Boll. Malacol., **51**: 91-96 (2, 30/11/2015)

A new species of *Stenoplax* (Mollusca: Polyplacophora: Ischnochitonidae) from southern Madagascar

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Abstract

Stenoplax lavanonensis n. sp. is described from Lavanono, southern Madagascar, living under small and smooth pebbles on reef, at a depth of 0.1-0.4 m. The new species is morphological compared with the two *Stenoplax* species known from Madagascar and the Indian Ocean, *Stenoplax madagassica* (Thiele, 1917) and *Stenoplax alata* (Sowerby, 1841).

Key words

Mollusca, Polyplacophora, new species, *Stenoplax*, Madagascar, Lavanono, Indian Ocean.

Riassunto

[*Una nuova specie di* Stenoplax *(Mollusca: Polyplacophora: Ischnochitonidae) dal sud del Madagascar*] Viene descritta la nuova specie *Stenoplax lavanonensis* da Lavanono, Madagascar meridionale, rinvenuta sul reef ad una profondità di 0,1-0,4 m, sotto ciottoli piccoli e lisci. La nuova specie viene confrontata con le altre due specie conosciute dal Madagascar e dall'Oceano Indiano, *Stenoplax madagassica* (Thiele, 1917) e *Stenoplax alata* (Sowerby, 1841).

Parole chiave: Mollusca, Polyplacophora, nuova specie, *Stenoplax*, Madagascar, Lavanono.

Introduction

Madagascar plays an important role in the context of Indo-Pacific marine biodiversity and biogeography because of the presence of one of the world's longest barrier reefs, off Tuléar (Spalding et al., 2001). In recent years, the chiton fauna of Madagascar has been the subject of a number of studies, resulting in the discovery of new species, in a better appreciation of the taxonomy of some particularly elusive species and in a reconsideration of their geographic distribution (Leloup, 1981; Kaas, 1986; Dell'Angelo et al., 2004, 2010, 2011, 2012; Prelle et al., 2013). Nevertheless, a comprehensive study of malagasy chitons is yet to be achieved, and the finding of new material allows a better insight into local biodiversity. As part of these studies a new species of *Stenoplax* has been identified and is described below.

Materials and Methods

The studied material was mostly collected in 2007/09 by one of the authors (Giovanni Prelle) at Lavanono, a locality situated in southern Madagascar, 40 km from Cape S. Marie and 60 km from Faux Cap, 25°25'43"S, 44°56'19"E (**Fig. 1**). The specimens were mainly collected from under small and smooth pebbles on reef, at a depth of 0.1-0.4 m.

The partly disarticulated holotype was boiled in 7% KOH during 10-15 minutes then was boiled twice in fresh water. The higher classification used below follows Sirenko (2006).

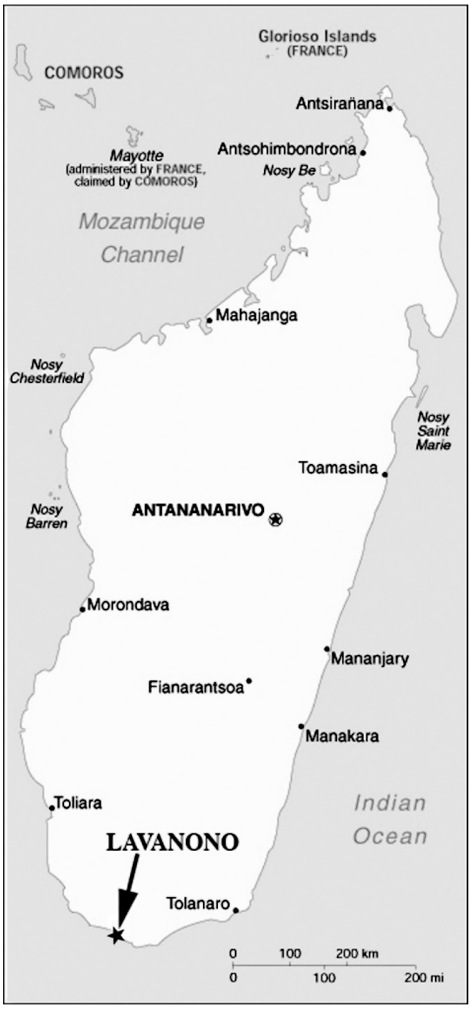

Fig. 1. Collecting locality (Madagascar, Lavanono).

Fig. 1. Località di rinvenimento (Madagascar, Lavanono).

Abbreviations

BD - Bruno Dell'Angelo collection, Genova, Italy (will be housed in MZB).
MNHN - Muséum National d'Histoire Naturelle, Paris, France.
MZB - Museo di Zoologia dell'Università di Bologna, Italy.
ZISP - Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia.

Systematics

Class Polyplacophora Gray, 1821
Order Chitonida Thiele, 1909
Suborder Chitonina Thiele, 1909
Family Ischnochitonidae Dall, 1889
Genus *Stenoplax* Dall, 1879
Type species: *Chiton limaciformis* Sowerby, 1832, by original designation.

Diagnosis

Of small to large size, elongate, the length 2 to 3 times the width, tail valve relatively large, depressed, mucro subcentral and inconspicuous, slit formula many/1 or more/many, girdle decorated with minute to large, more or less elongate scales, or with stout, bent, striated spines (Kaas & Van Belle 1987: 124).

Genus distribution

Central and East Pacific Ocean (Hawaii, and from Canada to Perù), Indo-Pacific Ocean (from Japan to India), Indian Ocean (Madagascar), East Atlantic Ocean (Gulf of Guinea), West Atlantic Ocean (from Florida to Brazil including the Caribbean). Eocene-Recent.

Remarks

This species was assigned to the genus *Stenoplax* mainly because of the elongate shape, with the length 2 to 3 times the width. Alone, not all characters of the new species match with those of the genus *Stenoplax*. The tail valves of *Stenoplax* species are generally depressed and much more elongate relatively to other valves (Kaas & Van Belle 1987: 124; Vendrasco et al. 2012: 34), but the tail valve is more elevated in our species. However, the same characteristic is seen in other *Stenoplax* species, e.g. *S. marcusi* (Righi, 1971) from Brasil, originally placed in *Ischnochiton*, and later attributed to *Stenoplax* by Kaas and Van Belle (1994) following study of the type material.
Many species of *Ischnochiton* are similar to *Stenoplax* species, and a revision of the genus *Ischnochiton* is necessary to clarify the differences with *Stenoplax*, but this is beyond the scope of the present study. The genus *Stenoplax* is currently divided in two subgenera, *Stenoplax* s.s. (having the insertion plates of intermediate valves single-slitted), and *Stenoradsia* Dall, 1879 (having the insertion plates of intermediate valves multi-slitted) (Kaas & Van Belle, 1987). This single, shared attribute does not reflect phylogenetic affinity amongst the scattered, non-Eastern Pacific species (Eernisse pers. comm.), so we do not consider an attribution at subgeneric level.

Stenoplax lavanonensis n. sp.
Figs 2-5

Type material

Holotype: ZISP 2248, body length 17.5 mm, now partly disarticulated. Paratypes (all from the type locality): ZISP 2249 (4 spm); MNHN IM-2014-6055 (3 spm); MZB 32055 (3 spm); BD 124 (3 spm).

Material examined

The type material and additional 15 specimens, all from the type locality.

Type locality

Madagascar, Lavanono.

Etymology

Named for Lavanono, the type locality of the species.

Diagnosis

Animal of medium size, elongate oval, colour of tegmentum and girdle uniformly light orange. Valves moderately elevated, rounded, not beaked, tail valve larger than head valve. Tegmentum sculptured with irregularly undulate concentric grooves crossed by many weak, radial riblets in head valve, lateral areas of intermediate valves, and postmucronal area of tail valve, and by longitudinal grooves slightly obliquely directed in central area of intermediate valves and antemucronal area of tail valve, more irregular and tending to coalesce in jugal area. Slit formula 15 / 2-3 / 11. Girdle densely covered with dorsal imbricating scales with ca. 30-35 riblets on each and ventral smooth spicules. Major lateral tooth of radula with a four-cusped head.

Description

Data from holotype, unless otherwise mentioned. Animal of medium size (**Fig. 2**), holotype 17.5 mm (maximum size 21 x 9 mm), elongate oval, much longer than twice the width, moderately elevated (dorsal elevation of valve V: 0.37), back evenly rounded with convex side slopes. Colour of tegmentum uniformly light orange, somewhat variegated with sandy brown flecks, sometimes the central area of valve II a bit more dark. Girdle of the same colour.
Head valve semicircular (**Fig. 3A**), posterior margin

Fig. 2. *Stenoplax lavanonensis* n. sp., Paratype ZISP 2249, Lavanono: whole animal, lateral and dorsal views.

Fig. 2. *Stenoplax lavanonensis* n. sp., Paratipo ZISP 2249, Lavanono: esemplare intero, viste laterale e dorsale.

widely V-shaped. Intermediate valves (**Fig. 3B**) with anterior margin slightly concave and obliquely posteriorly directed at both sides, side margins rounded, posterior margin about straight, apices hardly or not indicated, lateral areas well raised. Tail valve semicircular (**Fig. 3C**), larger than head valve, length ca. 2/3 of the width, anterior margin concave in the central part, mucro central, little indicated, antemucronal slope slightly convex (**Fig. 3F**), postmucronal slope almost straight, very slightly concave just behind the mucro.

Head valve, lateral areas of intermediate valves, and postmucronal area of tail valve sculptured with many close-set, more or less obvious concentric grooves, better defined towards the periphery (**Fig. 3D**), crossed by many weak, radial riblets, the riblets gradually becoming obsolete towards the apical region. Central area of intermediate valves and antemucronal area of tail valve ornamented with longitudinal grooves that continue

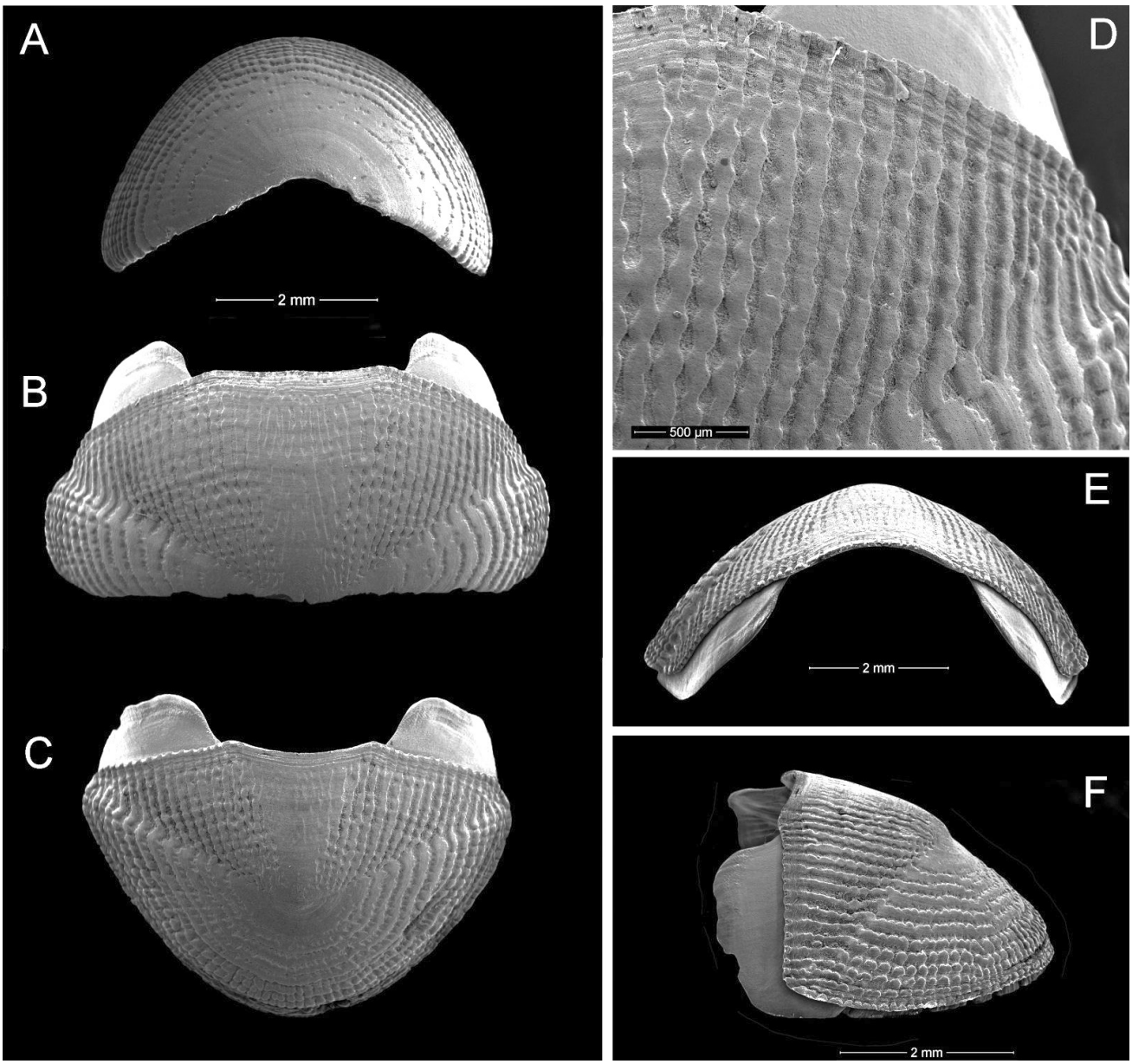

Fig. 3. A-F. *Stenoplax lavanonensis* n. sp., Holotype ZISP 2248, Lavanono. **A.** Head valve, dorsal view. **B.** Intermediate valve, dorsal view. **C.** Tail valve, dorsal view. **D.** Intermediate valve, tegmentum sculpture in pleural area. **E.** Intermediate valve, frontal view. **F.** Tail valve, lateral view.

Fig. 3. A-F. *Stenoplax lavanonensis* n. sp., Olotipo ZISP 2248, Lavanono. **A.** Piastra anteriore, vista dorsale. **B.** Piastra intermedia, vista dorsale. **C.** Piastra posteriore, vista dorsale. **D.** Piastra intermedia, scultura del tegmentum nell'area pleurale. **E.** Piastra intermedia, vista frontale. **F.** Piastra posteriore, vista laterale.

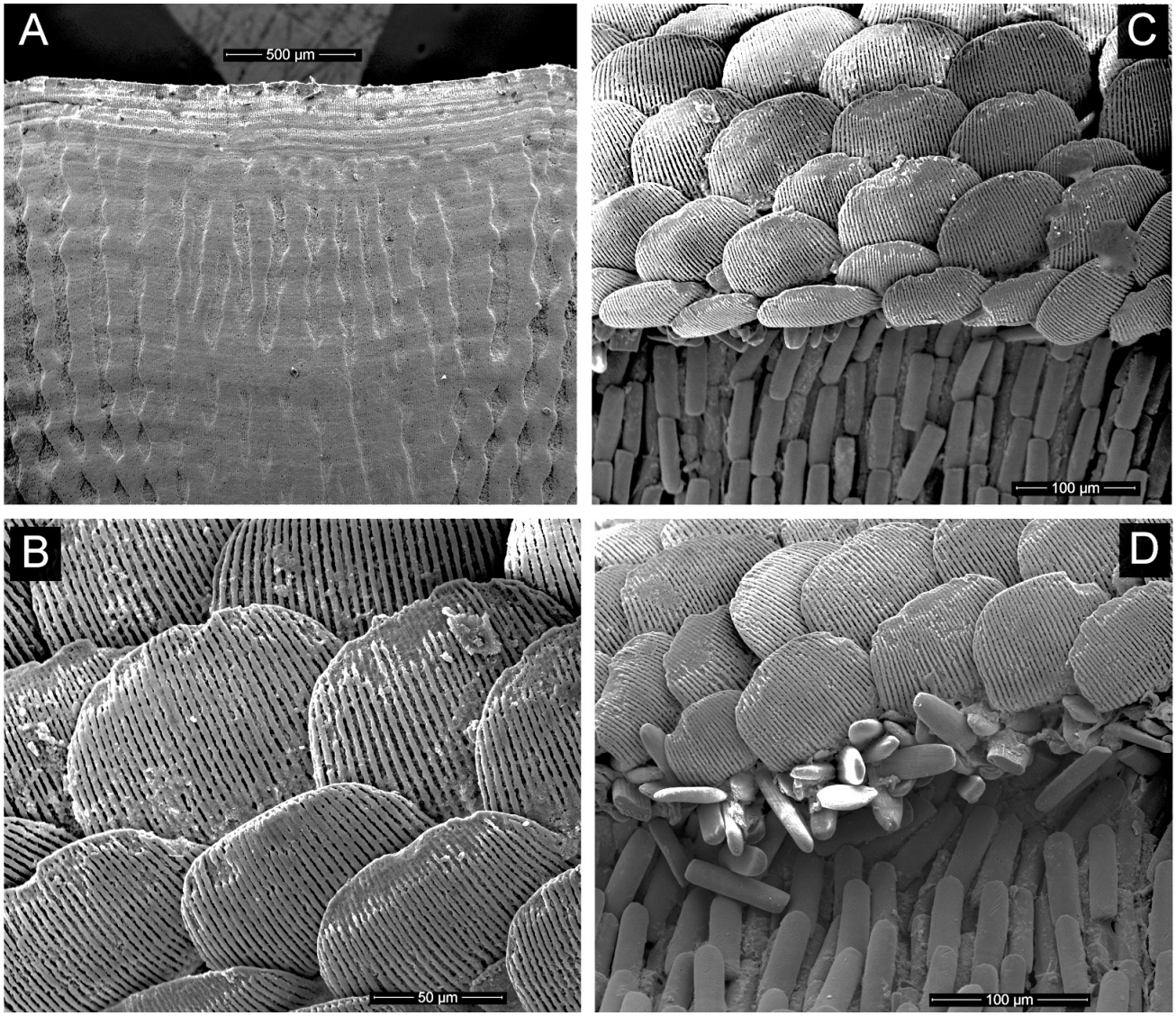

Fig. 4. A-D. *Stenoplax lavanonensis* n. sp., Holotype ZISP 2248, Lavanono. **A.** Intermediate valve, tegmentum sculpture in jugal area. **B.** Dorsal scales. **C, D.** Dorsal scales, marginal spicules and ventral spicules.

Fig. 4. A-D. *Stenoplax lavanonensis* n. sp., Olotipo ZISP 2248, Lavanono. **A.** Piastra intermedia, scultura del tegmentum nell'area jugale. **B.** Scaglie dorsali. **C, D.** Scaglie dorsali, spicole marginali e ventrali.

the concentric grooves from the lateral areas and postmucronal area respectively, slightly obliquely directed; the longitudinal grooves are less evident in the jugal area, where they are more irregular, larger, and tending to coalesce (**Fig. 4A**).

Articulamentum white. Apophyses triangular, trapezoidal in tail valve, widely separated by a slightly concave jugal sinus in intermediate valves, more concave in tail valve, insertion plates short, slit formula 15 / 2-3 / 11. All intermediate valves with 2 slits except right side of valve II, with 3 distinct slits.

Girdle (in situ measurements) dorsally densely covered with small, trapezoid, round-topped, slightly bent, imbricating scales (**Fig. 4B**), rounded at the top, up to 100 µm wide and 80 µm long, with 30-35 narrow riblets, interstices narrower. Marginal spicules simple (**Fig. 4D**), smooth, straight, bluntly pointed up to 90 µm long.Ventrally, the girdle is paved with radiating rows of small, smooth, rectangular, round-tipped spicules (**Fig. 4D**), up to 65 x 17 µm.

Radula of holotype 6.5 mm long with 50 transverse rows of mature teeth. Central tooth of radula small and narrow (**Fig. 5C**), first lateral tooth wider (**Fig. 5B**), major lateral tooth with a four-cusped head (**Fig. 5D**), denticles bluntly pointed, the two central ones longer than the others; minute granulations on the upper surface of the two central cusps.

Holotype has 22 gills on each side extending from valve II to the end of valve VII. Paratype (ZISP 2249), with body length 20.0 mm has 23 gills on each side and arrangement of nephropore between 3-4 gills and gonopore between 6-7 gills from the end of body.

Remarks

The genus *Stenoplax* is known for 22 living worldwide species (Gofas, 2015), more than half of which occur in the northern temperate or tropical eastern Pacific, few other species occur exclusively in the Caribbean (one species, *Stenoplax boogii* [Haddon, 1886] is reported in both regions), and the remaining occur in the Indo-Pacific, Ja-

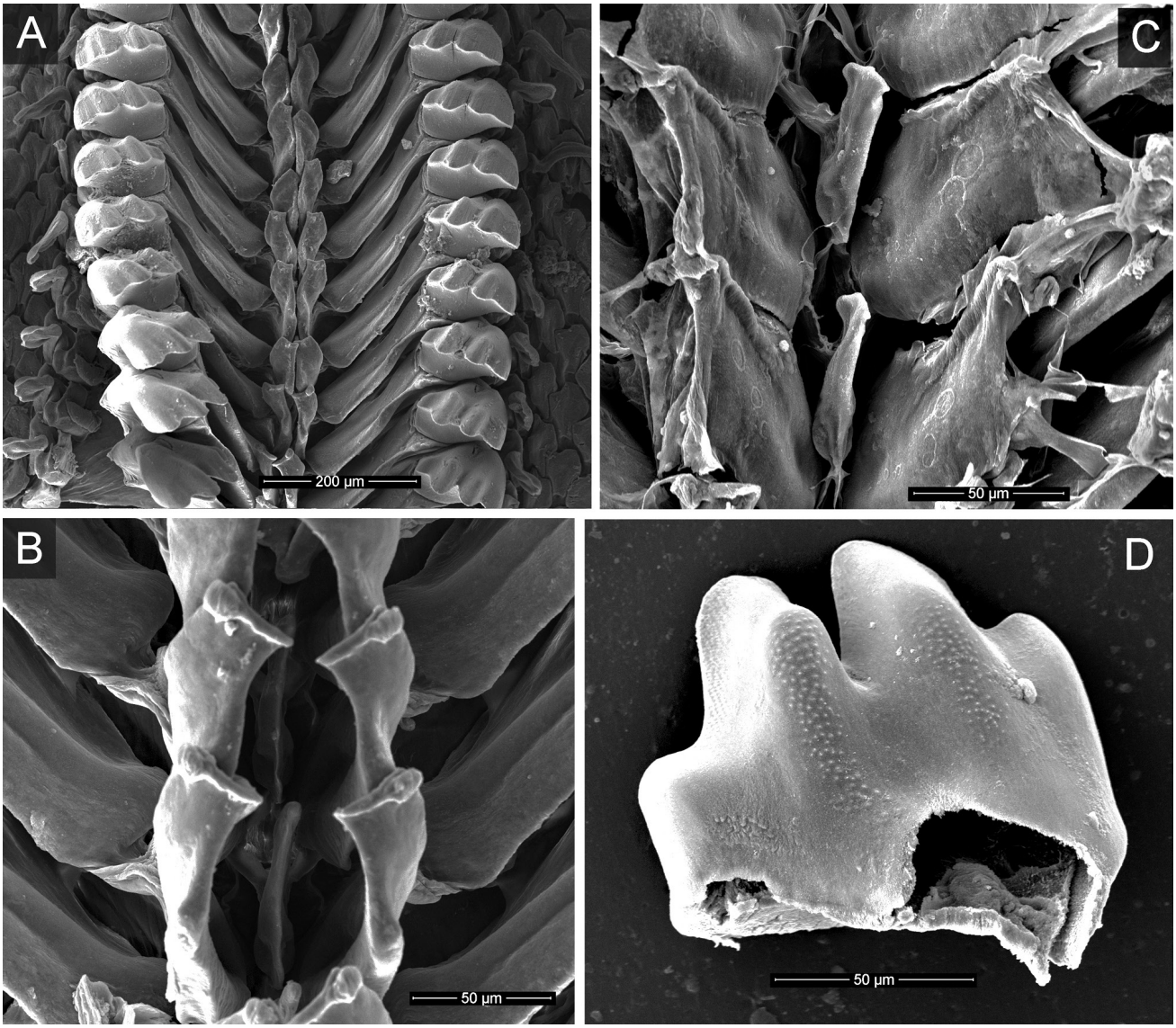

Fig. 5. A-D. *Stenoplax lavanonensis* n. sp., Holotype ZISP 2248, Lavanono. **A.** Radula. **B.** Central and first lateral teeth. **C.** Central portion of radula. **D.** Four-cusped head of major lateral tooth.

Fig. 5. A-D. *Stenoplax lavanonensis* n. sp., Olotipo ZISP 2248, Lavanono. **A.** Radula. **B.** Denti centrale e primo laterale. **C.** Porzione centrale della radula. **D.** Testa con quattro cuspidi del secondo dente laterale.

pan, and western Atlantic (Brazil) (Kaas & Van Belle, 1987, 1990). Only two species are known from the Indian Ocean, *Stenoplax madagassica* (Thiele, 1917), an uncommon species also reported only from Madagascar, on the Tamatave reef in the East, and on the coral reef of Tuléar in the South West (Kaas, 1986; Kaas & Van Belle, 1987), and *S. alata* (Sowerby, 1841), a widespread species in the Indo-Pacific between India and Taiwan (Kaas & Van Belle, 1987), and also reported from Japan (Taki, 1954).

Stenoplax lavanonensis n. sp. differs from *S. madagassica* by the sculpture (smooth and glossy in *S. madagassica*, with scarce evidence of longitudinal grooves only near the anterior margin of the valves), the girdle (dorsal scales more wide than long in *S. lavanonensis*, 100 x 80 µm vs. 78 x 145 µm, with a greater number of longitudinal riblets, 30-35 vs. ca. 18, and no presence of ring-shaft-needles along the margin), and the radula (major lateral tooth with tricuspid head in *S. madagassica*, four-cusped in *S. lavanonensis*).

Kaas (1986: 11) considered *Ischnochiton sinuosus* Leloup, 1981 and *I. sinuosus* var. *varius* Leloup, 1981, both from the Tulear reef, as synonyms of *Stenoplax madagassica*, and we confirm this synonymy, on the basis of Leloup's description and the photo of Holotype (MNHN-IM-2000-6089) of *I. sinuosus* (Odido et al., 2015).

Stenoplax lavanonensis n. sp. differs from *S. alata* by having 2-3 slits in intermediate valves (vs. 1 slit in *S. alata*) and four cuspid head of major lateral teeth (vs. tricuspid in *S. alata*).

The new species *Stenoplax lavanonensis* has the major lateral tooth four-cuspid, and this character is shared only by one of the 22 living worldwide species of the genus, *Stenoplax conspicua* (Carpenter MS, Pilsbry, 1892).

Acknowledgments

We would like to thank Alexey Miroljubov (ZISP) for his help in our work with scanning electron microscope

and Christine Zorn (Museum für Naturkunde Berlin, Germany) for the photos of the holotype of *Ischnochiton* (*Stenoplax*) *madagassicus*. We thank Douglas J. Eernisse (California State University, Fullerton, USA) and Enrico Schwabe (Bavarian State Collection of Zoology, München, Germany) for their constructive comments on the manuscript.

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Lavoro inviato il 31 agosto 2015
Lavoro accettato l'11 novembre 2015