

A new species of the genus *Rostanga* Bergh, 1879 (Mollusca: Opisthobranchia) from the Peter the Great Bay, the Japan Sea, with a discussion on the genus *Boreodoris* Odhner, 1939

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ABSTRACT. A new species of the genus *Rostanga* Bergh is described from the Peter the Great Bay, the Japan Sea. It is the only species of the genus inhabiting Russian seas. The new species is most similar in its radula to Argentinian and North Brazilian *Rostanga byga* Er. Marcus, 1958 and belongs to *R. pulchra* — *R. rubra* species group, which are the most specialized in the genus in the form of innermost lateral tooth of the radula. The genus *Boreodoris* Odhner is not considered a synonym of *Rostanga*.

The taxonomy of the genus *Rostanga* was not summarized until Rudman and Avern [1989] published a comprehensive revision of the Indo-West Pacific species. A decade later, a cladistic analysis of the genus *Rostanga* was published together with the descriptions of three very unusual new species from South Africa that are similar to enigmatic *Boreodoris* Odhner, 1939 [Garovoy et al., 2001]. In the same year Valdés and Gosliner [2001] suggested a new conception uniting all caryophyllidia-bearing cryptobranchial dorids, and also synonymized *Boreodoris* and *Rostanga*. Finally Valdés [2001] described the first deep-water species of *Rostanga*, *R. ankya* from depth 650 m.

The species described in the present paper has been known since at least 1971, when it appeared in the first list of nudibranchs from the Peter the Great Bay [Minichev et al., 1971] as *Rostanga* sp. However, no details about the animal were published, and the material was most likely lost. The first recently collected living specimen of this species was found in July, 1987 by Alexander Radko (Vladivostok). It was collected in an unusual environment: on intertidal stones after typhoon in Vostok Bay. The present paper is based on the specimens collected in the first half of the 1990s.

Abbreviations in figures: a — ampulla, bc — bursa copulatrix, ca — copulative apparatus, fm — female gland mass, m — muscular part of vas deferens, p — prostate, rs — receptaculum seminis, v — vaginal duct.

Rostanga alisae Martynov, sp. nov.

(Figs. 1-3)

Rostanga sp.: Minichev et al., 1971: 316; Martynov, 1998: 206.

MATERIAL. Holotype (ZIN*, No. 1), Japan Sea, Peter the Great Bay, Boismana Bay, Klerk Peninsula, September 12, 1992, depth 1-1.5 m, on red sponge *Ophlitaspongia pennata*, covering bundles of *Crenomytilus grayanus*; collected by A.V. Martynov, A.V. Chernyshev. Paratypes: 2 specimens (ZIN, No. 2, N 3), Japan Sea, Peter the Great Bay, Boismana Bay, Klerk Peninsula, August, 15, 1992, depth 1-1.5 m, collected by A.V. Martynov A.V. Chernyshev; 2 specimens (ZIN, Nos. 4, 5), Japan Sea, Peter the Great Bay, Boismana Bay, Klerk Peninsula, September 12, 1992, depth 1-1.5 m, collected by A.V. Martynov, A.V. Chernyshev; 2 specimens (ZIN, No. 6), Japan Sea, Tumannaya Bay, August 1996, depth 1-1.5 m, on rocky substrate, collected by S.P.Plekhov.

DESCRIPTION. External morphology. Maximum length of preserved specimen from Tumannaya Bay (ZIN, No. 6) is 11.6 mm. The holotype is 3.2 mm long in preserved state. The notum is wide, thickened to the edges and sufficiently overlaps the foot. The entire surface of the notum is densely covered with caryophyllidia. The largest caryophyllidia are situated behind the branchial circlet, in front of rhinophores and on the lateral edges of notum. In the central part of notum the caryophyllidia are smaller (in alive specimen 3.5 mm long). The edges of notum and rhinophoral pockets are covered by very small caryophyllidia. The holotype has caryophyllidia with diameter about 100 µm in the middle part of notum. In alive specimen 1 mm long, each caryophyllidium consists of a large tubercle and 6 surrounding spicules. The rhinophores have strong lamellae. A living specimen 9.5 mm long has 8-10 vertical lamellae on each side of rhinophore (Fig. 1, C), rhinophoral stalk sharply protruded. Specimen 2.5 mm long (alive) has about 6 moderately oblique lamellae on each side, and a slightly protruded stalk (Fig. 1, D). Finally, a juvenile specimen 1 mm long

*ZIN — The Zoological Institute, Russian Academy of Sciences, St.-Petersburg; the numbers refer to systematic catalogue, without inventory numbers in this case.

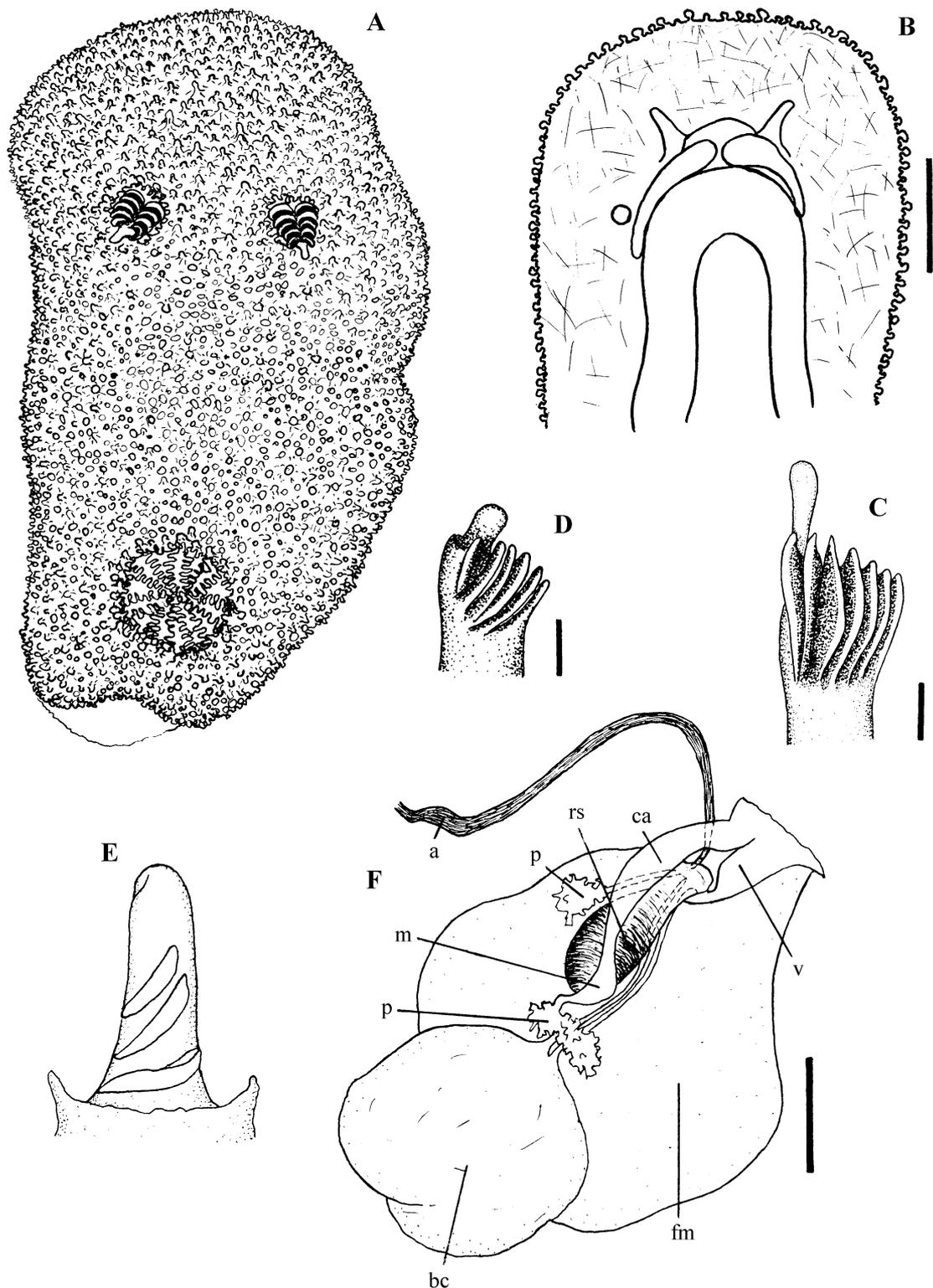


FIG. 1. *Rostanga alisae* sp. nov. A — live animal from Klerk Peninsula, 9.5 mm long; B — ventral view of the body anterior part of animal from the same locality, 2.5 mm long; C — lateral view of rhinophore of animal 9.5 mm long; D — rhinophore of animal 2.5 mm long; E — rhinophore of animal 1 mm long; F — reproductive system (based on specimen ZIN No. 6). Scale bar: B — 0.35 mm; C — 0.25 mm; D — 0.3 mm; E — not to scale; F — 1.5 mm.

РИС. 1. *Rostanga alisae* sp. nov., A — живой экземпляр длиной 9,5 мм с п-ова Клерк; B — вид с вентральной стороны передней части тела особи 2,5 мм длиной, из того же местонахождения; C — ринофор сбоку, экземпляр длиной 9,5 мм длиной; D — ринофор особи 2,5 мм длиной; E — ринофор 1-мм экземпляра; F — половая система (экземпляр ЗИН No. 6). Масштаб: B — 0,35 мм; C — 0,25 мм; D — 0,3 мм; E — без масштаба; F — 1,5 мм.

has rhinophores with 3 oblique lamellae, upper part of the stalk is naked, but not protruding like in adult *Rostanga alisae* and similar to "usual" dorids (Fig. 1, E). The branchial plume is in form of nearly precise ring around the central anus. The gills are unipinnate; 3.5 mm and 9.5 mm long specimens have 11 leaves. The hyponotum of preserved specimen 11.6 mm long is thick and paddy. In living animals a dense network of spicules is seen through hyponotum. The foot is relatively narrow. Two broad postoral lobes encircle the anterior part of foot and join under the head, forming a notch (Fig. 1, B). The oral tentacles are long, finger-shaped. The penis in specimen 11.6 mm long is everted, it has a stalk and upper widened part, like a boxing glove with longitudinal slit atop.

Colour. General colour of the notum is orange-red. The terminal knob of the rhinophore is whitish or whitish-orange. The rhinophoral lamellae are orange-red. Inner part of rhinophoral pocket is whitish, with translucent eyes. The centre of branchial pocket is whitish. The gills are orange-whitish, their edges are reddish. The foot, hyponotum and edges of notum are light-pink. Some anterior caryophyllidia on the notum edge are light, with yellowish dust.

Anatomy. The buccal bulb in specimen 11.6 mm long is round in dorsal view; oral tube is narrow and short. The jaws are in form of two small narrow rectangular bands (Fig. 3 B). The elements of the jaws are widely-lanceolate outside, polygonal inside, light-amber in colour. The cuticle of the oral tube near the jaws is covered with polygonal semitranslucent scales. The radular formula of a preserved specimen 9 mm long (ZIN No. 6) is about 47 x 54.0.54. The innermost lateral tooth has an irregular-square base and rather long, slightly conical to the top cusp directed down and slightly inside and covered from inner side with about 9-11 denticles (Fig. 2 A, B). The mid-laterals (Fig. 2, C-E) have wide base and a strong cusp often covered by little folds, below this cusp there is a flange sometimes looking like a triangular denticle, which is covered by folds too (these folds may resemble a serration). The outer laterals (Fig. 3, C-E) are long, curved, with brush of 4-8 denticles on the top.

The ampulla is long, thin and slightly bending. It distally branches into vas deferens, short oviduct entering the female gland mass, and the uterine duct. The vas deferens has a very thin portion before entering the prostate. Unfortunately most specimens are small, with weakly developed reproductive system, and the prostate of a specimen 11 mm long is broken into two small parts. Probably, the prostate is flattened, not very large and tightly adhering to the wall of very large spherical bursa copulatrix. After prostate the vas deferens has a short, slightly widened portion, and then enters the copulative apparatus. Later it has a form of a muscular fusiform tube. The penis is unarmed. The thin and long vaginal duct leaves the bursa copulatrix and abruptly widens in distal portion. Vagina and copulative apparatus are joined only in most distal small portion.

Receptaculum seminis is rather large and irregularly oval.

[**ДИАГНОЗ.** На каждой стороне ринофоров 8-10 вертикальных пластинок. Кариофиллии состоят из крупного бугорка и 6 окружающих спикул. Общий цвет нотума и пластинок ринофоров оранжево-красный, жабры беловато-оранжевые, с красноватыми краями. Челюсти маленькие и содержат элементы разной формы. Первые латеральные зубы радулы с конообразным зубцом, несущим 9-11 зубчиков. Средние латеральные зубы с широким основанием, боковым утолщением и мощным зубцом. Внешние латеральные зубы длинные, изогнутые, с щеточкой из 4-8 зубчиков. Вагинальный канал открывается в крупную бурсу рядом с каналом к рецептакулуму.]

Remarks. The new species is most similar to the Argentinian and North Brazilian *Rostanga byga* Er. Marcus, 1958 [Marcus, 1958] in the structure of radula. The latter species has been recently redescribed by Munian and Valdés [2000]. The main difference between *R. byga* and *R. alisae* sp. nov. is the form of innermost lateral tooth. Despite general similarity, *R. byga* has roundish and widened to the top cusp whereas *R. alisae* has slightly conical to the top cusp. Furthermore, *R. alisae* has a special denticle on inner side of base of innermost tooth. The mid-lateral teeth of *R. alisae* have wider base and more conspicuous outer fold (reduced cusp) than *R. byga*. The jaws of *R. alisae* are small but contain regular elements, while in *R. byga* the elements are much reduced. The reproductive system of *R. alisae* has a very thin ampulla, distally strongly widened vaginal duct, contrary to *R. byga*, which is characterized by distinct tube-shaped ampulla and slightly widened distally vaginal duct. Common North Pacific *Rostanga pulchra* MacFarland, 1905 [MacFarland, 1906; Marcus, 1961; Munian and Valdés, 2000] is rather sufficiently distinct from *R. alisae* by shorter cusp of innermost laterals, bicuspidate mid-laterals, wide short ampulla, smaller bursa copulatrix. Externally, the new *Rostanga* is different from *R. pulchra* mainly in nearly complete absence of any brown or black spots on the notum, except sometimes for yellowish-brownish dust. Geographically, the new species is closest to *Rostanga orientalis* Rudman et Avern, 1989 and *R. risbeci* Baba, 1991 [Eliot, 1913; Baba, 1935, 1949, 1991; Rudman, Avern, 1989] which are distributed to the middle Japan. Both species clearly differ from *R. alisae*, in particular, by absolutely different shape of innermost and mid-lateral teeth. *R. orientalis* and *R. risbeci* are distinctly thermophilic like many tropical *Rostanga* species, whereas *R. alisae* is related to three temperate-subtropical Atlantic and Pacific species, *R. rubra*, *R. pulchra* and *R. byga*. Both *R. alisae* and *R. orientalis* inhabit the Japan Sea, but its different parts, and if use a phylogenetic relationship of species of genus *Rostanga* proposed by Garovoy et al. [2001], *R. alisae* represent a bridge in the world distribution of *Rostanga* species since representatives of temperate-subtropical and tropical clades inhabit the same sea. However, only four

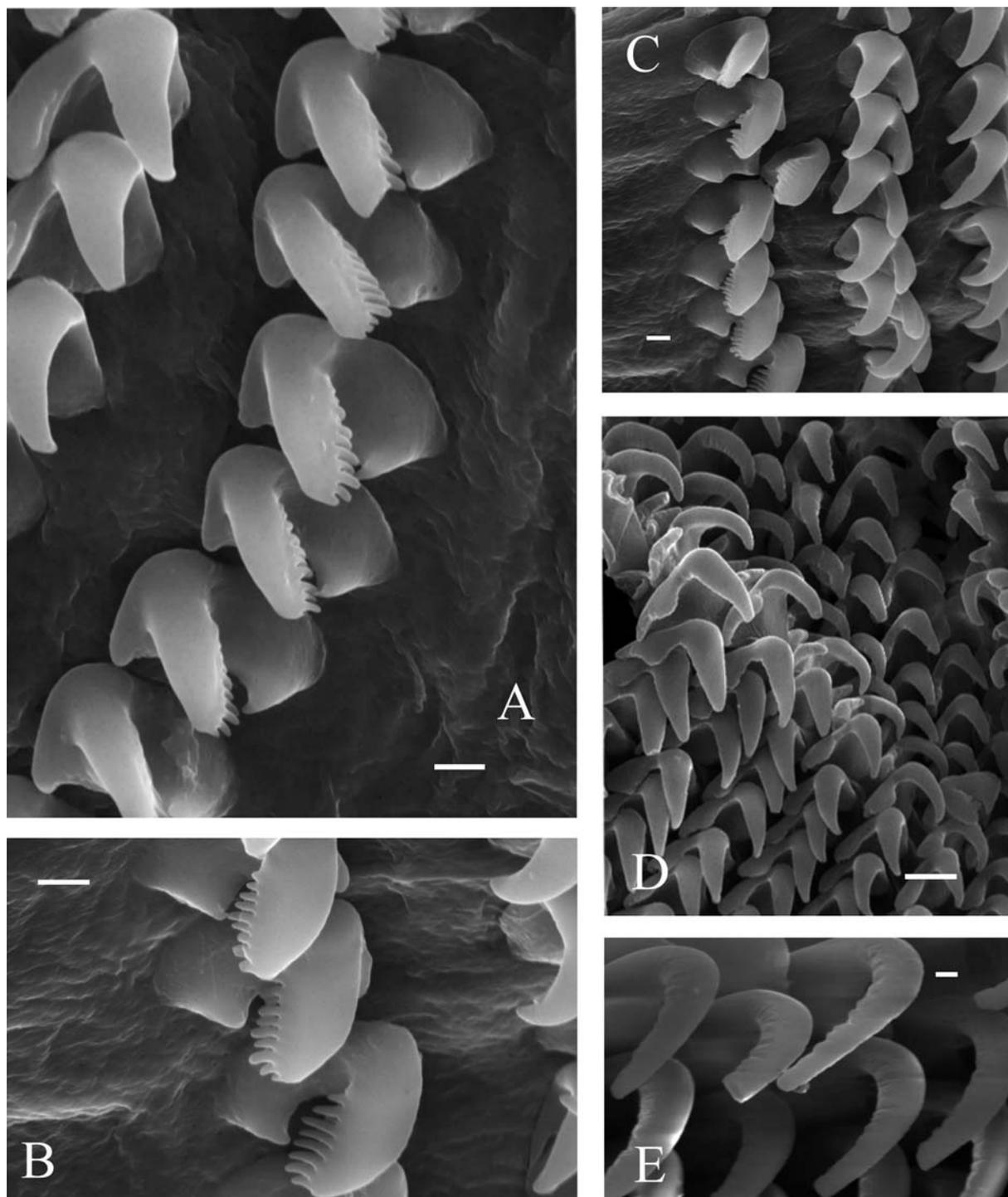


FIG. 2. *Rostanga alisae* sp. nov., scanning electron photographs of radula (ZIN No. 6) A, C – inner lateral teeth; B – innermost lateral teeth; D – mid-lateral teeth; E – details of mid-lateral teeth. Scale bar: A-C, E – 3 μm ; D – 10 μm .

РИС. 2. *Rostanga alisae* sp. nov., Фотографии радулы (сканирующий электронный микроскоп), ЗИН No. 6. А, С – внутренние латеральные зубы; В – первые латеральные зубы; D – средне-латеральные зубы; E – детали строения средне-латеральных зубов. Масштаб: А-С, E – 3 мкм; D – 10 мкм.

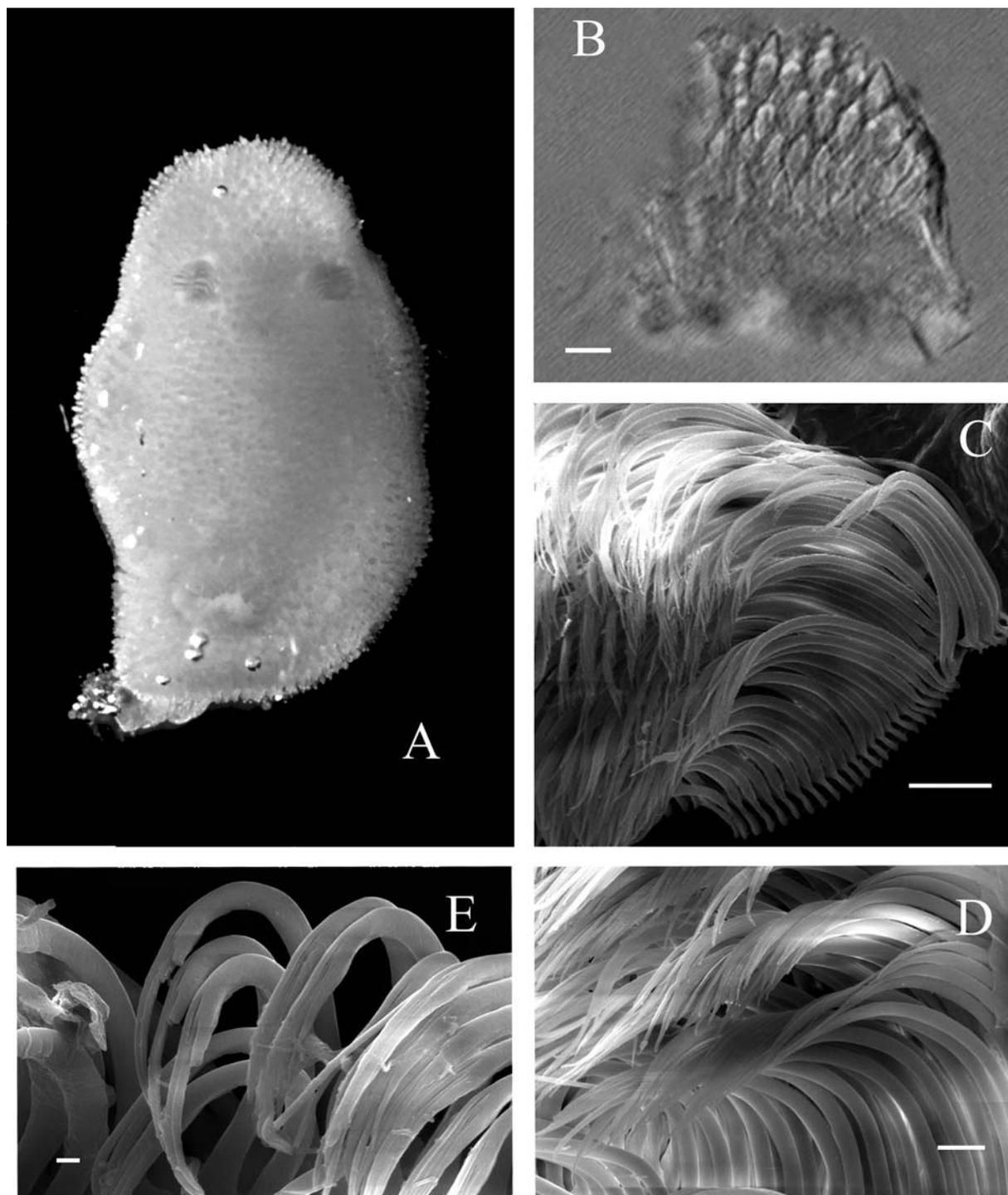


FIG. 3. *Rostanga alisae* sp. nov., A — live animal from Klerk Peninsula 9.5 mm long, photograph by the author; B — light microscopic photograph of jaw (partially damaged from left) (ZIN No. 4); C-E — scanning electron photographs of radula (ZIN N 6) — outer lateral teeth (C, D), details of the outermost teeth (E). Scale bar: B — 10 μ m; C — 30 μ m; D — 10 μ m; E — 3 μ m.

FIG. 3. *Rostanga alisae* sp. nov., A — фотография (с цветного слайда) живого экземпляра 9,5 мм длиной, с п-ова Клерк, фото автора; B — фотография челюсти (световой микроскоп), частично поврежденной с левой стороны (ЗИН No. 4); C-E — фотографии радулы под сканирующим электронным микроскопом (ЗИН No. 6): — внешние латеральные зубы (C, D), и детали их строения (E). Масштаб: B — 10 мкм; C — 30 мкм; D — 10 мкм; E — 3 мкм.

species of *Rostanga* – *R. byga*, *R. alisae*, *R. pulchra*, *R. rubra* have a short cusp of the innermost tooth folded inward in relation to the middle of radula and broad mid-lateral teeth, whereas in all other species of the genus the cusp is usually rather long and always directed outward. Although on the cladogram proposed by Garovoy et al. [2001] this group appeared as sister to the tropical species *R. australis*, the latter does not have a cusp directed inward and broad almost triangular mid-lateral teeth. The shortening of the cusp of innermost tooth is the first step to the formation of tooth as in *R. pulchra* – *R. rubra* group and probably could rather easily happen in different *Rostanga* species. The very long innermost tooth in adult stage of *R. orientalis*, for example, in the juvenile specimen has a short cusp somewhat directed inward. Summing up, the origin of the above mentioned species group is not clear and they are not obviously related to *R. australis*.

Valdés and Gosliner [2001] argued that despite the radula of the genus *Boreodoris* Odhner [Odhner, 1939] is different enough from *Rostanga* and these two taxa are sister groups, they are just synonym. Besides the absence of jaws, *Boreodoris* has no innermost teeth with denticulated flange on inner side (sometimes the denticulation is obviously secondarily reduced), which are characteristic of all species of *Rostanga*. Furthermore, innermost tooth of the *Boreodoris* is not very different from closest laterals that looks like in many other cryptobranchial dorids. In *Rostanga bifurcata* Rudman et Avern, 1989, mid-lateral teeth are also similar to the innermost teeth, but the latter always differ by only one denticulated side. Garovoy et al. [2001] established that in all species of *Rostanga* (including *Boreodoris*) the innermost lateral teeth of the radula have the main cusp characteristically folded inwards relatively to the base of the teeth. Nevertheless, the innermost tooth of the cryptobranchial dorids is often folded inwards to a different degree and has a tendency to widen at the base (for example in the genera *Asteronotus*, *Gargamella*, *Alloidoris*, as figured by Valdés and Gosliner [2001]) and therefore this feature is not unique for *Boreodoris* and *Rostanga*. Thus, *Boreodoris* lacks the main feature of *Rostanga* – a special innermost tooth, and should be maintained as a separate genus. The three South African species described as *Rostanga* are transferred here into *Boreodoris*: *Boreodoris elandsia* (Garovoy, Valdés et Gosliner, 2001) comb. nov., *Boreodoris*

aureomala (Garovoy, Valdés et Gosliner, 2001) comb. nov. and *Boreodoris phepha* (Garovoy, Valdés et Gosliner, 2001) comb. nov. *R. ankyra* Valdés, 2001 has smooth labial cuticle and lacks differentiation between innermost lateral tooth and closest laterals, and, according to these characters, should be transferred to the genus *Boreodoris* – *B. ankyra* (Valdés, 2001) comb. nov.

One of the most typical features of Dorididae s.l. is a transformation of denticulated radular teeth to smooth ones. Within this group there are genera with different degree of denticulation of the teeth, but radula of the genus *Rostanga* is probably the most specialized in this respect. However, the closest to the *Rostanga* genus is *Diaulula* Bergh, 1880 which is fully devoid of denticles on the teeth. This contradiction can be explained if one takes into consideration that juvenile specimens (0.3-1.0 mm) of *Diaulula sandiegensis* have radula with different range of denticulation (personal observation). Thus, the genus *Rostanga* could originate via heterochrony of particular character – radula.

Natural history. The new species lives at the depth 1-4 m, virtually always on red sponge *Ophlitaspongia pennata*, which covers stones, rocks and bundles of *Crenomytilus grayanus* (sponges with *Rostanga alisae* are rarely found). The reproduction occurs in August and first half of September. The juvenile specimens 1-3 mm long were observed since middle of August. The egg mass is a moderately broad pinkish ribbon, sometimes sinuous along the free edge.

Distribution. Japan Sea: Peter the Great Bay (Furugelm Id., Boismaya Bay at Klerk Peninsula, Vostok Bay) and Tumannaya Bay (south of Olga Bay). In these areas the new species is relatively rare. This species probably lives also in waters of North-West Hokkaido.

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- Новый вид рода *Rostanga* Bergh, 1879 (Mollusca: Opisthobranchia) из залива Петра Великого Японского моря с замечаниями о роде *Boreodoris* Odhner, 1939
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- РЕЗЮМЕ.** Описан новый вид рода *Rostanga* Bergh из залива Петра Великого Японского моря. Это единственный представитель рода, обитающий в водах России. Новый вид наиболее близок аргентинскому и северо-бразильскому виду *Rostanga byga* Er. Marcus, 1958 и принадлежит группе видов *R. pulchra* — *R. rubra*, наиболее специализированных по строению внутреннего латерального зуба радулы. Обсуждается таксономия близкого рода *Boreodoris* Odhner, который автор рассматривает как самостоятельный.