

New data on the Polyplacophora of Madagascar (Western Indian Ocean)

(Mollusca: Polyplacophora)

BRUNO DELL'ANGELO, BRUNO SABELLI, MARCO TAVIANI & ANTONIO BONFITTO

Abstract

The chitons studied here are all from the coral reefs in the Tuléar area, SW Madagascar. This second note on Tuléar chitons benefits of the availability of well preserved complete specimens whereas the previous one (DELL'ANGELO et al. 2004) was mainly based on single valves. A small collection of living-collected Polyplacophora from shallow coral reef habitats in Tuléar permits to update the chiton fauna from Madagascar. The material was collected in the 1960s/70s (main collector JEAN FRANCOIS BRUNEL in 1971) by people then working at Station Marine d'Endoume, Marseille, and consists of seven species: *Callistochiton rotundus* LELOUP 1981, *Chiton kaasi* (LELOUP 1981), *Lucilina tilbrooki* MILNE 1958, *Acanthochitona penicillata* (DESHAYES 1863), *Acanthochitona limbata* KAAS 1986, *Choneplax indica* ODHNER 1919, and *Cryptoplax sykesi* THIELE 1909. Before, *Lucilina tilbrooki* was formerly only known from Heron Island, Australia. The finding of *Callistochiton rotundus* is noteworthy because is a very elusive species previously only known from the holotype.

Key words: Polyplacophora, systematics, biogeography, new records, coral reefs, Madagascar, Western Indian Ocean

Introduction

Madagascar is significant 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 Polyplacophora from the Western Indian Ocean have been the subject of a number of studies, resulting in a better appreciation of the taxonomy of some elusive species and a reconsideration of their geographic distribution (KAAS 1979; LELOUP 1981; FERREIRA 1983; KAAS 1986; VAN BELLE & WRANIK

1991; ANSEEUW & TERRY 2004; DELL'ANGELO et al. 2004; DINAPOLI & JANSSEN 2009). Nevertheless, a comprehensive study of its chiton fauna is yet to be achieved, with most scientific information published so far concentrated on shallow-water habitats of the Ifaty-Tuléar region. For instance, DELL'ANGELO et al. (2004) discussed the finding of 16 species of Polyplacophora, mostly loose valves, in the sandy fraction of sediments collected at various back-reef stations in the lagoons of Tuléar, Ifaty and at Nossi Vé.

Authors' addresses

Bruno DELL'ANGELO, Via Santelia 55/12A, I-16153 Genova, bruno.dellangelo@chitons.it (corresponding author)

Bruno SABELLI, Antonio Bonfitto, Dipartimento di Biologia evolutiva e sperimentale, Via Selmi 3, I-40126 Bologna

Marco TAVIANI, Istituto di Scienze Marine, C.N.R., Via Gobetti 101, I-40129 Bologna, marco.taviani@bo.ismar.cnr.it

Material and Methods

New material considered here is mainly from a collection assembled in 1971 by JEAN FRANCOIS BRUNEL, then a student at Station Marine d'Endoume (SME), Marseille, which is built in the frame of a bioerosion project on Tuléar coral reefs. However, his chiton collection remained unstudied and forgotten for decades. HELMUT ZIBROWIUS rediscovered this collection at SME only a few years ago and made it available to us to study. In addition to BRUNEL'S collection a few more chiton samples taken at Tuléar in the 1960s/1970s by other persons then working at SME became available for this study after their rediscovery under similar conditions. The collection will be stored in the Muséum National d'Histoire Naturelle in Paris.

Most of BRUNEL'S samples are labeled with a collecting code, but no station list or complementary data are available. His collecting in 1971 is summarily mentioned in a paper on the macroborers of the reef flats of Tuléar (PEYROT-CLAUSADE & BRUNEL 1990). Likewise, the few additional specimens are without detailed data. All specimens had been collected alive and preserved in ethanol. Only part had dried out over the decades. Having ethanol preserved complete specimens available allows us to report these new observations whereas our previous paper was mainly based on single valves.

The labels of the BRUNEL'S samples are: Tuléar 1110, 1111, 1112, 1113, 1116, 1131, 1217, 1285, 1322, 1323, 1327, 1329, 1331, 1332, 1417, 1419, 1428, 12112,

21123, 21124, 21125, 21214, 21225, 21714, 21726, 22114, 22116, 22212, 22213, 22314.

The labels of the additional species are: Tuléar (BRUNEL), Tuléar (RÉGINE HIPEAU JACQUOTTE 1960s), Tuléar Grand Recif, Tuléar Lovobé (MICHEL PICHON 4/10/1971), Tuléar Sarodrano (J. Picard 1960s), Tuléar D20B (J. PICARD ca. 1960/70s dredge), Tuléar TUG 8/16 (1965/66 Thesis GALENON).

Specimens used for SEM were partly disarticulating, enabling examination of valves, and perinotum. Microsculpture and perinotum photographs were made on a JEOL mod. JSM-5200 SEM (at the MZB).

Abbreviations

AM	Australian Museum, Sydney, Australia
IRSN	Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium
MNHN	Museum National d'Histoire Naturelle, Paris, France
NMV	National Museum of Victoria, Melbourne, Australia
RMNH	Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands
SAMA	South Australian Museum, Adelaide, Australia
SME	Station Marine d'Endoume, Marseille, France
SMNH	Swedish Museum of Natural History, Stockholm, Sweden
ZMB	Natural History Museum Berlin (formerly Zoologisches Museum Berlin), Germany
ZSM	Bavarian State collection of Zoology, Germany

Systematics

The taxonomic arrangement follows SIRENKO (2006).

Order Chitonida THIELE 1909

Suborder Chitonina THIELE 1909

Family Callistoplacidae PILSBRY 1893

Genus *Callistochiton* DALL 1879

Type species: *Callistochiton palmulatus* CARPENTER MS, DALL 1879, by monotypy.

Callistochiton rotundus LELOUP 1981

Figs 1 A–E, 4 A–B

Callistochiton rotundus LELOUP 1981: 14, fig. 7, pl. 2. — KAAS 1986: 13. — KAAS & VAN BELLE 1994: 144, fig. 58.

Type material: holotype MNHN.

Type locality: Madagascar, Tuléar, st. 18/15 (coll. GALENON).

Material examined: Tuléar: 1 spm.

Remarks: LELOUP (1981) and KAAS & VAN BELLE (1994) supplied a detailed description of the holotype, picked up by P. GALENON at the Tuléar reefs.

The available single specimen of the present material is slightly curled, measuring 19.5 × 10 mm; colour of tegmentum and girdle uniformly yellowish. It differs from the holotype (KAAS & VAN BELLE 1994), by a variety of characters, such as (i) its smaller size, (the holotype is 30 × 14 mm); (ii) fewer radial ribs in the head valve (11 vs. 14), ornamented with a lower number of nodules (5 vs. 7–10), with a more subdued sculpture.

A SEM study of a portion of the girdle reveals the following features. The dorsal girdle scales (Figs 1 A–E) are strongly imbricated (Fig. 1 A) and rectangular in shape, folded up at about half of their length, forming a right angle (Fig. 1 B), with rounded tips (Fig. 1 C). The scales are sculptured with about 22–25 longitudi-

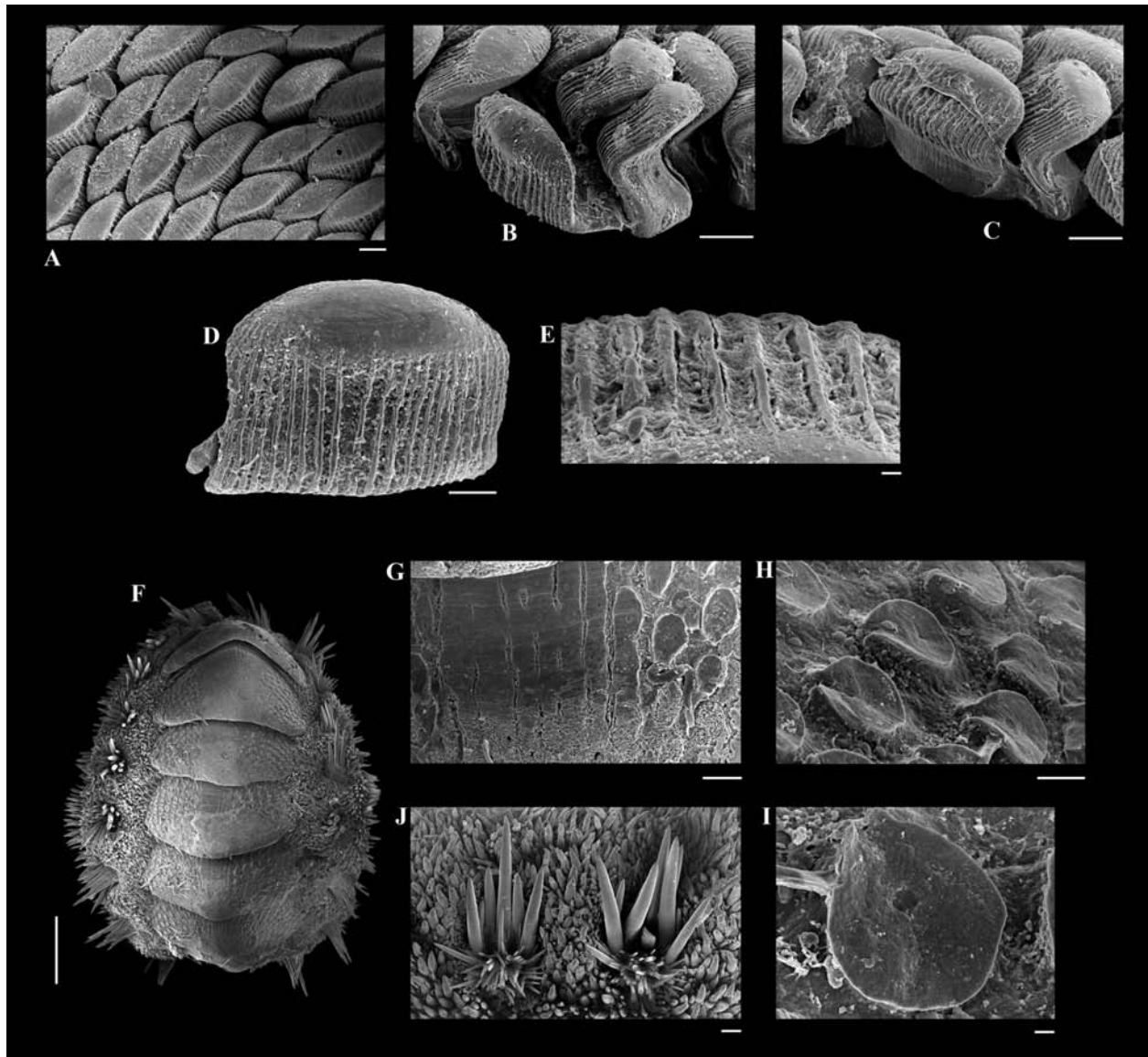


Fig. 1: Polyplacophora from Madagascar. — A–E: *Callistochiton rotundus* LELOUP 1981 (Tuléar), dorsal girdle scales. — F–J: *Acanthochitona limbata* KAAS 1986 (Tuléar 21714), F) living collected specimen, G) detail of jugal area, H–I) granules from an intermediate valve, J) dorsal girdle. — Scale bars: 1 mm: F; 100 μ m: A–C, G, J; 50 μ m: D, H; 10 μ m: E, I.

nal riblets, wider separated in the middle (Fig. 1 D), the interstices latticed (Fig. 1 E). The size of the only upper part of the figured scale is about 230 μ m high, 310 μ m wide (Fig. 1 D). Compared with the description of the holotype's girdle scales (KAAS & VAN BELLE 1994, figs 58/4–5), there are some differences (scales 256 μ m high, 450 μ m wide, with 30 longitudinal riblets, without rounded tips) that potentially occur due to the smaller size of the herein examined specimen. Due to the lack of comparable material, nothing is known about the infra-specific variation of this species.

The species is similar to *Callistochiton crosslandi* SYKES 1907, which differs by its smoother longitudinal ribs, fewer on central area of the intermediate valves (15 vs. 18–20), and other minor characters in the girdle formations (KAAS & VAN BELLE 1994: 138).

Distribution: Madagascar (Tuléar).

Family Chitonidae RAFINESQUE 1815

Subfamily Chitoninae RAFINESQUE 1815

Genus *Chiton* LINNAEUS 1758

Type species: *Chiton tuberculatus* GRAY 1828, by subsequent designation (DALL 1879: 79).

Chiton kaasi (LELOUP 1981)

Fig. 4 C

Callistochiton kaasi LELOUP 1981: 11, fig. 5, pl. 1, fig. 6.

Chiton (*C.*) *kaasi*. — DELL'ANGELO et al. 2004: 52, pl. 4, figs 1–2 (bibliography and synonymy). — KAAS et al. 2006: 103, fig. 32.

Type material: holotype MNHN (figured in DELL'ANGELO et al. 2004: pl. 4, figs 4–6).

Type locality: Madagascar, Tuléar, 10 m depth.

Material examined: Tuléar: 1 spm dry.

Remarks: Our single specimen well agrees with the description of the species given by LELOUP 1981 and KAAS et al. 2006.

Distribution: Madagascar, Réunion, Mauritius, and the Comoro Archipelago.

Subfamily Toniciinae PILSBRY 1893

Genus *Lucilina* DALL 1882

Following the suggestions of some authors (e.g., STRACK 2003, SCHWABE 2004, 2006, SCHWABE et al. 2008), the genus *Lucilina* is here considered as a separate genus, and not as a subgenus of *Tonicia* GRAY 1847. It differs from the latter mainly in having a multi-dentate second lateral tooth, whereas it is unicuspidate in *Tonicia* (SCHWABE et al. 2008: 24).

Type species: *Chiton confossus* GOULD 1846 (= *Chiton lamellosus* QUOY & GAIMARD 1835), by subsequent designation (PILSBRY 1893: 210).

Lucilina tilbrooki MILNE 1958

Figs 2 A–L, 3 A–D, 4 D–E

Lucilina tilbrooki MILNE 1958: 152, figs 1–4. — SMITH & ROBERTSON 1970: 87. — ZEIDLER & GOWLETT 1986: 105.

Tonicia (Lucilina) tilbrooki. — KAAS et al. 2006: 346, fig. 145.

Type material: holotype: NMV F18471; paratypes: NMV F18061, disarticulated valves of one specimen; SAMA D14591, 1 specimen; AM C62216, 1 specimen. All from type locality.

Type locality: Heron Island, Capricorn Group, Queensland, “living on algae the same colour as the shell, growing on coral rocks well inside the reef, near the shore at low-tide mark”.

Material examined: Tuléar: 1 spm dry, “Tuléar, with maerl-like calcareous algae. RÉGINE HYPEAU-JACQUOTTE 1960”.

Description: Head valve semicircular, with a wide V-shaped posterior margin, tegmentum sculptured with 12 radiating rows of inverted V-shaped nodules (2–3 nodules for each row), becoming obsolete towards the apex, ocelli arranged in 7–8 radiating rows (5–6 ocelli per row).

Intermediate valves broadly rectangular, side margins rounded, hind margin straight to concave at both sides of the strongly protruding, blunt-topped apex. Lateral areas little raised, separated from central area by a radial series of large and irregular elliptical pustules (Fig. 2 D), a similar rib accompanying the posterior margin (Fig. 2E), ocelli arranged in one row behind the diagonal rib (Figs 2 D–E), plus some others irregularly dispersed in the anterior part of the lateral area. Apical caps visible on the

megalaesthetes and microaesthetes, uniformly distributed, and patterned with a semi-spherical layout, at least from the outside resembling small ocelli (Figs 2 H–I). Jugal area smooth, pleural areas with 6–7 longitudinal ribs, large and regular, becoming wider toward the front margin (Fig. 2 F), the 2–3 inner ribs do not reach the front margin and stop at about half of the length.

Tail valve with a postmedian elevated mucro, ante-mucronal area sculptured like central areas, postmucronal area irregularly pustulose (Fig. 2 B), ocelli irregularly dispersed.

Girdle covered with closely packed minute spicules (Fig. 2 J), sculptured with three lamellae on the half upper part (Fig. 2 K). Marginal spicules were not observed. Ventral side covered with large rectangular smooth scales (Fig. 2 L).

Remarks: The only specimen found is poorly preserved; the valves vii and viii are complete while the remaining are more or less broken and crushed. A small portion of an intermediate is illustrated in Figures 2 D–I.

Three *Lucilina* species have been reported from Madagascar, mainly from the Tuléar region: *L. carnosa* (KAAS 1979), *L. indica* (LELOUP 1981) [synonymized with *L. carnosa* by KAAS (1986), but recently considered a distinct species by SCHWABE (2004)], and *L. dilecta* THIELE 1911. None of these species resembles the available specimen, that we attribute to *Lucilina tilbrooki* MILNE 1958, previously only known from the type material (5 specimens) collected at Heron Island, Capricorn Group, Queensland, Australia. Our identification is strengthened by comparison with a paratype (SAMA D14591, Figs 3 A–D, 4 D–E) of *L. tilbrooki*. This is the first record of this elusive species since its original description and this is the first record from the Indian Ocean.

Other chiton species shows a similar unusual distribution, e.g., *Lucilina dilecta*, originally described from Western Australia (KAAS et al. 2006: 344) and subsequently reported from Madagascar (LELOUP 1981: 31), and *Ischnochiton albinus* THIELE 1911, also originally described from SW Australia (KAAS & VAN BELLE 1990: 218) and subsequently reported from the Vietnamese coast (STRACK 2003), Japan (SAITO 1998, 2005), the Philippines (SAITO 2006), Indonesia (KAAS & VAN BELLE 1990, BURGHARDT et al. 2006), and from the Indian Ocean too (the Maldiv Islands, B. DELL'ANGELO, unpublished data).

Distribution: Only known from Australia (Heron Island, Capricorn Group, Queensland) and Madagascar (Tuléar).

Suborder Acanthochitonina BERGENHAYN 1930

Family Acanthochitonidae PILSBRY 1893

Genus *Acanthochitona* GRAY 1821

Type species: *Chiton fascicularis* LINNAEUS 1767, by monotypy.

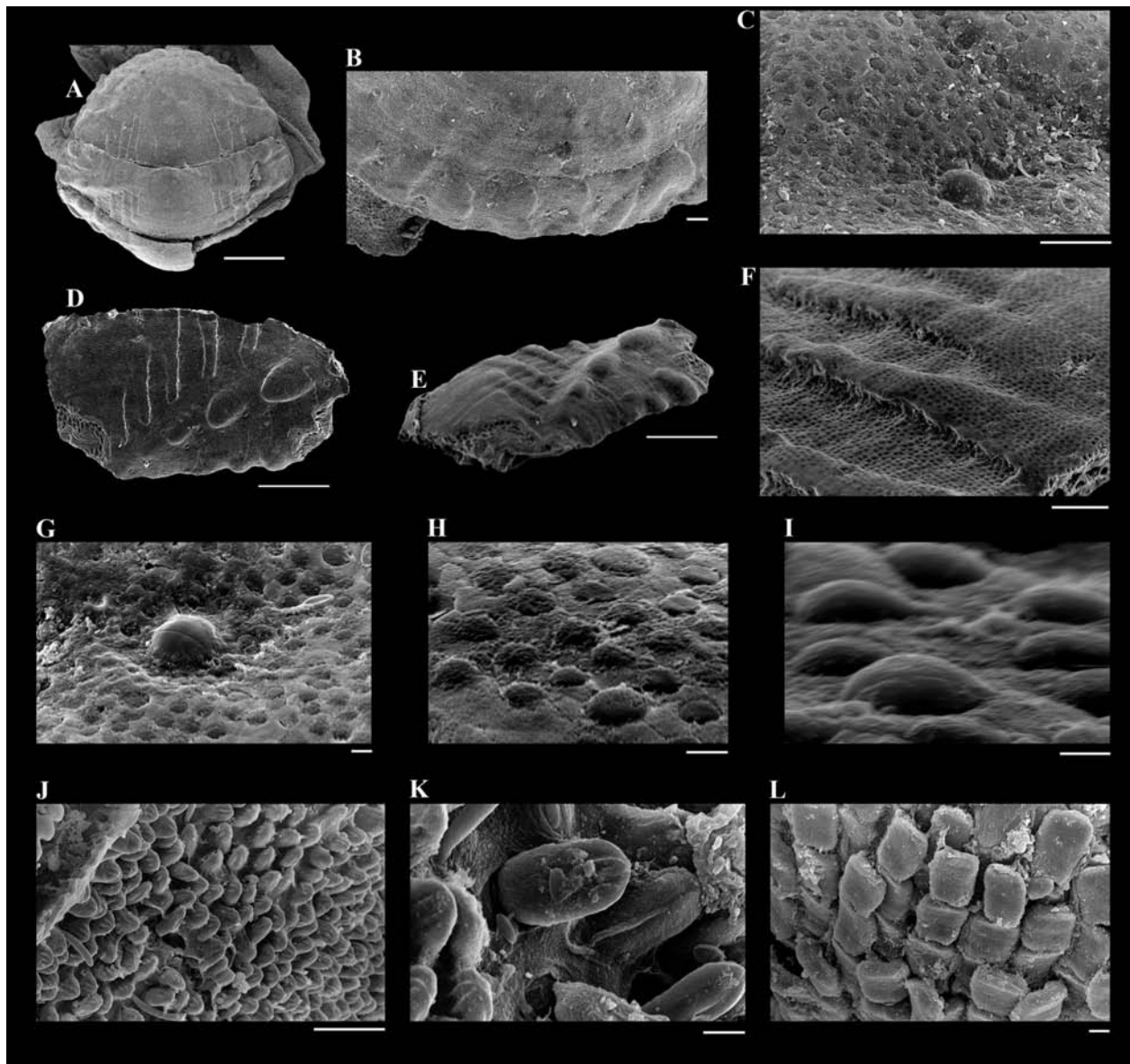


Fig. 2: Polyplacophora from Madagascar. — A–L. *Lucilina tilbrooki* MILNE 1958 (Tuléar), A) living collected specimen, B–C) details of the postmucronal area of tail valve, D–E) half intermediate valve detached from the living specimen, F) detail of longitudinal ribs in the pleural area, G) ocellus, surrounded by apical caps, H–I) details of the apical caps, J–K) dorsal girdle spicules, L) ventral girdle scales. — Scale bars: 1 mm: A; 500 μ m: D, E; 100 μ m: B, F; 50 μ m: C, J; 10 μ m: G, H, K, L; 5 μ m: I.

Acanthochitona penicillata (DESHAYES 1863)

Fig. 4 F

Chiton penicillatus DESHAYES 1863: 41, pl. 6, figs 8, 10.

Acanthochitona penicillata. — STRACK 1993: 23, pl. 5, fig. 6. — DELL'ANGELO et al. 2004: 56, pl. 5, figs 10–16 (bibliography and synonymy). — ANSEEUW & TERRYN 2004: 17, figs 56–57. — DINAPOLI & JANSSEN 2009: 27, figs 14 a–d (bibliography and synonymy).

Type material: probably lost (fide STRACK 1993: 25).

Type locality: Réunion.

Material examined: Tuléar D20B: 1 spm.

Remarks: *Acanthochitona penicillata* is a common and widespread species in the Indian Ocean at shallow

depths, mostly intertidal. It was fully discussed and well figured by DELL'ANGELO et al. (2004) and DINAPOLI & JANSSEN (2009).

Distribution: From the Western Indian Ocean (Madagascar, Tanzania, Somalia, Seychelles, Réunion, Mauritius) to the Red Sea, Suez Canal, Socotra, Yemen, and the Maldivé Islands.

Acanthochitona limbata KAAS 1986

Figs 1 F–J, 4 G

Acanthochitona limbata KAAS 1986: 18, figs 49–61. — DRIVAS & JAY 1998: 33, fig. 8. — SLIEKER 2000: 50, fig. 34. — DELL'ANGELO et al. 2004: 56, pl. 6, figs 1–5.

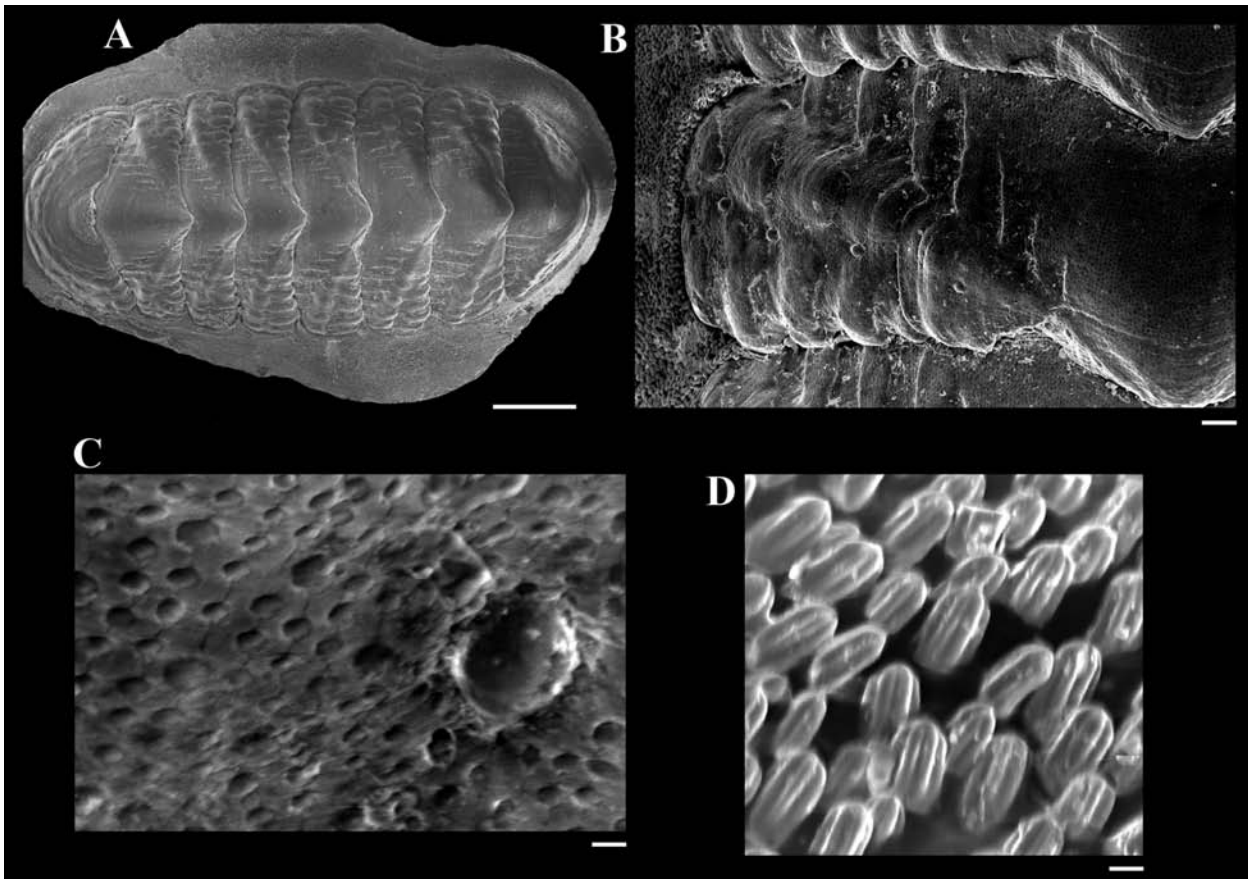


Fig. 3: species of Polyplacophora. — A–D. *Lucilina tilbrooki* MILNE 1958, paratype, SAMA D14591, 1 specimen (not coated), Heron Is., Capricorn Group, Queensland, A) dorsal view, B) detail of an intermediate valve, C) ocellus surrounded by apical caps, D) dorsal girdle spicules. — Scale bars: 1 mm: A; 100 μ m: B; 10 μ m: C, D.

Acanthochiton zelandicus doubtlessensis LELOUP 1981: 7, fig. 2 (fide KAAS 1986).

Type material: holotype and 46 paratypes MNHN (a paratype figured in DELL'ANGELO et al. 2004: pl. 6, figs 1–5); coll. KAAS 5040 (now in RMNH, Leiden): 4 paratypes; coll. VAN BELLE VB2923a (now in IRSN, Brussels): 2 paratypes; MNHN: 1 paratype (from st. 8-10-1).

Type locality: Madagascar, Tuléar, “faune cavitaire, platier”, coll. PEYROT-CLAUSADE, 1968; st. 8-10-1: “pente interne; Grande Vasque”, 8 m.

Material examined: Tuléar: 1112: 3 spm dry; 1131: 1 spm dry; 1285: 2 spm; 1322: 3 spm dry; 1323: 2 spm; 1327: 2 spm; 1329: 3 spm dry; 1331: 16 spm; 1332: 5 spm; 21214: 1 spm and 3 spm dry; 21225: 1 spm dry; 22212: 3 spm; 22213: 1 spm; 22314: 1 spm dry; 21714: 6 spm. Tuléar Grand Recif: 5 spm.

Remarks: *A. limbata* was established by KAAS (1986) on the basis of 54 specimens collected in Tuléar. Surprisingly, this relatively common species was not identified in the rich material (loose valves mostly) discussed by DELL'ANGELO et al. (2004). On the contrary, *A. limbata* is very abundant, in the present material.

The granules are drop-shaped thus differing from those decidedly triangular of *A. penicillata*, a congeneric

species also found in Tuléar. Furthermore, the jugal area is longitudinally striated, while smooth in *A. penicillata*. Outside Madagascar the species is only known from La Réunion, by two valves, which were dredged in 40 m (DRIVAS & JAY 1998).

Distribution: Madagascar and Réunion.

Genus *Choneplax* DALL 1882

Type species: *Chiton strigatus* SOWERBY 1840 (= *Chitonellus latus* GUILDING 1829), by original designation.

Choneplax indica ODHNER 1919

Fig. 4 H

Choneplax indicus ODHNER 1919: 40, pl. 3, figs 44–45.

Choneplax indica. — SIRENKO 2003: 33, 35. — DELL'ANGELO et al. 2004: 58, pl. 6, figs 8–13 (bibliography and synonymy). — SCHWABE 2004: 3160, figs 11–13, 17D (bibliography and synonymy). — DINAPOLI & JANSSEN 2009: 31, figs 16 a–c.

Type material: holotype (SMNH 1324, indicated as syntype).

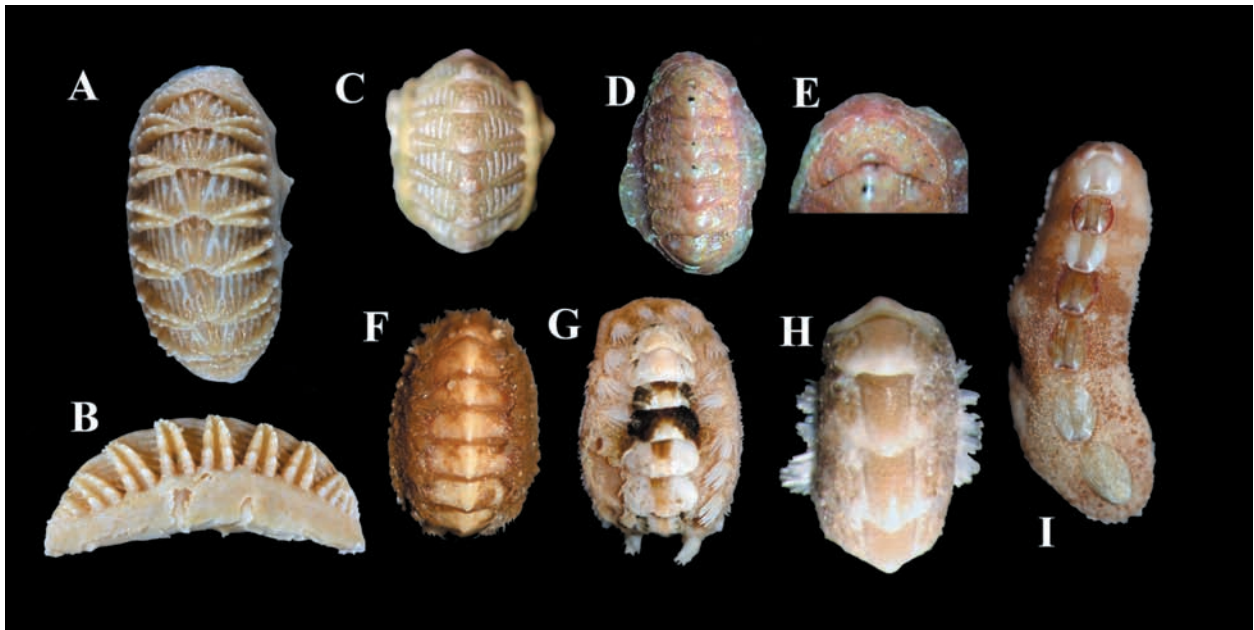


Fig. 4: species of Polyplacophora. — A–B. *Callistochiton rotundus* LELOUP 1981, Tuléar, st. 18/15 (length 20 mm), dorsal and lateral view, respectively. — C. *Chiton kaasi* (LELOUP 1981), Tuléar (length 5 mm). — D–E. *Lucilina tilbrookii* MILNE 1958, paratype, SAMA D14591, Heron Is., Capricorn Group, Queensland (length 7.7 mm), D) dorsal view, E) details of the head valve. — F. *Acanthochitona penicillata* (DESHAYES 1863), Tuléar D20B (length 7.7 mm). — G. *Acanthochitona limbata* KAAS 1986, Tuléar 21714 (length 8.1 mm). H. *Choneplax indica* ODHNER 1919, Tuléar Lovobé (length 3.6 mm). — I. *Cryptoplax sykesi* THIELE 1909, Tuléar 1111 (length 12.8 mm).

Type species: Madagascar, Tamatave (“sur le récif de coraux”).

Material examined: Tuléar: 1112: 1 spm; Lovobé: 1 spm; TUG 8/16: 1 spm.

Remarks: The examined specimens fully agree with descriptions and figures provided by KAAS (1986), SCHWABE (2004) and DINAPOLI & JANSSEN (2009).

Distribution: Leven Bank (North of Mozambique Channel), Madagascar, Réunion, Mauritius, and Rodrigues (Mascarene Islands), Socotra.

Family Cryptoplacidae H. & A. ADAMS 1858

Genus *Cryptoplax* DE BLAINVILLE 1818

Type species: *Chiton larvaeformis* DE BLAINVILLE MS, BURROW 1815, by subsequent designation (GRAY 1821: 234).

Cryptoplax sykesi THIELE 1909

Fig. 4 I

Cryptoplax sykesi THIELE 1909: 53, pl. 6, figs 83–86. — KILIAS 1995: 169. — ANSEEUW & TERRY 2004: 16, fig. 55. — DELL'ANGELO et al. 2004: 60, pl. 6, figs 14–15 (bibliography and synonymy). — DINAPOLI & JANSSEN 2009: 36, figs 19 a–b.

Type material: lectotype ZMB Moll. 102074; 2 paratypes ZMB Moll. 102075 (KILIAS, 1995: 169).

Type locality: Red Sea, Gimsah Bay.

Material examined: Tuléar: 1110: 6 spm; 1111: 10 spm; 1112: 6 spm; 1113: 11 spm; 1116: 1 spm; 1217: 1 spm; 1285: 4 spm; 1417: 1 spm; 1419: 2 spm; 1428: 2 spm; 12112: 1 spm; 21123: 4 spm; 21124: 1 spm; 21125: 2 spm; 21726: 1 spm; 22114: 1 spm; 22116: 2 spm. Tuléar Sarodrano: 2 spm.

Remarks: *Cryptoplax sykesi* is an intertidal to shallow sublittoral species, widespread in the Western Indian Ocean, Red Sea included (type locality). It is very abundant in the present material. The examined specimens fully agree with descriptions and figures provided by FERREIRA (1983) and KAAS (1986).

Distribution: Red Sea, Socotra, Somalia, Tanzania, Mozambique, Natal, Amirante Islands, Geyser Bank (North of Mozambique Channel), Madagascar and Maldives.

Conclusions

The study of a small amount of living-collected Polyplacophora from shallow coral reef habitats in Madagascar permits a refinement of the Western Indian Ocean chiton fauna. The material studied consists of seven species, represented by 123 living specimens (table 1). The availability of well preserved complete specimens allows us to improve the data presented in our previous paper on Tulear chitons (DELL'ANGELO et al. 2004), mainly based on single valves.

Table 1. Total number of living specimens examined in this study

Species	Samples	Specimens
<i>Callistochiton rotundus</i>	1	1
<i>Chiton kaasi</i>	1	1
<i>Lucilina tilbrooki</i>	1	1
<i>Acanthochitona penicillata</i>	1	1
<i>Acanthochitona limbata</i>	18	58
<i>Choneplax indica</i>	3	3
<i>Cryptoplax sykesi</i>	18	58
total	43	123

Two species (*A. limbata* and *C. sykesi*) represent 94.3 % of the total amount, while, at an opposite extreme, four species (*C. rotundus*, *C. kaasi*, *L. tilbrooki* and *A. penicillata*) are known from only one specimen each. *Lucilina tilbrooki* is reported for the first time from

Madagascar and from the Indian Ocean, and the finding of this elusive species is the most relevant datum from a biogeographic point of view. This species was so far only known from the type material (5 specimens) from the Western Pacific at Heron Island, Australia. Also of interest is the record of a second specimen of *Callistochiton rotundus* a very rare species previously only known from its holotype. More in general, the present study permits to update the knowledge of Polyplacophora known so far from Madagascar.

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