

## A new species of *Callochiton* (Mollusca: Polyplacophora) from southern Madagascar

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### Abstract

*Callochiton cupreus* n. sp. is described from Lavanono, southern Madagascar. The new species is compared with the three *Callochiton* species known from Madagascar, *C. vaminii* Ferreira, 1983, *C. clausadeae* Kaas & Van Belle, 1985, and *C. levatus* Kaas & Van Belle, 1998, and all others known from the Indian Ocean.

**Key words:** taxonomy, marine, new species, Lavanono.

### Introduction

Ongoing research on the marine molluscs inhabiting the coast of Southern Madagascar by one of us (GP) has revealed several species of chitons, some of which have been described recently (Dell'Angelo *et al.* 2011). Recent studies have greatly increased the knowledge of the chiton fauna of Madagascar, resulting in a better appreciation of the taxonomy of some rarer species and a reconsideration of their geographic distribution (Leloup 1981; Kaas 1986; Dell'Angelo *et al.* 2004, 2010b). As part of these studies the authors have identified a new species of *Callochiton* which is described below.

### Materials and Methods

Specimens used for SEM were disarticulated, to enable examination of the valves and perinotum. Micrographs were taken using a Hitachi S 2400 SEM (at the MZB).

#### Abbreviations:

BD — Bruno Dell'Angelo collection (Genova, Italy)

GP — Giovanni Prelle collection (Torino, Italy)

MNHN — Muséum National d'Histoire Naturelle, Paris, France

MS — Maurizio Sosso collection (Genova, Italy)

MSNG — Museo Civico di Storia Naturale "Giacomo Doria", Genova, Italy

MZB — Museo di Zoologia dell'Università di Bologna, Italy  
NHMUK — The Natural History Museum of United Kingdom [formerly British Museum (Natural History)], London, United Kingdom

NMSA — Natal Museum, Pietermaritzburg, South Africa

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

ZSM — Bavarian State collection of Zoology, Germany.

### Systematics

Class **Polyplacophora** Gray, 1821  
Subclass **Loricata** Schumacher, 1817  
Order **Chitonida** Thiele, 1909  
Suborder **Chitonina** Thiele, 1909  
Family **Callochitonidae** Plate, 1901  
Genus ***Callochiton*** Gray, 1847

Type species: *Chiton laevis* Montagu, 1803 (*non* Pennant, 1777) [= *Callochiton septemvalvis* (Montagu, 1803), fide Kaas 1978], by subsequent designation (Gray 1847). For synonymy, see Kaas and Van Belle 1985.

Distribution: Mostly tropical and subtropical regions of the Indo-Pacific (including Japan, absent from the northeastern Pacific). In the Atlantic Ocean restricted to the eastern part and to sub-Antarctic part. Neogene–Recent (Kaas and Van Belle 1985).

Diagnosis: Of small to medium size for family, tegmental sculpture finely granulose, with or without grooves on the pleural areas, slit formula: many / 1–4 / many, girdle wide, covered with small, imbricating, inwardly directed spicules, with or without isolated or grouped longer spicules (Kaas and Van Belle 1985).

#### ***Callochiton cupreus* n. sp.** (Figs 2A–G, 3A–X)

#### Type material

*Holotype* southern Madagascar, Lavanono, length 10.3 mm, Fig. 2A–B (MZB 49976). *Paratypes* from type locality: 1 specimen, length 9.5 mm, slightly curled, Fig. 2E–G (MNHN); 1 specimen, length 7.3 mm (MSNG 56878); 1 specimen disarticulated and coated for SEM analysis, Fig. 3A–X (MZB 49975); 1 specimen, length 10.5 mm, slightly curled (NHM); 1 specimen, length 8.5 mm, slightly curled (NMSA); 1 specimen, length 8.2 mm, slightly curled, Fig. 2C (ZISP 2189); 1 specimen, length 11 mm, slightly curled (ZSM Mol 20120000); 2 specimens, length 9.5 and 11.3 mm,

respectively, slightly curled (BD); 2 specimens, length 8 and 9.5 mm, respectively, slightly curled (GP); 1 specimen, length 8.5 mm (MS).

#### Type locality

Lavanono, southern Madagascar, 40 km from Cape S. Marie and 60 km from Faux Cap, 25°25'43"S, 44°56'19"E (Fig. 1; under small and smooth pebbles of beach-rock, at a depth of 0.1–0.4 m. Coll. Giovanni Prella, Torino) Nov. 2009.

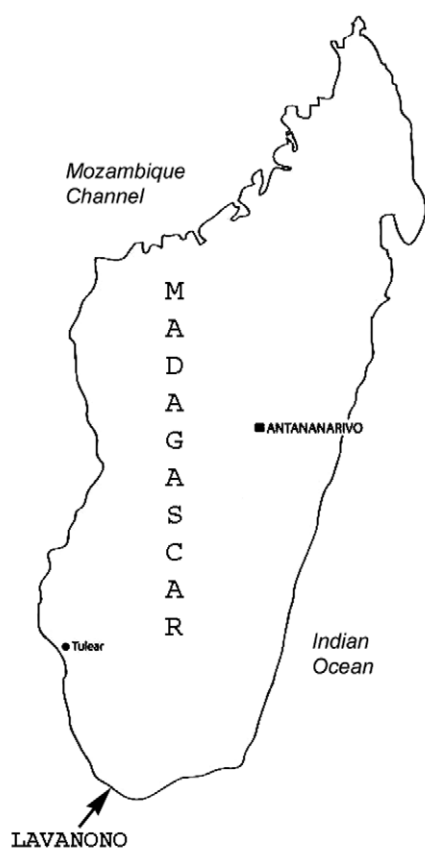


FIGURE 1. Location of Lavanono in southern Madagascar.

#### Non-type material

From type locality: 6 specimens, curled (BD, GP); 2 specimens with 7 valves, Fig. 2D (BD, GP).

#### Description

General shell shape: animal of small size, maximum length of 11.5 mm, elongate, highly elevated, dorsal elevation of valve iv 0.5–0.55, carinated. Tegmentum evenly reddish-copper colour and girdle evenly lighter tone, except for narrow whitish bands on both sides next to sutures of valves i/ii and vii/viii.

Head valve semicircular, with straight anterior slope and wide, V-shaped posterior margin, unnotched in middle (Fig. 3A). Intermediate valves broadly rectangular (Fig. 3E), anterior margin slightly concave in jugal area, side margins somewhat rounded, posterior margin concave on both sides of slightly beaked apex, lateral areas raised. Tail valve more than semicircular (Fig. 3K), mucro not elevated and situated subcentrally or somewhat anteriorly, postmucronal slope straight.

Tegmentum almost smooth with slightly raised dorsal papillae (Fig. 3I), on which apical caps situated, with no apparent association with surrounding subsidiary caps (Fig. 3D). Subsidiary caps arranged in regular rows, radially in head valve, lateral areas and postmucronal area, longitudinally in central area and antemucronal area, rows anteriorly diverging towards the sides. The apical caps slightly elliptical in shape (Fig. 3J), long diameter 11–12  $\mu$ m. Central areas and antemucronal area with 5–6 distinct, deep and narrow longitudinal sulci, only outer portion reaching anterior margin. Row of sulci slightly diverging from diagonal ridge (Figs 3E, 3K).

Articulamentum: Inner layer of shell plates red-brown and thin. Apophyses short, wide with anterior edge broadly rounded, connected by wide V-shaped sinus. Insertion plates long, slit formula 14/1–2/13. Teeth of insertion plates broad, solid and obtuse. Slit rays indicated on all valves by radial rows of elongate holes (Fig. 3H); eaves very spongy.

Girdle: Dorsally densely covered with long, smooth, fusiform spicules, up to 120  $\mu$ m in length (Fig. 3R), inwardly directed with upper ends slightly curved. Among them some scattered whitish long and slightly curved spines, length up to 350  $\mu$ m (Fig. 2G). Ventrally girdle paved with radiating rows of more or less rectangular, imbricating scales, 56 x 21  $\mu$ m (Fig. 3T).

Radula (based on paratype MZB 49975): Central tooth rather short, tulip-shaped (Fig. 3W), with thin, sharply keeled blade on back side and expanded on front side. First lateral tooth (Fig. 3X) broad and wing-shaped, with extensions nearly reaching axial line of central tooth. Major lateral tooth (Fig. 3V) bears broad tridentate cusp with pointed denticles. Shaft of major lateral slender and long, with small extension near base.

Mantle cavity: Gills holobranchial, abanally arranged with interspaces, 13 on the left side (observed on paratype BD, length 11 mm) This is the only specimen, all of which are dry, in which the gills are visible).

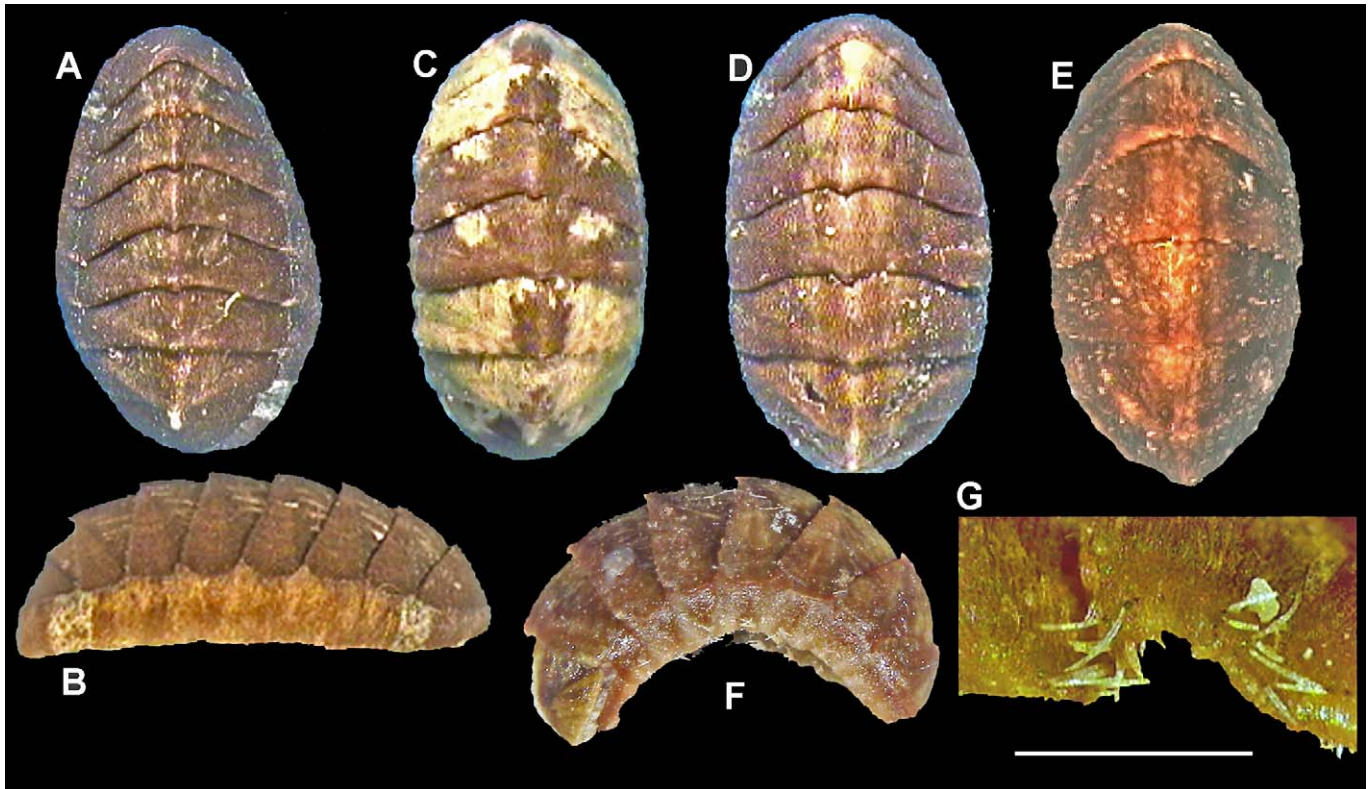
#### Variability

A rather uniform species, which is fairly consistently reddish-copper in colour. Only a few specimens show some variability, with some valves evenly reddish copper colour (normally valves i, iv–v and viii), and the others mainly dirty whitish (normally valves ii–iii and vi–vii), with the jugal region spotted with brown, and the girdle with irregular brownish and whitish bands (Fig. 2C, paratype ZISP).

Two specimens with seven valves (hypomerism) were found (Fig. 2D). Reports of anomalous chitons are quite rare, with the number of anomalous specimens reported in literature estimated between one and five in a thousand (Dell'Angelo and Schwabe 2010), so the finding of the two specimens with seven valves (in a total of 21 specimens examined) is unexpected.

#### Distribution

Known only from Lavanono, southern Madagascar.



**FIGURE 2.** *Callochiton cupreus* n. sp., southern Madagascar, Lavanono. **A, B.** Holotype MZB 49976, length 10.3 mm, dorsal and lateral views, respectively; **C.** Paratype ZISP, length 8.3 mm, dorsal view; **D.** Specimen with 7 valves, length 7.2 mm, dorsal view; **E–G,** Paratype MNHN, length 9.5 mm; **E, F,** dorsal and lateral views, respectively; **G,** detail of the scattered whitish long and slightly curved dorsal spines; scale bar 1 mm.

#### Remarks

The new species differs from many other species of *Callochiton* in lacking black pigment spots that form an intrapigmented aesthete structure visible on the tegmental surface under low magnification [e.g. Baxter and Jones 1984, Baxter *et al.* 1990 for *C. septemvalvis* (Montagu, 1803); Schwabe 2010 for *C. dentatus* (Spengler, 1797)].

The other *Callochiton* species known from the Indian Ocean differ from *C. cupreus* n. sp. as follows:

*Callochiton dentatus* (Spengler, 1797) (a large species, up to 55 mm long, from South Africa), *C. vanninii* Ferreira, 1983 (from Somalia, Madagascar, Red Sea and Bahrain), *C. deshayesi* Thiele, 1909 (from Réunion, Mauritius), *C. levatus* Kaas & Van Belle, 1998 (from Madagascar, Réunion, Mauritius and Chagos Archipelago) and *C. christamariae* Schwabe, 2003 (from Mauritius) have pleural areas and antemucronal area lacking any sulci (Kaas and Van Belle 1985; Schwabe 2003; Dell'Angelo *et al.* 2004).

*Callochiton klemioides* Leloup, 1937 (a species from India, only known from the holotype) differs in its smaller size, the slit formula (13 / 1 / 12 vs. 14 / 2 / 13), a different arrangement of the longer and narrower sulci (3–4 shorter vs. 5–6) and a different structure of girdle spicules (finely striated needles, oval in diameter, and distally bluntly pointed, vs. smooth, fusiform spicules) (Kaas and Van Belle 1985).

*Callochiton clausadeae* Kaas & Van Belle, 1985 (from

Madagascar, Mauritius, Réunion, and the Maldives Islands) differs in its smaller size, lower dorsal elevation (0.35 vs. 0.5–0.55), colour of the tegmentum, and the slit formula (18 / 1 / 12 or 12–16 / 1 / 12–15 for the Maldives specimens vs. 14 / 2 / 13) (Kaas and Van Belle 1985; Dell'Angelo *et al.* 2004, 2010a).

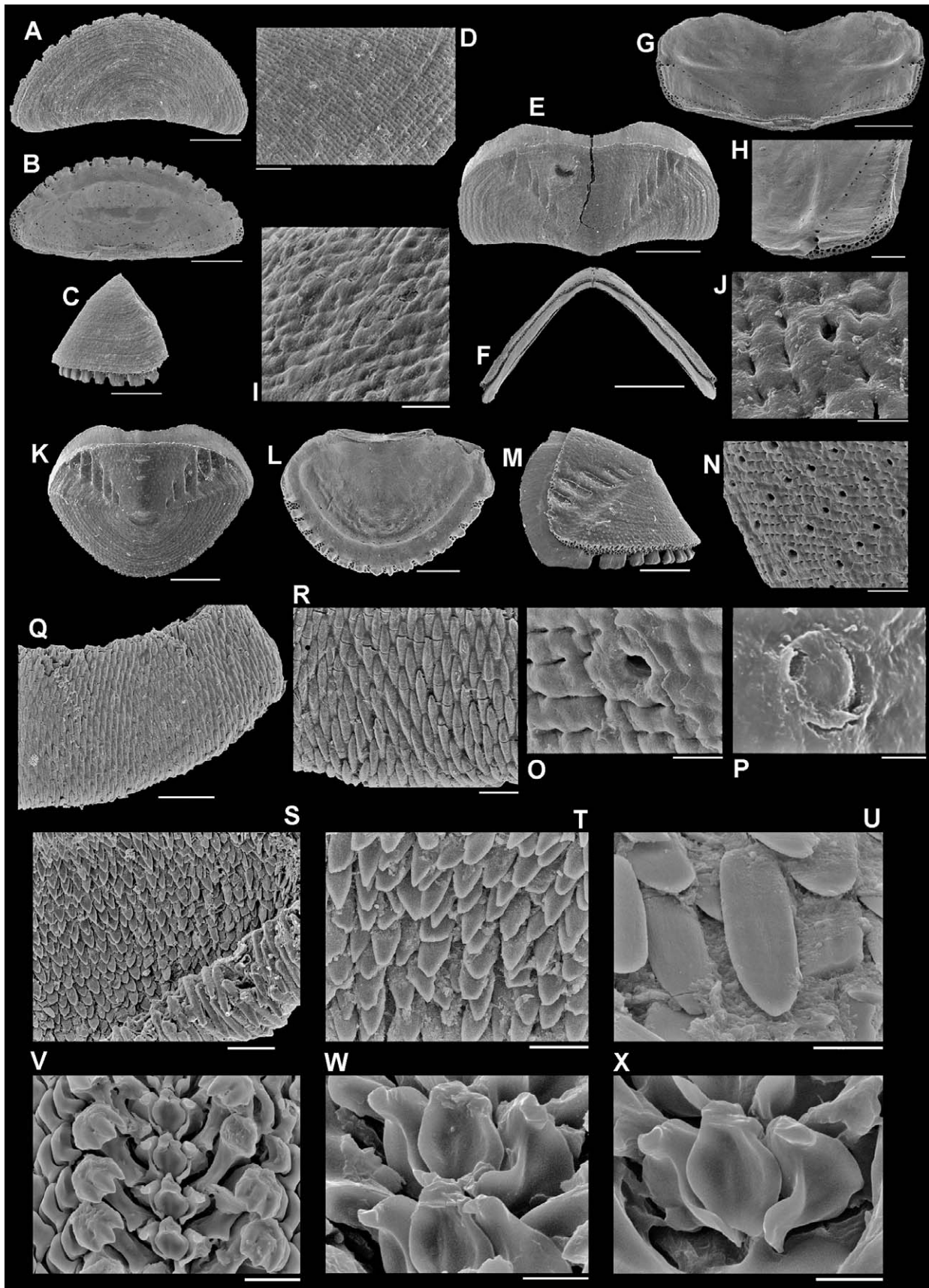
*Callochiton herberti* Kaas & Van Belle, 1990 (from South Africa) is a small, rather flat (dorsal elevation ca. 0.24) species, with the tegmentum minutely granulate, and the granules forming numerous longitudinal rows on the central area (Kaas and Van Belle 1990), entirely different from *C. cupreus*.

*Callochiton jeareyae* Dell'Angelo & Mifsud, 1998 (from South Africa) differs in its larger size, lower dorsal elevation (0.4 vs. 0.5–0.55), the intermediate valves not being beaked, and the slit formula (21 / 2–3 / 16 vs. 14 / 2 / 13) (Dell'Angelo and Mifsud 1998).

*Callochiton schilfi* Schwabe & Ruthensteiner, 2001 (from Bali Island, Indonesia) differs in its smaller size, colour, a different arrangement of the small sulci (3–5 deep and broad longitudinal sulci, becoming larger towards the lateral margins), and the clearly visible black ocelli (Schwabe and Ruthensteiner 2001).

#### Etymology

From Latin *cupreum* = copper, from the tegmentum colour.



**FIGURE 3.** *Callochiton cupreus* n. sp., southern Madagascar, Lavanono, paratype MZB 49975, specimen coated and dismantled for SEM analysis. **A–D.** Head valve; A–C, dorsal, ventral and lateral views, respectively; D, detail of the sculpture. **E–J.** Intermediate valve; E–G, dorsal, frontal and ventral views, respectively; H, detail of slit; I, detail of the sculpture; J, detail of apical caps. **K–P.** Tail valve; K–M, dorsal, ventral and lateral views, respectively; N, detail of the sculpture of postmucronal area; O–P, detail of apical caps. **Q–U.** Girdle elements; Q–R, dorsal spicules; S, ventral scales (on the left) and dorsal spicules (on the right); T, imbricating ventral scales; U, a single ventral scale. **V–X.** Radula; V, complete view; W–X, detail of central and first lateral teeth. Scale bars: E, F—1 mm; G, K—800  $\mu$ m; A–C, L, M—600  $\mu$ m; H, Q—300  $\mu$ m; D, R, S—100  $\mu$ m; N, T—60  $\mu$ m; V—50  $\mu$ m; I—30  $\mu$ m; J, O, U, W, X—20  $\mu$ m; P—6  $\mu$ m.

## Discussion

The genus *Callochiton* includes 40 species worldwide, 15 of which (37.5%) have been described since 1983; its geographic distribution covers the Indian Ocean (9 species, corresponding to 22.5% of the total), Australia-New Zealand (11), Pacific Ocean (8), Antarctic (4), Japan (3), S. Africa (3) and Europe-Mediterranean Sea (2). Three species of *Callochiton* were already known for Madagascar, *C. vanninii*, *C. clausadeae* and *C. levatus*. Despite the Madagascan chiton fauna having been the subject of a number of studies (Leloup 1981; Kaas 1986; Dell'Angelo *et al.* 2004, 2010b; Dell'Angelo *et al.* 2011), the finding of a new littoral species indicates that the knowledge of the chiton fauna of this very interesting biogeographical region is probably still incomplete, and needs further investigation.

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