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RESEARCH ARTICLE

A new species of *Microcosmus* (Tunicata: Ascidiacea: Bolteniidae) from the Sea of Okhotsk

Новый вид рода *Microcosmus* (Tunicata: Ascidiacea: Bolteniidae) из Охотского моря

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Abstract. A large solitary ascidian *Microcosmus armatus* **sp. nov.**, described from the Sea of Okhotsk, represents the first record of the genus *Microcosmus* Heller, 1877 in the cold waters of the Northwestern Pacific. The genus belongs to the family Bolteniidae formerly known as Pyuridae.

Резюме. Большая одиночная асцидия *Microcosmus armatus* **sp. nov.** описана из Охотского моря. Это первая находка представителя рода *Microcosmus* Heller, 1877 в холодных водах Северо-Западной Пацифики. Род относится к семейству Bolteniidae, ранее известному как Pyuridae.

Key words: biodiversity, Sea of Okhotsk, Northwestern Pacific, Ascidiacea, Bolteniidae, Pyuridae, *Microcosmus*, new species

Ключевые слова: биоразнообразие, Охотское море, Северо-Западная Пацифика, Ascidiacea, Bolteniidae, Pyuridae, *Microcosmus*, new species

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Introduction

In the summer 2020, one of us (Taras Morozov) took part in the expedition of the Russian Federal Research Institute of Fisheries and Oceanography in the Sea of Okhotsk where two specimens of large unusually looking specimens of benthic invertebrates were trawled. They had spherical bodies encased into a very firm and rigid coating of small stones with two rigid orifices leading into an inner space, where flexible siphons were located. Such specimens are said to be rather common in trawl captures in the Sea of Okhotsk, but in general, the participants of this expedition did not recognised them as ascidians, and they have not been collected. The examination of the collected specimens showed that they belong to an undescribed ascidian of the genus *Microcosmus* Heller, 1877. It was quite surprising to discover a new species of a large solitary ascidian in the northern part of the Sea of Okhotsk, because this sea, except a region along the Kuril Islands, is rather well sampled for ascidians with many papers published previously (e.g. Redikorzev, 1916, 1941; Sanamyan, 1992, 1993a, 1993b, 1996, 1998a, 1998b, 2000; Sanamyan & Sanamyan, 2017a, 2017b).

Material and methods

The collected specimens were initially fixed by seawater formalin and transferred into 70–80% ethanol after examination. Type specimens are deposited at the Kamchatka Branch of the Pacific Geographical Institute (KBPGI).

Results

Order **Stolidobranchia** Lahille, 1886

Family **Bolteniidae** Herdman, 1882

Cynthiidae Lacaze-Duthiers, 1879 (permanently invalid: type genus is a homonym).
Halocynthiidae Hartmeyer, 1903 (invalid: junior synonym of Bolteniidae).
Pyuridae Hartmeyer, 1908 (invalid: junior synonym of Bolteniidae and Halocynthiidae).
Tethyidae Hartmeyer, 1908 (permanently invalid: type genus suppressed).

Note. The nomenclatural status of the family name and its synonyms are discussed in details by Sanamyan & Sanamyan (2021).

Genus ***Microcosmus*** Heller, 1877

***Microcosmus armatus* sp. nov.**

(Figs 1–4)

Holotype. KBPGI 1456/1, **Sea of Okhotsk**, nr west coast of Kamchatka, 57°27.6′N, 156°23.9′E – 57°29.0′N, 156°25.4′E, 42 m, 5 July 2020, coll. T. Morozov.

Paratype. KBPGI 1457/2, same data as for holotype, one specimen.

Description. Specimens almost globular, slightly compressed laterally, holotype 11 cm in greatest diameter and 10 cm in height; paratype 6.5 × 5.5 cm. Body covered with extremely firm and thick layer of pebbles and small stones, which partly attached to surface and firmly cemented by thick outgrows of test, partly embedded into test (Fig. 1A–C). Test itself very hard and firm and together with stony coating forming a kind of absolutely not flexible armour, so that intact specimens looking like globular pieces of concrete. Coating much harder than in any other ascidians examined by us previously (we had to use industrial shears for thick-walled plastic pipes to open it). Siphons covered with double layer of test with voluminous space between outer (or external) (Fig. 1C, *el*) and inner (Fig. 1C, *il*) layers. Outer layer forming rigid capsule encasing each siphon and having round opening at the top (Fig. 1B, C, black arrow). Beneath layer of stones, test not especially thick (3–5 mm), dark brown (Fig. 1C). No siphonal spinules found on test lining siphons, using an optical microscope.

Body wall loosely adherent to test, dark-brown; thin test layer lining inner surface of siphons bright red. When removed from test, body oval, wider than high (Fig. 1D). Siphons short but with wide bases, both equal in size, located at anterior (upper) surface of body and well separated from each other. Musculature very distinct, strong, especially in dorsal half of body. Radial muscles forming continuous layer on siphons and extending down over sides of body; radial muscles, extending from each siphon, almost not crossing each other (character more peculiar to molgulid species). Strong circular muscles forming rather high fold around base of each siphon. Thin short muscles crossing intersiphonal area, and ribbon of thick crowded muscles, crossing mid-ventral line, running along whole ventral side from base of one siphon to base of another one.

About 18 relatively short, stout branchial tentacles counted in each specimen, all about equal in size with several smaller ones sometimes inserted between them. Side branches on tentacles short, mostly simple, triangular, rarely with minute projections of the second order. Prepharyngeal band deep, V-shaped, lying around large dorsal tubercle. U-shaped slit of dorsal tubercle with both horns turned inwards; its open interval directed anteriorly. Dorsal lamina shaped as low continuous membrane with irregularly serrated margin (Fig. 4C). Branchial sac thick-walled, with five almost straight folds on each side (Fig. 4A). All folds well-developed and reaching bottom of branchial sac. Branchial formulae: for holotype, E2(14)4(20)5(22)4(22)5(21)2DL3(21)6(24)6(23)5(16)4(6)2E; for paratype, E2(10)3(16)4(18)3(20)2(21)0DL3(17)3(18)3(15)2(13)2(6)1E.

Stigmata barely visible between numerous thick branchial vessels (Fig. 4B), short and straight. About 13 infundibula formed beneath most dorsal fold of branchial sac, but they becoming much more numerous under more ventrally located folds.

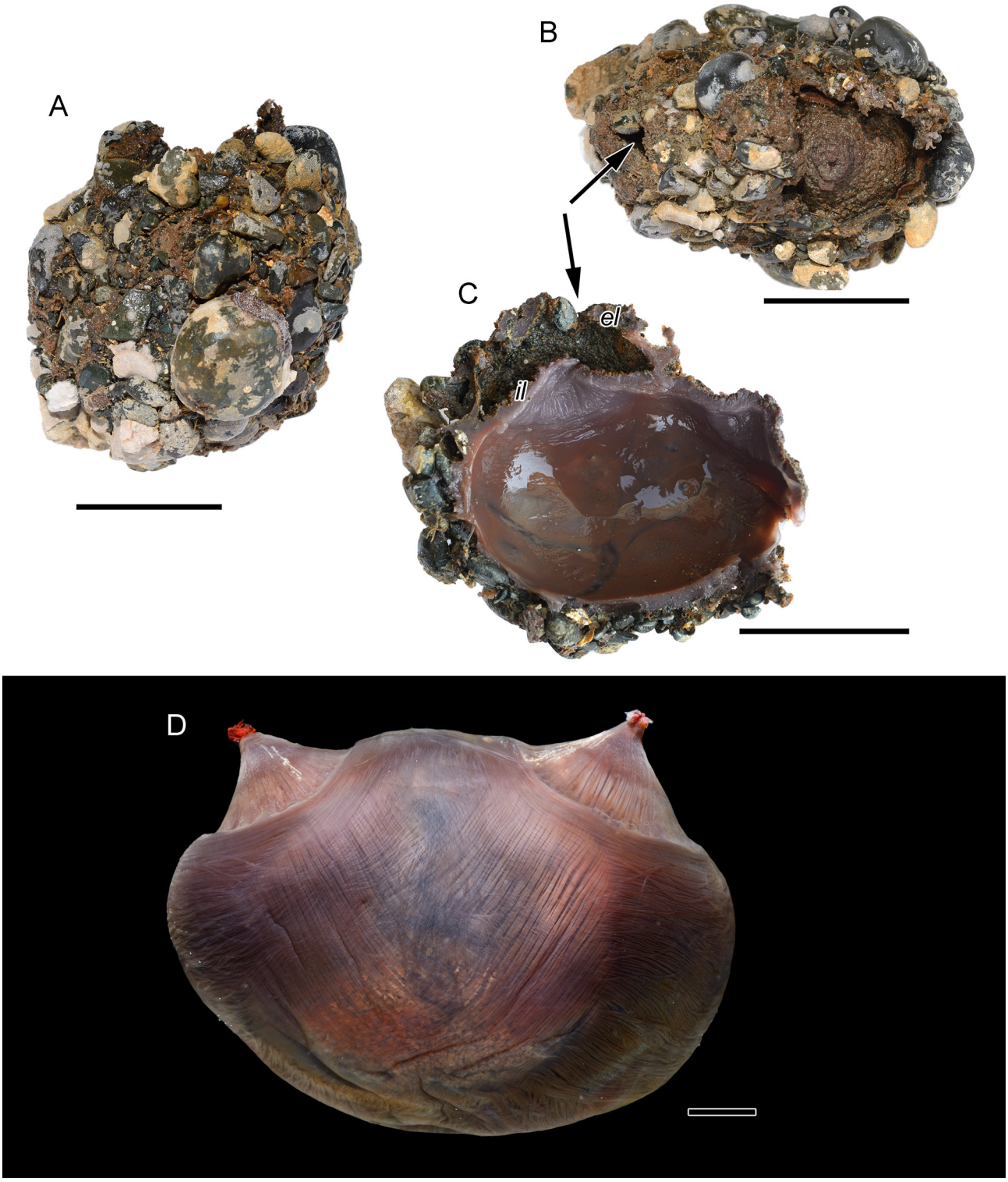

Fig. 1. *Microcosmus armatus* **sp. nov.**, holotype. **A**, intact specimen, from side; **B**, top view; a part of the external test layer is removed to show the double test around the siphon; **C**, longitudinal section of empty test; note the double test coating on the branchial siphon (left siphon on the photo); similar coating around the atrial siphon was removed; **D**, specimen with test removed. Arrows point to the opening on the external layer of test; *el* – external layer of test; *il* – inner layer of test (covering muscular body is removed in this photograph). Scale bars: 5 cm (A–C); 1 cm (D).

Fig. 2. *Microcosmus armatus* **sp. nov.**, opened specimens. **A**, paratype; **B**, holotype. Scale bars: 1 cm.

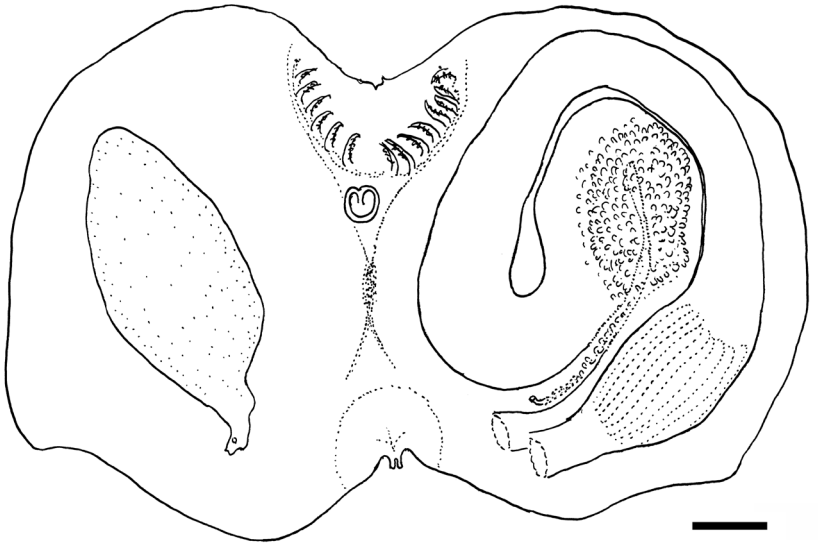

Fig. 3. *Microcosmus armatus* **sp. nov.**, schematic drawing to show the shape of gut loop and the position of gonads. Scale bar: 1 cm.

In larger specimen (holotype), all organs on both sides of body deeply embedded into opaque grey parenchymal tissue completely hiding their structure. To reveal shape of gut loop and position of left gonad, this tissue was partially removed (Fig. 2B). In smaller specimen, parenchymal covering of inner body wall not so strongly developed (Fig. 2A). Stomach isodiametric, slightly wider than diameter of intestine, short, about twice as long as diameter. Glandular stomach wall dark greenish brown, with numerous longitudinal folds, but details obscured by parenchymal tissue covering it. Gut loop occupying entire left side of body. Primary loop very long and narrow, with ascending and descending limbs running in close contact with each other along most of their length. Distal half of loop curved dorsally and posteriorly, so that pole of gut loop close to oesophagus and narrow secondary loop formed.

One gonad on each side of body. Right gonad better developed in both specimens; in smaller specimen, it shaped as thick cylinder filled by large ova; in larger specimen, right gonad much flattened, composed of many small testicular follicles, ovary or ova not seen. In both cases, right gonad occupying significant part of right side of body wall. Oviduct and sperm duct opening close to each other on distal end of gonad not far from base of atrial siphon. Left gonad barely visible; in both specimens, its most part lying in secondary gut loop, with male follicles of its proximal* (i.e., antiorifice) part spread over intestine (Fig. 3). It is not clear whether proximal part of gonad located in primary gut loop (as in most *Microcosmus* species) or gonad, as it seems, completely lying in secondary gut loop and on intestine.

Specimens have no endocarps. Thin-walled sac-like heart embedded into parenchymal tissue and exposed in part on right side between gonad and endostyle. It remotely similar to molgulid renal sac. Details of its structure are hard to access on material examined.

Etymology. The specific name is the Latin adjective *armatus* (armed); it reflects the presence of a firm external layer of pebbles cemented in the test.

Diagnosis. Microcosmus armatus **sp. nov.** characterised by the presence of only five folds on each side of branchial sac, deeply curved gut loop with narrow and closed primary and secondary loops, absence of siphonal spinules, and very strong external coating formed by small stones cemented by test.

Comparison. The genus *Microcosmus* comprises about 40 species distributed mainly in warm waters. Most species of this genus are characterised by the presence of seven or more folds on each side of the branchial sac, four or five species have six folds, and only three species, as the present one, have five folds on each side: *M. anomalocarpus* Millar, 1988, *M. oligophyl-*

* The terms "proximal" and "distal" are used here according to Kott (1985: 16, "Annotated glossary").

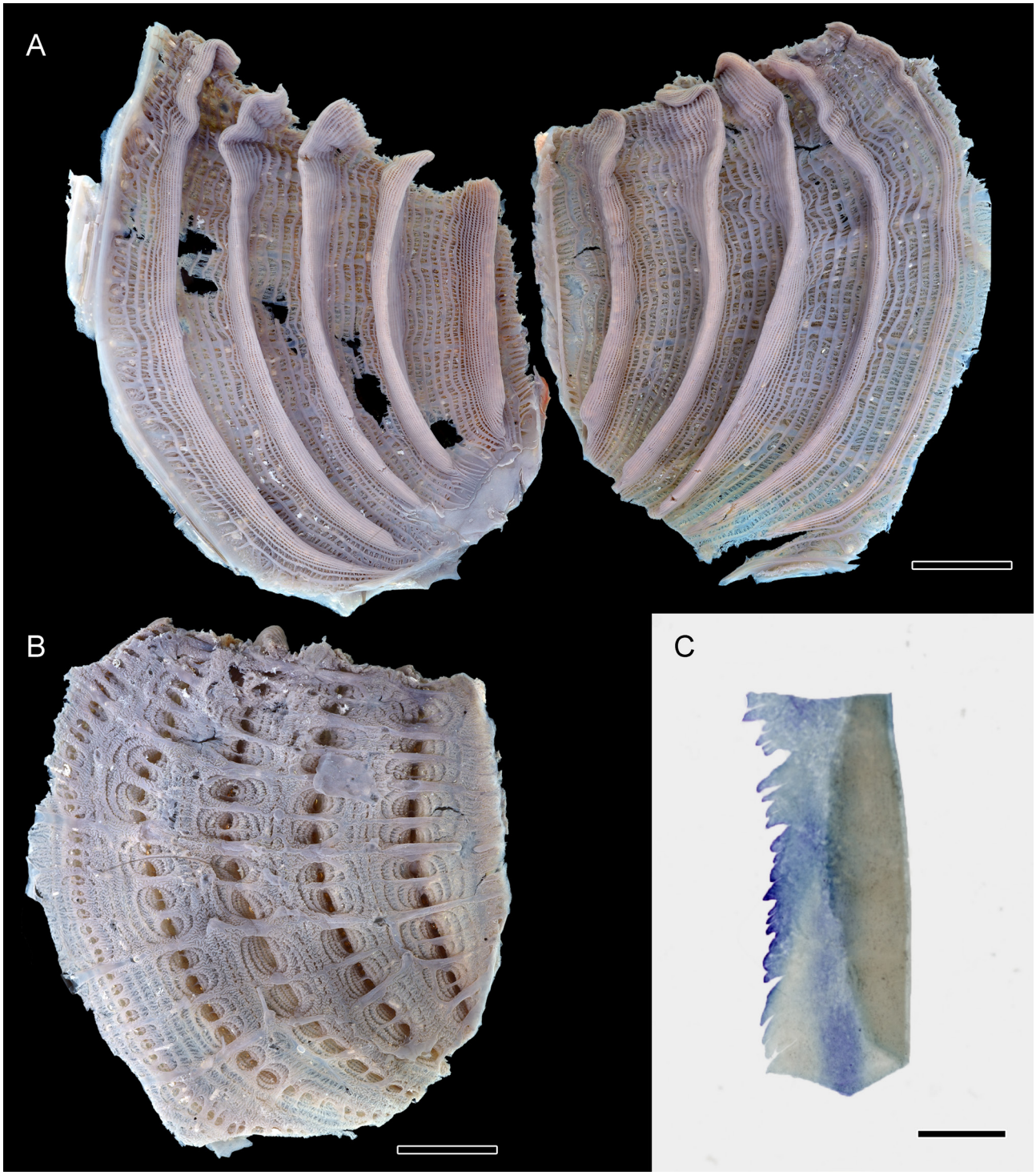

Fig. 4. *Microcosmus armatus* **sp. nov. A**, branchial sac of holotype; **B**, external side of branchial sac of the same specimen to show the arrangement of infundibulae; **C**, margin of dorsal lamina (stained by toluidine blue). Scale bars: 1 cm.

lus Heller, 1878 and *M. glacialis* (Sars, 1859). Two former species are very different in their morphology and known from distant geographic locations (India and South Africa). They are obviously not closely related with *M. armatus* **sp. nov.**: *M. anomalocarpus* has a straight gut loop and very long (6 mm) spines around the siphons (Millar, 1988), while in *M. oligophyllus*,

the gonads are strongly recurved back and almost U-shaped (Monniot et al., 2001). The third species, *M. glacialis*, is more closely related to the new species, being the only species of this genus inhabiting cold northern waters (it is known from several localities in Norway, the Davis Strait, southeastern Greenland and the northeastern coast of North America, as summarised by Millar, 1966). Existing descriptions of *M. glacialis* are old and may refer to several similar species. In particular, Monniot (1965) discusses the differences in the structure of the branchial sac between the specimens of *M. glacialis* known from the European and North Atlantic American waters (the American species was described originally as a separate species *M. nacreus* Van Name, 1912, but synonymised later with *M. glacialis* by Van Name, 1945). The new species differs from *M. glacialis* in the shape of the gut loop: all existing descriptions of *M. glacialis* accompanied with figures (e.g. Redikorzev, 1916; Hartmeyer, 1922; Van Name, 1945; Monniot, 1965; Millar, 1966), as well as the original description of its putative synonym *M. nacreus* (see Van Name, 1912), show a species with a widely open secondary gut loop very different from the gut loop of *M. armatus* **sp. nov.**, and therefore they cannot be conspecific. Further, the test of *M. armatus* **sp. nov.** is much harder and forms much firmer coating than in *M. glacialis*. The double test around the siphons in the new species also is a very peculiar, although not unique, feature not characteristic for *M. glacialis*. The double test is described for several other species of *Microcosmus* (e.g. *Microcosmus curvus* Tokioka, 1954, see Monniot & Monniot, 2001; Kott 2003) which have more numerous folds of the branchial sac and cannot be conspecific with the new species.

References

Hartmeyer R. 1922. Miscellanea ascidiologica. *Mitteilungen aus dem Zoologischen Museum in Berlin*, **10**: 301–323.

Kott P. 1985. The Australian Ascidiacea, part 1, Phlebobranchia and Stolidobranchia. *Memoirs of the Queensland Museum*, **23**: 1–440.

Kott P. 2003. New syntheses and new species in Australian Ascidiacea. *Journal of natural History*, **37**(13): 1611–1653. https://doi.org/10.1080/00222930110104258

Millar R.H. 1966. *Tunicata Ascidiacea. Marine invertebrates of Scandinavia,* **1**. Oslo: Scandinavian University Book. 123 p.

Millar R.H. 1988. Ascidians collected during the International Indian Ocean Expedition. *Journal of natural History*, **22**: 823–848. https://doi.org/10.1080/00222938800770541

Monniot C. 1965. Etude systématique et évolutive de la famille des Pyuridae (Ascidiacea). *Mémoires du Muséum national d'Histoire naturelle, série A, Zoology*, **36**: 1–203.

Monniot C., Monniot F., Griffiths C.L. & Schleyer M. 2001. South African ascidians. *Annals of the South African Museum*, **108**(1): 1–141.

Monniot F. & Monniot C. 2001. Ascidians from the tropical western Pacific. *Zoosystema*, **23**(2): 201–383.

Redikorzev V. 1916. Tunicates (Tunicata). Issue 1. *In*: **Nasonov N.V.** (Ed.). *Fauna Rossii i sopredel'nykh stran preimushchestvenno po kollektsiyam Zoologicheskogo muzeya Imperatorskoy Akademii nauk* [Fauna of Russia and adjacent countries, basing mainly on collections of the Zoological Museum of the Imperial Academy of Sciences]. Petrograd: A. Benke. 339 p. (In Russian, with Latin diagnoses).

Redikorzev V. 1941. I. Ascidians of the Far Eastern seas of the USSR. *In*: **Derjugin K.M. & Sernov S.A.** (Eds). *Issledovaniya dal'nevostochnykh morey SSSR* [Investigations of the Far Eastern seas of the USSR], **1**: 164–212. Moscow–Leningrad: USSR Academy of Sciences Press. (In Russian, with German descriptions).

Sanamyan K. 1992. Ascidians from the Sea of Okhotsk collected by R.V. "Novoulyanovsk". *Ophelia*, **36**(3): 187–197. https://doi.org/10.1080/00785326.1992.10430369

Sanamyan K. 1993a. Ascidians from the North-Western Pacific region. 1. Polycitoridae. *Ophelia*, **37**(3): 163–173. https://doi.org/10.1080/00785326.1993.10429915

Sanamyan K. 1993b. Ascidians from the North-Western Pacific region. 2. Molgulidae. *Ophelia*, **38**(2): 127–135. https://doi.org/10.1080/00785326.1993.10429894

Sanamyan K. 1996. Ascidians from the North-Western Pacific region. 3. Pyuridae. *Ophelia*, **45**(3): 199–209. https://doi.org/10.1080/00785326.1996.10432472

Sanamyan K. 1998a. Ascidians from the North-Western Pacific region. 4. Polyclinidae and Placentelidae. *Ophelia*, **48**(2): 103–135. https://doi.org/10.1080/00785236.1998.10428680

Sanamyan K. 1998b. Ascidians from the North-Western Pacific region. 5. Phlebobranchia. *Ophelia*, **49**(2): 97–116. https://doi.org/10.1080/00785326.1998.10409376

Sanamyan K. 2000. Ascidians from the North-Western Pacific region. 7. Styelidae. *Ophelia*, **53**(1): 67–78. https://doi.org/10.1080/00785326.2000.10409436

Sanamyan K. & Sanamyan N. 2017a. Shallow-water ascidians from Matua Island (central Kuril Islands, NW Pacific). *Zootaxa*, **4232**(3): 301–321. https://doi.org/10.11646/zootaxa.4232.3.1

Sanamyan K. & Sanamyan N. 2017b. Shallow-water ascidians from Matua Island (central Kuril Islands, NW Pacific), part 2. *Zootaxa*, **4337**(1): 121–131. https://doi.org/10.11646/zootaxa.4337.1.6

Sanamyan K. & Sanamyan N. 2021. Nomenclatural status of Pyuridae and Bolteniidae (Tunicata, Ascidiacea) with comments on several included genera. *Bionomina*, **24**: 9–18. https://doi.org/10.11646/bionomina.24.1.2

Van Name W.G. 1912. Simple ascidians of the coasts of New England and neighboring British provinces. *Proceedings of the Boston Society of Natural History*, **34**: 439–619.

Van Name W.G. 1945. The North and South American ascidians. *Bulletin of the American Museum of Natural History*, **84**: 1–476.

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