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New Gastropods from the São Pedro e São Paulo Archipelago, Brazil (Vetigastropoda and Caenogastropoda)

Luiz R. L. Simone

Museu de Zoologia da Universidade de São Paulo;
Cx. Postal 42494; 04299-970 São Paulo, SP, Brazil.
e-mail: lrsimone@usp.br; lrlsimone@gmail.com

Abstract

São Pedro e São Paulo Archipelago (ASPSP) is located almost in the middle of the Atlantic Ocean, and its fauna has only been recently studied. This paper describes three species of gastropods based on shells. The species are two vetigastropods: *Sinezona insularis* n.sp, Scissurellidae; and *Synaptocochlea belmonti* n.sp., Stomatellidae. Also it is included a caenogastropod: *Zafrona macronata* n.sp., a Columbellidae. Comparisons with the most similar species are given, and possible miniaturization, due to the insular mode of life of these species, is discussed.

Key words: New species, Oceanic Islands, Brazil, insular life, miniaturization.

Resumo

O Arquipélago de São Pedro e São Paulo (ASPSP) é quase localizado no meio do Oceano Atlântico e só recentemente tem sido alvo de estudos faunísticos. Este artigo descreve três novas espécies de gastrópodes até então representados somente por conchas. As espécies são dois vetigastrópodes: *Sinezona insularis* nov. sp, um Scissurellidae; e *Synaptocochlea belmonti* nov. sp, um Stomatellidae. Assim como um cenogastrópode: *Zafrona macronata* nov. sp, um Columbellidae. Além disso, são realizadas comparações com espécies mais próximas, assim como uma discussão geral sobre um possível processo de miniaturização, resultante do modo de vida insular dessas espécies.

Palavras-chave: novas espécies, Ilhas oceânicas, Brasil, vida insular, miniaturização.

Introduction

Arquipélago de São Pedro e São Paulo (ASPSP), or Saint Peter and Saint Paul Archipelago, is the remotest Brazilian oceanic set of islands (Fig. 1). It is the tip of a huge seamount, with a base of approximately 4 by 2 km in size, at 4 km depth, and an emerged tip of 13,000 m². ASPSP is located about 1,010 km NE off Calcanhar Cape, Rio Grande do Norte State, and about 870 km NE off Fernando de Noronha, the largest Brazilian oceanic archipelago. ASPSP is located approximately in the middle between Brazil and Africa, and close to Equator line, at 00°55'00"N 29°20'45"W (Souza, 2007).

ASPSP is a strategic point for the Brazilian economy, as ensures 238,000 km² of exclusive economic zone (Gonçalves, 2002). Since 1996, the Archipelago has continuously been occupied by 4-people researcher teams. Every person is allowed to work in that place only after hard training, provided by the Brazilian Navy in its Rio Grande do Norte Base. Each team is allowed to work in 15-day expeditions.

Despite its importance in biological aspects, in being such an isolated place and important source for evolutionary and biological colonization understandings, the local malacofauna has not been the main goal of projects. The information on the malacofauna of ASPSP is limited (Edwards & Lubbock, 1983, listed four molluscan species). Leal (1991) dealt with several Brazilian oceanic ilstands, but did not treated ASPSP, while Rios (2009) is restricted to the mainland and to main oceanic islands only.

This contribution refers to the taxonomy of three species of Mollusca collected in ASPSP, specifically on the gastropod species represented by shells only. The data on species with samples collected alive was and will be published elsewhere, with descriptions or re-descriptions including detailed anatomical features (Simone, 2008, 2009).

Abbreviatons of institutions: **MNRJ**, Museu Nacional da Universidade Federal do Rio de Janeiro, Brazil; **MZSP**: Museu de Zoologia da Universidade de São Paulo,

Brazil; **USNM**, National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA.

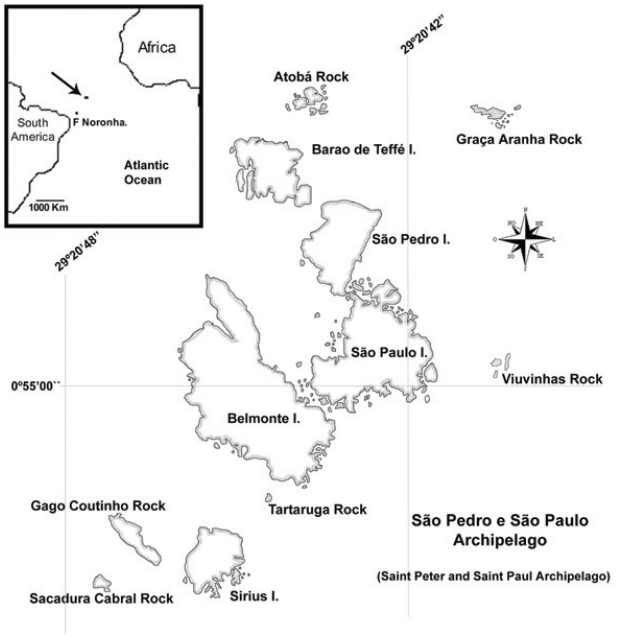


Figure 1, São Pedro e São Paulo Archipelago map, with names of main islands, including approximate localization of it in Atlantic Ocean in upper-left square.

Systematics

Order Vetigastropoda

Family Scissurellidae
Genus *Sinezona* Finlay, 1926

Sinezona insularis new species
(Figs. 2-9)

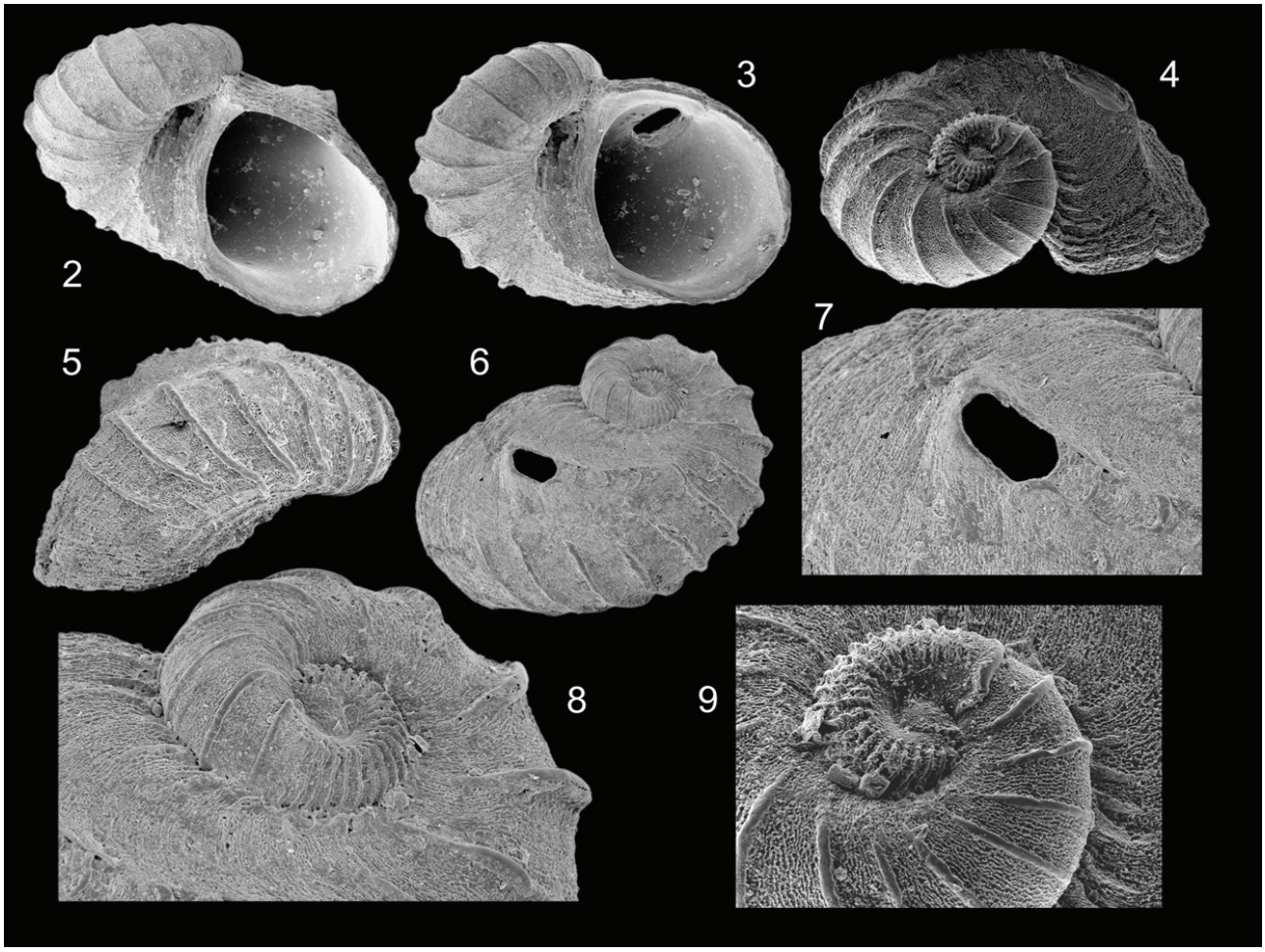
Types: Holotype: MZSP 87357. **Paratypes:** BRAZIL. São Pedro e São Paulo Archipelago; 00°55'01"N 29°20'44"W (Simone, Cunha & Gonçalves col., xi/2007); MZSP 87355, 1 shell, 87356, 2 shells, 88191, 7 shells, MNRJ 12868, 2 shells, USNM, 2 shells, MZSP 86665, 1 shell (03/xi/2007).

Type locality: BRAZIL. São Pedro e São Paulo Archipelago; 00°55'01"N 29°20'44"W [Simone, Cunha & Gonçalves col., xi/2007].

Diagnosis: Shell up to 2.5 whorls, protoconch 1 with whorl. Primary sculpture exclusively sculptured by axial cords, with spiral cords on base. Umbilicus deep, umbilical area about three times wider than long. Selenizone only posterior to foramen, with ¼ whorl; foramen with elevated edges, about twice longer than wide, located about 1/8 whorl posterior to outer lip.

Description

Shell: Larger diameter up to 1 mm. Color pure white, barely translucent, opaque. Protoconch 1 smooth, semispherical, about half whorl (Figs. 4, 6, 8, 9). Protoconch 2 of ¾ whorl, with about 15 strong axial cords, more or less uniformly distributed, about as tall as wide; distance between cords equivalent to twice width of cords; cords forming weak shoulder at periphery of apical-most portion, ending at distance from suture of previous whorl, equivalent to 1/3 of its total width (Figs. 8, 9). Protoconch and teleoconch division marked by straight, more or less sinusoid thickening, preceded by smooth area (lacking axial cords), equivalent to tree cords wide; thickening size approximately double as axial cords (Figs. 8, 9). Teleoconch with about 18-20 strong axial cords, successively stronger; smooth, unsculptured area between cords equivalent to three times cord width; each cord with about 0.25% of total shell length, and about twice as tall as wide, distal edge rounded, base slightly wider (Figs. 2-6). Selenizone (Figs. 6, 7) about 1/3 of shell length; located approximately in middle-dorsal region of body whorl, and between its middle and upper thirds. Foramen elliptical (longer axis antero-posterior), occupying about 1.5 % of dorsal shell surface (Figs. 6, 7); edges weakly elevated (Fig. 5) to an elevation equivalent to ~1/5 of body whorl width, elevated edges, directed towards dorsal and anterior (Fig. 4). Region anterior to foramen having only growth lines (Figs. 4, 6) with weak signal of residual selenizone (raphe), clearer in internal surface of aperture (Fig. 3). Spire with about 1/3 of body whorls diameter (Figs. 4, 6); central region planispiral; whorl preceding body whorl protruding about ¼ of body whorl width beyond aperture right edge. Umbilicus deep, bordered by distinct carina, moderately wide (about 15-20% of shell width), marked by transverse, somewhat irregular growth undulations (Figs. 2, 3), abruptly widening up to inner lip; low, weak carina flanking edge of umbilicus; 3-4 spiral, low secondary cords between this carina and periphery (Figs. 3, 5); each secondary cord with approximately same width than axial cords, about 1/5 their height, interval between them somewhat 1/3 their width, gradually increasing towards aperture. Aperture rounded, strongly prosogyre; occupying about half of shell ventral area (Figs. 2, 3). Outer lip simple, relatively thick. Inner lip almost straight in middle region; callus wanting. Upper region of aperture covering superior region of umbilicus at about 1/8 of shell length.



Figures 2-9, in SEM: 2-9) *Sinezona insularis* n. sp. in SEM from São Pedro e São Paulo Archipelago, 2-4) holotype, length = 0.7 mm; 2) apertural view; 3) same, slightly umbilical view; 4) dorsal-slightly apical view; 5-8) paratype MZSP 87355, length = 0.6 mm; 5) umbilical-slightly dorsal view; 6) dorsal view; 7) detail of foramen and adjacent region, dorsal view; 8) detail of spire and adjacent region of body whorl; 9) holotype, detail of protoconch and adjacent region of teleoconch, dorsal view.

Measurements (in mm): Holotype: 0.7 by 0.5; Paratype 1 = 0.6 by 0.5.

Distribution: Brazil. São Pedro e São Paulo Archipelago, Enseada area.

Habitat: Under rocks, about 5 m depth.

Material examined: Types.

Etymology: The specific epithet refers to the insular locality, restricted to that Archipelago.

Remarks

Sinezona insularis resembles Sinezona sp. (Leal, 1991) from Atol das Rocas, another Brazilian oceanic island. *S. insularis* differs by its smaller size, more spaced sculpture, and by a shorter selenizone. *S. insularis* differs from *A. haliotimorpha* Bandel, 1998, the type species of the genus *Ariella* Bandel, 1998 (by original designation) in having a selenizone, by its smaller size and by the presence of a deep umbilicus. Because of the isolated and elevated foramen, there is no scissurellid occurring in Brazilian coast that can be confused with *S. insularis*. Only *Sinezona brasiliensis* Mattar, 1987 has a somewhat elevated foramen, *S. insularis* differs in having much shorter selenizone, more elevated and fewer axial cords. It differs from the Caribbean species *Scissurella redferni* Rolán, 1996 and *Sinezona confusa* Rolán & Luque, 1994 by the anteriorly closed foramen, instead of a slit. S. insularis differs from *Scissurella electilis* Mountouchet, 1972 by the much more elevated axial sculpture and by deeper umbilicus. The generic attribution is based on the set of characters, such as the minute

size; the somewhat trochoid shape; the protoconch and teleoconch strong sculptures; the presence of protoconch varix (Figs. 8, 9); the low, shoulder located keel of the foramen, lacking selenizone anterior to foramen; by the continuous curve of umbilicus with the base of the shell; and the umbilical keel lacking (Marshall, 1993; Geiger, 2003: 32).

Family Stomatellidae
Genus *Synaptocochlea* Pilsbry, 1890

Synaptocochlea belmonti new species
(Figs. 13-17)

Types: Holotype: MZSP 87363. **Paratypes:** BRAZIL. São Pedro e São Paulo Archipelago; 00°55'01"N 29°20'44"W (Simone, Cunha & Gonçalves col., xi/2007); Enseada, 3-10 m depth, MZSP 86537, 4 shells, 86552, 7 shells, 86620, 1 shell, 86637, 20 shells, 86661, 4 shells, 86665, 1 shell, 86673, 3 shells, 87361, 4 shells, 87362, 1 shell, 87364, 2 shells, 87487, 20 shells, 88190, 8 shells, MNRJ 12869, 2 shells, USNM, 2 shells.

Type locality: BRAZIL. São Pedro e São Paulo Archipelago; 00°55'01"N 29°20'44"W [Simone, Cunha & Gonçalves col., xi/2007].

Diagnosis: Shell generally pink colored; spire low, umbilicus evident, callus very small. Protoconch mainly spiral sculptured.

Description

Shell: About 2 mm, auriform, outline elliptical. Protoconch white (Fig. 15), of 1 whorl; micro-sculptured by a series of spiral striae, about 20 in outer half, sometimes dichotomizing (Fig. 16). Limit protoconch-teleoconch clear, straight. Teleoconch of about 1.5 whorls, widely expanding. Sculpture about 15 spiral cords, sometimes dichotomizing, uniform, low, separated from each other by space equivalent to their width (Figs. 10, 12, 13, 17); cords gradually appearing at about ¼ to ½ whorl from protoconch (Fig. 15). Axial undulations of growth lines (Fig. 10). Color variable, mostly white with strong continuous (Figs. 10, 12) to interrupted (Fig. 13) pink; sometimes (about 5% of specimens) with brown spots (Fig. 17) covering total or partially dorsal surface. Spire area ~1/5 of body whorl; height about 1/6 of that of shell. Aperture very wide, occupying ~70% of ventral surface, strongly prosocline; elliptical, with low, blunt superior angle. Outer lip rounded, simple, somewhat thick. Inner lip rounded, narrowly covering columella, weakly thicker superiorly, forming callus equivalent to about 2% of ventral shell surface, and ~1/3 of superior region of inner lip (Figs. 11, 14).umbilicus shallow, partially covered by callus in superior region, sculptured by strong growth lines.

Measurements (in mm) Holotype: 2.1 by 1.3; Paratype 1 = 2.2 by 1.5.

Distribution: Brazil. São Pedro e São Paulo Archipelago, Enseada area.
Habitat: Under rocks, about 5 m depth.

Material examined: Types.

Etymology: The specific epithet is derived from the main island of the Archipelago, Belmonte.

Remarks

Synaptocochlea belmonti is similar to *S. picta* (d'Orbigny, 1842), which occurs in Florida and Caribbean Sea, and has been reported to some Brazilian oceanic Islands, such as Trindade and Fernando de Noronha region (Leal, 1991). *S. belmonti* differs from *S. picta* collected in the Caribbean Sea (Abbott, 1974; Jong & Coomans, 1988; Redfern, 2001), in having a lower spire (about 1/6 of total shell height, instead of about ¼), axial sculpture poorly developed, spiral sculpture more uniform, callus of inner lip smaller and umbilicus evident (instead in being totally covered). Additionally, *S. belmonti* still differs from *S.* cf *picta* collected in other Brazilian oceanic islands (Leal, 1991; Rios, 1994, personal observation) by more delicate sculpture, by pinkish color (normally brown), and by a narrower callus.

Order Caenogastropoda

Family Columbellidae
Genus *Zafrona* Iredale, 1916

Zafrona macronata new species
(Figs. 18-22)

Types: Holotype: MZSP 87354. Paratypes: BRAZIL. São Pedro e São Paulo Archipelago; 00°55'01"N 29°20'44"W (Simone, Cunha & Gonçalves col., xi/2007), MZSP 86639, 2 shells, 87353, 3 shells.

Type locality: BRAZIL. São Pedro e São Paulo Archipelago; 00°55'01"N 29°20'44"W (Simone, Cunha & Gonçalves col., xi/2007).

Diagnosis: Minute species (up to 3 mm) with strong axial sculpture and proportionally large protoconch.

Description

Shell: Total length up to 3 mm; outline elongated (width about 37% of length); walls weakly translucent, somewhat thick. Color white or yellowish white (Figs. 18-22), with a mosaic of brown, somewhat uniform, elongated, axial spots; about 10 spots in body whorl organized in two bands separated by spiral, middle, white band with approximately 1/3 of body whorl length; superior band subsutural, with about 1/3 of body whorl length, with spots axially organized and separated from neighbor spots by area equivalent to their width; inferior band composed by narrower, irregular, obliquely organized spots, being more evident in body whorl with about 1/3 of body whorl length, in preceding whorls inferior band occupying about 20% of each whorl. Protoconch with 1.5 convex whorls, smooth, with about 20% of total shell length and about 44% of shell width (Figs. 18, 22); transition protoconch-teleoconch unclear. About four teleoconch whorls; each whorl rounded and convex; suture somewhat deep (suture with about 85% of wider region of immediately superior whorl). Sculpture about 18 strong axial cords in penultimate whorl, from suture to suture but taller in middle region of whorl, interval between cords of approximately same width of cords (Figs. 18-20); each cord low, profile rounded, like a undulation; in body whorl axial sculpture gradually disappearing in inferior third, 4-5 spiral cords with similar characters than axial cords present in ventral surface of siphon base, these spiral cords gradually disappearing in dorsal surface (Figs. 18, 21). Umbilicus absent. Aperture elliptic (Fig. 21), with about 35% of total shell length, and about 33% of shell width, orthocline (Figs. 18, 19). Peristome white, somewhat thick, inner and outer lip equally thick; no callus, no labial tooth (Figs. 21). Canal with about 5% of shell length and about half of aperture width; projected anteriorly (Figs. 18, 21).

Measurements (in mm) Holotype: 2.6 by 1.1.

Distribution: Brazil. São Pedro e São Paulo Archipelago, Enseada area.

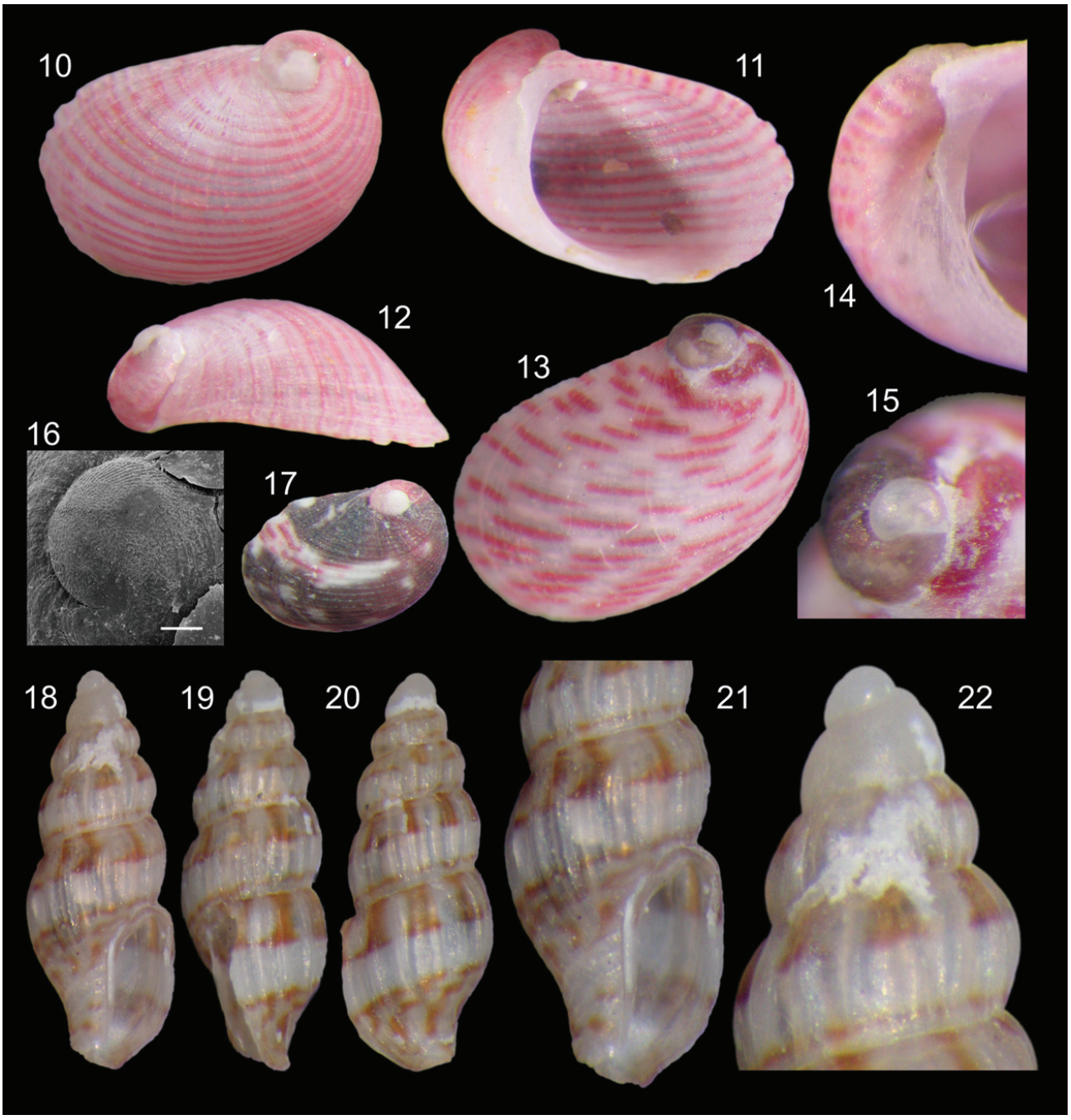
Habitat: Under rocks, about 5 m depth.

Material examined: Types.

Etymology: The specific epithet refers to the characteristic proportionally large protoconch, from the Latin suffix macro, meaning large; and Latin nata, meaning daughter (young girl).

Remarks

Zafrona macronata is somewhat similar to the South African *Aesopus geraldsmithi* Lussi, 2002, in having stronger axial sculpture; differs by proportionally larger protoconch, in lacking spiral sculpture and teeth at outer lip, and in being smaller. There is no other congeneric species in the Caribbean and Brazilian regions, such as *Aesopus obesus* (Hinds, 1844) and *A. stearnsi* (Tryon, 1883), that *Z. macronata* can be confused, based on the small size, proportionally larger protoconch and the well-developed axial sculpture. *Zafrona macronata* has elongated spire, which is not widespread in the congeners, only some species possess this character. From those, *Z. macronata* differs from the South African *Zafrona trifilosa* (E.A. Smith, 1882), from W. Pacific *Z. striatula* (Dunker, 1871), *Z. nebulosa* (Gould, 1860) and *Z. isomella* (Duclos, 1840) by the more elongated outline and aperture, by the stronger axial sculpture, and by the smooth cords (those species have well developed spiral threads, forming nodes on axial cords). *Z. isomella* is the type species of the genus *Zafrona*.
The generic attribute is based on the elongation of the shell, the paucispiral protoconch, small sized aperture lacking teeth, and by short canal (Gould, 1860; Radwin, 1978; Costa, 2005). Another possible attribution is *Anachis* Adams & Adams, 1853, because of the size, axial sculpture and small aperture; however, *Z. macronata* has the shell too long, spire wider, lack of spiral sculpture and absence of teeth at peristome to be considered *Anachis* (Radwin, 1968: 62). The genus *Aesopus* is another possibility, in having elongated shelled species, however, *Z. macronata* is well sculptured, while the typical *Aesopus* Gould, 1860 are normally smooth (Radwin, 1978; Costa, 2005), as the type species *A. japonicus* Gould, 1860. Most species of the genus *Steironepion* Pilsbry & Lowe, 1932 is also elongated and minute, however, *Z. macronata* has more elongated whorls (they have not rounded profile), lack spiral nodes and the aperture is wider. Nevertheless, the generic attribution is not totally secure, as the columbellid genera still lack precise definitions. Respect to above mentioned characters that supposedly define the genus *Zafrona*, the type species, *Z. isomella*, appears to possess teeth at aperture and a more whorled protoconch. Some New World *Zafrona* present columellar plaits, which is not well-developed in *Z. macronata*. However, despite these incongruities, there is no other genus with the presently describes species can be attributed without



Figs 10-22, shells of new species from São Pedro e São Paulo Archipelago. 10-17) *Synaptocochlea belmonti* n. sp.; 10-12, holotype, length = 2.1 mm; 10) dorsal view; 11) apertural view; 12) profile; 13) paratype MZSP 87361, dorsal view, length = 2.2 mm; 14) paratype 2, apertural view, detail of umbilicus, length = 2.0 mm; 15) same specimen of Fig. 13, detail of protoconch and first teleoconch whorl; 16) paratype 3 in SEM, detail of protoconch and adjacent teleoconch whorl, scale = 50 µm; 17) paratype 4, dorsal view, a rare dark color pattern, length = 1.8 mm. 18-22) *Zafrona macronata* n. sp. holotype, length = 2.6 mm; 18) apertural view; 19) profile; 20) dorsal view; 21) detail of body whorl, apertural view; 22) detail of protoconch and first teleoconch whorls, apertural view.

Discussion

Despite the taxonomical wide range of taxa of the present paper, one character is clearly related to all species: they are smaller than their relatives in the mainland. The maximum size of these species described here is about half and even a third of the normal size of their correlates. Similar processes of miniaturization is commonly found in isolated, insular communities in other organisms (e.g., Hanken & Wake, 1993; Yeh, 2002; Alcover & Bover, 2005), but it is, apparently, by fist time found in mollusks. This miniaturization is not outstanding in the presently described Sinezona, as all they are normally minute. However, S. insularis appear to be smaller than its mainland relatives. The columbellid has not secure close relatives; however, the size of Zafrona macronata is conspicuously smaller than the normal family standard.

Previous analyses related to the ASPSP malacofauna have found a mixture of faunas originated from the South American and African mainlands (e.g., Edwards & Lubbock, 1983). However, as far as is possible to realize, all the species described herein are related to the South American species as commented in the respective taxonomical discussions.

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