

Lepidochitona bondarevi sp. nov. (Mollusca: Polyplacophora) from the Black Sea and its relatives

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ABSTRACT. A revision of Black Sea chitons of the genus *Lepidochitona* has been conducted. The revision revealed new features of intrageneric similarity and differences of Black Sea species as well as with Mediterranean species. Species similarity of Black Sea and Mediterranean representatives of *Lepidochitona cinerea* is confirmed. A new species *L. bondarevi* sp. nov. is described. Previously its specimens were attributed erroneously to *L. caprearum*. The new species differs from *L. caprearum* in having a less broad head valve, shorter apophyses, a much longer postmucronal area on the tail valve, 7–8 longitudinal grooves around the upper half of dorsal girdle spicules and smooth dorsal girdle needles.

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Lepidochitona bondarevi sp. nov. (Mollusca:
Polyplacophora) из Черного моря и его
родственники

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РЕЗЮМЕ. Проведена ревизия черноморских хитонов рода *Lepidochitona*, в результате которой выявлены новые признаки сходства и отличия черноморских видов этого рода между собой и со средиземноморскими видами. Подтверждено видовое сходство черноморских и средиземноморских представителей *Lepidochitona cinerea*. Описан новый вид *L. bondarevi* sp. nov., экземпляры которого ранее считались принадлежащими виду *L. caprearum*. Новый вид отличается от *L. caprearum* менее широким головным щитком, более короткими апофизами, значительно более длинным постмукрональным полем на хвостовом щитке, 7–8 продольными бороздами вокруг верхней части дорсальных спикул и гладкими дорсальными иглами.

Introduction

For many years, the literature on Black Sea molluscs recognized the presence of only one species of chitons of the genus *Lepidochitona*: *L. marginatus* (Pennant, 1777) [Milachewitch, 1909a,b, 1916; Jakovleva, 1952], although a second species *Chiton polii* Philippi, 1836 was also mentioned in some articles [Kowalevsky, 1883; Zernov, 1913]. Staro-

bogatov [1972] finally recognized the existence of two species presently classified in *Lepidochitona*: *L. cinerea* (Linnaeus, 1767) and *Middendorffia caprearum* (sic) (Scacchi, 1836) there. Kaas and Van Belle [1985] supported the opinion of two species of *Lepidochitona* in the Black Sea.

The existence of the first species *Lepidochitona cinerea* in the Black Sea was not in doubt. The second Black Sea species of the genus, despite the similarities with *L. caprearum*, such as broad head valve, upper part of first lateral teeth of radula not higher than blade of central teeth and longitudinal sculpture of dorsal spicules, differs significantly from this Mediterranean species. This article is devoted to the solution of this problem.

Material and methods

The material for this article originated from the collections of the Zoological Institute collected in the Black Sea from the late 19th century to the present, as well as materials from the Mediterranean, North, Baltic and Norwegian seas, sent to the Zoological Institute as a scientific exchange. A total of about 120 specimens of *Lepidochitona cinerea* (Linnaeus, 1767) and more than 600 specimens of *L. bondarevi* sp. nov. collected in the Black Sea and the Sea of Marmara, as well as more than 110 specimens of *L. cinerea* and 36 specimens of *L. caprearum* from the Mediterranean, Baltic, Northern and Norwegian seas were studied. About 20 specimens of these four species selected for scanning electron microscopy (SEM) were boiled in 7% KOH for 5–7 minutes. Afterwards they were boiled twice in fresh water,

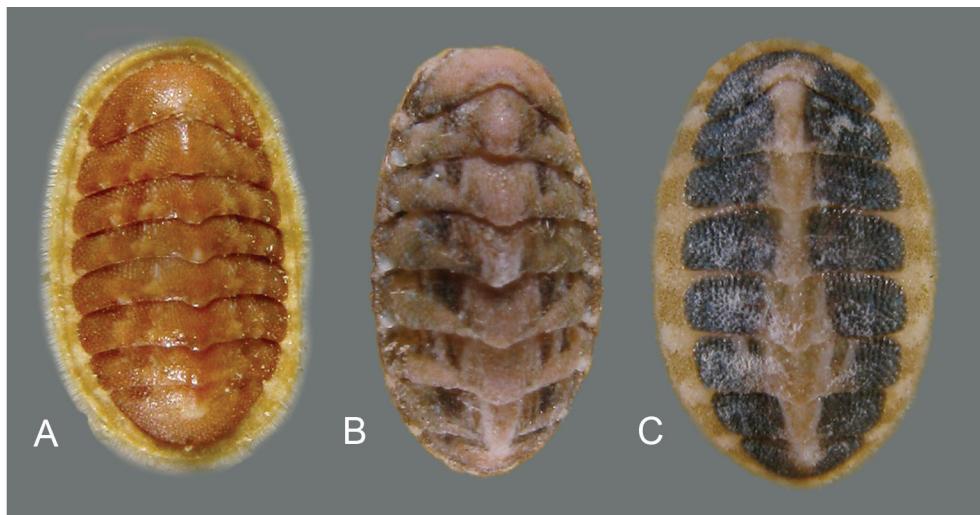


FIG. 1. *Lepidochitona cinerea*, Black Sea, Crimea Peninsula, near Balaklava Bight (ZIN 217), BL 5.5 mm (A), *Lepidochitona bondarevi* sp. nov., Crimea Peninsula, Kara Dag, BL 4.8 mm (B), *Lepidochitona bondarevi* sp. nov., Crimea Peninsula, Fiolent Cape, BL 6.0 mm (C).

РИС. 1. *Lepidochitona cinerea*, Черное море, Крымский полуостров у Балаклавской бухты, (ZIN 217) BL 5,5 мм (А), *Lepidochitona bondarevi* sp. nov., Крымский полуостров, Кара Даг, BL 4,8 мм (Б), *Lepidochitona bondarevi* sp. nov., Крымский полуостров, мыс Фиолент, BL 6,0 мм (С).

or were treated with sodium hypochlorite (NaOCl) with control under a microscope, and then washed in fresh water. Then several valves (usually valves I, II, IV, V and VIII), half of the radula and a portion of the girdle were examined with FEI SEM Quanta 250 scan microscope. The remains of the radulae and girdles were dried and embedded in the Canada balsam for examination under a light microscope.

Abbreviations: BL, body length. FRC IBSS, Kovalevsky Institute of Biology of the Southern Seas of RAS, Sevastopol, Russia. ZIN, Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia.

Taxonomy

Class Polyplacophora Gray, 1821
Subclass Neoloricata Bergenhayn, 1955
Order Chitonida Thiele, 1909
Suborder Acanthochitonina
Bergenhayn, 1930
Superfamily Mopalioidea Dall, 1889
Family Lepidochitonidae Iredale, 1914

Genus *Lepidochitona* Gray, 1821

Type species. *Chiton marginatus* Pennant, 1777 (= *Chiton cinereus* Linnaeus, 1767), by monotypy.

Genus distribution. Mediterranean Sea, northeastern Atlantic Ocean, Caribbean Sea and adjacent western Atlantic Ocean, Pacific coast near Central America, south Atlantic and Indian oceans

near South Africa and northwestern Indian Ocean. Eocene-Recent.

Lepidochitona cinerea (Linneus, 1767) (Figs 1A, 2–7)

Complete synonymy in Kaas, Van Belle [1985] and Dell'Angelo, Smriglio [2001].

Here I cite only the publications on the Black Sea.

Chiton marginatus.—Milachewitch, 1909a: 154; 1909b: 316; 1916: 142.

Lepidochitona cinerea.—Starobogatov, 1972: 64, pl. I, fig. 1; Kaas, Van Belle, 1985: 84, fig. 39, map 17; Anistratenko, Anistratenko, 2001: 46, fig. 14; Micu, 2004: 88; Bondarev, Revkov, 2017: 15.

Lepidochitona marginatus.—Jakovleva, 1952: 72, fig. 29, pl. 3, fig. 5.

Type material. In the Linnean Society of London.

Type locality. In O. Norvegico.

Material examined. More than 220 spms. **Norway Sea**, Tromsø Island, intertidal pool, about 100 spms (ZIN 2469) BL 3.0–15.0 mm, 16.05.1995; **North Sea**, Helgoland Islands, 5 spms (ZIN 209), BL (9.0–10.0 mm); **Baltic Sea**, Store Belt, 4 spms (ZIN 208), BL 8.0–15.0 mm; **Mediterranean Sea**, 4 spms (ZIN 211), BL 3.0–7.0 mm; **Aegean Sea**, Smirna, 1 spm (ZIN 215) BL 3.0; **Marmara Sea**, Prinkipo, 15 spms (ZIN 216), BL 3.0–5.0 mm; **Black Sea**, Northwest of the Black Sea, Karkinitkiy Bay, 45°40'N, 32°08'E, 33 m, 1 spm, BL 7.0 mm, 23.09.1981; 45°32'N, 32°13'E, 38 m, 1 spm, BL 9.0 mm, 06.06.1981; 45°31'N, 32°12'E, 38 m, 1 spm, BL 7.0 mm, 23.09.1981; 45°38'N, 32°45'E, 22 m, 5 spms, BL 2.0–5.0 mm, 30.08.1981; 46°00'3"N, 32°28'01"E, 15 m, muddy sand with shells, 4 spms, BL 5.1–9.2 mm, 16.10.1979; 46°00'00"N, 32°27'5"E, 14–15 m, muddy sand with shells, 1

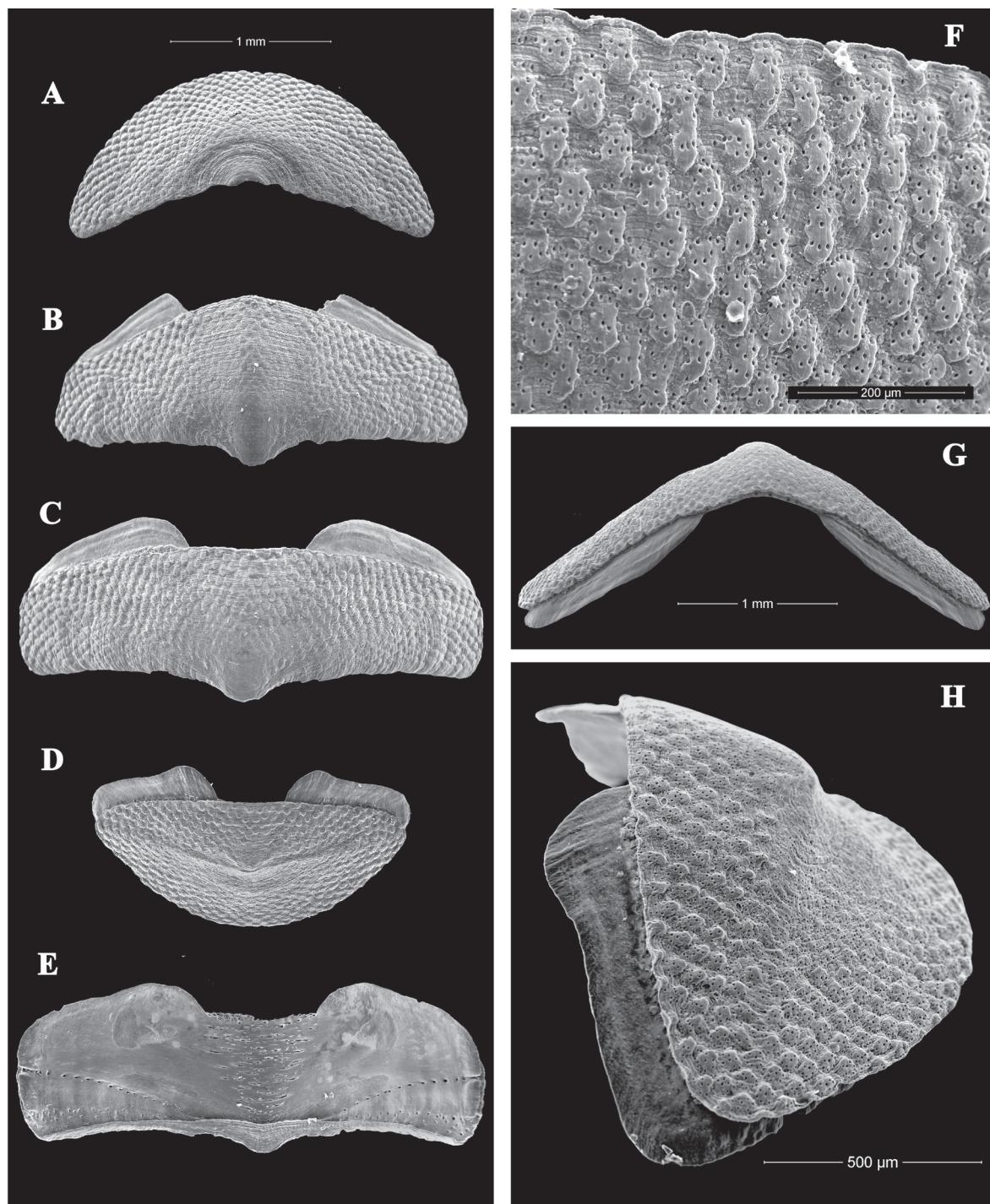


FIG. 2. *Lepidochitona cinerea*, Black Sea, Crimea Peninsula, near Balaklava Bight (ZIN 217), BL 5.5 mm. A. Head valve, dorsal view. B. Valve II, dorsal view. C. Valve IV, dorsal view. D. Valve VIII, dorsal view. E. Valve V, ventral view. F. Valve IV, tegmentum sculpture in central area. G. Valve IV, frontal view. H. Valve VIII, lateral view.

РИС. 2. *Lepidochitona cinerea*, Черное море, Крымский полуостров у Балаклавской бухты, (ZIN 217) BL 5,5 мм. А. Головной щиток, вид сверху. В. Щиток II, вид сверху. С. Щиток IV, вид сверху. Д. Щиток VIII, вид сверху. Е. Щиток V, вид снизу. Ф. Щиток IV, скульптура тегментума на центральном поле. Г. Щиток IV, вид спереди. Н. Щиток VIII, вид сбоку.

spm, BL 3.5 mm, 18.10.1979; Crimea Peninsula, Sevastopol Bight, 4 spms, (ZISP 240), BL 3.8–6.7 mm; Golubaja Bight, 4–6 m, 1 spm, BL 5.0 mm, 12.08.2015; Omega Bight, 2–3 m, on *Rapana venosa*, 2 spms, BL 3.0–3.5 mm, 11.08.2015; Omega Bight, 2–3 m, on *Rapana venosa*, 3 spms, BL 3.0–4.5 mm, June, 2015; Omega Bight, 2–3 m, on *Rapana venosa*, 1 spm, BL 6.5 mm, 2014; near Balaklava Bight, 43 spms (ZIN

217), BL 2.0–5.5 mm; Kazachja Bicht, 11–12 m, 7 spms, BL 4.5–8.0 mm, 26.05.1977; Kara Dag, 3 m, on *Rapana venosa*, 2 spms, BL 4.0–8.0 mm, 15.07.2004 near Alupka, 44°24'20"N, 34°03'20"E, 14.6 m, sand with shells, 1 spm (ZIN 226), BL 3.5 mm, August, September 1909; East of the Black Sea, northwest of Anapa, 44°56'45"N, 37°00'15"E, 31 m, on small shells, 13 spms (ZIN 220), BL 2.5–5.0 mm, May, 1910.

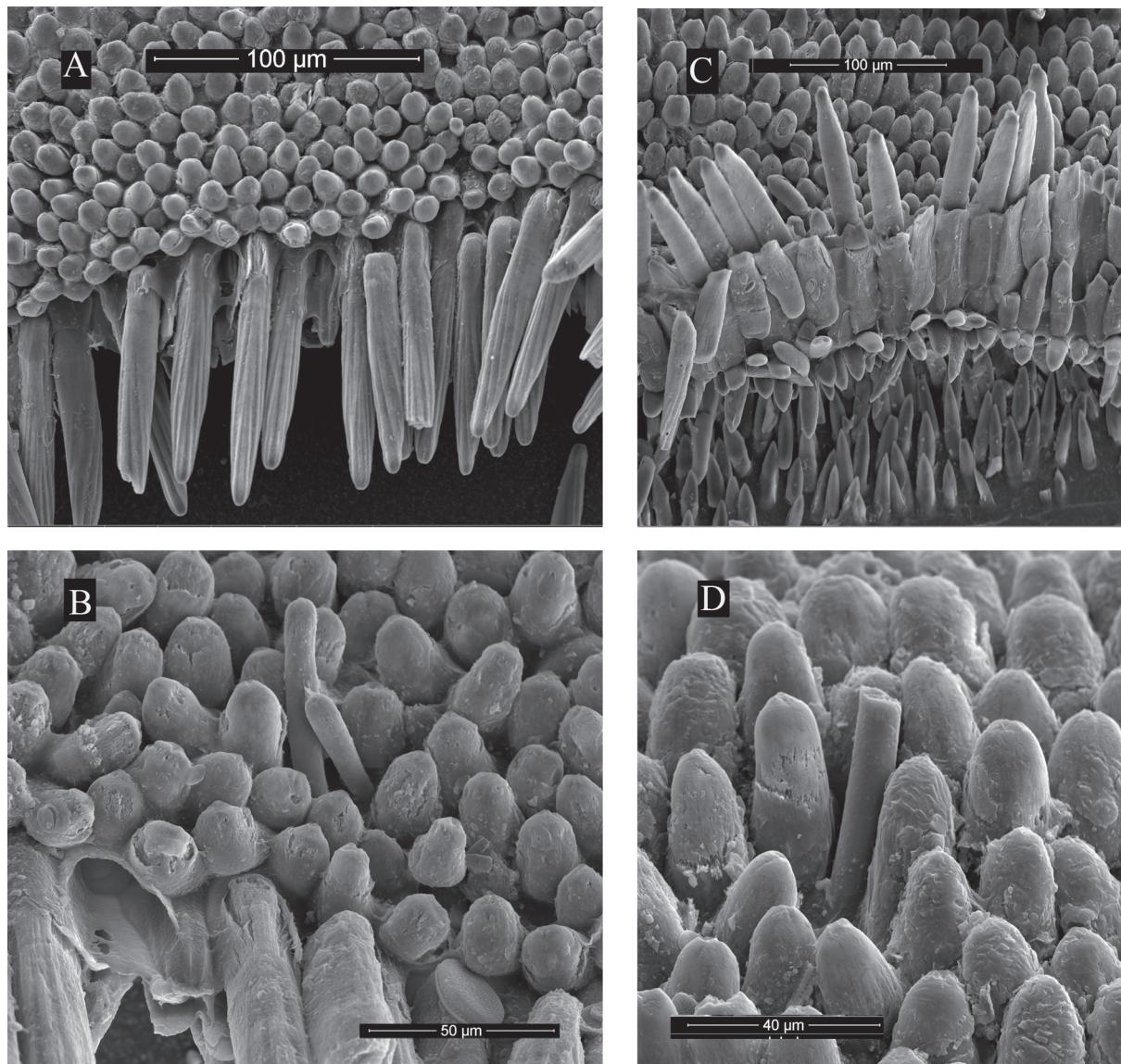


FIG. 3. *Lepidochitona cinerea*, Black Sea, Crimea Peninsula, near Balaklava Bight (ZIN 217), BL 5.5 mm. A. Dorsal spicules and marginal needles. B. Dorsal spicules and needles, and marginal needles. C. Dorsal spicules, marginal needles and ventral scales. D. Dorsal spicules and needle.

РИС. 3. *Lepidochitona cinerea*, Черное море, Крымский полуостров у Балаклавской бухты, (ZIN 217) BL 5,5 мм. А. Дорсальные спикулы и маргинальные иглы. В. Дорсальные спикулы и иглы, и маргинальные иглы. С. Дорсальные спикулы, маргинальные иглы и вентральные чешуйки. Д. Дорсальные спикулы и игла.

Distribution. Eastern Atlantic from Norwegian coast (Tromsö) to northwestern coast of Morocco including Norwegian, North, west Baltic, Mediterranean, Aegean, Marmara and Black seas. Reports of findings of this species off the eastern and western shores of North America [Kaas, Van Belle, 1985] are most likely based on misidentifications.

Diagnosis. Chiton usually of small size, up to 16.0 mm, rarely up to 25.0 mm, color of tegumentum very variable from completely orange, flesh-colored, red or sandy to light brown with white, orange or dark brown spots; valves subcarinated, little beaked, slightly elevated (dorsal elevation 0.30–0.44), mucro anterior (ratio of length of postmucronal area

to length of antemucronal area 1.09–1.44). Head valve equal to tail valve or slightly larger than tail valve (ratio of width of head to width of tail valve 1.00–1.19). Tegmentum evenly sculptured all over with fine diamond-shaped granules arranged in quincunx patterns, each granule has 5–20 rounded and of about the same size pores of aesthetes. Slit formula 9–10/1/8–11. Girdle dorsally clothed with small, oblong, slightly bent, obtusely pointed calcareous corpuscles (60–90 µm); irregularly scattered among these occur slender, slightly bent needles (65–250 µm); marginal needles obliquely grooved on dorsal side in two directions (feather-like). Central tooth of radula tulip-shaped with a rounded blade; first lateral

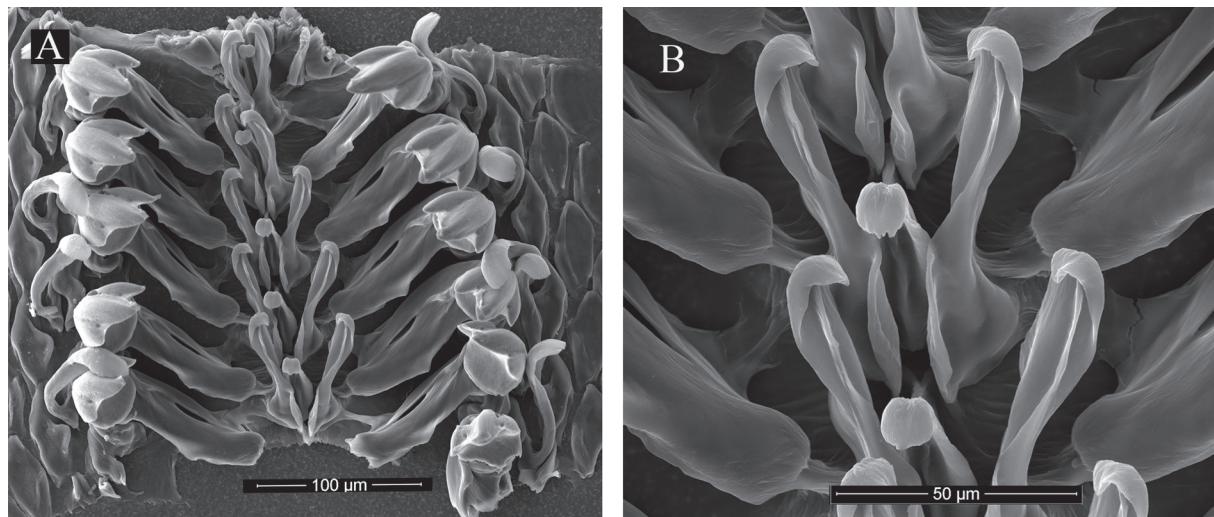


FIG. 4. *Lepidochitona cinerea*, Black Sea, Crimea Peninsula, near Balaklava Bight (ZIN 217), BL 5.5 mm. **A.** Radula. **B.** Central and first lateral teeth of radula.

РИС. 4. *Lepidochitona cinerea*, Черное море, Крымский полуостров у Балаклавской бухты, (ZIN 217) BL 5,5 мм. **A.** Радула. **B.** Центральные и первые латеральные зубы радулы.

Table 1. Comparison of some important features of shell of three species of *Lepidochitona* from the Mediterranean, North, Norwegian and Black seas.

Таблица 1. Сравнение некоторых важных признаков раковины трех видов *Lepidochitona* из Средиземного, Северного, Норвежского и Черного морей.

Species, locality and BL (mm)	Ratio of width of head to width of tail valve	Ratio of width of apophyse to width of jugal sinus in valve V	Ratio of length of tail valve to length of apophyse in tail valve	Ratio of length of postmucronal area to length of antemucronal area	Number of aesthetes in one granule
<i>Lepidochitona cinerea</i> , Mediterranean, North, and Norwegian seas, 5,0–14,5	1.10–1.31	1.32–2.16	3.50–3.71	1.09–1.44	7–20
<i>L. cinerea</i> , Black Sea, 4.8–7.0	1.00–1.16	1.32–1.84	3.80–4.89	1.00–1.08	5–15
<i>L. caprearum</i> , Mediterranean Sea, 7.0–12,5	1.40–1.45	1.35–1.87	1.50–1.63	1.00–1.14	16–20
<i>L. bondarevi</i> n. sp., Black Sea, 4.7–9.5	1.16–1.38	1.21–1.87	2.81–3.70	1.42–2.17	7–15

tooth higher than central; major lateral tooth with tridentate cusp, median denticle somewhat larger than the others. From eleven to sixteenth gills arranged from valve III to valve VII.

Remarks. The Black Sea representatives of this species differ from specimens from other parts of the range by small body size (BL up to 9.2 mm), shorter apophyses of the tail valve, and shorter postmucronal areas (Table 1). Most individuals of this species from the Black Sea have smooth dorsal spicules, but sometimes there are specimens with very short grooves at the top of spicules, as in individuals from the Mediterranean Sea. Kaas and Van Belle [1985] do not mention these short grooves at top of dorsal spiculae in specimen from Netherlands.

According to Kaas and Van Belle [1985], *L. cinerea* inhabits from the intertidal to 50–70 m. In the Black Sea this species is found from 0.2 to 38 m.

Lepidochitona bondarevi sp. nov.
(Figs 1B, C, 8–16)

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Chiton polii.—Kowalevsky, 1883:1; Zernov, 1913: 245, part, non *Chiton polii* Philippi, 1836.

Chiton marginatus.—Milachewitch, 1916: 142, part, not *Chiton marginatus* Pennant, 1777.

Lepidochiton marginatus.—Jakovleva, 1952: 72, fig. 29, part, not *Chiton marginatus* Pennant, 1777.

Lepidochitona corrugata.—Kaas, Van Belle, 1985: 86, fig. 40,

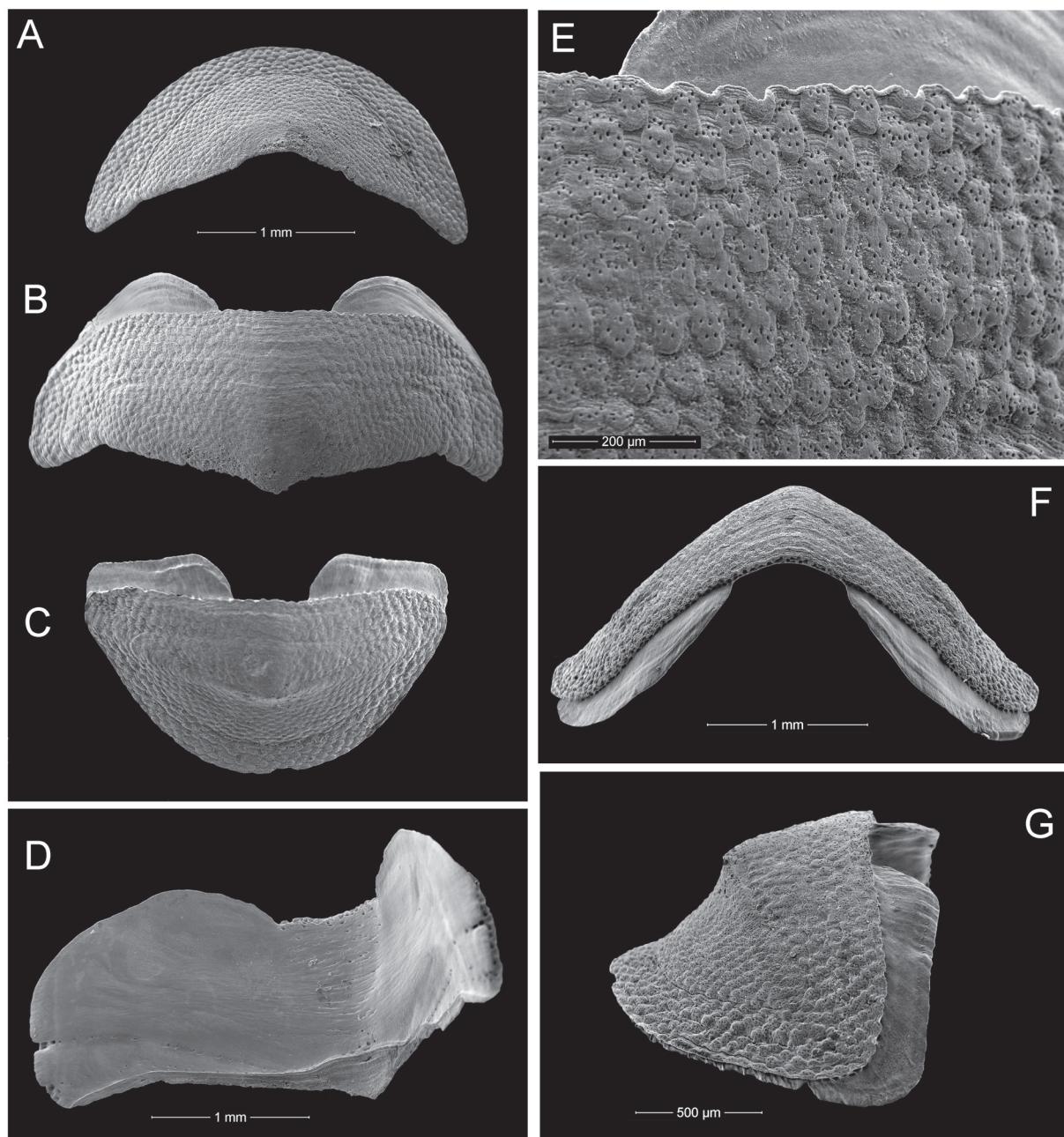


FIG. 5. *Lepidochitona cinerea*, Black Sea, Crimea Peninsula, Omega Bight, 2–3 m, BL 7.0 mm. A. Head valve, dorsal view. B. Valve V, dorsal view. C. Valve VIII, dorsal view. D. Valve IV, ventral view. E. Valve V, tegmentum sculpture in central area. F. Valve V, frontal view. G. Tail valve, lateral view.

РИС. 5. *Lepidochitona cinerea*, Черное море, Крымский полуостров, бухта Омега, 2–3 м, BL 7,0 мм. А. Головной щиток, вид сверху. Б. Пятый щиток, вид сверху. С. Хвостовой щиток, вид сверху. Д. Четвертый щиток, вид снизу. Е. Пятый щиток, скульптура тегментума на центральном поле. Ф. Пятый щиток, вид спереди. Г. Хвостовой щиток, вид сбоку.

map 19; Bondarev, Revkov, 2017: 15, part., not *Chiton corrugatus* Reeve, 1848.
Lepidochitona (Lepidochitona) caprearum.— Dell'Angelo, Smriglio, 2001: 143, pls 46–48, figs 73–76; Micu 2004:88, part, not *Chiton caprearum* Scacchi, 1836.
Lepidochitona caprearum.— Sirenko, 2015: 23; Teaca et al., 2010: 10, not *Chiton caprearum* Scacchi, 1836.

Type material. Holotype (ZIN 2470), and two paratypes (ZIN 2471, ZIN 2472), now disarticulated

consisting of SEM stub of valves I, V, VIII, part of perinotum and radula, mount of part of perinotum and radula and vial with other valves,

Type locality. Black Sea, Crimea Peninsula, Fiolent Cape, 44°29'55"N, 33°29'20"E, 0.2 m

Etymology. Named after Igor Bondarev (FRC IBSS), specialist of gastropods who helped me to collect chitons off Crimea Peninsula.

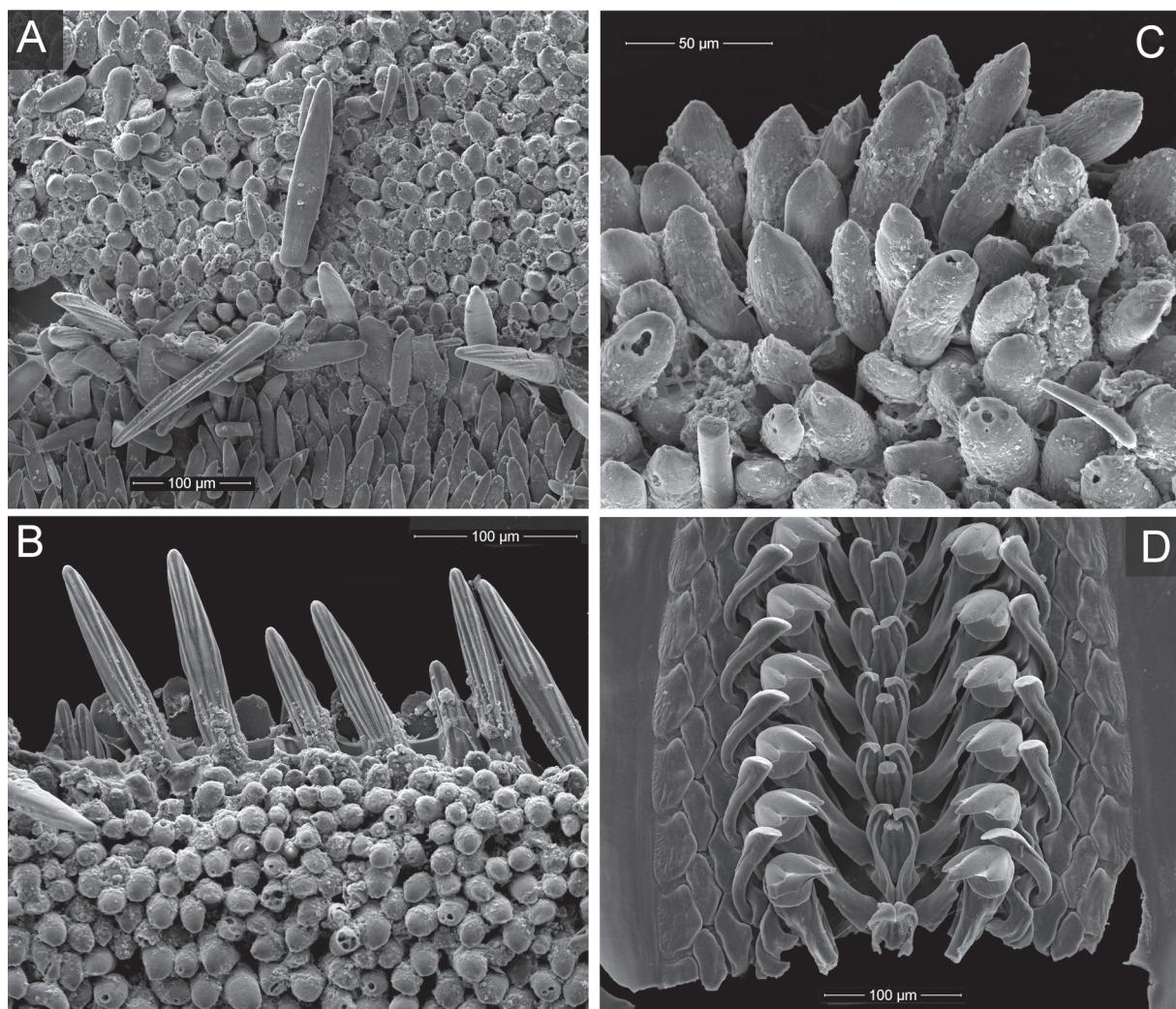


FIG. 6. *Lepidochitona cinerea*, Black Sea, Crimea Peninsula, Omega Bight, 2–3 m, BL 7.0 mm. A. Dorsal spicules, marginal needles and ventral scales. B. Dorsal spicules and marginal needles. C. Dorsal spicules and needles. D. Radula.

РИС. 6. *Lepidochitona cinerea*, Черное море, Крымский полуостров, бухта Омега, 2–3 м, BL 7,0 мм. А. Дорсальные спикулы, маргинальные иглы и вентральные чешуйки. В. Дорсальные спикулы и маргинальные иглы. С. Дорсальные спикулы и иглы. Д. Радула.

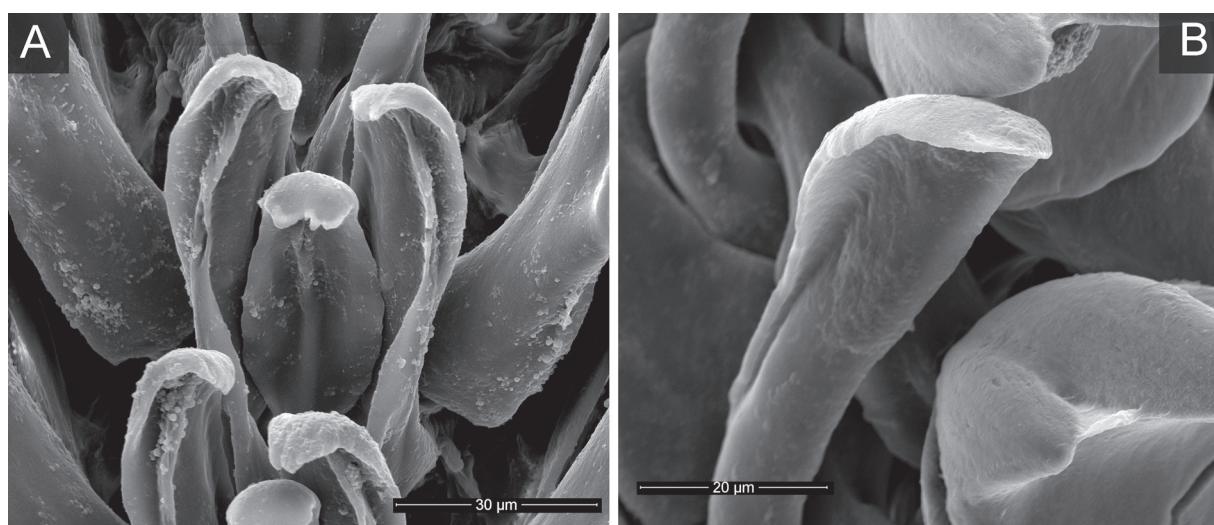


FIG. 7. *Lepidochitona cinerea*, Black Sea, Crimea Peninsula, Omega Bight, 2–3 m, BL 7.0 mm. A. Central and first lateral teeth of radula. B. Uncinal tooth of radula.

РИС. 7. *Lepidochitona cinerea*, Черное море, Крымский полуостров, бухта Омега, 2–3 м, BL 7,0 мм. А. Центральный и первый латеральный зубы радулы. В. Унцинальный зуб радулы.

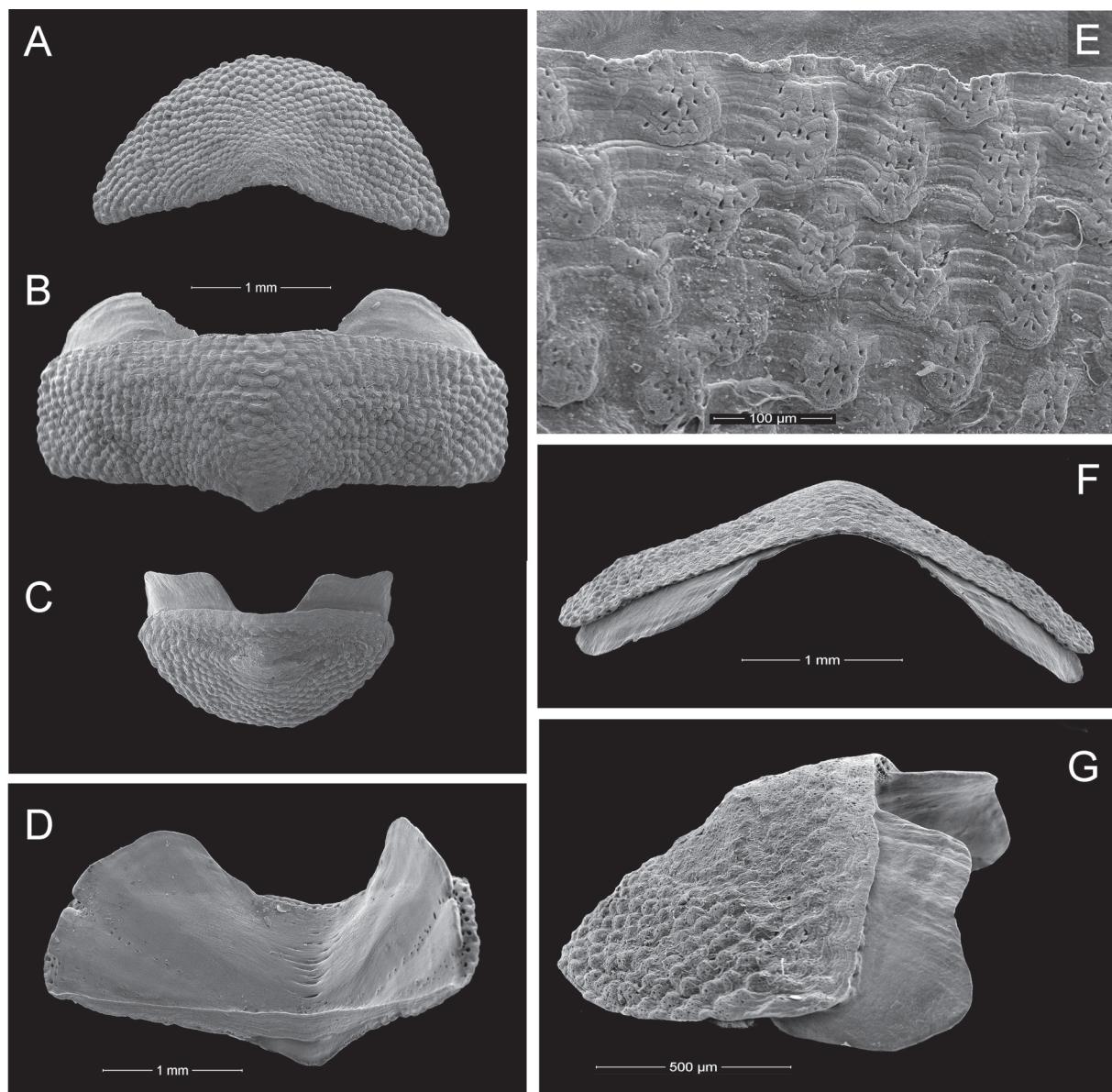


FIG. 8. *Lepidochitona bondarevi* sp. nov., Black Sea, Crimea Peninsula, Fiolent Cape, 0–0.2 m, holotype (ZIN 2470), BL 7.2 mm. A. Head valve, dorsal view. B. Valve V, dorsal view. C. Valve VIII, dorsal view. D. Valve IV, ventral view. E. Valve V, tegmentum sculpture in central area. F. Valve V, frontal view. G. Tail valve, lateral view.

РИС. 8. *Lepidochitona bondarevi* sp. nov., Черное море, Крымский полуостров, мыс Фиолент, 0–0,2 м, голотип (ZIN 2470), BL 7,2 мм. А. Головной щиток, вид сверху. В. Пятый щиток, вид сверху. С. Хвостовой щиток, вид сверху. Д. Четвертый щиток, вид снизу. Е. Пятый щиток, скульптура тегментума на центральном поле. Ф. Пятый щиток, вид спереди. Г. Хвостовой щиток, вид сбоку.

Material examined. More than 600 spms. All of the material listed here is stored in ZIN. **Black Sea**, Zmeinij Island, 45°15'18"N, 30°12'15"E, 0–3 m, 6 spms, BL 3.0–8.0 mm, 20.09.2003; **Crimea Peninsula**, Tarkhankut Cape, 45°20'52"N, 32°29'46"E, 0 m, stones, 1 spm, BL 5.0 mm, August 1969; Kazachja Bight, 1 m, on *Cystoseira* sp., 95 spms, BL 2.0–3.0 mm, 23.06.1971; Omega Bight, 20 m, on *Phyllophora* sp. 102 spms, BL 2.0–3.5 mm, 25.02.1971; Fiolent Cape, 0.5–1.5 m, holotype (ZIN 2470), 96 spms, BL 3.0–7.0 mm, 25.02.1984; Fiolent Cape, 0–0.2 m, 30 spms, BL 3.0–9.0 mm, 25.02.1984; Fiolent Cape, 2.0–4.0 m, stones, 87 spms, BL 4.0–6.0 mm, 02.05.1984; Fiolent Cape, 0.3–0.7 m, stones, 25 spms, BL 3.0–7.0 mm, 02.05.1984; Fiolent Cape, 0.5–1.5 m, 26 spms, BL 3.0–7.0 mm, 22.05.1987; Fiolent Cape, 1–3 m, 46 spms, BL 3.0–8.0 mm, 21.05.1990; Golubaja Bight, 4–6

mm, on *Rapana venosa*, paratype (ZIN 2471), BL 5.5 mm, 6 spms, BL 2.0–6.0 mm, 12.08.2015; Omega Bight, 1–1.5 m, 50 spms, BL 4.0–8.0 mm, 11.02.1984; Kamishovaja Bight, 1.0 m, 1 spm, BL 5.0 mm, April, 1984; Kazachja Bicht, 11–12 m, 1 spm, BL 5.0 mm, 26.05.1977; Streletskaia Bight, 0.3 m, paratype (ZIN 2472), 28 spms, BL 3.0–5.5 mm, 17.09.2018; Streletskaia Bight, 0 m, 7 spms, BL 4.0–12.0 mm, 17.09.2018; Laspi Bight, 44° 25' 43" N, 33° 42' 39.2" E, 5 m, on *Phyllophora*, 6 spms, BL 3.5–4.0 mm, June 1992; Yalta Bight, 10–12 m, 3 spms (ZIN 229), BL 4.5–7.0 mm, March, 1870; Kara Dag, 2–6 m, on *Rapana venosa*, 73 spms, BL 3.0–6.5 mm, 27.08.1998; Kara Dag, 3 m, on *Rapana venosa*, 8 spms, BL 4.0–8.0 mm, 15.07.2004; **Novorossijskaja Bight**, 3 m, on *Zostera* sp., 1 spm, BL 5.0 mm, 06.1870; **Gelendjik**, 0.2 m, 12 spms, BL 2–4 mm, October 2015; **Sukhum Bight**, 0.5–2.5

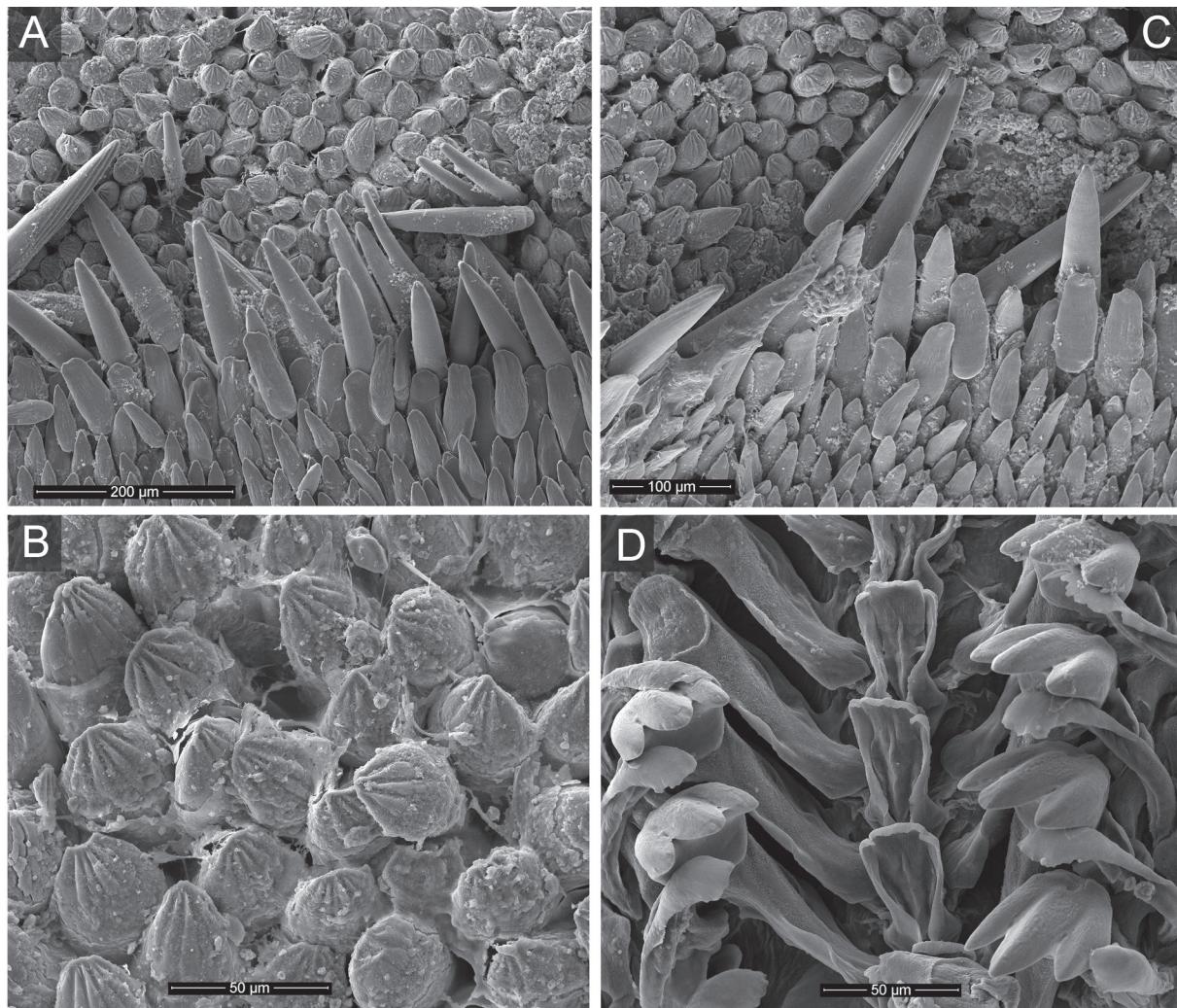


FIG. 9. *Lepidochitona bondarevi* sp. nov., Black Sea, Crimea Peninsula, Fiolent Cape, 0–0.2 m, holotype (ZIN 2470), BL 7.2 mm. **A.** Dorsal spicules and needles, marginal needles and ventral scales. **B.** Dorsal spicules. **C.** Dorsal spicules, marginal needles and ventral scales. **D.** Radula.

РИС. 9. *Lepidochitona bondarevi* sp. nov., Черное море, Крымский полуостров, мыс Фиолент, 0–0,2 м, голотип (ZIN 2470), BL 7,2 мм. **А.** Дорсальные спикулы и иглы, маргинальные иглы и вентральные чешуйки. **Б.** Дорсальные спикулы. **С.** Дорсальные спикулы, маргинальные иглы и вентральные чешуйки. **Д.** Радула.

m, 1 spm (ZIN 235), BL 8.2 mm, May, June, 1876; **Batum Port**, 0-7,3 m 1 spm (ZIN 222), BL 10.0 mm, May, 1910; **Marmara Sea**, Istanbul, 3 spms (ZIN 213), BL 2.0–3.5 mm.

Distribution. Black Sea from the Romanian coast and Zmeinij Island in the northwest, along the entire Crimean Peninsula, and to the port of Batum, as well as the Sea of Marmara, at depths from 0 to 20 m (more often found from 0 to 1 m).

Diagnosis. Chiton small, up to 8.0 mm, rarely up to 10-12 mm, color of tegument very variable, usually rose blotched with brown, black and blue patches in different, symmetrical patterns, head valve significantly wider than tail valve (Table 1), valves subcarinated, little beaked, slightly elevated, postmucronal area long, mucro anterior. Tegumentum all over evenly covered with round or oval granules arranged in irregular quincunx pattern, each granule

with about 7–15 pores of aesthetes. Slit formula 8/1/10. Girdle dorsally clothed with small, slightly flattened, pointed spicules with 7–8 longitudinal grooves around their upper half; tufts of long, bent, smooth needles scattered between the spicules. Upper part of first lateral teeth of radula is not higher than blade of central teeth. Eleven gills per side in holotype, arranged between valve IV and VII.

Description. Holotype small, BL 7.2 mm, elongate oval. Shell lowly elevated (dorsal elevation in valve V 0.26), back subcarinated, valves with side slopes weakly convex, little beaked. color of tegument olive with narrow longitudinal brown and blue spots usually rose blotched with brown, black and green patches in different, symmetrical patterns.

Head valve semicircular, significantly wider than tail one (ratio of width of head to width of tail valve

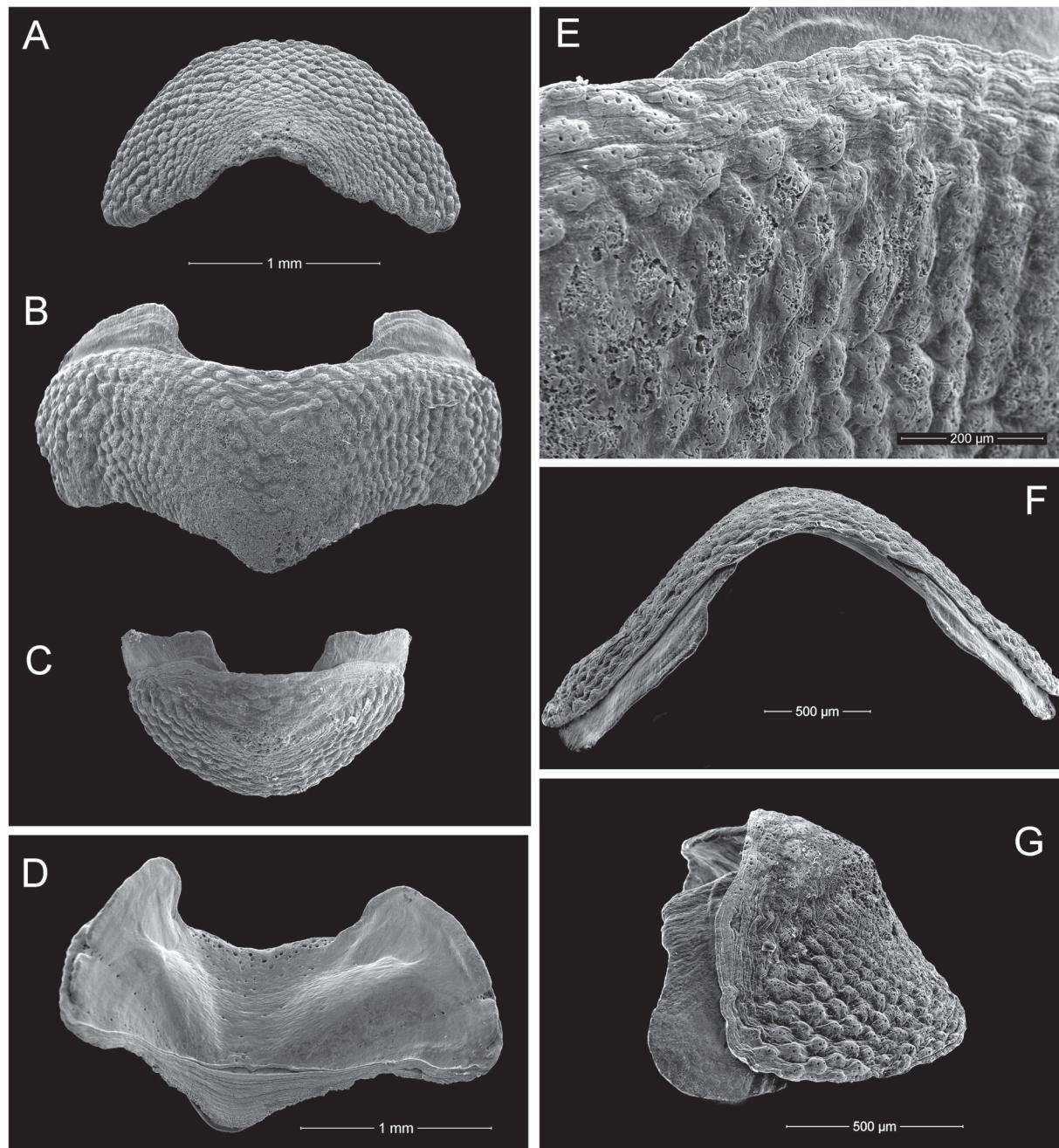


FIG. 10. *Lepidochitona bondarevi* sp. nov., Black Sea, Crimea Peninsula, Golubaya Bight, 4–6 m, paratype (ZIN 2471), BL 5.5 mm. A. Head valve, dorsal view. B. Valve V, dorsal view. C. Valve VIII, dorsal view. D. Valve IV, ventral view. E. Valve V, tegmentum sculpture in central area. F. Valve V, frontal view. G. Tail valve, lateral view.

РИС. 10. *Lepidochitona bondarevi* sp. nov., Черное море, Крымский полуостров, Голубая бухта, 4–6 м, параптип (ZIN 2471), BL 7,2 мм. А. Головной щиток, вид сверху. В. Пятый щиток, вид сверху. С. Хвостовой щиток, вид сверху. Д. Четвертый щиток, вид снизу. Е. Пятый щиток, скульптура тегментума на центральном поле. Ф. Пятый щиток, вид спереди. Г. Хвостовой щиток, вид сбоку.

1.38) posterior margin widely V-shaped, intermediate valves broadly rectangular, front margin anteriorly elevated in valve II, little convex in valves III–VII, hind margin concave at both sides of the prominent apex, lateral areas weakly raised, side margins rounded. Tail valve with short antemucronal area, mucro anterior, ratio of length of postmucronal area to length of antemucronal area 1.68, postmucronal slope slightly convex.

Tegmentum all over evenly covered with round or oval granules arranged in irregular quincunx pattern, eventually forming more or less longitudinal rows in pleural areas of intermediate valves and flexuous rows in other areas of valves, each granule with about 7–15 pores of aesthetes.

Articulamentum well developed, white. Apophyses broad and rather long (ratio of length of tail valve to length of apophysis in tail valve 2.81), triangular

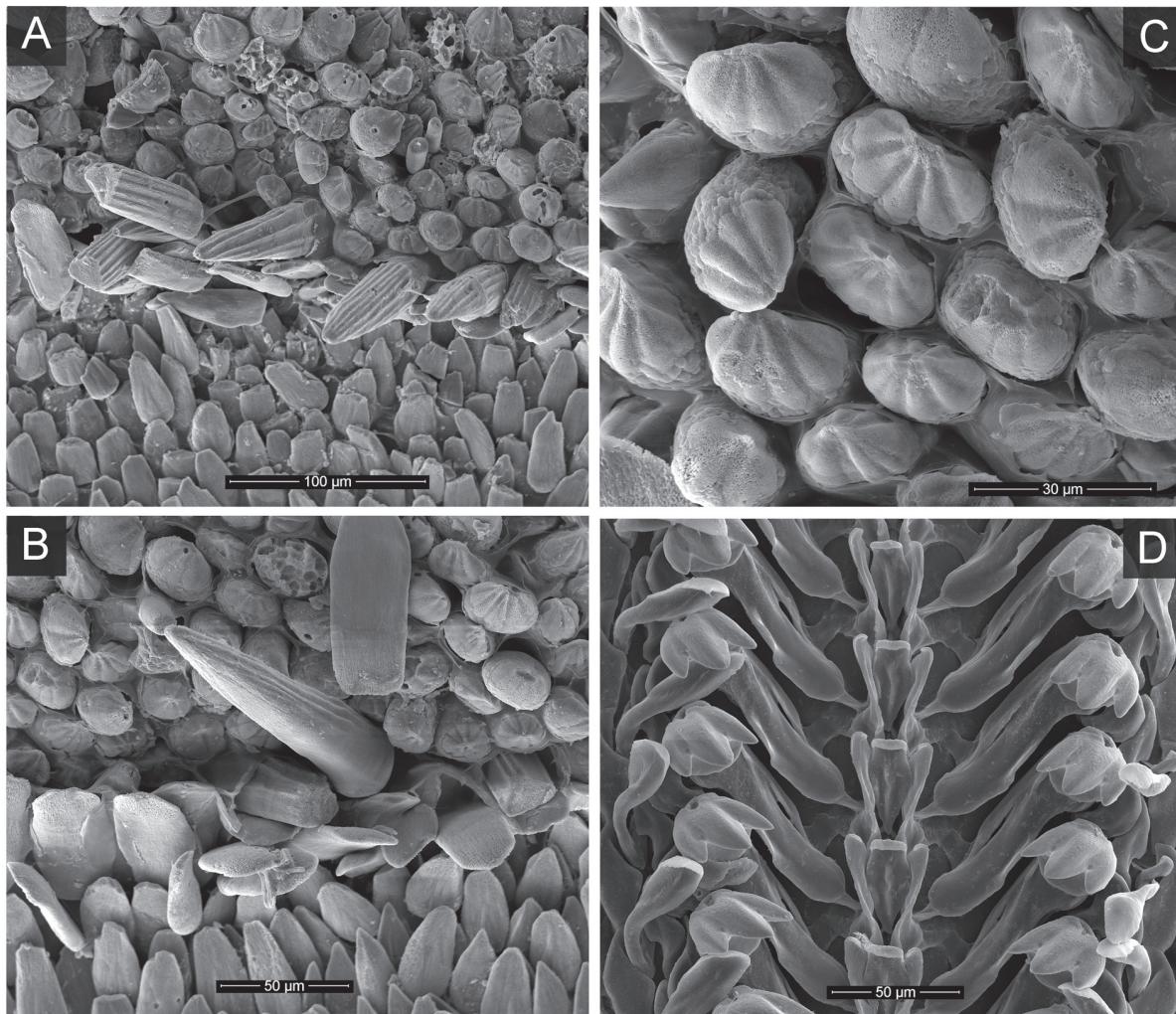


FIG. 11. *Lepidochitona bondarevi* sp. nov., Black Sea, Crimea Peninsula, Golubaya Bight, 4–6 m, paratype (ZIN 2471), BL 5.5 mm. **A, B.** Dorsal spicules and needles, marginal needles and ventral scales; **C.** Dorsal spicules. **D.** Radula.

РИС. 11. *Lepidochitona bondarevi* sp. nov., Черное море, Крымский полуостров, Голубая бухта, 4–6 м, паратип (ZIN 2471), BL 5,5 мм. **A, B.** Дорсальные спикулы и иглы, маргинальные иглы и вентральные чешуйки. **C.** Дорсальные спикулы. **D.** Радула.

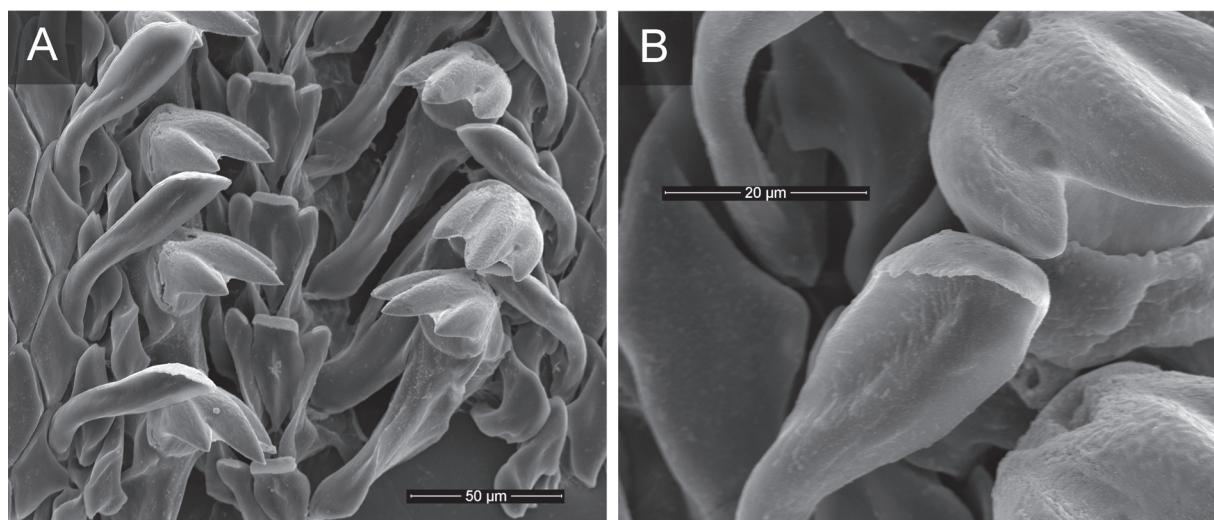


FIG. 12. *Lepidochitona bondarevi* sp. nov., Black Sea, Crimea Peninsula, Golubaya Bight, 4–6 m, paratype (ZIN 2471), BL 5.5 mm. **A.** Radula; **B.** Major lateral and major uncinal teeth of radula.

РИС. 12. *Lepidochitona bondarevi* sp. nov., Черное море, Крымский полуостров, Голубая бухта, 4–6 м, паратип (ZIN 2471), BL 5,5 мм. **A.** Радула. **B.** Большой унцинальный и большой латеральный зубы радулы.

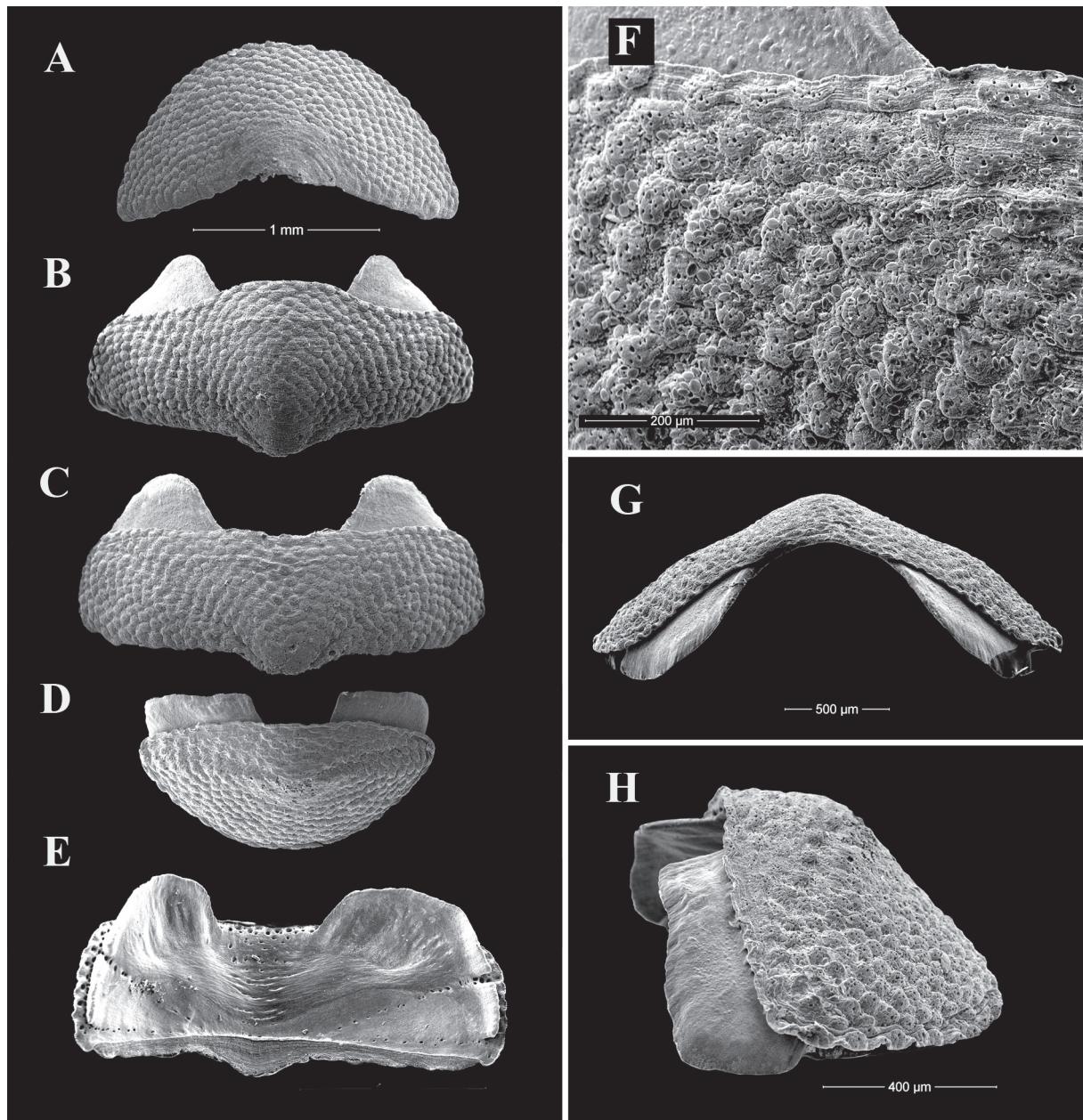


FIG. 13. *Lepidochitona bondarevi* sp. nov., Black Sea, Crimea Peninsula, Streletska Bay, 0.3 m, paratype (ZIN 2472), BL 4.7 mm. **A.** Head valve, dorsal view. **B.** Valve II, dorsal view. **C.** Valve IV, dorsal view. **D.** Valve VIII, dorsal view. **E.** Valve V, ventral view. **F.** Valve IV, tegmentum sculpture in central area. **G.** Valve IV, frontal view. **H.** Valve VIII, lateral view.

РИС. 13. *Lepidochitona bondarevi* sp. nov., Черное море, Крымский полуостров, Стрелецкая бухта, 0,3 м, паратип (ZIN 2472), BL 4,7 мм. А. Головной щиток, вид сверху. В. Щиток II, вид сверху. С. Щиток IV, вид сверху. Д. Щиток VIII, вид сверху. Е. Щиток V, вид снизу. Ф. Щиток IV, скульптура тегментума на центральном поле. Г. Щиток IV, вид спереди. Н. Щиток VIII, вид сбоку.

in valve II, broadly rounded in other intermediate valves and trapezoid in tail valve, with concave front edge, insertion plates short, wide, slit formula 8/1/10, slits narrow, slit rays present on all valves, very fine, eaves narrow, porous.

Girdle narrow, colored in alternating bands of olive and white, dorsally covered with small, slightly flattened and bent, pointed spicules ($55 \times 31 \mu\text{m}$) with 7–8 longitudinal furrows around them in upper half of spicules; tufts of 1–4 long, bent, smooth needles

(up to $260 \times 25 \mu\text{m}$) scattered between the spicules, Marginal fringe formed by stout, longitudinally ribbed in dorsal side, sharply pointed needles ($170 \times 33 \mu\text{m}$). Ventral part of girdle with two kinds of scales: one row of sharply pointed scales ($100 \times 25 \mu\text{m}$) along margin and sharply pointed scales ($60 \times 21 \mu\text{m}$) in other part of hyponotum.

Radula of holotype 2.0 mm long with 27 rows of mature teeth. Central tooth short, tulip-shaped with a wide, straight blade, Upper part of first lateral teeth

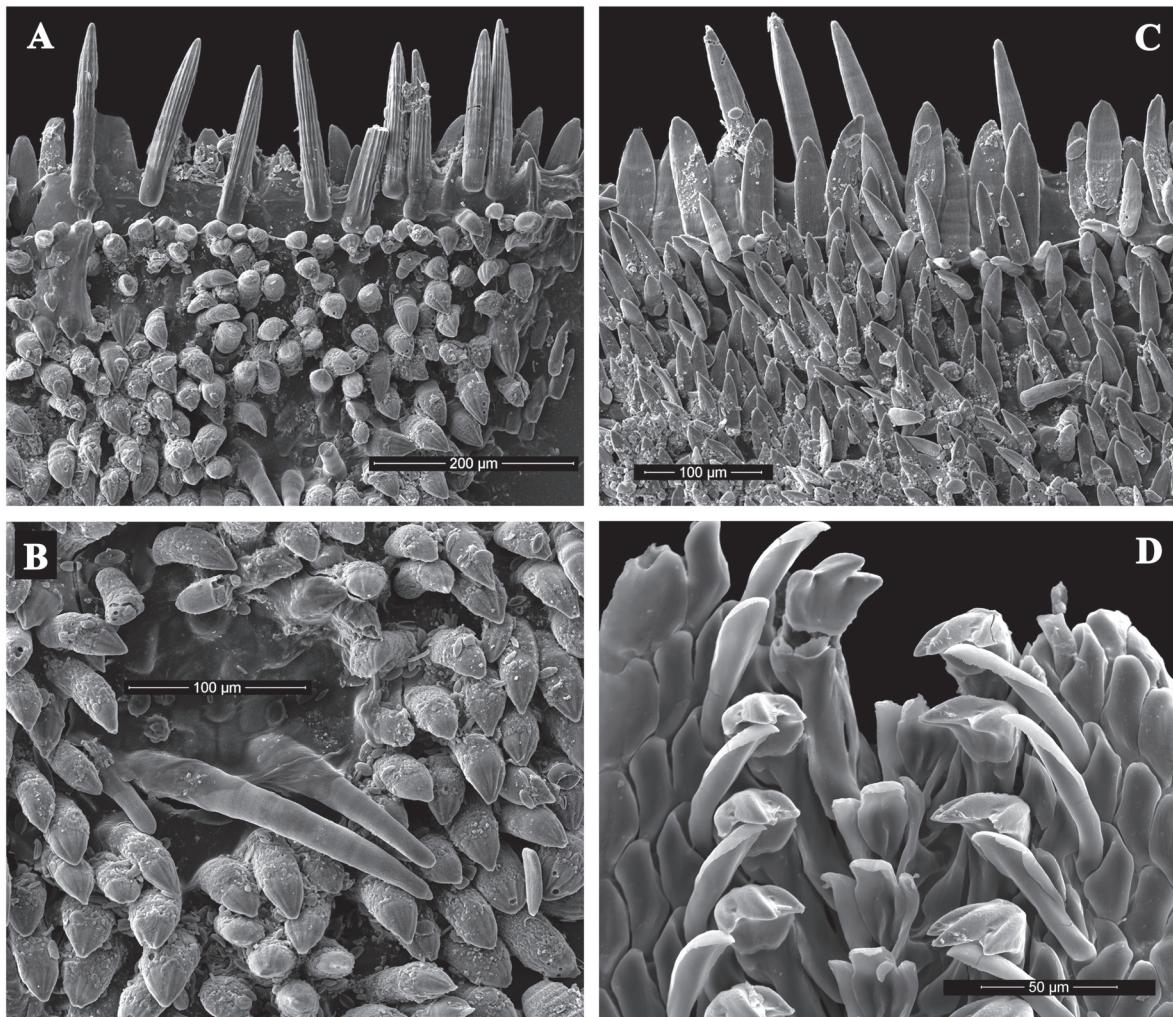


FIG. 14. *Lepidochiton bondarevi* sp. nov., Black Sea, Crimea Peninsula, Streletska Bay, 0.3 m, paratype (ZIN 2472), BL 4.7 mm. **A.** Dorsal spicules, marginal needles and ventral scales; **B.** Dorsal spicules and needles; **C.** Ventral scales and marginal needles; **D.** Radula.

РИС. 14. *Lepidochiton bondarevi* sp. nov., Черное море, Крымский полуостров, Стрелецкая бухта, 0,3 м, паратип (ZIN 2472), BL 4,7 мм. **А.** Дорсальные спикулы, маргинальные иглы и вентральные чешуйки. **Б.** Дорсальные спикулы и иглы. **С.** Вентральные чешуйки и маргинальные иглы. **Д.** Радула.

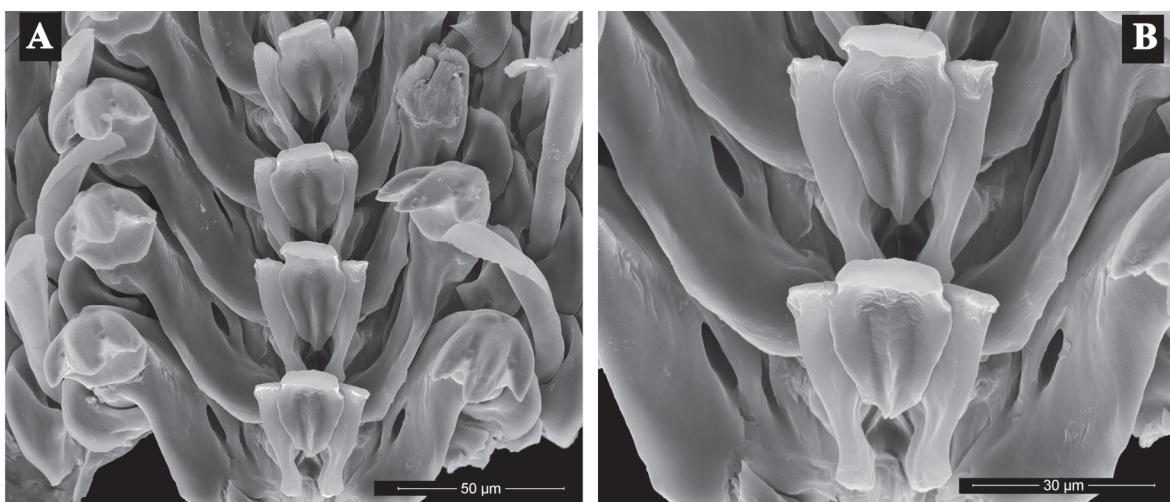


FIG. 15. *Lepidochiton bondarevi* sp. nov., Black Sea, Crimea Peninsula, Streletska Bay, 0.3 m, paratype (ZIN 2472), BL 4.7 mm. **A.** Radula. **B.** Central and first lateral teeth of radula.

РИС. 15. *Lepidochiton bondarevi* sp. nov., Черное море, Крымский полуостров, Стрелецкая бухта, 0,3 м, паратип (ZIN 2472), BL 4,7 мм. **А.** Радула. **В.** Центральные и первые латеральные зубы радулы.

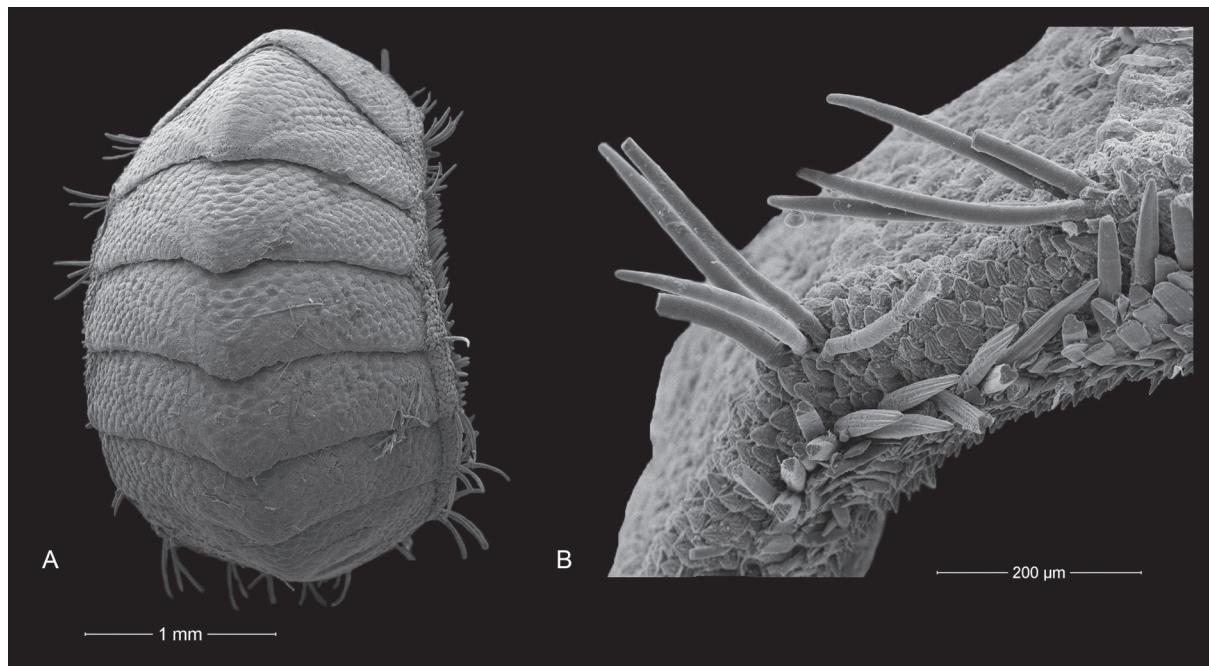


FIG. 16. *Lepidochitona bondarevi* sp. nov., Black Sea, Gelendjik, 0.3 m, BL 4.0 mm. A. Whole specimen, dorsal view. B. Dorsal spicules, tuft of dorsal needles, marginal needles and ventral scales.

РИС. 16. *Lepidochitona bondarevi* sp. nov., Черное море, Крымский полуостров, Стрелецкая бухта, 0,3 м, BL 4,0 мм. А. Целый экземпляр, вид сверху. В. Дорсальные спикулы, пучок дорсальных игл, маргинальные иглы и вентральные чешуйки.

of radula is not higher than top of central teeth, major lateral teeth with tridentate cusps, central denticle slightly larger.

Holotype has 11 long gills per side arranged from valve IV to valve VII.

Remarks. Intraspecific variability in the new species is noticeably expressed in the ratios of different parts of the shell valves (Table 1). The values of ratios of different parts of the valves overlap in some cases, which does not always allow them to be used. However, a number of features of the shell, perinotum, and radula support the opinion that this is definitely a new species. The following characters distinguish the new species from the second Black Sea species of this genus, *Lepidochitona cinerea*, which is often found in the same biotopes with the new species. *L. bondarevi* sp. nov. differs from *L. cinerea* in having head valve noticeably wider than tail valve (ratio of width of head to width of tail valve 1.16–1.38 in *L. bondarevi* sp. nov. and 1.00–1.16 in *L. cinerea* from the Black Sea); lower ratio of length of tail valve to length of apophysis in tail valve (2.81–3.70), (vs. 3.80–4.89 in *L. cinerea* from the Black Sea); longer postmucronal area than antemucronal area (ratio of length of postmucronal area to length of antemucronal area 1.42–2.17, vs. 1.00–1.08 in *L. cinerea* from the Black Sea); 7–8 longitudinal grooves around dorsal spicules in upper half of them (vs. no grooves or 1–2 very short grooves on the top of spicule in *L. cinerea* from the Black Sea); the first lateral teeth never rise above the top of the central tooth (vs. the

first teeth always rise above the top of the central tooth in *L. cinerea*). Additionally, new species has longer apophyses than *L. cinerea* (Table 1).

The new species is closest morphologically to five other species inhabiting the Mediterranean Sea and the eastern Atlantic coast, namely *L. caprearum* (Scacchi, 1836), *L. monterosatoi* Kaas, Van Belle, 1981, *L. piceola* (Shuttleworth, 1853), *L. canariensis* (Thiele, 1909), and *L. granpoderi* Dell'Angelo, Sirenko, Anseeuw, 2022

The main differences of *L. bondarevi* sp. nov. from *L. caprearum* (Figs 17–19) are the following: ratio of width of head to width of tail valve 1.16–1.38 (vs. 1.40–1.45 in *L. caprearum*), ratio of length of tail valve to length of apophysis in tail valve 2.81–3.70 (vs. 1.50–1.63 in *L. caprearum*), ratio of length of postmucronal area to length of antemucronal area 1.42–2.17 (vs. 1.00–1.14 in *L. caprearum*), dorsal spicules have 7–8 longitudinal grooves around their upper half (vs. 16–18 sharp, longitudinal ribs around spicule in *L. caprearum*). The number of aesthetes on the tegmental granules 7–15 (vs. 16–20 in *L. caprearum*). Moreover the new species has smooth dorsal needles (vs. ribbed dorsal needles in *L. caprearum*).

L. bondarevi sp. nov. differs from *L. monterosatoi* by having grooves in pointed dorsal girdle spicules (vs. spicules somewhat pitted at the round top in *L. monterosatoi*), smooth dorsal needles (vs. finely longitudinally grooved needles in *L. monterosatoi*), front margin of apophyses in tail valve concave (vs. straight in *L. monterosatoi*)

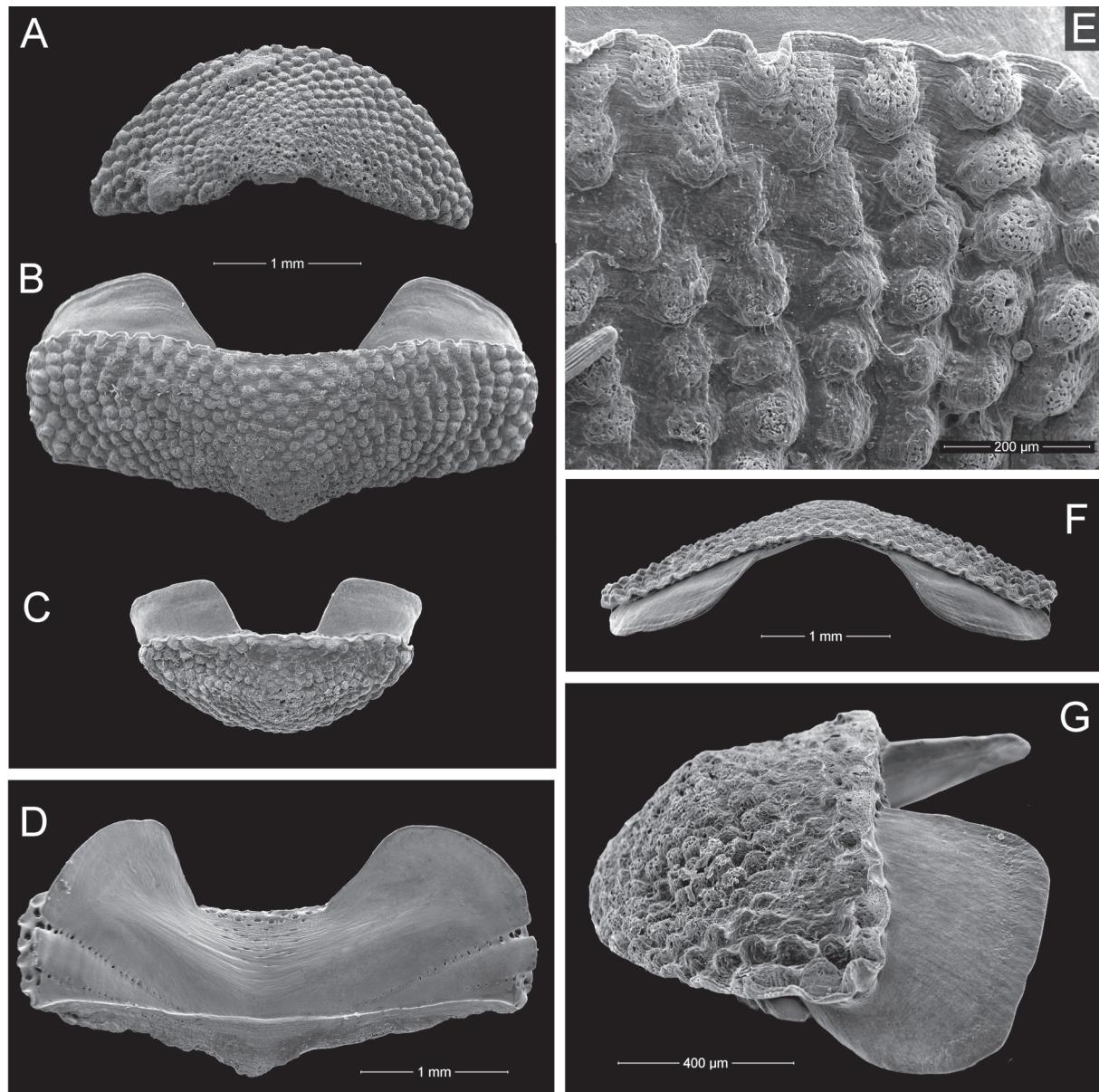


FIG. 17. *Lepidochitona caprearum*, Mediterranean Sea, Capri Island, intertidal, on rocks, BL 8.0 mm. A. Head valve, dorsal view. B. Valve II, dorsal view. C. Valve IV, dorsal view. D. Valve VIII, dorsal view. E. Valve V, ventral view. F. Valve IV, tegmentum sculpture in central area. G. Valve IV, frontal view. H. Valve VIII, lateral view.

РИС. 17. *Lepidochitona caprearum*, Средиземное море, остров Капри, литораль, на камнях, BL 4,7 мм. А. Головной щиток, вид сверху. В. Щиток II, вид сверху. С. Щиток IV, вид сверху. Д. Щиток VIII, вид сверху. Е. Щиток V, вид снизу. Ф. Щиток IV, скульптура тегментума на центральном поле. Г. Щиток IV, вид спереди. Н. Щиток VIII, вид сбоку.

The new species differs from *L. piceola* by having subcarinated valves (vs. regularly rounded in *L. piceola*), slightly convex front margin (vs. regularly concave front margin in *L. piceola*).

L. bondarevi sp. nov. differs from *L. canariensis* by having pointed spicules with 7–8 longitudinal grooves around them in upper half of spicules (vs. oval spicules on a narrow, striated base embedded in the girdle tissue in *L. canariensis*), postmucronal slope slightly convex (vs. postmucronal slope concave in *L. canariensis*).

The new species differs from *L. granpoderi* in that the upper part of the first lateral teeth of radula is not higher than the blade of the central teeth (vs. the upper part of the first lateral teeth of radula is noticeably higher than the blade of the central teeth in *L. granpoderi*) and in that the pores of aesthetes are located only on the granules (vs. the pores of the aesthetes are located on and between the granules in *L. granpoderi*).

The new species often behaves like a true phytophilic species. Young individuals with body length

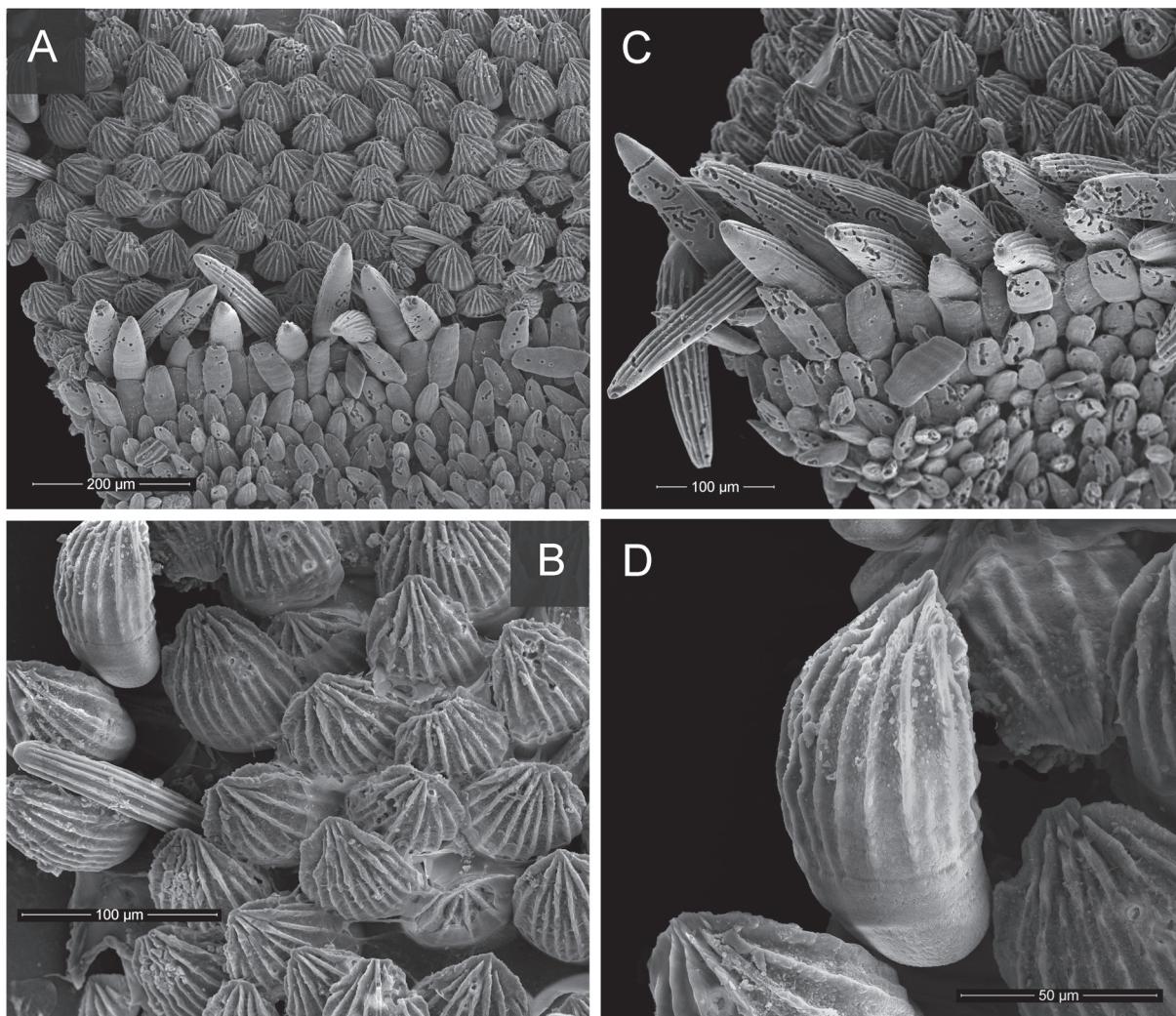


FIG. 18. *Lepidochitona caprearum*, Mediterranean Sea, Capri Island, intertidal, on rocks, BL 8.0 mm. **A.** Dorsal spicules and dorsal ribbed needles, marginal needles and ventral scales. **B.** Dorsal spicules and dorsal ribbed needle. **C.** Dorsal spicules, marginal needles and ventral scales. **D.** Dorsal spicules.

РИС. 18. *Lepidochitona caprearum*, Средиземное море, остров Капри, литораль, на камнях, BL 8,0 мм. **А.** Дорсальные спикулы и дорсальные ребристые иглы, маргинальные иглы и вентральные чешуйки. **Б.** Дорсальные спикулы и дорсальные ребристые иглы. **С.** Дорсальные спикулы, маргинальные иглы и вентральные чешуйки. **Д.** Дорсальные спикулы.

up to 2.0–3.5 mm often form mass settlements on thallus of *Cystoseira* sp. and *Phyllophora* sp. Larger specimens can be found on the shells of the gastropod mollusk *Rapana venosa* Valenciennes, 1846 and on stones.

The new species belongs to the group of brooding juveniles in the pallial groove to the trochophora stage [Sirenko, 2015]. In the beginning of May 1984, females of *L. bondarevi* sp. nov. with eggs and larvae that had not grown out of the outer shell were collected in the Black Sea near the southern coast of Crimea at a depth of 0 to 0.3 m.

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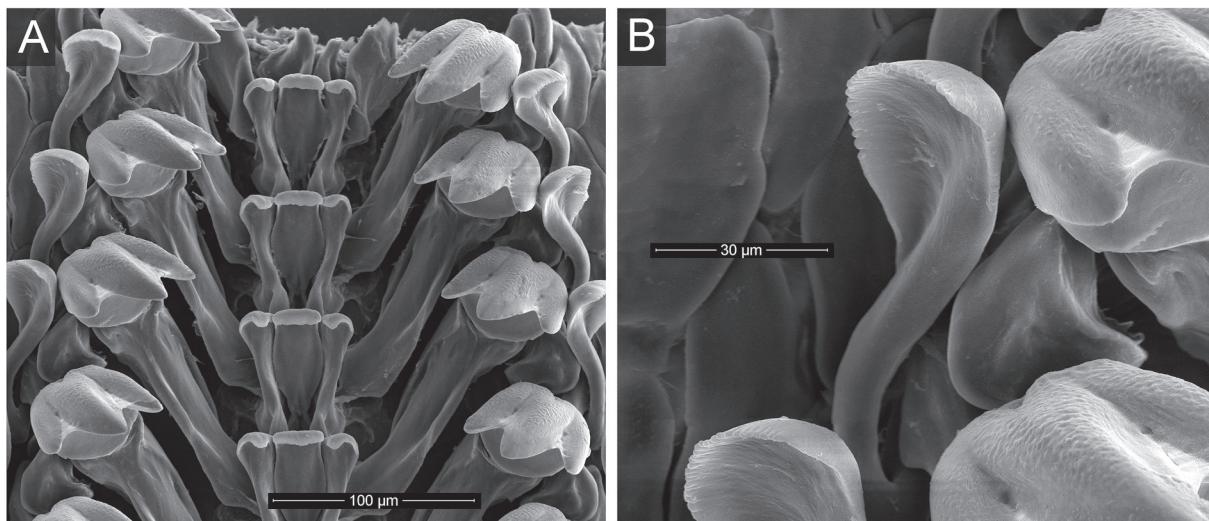


FIG. 19. *Lepidochiton caprearum*, Mediterranean Sea, Capri Island, intertidal, on rocks, BL 8.0 mm. **A.** Radula. **B.** Major lateral and major uncinal teeth of radula.

РИС. 19. *Lepidochiton caprearum*, Средиземное море, остров Капри, литораль, на камнях, BL 8,0 мм. **А.** Радула. **Б.** Большой унцинальный и большие латеральные зубы радулы.

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References

- Anistratenko V.V., Anistratenko O.Yu. 2001. Class Polyplacophora or Chitons. Class Gastropoda – Cyclobranchia, Scutibranchia and Pectibranchia (part). *Fauna Ukraine*, vol. 29. *Mollusca. Fasc I. B. I.* Veles, Kyiv: 1–240 [In Russian].
- Bondarev I.P., Revkov N.K. 2017. Consorts of gastropod *Rapana venosa* (Valenciennes, 1846) in the Northern Black Sea. Pt. II: Mollusca (Polyplacophora, Bivalvia). *Morskoy biologicheskij zhurnal*, 2(3): 12–22 [In Russian].
- Dell'Angelo B., Smriglio C. 2001. *Living chitons of the Mediterranean*. Arti Grafiche La Moderna, Rome, 255 pp.
- Jakovleva A.M. 1952. Shell-bearing molluscs (Loricata) of the seas of the USSR. *Opredeliteli po Faune SSSR Izdavayemye Zoologicheskim Institutom AN SSSR*, 45, 1–107 [in Russian, translated into English by the Israel Program for Scientific Translations, Jerusalem, 1965].
- Kaas P., Van Belle R.A. 1985. *Monograph of Living Chitons (Mollusca: Polyplacophora)*. Vol. 2. Suborder Ischnochitonina. Ischnochitonidae: Schizoplacinae, Callochitoninae & Lepidochitoninae. E. J. Brill/W. Backhuys, Publisher, Leiden, 198 p.
- Kowalevsky A.O. 1883. Embryogenie du *Chiton polii* (Philippi) avec quelques remarques sur le développement des autres Chitons. *Annales du Musée d'histoire naturelle de Marseille, Zoologie*, 1(5): 1–46.
- Micu D. 2004. Annotated checklist of the marine mollusca from the Romanian Black Sea. In: Öztürk B., Mokievsky V.O., Topaloğlu B. (Eds). *International workshop on Black Sea benthos, 18–23 April 2004, Istanbul-Turkey*. 149 p.
- Milachewitch K.O. 1909a. Liste des mollusques, collectionnées durant l'expédition zoologique de Mr. S.A. Zernov dans la partie N.-W. de la mer Noire à bord du bateau "Académicien Baer". *Ezhegodnik Zoologicheskogo Muzeya Imperatorskoi Academii Nauk (Annuaire du Musée Zoologique de l'Académie Impériale des Sciences de St.-Pétersbourg)*, 14: 145–166.
- Milachewitch K.O. 1909b. Liste des mollusques marins collectionnés en 1908 par Mr. K.P. Jagodovsky dans la Mer Noire près côtes du Caucase. *Ezhegodnik Zoologicheskogo Muzeya Imperatorskoi Academii Nauk (Annuaire du Musée Zoologique de l'Académie Impériale des Sciences de St.-Pétersbourg)*, 14: 310–318.
- Milachewitch K.O. 1916. Molluscs of Russian seas. Vol. 1. Molluscs of the Black and Azov seas. *Faune de la Russie et des pays limitrophes*, 312 p.
- Sirenko B.I. 2015. The enigmatic viviparous chiton *Calloplax vivipara* (Plate, 1899) (Mollusca: Polyplacophora) and a survey of the types of reproduction in chitons. *Russian Journal of Marine Biology*, 41(1): 24–31.
- Starobogatov Ya.I. 1972. Class shell-bearing molluscs – Loricata. In: Mordukhai-Boltovskoi F.D. (Ed.), *Guide to the fauna of the Black and Azov seas*. Vol. 3. Kiev, Naukova Dumka: 60–65.
- Teaca A., Begun T., Surugiu V., Gomoiu M.-R. 2010. Changes in the structure of the rocky mussels littoral biocoenosis from the Romanian Black Sea coast. *Analele Științifice ale Universității "Al. I. Cuza" Iași, s. Biologie animală*, 54: 7–22.
- Zernov S.A. 1913. On the study of Black Sea life. *Mémoires de l'Académie Impériale des Sciences de St.-Pétersbourg*. VII série, Classe phisico-mathématique, Vol. 32, N1, 299 p.