



First findings of the rare chiton *Acanthochitona leopoldi* (Mollusca: Polyplacophora) in the South China Sea

Первые находки редкого хитона *Acanthochitona leopoldi* (Mollusca: Polyplacophora) в Южно-Китайском море

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Abstract. The rare chiton *Acanthochitona leopoldi* (Leloup, 1933) is recorded for the first time from the Spratly Islands (Truong Sa), Vietnam. The species is redescribed based on the scanning electron microscope examination of the recently collected specimens. Age variability of the shell, radula and perinotum of this species is also given.

Резюме. Редкий вид хитонов *Acanthochitona leopoldi* (Leloup, 1933) впервые зарегистрирован у островов Спратли (Чыонг Ша), Вьетнам. Дано переописание этого вида на основе электронно-микроскопического изучения собранных экземпляров. Представлена также возрастная изменчивость раковины, радулы и перинотума этого вида.

Key words: chitons, redescription, age variability, South China Sea, Spratly Islands, Acanthochitonidae, *Acanthochitona*

Ключевые слова: хитоны, переописание, возрастная изменчивость, Южно-Китайское море, острова Спратли, Acanthochitonidae, *Acanthochitona*

Zoobank Article LSID: urn:lsid:zoobank.org:pub:7723201B-6228-41FD-8C8C-F5454A275670

Introduction

Despite a large body of publications, we still know little about the composition of the chiton fauna, especially of the genus *Acanthochitona* Gray, 1821 in the north-western Indo-Pacific region. This is evidenced by the findings of nine new species of chitons of this genus in recent years (Sirenko, 2012; Sirenko & Saito, 2017).

In the late 2018 and early 2019, the Joint Russian–Vietnamese Tropical Research and Technol-

ogy Centre organised two marine expeditions to the southern part of the South China Sea. Main objectives were to research the state of coral communities and to study the biodiversity of benthic animals. The work was carried out at the depths from 0 to 50 m around the Spratly Islands (Truong Sa in Vietnamese), Vietnam, with SCUBA equipment. The Spratly Islands are several dozen atolls scattered throughout a large area of shallow water in the southeastern part of the South China Sea. The faunal literature on Spratly includes only

a few works on corals (Dai & Fan, 1996; Li et al., 2011; Latypov, 2012; Zhao et al., 2013). Among the recently collected samples, four contained the rare chiton *Acanthochitona leopoldi* (Leloup, 1933). Considering that the new details of the sculpture of tegmentum, perinotum, and radula were revealed during the study under a scanning electron microscope, we decided to redescribe this species, in which the age variability was also evident.

Material and methods

Three whole specimens and two intermediate valves of *A. leopoldi* were collected in shallow waters near the Spratly Islands, the South China Sea, by hand or using the special method described by Sirenko (2012).

All specimens were prepared for a scanning electron microscopy (SEM). The specimens were boiled in 7% KOH for five to ten minutes and then boiled twice in fresh water. Then several valves (usually valves I, II, IV, V and VIII), anterior half of radula and a portion of the girdle were studied with a FEI Quanta 250 SEM. The rest of the radula and girdle were dried and mounted in Canada balsam for examination with a light microscope.

The following abbreviations are used: BL – body length; IRSN – Institut royal des Sciences naturelles de Belgique, Brussels, Belgium; ZIN – Zoological Institute, Russian Academy of Sciences, St Petersburg, Russia.

Taxonomy

Class **Polyplacophora** Gray, 1821

Subclass **Neoloricata** Bergenhayn, 1955

Order **Chitonida** Thiele, 1909

Suborder **Acanthochitonina** Bergenayn, 1930

Superfamily **Cryptoplacoidea** H. et A. Adams, 1858

Family **Acanthochitonidae** Pilsbry, 1893

Genus ***Acanthochitona*** Gray, 1821

Acanthochitona leopoldi (Leloup, 1933)
(Figs 1–5)

Acanthochites leopoldi Leloup, 1933: 27, pl. II, figs 1–9.
Acanthochitona leopoldi: Burghardt et al., 2006: 43;
Sirenko & Schwabe, 2011: 119.

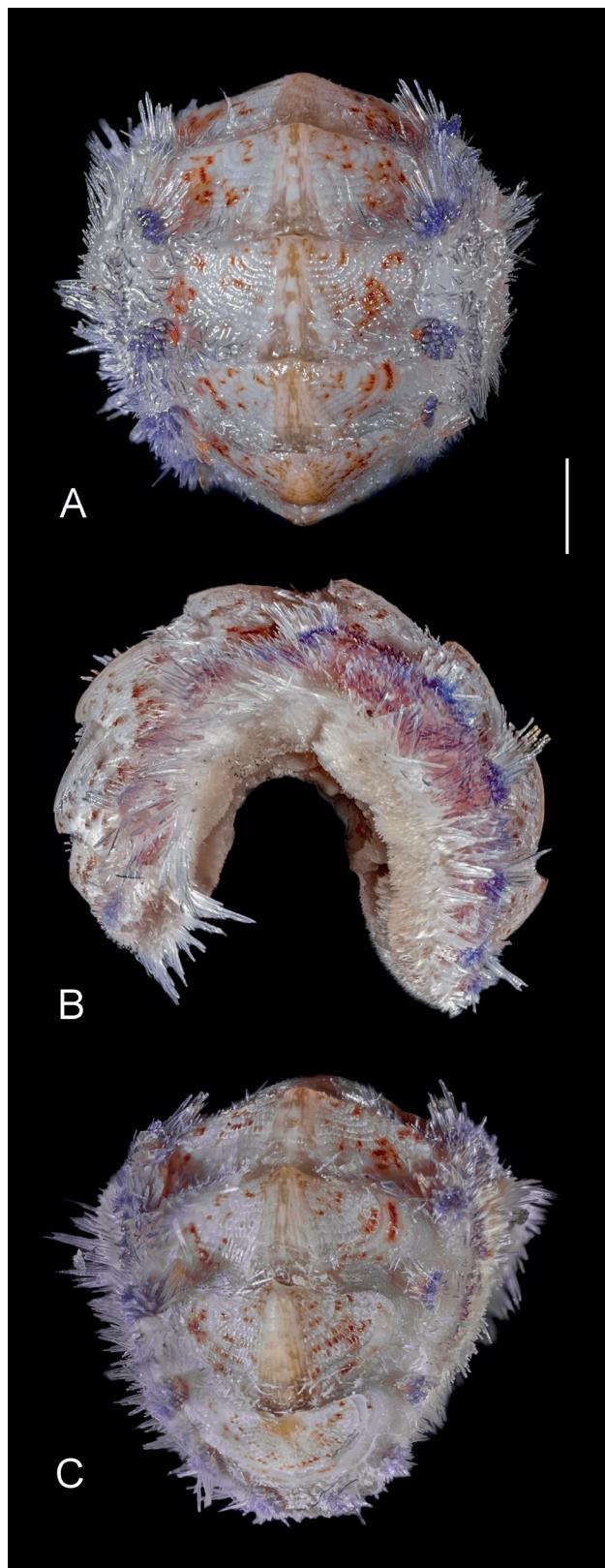


Fig. 1. *Acanthochitona leopoldi*. ZIN, No. 2369, BL 8.0 mm. Middle part, dorsal view (A); lateral view (B); anterior part, dorsal view (C). Scale bar: 1 mm.

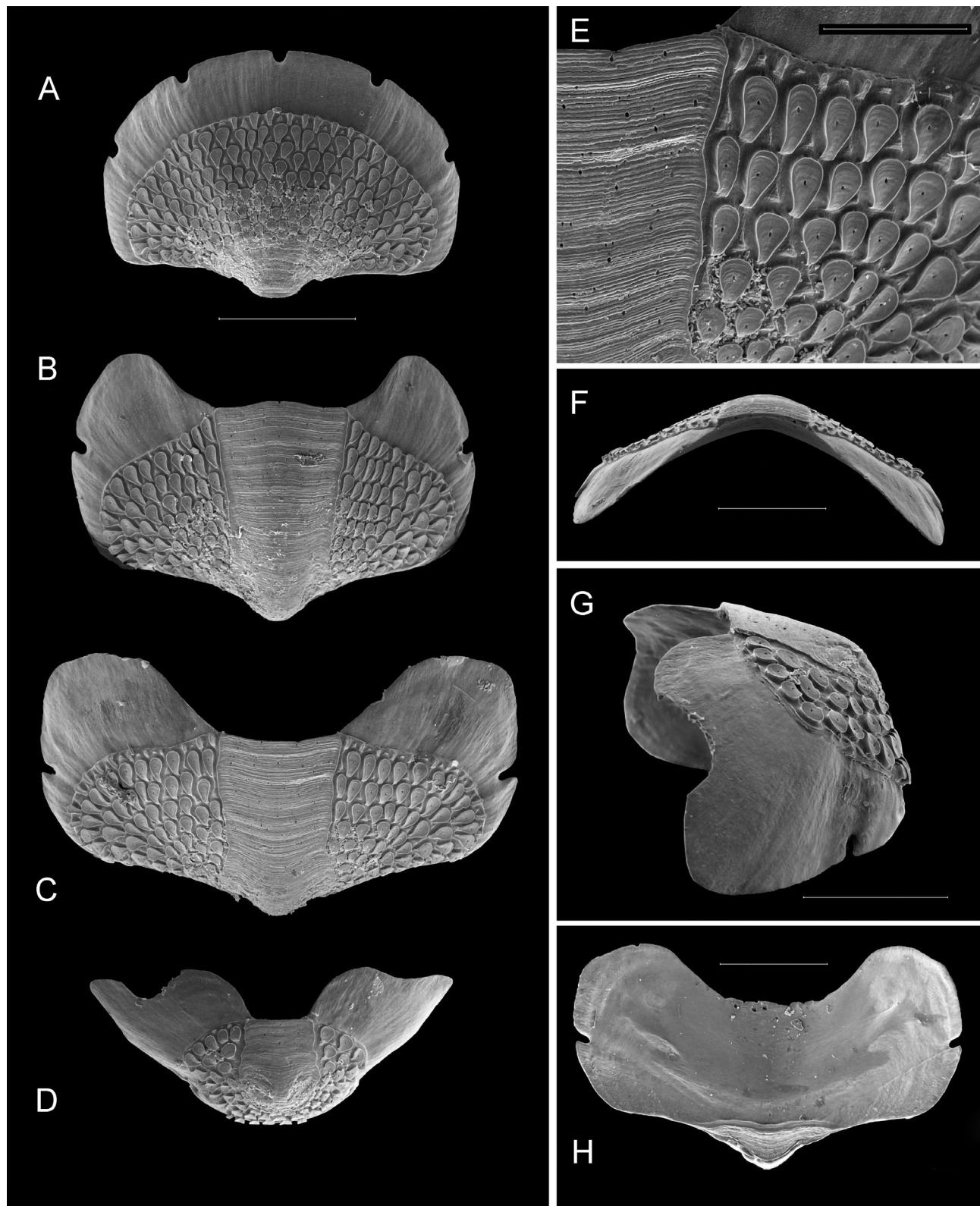


Fig. 2. *Acanthochitona leopoldi*. ZIN, No. 2368, BL 4.5 mm. Valve I, dorsal view (A); valve II, dorsal view (B); valve V, dorsal view (C); valve VIII, dorsal view (D); valve V, tegmentum sculpture in jugal and pleurolateral areas (E); valve V, rostral view (F); valve VIII, lateral view (G); valve IV, ventral view (H). Scale bars: 500 µm (A–D, F, H); 200 µm (E); 300 µm (G).

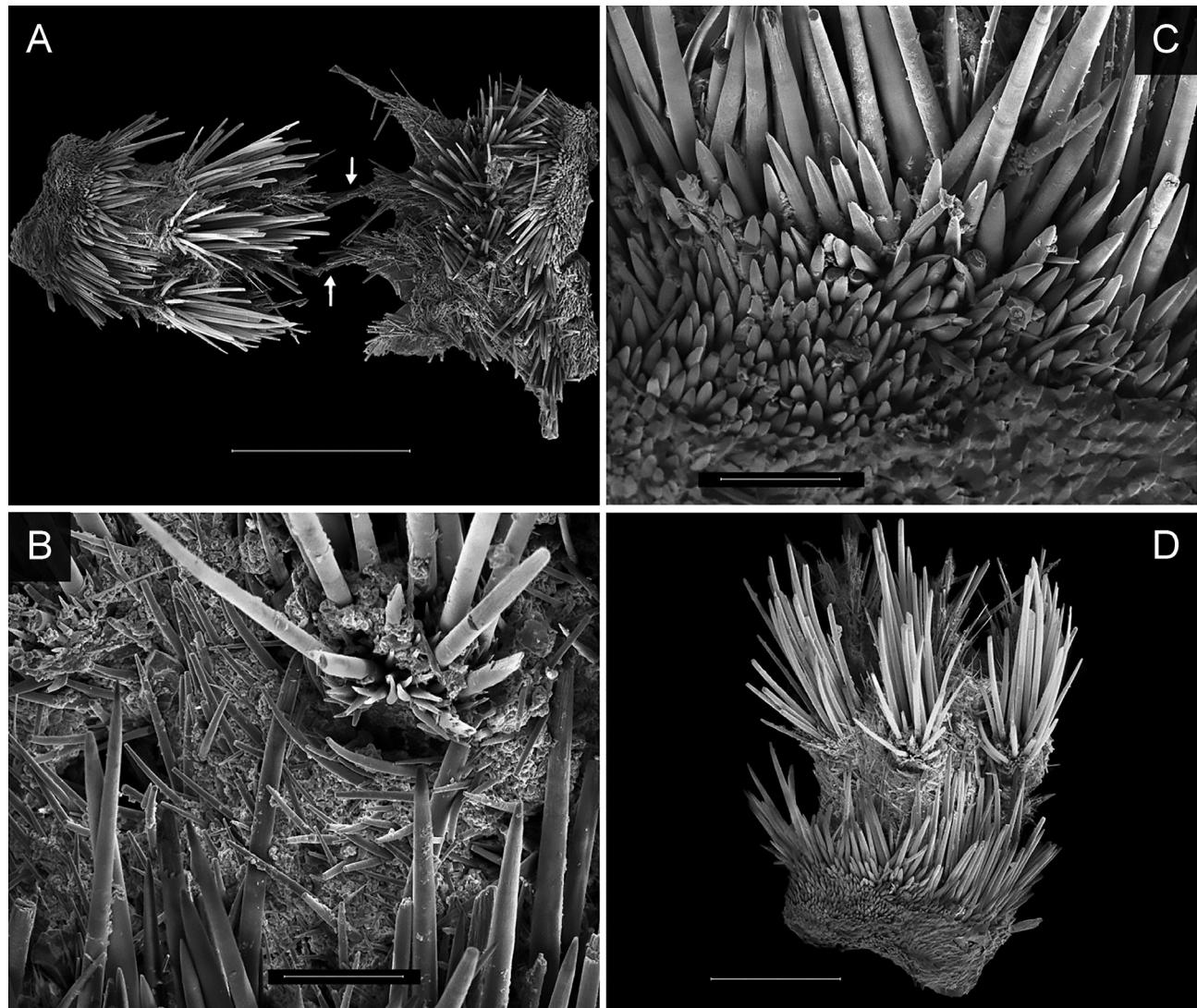


Fig. 3. *Acanthochitona leopoldi*. ZIN, No. 2368, BL 4.5 mm. Two opposite pieces of perinotum, connected by two narrow strips of spicules between the valves (arrows show the strips) (A); tuft of needles, dorsal and marginal needles (B); marginal needles and ventral spicules (C); three tufts of needles, dorsal and marginal needles and ventral spicules (D). Scale bars: 1 mm (A); 100 µm (B, C); 500 µm (D).

Holotype (No. IRSN I.G. 9223/MT. 3805) [not examined]. Type locality: Mansfield Island, Indonesia.

Material examined. South China Sea, Spratly Islands: 1 specimen (ZIN, No. 2368), 10°10'17.0"N, 114°21'59.2"E, depth 31–42 m, on dead corals, SCUBA, 4 Dec. 2018, B. Sirenko leg.; two intermediate valves (ZIN, No. 2371), 11°23'45.1"N, 114°35'15.1"E, depth 14–15 m, in sand, SCUBA, 25 Nov. 2018, B. Sirenko leg.; 1 specimen (ZIN, No. 2369), 11°23'05.7"N, 114°18'30.6"E, depth 10–15 m, on dead corals, SCUBA, 15 May 2019, T. Nguyen Tai leg.; 1 specimen (ZIN, No. 2370), 08°48'47.8"N, 113°56'03.2"E, 2–4 m, on old shells, SCUBA, 15 May 2019, B. Sirenko leg.

Redescription. Chiton of small size, largest body length 15 mm. In our material, BL 3 mm (No. 2370), 4.5 mm (No. 2368) and 8 mm (No. 2369). Body oval; valves hardly beaked, low elevated (dorsal elevation 0.23–0.24 mm), back evenly rounded. Colour of tegmentum as various combinations of white, yellow and brown.

Head valve semicircular, front slope convex, posterior margin almost straight with projecting apex. Intermediate valves rather wide, trapezoidal, low; front margin slightly sinuate between apophyses and splayed laterally; hind margin slightly concave at both sides of beak; side margins

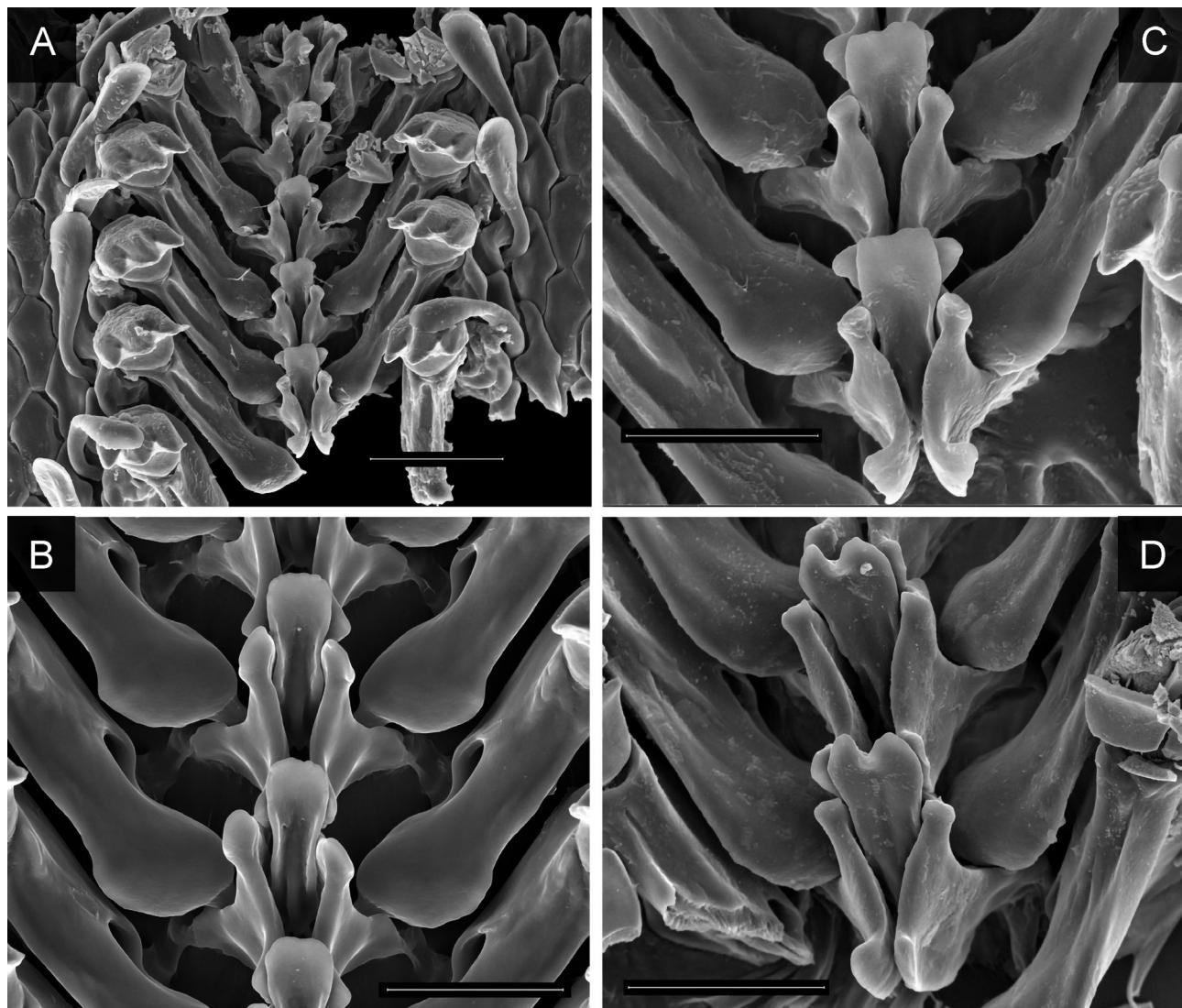


Fig. 4. *Acanthochiton leopoldi*. ZIN, No. 2368, BL 4.5 mm (A, C); ZIN, No. 2370, BL 3.0 mm (B); ZIN, No. 2369, BL 8.0 mm (D). Part of radula (A); central and first lateral teeth of radula (B–D). Scale bars: 50 μm (A, D); 30 μm (B, C).

rounded. Tail valve oval, with central, low mucro; width of tegmentum ca. 62% of that of head valve.

Tegmentum sculptured with droplet-shaped, concave, chequered pustules. Pustules forming rows; transverse rows especially noticeable on pleurolateral areas. Each pustule with single macraesthete pore located approximately in centre. No pores on tegmental plain. Jugal area smooth, with growth lines only and with sparsely distributed aesthete pores.

Articulamentum well-developed, white; apophyses rounded, widely apart from each other in intermediate valves, truncated in tail valve. Slit formula 5/1/2.

Girdle rather wide, ca. 0.8 mm from valve V (width 1.5 mm in examined specimen; its BL 4.5 mm), white with large light brown patches and with violet spots at base of each tuft. Dorsal side of girdle surrounded with minute, slightly bent, sharply pointed, smooth needles 60–100 \times 6 μm ; some needles violet, but most of them white. Same small needles located in a narrow strip between valves (Fig. 3A). Sutural tufts of up to 20 weakly curved, smooth needles 500–1000 \times 17 μm . Marginal needles similar to those of sutural tufts but smaller, up to 500 \times 16 μm . Ventral spicules flattened, bluntly pointed, 50 \times 14 μm .

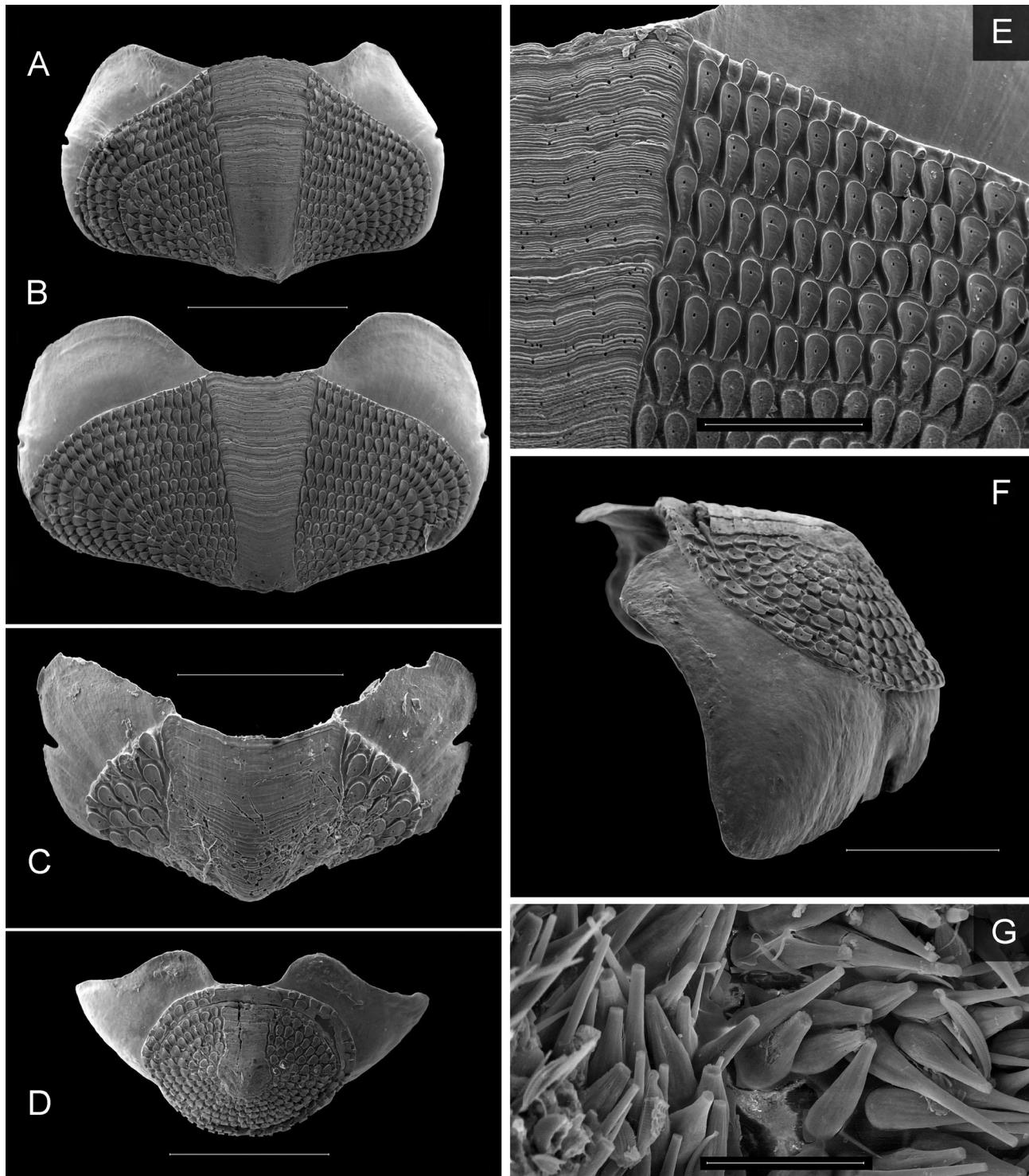


Fig. 5. *Acanthochitona leopoldi*. ZIN, No. 2369, BL 8.0 mm (A, B, D–F); ZIN, No. 2370, BL 3.0 mm (C, G). Valve II, dorsal view (A); valve V, dorsal view (B, C); valve VIII, dorsal view (D); valve V, tegmentum sculpture in jugal and pleurolateral areas (E); valve VII, lateral view (F); dorsal bottle-shaped spicules (G). Scale bars: 1 mm (A, D); 400 µm (C); 300 µm (E); 500 µm (F); 30 µm (G).

All three available whole specimens with eight gills on either side, extending from valve IV to valve VII.

Radula 1.2 mm long, with 22 transverse rows of mature teeth in specimen with BL 4.5 mm. Central tooth small, spatulate in outline, thin. First lateral tooth with thick, nodulous anterodorsal angle. Major lateral tooth with tricuspid head; denticles blunt at tip; central one a little longer than others.

Notes. We would like to note the differences between the Spratly specimens and the type specimen. All available specimens from the Spratly Islands have small needles located in a narrow strip between the valves (Figs 1A, 1C, 3A). Leloup (1933) did not mention this feature in the holotype, possibly because he did not see it. All our specimens (BL 3.0, 4.5 and 8.0 mm) have eight gills on either side, whereas the holotype (BL 15.0 mm) has 13 gills, perhaps also because the latter is twice as large as our largest specimen. Leloup (1933) provided excellent drawings of the valves and the girdle armature of the holotype. All other features of our specimens conform to those of the holotype.

During our examination of the Spratly specimens with SEM, we found the age variability in some of the features. With age, the width of the pleurolateral area increases as compared with the jugal area (Figs 2C, 5B, 5C), the notch on top of the central tooth of radula increases (Fig. 4B–D) and the shape of the dorsal spicules changes from bottle-shaped to needle-shaped (Figs 5G, 3B).

Acanthochitona leopoldi resembles *A. penicillatus* (Deshayes, 1863) from the Indian Ocean and the Philippines, *A. jugotenuis* Kaas, 1979 from the Indian Ocean, *A. intermedia* (Nierstrasz, 1905) from Indonesia, and *A. biformis* (Nierstrasz, 1905) from Indonesia, the Philippines and Vietnam.

From *A. penicillatus*, *A. leopoldi* differs in having the central mucro (vs posterior mucro), one macraesthete and no micraesthete pores in pustule (vs one macraesthete and one to three micraesthete pores in pustule) (Dell'Angelo et al., 2010).

From *A. jugotenuis*, *A. leopoldi* differs in having the smooth jugal area (vs finally longitudinally ribbed), droplet-shaped pustules (vs rounded pustules), central mucro (vs posterior mucro), and smooth marginal needles (vs ribbed marginal needles) (Kaas, 1979).

From *A. intermedia*, *A. leopoldi* differs in having the wider valves, central mucro (vs posterior mucro), chequered pustules which at the same time form rows (vs pustules do not form rows), and each tuft with ca. 20 needles (vs each tuft with more than 50 needles).

From *A. biformis*, *A. leopoldi* differs in having the wider valves with a wider jugum and droplet-shaped pustules in pleurolateral areas (vs oval pustules in pleurolateral areas), and smooth marginal needles (vs ribbed marginal needles).

Of all the related species mentioned above, *A. penicillatus* is the closest to *A. leopoldi*. It should also be mentioned that both these species have been recorded in Sri Lanka (Sirenko & Schwabe, 2011).

Distribution. Indonesia, Sri Lanka. The new records expand the known distribution up to the Spratly Islands in the north. The species occurs at the depths from 4 to 31 m.

Acknowledgements

We would like to thank the administration of the Joint Russian–Vietnamese Tropical Research and Technology Centre for organisation of expedition to the Spratly Islands, Yves Samyn (IRSN) for the detailed information about the type material of *Acanthochitona leopoldi*, Pavel Kijashko (ZIN) for his beautiful colour photographs, Mihael Blikshteyn (Portland, Oregon, USA) for polishing our English, Alexey Mirolyubov (ZIN) for his technical assistance with SEM procedures, and Galina Kuznetsova (ZIN), who prepared the digital plates. The present research was performed using equipment of the Research Resource Center “Taxon” of ZIN. This work was supported by State scientific program “Taxonomy, biodiversity and ecology of invertebrates from Russian and adjacent waters of World Ocean, continental water bodies and damped areas”, No. AAAA-A19-119020690072-9.

References

- Burghardt I., Carvalho R., Eheberg D., Gerung G., Kaligis F., Mamangkey G., Schrödl M., Schwabe E., Vonnemann V., Wägele B. & Wägele H. 2006. Molluscan diversity at Bunaken National Park, Sulawesi. *Journal of Zoological Society Wallacea*, 2: 29–43.
Dai C-F. & Fan T-Y. 1996. Coral fauna of Taiping Island (Itu Aba Island) in the Spratlys of the South China Sea. *Atoll Research Bulletin*, 436: 1–21.

- Dell'Angelo B., Gori S., Baschieri L. & Bonfitto A.** 2010. Chitons (Mollusca, Polyplacophora) from the Maldives Islands. *Zootaxa*, **2673**: 1–38. <https://doi.org/10.11646/zootaxa.2673.1.1>
- Kaas P.** 1979. The chitons (Mollusca: Polyplacophora) of Mozambique. *Annals of the Natal Museum*, **23**: 855–879.
- Latypov Y.Y.** 2012. Spratly Archipelago as a potential reserve recovery of biodiversity in coastal and island reefs of Vietnam. *Marine Science*, **2**: 34–38. <https://doi.org/10.5923/j.ms.20120204.02>
- Leloup E.** 1933. Résultats scientifiques du voyage aux Indes Orientales néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. Brachiopodes et Amphineures. *Mémoires du Musée royal d'histoire naturelle de Belgique*, **2**(13): 5–33, pls. 1–2.
- Li S., Yu K., Chen T., Shi Q. & Zhang H.** 2011. Assessment of coral bleaching using symbiotic zooxanthellae density and satellite remote sensing data in the Nansha Islands, South China Sea. *Chinese Science Bulletin*, **56**(10): 1031–1037. <https://doi.org/10.1007/s11434-011-4390-6>
- Sirenko B.I.** 2012. Chitons (Mollusca, Polyplacophora) of Nha Trang Bay, South Vietnam. In: **Britayev T.A. & Pavlov D.S.** (Eds). *Benthic fauna of the Bay of Nha Trang, South Vietnam*, **2**: 56–122. Moscow: KMK Scientific Press Ltd.
- Sirenko B.I. & Saito H.** 2017. New species of chitons of the superfamily Cryptoplacoidea (Mollusca: Polyplacophora) from Vietnamese waters. *Zootaxa*, **4299**: 451–506. <https://doi.org/10.11646/zootaxa.4299.4.1>
- Sirenko B.I. & Schwabe E.** 2011. Description of a minute chiton (Mollusca, Polyplacophora) from Sri Lanka. *Ruthenica*, **21**(2): 113–121.
- Zhao M.X., Yu K.F., Shi Q., Chen T.R., Zhang H.L. & Chen T.G.** 2013. Coral communities of the remote atoll reefs in the Nansha Islands, South China Sea. *Environmental Monitoring and Assessment*, **185**: 7381–7392. <https://doi.org/10.1007/s10661-013-3107-5>

Received 30 December 2019 / Accepted 2 June 2020. Editorial responsibility: P.V. Kijashko