

Northwestern Pacific ascidians (Tunicata: Ascidacea). Part 2. Order Phlebobranchia

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ABSTRACT: A taxonomy of phlebobranch ascidians from the NW Pacific coasts of Russia, including Bering Sea, Sea of Okhotsk and northern part of the Sea of Japan, is presented. Order Phlebobranchia currently comprises 8 families, 5 of which are represented in the region. Twenty-three species and 11 genera are recognized as valid in the region. Four new species are described: *Chelyosoma translucidum* sp.n., *Ascidia beringia* sp.n., *A. kurila* sp.n. and *A. vivipara* sp.n. All species known in this region are included and most of them redescribed based on newly collected specimens and/or on museum material. Identification keys and quality photographic images are provided to simplify a task of species identification for a wide range of biologists. Special attention is paid on nomenclature of discussed families, genera and species, a subject that received little attention from most ascidian experts previously.

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KEY WORDS: Biodiversity, Ascidacea, Ascidiidae, Agneziidae, Corellidae, Octacnemidae, Perophoridae, Sea of Okhotsk, Bering Sea, Sea of Japan, NW Pacific.

Асцидии северо-западной части Тихого океана. Часть 2. Отряд Phlebobranchia (Tunicata: Ascidacea)

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РЕЗЮМЕ: В работе дана таксономическая информация по всем асцидиям отряда Phlebobranchia, известным из Российских вод северо-западной части Тихого океана, включая Берингово море, Охотское море и северную часть Японского моря. Отряд Phlebobranchia в настоящее время объединяет 8 семейств, 5 из которых представлены в регионе. Двадцать три вида и 11 родов из встречающихся в регионе считаются валидными. Описаны 4 новых вида: *Chelyosoma translucidum* sp.n., *Ascidia beringia* sp.n., *A. kurila* sp.n. и *A. vivipara* sp.n. В работу включены все известные из данного региона виды и большинство из них переописано на основе новых сборов и/или музейного материала. Для облегчения идентификации асцидий широким кругом биологов даны ключи для определения всех таксонов. Особое внимание уделено номенклатуре обсуждаемых семейств, родов и видов — этому аспекту специалисты по данной группе уделяли очень мало внимания.

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КЛЮЧЕВЫЕ СЛОВА: Биоразнообразие, Ascidiacea, Ascidiidae, Agneziidae, Corellidae, Octacnemidae, Perophoridae, Охотское море, Берингово море, Японское море.

Introduction

Class Ascidiacea comprises three orders, Aplousobranchia, Phlebobranchia and Stolidobranchia. Members of Aplousobranchia known from Far Eastern Seas of Russia were described in the first part of the present work (Sanamyan, 2022). The present (the second) part includes all taxa belonging to the second order, Phlebobranchia, known from the eastern coasts of Russia and adjacent waters: western half of the Bering Sea, Pacific waters around Commander Islands and Kamchatka, Sea of Okhotsk and Kuril Islands and northern part of the Sea of Japan. For a detailed introductory text and important notes on nomenclature see Sanamyan (2022).

Material and methods

The significant part of the material, on which the present paper is based, was collected during cruise 56 of RV *Academik Oparin* in the summer 2019 (*Ak. Oparin-56*, expedition was conducted by G.B. Elyakov Pacific Institute of Bioorganic Chemistry and A.V. Zhirmunsky National Scientific Center of Marine Biology, Far Eastern Branch of Russian Academy of Sciences). In addition, the samples collected by other expeditions and persons were used (mostly stored in the Kamchatka Branch of Pacific Geographical Institute). The precise locality data are given in the “Material examined” sections under the description of each species. All dates in these sections are in Day.Month.Year format. The specimens are deposited in the Museum of the Institute of Marine Biology, A.V. Zhirmunsky National Scientific Center of Marine Biology FEB RAS, Vladivostok (MIMB) and in Kamchatka Branch of the Pacific Geographical Institute (KBPGI). The International Code of Zoological Nomenclature (ICZN 1999) is referenced as “Code”; relevant articles of the Code as “Article...”; International Commission on Zoological Nomenclature as “Commission”. For other details, including terminological preferences, methods of fixation, taking photographic images, see “Material and methods” section in Sanamyan (2022).

Taxonomy

KEY TO ORDERS AND FAMILIES OF ASCIDIACEA KNOWN FROM FAR EAST SEAS OF RUSSIA

1. Gut loop and gonad below branchial sac
order **Aplousobranchia** (see Sanamyan, 2022)
– Body not divided into regions, gut loop on the side of the branchial sac 2
2. Branchial sac usually with permanent longitudinal folds, sometimes they are reduced or absent; gonads often on both sides of the body; kidney present in some taxa
..... order **Stolidobranchia**
(will be described in the third part of this work).
– Branchial sac always flat or finely plicated, without distinct permanent folds; one gonad only, enclosed in the gut loop, no kidney (**Phlebobranchia**) 3
3. Deep-water ascidians with hypertrophied branchial siphon composed of two prominent lobes or with eight very large triangular lobes surrounding branchial orifice **Octacnemidae**
– Branchial siphon not modified 4
4. Stigmata straight 5
– Stigmata spiral or irregular 6
5. Solitary **Ascidiidae**
– Colonial or “social” (separate solitary zooids connected by stolons) **Perophoridae**
6. Internal longitudinal branchial vessels present, gut loop either distinctly on the right side or, at least, located along median mid-line, stigmata spiral or irregular **Corellidae**
– Internal longitudinal branchial vessels reduced completely or represented by simple or T-shaped papillae, gut loop on the left, stigmata spiral and usually very regular **Agneziidae**

Order PHLEBOBRANCHIA Lahille, 1886

Order Phlebobranchia comprises eight families, five of which, Ascidiidae, Agneziidae, Corellidae, Octacnemidae and Perophoridae are known from Far Eastern Seas of Russia. Almost all species belonging to this order inhabiting Far Eastern Seas of Russia are solitary and only *Perophora* (one or two species in the region) is colonial.

Three remaining families, members of which not known in the region covered by the present paper, are Ciallusiidae Huus, 1937, Dimeatidae Sanamyan, 2001

and Plurellidae Kott, 1973. Together they comprise ten species.

Ciallusiidae is a monotypic family containing single genus and species *Pterygascidia mirabilis* Sluiter, 1904, a characteristically looking stalked cylindrical species (see Sanamyan, Hissman, 2008, fig. 4B, photo of live specimen). It has some resemblance with *Ciona* but lacks epicardial sacs which are well developed in *Ciona* and other aplousobranch ascidians. Kott (2008) suggested a relationship of Ciallusiidae with ancestors of the family Agneziidae. *Pterygascidia mirabilis* is known from tropical Indo-Pacific and usually recorded at depths about 100–200 m.

Dimeatidae comprise two species of highly aberrant abyssal genus *Dimeatus* C. Monniot et F. Monniot, 1982, one is known from southern Atlantic and another from southern Pacific. *Dimeatus* is unique in having two large atrial openings and male and female ducts penetrating the test and open directly to exterior.

Plurellidae comprise two shallow-water tropical genera, solitary *Microgastra* Kott, 1985 (monotypic) and colonial *Plurella* Kott, 1973 (six species). In contrast to all other phlebobranch ascidians, in Plurellidae the gonads are not enclosed in the gut loop but embedded in the test.

Family Agneziidae C. Monniot et F. Monniot, 1991

The family comprises solitary phlebobranch ascidians with gut loop located on the left, spiral stigmata and longitudinal branchial vessels reduced completely or represented by bifid or simple papillae.

In older literature this family was known as Agnesiidae Huntsman, 1912. However, the type genus of Agnesiidae, *Agnesia* Michaelsen, 1898, is a junior homonym of *Agnesia* Koninck, 1883 (Mollusca), therefore Agnesiidae Huntsman, 1912a not valid (Article 39). C. Monniot & F. Monniot (1991a) proposed a new replacement name *Agnezia* C. Monniot et F. Monniot, 1991 for *Agnesia* Michaelsen and Agneziidae C. Monniot et F. Monniot, 1991 for Agnesiidae Huntsman, 1912. [Note that there is some inaccuracy in the interpretation of such nomenclatural acts in ascidian taxonomic literature and online databases. For instance, Young, Vazques (1997) stated that “the names of the genus *Agnesia* Michaelsen, 1898 and the family Agnesiidae Huntsman, 1912 were changed by Monniot & Monniot (1991a) to *Agnezia* nom. nov. and Agneziidae nom. nov. because the gastropod genus *Agnesia* Koninck, 1883 and its family Agnesiidae had taxonomic priority”. Such statements are not correct. C. Monniot & F. Monniot (1991a) did not change the existing names but created new names *Agnezia* and Agneziidae. The name *Agnesia* Michaelsen, 1898 still exists and still available, but invalid being junior homonym of mollusk genus *Agnesia* Koninck,

1883. Further, Agneziidae was suggested not because “gastropod ... family Agnesiidae had taxonomic priority”, the family Agnesiidae does not exist in Gastropoda, but because Article 39 says that “the name of a family-group taxon is invalid if the name of its type genus is a junior homonym”. Also, Agnesiidae and Agneziidae are not spelling variations (as stated in WORMS database, Shenkar *et al.*, 2023), but two different names. The former of them is not simply “unaccepted” (as stated in WORMS, a term of unclear meaning assuming a subjective opinion) but objectively invalid basing on Article 39.]

Kott (1985, 1998) recognized a subfamily Ciallusiinae Huus, 1937 within this family but later (Kott, 2008) removed it from Agneziidae and reinstated as a separate family Ciallusiidae.

Agneziidae includes four genera: *Adagnesia* Kott, 1963 (12 species), *Agnezia* C. Monniot et F. Monniot, 1991 (12 species), *Caenagnesia* Ärnäck, 1938 (three species) and monotypic *Proagnesia* Millar, 1955. They differ in degree of reduction of longitudinal vessels (reduced completely in *Proagnesia*, simple papillae in *Agnezia* and bifid papillae in *Adagnesia* and *Caenagnesia*) and the structure of the dorsal lamina (plain membrane in *Caenagnesia*, languets in all remaining genera).

Two genera, *Agnezia* and *Adagnesia*, are known in the region covered by the present work.

KEY TO GENERA OF THE FAMILY AGNEZIIDAE KNOWN FROM FAR EAST SEAS OF RUSSIA

1. Simple (not branched) papillae on transverse branchial vessels *Agnezia*
– T-shaped (with two terminal branches) papillae on transverse branchial vessels *Adagnesia*

Genus *Agnezia* C. Monniot et F. Monniot, 1991

Type species: *Agnesia glaciata* Michaelsen, 1898 by monotypy.

The main features of the genus are: gut loop clearly on the left; branchial sac lacks internal longitudinal vessels; stigmatic spirals (usually flat and square) arranged in transverse rows; transverse branchial vessels bear large simple (not branched) papillae; dorsal lamina represented by long triangular languets.

Agnezia comprises 12 species but taxonomic status of some of them is not clear. Three species are known from North Pacific. Two of them, *Agnezia himeboja* (Oka, 1915) and *A. orthenteron* (Redikorzev, 1941) are known from Far East Seas of Russia and described below. Third species, *A. septentrionalis* (Huntsman, 1912), is reported from British Columbia and SE part of the Bering Sea. It differs from *A. himeboja* and *A. orthenteron* in significantly more numerous transverse vessels and rows of stigmata.

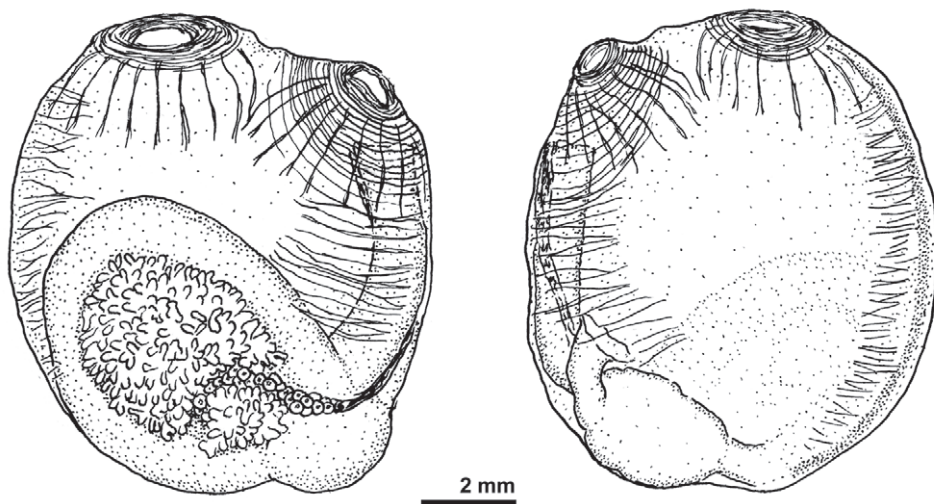


Fig. 1. *Agnezia himeboja* (after Sanamyan, 1998).

Рис. 1. *Agnezia himeboja* (по Sanamyan, 1998).

KEY TO SPECIES OF *AGNEZIA* KNOWN FROM FAR EASTERN SEAS OF RUSSIA

1. Four to 6 papillae on each transverse branchial vessel on each side of the body; gut loop voluminous, S-shaped; relatively shallow-water species
..... *Agnezia himeboja*
- Nine to 11 papillae on each transverse branchial vessel; gut loop small and almost straight; abyssal species..... *Agnezia orthenteron*

Agnezia himeboja (Oka, 1915)

Fig. 1.

Agnezia himeboja Oka, 1915: 1. Nishikawa, 1991: 1. Tokioka, 1949: 6.

Agnezia himeboja: Sanamyan, 1998: 106.

Agnezia sabulosa Oka, 1929: 152.

MATERIAL EXAMINED. None.

DESCRIPTION. This species was reported by Sanamyan (1998) from Atlasov Island (Northern group of Kuril Islands). The specimens were 5–12 mm in greatest dimension, with clear transparent test free from attached matter or hair-like outgrowths. Rather voluminous gut loop occupies a significant part of the left side of the body, its secondary loop is well marked and deep (Fig. 1). The branchial sac has six transverse double rows of flat spirals, ten spirals per row. Double rows are separated by five transverse vessels. Each transverse vessel has four to six simple papillae on each side of the branchial sac.

REMARKS. The original description of this species (Oka, 1915: 6) is based on many specimens from “Bucht von Tateyama, Prov. Awa”, Japan (Sea of Japan), 5–7 fathoms (9–12 m) and is quite detailed. The branchial sac of type specimens corresponds closely to that of the specimens from Atlasov Island: Oka (1915) reported 12 transverse rows (six double rows as appears from his drawing and description) with 11 spirals in each and five simple papillae on each transverse vessel on each side of the branchial sac. Oka (1915) says the specimens had clear test, occasionally with sparse sand grains. Nishikawa (1991) reexamined the type material and found that many specimens have posterior part of the body covered by many fine filamentous processes of the test, sometimes carrying some sand grains. He synonymized *Agnezia sabulosa* (Oka, 1929), described from Hakodate (Japan), 17–25 m, with *A. himeboja*, stating that the only reported difference between them is that in *A. sabulosa* the test is furnished wholly and densely with fine hair-like processes carrying sand and shell fragments.

The only other *Agnezia* species known from NW Pacific is abyssal *A. orthenteron* (see below). It differs from *A. himeboja* in its compact and almost straight gut loop and more numerous papillae on the transverse vessels of the branchial sac.

Van Name (1945: 200) inclined to believe that all known to him North Pacific species of *Agnezia* (he omitted *A. orthenteron*) are conspecific. He synonymized *A. septentrionalis*, originally described from British Columbia, with *A. beringia* (Ritter, 1913),

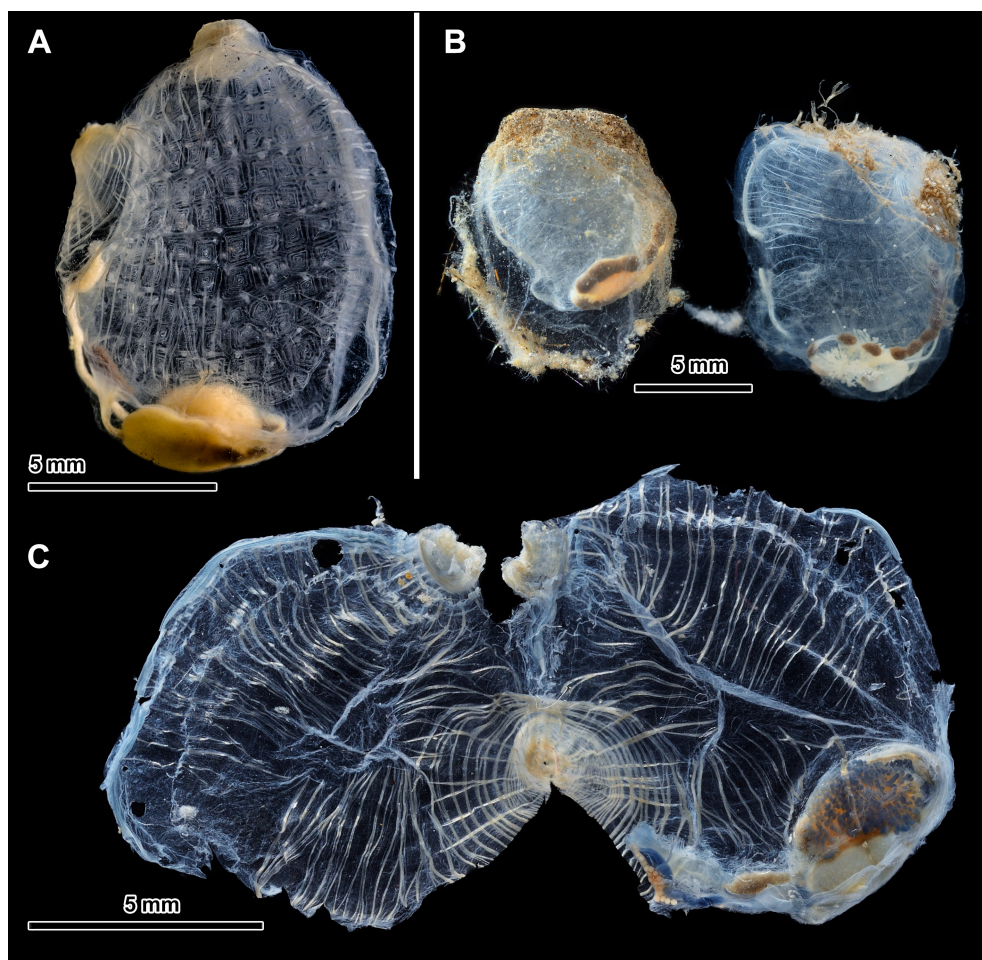


Fig. 2. *Agnezia orthenteron*. A — specimen with test removed; B — two intact specimens; C — opened specimen.

Рис. 2. *Agnezia orthenteron*. А — вид справа, туника удалена; В — два целых экземпляра; С — вскрытие.

reported from several stations in south-east part of the Bering Sea at about 26–70 m. This opinion is adopted in the present work. In addition, he suggested that Japanese *A. himeboja* and *A. sabulosa* also may be conspecific with *A. septentrionalis*, he wrote that all these species are “*closely related, not to make any stronger statement*”. However, according to Huntsman (1912b), *A. septentrionalis* has 11 or 12 transverse vessels on each side (twice as many as in *A. himeboja*), each with six to nine simple papilla, and two rows of spirals between each two transverse vessels (i.e. the total number of transverse rows of spirals about two times larger than in *A. himeboja*). At my opinion *A. septentrionalis* and *A. himeboja* cannot be conspecific, the differences in the structure of the branchial sac are significant. Kott (1985) also rejected synonymy of *A.*

septentrionalis and *A. himeboja* but she synonymized *A. himeboja* with *A. glaciata*, originally described from Terra del Fuego (the opinion not followed by Nishikawa, 1991 and Sanamyan, 1998 and not adopted in the present work).

In Far East Seas of Russia *Agnezia himeboja* was recorded only once, Sanamyan (1998) reported it from Atlasov Island (north group of Kuril Islands). The specimens were very numerous (about 150 specimens per square meter) in volcanic slag at the depth of 6–24 m.

Agnezia orthenteron (Redikorzev, 1941)
Figs 2, 3.

Agnezia orthenteron Redikorzev, 1941: 199.

Agnezia orthenteron: Sanamyan, Sanamyan, 2012: 64.

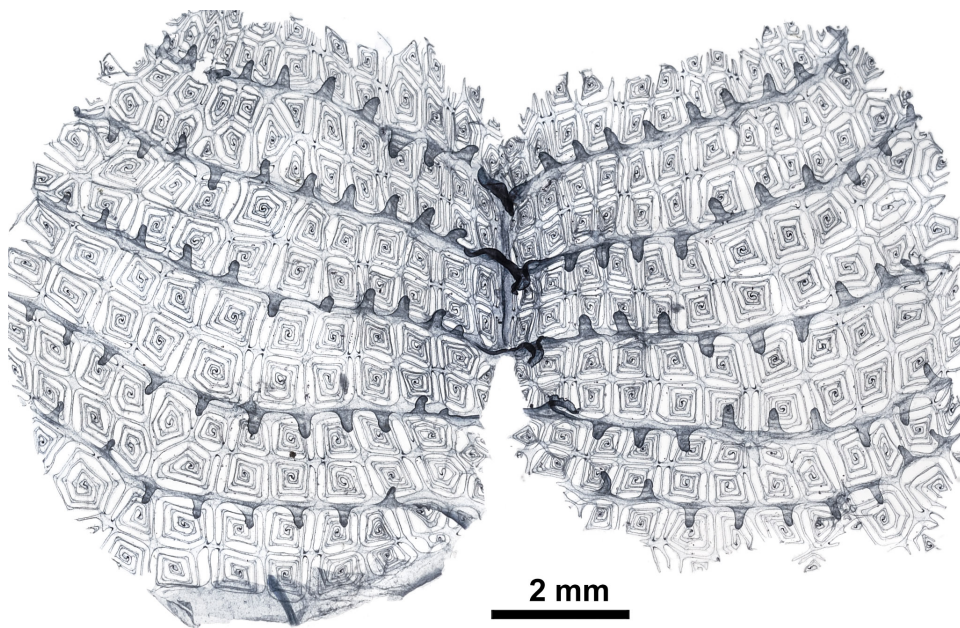


Fig. 3. *Agnezia orthenteron*, branchial sac (after Sanamyan, Sanamyan, 2012).

Рис. 3. *Agnezia orthenteron*, жаберный мешок (по Sanamyan, Sanamyan, 2012).

MATERIAL EXAMINED. RV *Ak. Lavrentyev*, expedition "SoJaBio", Sea of Japan: 44° 18.6270'N, 137°24.4079'E–44°18.4712'N, 137° 24.3985'E, 2545–2555 m, 16.08.2010, three specimens; 44°00.2607'N, 13731.1584'E – 44°19.2650'N, 137° 24.1206'E, 2511–2534 m, 16.08.2010, two specimens; 43°01.3064'N, 135°05.9562'E – 43°00.9363'N, 135° 06.5366'E, 2609–2655 m, 23.8.2010, one specimen.

DESCRIPTION. The specimens were previously described in details by Sanamyan, Sanamyan (2012). Intact preserved specimens are about 1 cm in height, the largest was 1.5 cm, laterally flattened. Very transparent test sometimes has rather long and tangled hair-like outgrowths proximally, sometimes lacks them. Fine sand grains or attached epibionts (hydroids) are present only around the siphons, otherwise the test is bare (Fig. 2B). Body wall thin, transparent, all internal organs, including the stigmata of the branchial sac are clearly visible through it (Fig. 2A). The musculature of the body consists of the following elements: 1) circular muscles around the siphons, they are better developed around the atrial siphon; 2) spaced radial siphonal muscles; 3) spaced transverse muscles crossing ventral mid-line (the endostyle), they are rather long and occupy a significant part of both sides of the body; 4) similar but slightly shorter muscles crossing mid-dorsal line (Fig. 2A, C). Visceral mass (the gut loop and gonad) occupies rather small part of the body.

The branchial sac has six double rows of very regular flat square spiral stigmata with 10 or 11

stigmata in each row. Stigmata are not interrupted, mostly in four coils. Double rows are separated by five transverse vessels, each with nine to 11 simple papillae on each side of the body and a long dorsal languet slightly displaced to the left side (Fig. 3).

The gut forms short, narrow and closed primary loop and widely open shallow secondary loop. The gonads are in the gut loop and on its internal side, male and female ducts open together near the anus.

REMARKS. This species is known from two records only. Its original description (Redikorzev, 1941) is based on one specimen from the Sea of Japan, 2090 m. Several specimens described by Sanamyan, Sanamyan (2012) and redescribed in the present work also were collected in the abyssal zone of the Sea of Japan. The species is distinguished from shallow-water species of *Agnezia* known North Pacific by its small and almost straight gut loop and by numeric characters of the branchial sac (number of rows, vessels and papillae on them).

Genus *Adagnesia* Kott, 1963

Type species: *Adagnesia opaca* Kott, 1963 by original designation.

Adagnesia has all the features characteristic for *Agnezia* but the papillae on the transverse branchial vessels are T-shaped, with two short and usually thin processes at the apex, usually interpreted as the rudiments of longitudinal branchial vessels.

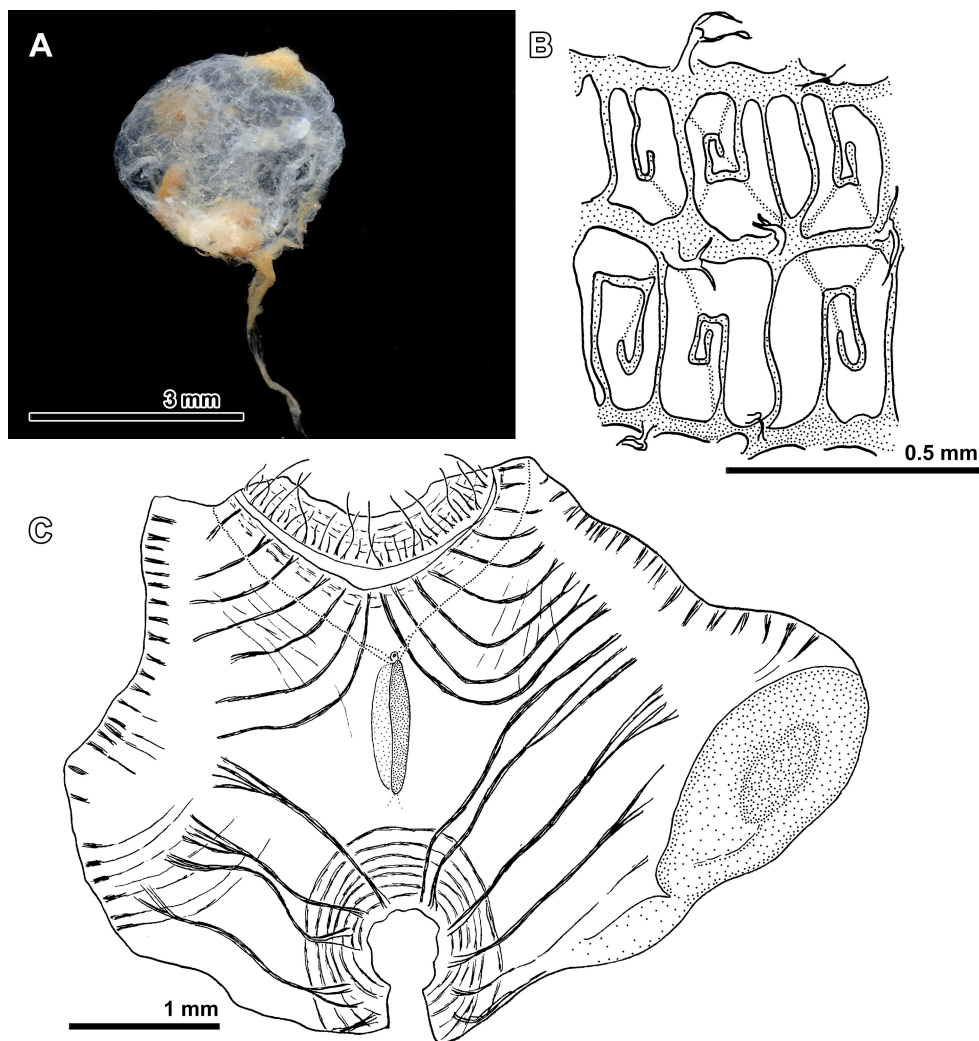


Fig. 4. *Adagnesia pacifica*. A — specimen from Sea of Okhotsk; B — branchial sac; C — specimen opened ventrally. (B and C after Sanamyan, Sanamyan, 1998).

Рис. 4. *Adagnesia pacifica*. A — экземпляр из Охотского моря; B — жаберный мешок; C — вскрытие. (B и C по Sanamyan, Sanamyan, 1998).

Adagnesia includes 12 valid species, many of them are deep-water. Two species, *A. pacifica* Sanamyan et Sanamyan, 1998 and *A. vesiculiphora* Nishikawa, 1982, are known in NW Pacific, but only *A. pacifica* was reported in Far East Seas of Russia. *Adagnesia vesiculiphora* is a shallow water species known from two records from Japan (Nishikawa, 1982, 1991). It has a very characteristic appearance (the specimens have long thin stalks) and cannot be confused with abyssal *A. pacifica*.

Adagnesia pacifica Sanamyan et Sanamyan, 1998
Fig. 4.

Adagnesia pacifica Sanamyan, Sanamyan, 1998: 209.
MATERIAL EXAMINED. RV *Ak. Lavrentyev*, expedition "SokhoBio", Sea of Okhotsk: 46°08.7'N, 145°59.8'E, 3304 m, 10.07.2015, several specimens.

DESCRIPTION. Type specimens, described by Sanamyan & Sanamyan (1998) are 3–10 mm in diameter, sometimes pear-shaped, narrowed posteriorly,

with clear translucent test without attached particles. Body musculature is composed of: circular siphonal muscles; spaced muscle bands radiating from both siphons and extending a half or more of the body height and ending abruptly at nearly one line; short muscles crossing mid-dorsal and mid-ventral lines but not the space between the siphons (Fig. 4C). The prepharyngeal bands forms no distinct dorsal V. Spiral stigmata make 1–1.5, sometimes 2 turns (Fig. 4B). They are arranged in 9–12 single transverse rows separated by transverse vessels, 10–12 spirals in each row and about the same number of T-shaped papillae in each transverse vessels on each side.

REMARKS. Original description of this species is based on about 50 specimens collected at 4294–4200 m in the south-eastern part of Bering Sea.

The specimens of *Adagnesia* collected in the Sea of Okhotsk (listed in the “Material examined” section above) are very small, the largest is about 3 mm in diameter, and have long process of the test on posterior end of the body (Fig. 4A). They have poorly developed gonads and considered to be young specimens of the *A. pacifica*. Unfortunately, the condition of this material is not good, the specimens were initially fixed in alcohol and I even failed to remove the test from very thin body to reveal all necessary details of their morphology.

Family Corellidae Lahille, 1888

The family comprises eight genera of solitary phlebobranch ascidians in which the gut loop is located on the right side. The stigmata are spiral in *Chelyosoma* Broderip et Sowerby, 1830, *Corella* Hancock, 1870 and *Corellopsis* Hartmeyer, 1903, straight in *Abyssascidia* Herdman, 1880, *Rhodosoma* Ehrenberg, 1828 and *Dextrogaster* F. Monniot, 1962, irregular oval or absent in *Xenobranchion* Årnbäck, 1950 and *Clatripes* F. Monniot et C. Monniot, 1976. The latter genus is unusual in the position of the ovary outside of the gut loop (unique feature for Phlebobranchia) and its position within Corellidae is problematic.

The family is small, about 40 species are known, most of them are concentrated in *Corella* (18 or 20 species) and *Chelyosoma* (10 species). Genera *Corellopsis*, *Dextrogaster* and *Clatripes* are monotypic and the remaining genera contain two or three species each.

Three genera, *Chelyosoma*, *Corella* and *Corellopsis* are known from the Far Eastern Seas of Russia.

KEY TO GENERA OF THE FAMILY CORELLIDAE KNOWN FROM FAR EAST SEAS OF RUSSIA

1. Body sessile, its distal part modified into a definite disc usually covered with horny test plates
..... *Chelyosoma*
- No definite disc 2

2. Body sessile or on wide soft peduncle, internal longitudinal branchial vessels present at least in some parts of branchial sac *Corella*
- Body pedunculated, peduncle thin and wiry, longitudinal vessels absent, reduced to T-shaped papillae *Corellopsis*

Genus *Chelyosoma* Broderip et Sowerby, 1830

Type species: *Chelyosoma macleayanum* Broderip et Sowerby, 1830 by monotypy.

The genus comprises ten species which have characteristic appearance with the upper part of the body modified into a definite disc covered with thickened test plates. *Chelyosoma inaequale* Redikorzev, 1913 is the only species lacking plates but otherwise the shape of its body and the presence of the disc left no doubt on its generic assignment.

Internally most species of the genus are remarkably similar. All have numerous filiform tentacles, voluminous gut loop embedded into parenchymatous tissue on the right side of the body and flat branchial sac with numerous well developed internal longitudinal vessels supported by short papillae; transverse vessels, instead, often are poorly developed and obscured by secondary branches and anastomoses. The shape of the stigmata and the complexity of the branchial sac may be in some degree species specific, but in most cases hard to use in practice because of strong dependence on the age and size of the specimen: the branchial sac is usually more complicated in larger specimens and the spiral stigmata are more regular in smaller. The arrangement of the horny plated on the disc is currently considered a reliable feature to delimitate *Chelyosoma* species (e.g. see Nishikawa, 1991). Oka (1928) defined three groups of Japanese *Chelyosoma* species basing on the arrangement of the plates.

The first group includes the species lacking intermediate plates (the plates on the disc located between the single or paired central plate and the marginal plates): *C. macleayanum* Broderip et Sowerby, 1830 and *C. orientale* Redikorzev, 1911. Described below *C. translucidum* sp.n. also belongs to this group.

The second group includes the species with two or more intermediate plates and unpaired (single) central plate: *C. siboja* Oka, 1906 and *C. yezoense* Oka, 1928.

The third group includes the species with intermediate plates and with paired central plate: *C. sibogae* Sluiter, 1904 and *C. dofleini* Hartmeyer, 1906. Both NE Pacific species, *C. columbianum* and *C. productum* belong to this group.

Finally, we can define the fourth group for the species lacking plates on the disc. Formally only one such species is described, *C. inaequale* Redikorzev, 1913, but Van Name (1945: 209) reported three similar (unnamed) specimens which he thought are allied but distinct from *C. inaequale*.

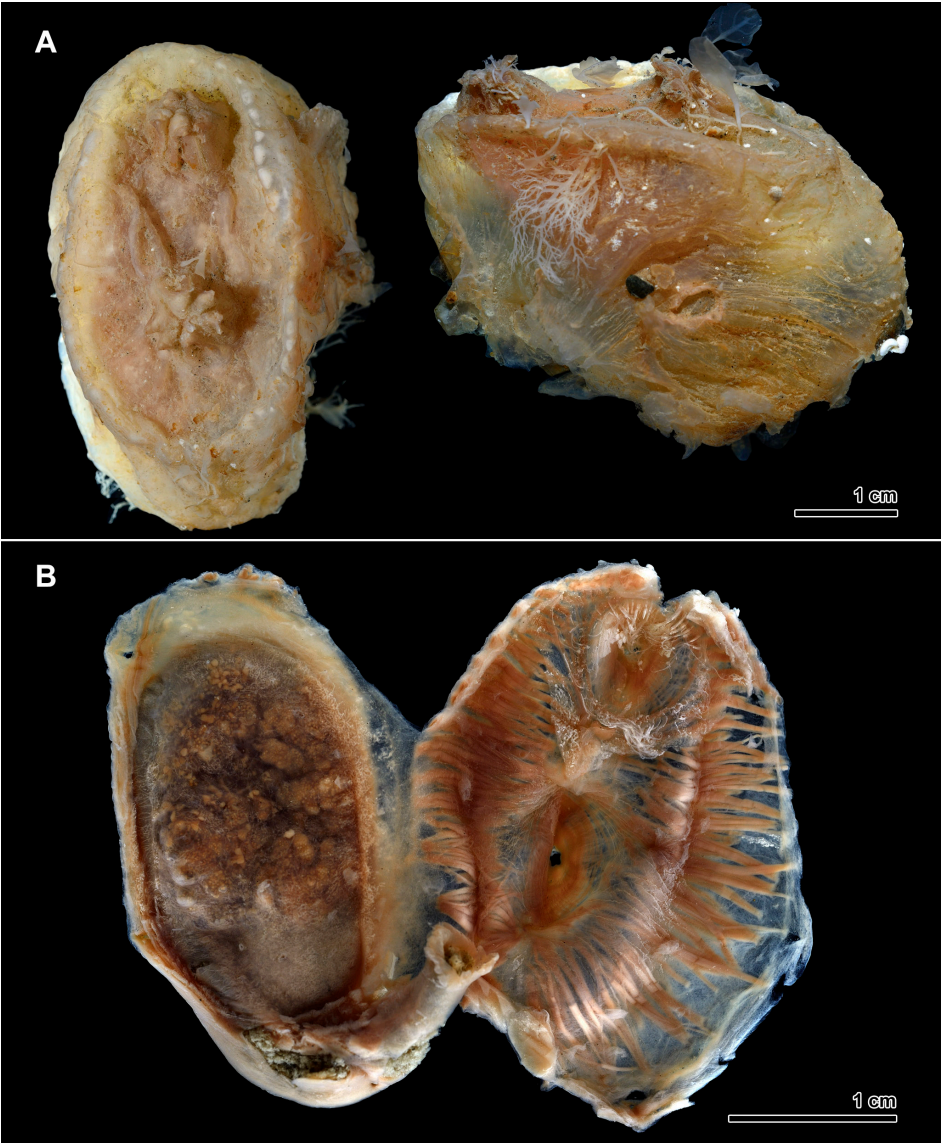


Fig. 5. *Chelyosoma inaequale*. A — external appearance; B — opened specimen.
Рис. 5. *Chelyosoma inaequale*. A — внешний вид; B — вскрытие.

Four species are known with certainty from Far Eastern Seas of Russia. The records of *C. macleayanum* in this region are most probably misidentifications of *C. orientale* (see discussion under this species).

KEY TO SPECIES OF *CHELYOSOMA* KNOWN FROM FAR EASTERN SEAS OF RUSSIA

- 1. Disc without plates..... *C. inaequale*
- Disc covered with plates2
- 2. Two central plates, no intermediate plates
.....*C. translucidum* sp.n.

- One central plate3
- 3. No intermediate plates, 6–10 marginal plates.....
.....*C. orientale*
- At least two intermediate plates, 14 or more marginal
plates*C. yezoense*

Chelyosoma inaequale Redikorzev, 1913
Figs 5, 6.

Chelyosoma inaequale Redikorzev, 1913: 206; 1941:
199. Van Name, 1945: 209. Abbott, 1961: 140. Sanamyan,
1998: 111.

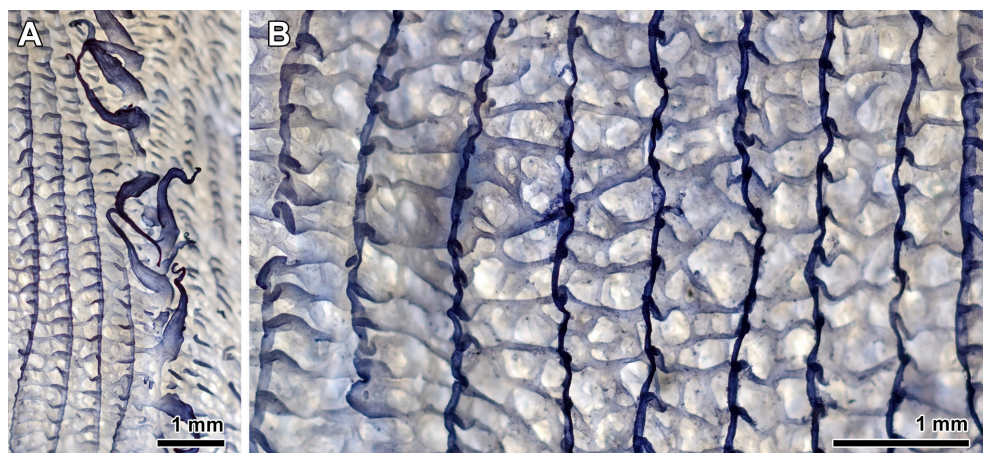


Fig. 6. *Chelyosoma inaequale*. A — dorsal languets; B — branchial sac.

Рис. 6. *Chelyosoma inaequale*. A — спинная пластинка; B — жаберный мешок.

MATERIALEXAMINED. Sea of Okhotsk, Shantar Island, Yakshina Bay (~54°49'N, 137°29'E), 10 m, in *Laminaria* kelp, collector B. Sheiko, 12 specimens.

DESCRIPTION. Most specimens are large, 4–6 cm in greatest dimension. They are attached to small stones and/or to each other forming clusters. Unlike other *Chelyosoma* species, the test is rather thick and soft, often in part overgrown with algae. The body is, therefore, not rigid, most specimens are shapeless, potato-like. In general, the consistence of the test and a whole habitus resemble large specimens of *Molgula* (e.g. *M. retortiformis*) rather than *Chelyosoma*. The distal disc, characteristic for the genus, always present although in some specimens may be not clearly defined. The siphons are placed asymmetrically on the disc, the branchial is closer to its margin, the atrial has a more central position. Both siphons have six triangular lobes with prominent sharp tips. The test of the siphonal lobes is thinner and firmer than the test of the disc and in some specimens may show a hint of the presence of the siphonal plates. The test of the disc lacks any plates or grow lines. The disc is surrounded by well-defined raised rim with a chain of low whitish tubercles on its margin (Fig. 5A).

The musculature of the body is much stronger than in other *Chelyosoma* species. It is confined to the upper part of the body and the disc and consists of numerous crowded, rather long and thick muscle bands crossing the margin of the disc and extending to some distance down the body. There are strong circular and much weaker sparse radial siphonal muscles (Fig. 5B).

Branchial tentacles are long, filiform, numerous and difficult to count, about 200 in number. The prebranchial band makes a simple circle (without undulations), it runs close a ring of the branchial tentacles dorsally but far from it on the ventral and

lateral sides. Ventrally the lamella of the prebranchial ban becomes thick and high and makes a shallow V. Simple wide funnel shaped dorsal tubercle displaced to the left branch of the dorsal V and has simple transverse slit-like opening. The tissue of the branchial sac is thick, composed mostly of short, laterally flattened anastomosed vessels (Fig. 6B). In a single small specimen (18 mm), present in the material examined, the spiral arrangement of the stigmata could be seen. We counted 22 to 28 internal longitudinal branchial vessels on each side. Dorsal languets are long and spaced (Fig. 6A).

The gut loop and gonads form a visceral mass occupying the whole right side of the body and embedded into parenchymatous tissue which obscures details of its structure. The rectum is short and the anal margin obscurely lobed.

REMARKS. *Chelyosoma inaequale* differs from all other *Chelyosoma* species by lack of plates on the disc and therefore is easy to identify. It seems that it can fold the disc over the apertures in emergency, a feature resembling that of *Rhodosoma turcicum* (Savigny, 1816).

The original description (Redikorzev, 1913) is based on the material from the Sea of Okhotsk (exact location not specified), Van Name (1945) and Abbott (1961) reported several specimens from Alaskan coast north of Bering Strait.

Chelyosoma orientale Redikorzev, 1911 Figs 7, 8.

Chelyosoma orientale Redikorzev, 1911: 146; 1941: 198. Sanamyan, 1998: 112.

? *Chelyosoma ochotense* Redikorzev, 1911: 143.

? *Chelyosoma macleayanum*: Redikorzev, 1941: 197. Sanamyan, 1998: 112.

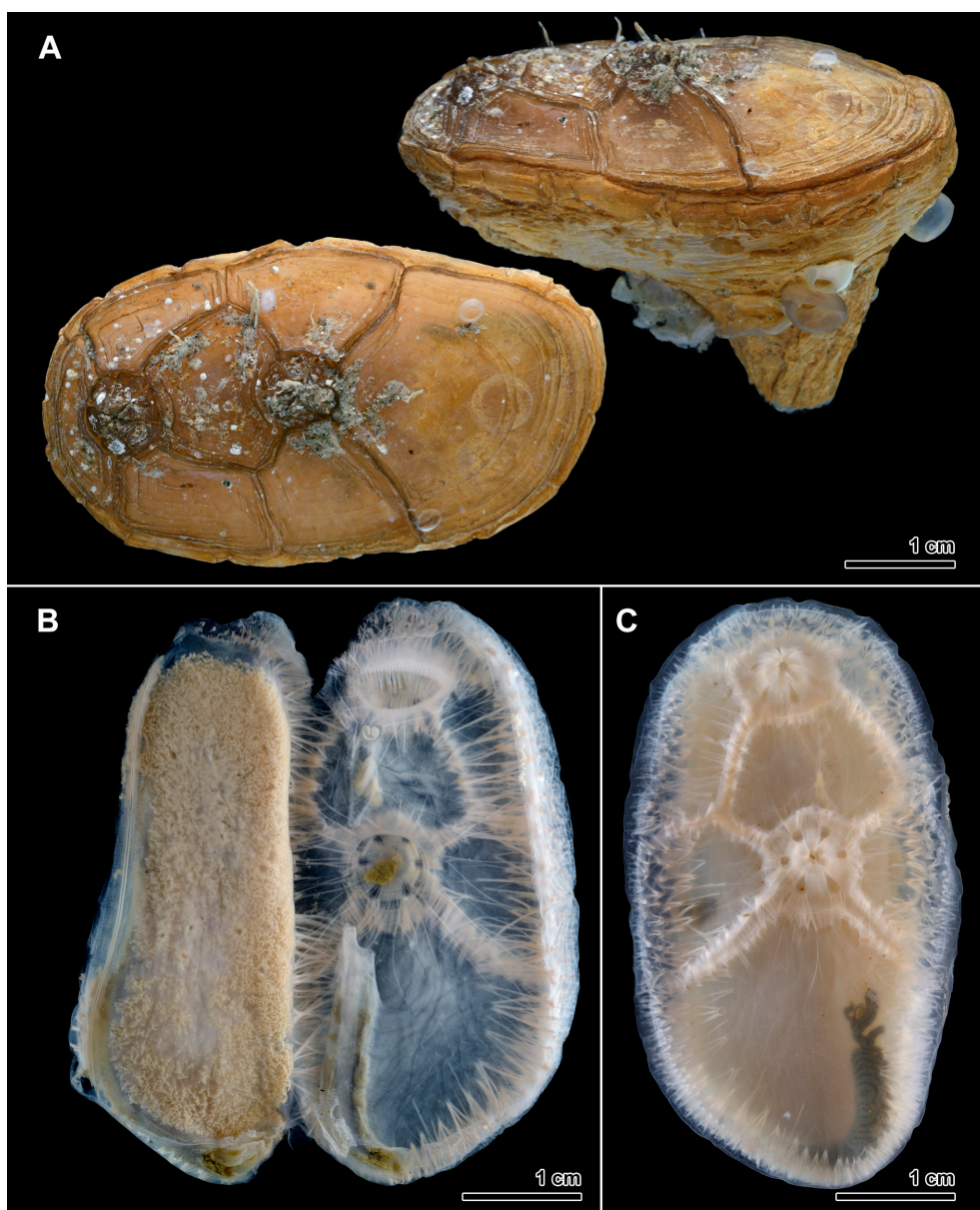


Fig. 7. *Chelyosoma orientale*. A — external appearance; B — opened specimen; C — top view of specimen with test removed.

Рис. 7. *Chelyosoma orientale*. А — внешний вид; В — вскрытие; С — вид сверху, туника удалена.

MATERIALEXAMINED. RV *Ak. Oparin*, St. 44, Sakhalin Island, Severny Bay, 54°31.5'N, 140°44.7'E, 82–80 m, 31.07.2019, two specimens.

DESCRIPTION. Two specimens in the material, 3 and 6 cm along the long axis of the disc. The test is thin but firm, opaque, brown. The body is rather low. The distal disc has a form of an elongated oval, slightly convex, without raised rim. The apertures

asymmetrically placed, the branchial is rather close to the anterior margin of the disc, the atrial is almost at the center of the disc and both slightly displaced to the right side. The plates on the disc are strongly developed. Each aperture is surrounded by six triangular plates; there is one central plate between the apertures and six symmetrically arranged marginal plates (Fig. 7A). All plates show distinct lines of grow.

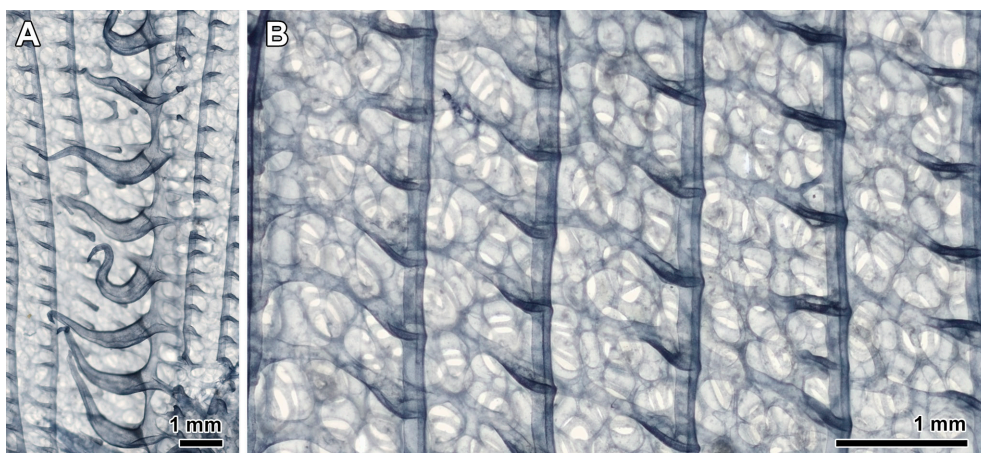


Fig. 8. *Chelyosoma orientale*. A — dorsal languets; B — branchial sac.

Рис. 8. *Chelyosoma orientale*. А — спинная пластинка; В — жаберный мешок.

The body removed from the test is strongly flattened laterally. Despite large size of the examined specimen the body wall is rather thin and transparent. The musculature is not strong. Weak circular muscles are limited to the siphons and do not extend into the body wall. Radial siphonal muscles form six wide but short bunds composed of many crowded muscle fibers in the siphonal lobes; in addition, sparse thin and long muscles run from the apertures to the periphery of the disc. Short crowded muscle bands connect adjacent plates on the disc and cross the margin of the disc (Fig. 7B, C).

The branchial tentacles are thin and long, very numerous (more than 200). The prepharyngeal band runs on some distance from the ring of the tentacles and makes deep and narrow (sharp) V dorsally. The dorsal tubercle is on the left from the dorsal V, rather large, with incurved horns, open interval directed forward (to the branchial aperture). The dorsal languets are rather wide and spaced. The branchial sac in large specimen has about 40–45 internal longitudinal vessels on each side. Transverse branchial vessels are present but in some parts of the branchial sac are barely recognizable and obscured by numerous irregular anastomosing side branches and radial parastigmatic vessels (Fig. 8). The stigmata form spirals of one to two turns.

The visceral mass occupies the whole right side of the body. Profusely developed gonad and parenchymatous tissue completely hides details of the structure of the alimentary tract. The rectum is long, the anus, in examined specimen, is not lobed and has a smooth margin.

REMARKS. This is the most common species of *Chelyosoma* in the Sea of Okhotsk. The specimens often attain a large size (Redikorzev, 1941 reported a specimen 66 mm in length). The species may be found attached to stones or growing on sandy or soft bottom,

in the latter case the thick root-like outgrowths of the test (resembling rhizoids of *Laminaria*) are developed. The identification of large specimens of *C. orientale* is easy, the external appearance with only one central plate and a limited number (usually six but sometimes more, rarely up to ten) of robust horny marginal plates is characteristic. Redikorzev (1911, 1941) attached too much importance to the structure of the branchial sac as a distinguishing feature of this species. According to him the branchial sac in this species is unique in complete absence of the transverse branchial vessels and by the unique shape (oval) of stigmata. Indeed, in the older specimens the structure of the branchial sac becomes more complex due to the gradual development of secondary branches of transverse vessels and by the thickening of the radial parastigmatic vessels which may obscure spirals, but normally the spirals remain recognizable and the transverse vessels are present and not disappear completely. Similarly, I'm not inclined to assign much taxonomic value to minor variations in the structure of dorsal tubercle which Redikorzev (1911) used to distinguish his species as an additional feature.

Chelyosoma ochotense Redikorzev, 1911 is probably a synonym, it is based on three specimens from the Sea of Okhotsk and was not recorded again. The specimens had ten marginal plates and simpler structure of the branchial sac with better defined spirals. Otherwise they are not distinguishable from *C. orientale*. All records of *C. macleayanum* from the Sea of Okhotsk (including a record of Sanamyan, 1998) are probably based on young specimens of *C. orientale*. Sanamyan (1998) followed Redikorzev (1911) in distinguishing *C. macleayanum* from *C. orientale* by the presence of spiral stigmata in the former and oval stigmata in the latter species. As was shown above, *C. orientale* also has spiral stig-

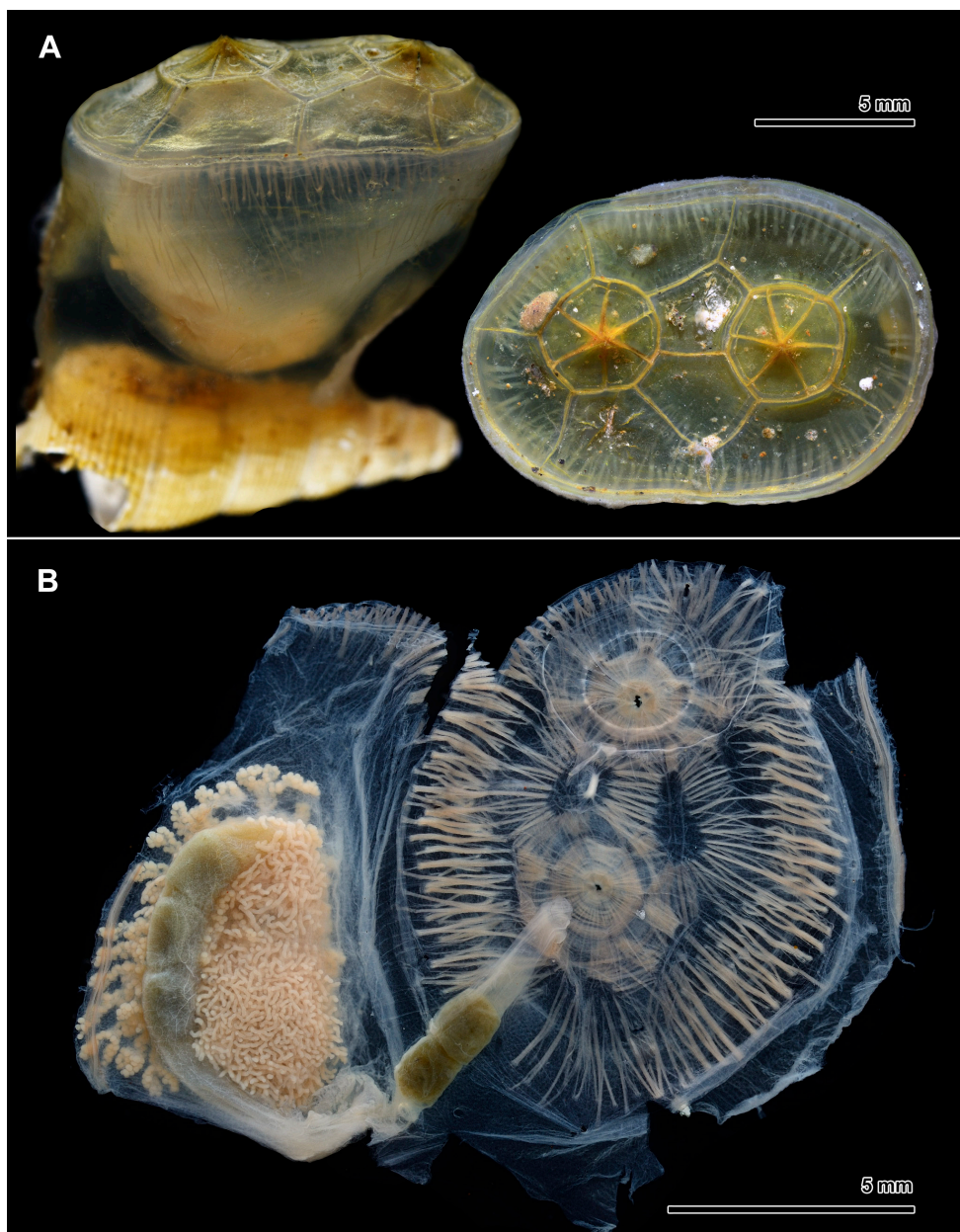


Fig. 9. *Chelyosoma translucidum* sp.n., A — external appearance (paratype MIMB 47317); B — opened specimen (holotype).

Рис. 9. *Chelyosoma translucidum* sp.n., A — внешний вид (паратип MIMB 47317); B — вскрытие (голотип).

mata while the oval structures may be formed in the older specimens by secondary development of the branchial vessels.

Chelyosoma orientale is known from all Far Eastern Seas of Russia and is especially abundant in the Sea of Okhotsk (Redikorzev, 1941).

Chelyosoma translucidum sp.n.

Figs 9, 10.

Chelyosoma columbianum: Sanamyan, 1998: 110; Sanamyan, Sanamyan, 2006: 309.

Not *Chelyosoma columbianum* Huntsman, 1912a: 124; 1912b: 126.

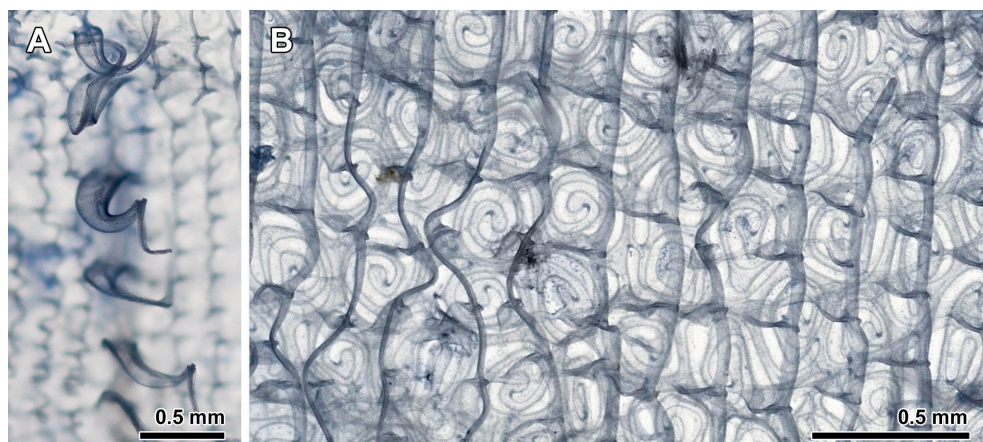


Fig. 10. *Chelyosoma translucidum* sp.n., holotype. A — dorsal languets; B — branchial sac.

Рис. 10. *Chelyosoma translucidum* sp.n., голотип. А — спинная пластинка; В — жаберный мешок.

MATERIAL EXAMINED. Holotype MIMB 47316: *Ak. Oparin-56*, St. 4, Urup Island (Pacific side), 45°55.2'N, 150°15.8'E, 169–150 m, 27.06.2019, one specimen. Paratypes: MIMB 47317, St. 4, Urup Island (Pacific side), 45°55.2'N, 150°15.8'E, 169–150 m, 27.06.2019, one specimen; MIMB 47318, St. 2, Urup Island (Pacific side), 45°38.2'N, 149°53.1'E, 253–222 m, 27.06.2019, three specimens.

DESCRIPTION. All specimens are small, the largest is 10 mm in height and 16 mm in width. Some of them are attached to small objects by more narrow posterior end (Fig. 9A). The test is thin and transparent, rigid and rather firm, with yellowish tint. The distal disc is wide oval, flat or slightly convex, in one specimen with slightly raised rim, in all others the rim is not raised. The siphons are located on the disc almost symmetrically, or slightly asymmetrically (as in most other *Chelyosoma* species). There are the usual 12 triangular siphonal plates (six on each siphon), two pentagonal central plates and seven or eight tetragonal or pentagonal marginal plates (Fig. 9A). The plates have no lines of grow.

The body removed from the tunic is very thin and transparent. The body musculature consists of a complex set of muscle fibers confined to the disc. Short radial muscle bands together with circular siphonal muscles form a complex hexagonal pattern around the apertures (Fig. 9B). Many short muscle bands cross the margin of the disc. Bands of short muscles cross a line separating two central plates; similar muscle bands connect each central plate with two adjacent marginal plates. Transverse muscles connecting adjacent marginal plates with each other are poorly developed or absent.

The tentacles are thin and numerous. The pre-branchial band runs as a light line on a significant distance from the ring of the tentacles. The dorsal

tubercle is funnel-shaped with a simple transverse slit. The branchial sac has about 35 internal longitudinal vessels on each side. The stigmata form regular not interrupted and almost flat spirals of two turns. The dorsal languets are long and spaced.

The gut loop occupies a half of the right side of the body. The stomach is voluminous, completely hidden by numerous thin branches of male gonad located in the gut loop. The ovary is composed of many branches located between the endostyle and the intestine and between the gut loop and body wall. The rectum is long and the anus is bilobed.

REMARKS. The most significant distinguishing feature of the present species is the presence of two central plates connected by muscle fibers and the absence of intermediate plates. Five specimens from the present material correspond exactly to the specimens from Commander Islands and from Alaska Bay described by Sanamyan (1998) and Sanamyan & Sanamyan (2006) which at that time with some hesitation were assigned to *C. columbianum*. The body shape and the musculature of the disc, figured by Sanamyan (1998, fig. 7C) are characteristic and identical to those of the present specimens in all minor details. The specimens from Alaska described by Sanamyan, Sanamyan (2006: 309) have two central plates connected by short muscles, 8–11 marginal plates and “none of the 25 examined specimens had intermediate plates that Huntsman (1912b) recorded for this species”. Huntsman (1912a, b) based his description of *C. columbianum* on 35 specimens collected in several locations in British Columbia. According to Huntsman (1912a: 124) his species has typically “2 central, 12 marginal and 2 left intermediate plates, but there is a fairly wide range of variation”. In his next paper (Huntsman 1912b: 126) he gave more details on the range of variations: “there may be an

additional central plate, only one or several additional intermediate plates on the left side, intermediate plates on the right side, larger or smaller number of marginal plates, etc.” It is clear from his text, that all his 35 specimens had intermediate plates (which sometimes are differently arranged or slightly vary in number). In contrast, none of the numerous specimens from Alaska, Commander Islands and Kuril Islands reported by Sanamyan (1998), Sanamyan & Sanamyan (2006) and the present work exhibit any traces of intermediate plates. The number of specimens examined by mentioned authors is large enough to ensure that the discussed specimens belong to two different species. Another NE Pacific species, *C. productum*, lacks bands of short muscles connecting adjacent plates (see Van Name, 1945). In the present species these muscle bands are well developed.

Among Japanese species paired central plates have only *C. sibogae* Sluiter, 1904 and *C. dofleini* Hartmeyer, 1906 (see Sluiter, 1904; Hartmeyer, 1906 and Oka, 1928), but they have intermediate plates and the total number of the plates is much larger than in the present species.

Chelyosoma translucidum sp.n. has a wide distribution in cold waters of North and NW Pacific and is known from Alaska Gulf, Commander Islands and Urup Island (southern group of Kuril Islands).

Chelyosoma yezoense Oka, 1928
Figs 11, 12.

Chelyosoma yezoense Oka, 1928: 397. Nishikawa, 1991: 70.

MATERIAL EXAMINED. *Ak. Oparin-56*, St. 7, Urup Island (Sea of Okhotsk side), 45°52.2'N, 149°37.0'E, 142 m, 28.06.2019, one specimen.

DESCRIPTION. The specimen has a form of a rather high laterally flattened cylinder, 4 cm in height and 3.2 cm in maximal diameter over the distal disc. The test is cartilaginous, thin but rigid, translucent, of dirty brownish-yellow colour. The disc is concave and has a high raised rim. Each siphon is surrounded by six triangular plates. The siphons are wide, symmetrically placed on equal distances from the disc margin and occupy a significant space on the disc. There is one small rectangular central plate; two pentagonal intermediate plates and 14 marginal plates (Fig. 11A). Lines of grow are distinguishable on some plates.

The body muscles, as in all *Chelyosoma* species, are confined to the disc. Radial and circular siphonal muscles form a complex hexagonal pattern around each aperture (Fig. 11B). Numerous thick muscle bands cross the margin of the disc, but no special muscles connecting central and intermediate plates.

The branchial tentacles are of several distinct size orders, with numerous small tentacles inserted between about 30 long ones. Prebranchial band makes an almost perfect circle on some distance from the ring

of tentacles; dorsal V is shallow and wide. Funnel-shaped dorsal tubercle has a simple long transverse slit, it lies outside of the dorsal V, on the left side of it. The dorsal languets are long and crowded. The branchial sac has about 60 internal longitudinal vessels on each side. Transverse branchial vessels are thin and irregular due to numerous anastomosing side branches intermingled with the radial parastigmatic vessels. The stigmata form deep funnels, the spirals are regular, not interrupted, of two turns.

The gut loop occupies about a half of the right side of the body where it, together with the gonads and the surrounding parenchymatous tissue forms a round visceral mass. The rectum is long; the anal margin has six rounded lobes.

REMARKS. The gross morphology with much elongated body, concave disc and a clear border around it, and the number of lateral plates (14) resemble closely *C. productum* as figured by Van Name (1945, figs 119 and 120). *Chelyosoma productum*, however, has two central plates, a difference usually regarded as taxonomically important for species delimitation in *Chelyosoma*. Among Japanese species the most similar is *C. yezoense*. Originally it was described from the Pacific coast of Hokkaido (Oka, 1928). In the arrangement of the plates, the present specimen is in agreement with Oka's (1928) original description who described and figured a specimen with one central plate, two intermediate and 17 marginal plates. However, Oka (1928) especially noted that in *C. yezoense*, in contrast to *C. sibogae* Oka, 1906 (and in contrast to the present specimen), the disc is not concave and the raised border around it not developed. We inclined to believe that this feature may be variable (e.g. see description of *C. translucidum* sp.n. above) and in the present paper assign the specimen from Urup Island (southern group of Kuril Islands) to *C. yezoense*. Previously *C. yezoense* was known only from Hokkaido (Oka, 1928; Nishikawa, 1991).

Genus *Corella* Hancock, 1870

Type species: *Ascidia parallelogramma* Müller, 1776 by subsequent designation by Hartmeyer (1924).

Synonyms: *Corynascidia* Herdman, 1882c and *Corelloides* Oka, 1926.

The main features of the genus include: gut loop clearly on the right; branchial sac with stigmatic spirals arranged in transverse rows; internal longitudinal vessels sometimes interrupted, supported by long papillae rising from transverse vessels.

In the original description Hancock (1870) indicated the authorship of this genus as “Alder & Hancock, MS”. According Article 50.1 authorship of this genus should be attributed to Hancock (1870) but not to “Alder & Hancock” as currently almost universally accepted (e.g. Kott 1985).

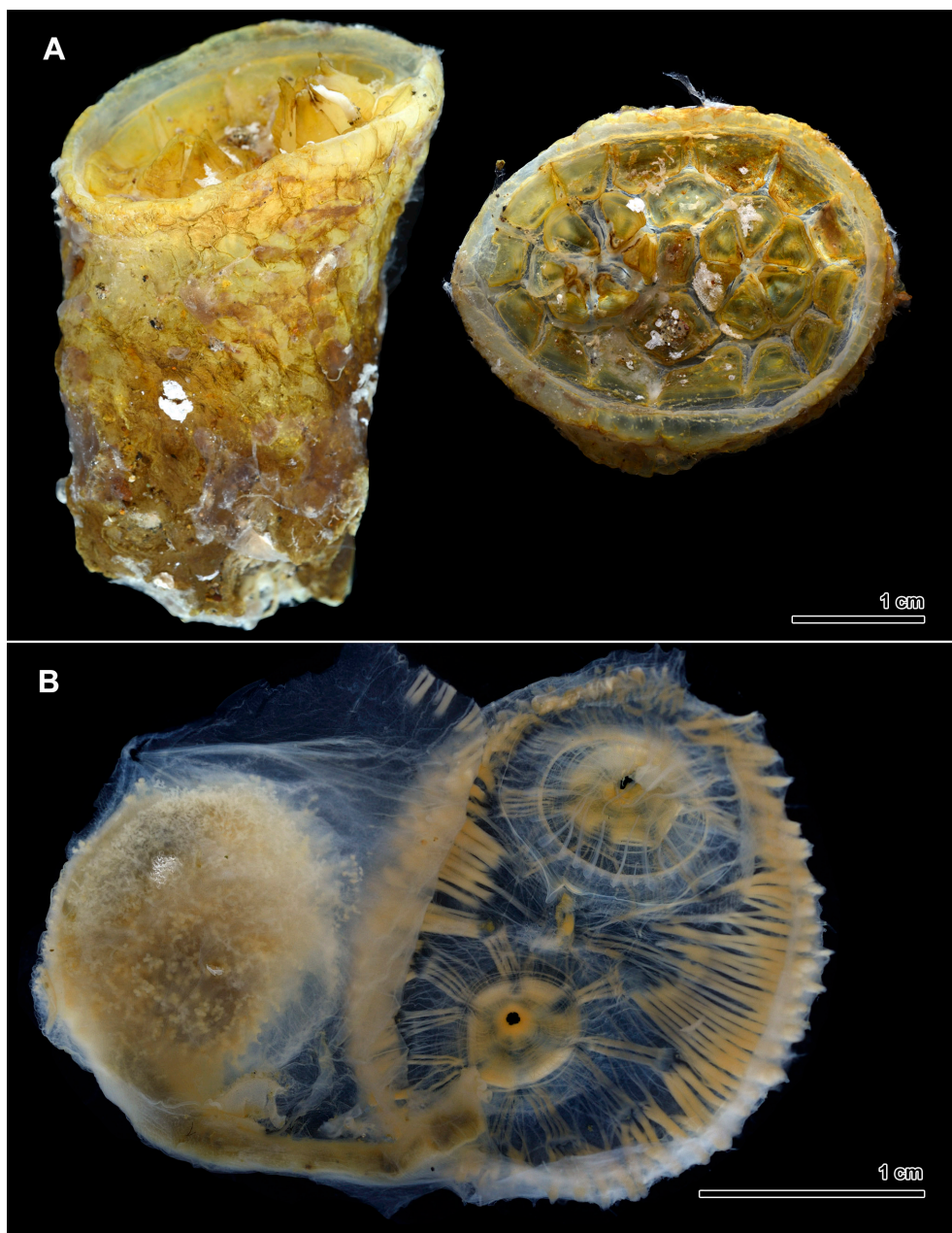


Fig. 11. *Chelyosoma yezoense*. A — external appearance; B — opened specimen.

Рис. 11. *Chelyosoma yezoense*. A — внешний вид; B — вскрытие.

Synonymization of Corynascidia and Corelloides with Corella

Corynascidia is synonymized here with *Corella*. *Corynascidia* was established by Herdman (1882c) for *Corynascidia suhmi* Herdman, 1882, originally based on three specimens obtained in abyssal depths

from two distant locations, in Pacific off Chile and in Indian Ocean. Herdman (1882c: 187) recognized its close relationship with *Corella*, and stated that “this remarkable form seems to be a deep-sea representative of *Corella*”, but decided that the differences in “many particulars” warrant a separate generic status. He listed three main distinguishing features

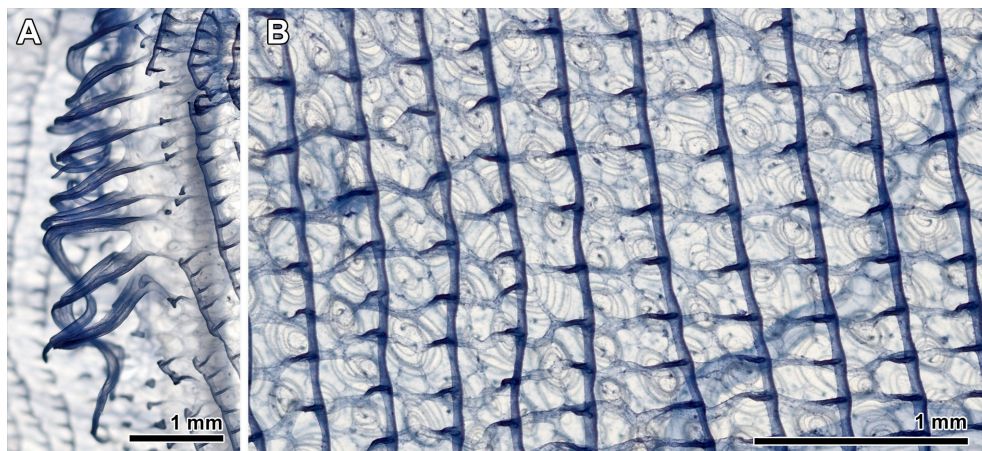


Fig. 12. *Chelyosoma yezoense*. A — dorsal languets; B — branchial sac.

Рис. 12. *Chelyosoma yezoense*. А — спинная пластинка; В — жаберный мешок.

of *Corynascidia*: pedunculated body, very delicate thin branchial sac and the form and position of small visceral mass (the gut loop and gonad). Van Name (1945: 215) stated that *Corynascidia* “perhaps worthy of only subgeneric status” but used it in a generic rank (not as a subgenus). Kott (1969: 87) had an opinion that in *Corynascidia* “the condition of the gut and muscles seems sufficiently constant” to justify generic separation, but later (Kott, 2009: 1971) wrote that “a stalk from the antero-ventral part of the body is the only consistent feature of *Corynascidia* that does not occur in *Corella*.” However, some *Corella* species (*C. borealis* Traustedt, 1886) have stalk, and some species assigned to *Corynascidia* lack it. Moreover, its position differs significantly in two most typical stalked *Corynascidia* species (in *C. suhmi* and *C. herdmani*).

The second feature, a very delicate thin branchial sac, also cannot be used to distinguish *Corynascidia* from *Corella*. A reduction of the branchial tissue is common in many deep-water species. For example, several deep-water species of *Ascidia* have very thin branchial tissue (e.g. *Ascidia escabanae* C. Monniot, 1998, see below) while shallow-water species of the same genus have normally developed branchial sac. Moreover, the thickness of the branchial tissue varies significantly in different species assigned to *Corynascidia*. Sometimes it is extremely delicate, with the stigmatic meshes resembling fine spider web formed by thin threads, in other cases the spirals may be thicker and have quite “normal” appearance (e.g. compare figures of the branchial sac of *C. suhmi*, *C. lambertae* and *C. mironovi* in Sanamyan & Sanamyan (2002)).

Similarly, the size and the position of the alimentary tract is hard to use to separate *Corynascidia* from *Corella*. Smaller size of the visceral mass is a known phenomenon in abyssal species of several

ascidian genera. For example, in many shallow-water species of *Ascidia* the visceral mass is voluminous and occupies the whole side of the body, while in the deep-water species (e.g. in the mentioned above *A. escabanae*) may be small. In the species assigned to *Corella* and *Corynascidia* we see the same tendency: the visceral mass is larger in shallow-water and smaller in abyssal species.

C. Monniot & F. Monniot (1991a) noted that in *Corynascidia* the internal longitudinal vessels are more numerous than the number of spiral stigmata per transverse row, while in *Corella* the number of longitudinal vessels correspond exactly to the number of spirals. They considered this feature as the most important character separating *Corynascidia* from all genera of *Corellidae* and placed it in *Agneziidae*. Sanamyan (1998) supported this opinion but later argued against it (see Sanamyan & Sanamyan (2002: 337)) and placed *Corynascidia* to *Corellidae*. F. Monniot *et al.* (2011) also placed *Corynascidia* to *Corellidae*. Having studied many species referable to *Corella* and *Corynascidia* from many distant locations I came to a conclusion that the vessels/spirals ratio cannot be used to separate *Corynascidia* from *Corella*. In particular, some species of *Corella* (e.g. *Corella eumyota* Traustedt, 1882 and other southern *Corella* species, see F. Monniot, 2013) have too complex structure of the branchial sac where the ratio of the number of vessels to spirals cannot be determined (and certainly their numbers are not equal). Even in the type species of *Corella*, *C. parallelogramma*, the internal longitudinal vessels may be sometimes slightly more numerous than the spiral stigmata per row (Fig. 13 and see also F. Monniot (2013, fig. 10 D), the photo in the latter work shows six spirals in the middle row but eight papillae supporting the longitudinal vessels between them).

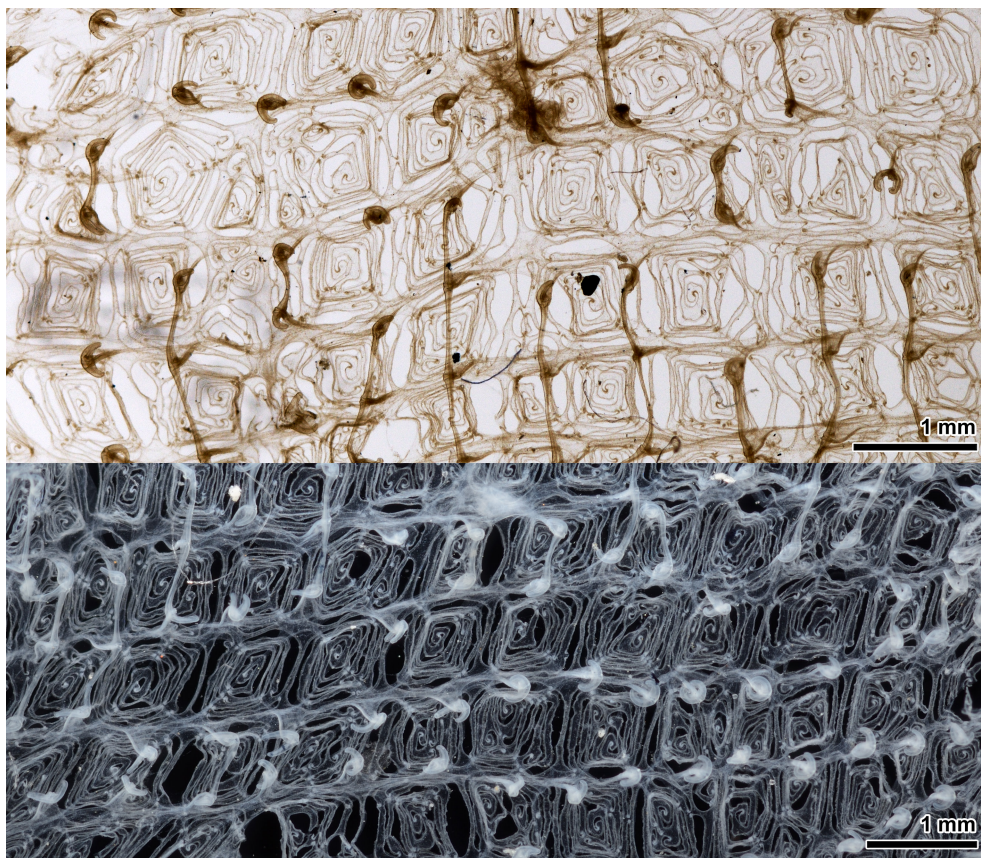


Fig. 13. *Corella parallelogramma*. Branchial sac in transmitted and reflected light to show incomplete branchial vessels in the specimen from Norway (KBPGI 2/1257).

Рис. 13. *Corella parallelogramma*. Жаберный мешок экземпляра из Норвегии (KBPGI 2/1257) в проходящем и отраженном свете, видны прерывистые продольные сосуды

It is noteworthy that several species initially described in *Corynascidia* basing on some features were then transferred to *Corella* on the basis of other features. For example, the species described as *Corynascidia sedens* Sluiter, 1904 lacks peduncle and was originally placed in *Corynascidia* because its stigmatic spirals are formed by fine strips and resemble spider-web and its visceral mass is small, but later transferred to *Corella* because it has the same number of longitudinal vessels and spirals (C. Monniot, F. Monniot, 1991a). Kott (2009) transferred *Corynascidia alata* C. Monniot et F. Monniot, and *Corynascidia translucida* (C. Monniot, 1969) to *Corella* and *Corynascidia vinogradovae* described by Sanamyan (1998) is shown to be a species of *Corella* in the present work. It is clear that the supposed generic differences seen in the species assigned to *Corella* and *Corynascidia* are either overestimated and not reliable, or are linked with deep-sea habitat.

Corelloides Oka, 1926 also is synonymized here with *Corella*. The original description of its type species, *C. molle* Oka, 1926, is based on two specimens from NW Pacific. Van Name (1945: 214) wrote that this genus resembles *Corella* in nearly all respects but differs in the structure of the branchial sac: “the internal longitudinal vessels are incomplete, represented by branches of various lengths borne on the papillae.” Mentioned by Van Name (1945) difference does not distinguish *Corelloides* from *Corella*, the structure of the branchial sac of *Corelloides* is the same as in certain the species of *Corella*. In all species of *Corella* (and in synonymized *Corynascidia*) the internal longitudinal branchial vessels borne on papillae. In many of these species they may be interrupted and represented by branches of various length on smaller or larger part of the branchial sac. For instance, in such species as *C. suhmi* or *C. mironovi* the internal branchial vessels may be represented by

very short branches (e.g., see figures in Sanamyan, Sanamyan, 2002). Moreover, I observed incomplete branchial vessels in the specimens of the type species of *Corella*, *C. parallelogramma*, collected at about 10 m in Lofoten, Norway (KBPGI 2/1257) in which the longitudinal vessels were strongly reduced on a significant part of the branchial sac (see Fig. 13). Thus, monotypic genus *Corelloides* cannot be distinguished from *Corella* basing on the morphology of the branchial sac. Valid name of its type species is *Corella mollis* (Oka, 1926).

The genus *Corella* (together with synonymized *Corynascidia* and *Corelloides*) includes 18 or 20 species:

– Two species inhabiting shallow-waters and moderate depths (down to 200 and 460 m) in the northern and European seas, *C. parallelogramma* (Müller, 1776) and *C. borealis* Traustedt, 1886. Their ranges do not reach the North Pacific. Another nominal European species, *C. halli* Kott, 1951 was synonymized with *C. parallelogramma* by Millar (1970: 42).

– Two well-known shallow-water species are reported in NE Pacific, *C. inflata* Huntsman, 1912 and *C. willmeriana* Herdman, 1898, their range extends from Alaska to Oregon and Central California (Lambert, 2019).

– Two shallow-water species inhabiting warm and tropical waters: *C. japonica* Herdman, 1880, known from Japan and many distant tropical locations (see Nishikawa, 1991), and *C. minuta* Traustedt, 1882, known from West Indian region. According to C. Monniot & F. Monniot (1987) the latter species occurs also in tropical Pacific, from where it was reported previously as *C. japonica*.

– Southern species formerly united under *C. eumyota* Traustedt, 1882, but now showed to be valid species: *C. antarctica* Sluiter, 1905, *C. eumyota* and *C. brewinae* F. Monniot, 2013 (see detailed descriptions in F. Monniot, 2013).

– A group of related species known from the depths of about 100–700 m in the region of Indonesia and Western Australia: *C. aequabilis* Sluiter, 1904, *C. sedens* (Sluiter, 1904) and *C. alata* (C. Monniot et F. Monniot, 1991a). The former of these species was rescribed by Kott (2009). She tentatively included *C. sedens* and *C. alata*, both originally described in *Corynascidia*, as junior synonyms of *C. aequabilis*, although pointed to some morphological differences between them.

– Antarctic *C. cubare* (C. Monniot et F. Monniot, 1994), originally described in *Corynascidia*, known from one damaged specimen from 700 m, is said to be related to *C. alata* but differs in design of body muscles.

– Two related deep-water species from Atlantic: predominantly bathyal *C. translucida* (C. Monniot, 1969) and true abyssal *C. mironovi* (Sanamyan et Sanamyan, 2002). *Corella mironovi* was originally de-

scribed in *Corynascidia*, while *C. translucida* initially assigned to its own genus *Agnesiopsis* C. Monniot, 1969 but then synonymized with *Corynascidia* by C. Monniot & F. Monniot (1991a) and later transferred to *Corella* by Kott (2009).

– *Corella mollis* (Oka, 1926) and *Corella vinogradovae* (Sanamyan, 1998), two sessile bathyal species from Bering Sea, the former was originally described in its own genus *Corelloides* Oka, 1926, the latter in *Corynascidia*.

– Deep-water pedunculated species originally described in *Corynascidia*: *C. suhmi* (Herdman, 1882), *C. herdmani* (Ritter, 1913) and *C. lambertae* (Sanamyan et Sanamyan, 2002). The latter species is based on one specimen only and its validity needs confirmation. *Corynascidia hartmeyer* C. Monniot et F. Monniot, 1994 was synonymized with *C. suhmi* by Sanamyan & Sanamyan (2005).

KEY TO SPECIES OF *CORELLA* KNOWN FROM FAR EASTERN SEAS OF RUSSIA

1. Sessile *C. vinogradovae*
- Pedunculated *C. herdmani*

Corella vinogradovae Sanamyan 1998

Figs 14, 15.

Corynascidia vinogradovae Sanamyan, 1998: 108.

MATERIAL EXAMINED. RV *Ak. Oparin*-56, St.24, Urup Island (Sea of Okhotsk side), 46°15.9'N, 150°15.4'E, 450–460 m, 05.07.2019, two specimens; St.65, North of the Sea of Okhotsk, Erineyaskaya Bay, 56°43.4'N, 144°40.7'E, 286 m, 09.08.2019, two specimens.

DESCRIPTION. Four available specimens are from 2 to 5 cm in height. The body is more or less rectangular in outline, flattened laterally. The largest specimen was attached to a glass sponge by relatively wide area at posterior end. The test is thin, soft and transparent, the gut loop and dirty-yellowish gonads are clearly seen on intact specimens. The surface of the test is smooth, free from incrustation. Wide but short terminal branchial siphon has eight distinct lobes in one specimen (middle specimen in Fig. 14A) but is damaged in others. The atrial siphon is smaller, situated on the dorsal side on the anterior third of the body and has six lobes. Small yellow spots are present between the lobes on both siphons.

The body wall is very thin. Crowded circular siphonal muscles do not extend to the body wall below the base of siphons; on the branchial siphon they do not extend below the ring of the tentacles. On the branchial siphon the radial siphonal muscles very sparse and thin; they are slightly better developed on the atrial siphon. The muscles are symmetrically developed on the left and right sides of the body

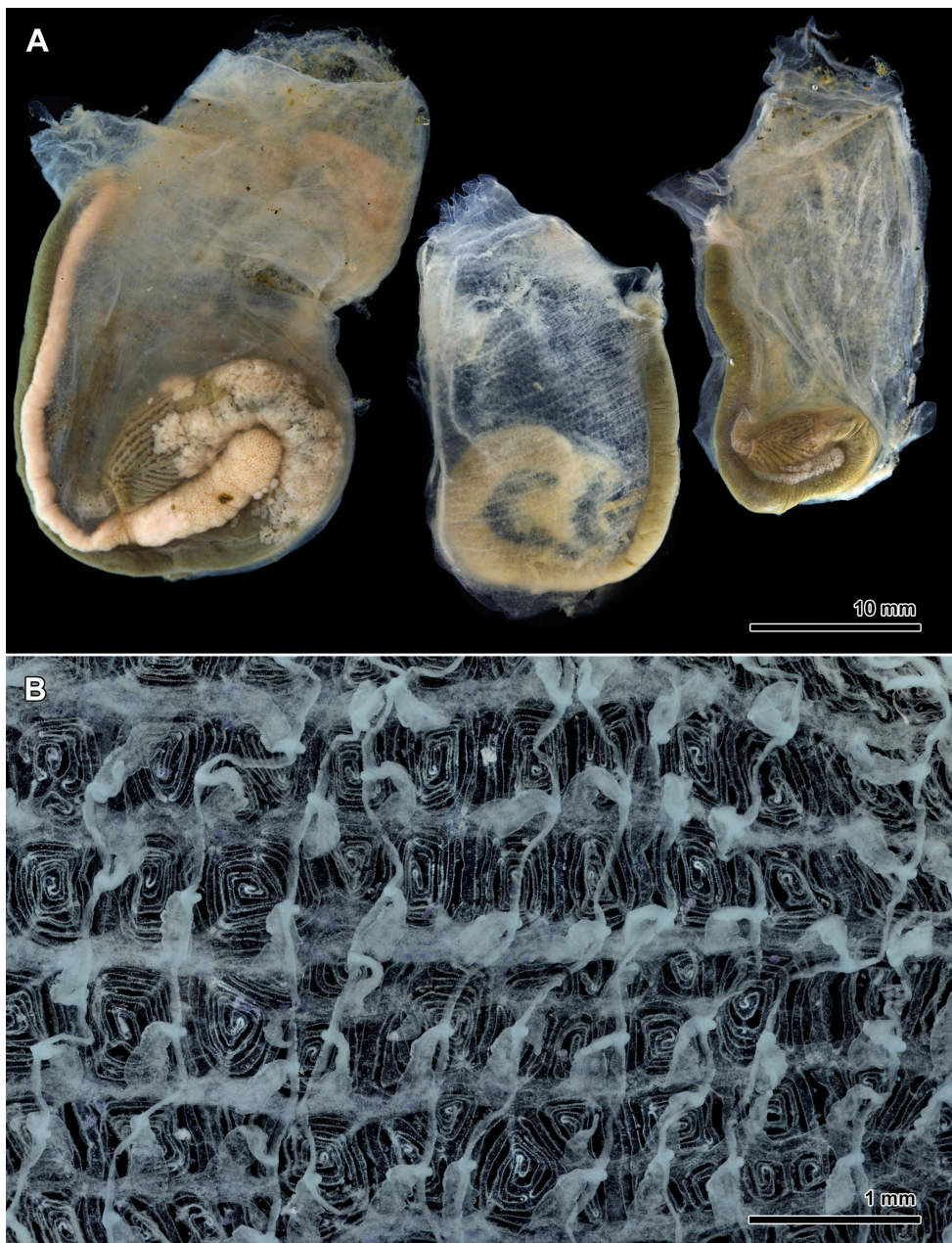


Fig. 14. *Corella vinogradovae*. A — three specimens, test removed; B — branchial sac.

Рис. 14. *Corella vinogradovae*. А — три экземпляра, туника удалена; В — жаберный мешок.

wall. On each side they are represented by a band of short and rather thick transverse muscles originating from mid-dorsal line and from an area between the siphons. Also there are short and thin longitudinal muscles extending a short distance from base of the branchial siphon. A circular muscle runs on the edge of a low branchial velum.

About 80 branchial tentacles extend from inner side of the branchial velum. Most of them are long and thin; occasional short tentacles are inserted between the longer ones but not regularly. The prebranchial band is composed of two thick blades, runs on some distance from the ring of the tentacles and makes no dorsal V. The dorsal tubercle with C-shaped open-

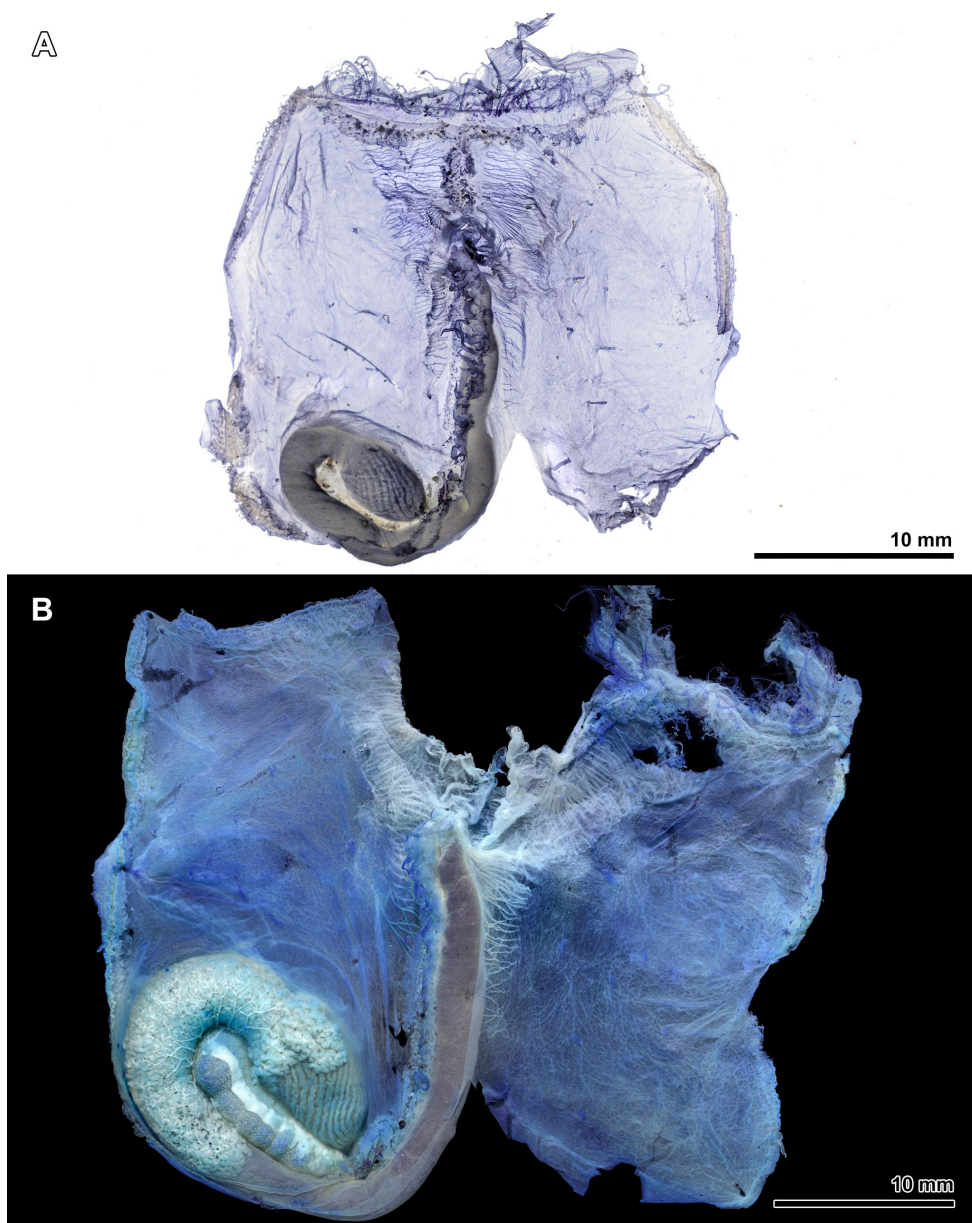


Fig. 15. *Corella vinogradovae*. A, B — two specimens opened ventrally.

Рис. 15. *Corella vinogradovae*. A, B — два экземпляра, вскрытие.

ing. The dorsal lamina is composed of about 30 long languets arranged in a single row. The branchial tissue is thick. The branchial sac has about 50 transverse rows of rectangular spiral stigmata, separated by transverse vessels. About 40 internal longitudinal vessels supported on long papillae rising from the transverse vessels are present on each side of the branchial sac. Most of these vessels are continuous and only rarely interrupted. Most spirals are not interrupted, of four

to six turns. Most of them are regularly arranged but some are divided in two and occasional additional smaller spirals may occur. The number of the spirals in each row is about the same (or slightly smaller) than the number of the internal longitudinal vessels. The stigmata are ciliated.

The gut loop is clearly on the right side. In some specimens it is voluminous and occupies up to third of the posterior part of the right side of the body,

in others it is smaller (Figs 14A; 15). The stomach is about twice as long as wide, obliquely or, in one specimen, almost horizontally oriented. Its wall has about 20 longitudinal or oblique folds, some of them originate from the typhlosolis. The primary gut loop is closed and may be narrow, with the descending limb parallel to the stomach, or slightly wider and rounder. The straight rectum runs along dorsal line and opens just below the atrial siphon. The anus is V-shaped with many small round lobes at margin. Robust cylindrical ovary fills the space within the gut loop. Numerous small male follicles spread along the pyloric part of the stomach and the intestine. Both male and female ducts are very thick, run along the rectum and open close together near the anus; male and female openings are almost sessile, they look as two simple holes on very low elevations just below the anus.

REMARKS. The holotype of this species, collected in Bering Sea in vicinity of Commander Islands, 54°12.0'N, 168°32.0'E, 328 m, had a narrow gut loop and the number of the internal longitudinal vessels was slightly higher than the number of spiral stigmata per row. Basing on these features the species was assigned to *Corynascidia*. In the present specimens the number of longitudinal vessels is about the same as the number of spirals and larger specimens have a rather wide gut loop.

Sanamyan (1998) recognized similarity of his specimen and *Corelloides molle*, but stated that they differ in the structure of the branchial sac (interrupted longitudinal vessels in *C. molle*) and the number of branchial tentacles. The former of these features may be valid, while the statement regarding the number of the branchial tentacles is an error based on Van Name (1945: 214) who wrote that *C. molle* has 16 tentacles (rather than 60 indicated in the original description).

The known distribution range of *Corella vinogradovae* includes two widely separated locations in the Sea of Okhotsk (present study) and one location in the Bering Sea, east off Commander Islands (Sanamyan, 1998).

Corella herdmani (Ritter, 1913)

Fig. 16.

Corynascidia herdmani Ritter, 1913: 491; Sanamyan, 1998: 107.

MATERIAL EXAMINED. RV *Ak. Oparin*-14, St. 4, SW of Bering Sea, 54°11.8'N, 168°36.5'E, 508 m, 2.08.1991, three specimens.

DESCRIPTION. The specimens were previously described in details by Sanamyan (1998). They were 20, 16 and 9 cm in length when preserved in formalin but have shrank somewhat after keeping in alcohol. The test is very soft, thin, smooth and transparent. Well-marked cylindrical peduncle is about 2 cm diameter, slightly shorter than the relatively wide body and clearly demarcated from it. The siphons are on the

sides of the top of the body (Fig. 16A). The branchial is smooth-edged, without distinct lobes, turned down. Ritter (1913) describes it as having “a wide thin lip or flange subtending nearly its dorsal semicircumference”, this description corresponds exactly to the shape of the branchial siphon in the present material. The atrial siphon has a shape of short wide tube with five or six equal lobes. Muscles are equally and symmetrically developed on both sides of the body. The musculature is composed of circular siphonal muscles and of equally spaced, more or less parallel, longitudinal muscle bands running on the both sides of the anterior third or half of the body (Fig. 16B). Two thick short muscle band cross midline dorsal and ventral to the base of the atrial siphon, the former band crosses the distal end of the intestine and probably fixes it in place. About 90 long branchial tentacles of similar size are on the short muscular velum. The dorsal lamina is represented by about 40 languets. The branchial sac (Fig. 16C) of the largest specimen has about 48–50 stigmata spirals in a row on the left and 47–50 spirals on the right and about 65 longitudinal vessels on the left and 70 on the right. The stigmata are not regular, interrupted, crossed by four–six radial parastigmatic vessel. Each stigma makes three or four turns. I failed to find cilia on them. The stomach is compact, egg-shaped, with pronounced longitudinal folds. The gut curves immediately behind the stomach and forms narrow closed loop orientated vertically with the pole directed down, toward the peduncle. The long rectum and the whole ascending limb of the gut loop lies directly on the mid-line of the body (marked by retropharyngeal groove of the branchial sac and a line of dorsal languets), while the whole descending part of the gut loop, including oesophagus, stomach and a part of the intestine behind the stomach, is on the right side of the body. The ovary forms compact elongated pear-shaped mass in the gut loop; small separate testis follicles spread over the ovary and on the body wall in the gut loop and, in part, outside of the gut loop near its pole. Gonoducts run along the rectum and open near the anus. The anus has long papillae on its rim.

REMARKS. Sanamyan (1998) wrote that due to very soft body is difficult to determine whether the gut loop is displaced to the right. Reexamination of the same specimens showed that at least descending part of the gut loop (including the stomach) is located clearly on the right side of the body, as in all other species of Corellidae.

Van Name (1945) and Millar (1988) doubted the validity of *Corella herdmani* and inclined to believe that it may be a synonym of *C. suhmi*. Ritter (1907: 492) distinguished *C. herdmani* from *C. suhmi* by 1) the difference in the shape of the siphons, they are large and have a characteristic shape in *C. herdmani* and distinct from almost sessile openings in *C. suhmi*, and 2) by the structure of stigmata, for which he

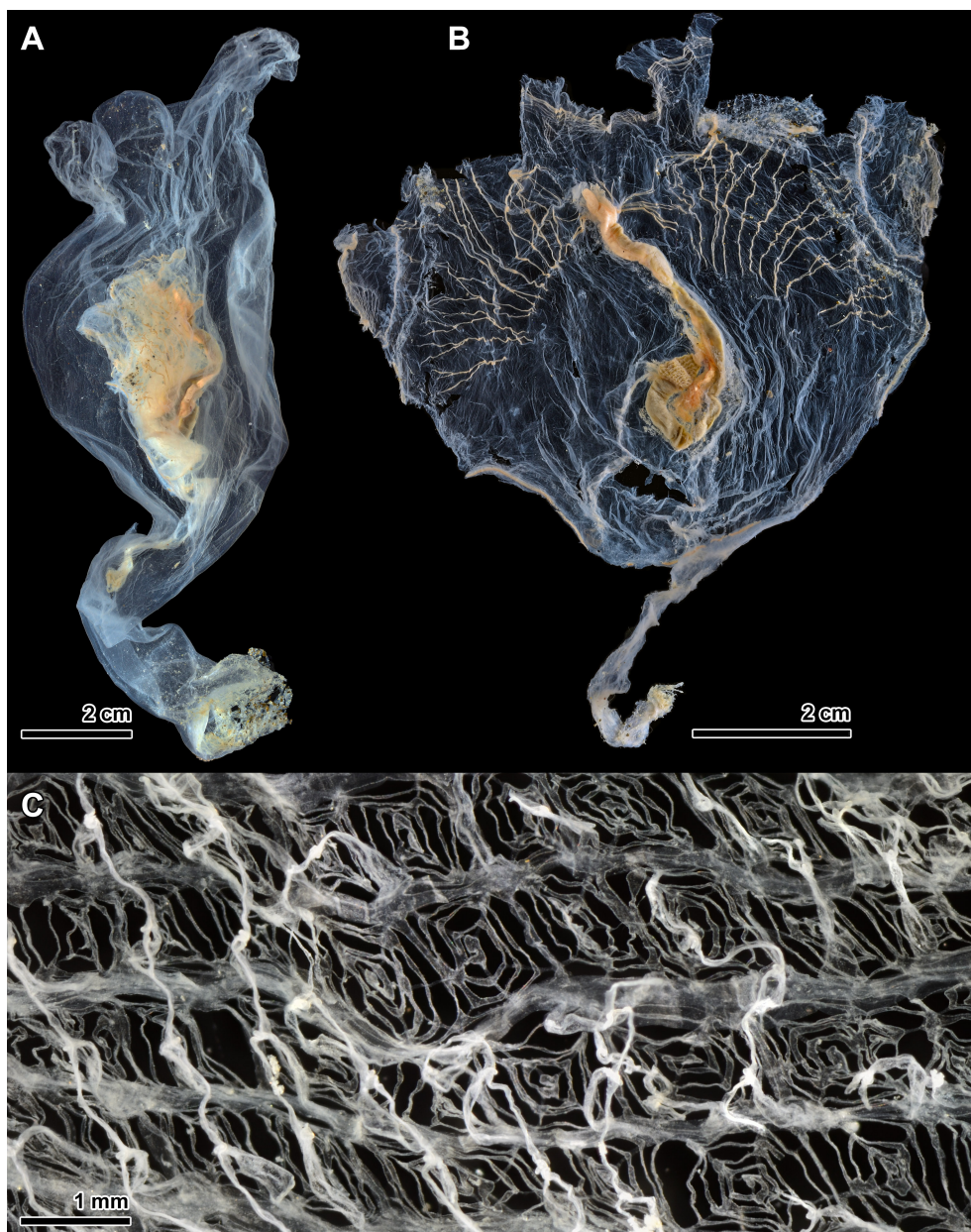


Fig. 16. *Corella herdmani*. A — whole specimen; B — opened specimen; C — branchial sac.

Рис. 16. *Corella herdmani*. А — целый экземпляр; В — вскрытие; С — жаберный мешок.

wrote that they show “very little or no suggestion of the quadrate or spiral disposition” in *C. herdmani*. The last sentence is hard to understand because the figures provided by Ritter (1907, figs 33, 35) show stigmata arranged in well-defined quadrate spirals. *Corella suhmi* has similar spirals (see Sanamyan, Sanamyan, 2002). The main feature distinguishing these two species is the position of the stalk and the

gut loop: in *C. herdmani* the gut loop is orientated vertically with the pole directed down (toward the peduncle and substratum) while in *C. suhmi* the gut is on the top of the body.

Only four specimens of *Corynascidia herdmani* are known: the holotype was described by Ritter (1913) from the southern part of the Bering Sea near Unalaska Island, 576 fathoms (990 m) and three

other specimens, redescribed here, were reported by Sanamyan (1998) from the south-western part of Bering Sea, east from Medny Island, 508 m. Till now no other specimens of this species were collected and I never saw ascidians which may be identified with this species in rather numerous available underwater photographs of deep-water bottom fauna of this region.

Genus *Corellopsis* Hartmeyer, 1903

Type species: *Corellopsis pedunculata* Hartmeyer, 1903 by monotypy.

The genus is characterized by the following features: gut loop clearly on the right; regular spiral stigmata; internal longitudinal vessels reduced and represented by short side branches on papillae rising from transverse vessels (thus T-shaped papillae are formed).

The genus contains one species, *C. pedunculata* Hartmeyer, 1903. The second species, *C. translucida* Millar, 1970, has simple (not T-shaped) branchial papillae and central position of the gut. This species is based on one specimen from abyssal depths and its status cannot be clarified now, but its assignment to *Corellopsis* is certainly not correct and its assignment to Corellidae is under the question (see Millar, 1970).

Corellopsis pedunculata Hartmeyer, 1903

Fig. 17.

Corellopsis pedunculata Hartmeyer, 1903: 273. Redikorzev, 1908: 40. Ritter, 1913: 491. Van Name, 1945: 214.

MATERIAL EXAMINED. RV *Ak. Oparin*-56, St.2, Urup Island (Pacific side), 45°38.2'N, 149°53.1'E, 253–222 m, 27.06.2019, one specimen; St.7, Urup Island (Sea of Okhotsk side), 45°52.2'N, 149°37.0'E, 142 m, 28.06.2019, one specimen.

DESCRIPTION. Two available specimens are similar in size and shape, the smaller is in better condition, the larger is damaged. Both have small oval body about 1.5 and 2 cm in length supported on a thin isodiametric stalk 4 and 5.5 cm in length. The stalk is firm and wiry, attached to substratum by several short and thick root-like outgrowths on its posterior end. The test of the body is thin, transparent and colourless, soft, its surface is smooth and clean. In both specimens the mantle body is much contracted and detached from the test (Fig. 17A). The body wall is thin and transparent. Apertures are on short obscurely lobed siphons (Fig. 17D). The branchial siphon is turned in antero-ventral direction (i.e. down, toward the stalk). There are strong circular siphonal muscles, especially around the atrial siphon. Radial siphonal muscles are thin and sparse. Body muscles are represented by spaced bands crossing dorsal border between the siphons and similar bands originating from the base of the branchial siphon; these muscles continue

about a half way down along the body in ventral and postero-ventral direction and end abruptly. The bands on the sides of the body are branched and sometimes cross each other. At the right side they do not reach the dorsal side of the gut loop.

The branchial tentacles of two or three size orders, 14 in number. The prebranchial band, composed of one thick lamella, runs on considerable distance from the ring of the tentacles and makes wide dorsal V. The dorsal tubercle is a relatively large oval mass on the left side of the tip of the dorsal V. In both specimens it has an unusual long straight band-like extension running anteriorly along the dorsal mid-line (Fig. 17B).

The branchial sac has six double rows of square spiral stigmata. Each spiral has five or four turns and is formed by one, several times interrupted, stigma. It is crossed by typically four radial parastigmatic vessels running from the center to four corners of spirals (Fig. 17C). On the right each row contains 12 or 13 spirals, and ten spirals per row are on the left. Double rows are separated by five transverse vessels with regularly distributed branchial papillae. The number of papillae in general corresponds the number of spirals per row. Each papilla has a wide triangular base and two short side branches at the tip (usually considered to be rudiments of the longitudinal vessels); the tips of the papillae do not project above these branches. The dorsal lamina is represented by five dorsal languets rising from the transverse vessels. They are of the same size as branchial papillae but without branches on the tip.

The gut loop occupies ventral half of the right side of the body. The oesophagus is long and curved at 180° to enter the branchial sac. The stomach is small, short barrel shaped, clearly demarcated from the oesophagus and intestine. Stomach wall with about 20–25 distinct and rather regular longitudinal folds. The intestine is isodiametric and makes a wide oval closed loop. Its distal part crosses oesophagus. The rectum opens by smooth-edged anus just behind the atrial orifice. The voluminous gonad is completely within the gut loop; it is composed of short cylindrical ovary and a compact mass of male follicles embracing its proximal end. Both male and female ducts are thick tubes running together along the distal part of the intestine and the rectum and open at the level of the anus.

REMARKS. The present record of this Arctic species in vicinity of Urup Island (southern group of Kuril Islands) is unexpected but I failed to find any morphological differences from the original description based on one specimen from Spitsbergen (105 m) (Hartmeyer, 1903). Redikorzev (1908) reported two specimens from Siberian coast (76°8'N, 95°6.5'E, 18–20 m). He gave size of his specimens but no further details were reported. Finally, one specimen was reported by Ritter (1913) from east end of Aleutian Chain (54°15'N, 166°03'W, 72 fathoms = 131 m). Ritter (1913) had some doubt regarding identity of his

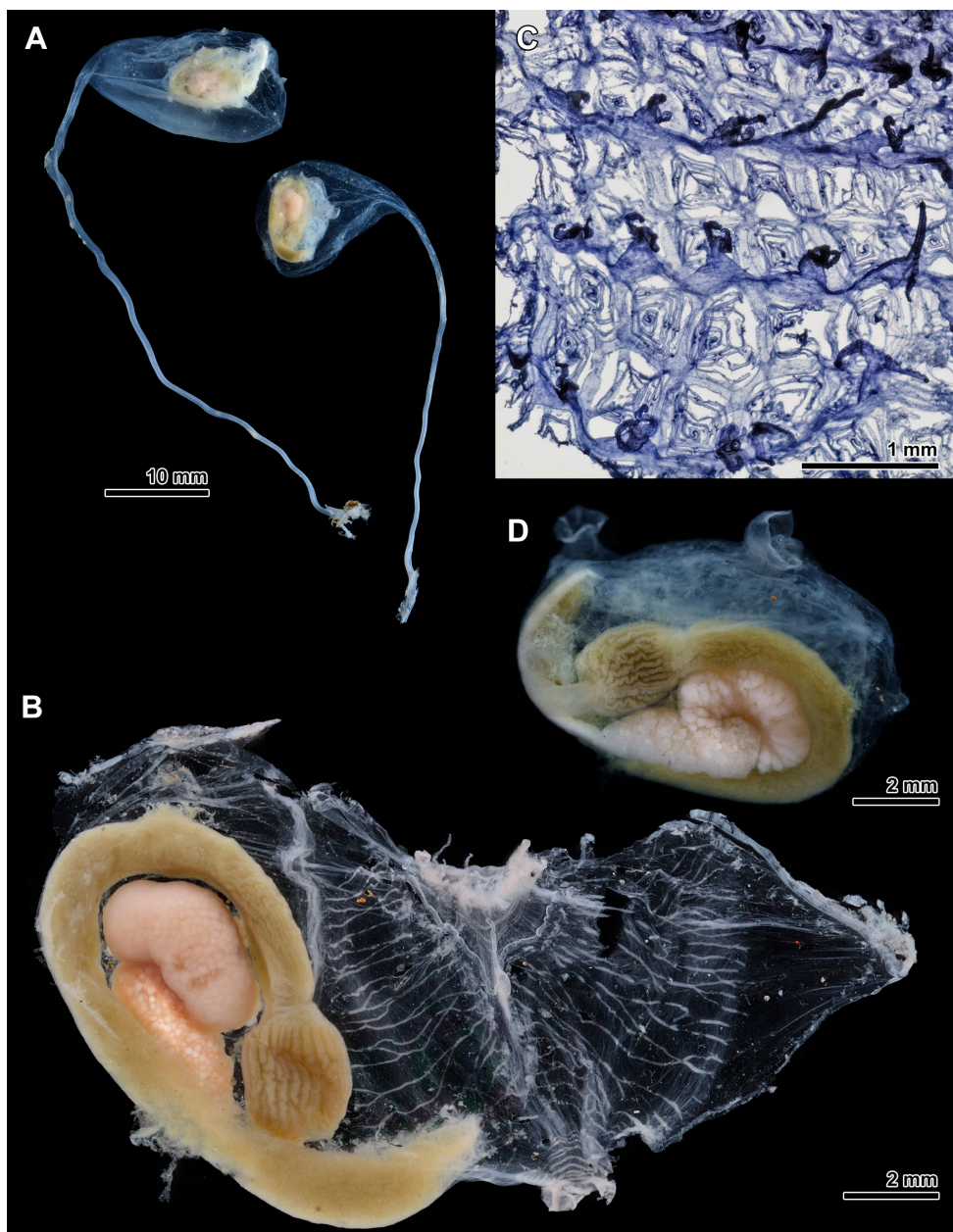


Fig. 17. *Corellopsis pedunculata*. A — external appearance; B — specimen opened ventrally; C — branchial sac; D, specimen without the test, from the right side.

Рис. 17. *Corellopsis pedunculata*. А — внешний вид; В — вскрытие; С — жаберный мешок; D — тело без туники, вид с правой стороны.

specimen, in particular he wrote that the rudiments of internal longitudinal vessels of the branchial sac are much longer in his specimen than are those figured by Hartmeyer (1903). This difference may be of some taxonomic value but Ritter's (1913) description is too

brief and lacks figures and a certain conclusion cannot be made. In addition, some authors (Millar, 1966; Van Name, 1945) list "Kola Fjord" as another locality where the species was recorded. Most probably this record is based on a table published by Redikorzev

(1910) where *C. pedunculata* is shown for “Murman” (= Murmansk, Barents Sea, Kola Peninsula). I failed to find the source of this record, it may be a mistype in the table in Redikorzev’s (1910) work. No other specimens of *C. pedunculata* were recorded till now for more than 100 years.

Family Octacnemidae Herdman, 1888

The family comprises exclusively deep-water aberrant ascidians with modified or significantly reduced branchial sac, without ciliated stigmata. As in almost all phlebobranch ascidians the gonads are located in the gut loop. In most cases the gut loop has a mid-dorsal position. Other common features are difficult to enumerate because included genera have different morphologies.

Three groups of genera and, accordingly, three different morphologies are recognized:

1) The first group includes two genera, *Octacnemus* Moseley, 1877 (six species) and *Polyoctacnemus* Ihle, 1935 (monotypic). Members of this group have eight large triangular lobes on the anterior part of the body around a small branchial opening. These lobes constitute the most peculiar distinguishing feature allowing unmistakable identification of the genus.

2) The second group comprises six genera: *Hypobythius* Moseley, 1877, *Benthascidia* Ritter, 1907, *Dicopia* Sluiter, 1905, *Megalodicopia* Oka, 1918, *Situla* Vinogradova, 1969 and *Kaikoja* C. Monniot, 1998. The specimens belonging to these genera have very characteristic exterior. They all have very wide branchial opening, often with two large “lips” (dorsal and ventral). Gut forms simple oval or almost circular loop with the opening of the oesophagus being not far from the anus; the branchial sac has numerous irregular (oval or polygonal) unciliated stigmata. *Dicopia* and *Megalodicopia* have cone shaped branchial sac, the diameter of the mouth (=the entrance to the branchial sac in the bottom of bi-lobed branchial siphon) is not large (and, therefore, some dissection is necessary to access inner structures of the branchial sac). *Megalodicopia* differs from *Dicopia* only by the presence of longitudinal muscles in the peduncle.

In *Benthascidia*, *Situla* and *Kaikoja* the branchial sac is transformed into a flat (or almost flat) plate perforated by unciliated stigmata and fully exposed to the exterior. The tissue of the branchial sac is thinner than in *Dicopia* and *Megalodicopia*, at least in the species I had chance to examine. Formally, *Kaikoja* differs from *Situla* in the presence of a tuft of long crowded hairs on the entrance of the oesophagus and long and short papillae on the branchial sac; *Benthascidia* also has hairs on the entrance of the oesophagus but lacks branchial papillae; *Situla* lacks hairs and branchial papillae. These differences do not seem to be very convincing for generic separation, but here I refrain

from uniting them and treat all these genera as valid.

The remaining genus, *Hypobythius*, is insufficiently described. According to Moseley (1877: 288), in *Hypobythius* “the inhalant aperture was entirely obliterated in the only specimen obtained” and, therefore, the relatively small circular terminal branchial orifice shown in his figure of *H. calycodes* (Moseley, 1877) is a reconstruction based on misinterpretation of its structure. All other reported features left no doubt that *Hypobythius* is closely related to *Situla* and, possibly, may be congeneric with it. Fortunately, *H. calycodes* has a distinctive feature – prominent regularly arranged thickening of the test and there is a chance that it will be recognized in future collections, and then its taxonomic affinity, and, therefore, the validity of *Situla* and other mentioned genera, over which *Hypobythius* has a precedence, may be clarified.

3) The third group includes three small genera, *Cibacapsa* C. Monniot et F. Monniot, 1983 *Cryptia* C. Monniot et F. Monniot, 1985 and *Myopegma* F. Monniot et C. Monniot, 2003. *Cibacapsa* and *Cryptia* are monotypic, *Myopegma* includes two species. All species are known from a single or a few specimens. These are highly aberrant carnivorous ascidians with completely reduced branchial sac. Their morphology deviates significantly from other octacnemids (especially from the genera listed in the second group above).

Kurabayashi *et al.* (2003) performed molecular analysis of *Megalodicopia hians* and found that *Megalodicopia* forms a monophyletic clade with corellid genera *Chelyosoma* and *Corella*. This result is in agreement with the view of Kott (1969: 191) who considered *Hypobythius*, *Benthascidia*, *Dicopia* and *Megalodicopia* being “highly specialized genera related to the Corellidae, and in particular to the Corellinae” and “characterized by complete loss of internal longitudinal branchial vessels and by very irregular stigmata.” She united these genera in the family Hypobythiidae, while the family Octacnemidae contained, according to her, only *Octacnemus* and *Polyoctacnemus*. Vinogradova (1969) placed her genus *Situla* (together with *Dicopia*, *Megalodicopia* and *Benthascidia*) in Corellidae. C. Monniot (1972) gave detailed interpretation of the morphological characters of these genera and was first who placed them in Octacnemidae. He though this group is related to Cionidae, but the relationship with Cionidae was not confirmed by molecular data (Kurabayashi *et al.*, 2003). Vinogradova (1975), as it appears from her text, did not agree with the placement of *Situla* in Octacnemidae, but preferred not to propose her own classification of the group. She pointed that *Dicopia*, *Megalodicopia*, *Benthascidia* and *Situla* should be placed in a separate (unnamed) family, related to Corellidae, an opinion similar to that of Kott (1969). However, Vinogradova (1975) thought that *Hypobythius* has a distant relation to these genera and, therefore, Hypobythiidae is not suitable to unite them.

This opinion was obviously based on her belief that the description of *Hypobythius* (with small branchial orifice) is correct, but this is not so (see above). In the present paper I refrain from rearrangement of discussed genera and treat them as members of Octacnemidae pending further research.

Four genera, *Benthascidia*, *Megalodicopia*, *Octacnemus* and *Situla* are known in the region covered by the present work.

KEY TO GENERA OF THE FAMILY OCTACNEMIDAE KNOWN FROM FAR EAST SEAS OF RUSSIA

1. Branchial siphon with eight prominent triangular lobes..... *Octacnemus*
- Branchial siphon with two large lobes, usually widely open..... 2
2. Branchial sac cone shaped, peduncle with longitudinal muscles *Megalodicopia*
- Branchial sac flat or almost flat 3
3. A tuft of hairs on the entrance of the oesophagus .
..... *Benthascidia*
- No hairs on the entrance of the oesophagus.....
..... *Situla*

Genus *Benthascidia* Ritter, 1907

Type species: *Benthascidia michaelsoni* Ritter, 1907 by monotypy.

Monotypic genus known from three strongly damaged specimens. All known features are as in *Situla*, the only difference is the presence of a tuft of long crowded hairs on the entrance of the oesophagus in *Benthascidia*. Such hairs on the entrance of the oesophagus present in *Kaikoja*, but *Kaikoja* is distinguished by the presence of papillae on the branchial sac.

Benthascidia michaelsoni Ritter, 1907 Fig. 18.

Benthascidia michaelsoni Ritter, 1907: 24. C. Monniot, 1998: 550.

NOT *Benthascidia michaelsoni*: Redikorzev, 1941: 202.

MATERIAL EXAMINED. RV *Vityaz*, St. 5624, Kuril-Kamchatka Trench, 45°22'N, 154°00'E, 5220 m, 20.08.1966, one specimen.

DESCRIPTION. The specimen is very large but so strongly damaged, that its real size and shape are hard to determine. The test and the body are separated and the test is torn in two parts and, probably, cut by a previous investigator (Fig. 18A). The test is thin, smooth and transparent, without any kinds of thickenings on most its part. At the base of the specimen a well-developed massive disc is formed by crowded hair-like outgrowths intermingled with sediment and sand. The basal disc is large, 5.5 cm in diameter and 1 cm thick, firm and rather heavy. The peduncle, ris-

ing from the basal disc, is about 15 cm in length and apparently about 2 cm in diameter. The remaining test (the test of the body) is represented by a large shapeless sheet of tunic, separated from the peduncle, on which no any traces of branchial or atrial openings could be recognized. It might be estimated that the body itself (without the peduncle) was about 20–30 cm in length in intact specimen.

The whole prebranchial area and most other parts of the body are in shreds, I even failed to find any traces of the branchial tentacles. The branchial sac is also in shreds, but some of them are large enough to determine its structure (Fig. 18C). The wall is formed by a net of anastomosing vessels of several size ranges which form more or less polygonal meshes of several orders. Among these vessels several larger parallel ones are recognizable (probably they are morphologically transverse, i.e. running from the dorsal lamina to the endostyle as in related genera of Octacnemidae, but it cannot be determined clearly in the present material). All vessels lie on the same level and therefore the branchial tissue is thin. The branchial wall is connected with the body wall by long (4–5.5 mm) thin strips (they are figured by Ritter, 1907, fig. 30). Some of these strips are detached from the body and may be mistaken with the branchial papillae, but true papillae (like those found in *Kaikoja*) not seen. A cluster of crowded hair-like papillae is on the left and ventral margin of the oesophageal opening (Fig. 18B).

Visceral mass (gut loop and gonads) forms a compact round body 3 cm in diameter. The gut loop and the gonads are deeply embedded in the opaque body wall and difficult to trace without destructive dissecting. The gut appears to be empty, it forms a simple closed circular loop. I failed to trace the stomach. The ovary is a long and thick C-shaped cylindrical organ lying within the gut loop. I failed to trace the testis but a very thick sausage-shaped sperm duct runs from the ovarian loop and ends near the anus and oesophagus (which are close to each other) exactly as described by Ritter (1907). His figure of the gut loop and gonads (Ritter, 1907, fig. 27) matches well with what can be traced in the present specimen.

REMARKS. This is the first record of the monotypic genus *Benthascidia* since its original description. The original publication was based on two specimens collected in NE Pacific, 33°02'N, 120°42'W, at the foot of the continental shelf at 2182 fathoms (=3971 m) (Ritter, 1907). Type specimens were redescribed by C. Monniot (1998).

Redikorzev's (1941) record of *B. michaelsoni* from the Sea of Okhotsk is based on misidentification. He listed numerous differences of his specimen from Ritter's (1907) description, among most important of them are the absence of the tuft of hair-like outgrowths on the oesophagus and the presence of well-developed muscles in the peduncle. The whole his description, and especially described and figured longitudinal

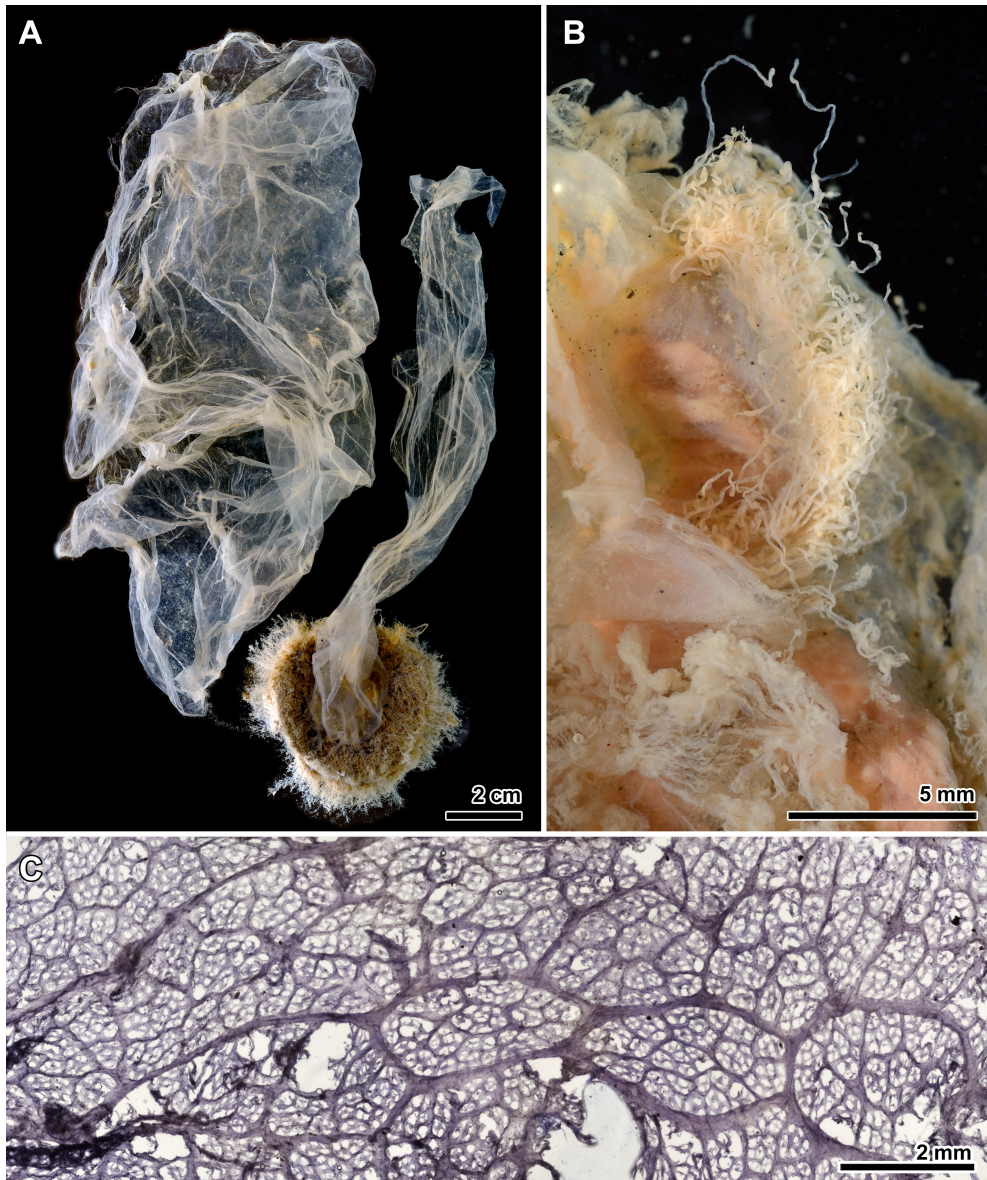


Fig. 18. *Benthascidia michaelsoni*. A — the test of the body and peduncle; B — hair-like processes at entrance of the oesophagus; C — branchial sac.

Рис. 18. *Benthascidia michaelsoni*. А — туника тела и ножки; В — выросты у входа в пищевод; С — жаберный мешок.

muscles in the peduncle, indicate that his specimen belongs to *Megalodicopia hians*.

The present specimen, although in poor condition, corresponds well to the type material as described by Ritter (1907) and C. Monniot (1998). Redikorzev (1941) believed that Ritter's (1907) description and figure of gonads of *Benthascidia michaelsoni*, with peripheral C-shaped ovary and central male part of

gonad is not correct because in most ascidians the ovary attains a central position while male follicles are on the periphery. However, the central large sausage-shaped part of gonad in Ritter's specimens, as well as in the present specimen, is not a whole male gonad but a hypertrophied sperm duct containing mature spermatozoa (confirmed microscopically in the present specimen).

A tuft of long crowded hairs on the entrance of the oesophagus is assumed to be a feature specific for *Benthascidia* and *Kaikoja*. C. Monniot (1998) believed that Ritter's (1907) interpretation of these hairs as a condensed dorsal lamina is plausible, but I do not think so (see Sanamyan, Sanamyan, 2002: 321 for argumentation).

Genus *Megalodicopia* Oka, 1918

Type species: *Megalodicopia hians* Oka, 1918 by monotypy.

Megalodicopia is characterized by the following features: branchial aperture with two large lips, dorsal and ventral; cone-shaped branchial sac without papillae or other outgrowths on its morphologically internal (facing to exterior) side or around the entrance of the oesophagus; branchial tentacles located directly on the surface of prebranchial area or on a low velum (which does not form deep ventral pocket); well-formed longitudinal muscles in the peduncle.

Only two species of *Megalodicopia* are recognized: the type species, *M. hians*, known from NW Pacific (see below) and *M. rineharti* (C. Monniot et F. Monniot, 1989) from Galapagos Islands, South Shetland Islands and Vanuatu. The latter species was originally described in the genus *Situla* but then transferred to *Megalodicopia* by Sanamyan & Sanamyan (2002) basing on the presence of muscles in the peduncle and the absence of the ventral pocket found in *Situla*.

Megalodicopia hians Oka, 1918

Fig. 19.

Megalodicopia hians Oka, 1918: 399. Tokioka, 1953a: 235. Sanamyan, 1998: 113. Okuyama *et al.*, 2002.

Benthascidia michaelsoni: Redikorzev, 1941: 202 (not Ritter, 1907).

MATERIAL EXAMINED. RV *Ak. Oparin*, St. 94, east off South Kurile Islands, 43°10.2'N, 146°18.2'E, 535 m, 10.09.1991, one specimen; RV *Ak. Lavrentyev-75*, St. 21, Bering Sea, north off Commander Islands, underwater Piip Volcano, 55°29'N, 167°15.5'E, 2878 m, 1.07.2016, one specimen.

DESCRIPTION. Several specimens were photographed and one was collected by ROV during the expedition of RV *Ak. Lavrentyev* in the Bering Sea in 2016 (Fig. 19C, F). Photographically documented specimens were attached to a stone by a thick peduncle. The peduncle in live specimens appears to be slightly shorter than the height of the body; two large oral lips widely open so that the branchial sac is exposed, but its details are difficult to recognize on the photographs. The atrial aperture is on the top of short but distinct, directed upward terminal siphon. It has five or six lobes quite distinct in live specimens but difficult to detect

in the preserved material. The specimen collected by ROV (Fig. 19C, F) is 7 cm in height (preserved), body removed from the test is 4.5 in length and the body proper about 2 cm in diameter. In all features it is similar to a smaller specimen from South Kurile Islands described previously by Sanamyan (1998) (Fig. 19A, B, D, E). Both have prominent circular muscles on the both oral lips, especially crowded around the margin of each lip; thinner radial siphonal muscles; bunch of thick muscles radiating from the corners of the lips and a circular ribbon of muscle fibers encircling the body along the line of the oral tentacles (Fig. 19D). Longitudinal musculature of the peduncle in both specimens is composed by thick crowded muscle fibers forming a wide band on its ventral and lateral sides. Dorsal side of the peduncle has no muscles.

The branchial tentacles leaf-shaped, without offshoots (or ampullae) at the base, crowded, inserted along a plain oval line. The space between the tentacular ring and the prepharyngeal band is small laterally and ventrally but larger dorsally. Many small sensory papillae are present between prepharyngeal band and the tentacles, especially dorsally (Fig. 19E). The prepharyngeal band runs close to large oval perforated zone of the branchial sac and makes no dorsal V around small round dorsal tubercle which has simple slit-like opening. The branchial sac is cone-shaped; its tissue is thick (significantly thicker than in described above *Benthascidia michaelsoni*). The dorsal lamina in the smaller specimen is low, poorly developed, but more or less discernible. In the larger specimen the mid-dorsal line of the branchial sac is marked by a thickened unperforated tissue, but distinct dorsal lamina could not be recognized. Three or four transverse (from mid-dorsal to mid-ventral lines) vessels run on the inner side of the branchial sac and smaller vessels form an irregular three-dimension net with the thicker vessels running on external (facing to body wall) side of the branchial sac. The gut forms a wide circular loop with the opening of the oesophagus and the anus being close to each other. The retropharyngeal band divides the gut loop in two equal halves: the ascending limb (the oesophagus, the stomach and proximal part of the intestine) are on the right side of the body, while the descending limb (the whole distal half of the intestine) on the left side. Gonad fills whole gut loop, the compact round ovary occupies a central position in the gut loop and compact mass of testis follicles is between the ovary and the pole of the gut loop.

REMARKS. The main feature, allowing identification of *Megalodicopia hians*, is the presence of well-developed longitudinal muscles in the peduncle. The only other similarly looking octacnemid species with muscular peduncle is *M. rineharti*. It is not known in the North Pacific and has different structure of the branchial zone: the prepharyngeal band has a long

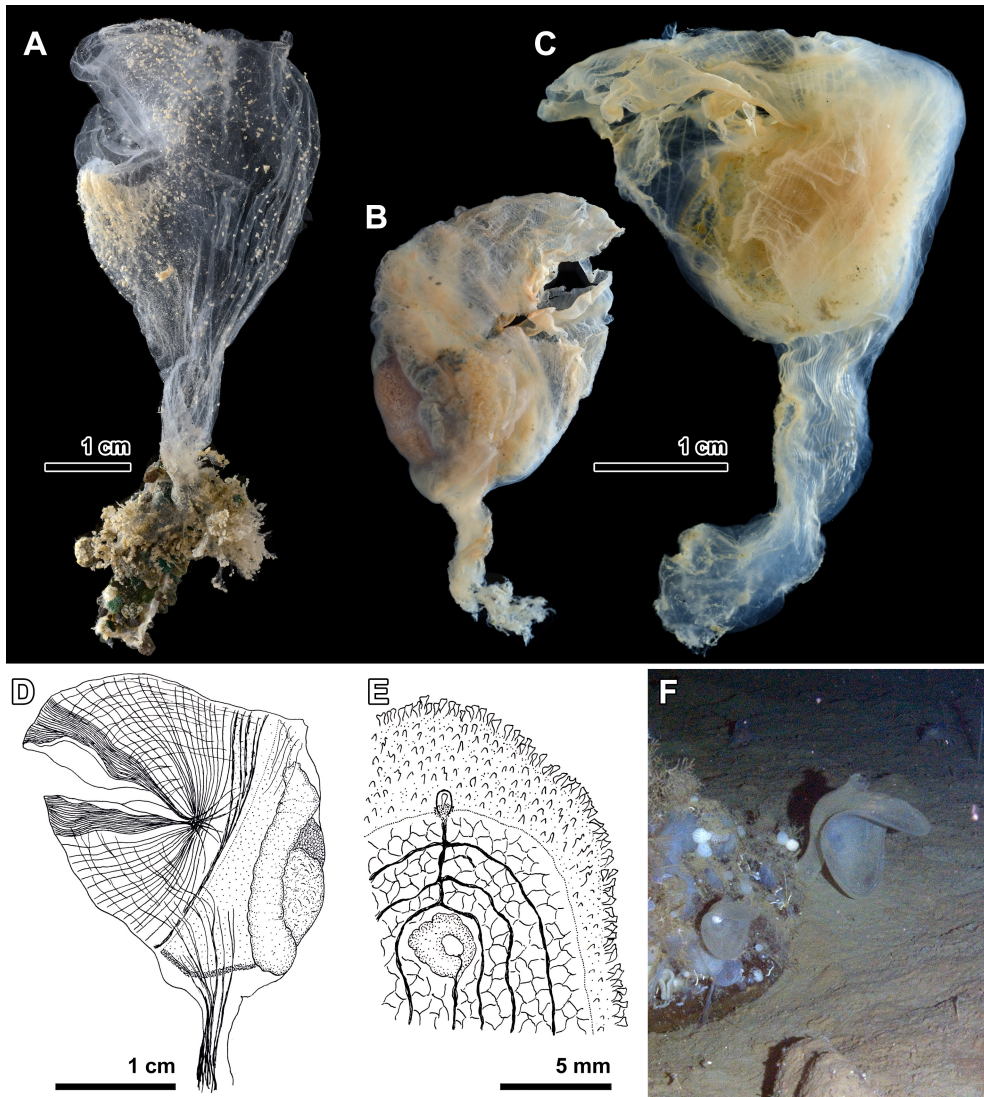


Fig. 19. *Megalodicopia hians*. A — empty tunic; B–D — smaller and larger specimens from right (B) and left (C, D) sides; E — anterior part of the branchial sac and peribranchial area; F — two specimens at 2878 m (photo of ROV *Comanche 18* NSCMB FEB RAS, A.V. Zhirmunsky National Scientific Center for Marine Biology). B and E after Sanamyan, 1998.

Рис. 19. *Megalodicopia hians*. A — туника; B–D — маленький и большой экземпляры с правой (B) и левой (C, D) стороны; E — передняя часть жаберного мешка и перибранхиальной области; F — два экземпляра на глубине 2878 м (фотография ROV *Comanche 18* NSCMB ДВО РАН, Национальный научный центр морской биологии им. А.В. Жирмунского). B и E по Sanamyan, 1998.

narrow dorsal indentation and the branchial sac has large unperforated zone in its anterior part.

Although not often reported *Megalodicopia hians* appear to be not rare in bathyal depths in NW Pacific where its known range extends from the southern part of Bering Sea (north of Commander Islands, present

study) to the west and east coasts of central part of Japan where it sometimes forms large settlements (Okuyama *et al.*, 2002). Most records are from bathyal depths less than 1000 m (350–978 m) but reported here specimen from Bering Sea was collected much deeper (2878 m).

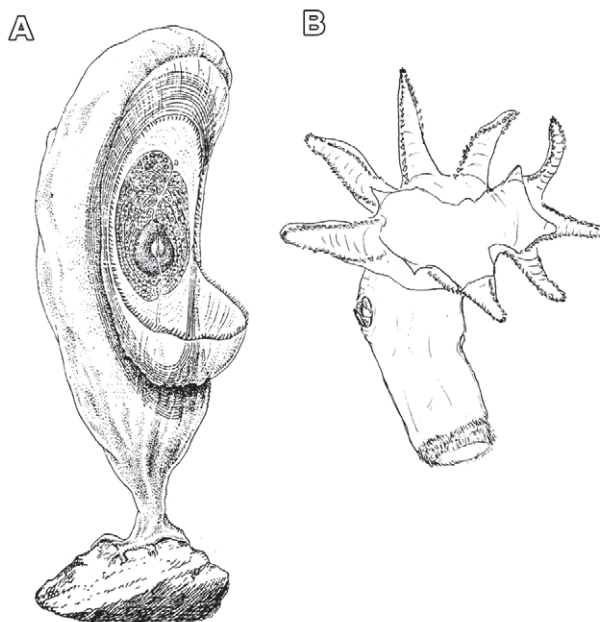


Fig. 20. A — *Situla pelliculosa* (after Vinogradova, 1969); B — *Octacnemus* sp., empty test (a drawing of N.G. Vinogradova first published by Sanamyan, Sanamyan, 2002).

Рис. 20. А — *Situla pelliculosa* (по Vinogradova, 1969); В — *Octacnemus* sp., пустая туника (рисунок Н.Г. Виноградовой впервые опубликованный в работе Sanamyan, Sanamyan, 2002).

Genus *Octacnemus* Moseley, 1877

Type species: *Octacnemus bythius* Moseley, 1877 by monotypy.

The most noticeable feature allowing identification of *Octacnemus* is the presence of eight large triangular lobes around a small branchial opening.

Octacnemus comprises six species that may be divided into two groups:

1) Two species having lateral pinnules on the oral lobes: *O. ingolfi* Madsen, 1947 and *O. kottae* Sanamyan et Sanamyan, 2002;

2) Four species having plain edge of the oral lobes: *O. bythius*, *O. zarcoi* C. Monniot et F. Monniot, 1984, *O. alatus* C. Monniot et F. Monniot, 1985 and *O. vinogradovae* Sanamyan et Sanamyan, 1999.

An important difference between the species is the structure of the branchial sac. In some species the pharyngeal wall is entirely perforated by irregular unciliated stigmata (*O. zarcoi*, *O. kottae*), in other species the perforations form limited “fields” on the pharyngeal wall (*O. vinogradovae*) and sometimes the wall is pierced by several spaced perforations (*O. bythius*). Unfortunately, in many existing descriptions the detailed structure of the branchial sac is not referenced sufficiently (as commented under *O. kottae* in Sanamyan, Sanamyan, 2002) and it is difficult to understand the degree of morphological variability of several species. For instance, in *O. bythius* the size,

position and the number of the perforations differ in the specimens described by different authors: Ritter (1906) figured several irregular vertical slits in the middle of each side of the branchial sac, Millar (1959) describes two or three transversely-oval slits on each side of the postero-dorsal part of the pharynx while F. Monniot & Lopez-Legentil (2017) indicated only one simple hole in the bottom right of the pharynx. It seems that in some cases authors had different species in hand and species diversity of this interesting and rarely recorded genus is underestimated.

Closely related, if distinct, *Polyoctacnemus* differs from *Octacnemus* in being colonial: several specimens are connected by a stolon. This monotypic genus was recorded only once and is too poorly known, its coloniality and a separate generic status need conformation. On the other hand, some species of *Octacnemus* have outgrowths of the body, which may be wide as lateral lobes in *O. alatus*, or thin and long, as posterior process in *O. ingolfi*. They remotely resemble “stolons” of *Polyoctacnemus* by which individuals of this species are connected according to Metcalf (1893, 1900).

Octacnemus sp.

Fig. 20B.

Octacnemus sp. Sanamyan, Sanamyan, 2002: 323, fig. 12D.

MATERIAL EXAMINED. None.

REMARKS. The only evidence of the presence of *Octacnemus* in NW Pacific is the picture drawn by N.G. Vinogradova and published by Sanamyan & Sanamyan (2002) (reproduced here, Fig. 20B). The picture was captioned as: "*Octacnemus*, empty test (the separated body exists), St. 5612, 8200–8050 m". This station was taken during expedition of RV *Vityaz* in 1965 in Kuril-Kamchatka trench, 45°25'N, 153°07'W. The "separated body" was not found in the collection of IOAN, where N.G. Vinogradova worked and, therefore, the precise identification of the sample to species level not possible. The drawing of N.G. Vinogradova shows lateral pinnules on the oral lobes. Similar pinnules occur in only two *Octacnemus* species: *O. ingolfi* and *O. kottae*. None of them is known in North Pacific: *O. ingolfi* was recorded from the north and south Atlantic, Indian Ocean and from the south-western Pacific while *O. kottae* is known from only from southern Atlantic.

Genus *Situla* Vinogradova, 1969

Type species: *Situla pelliculosa* Vinogradova, 1969 by monotypy.

Situla is characterized by the following features: flat plate-like branchial sac fully exposed to exterior through a very wide branchial aperture which may has two large lips, dorsal and ventral, or the lips are not formed; no papillae or other outgrows on the branchial sac or around entrance of oesophagus; on ventral side the branchial tentacles located on high velum which forms deep ventral pocket; peduncle, if present, contains no longitudinal muscles.

Six species of *Situla* are recognized. Two of them, *S. pelliculosa* and *S. galeata* are known from the region covered by the present paper and described below. Remaining four species include: *S. lanosa* C. Monniot et F. Monniot, 1973 (Atlantic and Indian Ocean), *S. cuculli* C. Monniot et F. Monniot, 1991 (New Caledonia), *S. rebainsi* Vinogradova, 1975 (South Sandwich Trench) and *S. macdonaldi* C. Monniot et F. Monniot, 1977 (Indian Ocean). Two species, originally described in *Situla*, were subsequently removed to other genera: *Situla rineharti* C. Monniot et F. Monniot, 1989 is currently classified in *Megalodicopia* and *Situla multitentaculata* Vinogradova, 1975 is transferred to *Kaikoja*.

KEY TO SPECIES OF *SITULA* KNOWN FROM FAR EASTERN SEAS OF RUSSIA

1. Body removed from the tunic has two large (dorsal and ventral) branchial lips (Fig. 21E) *S. galeata*
- No distinct branchial lips (Fig. 20A) *S. pelliculosa*

Situla galeata C. Monniot et F. Monniot, 1991
Fig. 21.

Situla galeata C. Monniot, F. Monniot, 1991a: 391.
Sanamyan, Sanamyan, 1998: 210. F. Monniot, C. Monniot, 2003: 694.

MATERIAL EXAMINED. None.

DESCRIPTION. Description below is based on Sanamyan & Sanamyan (1998), who reported one specimen from this species from NW end of the Aleutian Trench. Two available photographs of this specimen, taken by research submersible *MIR I* and published here for the first time, show a very peculiar appearance of this species in live (Fig. 21A, B). Transparent elongated body is attached to substratum by a peduncle, which is slightly shorter than the body itself. Gut loop and gonad are visible as a compact white and highly reflective mass in the middle of the longitudinal medial line of the body. The branchial sac is a flat plate fully exposed to the exterior. In live the branchial aperture is so widely open that the whole body appears as a flat plate with two large curved lateral (but not dorsal and ventral) lobes. In preserved condition (formalin) the same specimen has a typical "octacnemid" shape (Fig. 21C), little in common with its appearance in live. Preserved specimen is 6 cm in height, ovoid, attached by a short peduncle. The branchial aperture in preserved specimen is a closed deep transverse slit at the middle on the body. The body removed from the test is triangular, with two large branchial lips, dorsal and ventral, which completely hide the branchial sac. Musculature on the lips (Fig. 21E) is represented by circular and weaker radial muscles and by a bunch of thick muscles (a part of circular musculature) on the dorsal lip just above its corner. The branchial tentacles are leaf-shaped; each tentacle has an offshoot or ampulla at the base. Dorsally they run along a wide semicircular line on a large distance from the branchial sac, laterally close to the branchial sac and ventrally placed on a free upper rim of a deep thin-walled pocket (Fig. 21D). The prepharyngeal band runs along plain oval line close to the branchial sac, its ventral part is in the bottom of the ventral pocket; it makes no V around the dorsal tubercle. The area between the tentacles and the prebranchial band contains minute sensory papillae. The branchial sac is almost flat. Perforations form a wide zone dorsally and laterally but the central and the whole ventral parts of the branchial sac are not perforated. There are no papillae or hair-like outgrows on the branchial sac or on the border of the oesophagus.

REMARKS. This species was recorded from New Caledonia, 1395–2340 m (C. Monniot, F. Monniot, 1991a), Fiji and Indonesia, 350–600 m (F. Monniot, C. Monniot, 2003) and one specimen, described above, reported in Aleutian Trench near Commander Islands (54°57.3'N, 165°48.1'E – 54°59.2'N, 165°51.7'E)

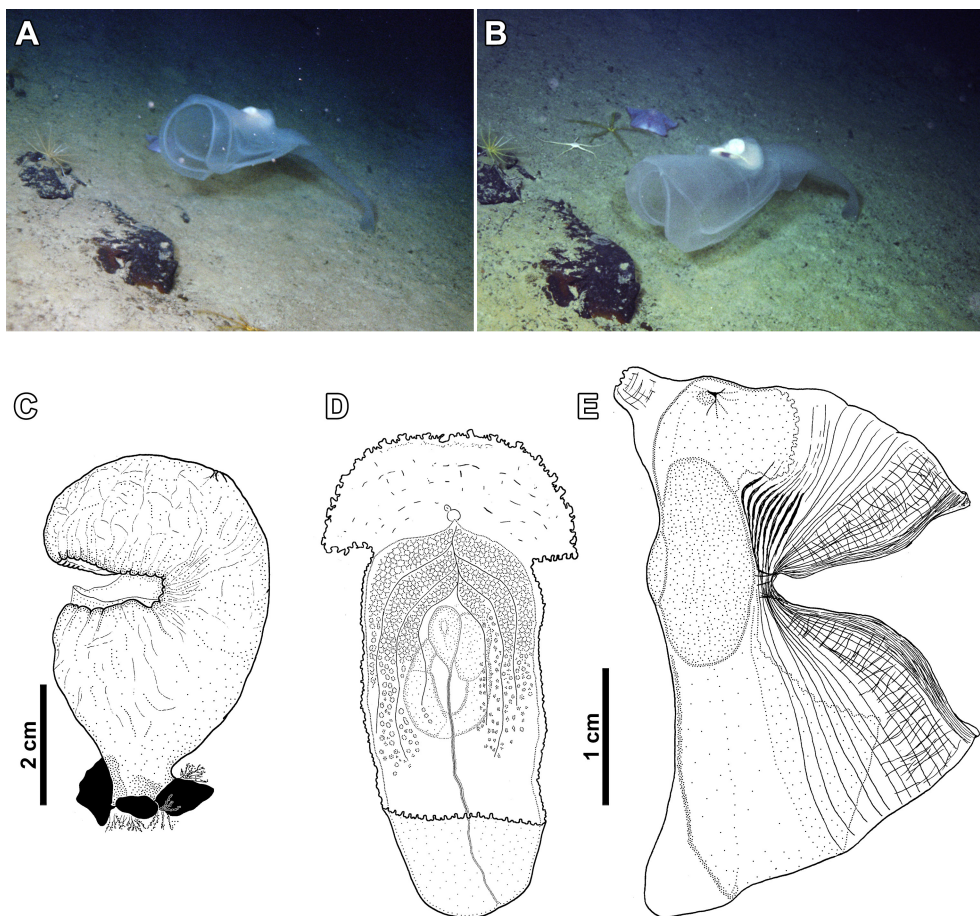


Fig. 21. *Situla galeata*. A, B — underwater photographs taken by research submersible *MIR 1* (P.P. Shirshov Institute of Oceanology, Moscow); C — the same specimen preserved in formalin; D — branchial plate; E — body with test removed. C–E after Sanamyan, Sanamyan, 1998.

Рис. 21. *Situla galeata*. A, B — подводные фотографии сделанные аппаратом *МИР 1* (Институт океанологии им. П.П. Ширишова, Москва); C — этот же экземпляр в формалине; D — жаберная пластинка; E — тело без туники. C–E по Sanamyan, Sanamyan, 1998.

between 2926 and 4891 m. Morphology of the latter specimen is remarkably similar to the originally described type material, and despite large geographic distance between the records I failed to find any significant morphological differences between them, and, therefore, treat them as conspecific.

Situla pelliculosa Vinogradova, 1969

Fig. 20A.

Situla pelliculosa Vinogradova, 1969: 30.

MARETIAL EXAMINED. None.

DESCRIPTION. I had no chance to examine this species but the original description is very detailed, accompanied by excellent drawings and contains

all details necessary for accurate identification. According to Vinogradova (1969) the type specimens are 49–346 mm in height and have a characteristic shape with very large branchial opening and with flat, fully exposed to exterior, branchial sac (Fig. 20A). Oral lips are not developed, and the species probably does not have the ability to close its mouth on prey. Very numerous leaf-like oral tentacles arranged along a plain oval line. Ventrally they placed on the rim of high thin-wallet pocket (Fig. 20A). The oral tentacles are simple, without ampullae at the base. The prepharyngeal band runs along a plain oval line with poorly defined inflection around the dorsal tubercle; the prepharyngeal band runs close to the perforated zone of the branchial sac laterally but far

from it dorsally and ventrally. Ventrally it runs along the bottom of the ventral pocket. The prepharyngeal zone (the space between the ring of the tentacles and the prepharyngeal band) also is narrow laterally but wide dorsally and, especially, ventrally. The perforated zone of the branchial sac forms a ring around the visceral mass (gut loop and gonad). The tissue of the branchial wall is described as very thin. It lacks any kinds of papillae or filamentous outgrowths. The stigmata are irregular and, in general, resemble those of *Benthascidia michaelsoni* illustrated in the present work (Fig. 18C). At least three transverse (perpendicular to the dorsal lamina) vessels are discernible on each side, but no longitudinal vessels. The dorsal lamina is described as low but rather thick membrane with plain margin. No hair-like outgrowths around the entrance of the oesophagus.

REMARKS. *Situla pelliculosa*, the type species of the genus, is known only from the original description based on numerous (about 30) specimens recorded in four stations in Kuril-Kamchatka Trench and abyssal plain east of it at depths 5235–8430 m. No other specimens referable to this species have been collected subsequently. Key features of this species include: 1) the absence of the large oral lips characteristic for several other *Situla* species and also for *Dicopia* and *Megalodicopia*; 2) the oral tentacles without ampullae at their bases; 3) flat branchial sac without papillae; 4) the prepharyngeal band without deep inflection around the dorsal tubercle; 5) smooth-walled entrance of the oesophagus.

Family Ascidiidae Rafinesque, 1815

The family comprises solitary phlebobranch ascidians having flat or finely plicate branchial sac with straight vertical stigmata and internal longitudinal vessels supported by papillae; gut loop on left side; gonads in gut loop or spread over intestine; usually numerous small renal vesicles spread over left body wall and visceral mass.

The family contains three main genera, *Ascidia* Linnaeus, 1767, *Phallusia* Savigny, 1816 and *Ascidella* Roule, 1883, and two monotypic aberrant genera, interstitial *Psammascidia* F. Monniot, 1962 and deep-water *Fimbrora* C. Monniot et F. Monniot, 1991. In the North Pacific only members of the genus *Ascidia* are recorded.

Nomenclatural notes on the family Ascidiidae

Authorship of the family Ascidiidae is cited in many different ways in taxonomic literature. Herdman (1891: 586) ascribed the family to himself: “Family Ascidiidae Herdman 1880” and a subfamily with the same name to another his work: “Subfamily Ascidiinae Herdman, 1882”. According to the Principle of

Coordination, Article 36.1, these family and subfamily names must have the same authorship and date. Hartmeyer (1903) raised several subfamilies mentioned by Herdman (1891) to a family level and ascribed Ascidiidae to “Herdman, 1891”. Van Name (1945) cited it again as “Ascidiidae Herdman, 1880”. Kott (1985) cited the authorship of this family as “Adams, 1858”, but she probably intended to write “Adams et Adams” because only the paper of Adams, Adams (1858) is listed in the references she provided. Then, in her Catalogue to Australian ascidians (Kott, 1998), she cited the authorship of the family as “Herdman, 1882”, and finally (Kott, 2009), as “Adams & Adams 1858”. In a very recent literature the authorship of the family is usually indicated as “Herdman, 1882” (e.g. Palomino-Alvarez *et al.*, 2019; Bonnet *et al.*, 2013).

Obviously, the authorship of Ascidiacea cannot be ascribed to any work of Herdman published in 1882 (Herdman, 1882a, b, c) because he used this name earlier, in 1880 (Herdman 1880) (family name appeared even in the title of his publication: “Preliminary Report on the Tunicata of the Challenger Expedition. 1. Ascidiidae”). As indicated by Kott (1985, 2009) the family name Ascidiidae was used before Herdman’s work by Adams, Adams (1858). In their paper Adams, Adams (1858: 589) used it as “Fam. Ascidiidae” and briefly characterized. However, earlier, Alder, Hancock (1848) already cited this name and ascribed it to Forbes as “Ascidiadae, Forbes”. The first appearance of the family name Ascidiacea in the publications of Forbes is in his catalogue of Mollusca published in 1838 (Forbes, 1838: 57). He used it explicitly as “Fam. Ascidiadae” and the first included genus was “*Ascidia*, Lin.” Earlier, this name (as family “Ascidiadae”) was used by MacLeay (1825). However, the earliest work, which I was able to find, where this name was established, is a work of Rafinesque (1815: 148). This author established numerous new names and among them the family Ascidiina with two subfamilies, Scytinomia and Salparia. The subfamily Scytinomia was based on the genus *Scytinoma* Rafinesque, 1815, which is *nomen nudum*, and also contained the genus *Ascidia* Linnaeus. This fact makes family Ascidiina Rafinesque, 1815 validly established and, according to Article 11.7.1.3, “available with its original authorship and date, but with a corrected suffix”, i.e. as Ascidiidae Rafinesque, 1815. A subfamily Salparia was based on the genus *Salpa* Linnaeus and also validly established. Thus, authorship of the family Salpidae also belongs to Rafinesque (1815) (Article 36.1), rather than to Lahille (1888), as is accepted now.

Van Name (1945: 174) noted that Ascidiidae is a “*Nomen conservandum*”. The meaning of “*nomen conservandum*” in this context is not clear. Indeed, the family Ascidiidae (without authorship) is mentioned in a work of Hartmeyer (1915) entitled “*Ascidiarum nomina conservanda*”, which is usually cited by ascidian taxonomists in a connection with several “conserved”

names. But, contrary to belief of many ascidian taxonomists, the taxa cannot be conserved just because they were listed in that work, family name Ascidiidae is not “conserved” (whatever meaning this term has) and not needs to be conserved because it is the oldest family in Ascidiacea. (Detailed discussion is provided in the first part of the present work, see “Notes on the nomenclature of Ascidiacea” in Sanamyan. 2022).

Genus *Ascidia* Linnaeus, 1767

Type species: *Ascidia gelatinosa* Linnaeus, 1767 designated herein.

Nomenclatural notes on genus Ascidia

Kott (1998: 147) stated that the genus *Ascidia* was originally described by Linnaeus (1767) without included species and that the type species of *Ascidia* is *Ascidia mentula* Müller, 1776 by subsequent designation by Hartmeyer (1915). Both these statements are not correct. Linnaeus (1767: 1087) originally included six species in *Ascidia* listed as “*papillosum*”, “*gelatinosum*”, “*intestinalis*”, “*quadridentata*”, “*rustica*”, “*echinata*”. In his work entitled “*Ascidiarum nomina conservanda*” Hartmeyer (1915) stated that he designates *Ascidia mentula* as type species of *Ascidia* but this designation not valid because *Ascidia mentula* was not originally included in *Ascidia* (Article 67.2). Taxonomic assignment of five species originally included in *Ascidia* is well established (*A. papillosum* belongs to *Halocynthia*, *A. intestinalis* to *Ciona*, *A. quadridentata* and *A. rustica* to *Styela* and *A. echinata* to *Boltenia*). The remaining species, *A. gelatinosa*, is the only originally included species which may belong to the genus *Ascidia* as it currently defined. In his definition of *Ascidia gelatinosa* from Mediterranean Linnaeus (1767) refers to a not binominal work of Bohadsch (1761) who gave description and figure of this species. Although its taxonomic status cannot be resolved now with confidence, a very schematic figure of Bohadsch (1761) suggests that it may be conspecific with *Ascidia mentula* Müller, 1776 which also occurs in the Mediterranean Sea. The assignment of this species as a type species of *Ascidia* is the only Code-compliant way to save the genus *Ascidia* in its current understanding (because all other originally included species belong to other genera now).

To summarize: *Ascidia gelatinosa* Linnaeus, 1767 is synonymized here with *Ascidia mentula* Müller, 1776 and designated as the type species of *Ascidia* Linnaeus, 1767. Precedence of *Ascidia gelatinosa* Linnaeus, 1767 over *Ascidia mentula* Müller, 1776 is suppressed here by applying Article 23.9 (“Reversal of precedence”); *Ascidia mentula* Müller, 1776 remains a valid name while older *Ascidia gelatinosa* Linnaeus, 1767 is deemed to be its junior synonym.

Ascidia is characterized by the following features: papillae rising from transverse vessels project above the level of longitudinal vessels (a difference from *Ascidella*); neural gland has no accessory openings (a difference from *Phallusia*).

Ascidia is the most diverse genus of Ascidiidae comprising more than 130 species. The genus is especially diverse in tropics but many species inhabit temperate and cold waters. The most detailed descriptions of the northern members of the genus were made mainly by old authors (Hartmeyer, 1903, 1924; Ärnäck, 1934, etc.) Millar (1966) in his key to north European species listed eight species of *Ascidia*, two of which, *A. callosa* Stimpson 1852 and, possibly, *A. prunum* Müller, 1776 (as *Ascidopsis nanaimoensis* Huntsman, 1912), were reported in the North Pacific. In Far Eastern Seas of Russia the genus is represented by seven species: *A. beringia* sp.n., *A. callosa*, *A. kurila* sp.n., *A. vivipara* sp.n., *A. zyogasima* Tokioka, 1962, *A. escabanae* C. Monniot, 1998 and *A. zara* Oka, 1935.

KEY TO SPECIES OF *ASCIDIA* KNOWN FROM FAR EASTERN SEAS OF RUSSIA

1. Only primary gut loop present, gut forms widely open C-shaped arc. Abyssal species
.....*A. escabanae*
– Gut makes two loops, primary and secondary ... 2
2. No intermediate papillae on longitudinal branchial vessels, test papillated *A. zara*
– Intermediate papillae present, at least in some parts of branchial sac 3
3. Ovary forms a compact lobulated mass located completely in the gut loop. Larvae or eggs may present in peribranchial cavity ... *A. vivipara* sp.n.
– Ovary has numerous tubular branches spread over the intestine. Larvae or eggs present or absent in peribranchial cavity 4
4. Longitudinal branchial vessels less than 22 (rarely up to 25) on each side. Ovary branches over ascending and descending limbs of primary gut loop. Larvae often present in peribranchial cavity
.....*A. callosa*
– Longitudinal branchial vessels more than 30 5
5. Primary gut loop more or less transverse (its axis passing through endostyle) *A. beringia* sp.n.
– Primary gut loop vertical or curved dorsally 6
6. Gut loop occupies more than 2/3 of the left side. Ovary branches over ascending limb of primary gut loop only. Less than 55 longitudinal branchial vessels on each side. Larvae or eggs may present in peribranchial cavity *A. kurila* sp.n.
– Gut loop usually occupies less than a half of left side. In most cases more than 55 longitudinal vessels on each side. Larvae or eggs never present in peribranchial cavity *A. zyogasima*

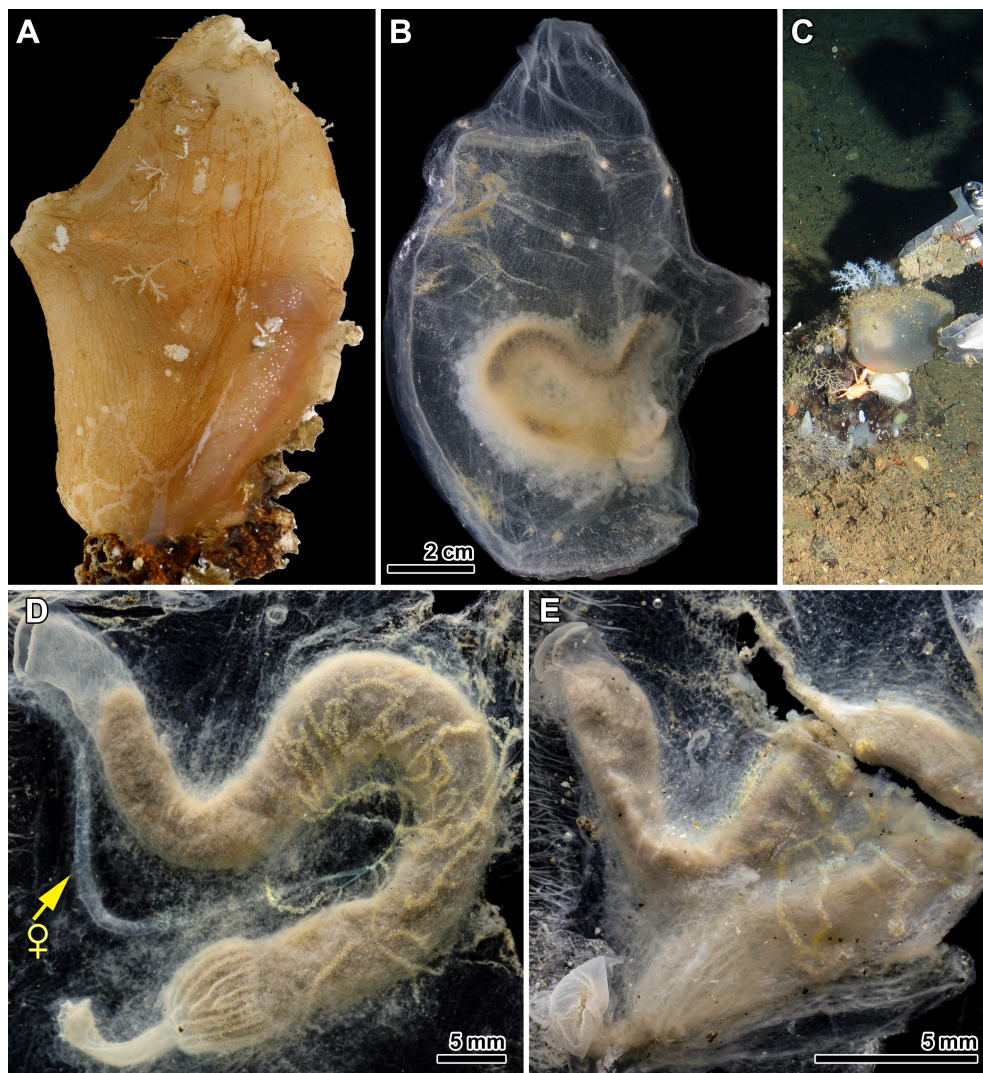


Fig. 22. *Ascidia beringia* sp.n. A — live specimen, paratype MIMB 47320; B — the same specimen with test removed; C — holotype, photo taken by ROV Comanche 18, NSCMB FEB RAS, A.V. Zhirmunsky National Scientific Center for Marine Biology; D — gut loop of holotype; E — gut loop of smaller paratype MIMB 47321.

Рис. 22. *Ascidia beringia* sp.n. A — живой экземпляр, паратип MIMB 47320; B — тот же экземпляр без туники; C — голотип, фото ROV Comanche 18 NSCMB ДВО РАН, Национальный научный центр морской биологии им. А.В. Жирмунского; D — петля кишечника, голотип; E — петля кишечника, паратип MIMB 47321.

Ascidia beringia sp.n.

Figs 22, 23.

MATERIAL EXAMINED. Holotype MIMB 47319. RV *Ak. Lavrentyev-82*, Bering Sea, St.7, 17.06.2018, sample 2, 55.3688°N, 167.2662°E, 981 m. Paratypes: MIMB 47320, same station, sample 8, 55.3708°N, 167.2670°E, 895 m, one specimen;

MIMB 47321, same station, sample 7, 55.3693°N, 167.2670°E, 966 m, one specimen.

DESCRIPTION. The largest specimen (paratype MIMB 47320) is 14 cm in height and 7 cm wide, flattened laterally, erect, attached to a dead glass sponge by a small area on the proximal end (Fig. 22A). Two remaining specimens are 12 cm (holotype) and 4.5 cm in height, the latter is strongly damaged. The

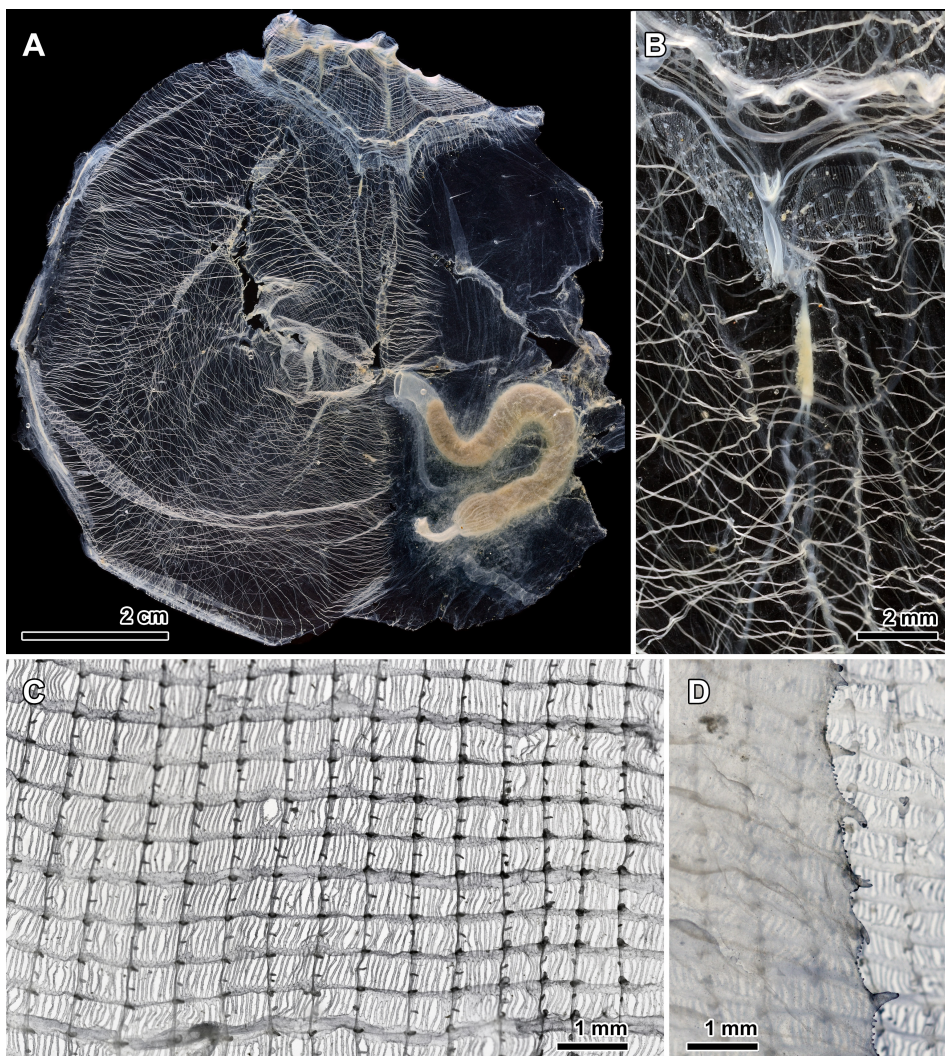


Fig. 23. *Ascidia beringia* sp.n., holotype. A — holotype opened ventrally; B — dorsal area; C — branchial sac; D — dorsal lamina.

Рис. 23. *Ascidia beringia* sp.n., holotype. A — вскрытие; B — дорсальная область; C — жаберный мешок; D — спинная пластинка.

test is about 2–4 mm thick. In freshly collected live specimens the superficial layer of the test had a distinct reddish-brown tint, but the colour is not obvious in underwater photographs of live specimens (Fig. 22C). Brown pigment faded considerably in preservative and in the fixed specimens the test is nearly colourless and translucent (similar to that of many other species of the genus). The surface is finely wrinkled, almost free from foreign particles except for a few small bryozoan colonies growing on the test.

The body removed from the test has a characteristic rectangular shape (Fig. 22B), its wall is very thin and

transparent. The siphons are large, triangular, with wide base; the branchial siphon terminal, the atrial is in the middle of the dorsal line of the body. Circular and radial siphonal muscles are well-developed and crowded on both siphons. Muscle fibers are crowded on the right side where they form dorsal and ventral fields of numerous parallel transverse muscles which intermingle and form a network in the middle of the right side of the body wall. Most part of the left side has no muscles (Fig. 23A).

About 30 spaced tentacles of several sizes are on a high muscular velum. The prebranchial band

consists of two blades running close to the tentacular velum and to the branchial sac; dorsal V is not deep but quite noticeable. The prebranchial area is smooth. The dorsal tubercle is small and has V-shaped slit. The neural gland is on the side of the neural ganglion; the ganglion is located at distance of its own length from the dorsal tubercle (Fig. 23B). The dorsal lamina consists of two low thick blades in its anterior part (Fig. 23B) which then fuse and form high thin membrane with toothed rim (Fig. 23D).

The branchial sac is flat, without plications. The meshes are perfectly square with seven or eight stigmata per mesh. Holotype has 73 longitudinal vessels on the right and 64 on the left. Parastigmatic vessels totally absent but intermediate papillae on the longitudinal vessels are well-developed in all parts of the branchial sac, they are slightly smaller than the primary papillae (Fig. 23C).

The visceral mass occupies a small part of the middle of the left side of the body. The stomach is short, clearly demarcated from the intestine, with well-formed longitudinal folds. The shape of the gut loop is characteristic and similar in all three available specimens (Fig. 22B, D, E). The primary loop is short, narrow but open, transversely orientated so that its axis passing through the middle of the ventral line of the body. The secondary loop is pronounced, widely open, with its distal part being perpendicular to the ascending limb of the primary gut loop. Anal margin smooth. The ovary is composed of thin branching tubes issued from the oviduct. The oviduct forms an open loop in the primary gut loop; ovarian tubes are present in the gut loop and on the inner (facing to the branchial sac) side of the intestine. Male follicles not seen. Renal vesicles present in all specimens but most abundant in the largest one (Fig. 22B), where they hide the gut loop almost completely.

REMARKS. In most features, including overall body shape, the structure of the branchial sac and digestive tract, *Ascidia beringia* sp.n. closely resembles *A. clementea* Ritter, 1907. The original description of *A. clementea* is based on eight specimens from California, San Clemente and San Nicolas Island, 1145–1892 m (Ritter, 1907). C. Monniot & F. Monniot (1989) described one specimen collected near Galapagos Islands at 335 m depth and no other specimens of this species are known. Ritter (1907: 33) stated that the reproductive organs in his species are “situated in the intestinal loop chiefly” and according to C. Monniot & F. Monniot (1989: 24) “the ovary, a network of tubes inside the intestinal loop, does not spread out onto the intestine”. In contrast, in all three specimens described here most part of ramified ovary is spread over the intestine and cover both ascending and descending limbs of the primary gut loop.

Ascidia callosa Stimpson, 1852

Fig. 24.

Ascidia callosa Stimpson, 1852: 228. Hartmeyer, 1924: 41. Årnbäck, 1934: 49. Van Name, 1945: 178. Millar, 1966: 5. Nishikawa, 1991: 56. Lambert, Sanamyan, 2001: 1772. Sanamyan, 1998: 102. Sanamyan, Sanamyan, 2017: 302.

? *Ascidia (Ascidopsis) columbiana*: Årnbäck 1934: 53. NOT *Ascidopsis columbiana* Huntsman, 1912a.

MATERIAL EXAMINED. RV *Ak. Oparin*-56, St.7, Urup Island (Sea of Okhotsk side), 45°52.2'N, 149°37.0'E, 142 m, 28.06.2019, one specimen. Shiaskotan Island, Krabovaya Bay, (~43°53.2'N, 146°49.1'E), intertidal zone, 31.08.1997, coll. A. Tsurpalo, one specimen; Atlasova Island, 18 m, 22.07.1989, coll. A. Strelkov, one specimen.

DESCRIPTION. Available specimens are relatively large, 3–5 cm in length, more or less oval but the shape is rather irregular. The test is colourless and translucent, gelatinous but rather firm, capable to retain its shape when removed from the water, not smooth (looks like to be crumpled), with some epibionts (bryozoans and hydroids) on surface. The siphons are short, the branchial one is terminal, the atrial slightly displaced dorsally. Both siphons are six-lobed, the lobes are very inconspicuous, smooth, marked by a minute pigment spot.

The musculature is composed of circular and short radial siphonal muscles and an irregular mesh of numerous fine fibers on the right side. The tentacles arise from a rather high muscular velum, 24 and 45 were counted in two specimens. Prepharyngeal band consists of two lamellae, the anterior lamella is high, the posterior is taller. The prepharyngeal zone is smooth, its width is variable, in a specimen from Urup Island it is significantly wider on the left than on the right (Fig. 24A). Ribbed dorsal lamina has short languets projecting from its free edge (Fig. 24C), secondary serrations are present only in a specimen from Shiaskotan Island.

The wall of the branchial sac is strongly plicate (Fig. 24E). The number of stigmata per mesh is variable, up to 15 or (possibly more) in the parts of the branchial sac where the plications are especially high. Intermediate papillae present in some parts of the branchial sac (Fig. 24D, E). Internal branchial longitudinal vessels are robust, 19–22 on the right and 17–21 on the left.

The visceral mass occupies a significant (three quarters or almost the whole) part of the left side. The stomach is globular, with longitudinal folds (nine are visible from the outside in a specimen from Urup Island, Fig. 24B). The primary and the secondary gut loops are long and straight. The anus has two lobes with smooth margin, it opens slightly posterior to the level of the pole of the first gut. The ovary forms numerous tubular branches spread over ascending and descending limbs of the primary gut loop. The

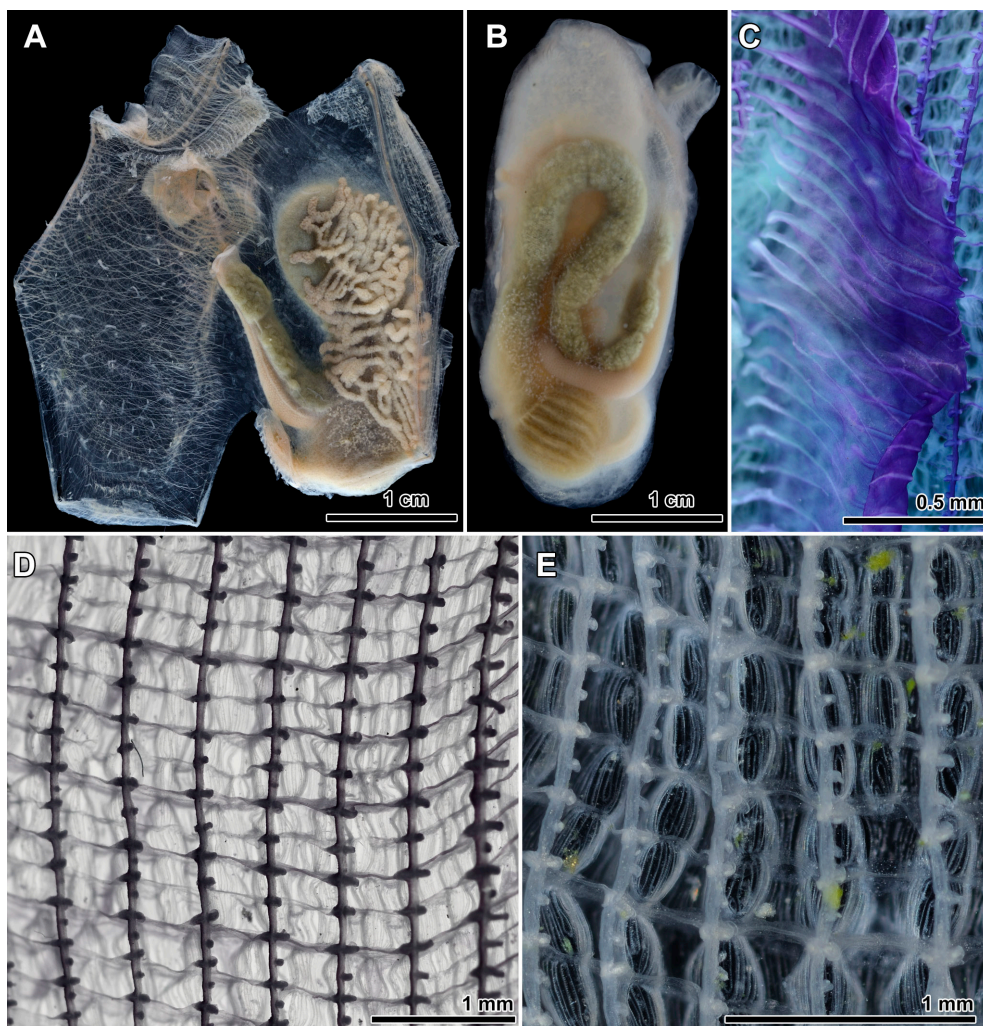


Fig. 24. *Ascidia callosa*, specimen from Urup Island. A — opened specimen; B — the same specimen from left side; C — dorsal lamina; D — branchial sac in transmitted light to show papillae on longitudinal vessels; E — branchial sac in reflected light to show plications.

Рис. 24. *Ascidia callosa*, экземпляр с о. Уруп. А — вскрытие; В — вид с левой стороны; С — спинная пластинка; D — жаберный мешок в проходящем свете, видны папиллы на продольных сосудах; Е — жаберный мешок в отраженном свете, видна мелкая складчатость стенки.

oviduct follows the intestine and opens on the level of the anus. Numerous eggs are present in all examined specimens, the specimen from Urup Island had also tailed larvae. Renal vesicles are profusely developed.

REMARKS. This species has a long and complicated taxonomic history. Hartmeyer (1903), in his monographic account on Arctic ascidians, synonymized it, together with many other species, with *Ascidia prunum*. Later, when he worked with ascidians identified as *A. prunum* from West Greenland, he discovered that the material consists of two very different species, one of which is true *A. prunum*

while another species had much smaller number of longitudinal branchial vessels (Hartmeyer, 1924). He associated the latter species with *A. callosa* described by Stimpson (1852) from Atlantic coast of USA (Grand Manan, New Brunswick). Hartmeyer (1924) examined numerous specimens from various locations and published an extensive list of previous records and synonyms referable to this species. As a result, *A. callosa* received a very wide distribution including many locations in the Arctic seas, Atlantic and North Pacific coasts of USA and Canada, Bering Sea and even the coasts of Korea (as *Phallusia koreana*

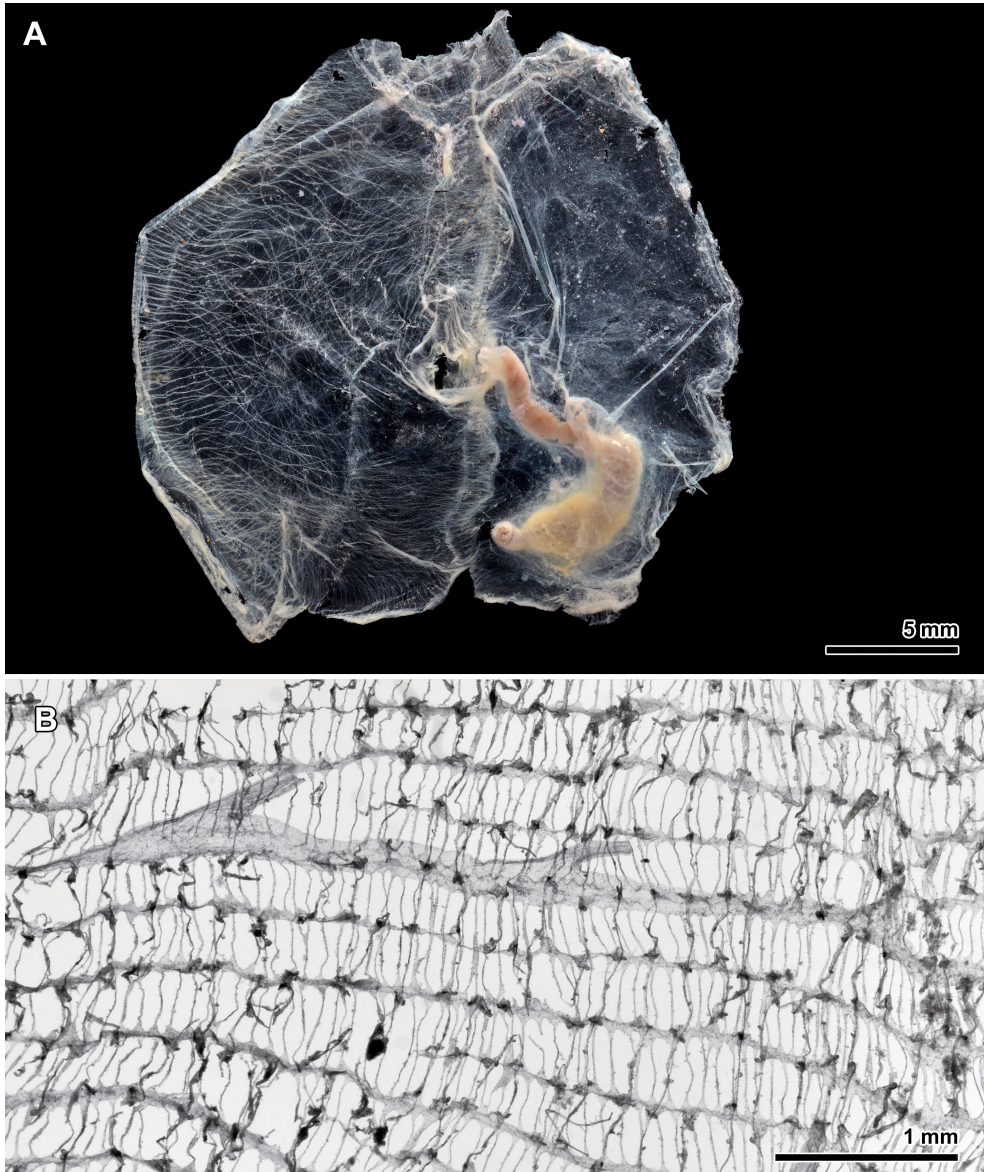


Fig. 25. *Ascidia escabanae*. A — specimen opened ventrally; B — branchial sac.
 Рис. 25. *Ascidia escabanae*. A — вскрытие; B — жаберный мешок.

Traustedt, 1885 and *P. suensonii* Traustedt, 1885). An extensive description of *A. callosa* was published by Huus (1930) who described tailed larva incubated in the peribranchial cavity in this species. Since that time the species was distinguished by two main features: a small number of the longitudinal branchial vessels and viviparity. Nishikawa (1991) removed from the synonymy of *A. callosa* two Korean species described by Traustedt (1885). Lambert & Sanamyan (2001) reinstated another species, *A. columbiana*, previously

regarded as conspecific with *A. callosa*. Very wide range of distribution (even without Korean records) suggests that there may be several species united under the name of *A. callosa*. In particular, I have doubt whether the specimens from Pacific are correctly attributed to *A. callosa* although the existing descriptions and available specimens provide insufficient information to separate them. The specimens from Pacific were originally described by Ritter (1901) as *A. adhaerens* Ritter, 1901, this name may be applied

to Pacific specimens if will be shown that they are distinct from Atlantic *A. callosa*. Type specimens of *A. callosa* were reexamined by G. Lambert, they contained no larvae and were very disintegrated (Lambert, Sanamyan 2001).

In NW Pacific *A. callosa* is abundant around Commander Islands and East Kamchatka (Sanamyan, 1998). Confirmed records also include north, middle and south Kuril Islands (Sanamyan, Sanamyan, 2017; present study).

Ascidia escabanae C. Monniot, 1998

Fig. 25.

Ascidia escabanae C. Monniot, 1998: 554. Sanamyan, Sanamyan, 2007: 60.

Ascidia clementea: Sanamyan, Sanamyan, 1998: 212 (not Ritter, 1907: 32).

MATERIAL EXAMINED. RV *Ak. Keldysh*, St. 2316, Bering Sea north off Commander Islands, 55°38'N, 167°23.04'E – 55°35.0'N, 167°24.4'E, 4294–4200 m, 5.08.1990, one specimen.

DESCRIPTION. Examined specimen was already described in details by Sanamyan & Sanamyan (2007), here I provide only the main morphological characters and photographic illustrations. The specimen is 3.5 cm high. The test with minute sparse conical papillae. Body removed from the test is about 2 cm in height, its wall is very thin and transparent. The musculature consists of a network of thin fibers on the right side of the body wall only. Ventrally muscle fibers arranged transversely (perpendicular to the endostyle) and parallel to each other; similar band of parallel transverse fibers crosses mid-dorsal line (Fig. 25A). About 25 branchial tentacles attached directly to the body wall (no branchial velum). The prepharyngeal band runs along the circular line and makes no dorsal V around very small dorsal tubercle. The prepharyngeal zone is smooth. Elongated ganglion is just behind the dorsal tubercle. The margin of the dorsal lamina has minute spaced indentations (see Sanamyan, Sanamyan, 2007, fig. 3A). The branchial sac is very delicate, thin-walled and flat, without plications (Fig. 25B). It has more than 60 transverse vessels and about 50 thin internal longitudinal vessels on each side supported by short papillae. Minute intermediate papillae are present. The gut forms small widely open simple arc, its proximal limb, which includes the elongated stomach and a part of the intestine, is shorter than the distal limb (Fig. 25A); it occupies a small part of the left side and lies in the posterior half of the body. Gonads are poorly developed; the ovary is represented by thin tubes spread over the intestine; male follicles not seen. The whole gut loop, with the exception of the distal end of the rectum, is embedded in a mass of renal vesicles.

REMARKS. The original description of *Ascidia escabanae* is based on four specimens from NE Pacific, 40°59.8'N, 127°31.1'W, 3230–3260 m (C. Monniot,

1998). Later, several specimens of this species were collected at one station north off Commander Islands in the Bering Sea. A part of this material was initially identified as *A. clementea* by Sanamyan & Sanamyan (1998) but then redescribed as *A. escabanae* by Sanamyan & Sanamyan (2007). The species is characterized by its unique (for *Ascidia* species known from North Pacific) shape of the gut loop forming a simple arc. In all other *Ascidia* species from this region the gut is more or less S-shaped, with well-marked primary and secondary loops.

Ascidia kurila sp.n.

Figs 26, 27.

Ascidia prunum: Sanamyan, 1998: 103 (NOT *Ascidia prunum* Müller, 1776: 225).

MATERIAL EXAMINED. Holotype MIMB 47322: RV *Ak. Oparin*-56, St.69, Onkotan Island (Sea of Okhotsk side), 49°24.0'N, 154°16.1'E, 146–147 m, 12.08.2019. Paratypes: MIMB 47323, St.1, Urup Island (Pacific side), 45°45.7'N, 150°05.8'E, 257 m, 27.06.2019, one specimen; MIMB 47324, St.4, Urup Island (Pacific side), 45°55.2'N, 150°15.8'E, 169–150 m, 27.06.2019, one specimen; MIMB 47325, St.69, Onkotan Island (Sea of Okhotsk side), 49°24.0'N, 154°16.1'E, 146–147 m, 12.08.2019, one specimen; MIMB 47326, RV *Lebed*, St. 97, Paramushir Island, 49°1.7'N, 156°4.7'E, 156–165 m, 10.08.1954, one specimen (reported as *Ascidia prunum* by Sanamyan, 1998).

DESCRIPTION. The largest specimen is 55 mm long and 40 mm in width. The specimens are wide oval in outline, flattened laterally, with rounded edges. The test is colourless and transparent, gelatinous but rather rigid. Minute inconspicuous papillae similar to those described for *A. vivipara* sp.n. are present on the surface of the smaller specimens but become less noticeable in the larger specimens. Larger papillae are present on siphons. The apertures are on short conical siphons, the branchial is terminal, the atrial on some distance (one fourth of the body length) from it. The branchial siphon has six or seven lobes, the atrial five or six; the lobes are not prominent and rather indistinct, with smooth (not serrated) margin, each is marked by a yellow spot.

The body wall is not thin. The musculature is of *A. callosa* type with a dense network of thin and mostly straight fibers on the right side some of which cross mid-dorsal line and intersiphonal area and extend on a short distance to the left side (Figs 26C, 27A). Most specimens have about 30 tentacles except the largest specimen from Paramushir Island which has about 60 tentacles. The prepharyngeal zone is of moderate width, smooth. The prepharyngeal band is composed of high anterior membrane and thick but low posterior one. The dorsal tubercle is small, with V-shaped opening, the open interval directed

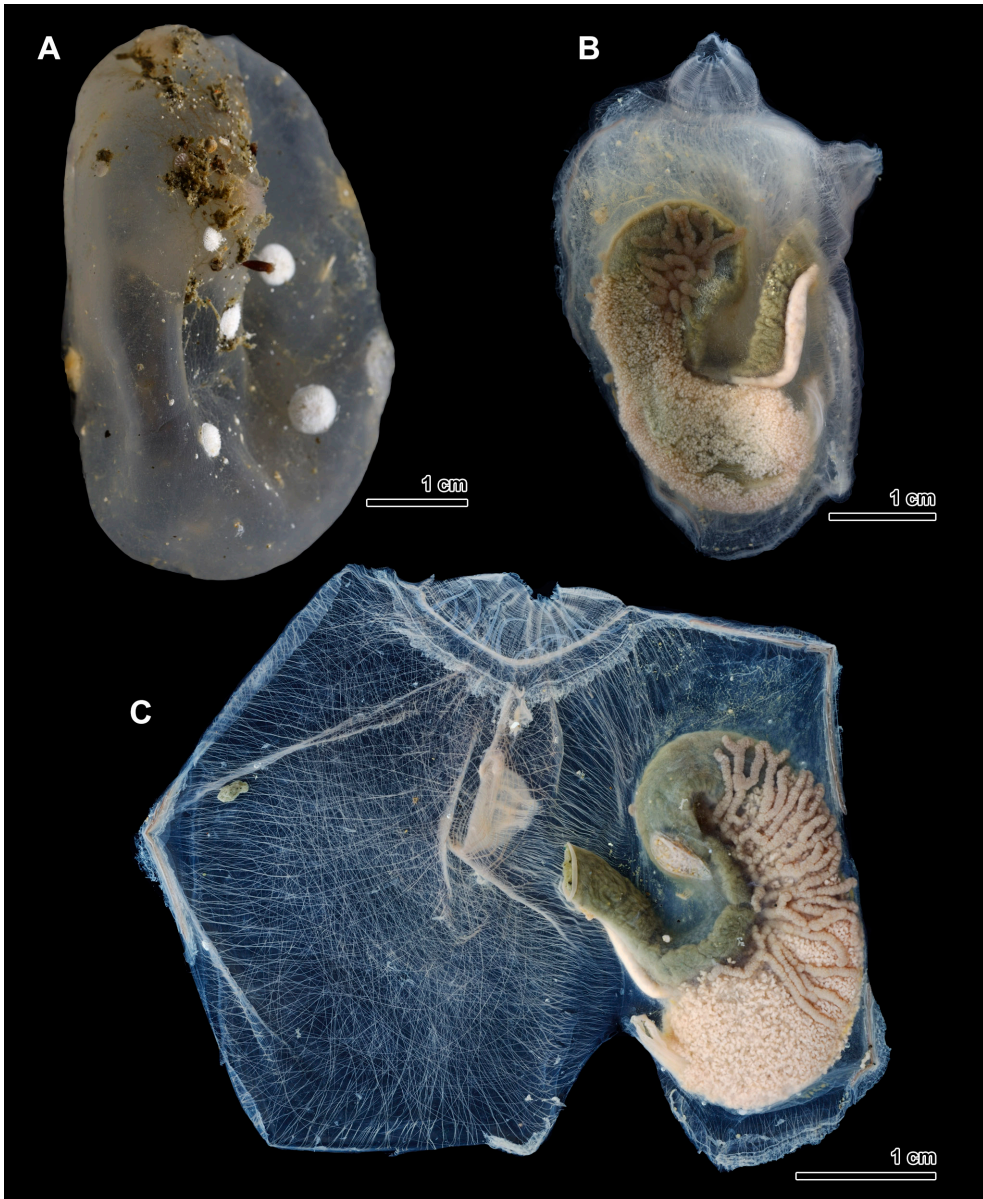


Fig. 26. *Ascidia kurila* sp.n., paratype MIMB 47323. A — the test, B — left side of the body; C — opened specimen.

Рис. 26. *Ascidia kurila* sp.n., паратип МІМВ 47323. А — туника, В — левая сторона тела; С — вскрытие.

anteriorly. The ganglion is on a short distance behind the dorsal tubercle. The dorsal lamina is ribbed with the tips of the ribs projecting from a free edge of dorsal lamina as long languets. Secondary languets and serration between the main languets are distinct in some specimens (e.g. the large specimen from St. 1) but undiscernible in others (holotype lacks them). The wall of the branchial sac has plications in most

specimens but more or less flat in the largest specimen from Paramushir Island. The number of the longitudinal branchial vessels increases with the size of the specimen and varies from 32 to 54 on the right and from 33 to 41 on the left. Intermediate papillae are present, but, as usual in this group of *Ascidia* spp., not everywhere (Fig. 27C). Generally, about ten stigmata per mesh, but the number is variable.

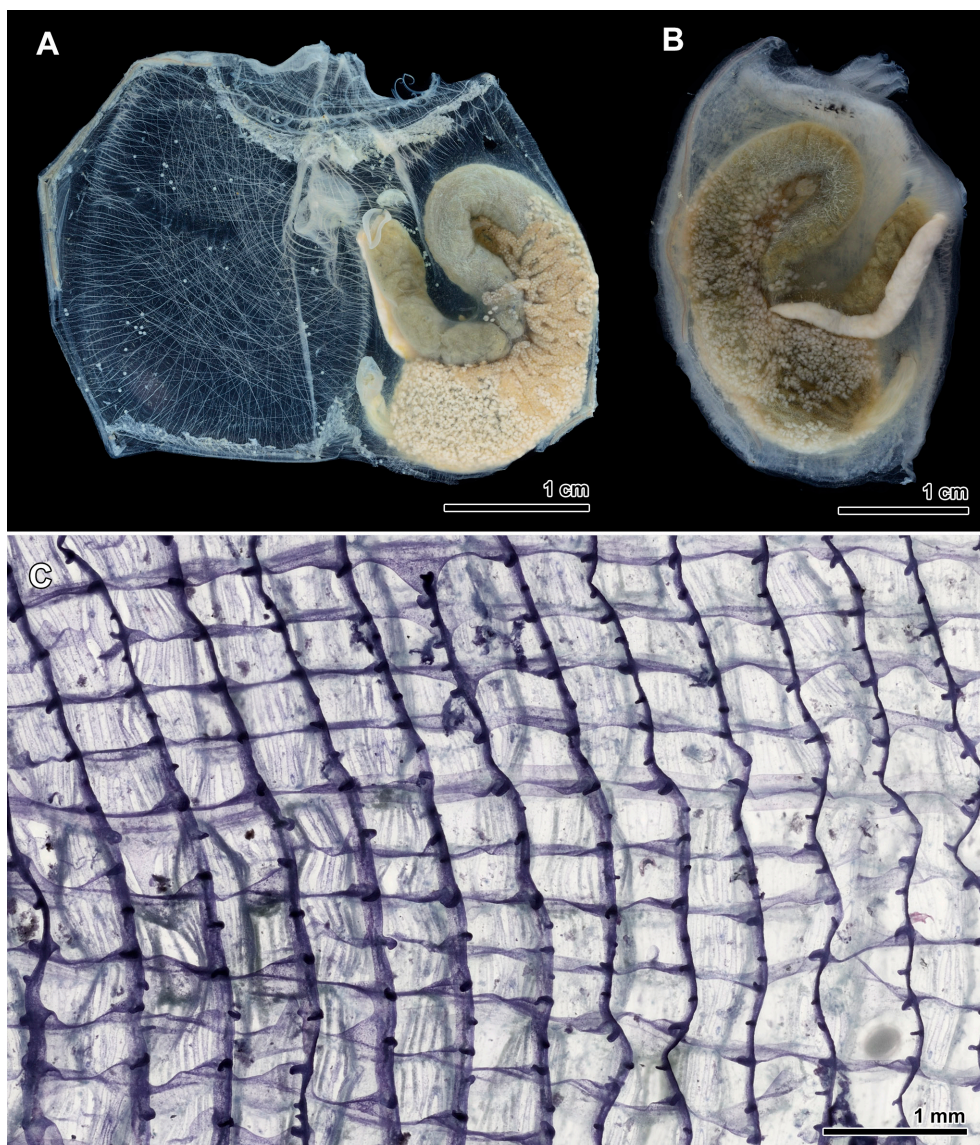


Fig. 27. *Ascidia kurila* sp.n., holotype. A — opened holotype; B — left side of the body; C — branchial sac.
Рис. 27. *Ascidia kurila* sp.n., голотип. А — вскрытие; В — левая сторона тела; С — жаберный мешок.

The visceral mass occupies about three quarters of the left side. The stomach is voluminous, globular or slightly elongated, with wide pyloric end. Its wall has longitudinal folds but in most specimens they are hidden by male follicles and not possible to count, nine are visible from the outer side in one specimen. Pyloric part of the intestine (the whole ascending limb) is slightly thicker than other parts of intestine. Primary gut loop is narrow and closed, slightly bent dorsally. The secondary loop is wider than primary, with open space at the pole (Figs 26B, C; 27A, B). The anus has

two smooth lobes and opens slightly posterior to the level of the pole of the first gut loop. The ovary has numerous tubular branches visible from both, outer (Fig. 26B) and inner (Figs 26C, 27A) sides. In all examined specimens the branches of the ovary are spread over the ascending limb of the primary gut loop but not over the descending limb. Male follicles form a layer over the whole stomach and ascending limb of the primary loop. The spermduct and the oviduct run together along the intestine and open near the anus. Two specimens have numerous eggs incubated in

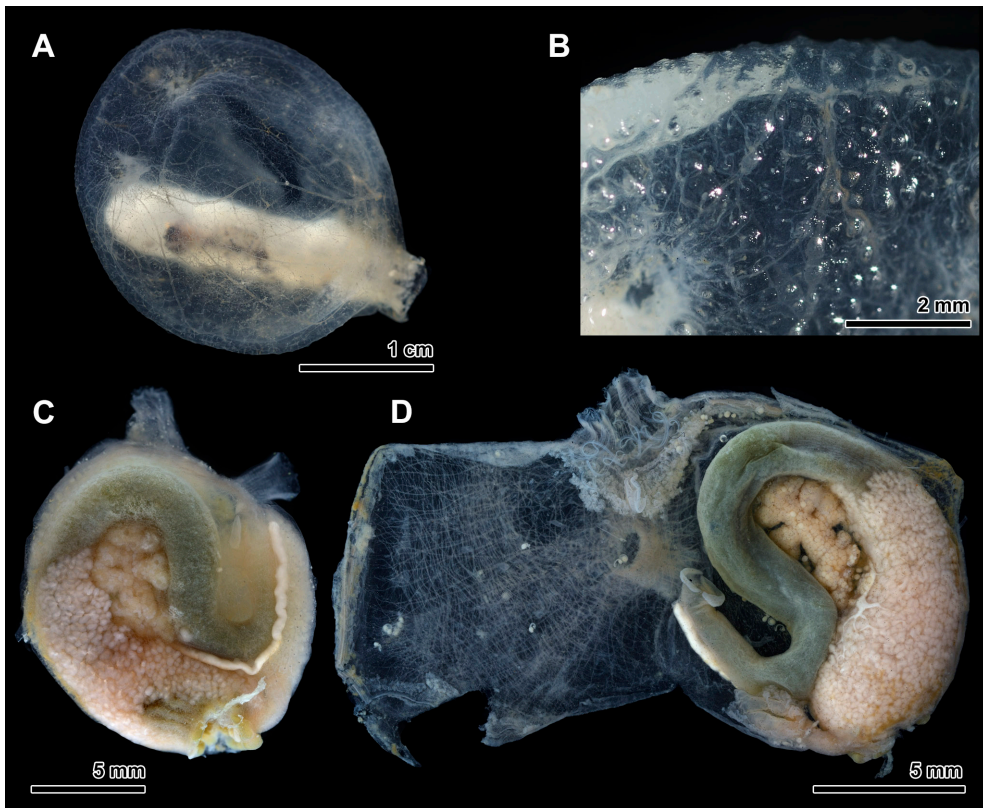


Fig. 28. *Ascidia vivipara* sp.n., holotype. A — empty test (the body removed) to show overall shape; B — minute papillae on the test surface; C — left side of the body; D — opened holotype.

Рис. 28. *Ascidia vivipara* sp.n., голотип. А — пустая туника; В — папиллы на поверхности туники; С — левая сторона тела; D — вскрытие.

the peribranchial cavity, but no one had tailed larvae. Renal vesicles present but not abundant.

REMARKS. *Ascidia kurila* sp.n. incubates eggs (and, possibly, larvae?) in the peribranchial cavity and in this feature resembles *A. callosa* and *A. vivipara* sp.n. It clearly differs from *A. callosa* by significantly more numerous internal longitudinal branchial vessels (less than 25 on one side in *A. callosa* and up to 54 in *A. kurila* sp.n.) The tubular branches of the ovary in all examined specimens of *A. kurila* sp.n. were spread over ascending limb of the primary gut loop while in *A. callosa* they cover both limbs, ascending and descending (Fig. 24A and see also Sanamyan & Sanamyan, (2017) and Lambert & Sanamyan, (2001)). *Ascidia vivipara* sp.n. has less numerous longitudinal vessels than *A. kurila* sp.n., but the difference is less prominent and in smaller specimens the ranges overlap. However, *A. vivipara* sp.n. differs from *A. kurila* sp.n. (and from all other *Ascidia* species described in the present paper) in its compact ovary located completely within the gut loop and lacking tubular branches.

Ascidia kurila sp.n. was reported previously as *A. prunum* by Sanamyan (1998). Indeed, it resembles *A. prunum* in the number of longitudinal branchial vessels, the shape of the alimentary tract and, in lesser degree, in the general shape of the body (the shape of *A. prunum* is usually more regular). However, *A. prunum* does not incubate eggs or larvae. Hartmeyer (1903) examined numerous specimens of *A. prunum* from northern localities and not mentioned the presence of incubated eggs in his specimens. In addition, *A. prunum* has papillae in the prebranchial zone while in *A. kurila* sp.n. the prebranchial zone is smooth. Hartmeyer (1903: 286) considered the presence of papillae as a characteristic and important feature of *A. prunum* and included it in the diagnosis of the species: “Präbranchialzone: mit Papillen.” Should be noted that although Hartmeyer (1903) united *A. prunum* and *A. callosa* in the list of references he provided, his description of *A. prunum* was based only on the specimens really belonging to this species (see comments in Hartmeyer, 1924). *Ascidia nanaimoensis*

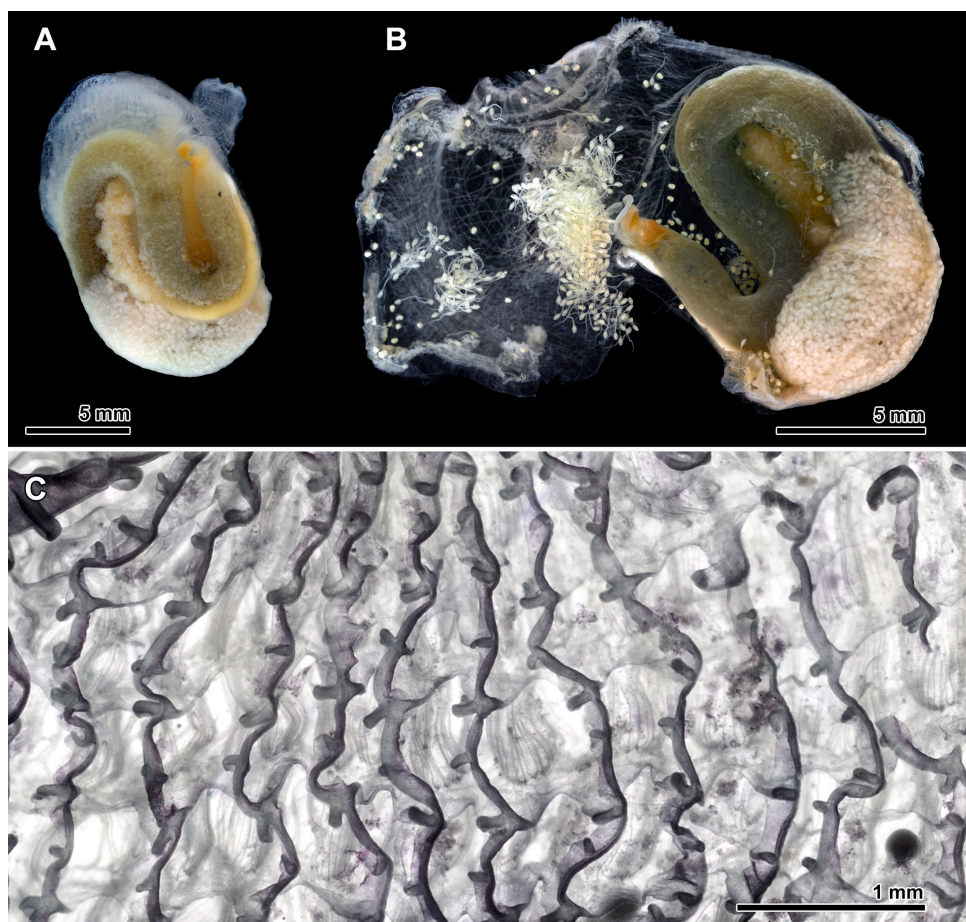


Fig. 29. *Ascidia vivipara* sp.n. A — paratype MIMB 47329; B — the same specimen opened ventrally, note numerous larvae; C — branchial sac (holotype).

Рис. 29. *Ascidia vivipara* sp.n. A — паратип MIMB 47329; B — тот же экземпляр, вскрытие, видны многочисленные личинки; C — жаберный мешок (голотип).

(Huntsman, 1912) described from British Columbia also resembles the present species in the number of longitudinal vessels and the shape of gut loop and gonad. Huntsman's (1912a, b) descriptions are based on three specimens, they had no larvae or eggs in the peribranchial cavity and had papillae in the prebranchial zone. Hartmeyer (1924) and Van Name (1945) synonymized this species with *A. prunum*.

The species is currently known from Paramushir and Onkotan Islands (north group of Kuril Islands) and from Urup Island (south group of Kuril Islands) (Sanamyan, 1998; present study).

***Ascidia vivipara* sp.n.**

Figs. 28, 29.

MATERIAL EXAMINED. Holotype MIMB 47327: *Ak. Oparin*-56, St.8, Urup Island (Sea of Ok-

hotsk side), 45°54.5'N, 149°42.6'E, 128 m, 28.06.2019. Paratypes: MIMB 47328, St.7, Urup Island (Sea of Okhotsk side), 45°52.2'N, 149°37.0'E, 142 m, 28.06.2019, four specimens; MIMB 47329, St.69, Onkotan Island (Sea of Okhotsk side), 49°24.0'N, 154°16.1'E, 146–147 m, 12.08.2019, one specimen.

DESCRIPTION. The holotype is almost round in outline, 25 mm in diameter, with round edges, flattened laterally and attached by a left side to a tubular sponge (Fig. 28A). Other specimens are smaller (15–22 mm). The test is colourless and transparent, gelatinous, rigid enough to retain its shape when removed from fixative. Numerous small (about 0.2 mm) papillae are present on the test surface, they are transparent and not visible when the specimen is in the water (Fig. 28A), but become evident on the air (Fig. 28B). On the test both apertures are sessile, the branchial is closer to anterior margin of the body, the

atrial on some distance from it on the upper (morphologically left) surface of the test. On the mantle body both siphons are short but well discernible (Fig. 28C). The branchial siphon has seven and the atrial six not prominent lobes, each is marked by a yellow spot. Their margin is undulating but smooth (not serrated). The muscles are as in *A. callosa*, there are the usual circular and short radial siphonal muscles, the latter are not arranged into noticeable bands, and a dense network of muscle fibers covering the whole right side of the body. The tentacles are of at least two sizes, 25–32 in examined specimens. The prepharyngeal band is composed of two low and thick lamellae. The dorsal V is inconspicuous. The prebranchial area (the space between the prebranchial band and the ring of the tentacles) is smooth and narrow, slightly wider on the left than on the right side of the body. The dorsal tubercle very small, with C-shaped opening, open interval directed anteriorly. The dorsal lamina is ribbed. The tips of the ribs project from a free edge of dorsal lamina as long languets, but no secondary languets or serration between them are present. The branchial sac is thick-walled, with well-developed plications. The number of stigmata per mesh is variable even within the same branchial sac and difficult to count because of the presence of plications: the parts of the branchial sac where the plications are high may have more than 10–15 stigmata per mesh, while other parts may have only 4–5 stigmata per mesh. The number of the internal longitudinal vessels in the holotype is 28|22 (right|left), the range of variation in all examined specimens is 28–33 on the left and 19–25 on the right. Intermediate papillae present in some parts of the branchial sac (Fig. 29C).

The visceral mass occupies most part of the left side. The stomach in all specimens is hidden by male follicles. It appears to be more or less oval or cylindrical and has regular longitudinal folds, five and eight folds are visible from the outer (left) side in two specimens. The intestine is isodiametric, primary and secondary loops are similar in shape and size, both are straight, with parallel ascending and descending limbs, deep, narrow and open (Figs 28C, D; 29A, B). The anus has two smooth lobes; it opens slightly posterior to the level of the pole of the first gut. The ovary is located completely within the gut loop. Its proximal third has short round side branches or lobes which do not extend over the surface of the intestine. Male follicles are rather large, they form a continuous layer over the stomach and the proximal part of the intestine, visible from outer and inner sides. The oviduct and spermduct are very thick and follow the posterior curve of the intestine (Figs 28C, 29A). Numerous fully developed tailed larvae are present in all examined specimens including the holotype. Renal vesicles not found.

REMARKS. In the northern *Ascidia* species tailed larvae and embryos in the peribranchial cavity

were known previously only for *A. callosa* (see Huus 1930; Van Name, 1945; Millar, 1966) and the present specimens were initially identified as this species. The present specimens, however, have larger number of internal longitudinal branchial vessels than usually found in *A. callosa*. According to Millar (1966: 55) in *A. callosa* longitudinal branchial vessels “do not exceed 30 on each side”. This number is probably based on a key of northern *Ascidia* species published by Hartmeyer (1924) and is an arbitrary selected threshold separating *A. callosa* from *A. prunum*. In the same paper Hartmeyer (1924: 47) published a table where he listed examined specimens, no one had more than 25 longitudinal vessels on the left and 23 on the right and many had fewer than 20. In the numerous examined specimens from Kamchatka we never found more than 20–22 vessels on one side (e.g. 20 on the right and 16 on the left in a large specimen 40 mm long without tunic, see Sanamyan, 1998: 103) or more than 20 vessels per side (e.g. 14 and 17) in the numerous specimens from British Columbia (see Lambert & Sanamyan (2001)). Available specimens of *A. vivipara* sp.n. are in general smaller but have 28–33 longitudinal vessels on the right side. The ovary in *A. vivipara* sp.n. forms a compact lobed mass located completely in the primary gut loop while in *A. callosa* the ovary has tubular side branches profusely developed and spread over the intestine. Renal vesicles are usually profusely developed in *A. callosa* and sometimes hide completely the intestine (Lambert, Sanamyan, 2001 were forced to use glycerol to clear their specimens of *A. callosa* to trace gonads and gonoducts because these organs were completely hidden in a mass of renal vesicles). In *A. vivipara* sp.n. I failed to find any traces of renal vesicles. Finally, the test of *A. vivipara* sp.n. is distinctly papillated, while in *A. callosa* the test is usually (but probably not always) more or less smooth.

The species is known only from Onkotan Island (north group of Kuril Islands) and Urup Island (south group of Kuril Islands).

Ascidia zara Oka, 1935

Figs 30, 31.

Ascidia zara Oka, 1935: 463. Tokioka, 1953a: 222; 1953b: 6. Nishikawa, 1991: 52 (and synonymy).

MATERIAL EXAMINED. Sea of Japan, Ussuriysky Bay, ~43°05.2'N, 131°58.71'E, 23.06.1997, one specimen found on the beach, coll. A. Chernyshev.

DESCRIPTION. The single available specimen, 18 mm in height and 11 mm in width, is attached to thin stem of hydroid by a narrow part of its left side. It is roundish-oval in outline; the edges are round. The test is gelatinous, colourless, translucent, very thick and filled with numerous dichotomically branched (not anastomosing) vessels. Small terminal branches of these vessels stand more or less perpendicular to

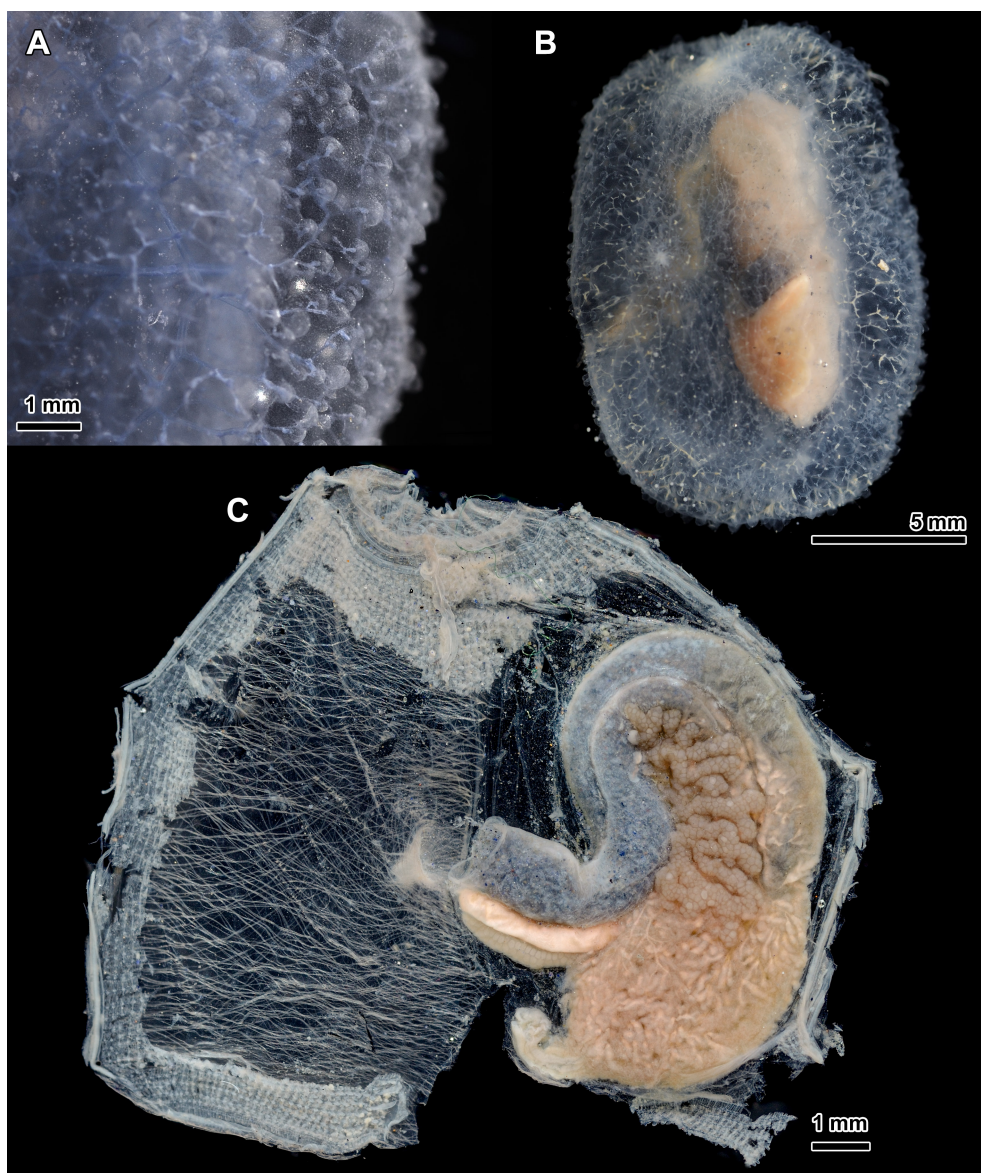


Fig. 30. *Ascidia zara*. A — papillated surface of the test; B — intact specimen; C — specimen opened ventrally.
 Рис. 30. *Ascidia zara*. A — папиллы на поверхности туники; B — целый экземпляр; C — вскрытие.

the outer surface of the test where they end within small roundish test papillae 0.2–0.5 mm in diameter and height (Fig. 30A, B). Both apertures are sessile and small, poorly recognizable on preserved specimen (Fig. 30B), the branchial one is terminal, the atrial displaced along the dorsal side by about a third of the length of the body.

Body removed from the test is 11 mm in length, its wall is very thin and transparent. Muscles form dense network on the right side but almost completely

absent on the left. About 30 larger and about the same number smaller tentacles arise from the inner (facing to the branchial sac) side of high muscular velum. The prebranchial zone (the space between the branchial velum and the prebranchial band) is densely papillated. The prepharyngeal band consists of two blades running along a circular line close to the branchial velum and makes no V around the dorsal tubercle. The latter is round, with C-shaped slit with open interval directed anteriorly. Elongated ganglion is on a short

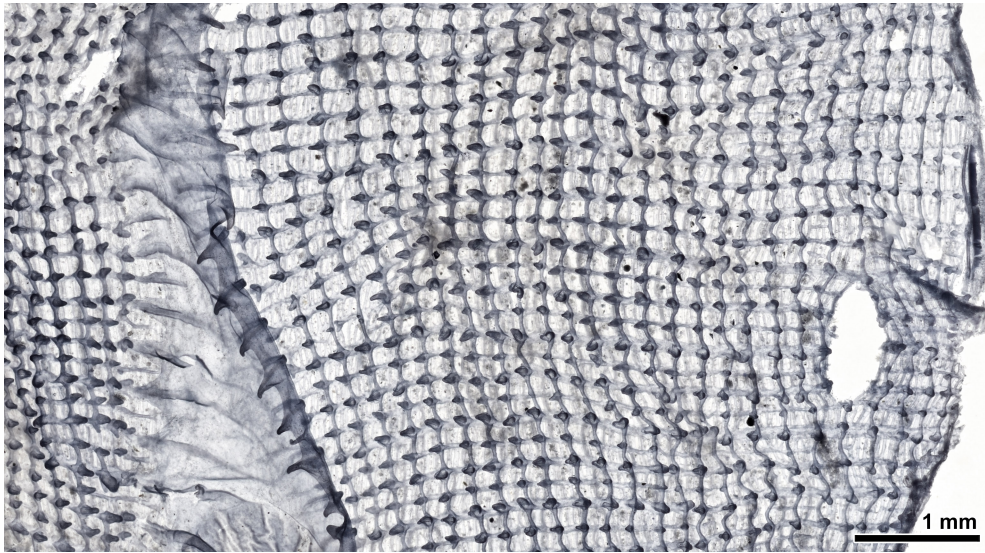


Fig. 31. *Ascidia zara*, branchial sac.

Рис. 31. *Ascidia zara*, жаберный мешок.

distance from the dorsal tubercle. A short anterior part of the dorsal lamina consists of two low and thick plain-edged blades, the whole remained part is a high membrane with transverse branchial vessels running as high ribs on its sides and forming long languets on its edge (Fig. 31). The wall of the branchial sac is flat, without noticeable plications. The number of the longitudinal vessels is about 30 on the right and 20 on the left. Longitudinal and transverse vessels form rectangular meshes with about four stigmata in each. Large branchial papillae present on the intersections of the longitudinal and transverse vessels (Fig. 31). Neither parastigmatic vessels nor intermediate papillae are present.

Visceral mass occupies a significant part (about three quarters) of the left side. The stomach is voluminous, oval, occupies almost a half of ascending limb of the gut loop. The primary loop is narrow and closed, slightly bent dorsally so that its pole faces the branchial siphon (Fig. 30C). The secondary loop short, wide and open; the rectum is short, perpendicular to the axis of the primary loop. Plain-edged anus opens directly under the atrial opening posterior to the level of the pole of primary gut loop. The ovary is composed of thick crowded branches located between ascending and descending parts of the primary loop of the intestine and better developed on its inner (faced to the branchial sac) side (Fig. 30C). The male follicles form a continuous layer over the whole stomach, including its inner (visible in Fig. 30C) and outer, facing to the body wall, sides, hiding completely its structure. Sparse male follicles present also on the part of the intestine constituting the primary gut loop

and between the intestine and body wall. Thick male and female ducts run along the distal portion of the intestine and the rectum and open near the anus. Renal vesicles not detected.

REMARKS. *Ascidia zara* is a distinctive species recognized by its characteristic papillated test and the absence of the intermediate branchial papillae. The original description (Oka, 1935) is based on several specimens from Hokkaido. The specimens described by Oka (1935) were attached by the whole left side forming a flat surface without rounding edges but in all other reported features are similar to described here specimen. Many other specimens were subsequently reported from the Pacific and Sea of Japan coasts of Japan (summarized by Nishikawa, 1991). The present record from the Russian coasts of the Sea of Japan is the first record in the Russian waters. It is certainly not present in more northern locations of Far East Seas of Russia, ascidian fauna of which is explored much better than the fauna of Russian coasts of Sea of Japan.

Ascidia zyogasima Tokioka, 1962
Figs 32, 33.

Ascidia zyogasima Tokioka, 1962: 134. Nishikawa, 1991: 51. Sanamyan, 1998: 104.

MATERIAL EXAMINED. AK *Ak. Oparin*-56, St.64, north of the Sea of Okhotsk, Erineyaskaya Bay, 57°00.4'N, 145°00.4'E, 238–237 m, 9.08.2019, one specimen; St.66, north of the Sea of Okhotsk, Erineyaskaya Bay, 56°30.7'N, 144°57.9'E, 293 m, 9.08.2019, one specimen. AK *Oparin*-14, Commander Islands, st.3, 54°12.0'N, 168°32.0'E, 328 m, 2.08.1991,

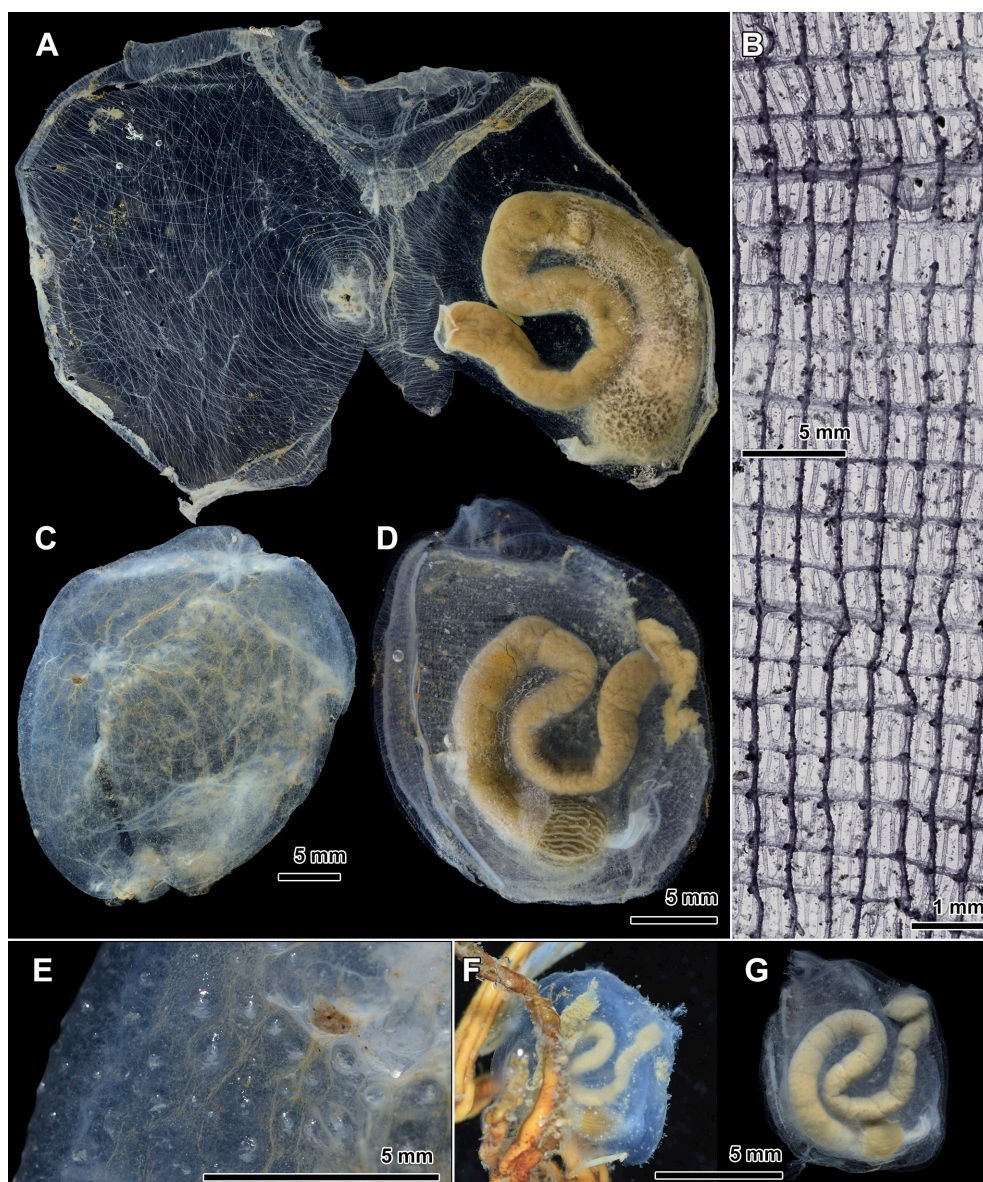


Fig. 32. *Ascidia zyogasima*, specimens from Sea of Okhotsk (A–E, St. 66; F, G, St. 64). A — opened specimen; B — branchial sac; C — external view; D — left side of the body, test removed; E — papillae on the test; F — small intact specimen; G — the same specimen with test removed.

Рис. 32. *Ascidia zyogasima*, экземпляры из Охотского моря (A–E, Ст. 66; F, G, Ст. 64). A — вскрытие; B — жаберный мешок; C — внешний вид; D — левая сторона тела; E — папиллы на поверхности туники; F — мелкий экземпляр; G — тот же экземпляр, левая сторона тела.

one specimen and St. 6, 54°15.2'N, 168°41.6'E, 242 m, 2.08.1991, one specimen. North Kuril Islands, 49°12'N, 155°42'E – 49°02'N, 155°28'E, 430–504 m, $t = 3.4-3.5^{\circ}\text{C}$, 18.07.2012, one specimen.

DESCRIPTION. Specimens from northern part of the Sea of Okhotsk (St. 64 and St. 66) have wide

oval body flattened laterally, 30 mm (St. 66, Fig. 32C) and 10 mm (St. 64, Fig. 32F) in greatest diameter. The test is translucent and courless, soft but capable to retain its shape when removed from fixative, about 0.5 mm in thickness in larger specimen. The surface covered with small wide conical papillae, 0.2–0.3

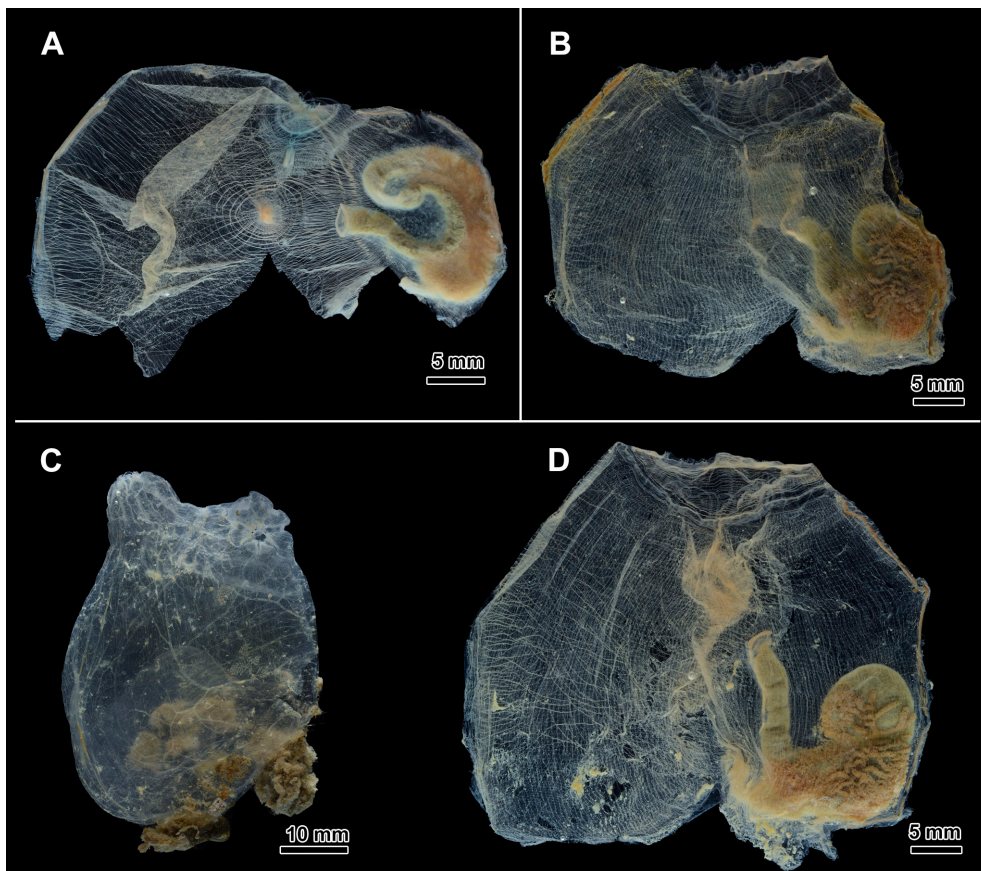


Fig. 33. *Ascidia zyogasima*. A — specimens from Kuril Islands (KBPGI 5/1024); B — specimen from Commander Islands (KBPGI 4/957); C, D — specimen from Commander Islands (KBPGI 3/956).

Рис. 33. *Ascidia zyogasima*. А — экземпляры с Курильских островов (KBPGI 5/1024); В — экземпляр с Командорских островов (KBPGI 4/957); С, D — экземпляры с Командорских островов (KBPGI 3/956).

mm in basal diameter and in height (Fig. 32E). The papillae are slightly larger around the apertures and on the siphonal lobes. Both apertures sessile, the branchial orifice situated anteriorly and has seven indistinct lobes, the atrial is on some distance down along the dorsal line, it has six lobes.

Body removed from the test is 22 mm in greatest diameter in larger specimen (Fig. 32D) and 8 mm in smaller (Fig. 32G). Body wall very thin and transparent. Each lobe is marked by a small pigment spot. On the branchial siphon the circular muscles do not extend farther than the ring of the tentacles; around the atrial aperture spaced concentric circular muscles extend into the body wall, especially on the right side. Radial siphonal muscles form loose bunches on the siphonal lobes. Whole right side is covered with a net of thin spaced muscle fibrils; in the antero-ventral part of the right side they are arranged more or less parallel to each other and perpendicular to the endostyle

(Fig. 32A). Numerous thin crowded parallel muscles originating on the siphons and in the intersiphonal area extend on a short distance in antero-dorsal portion of the left side; otherwise the left side of the body is devoid of muscles.

I counted 46 tentacles in the larger specimen and 34 in the smaller. The prepharyngeal band consists of two lamellae, the anterior one is high, the posterior is low and wide. The dorsal V is very small. The distance between the prepharyngeal band and the ring of the tentacles is small on the right and wide on the left side. The prepharyngeal area appear to be smooth (no papillae were detected). The dorsal tubercle is small, with simple v-shaped opening, open interval directed anteriorly. Elongated ganglion located on a short distance posterior to the dorsal tubercle. The dorsal lamina has small secondary serration between the main languets. The branchial sac has 77|63 (right|left) longitudinal vessels in the larger specimen

and 58|51 in the smaller. Intermediate papillae present but not everywhere. The tissue of the branchial sac is perfectly flat (Fig. 32B) and the meshes are small, 1.5–3 stigmata in each.

The visceral mass is almost round in outline, occupies about third of the left side of the body. Small globular stomach clearly demarcated from the intestine and has about nine longitudinal folds on its left side (visible through the body wall). The intestine is isodiametric. Long narrow primary loop strongly bent dorsally and almost touches the rectum. The secondary loop is wide and closed, circular, with its pole coming in contact with the stomach. Renal vesicles are present but few, transparent and inconspicuous. The anus has two smooth lobes; it opens at the level of the pole of the first gut loop or slightly anterior to it. The gonads are poorly developed in both specimens and no larvae or eggs were present in the atrial cavity.

A specimen from North Kuril Islands (Fig. 33A) is similar to above described specimens, but papillae on the test poorly discernible and body muscles slightly better developed. The specimen is 35 mm in greatest diameter (25 mm for body removed from the test) and has 60 branchial tentacles and 64|52 longitudinal branchial vessels. The shape of the gut loop is as in described above specimens, but stomach folds are obscured by better developed renal vesicles. It differs in the structure of the branchial sac which has, at least in some parts, fine plications, and the number of stigmata per mesh is somewhat larger (up to eight).

In addition, the specimens from Commander Islands reported previously by Sanamyan (1998) as *Ascidia zyogasima* (Fig. 33B–D) were reexamined. They have very soft test, it cannot retain its shape when removed from the fixative, the papillae on the test are not discernible and the apertures are on short siphons situated anteriorly (Fig. 33C). The shape of the gut loop slightly differs in two examined specimens (Fig. 33B and D) but in general resembles that of the specimens from Sea of Okhotsk, although the visceral mass is somewhat smaller. One specimen, 30 mm without the test, has 49 tentacles and 71|53 longitudinal vessels, another, 35 mm without the test, has 45 tentacles and 66|57 longitudinal vessels. The branchial sac is perfectly flat, up to six stigmata per field. Other features as described by Sanamyan (1998).

REMARKS. It is hard to decide whether the specimens from Commander Islands (Fig. 33B–D), reported previously by Sanamyan (1998), are conspecific with the specimens from Sea of Okhotsk and Kuril Islands (Fig. 32 and 33A) described above. The main differences are the consistency of the test, significantly softer in the former specimens and slightly more compact visceral mass, but other features are comparable and I prefer to treat all these specimens as conspecific.

The shape of the gut loop, especially in specimens from the Sea of Okhotsk (Fig. 32A, D, G) with their almost round secondary loop, strongly resembles the

gut loop of *Ascidia dijmphniana* (Traustedt, 1886) (e.g. see Van Name 1945, Fig. 91). *Ascidia dijmphniana* is a rarely encountered Arctic species, it has not been reported from North Pacific although it occurrence here is possible. In the key to of northern *Ascidia* species Hartmeyer (1924) distinguishes this species by the presence of 70–100 longitudinal branchial vessels on each side, and in the text he reported more than 100 vessels on the right and more than 80 on the left for a specimen 26 mm long without the test. Huus (1929) reported about 80 longitudinal vessels on the right and 77 on the left, but his specimens were larger (65 and 45 mm with the test). These numbers are slightly higher than we found in Pacific specimens. The taxonomic significance of this slight difference cannot be evaluated on available limited number of published records and a few known specimens from Arctic and Pacific.

Tokioka (1962) reported 68 longitudinal branchial vessels for the type specimen of *A. zyogasima* (23 mm with the test). The number of the vessels on the left is not reported but they should be less numerous there (as is common in this group of *Ascidia* spp.) This number better fits a range of variations seen in the present specimens. The secondary gut loop in *A. zyogasima*, as figured by Tokioka (1962, Fig. 35), resembles the gut loop of some specimens from Commander Islands (Fig. 33D and see also Sanamyan (1998, fig. 2)) but the primary loop not so strongly bent dorsally and the secondary loop is more elongated (less round) than in the specimens from the Sea of Okhotsk. Thus, the features of the present specimens are in some degree intermediate between the features reported for *A. zyogasima* and *A. dijmphniana*. Tokioka (1962: 280) never provided a detailed comparison of his *A. zyogasima* with other species, he said only that it “is characterized most remarkably by the existence of so many inner longitudinal vessels for such a small body size”. This feature is characteristic for *A. dijmphniana* too. It is possible that these two species are conspecific, but in the present paper we refrain from synonymizing them and prefer to identify our specimens as *A. zyogasima* because the differences seen in the shape of the gut loop seem to be less important than the differences in the number of longitudinal vessels, and because *A. dijmphniana* has not been reported previously from Pacific. If the present material is correctly identified as *A. zyogasima*, this species may be widely distributed in the North West Pacific at the depths of several hundred meters.

Family Perophoridae Giard, 1872

The family comprises phlebobranch ascidians forming colonies usually composed of separate zooids joined by stolons or, rarely, zooids embedded in common test. Zooids have flat branchial sac with

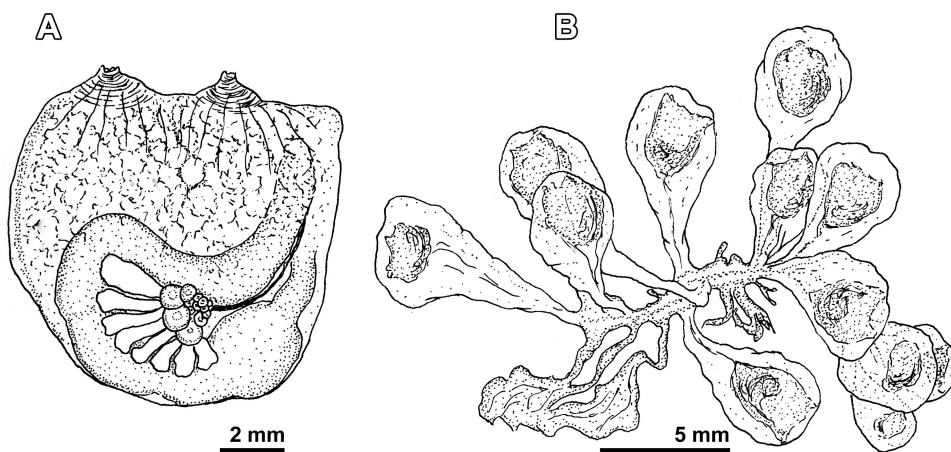


Fig. 34. *Perophora japonica*. A — zooid; B — colony. After Sanamyan, 1998)
Рис. 34. *Perophora japonica*. A — зооид; B — колония. По Sanamyan, 1998.

straight vertical stigmata arranged in several (usually few) transverse rows; gut loop on left side; gonads in gut loop. In general, zooids of Perophoridae resemble small species of the genus *Ascidia* and molecular data confirm their relationship.

The family contains two genera, *Perophora* Wiegmann, 1835 and *Ecteinascidia* Herdman, 1880 comprising mostly tropical and warm-water species. The genera differ by the size of zooids (smaller and with fewer rows of stigmata in *Perophora*), shape and size of testis follicles (larger in *Perophora*) and shape of the gut (longer rectum in *Ecteinascidia*). In Far Eastern Seas of Russia only members of the genus *Perophora* are recorded.

Genus *Perophora* Wiegmann, 1835

Type species: *Perophora listeri* Forbes et Hanley, 1848 by subsequent monotypy (Article 67.2.2).

Perophora is characterized by small zooids which usually have four or five, but rarely up to eight (in *P. multistigmata* Kott, 1952) rows of stigmata, large testis (a difference from *Ecteinascidia*) and the rectum shorter than the primary gut loop.

Two species were formally reported from Far Eastern Seas of Russia, *Perophora annectens* Ritter, 1893 and *P. japonica* Oka, 1927, both from the Sea of Japan, but only one, *P. japonica*, probably really occurs there.

Perophora japonica Oka, 1927

Fig. 34.

Perophora japonica Oka, 1927: 558. Nishikawa, 1991: 33. Sanamyan, 1998: 105.

? *Perophora annectens*: Redikorzev, 1941: 204.

MATERIAL EXAMINED. None.

REMARKS. Single 2 cm long colony reported by Sanamyan (1998) from Peter the Great Bay (Sea of Japan) was composed by 12 zooids connected by stolons. The largest zooid was 5 mm in length. Zooids had four rows of about 27–30 stigmata per row and nine incomplete longitudinal vessels on each side of the branchial sac. Unfortunately, this material has dried out and cannot be reexamined but its assignment to *Perophora japonica* seems correct.

Redikorzev (1941) reported *P. annectens* Ritter, 1893 from the same locality (Peter the Great Bay) and also from adjacent Possjet Bay. He stated that his specimens more closely resemble description of *P. japonica* but he treated it as a junior synonym of *P. annectens*. Zooids of Redikorzev's specimens were 3 mm in diameter (more than two times larger than in the original description of *P. annectens*) and had up to 32 stigmata in each row while up to 18 indicated by Ritter (1893) for *P. annectens*. However, Redikorzev (1941) says that zooids in his colonies were in various degree immersed into the common test (a feature characteristic for *P. annectens* but not for *P. japonica*), but he noted that they were never fully immersed into the common test and in one colony were fully separated from each other (as in *P. japonica*). Originally *P. annectens* was described from California (Monterey Bay) and although subsequently it was reported from more northern locations, there is some doubt in their identification. For instance, Huntsman's (1912a, b) specimens identified as *P. annectens* from British Columbia formed "typical social colonies and in no case were imbedded in a common test". Nishikawa (1991) examined many colonies from various locations, including the paratype of *P. annectens* (which had very small, 1.5 mm long zooids

completely embedded in the common test) and come to a conclusion that Redikorzev's (1941) material is probably *P. annectens*. Unfortunately, I was not able to reexamine Redikorzev's specimens but the information he provided about the structure of the colonies is too superficial and I prefer not to state the presence of Californian *P. annectens* in Far Eastern Seas of Russia on the basis of his description. On the other hand, the size of zooids and the number of stigmata are as in *P. japonica* so Redikorzev's record is included here under the question in a synonymic list of *P. japonica*.

Summary on nomenclatural and taxonomic changes

The following nomenclatural and taxonomic changes have been made in the present work:

1) Genera *Corelloides* and *Corynascidia* are synonymized with *Corella*.

2) Authorship of generic name *Corella* must be ascribed to Hancock (1870) but not to Alder et Hancock as currently almost universally accepted.

3) Authorship of family name Ascidiidae belongs to Rafinesque (1815) but not to various works of Herdman or Adams et Adams to whom this family is ascribed in different sources.

4) Authorship of the family name Salpidae also belongs to Rafinesque (1815) but not to Lahille, as currently accepted.

5) *Ascidia gelatinosa* Linnaeus, 1767 designated in the present work as type species of *Ascidia*.

6) *Ascidia gelatinosa* Linnaeus, 1767 is formally synonymized here with *Ascidia mentula* Müller, 1776. Its precedence over *A. mentula* is suppressed by applying Article 23.9.

Acknowledgments

I must thank Dr. Vladimir Mordukhovich and Dr. Anastaiia Maiorova (Zhirmunsky National Scientific Center for Marine Biology, Vladivostok) who collected ascidians during cruise 56 of RV *Academik Oparin* in the summer of 2019 and sent me this carefully documented material. There was an unusually large number of species, a fact that prompted me to write this monograph. I also thank Dr. Antonina Kremenetskaia (P.P. Shirshov Institute of Oceanology, Moscow) who scanned and sent me very interesting underwater photographs of *Situla galeata* taken by submersible *MIR I*. This work has not been supported by any grants.

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