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MUSEU DE ZOOLOGIA

Daniel Caracanhas Cavallari

Taxonomical study on the Vetigastropoda (Mollusca) from Canopus Bank, NE Brazil, with further remarks on their distribution along the Western Atlantic

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Orientador: Prof. Dr. Luiz Ricardo Lopes de Simone

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To my beloved wife,
my parents, and family

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Above all else, I thank my wife and family for the unending love and support I have received: Daniele, Geraldo and Ana Lúcia. None of my accomplishments would be the same without you. My advisor, Luiz Simone, for the opportunity and for sharing his adoration for mollusks and his morphological and taxonomical wisdom. I am also thankful to my many friends and partners at the malacology lab, past and present: Rodrigo B. Salvador, Barbara V. Romera, Carlo Magenta Cunha, Sérgio Almeida, Hilton Galvão Filho, Diogo Couto, Jaime Jardim, Rodrigo C. Marques, Daniel & Patricia Abbate, Vanessa S. Amaral, Ana Paula Dornellas, Natan C. Pedro, Eugênio Mello, Fernanda Santos, Cibele Carvalho. To my coworkers and friends at the MZSP: Ana Vasques, Alberto B. Carvalho, Lara Guimarães, Jaqueline Battilana, Marta Grobel, Omair Tizzot, Rita Dias, Glaucia Bio, Dione Seripierri, among many other cherished colleagues. I am also very thankful to the following persons from several institutions for providing papers, photographs of type material, and other crucial information: Alexandre Pimenta (MNRJ), Andreia Salvador (NHMUK), Adam Baldinger and James McCarthy (MCZ), Gary Rosenberg (ANSP), Emílio Rolán, Philippe Maestrati (MNHN), and José Leal (Bailey-Matthews). I especially thank prof. José Leal for gifting me a copy of his excellent book, which greatly contributed to this study.

ABSTRACT

A taxonomic revision of 29 species distributed in 12 vetigastropod families collected in a 60-260 m depth range at Canopus Bank, a seamount off NE Brazil, is performed based on detailed shell morphology. Their distribution and bathymetric ranges are re-examined based on specimens from Canopus and the MZSP collection. Three possibly new species are revealed and tentatively described: *Arene* aff. *brareus* can be distinguished by a large shell for the genus; sculpture consisting of spiral cords ornamented by large, semi-hollow, scale-like spines; cords separated by equally wide, deep interspaces and thin axial growth lines more visible in the interspaces; protoconch sculptured by small, subsutural axial lamellae; and color ranging from white to intense reddish, darker on spiral cords, and lighter at the base, with a yellow apex. *Parviturbo* aff. *tuberculosus* can be told apart from local congeners by its slightly taller than wide shell, which is profusely sculptured by a reticulate pattern of equally strong axial ribs and spiral cords, with angular nodules at the intersections. *Calliostoma* sp.1 shows no close affinities with any other local congener and is characterized by a small shells with convex whorls and a large, rounded apex; ivory white ground color with honey yellow apex and spiral cords; sculpture consisting of 4-6 narrow, nodulous spiral cords per whorl; suture marked by a suprasutural cord; inflated and mostly smooth base; narrow, shallow, and axially sculptured umbilicus. Moreover, three species have their distributions expanded northward from SE to NE Brazilian waters: *Emarginula suspira* Simone & Cunha, 2014, *Hemimarginula hemitoma* Simone & Cunha, 2014, and *Homalopoma boffi* Marini, 1975. Three species have their northern range limit expanded from Bahia state to Ceará state: *Arene flexispina* Leal & Coelho, 1985 and *Turbo heisei* Prado, 1999; a single NE Brazilian species is newly reported from northern waters: *Haplocochlias risoneideneryae* Barros, Santos, Santos, Cabral & Acioli, 2002; and another species, previously known only from Pernambuco state, is newly reported from Ceará state, also in NE Brazil: *Solariella quinni* Barros & Pereira, 2008. Two Caribbean species are firstly reported in the SW Atlantic: *Dentistyla dentifera* (Dall, 1889) and *Gaza* cf. *fischeri* (Dall, 1889); and a species previously reported from the Venezuelan shelf is firstly recorded in Brazilian waters: *Parviturbo annejoffeae* Rubio, Rolán & Lee, 2015. The bathymetric ranges of 11 species are expanded. High-resolution photographs of the type specimens, SEM images, and comparisons with local congeners are also provided.

Keywords: Diversity; Gastropoda; Revision; Seamount; Zonation.

RESUMO

Uma revisão taxonômica de 29 espécies distribuídas em 12 famílias de vetigastrópodes coletadas a 60-260 m de profundidade no Banco de Canopus, uma montanha submarina do Nordeste do Brasil, é fornecida com base na morfologia detalhada da concha. Sua distribuição e intervalos batimétricos são reexaminados com base em espécimes de Canopus e da coleção do MZSP. Três espécies possivelmente novas são reveladas e tentativamente descritas: *Arene* aff. *briareus* pode ser distinguido por uma concha grande para o gênero; escultura constituída por cordas espirais ornamentadas por espinhos grandes, semi-ocos e escalares; cordas separadas por intervalos igualmente amplos e profundos e linhas de crescimento axiais finas mais visíveis nos inter-espaços; protoconcha esculturada por pequenas lamelas axiais subsuturais; e cor variando de branco a avermelhado intenso, mais escura nas costelas espirais, e mais clara na base, com um ápice amarelo. *Parviturbo* aff. *tuberculosus* pode ser distinguida dos congéneres locais pela sua concha mais alta do que larga, profusamente esculturada por um padrão reticulado de costelas axiais igualmente fortes e cordas espirais, com nódulos angulares nas intersecções. *Calliostoma* sp.1 não apresenta estreitas afinidades com qualquer outro congênere local e é caracterizado por uma concha pequena com voltas convexas e um grande ápice arredondado; cor branco-marfim com ápice e cordas espirais amarelo mel; escultura de 4-6 cordas espirais estreitas e nodulosas por volta; sutura marcada por um cordão suprasutural; base inflada e lisa; umbílico estreito, raso e axialmente esculturado. Três espécies têm suas distribuições expandidas para o norte, de águas do SE para o NE do Brasil: *Emarginula suspira* Simone & Cunha, 2014, *Hemimarginula hemitoma* Simone & Cunha, 2014, e *Homalopoma boffi* Marini, 1975. Três espécies têm seu limite de extensão norte expandido da Bahia para o Ceará: *Arene flexispina* Leal & Coelho, 1985 e *Turbo heisei* Prado, 1999; Uma única espécie brasileira do NE é relatada para águas do Norte: *Haplocochlias risoneideneryae* Barros, Santos, Santos, Cabral & Acioli, 2002; E uma outra espécie, anteriormente conhecida apenas do estado de Pernambuco, é reportada para o estado do Ceará: *Solariella quinni* Barros & Pereira, 2008. Duas espécies caribenhas são registradas pela primeira vez no Atlântico sudoeste: *Dentistyla dentifera* (Dall, 1889) e *Gaza* cf. *fischeri* (Dall, 1889); e uma espécie reportada previamente para a plataforma venezuelana é registrada pela primeira vez no Brasil: *Parviturbo annejoffeae* Rubio, Rolán & Lee, 2015. As distribuições batimétricas de 11 espécies são expandidas. Fotografias dos espécimes tipo, imagens MEV e comparações com congêneres locais são fornecidas.

Palavras-chave: Diversidade; Gastropoda; Montanha submarina; Revisão; Zonação.

LIST OF FIGURES

LIST OF TABLES

SUMMARY

1. INTRODUCTION

1.1 Vetigastropoda

Vetigastropoda is a large and ancient gastropod clade comprising over 3,700 exclusively marine species. The group's shell morphology is incredibly diverse, encompassing limpet-like, calyptraeiform, neritiform, trochiform, biconical, and turbinoid shapes, and may bear foramens, slits or other similar openings (Geiger et al., 2008). Some of the most familiar animals (Fig. 1) include turban shells (family Turbinidae), top-snails (Trochidae), abalones (Haliotidae), key-hole limpets (Fissurellidae), pheasant shells (Phasianelldae), and slit snails (Pleurotomariidae); their less-known kin are the deep-water seguenzioideans (e.g., Seguenziidae, Calliotropidae), and hot-vent taxa (e.g., Lepetodrilidae, Sutilizonidae) (Geiger et al., 2008; Aktipis & Giribet, 2012).

An astounding adaptation to a wide assortment of marine environments from intertidal areas to abyssal depths, including harsher surroundings such as hydrothermal vents (Geiger et al., 2008; Aktipis & Giribet, 2012), made vetigastropod feeding habits correspondingly varied. While the majority of species are herbivores, feeding on periphyton, algae and marine angiosperms, there are filter feeders and species that feed on detritus and bacterial film. Some are even specialized carnivores, and their prey include foraminiferans, poriferans, and cnidarians (Hickman, 1988; Geiger et al., 2008). Likewise, reproductive strategies have become quite diverse in the Vetigastropoda, from broadcast spawners to species that lay eggs in gelatinous masses or in fewer numbers on particular substrata (Hickman, 1992; Geiger et al., 2008).

The earliest vetigastropods appeared in the Paleozoic, most probably in the Cambrian/Ordovician boundary (~488 Ma), judging by a rich fossil record. Teleoconch features such as the outline, presence of a narrow sinus, slits, and selenizones are usually employed to typify fossilized basal vetigastropod shells (Frýda et al., 2008). Other features such as the presence of a nacreous layer or the absence of a second-stage protoconch associated with specific

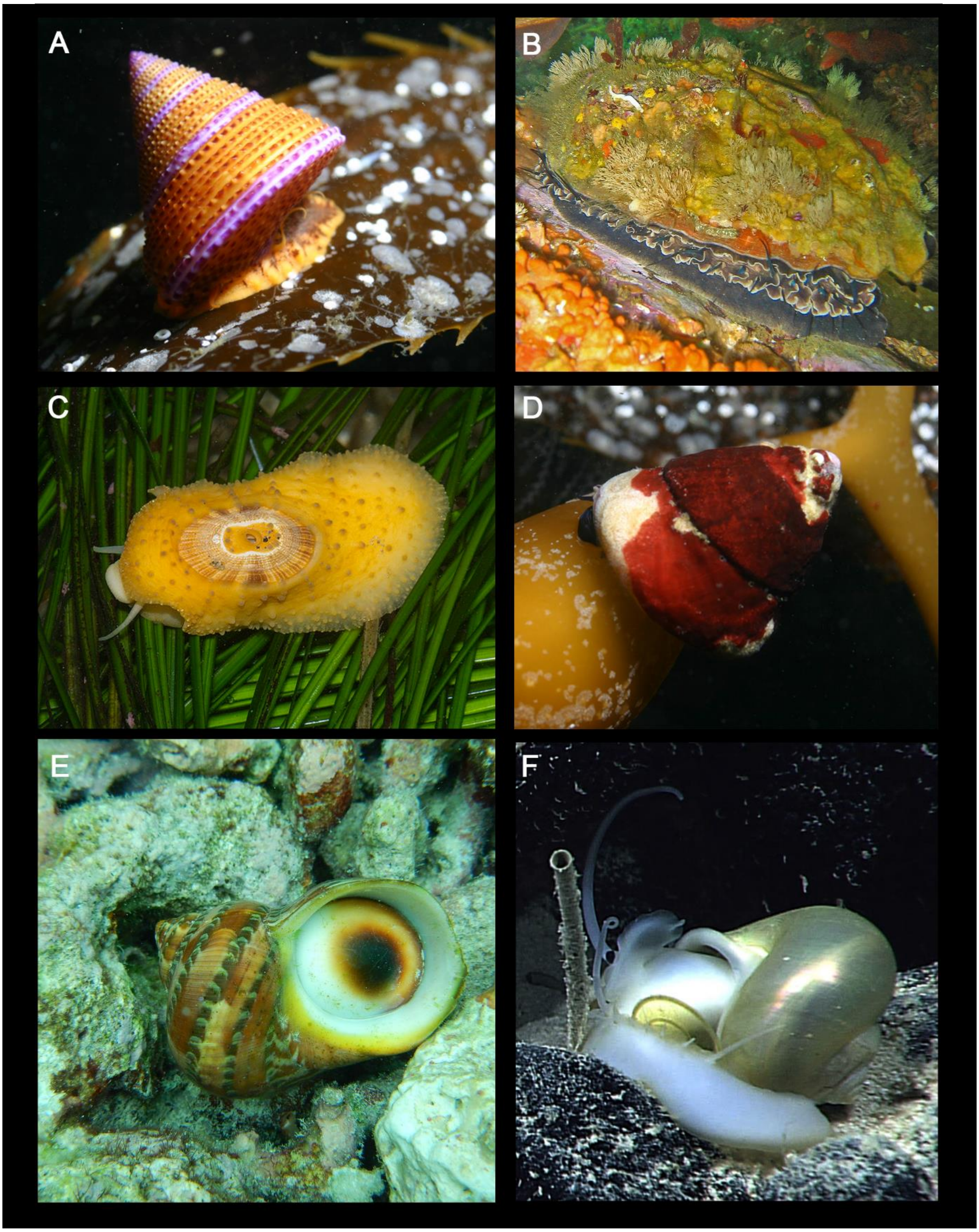

Figure 1: Vetigastropod diversity. **A.** *Calliostoma annulatum* (Lightfoot, 1786), family Calliostomatidae (public domain image); **B.** *Haliotis rufescens* Swainson, 1822, Haliotidae (public domain image); **C.** *Fissurellidea bimaculata* Dall, 1871, Fissurellidae (photo by Marlin Harms); **D.** *Tegula brunnea* (Philippi, 1848), Tegulidae (public domain image); **E.** *Turbo petholatus* Linnaeus, 1758, Turbinidae (photo by Frédéric Ducarme); **F.** *Gaza daedala* Watson, 1879 (public domain image).

larval development modes were often used as well (Bandel, 1997), but then again some of these features are shared with other mollusk groups, and their usage for such purpose is somewhat controversial (Frýda et al., 2008). Regardless, most of the specimens that can be safely associated with extant families date from the Mesozoic (Geiger et al., 2008). Vetigastropod diversity increased significantly in the Early Ordovician, reaching its peak in the Devonian and suffering great loss in the Permian-Triassic extinction event (252 Ma). A recovery followed in the Triassic, with the emergence of trochoideans and other smaller lineages. The group was yet again greatly affected by the Triassic-Jurassic mass extinction (201 Ma) but has since then remained stable in terms of family numbers (Sepkoski & Hulver, 1985; Erwin, 1990).

In addition to being a food source for humans, vetigastropods and their shells are often sought for their nacre (mother of pearl), used as decoration or in handicraft. Either fished by tons or even farmed, animals such as abalones (family Haliotidae, Fig. 1B) constitute a relevant part of the economy in many countries (Freeman, 2001). These facts also help explain why these animals have been extensively investigated by science, and are, in fact, one of the most frequently studied mollusk groups (Geiger et al., 2008).

1.1.1 Taxonomy and phylogeny

Vetigastropoda was broadly investigated and redefined since being first introduced in the 1980s (Salvini-Plawén, 1980). Despite the fact that its monophyly has been recognized by a plethora of morphological and molecular studies (e.g., Ponder & Lindberg, 1997; Sasaki, 1998; Geiger & Thacker, 2005; Kano, 2008; Williams et al., 2008; Uribe et al., 2015), the group's taxonomic rank changed a few times over the years. Since its introduction, Vetigastropoda was traditionally ranked as a suborder of the Archaeogastropoda Thiele, 1925, a group now widely recognized as paraphyletic (Lindberg, 2008; Gofas, 2009c). Ponder & Lindberg (1997) considered it as a superorder belonging to their subclass Orthogastropoda (also non-monophyletic by recent standards; Zapata et al., 2014). In their wide-ranging nomenclatural revision, Bouchet et al. (2005) rebutted Ponder & Lindberg's (1997) classification, referring to Vetigastropoda as an unranked clade. It has been treated as such in recent

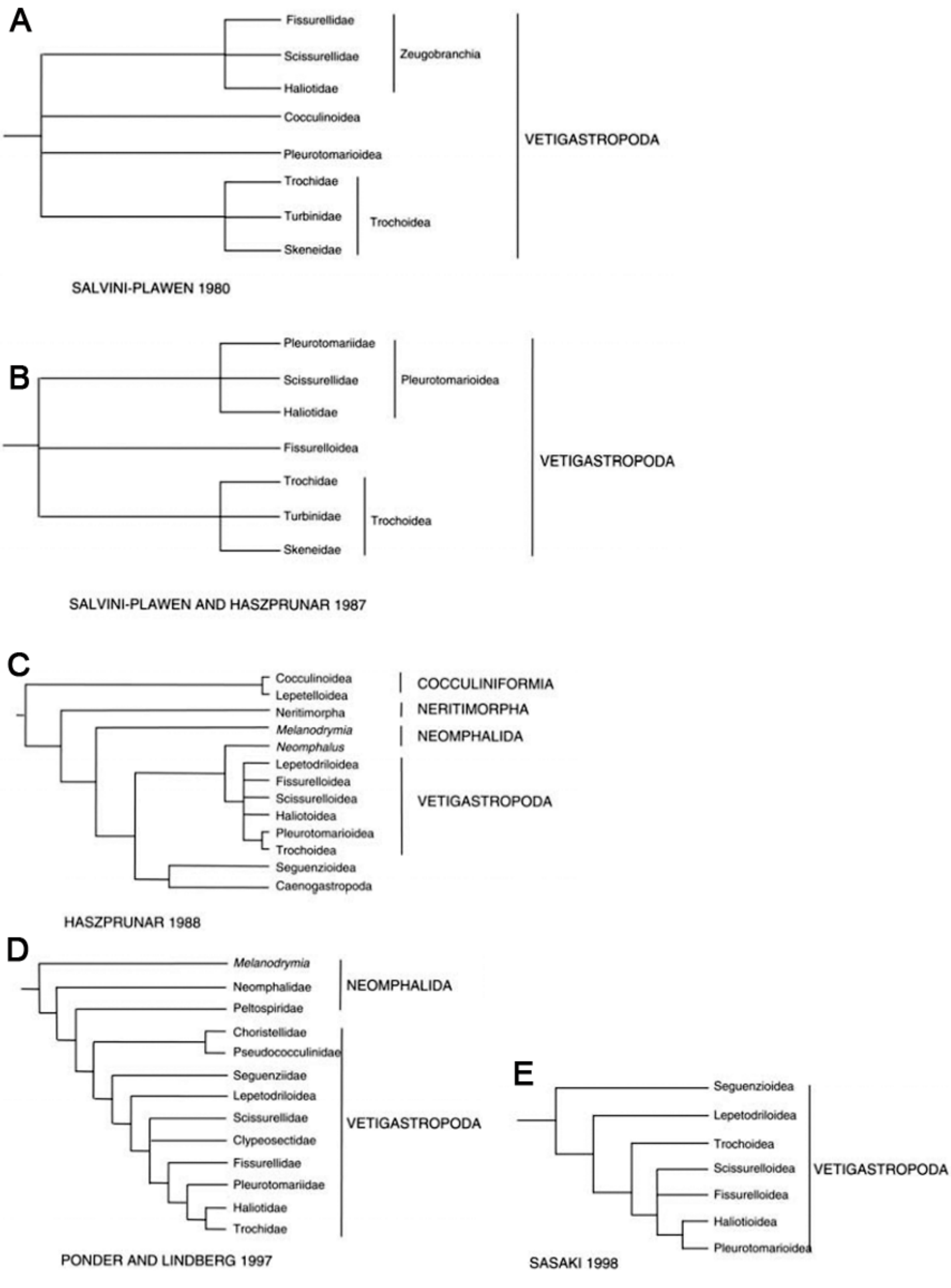

Figure 2: Morphology-based phylogenetic hypotheses of Vetigastropoda. **A.** After Salvini-Plawen (1980); **B.** After Salvini-Plawen & Haszprunar (1987) **C.** After Haszprunar (1988); **D.** After Ponder & Lindberg (1997). **E.** After Sasaki (1998). Extracted and modified from Aktipis & Giribet (2012).

systematics works (e.g., Williams, 2012; Uribe, 2015) and the matter is unresolved, even though the World Register of Marine Species database currently ranks it as a subclass of Gastropoda, without any support of published material.

Added to the wide variety of shell shapes, the internal morphology of Vetigastropoda is correspondingly quite diverse, and, naturally, reaching a consensus on a general characterization of the group is a problematic task at best. This becomes evident when observing the dissimilar topologies resulting from morphological analyses (Fig. 2), which differ expressively among themselves. Furthermore, such studies have pointed different characters as synapomorphies of Vetigastropoda over the course of time. For instance, Salvini-Plawen & Haszprunar (1987) listed the ctenidial sense organs (or bursicles), esophageal structures (specialized tissues and papillae), epipodial sensory organs, position and structure of the osphradia, and chromosomal arrangement as synapomorphic characters. Ponder & Lindberg (1997) cited the position of the renal organs on either side of the pericardium, absence of a nephridial gland, ctenidial bursicles, sensory papillae, multiple statoconia; and Sasaki (1998) enumerated the epipodial sensory organs, expanded esophageal pouches, fimbriate anterior edge of the jaw, papillate esophageal glands, and paired kidneys on either side of the pericardium as synapomorphies, also citing micropapillae on the tentacles, posterior depressor muscles, five pairs of lateral teeth, paired auricles and the transverse pallial vein as possible synapomorphies depending on character optimization. Although there is little apparent consensus, the ctenidial bursicles and epipodial sensory structures appear as synapomorphies in most cases. A summary of these and additional characters from the phylogenies was presented by Geiger et al. (2008; tab. 12.2), and brief discussions on several characters were provided by Simone (2011) in a broader context.

As molecular techniques emerged, several molecular phylogenies of Vetigastropoda were published. Unsurprisingly, earliest published topologies agreed very little, displaying widely different relationship hypotheses (e.g., Geiger & Thacker, 2005; Williams & Ozawa, 2006; Kano, 2007). This dissimilarity was initially attributed to insufficient taxon sampling, and a low number of analyzed genes or base pairs (Geiger et al., 2008). Consequently, subsequent approaches (Fig. 3) sought to remediate these issues by including more analyzed loci and widening taxon sampling, e.g., Williams et al. (2008) sampled 162 terminals; Aktipis & Giribet (2010) analyzed 7 different loci and sampled 31 ingroup taxa; Aktipis & Giribet (2012) analyzed 6 kb from 5 different loci, and sampled 69 terminals. Alternatively, more recent methods

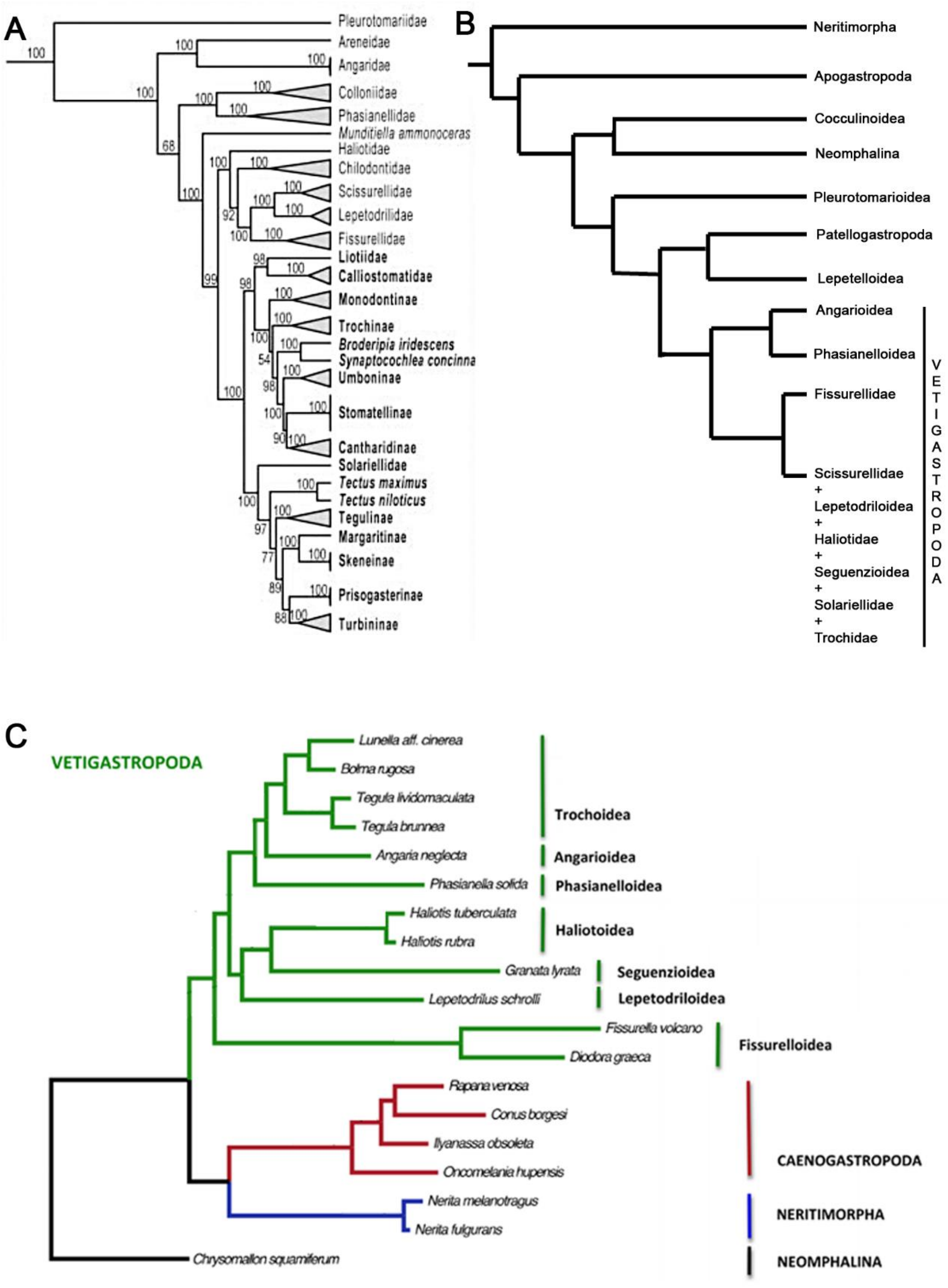

Figure 3: Molecular-based phylogenetic hypotheses of vetigastropod relationships. **A.** Simplified topology after Williams et al. (2008); **B.** Redrawn and simplified topology after Aktipis & Giribet (2012); **C.** Extracted and simplified topology after Uribe (2015).

such as mitogenomics, have begun to be employed to produce hypotheses for Vetigastropoda (Uribe et al., 2015). Nevertheless, the resulting topologies are still very discrepant. Wort et al. (2016), while examining the use of mitochondrial markers in phylogenetic studies on Vetigastropoda, cautioned against the careless use of these markers, as diverse marker combinations produced drastically different topologies in their own analysis. This may at least partially explain the different topologies obtained by the studies published so far, and it is clear that more work is necessary in order to resolve vetigastropod relationships.

1.2 Brazilian seamounts and mollusk diversity

Seamounts are undersea elevations rising from the seabed to waters below sea level, having a relatively restrict summit area. These topographic features often reach over a thousand meters bottom to top and may present particular and intricate surface structures such as calderas, terraces, pit craters, canyons, etc., which provide rich, complex habitats (Vieira et al., 2010). In fact, seamounts are a common feature in the world's oceans and harbor a richly diverse and often highly endemic part of the marine biota (Stocks, 2004). They often suffer greatly from the intense commercial fishery, which causes severe impact on local species (Morato et al., 2004; 2006). Despite that, and even though there are thousands of seamounts around the globe, few (~300) have been thoroughly sampled and studied, and many questions regarding these interesting environments are still beginning to be answered (Santana & Tavares, 2008; Schlacher et al., 2010).

The Brazilian seamounts are mainly clustered off the coast of Ceará state, the Fernando de Noronha Chain, and off Bahia state in northeastern waters, the Vitória-Trindade Chain in the southeast, and the Rio Grande Rise in the south (Vieira et al., 2010). They are no exception to the "general rules" of being poorly known and overfished. The faunal diversity of Brazilian seamounts is mostly known from isolated surveys carried out in the 19th and 20th centuries (e.g., Challenger, Calypso, and Branner-Agassiz expeditions), and, more recently, from the REVIZEE project, which was not focused on seamounts (Coelho-Filho, 2006). Fortunately, however, scientific attention has been increasingly drawn to these sites. Recent studies on species from Brazilian seamounts have been published, mostly describing new invertebrates (e.g., Santana & Tavares, 2008; Vieira et al., 2010).

Deep-sea and shelf-dwelling mollusks have received particular attention in Brazil as of late, and many new species have emerged from recent studies (e.g., Simone & Cunha, 2008; Fernandes et al., 2013; Cavallari et al., 2014; Simone, 2014; Simone & Cunha, 2014). A notable case is a Brazilian-French expedition, Marion Dufresne MD55, which conducted an extensive sampling along the Vitória-Trindade Chain in SE Brazil (see Tavares, 1999, for details). This sampling resulted in several papers on mollusks (some cited above), with dozens of new species, and much of this material is still being studied. Nevertheless, apart from the MD55, the Brazilian mollusk fauna from seamounts along the coast remains largely unknown, except perhaps for a small point outside of the curve: Canopus Bank.

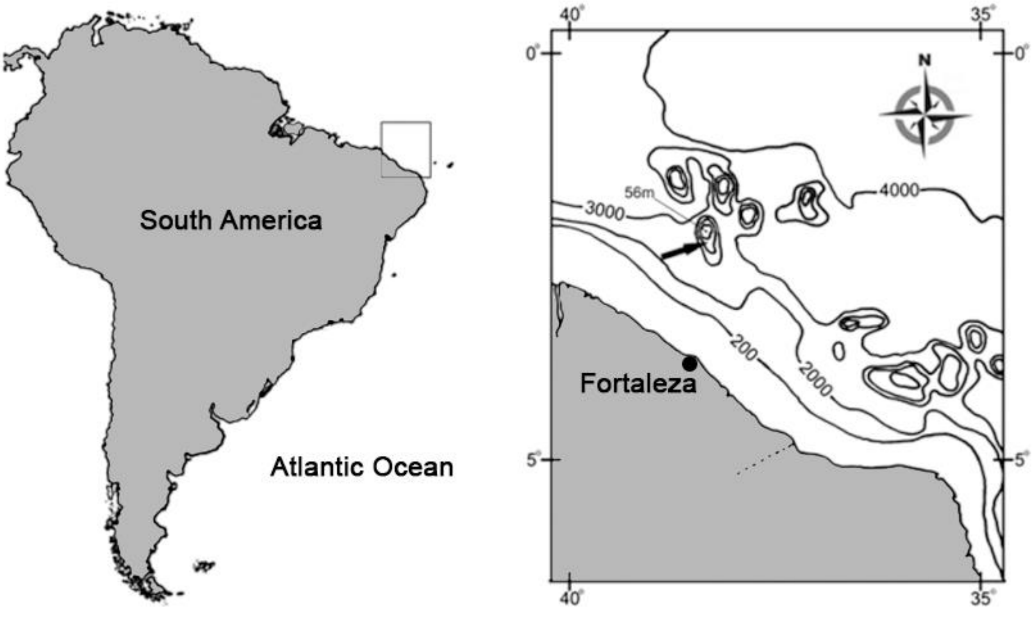

Figure 4: Seamount cluster off Ceará state; arrow indicates the location of Canopus Bank, the site studied in the present work. Extracted and modified from Andrade et al. (2011).

Canopus Bank is a seamount located ~190 km off the capital city of Fortaleza (Fig. 4), Ceará state, in NE Brazilian waters (02°14’25”S, 38°22’50”W), which is known to harbor a highly diverse mollusk fauna. The study of relatively limited sediment samples collected in

2005 by a team of fishermen, naturalists and malacologists has resulted in an impressive amount of published material describing new gastropod species (e.g., Simone, 2005; Simone & abate, 2005; Cossignani, 2006; Costa & Simone, 2006; Simone, 2006; Pimenta et al., 2008; Cunha, 2011; Andrade et al., 2011; Costa & Pastorino, 2012; Costa & Pimenta, 2012; Abbate & Cavallari, 2013; Simone & Cunha, 2014; Fernandes et al., 2015). To date, 17 new gastropod species belonging to 12 different families have been described from Canopus, four of which are vetigastropods (Tab. 1).

Even though many new species from Canopus were described since 2005, more comprehensive studies on the local fauna are still lacking. While the local species diversity appears to be very high based on the sheer amount of published material, no checklists or large taxonomical studies focused on Canopus have been published to date. It is clear that studies dedicated to entire mollusk groups are needed to better understand, and thoroughly describe the local diversity. Such studies would allow for effective comparisons with faunas from the Caribbean and especially the remaining Brazilian seamounts. In that regard, according to Spalding's (2007) biogeographical hypothesis, Canopus is close to the Northeastern Brazil Ecoregion, within the Tropical Southwestern Atlantic province. Nearby Oceanic Islands (and surrounding seamounts) such as Fernando de Noronha and Trindade & Martim Vaz were placed in homonymous isolated ecoregions, based on a wide understanding of the local biodiversity (among may other characteristics). The numerous studies published to date have shown that Canopus may harbor many endemic species. Consequently, the faunal composition may as well be very distinct from the nearest coastal-shelf fauna from off Ceará, and other seamounts, which reinforces the necessity of broader studies.

Table 1: Gastropod species described from Canopus Bank, organized by year of description (2005-2015), with indications to clades and families.

Taxa	**Clade**	**Family**
Diptychophlia hubrechti Cunha, 2005	Neogastropoda	Turridae
Hipponix climax Simone, 2005	Caenogastropoda	Hipponicidae
Pedicularia tibia Simone, 2005	Caenogastropoda	Pediculariidae
Fasciolaria agatha Simone & Abbate, 2005	Neogastropoda	Fasciolariidae
Pedicularia bonfigliolii Cossignani, 2006	Caenogastropoda	Pediculariidae
Lucapina elisae Costa & Simone, 2006	Vetigastropoda	Fissurellidae
Inella unicornium Simone, 2006	Caenogastropoda	Triphoridae
Leptotrophon atlanticus Pimenta, Couto & Costa, 2008	Neogastropoda	Muricidae
Acteon mirim Cunha, 2011	Heterobranchia	Acteonidae
Opaliopsis cearense Andrade, Costa & Pimenta, 2011	Caenogastropoda	Epitoniidae
Notocochlis laurae Costa & Pastorino, 2012	Caenogastropoda	Naticidae
Pazinotus gili Costa & Pimenta, 2012	Neogastropoda	Muricidae
Nassarius levis Abbate & Cavallari, 2013	Neogastropoda	Nassariidae
Cranopsis canopa Simone & Cunha, 2014	Vetigastropoda	Fissurellidae
Cranopsis cearensis Simone & Cunha, 2014	Vetigastropoda	Fissurellidae
Cranopsis columbaris Simone & Cunha, 2014	Vetigastropoda	Fissurellidae
Trituba anubis Fernandes, Garofalo & Pimenta, 2015	Caenogastropoda	Newtoniellidae

2. JUSTIFICATION AND OBJECTIVES

Vetigastropoda is one of the most well-studied mollusk groups, which is why it provides an incredible base for comparative studies. Vetigastropods from Brazilian seamounts, however, are poorly studied. The most notable exceptions are Leal (1991), Salvador et al. (2014), and Simone & Cunha (2014), which are mainly focused on the plentiful material collected by the MD55 expedition. The latter only described fissurellid species, two of which from Canopus. In fact, only four of the 17 species described from Canopus so far are Vetigastropods, and all of them are fissurellids.

Based on the remaining diversity from Canopus evidenced by the works published thus far, the knowledge on the local vetigastropod fauna seemed incipient at best. The sorting of material from Canopus confirmed this initial suspicion and revealed a rich diversity of vetigastropod species. In order to provide a sound basis for comparative works in the future, including the studies on Brazilian seamount species published up to now and others that are yet to be published, as well as expand the current general knowledge on the Brazilian mollusk diversity in seamounts, we have set our efforts to describe and better understand the Vetigastropoda from Canopus.

With that in mind, the present study strives to:

1) Perform a taxonomical revision of vetigastropod species present in the Canopus assemblage;
2) Expand and refine species descriptions, since several of these are old and/or poorly detailed, or based on scarce material, leaving behind many details on variation;
3) Update and discuss species distributions based on the Canopus assemblage and additional material from museum collections, in a Caribbean/SW Atlantic scenario;
4) Identify and tentatively describe taxa that are possibly new to science.

3. MATERIAL & METHODS

3.1 Specimen analysis

The ordinary and type specimens studied herein are housed in the malacological collections of the Museu de Zoologia da Universidade de São Paulo (MZSP), São Paulo, Brazil, and several institutions worldwide, namely **ANSP** – Academy of Natural Sciences of Drexel University, USA; **FLMNH** – Florida Museum of Natural History, USA; **LACM** – Natural History Museum of Los Angeles County, USA; **MCZ** – Museum of Comparative Zoology, Harvard, USA; **MNHN** – Museum national d'histoire naturelle, France; **MORG** – Museu Oceanográfico Prof. Eliézer de Carvalho Rios, Brazil; **MNRJ** – Museu Nacional do Rio de Janeiro, Brazil; **NHMUK** – National History Museum, United Kingdom; **NMR** – Natural History Museum Rotterdam, Netherlands; **USNM/NMNH** – National Museum of Natural History, Smithsonian Institution, USA. Type specimens were examined physically or with the aid of high-resolution photographs kindly provided by their respective harboring institutions.

Specimens studied herein were retrieved from a 0.3 m³ sediment sample from Canopus Bank collected in August and November 2005 by a joint team of naturalists and malacologists from the MZSP and other institutions. The sample consisted mostly of coarse biogenic carbonate sediment, e.g., dry coralline algae and scleractinian coral debris, mollusk shells, and other organic materials such as shark teeth, echinoderm spines, bryozoan remains and brachiopods. Mollusks were sorted out of the sediment with the aid of a standard stereomicroscope. Sorted individuals were subsequently photographed under a Zeiss SteREO Discovery® V12 stereomicroscope coupled with a Zeiss Axiocam® MRc5 digital camera. Autofocus images and specimen measurements were obtained digitally and processed with the Zeiss AxioVision® SE64 Rel 4.8 imaging software. Photographs were posteriorly edited with Adobe Photoshop® CS3. Specimens examined under SEM were previously spur-coated with gold, analyzed and photographed at the Laboratório de Microscopia Eletrônica, MZSP. Additional specimens from other locations deposited in the MZSP and other collections were included in the present study for comparative, and range study purposes. This is the case in the specimens from the Brazilian-French Marion Dufresne MD55 expedition, some of which are housed in the MNHN.

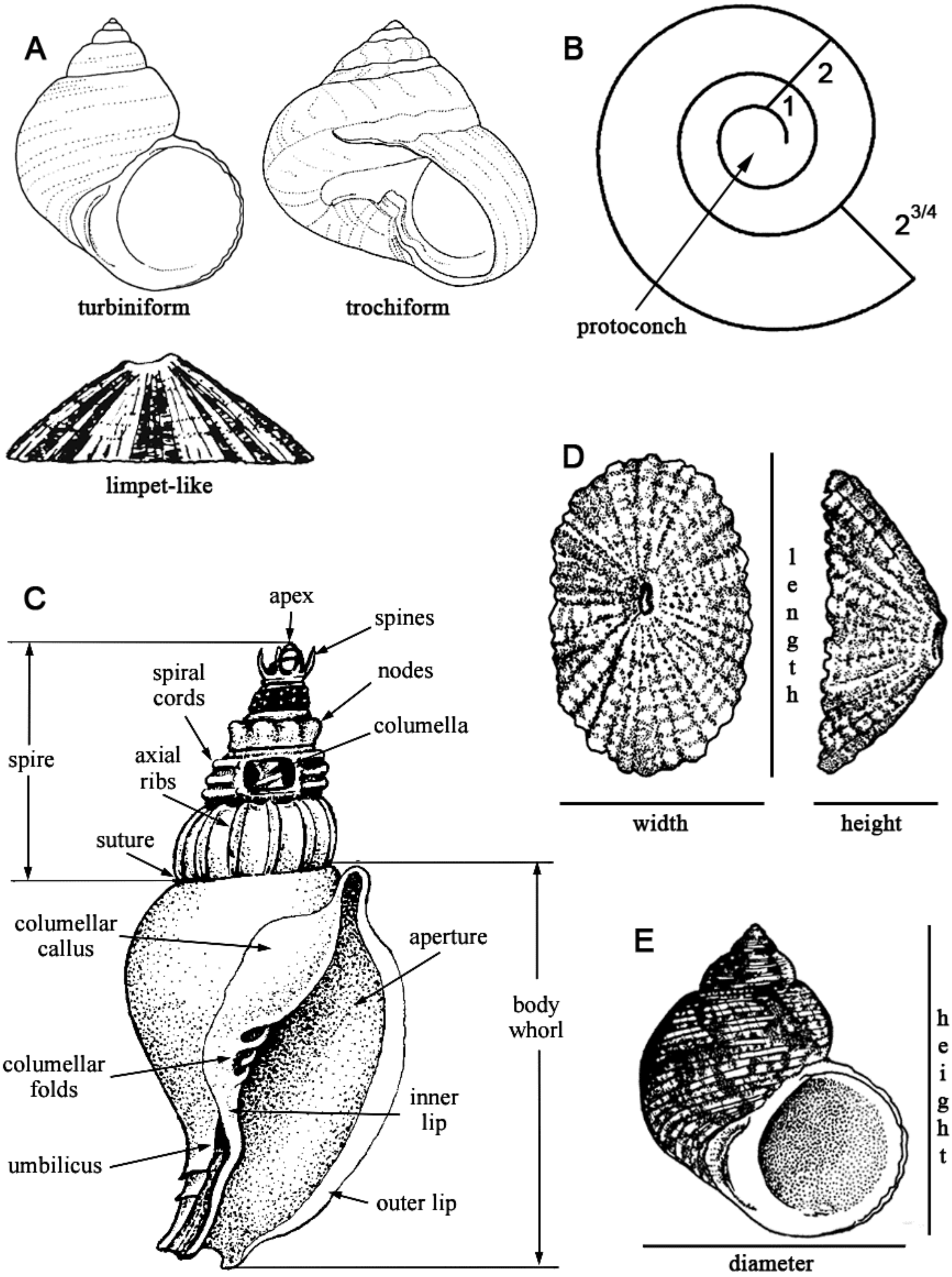

Figure 5: Illustrated terminology used in the present study; **A.** shell outline terminology; **B.** whorl counting criteria; **C.** general terminology for shell ornamentation and structures; **D.** shell measurement terminology for limpet-like specimens; **E.** shell measurement terminology for non-limpet specimens; A, C-E are extracted and modified from Leal (2002).

3.2 Taxonomical study

The taxonomical study on each species was carried out according to guidelines for a good taxonomical practice presented and discussed by Winston (1999), Valdecasas (2011) and Wiley & Lieberman (2011). With these standards in mind, the following study strived to: be in accordance with the pertinent nomenclature code, in this case the fourth edition of ICZN (1999); provide an analysis of the type specimens; provide a summary of the taxonomical history of the taxon in question (i.e., synonymy); provide a diagnosis and a formal description of the taxon, bringing forth sufficient data to distinguish the taxon, i.e., a complete description in accordance with other works in the same field; provide comparisons with local taxa, highlighting their differences; explain the reasons for changes in classification and nomenclature, if any; always provide one or more images illustrating the taxon, chiefly the type specimens (photos or illustrations, depending on the need); be as precise as possible when describing the geographic occurrence of the taxon. For taxa above species-level, information is presented as follows:

1) **Families:** General remarks are provided, bringing a brief, introductory discussion on the *status quo* of the taxon, mainly regarding general biology, taxonomy, systematics, and diversity estimates (global and local).
2) **Genera:** A synonymy, as well as information on the type species and diagnosis, are provided, based on the literature.

The information in each species entry fulfills the following criteria, and is organized into sections as follows:

1) **Synonymy:** Focused on taxonomical and occurrence/survey papers, as well as catalogs.
2) **Types:** Information on all known type specimens of the taxon are provided, including catalog numbers and label/locality data. In order to indicate which specimens were examined in the present study, an (examined) tag is provided after individual catalog numbers in such cases.
3) **Type locality:** Information on the type locality is given based on the original description. Special remarks are provided in cases when such information was not originally provided, and/or could not be retrieved from specimen labels or by other means; complimentary data may be discussed in the remarks section (see below).

4) **Diagnosis:** Provided according to the original description (*ipsis litteris*). If the original description brings no such information, then a diagnosis from a revision work is provided instead. In case there is no formal diagnosis in the literature, a novel one is presented herein based on the analysis of the type material and the remaining specimens.
5) **Original description:** This information is only provided herein for ancient (100-year-old or older) or obscure works. Descriptions not originally written in English are also provided, followed by a translation. Recent descriptions are not provided unless they are utterly necessary to complement the analysis of the present specimens.
6) **Redescription:** Provided herein when the original description was poorly detailed (mostly ancient works), unclear or confuse. This section is either based on review papers or newly provided herein. Such redescriptions are based on the type material and the remaining studied specimens.
7) **Distribution:** Range data compiled from the literature are provided and updated by the current data. Distribution maps were drawn with DIVA-GIS®.
8) **Habitat:** Data on substrate types, depth, etc., are recovered from the literature, and complemented by the present material (whenever live-collected individuals were available).
9) **Etymology:** Information on etymology is provided according to the original description, or inferred from it whenever possible or plausible.
10) **Measurements:** Are always given in mm. A mean value and standard deviation values for a given number of specimens were calculated for each shell dimension. Measurements are only provided for Canopus specimens, and only adult, intact individuals were measured. Whenever the sample consists of juveniles, measurements of the largest specimen are provided.
11) **Material examined:** A list of the examined specimens is given, including those not coming from Canopus.
12) **Remarks:** This section contains a brief discussion on taxonomy, comparisons with local congeners, as well as relevant aspects of the species' distribution.

The general taxonomical arrangement presented herein follows the World Register of Marine Species (WorMS) online database, which incorporates most of the recently published literature on Vetigastropoda. Genera and species are arranged in alphabetical order within each family section.

4. RESULTS AND DISCUSSION

4.1 Taxonomy

Superfamily Fissurelloidea

Family Fissurellidae Fleming, 1822

General remarks: Fissurellidae is a very diverse family of small to large (2-125 mm), limpet-like marine snails with global distribution. Species in this family usually live attached to rocks, from the intertidal zone to deep-water environments (Farfante, 1943). They are chiefly recognized for their characteristic limpet-like shell, which usually bears a conspicuous apical hole (foramen), slit or notch (Aktipis et al., 2011). Fissurellids seem to feed on a wide variety of materials and organisms, including algae and detritus, sponges, foraminiferans, tunicates and other animals (Herbert, 1991; Williams et al., 2010). The family's fossil record is quite rich, with the oldest specimens dating back from the Triassic (Tracey et al., 1993). Even though fissurellids have been commonly included in a plethora of analyses on Vetigastropoda and other related groups (e.g., Harasewych et al., 1997; Sasaki, 1998; Geiger & Thacker, 2005; Kano, 2008; Williams et al., 2008; Aktipis & Giribet, 2012; Uribe et al., 2015), studies focused on the relationships within the family are relatively scarce (e.g., McLean & Geiger, 1998; Aktipis et al., 2011), as are the ones on anatomy (e.g., Simone, 2008). Fissurellidae includes over 55 genera and 500-600 species (Geiger & Thacker, 2005; Aissaoui et al., 2016); currently, over 40 fissurellid species belonging to at least 11 genera have been recorded in Brazilian waters (Rios, 2009; Simone & Cunha, 2014).

Genus *Cranopsis* Adams, 1860

Cranopsis Adams, 1860: 302.

Puncturella (*Craniopsis*) [sic]: Nordsieck, 1968: 12 (incorrect spelling).

Type species: *Cranopsis pelex* Adams, 1860 by monotypy; Recent, Japan.

Diagnosis: Shell height moderate; anterior slope broadly convex; apical whorl overhanging posterior slope; posterior slope concave; protoconch with linear and concentric sculpture; foramen on anterior slope of shell, its position in earlier growth stages marked by strong selenizone. Anterior slope in advance of foramen marked by doubled anterior rib and seam on interior surface. Foramen bordered posteriorly on inner surface by low, curved septum. Sculpture usually radian and concentric, radial sculpture marked by primary and secondary ribs. Mantle skirt slit extending to position of foramen. Epipodial tentacles numerous. Ctenidia bipectinate, gill axis free. Rachidian tooth usually narrow, inner lateral teeth narrow; pluricuspid tooth massive, with inner and outer secondary cusps. (McLean & Geiger, 1998, p. 5)

Cranopsis canopa Simone & Cunha, 2014

(Figure 6)

Cranopsis canopa Simone & Cunha, 2014: 449, figs. 76-83; Cavallari et al., 2016: 13.

Types: Holotype MZSP 107718 (examined), Brazil, Ceará, off Fortaleza, Canopus Bank, 2°12’43”S, 38°18’52”W, 250 m, Coltro col. (viii/2005). Paratypes: MNHN IM-2000-25309, 5 sh (examined); MNRJ 30825, 2 sh; UF Mollusca 451489, 2 sh; USNM 1207437, 2 sh; MZSP 90281, 24 sh (examined); MZSP 94183, 11 sh (examined); all from type locality.

Type locality: Brazil, Ceará, off Fortaleza, Canopus Bank, 2°12’43”S, 38°18’52”W, 250 m.

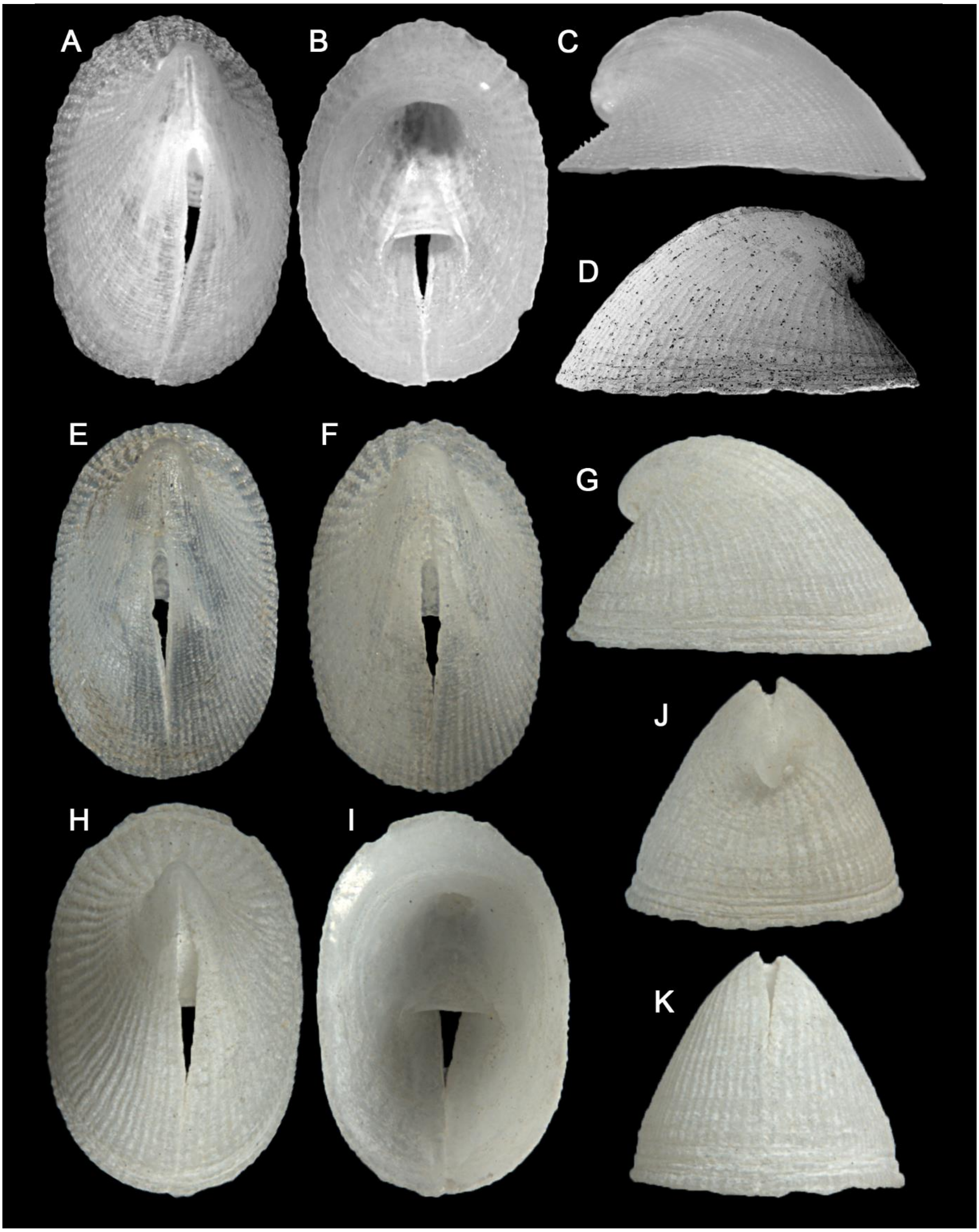

Figure 6: *Cranopsis canopa*. **A-D.** Types (extracted and modified from Simone & Cunha, 2014); **A-C.** Holotype MZSP 107718; **A.** apical view (L = 3.3 mm); **B.** apertural view; **C.** right lateral view; **D.** Paratype MZSP 90281, left lateral view under SEM (L = 3.8 mm); **E.** MZSP 66603 from Canopus, apical view (L = 3.13 mm); **F.** MZSP 70315 from Canopus, apical view (L = 3.11 mm); G-K. MZSP 72059 from Canopus; **G.** right lateral view (H = 2.55 mm); **H.** apical view (L = 4.21 mm); **I.** apertural view; **J.** posterior view (W = 2.77 mm); **K.** anterior view.

Diagnosis: Apex curved ventrally, posterior-located. Height 43% of length; width 68% of length. Sculpted by ca. 70 radial, low cords, with transverse folds; interspaces minute. Foramen flanked by low edges; located dorso-anteriorly. (Simone & Cunha, 2014, p. 449)

Distribution: Known only from type locality.

Habitat: Sandy bottoms with gravel, 60-260 m (empty shells only; Simone & Cunha, 2014; present work).

Etymology: Name derived from Canopus, the type locality (Simone & Cunha, 2014).

Material examined: Types. *Additional material*: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 53944, 60 m, 11 sh (viii/2005); MZSP 67298, 260 m, 11 sh (viii/2005); MZSP 70319, 260 m, 50 sh (xi/2005).

Measurements (in mm): Largest specimen (MZSP 67298), L = 3.13 mm, W = 2.01.

Remarks: This seemingly rare species is only known from Canopus, the type locality. Only a small number of specimens were obtained in the studied samples. Though Simone & Cunha (2014) did not regard the semitranslucent and lustrous shell of *C. canopa* as diagnostic, the well-preserved specimens (Fig. 6E-F), as well as the holotype (Fig. 6A-C) examined here point toward this conclusion. Shells collected in Canopus are usually heavily calcified post-mortem, probably due to environmental factors, which may help explain why some specimens have become opaque and dull (Fig. 6H-K). Added to the diagnostic characters raised by Simone & Cunha (2014), which are mainly related to proportions and number of sculpture elements, the translucent and glossy shell of *C. canopa* further distinguishes it from a very similar species, *C. tuberculata* (Watson, 1883), as does the absence of conspicuous granulations spread throughout the outer surface (see Farfante, 1947: pl. 54, figs. 4-5). Furthermore, Watson's (1883) description of *C. tuberculata* was based on fossil material from the Miocene of Italy, and I believe it is highly unlikely that the Caribbean specimens belong to the same taxon despite the conchological similarity; Recent animals attributed to this name in several catalogs may as well belong to an undescribed species, and the matter needs further investigation. The bathymetric range of *C. canopa* is expanded based on the currently analyzed material, from 250 m to a range of 60 to 260 m, with well-preserved individuals coming from shallower depths.

Cranopsis cearensis Simone & Cunha, 2014

(Figure 7)

Cranopsis cearensis Simone & Cunha, 2014: 445, figs. 48-55; Cavallari et al., 2016: 15.

Types: Holotype MZSP 106894 (examined), Brazil, Ceará, off Fortaleza, Canopus Bank, 2°12’43”S, 38°18’52”W, 250 m (Coltro col., viii/2005). Paratypes: MNHN IM-2000-25299, 1 sh (examined); MNRJ 30824, 1 sh; MZSP 93940, 18 sh (examined); MZSP 90280, 19 sh (examined); MZSP 100415, 2 sh (examined); all from type locality, same data as holotype.

Type locality: Brazil, Ceará, off Fortaleza, Canopus Bank, 2°12’43”S, 38°18’52”W, 250 m.

Diagnosis: Apex slightly high, located preceding posterior third. Height ca. 40% of length; width ca. 80% of length. Sculptured by ca. 60 rounded radial ribs, relatively narrow, profile rounded, extending beyond shell edges; bearing transverse low scales extending on relatively wide interspaces between ribs forming comarginal sculpture. Foramen slightly deviated to right, flanked by low edges; located more posteriorly, separated from anterior edge. (Simone & Cunha, 2014, p. 445)

Distribution: Known only from type locality.

Habitat: Sandy bottoms with gravel, 60-260 m (empty shells only; Simone & Cunha, 2014; present work).

Etymology: Name derived from the Brazilian state of Ceará (Simone & Cunha, 2014).

Material examined: Types. *Additional material*: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 53944, 60 m, 11 sh (viii/2005); MZSP 67298, 260 m, 11 sh (viii/2005); MZSP 70319, 260 m, 50 sh (xi/2005).

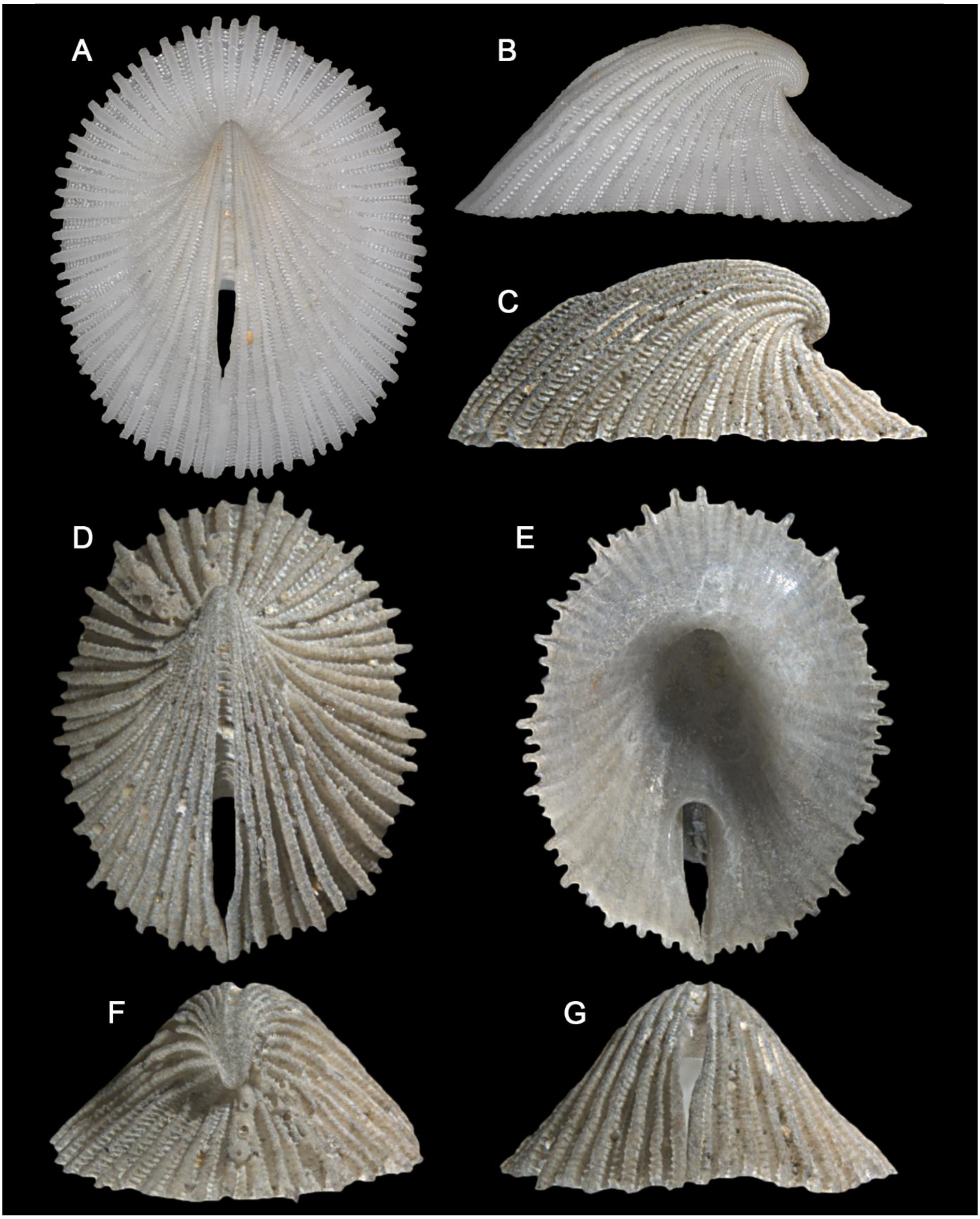

Figure 7: *Cranopsis cearensis*. **A-B.** Holotype MZSP 106894; **A.** apical view (L = 13.0 mm); **B.** left lateral view; **C-G.** MZSP 53944 from Canopus; **C.** left lateral view (H = 3.96 mm); **D.** apical view (L = 9.18 mm); **E.** apertural view; **F.** posterior view (W = 7.24 mm); **G.** anterior view.

Measurements (in mm; n= 14): L = 12.43 ± 1.00, W = 10.25 ± 1.06, H = 5.05 ± 0.53.

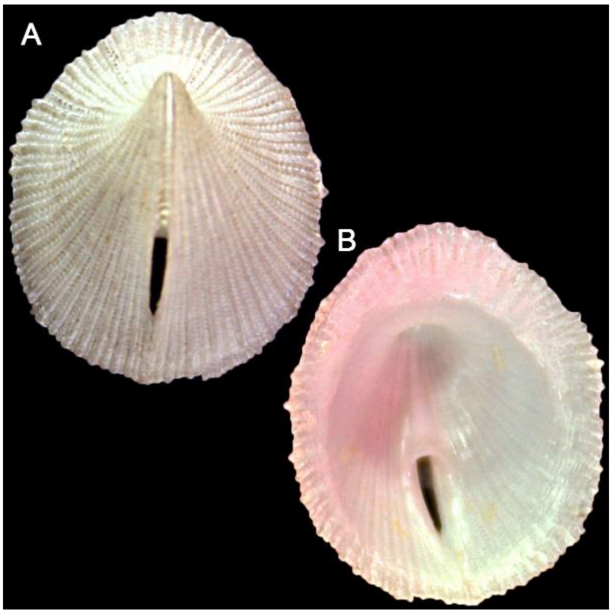

Figure 8: *Cranopsis antillana*. **A-B.** Holotype MCZ 160518 (L = 11.5 mm, W = 10 mm, H = 5 mm); **A.** apical view; **B.** apertural view; photos are a courtesy of the MCZ.

Remarks: This recently described species is only known from Canopus. No live individuals or specimens of *Cranopsis cearensis* with soft parts were collected to date as well, and details of its anatomy remain unknown. It can be told apart from the similar Caribbean congener *Cranopsis antillana* (Farfante, 1947) by its larger septum (Fig. 7A, D, E), higher and more widely spaced radial ribs (Fig. 7D), and the projection of the radial ribs forming strong undulations along the shell's margin (Simone & Cunha, 2014). Additionally, *C. cearensis* has an elliptical outline in apertural/apical view, whereas *C. antillana* is oval (narrower posteriorly; Fig. 8A-B). Nevertheless, *C. cearensis* seems to be particularly abundant in Canopus, judging by the sheer number of specimens in the current samples. The bathymetric range of the species is also expanded herein from the previously fixed depth of 250 m to an interval of 60 to 260 m (empty shells only).

Genus *Diodora* Gray, 1821

Synonymy see McLean & Geiger (1998: 10).

Type species: *Patella apertura* Montagu, 1803 (= *Diodora graeca* L.) by monotypy; Recent, Mediterranean.

Diagnosis: Shell height moderate; anterior slope short, sometimes concave; protoconch and short selenizone present only on juvenile shell posterior to foramen; protoconch with linear and concentric sculpture; expansion of foramen obliterates protoconch with growth. Foramen bordered posteriorly on inner surface by a broad, truncated callus. Sculpture radial and concentric, radial sculpture marked by primary and secondary ribs. Mantle skirt intact anteriorly. Epipodial tentacles numerous, of similar size. Ctenidia bipectinate, gill axis free. Rachidian tooth broad to narrow, inner lateral teeth narrow; pluricuspid tooth massive. (McLean & Geiger, 1998, p. 10)

Diodora mirifica Métivier, 1972

(Figure 9)

Synonymy see Simone & Cunha (2014). Complement:

Diodora mirifica: Benkendorfer & Soares-Gomes, 2009: 147; Simone & Cunha, 2014: 464, fig. 152.

Types: Holotype MNHN IM-2000-4962 (examined), Brazil, Fernando de Noronha Is. (1968). Paratypes: MNHN IM-2000-4963 (examined), Brazil, Ceará, off Fortaleza, R/V “Almirante Saldanha” sta. 1701, 01°57’S, 37°46’W, 57 m, 2 sh (viii-xii/1967).

Type locality: Brazil, Fernando de Noronha Island.

Diagnosis: Shell small (7-8 mm), sculpture consisting of 26-28 wide radial ribs crossed by secondary, narrower concentric ribs, with angular nodules at the intersections. Ground color ivory white, with dark-brown to black, radially arranged spots of variable size and intensity; spots usually present on alternate radial ribs; internal side glossy, white, with a darker stripe partially circling the foramen.

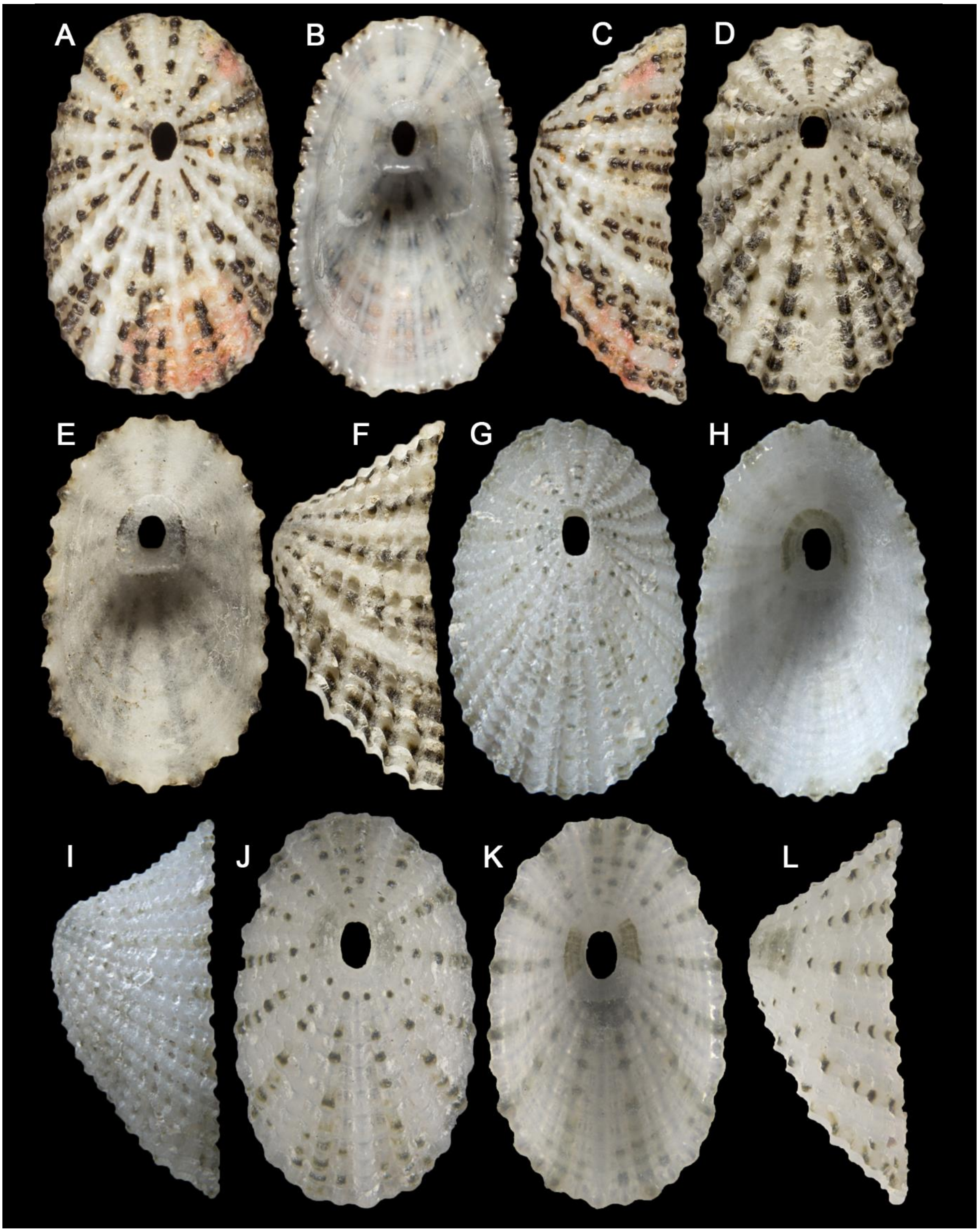

Figure 9: *Diodora mirifica*. **A-C.** Holotype MNHN IM-2000-4962; **A.** apical view (L = 8.0 mm, W = 5.2 mm); **B.** apertural view; **C.** leftt lateral view (H = 3.4 mm); **D-F.** Paratype MNHN IM-2000-4963 (L = 6.8 mm, W = 4.0 mm); **D.** apical view; **E.** apertural view; **F.** left lateral view (H = 3.3 mm); **G-I.** MZSP 131040 from Canopus; **G.** apical view (L = 9.63 mm, W = 5.99 mm); **H.** left lateral view (H = 4.32 mm); **J-L.** MZSP 131040 from Canopus; **J.** apical view (L = 6.95 mm, W = 4.26 mm); **K.** apertural view; **L.** left lateral view (H = 2.91 mm). Type photos are a courtesy of the MNHN.

Original description (in French): Coquille mince, petite, d'aspect fragile, en forme de cône déprimé, légèrement plus étroite dans sa partie antérieure, oblongue à contour basal ovale, un peu plus de deux fois plus longue que haute et qui, lorsqu'elle est posée sur une surface plane, ne repose que sur ses extrémités antérieure et postérieure. Le côté antérieur est court, rectiligne; le côté postérieur est beaucoup plus long et nettement convexe. Sommet situé au tiers antérieur, remplacé par une petite perforation ovale, un peu plus étroite vers l'arrière, bordée par deux portions de lignes noires de chaque côté dans un peu moins de la moitié antérieure. La longueur de la fissure occupe l/10e de celle de la coquille. La sculpture est réticulée par l'intersection de côtes radiaires et de côtes concentriques. Il ya 28 côtes radiaires principales assez fortes, qui vont du bord basal à la fissure et qui alternent avec 28 côtes radiaires secondaires, beaucoup plus fines, bien individualisées dans leur moitié basale mais qui disparaissent ensuite avant d'atteindre la perforation. L'intersection de ces côtes rayon - nantes avec les côtes concentriques, qui sont un peu plus fortes que les côtes rayonnantes secondaires, forme de petits nodules. Dans l'intervalle situé entre deux côtes concentriques se trouvent trois côtes concentriques très fines (visibles seulement à la loupe), interrompues par les côtes rayonnantes principales, mais qui interceptent les côtes rayonnantes secondaires en formant de très petits nodules. La couleur externe est blanche avec quatorze zones noires. Chaque zone de coloration est formée par trois côtes rayonnantes noires, une fine, une forte, une fine, avec, entre chacune, un intervalle blanc. Cette zone est séparée de la suivante par une forte côte blanche. La couleur noire des côtes colorées est localisée aux nodules et aux portions de côtes qui les relient. Ainsi, on peut trouver un nodule coloré relié au précédent et au suivant, colorés ou blancs, par une portion de côte en partie ou complètement colorée. Les fines côtes ne sont colorées, à partir de la base, que sur une très faible longueur sur le côté antérieur, longueur qui s'accroît en allant versl'arrière pour y atteindre un peu plus de la moitié de celle du côté postérieur. Couleur intérieure d'un blanc porcelaine, avec des raies d'un blanc plus foncé et des zones sombres qui correspondent respectivement aux fortes côtes blanches et aux zones colorées. Le calautour de l'orifice est ovale, blanc, brillant, très nettement tronqué versl'arrière, avec deux zones sombres de chaque côté qui correspondent aux deux portions de lignes noires qui bordent extérieurement la perforation. L'ouverture basale est très finement denticulée et colorée: à chaque côte colorée correspond un denticule noir, séparé du suivant par un faible intervalle blanc; les denticules colorés sont groupés par trois, chaque groupe étant séparé du suivant par une large denticulation blanchâtre qui correspond à la forte côte. (Métivier, 1972b, pp. 409-410)

Translation: Shell slender, small, fragile in appearance, depressed cone-shaped, slightly narrower in its anterior part, oblong with oval basal contour, slightly more than twice as long as high and which, when placed on a flat surface, rests only on its anterior and posterior extremities. The anterior side is short, rectilinear; The posterior side is much longer and clearly convex. The apex at the anterior third, are replaced by a small oval perforation, a little narrower towards the rear, bordered by two black lines on each side in a little less than the anterior half. The length of the foramen occupies 1/10 of that of the shell. The sculpture is cross-linked by the intersection of radial ribs and concentric ribs. There are 28 strong main ribs, ranging from the base to the foramen, alternating with 28 minor secondary ribs, much finer, well individualized in their basal half but disappearing before reaching the foramen. The intersection of these radiating ribs with the concentric ribs, which are somewhat stronger than the secondary radiating ribs, forms small nodules. In the interval between two concentric ribs are three very fine concentric ribs (visible only under the microscope), interrupted by the principal radiating ribs, but which intercept the secondary radiating ribs, forming very small nodules. The outer color is white with fourteen black areas. Each coloration zone is formed by three black radiating ribs, two thin ones separated by a stronger one with a white interval between them. This zone is separated from the following by a white interspace. The color of the colored ribs is located at the nodules and to the portions of ribs connecting them. Thus, a colored nodule may be found connected to the preceding and following ones, colored or white, by a portion of the rib that is partly or completely colored. The fine ribs are colored from the base only on a very short length on the anterior side, a length that increases towards the rear, reaching a little more than half that of the posterior side. Interior color of a white porcelain, with darker white stripes and dark areas corresponding respectively to the strong white ribs and the colored areas. The foramen is oval, white, shiny, very distinctly truncated to the rear, with two dark areas on each side, which correspond to the two portions of black lines that border the foramen externally. The basal opening is very finely denticulate and colored: on each colored rib there is a black denticle, separated from the next by a small white interval; The colored denticles are grouped by three, each group being separated from the next by a broad whitish denticulation corresponding to the strong white cord. The muscular impression is barely visible and is about 1 mm from the basal border.

Distribution: Brazil, from Maranhão to Espírito Santo states, including oceanic islands (Leal, 1991).

Habitat: On corals and calcareous algae from 0 to 63 m depths (Rios, 2009), up to 260 m (shells only; present study).

Material examined: Types. *Additional material*: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 131040, 240-260 m, 26 sh (viii/2005).

Measurements (in mm; n = 10): L = 7.56 ± 0.78, W = 4.48 ± 0.48, H = 3.40 ± 0.40.

Remarks: The peculiar color pattern of radially arranged dark brown – black spots on a white background makes *Diodora mirifica* very easy to recognize, and sets it apart from any other local congener. Still concerning the coloration, Métivier (1972b) mentioned two dark areas on each side of the fissure (Fig. 9B, K), but in most specimens, these dark areas are connected forming a semicircle (Fig. 9H). This dark stripe is also a distinguishing character of *D. mirifica* and is not necessarily related to any external coloration or marking, diverging from Métivier's (1972b) observations. Moreover, most of the internal coloration mentioned in the original description actually corresponds to the external coloration made visible through transparency in young and worn out specimens (Fig. 9K), and as such are not diagnostic. The intensity and extent of the dark-colored areas seem to be quite variable; in the Canopus specimens, the darker areas seem to be much less intense and spread apart than in the types from Fernando de Noronha, with some individuals being almost purely white (Fig. 9H-I).

This species was described from the Fernando de Noronha Archipelago but is also very common along a large portion of the north-northeastern Brazilian coast. It occurs in other oceanic islands and seamounts (Leal, 1991; Rios, 2009) and except for the bathyal range expansion (from 0-63 to 260 m) consisting of dead specimens, the records from Canopus are within the known distribution of the species.

Diodora sayi (Dall, 1889)

(Figure 10)

Synonymy see Métivier (1972b) and Leal (1991). Complement:

Diodora sayi: Métivier, 1972b: 409; Leal, 1991: 36; Díaz & Puyana, 1994: 110, fig. 330; Rios, 1994: 26, pl. 7, fig. 59; Macsotay & Campos, 2001: 26; Gracia et al., 2004: 45; Cruz & Gándara, 2006: 130; Benkendorfer & Soares-Gomes, 2009: 147; Rios, 2009: 33, text fig.; Rosenberg et al., 2009: 619; Tunnell et al., 2010: 107, text fig.; Daccarett & Bossio, 2011: 48, fig. 25; Villegas et al., 2013: 8, tab. 4.

Diodora arcuata: Rios, 2009: 30, text fig. [*non* Sowerby, 1862; *partim*].

Types: Lectotype MCZ 125767 (examined), Cuba, off Havana, R/V Blake sta. 62, 146 m (1877-78); Paralectotypes: MCZ 7637 (examined), Cuba, off Morro Light, R/V Blake sta. 2, 23°14’N, 82°25’W, 1472 m, 1 sh (1877); MCZ 7638, Mexico, Yucatan, Campeche Bank, R/V Blake sta. 32, 23°32’N, 88°5’W, 173 m, 1 sh (1877); USNM 95158 (examined), 9 sh, same data as lectotype; MCZ 7640, 5 sh, same data as lectotype; MCZ 7642, Cuba, Yucatan Strait, 1170 m, 2 sh (1877).

Type locality: Not given.

Diagnosis: Shell small to medium-sized (30 mm or less), with oval outline and moderately high apex (H/L = ~1/3); sculpture uniform, composed of similar-sized radial ribs crossed by usually weaker commarginal cordlets; orifice with an asymmetrical internal thickening, giving it a trilobated contour.

Original description: The deep-water specimens (var. Sayi) are generally smaller, of an olivaceous cast, and with the color rays very faint or entirely absent. (Dall, 1889, p. 407)

Redescription: Shell depressedly conical with the apex completely directed forward, medium in size, generally not exceeding 30 mm, narrower in front and from thin to moderately heavy. Anterior slope short, straight or concave; posterior, long and convex. Base oblong-ovate. Orifice placed in the anteriorly directed apex; it is long, narrow and tends to be trilobated, its length being from one-fourth to one-sixth of that of the shell. Surface dull; sculpture consists of fine close set nearly equal, radiating ribs which are crossed by numerous concentric threads. Color uniformly white, cream or faintly olive. In the latter case there are seven slightly darker rays, placed three on each side and one at the front. Margin finely crenulated, the denticulations

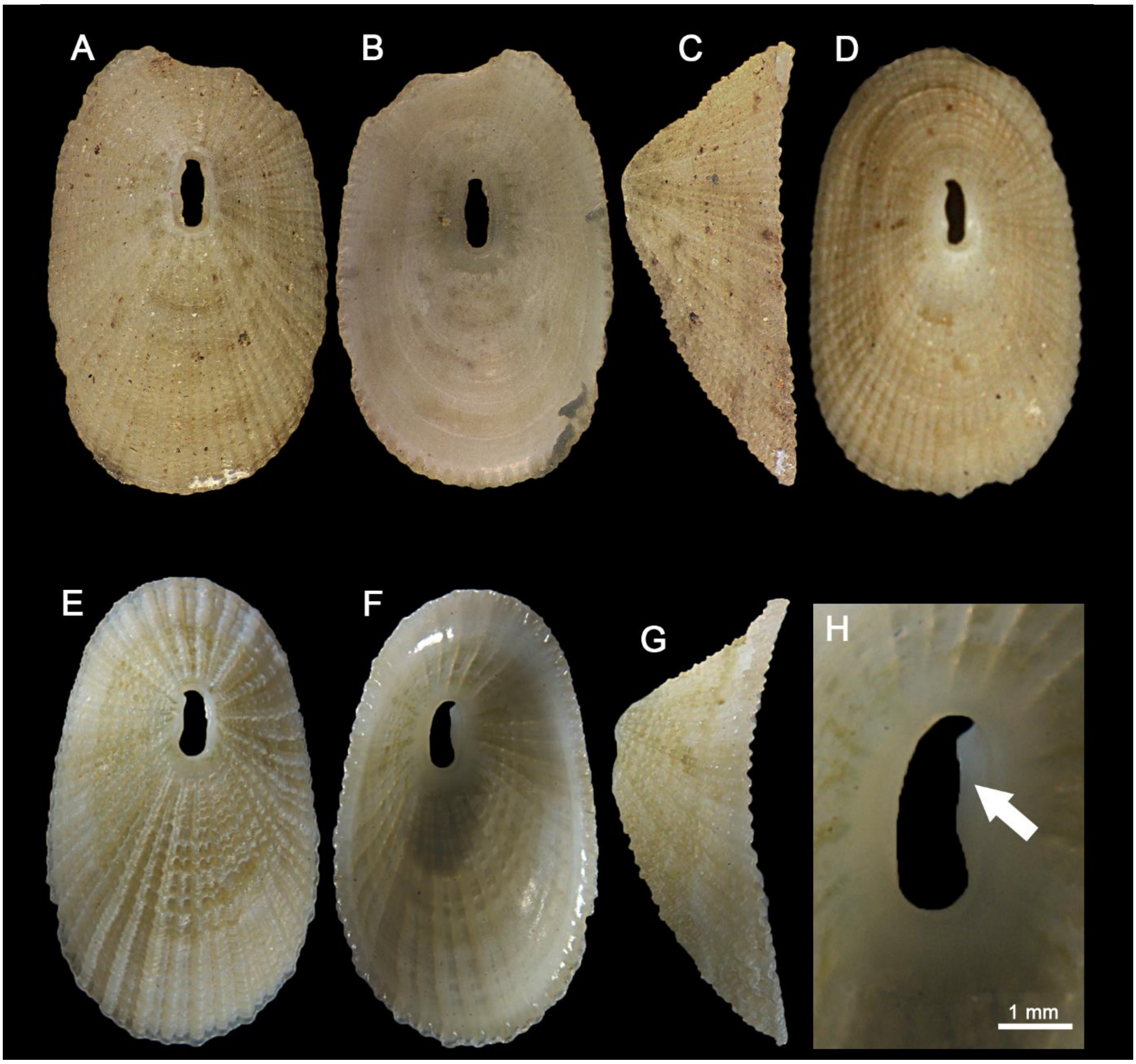

Figure 10: *Diodora sayi*. **A-C.** Lectotype MCZ 125767; **A.** apical view (L = 8.0 mm, W = 5.2 mm); **B.** apertural view; **C.** leftt lateral view (H = 3.4 mm); **D.** Paralectotype MCZ 7637, apical view (L = 6.8 mm, W = 4.0 mm); **E-H.** MZSP 70292 from Canopus; **E.** apical view (L = 9.18 mm, W = 5.35 mm); **F.** apertural view **G.** left lateral view (H = 3.5 mm); H. detail of inner side, showing the foramen (arrow indicates the location of the internal callus). Type photos are a courtesy of the MCZ.

tending to be arranged in pairs. Internal callus of the orifice sharply truncated behind, of the same color as the inside and sometimes bounded by an olive-green, interrupted streak. (Farfante, 1943, pp. 8-9)

Distribution: Southeast Florida to southeastern Brazil, including oceanic islands (Leal, 1991).

Habitat: From 15 to 174 m (live specimens; Rosenberg, 2009), up to 1472 m (empty shells).

Etymology: Named after American zoologist Thomas Say (1787-1843).

Material examined: Types. *Additional material*: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 70292, 60-70 m, 1 sh (viii/2005).

Measurements (in mm): L = 9.2, W = 5.3, H = 3.3.

Remarks: Dall (1889) introduced the name *sayi* as a variation of *Diodora alternata* Say, 1822 (= *D. cayenensis* Lamarck, 1822), providing a brief and vague description. Farfante (1943) recognized this so-called variation as a distinct species based on conchological dissimilarities such as a more anterior apex, sculpture consisting of even-sized ribs and the trilobated orifice (as opposed to keyhole-shaped in *D. cayenensis*). Having access to the specimens studied by Dall, Farfante (1943) also took the opportunity to designate a lectotype (MCZ 125767, Fig. 10A-C). Dall (1889) himself, however, never stated the type locality.

Despite the enormous range of the species, no new synonyms were described and the name remained stable with no new proposed combinations after Farfante's (1943) revision. Even so, it is curious that no formal diagnosis for *Diodora sayi* was ever given in the literature, but distinct authors mentioned the trilobated orifice as a strongly distinctive character (e.g., Farfante, 1943; Leal, 1991). This trilobated aspect stems from an asymmetrical internal thickening that produces a callus (Fig. 10H). This feature sets *D. sayi* apart from virtually every other local congener in the SW Atlantic, which usually has a keyhole-shaped or circular/rounded orifice. It can be verified in the present specimen, which also agrees quite well with Farfante's (1943) redescription in having an oblong-ovate base (Fig. 10E-F), crenulated margin, and uniform sculpture consisting of evenly sized radial elements, though the sculpture seems to become uniform in larger, older specimens (Fig. 10D). It also compares well with the lectotype in color, shape, and sculpture, though it is considerably younger. Moreover, the occurrence reported here is within the normal range of the species.

Genus *Emarginula* Lamarck, 1801

Type species: *Emarginula conica* Lamarck, 1801 [= *Emarginula fissura* (L.)] by monotypy; Recent, Eastern Atlantic.

Diagnosis: Shell height moderate; anterior slope broadly convex; apical whorl overhanging posterior slope; posterior slope concave; protoconch with linear and concentric sculpture; foramen represented by deep anterior slit, its position in earlier growth stages marked by a long selenizone. Sculpture radial and concentric; radial sculpture marked by the primary and secondary ribs. Mantle skirt corresponding to shell slit; epipodial tentacles of similar size, numerous. Ctenidia bipectinate, gill axis free. Rachidian tooth broad, inner lateral teeth narrow; pluricuspid tooth massive, with inner and outer secondary cusps. (McLean, 2011, pp. 474-475)

***Emarginula suspira* Simone & Cunha, 2014**

(Figures 11A-E, 12A-E)

Synonymy see Simone & Cunha (2014). Complement:

Emarginula suspira Simone & Cunha, 2014: 453, figs. 90-102; Cavallari et al., 2016: 48.

Types: Holotype MNHN IM-2000-25310 (examined), Brazil, Espírito Santo, off Itaúnas, Abrolhos Slope, MD55 sta. DC75, 18°59’S, 37°50’W, 295 m (27/v/1987). Paratypes:

MNHN IM-2000-25311, 16 shells, MZSP 102932 (examined), 5 shells, MZSP 102939 (examined), 2 shells, MNRJ 25959, 3 shells, all from type locality. Brazil, Espírito Santo, (Bouchet, Leal & Métivier col.): off Itaúnas, Abrolhos Slope, MD 55 sta. DC73, 18°59'S, 37°48'W, 607–620 m, MNHN IM-2000-25312, 5 shells (27/v/1987); off Regência, MD55 sta. CB77, 19°40'S, 37°48'W, 790–940 m, MNHN IM-2000-25313, 2 shells, MZSP 102921, 1 shell (examined) (27/v/1987); off Conceição da Barra, MD55 sta. CB76, 18°58'S, 37°49'W, 637 m, MNHN IM-2000-25314, 1 shell (27/v/1987); Jaseur Seamount, MD55 sta. DC34, 20°27'S, 35°54'W, 54 m, MNHN IM-2000-25315, 1 shell (15/v/1987); Montague Seamount, MD55 sta. CB79, 20°26'S, 36°41'W, 310–350 m, MNHN IM-2000-25316, 1 shell (14/v/1987).

Type locality: Brazil, Espírito Santo, off Itaúnas, Abrolhos Slope, MD55 sta. DC75, 18°59'S, 37°50'W, 295 m.

Diagnosis: Apex greatly curved inwards, located posteriorly, close to posterior apertural lip. Height ca. 40% of length. Sculpted by ca. 40 radial cords, regularly interrupted by concentric, less developed cords, forming nodes at intersections; mostly alternating wide and narrow cords. Slit ca. 30% of shell length. (Simone & Cunha, 2014, p. 454)

Distribution: NE to SE Brazilian waters, from Ceará to Espírito santo (present study).

Habitat: Coralline and sandy-mud bottoms, 54-940 m, as empty shells only (Simone & Cunha, 2014; present study).

Etymology: The name is a noun in apposition stemming from the Portuguese word "suspiro", a reference to a Brazilian candy with an appearance similar to the shell of this species (Simone & Cunha, 2014).

Material examined: Types. *Additional material*: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 70283, 260 m, 2 sh (xi/2005); MZSP 90277, 260 m, 1 sh (xi/2005); MZSP 105522, 240-260 m, 2 sh (viii/2005); MZSP 131278, 240-260 m, 1 sh (viii/2005).

Measurements (in mm): Largest specimen (MZSP 131278): L = 8.4, W = 6.0, H = 3.2.

Remarks: Simone & Cunha (2014) recently described this species on their account on the Fissurellidae collected by the MD55 expedition. The present specimens are easily recognizable as *Emarginula suspira* in presenting the characteristic outline (Fig. 12C-D), matching proportions, and conspicuous sculpture consisting of radial ribs crossed by concentric cords (Fig. 12A). They also compare very well with the types examined herein (Fig. 11A-E). The present record is the second to date and far removed from the original distribution. It nonetheless represents an impressive range expansion of over 1,900 km northward, from the Vitória-Trindade Chain to NE Brazilian waters.

Genus *Hemimarginula* McLean, 2011

Hemimarginula McLean, 2011: 412, figs. 1-2, 13-18.

Type species: *Emarginula dentigera* Heilprin, 1889 by original designation; Recent, Western Atlantic.

Diagnosis: (Shell) Profile low to moderately elevated; primary radial rib count varies, each primary separated by secondary ribs of lesser size. Slit short, slit and selenizone within bifurcated anterior cord, flanked by two primary cords to make a raised anterior slope; color brown with lighter broad cords. Interior with a channel of selenizone width leading to apex. (McLean, 2011, p. 412)

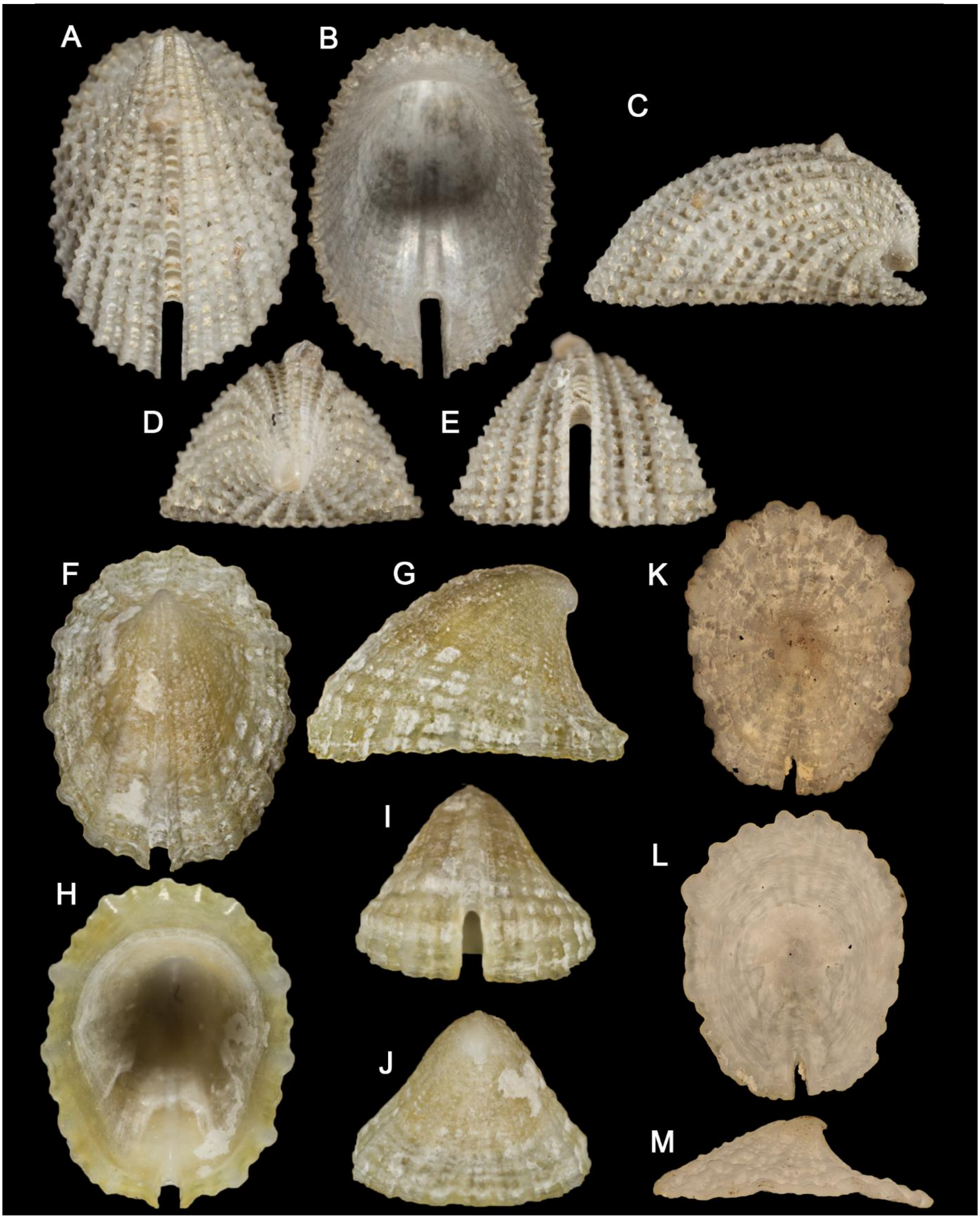

Figure 11: Fissurellid types. **A-E.** *Emarginula suspira* Holotype MNHN IM-2000-25310; A. apical view (L = 6.8 mm, W = 4.7 mm); **B.** apertural view; **C.** left lateral view (H = 2.9 mm); **D.** posterior view; **E.** anterior view; **F-J.** *Hemimarginula hemitoma* Holotype MNHN IM-2000-25324; **F.** apical view (L = 4.6 mm, W = 3.7 mm); **G.** left lateral view (H = 2.8 mm); **H.** apertural view; **I.** anterior view; **J.** posterior view; **K-M.** *Emarginula dentigera* Holotype ANSP 61940; **K.** apical view (L = 5.7 mm, W = 4.5 mm); **L.** apertural view; **M.** left lateral view (H = 1.6 mm). Photos are a courtesy of the ANSP and MNHN.

Hemimarginula hemitoma Simone & Cunha, 2014

(Figures 11F-J, 12F-J)

Synonymy see Simone & Cunha (2014). Complement:

Emarginula tumida: Morretes, 1949: 55 (*non* Sowerby, 1874).

Emarginula pumila: Farfante, 1947: 107 [*in partim*]; Rios, 1975: 13 [*in partim*]; Métivier, 1972: 63 [*in partim*]; 1985: 11 [*in partim*]; Díaz & Puyana, 1994: 108 [*in partim*]; Rios, 1994: 23 [*in partim*]; Rosenberg et al., 2009: 620 [*in partim*]; Tunnell et al., 2010: 108 [*in partim*]; Daccarett & Bossio, 2011: 48 [*in partim*].

Hemimarginula hemitoma Simone & Cunha, 2014: 463, figs. 140-151; Cavallari et al., 2016: 28.

Types: Holotype MZSP IM-2000-25324 (examined), Brazil, Espírito Santo, off Itaúnas, Abrolhos Slope, MD55 sta. DC83, 18°50'S, 37°57'W, 60 m (28/v/1987). Paratypes: MZSP 102947 (examined), 2 sh, from type locality. Brazil, Espírito Santo: off Itaúnas, Abrolhos Slope, MD55 sta. DC82, 18°56'S, 37°52'W, 85–105 m (28/v/1987), MNHN IM-2000-25326 (examined), 4 sh, MZSP 102948 (examined), 3 sh; Jaseur Seamount, MD55 sta. DC34, 20°27'S, 35°54'W, 54 m (15/v/1987), MNHN IM-2000-25327 (examined), 1 sh; Trindade Island, Enseada dos Portugueses, 20°30'15"S, 29°18'46"W, 10–12 m, MNHN IM-2000-25881 (examined), 3 sh (Bouchet col., v/1987); Andradas Beach, 20°30'50"S, 29°18'20"W, 0–1 m, MZSP 101247 (examined), 1 sh (Simone col., 24/vii/2011).

Type locality: Brazil, Espírito Santo, off Itaúnas, continental slope of Abrolhos, 18°50'S, 37°57'W, 60 m.

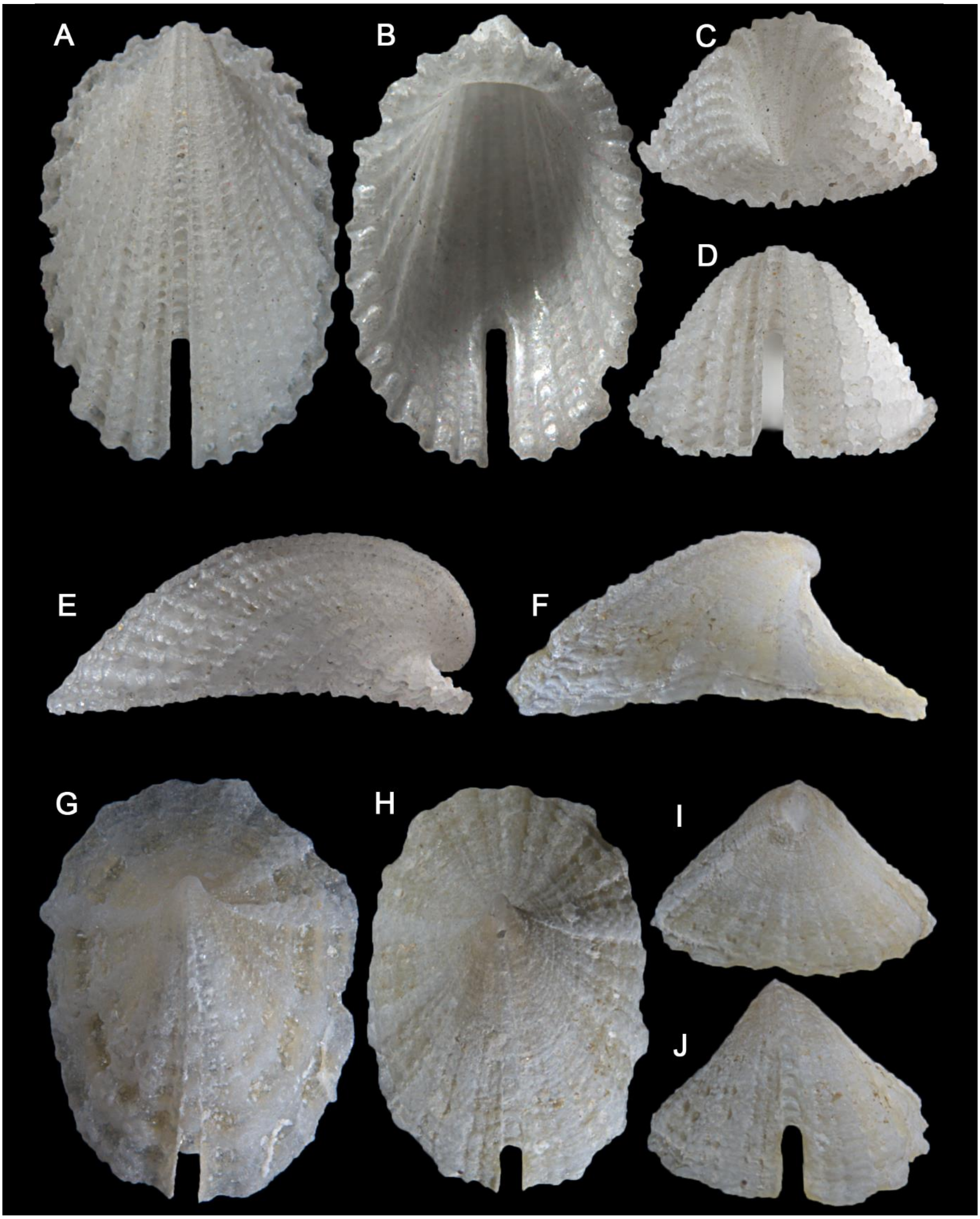

Figure 12: *Emarginula suspira* and *Hemimarginula hemitoma* from Canopus Bank. **A-E.** *Emarginula suspira* MZSP 70823; **A.** apical view (L = 8.0 mm, W = 5.2 mm); **B.** apertural view; **C.** posterior view (H = 2.17 mm); **D.** anterior view; **E.** left lateral view; **F-J.** *Hemimarginula hemitoma* MZSP 131277; F. left lateral view (H = 3.05 mm); G. apical view (L = 5.01 mm, W = 3.79 mm); **H-I.** specimen #2; **H.** apical view (L = 6.55 mm, W = 4.65 mm); **I.** posterior view (H = 3.2 mm); **J.** anterior view.

Diagnosis: Apex blunt, located in middle, turned postero-dorsally. Height 40–60% of length. Sculpted by 50–60 strong radial cords, mostly alternating wide and narrow cords, interspaces regularly filled by minute transverse cords. (Simone & Cunha, 2014, p. 463)

Distribution: NE to SE Brazilian waters (Simone & Cunha, 2014; present work).

Habitat: Coralline and rocky bottoms, 1–260 m (empty shells; Simone & Cunha, 2014; present work).

Etymology: The name is attributed to a resemblance to species in the closely related genus *Hemitoma* Swainson, 1840 (Simone & Cunha, 2014).

Material examined: Types. *Additional material*: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 131277, 240-260 m, 6 sh (viii/2005).

Measurements (in mm; n = 5): L = 6.15 ± 1.24, W = 4.6 ± 0.94, H = 2.81 ± 0.39.

Remarks: This recently described species was widely identified as *Hemimarginula pumila* (Adams, 1851), or its synonyms, in revisions and local catalogs. Several authors cited records from Brazil, but at least part of these specimens (judging by the figures) are in fact *Hemimarginula hemitoma.* It can be readily distinguished from *H. pumila* and another local congener, *Hemitoma pileum* (Heilprin, 1889), by having delicate, radially arranged square pits formed by the crossing of radial and commarginal sculpture elements (Fig. 12H), and overall narrower radial ribs (Simone & Cunha, 2014). Additionally, Simone & Cunha (2014) remarked on its similarity to *H. dentigera* (Heilprin, 1889), citing the taller height/length ratio (40-60% as opposed to 27% in *dentigera*) and the double-lined radial pits on the outer surface as the most prominent distinctions. Both these characters remain very consistent in the Canopus specimens, especially the height/width proportion (Figs. 11G, I, 12F, I). After examining the holotype of *H. dentigera* (ANSP 61940; Fig. 11K-M), I also reckon the ellipsoid outline (oval in *dentigera*), posteriorly dislocated apex of *H. hemitoma* as opposed to a more centralized one in *H. dentigera*, and more numerous radial ribs (40-50 vs 18-26 in *dentigera*; also see Teskey, 1973) as additional remarkable distinctions.

Genus *Lucapina* Sowerby I, 1835

Synonymy see Dall (1915: 437).

Type species: *Lucapina elegans* Sowerby I, 1835 (= *Lucapina sowerbii* Sowerby I, 1835) by subsequent designation (Dall, 1915); Recent, Atlantic.

Diagnosis: Shell thin, small, of medium size, conical and rather depressed. Basal margin oblong or ovate, resting on a plane, not raised at the ends. Apex in front of the middle, the orifice large, oval and situated immediately before the apex. Outer surface of the shell decussated by numerous radiating ribs and concentric threads. Margin strongly and finely crenulated. Internal callus of the orifice roundly truncated posteriorly. Muscle impression of a uniform width. Body of the animal much thickened behind. The mantle is smooth and extends up and over the shell covering about one-third of it. It also extends below and shields the head, sides and back of the foot. Its border simple and non-papillose. Tentacles long with large eyes situated on stout tubercles at their outer bases. (Farfante, 1943, p. 14)

***Lucapina aegis* (Reeve, 1850)**

(Figures 13A-B, 14A-G)

Synonymy see Métivier (1972b). Complement:

Lucapina aegis: Matthews & Kempf, 1970: 17; Métivier, 1972: 66; 1972b: 407; Abbott, 1974: 25, fig. 117; Rios, 1975: 16; 1985: 15; Díaz & Puyana, 1994: 111, pl. 34, fig. 332; Rios, 1994: 27; Lyons, 1998: 16; Redfern, 2001: 7, pl. 4, fig. 29; Rios, 2009: 36, text fig.; Rosenberg et al., 2009: 620; Tunnell et al., 2010: 110, text fig.; Daccarett & Bossio, 2011: 49, fig. 37; Espinosa et al., 2012: 56; Redfern, 2013: 5, fig. 10.

Types: Syntype NHMUK 1984194 (examined), unknown locality (Hugh Cumming Collection).

Type locality: Not given.

Original description: Shell oblong, depressed, but little raised, neatly squamately cancellated with numerous close-set nearly equal ridges and concentric lines, orifice oblong, rather large, inclined anteriorly; white, rather obscurely broadly rayed with greenish olive (Reeve, 1850).

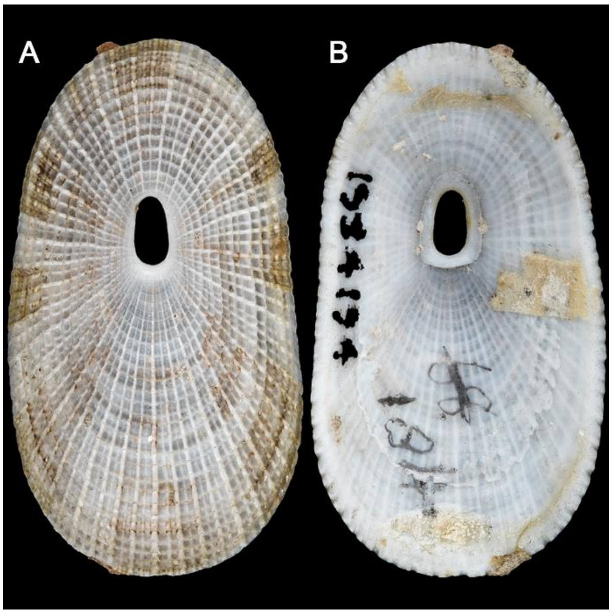

Figure 13: *Lucapina aegis* syntype NHMUK 1984194. **A.** apical view (L = 34 mm, W = 18 mm); **B.** apertural view.

Redescription: Shell thin, reaching about 35 mm in length, conical and depressed. Basal outline oblong. Anterior slope straight or slightly concave, posterior slope convex. Summit in front of the middle, the orifice situated before it. The orifice is narrow, oblong, contracted in the central position, its sides produced upward in little points on either margin, its length being from one-sixth to one-seventh that of the shell. Sculpture consists of about 40 radiating ribs separated by wide and rather deep grooves which generally bear an intermediate riblet. Strong and elevated concentric laminae are formed which produce scales at their junction with radiating ribs. Between the concentric laminae there are two or three fine threads. Color varying from light brown to olive-green with 8 darker broken rays. Margin finely crenulated. Inside, a polished grayish-with, the sculpture of the outside showing through in the form of radial and concentric white lines. Internal callus of the orifice narrow, with the same color as the interior and almost triangular in shape. Muscle impression distinct and of a uniform width. (Farfante, 1943, p. 15)

Distribution: From East Florida to Brazil (Rosenberg et al., 2009).

Habitat: From 0-55 m depths (Rosenberg et al., 2009), up to 260 m (empty shells only; present study).

Material examined: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 131284, 240-260 m, 5 sh (viii/2005). **São Paulo:** Santos, Iráraré Beach, 23°57'S, 46°18'W, MZSP 121163, 8 sh (Colella col., vii/1968).

Measurements (in mm): Largest specimen, L = 7.3, W = 4.2, H = 2.2.

Remarks: Farfante (1943) stated that the types of *Lucapina aegis* were probably held at the British Museum. I have contacted the NHMUK personnel, and a syntype specimen was located (NHMUK 1984194, Fig. 13A-B). Despite being juveniles, the present specimens compare well with redescriptions and illustrations in the literature, particularly the also juvenile shell figured by Redfern (2013: 4, fig. 10). Farfante (1943) mentioned the coloration varying from light brown to olive green, with darker rays, and the triangle-shaped foramen callus (Fig. 14B), all of which can be verified in the Canopus specimens. Also according to Farfante (1943), this species attains a much larger size (35 mm). In reality, the coloration pattern may change drastically with age: as the shell grows further (15 mm +), the margins often acquire a dark green hue (Fig. 14D-E). A possible beginning of this greenish, older-stage coloration can be seen along the shell margin in one of the studied specimens (Fig. 14A).

The particular color transition with age can be used to distinguish *Lucapina aegis* from virtually every other local congener. Additionally, it can be distinguished from the sympatric *Lucapina philippiana* (Finlay, 1930) by being much larger (maximum L = 35 mm vs. 18 mm; Rosenberg, 2009) and having sharper and larger sculpture elements (Fig. 14G); *Lucapina sowerbii* by being slightly larger (35 mm vs 30 mm; Rosenberg, 2009), and presenting a smaller number of ribs and cords; and *Lucapina suffusa* (Reeve, 1850) by having a sharper sculpture, with more numerous, narrower radial ribs and concentric cords, and a proportionally smaller foramen. It differs from the Brazilian species *Lucapina elisae* Costa & Simone, 2006, by being much smaller (35 mm vs. 60.5 mm), having a lower profile and proportionally larger foramen and stronger and less numerous ribs and cords.

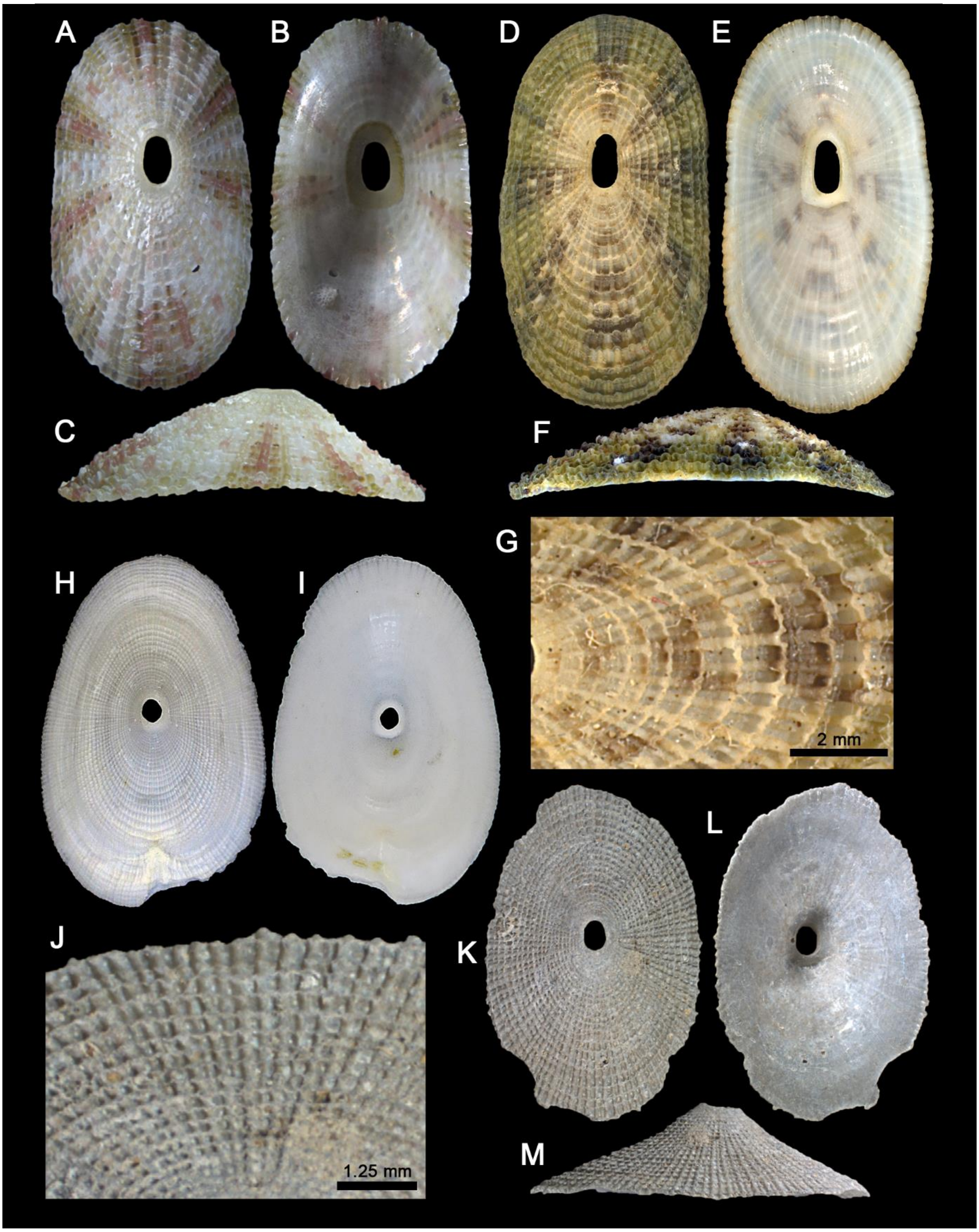

Figure 14: *Lucapina aegis*. **A-C.** MZSP 131284 from Canopus; **A.** apical view (L = 7.3 mm, W = 4.2 mm); **B.** apertural view; **C.** leftt lateral view (H = 2.2 mm); **D-G.** adult specimen, MZSP 121163 from Santos, off SE Brazil; **D.** apical view (L = 23.0 mm, W = 12.2 mm); **E.** apertural view; **F.** left lateral view (H = 5.8 mm); **G.** detail of region just anterior to the foramen, showing the sculpture; **H-I.** *Lucapina elisae* Paratype MZSP 61229; **H.** apical view (L = 50.0 mm, W = 33.0 mm); **I.** apertural view; **J-M.** MZSP 93931 from Canopus; **J.** detail of median region of left side showing the reticulate sculpture; **K.** apical view (L = 17.4 mm, W = 11.3 mm); **L.** apertural view**; M.** left lateral view (H = 5.0 mm).

This species has been reported to occur in Brazilian waters at least since Rios (1970) and Matthews & Kempf (1970), and several catalogs reiterate this information (Abbott, 1974; Rios, 1994; 2009; Rosenberg et al., 2009). The records include archipelagos (Fernando de Noronha) and oceanic islands and atolls (Trindade Island, Rocas Atoll). The present specimens are within the known range of *Lucapina aegis*, but represent a bathymetric expansion from the previously known range of 0-55 m to a maximum depth of 260 m, though the samples consist of empty shells only.

Lucapina elisae Costa & Simone, 2006

(Figure 14H-M)

Lucapina elisae Costa & Simone, 2006: 1, figs 1-18; Pimenta et al., 2014: 63.

Types: Holotype MNRJ 10661, Brazil, Ceará, Canopus Bank, off Fortaleza, 02°14’ 25”S, 38°22’50”W, 240-260 m depth (J. Coltro & P.M. Costa col., xi/2005). Paratypes: MZSP 61229 (examined), 9 specimens (6 lacking shell); MZSP 53934 (examined), 3 sh; MZSP 78194 (examined), 1 sh; MNRJ 10680, 2 sh; MNRJ 10681, 1 sh; MNRJ 10683, 2 sh; MORG 46442, 1 sh; all from type locality.

Type locality: Brazil, Ceará, Canopus Bank, off Fortaleza, 02°14’25”S, 38°22’50”W, 240-260 m depth.

Diagnosis: Shell with relatively thin walls; size large (about 50 mm); orifice relatively small, located between middle and posterior thirds; about 170 radial delicate lines uniformly distributed, normally equally predominant that [*sic*] concentric lines (Costa & Simone, 2006).

Original description: Shell elliptical, fragile, about 50 mm, anteroposteriorly elongated (length/width ratio about 1.6; length/width e•1.53, d•1.69); anterior region somewhat wider or similar sized than posterior region. Elevation weak, height somewhat a third of length (height

/length e•0.23, d•0.29). Color pure white. Protoconch (seen in a very young specimen) translucent, white, with about 11⁄4 smooth, weakly planispiral whorls; situated perpendicularly to longitudinal axis. Orifice located approximately between middle and posterior thirds; proportionally small (about 6% of outer shell area); orifice borders slightly oval, irregular, often feebly turned posteriorly. Outer sculpture constituted by delicate spiral and radial lines, both equally predominating or weak predomination of radial lines; about 170 radial lines in uniform arrangement; radial lines forming a mosaic of larger radial lines separated by four narrower radial lines. Inner surface smooth, glossy; narrow undulations close to edge, corresponding to outer sculpture. Muscular scars very weak. Narrow and shallow thickness surrounding orifice; shallow concavity anterior to this thickness in some specimens, absent in others. (Costa & Simone, 2006, pp.1-4)

Distribution: Only known from Canopus Bank.

Habitat: Gravel bottoms at 240-260 m depths.

Etymology: Named after Ms. Elisa Gradvohl Bezerra.

Material examined: Types. *Additional material:* BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 90276, 260 m, 1 sh and 1 frag (juveniles; xi/2005); MZSP 93931, 260 m, 4 sh (juveniles; xi/2005).

Measurements (in mm): Largest specimen **(**MZSP 93931), L= 17.47, W = 11.31, H = 5.01.

Remarks: This very large species differs from every remaining congener by its size and proportions, and a proportionally small orifice (Costa & Simone, 2006; Fig. 14H). I also add the characteristic sculpture consisting of a series of delicate, evenly sized axial and concentric ribs and cords, which cross each other forming a reticulate pattern (Fig. 14J). This produces an overall irregular but finely sculptured outer shell surface (Fig. 14H-I), which is unparalleled among local species of *Lucapina*. Added to the current samples, several specimens of *Lucapina elisae* were collected alive, including some of the types. Such a conspicuous species never being collected anywhere on the Brazilian coast strongly indicates it is likely endemic to Canopus, but more samplings would be necessary to confirm this.

Genus *Lucapinella* Pilsbry, 1890

Synonymy see McLean (1967: 349).

Type species: *Clypidella callomarginata* Dall, 1871 by subsequent designation (Pislbry, 1890); Recent, Pacific.

Diagnosis: Shell elongate, anterior end narrow, fissure centrally located, oval or oblong. Sculpture of imbricating ribs; internal margin thickened, offset by a groove. Shell not covered by mantle margin but animal too large to be contained within the shell. (McLean, 1967, p. 349)

***Lucapinella limatula* (Reeve, 1850)**

(Figure 15A-C)

Synonymy see Farfante (1943) and Métivier (1972b). Complement:

Lucapinella limatula: Farfante, 1943: 19, pl. 5, figs. 1-3; Métivier, 1972: 67; 1972b: 408; Abbott, 1974: 26, fig. 120; Matthews & Rios, 1974: 48; Ekdale, 1974: 641; Rios, 1975: 16, pl. 3, fig. 27; Vokes & Vokes, 1983: 11, pl. 1, fig. 13; Brattström, 1985: 201, tab. 2; Rios, 1985: 15, pl. 7, fig. 60; Díaz & Puyana, 1994: 111, pl. 34, fig. 335; Rios, 1994: 28, pl. 8, fig. 70; Capelo & Buitrago, 1998: 117, tab. 1; Lyons, 1998: 16; Redfern, 2001: pl. 4, fig. 33; Benkendorfer & Soares-Gomes, 2009: 147; Rios, 2009: 38, text fig.; Palacio et al., 2010: 403, tab. 2; Tunnell et al., 2010: 111, text fig.; Daccarett & Bossio, 2011: 50, fig. 40; Espinosa et al., 2012: 56; Redfern, 2013: 6, fig. 13.

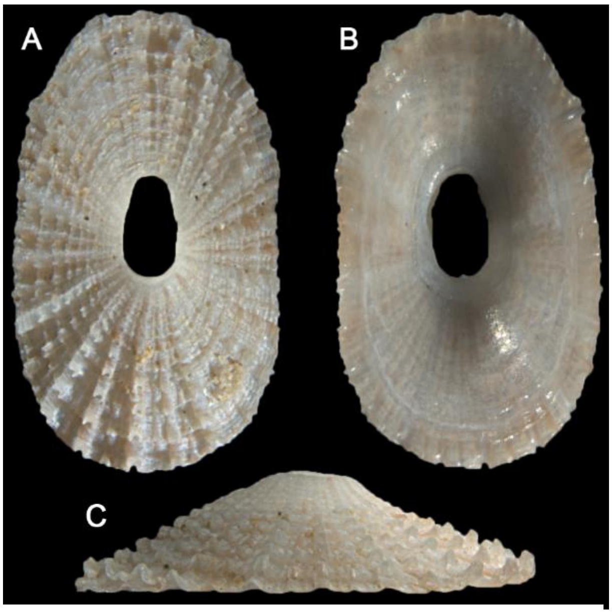

Figure 15: *Lucapinella limatula* MZSP from Canopus. **A.** apical view (L = 7.0 mm, W = 4.1 mm); **B.** apertural view; **C.** left lateral view (H = 1.8 mm).

Types: Not formally designated.

Type locality: Not given.

Original description: Shell oblong-ovate, somewhat attenuated anteriorly, sides a little compressed, radiately finely and closely prickly-striated, orifice large, ovate; white, stained and variegated with pale black. (Reeve, 1850)

Redescription: Shell generally thin and small, not exceeding 20 mm in length, depressed and attenuated anteriorly. Base ovate. Slopes straight or somewhat concave. Orifice almost at the shell center, triangular, with its sides projected upwards. In length is from on e-third to one-fifth that of the shell. Sculpture consists of alternately large and small ribs anteriorly, but posteriorly and laterally there are three riblets between each pair of primary ribs, the central one being the strongest. The shell is crossed by numerous concentric laminae which form small, erect, imbricated scales where they intercept the radial ribs and riblets. The growth lines are numerous and clearly distinct between the laminae. Color white, yellow, pink or brown, either solid or with 6 broad rays of deep pink, dark brown or black extending from the apex to the margin. These may be arranged in two ways: either with one anterior, one posterior and two on each side, or with three on each side. Margin thickened and crenulated, sometimes with the crenulations in pairs. Interior polished white, the outside color showing though the shell. Muscle scar rather deeply impressed, narrow, of a uniform width and lying very close to the margin. Internal callus of the orifice narrow, roundly truncated behind and outlined by a marked indenture. (Farfante, 1943, p. 19)

Distribution: North Carolina to Brazil (Rosenberg et al., 2009).

Habitat: Sublittoral, 0-146 m (Rosenberg et al., 2009), up to 260 m (empty shells only; present study).

Material examined: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP, 240-260 m, 1 sh (viii/2005).

Measurements (in mm): L = 7.0, W = 4.1, H = 1.8.

Remarks: As is the case in another fissurellid species studied herein (*Lucapina aegis*, above), the type material of *Lucapinella limatula* was not formally pointed out by Reeve. They should be at the British Museum according to Farfante (1943), but I have contacted the NHMUK personnel and no such specimens could be found (Salvador, pers. comm). Even so, the Canopus specimen compares fittingly with the redescription by Farfante (1943), particularly in presenting a large orifice, with sides projected upwards and sculpture consisting of alternately large and small radial ribs and riblets, crossed by concentric laminae that form scale-like, upward-oriented projections at the intersections (Fig. 15A, C). Regarding other local congeners, *L. limatula* differs from *Lucapinella henseli* (Martens, 1900) by being smaller (maximum length is 18 mm, against 27.8 mm in *L. henseni*; Rosenberg, 2009), by the alternated pattern of the radial sculpture and by presenting erected scale-like projections. This species is quite common and has been formally reported from Brazil at least since the late 40s (Morretes, 1949). It appears in virtually every local catalog and occurs along the entire Brazilian coast, according to Rios (1994; 2009). The present specimen expands the maximum depth recorded for the species from 146 m to 260 m, though it is only an empty shell.

Superfamily Angarioidea

Family Areneidae McLean, 2012

General remarks: Areneidae has been formally erected only recently to remediate nomenclatural issues and in compliance with recent phylogenetic hypotheses (Williams et al., 2008; McLean, 2012b). It mainly accommodates species previously belonging to Liotiidae Gray, 1850. The group is characterized by the colored shells (as opposed to colorless in Liotiidae), with dominant spiral sculpture, tangential aperture with denticles and lip preceded by a short phase of whorl expansion (McLean, 2012b). The family currently includes the African genus *Cinysca* Kilburn, 1970 and the Atlantic-Pacific *Arene* Adams & Adams, 1854, which is represented in Brazil by at least nine species (Rios, 2009).

Genus *Arene* Adams & Adams, 1854

Type species: *Turbo cruentatus* Mühlfeld, 1824, by subsequent designation (Woodring, 1928); Recent, Atlantic.

Diagnosis: Shell radiately painted with red: whorls muricated, the last stellate at the periphery, or angulated and keeled; peritreme more or less varicose. (Adams & Adams, 1854).

***Arene brasiliana* (Dall, 1927)**

(Figure 16)

Synonymy see Leal (1991). Complement:

Arene riisei Rehder, 1943: 192, pl. 19, figs. 17-18 [syn. nov].

Liotia brasiliana: Morretes, 1949: 61.

Arene brasiliana: Rios, 1970: 29, pl. 3; 1975: 26, pl. 7, fig. 74; 1985: 27, pl. 12, fig. 116; Leal, 1991: 55; Rios, 1994: 40, pl. 12, fig. 131; Benkendorfer & Soares-Gomes, 2009: 147; Rios, 2009: 64 (text fig. in error); Gondim et al., 2011: 78, tab. 1.

Types: Holotype USNM 214135, Brazil, Paraíba, off João Pessoa, SE of Cape Roque, R/V Albatross sta. 2758, 37 m (16/xii/1887).

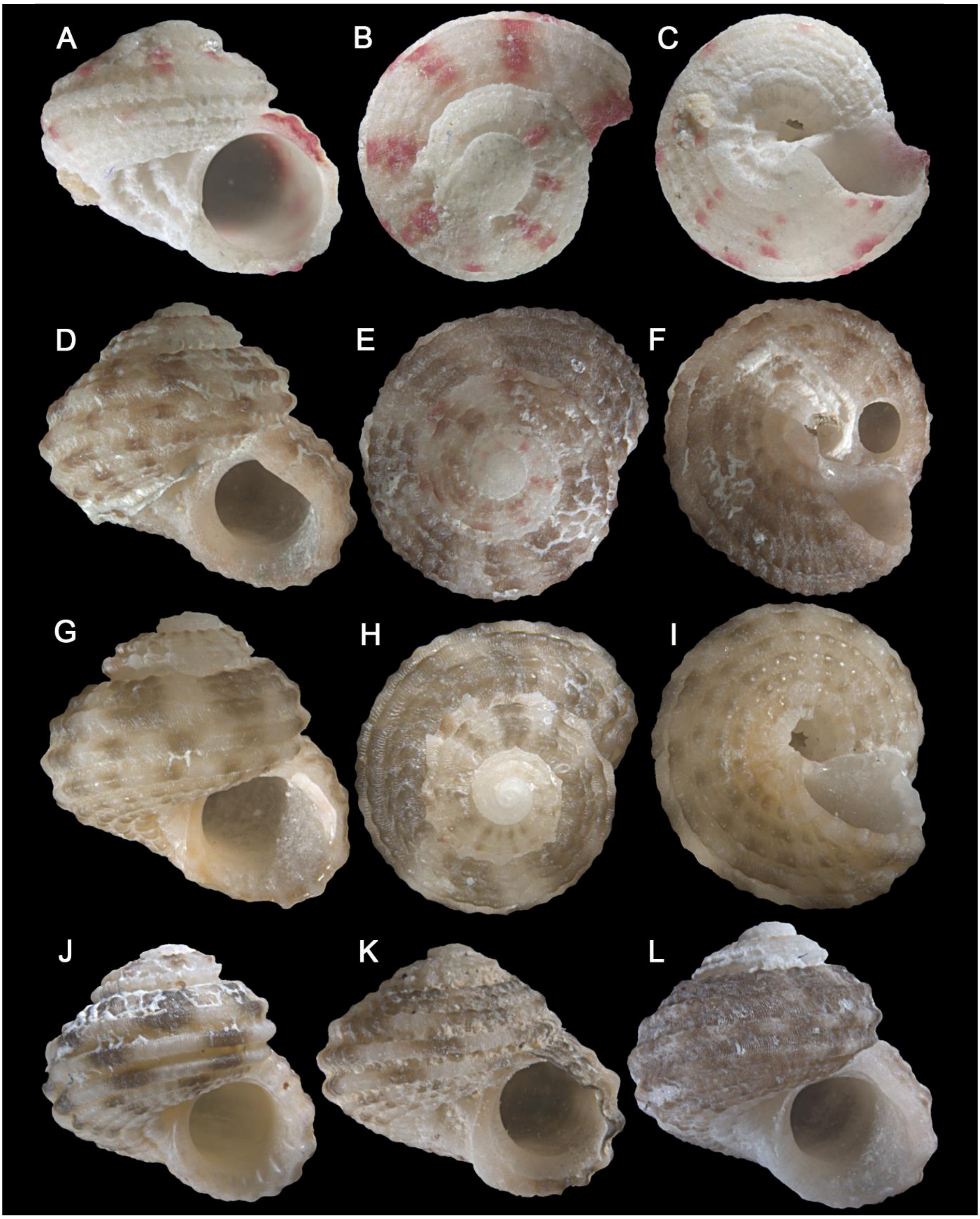

Figure 16: *Arene brasiliana* from Canopus. **A-C.** MZSP 131038, spm. #1; **A.** apertural view (H = 3.0 mm, D = 3.5 mm); **B.** apical view; **C.** umbilical view; **D-F.** MZSP 70236; **D.** apertural view (H = 4.7 mm, D = 5.5 mm); **E.** apical view; **F.** umbilical view; **G-I.** MZSP 131038, spm. #2; **G.** apertural view (H = 4.8 mm, D = 5.5 mm); **H.** apical view; **I.** umbilical view; **J-L.** MZSP 131038; **J.** spm. #3, apertural view (H = 4.25 mm, D= 5.0 mm); **K.** spm. #4, apertural view (H = 3.8 mm, D = 4.9 mm); **L.** spm. #5, apertural view (H = 4.8 mm, D = 5.0 mm).

Type locality: Brazil, southeast of Cape Roque, Albatross sta. 2758.

Diagnosis: Shell trochoid-turbiniform, small (H = ~5 mm). Suture channeled. Color widely variable from homogeneous dark-brown to homogeneous dark-red, usually forming axial bands/marks with different intensities on an otherwise white-cream background. Sculpture consisting of 3 dominant spiral cords bearing nodules, and axial growth lines that are more conspicuous in the interspaces between the cords.

Original description: Shell small, solid, white, with radiating blotches of rose pink and about four whorls, of which the earlier ones are subtabulate; suture closely appressed; nucleus minute, smooth; spiral sculpture of (on the periphery of the last whorl three) prominent crenulated cords with a smaller thread in the interspaces, and three or four other minor threads between the suture and the posterior major cord; on the base the deep narrow umbilicus has a coarsely crenulate margin with four equal crenulate minor threads between it and the anterior peripheral cord; the aperture is circular with a thickened peristome somewhat crenulated by the external scukpture; the very fine incremental lines give a velvety appearance to the interstices of the sculpture. (Dall, 1927, pp. 4-5)

Distribution: NE Brazil, from Ceará to southern Bahia state, including oceanic islands (Leal, 1991; Rios, 1994; present study).

Habitat: Coralline bottoms, 52-120 m (live specimens; present study).

Material examined: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 70326, 60-70 m, 1 sh (viii/2005); MZSP 70366, 60-70 m, 1 sh (viii/2005); MZSP 131038, 240-260 m, 8 sh (xi/2005); MZSP 67312, 60-70 m, 1 sh (viii/2005). **Bahia:** off Alcobaça, Minerva Bank, 17°01'S, 37°37'W, 120 m, MZSP 107929, 100 spm (Abbate & Lima col., 12/viii/2012).

Measurements (in mm; n = 5): 4 whorls, H = 4.47 ± 0.43, D = 5.18 ± 0.29.

Remarks: This is an apparently widespread species in NE Brazil, ranging from Ceará to southern Bahia state (Leal, 1991; present study). It has some variation in shell proportions, sculpture strength and number of sculpture elements and coloration. There are three dominant spiral cords on every whorl, but they can be very strong and separated by deep interspaces (Fig. 16J) or weaker with shallower interspaces, producing a smoother shell profile (Fig. 16L), with a complete range of intermediary states. The number and shape of the nodules they bear is also remarkably variable, with spikier, angular nodules in some specimens (Fig. 16E), to rounder, less prominent in others (Fig. 16H). In that regard, and having examined photographs of the type specimens, we consider the sympatric *Arene riisei* Rehder, 1943 to be merely a taller form of *A. brasiliana*, and thus a junior synonym. Leal (1991) had already perceived the color variation of the species, and described these variants in detail. I have verified the same color patterns in the Minerva Bank specimens from southern Bahia state examined herein. The specimens from Canopus themselves are unfortunately few and damaged, and mostly fall within the brown spectre of variation, though some specimens are mainly red (Fig. 16A-C), or have slight red markings (Fig. 16E), indicating an intermediary state. The present record from Canopus expands the known range of the species ca. 300 km northeastward, from Alagoas to Ceará state. The live specimens collected in the Minerva Bank expand the maximum depth from 81 m (Rosenberg, 2009) to 120 m.

Arene flexispina Leal & Coelho, 1985

(Figure 17)

Synonymy see Leal (1991). Complement:

Arene flexispina: Leal, 1991: 54, pl. 1, fig. F, pl. 4, figs. E-F; Rios, 1994: 40, pl. 12, fig. 133; 2009: 64, text fig.; Pimenta et al., 2014: 64, fig. 4a-c.

Types: Holotype MNRJ 5352 (examined), Brazil, Bahia, 40 km off Ponta de Corumbaú, GEOMAR X sta. 48, 16°56’30”S, 38°39’30”W, 80 m (R/V Almirante Câmara col., 09/vi/1978). Paratypes: USNM 820786, 1 sh, USNM 820786A, 1sh, MNRJ 5353, 1 sh, MORG 22807, 1 sh, MORG 22808, 1 sh, all from the type locality; MORG 22619, Brazil, Espírito Santo, off Conceicção da Barra, GEOMAR X sta. 38, 18°49’S, 37°52’W, 54 m, 1 sh (R/V

Almirante Câmara col., 07/vi/1978); MNRJ 5354, Brazil, Bahia, 120 km off Abrolhos Reef, GEOMAR X sta. 47, 16°44’S, 37°21’W, 54 m (R/V Almirante Câmara col., 08/vi/1978).

Type locality: Brazil, Bahia, 40 km off Ponta de Corumbaú, 16°56’30”S, 38°39’30”W, 80 m.

Diagnosis: Shell large for the genus (H = 7-8 mm), slightly taller than wide. Sculpture consisting of spiral cords bearing large, recurved spines; ground color reddish, with yellowish-green spiral cords.

Distribution: NE to SE Brazil, from Ceará to Espírito states (present study).

Habitat: Coralline bottoms, 54-780 m (Leal, 1991; present study).

Etymology: The name refers to the conspicuous recurved spines present in the shell’s ornamentation (Leal & Coelho, 1985).

Material examined: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 122851, 240-260 m, 4 sh (2 juv.). **Bahia:** Minerva Bank, 17°06’S, 37°38’W, 120 m, MZSP 110862, 30 sh + 5 spm (Abbate & Lima col., 2013).

Measurements (in mm): Largest specimen 4½ whorls, H = 8.53, D = 7.02.

Remarks: This species was described from Bahia state, in NE Brazil. It has since been recorted in the Vitória-Trindade Seamount Chain off the southeastern Brazilian state of Espírito Santo by Leal (1991), based on Marion Dufresne MD55 expedition specimens. The adult specimens in the Canopus assemblage are badly worn out. Except for a very faint reminiscent coloration and sculpture elements, the shell outline was the only clue of their identity. Yet, a very well preserved juvenile illustrated herein (Fig. 17E) presented the unmistakable sculpture elements of the species, consisting of spiral cords presenting large, recurved spines, and the typical combination of reddish and yellowish-green coloration. It also differs drastically from juveniles of its most similar local congener, *Arene aff. briareus* (see above), both in color and sculpture. Nevertheless, the outline of the adult specimens from Canopus (Fig. 17B, F) are very similar to adult specimens from Minerva Bank (Fig. 17H-I) examined herein, a region that is relatively close to the type locality. The specimens from Minerva also reveal that most *A. flexispina* shells illustrated so far, which includes the holotype (Fig. 17A), may be subadult individuals.

The species in fact attains a larger maximum size than the one originally reported by Leal & Coelho (1985), which is a shell height of 6.4 mm and a diameter of 6.7 mm. Comparatively, the largest specimen examined herein (Fig. 17H) is as tall as 7.9 mm and as wide as 6.7 mm, and seems to have grown an extra half whorl. Besides intraspecific variation itself, this additional whorl length may explain the distinct height/diameter proportion, as the larger, older shell examined herein is slightly taller than wide. In fact, Leal and Coelho (1985) remarked that the shell seemed to become proportionally higher with age, which is further confirmed here. The umbilicus, which was originally described as wide and deep, also seems to become narrower and even imperforate in larger specimens (Fig. 17D). The shell size of *Arene flexispina* distinguishes it from most local congeners, except for *A.* aff. *briareus* (see below). From the latter, it differs by having a distinct coloration, a proportionally taller shell with a more inflated base, spiral cords bearing larger but much fewer spines, narrower interspaces between spiral cords, and indistinctly colored apex. The new record from Canopus is far removed from the original distribution of the species, which is from southern Bahia to Espírito Santo states. It represents a great expansion of 1,600 km northwards. The bathymetric range falls within the previously known minimum and maximum values of 54 to 780 m.

Arene* aff. *briareus

(Figure 19)

Diagnosis: Shell relatively large for the genus (H = 7-9 mm), trochiform. Sculpture consisting of 3 wide spiral cords (8 on body whorl) profusely ornamented by large, semi-hollow, scale-like spines; cords separated by equally wide, deep interspaces; and closely-packed, thin axial growth lines, more visible in the interspaces. Protoconch sculptured by small, subsutural axial lamellae. Color ranging from white to intense reddish, darker on spiral cords, and lighter at the base; apex yellow.

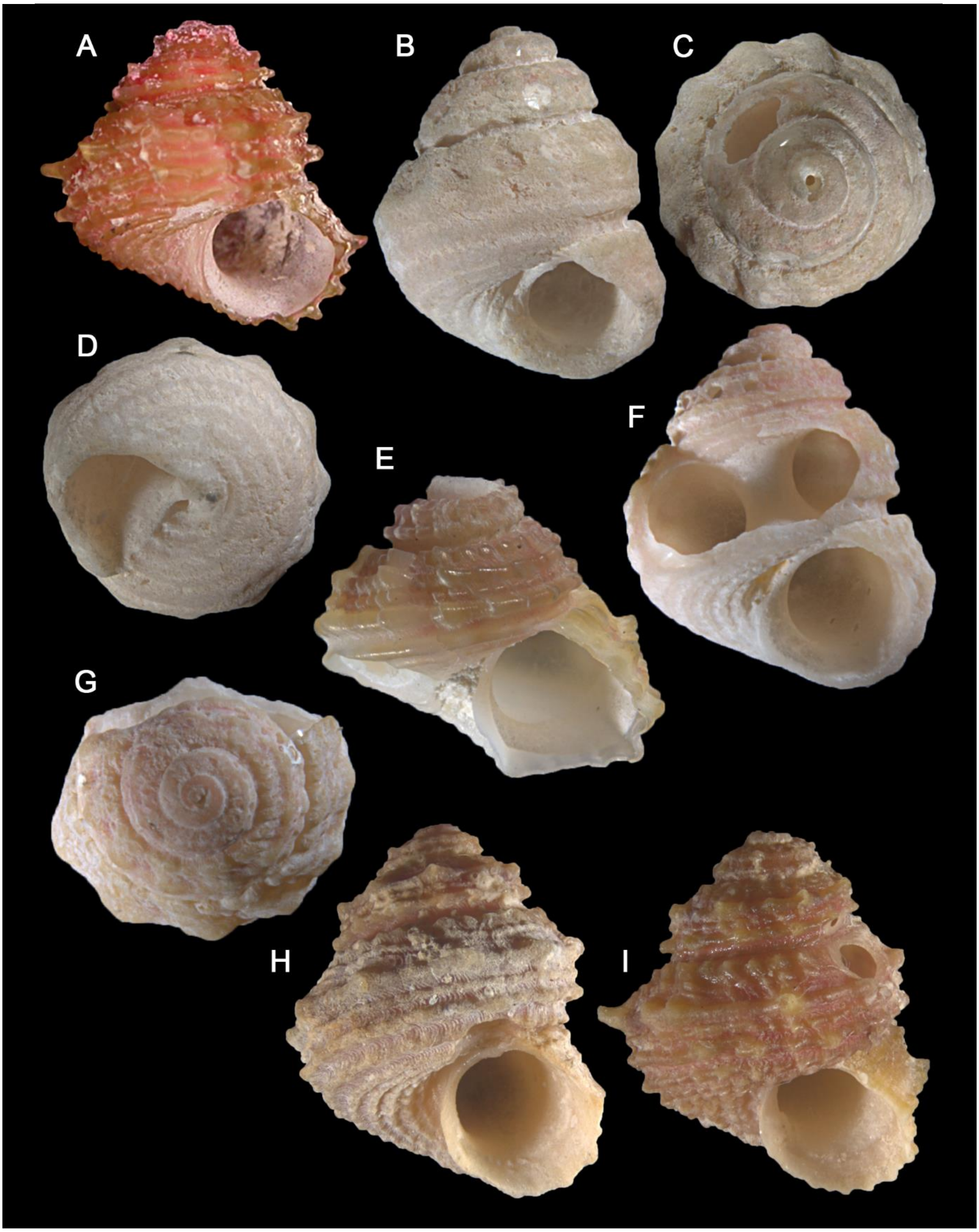

Figure 17: *Arene flexispina*. **A.** Holotype MNRJ 5352, apertural view (H = 6.3 mm, D = 6.0 mm), extracted and modified from Pimenta et al. (2014); **B-D.** MZSP 122851, from Canopus, spm. #1; **B.** apertural view (H = 8.5 mm, D = 7.0 mm); **C.** apical view; **D.** umbilical view; **E.** MZSP 122851, juvenile specimen, apertural view (H = 3.9 mm, D = 4.6 mm); F-G. MZSP 122851, spm. #2; **F.** apertural view (H = 7.5 mm, D = 6.4 mm); **G.** apical view; **H.** MZSP 110862, from Minerva Bank, apertural view (H = 7.9 mm, D = 6.6 mm); **I.** same, spm. #2 (H = 7.5 mm, D = 6.8 mm).

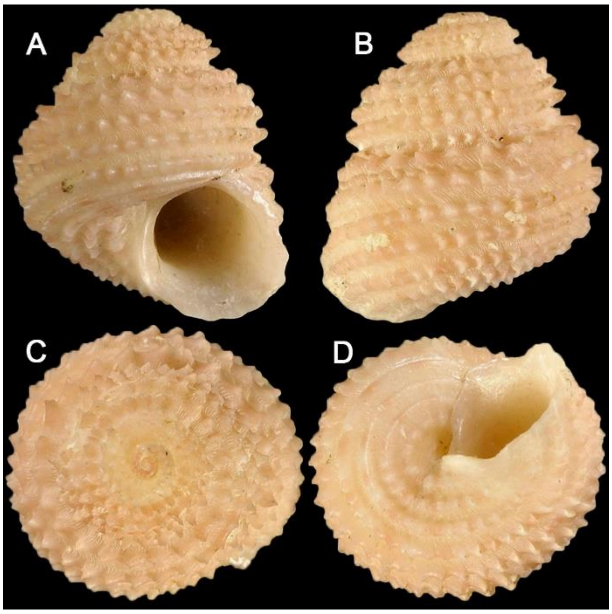

Figure 18: *Arene briareus* var. *perforata* Syntype USNM 95025; **A.** apertural view (H = 8.3, D = 7.5 mm); **B.** abapertural view; **C.** apical view; **D.** umbilical view.

Description: Shell relatively large for the genus (H = 7-9 mm), trochoid, slightly taller than wide (H/D ~1.1), with 5 convex whorls; color white to strong reddish, darker on spiral cords and lighter at the shell's base; apex yellow. Spire medium-sized (height ~1/3 of shell height); apex rounded; spire angle ~85°. Protoconch (Fig. 19G-H) small (0.75 mm), protruding, of 1½ whorl; color yellow (Fig. 19H); sculptured by very small, subsutural axial lamellae; transition visible as a depression (Fig. 19G), followed by a widening of the shell. Teleoconch of 3½ convex whorls with a rounded profile; sculpture consisting of 3 evenly sized, spiny spiral cords (8 on body whorl) separated by equally wide, deep interspaces; spines angular, large, spaced, and, on whorls 2 and beyond, becoming partially hollow and scale-like (Fig. 19D); axial growth lines closely-packed, thin, more visible in the interspaces between spiral cords. Suture barely visible. Aperture rounded, aperture height ~1/3 of shell height, white to light pinkish; inner lip thick, slightly flaring (Fig. 19A), producing a short callus; outer lip slightly bending over the aperture near whorl attachment (Fig. 19A, F). Shell base convex, sculptured by 4 spiral cords (with smaller spines than upper cords); periumbilical cord with larger, coarser nodules (Fig. 19C); umbilicus short, shallow. Operculum unknown.

Distribution: Known only from Canopus Bank.

Habitat: Coralline bottoms at 200-260 m.

Material examined: RAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 70301, 260 m, 3 sh (4 juv.); MZSP 93482, 200 m, 2 sh (juv.; viii/2005); MZSP 93501, 200 m, 2 sh. *Arene briareus* var. *perforata*: Syntype USNM 95025, Barbados, R/V Blake sta. 272, 139 m (05/iii/1879).

Measurements (in mm; n = 3): 5½ whorls, H = 7.82 ± 0.59, D = 7.00 ± 0.50.

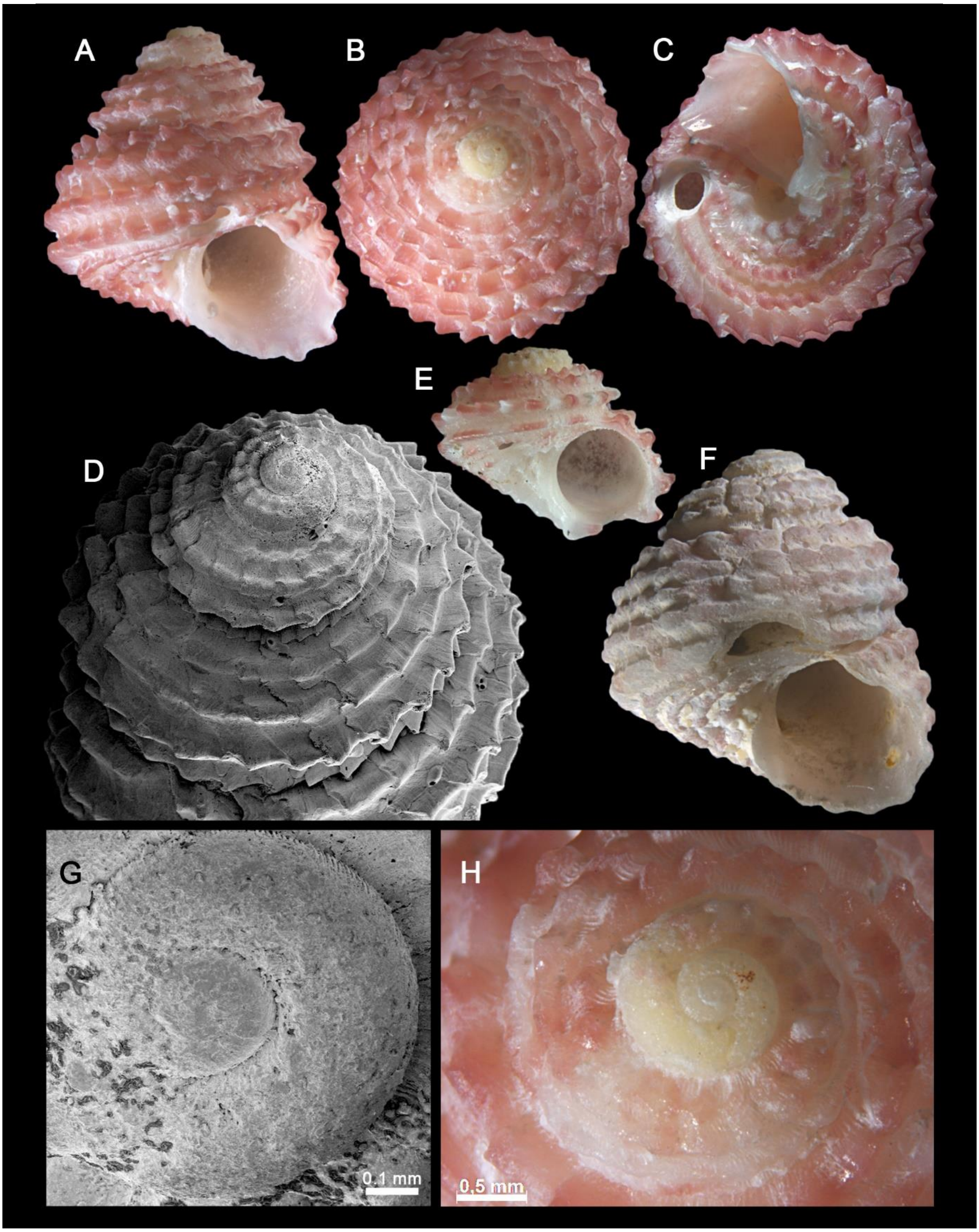

Figure 19: *Arene* aff. *briareus*, MZSP 70301 from Canopus. **A-D.** spm. #1; **A.** apertural view (H = 8.3 mm, D = 7.5 mm); **B.** apical view; **C.** umbilical view; **D.** apical, slightly lateral view under SEM; **E.** same, juvenile specimen (H = 3.6 mm, D = 4.7 mm); **F.** same, spm. #2, apical view (H = 7.2 mm, D = 6.5 mm); **G.** spm. #1, protoconch detail under SEM; **H.** same, detail of the apex.

Remarks: This unusual species resembles *Arene briareus* (Dall, 1881) from the Caribbean (Fig. 18A-D), in both color pattern and size, and seems to be related to it. I have compared the Canopus specimens with the syntype of *Arene briareus* var. *perforata* (Dall, 1889) (= *Arene briareus*), and the specimens are somewhat similar. I am unable to determine if the coloration of the USNM syntype specimen has been altered or damaged in some way, as it seems to be only faintly reddish. It certainly has a yellowish apex, however. The Canopus specimens differ by having one less spiral cord per whorl and bearing much larger, coarser, and more pronounced nodules/spines, and a proportionally taller, trochoid shell with a straighter profile. Moreover, it distinguishes itself from nearly every other congener in Brazilian waters by the size alone, being at least 25% larger than the remaining species, exept for *Arene flexispina* Leal & Coelho, 1985. From the latter it can be distinguished by the dissimilar color pattern (a predominantly red shell with a yellow apex), the more numerous nodules/spines, by being proportionally shorter and wider, and having a less convex and more coarsely sculptured base.

Superfamily Phasianelloidea

Family Colloniidae Cossmann, 1917

General remarks: Shell features such as the absence of nacre, aperture outline, and the calcified operculum were widely used to characterize the Colloniidae, though some of these features vary considerably (McLean, 2012b). Because of shell similarities and the calcified operculum itself, Colloniidae was considered as a subfamily of Turbinidae until very recently (Williams et al., 2008). The oldest fossil record of the family dates from the Jurassic (Monari et al., 1996) and possibly even earlier, since very similar operculae have been found in Cretaceous formations (McLean, 2012b). The family currently includes 19 genera (Bouchet & Gofas, 2011), of which only *Homalopoma* Capenter, 1864 occurs in Brazilian waters.

Genus *Homalopoma* Carpenter, 1864

Homalopoma Carpenter, 1864: 537.

Leptonyx Carpenter, 1864: 652 (objective synonym, preoccupied name).

Leptothyra Cooper, 1867: 25 (objective synonym).

Type species: *Turbo sanguineus* Linnaeus, 1758, by monotypy; Recent, northeastern Atlantic and Mediterranean.

Diagnosis: Shell small or minute, globose-depressed, solid, compact; umbilicate or imperforate, whorls 3-7, spirally sculptured, the last generally somewhat deflexed at the aperture; aperture subcircular, white and nacreous within; columella generally but not always bluntly denticulate near the base. Operculum subcircular, nearly flat or concave-convex, inside with a very thin corneous layer, slightly convex, with many gradually increasing whorls, the nucleus subcentral; outside calcareous, subspiral, with a slightly convex concentric elevation or ridge around the margin, most prominent at its termination, the middle portion concave and more or less rugose. (diagnosis for *Leptothyra* Cooper, 1967; Pilsbry, 1889, p. 245).

Homalopoma boffii **Marini, 1975**

(Figure 20)

Homalopoma boffii Marini, 1975: 31, figs. 1-3. Rios, 1985: 26, pl. 11, fig. 109; Rios, 1994: 43, pl. 14, fig. 145; Rios, 2009: 69, textfig. (switched with preceding species' entry in error).

Homalopoma boffi [sic]: Leal, 1991: 58; Benkendorfer & Soares-Gomes, 2009: 151.

Types: Holotype MZSP 18772 (examined), Brazil, off Rio Grande do Sul state, 31°08'S, 49°31'W, 183-253 m, R/V "W. Besnard" sta. 1858 (6/viii/1972); Paratype MZSP 18773, 1 spm (examined), same data as holotype.

Type locality: Brazil, off Rio Grande do Sul state, 31°08'S, 49°31'W, 183−253 m.

Diagnosis: Shell small, globose, sculptured by blunt nodules; nodules restricted from initial teleoconch whorls to median region of body whorl; color cream to reddish; protoconch flattened; operculum with 10-12 whorls.

Original description (in Portuguese): Concha pequena, avermelhada com nódulos brancos, sólida, elevada, 5¼ voltas, predominantemente esculturada por cordas espirais separadas, as mais nodulosas junto à sutura interna; toda a concha, inclusive a base, percorrida por finas linhas axiais oblíquas, muito juntas, coincidentes com as linhas de crescimento, mais espessas em alguns pontos, que produzem a nodulosidade das cordas esirais e esculturam seus interspaços; protoconcha lisa, esbranquiçada, uma volta; teleoconcha com quarto voltas e meia, separadas por sutura profunda, não cancelada, a primeira volta com três cordas espirais, sendo a superior a mais nodulosa, a segunda volta com quarto cordas espirais, sendo as duas superiores mais nodulosas , a terceira volta com quatro ou seis cordas espirais, sendo as duas ou três superiores as mais nodulosas e as voltas restantes apresentando sete ou oito cordas aproximadamente iguais em espessura e nodulosidade; abertura arredondada, internamente lisa, nacarada; lábio exerno afiado, ligeiramente ondulado pelas cordas espirais externas; columela curta, espessa, muito arqueada, apresentando próximo à base um único e forte dente achatado junto a um sulco profundo que o separa da parte inferior do lábio externo; base imperforada, contorno arredondado, apresentando de oito a dez lirações espirais, concêntricas, regularmente espaçadas, as duas mais centrais um pouco mais expessas [*sic*] limitando a calosidade esbranquiçada que se espalha a partir da columela; a corda mais periférica do conjunto, no limite externo da base, é a mais espessa de todas; opérculo calcário, brilhante, externamente côncavo, liso, internamente convexo, multiespiral. (Marini, 1975, pp. 31-32)

Translation: Shell small, reddish with white spots, solid, inflated, with 5¼ whorls mainly sculptured by spaced spiral cords, the most nodulose of which near the suture; whole shell including its base bearing thin, oblique, closely-packed axial lines congruent with growth lines, wider at some regions, producing nodules at intersections with spiral cords and ornamenting the interspaces; protoconch smooth, whitish, with a single whorl; teleoconch of 4½ whorls with deep suture, not reticular, the first whorl with three spiral cords, the uppermost of which more nodulose; second whorl with four spiral cords, the two uppermost of which more nodulose; third whorl with 4-6 spiral cords, the 2-3 uppermost of which more nodulose; remaining whorls with 7-8 spiral cords with similar width and sculpture; aperture rounded, internally smooth, nacreous; outer lip sharp, slightly undulated by the external spiral cords; columella short, thick, strongly arched, with a single prominent, flattened fold near a deep sulcus that delimitates the outer lip's lower part; base imperforated, convex, bearing 8-10 concentric, regularly-spaced spiral cordlets, the ones in the middle delimitating the expansion of the callus from the columella; the outermost cordlet is the widest; operculum calcareous, glossy, externally concave, internally convex, smooth, multispiral.

Distribution: Brazil, from Rio Grande do Sul to São Paulo states (Rios, 1994), off SE Brazil, Trindade and Martim Vaz Islands, Montague and Columbia Seamounts (Leal, 1991); NE Brazil, off Ceará state (present work).

Habitat: Coralline bottoms, 60–780 m (Rosenberg, 2009; present study).

Etymology: In honor of late Brazilian biologist Alexandre V. Boffi (Marini, 1975).

Material examined: Types; *Additional material*: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 53938, 240-260 m, 2 sh (viii/2005); MZSP 67303, 260 m, 7 sh (xi/2005); MZSP 70298, 260 m, 4 sh (xi/2005); MZSP 93535, 60-200 m, 27 sh (viii/2005); **Espírito Santo:** off São Mateus, Abrolhos Slope, MD55 sta. DC73, 18°59'05''S, 37°48'02''W, 607–620 m, MNHN, 1 sh (27/v/1987); **São Paulo:** off Santos, MZSP 36037, 2 sh (local fishermen col., xii/2002).

Measurements (in mm; n = 3): 6 whorls, H = 8.76 ± 1.25, D = 9.01 ± 1.37.

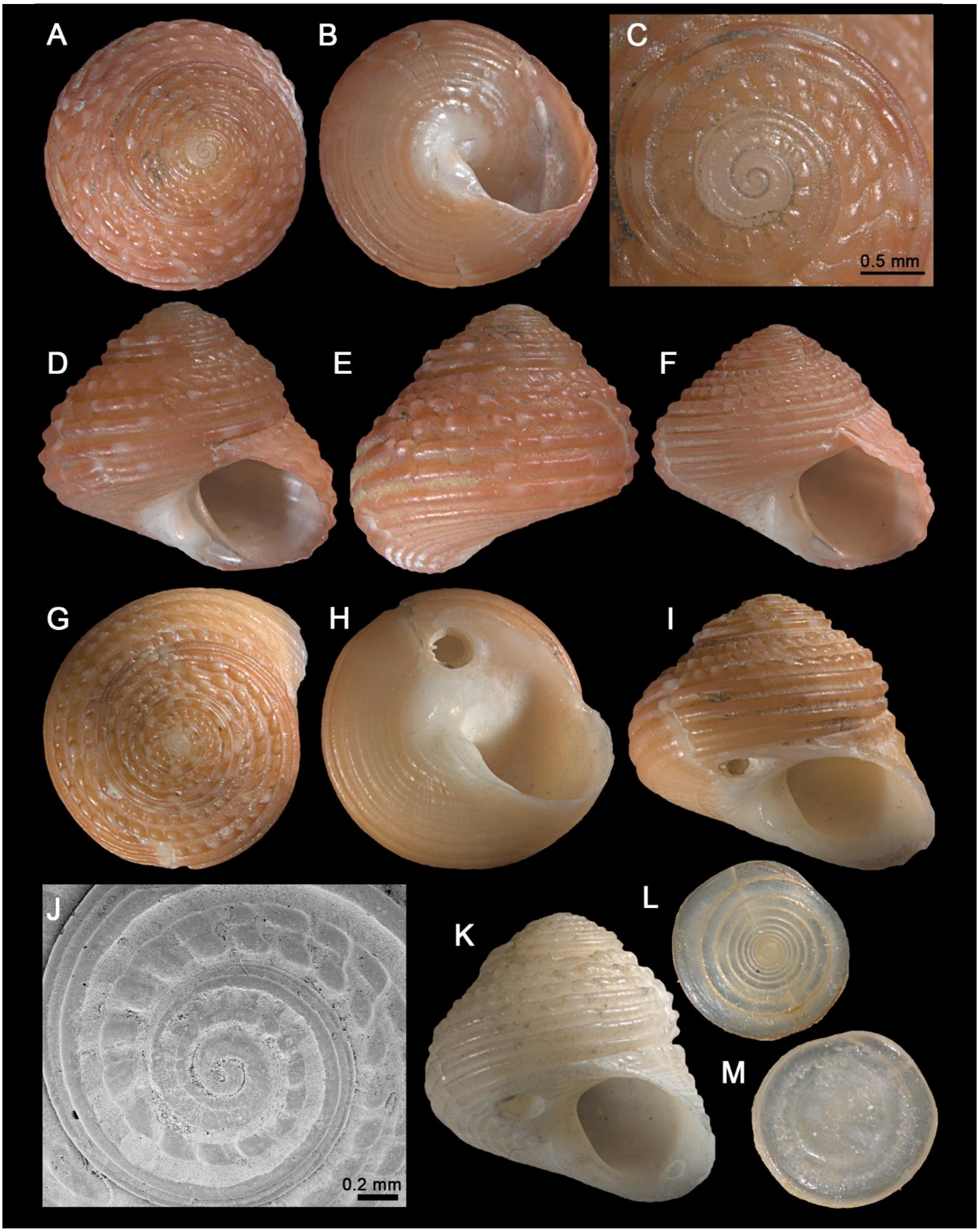

Figure 20: *Homalopoma boffii*. **A-E.** Holotype MZSP 18772; **A.** apical view (D = 6.98 mm); **B.** umbilical view; **C.** protoconch detail; **D.** apertural view (H = 6.27 mm); **E.** abapertural view. **F.** Paratype MZSP 18773, apertural view (H = 6.08 mm, D = 6.9 mm). **G-M.** MZSP 93535, from Canopus; **G-I**. orange-colored specimen; **G.** apical view (D = 7.79 mm); **H.** umbilical view; **I.** apertural view (H = 7.28 mm); **J.** protoconch detail under SEM; **K.** cream-colored specimen, apertural view (H = 8.25 mm, D = 8.09 mm); **L-M.** operculum; **L.** inner side (D = 1.2 mm); **M.** outer side.

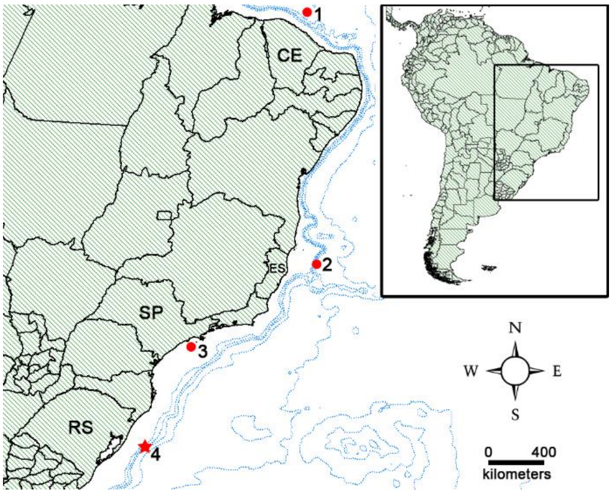

Figure 21: Records of *Homalopoma boffii* along the Brazilian coastline: **1.** Canopus Bank; **2.** Off Espírito Santo, MD55 sta. DC73; **3.** Off Santos; **4.** Off Rio Grande do Sul state, type locality. Abbreviations: CE: Ceará state; ES: Espírito Santo state; SP: São Paulo state; RS: Rio Grande do Sul state.

Remarks: This seemingly rare species seems to be especially abundant in Canopus and is usually characterized by its reddish color, large shell with strong, rounded spiral cords and coarse nodulose sculpture starting at the initial teleoconch whorls, but usually restricted to the 3-4 first whorls (Marini, 1975). Specimens from Canopus Bank relate extremely well to the types, differing only in a few aspects. The ground color in the Canopus specimens is actually variable from cream (Fig. 20K) to orange-reddish (Fig. 20G-I), with intermediary specimens, and such variation has never been reported before in the literature. The typical white spots reported by Marini (1975) are present in all the examined specimens with variable intensity. Shells from Canopus are slightly taller (Fig. 20I, K), though this may be attributed to the specimens being somewhat older than the subadult types, having an additional 0.5 teleoconch whorl. This difference in outline is also the case in the specimens from São Paulo state examined herein. The species, in fact, attains a larger size than the one reported in the original description (H = 6.9, D = 7.0 mm) and followed by the literature (e.g., Rios 1994; 2009; Rosenberg, 2009), reaching a shell height of 10.9 mm (MZSP 67303) and a maximum diameter of 10.8 mm (MZSP 36037) in the Canopus specimens.

Leal (1991) argued that the figures in the original description by Marini (1975: figs. 1-3) were switched with those of another species, but my examination of the types proves that the proportions, sculpture and even the location of damaged areas in the figured specimen is indeed the holotype (MZSP 18772, Fig. 20A-E). In fact, both type specimens are subadult shells (Figs 20A-F), and the slight change in outline with age may have caused confusion.

With its known distribution restricted to southern-southeastern Brazilian waters in recent works (Leal, 1991; Rios, 1994; 2009), *Homalopoma boffii* is here revealed as more widely distributed than initially assumed, ranging as far as NE Brazil (Fig. 21). Part of this newly reported range overlaps with that of *Homalopoma linnei* (Dall, 1889), which has also been found in Canopus and other localities along the Brazilian Coast (see below). Marini (1975) had already pointed the similarity between these species, arguing that the main differences resided in the shell's ground color (reddish as opposed to pure white in *H. linnei*), number of spiral cords (fewer in *H. linnei*), and overall size (~25% larger than *H. linnei*). Except for the discrepancy in size, which is strongly consistent (and even amplified) in the assemblage examined here, the remaining dissimilarities are not confirmed: some specimens of *H. boffii* from Canopus are almost pure white (Fig. 20K), and the number of spiral cords on the body whorl is variable from 12 to 16 in both species. Even so, there are additional differences to be noted. In *H. boffii*, the protoconch is much less inflated, nearly flattened (Fig. 20C, J), and the very first teleoconch whorl already bears coarse, large nodules. These nodules only appear at 2½ to 3 whorls in *H. linnei* and are much smaller and delicate. The nodules themselves are always rounder and proportionally larger in *H. boffii*. Moreover, the shell of *H. boffii* has a more compact outline with a shorter spire, giving it a more globose profile. The suture is shallower in *H. boffii*, lacking the prominent, deep subsutural channel present in *H. linnei*. Finally, the spiral cords in *H. boffii* are proportionally wider, as are the interspaces, which in turn are shallower and less prominent than in *H. linnei*.

***Homalopoma linnei* (Dall, 1889)**

(Figures 22, 23, 24)

Leptothyra linnei Dall, 1889: 353, pl. 33, fig. 8 (9 in error, see below).

Leptothyra linnei var. limata Dall, 1889: 353.

Homalopoma linnei: Poirier, 1954: 26; Abbott, 1974: 60; Rios, 1985: 26, pl. 11, fig. 110; Rios, 1994: 43, pl. 14, fig. 146; Miyaji, 2004: 79; Rios, 2009: 69 [*in partim*]; Rosenberg et al. 2009: 624; Miloslavich et al., 2010: table S6; Welch, 2010: table S1.

Homalopoma sp.1: Leal, 1991: 58.

Types: Syntype MCZ 7538, Cuba, Havana, off Morro Light, Blake sta. 02, 23°14’N, 82°25’W, 1472 m, 1 sh (R/V Blake col., 1877); Syntype MCZ 7539, Cuba, off Havana, 822 m, 1 sh (R/V Blake col., 1877); Syntype MCZ 7540, Cuba, off Honda Bay, 23°2’30”N, 83°11’0”W, 402 m, 1 sh (R/V Blake col., i/1878); Syntype NMNH 94984 (examined), Caribbean Sea, Barbados, 13°17’N, 59°53’W, 183 m, 5 sh (R/V Blake col.); Syntype NMNH 94985 (examined), Caribbean Sea, St. Lucia, Blake sta. 220, 13.8375N, 61.0625W, 212 m, 1 sh (R/V Blake col., 16/ii/1879).

Type locality: Saint Lucia, BLAKE sta. 02, 1472 m depth; BLAKE sta. 20, 402 m depth; sta. 220, 212 m depth. Cuba, off Havana, 823 m depth. Barbados, 183 m depth.

Diagnosis: Shell small, sculptured by numerous, closely-packed angular nodules that may overlap producing a scaly appearance; nodules restricted from teleoconch whorls 2-3 to median region of body whorl, sometimes covering whole shell; protoconch rounded, protruded; suture channeled; operculum with 9-10 whorls.

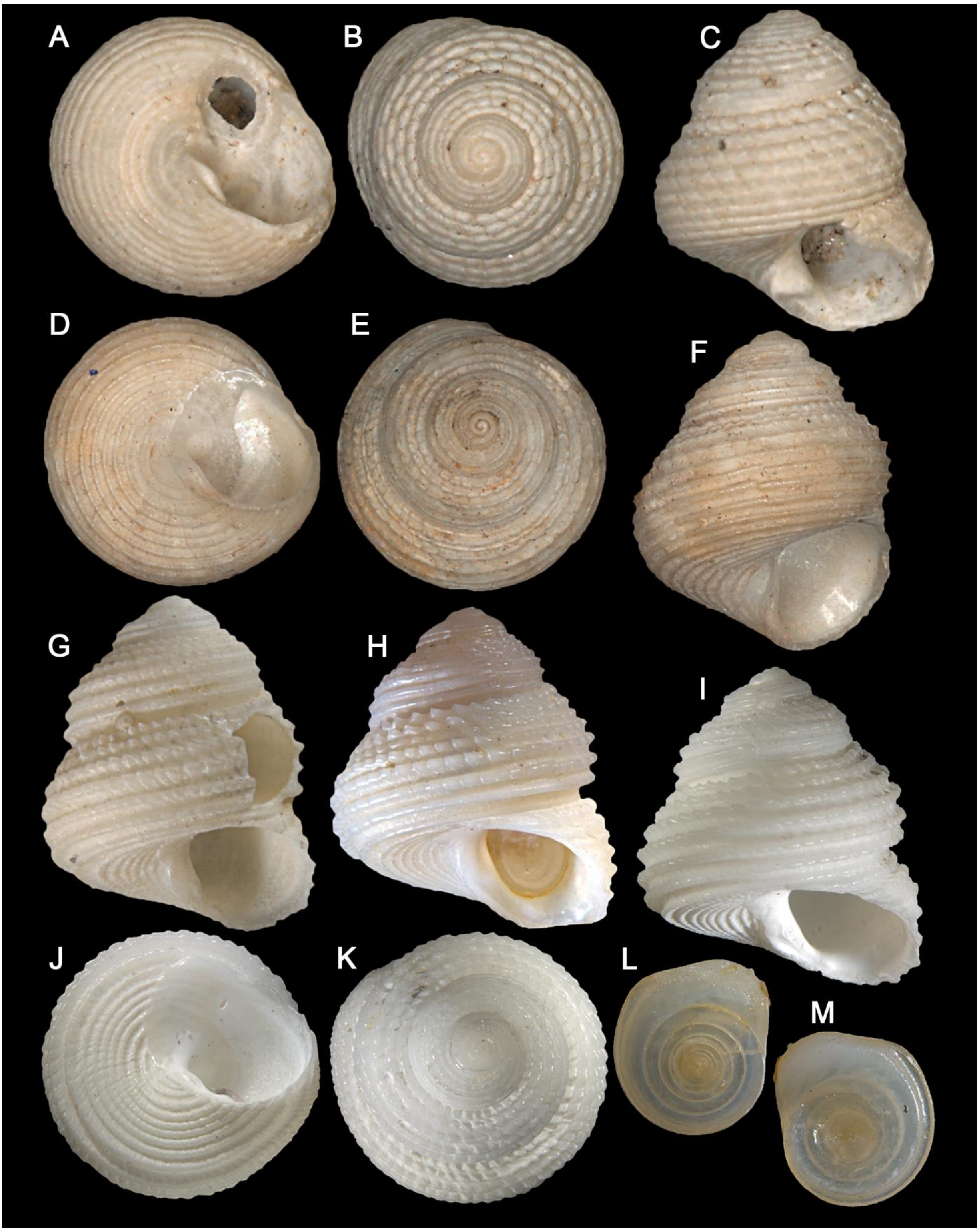

Figure 22: *Homalopoma linnei*. **A-F.** Syntype USNM 94985; **A.** umbilical view (D = 3.7 mm); **B.** apical view; **C.** apertural view (H = 4.1 mm); **D.** specimen #2, umbilical view (D = 5.0 mm); **E.** same, apical view; **F.** same, apertural, slightly lateral view (H = 5.5 mm). G-M. specimens from Canopus Bank; **G.** MZSP 53726, apertural view (H = 6.2 mm, D = 5.0 mm); **H.** MZSP 70295, apertural view (H = 5.3 mm, D = 4.7 mm); **I.** same, specimen #2, apertural view (H = 5.7 mm, D = 4.8 mm); **J.** umbilical view; **K.** apical view; **L.** operculum, inner side (L = 1.5 mm); **M.** same, outer side. Type photos by Barbara V. Romera.

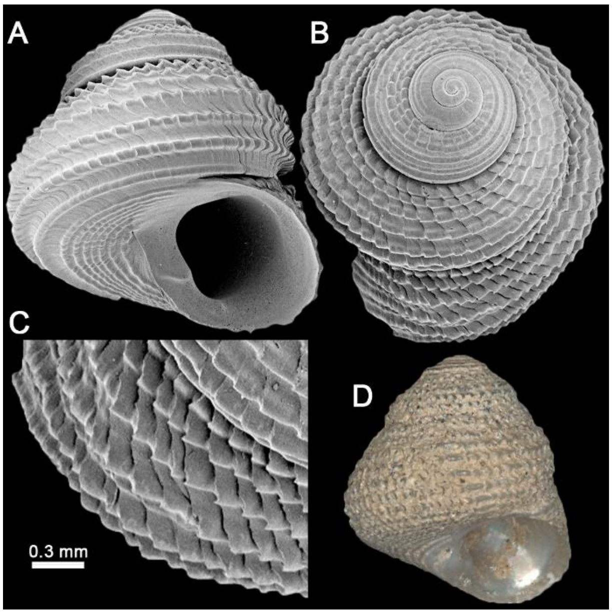

Figure 23: *Homalopoma linnei*. **A-C.** MZSP 70295 from Canopus, under SEM. **A.** apertural view (H = 4.9 mm, D = 4.6 mm); **B.** apical view; **C.** detail of body whorl under SEM showing scaly appearance given by the overlapping nodules; **D.** syntype USNM 94985 specimen #3, apertural view (H = 4.8 mm, D = 4.4 mm), photo by B. V. Romera.

Original description: Shell small, white, solid, elevated, blunt, with five well rounded whorls; spiral sculpture of about sixteen even rounded costae, separated by wider interspaces, with an occasional intercalar thread; the two nearest the suture are generally more or less beaded by the radiating sculpture, the rest usually plain; spiral sculpture of close oblique radiating lines coincident with the lines of growth, with a regular intervals more emphasized depressions which nodulate the upper spirals and in rare instances are produced all over the shell; the costae are more or less nodulated or even imbricated at the intersections, so that in extreme cases (var. limata) the shell is as rough as a file all over; base full and rounded, umbilical depression or perforation occasionally present in the young, wholly absent in the adult; aperture rounded, the upper part produced and depressed about the width of two or three spirals with their interspaces. Operculum as usual. (Dall, 1889, p. 353)

Redescription: Shell small (H = 5-6 mm), trochoid-turbiniform, taller than wide (H/D ~1.2), with 6 convex whorls; ground color homogeneous pearly white to cream. Spire short (height ~1/3-1/4 of shell height), prominent; apex rounded; spire angle ~80°. Protoconch (Fig. 24 B, D) small (0.3 mm), protruding, smooth, glossy, of 1 whorl; color white (Fig. 24D); transition visible as a very delicate varix, followed by numerous thin, axial growth lines. Teleoconch of ~5 convex whorls with a rounded profile; sculpture consisting of (7-8) nodulose spiral cords with similar width, separated by well-marked, slightly wider interspaces; nodules angular, small, closely-packed, and, especially on body whorl, becoming hollow and more crowded together, sometime overlapping, producing a scaly appearance (Fig. 23C); usually restricted from whorls 2-3 to median region of body whorl (Figs. 22G-H, 23C), but covering whole shell in some specimens (Fig. 23D). Suture well-marked, channeled; subsutural channel deep. Aperture circular, aperture height ~1/3 of shell height, white, nacreous; inner lip slightly flaring (Fig. 24C), producing a short, thick, callus; outer lip sometimes bending over the aperture near whorl attachment, producing a dislocated profile. Shell base convex, sculptured by (7-

10) spiral cords (usually less nodulose than upper cords), becoming progressively narrower toward umbilical region (Fig. X); umbilicus imperforate. Operculum (Fig. 22L-M) circular, multispiral (9-10 whorls), with enlarged terminal whorl, calcareous, with a central nucleus; inner surface somewhat flat, outer surface concave.

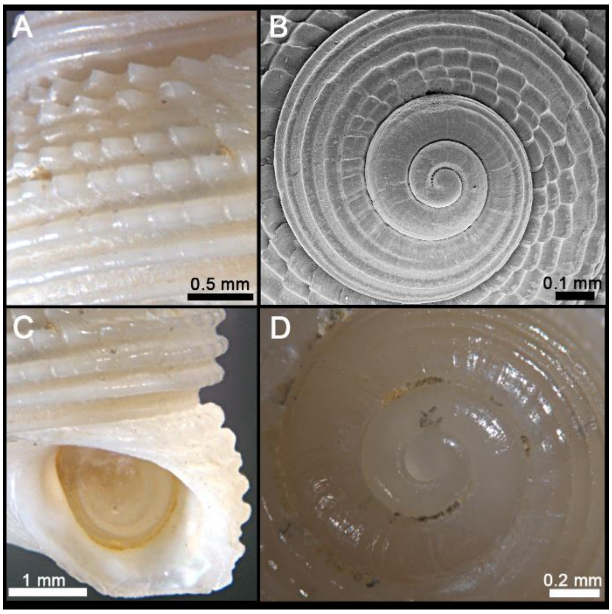

Figure 24: *Homalopoma linnei*. MZSP 70295 from Canopus; **A.** detail of body whorl sculpture; **B.** protoconch detail under SEM; **C.** detail of body whorl showing aperture with operculum; **D.** protonch detail.

Distribution: Florida, USA, to southern Brazil (Miyaji, 2004; Rosenberg et al., 2009).

Habitat: Coralline bottoms, 60–1472 m (Miyaji, 2004; present study).

Etymology: In honor of Carl Linnaeus.

Material examined: Types. *Additional material*: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 53726, 60-260 m, 24 sh (viii/2005); MZSP 55524, 240-260 m, 2 spm (xi/2005); MZSP 67309, 260 m, 5 sh (viii/2005); MZSP 70295, 260 m, 3 sh + 4 spm (xi/2005); MZSP 94229, 260 m, 4 sh (xi/2005). **Espírito Santo:** off São Mateus, Abrolhos Slope, MD55, sta. DC73, 18°59’05’’S, 37°48’02’’W, 607–620 m, MNHN, 4 sh (Bouchet, Leal & Métivier col., 27/v/1987); MD55, sta. CB77, 19°40’S, 37°48’W, 790–940 m, MNHN, 1 sh (Bouchet, Leal & Métivier col., 27/v/1987).

Measurements: Largest specimen, 6 whorls, H = 6.26 mm, D = 5.07 mm (MZSP 53726).

Remarks: In the original description, Dall (1889) cited figure 9 on plate 33. This figure, however, corresponds to another taxon introduced in the same work (*Arene bairdii*, p. 389). The correct figure is the figure number 8, which perfectly agrees with the original description as well as the types examined herein (Fig. 22A-F, 23D). Due likely to a typographical error, the figure number was switched with figure 8 before the final printing; one can easily notice that

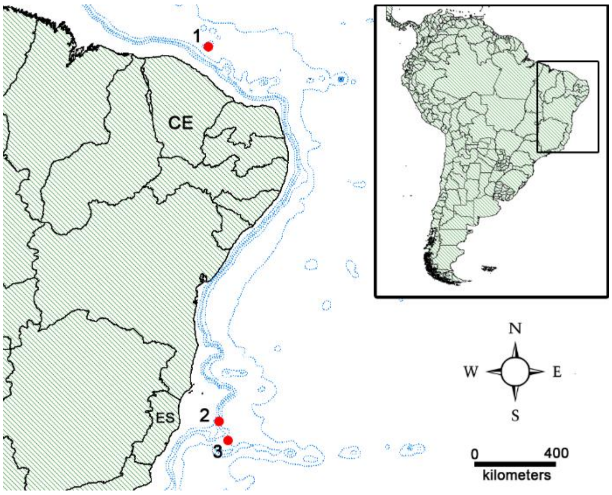

Figure 25: Records of *Homalopoma linnei* along the Brazilian coastline: **1.** Canopus Bank; **2.** Off Espírito Santo, MD55 sta. DC73; **3.** Same, sta. CB77. Abbreviations: CE: Ceará state; ES: Espírito Santo state.

by the obvious interruption in the logical sequence of numbers. The specimens studied here compare exceedingly well with the original description and the examined syntypes in size, sculpture elements, and variation. Even so, most shells inspected have spiral cords sculptured by spiny nodules on nearly all whorls, which produce an overall rougher surface and a "spiky" appearance. Dall (1889) had already mentioned this variation, indicating it as rare, probably based on a syntype specimen figured herein (UNSM 04984, Fig. 23D). Nevertheless, based on the current assemblage, this variation seems to be more common than initially assumed, which appears to be especially true in the Canopus specimens. Leal (1991) described this variation as a probable distinct species based on MD55 material, tentatively naming it "*Homalopoma* sp.1" (records from the MD55 are illustrated herein, Fig. 25)

This species is quite similar to the sympatric congener *H. boffii*, but differs in being twice as small, exclusively cream/white colored, and more profusely sculptured. Regarding the sculpture elements, the spiral cords referred to as "costae" by Dall in the original (1889) description, are also narrower (though the number of spiral cords per whorl is variable and overlaps in both species) and the nodules are more irregular, angular (spiky), smaller and numerous than in *H. boffii*. They are usually also more closely packed in *H. linnei*, and become hollow and often overlap, giving the shell a scaly appearance (Fig. 23C), which is very distinct from the more rounded, solid nodules of *H. boffii*. It can also be told apart from it by its more prominent, smoother and inflated protoconch, and by the sculpture of the initial whorls, which lacks the large, sequential nodules already seen in *H. boffii* since the very beginning of the teleoconch. Furthermore, the deep, well-marked subsutural channel in *H. linnei* (especially evident in the Canopus specimens; Fig. 22G-I) is not so pronounced in *H. boffii*. The operculum is also distinct, having 9-10 whorls, as opposed to 10-12 in *H. boffii*. All of these characteristics are consistent with the examined types and endorse the specific separation.

Family Phasianellidae Sainson, 1840

General remarks: Phasianellidae is a group of small, shallow-water snails that live in tropical and subtropical seas worlwide. Their rounded, globose shells are procellaneous, usually richly colored and patterned, and are a few millimeters in height/width; Western Atlantic species are from 2-9 mm in shell height (Rosenberg, 2009), but larger species occur in the Australasian region. The operculum is paucispiral and calcareous (Robertson, 1958). The oldest fossils date back to the Paleogene. Extant phasianellids usually live on, or in association with marine angiosperm and algae (Hickman & McLean, 1990). The family was historically considered as a subfamily of Turbinidae Rafinesque, 1815, but was redefined and raised to the family level by Williams & Ozawa (2006), based on molecular data. As it is currently understood, Phasianellidae also incorporates the former turbinid subfamilies Gabrielloninae and Tricoliinae. There are three species currently recorded in Brazil, namely *Eulithidium thalassicola* (Robertson, 1958), *Eulihidium bellum* (Smith, 1937), and *Eulithidium affine* (Adams, 1850) (Rosenberg, 2009).

Genus *Eulithidium* Pilsbry, 1898

Eulithidium Pilsbry, 1898: 60.

Eucosmia Carpenter, 1864b: 475 (*non* Stephens, 1831; replaced name).

Type species: *Eucosmia variegata* Carpenter, 1864, by monotypy; Recent, USA.

Diagnosis: Minute shells like *Phasianella* in smoothness and the stony operculum, but differing in being depressed with very short spire (Pilsbry, 1898).

Eulithidium affine (Adams, 1850)

(Figure 26)

Ancient synonymy see Robertson (1958). Recent synonymy see Leal (1991). Complement:

Tricolia concinna: Morretes, 1949: 62.

Tricolia affinis: Poirier, 1954: 26; Warmke & Abbott, 1961: 48, pl. 8, fig. I; Ekdale, 1974: 642; Oliveira et al., 1981: 67; Vokes & Vokes, 1983: 13, pl. 23, fig. 11; Leal, 1991: 61; Díaz & Puyana, 1994: 120, pl. 37, fig. 379; Paranaguá et al., 1999: 62; Absalão & Pimenta, 2005: 17, fig. 20.

Tricolia affinis affinis: Robertson, 1958: 262, pl. 138, fig. 5, pl. 139, figs. 6-8, pl. 143 figs. 1-2, pl. 145, fig.1; Abbott, 1974: 62, fig. 506.

Tricolia affinis cruenta: Rios, 1970: 29, pl. 6; Jong & Coomans, 1988: 17.

Tricolia (*Tricolia*) *affinis*: Rios, 1975: 30, pl. 8, fig. 91; Rios, 1985: 30, pl. 13, fig. 127; Rios, 1994: 43, pl. 14, fig. 147; Rios, 2009: 70, textfig.

Eulithidium affine: Lyons, 1998: 16; Rosenberg et al. 2009: 625; Miloslavich et al., 2010: table S6; Tunnell et al., 2010: 123, text fig.; Welch, 2010: table S1; Gondim et al., 2011: 78, tab. 1; Zhang, 2011: 53, figs. 38(1)-38(5); Espinosa et al., 2012: 60; Redfern, 2013: 27, fig. 73A-C; Longo et al., 2014: 3, tab. 1, fig. 2C; Tunnell et al., 2014: 34, text fig.

Eulithidium affine cruentum: Sevilla et al., 2003: 311.

Tricolia “aff.” [sic]: Benkendorfer & Soares-Gomes, 2009: 147.

Tricolia aff.inis [sic]: Benkendorfer & Soares-Gomes, 2009: 151 (typographical error).

Tricolia affine: Daccarett & Bossio, 2011: 57, fig. 117 (incorrect termination).

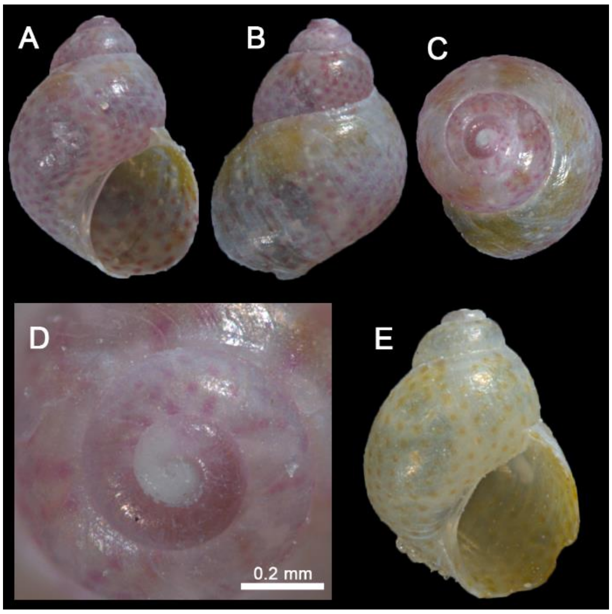

Figure 26: *Eulithidium affine* MZSP 132136 from Canopus; **A.** apertural view (H = 2.4 mm, D = 1.7 mm); **B.** abapertural view; **C.** apical view; **D.** protonch detail; **E.** spm. #2, apertural view (H = 2.3 mm, D = 1.7 mm).

Types: Lectotype MCZ 186020, Jamaica, (Adams col.); Paralectotypes: NMNH 61764, Jamaica, 4 sh; ANSP 199422, Jamaica, 13 sh (Adams col.).

Type locality: Jamaica.

Original description: Shell ovate: with waving or zigzag transverse flames of brown or red; and very numerous minute well defined dots of red or brown, with white shadows on their right side, somewhat in irregular waving or zigzag series, on a whitish ground: apex acute: spire with moderately convex outlines: whorls nearly five, moderately convex, a little flattened along the middle, with a moderately impressed suture: aperture elliptical: with a small umbilicus and groove issuing from it, which are sometimes concealed by the labial deposit. This species was at first mistaken for *P. pulla*. (Adams, 1850, p. 67)

Redescription: See Robertson (1958).

Distribution: Florida, USA, to southern Brazil (Rosenberg et al. 2009).

Habitat: Seagrass beds or coral reefs in shallow waters, 0–60 m (Rosenberg et al. 2009; Tunnell et al., 2014).

Material examined: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 132136, 260 m, 2 sh (viii/2005).

Measurements (in mm): Largest specimen, 4½ whorls, H = 2.39, D = 1.72.

Remarks: This very common and widespread species lives in shallow waters among seagrass beds or coral reefs (Robertson, 1958; Tunnell et al., 2014). Since no live individuals were found in the Canopus material, the specimens examined herein were probably either carried to the sampling site by currents or attached to floating algae. A color variation from reddish to yellowish is present in the current specimens (Figure 26A, E), but this has already been reported by Robertson (1958). Nonetheless, this species is widespread in the SW Atlantic, and so the present record is not entirely unexpected.

Superfamily Trochoidea

Family Calliostomatidae Thiele, 1924

General remarks: Calliostomatidae is a diverse family of trochiform snails that includes over 30 genera and 300 species of widely variable size (8-100 mm). They can be found in all oceans ranging from tropical to polar latitudes, from intertidal to bathyal (3,000 m) depths, on soft or more commonly rocky substrata (Marshall, 1995; Williams et al., 2010; Marshall, 2016). Morphologically, Calliostomatids are characterized by the typical depressed-conical shell outline and, in relation to trochids, by the protoconch sculpture and radular features (Hickman & McLean, 1990; Marshall, 1995). Several species in this family are carnivorous, feeding on cnidarians, sponges, carrion and possibly even smaller mollusks (Williams et al., 2010; Dornellas & Simone, 2011b). Calliostomatidae has been included in broader molecular systematics studies on Trochoidea (Williams et al., 2008; Williams, 2012), and relationships within the family have also been investigated based on molecular data (Williams et al., 2010). These studies have so far corroborated the familial status of the taxon, as opposed to previous hypotheses that considered it as a subfamily of Trochidae Rafinesque, 1815 (Hickman & McLean, 1990). According to Williams (2012; 2013), it currently includes three subfamilies: Calliostomatinae Thiele, 1924, Margarellinae Williams, 2013 and Thysanodontinae Marshall, 1988. Two additional subfamilies, Fautricinae Marshall, 1995 and Xeniostomatinae McLean, 2012 were proposed based on morphological data (McLean, 2012; Marshall, 2016), but their monophyly and relationships have not yet been investigated. The genus *Calliostoma* Swainson, 1840 within Calliostomatinae is the largest of the family, comprising over 200 species, 19 of which occur in Brazilian waters (Dornellas, 2012).

Genus *Calliostoma* Swainson, 1840

Synonymy see Clench & Turner (1960: 11) and Marshall (1995: 387).

Type species: *Trochus conulus* Linnaeus, 1758, by subsequent designation (Herrmannsen, 1846); Recent, Northeast Atlantic Ocean and Mediterranean Sea.

Calliostoma hassler Clench & Aguayo, 1939

(Figure 27)

Synonymy see Dornellas & Simone (2013). Complement:

Calliostoma hassler: Abbott, 1974: 46; Dornellas, 2012: 104, figs 13-15; Dornellas & Simone, 2013: 285, figs 24-25, 44, 51-53, 91-98.

Astele (Leiotrochus) hassler: Macsotay & Campos, 2001: 35, pl. 13, figs 9-10.

Types: Holotype MCZ 104554 (examined), Brazil, off Cabo Frio, 75 miles east of Rio de Janeiro, 35 fathoms (20/ii/1872). Paratype MCZ 104555 (examined), 1 sh; MPUH (Cuba), 1 sh; same data as holotype.

Type locality: Brazil, off Cabo Frio, 75 miles east of Rio de Janeiro, 35 fathoms (~64 m).

Diagnosis: Shell with rounded peripheral keel. Foot strongly reddish brown colored, densely papillated on dorsal region. Rachidian slender, with two pronounced flaps on its base.

Two esophageal folds. Intestine forming two wide loops; spiral caecum absent. (Dornellas & Simone, 2013, p. 285)

Original description: Shell solid and deeply umbilicated. Color a somewhat faintly mottled reddish brown. (The three specimens had been originally preserved in alcohol, and as a consequence, a change in color has probably taken place. Characteristic of the group, the color would possibly have been near a reddish tone.) Whorls 10, exceedingly regular in enlarging and having flat sides. Spire acute, extended, smooth in outline, forming a cone of 76°. Suture hardly discernible owing to the uniformity of the whorls. The whorls are really strongly carinated, though only apparent on the last whorl. Aperture subquadrate. Palatal lip simple, smoothly rounded at the outer base. Parietal wall very thinly glazed. Columella slightly arched above, thickened or narrowly folded, the fold terminating abruptly at the base. Umbilicus funicular, fairly wide and deep. Base of body whorl nearly flat at the parietal region, becoming more and more convex toward the end of the whorl at the aperture. Sculpture of numerous, fine, beaded, spiral threads (eight on the body whorl), between which are very fine and similarly beaded threads, the latter barely visible to the naked eye. Below the periphery of the body whorl (base of the shell) the beaded threads are all uniform in size, with the beads more closely set. The outer edge of the umbilicus is margined with a slightly wider thread. The umbilicus within is smooth. (Clench & Aguayo, 1939, p. 191)

Redescription: See Dornellas & Simone (2013).

Distribution: From northern Venezuela (Paria) to southeastern Brazil (Macsotay & Campos, 2001; Dornellas & Simone, 2013).

Habitat: On bottoms alongside bryozoans and coralline algae, 20–100 m (Clench & Turner, 1960).

Etymology: Named after the R/V “Hassler” Expedition to South America (1871-1872).

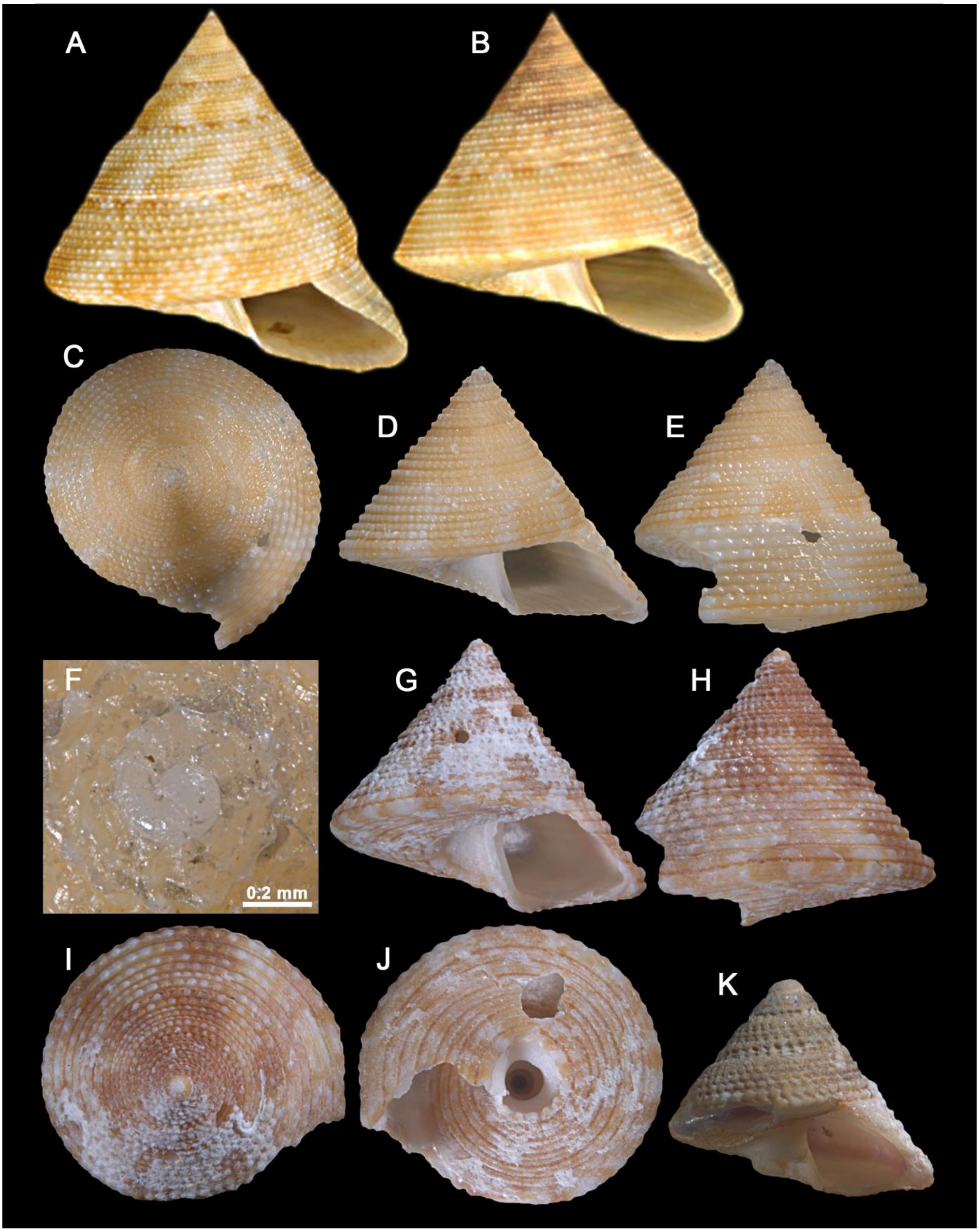

Figure 27: *Calliostoma hassler*. **A.** Holotype MCZ 104554, apertural view (H= 42 mm, D = 35 mm); **B.** Paratype MCZ 104555, apertural view (H = 27 mm, D = 30 mm); **C-F. MZSP 67311 from Canopus; C.** apical view (D = 7.2 mm); **D.** apertural view (H = 6.0 mm); **E.** lateral view; **F.** protoconch detail. **G-J.** same, spm. #2; **G.** apertural view (H = 5.8 mm, D = 6.7 mm); **H.** lateral view; **I.** apical view; **J.** umbilical view; **K.** same, # spm. #3, apertural view (H = 3.8 mm, D = 4.6 mm). Type photos are a courtesy of the MCZ.

Material examined: Types. *Additional material*: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 67311, 60 m, 6 sh (viii/2005).

Measurements (in mm): Largest specimen, ~6 whorls, H = 6.06, D = 7.24.

Remarks: Though the specimens from Canopus Bank are juveniles (Fig. 27), they compare well with the initial whorls of the types and the characteristics and specimens illustrated by Dornellas & Simone (2013: figs. 24-35). This is particularly true for the holotype of *Calliostoma vinosum* Quinn, 1992, which is regarded as a juvenile specimen (and junior synonym) of *Calliostoma hassler* (Dornellas & Simone, 2013: figs. 26-27). Dornellas & Simone (2013) also provided a thorough comparison between SE Atlantic *Calliostoma* species, based on an extensive analysis of conchological and soft-part characters. Clench & Aguayo (1939) emphasized the yellowish hue of the types owing to a probable color loss after an extended exposure to preservative fluid. Still, the material studied herein and the specimens illustrated by Dornellas & Simone (2013) suggest differently: the variation in color from yellowish (Fig. 27C-F) to strong red (Fig. 27G-K) seems to be the normal ground color range of the species. Longo et al. (2014) depicted an unidentified *Calliostoma* specimen from São Paulo state, Brazil that is remarkably similar to the *C. hassler* juveniles reported herein in both outline, sculpture, and color pattern, and probably belongs to this species. In any case, Canopus is within the known range of *C. hassler*, which is from northern Venezuela to southeastern Brazil according to Macsotay & Campos (2001).

***Calliostoma* sp. 1**

(Figures 28, 29)

Diagnosis: Shell small, trochoid, with convex whorls and a large, rounded apex; color ivory white with a nacreous gleam underneath, with honey yellow apex and spiral cords; sculpture consisting of 4-6 narrow spiral cords covered with numerous angular nodules per whorl; suture marked by a distinct smooth, suprasutural cord; base mostly distinctly inflated and mostly smooth; umbilicus narrow, shallow, sculptured by closely-packed axial striae.

Description: Shell small (H = 8-10 mm), trochoid, taller than wide (H/D ~1.2) with 7 convex whorls; ground color ivory white, with honey yellow apex and spiral cords, sometimes with a nacreous gleam underneath, which is visible through transparency (Fig. 28G). Spire tall (height ~1/2 of shell height), prominent; apex rounded; spire angle 60°. Protoconch (Fig. 28H, 29D) prominent, of ~1 whorl, glossy, honey yellow, sculptured by delicate lines forming a reticulate pattern of hexagons (Fig. 29D). Teleoconch of ~6 convex whorls, mainly sculptured by 4-6 spiral cords of similar width (Fig. 29B), separated by wider interspaces (~2x cord width); cords presenting numerous small, closely-packed, angular nodules; suture distinct, marked by a thin, smooth suprasutural spiral cord (Fig. 29B) and frequently channeled (Fig. 29A); body whorl sculptured by 8-12 similar spiral cords, sometimes presenting thinner, smooth intercalary cords between the nodulose cords. Aperture rounded to subquadrate, prosocline (Fig. 28F, 29A), height ~1/3 of shell height, ivory white, nacreous, somewhat dislocated laterally in older specimens (Fig. 28G); inner lip slightly flared, forming a narrow callus (Fig. 28F). Base distinctly convex, smooth or very rarely sculptured by smooth, almost obsolete spiral cords; umbilicus narrow, shallow, sculptured by 1-2 smooth, periumbilical spiral cords (Fig. 28E); interior sculptured by thin, closely packed axial striae. Operculum (Fig. 28F) golden yellow, corneous, circular, multispiral with a central nucleus.

Distribution: Known only from Canopus Bank.

Habitat: Coralline bottoms, from 60 m (live specimens) to 260 m (empty shells).

Measurements (in mm; n = 10): ~7 whorls, H = 8.03 ± 0.81, D = 7.02 ± 0.67.

Material examined: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 53923, 60 m, 1 spm (viii/2005); MZSP 53693, 60 m, 5 spm (viii/2005); MZSP 53711, 60 m, 2 sh (viii/2005); MZSP 53718, 60 m, 25 sh (viii/2005); MZSP 53939, 240-260 m, 2 sh (viii/2005); MZSP 55522, 60 m, 1 spm (viii/2005); MZSP 66589, 260 m, 1 sh (viii/2005); MZSP 67310, 260 m, 6 sh (xi/2005); MZSP 70308, 260 m, 70 sh (xi/2005); MZSP 71960, 260 m, 1 sh (viii/2005); MZSP 71961, 260 m, 1 sh (xi/2005); MZSP 90268, 260 m, 150 sh (xi/2005); MZSP 94218, 260 m, 27 sh (xi/2005); MZSP 94254, 260 m, 13 sh (xi/2005); MZSP 94837, 260 m, 1 sh (xi/2005); MZSP 100414, 260 m, 6 sh (xi/2005).

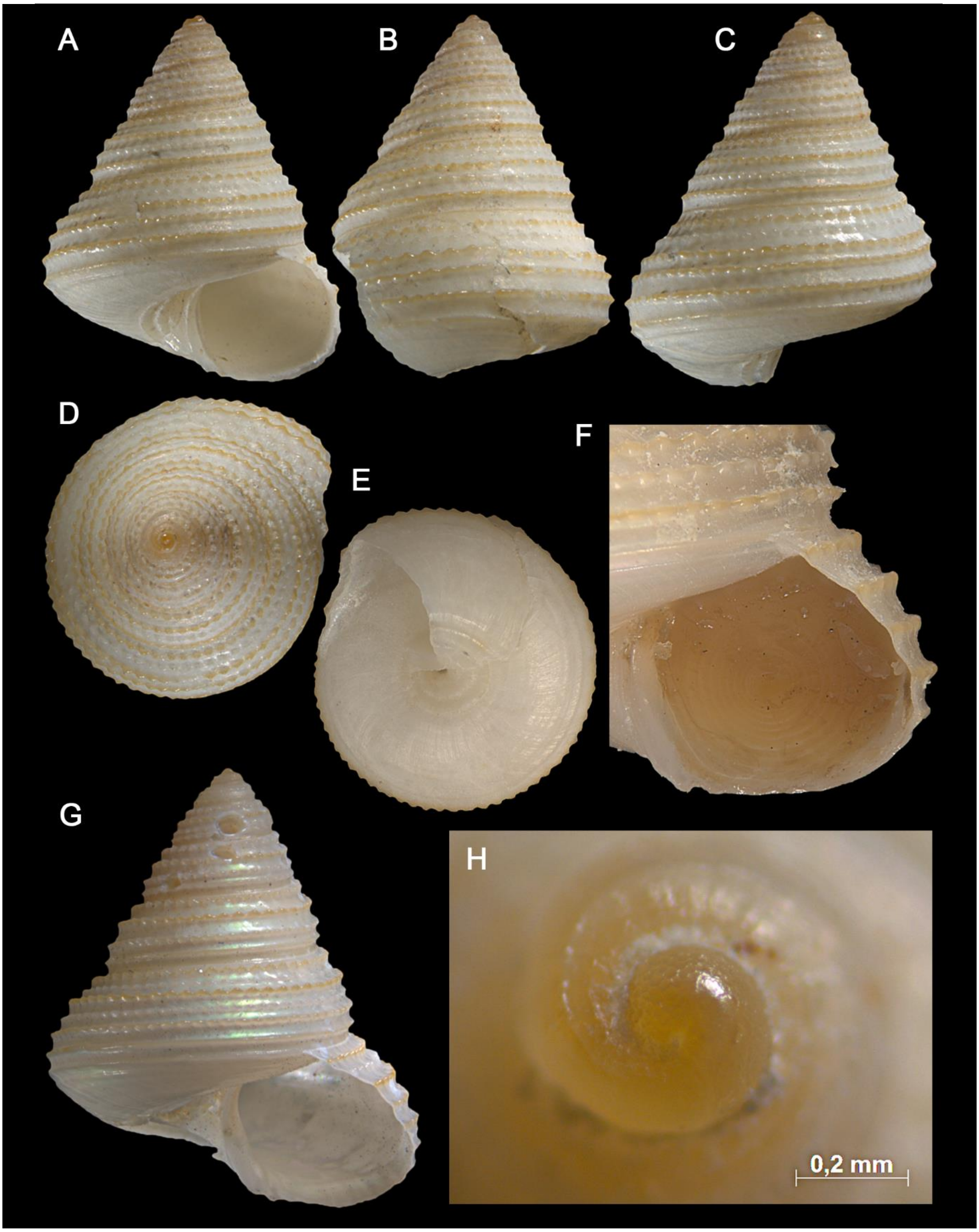

Figure 28: *Calliostoma* sp.1 from Canopus. **A-E.** MZSP 53718, apertural view (H= 7.4 mm, D = 6.1 mm); **B.** lateral view; **C.** abapertural view; **D.** apical view; **E.** umbilical view; F. detail of aperture **F.** MZSP 53923, detail of aperture (aperture width = 2.8 mm); **G-H.** MZSP 67310; **G.** apertural view (H = 9.6 mm, D = 8.1 mm); **H.** protoconch detail.

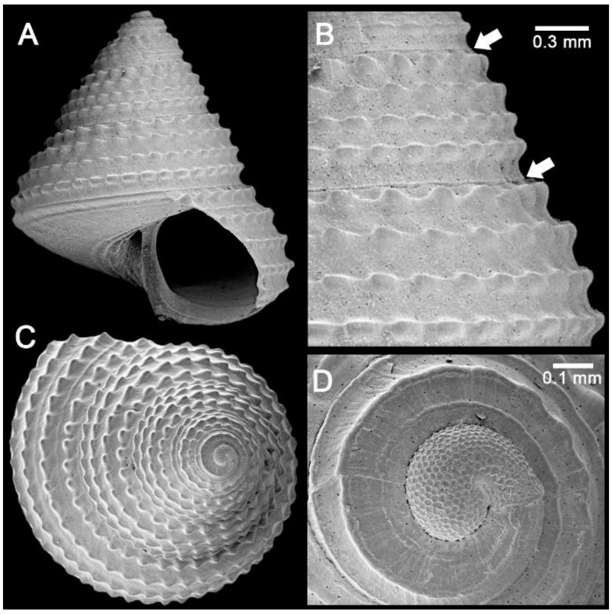

Figure 29: *Calliostoma* sp.1 from Canopus, MZSP 90268, under SEM. **A.** apertural view (H = 4.8 mm, D = 4.3 mm); **B.** detail of spire, arrows indicating suprasutural cords; **C.** apical view; **D.** protoconch.

Remarks: This small *Calliostoma* is very abundant locally, but is remarkably distinct from any other calliostomatid occurring in the Caribbean or in Brazilian waters, and is most certainly an undescribed species. It can be distinguished from nearly every other SW Atlantic *Calliostoma* by its smaller size, large and rounded apex (Fig. 28A, D), typical coloration consisting of an ivory white background (Fig. 28A) and honey-yellow apex and cords with a very frequent nacreous gleam underneath, smoothish base, and rounder and laterally dislocated aperture. Additionally, among the local species of comparable size range, it differs from *C. depictum* Dall, 1927, *C. coppingeri* (Smith, 1880) and *C. rota* Quinn, 1992 in having a proportionally taller shell, less convex whorls and much stronger overall sculpture and mostly smooth base; from the latter two, it also differs by lacking a distinct median carina. It can be told apart from *C. echinatum* Dall, 1881 and *C. brunneopictum* Quinn, 1992 by having a proportionally taller shell with more inflated whorls and base, larger but less numerous axial and spiral sculpture elements, and by having an umbilicated shell.

Family Liotiidae Gray, 1850

General remarks: Liotiids are a group of small (H = 10 mm or less) snails characterized by the shell sculptured consisting of axial lamellae, the thickened lip, the calcified periostracum, and a few other conchological characters (Hickman, 1998). The family's fossil record extends back to the Permian. Liotiidae was traditionally considered as a subfamily of Turbinidae (Hickman & McLean, 1990), with a few exceptions (e.g., Laseron, 1954, considered it as a family). Bouchet and colleagues (2005) and Williams and colleagues (2008) both raised the taxon to the family rank, the latter supported by a molecular phylogeny. Williams' (2008) interpretation of the family excludes the taxa belonging to the newly described Areneidae McLean, 2012. The familial status of Liotiidae was confirmed in subsequent molecular studies (Williams, 2012), but details on the biology and morphology of the group as it is currently understood still need to be further clarified. The family comprises 16 genera, and only two genera and three species, *Cyclostrema tortuganum* (Dall, 1927), *Cyclostrema cancellatum* Marryat, 1818 and *Macrarene digitata* McLean, Absalão & Cruz, 1951, occur in Brazil (Leal, 1991; Rios, 2009).

Genus *Macrarene* Hertlein & Strong, 1951

Macrarene Hertlein & Strong, 1951: 110.

Type species: *Liotia californica* Dall, 1908, by original designation; Recent, Pacific.

Diagnosis: *Macrarene* species are characterized by turbinate white shells, broad umbilici, and presence of axial ribs and spiral cords that form spines at their intersections. Spacing of the axial ribs increases in the final whorl. In some species the ribs then become more closely spaced in the final quarter whorl. The final lip is not thickened at maturity. (McLean et al., 1988, p. 99)

Macrarene digitata McLean, Absalão & Cruz, 1951

(Figure 30)

Synonymy see Leal (1991). Complement:

Macrarene digitata: Leal, 1991: 57; Mello & Barros, 1991: 281, figs. 2, 4; Rios, 1994: 41, pl. 13, fig. 138; 2009: 66, text fig.; Farrapeira, 2011: appendix 1.

Types: Holotype IBUFRJ 1562 (examined), off NE Brazil, R/V Almirante Saldanha sta. 1913, 03°59’N, 49°35’W, 100 m (06/v/1968). Paratype LACM 2377, Brazil, Rio Grande do Norte state, off Cabo São Roque, 04°30’S, 50°03’W, 146 m, R/V Almirante Saldanha sta. 1921, 1 sh (8/v/1968).

Type locality: off NE Brazil, Almirante Saldanha sta. 1913, 03°59’N, 49°35’W, 100 m.

Diagnosis: Shell small (D = ~6.5 mm), turbinate, sculptured by very strong axial lamellae crossed by well marked spiral cords, producing strong, angular, arched digitations at the intersections; color ivory white to cream.

Distribution: North-northeastern Brazilian waters, from Pará to Alagoas states (Mello & Barros, 1991; Rios, 1994).

Habitat: Coralline bottoms, from 0-260 m (present study).

Etymology: The name stems from the Latin *digitatus*, meaning “having fingers” (McLean et al., 1988), in allusion to the digitate shell sculpture.

Material examined: BRAZIL; **Maranhão:** off Maranhão, R/V Amorim do Valle, MZSP 94341, 1 sh; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 131287, 240-260 m, 4 sh (viii/2005).

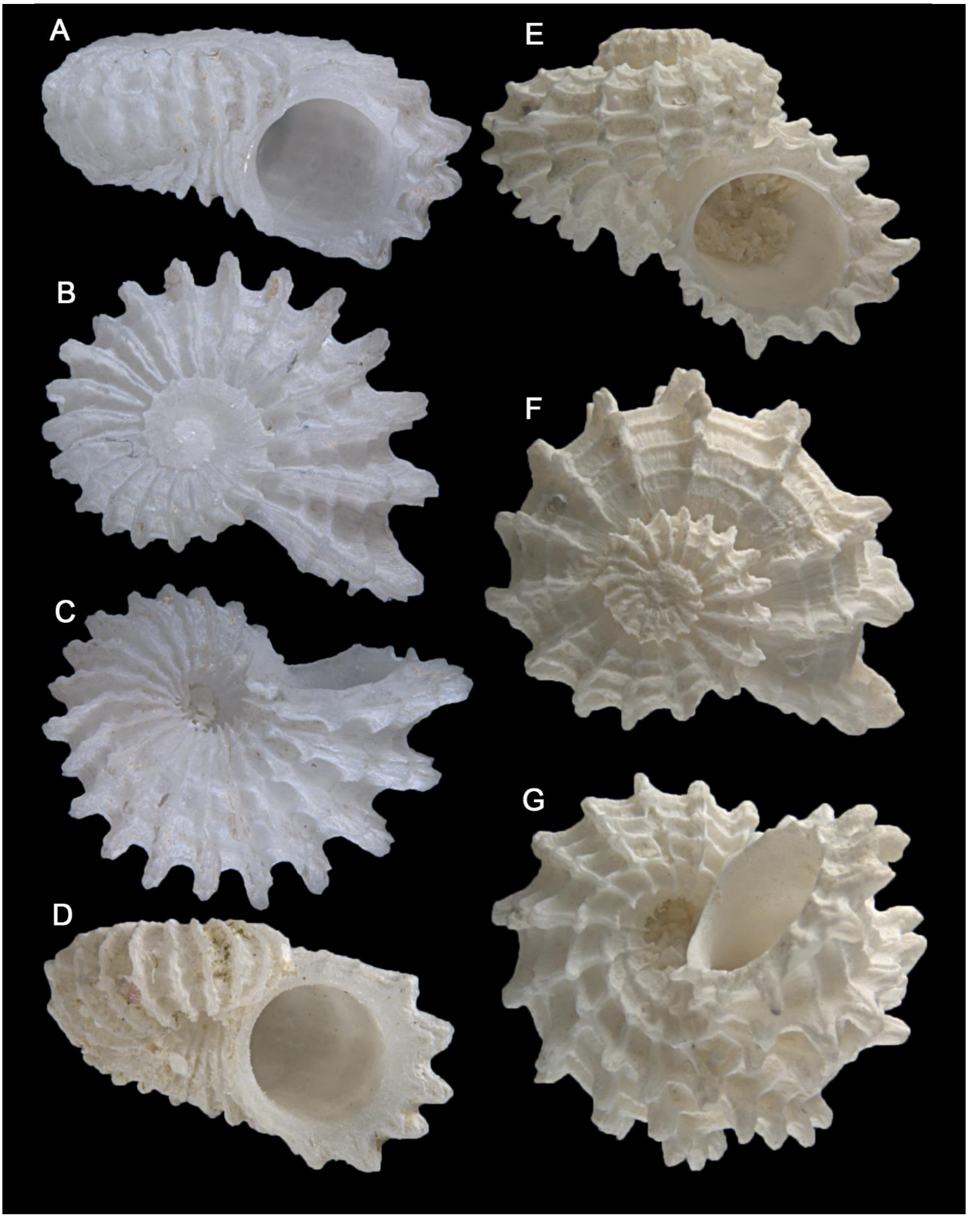

Figure 30: *Macrarene digitata*. **A-C.** MZSP 131287 from Canopus, spm. #1; **A.** apertural view (H= 2.4 mm, D = 4.3 mm); **B.** apical view; **C.** umbilical view; **D.** same, spm. #2, apertural view (H = 2.7 mm, D = 4.5 mm); **E-G.** MZSP 94341 from off Maranhão state; **E.** apertural view (H = 6.7 mm, D = 8.5 mm); **F.** apical view; **G.** umbilical view.

Measurements (in mm): Largest specimen (MZSP 131287) 4 whorls, H = 2.7, D = 4.5.

Remarks: This rare species has a characteristically rich sculpture consisting of digitate axial lamellae (Fig. 30F, G), and is the sole representative of the genus in Brazilian waters. Mello & Barros (1991) and Rios (1994) reported its occurrence from off the northern Brazilian states of Pará and Maranhão, and further south to the states of Rio Grande do Norte and Alagoas. The Canopus specimens are juveniles (Fig. 30A-D), but nonetheless, fill the short "gap" in the species' range between the states of Maranhão and Rio Grande do Norte. They also represent the new deepest records of the species, an expansion from the previous depth of 146 m to 240-260 m.

Family Margaritidae Thiele, 1924

General remarks: A former subfamily of Trochidae Rafinesque, 1815, Margaritidae was recently raised to family level by Williams et al. (2012), with support of molecular data. Stoliczka (1868) originally introduced the name, but her nomenclatural act has since been invalidated (Bouchet et al., 2005). The authorship is currently attributed to Thiele (1924), who first reevaluated the group. Margaritids have small to moderate size shells (maximum height hardly exceeds 20 mm), turbinoid-trochiform in shape, with smooth, rounded whorls often bearing a nacreous gleam, but these characters are highly variable within the family. They have a disjunct distribution, inhabiting shallow to deep waters at high and tropical latitudes. The oldest margaritid fossils were extracted from Upper Eocene formations (Hickman & McLean, 1990). Simone & Cunha (2006) provided a thorough revision of the genera *Gaza* Watson, 1879 and *Callogaza* Dall, 1881 within the family, including species recorded in Brazilian waters, with brief accounts on other local margaritids.

Genus *Callogaza* Dall, 1881

Synonymy see Simone & Cunha (2006: 20).

Type species: *Callogaza watsoni* Dall, 1881, by subsequent designation (Clench & Abbott, 1943); Recent, Atlantic.

Diagnosis: Similar to *Gaza*, but smaller (about to 20 mm), flat shaped, discoid to trochiform, stronger spiral and axial sculpture. Pigmentation mosaic of brown spots on pale beige background. Shell walls thicker, making shell less iridescent. Whorls somewhat shouldered. Umbilicus partially or totally covered by flap-like callus on lower region of inner lip in adult specimens. Peristome deflected (determinate growth) preceded by region weakly dislocated downwards. (Simone & Cunha, 2006, pp. 20-21)

Callogaza watsoni **Dall, 1881**

(Figure 31A-I)

Synonymy see Simone & Cunha (2006). Complement:

Callogaza watsoni: Simone & Cunha, 2006: 22, figs 41-44, 58-60; Rosenberg et al., 2009: 624.

Gaza (Callogaza) watsoni: Rios, 2009: 55.

Types: Holotype MCZ 7544 (examined), Blake Expedition (1877).

Type locality: Cuba, off Havana, 24°34'N, 83°16'W, 324 m depth.

Diagnosis: Shell color pale beige with brown spots, spire low with about five whorls. Protoconch without hole in adult. Height/width 1.44 on average. Spire 0.60 of body whorl high. Umbilicus half covered by callus. (Simone & Cunha, 2006, p. 22)

Original description: Shell much smaller than the last (*C. superba*) but slightly nacreous; whorls six and a quarter, having the same general form as in the last species, but with a more prominent nucleus; nucleus small, bulbous, dark brown; first two and a half whorls glassy, brown spotted, smooth; subsequently the exterior two thirds of the upper surface of the whorls sculptured with four or five strong revolving thereads; the space between them and the suture above, with strong even, flexuously radiating, shining, rounded plications (about eight to a millimiter) which pass obliquely over the revolving threads and appear again on the base as trong regular plications in the umbilical region, extending from the umbilical carina one third of the way toward the periphery. The base is covered with numerous revolving threads flattened until their interspaces appear like grooves; the umbilicus similarly formed to the last species, but somewhat more turreted internally. Last whorl less contracted behind the lip, which is not produced forward above, as in *superba*, but only slightly nacreous. Base waxy white, top the same, with cloudy radiating brown blotches near the suture and on the periphery; some of the revolving threads are also continuously brown. (Dall, 1881, p. 50)

Redescription: See Simone & Cunha (2006).

Distribution: From the Yucatan strait to NE Brazil (Simone & Cunha, 2006; present study).

Habitat: From 66–1170 m depth (Rosenberg et al., 2009).

Material examined: Types. *Additional material*: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP MZSP 55529, 260 m, 1 spm (xi/2005); MZSP 70320, 260 m, 2 sh (xi/2005); MZSP 70486, 260 m, 1 sh (viii/2005); MZSP 93487, 200 m, 1 sh (viii/2005); MZSP 93498, 200 m, 2 sh (viii/2005).

Measurements: Largest specimen 4½ whorls, H = 4.23, D = 5.21 (MZSP 122247).

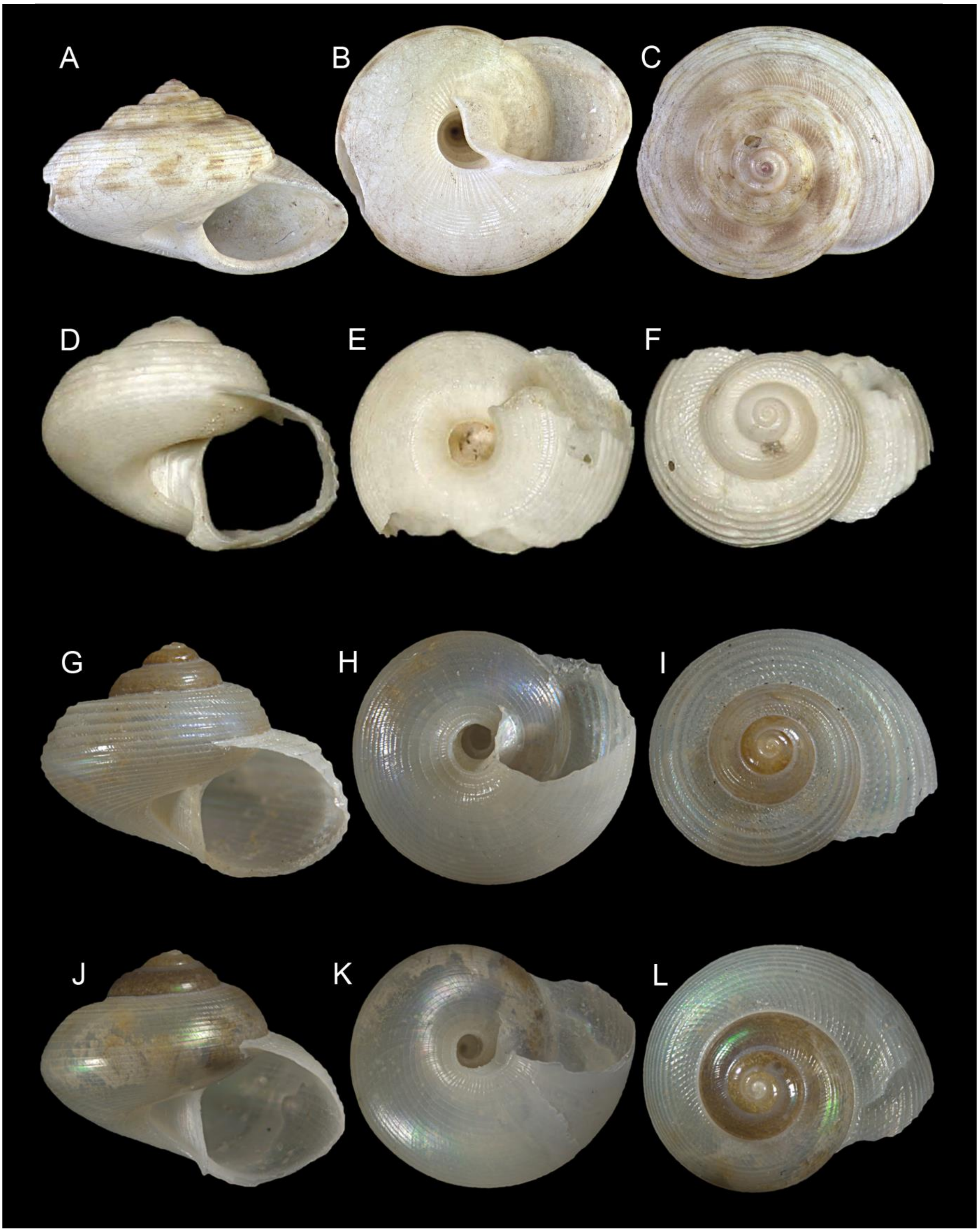

Figure 31: Margaritid types and ordinary specimens. **A-I.** *Callogaza watsoni*. **A-C.** Holotype MCZ 7544; **A.** apertural view (H = 8 mm; D = 12.5 mm); **B.** umbilical view; **C.** apical view; photos are a courtesy of the MCZ; **D-F.** USNM 97116 off Fortaleza (D = 7.1 mm), extracted and modified from Simone & Cunha (2006); **D.** apertural view; **E.** umbilical view; **F.** apical view; **G-I.** MZSP 70320 from Canopus; **G.** apertural view (H = 4.0 mm, D = 5.3 mm); **H.** umbilical view; **I.** apical view; **J-L.** *Gaza* cf. *fischeri*, MZSP 70486 from Canopus; **J.** apertural view (H = 3.6 mm, D = 4.7 mm); **J.** umbilical view; **L.** apical view.

Remarks: The present specimens are young individuals with no more than 4 ½ whorls. Adult specimens have seven whorls according to Simone & Cunha (2006), which can be verified in the holotype (Fig. 31A-C). The juveniles lack a well-developed callus and reflected lip typically found in adult specimens (Fig. 31D, G). Even so, they compare well with the holotype in that they present the strongly marked reticulate sculpture on the apical side of the whorls (Fig. 31I), dominant, well-marked spiral sculpture that produces a keeled shell profile, and a similarly sculptured periumbilical region (Fig. 31H), with numerous axial furrows. Moreover, they are identical to the individual reported by Simone & Cunha (2006; Fig. 31D-F), which was mentioned by Dall (1890: 342) as a record from Brazil. It was in fact collected off Fortaleza as well, although in a distinct location (R/V Albatross sta. 2756, 22’00”S 37°49’00”W, 716 m depth).

Genus *Gaza* Watson, 1879

Synonymy see Simone & Cunha (2006: 4).

Type species: *Gaza daedala* Watson, 1879, by original designation. Recent, Pacific.

Diagnosis: Shell of medium size (about 30 mm), white-iridescent with green tinge, turbiform. Iridescence given by transparence of thin shell layers. Periostracum very thin, translucent. Aperture rounded, prosocline. Outer lip well-formed, deflected. Umbilicus wide, partially or completely covered by thin-walled, flap-like callus (only in mature specimens), producing a hollow chamber. (Simone & Cunha, 2006, p. 4)

Gaza cf. *fischeri* (Dall, 1889)

(Figure 31J-L)

Synonymy see Simone & Cunha (2006). Complement:

Gaza fischeri: Simone & Cunha, 2006: 18, figs. 28-32, 55-57, 93-98; Rosenberg, 2009: 624.

Types: Lectotype MCZ 7543 (examined), BAHAMAS, off Long Island; Paralectotype USNM 94989 (examined), same data as lectotype.

Type locality: Caribbean Sea, off St. Lucia Island, 13°54’55”N, 61°06’05”W, 229 m depth.

Diagnosis: Color of entire shell pale-beige iridescent, smooth, spire very low with about five whorls. Protoconch without hole in adult. Body whorl with very narrow spiral lines, spire diameter about 60% of total shell diameter. Weak carina at middle level of body whorl. Umbilicus completely covered by callus. Orifices in anterior part of mesopodium: 5 on left, 6 on right side. Number of epipodial tentacles: 6 on right, 5 on left side. Rachidian tooth with trapezoidal base, about 1/6 of total radular width, about 20 tall, slender marginal teeth. (Simone & Cunha, 2006, p. 18)

Original description: This shell is of six and a half whorls, and closely resembles *Gaza daedala* Watson, except in the following particulars. It is much more depressed proportionally; the upper margin of the aperture is distinctly depressed below its general plane; and the radiating lines, almost microscopic in *G. daedala*, are in this form impressed in the early whorls near the suture, so as to produce a succession of short ripples, following the recurved lines of growth, which give a fringe-like ornamentation to the suture, at the rate of about five ripples to a millimeter. Nothing like this is visible in any of the specimens of *G. superba*. The margin of the suture in this form is distinctly appressed, forming a narrow border. The operculum has about seven whorls. The umbilicus is completely floored over. The soft parts are like those of *G.*

superba, but the tentacles are shorter and stouter, the lateral lobes of the epipodium proportionally larger, there is one more lateral process, and the muzzle is not so much expanded laterally at its termination. (Dall, 1889, pp. 355-356)

Redescription: See Simone & Cunha (2006).

Distribution: Caribbean sea to NE Brazil (Simone & Cunha, 2006; present study).

Habitat: Muddy sand bottom at ~230 m depths (Simone & Cunha, 2006).

Material examined: Types. *Additional material*: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 70486, 260 m, 1 sh (viii/2005).

Measurements: 3 ¾ whorls, H = 3.61, D = 4.68.

Remarks: The specimen from Canopus is a juvenile empty shell. Since the umbilical callus is still incipient, a more precise identification is, unfortunately, impossible. Still, the shell's rounded outline (Fig. 31J) and well-marked spiral sculpture (Fig. 31L) are strongly similar to the lectotype of *G. fischeri* (Simone & Cunha, 2006: figs. 28-32), as is the apertural profile. Moreover, since other Caribbean species have been found in Canopus in the present study, this range expansion southward to Brazilian waters is not at all unexpected. Still, more specimens, especially adult ones, must be examined to confirm this new record.

Family Skeneidae Clark, 1851

Genus *Haplocochlias* Carpenter, 1864

Type species: *Haplocochlias cyclophoreus* Carpenter, 1864, by monotypy; Recent, Pacific.

Diagnosis: The shell is small to minute (1-6 mm in height), turbiniform, with a closed to narrowly opening umbilicus with spiral cordlets inside. Protoconch ¾ whorl, smooth or with spiral cordlets. Teleoconch with a rounded or slightly angulous periphery; ornamentation formed by numerous spiral cords and axial striae with micro tubercles on their interspaces. Aperture prosocline, peristoma continuous; columella sometimes reflected towards the umbilicus, widened at its base with the presence in some species of a depressed area in the crossing point with the umbilical cord. Outer lip wide or fine, crenulated or expanded frontally (Rubio et al., 2013).

***Haplocochlias risoneideneryae* Barros, Santos, Santos, Cabral & Acioli, 2002**

(Figure 32A-F)

Haplocochlias risoneideneryae Barros, Santos, Santos, Cabral & Acioli, 2002: 44, fig. 4A-D; Rubio et al., 2013: 54, fig. 7A-F.

Haplocochlias aff. swifti: Rios, 2009: 61, textfig.

Types: Syntype, Museu de Malacologia da UFRPE 7601, 11 sh.

Type locality: Baía Sueste, Arquipélago de Fernando de Noronha; Praia do Jaguaribe, Ilha de Itamaracá; Praia de Suape; Itapuama.

Diagnosis: Shell very small, compact, roughly as wide as tall; sculpture of numerous spiral cords, with a single, predominant cord forming a distinct keel. Protoconch smooth; interspaces sculptured by numerous strong, closely-packed prosocline axial striae, usually more densely packed on the body whorl. Umbilicus imperforate.

Original description (in Portuguese): Concha pequena, turbinada. Protoconcha formada por uma volta e meia aproximadamente, de contornos amplamente convexos e de aspecto liso. Núcleo evidente, plano. Espira baixa, ornada por várias cordas espirais fortes e um ombro conspícuo. Umbílico parcialmente fechado, lábio externo espesso, abertura arredondada, sutura pouco profunda, não canaliculada; linhas de crescimento e cicatrizes pouco evidentes. Anfractos inflados fortemente convexos. Ornamentação axial inconspícua. Base curta e afilada desta com a parede umbilical. (Barros et al., 2002, p. 44) *Translation:* Shell small, turbinate. Protoconch consisting of nearly 1½ whorl, with a broadly convex outline and smooth aspect. Nucleus evident, flat. Spire low, sculptured by several strong spiral cords and a presenting a distinct keel. Umbilicus partially covered, outer lip thick, aperture rounded, suture shallow and not channeled; growth lines and scars inconspicuous. Whorls inflated, strongly convex. Axial sculpture inconspicuous. Base short, tapering towards the umbilical wall.

Redescription: Shell very small (H = 3-4 mm), turbiniform, compact, roughly as tall as wide (H/D = ~1), with 5½ convex whorls, and an overall globose outline; color homogeneous ivory white. Spire short (height ~1/4 of shell height), prominent, spire angle ~80-85°. Protoconch (Fig. 32E) small, protruding (Fig. 32F), glossy, of ~1 whorl; transition distinguishable as a change in sculpture and opaqueness. Teleoconch of 4½ convex whorls; sculpture consisting of numerous thin, rounded spiral cords of similar width, with a single stronger, wider, predominant cord on the upper half of each whorl forming a distinct keel; interspaces as wide as regular cords, sculptured by numerous strong, closely-packed, prosocline axial striae, which are usually more spaced on the spire whorls (Fig. 32F), and more densely packed on the body whorl. Suture barely distinguishable. Aperture drop-like, acuminate toward the implantation of the outer lip, strongly prosocline (Fig. 32B); aperture height ~½ of shell height; inner lip slightly flared (Figs 32A), forming a narrow but thick callus; outer lip very thick, sculptured internally by numerous lirae. Umbilicus (Fig. 32D) imperforate. Operculum unknown.

Distribution: NE Brazil from Maranhão to Pernambuco states, including the Fernando de Noronha Archipelago (Rubio et al., 2013; present study).

Habitat: Intertidal sediments, 15-20 m (Rubio et al., 2013) up to 200 m (empty shells; present work).

Etymology: In honor of the senior author's wife at the time, Risoneide Nery Feitosa de Barros (Barros et al., 2002).

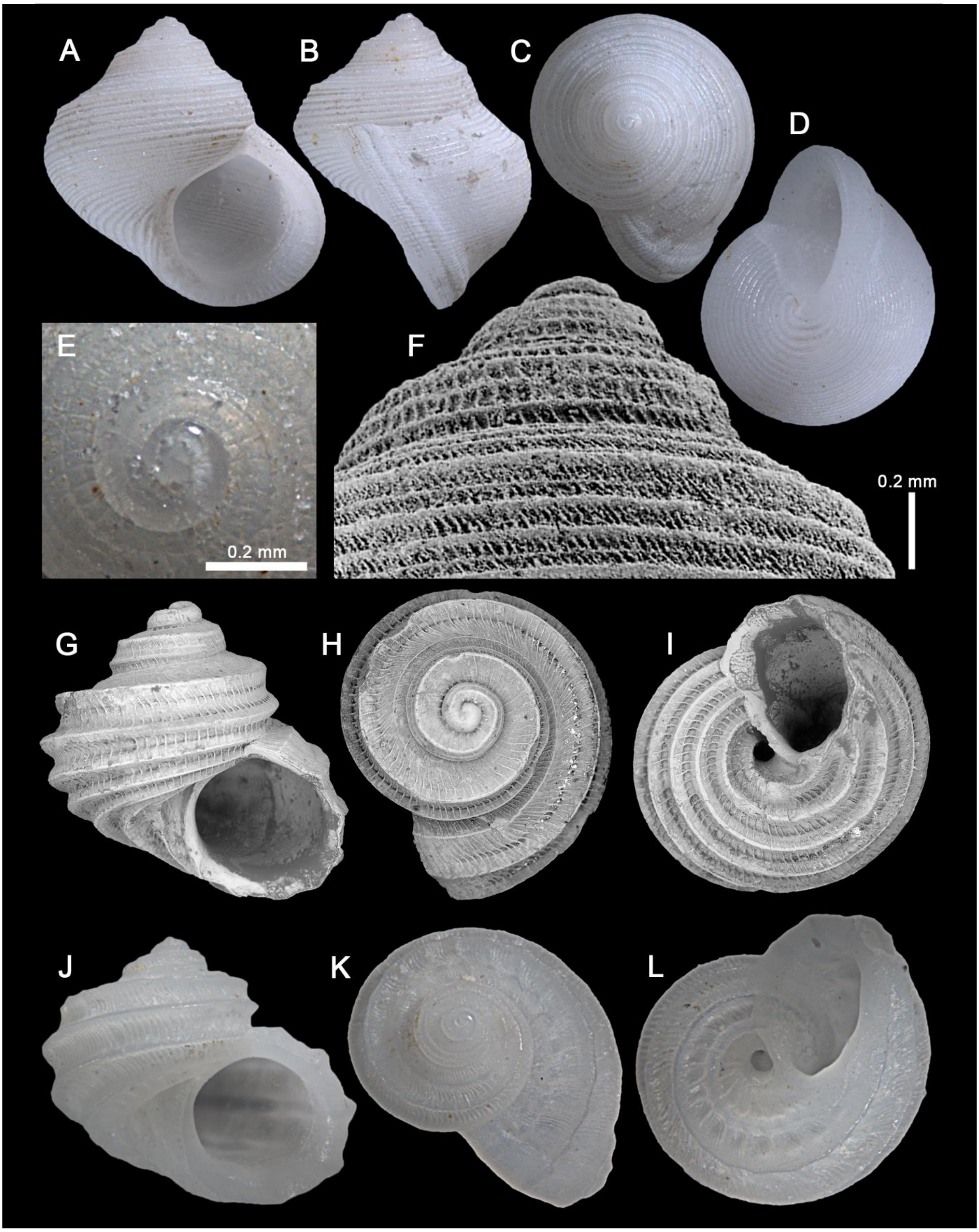

Figure 32: Skeneid types and ordinary specimens. **A-E.** *Haplocochlias risoneideneryae* MZSP 93497 from Canopus; **A.** apertural view (H = 3.8 mm, D = 3.7 mm); **B.** lateral view; **C.** apical view; **D.** umbilical view; **E.** protoconch; **F.** same, spm. #2, detail of spire under SEM; G-I. *Parviturbo rehderi* Holotype ANSP 181312 under SEM; G. apertural view; H. apical view; I. umbilical view; **J-L.** MZSP 131282 from Canopus; **J.** apertural view (H = 2.2 mm, D = 2.5 mm); **K.** apical view; **L.** umbilical view.

Material examined: BRAZIL; **Maranhão:** R/V Amorim do Valle sta. 107, 01°15.866'S, 43°39.509'W, 46-48 m, MZSP 96109, 3 sh (PIATAM, 21/xi/2008); R/V Amorim do Valle sta. 108, 01°30.554'S, 43°20.466'W, 59 m, MZSP 94457, 1 sh (PIATAM, 21/xi/2008); **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 93497, 200 m, 5 sh (viii/2005). *Haplocochlias swifti*: Syntype ANSP 10292, US Vigin Islands, St. Thomas, 18°22'N, 65°57'W (04/ii/1913).

Measurements (in mm; n = 9): 5½ whorls, H = 3.28 ± 0.32, D = 3.21 ± 0.28.

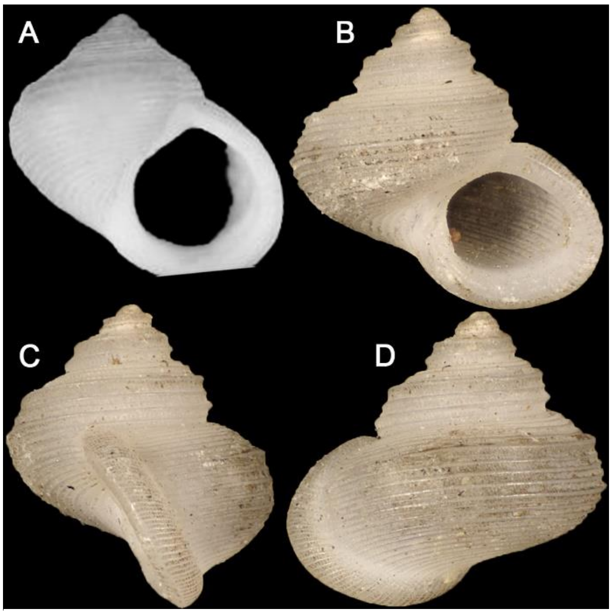

Figure 33: Type specimens of *Haplocochlias*. **A.** syntype of *H. risoneideneryae*, extracted and modified from Barros et al. (2002); **B-D.** *H. swifti* syntype ANSP 10292; **B.** apertural view (D = 4 mm); **C.** lateral view; **D.** abapertural view; photos are a courtesy of the ANSP.

Remarks: This is species has been misidentified as *Haplocochlias swifti* Vanatta, 1913 in catalogs and collections (Rubio et al., 2013). Barros and colleagues (2002: fig. 3) figured the supposed holotype of *H. swifti*, but as Rubio et al. (2013) stressed, that specimen is not a type of *H. swifti*. A specimen pertaining to the real syntype of *H. swifti* as originally indicated by Vanatta (1913) is illustrated herein (ANSP 10292, Fig. 33B-D). *Haplocochlias risoneideneryae* differs from *H. swifti* by its compact, narrower shell with a shallower suture, lower spire, less convex whorls, narrower spiral sculpture, smaller protoconch, and drop-like aperture. A comparison between *H. risoneideneryae* and its only co-occurring congener *Haplocochlias willami* Barros, Santos, Santos, Cabral & Acioli, 2002, which was described in the same paper, was adequately provided by Barros et al. (2002). Nevertheless, *H. risoneideneryae* appears to be rather uncommon given the small number of recorded specimens, though it has been found in several places along the NE Brazilian coast. The records from Maranhão and Ceará states introduced here mean a range expansion of over 900 km westward to the Brazilian North.

Genus *Parviturbo* Pilsbry & McGinty, 1945

Type species: *Parviturbo rehderi* Pilsbry & McGinty, 1945 by original designation; Recent, Atlantic.

Diagnosis: The very small shell is solid, perforate or narrowly umbilicate, turbinate or globose-conic, of few strongly convex whorls, with on to two smooth nuclear whorls, the rest sculptured with subequal spiral ridges, the intervals crossed by axial threads. Aperture rounded, the concave columella somewhat thickened. Operculum thin, corneous and multispiral. The living animal has a rather long narrow foot, expanding in narrow auricles in front, bearing three pairs of long, ciliated epipodial cirri and a much shorter pair forward. Tentacles tapering, ciliated. Radula rhipidoglossate (Pilsbry & McGinty, 1945). Rubio and colleagues (2015) provided a complimentary diagnosis for the genus, as follows: Protoconch with ¾ nuclear whorl (measured by the Verduin method), smooth or with spiral cords. Teleoconch sculptured with subequal spiral cords, smooth or nodulose; spaces between the cords crossed by axial threads and/or lamellae and its surface covered by microgranules. Outer lip modified by the spiral cords.

Parviturbo rehderi **Pilsbry & McGinty, 1945**

(Figure 33G-L)

Synonymy see Leal (1991). Complement:

Parviturbo rehderi: Treece, 1980: 559, tab.; Rios, 1985: 29, p. 13, fig. 126; Leal, 1991: 50; Rios, 1994: 39, pl. 12, fig. 124; Lyons, 1998: 17; Paranaguá et al., 1999: 62; Benkendorfer & Soares-Gomes, 2009: 147; Rios, 2009: 62, textfig.; Rubio et al., 2015: 191, fig. 13A-H.

Types: Holotype ANSP 181312 (examined), USA, Florida, Palm Beach, North Inlet of Lake Worth, 26°46’N, 80°07’W (McGinty col., 07/vii/1945). Paratypes: LACM 2233, 1 sh; MCZ 226800, former McGinty collection, 2 sh; MCZ 207087, former McGinty collection, 2 sh; all from type locality.

Type locality: USA, Florida, Palm Beach, North Inlet of Lake Worth.

Diagnosis: Spiral cords sharp; two rows of lamellae between the cords 1 and 2 on the last whorl; outer lip scalloped by the termination of the spiral cords, and without denticles on its inner side (Rubio et al., 2015).

Original description: The shell is solid, white, subglobose with conic spire, rather narrow umbilicus, and seven strong subequal spiral carinae. There are 4 strongly convex whorls with deep suture, the smooth nucleus of slightly more than one high whorl, narrowly rounded at summit; following whorl strongly angular, with some low weak spirals below the angle. Last whorl has seven strong spirals, the upper one with rather wide intervals above and below it, the rest with intervals about equal in width to the spiral ridges. The intervals are crossed by low, well-spaced axial threads, which continue weakly on the slopes of the ridges but not over their summits. The round aperture is slightly angular above. Peristome rather thick. Columella somewhat thickened, rounded, the parietal callus moderate. (Pilsbry & McGinty, 1945, pp. 54-55).

Redescription: See Rubio et al. (2015).

Distribution: East Florida to Brazil (Rosenberg et al., 2009).

Etymology: Named after American malacologist Harald Alfred Rehder (Pilsbry & McGinty, 1945).

Material examined: Types. *Additional material*: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 131282, 240-260 m, 7 sh (viii/2005).

Measurements (mean value ± standard deviation; n = 6): 4½ whorls, H = 2.11 ± 0.15, D = 2.46 ± 0.14.

Remarks: The Canopus specimens are readily identifiable as *Parviturbo rehderi* by their sharp spiral cords and wide shell profile. The remaining characteristics agree very well with the diagnosis provided by Rubio et al. (2015), e.g., two rows of lamellae between the cords 1 and 2 on the last whorl, and outer lip scalloped by the termination of the spiral cords and lacking denticles on its inner side. The Canopus specimens are also quite similar to the holotype (Fig. 32G-I), though the latter is a subadult individual. This may explain the few discrepancies between them, such as the presence of strong axial sculpture elements and proportionally lower spire in the Canopus specimens (Fig. 32G, J), which could be attributed to ontogenetic changes. Moreover, the Canopus specimens showed great variation in strength and extent of the spiral sculpture. Strong axial ribs are almost totally absent, to strongly present on the body whorl in some specimens (Fig. 32K), with intermediary states. The specimens examined herein are significantly larger (~ 0.25x) than the other local congener present in Canopus, *P. weberi*, from which it also differs by the much stronger, wider spiral cords, wider shell profile (H/D = 0.85, as opposed to nearly 0.98 in *P. weberi*), and the absence of denticles on the inner side of the outer lip.

Parviturbo annejoffeae **Rubio, Rolán & Lee, 2015**

(Figure 34H-J, 35I-L)

Parviturbo annejoffeae Rubio, Rolán & Lee in Rubio, Rolán & Fernández-Garcés 2015: 203, fig. 20A-D.

Types: Holotype FLMNH 478979, Tobago, Patrick Co., Pigeon Point Beach, mid-surf zone, 9 m (Auffenberg & Cordier col., 26/v/1994). Paratype Harry G. Lee Collection (private), same data as holotype, 1 sh.

Type locality: Tobago, Patrick Co., Pigeon Point Beach, mid-surf zone, 9 m.

Diagnosis: Shell very small, solid, turbiniform. Protoconch with spiral cordlets. Teleoconch sculptured by 3 strong spiral cords (8 on body whorl), with equidistant axial threads

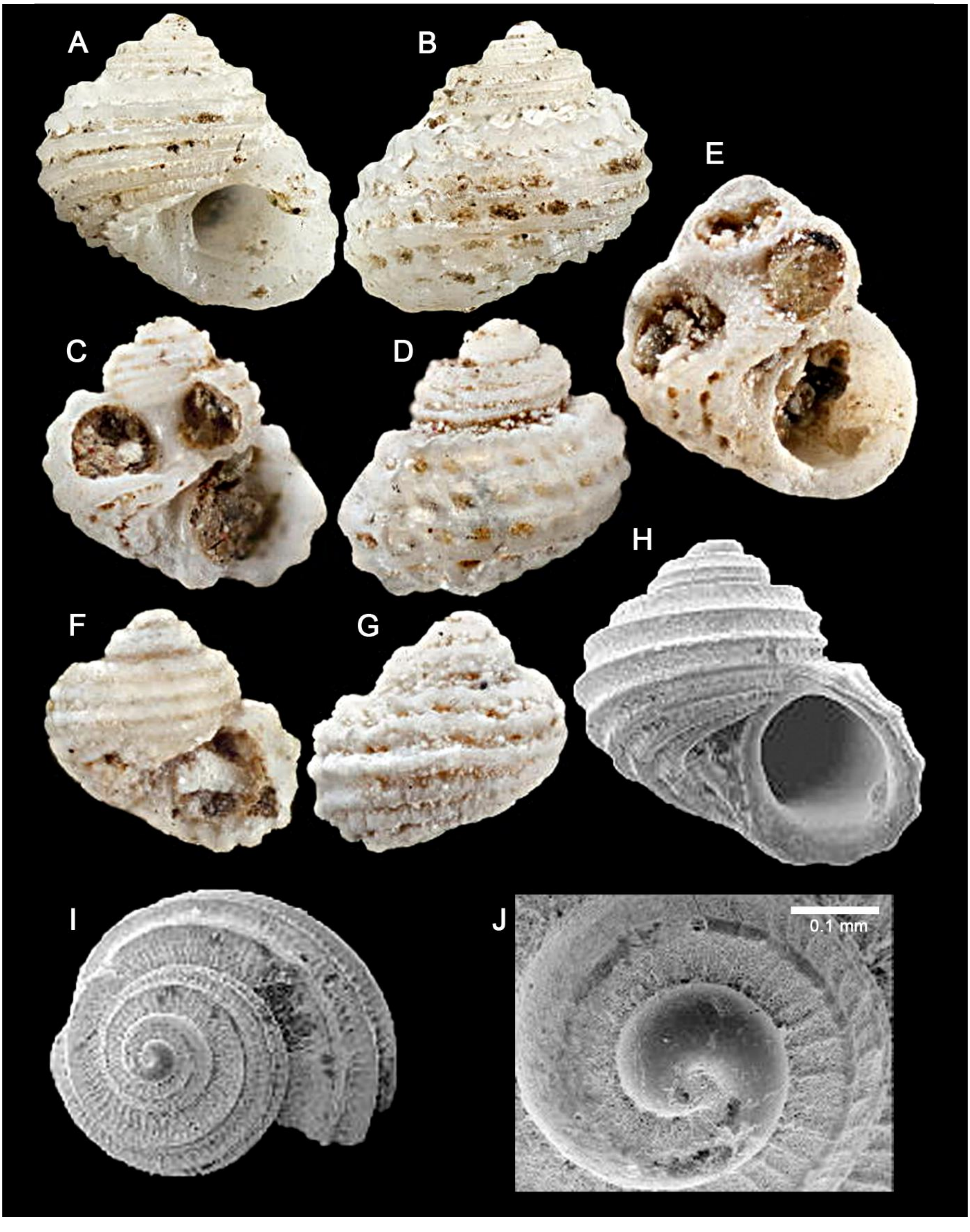

Figure 34: *Parviturbo* types. **A-G.** *Parviturbo tuberculosus* Syntype Syntype NHMUK 1854.10.4.270; **A.** spm. 1#, apertural view; **B.** same, abapertural view; C. spm. 2#, apertural view; **D.** same, abapertural view; E. spm. 3#, apertural view; F-G. spm. 4# apertural view; **G.** same, abapertural view**; H-J.** *Parviturbo annejoffeae* Holotype FLMNH 478979 under SEM; **H.** apertural view (H = 1.35 mm, D = 1.43 mm); **I.** apical view; **J.** protoconch.

covering the interspaces; cords with triangular profile, forming sharp-edged keels; periumbilical cords with scarcely visible nodules; axial threads between cords forming lamellae basally. Peristome continuous; columella widened basally in the insertion point with the periumbilical cord; outer lip very thick and with 5-6 internal denticles in adult individuals.

Distribution: Tobago to NE Brazil (present study).

Habitat: Sublittoral, in sand bottom at the mid-surf zone (Rubio et al., 2015); coralline bottoms, 240-260 m (empty shells only; present study).

Etymology: Named after Ms. Anne Joffe (Rubio et al., 2015).

Material examined: Type. *Additional material:* BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP MZSP 131283, 240-260 m, 10 sh (viii/2005).

Measurements (mean value ± standard deviation; n = 10): 4½ whorls, H = 1.88 ± 0.04, D = 1.90 ± 0.07.

Remarks: *Parviturbo annejoffeae* was recently described based on two empty shells from Tobago, the type locality. The Canopus specimens fit the original description well, in that they present a sculptured protoconch; axial threads in the interspaces between the spiral cords, which also form very distinct lamellae on the basal region of the shell (next to the umbilicus, Fig. 35K); angular, sharp spiral cords forming keels; periumbilical cords with weak, barely visible nodules; and a continuous, thick peristome. The holotype illustrated by Rubio and colleagues (2015; Fig. 34H-J) is also remarkably similar in outline, though it is a younger specimen. In fact, the shell of this species grows an additional whorl over the maximum number of 3½ reported by Rubio et al. (2015), attaining a larger size (thus the larger measurements reported herein). Moreover, the outer lip thickens considerably in adult specimens and also develops 5-6 internal denticles (Fig. 35I). Rubio et al. (2015) accurately provided a detailed comparison with other local congeners.

The present record extends the species' range over 2,900 km south-eastward. Such an expansion from Tobago-Venezuela to Brazilian waters is not entirely unheard of. Other species occupying similar habitats have a compatible range and are also distributed further south, such as *Solariella carvalhoi* Lopes & Cardoso, 1958, which is reported in this same study (see below). Considering this, it is very likely that *Parviturbo annejoffeae* is similarly distributed along the entire Brazilian Shelf at shallower (0-100 m) depths, but, of course, extensive samples would be necessary to verify this. The bathymetric range of *Parviturbo annejoffeae* is also expanded from a previous maximum depth of 9 m to 260 m, though the new record consists of empty shells only.

Parviturbo* aff. *tuberculosus

(Figure 35A-D)

Diagnosis: Shell small, slightly taller than wide, profusely sculptured by a reticulate pattern of equally strong axial ribs and spiral cords, with angular nodules at the intersections.

Description: Shell small (~H = 2.5 mm), turbiniform, compact, slightly taller than wide (H/D = 1.07), with 4½ convex whorls, and an overall spiky complexion; color homogeneous ivory white to cream. Spire short (height ~1/5 of shell height), prominent, spire angle ~80-85°. Protoconch (Fig. 35C) small, glossy, of ~1 whorl; transition distinguishable as a change in sculpture. Teleoconch of 3½ convex whorls; sculpture of first two whorls consisting of 3 rounded spiral cords of similar width, the uppermost of which slightly undulated; interspaces narrower than cords, sculptured by numerous strong, closely packed axial threads; sculpture of the remaining 1½ whorl consisting of 3-8 equally strong, axial and spiral cords and ribs, with angular nodules at the intersections (Fig. 35A), forming a reticulate pattern. Suture well-marked. Aperture circular, height ~2/5 of shell height; inner lip very narrow; outer lip thick, bearing 7 internal denticles. Umbilicus narrow, deep (Fig. 35D). Operculum unknown.

Distribution: Known only from Canopus Bank.

Habitat: Coralline bottoms, 240-260 m.

Material examined: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP MZSP 131281, 240-260 m, 4 sh (3 juveniles; viii/2005). *Parviturbo tuberculosus*: Syntype NHMUK 1854.10.4.270, Jamaica, 6 sh (d’Orbigny coll.).

Measurements (in mm): Largest specimen, H = 2.55, D = 2.37.

Remarks: This relatively large *Parviturbo* differs from nearly every other local congener by the conspicuous ornamentation consisting of equally strong, crossed axial and spiral elements, with angular nodules at the intersections. This produces a reticulate pattern that gives the shell a “spiky”, jackfruit-like appearance. It bears a strong resemblance to the Caribbean species *Parviturbo tuberculosus* (d’orbigny, 1842), the syntype of which I have examined here (Fig. 34A-G), but differs by being proportionally taller and narrower, and much more profusely sculptured. It also looks somewhat similar to the recently described *Parviturbo fortius* Rubio, Rolán & Fernández-Garcés, 2015 from Guadeloupe, but is less compact, taller, has a proportionally thinner outer lip, and the axial sculpture is much less spaced. It most certainly is closely related to both but is a distinct entity. Nevertheless, the samples examined here consist of juveniles and fragments, which hinders further conclusions. The sole well-preserved adult specimen is illustrated (Fig. 34A-D).

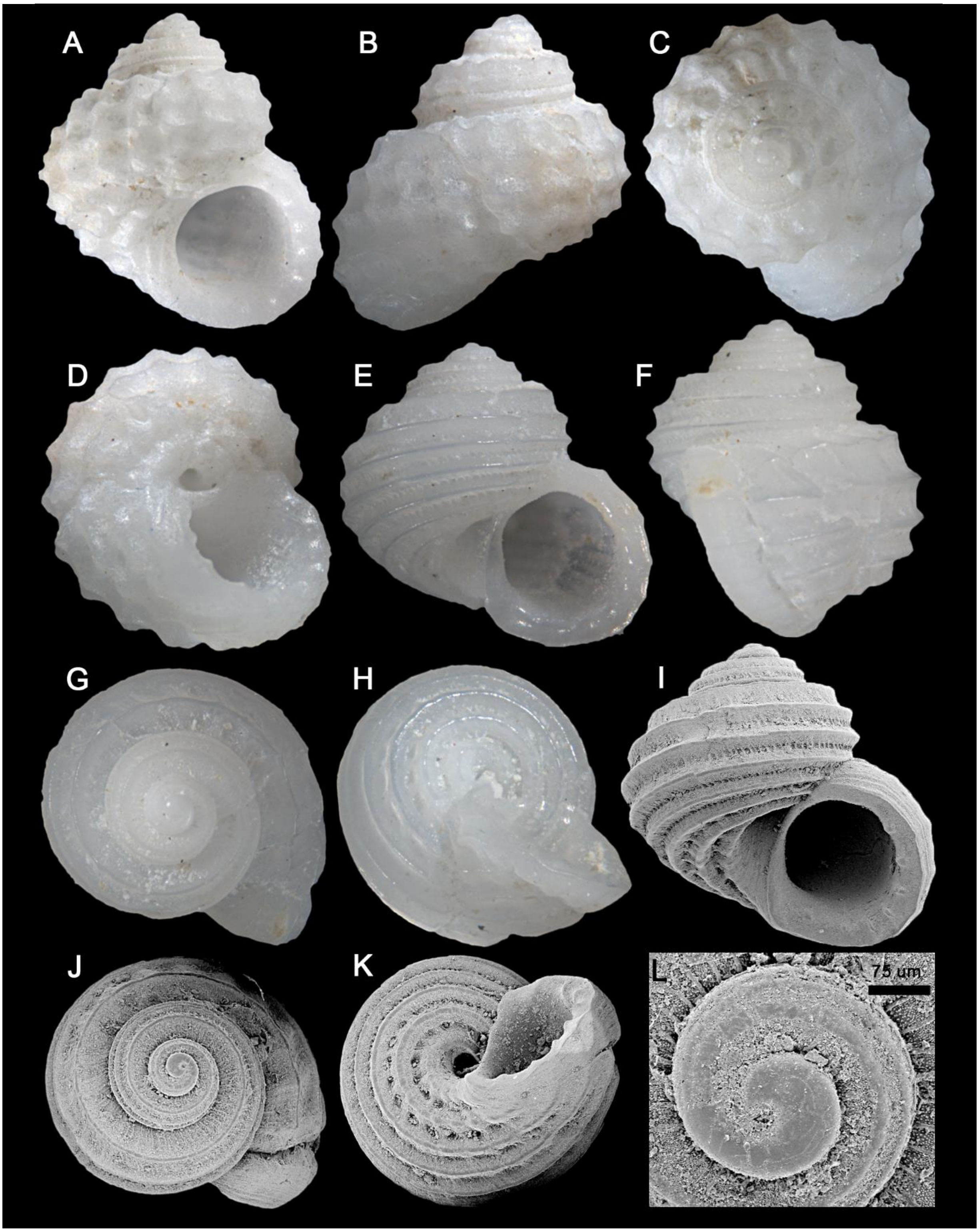

Figure 35: *Parviturbo* species from Canopus. **A-D.** *Parviturbo aff. tuberculosus* MZSP 131281; **A.** apertural view (H = 2.5 mm, D = 2.3 mm); **B.** abapertural view; **C.** apical view; **D.** umbilical view; **E-H.** *Parviturbo annejoffeae* MZSP 131283; **E.** apertural view (H = 1.9 mm, D = 1.97 mm); **F.** lateral view; **G.** apical view; **H.** umbilical view; **I-L.** same, spm. #2 under SEM; **I.** apertural view (H = 1.8 mm, D = 1.9 mm); **J.** apical view; **K.** umbilical view; **L.** prototonch.

Family Solariellidae Powell, 1951

General remarks: Solariellidae is a diverse, mostly deep-water group, with a circum-global distribution. Species in this family are usually small (5–20 mm) and live on fine sediment to unconsolidated substrates in tropical and extra-tropical seas (Hickman, 1998b; Williams et al., 2013). Solariellidae was initially introduced as a subfamily of Trochidae, but the name has been recently raised to family level based on molecular analyses (Bouchet et al., 2005; Williams et al., 2008). The evolutionary relationships among solariellids have been widely investigated on the basis of morphological and molecular evidence, but a comprehensive taxonomic revision that reflects recent discoveries is still lacking (Williams et al., 2010; Cavallari et al., 2016b). The family's fossil record possibly dates back to the Campanian of Torallola, Spain (Kiel & Bandel, 2001). Currently, Solariellidae includes 14 genera (Gofas, 2009b), and at least three of them are present in Brazilian waters, pending on recent new combinations and synonyms: *Microgaza* Dall, 1881, *Solariella* Wood, 1842 and *Suavotrochus* Dall, 1924 (Rios, 2009).

Genus *Solariella* Wood, 1842

Synonymy see Marshall (1999: 6).

Type species: *Solariella maculata* Wood, 1842, by monotypy; Pliocene, England.

Solariella carvalhoi **Lopes & Cardoso, 1958**

(Figure 36A-F)

Solariella carvalhoi Lopes & Cardoso, 1958: 59, figs. 1–3; Rios, 1970: 23; Abbott, 1974: 41;

Rios, 1975: 21, pl.4, fig. 45; Rios, 1985: 23, pl.10, fig. 95; Calvo, 1987: 59, fig. 24; Rios, 1994: 35, pl. 10, fig. 105; Miyaji, 2004: 78; Barros, Santos & Francisco, 2008: 11, figs. 8–14; Rios, 2009: 55, text fig.; Barros, 2010: 58, figs. 8–14; Daccaret & Bossio, 2011: 54, fig. 92; Dornellas & Simone, 2011: 10, figs. 41–43.

Solariella sp. 2: Leal, 1991: 47, pl. 3, figs. E–G.

Solariella quadricincta Quinn, 1992: 50, figs. 1–4; Barros, Santos & Francisco, 2008: 9, figs. 1–7; Barros, 2010: 56, figs. 1–7; Miloslavich et al., 2010: table S6.

Solariella staminea Quinn, 1992: 53, figs. 11–12; Benkendorfer & Soares-Gomes, 2009: 147.

Types: Holotype MZSP 18446 (examined), Moreira col. (11/xi/1956). *Paratype:* Paulo de Sá Cardoso Collection, same data as holotype (probably lost; J. Heise, pers. comm.).

Type locality: Brazil, off São Paulo state, 31°35’08”S, 50°50’00”W, 54 m depth.

Diagnosis: Shell ground color cream to light beige, with reddish-brown dispersed blotches, stripes, and spots; whorls sculptured by 2–5 spiral cords and numerous axial striae, usually more evident on the interspaces between spiral cords; a prominent subsutural cord bearing nodules; basal portion of shell sculptured by 5–7 spiral cords, with a prominent, knobby periumbilical cord forming a carina that divides the basal surface into a convex outer part and a concave inner part, the latter sculptured by knobby, closely packed spiral cords crossed by well-marked axial threads; aperture rounded; interior shell surface smooth, cream-colored, with an iridescent shade; operculum golden to yellowish brown, circular, corneous, thin, with a central nucleus and a convex inner and a concave outer surface (Cavallari et al., 2016b).

Original description (in Portuguese): Concha com 5⅓ espiras. Núcleo com 2⅜ espiras, inicialmente liso, com indicações cada vez mais acentuadas de 3 cordões espirais. As formações axiais, representadas por finos sulcus oblíquos só aparecem nitidamente nas espiras de crescimento. O cordão espiral superior delimita uma superfície plana, que se insere perpendicularmente na espira anterior. Inicialmente, êste primeiro cordão apresenta nódulos pequenos e aproximados, que se vão tornando mais espacejados à medida que o cordão se aproxima da abertura da concha. O Segundo cordão espiral, quase sem nódulos, delimita uma superfície quase perpendicular à primeira, tornando-se posteriormente oblíqua para fora. Entre o ultimo cordão espiral e a sutura da espira seguinte, a superfície da concha é obliquamente dirigida para dentro. Nessas 4 faixas espirais, delimitadas pelos cordões, há sulcus axiais estritos, situados em distâncias variáveis, dirigidos obliquamente. Êstes sulcos inicialmente coincide com os nódulos dos cordões espirais. Na última espira aparece o 4° cordão espiral, que é, nas espiras anteriores, encoberto pelas espirais seguintes. Ainda são vistos, lateralmente, na última espira, 4 cordões espirais pouco salientes, todos êles separados uns dos outros por faixas estridadas axialmente. Todos êstes cordões, em tôdas as espiras, não são lisos e sim percorridos por finos sulcus espirais, que são ondulados no 1° cordão, porque acompanham os nódulos aí existentes. A abertura é quase circular, tornando-se polygonal na região correspondente aos cordões espirais acima descritos (lábio externo). Lábio parietal um tanto distendido na direção do umbigo. Umbigo largo e profundo; a margem externa delimitada por um cordão espiral muito grosso e nodulose, havendo mais 5 cordões internos menos grossos, mas também nodulosos. Entre êstes cordões, as superficies apresentam largos sulcus radiais irregularmente dispostos (Lopes & Cardoso, 1958).

Translation: Shell with 5⅓ whorls; nucleus with 2⅜ whorls, initially smooth, then with three spiral cords that gradually increase in strength. Axial sculpture consisting of thin, oblique furrows, only clearly visible on the body whorl. Upper spiral cord delineates a flat subsutural surface; this cord presents small, closely packed nodules, which become increasingly spaced towards the aperture. The second uppermost cord, bearing almost no nodules, delimitates another surface, almost perpendicular to the subsutural shelf, becoming increasingly oblique toward the aperture. The third uppermost cord delimitates a surface that is wider than the previous one and becomes increasingly oblique towards the aperture. The shell surface between this third spiral cord and the suture is inclined inwards. In the interspaces between cords, there are randomly spaced, oblique axial furrows; these furrows are initially congruent with the nodules on the spiral cords. The fourth spiral cord is apparent on the body whorl; the suture in the preceding whorls overlaps it. Still, on the body whorl (basal portion), there are four, inconspicuous additional cords, with axially sculptured interspaces. Each spiral cord is not itself smooth but is instead present very thin spiral sulci, which are undulated on the uppermost cord due to the presence of the nodules. The aperture is nearly circular, becoming angulose near the outer spiral cords (outer lip). Inner lip distinctly flared toward the umbilicus. Umbilicus wide and deep; externally demarcated by a thick, nodulose spiral cord; internally sculptured by 5 thinner but also nodulose cords. The space between these cords presents wide, randomly arranged radial sulci.

Redescription: See Cavallari et al. (2016b).

Distribution: From Venezuela to southern Brazil (Cavallari et al., 2016).

Habitat: From 0–350 m depth (Cavallari et al., 2016b).

Etymology: Named after the late Brazilian researcher João de Paiva Carvalho.

Material examined: Types. *Additional material*: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 88203, 240-260 m, 1 sh (viii/2005); MZSP 122247, 240 m, 8 sh (viii/2005).

Measurements: Largest specimen 5 ¼ whorls, H = 4.23, D = 5.21 (MZSP 122247).

Remarks: The Canopus specimens compare well with the holotype. They usually have a lighter ground color, from white to light cream (Fig. 36D-F), but agree well with the complimentary description of *S. carvalhoi* presented by Cavallari and colleagues (2016b), who stressed the wide degree of conchological variation of this species. Still, some individuals studied here are very similar to the holotype (Fig. 36A-C) in having a wider shell outline (Fig. 36F). This species can be readily told apart from the local congener *Solariella quinni* Barros & Pereira in Barros, Santos & Francisco, 2008 mainly by its larger and proportionally wider shell, much wider umbilicus, which was originally and correctly emphasized by Lopes & Cardoso (1958), more delicate axial and much stronger spiral sculpture. The two remaining local congeners, *S. quadricincta* Quinn 1992 and *S. staminea* Quinn, 1992, have overlapping distributions with *S. carvalhoi* and are conchologically indistinguishable from it, representing simple intraspecific morphological variation. As such, these species are regarded as junior synonyms of *S. carvalhoi* (Cavallari et al. 2016b). Nevertheless, Canopus is located within the known range of *S. carvalhoi* according to the same authors.

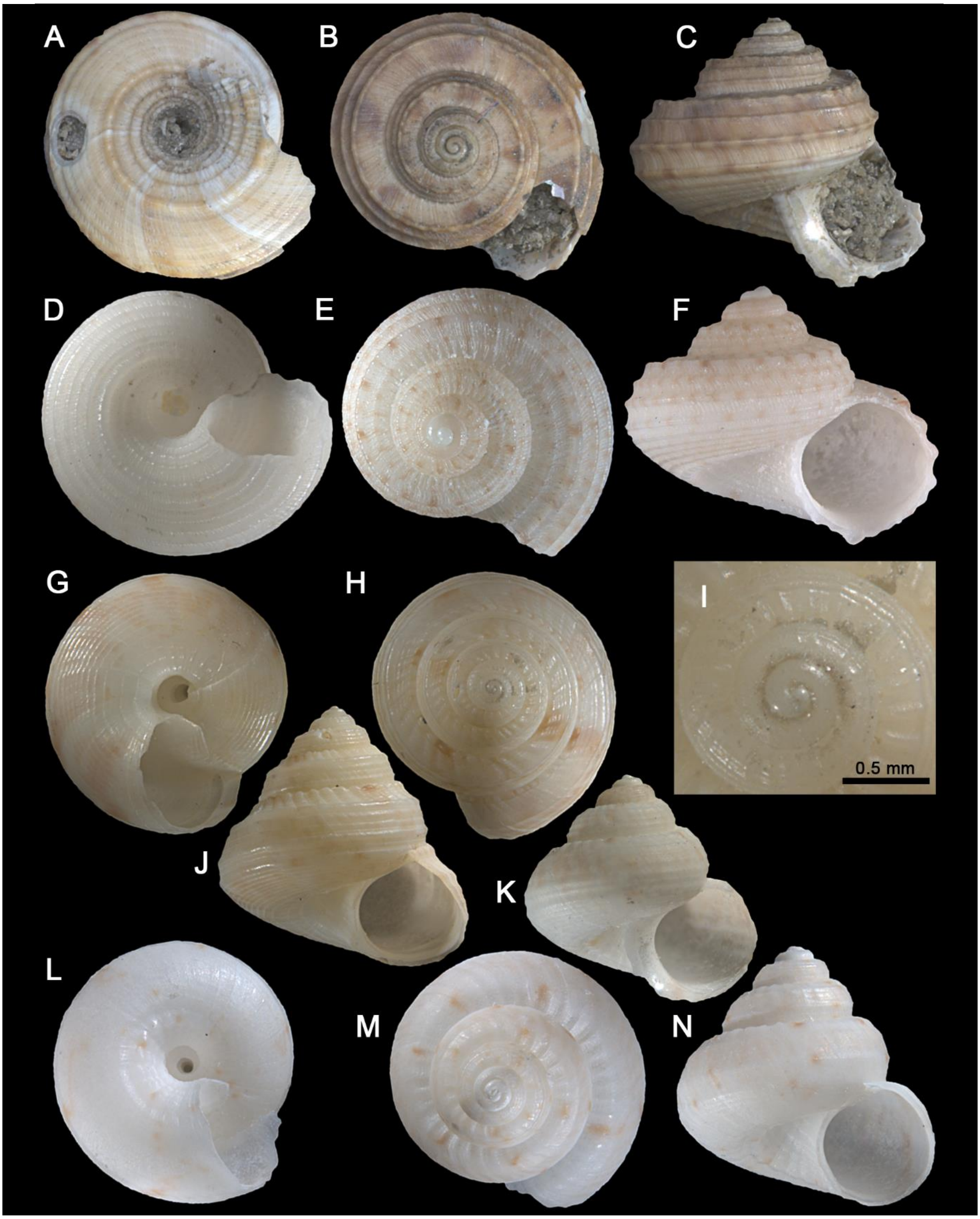

Figure 36: Solariellidae. **A-F.** *Solariella carvalhoi;* **A-C.** Holotype MZSP 18446; **A.** umbilical view (H = 4.9 mm, D = 5.8 mm); **B.** apical view; **C.** apertural view; **D-F.** MZSP 122247, from Canopus; D. umbilical view; E. apical view; F. apertural view (H = 3.3 mm, D = 3.75 mm); **G-N.** *Solariella quinni*; **G-J.** Holotype MZSP 77083; **G.** umbilical view; **H.** apical view; **I.** protoconch detail; **J.** apertural view (H = 6.1 mm, D = 6.2 mm); **K.** MZSP 70352, from Canopus, apertural view (H = 3.8 mm, D = 3.9 mm); **L-M.** MZSP 93523, from Canopus; **L.** umbilical view; **M.** apical view; **N.** apertural view (H = 4.5 mm, D = 4.2 mm).

Solariella quinni Barros & Pereira in Barros, Santos & Francisco, 2008

(Figure 36G-N)

Solariella quinni Barros & Pereira in Barros, Santos & Francisco, 2008: 13, figs. 15–21; Barros, 2010: 60, figs. 15–21; Cavallari et al., 2016: 44.

Types: Holotype MZSP 77083 (examined), Brazil, Pernambuco, 08°09’ S, 34°34’ W, gravel bottom, 51–71 m depth (19/xii/2004); Paratypes: MZSP 77082 (examined), 08°11’ S, 34°34’ W, 66–71 m (18/xii/2004); MZSP 77084 (examined), 08°11’ S, 34°36’ W, 69–71 m (19/xii/2004); MZSP 77085 (examined), 08°11’ S, 34°36’ W, 69–71 m (19/xii/2004).

Type locality: Brazil, off Pernambuco, 08°09’ S, 34°34’ W, 51–71 m depth.

Diagnosis: Conical-turbinate, body whorl weakly widened, shell with raised appearance. Suture reentrant, forming channel. Platform below the suture forming nodules, with 3-5 fine spiral threads. Shoulder with thinner tubercles or smooth appearance. Region below the shoulder with 2 spiral cords. Peripheral cord nodular, with the subperipheral area adorned by 2 fine spiral cords. Basal cord smooth. Circumbilical cord weakly tuberculate. Umbilicus narrow (Barros et al., 2008).

Original description: Shell conical-turbinate, 6 mm x 5.9 mm, angular contour, without nacre, base light-colored with tan streaks and spots, 5 3⁄4 whorls, shouldered. Protoconch small and smooth, about one whorl. 1st whorl with 3 spiral cords and the presence of the shoulder below the suture. 2nd whorl and subsequent whorls a bit more reticulated, 4 spiral cords making up the shoulder. Body whorl ample and broad. Suture reentrant, forming a channel in whorls 3 and 4, between the smooth abapical cord and the cord below the strongly nodular suture. The abapical cord forms the peripheral cord on the body whorl. Platform below the suture strongly ribbed, forming adapical nodules and the lower part crossed by 3 to 5 fine spiral threads. The axial ornament is always stronger in this region. Shoulder weakly forming tubercles that are weaker than those below the suture or has a smoother appearance, however no specimen has a secondary cord that is stronger than the shoulder. Region between the shoulder and the peripheral cord with the presence of 2 spiral cords of the same appearance, which can vary from fine to broad, in the latter case sub-equal to the shoulder and the peripheral cord. Platform with 2 spiral cords. Between these sub-shoulder secondary spiral cords there are microscopic spiral threads. Peripheral cord weakly nodular or smooth, but in both cases similar to the shoulder. Region below the peripheral cord with 2 sub-equal fine spiral cords. Base broad, slightly convex and ornamented by 10-12 spiral cords, the two innermost of which a bit more weakly tuberculate. Circumbilical cord weakly tuberculate, bordered by a small spiral groove. Intraumbilical region ornamented by 8-12 fine spiral threads intercalated by a fold that is a bit more reinforced. Umbilicus very narrow, corresponding to 11% of the maximum width; funnel-shaped and very sharp. Peristome strong. Inner lip concave, with a final reinforcement on the collumella due to the termination of the circumbilical cord. Aperture sub-circular with posterior thinning. Outer lip fine. Axial streaks on the platform below the suture and in the region between the shoulder and the peripheral cord (Barros et al., 2008).

Distribution: Previously known only from the type locality (Barros, 2008); northeastern to southeastern Brazil, off Ceará and Espírito Santo states (present work).

Etymology: In honor of late malacologist Dr. James F. Quinn.

Material examined: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 70352, 240 m, 1 sh (xi/2005); MZSP 93523, 260 m, 1 sh (viii/2005). **Espírito Santo:** off São Mateus, Abrolhos Slope, MD55 sta. DC73, 18°59'S, 37°48'W, 607-620 m, MNHN, 17 sh (Bouchet, Leal & Métivier col., 27/v/1987); MD55, sta. CB80, 18°59'S, 37°49'W, 290-315 m, MNHN, 2 sh (Bouchet, Leal & Métivier col., 28/v/1987).

Measurements: Largest specimen: 5 whorls, H = 4.54 mm, D = 4.28 mm (MZSP 93523).

Remarks: The present specimens compare exceedingly well with the type material of *Solariella quinni* (Fig. 36G-I), though both individuals from Canopus are juveniles (Fig. 36K-N). The species can be readily diagnosed by the sculpture pattern of the whorl shoulder and base and by the narrow, internally smooth umbilicus (Fig. 36G, L), as accurately pointed by Barros and colleagues (2008). This species was originally described by Barros et al. (2008); the subsequent paper by the senior author (Barros, 2010) is verbatim of the previous version and is herein considered a republication, even though it does not contain any reference to the former.

This species is similar to *S. lacunella* (Dall, 1881) from the Caribbean, but can be told apart form it by being much smaller (H = 5 mm, as opposed to 8.5 mm in *S. lacunella*); by presenting an overall stronger axial sculpture, with conspicuous axial ribs on the whorl shoulder (Fig. 36H, M), and weaker spiral sculpture with narrower cords, especially on the base; a more convex base, and a much narrower umbilicus. The records presented here greatly expand the species range ca. 670 km northward from off the state of Pernambuco to Ceará, and nearly 1200 km southward to Espírito Santo state, in southeastern Brazilian waters (MD55 specimens). The maximum depth for the species is also updated herein from 71 to 620 m, based on the MD55 specimens.

Family Turbinidae Rafinesque, 1815

General remarks: Turbinidae is a large family found in virtually every ocean, from high intertidal to deep-sea regions, in tropical, subtropical and, more rarely, temperate waters (Williams & Ozawa, 2006; Williams, 2007). The family has a rich fossil record dating back to the Permian Period (Hickman & McLean 1990). Turbinids have traditionally been characterized by shell morphology and the presence of a calcareous operculum (as in Turbinacea Rafinesque, 1815). Modern studies brought forth information on radular features and additional morphological characters, offering a better characterization of the group (Hickman & McLean, 1990; Williams & Ozawa, 2006). Regardless, the family was shown to be nonmonophyletic in molecular analyses (Williams & Ozawa, 2006). Williams et al. (2008) redefined the taxon as encompassing five subfamilies: Margaritinae Thiele, 1924, Prisogasterinae Hickman & McLean, 1990, Skeneinae Clark, 1851, Tegulinae Kuroda, Habe & Oyama, 1971, and Turbininae. In a subsequent classification based on further molecular data and a larger assemblage of species, Williams (2012) elevated some of these subfamilies to family level, and only Prisogasterinae and Turbininae remained in Turbinidae. The genus *Turbo* within Turbininae is currently represented in Brazil by three species: *Turbo castanea* Gmelin, 1791, *Turbo canaliculatus* Germann, 1781 and *Turbo heisei* Prado, 1999.

Genus *Turbo* Linnaeus, 1758

Type species: *Turbo petholatus* Linnaeus, 1758 by subsequent designation (Montfort, 1810); Recent, Indian Ocean, Red Sea.

Turbo heisei **Prado, 1999**

(Figures 37-39)

Turbo cailletii [*non* Fischer & Bernardi, 1857]: Rios et al., 1987: 58; Leal, 1991: 52.

Turbo heisei Prado, 1999: 1, figs. 1–4; Welch, 2010: table S1.

Turbo (Taenioturbo) heisei: Alf et al., 2003: 47, pl. 69, figs. 1–4; Rios, 2009: 67, textfig.; Petuch, 2013: 154, fig. 10.10E.

Types: Holotype MORG 40998, Brazil, Espírito Santo, Marataízes, 15–20 m depth (A. Bodart col.); Paratype MZSP 131294 (examined), 1 sh, same data as holotype, former José Roberto Heise Collection.

Type locality: Brazil, Espírito Santo, Marataízes, near “Octopus” hole at 15–20 m depth.

Diagnosis: Shell taller than wide, whorls strongly convex; suture well-marked, with deep, narrow subsutural channel. Spiral sculpture dominant, with spiral cords alternating sequentially between wider and narrower ones; subsutural spiral cord wider than remaining cords; axial sculpture conspicuous with growth lines crossing spiral sculpture, resulting in reticulate appearance and rough surface. Operculum inflated and rugose externally.

Original description: Shell turbiniform, medium sized, reaching 18-20 mm; 5 well rounded whorls, sculptured with 20 spiral cords at last whorl, crossed by fine striae, being the ones at the middle of the whorl stronger than the others near the suture. Aperture round and white. Umbilicus narrow and unknowed [sic] operculum. Color dark brown to rarely bright orange, with irregularly spaced axial white markings; iridescent interior and pink-red protoconch (Prado, 1999).

Redescription: Shell small to medium-sized (H = 17-23 mm), turbiniform, slightly taller than wide (H/D ~1.1), with 6 convex whorls. Ground shell color widely variable from intense yellowish-orange (Fig. 37A-D) to pinkish-red (Fig. 37I-J) or reddish-dark brown (Fig. 37F-H); usually with wide, sinuous, lighter-colored axial stripes on every whorl (Fig. 37F), seldom coupled with adjacent darker-colored stripe; more rarely presenting darker and lighter colored spots, more numerous on body whorl; basal region frequently lighter colored (Fig. 37F-H, I), with a greenish hue in brown specimens (Fig. 37H). Spire short (height ~1/3-1/4 of shell height), prominent; apex somewhat blunt, rounded; spire angle 70-85°. Protoconch of 1½ whorl (Fig. 37A, E) small (~0.3 mm), unsculptured, protruding (Fig. 37H) or flattened (Fig. 37O), of ~1 whorl; color white (Fig. 42L) or yellowish-pinkish (Fig. 37A, E), sometimes differing from remaining shell’s color along with first teleoconch whorls (Fig. 37F-H); transition noticeable by a sudden color change. Teleoconch of ~5 convex whorls, first 2 to 3 whorls frequently carinated (flat-protoconch individuals, Fig. 37O) or rounded (protruding protoconch); mainly sculptured by (4-6) thin, rounded spiral cords with similarly wide, shallow interspaces; spiral cord width sequentially alternated; subsutural cord wider than remaining cords; spiral sculpture crossed by numerous strong axial growth lines (Fig. 39A), forming a somewhat reticulate pattern and producing an uneven surface. Suture well-marked channeled (Fig. 37B, K); subsutural channel narrow, deep. Aperture circular (Fig. 37O), height ~½ of shell height, white, nacreous; inner lip frequently flaring (Fig. 37D, I). Umbilicus (Fig. 37O) narrow, deep. Operculum (Fig. 37M-O) circular, calcareous, paucispiral with an excentric nucleus; inner surface flat, covered by a thin corneous layer (Fig. 37M); outer surface convex, sculptured by numerous small pustules.

Distribution: Brazil, from the provinces/states of Ceará to Espírito Santo, including regional oceanic Islands.

Habitat: From 0–92 m depth (live specimens; Rosenberg, 2009); up to 620 m (empty shells only; present study).

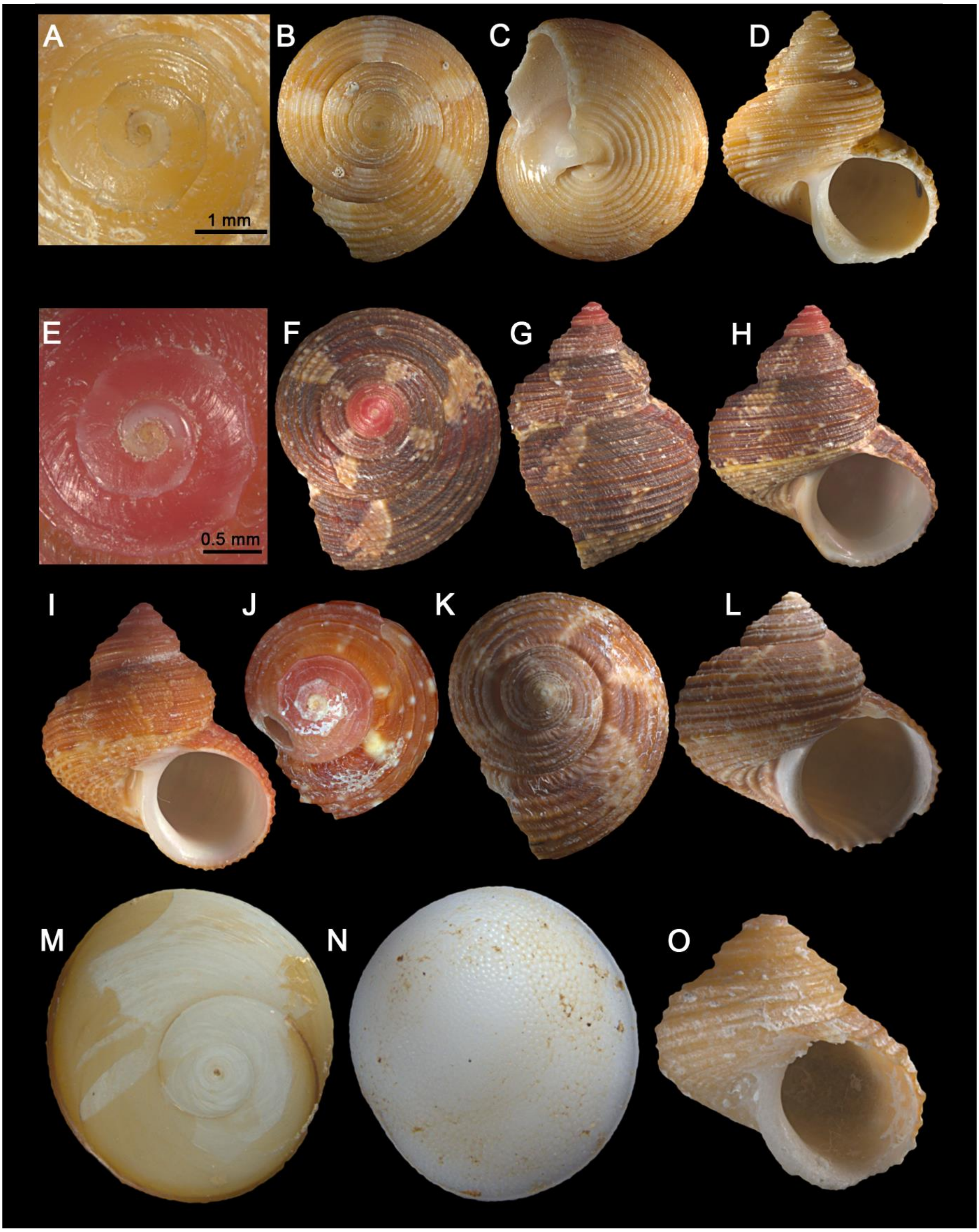

Figure 37: *Turbo heisei*. **A-D**. paratype MZSP 131294; **A.** protoconch detail, apical view; **B.** apical view (D = 17.2 mm); **C.** umbilical view; **D.** apertural view (H = 20.2 mm); **E-H.** Heise Collection specimen from off Guarapari, Espírito Santo state; **E.** protoconch detail, apical view; **F.** apical view (D = 17.0 mm); **G.** right lateral view (H = 20 mm); **H.** apertural view; **I.** MZSP 85519, off Camocim, Ceará state, apertural view (H = 16.2 mm); **J.** MZSP 122842, juvenile specimen, off Fortaleza, Canopus Bank, Ceará state, apertural view (H = 7.1 mm); **K-L.** MZSP 70220, same locality; **K.** apical view (D = 17.3 mm); **L.** apertural view (H = 16.9 mm); **M-O.** operculum; **M.** MZSP 68833, off Guarapari, inner view (L = 7.0 mm, W = 6.3 mm); **N.** same, outer view; **O.** MZSP 69187, off Alcobaça, Bahia state, apertural view (D = 14.9 mm).

Etymology: Named after Brazilian shell collector José Roberto Heise.

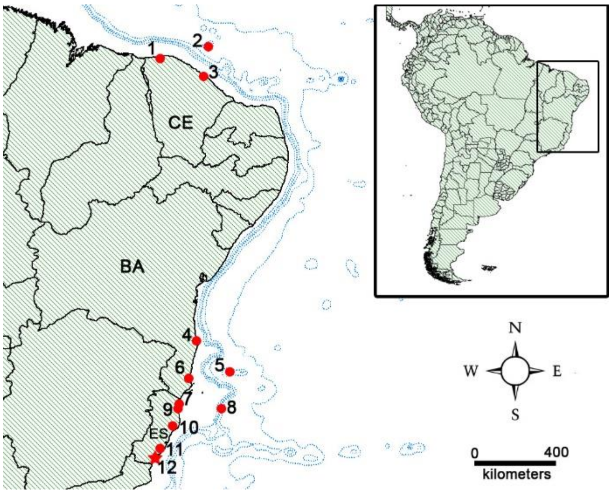

Figure 38: Records of *Turbo heisei* along the Brazilian coastline: **1.** Camocim; **2.** Canopus Bank; **3.** Fortaleza; **4.** Canavieiras; **5.** Minerva Bank; **6.** Alcobaça; **7.** Conceição da Barra; **8.** Abrolhos Slope; **9.** São Mateus; **10.** Linhares; **11.** Guarapari; **12.** Marataízes (type locality). Abbreviations: CE: Ceará state; BA: Bahia state; ES: Espírito Santo state.

Material examined: Types. *Additional material*: BRAZIL; **Ceará:** off Camocim, MZSP 85519, 5 sh (Monteiro col., 2007); 120 miles off Fortaleza, Canopus Bank, MZSP 53748, 60 m, 1 sh (viii/2005); MZSP 66563, 60 m, 1 sh (viii/2005); MZSP 67308, 60 m, 1 sh (viii/2005); MZSP 70220, 60 m, 1 sh (viii/2005); MZSP 72084, 60 m, 1 sh (xi/2005); MZSP 122842, 240-260 m, 23 sh (viii/2005). **Bahia:** off Canavieiras, on reef at 20-30 m, MZSP 72898, 1 sh (Bodart col., vi/2005); Minerva Bank, 17°01'S, 37°26'W, 100 m, MZSP 118211, 43 sh (Femorale col., 2005); 17°01'S, 37°36'W, 50 m, MZSP 107931, 2 spm; 17°06'S, 37°38'W, 120 m, MZSP 110861, 18 sh (Femorale col., viii/2012); MZSP 110960, 10 sh (Femorale col., viii/2012); off Alcobaça, 5-10 m, MZSP 33216, 1 sh (Bodart col., 2001); 70 km off Alcobaça, offshore reef, 10-12 m, MZSP 69187, 1 spm (Bodart col., vi/2005); MZSP 72309, 2 sh (Bodart col., 2003); MZSP 73296, 1 sh (Bodart col., v/2002); MZSP 126964, 1 sh (Femorale col., viii/2008); MZSP 127038, 13 sh (Femorale col., viii/2008). **Espírito Santo:** off Conceição da Barra, 40-50 m, MZSP 74295, 1 sh (v/2006); off north Linhares, 50-60 m, MZSP 69575, 3 spm (Lyra col., viii/2006); off Linhares, on reef at 20-30 m, MZSP 72795, 1 sh (Bodart col., v/2001); off São Mateus, Abrolhos Slope, MD55 sta. DC73, 18°59'S, 37°48'W, 607–620 m, MNHN, 1 sh (Bouchet, Leal & Métivier col., 27/v/1987); off Guarapari, MZSP 37375, 1 sh (Coltro col., vi/2003); 20-25 m, on briozoan bottoms, MZSP 68833, 4 spm (Bodart col., vii/2005); MZSP 69188, 1 spm (Bodart col., vii/2005). *Turbo cailleti:* HONDURAS; Roatan Island, on reef, 10-12 m, MZSP 67679, 1 sh (M. Coltro col., iv/2006); MZSP 70189, 1 sh (M. Coltro col., iv/2006); NW Roatan Island, under coral slab, 3-15 m, NMR 56452, 1 sh (Nieuwenhuis col., i/1990). *Turbo canaliculatus* Hermann, 1781: BRAZIL: **Rio Grande do Norte:** off Touros, 10-15 m, MZSP 70119, 1 sh (viii/2006). *Turbo castanea* Gmelin, 1791: BARBADOS; Spanish Point, at low tide, MZSP 68792 (A. Bodart col., i/2005).

Measurements (in mm): Holotype MORG 40998, 6 whorls, H = 20.2, D = 17.7; Paratype MZSP 131294, 6 whorls, H = 20.2, D = 17.2. Non-types (mean value ± standard deviation; n = 10): 6¼ whorls, H = 21.61 ± 1.36, D = 18.79 ± 1.37.

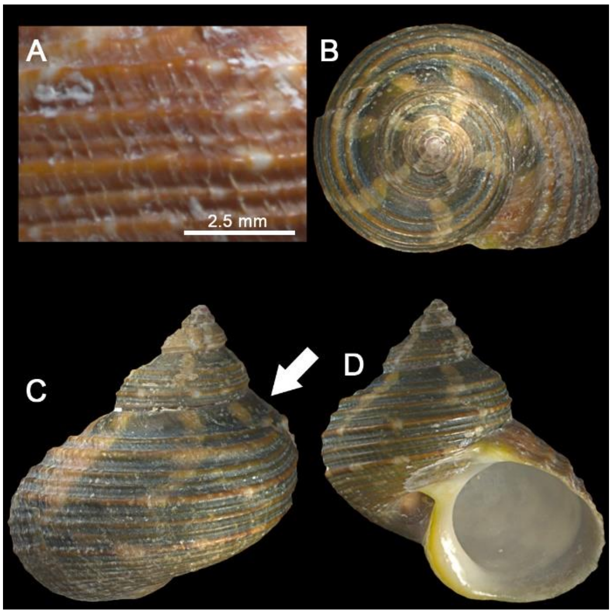

Figure 39: *Turbo* species. **A.***Turbo heisei*, MZSP 70220, from Canopus Bank, detail of body whorl showing sculpture pattern (scale = 2.5 mm); **B-D.** *Turbo cailletii*, MZSP 67679, from Roatan Island, Honduras (H = 27.2 mm, D = 23.5 mm; arrow indicates subsutural plateau).

Remarks: The examined specimens' sculpture pattern and color compare fittingly with both the examined paratype and the original description (Prado, 1999), though the latter is quite vague. The examination of specimens from the MZSP collection allows for further conclusions regarding the species' variation in color and shape. In general terms, it is more widely variable than initially assumed, but some characters remain consistent in the analyzed material.

The pink-red protoconch mentioned by Prado (1999), which in fact is a pinkish apex and spire encompassing the first 2-3 teleoconch whorls as well, is indeed a common feature of *Turbo heisei*. However, several specimens do not exhibit such a trait, having a white protoconch and indistinctly colored apex and spire (Fig. 37L). This is true even for specimens coming from the same locality of the pinkish-spired individuals. Moreover, this reddish apical coloration is also found in congeners (e.g., *Turbo cailleti* Fischer & Bernardi, 1857, NMR 56452), and is thus hardly diagnostic of the species. Ground coloration is widely variable, ranging anywhere from intense yellowish light orange to reddish brown with a faint greenish hue (Fig. 37F-G). The axial lighter colored stripes mentioned by Prado (1999) are present in most specimens, usually more evident in an apical view (Fig. 37B, F, K). The shell's basal region is often distinctly colored, presenting a lighter colored stripe extending from the outer lip attachment to the umbilicus, a feature not mentioned by Prado, but quite common in the specimens analyzed here (Figure 37H, I). Several isolated white spots and darker spirally extended markings are also present in some individuals (Figure 37H, J). Overall, this discrepancy in coloration elements is probably not found to specific localities or populations, since the entire range of variation can be observed in assemblages collected in the very same place. The same can be said about the width/height ratio of shells, though taller specimens seem to be more frequent than the wider ones in the present sample.

Regarding the sculpture elements, spiral cords intersected by well-marked axial lines (referred to as “striae” by Prado, 1999) give the shell an overall reticulate appearance and a rough surface that feels crispy to the touch. The spiral cords themselves have different widths along the same whorl, usually alternating sequentially between wider and narrower ones, and the subsutural cord is always wider than the remaining ones.

Turbo heisei is quite similar to *Turbo cailletii*, from the Caribbean (Figure 39B-D), but it can be distinguished by its proportionally taller and smaller shell, with a maximum reported size of 22.9 mm (herein) as opposed to 37.0 mm in *T. cailletii* (Rosenberg, 2009); by having a blunt apex; by lacking a wide subsutural plateau (Figure 2C, indicated by an arrow) as originally remarked by Prado (for additional examples see Tunnell et al. 2010: 126; Redfern 2013: 19, fig. 52); by having a more well-marked and channeled suture; by bearing stronger axial sculpture and consequently rougher surface; by having narrower, more delicate spiral cords and shallower interspaces and by its proportionally thinner shell. Additionally, it can be told apart from *T. castanea* Gmelin, 1791 by the smaller size, more delicate sculpture lacking nodules or tubercles, and rounder whorls lacking a keel; and from *T. canaliculatus* Hermann, 1781 by the much smaller size and more conspicuous sculpture.

Rosenberg (2009) regarded the *Turbo cailletii* reported by Leal (1991, non Fischer & Bernardi, 1857) among the R/V “Marion Dufresne” MD55 expedition specimens as a possible misidentification of *T. heisei*. Rios (2009) apparently followed this while describing the range of *T. heisei*. Leal did not figure the specimens, but the MD55 specimen examined here is indeed *T. heisei*. This is most likely the case in the other occurrences from MD55 stations along the Vitória-Trindade Seamount Chain (Leal, 1991). The range of *T. heisei* is greatly expanded herein from the previously known occurrences restricted to SE Brazilian waters to NE Brazil. Additionally, still regarding the species’ distribution, the occurrences presented here contradict Petuch’s (2013) biogeographical hypothesis, which reported *T. heisei* as endemic to his Bahian Subprovince, which extends from the states of Alagoas to Rio de Janeiro. As it turns out, this species also occurs in Petuch’s (2013) adjacent, northern Cearaian Subprovince, which ranges from the states of Amapá to Alagoas (Fig. 38).

Superfamily Seguenzioidea

Family Seguenziidae Verrill, 1884

General remarks: Seguenziidae is a family of globally distributed deep-water snails (200–1000 m) that usually live on fine sedimentary substrates. These animals exhibit a perplexing mixture of allegedly plesiomorphic and apomorphic features, e.g., bearing a nacreous shell while presenting copulatory organs in both sexes. Because of that, their positioning as either within Vetigastropoda or somewhere between Vetigastropoda and Caenogastropoda was widely debated (Haszprunar, 1988; Hickman, 1998a; Sasaki, 1998). Due mostly to the lack of specimens with soft parts in natural history collections, the classification of Seguenziids was nearly completely based on shell characters (Quinn, 1983), leading to taxonomical inconsistency. Recent molecular studies are slowly helping to change this scenario (see Kano et al., 2009; Aktipis & Giribet, 2012), but several taxa must still be sampled and sequenced in order to better define the relationships within the family. The family's fossil record is quite rich, and the oldest known seguenziids date back from the Middle Paleocene of Greenland (Kollmann & Peel, 1983). Seguenziidae currently includes over 20 genera (Bouchet, 2010), seven of which occur in Brazilian waters. Altogether, 10 seguenziid species have been recorded in Brazil to date (Salvador et al., 2014).

Genus *Ancistrobasis* Dall, 1889

Type species: *Basilissa costulata* Watson, 1879, by subsequent designation (Dall, 1927); Recent, Atlantic.

Diagnosis: Shell solid, slightly depressed, highly sculptured; aperture thickened within and provided with strong lirations forming denticles at the aperture; columella with a strong terminal tooth (Quinn, 1979).

Ancistrobasis costulata (Watson, 1879)

(Figure 40)

Synonymy see Quinn (1979) and Salvador et al. (2014). Complement:

Basilissa (Ancistrobasis) costulata: Quinn, 1979: 51, figs. 85-86.

Ancistrobasis costulata: Salvador et al., 2014: 537, figs. 1-3.

Types: Syntypes: NHMUK 1887.2.9.355, 1 sh; NHMUK 1887.2.9.356, 1 sh; NHMUK 1887.2.9.357, 1 sh; all from R/V Challenger Sta. 24, Puerto Rico, Saint Thomas, off Culebra Island (25/iii/1873).

Type locality: Puerto Rico, St. Thomas, off Culebra Island, 18°30’30”N, 65°05’30”W, 713 m.

Diagnosis: Shell small, depressedly conoidal and angulated, profusely sculptured by well-marked axial ribs crossed by equally wide spiral cords, with nodules at intersections; width of ribs and cords very variable, producing nodules of corresponding variable size and shape. Aperture rectangular to subquadrate, with two strong teeth near the columella. Base flattened; umbilicus wide, limited by strong, nodulose periumbilical cord. Color ivory white to cream.

Original description: *Shell* small, depressedly conoidal, sharply angulated, flattish on the base, sharply and deeply umbilicated, a little porcellaneous, flexuously ribbed. *Sculpture*. The whole surface is covered with longitudinal flexuous ribs, which are narrow, sharp, and uniform, and each is about 0.002 in. broad, and they are parted by intervals, which at the suture are twice and at the periphery thrice as broad as the ribs. There are about 40 of these on the last whorl. They are crossed by spirals, half the breadth of the ribs, running across the intercostal spaces and forming knobs on the ribs. Of these on the last whorl there are about seventeen, much closer-set and less uniform than the ribs; in particular the carinal spiral, which is very sharp, and the fourth and seventh above it, are stronger than the others; the last mentioned of these is especially so on the earliest whorls. On the base the longitudinals, though continued even into the umbilicus, become much less prominent and are no longer nodose; and the spirals, of which there are about fifteen, are closer-set, broader and flatter, except the first three below the carina, which are sharp and narrow. The whole base is pit-marked from the spiral interstitial furrows being cut up by the longitudinals. *Colour* dead white (on the base a little glossy) on the thin porcellaneous surface, through which the nacreous layer behind gleams. *Spire* raised, with a very slightly concave outline. *Apex*, which consists of the minute smooth embryonic whorl and a half, is itself a little flattened but rises sharply above the sculptured surface of the succeeding whorls. *Whorls* 5½, of slow and regular increase till the last, which begins to enlarge rapidly. They are slightly rounded above, very sharply angulated at the keel, and flattened on the base, with a bluntly angulated umbilical edge. Suture distinct, slightly impressed. *Mouth* perpendicular, square. *Outer lip* sharp, thickened by a slight internal remote callus, not patulous, not descending, advancing at its junction with the body-whorl and then slightly retreating so as to form the very shallow open sinus; right-angled at the periphery, flat on the base, where it retreats so as to form two rounded sinuses, making with the pillar an angle that is scarcely obtuse. *Pillar-lip* is straight, slightly thickened and reverted, so as to leave a slight groove behind it. It advances on the body whorl, then retreats so as to form a slight sinus, bending at the same time shortly but sharply to the right into the umbilicus and then advancing straight forward, but a little toward the left, to its junction with the outer lip at the base. *Umbilicus* funnel-shaped, open-mouthed, oblique-edged, straight-sided, deep and contracted internally. Its edge is sharply defined by a spiral thread, and is obliquely scored by the longitudinal ribs; further in its walls are marked by hair-like lines of growth and faint spirals (Watson, 1879).

Distribution: From Georgia, USA, to southern Brazil (Quinn, 1979; Rios, 2009; Salvador et al., 2014).

Habitat: 27-1170 m (Quinn, 1979).

Etymology: From Latin *costa* (diminutive *costula*), meaning rib (riblet) (Brown, 1954), a probable allusion to the shell’s conspicuously ribbed sculpture.

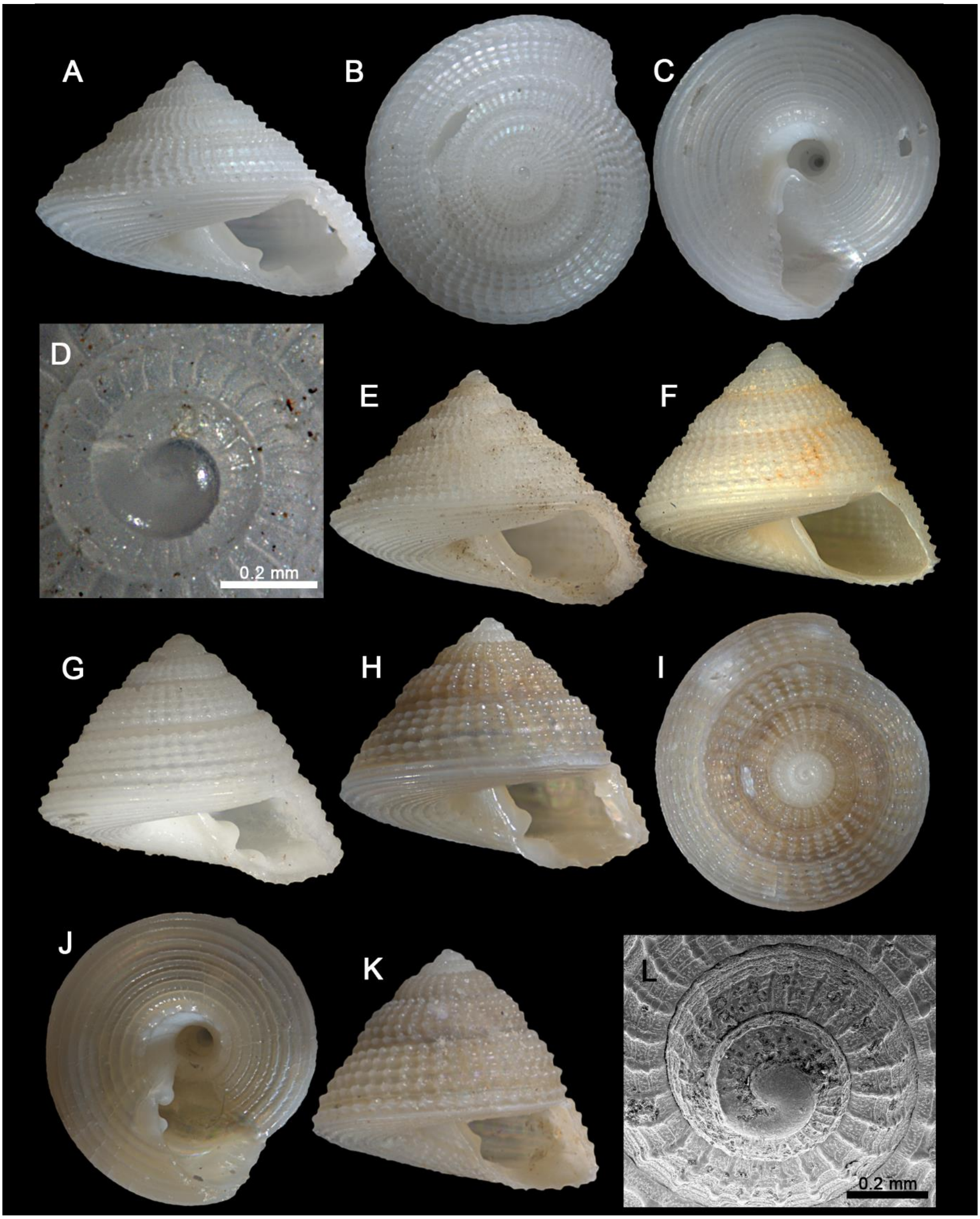

Figure 40: *Ancistrobasis costulata*. **A-D.** MZSP 70312, from Canopus; **A.** apertural view (H = 3.4 mm, D = 5.0 mm); **B.** apical view; **C.** umbilical view; **D.** protoconch detail; **E.** MZSP 93485, from Canopus, apertural view (H = 3.5 mm, D = 4.8 mm); **F.** MNHN, MD55 specimen from Espírito Santo, apertural view (H = 4.0 mm, D = 5.0 mm). **G.** MZSP 70313, from Canopus, apertural view (H = 3.5 mm, D = 4.1 mm); **H-J.** same, specimen #2; **H.** apertural view (H = 3.4 mm, D = 4.2 mm); **I.** apical view; **J.** umbilical view; **K.** same, specimen #3, apertural view (H = 3.4 mm, D = 3.7 mm); **L.** same, specimen #4, protoconch detail under SEM.

Material examined: BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 70312, 260 m, 2sh (viii/2004); MZSP 70313, 260 m, 9 sh (viii/2004); MZSP 88200, 240-260 m, 1sh (viii/2004); MZSP 88206, 240-260 m, 1 sh (viii/2004); MZSP 88210, 240-260 m, 3 sh (viii/2004); MZSP 94233, 260 m, 2 sh (xi/2005); MZSP 93485, 200 m, 2sh (2005); MZSP 112575, 260 m, 1 sh (2005); MZSP 121947, 260 m, 2 sh (2005); MZSP 122375, 240 m, 2 sh (2005); MZSP 122376, 240 m, 1 sh (2005); MZSP 131041, 200 m, 2 sh (2005).

Measurements: Largest specimen: 6½ whorls, H = 3.43 mm, D = 5.00 mm (MZSP 70312).

Remarks: Watson's (1879) description of *Ancistrobasis costulata* was based on three empty shells collected by an expedition of the R/V Challenger. The lack of a more extensive assemblage certainly hindered any further deductions on the variability of outline and sculpture elements. Quinn's (1979) account of the species also included very few specimens from Florida and the Yucatan Channel, and he did not mention any notable variations. Salvador and colleagues (2014) analyzed a larger sample of specimens from the MD55 expedition (off SE Brazil), and though they did not provide any extensive remark on the species' variation (apart from the coloration, see below), the two illustrated specimens (figs. 1-3) presented some differences regarding the spacing of the ribs and cords and distinct shell height/width ratio.

Nevertheless, a wide degree of conchological variation is present in the *Ancistrobasis costulata* specimens from the Canopus assemblage: the outline of the specimens can be anywhere from distinctly wider than tall (H/D = 0.69) with more convex whorls (Fig. 40A), to roughly as tall as wide (H/D = 0.86) with straighter whorl profiles (Fig. 40K). The intensity and number of ribs and cords are also variable from more numerous and delicate with angular nodules at the intersections (Fig. 40A, F) to fewer in number but stronger and wider, with large, rounded nodules at the intersections (Fig. 40H, K). In this regard, one of the specimens illustrated by Salvador et al. (2014) represents an intermediary state between the most extreme forms illustrated herein (Fig. 40F). Remarkably, in the present specimens, the protoconch morphology remained constant (Fig. 40D, L) while the initial teleoconch whorls were either only sculptured by axial ribs (Fig. 40D) or by a mixture of axial ribs and spiral cordlets producing a reticulate pattern (Fig. 40L). The original description also did not mention any color variation. Indeed, as mentioned by Watson (1879), some specimens are pure white with a nacreous gleam (Fig. 40A), but there are cream-colored forms as well (Fig. 40E). This was already pointed out by Salvador and colleagues (2014) and is reinforced here.

This species has been considered a junior synonym of *Ancistrobasis reticulata* (Philippi, 1844), a fossil taxon described from the Pliocene of Italy (Quinn, 1983; Rosenberg, 2009). Salvador et al. (2014) disagreed with this, stating that synonymizing these species without a thorough revision of both fossil and recent taxa would be problematic, a position that we still agree with.

Family Chilodontidae Wenz, 1938

General remarks: Chilodontidae is a large family of marine snails that live in tropical, subtropical and warm-temperate waters of the Atlantic and Indo-Pacific, from intertidal to bathyal depths (up to 2000 m). Based mostly on molecular data, the family has been recently recognized as a distinct, well-supported lineage belonging to the Seguenzioidea Verrill, 1884 (Kano, 2008; Williams et al., 2008; Kano et al., 2009; Aktipis & Giribet, 2012). Though external morphological characteristics of the group have been summarized in the literature (see Hickman & McLean, 1990; Hickman, 1998b), comparative morphological studies involving chilodontids and other groups now included in Seguenziodea aimed at further clarifying their affinities are still to be carried out. The group's fossil record extends back to the Early Mesozoic (Herbert, 2012). As it is currently understood, the family encompasses at least 18 different genera (both extant and extinct; Gofas, 2009), two of which are known to occur in Brazilian waters: *Euchelus* Philippi, 1847 and *Mirachelus* Woodring, 1928 (Rios, 2009).

Genus *Dentistyla* Dall, 1889

Synonymy see Quinn (1979: 34). Complement:

Antillachelus Woodring, 1928: 433 (*fide* Clench & Turner, 1960).

Type species: *Margarita asperrima* Dall, 1881, by subsequent designation (Keen, 1960); Recent, Caribbean.

Diagnosis: Shell rather thin, conical, base slightly convex, usually umbilicated; exterior sculptured by spiral rows of close-set conical or rounded nodules, interior nacreous; aperture subquadrate, somewhat oblique, sometimes thickened within; columella straight, thickened, often with a strong tooth in mature specimens (Quinn, 1979).

***Dentistyla dentifera* (Dall, 1889)**

(Figures 41, 42A-D, 44)

Synonymy see Quinn (1979). Complement:

Dentistyla dentiferum: Quinn, 1979: 35, figs. 47-48 [incorrect termination].

Dentistyla dentifera: Rosenberg et al., 2009: 621.

Types: Lectotype, USNM 95059 (examined), Barbados, R/V Blake sta. 299, 13°05’N, 59°39’40”W, 256 m (10/iii/1879).

Type locality: Barbados, R/V Blake sta. 299, 13°05’N, 59°39’40”W, 256 m.

Diagnosis: Shell small, depressed-conical, slightly taller than wide, richly sculptured; sculpture consisting of 3-4 wide spiral cords crossed by numerous axial ribs, producing well-marked, angular nodules; two lowermost cords larger than remaining ones, forming a distinct carina; outer lip bearing numerous lirations.

Original description: Sculpture strongly and exclusively nodulous; a strong blunt tooth on the columella just within the aperture and above the base. Outer lip lirate within (Dall, 1889).

Redescription: Shell attaining a height of 8 mm, conical, carinate, umbilicated, highly sculptured, of about 7 whorls. Protoconch small, glassy, of about 1 whorl. Spiral sculpture of 2 major beaded cords, the lower of which forms the peripheral carina; from 1 to 3 similar cords are intercalated between, often becoming subequal to the primaries. Below the peripheral cord, the whorl is sharply constricted to a beaded circumbasal cord; base rounded with 5 to 7 beaded cords, of which the innermost is strongest and defines the umbilicus. Umbilicus moderate, axially striate, usually with one to three rather strong nodulous spiral cords. Aperture oblique, subquadrate, thickened within by nacre in which there are numerous sharp lirations; lips thin, outer lip somewhat crenulated, inner lip slightly reflected; columella straight, oblique, usually with a strong swelling or blunt tooth (Quinn, 1979).

Distribution: North Carolina to Barbados (Rosenberg et al., 2009), to Brazilian waters (present study).

Habitat: Coralline bottoms, 70-311 m (Rosenber et al., 2009; present study).

Material examined: Types. *Additional material:* BRAZIL; **Ceará:** 120 miles off Fortaleza, Canopus Bank, MZSP 53725, 60 m, 1 sh (viii/2005); MZSP 68860, 260 m, 1 sh (viii/2005); MZSP 70310, 260 m, 17 sh (viii/2005; with operculae); MZSP 72004, 260 m, 1 sh; MZSP 88201, 240-260, 3 sh; MZSP 88205, 240-260 m, 1 sh; MZSP 121946, 260 m, 1 sh (viii/2005). Dentistyla asperrima: Lectotype MCZ 7568, USA, Florida, West of Dry Tortugas, R/V Blake sta. 12, 24°34’N, 83°16’W, 323 m (type locality; 1877). Paralectotypes: NMNH 95055, 1 sh, from type locality; NMNH 95096, 2 sh, MCZ 7569, 2 sh, Cuba, off Honda Bay, R/V Blake sta. 20, 23°2’30”N, 83°11’0”W, 402 m (i/1878); NMNH 95097, 2 sh, MCZ 7570, 2 sh, Caribbean, off Barbados, 183 m (1877). Dentistyla sericifila: Holotype USNM 95060, GRENADA, R/V Blake sta. 262, 12°01’45”N, 61°47’25”W, 168 m (01/iii/1879).

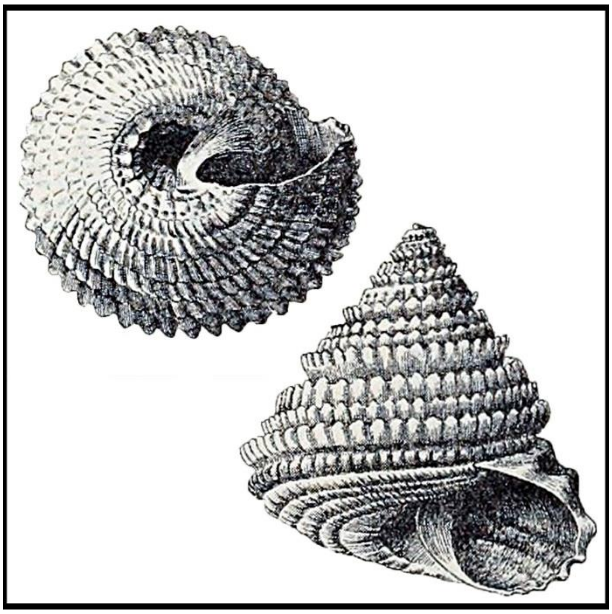

Figure 41: Dall’s (1889) original illustration of *Calliostoma (Dentistyla) asperrimum* var. *dentiferum*, figs. 7 (left) and 8 (right) from his plate 23.

Measurements (in mm; n = 10): 6½ whorls, H = 6.30 ± 0.45, D = 5.90 ± 0.20.

Remarks: The present specimens compare well with the original description and the Lectotype of *D. dentifera* (NMNH 95059; Fig. 42A-D), showing a conical shell with characteristic, rich sculpture. They also agree with Quinn’s (1979) redescription, in that they present a spiral sculpture consisting of two major nodulous cords, the lower of which forming a conspicuous carina; 1-3 similar but weaker intercalary cords; a moderately large, axially striate umbilicus, with one to three rather strong nodulous spiral cords; and an overall coarse, spiky sculpture. The Canopus specimens are also very similar to the ones figured by the author (Quinn, 1979: figs. 47-48), and illustrated by Dall (1889; Fig. 41).

Nearly eight years after the description of *Dentistyla asperrima* (Dall, 1881; originally *Margarita asperrima*), Dall (1889) introduced the name *dentifera* as a variation (there referred to as *Calliostoma (Dentistyla) asperrimum* var. *dentiferum*). The fact that he did not provide illustrations for *D. asperrima* made comparisons problematic, and he himself apparently had difficulty separating these morphotypes (Quinn, 1979). Regardless, Woodring (1928) recognized *dentifera* as a distinct taxon and recombined it within his newly erected genus *Antillachelus* (as *Antillachelus dentiferum*). Clench & Turner (1960) also perceived the species as valid, but instead regarded *Antillachelus* as a synonym of *Dentistyla* (then as a subgenus of *Solariella*), recombining the species as *Solariella (Dentistyla) dentifera*. Quinn (1979) elevated *Dentistyla* to genus level, still considering *D. asperrima* and *D. dentifera* as separate species. According to him, they are extremely similar taxa separated by subtle conchological disparities, such as a wider umbilicus with strong internal spiral sculpture, finer

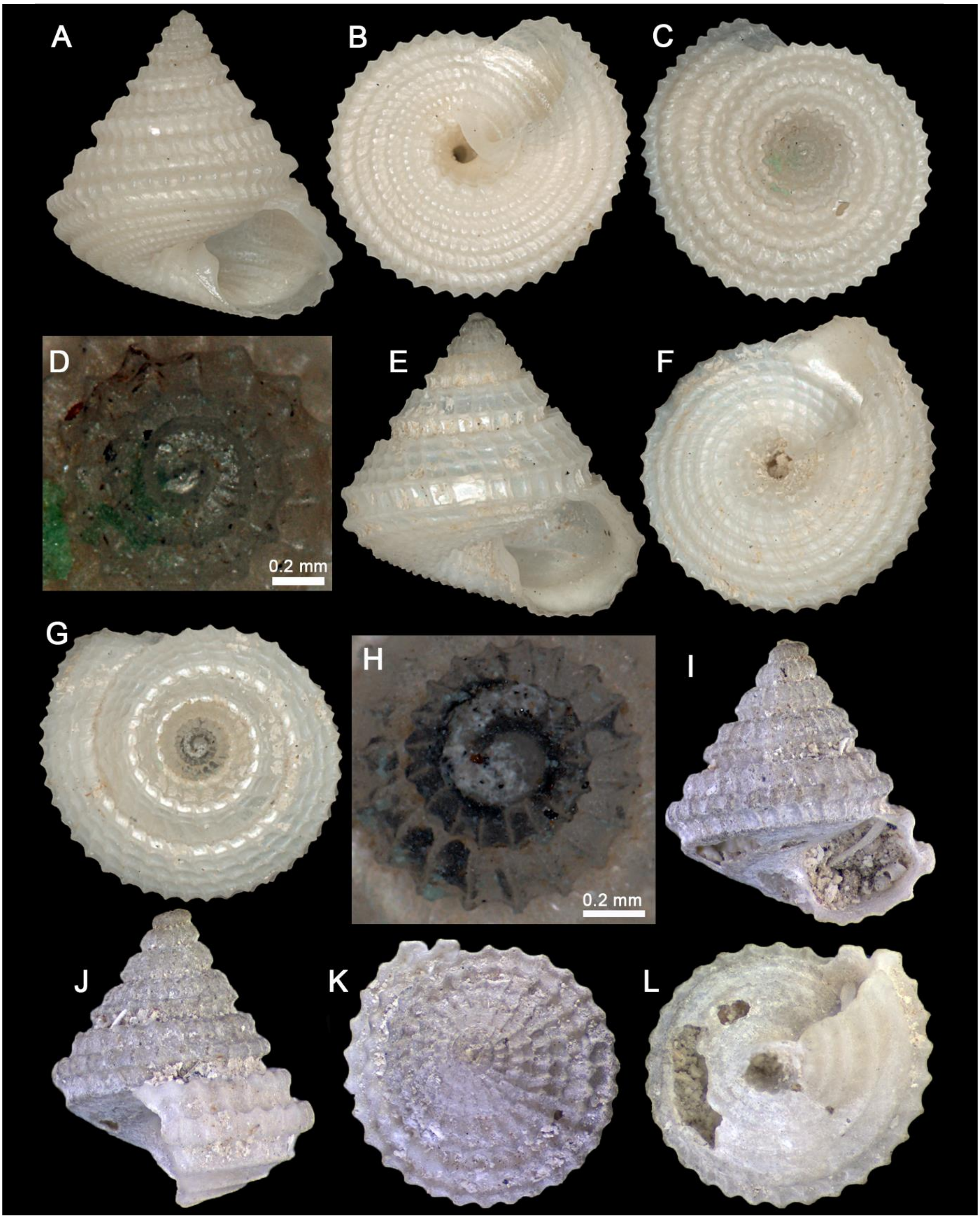

Figure 42: *Dentistyla* types. **A-D.** *Dentistyla dentifera* Lectotype USNM 95059; **A.** apertural view (H = 6.1 mm, D = 5.6 mm); **B.** umbilical view; **C.** apical view; **D.** protoconch; **E-H.** *Dentistyla sericifila* Lectotype USNM 95060; **E.** apertural view (H = 4.8 mm, D = 4.6 mm); **F.** umbilical view; **G.** apical view; **H.** protoconch; photos by Barbara V. Romera; **I-L.** *Dentistyla asperrima* paralectotype MCZ 7569; **I.** apertural view (H = 4.5 mm, D = 3.9 mm); **J.** lateral view; **K.** apical view; **L.** umbilical view; photos are a courtesy of the MCZ.

beading, more numerous basal cords and apertural lirations in *D. dentifera.*

The lectotype of *Dentistyla asperrima* (MCZ 7568, Fig. 43B-E) is much eroded and has a broken apex. Still, it fits Dall's (1881) description extremely well, especially regarding the "turreted, higher than wide" and "dull white" shell "with no visible nacre", the "four strong, simple revolving threads, not nodulated" between the peripheral carina and the bounding rib of the umbilicus, and the "transverse sculpture consisting of threads following the lines of growth, rising into lamellae between the ribs, and in passing over them (except the basal ones) forming squarish projections". In my understanding, the shell proportions and especially the shape of the nodules ("projections") are some of the most striking differences between *D. dentifera* and *D. asperrima*. The former has a proportionally shorter and wider shell, and angular, "spiky" nodules (as opposed to squarish in *D. asperrima*). I also add the overall coarser basal sculpture with wider and spaced axial elements in *D. dentifera*, versus a more delicate axial sculpture composed of very thin, closely packed threads in *D. asperrima*. The examined paralectotype (MCZ 7569, Fig. 42I-L) is juvenile and quite damaged, and consequently uninformative, though it also presents the characteristic squarish nodules.

Again regarding the lectotype of *Dentistyla asperrima*, it is very likely the specimen illustrated by Dall as *Dentistyla sericifila*, which he introduced together with *dentifera* in his 1889 report on the Blake dredgings. The measurements, proportions, and outline of the shell match the drawings perfectly (Fig. 43A), except for the apex, which could have been damaged much later. This seems to be an error by Dall, as the actual holotype of *D. sericifila* examined herein (Fig. 42E-G) compares exceedingly well with the written description and measurements while differing drastically from the illustrations. Lastly, *D. dentifera* can be told apart from *D. sericifila* by its much wider and closely packed axial sculpture, with more conspicuous nodules, and by lacking the reticulate aspect described by Dall (1889).

The Canopus specimens allowed for a few observations regarding intra-specific variation. In the specimens studied herein, the channel formed by the projection of the ribs above and below the suture, which gives the shell a turreted appearance, has variable width and depth. The aspect variates from shallower and narrower (Fig. 44A) to wider and deeper (Fig. 44D, G). The overall sculpture is also variable: some specimens have coarser sculpture produced by spiky, angular nodules (Fig. 44D), while others have a smoother complexion resulting from blunter nodules (akin to the lectotype of *D. dentifera*, Fig. 42A), but these forms seem to be within a continuum of conchological variation. Diverging from Quinn's (1979) observations, the umbilical width is very inconstant, and variates from relatively wide (Fig. 44F) to imperforate (Fig. 44C), and this seems to be related to the age of the specimens, with older ones having an obstructed umbilical region.

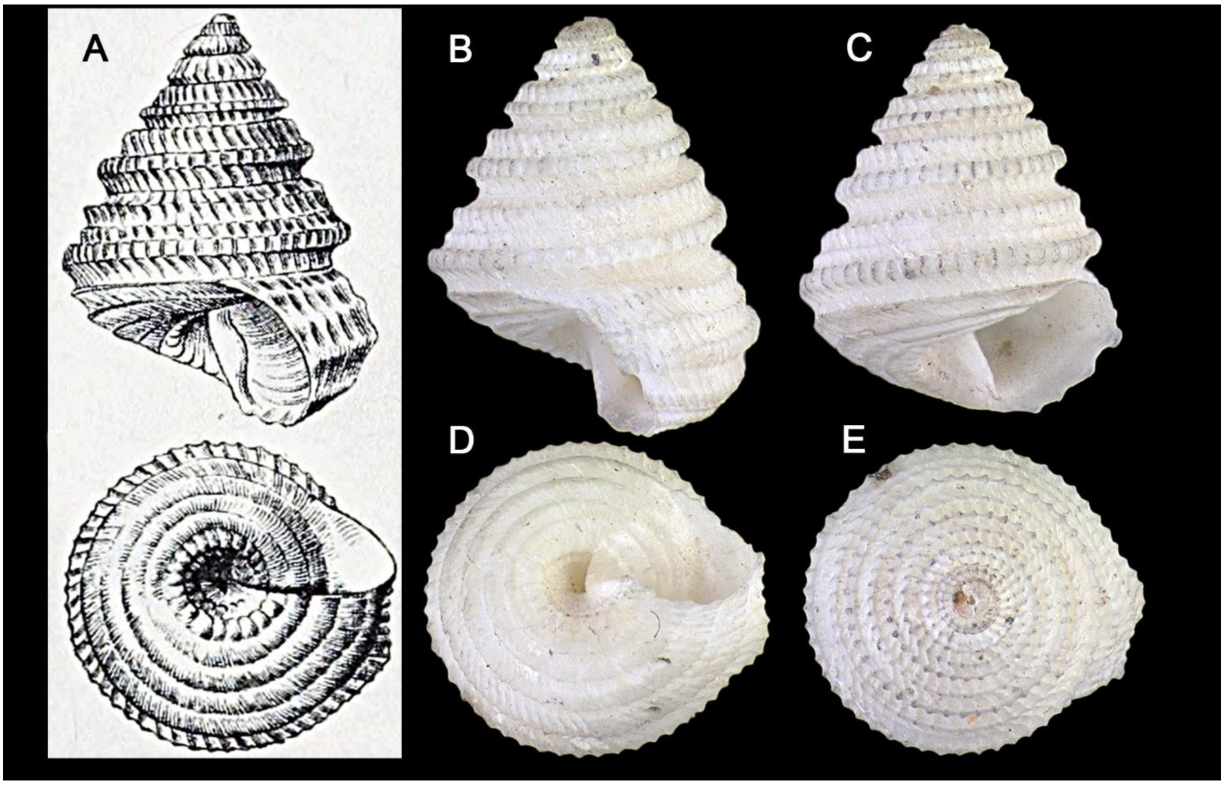

Figure 43: *Dentistyla* illustrations and type. **A-B.** Dall's (1889) illustration of *Calliostoma (Dentistyla) sericifilum*, figs. 1 and 1a, from his plate 24; **B-E.** Lectotype of *Dentistyla asperrima*, MCZ 7568; **B.** lateral view (H = 8.2 mm, D = 7.5 mm); C. apertural view; **D.** umbilical view; **E.** apical view; photos are a courtesy of the MCZ.

the internal sculpture is variable in terms of presence and strength of internal spiral cords, bearing 2-3 cords to none at all. Consequently, we reckon these characters are not useful in distinguishing this species from *D. asperrima*. The outer lip lirations evoked by Dall (1889) and Quinn (1979) are indeed present in most adult specimens and seem to be congruent with the outer sculpture. Furthermore, the spiral cords on the shell's base can be smoother, lacking any nodulations (as remarked in the original description; Fig. 44F), profusely nodulose (Fig. 42B), or show a combination of both conditions (Fig. 44C); they are however always crossed by the axial sculpture.

Judging by the number of specimens, *D. dentifera* seems to be relatively abundant in Canopus. This new record represents a significant range expansion of over 3,000 km SE from the Antillean Arc to NE Brazil. It is also the first occurrence of the genus in the SW Atlantic.

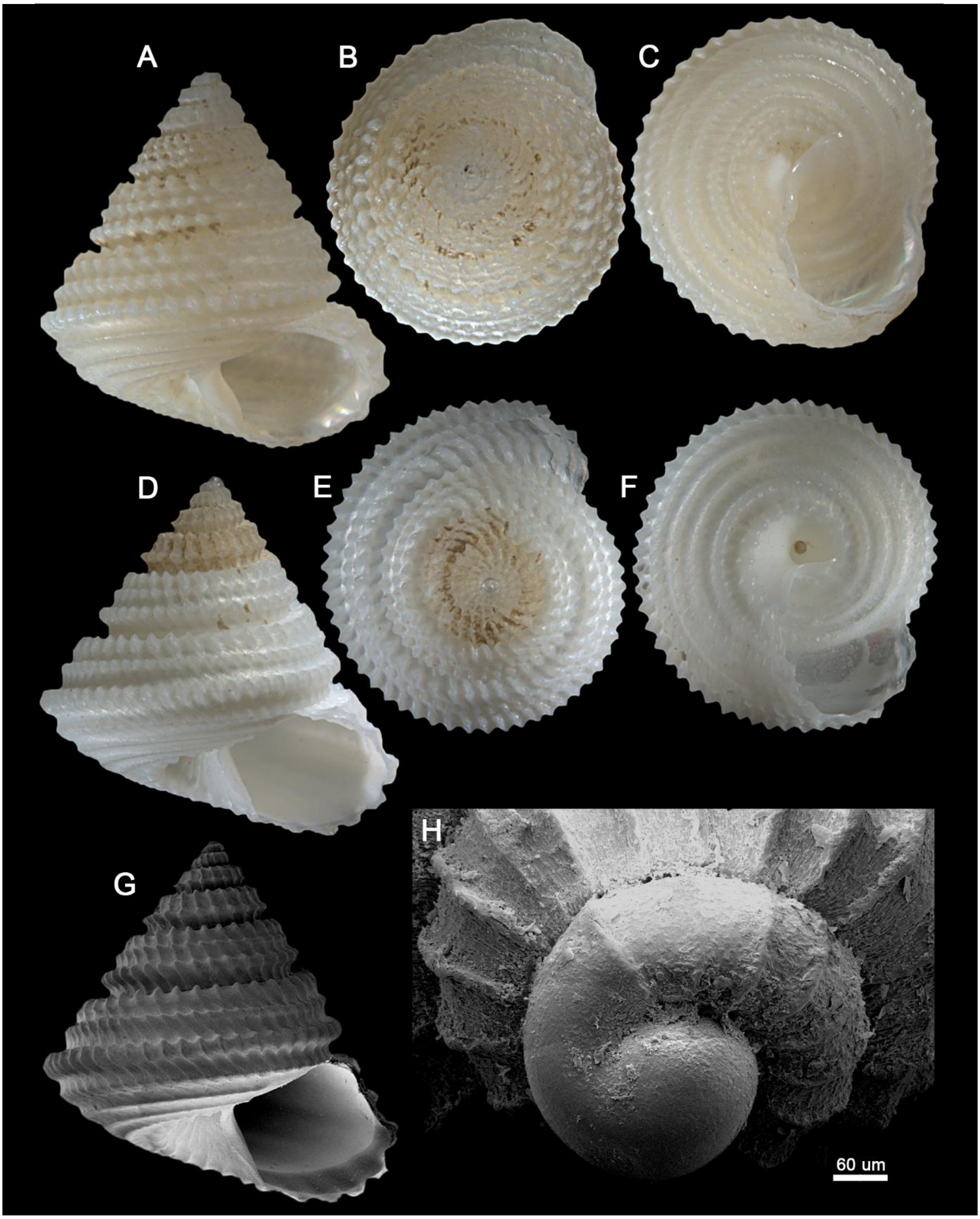

Figure 44: *Dentistyla dentifera* from Canopus. **A-C.** MZSP 70310; **A.** apertural view (H = 6.5 mm, D = 6.0 mm); **B.** apical view; **C.** umbilical view; **D-H.** same, specimen #2, **D.** apertural view (H = 5.7 mm, 5.8 mm); **E.** apical view; **F.** umbilical view; **G.** apertural view under SEM; **H.** protoconch detail under SEM.

Table 2: Range and bathymetric expansion of the vetigastropods studied herein.

Taxon	Range exp.?	From-to	Bathym. exp.?	From-to
Fissurellidae				
Cranopsis canopa	No		Yes	250-260m
Cranopsis cearensis	No		Yes	250-260 m
Diodora mirifica	No		Yes	63-260 m
Diodora sayi	No		No	
Emarginula suspira	Yes	SE to NE Brazil	No	
Hemimarginula hemitoma	Yes	SE to NE Brazil	No	
Lucapina aegis	No		Yes	55-260 m
Lucapina elisae	No		No	
Lucapinella limatula	No		Yes	146-260 m
Areneidae				
Arene brasiliana	No		Yes	81-120 m
Arene flexispina	Yes	S Bahia to Ceará	No	
Arene aff. *briareus*				
Colloniidae				
Homalopoma boffii	Yes	SE to NE Brazil	No	
Homalopoma linnei	No		No	
Phasianellidae				
Eulithidium affine	No		No	
Calliostomatidae				
Calliostoma hassler	No		No	
Calliostoma sp. 1				
Liotiidae				
Macrarene digitata	No		Yes	146-260 m
Margaritidae				
Callogaza watsoni	No		No	
Gaza cf. *fischeri*	Yes	Caribbean to NE Brazil	No	
Skeneidae				
Haplocochlias risoneideneryae	Yes	NE to N Brazil	Yes	20-200 m
Parviturbo rehderi	No		No	
Parviturbo annejoffeae	Yes	Venezuela to Brazil	Yes	0-260 m
Parviturbo aff. *tuberculosus*				
Turbinidae				
Turbo heisei	Yes	S Bahia to Ceará	Yes	92-620 m
Solariellidae				
Solariella carvalhoi	No		No	
Solariella quinni	Yes	Pernambuco to Ceará	Yes	71-350 m
Seguenziidae				
Ancistrobasis costulata	No		No	
Chilodontidae				
Dentistyla dentifera	Yes	Barbados to NE Brazil	No	

Table 3: Minimum and maximum depths of species studied herein.

Taxon	Min depth	Live?	Max depth	Live?
Fissurellidae				
Cranopsis canopa	60	no	260	no
Cranopsis cearensis	60	no	260	no
Diodora mirifica	240	no	260	no
Diodora sayi	60	no	70	no
Emarginula suspira	240	no	260	no
Hemimarginula hemitoma	240	no	260	no
Lucapina aegis	240	no	260	no
Lucapina elisae	260	yes	260	yes
Lucapinella limatula	240	no	260	no
Areneidae				
Arene brasiliana	60	operc	260	no
Arene flexispina	240	no	260	no
Arene aff. *briareus*	200	no	260	no
Colloniidae				
Homalopoma boffii	60	no	260	no
Homalopoma linnei	60	no	260	yes
Phasianellidae				
Eulithidium affine	260	no	260	no
Calliostomatidae				
Calliostoma hassler	60	no	60	no
Calliostoma sp. 1	60	yes	260	no
Liotiidae				
Macrarene digitata	240	no	260	no
Margaritidae				
Callogaza watsoni	260	no	260	no
Gaza cf. *fischeri*	260	no	260	no
Skeneidae				
Haplocochlias risoneideneryae	200	no	200	no
Parviturbo rehderi	240	no	260	no
Parviturbo annejoffeae	240	no	260	no
Parviturbo aff. *tuberculosus*	240	no	260	no
Solariellidae				
Solariella carvalhoi	240	no	260	no
Solariella quinni	240	no	260	no
Turbinidae				
Turbo heisei	60	no	260	no
Seguenziidae				
Ancistrobasis costulata	200	no	260	no
Chilodontidae				
Dentistyla dentifera	60	no	260	operc

4.2 Concluding remarks

The specimens studied herein reveal that the vetigastropod fauna from Canopus is quite diverse, adding up to 29 species distributed in 12 different families, three of which are possibly new. In number of species, this represents nearly 0.8% of the global extant vetigastropods, and 20% of the species recorded in Brazil (Geiger et al., 2008; Rios, 2009). These findings are apparently in line with the theoretically high diversity expected of seamounts, although any assertions on endemicity depend on more samplings, especially in the surrounding seamounts of the Ceará cluster. Nonetheless, compared to the Vitória-Trindade Chain, which harbors the most well-studied vetigastropod fauna from seamounts in Brazil, Canopus seems to be somewhat similarly diverse. Leal (1991; appendix C), while analyzing material from the Vitória-Trindade seamounts Jaseur, Columbia, Montague, Davis, and Dogaressa, reported 25 vetigastropod species belonging to 11 families. The author reported 8 fissurellid species (vs. 9 herein); 1 anatomid (vs none); 3 calliostomatids (vs. 2); 1 solariellid (vs. 2); 2 chilodontids (vs. 1); 1 trochid (vs. none); 1 skeneid (vs. 4); 1 turbinid (same); 4 areneid (vs. 3); 2 colloniids (vs. 2); 1 phasianellid (same). Subsequent studies on further specimens from the MD55 expedition revealed more species from the same locations: Salvador et al. (2014) revealed two additional seguenziids from Dogaressa and Montague, even though Simone & Cunha (2014) did not reveal any other fissurellids coming specifically from the seamounts.

It is noteworthy that the MD55 expedition collected large amounts of material using several different methods at variable depths (Tavares, 1999), while the present study is based on a limited sampling collected in a relatively restricted location at the shallowest portions of Canopus (50-260 m). Hence, additional diversity may yet be revealed by further samplings, especially at deeper portions (~600 m) of the seamount where deep-water species (e.g., several seguenzioideans) are usually more frequent (e.g., Salvador et al., 2014). Vetigastropoda aside, gastropod families belonging to other clades were present in large numbers in the samples analyzed herein, e.g., Turridae (l.s.), Muricidae, Columbellidae, several heterobranch families, and many others. The high diversity in seamounts has been attributed to the action of Taylor columns, which imprisons larvae, eggs, and nutrients in the water flowing over the seamount peaks (Norse et al., 2005). Nevertheless, although the present findings constitute an important step towards better understanding the Brazilian seamount fauna, the complete spectrum of reasons behind the astounding diversity present in Canopus, as is the case in most seamounts around the globe, are yet to be studied in detail.

Benthic depth zonation is a common phenomenon in continental shelves and slopes, where vertical gradients and stratification generates pelagic zones with diverse conditions for life. In such environments, the distribution of organisms is thus limited or rather defined by said conditions, and zones with distinct faunal composition and abundance can be observed along the depth range (Norse et al., 2005; Thresher et al., 2014). This phenomenon also happens in seamounts, but, compared to shelves and slopes, is dictated by distinct factors such as lower sediment load, the effect of the mountains on the ocean currents and water flow, oxygen concentration, etc (Wishner et al., 1990; Norse et al., 2005). The distribution of some species from Canopus seems to be restricted to certain depths. Some species were only found at the seamount's peak (60 m depth), e.g., *Calliostoma hassler*, *Diodora sayi*, while others seem to occur only at the deepest range (200-260 m), e.g., most fissurellids except for *Cranopsis* spp. and *Diodora sayi*, *Arene flexispina* and *Arene* aff. *briareus*, *Macrarene digitata*, the margaritids, skeneids, and solariellids. At first glance, there is an obvious difference between the faunas depending on the analyzed depth, with the greatest diversity occurring at the deepest range studied herein. This seems to be congruent with the general understanding that species richness tends to peak at intermediate depths, but declines with increasing depths (Rex et al., 2006). Then again, the diversity of the deepest parts (~600 m) of Canopus has not yet been surveyed, and further observations depend on more samplings.

Some of the Canopus species have very interesting distribution patterns. In fact, Canopus seems to be the north/northwestern range limit for species exclusively occurring in the SW Atlantic, e.g., *Emarginula suspira*, *Hemimarginula hemitoma*, *Arene flexispina*, *Homalopoma boffii*, *Solariella quinni*, and *Turbo heisei*. On the other hand, a few openly Caribbean species have their southernmost range limit set herein to Canopus, e.g., *Dentistyla dentifera*, and *Gaza* cf. *fischeri*, and some species studied herein occur in the Caribbean and along the Brazilian coast as well, e.g., *Ancistrobasis costulata*, *Diodora sayi*, *Parviturbo rehderi*, *Homalopoma linnei*, *Lucapina aegis*. A similar situation has been verified for other invertebrates collected in Canopus, such as brachiopods (see Marques, 2016). Several authors consider the fauna of the northern Brazilian coast as an "impoverished" extension of the Caribbean counterpart, with a continuous decrease in diversity towards the south (e.g., Mathews & Rios, 1974; Palacio, 1982).

If mollusks are concerned, recent studies have systematically contradicted this point of view, showing a rich, highly characteristic SW Atlantic/Brazilian fauna that is, in fact, poorly understood. This is the case in most studies on the MD55 material. The Canopus assemblage, in truth, illustrates this contradiction very well, showing a very rich fauna with several possibly endemic species, and a complex mixture of Caribbean-SW Atlantic faunas.

The present discoveries, though restricted to limited samplings and focused on a single mollusk group, are a testimony to the importance of thoroughly studying seamount habitats. Even as many species were described in the ten years that followed the 2005 samplings, an exhaustive analysis of a single (though very diverse) group revealed several novelties. It is clearly essential that other mollusk groups that are very abundant in Canopus be meticulously studied in the future, e.g., neogastropods or heterobranchs. Other similar discoveries are likely to happen, adding more pieces in the complex puzzle of seamount biology.

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APPENDIX