

Two new rare chitons of the genus *Stenosemus* (Mollusca: Polyplacophora: Ischnochitonidae)

Два новых редких хитона из рода *Stenosemus* (Mollusca: Polyplacophora: Ischnochitonidae)

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Two new species of chitons, *Stenosemus moskalevi* **sp. nov.** from the Bering Sea (northwestern Pacific Ocean) and *S. merweae* **sp. nov.** from the coastal waters of South Africa (southeastern Atlantic Ocean) are described in this paper: *S. moskalevi* **sp. nov.** is distinguishable from other congeneric species by its structures of tegmentum and dorsal spicules; *S. merweae* **sp. nov.** differs from many other species of the genus by having many-colored tegmentum and girdle and the structure of dorsal spicules.

Описаны два новых вида хитонов *Stenosemus moskalevi* **sp. nov.** из Берингова моря (северо-западная часть Тихого океана) и *S. merweae* **sp. nov.** из побережья Южной Африки (юго-восточная часть Атлантического океана): *S. moskalevi* **sp. nov.** отличается от других родственных видов структурой тегмента и дорсальными спикулами; *S. merweae* **sp. nov.** отличается от многих других видов этого рода наличием многоцветного тегмента и структурой дорсальных спикул.

Key words: chitons, taxonomy, Bering Sea, Pacific ocean, South Africa, Atlantic ocean, Ischnochitonidae, *Stenosemus*, new species

Ключевые слова: хитоны, таксономия, Берингово море, Тихий океан, Южная Африка, Атлантический океан, Ischnochitonidae, *Stenosemus*, новые виды

INTRODUCTION

The genus *Stenosemus* is the most widely-distributed genus of the order Chitonida. It includes nineteen described species (O'Neil, 1987; Kaas & Van Belle, 1990; Kaas, 1991; Sirenko, 1994; Van Belle & Dell'Angelo, 1998; Carmona-Zalvide et al., 2001; Clark, 2002; Schwabe, 2008; Sirenko, 2008) and eight additional known but undescribed species including two species under study (Saito, 2006; and author's data). The species of this genus have a distribution from the Arctic to the Antarctic, including cold deep waters of tropical region. Most species of the genus *Stenosemus* inhabit cold or temperate waters with temperature of less than 14 °C.

They inhabit mainly depths greater than 200 m and up to 4572 m. Such a wide depth distribution in chitons is otherwise characteristic of only the ancient genus *Leptochiton*. Perhaps this is evidence of the antiquity of the genus *Stenosemus*. However, fossil representatives of this genus are known only from the Miocene of Italy (Dell'Angelo et al., 2015), though a poor fossil record could be attributed to the deep-water habitation of most species of the genus.

The aim of this article is to describe two more species of the genus *Stenosemus*, each known from only a single specimen, but which possess unique morphological features.

Abbreviations:

IORAS – A.N. Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, Russia

SAM – South African Museum, Cape Town, South Africa

ZISP – Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia

MATERIAL AND METHODS

Both specimens in this study were collected by the South African R/V SFRI-R.S. *Africana* in 1993 and Russian R/V *Vitjaz* in 1950 and were given to the author. They were collected by bottom trawls.

Specimens were prepared for scanning electron microscopy (SEM). The specimens were boiled in 7% KOH for 10–15 minutes, then boiled twice in fresh water. Then several valves (usually valves I, IV, V and VIII), half of radula and a portion of the girdle were chosen for a Scanning Electron Microscope FEI SEM Quanta 250. The rest of the radula and girdle were dried and mounted in Canada balsam for examination under a light microscope.

The holotype of *S. moskalevi* sp. nov. is deposited at ZISP (No 1921). The holotype of *S. merweae* sp. nov. is deposited at SAM.

SYSTEMATICS

Class **POLYPLACOPHORA** Gray, 1821

Subclass **LORICATA** Schumacher, 1817

Order **CHITONIDA** Thiele, 1909

Family **ISCHNOCHITONIDAE**
Dall, 1889

Genus *Stenosemus* Middendorff, 1847

Type species *Chiton albus* Linnaeus, 1767, by subsequently designation by Winckworth, 1926

Lophyrus G.O. Sars, 1878 (non *Lophyrus* Poli, 1791, nom. null.); *Chondropleura* Thiele, 1906; *Lepidopleuroides* Thiele, 1928; *Lophy-rochiton* Jakovleva, 1952

Distribution. All oceans in cold and temperate waters, at temperatures usually not more than 14 °C. Miocene-Recent.

Stenosemus moskalevi sp. nov.

(Figs 1–3)

Stenosemus sp. Sirenko, 2013: 148

Holotype. Adult chiton (ZISP No 1921) is the only specimen. Despite damage, soft body, radula, girdle, valves III and IV and fragments of other valves remained. The holotype was disarticulated and consists of a mount of radula, valves III and IV, fragments of other valves and part of girdle and vail with remains of soft body with part of girdle; northwestern Pacific, to west of Commanders Islands, 55°37'N, 164°36.7'E, depth 2440 m, stones, pebbles, gravels (R/V *Vitjaz*, st. 626, Sigsby trawl, 28.09.1950).

Distribution. The species is known only from the type locality, southwestern Bering Sea, to west from Commanders Islands, depth 2440 m.

Diagnosis. Animal of small size, valves low elevated, rounded. Intermediate valves broadly rectangular, anterior margin slightly convex, posterior margin almost straight, side margins rounded, lateral areas not raised. Central area sculptured with about 40 distinct longitudinal ribs, lateral areas with rounded pustules. Dorsal spicules large, curved, smooth. Major lateral tooth with sharply pointed unicuspid head. Twenty-seven gills per side arranged from valve III to valve VII.

Description. Holotype 17 × 10 mm, valves low elevated (dorsal elevation 0.26) rounded, not beaked, tegmentum and girdle white.

Intermediate valves broadly rectangular, anterior margin slightly convex, posterior margin almost straight, side margins rounded, lateral areas not raised. Central area sculptured with about 40 distinct, slightly nodulous ribs, interstices wide in pleural portion but narrow near jugal area, lateral area sculptured with rounded pustules of irregular shape, arranged in a random manner.

Articulamentum white, apophyses wide and connected across the wide shallow si-

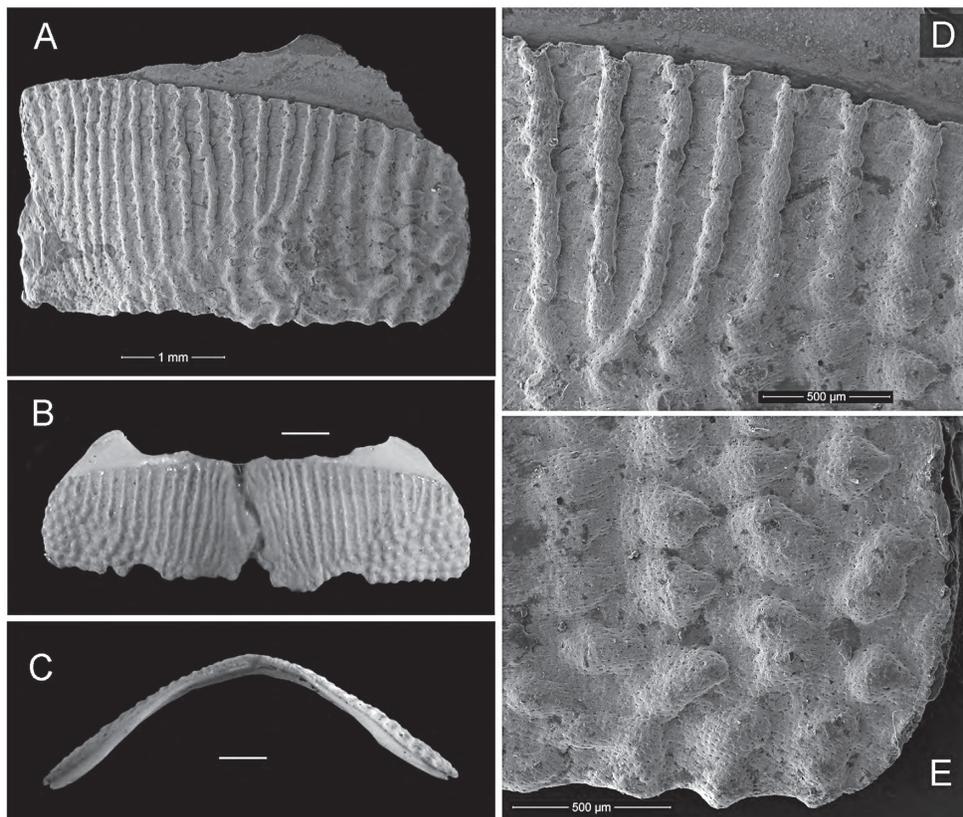


Fig. 1. *Stenosemus moskalevi* sp. nov. (holotype). **A** – half of valve IV, dorsal view; **B** – valve III, dorsal view; **C** – valve III, rostral view; **D** – valve IV, sculpture of tegmentum in pleural area; **E** – valve IV, sculpture of tegmentum in lateral area.

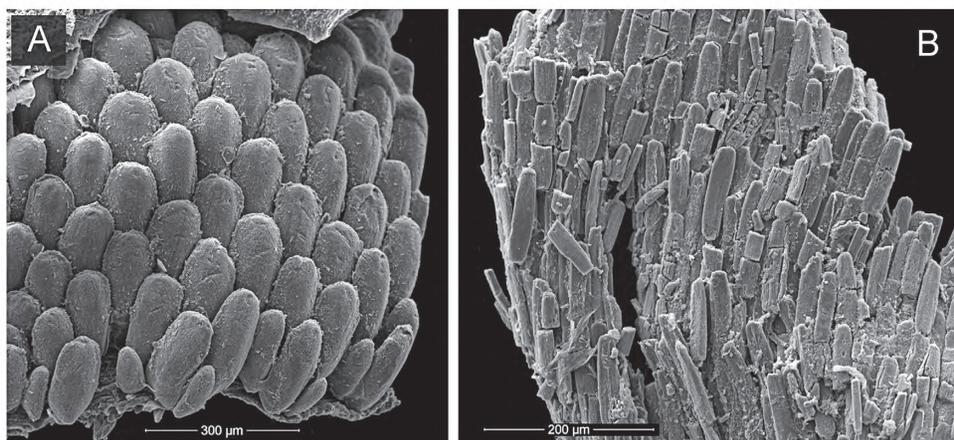


Fig. 2. *Stenosemus moskalevi* sp. nov. (holotype). **A** – dorsal spicules; **B** – ventral scales.

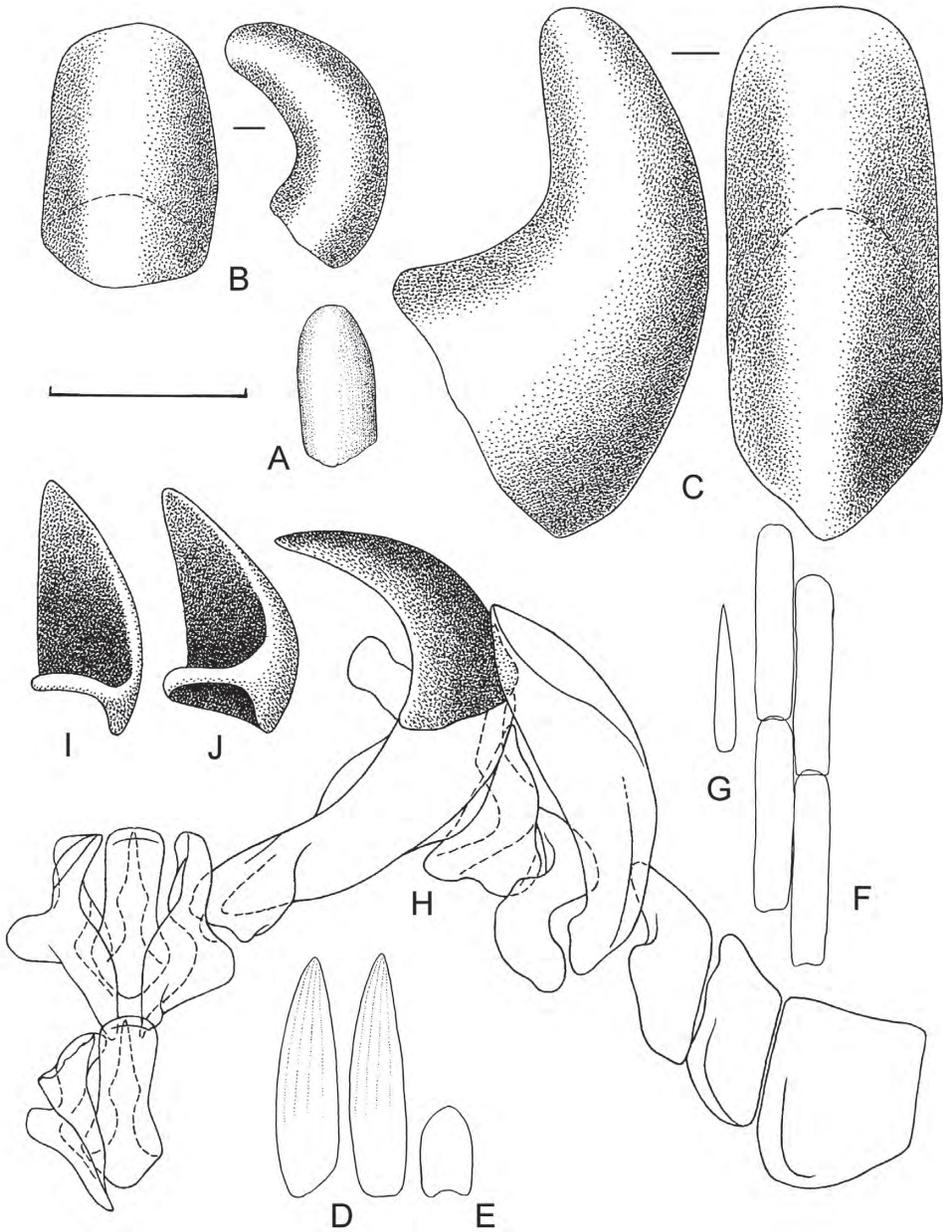


Fig. 3. *Stenosemus moskalevi* sp. nov. (holotype) **A, B** – dorsal spicules near margin; **C** – dorsal spicules in middle girdle; **D** – marginal spicules; **E** – marginal scale; **F** – ventral scales; **G** – ventral spicule near inner margin; **H** – portion of radula; **I, J** – heads of major lateral tooth of radula. Scale bar: 100 μ m.

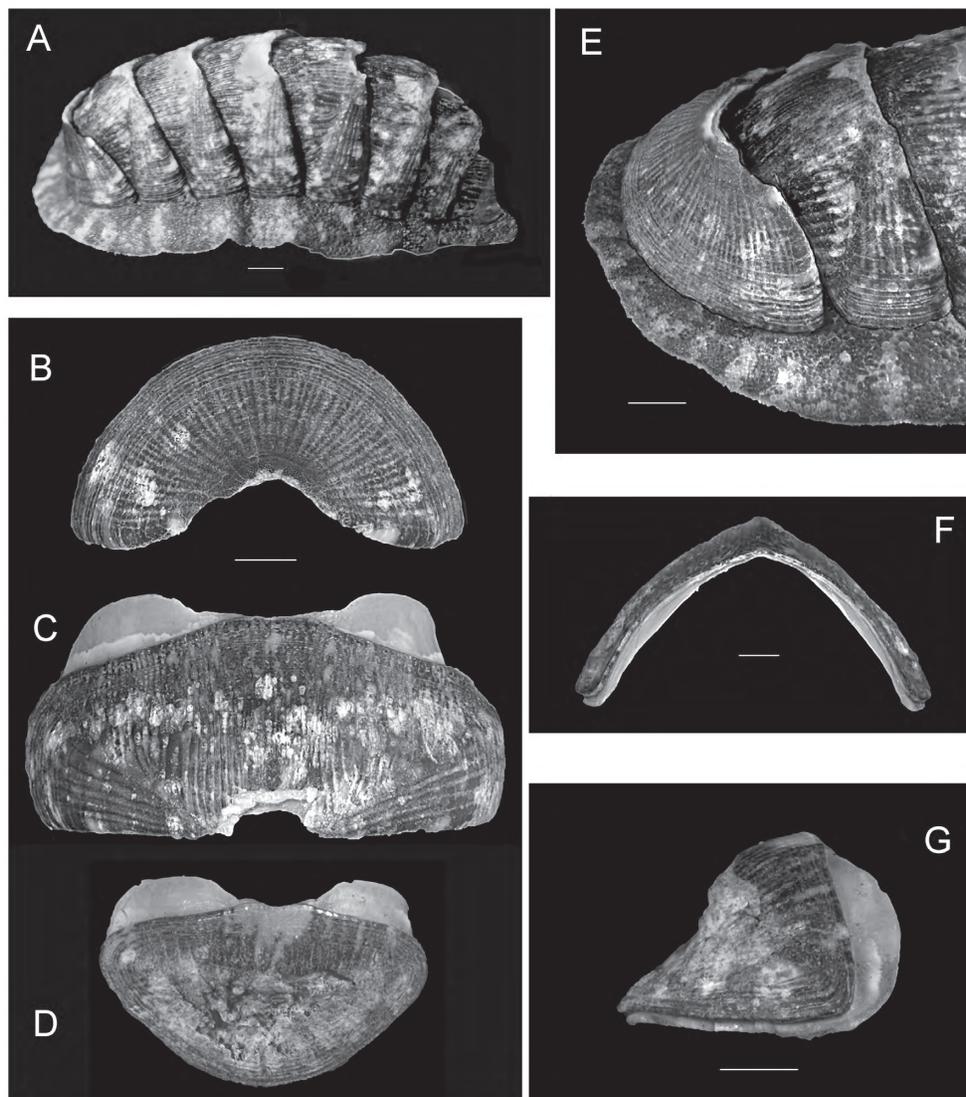


Fig. 4. *Stenosemus merweae* sp. nov. (holotype). **A** – whole animal, lateral view; **B** – valve I, dorsal view; **C** – valve V, dorsal view; **D** – valve VIII, dorsal view; **E** – anterior portion of chiton, lateral view; **F** – valve V – rostral view; **G** – valve VIII, lateral view. Scale bars: 1.0 mm.

nus by a short jugal plate. Slit rays hardly or not indicated. Eaves narrow with rare small pores (30 μm). Valves III and IV with 1–2 insertion plates. Number of slits in head and tail valves is unknown, because of it was impossible to count them on the preserved fragments of terminal valves.

Girdle narrow (width of girdle one-fourth the width of valve V) Most dorsal spicules juxtaposed, bent, smooth, round-

topped, spicules with broadened base, 300 \times 150 μm in middle part of perinotum and smaller (100 μm) near margin. Marginal spicules sharply pointed, longitudinally striated, up to 160 μm . Ventral side of girdle covered with radiating rows of elongate rectangular scales 80–90 μm .

Radula of holotype 6 mm long with 42 transverse rows of mature teeth. Central tooth pyriform, wide near base, distally ta-

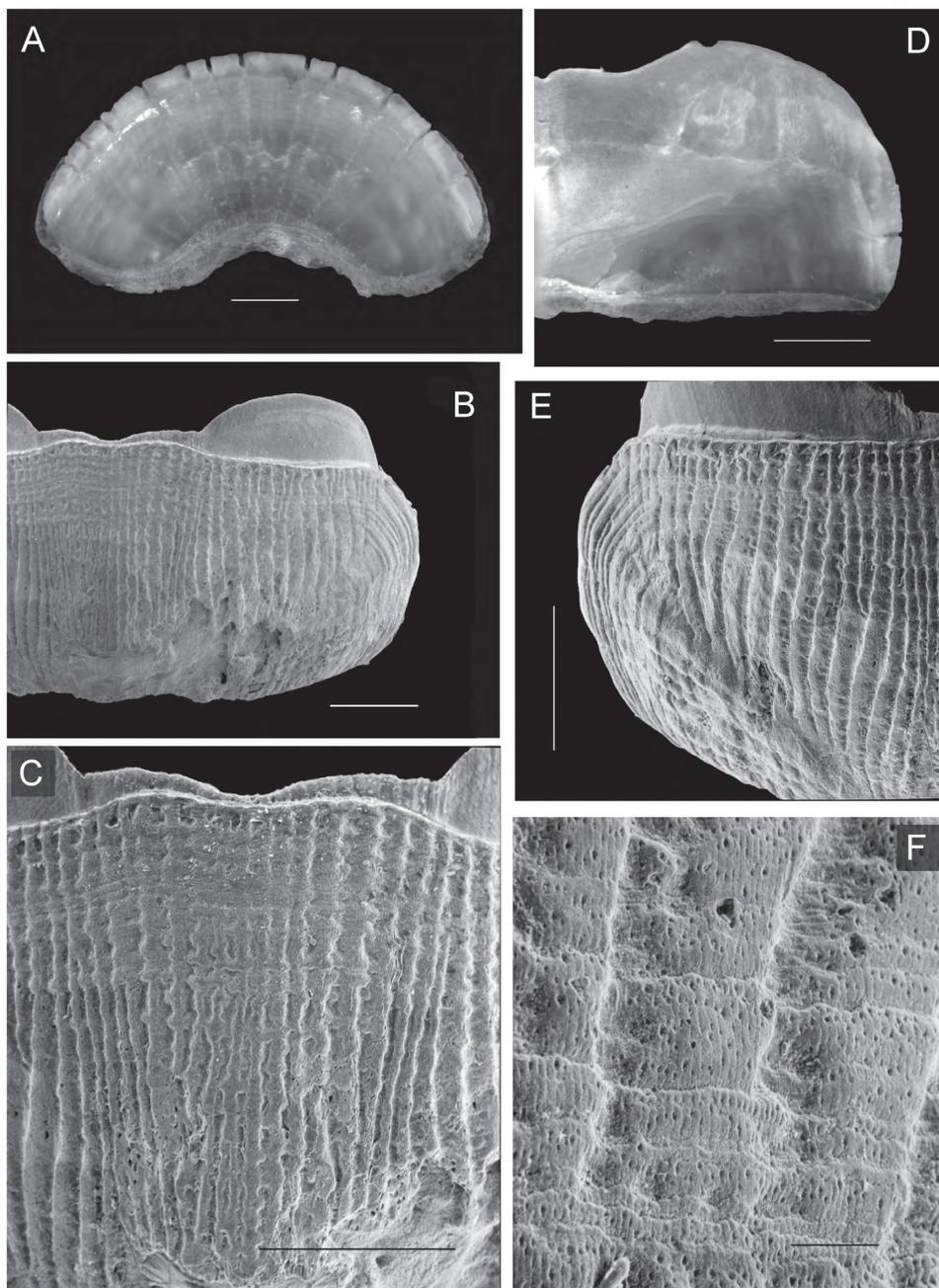


Fig. 5. *Stenosemus merweae* sp. nov. (holotype). **A** – valve I ventral view; **B** – valve VII, dorsal view; **C** – valve VII, dorsal view, sculpture of tegmentum in jugal area; **D** – valve VI, ventral view; **E** – valve VII, dorsal view, sculpture of tegmentum in pleural and lateral areas; **F** – valve VII, dorsal view, sculpture of tegmentum in pleural area. Scale bars: 1.0 mm (A–E), 100 µm (F).

pering to a small blade. Major lateral tooth with sharply pointed unicuspid head.

Twenty seven gills per side arranged from valve III to valve VII.

Etymology. Named after my friend Lev Moskalev (IORAS), well-known malacologist, investigator of deep-sea fauna and indefatigable collector of marine animals.

Comparison. *Stenosemus moskalevi* slightly similar to *S. exaratus* (G.O. Sars, 1878) (Atlantic ocean and southeastern Pacific ocean) and *S. chiversi* (Ferreira, 1981) (off Hawaii and Drake Passage) and differs from them by having 40 distinct longitudinal ribs on the central areas of intermediate valves (vs. about 14 irregular, longitudinal grooves per side in *S. exaratus* and sculpture without any longitudinal ribs in *S. chiversi*), rounded pustules arranged in a random manner in the lateral areas of the intermediate valves (vs. 3–6 radiating grooves in *S. exaratus* and rugose sculpture that acquires a vaguely concentric zig-zag disposition in *S. chiversi*), and smooth dorsal spicules (longitudinally striated spicules in both species).

Stenosemus mervae sp. nov.

(Figs 4–7)

Holotype. Adult specimen (SAM), a male with large gonad; now disarticulated and consist of mount of part of radula and part of girdle; vail with valve III, part of radula and part of girdle; body with the other valves and part of radula in alcohol; off South Africa, near Cape Town, 34°34'S, 23°04'E, depth 109 m (st. NA 14813-111-069-3464, bottom trawl, coll. SFRI-R.S. *Africana*, S.C.H.B.S., 01.05.1993).

Distribution. This species is known only from the type locality, near Cape Town, South Africa, depth 109 m.

Diagnosis. Animal of small size, oval, valves carinated, rather highly elevated. Color of tegmentum brown with cream, blue and white blotches, girdle banded in brown, cream and white colors. Central area sculptured with about 50 irregular, longitudinal grooves, head valve, lateral areas of intermediate valves and postmu-

cronal area of tail valve with radial grooves. Dorsal spicules large, bent, longitudinally striated in the middle part and fine grained on top. Major lateral tooth of radula with sharply pointed unicuspid head. Twenty-seven gills per side arranged from valve IV to valve VIII.

Description. Holotype 19 × 12 mm, oval, valves carinated, rather highly elevated (dorsal elevation 0.52), side slopes convex, apices broken off by damage. Color of tegmentum brown with cream, blue and white blotchings, girdle banded in brown, cream and white colors.

Head valve semicircular, posterior margin with notch at the top, tegmentum sculptured with about 45 radial sometimes bifurcating grooves, growth lines better indicated near outer margin. Intermediate valves broadly rectangular, front margin convex, posterior margin almost straight, side margins rounded, lateral areas slightly raised, well differentiated, sculptured like head valve with 5–6 radial grooves, central area sculptured with about 50 irregular, longitudinal grooves, some grooves intercalary. Tail valve decidedly less wide than head valve, short, erose mucro antemedian, antemucronal slope convex, postmucronal slope concave, antemucronal area sculptured like central area and postmucronal area eroded and sculptured like head area.

Articulamentum with blue color, especially in the central part of valves, apophyses more or less semi-oval, connected across the shallow sinus by a short, finely pectinated jugal plate, weakly notched at the sides, slit formula of insertion plates 13/1/12, slit rays weakly indicated, teeth short, smooth to faintly rugose, eaves short, relatively solid.

Girdle rather narrow (width of girdle five times less than width of valve V), dorsally clothed with large, juxtaposed, bent, round-topped, longitudinally striated in the middle part and fine grained on top spicules (18 × 130 μm), near the outer margin in dorsal side of girdle among large spicules arranged smaller dorsal spicules (60–115 × 23–25 μm) and a long, hollow,

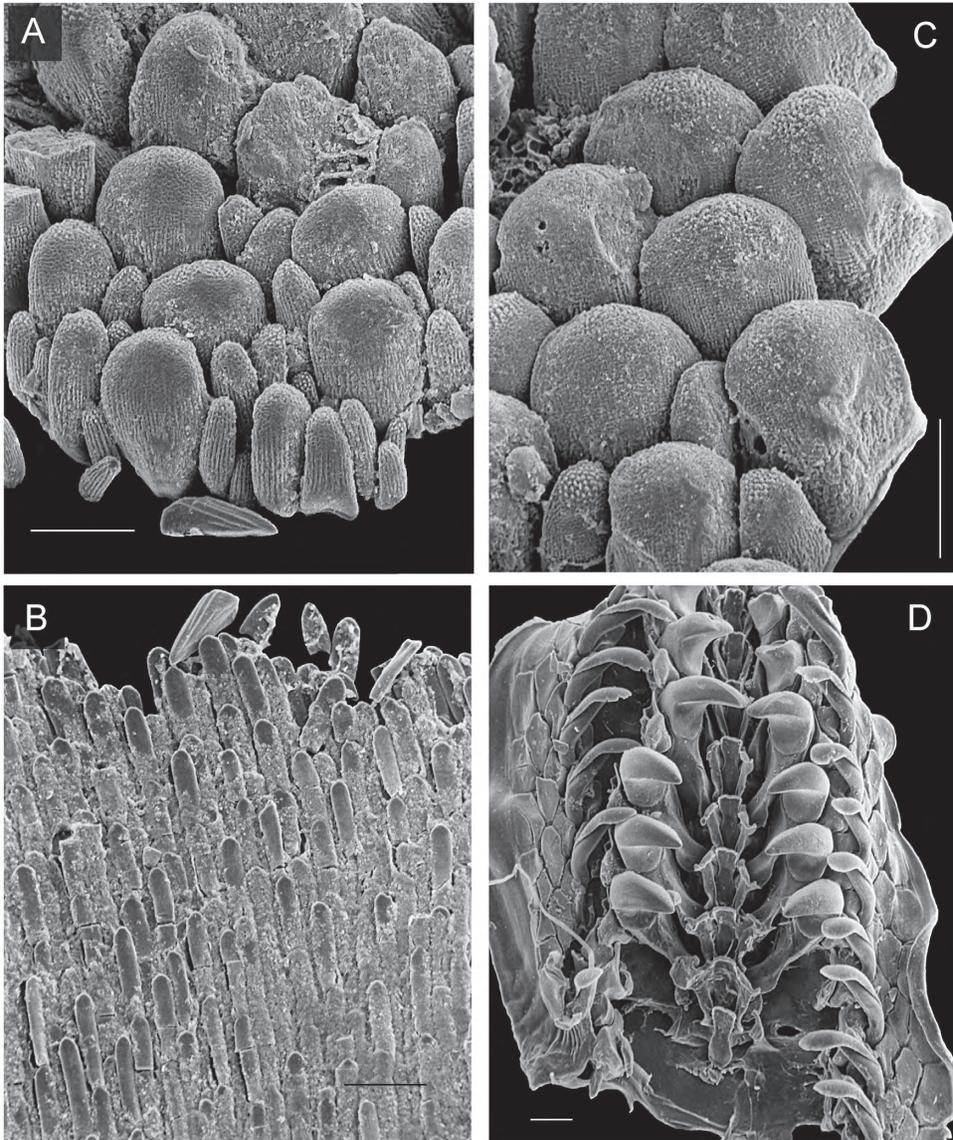


Fig. 6. *Stenosemus merweae* sp. nov. (holotype). **A** – dorsal spicules and one marginal spicule; **B** – ventral scales and one marginal spicule; **C** – dorsal spicules; **D** – radula. Scale bar: 100 μ m.

chitinous hairs (100 μ m), distally bearing a smooth, straight spicule (40–60 \times 10 μ m). There is a marginal fringe of relatively stout, flattened, longitudinally grooved, sharply pointed spicules (115 \times 40 μ m). Ventral side of girdle covered with radiating rows of thin, flat, rectangular scales 110 \times 18 μ m in mid-girdle, shorter towards the inner margin, near the outer margin there

is one row of short, flat, triangular scales (60 \times 22).

Radula of the holotype 6.5 mm long with 26 transverse rows of mature teeth, central tooth pyriform, wide near the base, distally tapering to a small blade, first lateral tooth wing-shaped, with a small blade, major lateral tooth with unicuspid sharply pointed head.

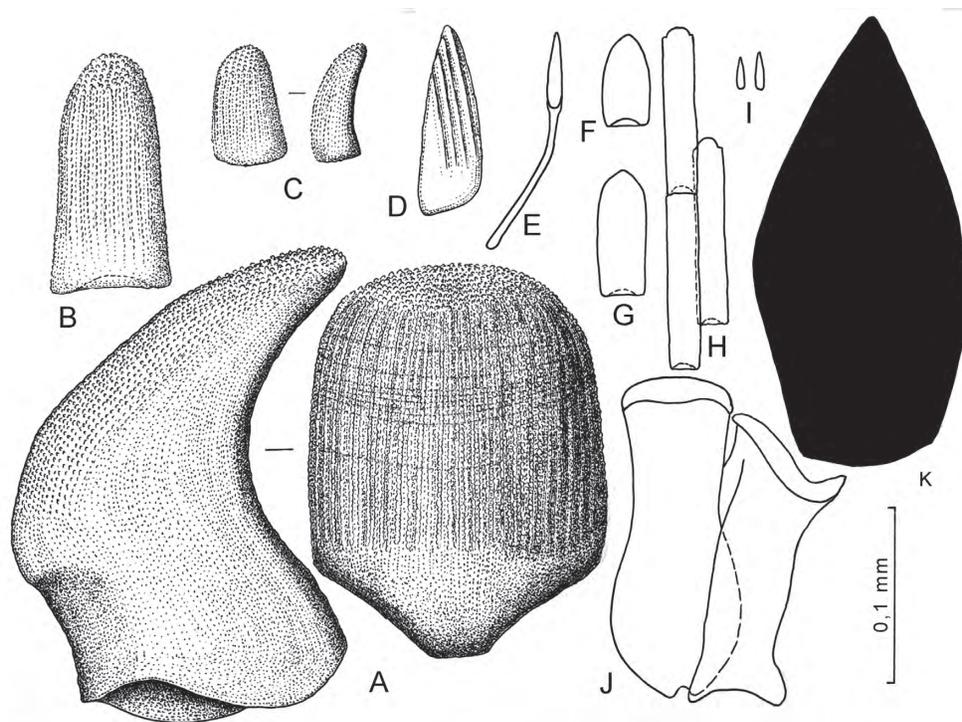


Fig. 7. *Stenosemus merweae* sp. nov. (holotype). **A** – dorsal spicules in middle girdle; **B**, **C** – dorsal spicules near outer margin; **D** – Marginal spicule; **E** – supra-marginal spicule stalked on a long, threadlike stem; **F**, **G** – ventral scales near outer margin; **H** – ventral scales in middle girdle; **I** – ventral spicules near inner margin; **J** – Central and first lateral teeth of radula; **K** – head of major lateral tooth of radula. Scale bar: 100 μ m.

Twenty-seven gills per side, arranged from valve IV to valve VIII.

Etymology. This species is named in honor of Michelle van der Merwe (SAM) who helped to organize our field trip along the coast of South Africa in 2000.

Intestine contents of the holotype contains detritus, foraminifers, small bivalves and sand.

Comparison. In some respects *S. merweae* resembles *S. vanbellei* (Kaas, 1985) (Mediterranean Sea and off Mauritania) and *S. beui* (O'Neill, 1987) (New Zealand). All these species are many-colored, whereas most species of the genus *Stenosemus* are white or rare light brown. The new species differs from *S. vanbellei* in having 50 longitudinal grooves on central area of intermediate valves (vs. 7–9 longitudinal sulci

per side in *S. vanbellei*), unidentate head of major lateral tooth of radula (vs. bidentate tooth in *S. vanbellei*). *S. merweae* differs from *S. beui* in having dorsal spicules fine grained on top (vs. without granules on top of dorsal spicules in *S. beui*), tegmentum of the head valve is sculptured with radial grooves (vs. tegmentum sculptured with close-packed radial series of small depressed rounded to oval granules in *S. beui*), the head of the major lateral tooth of the radula is unicuspid and without any protuberance (vs. a unicuspid head with protuberance on the inner side of the denticle in *S. beui*).

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REFERENCES

- Carmona-Zalvide P., Urgorri V. & Garcia F.J.** 2001. *Ischnochiton (Stenosemus) gallaecus* spec. nov. (Mollusca, Polyplacophora) an Atlantic species from the Iberian Peninsula. *Iberus*. **19**(2): 1–7.
- Clark R.N.** 2002. *Stenosemus sharpii* (Pylsbry, 1896) Rediscovery of a forgotten Chiton from the Aleutian Islands. *NEMOURIA Occasional Papers of the Delaware Museum of Natural History*. **47**: 1–7.
- Dell'Angelo B., Giuntelli P., Sosso M. & Zunino M.** 2015. Polyplacophora from the Miocene of north Italy. Part 1: Leptochitonidae, Hanleyidae, Ischnochitonidae and Callistoplacidae. *Rivista Italiana di Paleontologia e Stratigrafia*. **121**(2): 217–242.
- Kaas P.** 1991. Mollusca Polyplacophora: Deep-water chitons from New Caledonia. In: A. Crosnier & P. Bouchet (eds), Résultats des Campagnes MUSORSTOM. 2. *Mémoires du Muséum national d'Histoire naturelle, Paris (A)*. **150**: 9–27.
- Kaas P., Van Belle R.A.** 1990. New species and further records of known species of Polyplacophora from the tropical western Pacific. *Basteria*. **54**: 175–186.
- O'Neill M.H.B.** 1987. *Lepidozonia beui* n. sp. (Mollusca: Polyplacophora) from New Zealand. *New Zealand Journal of Zoology*. **14**: 131–134.
- Saito H.** 2006. A Preliminary List of Chitons (Mollusca: Polyplacophora) from the Sagami Bay. *Memoirs of the National Science Museum, Tokyo*. **40**: 203–224.
- Schwabe E.** 2008. Discovery of the South African polyplacophoran *Stenosemus simplicissimus* (Thiele, 1906) (Mollusca, Polyplacophora, Ischnochitonidae) in the Southern Ocean. *American Malacological Bulletin*. **24**: 71–77.
- Sirenko B.I.** 1994. Chitons (Polyplacophora) of the continental slope of the Kurile Islands with a brief review of deep water species of the Russian seas. The fauna of the continental slope of the Kurile Islands. *Explorations of the fauna of the seas*. **46**(54): 159–174.
- Sirenko B.** 2008. Bathyal chitons of families Callochitonidae, Ischnochitonidae and Loricidae (Mollusca, Polyplacophora) off New Caledonia and Vanuatu. *Memoires du Muséum national d'Histoire naturelle*. **196**: 41–75.
- Van Belle R.A., Dell'Angelo B.** 1998. Description of a new species *Ischnochiton dolii* sp. nov. (Polyplacophora: Ischnochitonidae) from Civitavecchia, Italy. *Apex*. **13**: 77–79.
- Winckworth R.** 1926. Notes on British Mollusca. I. *Journal of Conchology London*. **18**(1): 13–15.

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