

***Boreochiton jakovlevae* sp. nov.**  
**(Mollusca: Polyplacophora),**  
**a new chiton from the Sea of Okhotsk**

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A new species of the genus *Boreochiton* Sars, 1878, *Boreochiton jakovlevae* sp. nov., is described from Iona Island, the Sea of Okhotsk. It differs from other species of the genus in having higher head of major lateral tooth of radula, wider jugal sinus, and smaller dorsal spicules. The color of the tegmentum and wide girdle of the new species are similar to that of *Tonicella submarmorea* (Middendorff, 1847) from which the new species differs in having fenestral gland, wider jugal sinus and wider tail valve.

**Key words:** chiton, fenestral gland, *Boreochiton*, Tonicellidae, new species, Sea of Okhotsk.

***Boreochiton jakovlevae* sp. nov.**  
**(Mollusca: Polyplacophora),**  
**новый хитон из Охотского моря**

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Описывается новый вид рода *Boreochiton* Sars, 1878, *Boreochiton jakovlevae* sp. nov., найденный у острова Ионы в Охотском море. Он отличается от других видов этого рода наличием высокого лезвия крючковой пластинки радулы, широким югальным синусом и мелкими дорсальными спикулами. Окраска тегмента и широкий перинотум нового вида сходны с таковыми *Tonicella submarmorea* (Middendorff, 1847), от которого новый вид отличается наличием фенестральной железы, широкого югального синуса и широкого хвостового щитка.

**Ключевые слова:** хитон, фенестральная железа, *Boreochiton*, Tonicellidae, новый вид, Охотское море.

Jakovleva [1952] described two new species of chitons and assigned them to the genus *Tonicella* Carpenter, 1873 (*Tonicella beringensis* Jakovleva, 1952 and *T. granulata* Jakovleva, 1952) because they have superficial similarity to *Tonicella marmorea* (Fabricius, 1790). Sirenko [1974] added one more subspecies, *T. beringensis lucida* Sirenko, 1974. Later, Ferreira [1982] synonymized these three taxa with *Tonicella rubra* (L., 1767), and Kaas and Van Belle [1985] agreed with him. Sirenko et al. [1987] found

fenestral gland not only in *T. rubra* [Haddon, 1885; Plate, 1899], but in both subspecies of *T. beringensis*, *T. granulata* and *T. sp.* Sirenko [2000] reinstated the genus *Boreochiton* Sars, 1878. The main feature of the genus is the presence of a large fenestral gland in tail part of chitons. The fenestral gland is a characteristic feature found only in species of the genus. The function of the gland is obscure; perhaps it corresponds to the hypobranchial gland or osphradium of other molluscs. The genus *Boreochiton* includes five species and subspecies: *B. ruber*, *B. beringensis beringensis*, *B. beringensis lucidus*, *B. granulatus* and *B. jakovlevae* **sp. nov.**

The aim of this paper is to describe the new species of the genus *Boreochiton*.

## Material and methods

The species under study was collected in the Sea of Okhotsk, near Iona Island, in 1914 and 1978. There are seven samples containing 16 specimens in the collections of the Zoological Institute, Russian Academy of Sciences, St. Petersburg (ZISP). Most of them were collected in 1978 during the expedition aboard the R/V *Poseidon*.

The holotype and five paratypes of different size with body length (BL) 3.5, 14.0, 18.0, 25.0, and 32.0 mm were prepared for examination by a scanning electron microscope (SEM) and light microscope (Leica). The specimens were boiled in 7% KOH for 10–15 min, then boiled twice in fresh water. Several valves, half of a radula, and a portion of girdle were chosen for examination by SEM. The rest of radula and girdle were dried and put in Canadian balsam for examination under a light microscope.

## Taxonomy

Suborder **ACANTHOCHITONINA** Bergenhayn, 1930

Family **Tonicellidae** Simroth, 1894

Subfamily **Tonicellinae** Simroth, 1894

Genus *Boreochiton* Sars, 1878

Type species. *Chiton ruber* Linnaeus, 1767, by subsequent designation, Pilsbry, 1893.

Genus distribution. Northern Pacific and northern Atlantic, Pliocene – Recent.

*Boreochiton jakovlevae* Sirenko sp. nov.

Figs 1–5

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*Tonicella* sp.: Sirenko et al., 1987, p. 216.

*Boreochiton* sp.: Sirenko, 2000, p. 72; Sirenko 2013, p. 149.

**Type material.** The holotype (ZISP no. 1916), now disarticulated, consisting of mount of part of girdle and radula, vail with valves, part of radula and part of girdle, and 13 paratypes (ZISP nos. 2268, 2269, 2270, 2271).

**Type locality.** The Sea of Okhotsk, Iona Isl., 56°24' N, 143°23' E, depth 20 m, on rocks.

**Etymology.** After A.M. Jakovleva, who prepared the first guidebook for identification of chitons from Russian seas.

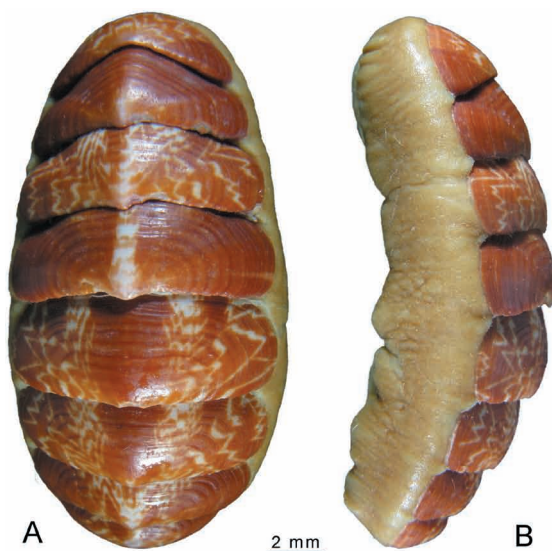
**Material examined.** The Sea of Okhotsk, 0.5 nautical mile from Iona Isl., depth 21.7 m, trawl, stones, 3 paratypes (ZISP no. 2271), BL 15.0–18.0 mm, 09.06.1914, leg. G.R. Meder; off Iona Isl., depth 13 m, SCUBA, st. 94, stones, rocks, on rhizoids of *Laminaria* sp., 1 specimen, BL 32 mm, 21.06.1978, leg. A. Sheremetevsky; depth 15 m, SCUBA, st. 95, stones, rocks, 6 paratypes (ZISP no. 2270), BL 14–33 mm, 21.06.1978, leg. A. Sheremetevsky; depth 20 m, SCUBA, st. 96, stones, rocks, holotype (ZISP no. 1916), 3 paratypes (ZISP no. 2268), BL 4.5–34 mm, 21.06.1978, leg. A. Sheremetevsky; depth 20 m, SCUBA, st. 97, stones, rocks, 1 specimen, BL 26 mm, 21.06.1978, leg. A. Sheremetevsky; depth 43 m, *Okean* bottom sampler, st. 85, stones, 1 paratype (ZISP no. 2269), BL 3.5 mm, 21.06.1978, leg. V. Koblikov; depth 50 m, *Okean* bottom sampler, st. 148, stones, 1 specimen, BL 15 mm, 31.07.1978, leg. V. Koblikov.

**Distribution.** Near Iona Isl., the Sea of Okhotsk, in a depth range of depth 13–50 m, on stones, rocks and rarely on rhizoids of *Laminaria* sp.

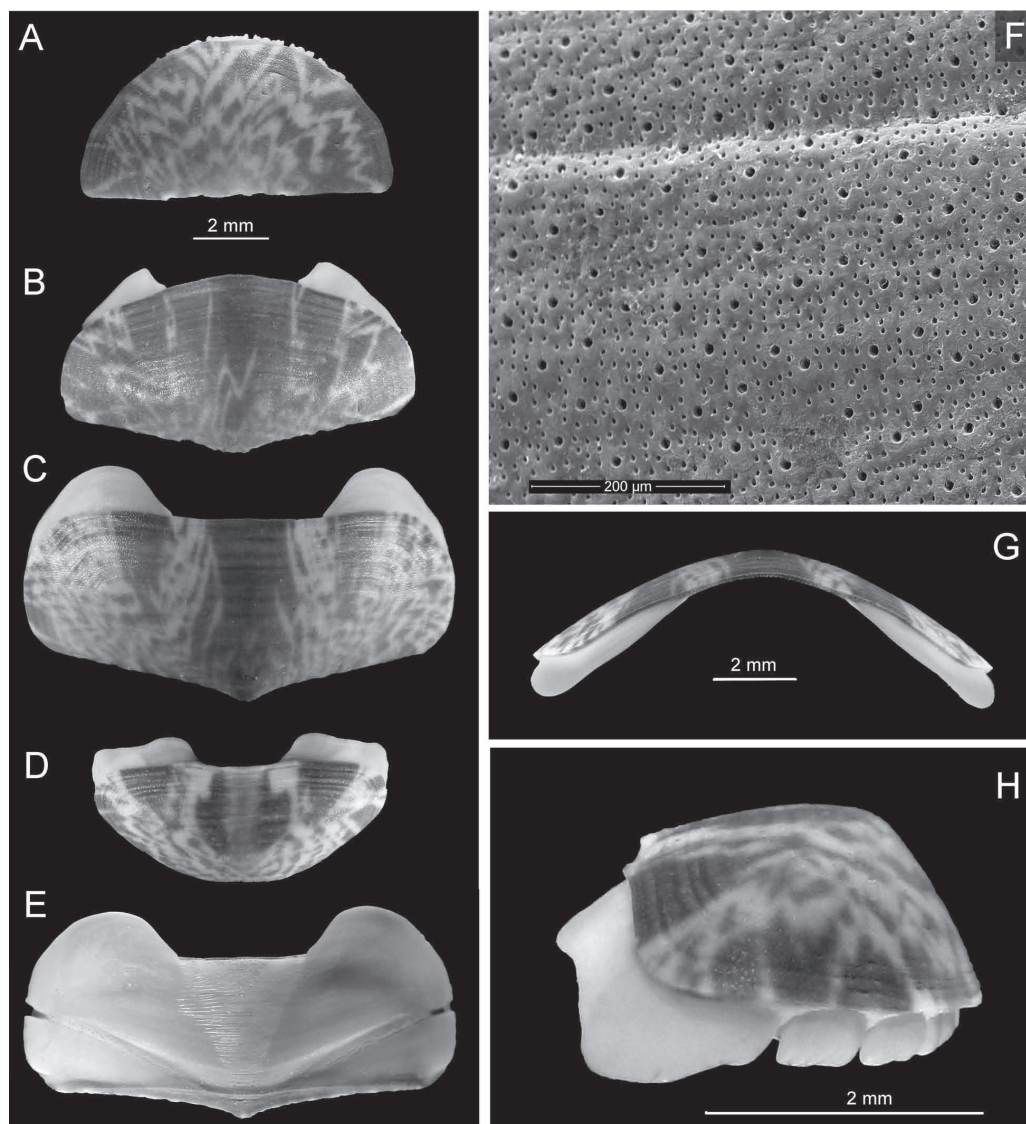
**Diagnosis.** Animal of moderate size, attaining a length of 34 mm, oval. Shell very low, round-backed; tegmentum smooth with growth lines; jugal sinus very wide. Girdle wide about half of valve V, looking smooth, leathery. Dorsal spicules small partly embedded into cuticle, ventral spicules with 2–3 ribs in their upper half. Height of head of major lateral tooth of radula equal or larger than its width.

**Description.** The holotype, 27.0x21.4 mm, oval, low elevated (dorsal elevation: 0.24), shell rounded, side slopes slightly convex, valves somewhat beak. Tegmentum fulvous, marmorated.

Head valve semicircular, front slope slightly convex. Intermediate valves rectangular. Valve II appreciably narrower than valve V, with convex front margin. Valve V with nearly straight front margin; side margin little rounded; apices neatly indicated; lateral



**Fig. 1.** *Boreochiton jakovlevae* sp. nov., a paratype (ZISP no. 2269), BL 32 mm. **A** – whole animal, dorsal view; **B** – whole animal, lateral view.



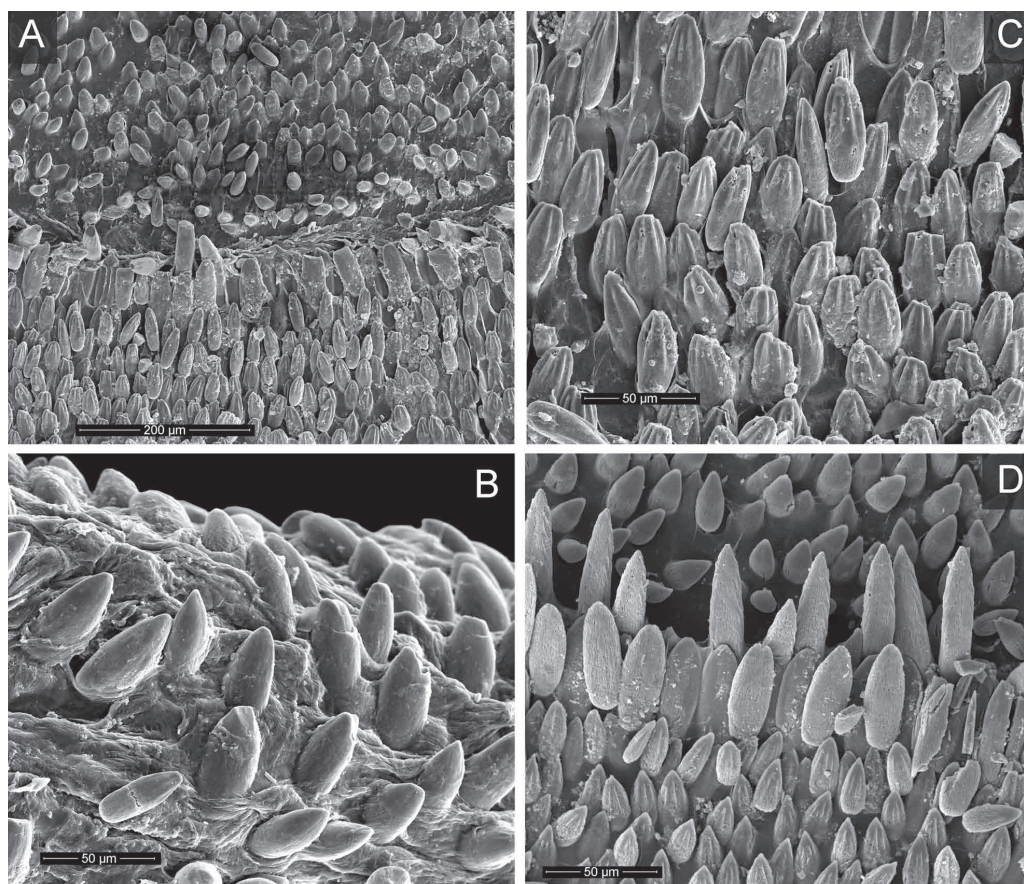
**Fig. 2.** *Boreochiton jakovlevae* sp. nov., the holotype (ZISP no. 1916), BL 27.0 mm. **A** – head valve, dorsal view; **B** – valve II, dorsal view; **C** – valve V, dorsal view; **D** – tail valve, dorsal view; **E** – valve V, ventral view; **F** – surface of tegmentum in central area; **G** – valve V, rostral view; **H** – tail valve, lateral view.

areas not raised. Tail valve narrower than head valve, elliptical in outline; mucro a little behind the center; posterior slope convex.

Tegmentum smooth to the naked eye, several growth lines clearly indicated.

Articulamentum strongly developed, rose color in most the surface of valves except white insertion plates; apophyses wide, broadly triangular with rounded top, more or less trapezoid in the tail valve, separated by a rather wide jugal sinus (ratio of width of



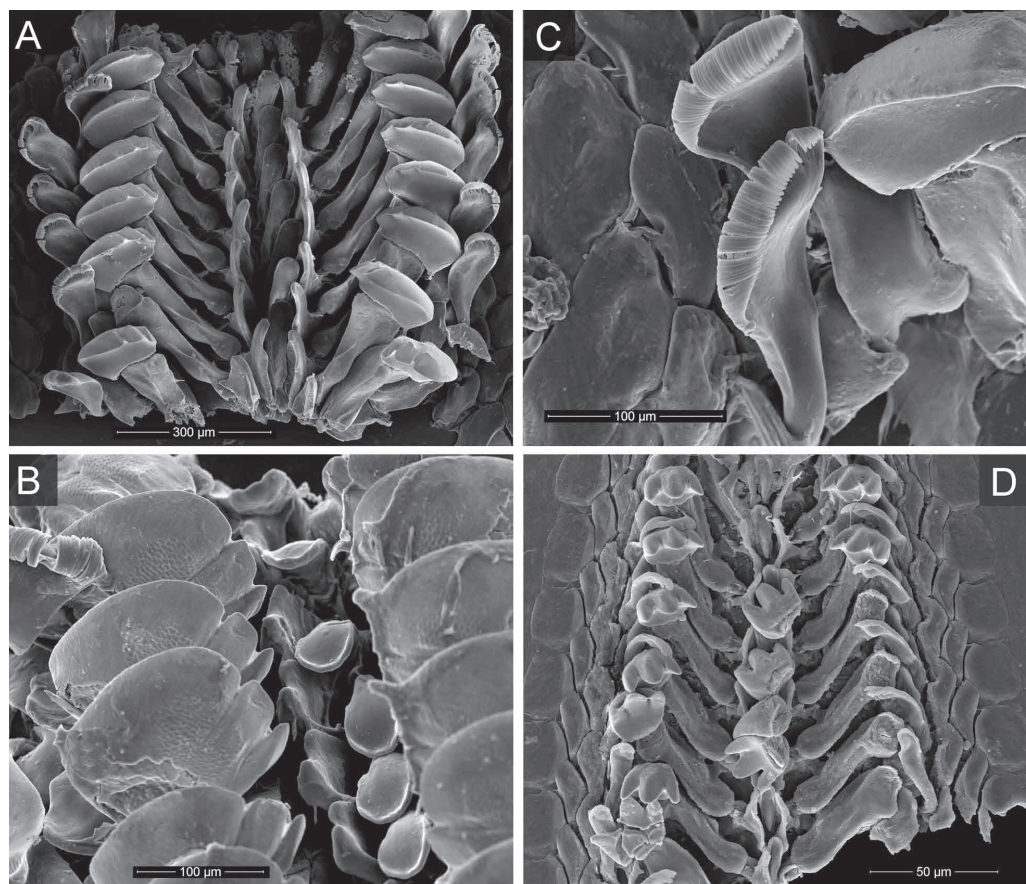


**Fig. 3.** *Boreochiton jakovlevae* sp. nov., the holotype (ZISP no. 1916), BL 27.0 mm (A–C) and a paratype (ZISP no. 2268), BL 3.5 mm (D). A, D – dorsal spicules, marginal needles and ventral spicules; B – dorsal spicules; C – ventral spicules.

apophyses to width of jugal sinus 1.1). Slit formula 9/1/10; teeth sharp, smooth; slit rays slightly indicated.

Girdle of the fixed holotype looking smooth and leathery, rather wide (width of girdle near valve V about half of width of the valve), dorsally not densely covered with small fulvous elongate oval spicules (51–60x17–20 μm) partly embedded into cuticle, short chitinous bristles (55 μm) with small spicule on its top scattered among spicules. Short marginal needles (cc. 100 μm) with 3–5 shallow grooves arranged diagonally on both their sides. Ventrally small sharply pointed spicules (50–52x18–21 μm) with 2–3 ribs on their upper half. There is one row of large, flattened smooth spicules (80x30 μm) near outer margin.

Radula of the holotype 9.0 mm long, with 49 transverse rows of mature teeth, central tooth long, major lateral tooth with high tricuspid head, outer denticle noticeably



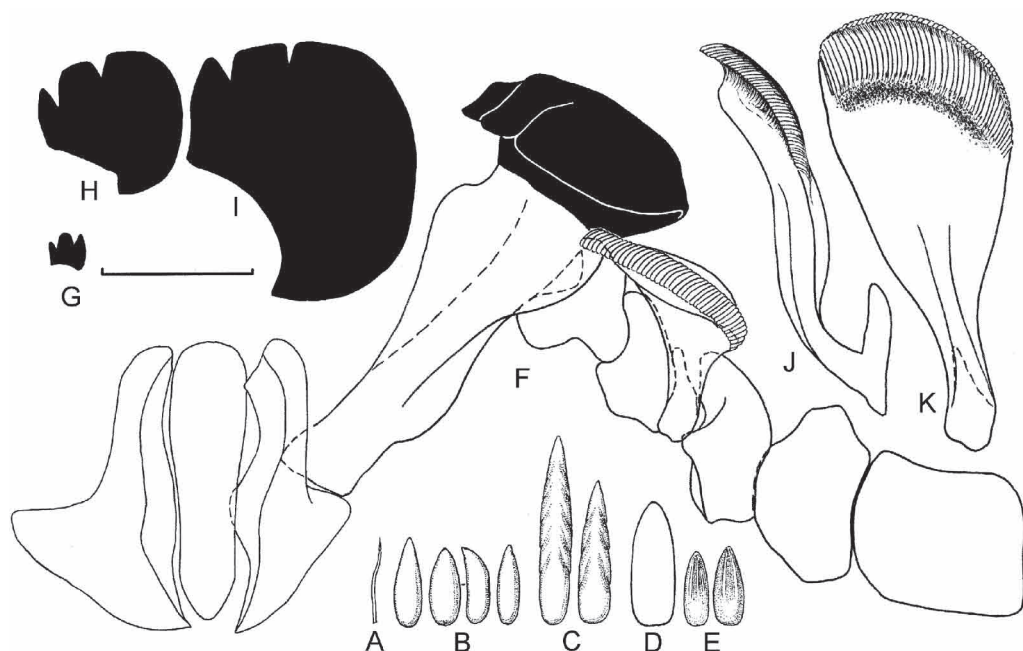
**Fig. 4.** *Boreochiton jakovlevae* sp. nov., the holotype (ZISP no. 1916), BL 27.0 mm (A–C) and paratype (ZISP no. 2268), BL 3.5 mm (D). A, D – radula; B – central portion of radula; C – first marginal teeth of radula.

broader than others (ratio of height of head to its width 1.16), major uncinal tooth with wide broom-like top.

The holotype with 24 gills on both sides, extending from valve III to valve VII.

Gut contents containing red crustose calcareous algae (90–95%), diatoms, detritus and sand.

**Remarks.** The examination of the paratypes showed some variability. Most paratypes have similar marmoreous color of tegmentum, but one paratype has monochromatic fulvous color. Size of denticles of head of major lateral tooth of radula undergo age variability: outer denticle is noticeably enlarged and ratio of height of head to its width is increased with age. The ratio of length of antemucronal area to length of post-mucronal area in holotype is 1.1, whereas the ratio in four paratypes (BL 14, 18, 18, 32 mm) varied from 0.7 to 1.0.



**Fig. 5.** *Boreochiton jakovlevae* sp. nov., the holotype (ZISP no. 1916), BL 27.0 mm (A–E, I), a paratype (ZISP no. 2270), BL 14 mm (H), a paratype (ZISP no. 2270), BL 25 mm (F, J, K) and a paratype (ZISP no. 2268), BL 3.5 mm (G). A – dorsal bristle; B – dorsal spicules; C – marginal needles; D – ventral spicule near outer margin; E – ventral spicules in middle part of girdle; F – half row of radula; G–I – head of major lateral tooth of radula; J, K – major uncinal tooth. Scale bar 100  $\mu$ m.

*B. jakovlevae* differs from other species of genus in having higher head of major lateral tooth of radula, small and scattered dorsal spicules, wider jugal sinus and marmorated color of tegmentum. New species differs from *B. granulatus* also in having smooth tegmentum (vs. granulated in *B. granulatus*). The marmorated color of tegmentum, low valves and wide girdle of *B. jakovlevae* are similar to those of *Tonicella submarmorea* Middendorff, 1847, but the new species easily differs from the latter one by having fenestral gland.

#### Key for identification of species of genus *Boreochiton*

- 1(2) Tegmentum granulated ..... *B. granulatus*.
- 2(1) Tegmentum smooth with growth lines only.
- 3(4) Head of major lateral tooth of radula higher than its own width. Ratio of width of apophyses to width of jugal sinus 1.1–1.3 ..... *B. jakovlevae*.
- 4(3) Height of head of major lateral tooth of radula less than its width. Ratio of width of apophyses to width of jugal sinus 1.4–2.6.
- 5(8) Dorsal spicules large, more than 60  $\mu$ m in middle part of girdle, densely cover girdle. Numerous bristles up to 140–320  $\mu$ m. Girdle orange-red, its surface rough and granulated.



- 6(7) Length of antemucronal area equal to or oftenly more than length of postmucronal area. Girdle 1.7–2.0 times narrower than width of valve V. Bristles up to 320  $\mu\text{m}$  height. Dorsal spicules 55–60  $\mu\text{m}$ . Height of head of major lateral tooth less than its width ..... *B. beringensis beringensis*.
- 7(6) Length of antemucronal area less than length of postmucronal area. Girdle 2.8–3.8 times narrower than valve V. Bristles up to 140  $\mu\text{m}$  height. Dorsal spicules up to 80  $\mu\text{m}$ . Height of head of major lateral tooth equal to its width ..... *B. ruber*.
- 8(5) Dorsal spicules small, about 40  $\mu\text{m}$  in middle part of girdle. A few bristles up to 50  $\mu\text{m}$  cover girdle. Girdle light with leathery surface ..... *B. beringensis lucidus*.

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