their length. Larger lobes are cushion-like, low, and contain several systems of zooids. They still have depressions between the systems on their upper surface giving an impression that these larger lobes are results of fusion of several smaller ones. The test is leathery, firm, reddish and opaque. Upper surface is in part covered by filamentous green algae and diatoms. Sides and basal parts of the colony are impregnated by some amount of sand.

Zooids within the colony stand vertically and parallel to each other, they extend whole length from the top to the bottom of the colony. Zoods are arranged in regular circular systems composed by few (usually five to seven) zooids (Figure 2B). Common cloacal openings and openings of the branchial siphons of individual zooids on the surface of the colony are similar in shape and size, they are large, almost round, on short siphons, and at first glance barely shown any traces of lobes. On macro photographs is evident that the margin of the common cloacal openings has undulating rim—the wall of common atrial siphons is supported by tridentate atrial languets of zooids and therefore the number of small lobes on the margin of common cloacal siphons is three times larger than the number of zooids composing the system.

Zooids in somewhat contracted state are about 10–15 mm long, with the thorax about 3 mm and the abdomen somewhat shorter than the thorax (Figure 1A, B). Branchial siphon is short and widely open, its margin is almost smooth, with weak hints of six lobes characteristic for the family. Atrial aperture is small, situated on a rather distinct siphon. Upper rim of this siphon is drawn into a wide tridentate atrial languet. Longitudinal thoracic muscles are very fine, equally spaced, about 15 in number. Branchial tentacles cannot be counted precisely, about 10 or 12 were seen in some zooids. Branchial sac has 12 rows of stigmata with 25–27 stigmata per row on each side.

The stomach is absolutely smooth, no any traces of areolation or folds are present (Figure 1C). It is situated in the middle of abdomen. The cardiac end of the stomach is rounded and somewhat narrower than the pyloric and its dorsal border (along the typhlosole) is somewhat shorter than the ventral border. The orientation of the stomach is nearly straight, the oesophagus enters its cardiac end nearly vertically. The post pyloric subdivision of the intestine is not clear. There is no gastric reservoir. Posterior abdomen is filled with parenchymatous tissue and no gonads are developed.

Remarks. In live, the colour, consistency, widely open round siphons and overall habitus of the colony resembles colonial styelid of the subfamily Polyzoinae (e.g. *Syncarpa oviformis*) rather than a member of Polyclinidae, hence suggested specific name "*polyzoinum*". The structure of zooids is, of course, very different.

The shape of the stomach reminiscent the stomach of *Aplidiopsis* spp. but the orientation of the stomach (straight) and a whole configuration of the gut loop is different and characteristic for *Synoicum* but not for *Aplidiopsis*. In *Aplidiopsis* (and in related *Polyclinum*) the stomach is always obliquely oriented with the oesophagus bent at right or sharp angle to enter its cardiac end (see photo of zooids of *Aplidiopsis pannosum* in Sanamyan & Sanamyan, 2017, Figure 9A).

The genus *Synoicum* in NW Pacific is represented by many nominal species and taxonomic status some of them is not clear. In order to compare described here *S. polyzoinum* **n. sp.** with other member of the genus, and in order to systematize our knowledge on species inhabiting NW Pacific waters, we give below an overview of all known nominal species reported in the region (Commander Islands, Kamchatka, Sea of Okhotsk and Kuril Islands). For convenience they may be divided into the following groups:

1. The first group comprises three nominal species with colonies composed of upright lobes, each with one or several (but generally few) circular systems, and zooids with very clear and prominent areolation of the stomach wall. This group includes *Synoicum cymosum* Redikorzev, 1927, *S. solidum* Redikorzev, 1937 and *S. irregulare* Ritter, 1899. The latter species was synonymized with *S. turgens* Phipps, 1774 by several authors (including Van Name, 1945 and Sanamyan, 1998), but actually the conspecificity between European *S. turgens* and Pacific species *S. irregulare* is not firmly established—existing descriptions of both species are old and rather superficial. *Synoicum cymosum* differs from *S. irregulare* only by possessing prominent papillae on the test. They are often arranged in longitudinal rows on the sides of the lobes composing the colony. Sanamyan (1998) examined several such colonies with longitudinally arranged test papillae and preferred to keep this species as distinct from *S. irregulare*. After publication of that paper we had chance to examine several other specimens from pacific coasts of Kamchatka referable to *S. irregulare* and *S. cymosum*. The presence and the degree of development of test papillae

vary significantly from colony to colony and now we believe these species are conspecific, *S. cymosum* becomes a junior subjective synonym of *S. irregulare*.

Synoicum solidum also synonymized here with *S. irregulare*—the reexamination of the holotype of *S. solidum* revealed that Redikorzev's figure of zooid (Redikorzev, 1937, Figure 8) is precise and correct, the zooids indeed have very prominent areolation of the stomach wall, and the shape of colony corresponds to that of *S. irregulare*.

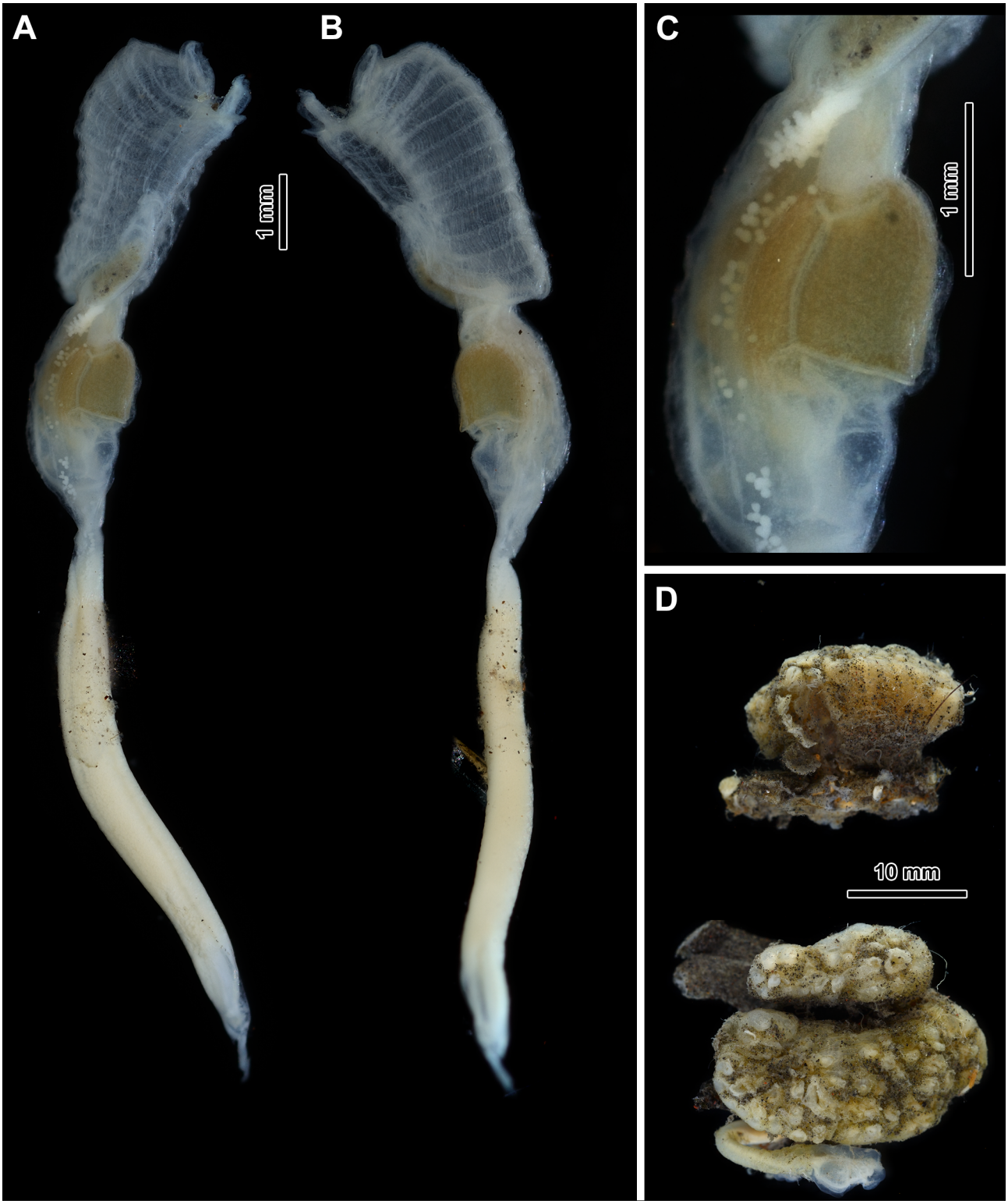

FIGURE 1. *Synoicum polyzoinum* **n. sp.** A, B, zooid; C, stomach, enlarged; D, parts of preserved colony (Holotype).

2. The second group of nominal species comprises several species forming large massive colonies and having smooth stomach. The better known species of this group, *Synoicum jordani* (Ritter, 1899) is rather common in Sea of Okhotsk and Kamchatka, especially in the places where water is turbid and where hard bottom is covered by some amount of sediment. It forms spherical colonies up to 12 cm in diameter, each with numerous circular systems of zooids. The systems in this species are not separated by any depressions or furrows on the surface of colony and the species not forms separate lobes containing single (or few) systems as in *S. irregulare* and in *S. polyzoinum* **n. sp.** Sanamyan (1998) examined many specimens assignable to this species. They all had large and easily recognizable gastric reservoir in the gut loop, a feature which Sanamyan (1998) believed to be constant and characteristic for this species.

Three species described by Ritter (1899) from NW Pacific, *Amaroucium kincaidi* Ritter, 1899, *A. pribilovense* Ritter, 1899 and *A. snodgrassii* Sanamyan (1998) were synonymized under the questions with *S. jordani* by Sanamyan (1998). Van Name (1945) also synonymized three mentioned species together under the name *Synoicum kincaidi* (spelled as "*kinkaidi*") but preferred to keep them separate from *S. jordani* basing on the structure of the stomach wall. He believed that in *S. jordani* the stomach is always smooth (that is in agreement with our data) while stomach being not smooth in *S. kincaidi*. It is not known if the irregular folds or areolation of the stomach in *S. kincaidi* are artefacts of fixation and are not caused by contraction of zooids and the status of *S. kincaidi* and its synonyms is uncertain. It has not been recorded in NW Pacific.

Two species described by Redikorzev (1927a, 1927b) from Sea of Japan and Sea of Okhotsk, *Aplidiopsis knipowitschi* Redikorzev, 1927 and *Synoicum jacobsoni* Redikorzev, 1927 were also synonymized with *S. jordani* by Sanamyan (1998). While the synomization of *A. knipowitschi* with *S. jordani* is certainly correct, the conspecificity of *S. jacobsoni* and *S. jordani* is less evident. Almost spherical of colony of *S. jacobsoni* with numerous round system is identical with colonies of *S. jordani*. Redikorzev's figure (1927a, Figure 16) shows rather long gut loop below the stomach and no gastric reservoir in it. Reexamination of the type material of this species revealed that the stomach is quite smooth (Redikorzev, 1927a, figured sparse fine areoles on it), as in *S. jordani*, while in all other respects Redikorzev's figure is very precise and corresponds exactly to real material. We failed to find gastric reservoir in the gut loop in type specimen. Nevertheless, due to overall similarity in other features and the geographic locality (Sea of Okhotsk) we prefer to keep it as a doubtful synonym of *S. jordani*.

Thus, currently in the region including Commander Islands, Kamchatka, north and middle Kuril Islands we recognize only one species of the genus *Synoicum* which forms large massive colonies and has smooth stomach wall—*S. jordani*.

3. The rest *Synoicum* species recorded in the Far East Seas of Russia, which cannot be assigned to groups described above, are:

Synoicum derjugini Redikorzev, 1927 known only from original description based on three specimens collected in the Sea of Japan near Vladivostok. This species most closely resembles *S. polyzoinum* **n. sp.** We reexamined type material of *S. derjugini*. It is represented by shapeless pieces which are probably composed by several lobes. The test is hard and clear, without any sand on surface or in internal layers. The zooids correspond exactly to original figure, they have only 10 rows of stigmata (i.e. slightly fewer than we counted in *S. polyzoinum* **n. sp.**) and lack gastric vesicle. Original figure (Redikorzev, 1927a, Figure 19) shows oval solid colony with typical for the genus circular systems. Despite the reexamination of the type material the obtained information is not sufficient and the taxonomic status of this species cannot be revealed without examination of additional colonies from the type locality. We prefer to keep specimen from Matua Island as distinct from *S. derjugini*.

Amaroucium polybunum Redikorzev, 1927 and *Amaroucium soldatovi* Redikorzev, 1937, both from the Sea of Okhotsk, were synonymized with each other and placed to the genus *Synoicum* by Sanamyan (1998). Both have numerous rows of stigmata (20–21) and stomach wall with distinct swelling arranged in longitudinal rows. We had no chance to examine any colonies assignable to these species and cannot currently comment their taxonomic position and generic assignment.

Synoicum sabuliferum Redikorzev, 1937 is known only from original description based on three specimens from Kamchatka. The species is certainly valid. Unlike other *Synoicum* species of the region it has colony composed of vertical sandy lobes. The waters around Kamchatka are rather well sampled for ascidians but we never encountered any specimens assignable to this species.

Synoicum pellucens Redikorzev, 1927 also is known from original description only. The species is based on one colony recorded in the vicinity of Vladivostok. The colony consists of several long upright lobes, each with only four of five zooids.

Synoicum parvum Redikorzev, 1937 is based on a small specimen from the Sea of Okhotsk. Most probably this is a juvenile colony of another species.

FIGURE 2. *Synoicum polyzoinum* **n. sp.** A, overall view of colony. (Solitary ascidians on this photograph are *Dendrodoa aggregata* and small whitish translucent colony in the central part of the image is *Placentela crystallina*); B, detail of colony composed of several cormidia, each with single system of zooids.

Synoicum clavatum: Sanamyan (1998) is certainly wrongly identified. *Synoicum clavatum* (Oka, 1927) is a warm water species and its occurrence in cold water around Kamchatka and North Kuril islands is highly dubious.

***Aplidium matua* n. sp.**
(Figures 3, 4)

Material examined. Matua Island, Point Kluv, 14 m, 16.08.2017, one colony (#409). Holotype KBPGI 1455/1.

Description. The species forms cushions several centimeters across (Figures 4A, B). The colony of examined specimen consists of two such cushions, the larger is 2.5 cm in diameter and 3 cm in height. Sides of colony are in part covered by sponge and sand, upper exposed surface also contains fine sand grains but here they are much sparser. Inner layers of the colony, especially at lower (basal) parts, also contains embedded sand grains. Apart from embedded sand the tunic is transparent, light-red in live. In preserved colony the upper half of the colony is deep brownish-red.

Zooids open on a whole exposed surface of the colony. They are arranged in small circular systems which are clearly visible on live inflated colonies and on colonies preserved in formalin. Each system is composed of seven to ten zooids arranged in a circle around large common cloacal opening through which atrial openings of some zooids may be visible (Figure 4C). Common cloacal cavity is limited to a small shallow space beneath common cloacal opening, its roof and margins of common cloacal opening are supported by three-lobed atrial languets of zooids (Figure 4C).

Zooids in contracted state are about 10–15 mm long in average, with thorax of about 2 mm and abdomen, in less contracted zooids, up to 5 mm long (Figures 4A–C). Branchial siphon has usual six lobes, which are short, wide and inconspicuous (they are obscurely visible on surface of the colony on macro photographs of inflated live colonies). Atrial opening of preserved zooids is small, on short siphon upper rim of which is drawn into short languet with tridentate margin.

Longitudinal thoracic muscles are thin and numerous (about 20 on each side of the thorax were counted, but this number is rather approximate). Longitudinal muscles continue along the whole length of abdomen where they and continue Branchial sac has 17 rows of stigmata. About 25 stigmata per row were counted in the middle part of the right side of the branchial sac.

Barrel shaped stomach is in the middle of abdomen. It has seven or eight narrow and rather regular longitudinal folds with wide flat depressed spaces between them (Figure 4B,C). Subdivision of the post pyloric part of the gut loop is typical and clear, there is rather long duodenum, mid-intestine with oval posterior stomach and noticeable rectal valves.

Posterior abdomen is long and filled with parenchyma. No gonads or larvae were found in examined zooids.

Remarks. *Aplidium matua* **n. sp.** can be distinguished by combination of the small circular systems, zooids with few (seven or eight) stomach folds and rather numerous (17) rows of stigmata.

Although the number of *Aplidium* species reported in Far East Seas of Russia in various published sources and lists (e.g. Sirenko, 2013) is rather high, many of these listed species are wrongly identified or were reassigned to other genera (e.g. to *Synoicum*). Below we provide a list of all species of the genus known from Commander Islands, Kamchatka, sea of Okhotsk and from Kurile Islands. For easier identification they may be divided in a following way:

1. The species with five prominent and sharply defined longitudinal stomach folds: *Aplidium spitzbergense* Hartmeyer, 1903, *A. redikorzevi* Sanamyan et Sanamyan, 2011 and *A. macrenteron* Sanamyan et Sanamyan, 2017. These three species are easy for identification and cannot be confused with other *Aplidium* species: *A. spitzbergense* has only four rows of stigmata, *A. redikorzevi* and *A. macrenteron* have very characteristic sandy colonies and characteristically looking zooids (see Sanamyan & Sanamyan, 2011, 2017).

2. The species with seven to 15 stomach folds: *Aplidium dubium* (Ritter, 1899), *A. vinogradovae* (Beniaminson, 1974), *A. disiphonium* (Beniaminson, 1975), *A. lebedi* Sanamyan, 1998 and *A. eborinum* Sanamyan et Sanamyan, 2011.

Above described *Aplidium matua* **n. sp.** also belongs to this group and is more closely related to *A. dubium*. *Aplidium dubium* was originally described from Commander Islands and not known from other places. It is most common colonial ascidian species there, we have numerous (more than 50) colonies identified as *A. dubium* from

Medny and Behring Islands. This material was briefly described by Sanamyan (1998) who reported 11–15 rows of stigmata and 8–10 longitudinal stomach folds for this species. These numbers differ slightly but are rather close to number of stomach folds and rows of stigmata of *A. matua* **n. sp.** We tried to reexamine the material from Commander Islands but it was found that all numerous colonies of this species contain so strongly contracted zooids that stomach folds and rows of stigmata cannot be counted correctly and the structure of systems cannot be revealed. The species certainly has strong thoracic and abdominal musculature, much stronger than in *A. matua* **n. sp.**, and the different degree of contraction of zooids is not an artefact of different handling—all these colonies were collected and fixed in a same way. We believe they belong to different species and describe here a specimen from Matua Island as a new species. Other species of this group differ quite distinctly from *A. matua* n. sp and cannot be confused with it.

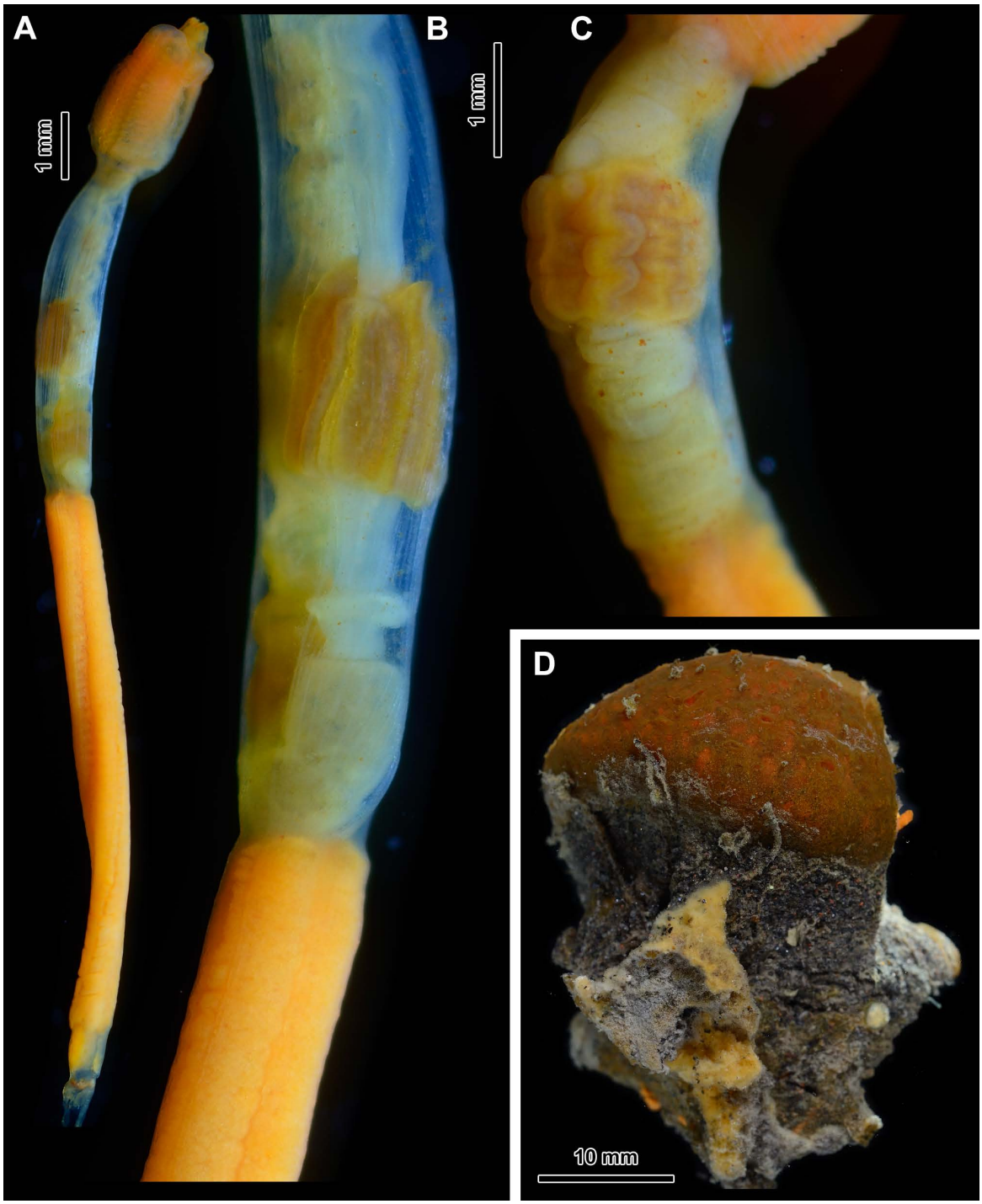

FIGURE 3. *Aplidium matua* **n. sp.** A, zooid; B, C, gut loop and stomach of two zooids; D, preserved colony (Holotype).

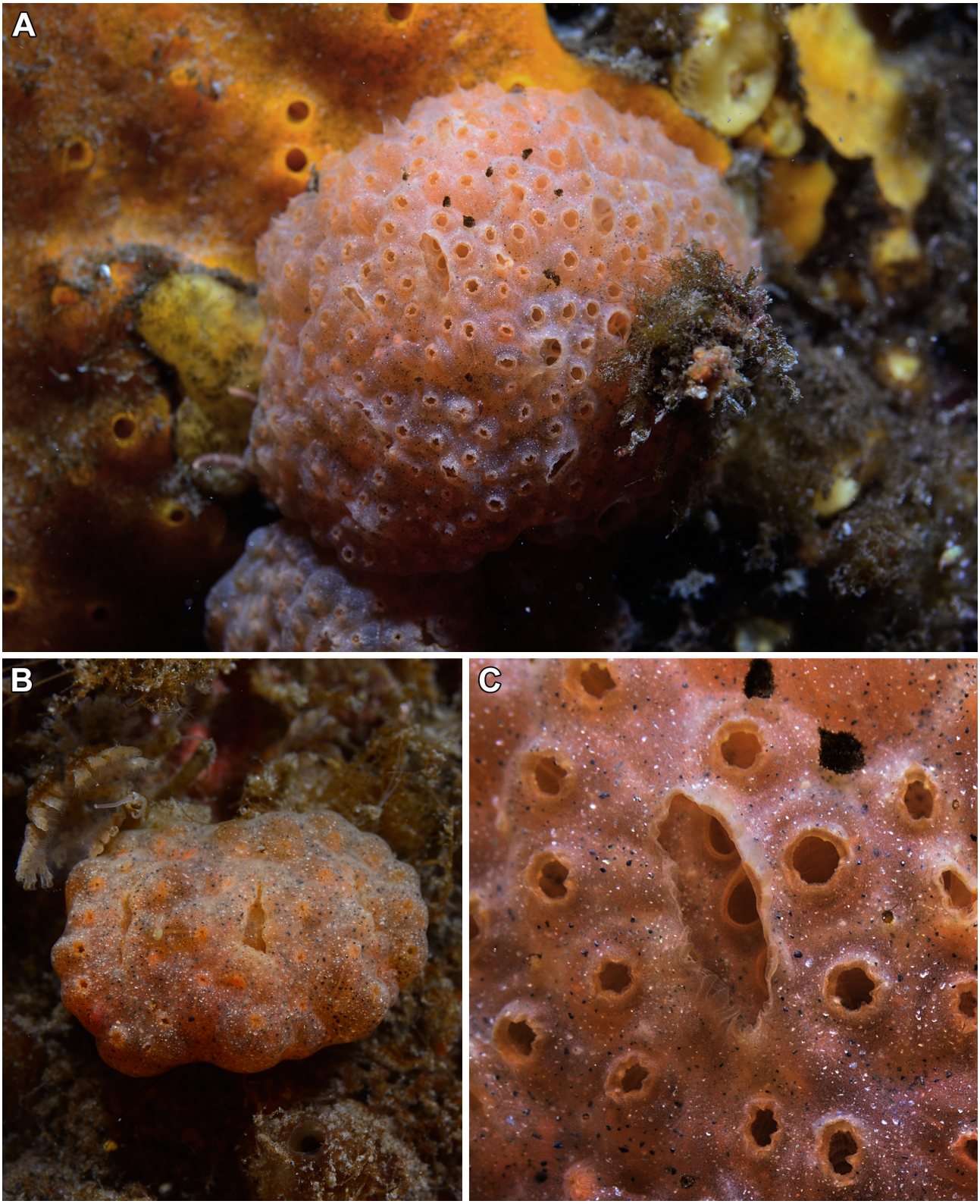

FIGURE 4. *Aplidium matua* **n. sp.** A, holotype; B, another colony (not collected); C, details of one system of zooids.

3. The species with 20 or more stomach folds include: *A. strandi* (Redikorzev, 1937), *A. oculatum* (Beniaminson, 1974), *A. kurilense* (Beniaminson, 1974), *A. tenuicaudatum* (Beniaminson, 1974), *A. confusum* Sanamyan, 2000 and *A. dissectum* Sanamyan et Sanamyan, 2011. Of these species *A. kurilense*, *A. tenuicaudatum* and *A. confusum* are known only from southern group of Kuril Islands, while other three known from North Kuril Islands and more northern localities. Unfortunately in this group the appearance of live, fully inflated colonies, and

the details of the structure of the systems, the features which constitute very reliable species specific characters, are known only for *A. oculatum* and *A. dissectum*. Anyway, high number of stomach folds clearly distinguish all these species from *A. matua* **n. sp.**

Finally it is necessary to mention *Aplidium* species reported in our earlier papers for Far East Seas of Russia which were erroneously identified:

Aplidium glabrum (Verrill, 1871) was reported by Sanamyan (1998, 2000) and Sanamyan & Sanamyan (2010) from Kamchatka and South Kuril Islands. All these specimens are distinct from European *A. glabrum*. True *A. glabrum* does not occurs in NE Pacific. The specimens from Kamchatka recorded under this name belong to *A. eborinum* (see Sanamyan & Sanamyan, 2011) and the taxonomic status of specimens from southern group of Kuril Islands is not clear.

Aplidium pliciferum (Redikorzev, 1927) reported from Kamchatka in several papers of Sanamyan (e.g. Sanamyan, 1998, Sanamyan & Sanamyan, 2010). As it was shown by Sanamyan & Sanamyan, 2011 this material belongs to *A. oculatum*. Original description of *A. pliciferum* is based on a specimen from warmer waters (Sagami Bay) and true *A. pliciferum* does not occurs in Kuril Islands, Kamchatka and more northern regions.

Aplidium sagamiense (Tokioka, 1967) reported by Sanamyan (1998) from Kamchatka is also wrongly identified. *Aplidium sagamiense* is known from much warmer waters and it is hard to believe it may occur in cold waters around Kamchatka and Kuril Islands. The taxonomic status of specimens from Kamchatka and north and central Kuril Islands is not clear. Most probably this is an undescribed species. However all colonies we examined have small, strongly contracted zooids, and we still have no good underwater photos of inflated colonies of this species to give adequate description of structure of systems. Therefore we refrain from describing of a new taxon.

Aplidium spitzbergense Hartmeyer, 1903

(Figures 5A)

Material examined. Matua Island, Point Kluv, intertidal pool, 06.08.2017, one colony (#419).

Remarks. The species has characteristic small zooids with four rows of stigmata and five stomach folds. Photos of living colonies of this species show flat dirty-yellowish colonies with some amount of sand on surface and with large sessile common cloacal openings and double rows of zooids radiating from them. Existing photos (Figure 5A) are not good and detailed organization of systems of zooids cannot be revealed.

~~*Aplidium*~~ *pannosum* (Ritter, 1899)

(Figure 5C)

Material examined. Matua Island, Point Kluv, 14 m, three colonies (#403, 404, 419).

Remarks. The species was reported from this locality and described in details in our previous paper (Sanamyan & Sanamyan, 2017). The cloacal systems, as it was revealed on newly obtained photographs, vary from more or less round to somewhat more complex, with short cloacal canals converging to common cloacal openings (Figure 5C).

Distaplia sp.

(Figures 5B)

Material examined. Matua Island, Point Kluv, 14 m, two colonies (#408, 416).

Remarks. The material is represented by two small colonies, each containing few zooids (Figure 5B). Similar colonies sometimes occur on Commander Islands and Kamchatka (e.g. see Sanamyan & Sanamyan, 2015). They most closely resemble Japan species *Distaplia dubia* (Oka, 1927). At our disposal are numerous specimens of *D. dubia* collected in vicinity of Valdivostok. Some of these colonies look exactly as figured by Nishikawa (1990, Figure 9) and certainly belong to this species. However we are not sure if colonies from more northern localities (central Kuril Islands, Kamchatka and Commander Islands) belong to the same species. The species is "featureless" and we still have no enough material to reveal its taxonomic status.

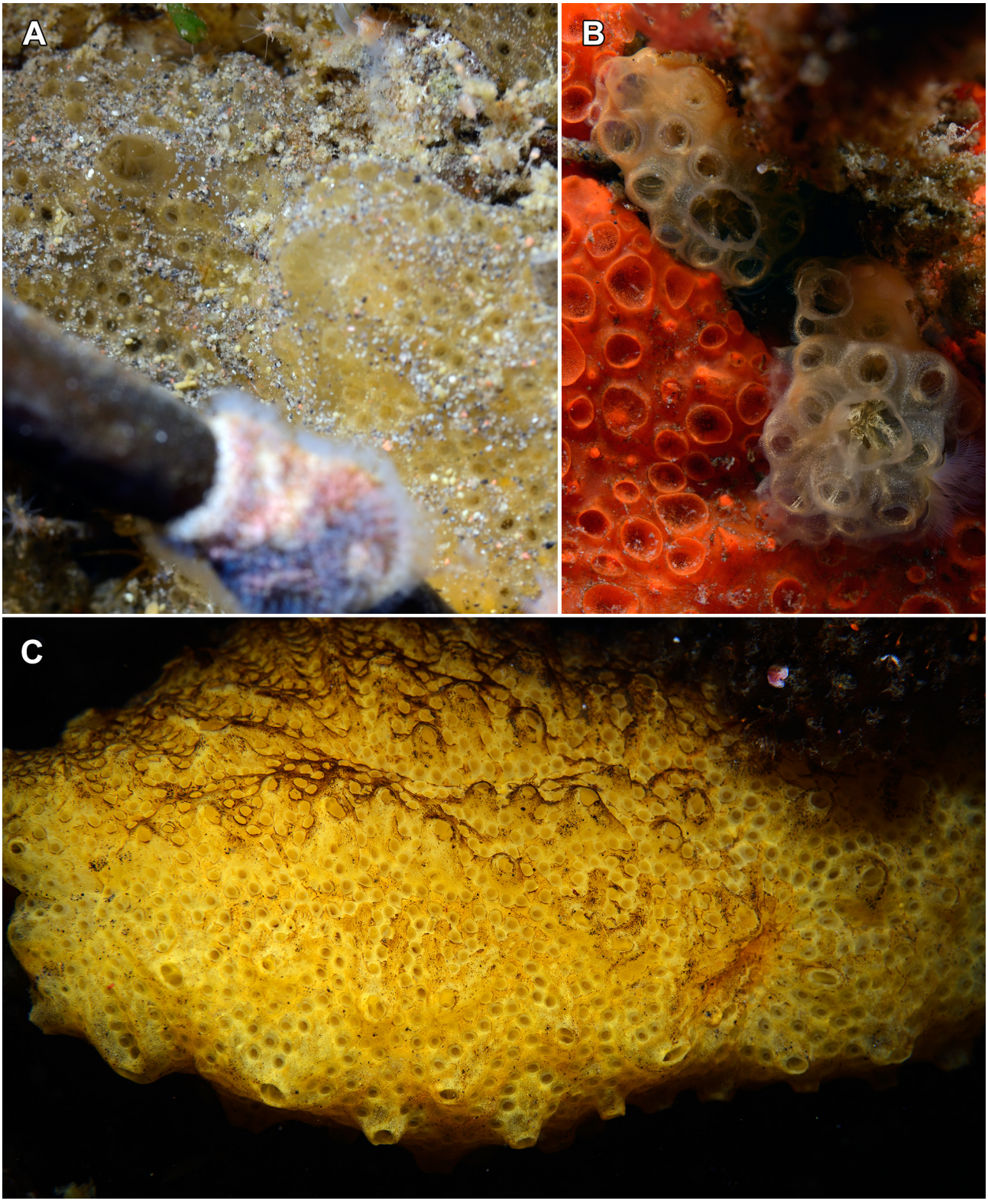

FIGURE 5. A, colony of *Aplidium spitzbergense*; B, two colonies of *Distaplia* sp.; C, colony of *Aplidiopsis pannosum*.

***Styela coriacea* (Alder et Hancock, 1848)**

Material examined. Matua Island, Point Kluv, intertidal pool, one specimen (#413).

Remarks. One small specimen collected in the intertidal pool.

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