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Three new species of *Anacithara* from the Southwestern Atlantic Ocean, Brazil

(Mollusca, Neogastropoda, Conoidea, Horaiclavidae)

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This paper reports the turrid-like genus *Anacithara* Hedley, 1922 for the Western Atlantic based on the description of three new species collected from the deep sea of the southwestern Atlantic. *Anacithara biconica* spec. nov. is characterized by a biconical shell, proto-teleoconch transition with thickened axial riblets, a teleoconch well constricted at suture, a deep suture and strongly crenulated on the body whorl; *A. pupiforme* spec. nov. has a pupoid shell, proto-teleoconch transition marked by appearance of fine axial riblets, a teleoconch sculptured by rounded, low, attenuated axial ribs, a moderately deep suture that is slightly crenulated on the body whorl; and *A. pyriforme* spec. nov. is diagnosed by a turritiform shell, a not regularly convex teleoconch whorls and ribs that are slightly flattened in the subsutural region, and a moderately deep suture that is slightly crenulated on the body whorl. The new species are compared with *A. angulosa* (E. A. Smith, 1871), *A. maltzani* (Knudsen, 1952) and *A. biscoitoi* Nolf & Swinnen, 2011 from the Eastern Atlantic.

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Introduction

Turridae H. Adams & A. Adams, 1853 was considered one of the most speciose families of marine conoideans (Kohn 1998, Tucker 2004), represented by about 17 subfamilies (Kohn 1998), more than 600 genera and 10000 both recent and fossil species (Bouchet 1990, Kohn 1998), until Bouchet et al. (2011) and Puillandre et al. (2011) elevated a number of taxa among recent turrids from the subfamily to the family level based on molecular phylogenies of Conoidea. Thus, Turridae is currently limited to a much smaller number of genera and species in comparison to its previously considered richness (Bouchet et al. 2011).

Members of the genus *Anacithara* Hedley, 1922 were traditionally classified within Turridae based on the shell (Hedley 1922, Kilburn 1994, Tucker 2004, Nolf & Swinnen 2011). Bouchet et al. (2011) transferred this taxon to Horaiclavidae Bouchet, Kantor, Sysoev & Puillandre, 2011 which shares many conchological and radular characters with Pseudomelatomidae Morrison, 1965.

Bouchet (2014) recognized 35 species of *Anacithara* as valid, which are distributed in all major tropical and subtropical oceans, with the greatest species richness in the Indo-Pacific (Hedley 1922). Only *Anacithara angulosa* (E. A. Smith, 1871), *A. maltzani* (Knudsen, 1952) and *A. biscoitoi* Nolf & Swinnen, 2011 have been previously reported for the Atlantic

Ocean from West African waters (Horro et al. 2010, Nolf & Swinnen 2011). However, there is certainly considerable *Anacithara* richness yet to be described for the Atlantic Ocean.

This paper records the genus *Anacithara* for the western Atlantic based on the description of three new species.

Material and methods

All specimens studied are represented by empty shells dredged up 2001 by the research vessel 'Natureza' (2001) on the continental slope off the state of Rio Grande do Norte (northeastern Brazil) between 223 to 510 meters depth.

All specimens were first studied under a stereomicroscope and later based on photographs taken under a scanning electron microscope. Taxonomic identification was made through comparison with the descriptions and images available mainly in Kilburn (1994), Horro et al. (2010) and Nolf & Swinnen (2011).

In the type material, number inside square brackets indicates number of specimens in each lot.

Abbreviations

ANSP	Academy of Natural Sciences of Philadelphia, Philadelphia, USA
MNHN	Muséum National d'Histoire Naturelle, Paris, France
MNRJ	Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil
MZSP	Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil
NHMUK	The Natural History Museum, London, Great Britain
UFS_MOL	Coleção Zoológica de Invertebrados do Departamento de Biologia da Universidade Federal de Sergipe, Aracajú, Sergipe, Brazil
UNICAMP	Universidade Estadual de Campinas, Campinas, São Paulo, Brazil
ZSM	Zoologische Staatssammlung Muenchen, malacological collection, Munich, Germany

Taxonomy

Conoidea Rafinesque, 1815
 Horaiclavidae Bouchet, Kantor, Sysoev
 & Puillandre, 2011

Anacithara Hedley, 1922

Type-species: *Mangilia naufragae* Hedley, 1909 by original description. Recent, Hope Island, Queensland, Australia.

Anacithara biconica spec. nov.

Figs 1 and 4A

Type material. Holotype – [1] MZSP 110.836 (Fig. 1): 06°14'04" S, 34°52'33" W, 510 m, 26.xi.2001. Paratypes – [2] ANSP 456811, [2] MZSP 110.837 (Fig. 4A), [1] NHMUK 20140089: 06°14'04" S, 34°52'33" W, 510 m, 26.xi.2001; [3] MNHN IM-2012-2776, [1] ZSM 20130767: 06°13'39" S, 34°51'37" W, 340 m, 26.xi.2001; [4] MNRJ 26705 (Fig. 1), [1] UFS_MOL 0006: 06°13'22" S, 34°52'20" W, 223 m, 26.xi.2001; [1] MZSP 110.838: 04°51'00" S, 35°06'46" W, 375 m, 24.xi.2001; [1] MZSP 110.839: 06°14'24" S, 34°52'06" W, 500 m, 26.xi.2001; [1] UNICAMP/ZUEC GAS 3316: 06°13'22" S, 34°52'20" W, 223 m, 26.xi.2001. All off the state of Rio Grande do Norte (northeastern Brazil).

Type locality. Off the state of Rio Grande do Norte (northeastern Brazil), 'Natureza' collector (06°14'04" S, 34°52'33" W, 510 m, 26.xi.2001).

Etymology. From biconic (lat. bi = twice + gr. konikos = cone-shaped), an adjective referring to the shape of the shell similar to two cones placed base to base.

Description

Shell up to 5.21 mm long and 2.26 mm wide, biconical, whitish (Fig. 1A–C). Protoconch of about 1.87 whorls, smooth, globose, dome-shaped, sculptured with numerous micropustules that align spirally (Fig. 1E). Proto-teleoconch transition abrupt, marked by appearance of spaced, arcuated, thickened and slightly sinuous axial riblets (Fig. 1E). Teleoconch of up to 4 whorls, rounded, inflated, regularly convex, well constricted at suture (Fig. 1A–C). Axial sculpture consisting of microscopic threads and well-spaced, rather straight, orthocline to slightly opisthocline, rounded, strong, raised, regularly convex axial ribs that extend from suture to suture (not continuous on whorls) (Fig. 1A–D). Axial interspaces shallowly concave about 2 times the width of ribs on first to penultimate teleoconch whorl and about 3 times on last whorl (Fig. 1A–C). Spiral sculpture consisting of fine, dense, numerous lirae wider than their interspaces (shallow, scratch-like grooves) on whole surface (Fig. 1D). Intersections of threads and lirae forming thin reticulum pattern on entire surface (Fig. 1D). First teleoconch whorl with about eight smooth axial ribs. Second teleoconch whorl with about 10 prominent ribs and more evident reticulate pattern on surface. Penultimate and last whorl with 10 to 12 very strong ribs (Fig. 1A–C). Suture deep, canalculated, distinctly undulating (strongly crenulated) by adapical termination of ribs from second teleoconch whorl (Fig. 1A–D). Spire conical, blunt, length smaller than body whorl (Fig. 1A–C). Body whorl large (about 60 % of total length), strongly crenulated in comparison to previous whorls. Base

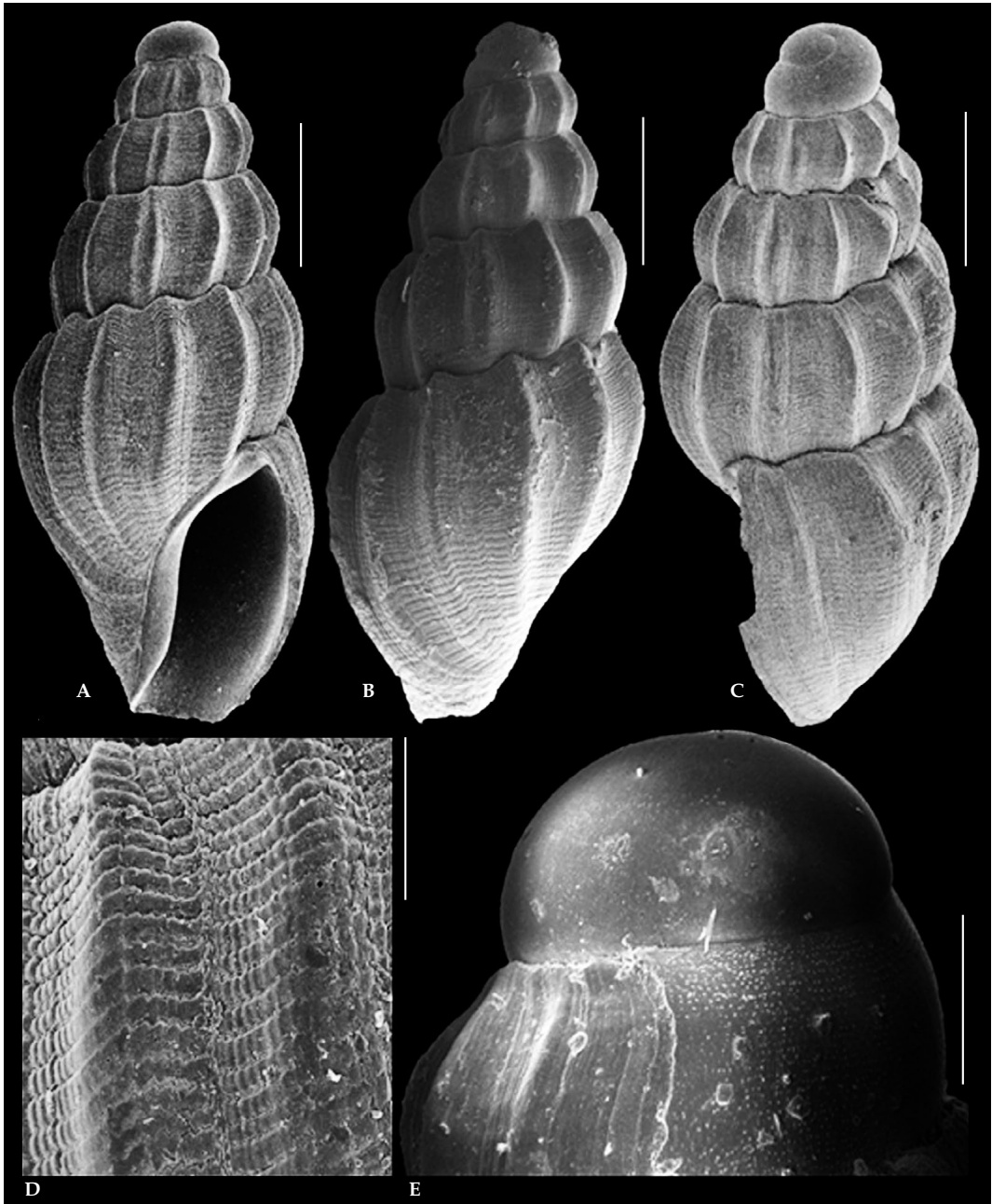


Fig. 1. *Anacithara biconica* spec. nov. (A, D, holotype, MZSP 110.836; B–C, E: paratypes, MNRJ 26705). A. ventral view; B. dorsal view; C. lateral view; D. detail of ornamentation; E. protoconch, lateral view. Scale bars: A–C, 1 mm; D–E, 100 μ m.

short, conical, fairly blunt; axial ribs evanescent on base at parietal level (Fig. 1A–C). Aperture oblong, subfusiform, narrower in adapical region (Fig. 1A).

Outer lip thin, smooth inside, slightly incurved (convex in side view) (Fig. 1A). Inner lip thin, smooth inside, slightly reflected on siphonal canal and parietal

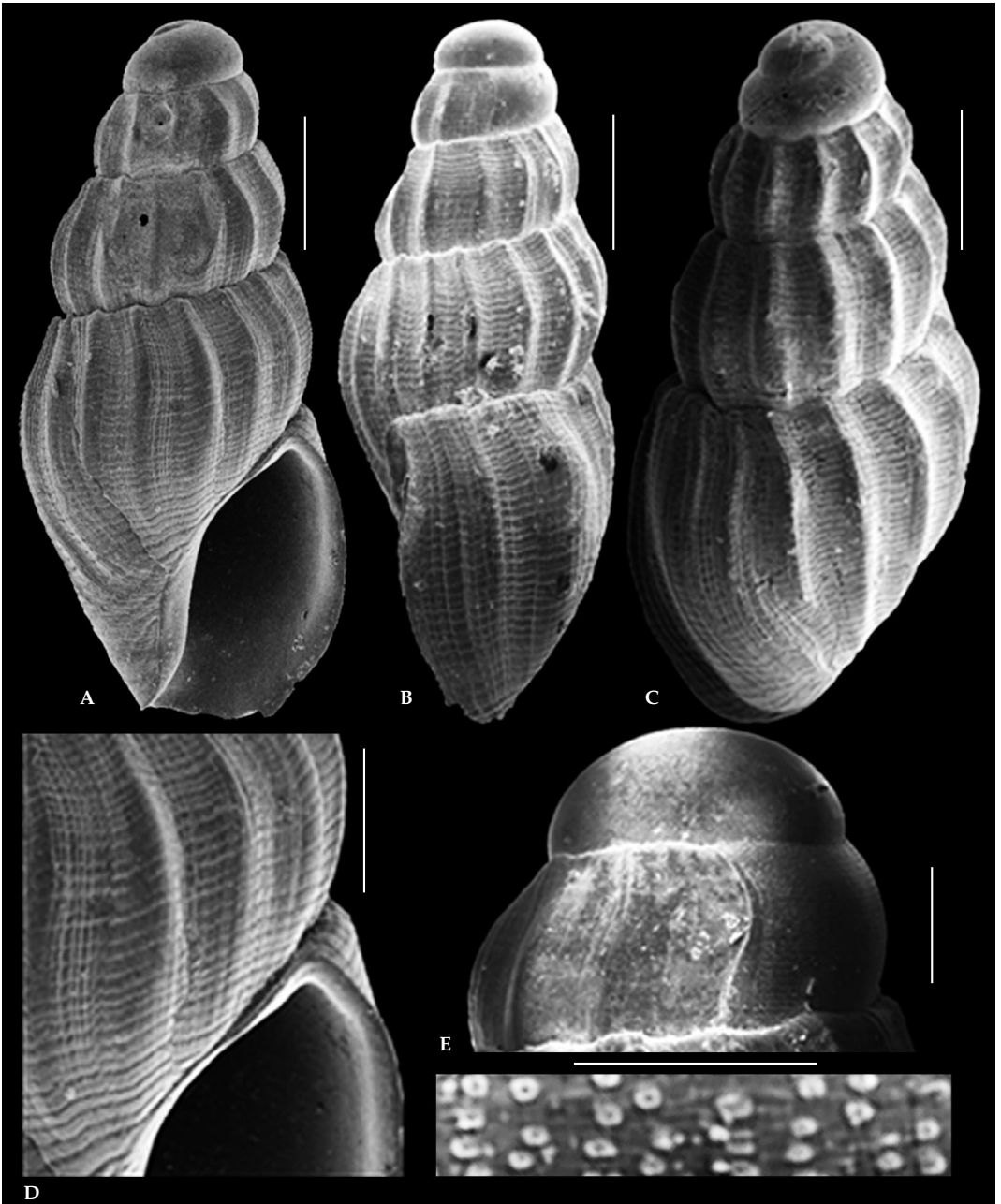


Fig. 2. *Anacithara pupiforme* spec. nov. (A–B, D, F, holotype, MZSP 110.840; C, E, paratypes, MNRJ 26706). A. ventral view; B. lateral view; C. dorsal view; D. sculpture of last whorl; E. protoconch, lateral view; F. protoconch, micro-pustules. Scale bars: A–C, 500 μ m; D, 200 μ m; E, 100 μ m; F, 20 μ m.

region (Fig. 1A). Parietal region smooth, thin, rather straight (Fig. 1A). Siphonal canal short (about 27 % of total length), wide, oblique, truncated termination; fasciole weak, indistinct (Fig. 1A). Anal sinus indistinct.

Distribution. Known only from the type locality from 223 to 510 meters depth.

Anacithara pupiforme spec. nov.

Figs 2 and 4B

Type material. Holotype – MZSP 110.840 (Fig. 2): 06°14'04"S, 34°52'33"W, 510 m, 26.xi.2001. Paratypes – [1] UNICAMP/ZUEC GAS 3317: 06°14'04"S, 34°52'33"W, 510 m, 26.xi.2001; [1] MZSP 110.841 (Fig. 4B): 04°51'00"S, 35°06'46"W, 375 m, 24.xi.2001; [2] MNRJ 26706 (Fig. 2): 06°14'24"S, 34°52'06"W, 500 m, 26.xi.2001; [1] MNHN IM-2012-2777: 06°13'22"S, 34°52'20"W, 223 m, 26.xi.2001. All off the state of Rio Grande do Norte (northeastern Brazil).

Type locality. Off the state of Rio Grande do Norte (northeastern Brazil), 'Natureza' collector (06°14'04"S, 34°52'33"W, 510 m, 26.xi.2001).

Etymology. From *pupiformis* (lat. pupa = nymph, post-larval stage of an insect + lat. formis = shape), an adjective referring to the pupal shape of the shell.

Description

Shell up to 3.76 mm long and 1.72 mm wide, pupoid, whitish. Protoconch of about 1.87 whorls, smooth, globose, dome-shaped, sculptured with numerous micropustules that align spirally. Proto-teleoconch transition abrupt, marked by appearance of fine, well sinuous, spaced axial riblets. Teleoconch of up to 3.5 whorls, rounded, inflated, regularly convex and slightly constricted at suture. Axial sculpture consisting of microscopic threads and well-spaced, rather straight, orthocone to slightly opisthocline, rounded, strong, but low, attenuated, regularly convex ribs, extending from suture to suture (not continuous on whorls). Axial interspaces shallowly concave with about 2 times the width of ribs. Spiral sculpture consisting of fine, dense, numerous lirae wider than their interspaces (shallow, scratch-like grooves) on whole surface. Intersections of threads and lirae forming thin reticulum pattern on entire surface. First teleoconch whorl with about eight smooth axial ribs. Second teleoconch whorl with about 10 prominent ribs and more evident reticulate pattern on surface. Penultimate and last whorl with 10 to 12 ribs. Suture moderately deep, canalculated, very slightly undulated (crenulated) by adapical termination of ribs from penultimate and last whorl. Spire conical, blunt, length smaller than body whorl. Body whorl large (about 60 % of total length). Base very short, conical, fairly blunt; axial ribs evanescent on base at parietal level. Aperture oblong, broadly subfusiform, narrower in adapical region. Outer lip thin (edge moderately sharp), smooth inside, slightly incurved (convex in side-view) and slightly reflected. Inner lip thin, smooth inside, slightly reflected on siphonal canal and parietal region. Parietal region smooth, straight. Siphonal canal short (about 25 % of total length), oblique, wide, truncated termination; fasciole weak, indistinct. Anal sinus indistinct.

Distribution. Known only from the type locality from 223 to 510 meters depth.

Anacithara pyrgoforme spec. nov.

Figs 3 and 4C

Type material. Holotype – [1] MZSP 110.842 (Fig. 3): 06°14'04"S, 34°52'33"W, 510 m, 26.xi.2001. Paratypes – [2] ANSP 456812, [4] MNHN IM-2012-2778, [2] UNICAMP/ZUEC GAS 3318: 06°14'04"S, 34°52'33"W, 510 m, 26.xi.2001; [1] ANSP 456813, [2] MNHN IM-2012-2779, [1] MNRJ 26707 (Fig. 3), [2] MZSP 110.843, [2] UNICAMP/ZUEC GAS 3321 (Fig. 4C): 06°13'39"S, 34°51'37"W, 340 m, 26.xi.2001; [2] MNHN IM-2012-2780, [4] MNRJ 26708, [4] MZSP 110.844, [2] NHMUK 20140090, [2] UFS_MOL 0007, [2] ZSM 20130766: 06°13'22"S, 34°52'20"W, 223 m, 26.xi.2001. All off the state of Rio Grande do Norte (northeastern Brazil).

Type locality. Off the state of Rio Grande do Norte (northeastern Brazil), 'Natureza' collector (06°14'04"S, 34°52'33"W, 510 m, 26.xi.2001).

Etymology. From *pyrgoformis* (gr. pyrgos = tower + lat. formis = shape), an adjective referring to the tower shape of the spire.

Description

Shell up to 4.48 mm long and 1.65 mm wide, turritiform, whitish. Protoconch of about 1.75 whorls, smooth, moderately globose, dome-shaped, sculptured with numerous micropustules that align spirally. Proto-teleoconch transition abrupt, marked by appearance of widely spaced, thickened, prominent axial ribs. Teleoconch of up to 4.5 whorls not regularly convex, inflated, slightly constricted at suture. Teleoconch whorls and ribs slightly flattened in subsutural region forming a peripheral angled from second whorl. Axial sculpture consisting of microscopic threads and well-spaced, straight, orthocone to slightly opisthocline, strong, not regularly convex ribs, extending from suture to suture (not continuous on whorls). Axial interspaces shallowly concave, about 2 times the width of ribs. Spiral sculpture consisting of fine, dense, numerous lirae with approximately the same width of their interspaces (shallow, scratch-like grooves) on whole surface. Intersections of threads and lirae forming thin reticulum pattern on entire surface. First teleoconch whorl with about eight prominent, strong axial ribs. Second teleoconch whorl with about 10 ribs and more evident reticulate pattern on surface. Penultimate and last whorl with 10 to 11 ribs. Suture moderately deep, very slightly undulated (crenulated) by adapical termination of ribs from penultimate and last whorl. Spire conical, moderately blunt, length smaller than body whorl. Body whorl large (about 55 % of total length), with

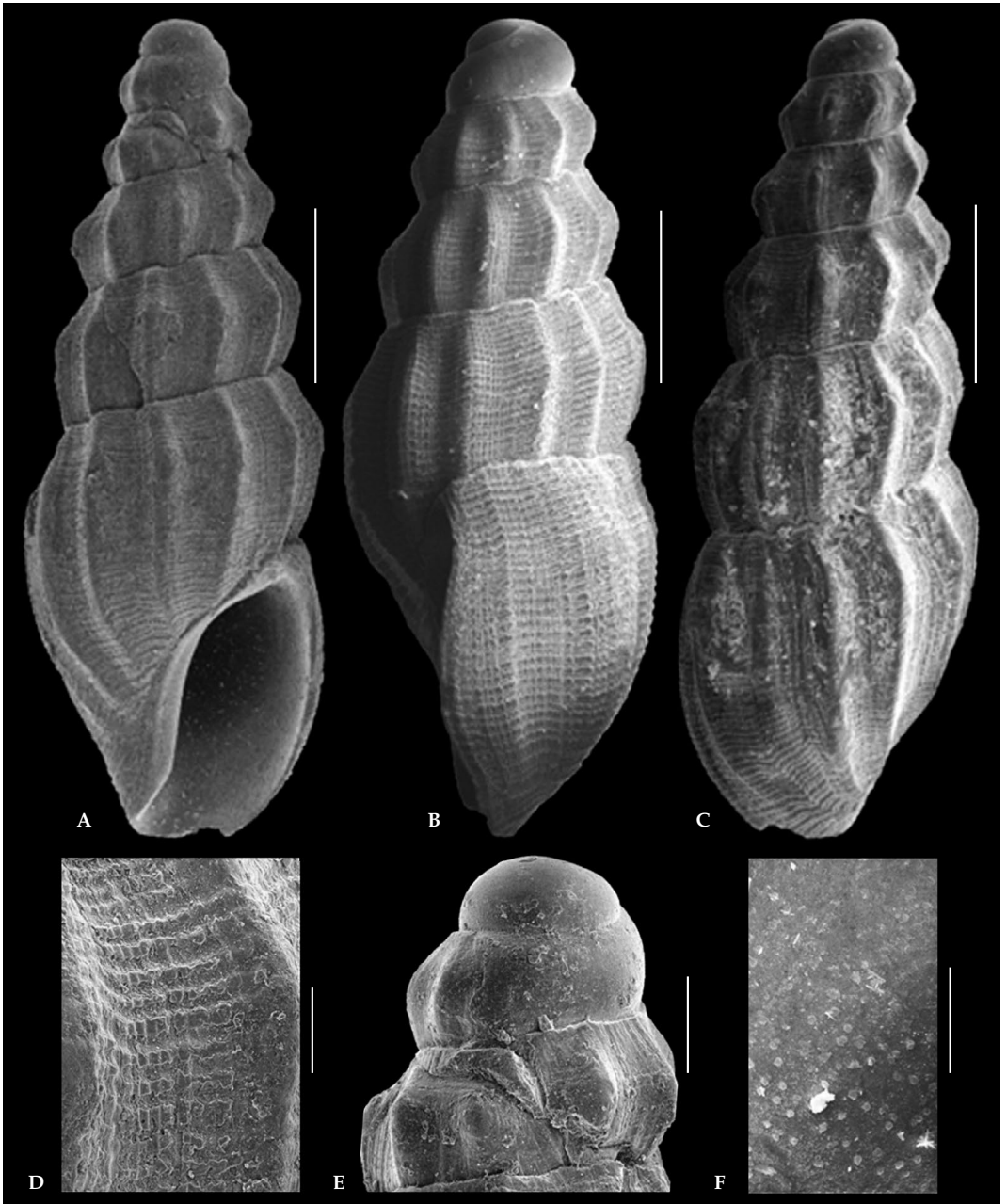


Fig. 3. *Anacithara pyrgoforme* spec. nov. (A, C-F, holotype, MZSP 110.842; B, paratype, MNRJ 26707). A. ventral view; B. lateral view; C. dorsal view; D. sculpture of teleoconch; E. protoconch – lateral view; F. protoconch – micropustules. Scale bars: A-C, 1 mm; D-E, 100 μ m; F, 20 μ m.

weakly flattened subsutural region. Base short, conical; axial ribs evanescent on base from median region of inner lip. Aperture oblong, subfusiform, narrower in adapical region. Outer lip thin, smooth

inside, slightly incurved (convex in side-view). Inner lip thin, smooth inside, slightly reflected on siphonal canal and parietal region. Parietal region smooth, rather straight. Siphonal canal short (about 23 % of

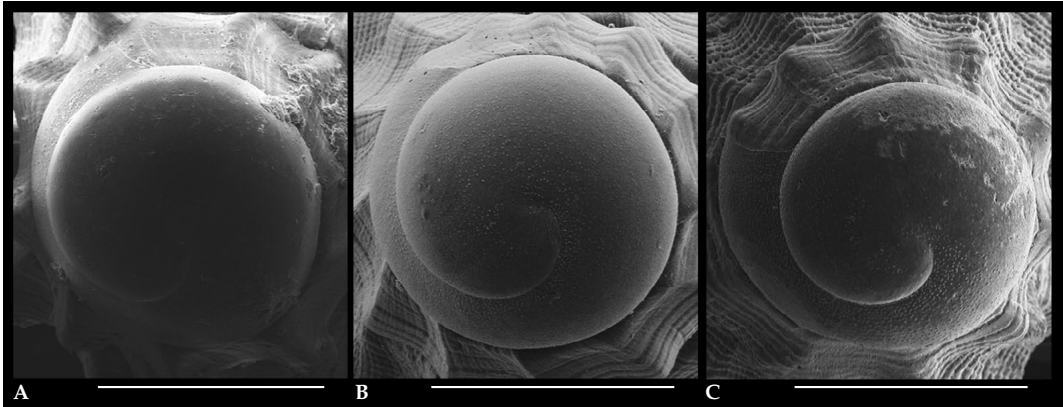


Fig. 4. Apical view of protoconch of the three new *Anacithara*. **A.** *Anacithara biconica* spec. nov. (paratype, MZSP 110.837); **B.** *Anacithara pupiforme* spec. nov. (paratype, MZSP 110.841); **C.** *Anacithara pyrgoforme* spec. nov. (paratype, UNICAMP/ZUEC GAS 3321). Scale bars: A–B, 500 μ m; C, 400 μ m.

total length), oblique, wide, truncated termination; fasciole weak, indistinct. Anal sinus indistinct.

Distribution. Known only from the type locality from 223 to 510 meters depth.

Remarks. *Anacithara biconica* spec. nov., *A. pupiforme* spec. nov. and *A. pyrgoforme* spec. nov. are similar to their Atlantic congeners *A. biscoitoidi*, *A. angulosa* and *A. maltzani* in presenting a rather blunt spire, a fine spiral sculpture on the teleoconch whorls and prominent, widely spaced axial ribs that become weaker towards the base. Furthermore, these species also have a large body whorl, a non-projected siphonal canal and smooth lips. The new species clearly differ from Atlantic congeners in having 1.75 to 1.87 whorls on the protoconch, well convex teleoconch whorls, a rather deep suture and a thin outer lip. *Anacithara biconica* spec. nov., *A. pupiforme* spec. nov. and *A. pyrgoforme* spec. nov. have a protoconch sculptured with micropustules and a teleoconch with no evidence of pits. Horro et al. (2010) characterized *A. angulosa* and *A. maltzani* and Nolf & Swinnen (2011) described *A. biscoitoidi* as having a multispiral protoconch with no evidence of micropustules, scarcely convex teleoconch whorls sculptured with pits (except *A. biscoitoidi*), a shallow suture and a thick outer lip (except *A. biscoitoidi*).

The differences between the species described herein can be summarized by the following characters: (1) overall shell shape: *Anacithara biconica* spec. nov. has a biconical outline, *A. pupiforme* spec. nov. is typically pupoid, and *A. pyrgoforme* spec. nov. has a turriform appearance; (2) contour of teleoconch whorls: *A. biconica* spec. nov. and *A. pupiforme* spec. nov. have regularly convex whorls, while *A. pyrgo-*

forme spec. nov. has a flattened subsutural region forming a peripheral angle; (3) axial sculpture: *A. biconica* spec. nov. and *A. pyrgoforme* spec. nov. develop prominent, strong ribs on all teleoconch whorls, whereas the ribs are well developed, but low and attenuated in *A. pupiforme* spec. nov.; (4) suture/sutural crenulation: the suture is deep and strongly crenulated on the penultimate and last whorl in *A. biconica* spec. nov., while the suture is moderately deep and slightly crenulated on the last two whorls in *A. pupiforme* spec. nov. and *A. pyrgoforme* spec. nov.; (5) axial interspaces: all species have shallowly concave interspaces with about 2 times the width of the ribs on the teleoconch whorls, except *A. biconica* on which the interspaces are about 3 times the width of the ribs on the last whorl; (6) outer lip: all species have a thin, incurved outer lip, which is slightly reflected only in *A. pupiforme*.

Discussion

Hedley (1922: 300) established the genus *Anacithara* to include shallow water gastropods from the Indo-West Pacific with “small shells, upper whorls and sculpture” similar to members of the genus *Eucithara* Fischer, 1883, but differing in the “wide aperture, devoid of teeth on either side”. Kilburn (1994) diagnosed *Anacithara* rather consistently, except for the presence of a paucispiral protoconch, outer lip with a strong to massive varix and U-shaped anal sinus. These characters are not seen in some congeners (Horro et al. 2010, Nolf & Swinnen 2011, present study).

Members of the genera *Eucithara* Fischer, 1883, *Haedropleura* Bucquoy, Dautzenberg & Dollfus, 1883,

Splendrillia Hedley, 1922, *Cerodrillia* Bartsch & Rehder, 1939 and *Inodrillia* Bartsch, 1943 are among the marine gastropods with shell morphology somewhat similar to *Anacithara* especially in the protoconch shape and mainly axial ornamentation pattern (Hedley 1922, Kilburn 1988, 1992, 1994, Absalão et al. 2005, Bouchet et al. 2011). However, these genera differ from *Anacithara* basically in having a rather fusiform shape, elongated aperture, strong peristome usually with dentition, pronounced posterior sinus and/or longer siphonal canal (Hedley 1922, Kilburn 1992, 1994).

Anacithara is strongly correlated to *Striatoguraleus* Kilburn, 1994 in the blunt apex, convex whorls sculptured by vigorous axial ribs and low spiral lirae, a moderately short base, short siphonal canal and smooth outer and inner lips (Kilburn 1994). *Striatoguraleus* differs from *Anacithara* in its nasariiform to claviform shell, paucispiral protoconch covered by a very fine spiral striae and a relatively wide aperture (Kilburn 1994).

Species of *Anacithara* have been characterized by a protoconch with a dome shape that is either smooth, apparently polished [e.g. *A. angulosa* and *A. maltzani* (Horro et al. 2010, Nolf & Swinnen 2011)] or sculptured with micropustules (present study). According to Bouchet et al. (2011), the protoconch of horaclavids can be medially carinate or with smooth whorls (as typically found in *Anacithara*).

The deep sea species of *Anacithara* from Brazil studied herein are very similar to Indo-Pacific congeners illustrated by Hedley (1922) and Kilburn (1994), especially in the same general shape and pattern of axial sculpture crossed by weak spiral lirae, including the expression of the axial ribs on the base. The main differences between Brazilian and Indo-Pacific congeners are the strength of the aperture and sinus morphology. To date, there are no other taxa on the Brazilian coast with shell morphology closely related to that of the species described herein.

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