

## Two new species of the skeneiform genus *Callodix* Laseron, 1954 from the Indian Ocean

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**KEYWORDS.** Gastropoda, Trochoidea, Skeneidae, *Callodix*, Indian Ocean, new species.

**ABSTRACT.** Two new species from the Indian Ocean are described in the skeneid genus *Callodix* Laseron, 1954. The new species are compared with the previously known *Callodix solida* Laseron, 1954 and *Callodix conica* Laseron, 1958. These two latter species are illustrated by photographs and also the new species by SEM micrographs. Data on habitat, bathymetry and geographic distribution of the new species are provided. At the same time, we here assign the previously described species *Anticlimax juanviano* Rubio & Rolán, 2018, *Anticlimax discus* Rubio & Rolán, 2014 and *Anticlimax religiosa* Rubio & Rolán, 2014 to *Callodix* and illustrate them.

**RESUMEN.** Se describen dos nuevas especies de skeneidos del género *Callodix* Laseron, 1954 procedentes del Océano Índico. Las nuevas especies se comparan con las especies previamente conocidas *Callodix solida* Laseron, 1954 y *Callodix conica* Laseron, 1958. Estas dos últimas especies, se ilustran mediante fotografías y las especies nuevas mediante micrografías obtenidas al MEB. Se aportan datos sobre hábitat, batimetría y distribución geográfica de las nuevas especies descritas. Al mismo tiempo se considera que las especies descritas previamente *Anticlimax juanviano* Rubio y Rolán, 2018, *Anticlimax discus*, Rubio y Rolán, 2014 y *Anticlimax religiosa* Rubio y Rolán, 2014, pertenecen a este género y se representan.

### INTRODUCTION

Laseron (1954) created the genus *Callodix*, designing *C. solida* as the type species. He considered that it was probably related to *Teinostoma*, mainly due to the striated columellar callus that is extended on the umbilicus occluding it completely; however, he placed it in Liotiidae, with genera as diverse as *Liotina* Fischer, 1885, *Orbitestella* Iredale, 1917, *Cirsonella* Angas, 1877, *Lodderena* Iredale, 1924, *Brookula* Iredale, 1912 and *Pseudoliotia* Tate, 1898, as well as new genera of uncertain classification such as *Microcarina*, *Liocarina*, *Helisalia*, *Cavotera*, *Cavostella*, *Rotostoma* and *Wanganella*, amongst others.

Some of these genera currently remain in Liotiidae (*Liotina*), or are assigned to other families, such as Skeneidae (*Callodix*, *Liocarina*, *Rotostoma*, *Cirsonella*, *Lodderena*) (MolluscaBase 2019), an unassigned Seguenzioidea (*Microcarina*, *Wanganella*, *Brookula*), in Orbitestellidae (*Orbitestella*), or Vitrinellidae (*Pseudoliotia*).

Iredale & McMichael (1962) assigned *Callodix* to their new family Callomphalidae along with six other genus group names proposed by Laseron. However, this family name is invalid and not available because the authors provided no diagnosis.

There are already detailed reviews in the literature of the problems of classifying skeneiform gastropods. Ponder (many papers) has treated taxa that have been uncomfortably transferred from indeterminate vetigastropod (“skeneiform status”) to indeterminate rissoidean Caenogastropod status or to heterobranch status. Ponder (1994) referred to a “vitrinellid-tornid assemblage”.

Ponder & de Keyzer (in Beesley *et al.* 1998) in a comprehensive review of rissoidean families note that most available names are based on species that have not been collected alive and that without information on the animals their relationships will continue to be questionable. They regard Vitrinellidae as in “a state of taxonomic chaos” such that any discussion of even the genera present in Australia is premature.

It is important to mention that Takano & Kano (2014) in their molecular phylogeny show that

Tornidae is not monophyletic if it includes *Vitrinella* (*Vitrinella* is sister to *Iravadia*).

The molecular evidence confirms the earlier skepticism of monophyly by Ponder & de Keyser (1998) in their review of Australian rissoidean family groups. It also supports the evidence from detailed study of live-collected animals of three anatomical characters separating Tornidae and Vitrinellidae as defined and discussed by Bieler & Mikkelsen (1988). Hickman & McLean (1990), Hickman (in Beesley *et al.* 1998), and Hickman (2013) have likewise treated Skeneidae as a large polyphyletic assemblage of genera (130 available genus-group names) that cannot be assigned under the restrictive radular and anatomical diagnosis of the family. *Callodix* has already been excluded from Skeneidae, but without reassignment, pending anatomical and/or molecular data.

In the meantime, we follow here the classification of MolluscaBase 2019. We decided simply to describe and to figure the existing species of *Callodix*, to describe two new species from Madagascar in this genus and to assign in *Callodix* our three species previously described under the genus *Anticlimax*.

## MATERIAL AND METHODS

Our knowledge of the marine biodiversity of Madagascar is to a very large extent based on research carried in the regions of Nossi-Bé and Tuléar [Toliara], both located in the "Western and Northern Madagascar" marine ecoregion (Spalding *et al.* 2007) and characterized by extensive coral reefs ecosystems. By contrast, the "Deep South" of Madagascar is an oceanic region of fierce promontories, open bays and extensive algal belts. The lack of infrastructures has arguably made it the least visited and least known coastline in the country. The marine hydroclimate is characterized by a coastal upwelling with cold surface water and high concentrations of chlorophyll-*a* (Lutjeharms & Machu 2000), with winter sea surface temperatures as low as 21.5°C, vs 24-25°C or more elsewhere around Madagascar (Piton & Laroche 1993). From the late 1990's, new species of molluscs started to be discovered on the coastline of the regions Anosy and Androy, first serendipitously as a by-product of the local lobster fishery (e.g. Bouchet 1999), and later specifically attracting shell collectors and amateur taxonomists (e.g. Bozzetti 2006, 2008). These scattered findings and the unique oceanographic background together suggested that the "Deep South" of Madagascar had a potential for more discoveries, and this was what motivated a large-scale exploring expedition that sampled the benthos of the region in April-June 2010. The name of the expedition, *Atimo Vatae*, means "Deep South" in the regional Antandroy language. For base line information on the project, see <http://laplaneterevisitee.org/en/87/accueil>.

All materials used in the present study were obtained in sediments collected by the oceanographic

expedition ATIMO VATAE (2012) doi.org/10.17600/10110040. Expedition to Madagascar "Deep South" marine fauna & flora, in shallow and deep waters off Madagascar.

In some stations, the material was obtained by dredging; the shells were separated under binocular set vision. For a more detail study, the scanning electron microscopy Quanta 200 was employed.

## Abbreviations

AM: Australian Museum, Sydney;

ICZN: International Commission of Zoological Nomenclature;

MNHN: Museum national d'Histoire naturelle, Paris, France;

CACTI: Centro de Apoyo Científico y Tecnológico a la Investigación, University of Vigo, Spain;

Stn: Station;

S: empty shell;

WoRMS: World Register of Marine Species.

## SYSTEMATICS

Superfamily **Trochoidea** Rafinesque, 1815

Family **Skeneidae** Clark, 1851

Genus ***Callodix*** Laseron, 1954

*Callodix* Laseron, 1954: 16, type species by original designation: *Callodix solida* Laseron, 1954 (Type locality: off Long Reef, Collaroy, Sydney N, NSW, Australia).

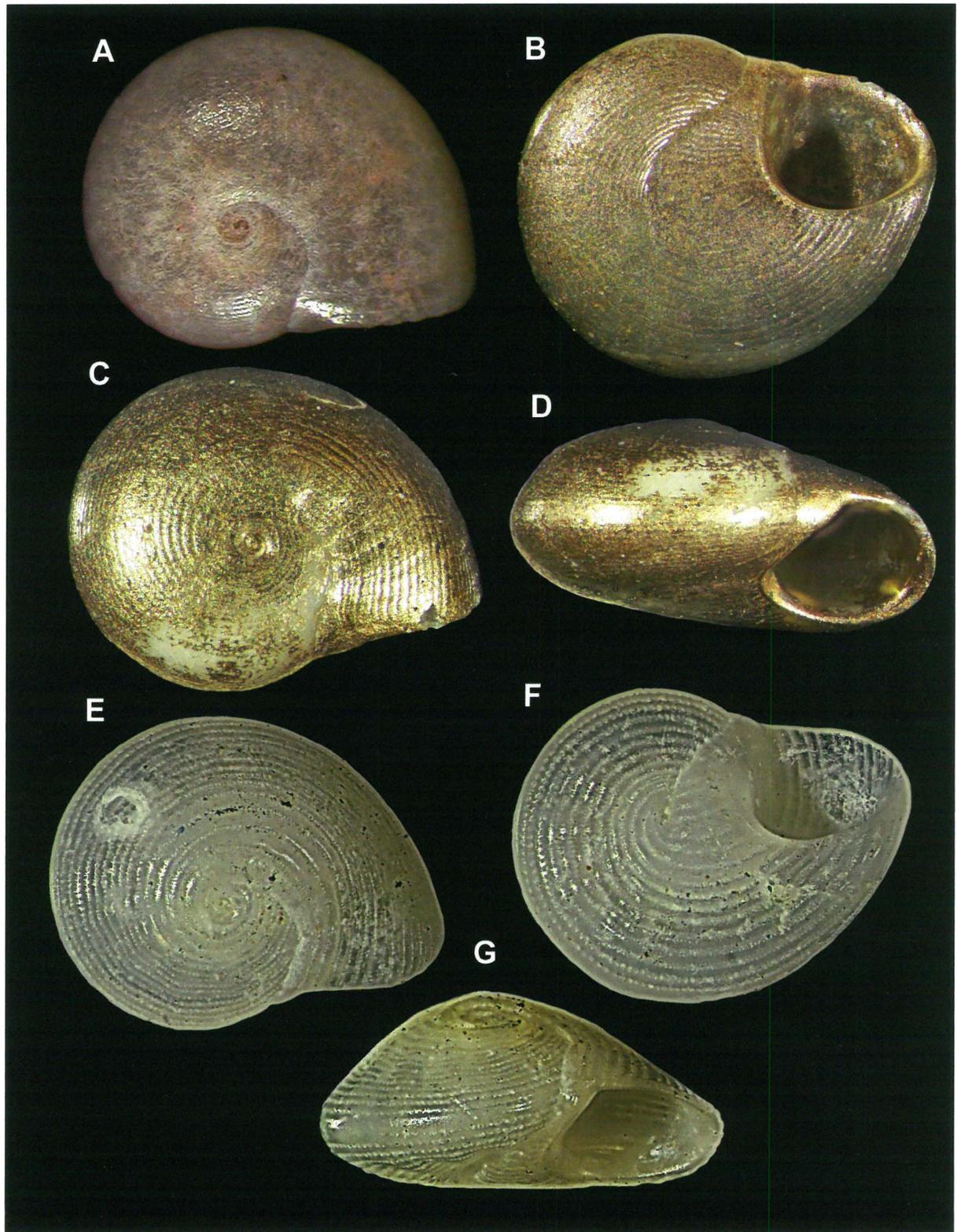
Diagnosis: "Shell small and with a depressed spire, solid, few whorled, the sculpture fine concentric ridges, the aperture extended and very oblique, without a varix, the callosity on the base striated and greatly developed, forming not only the inner margin and covering the whole of the umbilical area, but extending above the aperture on to the body whorl, where it partially obscures the suture" (Laseron 1954).

**Remarks.** The species of *Callodix* present generic characters defined by Laseron (1958: 173) as follows:

1. Small, depressed shell with fine spiral sculpture.
2. Greatly developed striate callus covering the base and extending posteriorly above the aperture upon the spire.

They also present other morphological characters such as:

1. Protoconch sometimes partially covered by the following whorls.
2. Teleoconch totally covered with spiral cords and grooves in the interspaces, which are usually in zigzag.
3. Aperture very prosocline.



**Figure 1**

**A-D.** *Callodix solida* Laseron, 1954. A. Syntype AM C.102626, 2.38 mm in diameter; B-D. syntype AM C. 102626, 2.40 mm in diameter.

**E-G.** *Callodix conica* Laseron, 1958. Holotype AM C.102625, 1.72 mm in diameter.

In our opinion, and after examining the morphology of the studied species, we are using *Callodix* as stating a subjective judgment of the *concept* and not validity of the *name* in the nomenclatural sense of the ICZN. For morphological reasons we consider that the species *Anticlimax discus*, Rubio & Rolán (2014) (Fig. 4A-B), *Anticlimax religiosa* Rubio & Rolán (2014) (Fig. 4C-E) and *Anticlimax juanviano* Rubio & Rolán (2018) (Fig. 4F-G) should be placed in *Callodix*.

***Callodix solida* Laseron, 1954**

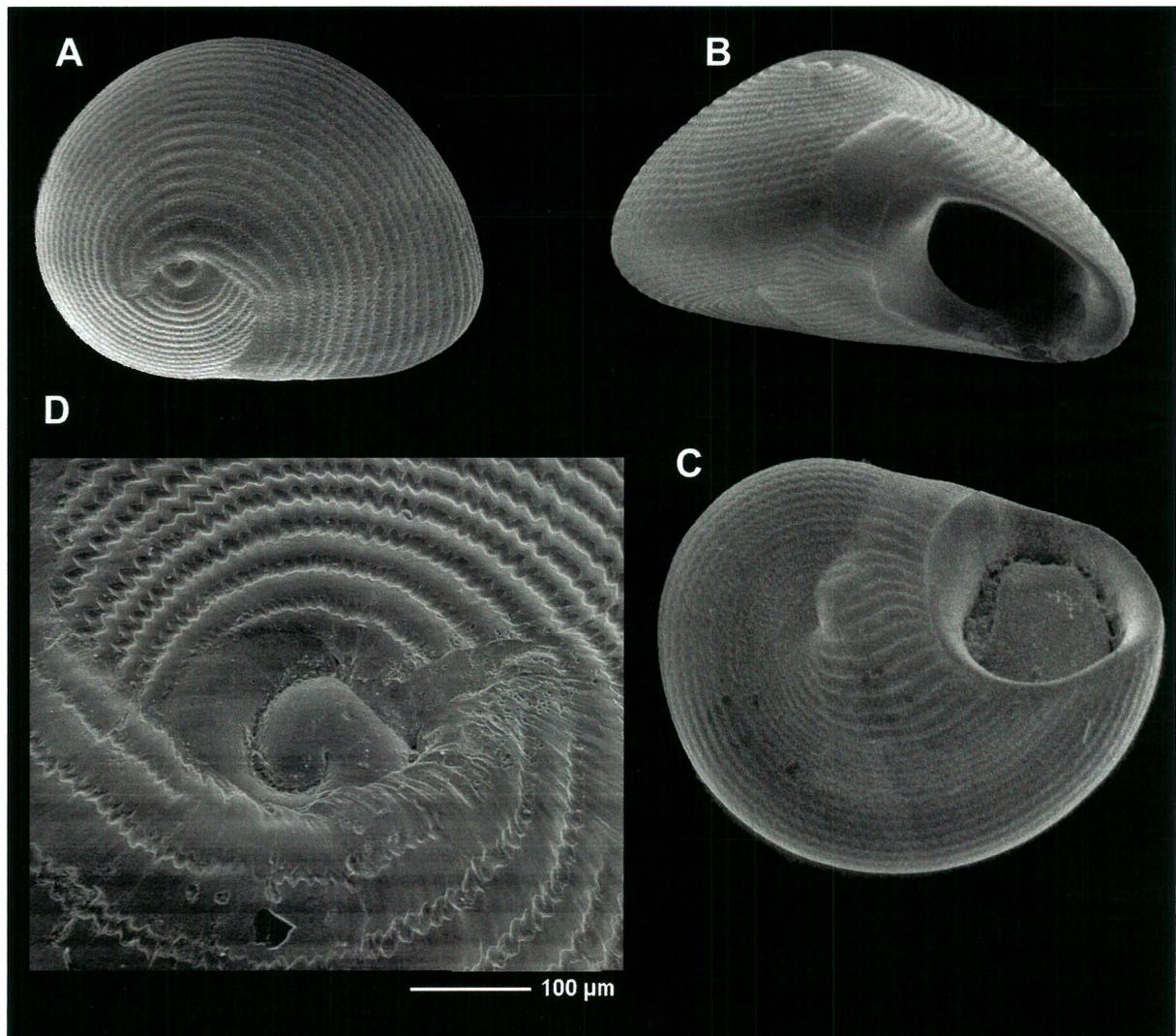
Fig 1A-D

*Callodix solida* Laseron, 1954: 16, fig. 25a-b.

**Type locality.** Off Long Reef, Collaroy, Sydney N, NSW, Australia.

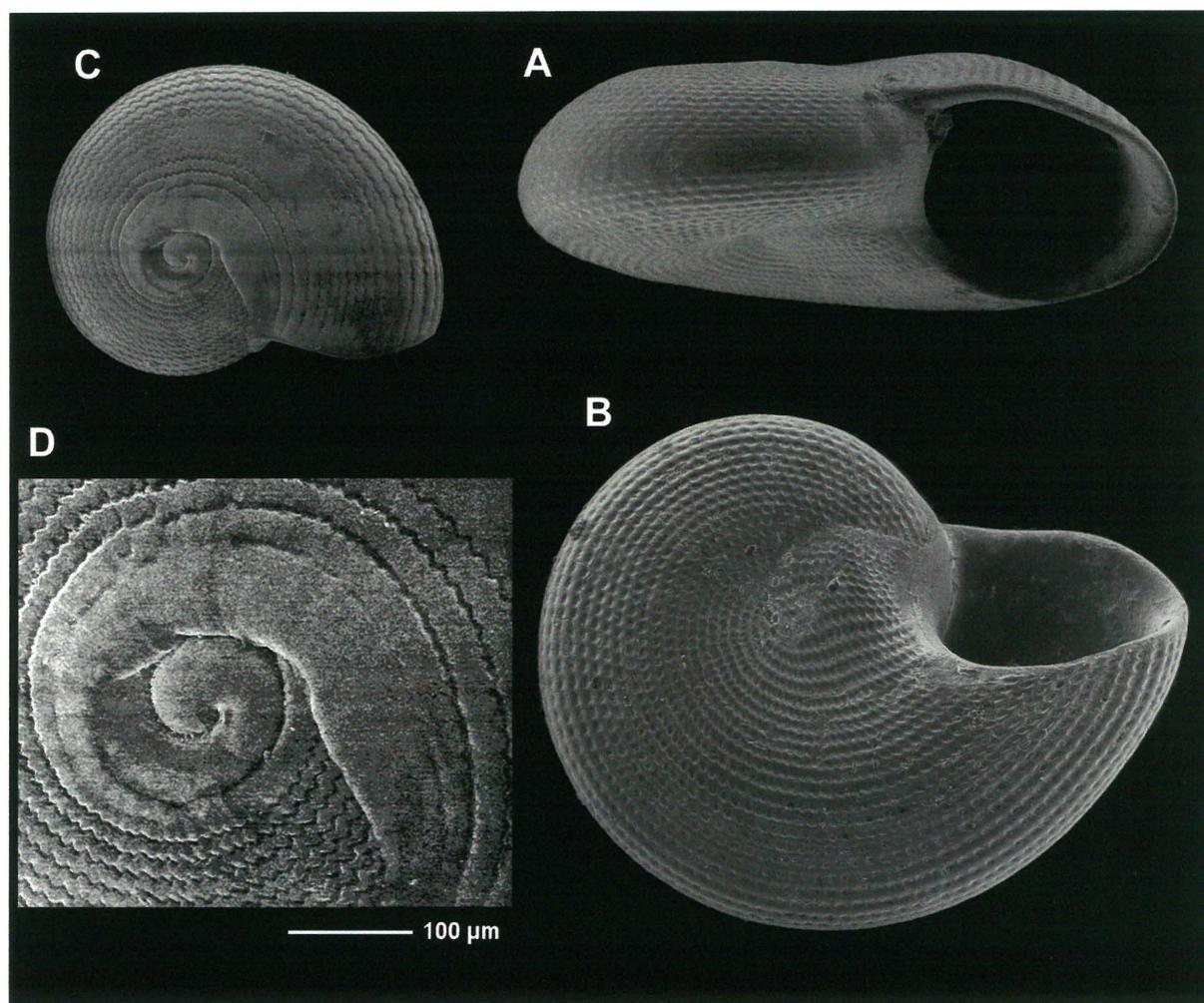
**Type material.** 4 syntypes AM C.102626.

**Remarks.** According to the *Atlas of Living Australia* (ala.org.au), there are 51 lots for *Callodix solida* in the Australian Museum in Sydney; its geographical distribution is almost restricted to the Australian shores, having been found in the states of Western Australia, Queensland and New South Wales, however, among these, there are also two lots of French Polynesia, whose confirmation is pending.



**Figure 2**

*Callodix pseudoconica* n. sp. A-C. Holotype MNHN-IM-2000-34585, 1.87 mm in diameter, South Madagascar, Libanona Beach, 25°02.5'S-46°59.7'E, 4-5 m, corallin rock bottom (ATIMO VATAE, stn TB07); D. Protoconch.

**Figure 3**

*Callodix planata* n. sp. **A-B.** MNHN-IM-2000-34587, 1.7 mm in diameter; **C.** paratype MNHN-IM-2000-34588, 0.95 mm; **D.** protoconch of the paratype.

***Callodix conica* Laseron, 1958**

Fig. 1E-G

*Callodix conica* Laseron, 1958: 177, figs. 55-57.

**Type locality.** Darwin, Northern Australia.

**Type material.** Holotype AM C.102625.

**Remarks.** The species is characterized by its more conical shell and the even greater development of the extraordinary callus.

*Callodix conica* apparently has a very uneven distribution; only two lots, deposited at the Australian Museum in Sydney, are known: that of the holotype, which comes from Darwin, Northern of Australia and a second collected in Okinawa, "Onna Flats", 1.5 km WNW Onna, in Japan. This last lot is, in our understanding, pending confirmation, given the large distance between both locations.

***Callodix pseudoconica* n. sp.**

Fig. 2A-D

**Type material.** Holotype MNHN-IM-2000-34585 (Fig. 2A-B) and one paratype MNHN-IM-2000-34586.

**Material examined.** 10 s: South Madagascar, ATIMO VATAE: 1 s, Monseigneur Beach, Stn TM01, 25°02.1-2'S-46°59.9'E, intertidal, rocky bottom with algae; 1 s, Sector of Lavanono, stn BB03, 25°26.4'S-44°56.1'E, 14-18 m, calcareous rocks bulged; 1 s, E Cap Antsirabe, stn TS04, 25°02.3'S-47°00.3'E, 22-24 m, flat rocks and sand with sponges; 2 s, Libanona Beach, stn TB07, 25°02.5'S-46°59.7'E, 4-5 m, corallin rock bottom (holotype and paratype MNHN); 1 s, South of Lokaro Bay, Stn TS09, 24°57.0'S-47°06.4'E, 5-6 m, rocks with sand and mud; 1 s, entrance East of Galions Bay, stn TB10, 25°09.3'S-46°45.3'E, 10 m, brush of rare rocks; 1 s, Flacourt Point, stn TB12, 25°01.5'S-47°00.0'E, 4-5 m, reef bottom; 2 s, W Cap

Antsirabe, stn TS12, 25°02.5'S-46°59.7'E, 4-5 m, rocky bottom in the limit of the reef.

**Type locality.** South Madagascar, Libanona Beach, 25°02.5'S-46°59.7'E, 4-5 m, coral rock bottom (ATIMO VATAE: Stn TB07).

**Etymology.** The specific name refers to the similarity with the type species *C. conica*.

**Description.** Shell very small (<2.00 mm), conoidal, robust, wider than high, basally carinate and not umbilicate.

The protoconch is partially covered by the following whorls, making it very difficult to specify size, number of whorls and ornamentation; however, from what we have been able to see with SEM, the protoconch should have something more than 1 ¼ whorls and a slightly rough surface at embryonic stage.

The teleoconch apparently has 2 whorls and there is not a very sharp basal carina; each whorl almost completely covers the previous one and its entire surface is covered with zigzagging spiral cords and grooves in the interspaces, including the surface of the carina and the umbilical callus.

There are between 40-42 spiral cords distributed between the suture and the umbilical callus.

Aperture oval, prosocline. Parietal area covered by a thick callous layer that is extended adapically until almost completely covering the previous whorl; columella arched, very thick and reflected towards the umbilicus, forming a large columellar callus which occludes it completely; both parietal and columellar callus are covered by spiral cords in zigzag, like the rest of the shell. Outer lip with a smooth margin.

Umbilicus completely covered by the expansion of the columellar callus.

Dimensions: the holotype measures 1.87 mm in diameter and 1.12 mm in height (H/D: 0.60).

**Habitat.** Infralittoral species collected at 0-24 m in limestone rock overhanging; coral rocky bottom; brushing on rare stones; reef background; slab and sand in Sponges; intertidal, rocky bed with algae; rock with sand and silt and rocky bottom in edge of flat.

**Distribution.** Only known from Southern Madagascar.

**Remarks.** *Callodix pseudoconica* n. sp. is characterized by its conoid shape and by the number of the spiral cords on the last whorl.

By its shape it is very similar to *C. conica*, from which it can be distinguished by the higher number of spiral cords and by having a less prominent the basal carinae.

From *Callodix discus*, which was assigned in the genus *Anticlimax* (see Rubio & Rolán, 2014), it may be differentiated by having a higher number of spiral cords and by the lack of a raised area around the umbilicus.

*Callodix planata* n. sp.

Fig. 3A-D

**Type material.** Holotype MNHN-IM-2000-34587 (Fig. 3A-B) and one paratype MNHN-IM-2000-34588.

**Material examined.** 2 s: **South Madagascar**, ATIMO VATAE: 1 s, Pointe Evatra, Stn TB01, 24°59'8S-47°05.7'E, 22 m, rocky bottom, depressions of sand (paratype); 1 s, South Lokaro Bay, TS09, 24°57.0'S-47°06.4'E, 5-6 m, rocks with sand and mud (holotype).

**Type locality.** South Lokaro Bay, South Madagascar, 24°57.0'S-47°06.4'E, 5-6 m, rocks with sand and mud (ATIMO VATAE: Stn TS09).

**Etymology.** The specific name derives from the past participle of the Latin verb *plano*, *as*, *ari*, *avi*, *atum*, meaning "roll flat" and alluding to its adapical part, in which the spire is almost non-appreciable.

**Description.** Shell very small (<2.00 mm), almost planispiral, robust, much wider than high, not carinated or umbilicated.

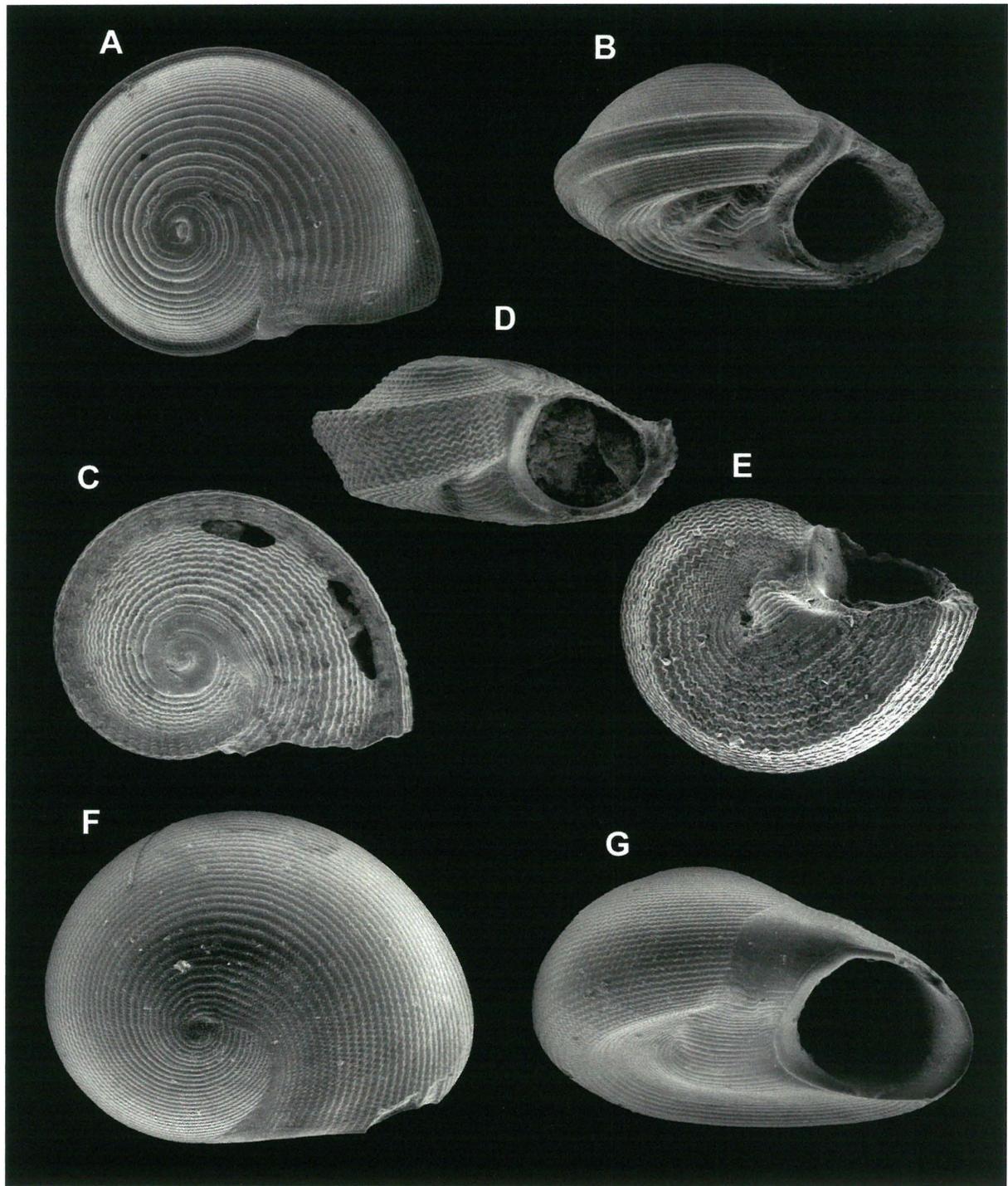
The protoconch is partially covered by the following whorls, making it very difficult to specify size, number of whorls or ornamentation; however, from what we have been able to see with SEM, the protoconch should have something more than 1 ½ whorls and, probably, it develops in two phases, but this would need the observation in juveniles.

The teleoconch apparently has 2 whorls and there is no basal carina; each whorl covers the previous one almost completely and its entire surface is completely covered by zigzagging spiral cords and grooves in the interspaces, including the surface of the umbilical callus; the spiral cords are wider than the grooves; the spiral grooves, in the last whorl, are transformed into rectangular spaces.

Base convex, somewhat concave in its umbilical zone.

Aperture oval, prosocline. Parietal area covered by a thick callous layer that extends adapically until covering the previous whorl almost completely; columella arched, very thick and reflected towards the umbilicus, forming a large callus which occludes it completely; both columellar callus are covered by spiral cords in zigzag, like the rest of the shell. Outer lip with a smooth margin.

Umbilicus completely covered by the expansion of the columellar callus



**Figure 4**

**A-B.** *Callodix discus* (Rubio & Rolán, 2014), holotype MNHN-IM-2000-27211, 1.78 mm; **C-E.** *Callodix religiosus* (Rubio & Rolán, 2014), holotype MNHN-IM-2000-27216, 1.4 mm; **F-G.** *Callodix juanvianoi* (Rubio & Rolán, 2018), holotype MNHN-IM-2000-33610, 2.3 mm.

Dimensions: the holotype measures 1.7 mm in diameter and 0.65 mm in height (H/D: 0.39).

**Habitat.** Infralittoral species collected at 5-6 m in rock with sand and silt bottom and at 22 m in rocky bottom.

**Distribution.** Only known from Pointe Evatra and South Lokaro Bay, South of Madagascar.

**Remarks.** *Callodix planata* n. sp. is characterized by its flat form, almost planispiral and by its protoconch which seems to be developed in two phases.

It is rather similar to *C. solida* in shape but it can be differentiated by the lower number of spiral cords and the apertural form.

From *C. conica*, *C. pseudoconica* n. sp. and *C. discus* it may be separated by its almost planispiral form.

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