A new species of *Tritonoharpa* Dall, 1908 (Gastropoda: Cancellariidae) from the southwestern Atlantic and an overview of other western Atlantic species

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ABSTRACT

A new southwestern Atlantic species belonging to genus *Tritonoharpa* is described from northeastern and southeastern Brazil. ***Tritonoharpa curvapex* new species** has a strongly deviated nucleus in the protoconch, which is the main feature that distinguishes it from the remaining congeners from the western Atlantic. Shell dimensions and number of cords in the teleoconch also distinguish this new species from the other *Tritonoharpa*. An overview of the remaining extant *Tritonoharpa* from the western Atlantic is also presented. We provide taxonomical remarks, illustrations and the known distribution of *Tritonoharpa lanceolata* (Menke, 1828), *Tritonoharpa cubapatriae* (Sarasúa, 1975), *Tritonoharpa bayeri* (Petuch, 1987), *Tritonoharpa leali* Harasewych, Petit, and Verhecken, 1992 and *Tritonoharpa janowskyi* Petuch and Sargent, 2011.

Additional Keywords: Neogastropoda, Volutoidea, Plesiotritoninae, taxonomy

INTRODUCTION

The family Cancellariidae Forbes and Hanley, 1851 consists of marine gastropods and is known from all oceans (Lima et al., 2007), but the majority of the species are tropical or temperate (Harasewych and Petit, 2011). This family currently comprises about 350 extant species (MolluscaBase, 2020) and presents a great variety of shell features (Modica et al., 2011b). Most recent classifications include three subfamilies: Cancellariinae Forbes and Hanley, 1851, Admetinae Troschel, 1865 and Plesiotritoninae Beu and Maxwell, 1987 (Modica et al., 2011b; Bouchet et al., 2017).

Among the Plesiotritoninae, the genus *Tritonoharpa* Dall, 1908 is one of the most diverse with 19 extant valid species (MolluscaBase, 2018). Five species of *Tritonoharpa* are known from the western Atlantic: *T. lanceolata* (Menke, 1828), *T. cubapatriae* (Sarasúa, 1975), *T. bayeri* (Petuch, 1987), *T. leali* Harasewych, Petit and Verhecken, 1992 and *T. janowskyi* Petuch and Sargent, 2011. *Tritonoharpa lanceolata* is currently known from several localities in the western Atlantic, occurring from the eastern USA to southeastern Brazil (Beu and Maxwell, 1987; Rios, 2009). *Tritonoharpa cubapatriae* is known from Cuba and Panama (Caribbean coast) (Sarasúa, 1975; Lee, 2009). *Tritonoharpa bayeri* and *T. janowskyi* are known only from their type localities off Caribbean Colombia and Florida, USA, respectively. *Tritonoharpa leali* is currently restricted to the states of Bahia, Espírito Santo, and Rio de Janeiro, Brazil (Harasewych et al., 1992; Absalão et al., 2006). Thus, until now *T. lanceolata* and *T. leali* are the only species recorded in Brazil (Harasewych et al., 1992; Absalão et al., 2006; Rios, 2009).

Verhecken (1991) commented on the scarcity of records or descriptions of Cancellariidae in the western Atlantic south of the Equator, but since then reports on cancellariids from Brazil increased considerably, especially in deep-sea studies (Harasewych et al., 1992; Simone and Birman, 2006; Barros and Lima, 2007; Barros and Petit, 2007; Lima et al., 2007). Recent surveys of malacological collections in Brazil revealed an undescribed species of *Tritonoharpa* from the coast of Brazil and the need for a revision of other known congeners in the western Atlantic. We formally describe ***Tritonoharpa curvapex* new species** and provide taxonomical comments on the other western Atlantic *Tritonoharpa*.

MATERIALS AND METHODS

The material studied consists mostly of empty shells deposited in malacological collections, collected by various oceanographic expeditions and smaller collecting events. The largest expeditions are: 1. REVIZEE Central: "Programa de Avaliação do Potencial Sustentável de Recursos Vivos da Zona Econômica Exclusiva, Score Central" (Program of Evaluation of the Sustainable

Potential of Living Resources in the Economic Exclusive Zone), carried out by "Ministério do Meio Ambiente", Brazilian government, samples collected by the research vessel (R/V) ANTARES and the supply-boat ASTRO GAROUPA between 1996–2002; 2. BPOT MR: "Projeto de Caracterização e Monitoramento Ambiental da Bacia Potiguar – Malha Regional" (Project of Environmental Characterization and Monitoring of Potiguar Basin – Regional Grid), carried out by Petrobras SA, samples collected by the supply-boat ASTRO GAROUPA between 2002–2004; 3. AMBES: "Caracterização Ambiental Marinha da Bacia do Espírito Santo e porção Norte da Bacia de Campos" (Marine environmental characterization of the Espírito Santo Basin and North part of Campos Basin), carried out by Petrobras SA, samples collected by the R/V LUKE THOMAS and R/V SEWARD JOHNSON, between 2010–2013.

Most shells were photographed (using focus stacking) by an AxioCam ICc 5 camera coupled to a stereomicroscope ZEISS Discovery.V20. A few shells were studied under a scanning electron microscope (SEM) Jeol JSM-6390LV for a detailed examination of sculpture. Shell measurements are: shell length (SL), body whorl length (BWL), aperture length (AL), shell width (SW), aperture width (AW), protoconch height (PCH) and width (PCW). The counting of protoconch whorls follows Verduin (1982) and Verhecken (2007). Some shells were treated with mineral oil to enhance the color pattern.

Collection acronyms are: ANSP: Academy of Natural Sciences of Philadelphia, Drexel University, Philadelphia; FLMNH: Florida Museum of Natural History, Gainesville; IBUFRJ: Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil; MNRJ: Museu Nacional, Rio de Janeiro, Brazil; MORG: Museu Oceanográfico "Professor Eliézer de Carvalho Rios", Universidade Federal do Rio Grande, Rio Grande, Brazil; MZSP: Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil; SMF: Naturmuseum Senckenberg, Frankfurt, Germany; USNM: National Museum of Natural History, Smithsonian Institution, Washington, DC.

Due to the recent fire at the Museu Nacional in Brazil (Zamudio et al., 2018) most lots from this institution listed in the material examined here, in addition to lots lent from other institutions, were destroyed. Destroyed specimens (spm) or shells (sh) are marked by a dagger (†) in the material examined of each species.

SYSTEMATICS

Family Cancellariidae Forbes and Hanley, 1851
Subfamily Plesiotritoninae Beu and Maxwell, 1987

Genus *Tritonoharpa* Dall, 1908

Nivitriton Iredale, 1929. Type species: *Triton antiquatus* Hinds in Reeve, 1844 (by original designation); Recent, tropical Indo-Pacific.
Esbelta Sarasúa, 1975. Type species: *Ranella lanceolata* Menke, 1828 (by original designation); Miocene to Recent, western Atlantic.

Type Species: *Tritonoharpa vexillata* Dall, 1908 (by original designation); Recent, western America and the Galapagos Island.

Description: Shell with weakly to moderately convex teleoconch whorls, retaining prominent varices on early as well as later whorls, well developed columellar collar, lacking columellar plaits or with a single very low, narrow columellar plait, and with a nematoglossan radula, consisting of a thin membrane and one central row of rachidian teeth (adapted from Beu and Maxwell, 1987 and Modica et al., 2009).

Tritonoharpa curvapex new species
(Figures 1–9)

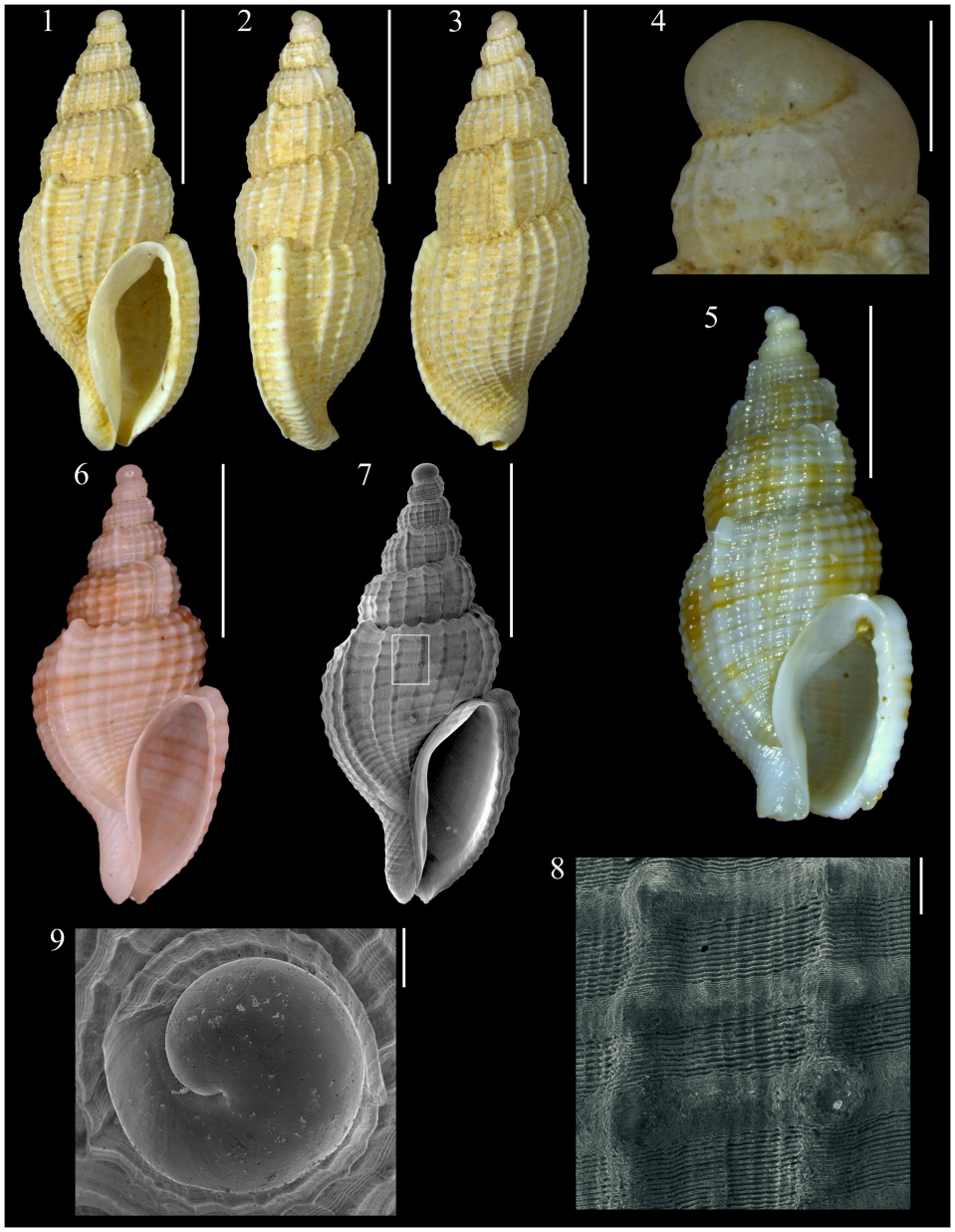
Diagnosis: Shell up to 15.0 mm long, 5.5 mm wide, with 6–7 whorls, cream to light brown, with scattered brown blotches and thin spiral bands. Whorls convex, with moderately prominent varices (1–2 per whorl) from early whorls to later whorls, sculptured with cancellate pattern. Protoconch paucispiral, smooth, 1.0 whorl, nucleus strongly deviated.

Description: Shell about 15.0 mm long, 6.5 mm wide, spire angle 35°, shouldered. Protoconch paucispiral, 1.0 whorl, nucleus deviated about 30° from teleoconch axis. Protoconch–teleoconch transition abrupt, marked by a thin lip and onset of cancellate sculpture. Teleoconch with up to 7 whorls, moderately inflated, weakly shouldered; suture deeply impressed, almost obscured by the axial coronation of succeeding whorl. Spiral and axial cords present, producing cancellate sculpture; strong nodules at the intersection of spiral and axial cords; spiral cords more pronounced than axial cords. Varices high, non-collabral, narrow, appearing periodically in every 2/3 whorl. About 11 axial ribs between varices in the last whorl; About 16 spiral cords from the suture to the beginning of the siphonal canal in the last whorl (frontal view). Aperture wide, elliptical, with well-defined posterior notch. Inner lip smooth, with columellar collar reflected over, but not adherent to, fasciole and pseudoumbilicus. Outer lip with up to 8 pairs of denticles confined to flared region beyond varix. Siphonal canal short, weakly deviated, partially covered abaxially. Shell color cream to brownish, with scattered brownish blotches and thin spiral bands.

Type Locality: Brazil: Northeast coast, imprecise locality between Pernambuco and Bahia states, coll. 1977.

Type Material: Holotype: IBUFRJ 5430 (sh). **Paratypes:** Brazil: Bahia state: Camamu Basin, 13°28′29″ S 38°48′41″ W, 30 m (MNRJ 14925, 1 sh†; MNRJ 27973, 1 sh†); Espírito Santo state: REVIZEE Central I stn. C65, 18°52′58″ S 39°06′00″ W, 50 m, coll. R/V Antares, 25/iv/1996 (IBUFRJ 9525, 1 sh).

Measurements: Holotype, IBUFRJ 5430: Whorls= 6.0; SL= 12.7 mm; BWL= 8.5 mm; AL= 6.0 mm; SW= 5.2 mm; AW= 2.7 mm; PCH= 0.8 mm; PCW= 0.9 mm; SL/SW= 2.4.



Figures 1–9. ***Tritonoharpa curvapex*** **new species. 1–4.** Holotype, IBUFRJ 5430. **5.** Paratype, MNRJ 27973. **6–9.** Paratype, MNRJ 14925. **1, 5–7.** Entire shell in frontal view, white square in **7** indicates detail in **8**. **2.** Entire shell in lateral view. **3.** Entire shell in dorsal view. **4, 9.** Detail of protoconch, lateral and apical views, respectively. **8.** Detail of teleoconch surface. Scale bars: **1–3, 5–7** = 5 mm; **4** = 500 μm; **8–9** = 200 μm.

Etymology: *Curvus*, Latin for bent; *apex*, Latin for tip; referring to the strongly deviated nucleus of the protoconch.

Distribution: Brazil: From Pernambuco to Espírito Santo. Empty shells from depths between 30 m to 50 m.

Remarks: The holotype IBUFRJ 5430 (Figures 1–4) and the paratype IBUFRJ 9525 of ***T. curvapex*** are safely preserved in the IBUFRJ collection. The other paratypes (Figures 6–9) were destroyed by the fire. To avoid the designation of a destroyed specimen as the holotype, the shell of IBUFRJ 5430 was selected as the holotype despite the imprecise locality of collection.

Tritonoharpa curvapex differs from all other western Atlantic species of the genus in having a conspicuous protoconch in which the nucleus is strongly deviated (Figures 4, 9). This newly described species is most similar to *T. bayeri* (Figures 23–27) based on the general shape and on having an aperture that is not very constricted posteriorly. The protoconch of the holotype of *T. bayeri* (USNM

859853) is partially broken (Figures 25, 26), but it is possible to note that the nucleus is not deviated as in ***T. curvapex***. ***Tritonoharpa curvapex*** can also be distinguished from *T. bayeri* by the relatively smaller dimensions of the shell (12.7 mm long, 5.2 mm wide *vs.* 16.2 mm long, 7.6 mm wide, respectively, both with 5 whorls) and by the smaller number of axial ribs between varices of the last whorl (11 *vs.* 16–18). These species also differ by their color pattern, ***T. curvapex*** has brownish spots like *T. bayeri*, but also some spiral bands (Figure 5) that are not present in *T. bayeri*.

Tritonoharpa curvapex also resembles *Tritonoharpa ponderi* Beu and Maxwell, 1987, from Australia, and *Tritonoharpa caunbonensis* Pacaud, Ledon, and Loubry, 2015, an extinct species from the Eocene of Paris Basin, because these species also have a strongly deviated protoconch (Beu and Maxwell, 1987: pl. 18, fig. E, I; Pacaud et al., 2015: pl. 10, fig. 1E). However, ***T. curvapex*** can be distinguished from *T. ponderi* by the abrupt increase in diameter of the teleoconch, which occurs more gradually in *T. ponderi*. ***Tritonoharpa curvapex*** can be distinguished from *T. caunbonensis* by its relatively larger size (holotype of *T. curvapex*, IBUFRJ 5430, ~6 whorls, 12.7 mm long, 5.2 mm wide, SL/SW= 2.4 *vs.* holotype of *T. caunbonensis*, MNHN.F.A51472, ~7 whorls, 10 mm long, 3.9 mm wide, SL/SW= 2.6), and in having thinner varices and a narrower inner lip.

Notes on Other Western Atlantic *Tritonoharpa*

***Tritonoharpa lanceolata* (Menke, 1828)**
(Figures 10–20)

Ranella lanceolata Menke, 1828: 87.
For synonymy up to 1987, see Beu and Maxwell (1987: 40)
Colubraria lanceolata (Menke, 1828) – Perry and Schwengel (1955: 158, pl. 31, fig. 222); Daccarett and Bossio (2011: 94, fig. 444).
Tritonoharpa lanceolata (Menke, 1828) – Lyons (1989: 26, pl. 9, fig. 1); Lyons (1998: 27 [annotated list]); Petit and Harasewych (2005: 63[annotated list]); Wolfe (2008 [annotated list]); Tunnell Jr. et al. (2010: 234); Espinosa et al. (2012: 291, fig. 525); Lamy and Pointier (2017: 528, pl. 184, fig. 9A–B).

Type Locality: Puerto Rico (Menke, 1828).

Type Material: Probably lost. After K.T. Menke's death his collection was sold and dispersed (Zilch, 1967; Kohn, 1988). The most probable place to find would be the SMF, however there is no material that seems to belong to Menke's material of *T. lanceolata* (Sigrid Hof, pers. comm.).

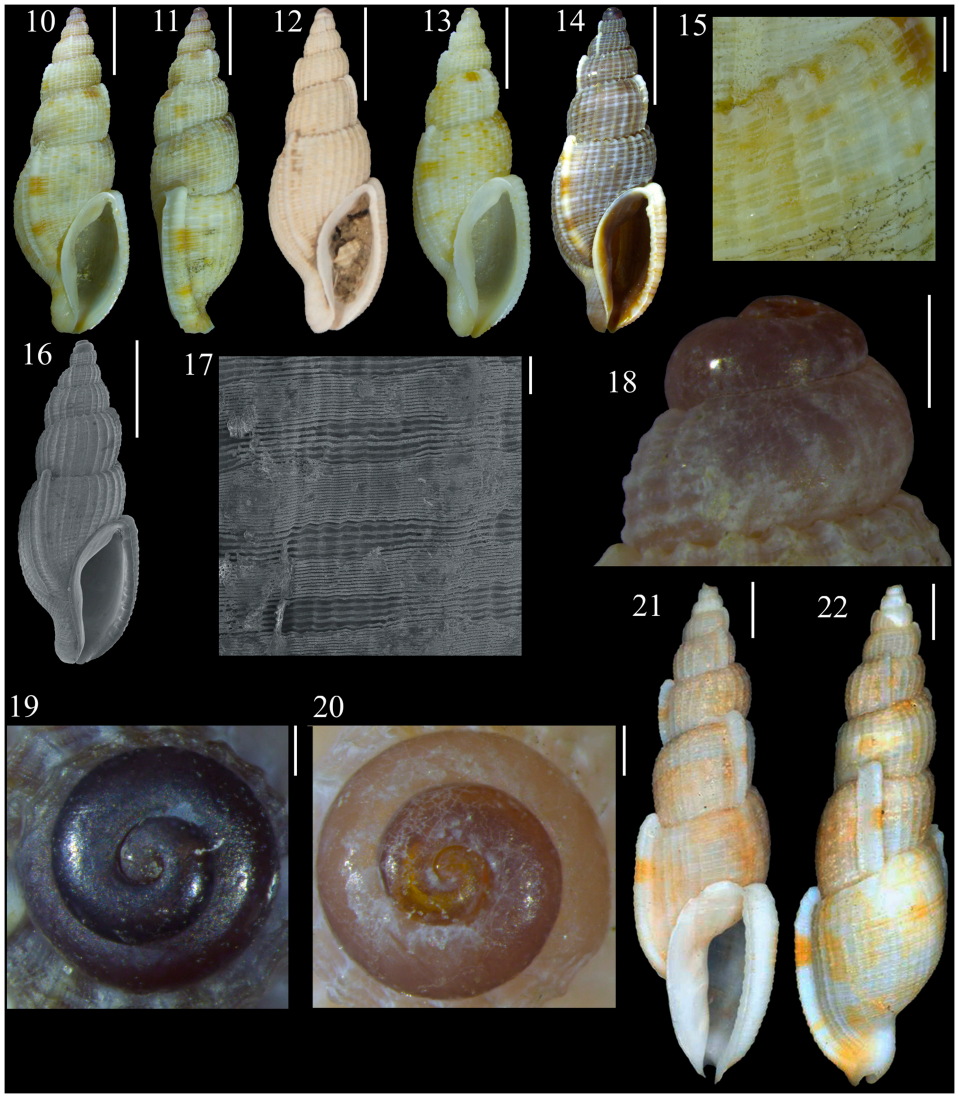
Other Material Examined: USA: Georgia: off Georgia (30°54′18″ N, 80°36′06″ W, 34 m), coll. R/V Bagby, 26/iii/1980: USNM 824010 [3 sh]; Florida: 12 miles Northeast Cape Canaveral (28°37′ N, 80°30′ W): USNM 486176 [1 sh]; Oculina Reef (27°50′ N, 79°58′ W, 91 m), coll. Houbrick: USNM 798073 [1 sh]; W of Boca Grande (26°44′ N, 84°09′ W, 55 m), coll. 1971: ANSP 395042 [6 sh]; Off Key West (182–213 m), coll. IX/1963: ANSP 294763 [1 sh]. Caribbean area: Jamaica: Montego Bay, coll. A. L. Mhering, 17/xii/1954: USNM 712137 [1 sh]. Panama: Minas Bay, Payardi Island: USNM 743644 [2 sh]. Haiti: Jeremy: USNM 383239 [1 sh]. Dominican Republic: Las Galeras, Samaná Bay (2 m), coll. 1994: ANSP 408384 [2 sh]. Puerto Rico: North of Mayaguez Docks: USNM 662026 [2 sh]. Virgin Islands: St. Thomas, coll. Brady, 1968: USNM 702792 [2 sh]. Anguilla: Sombrero Island: USNM 92993 [1 sh]. Grenada: Grand Anse Bay (12°01′46″ N, 61°46′19″ W, 3–6 m), coll. 08/x/2012: MZSP 108664 [1 sh]. Trinidad and Tobago: Off Scarborough, coll. 30/xi/1989: FLMNH 281379 [7 sh†].

Measurements: USNM 92993: Whorls= 8.0; ANSP 395042: SL= 29.1 mm; BWL= 17.0 mm; AL= 11.5 mm; SW= 9.0 mm; AW= 6.0 mm; PCH= not measured; PCW= not measured; SL/SW= 3.2. Whorls= 7.5; SL= 24.1 mm; BWL= 14.3 mm; AL= 10.1 mm; SW= 8.6 mm; AW= 4.8 mm; PCH= 1.1 mm; PCW= 1.2 mm; SL/SW= 2.8. ANSP 294763: Whorls= 7.0; SL= 20.2 mm; BWL= 13.7 mm; AL= 9.7 mm; SW= 7.0 mm; AW= 4.4 mm; PCH= 0.8 mm; PCW= 1.0 mm; SL/SW= 2.9.

Distribution: USA: New Jersey, North Carolina, Georgia, Florida (Beu and Maxwell 1987), Texas (Rosenberg et al., 2009; Tunnell Jr. et al., 2010). Bermuda (Lamy and Pointier, 2017); Bahamas (Beu and Maxwell, 1987; Redfern, 2013); Cuba; Haiti (Beu and Maxwell, 1987); Mexico (Vokes and Vokes, 1983; Beu and Maxwell, 1987); Jamaica (Beu and Maxwell, 1987); Honduras (Lamy and Pointier, 2017); Costa Rica (Lamy and Pointier, 2017); Panama (Lamy and Pointier, 2017); Colombia (Daccarett and Bossio, 2011); Puerto Rico (Menke, 1828); Virgin Islands (Mörch, 1877; Beu and Maxwell, 1987); St. Martin (Lamy and Pointier, 2017); Anguilla (Lamy and Pointier, 2017); Guadeloupe (Mörch, 1877; Lamy and Pointier, 2017); Martinique (Mörch, 1877); Trinidad and Tobago (Beu and Maxwell, 1987); Venezuela (Beu and Maxwell, 1987); Suriname (Altena, 1975); Brazil: from North to Southeast coast (?) (Rios 2009). From 0 to 178 m (Rosenberg et al., 2009).

Remarks: The whereabouts of the type material of *T. lanceolata* is unknown and as mentioned above, it is probably lost. The original description is not very informative and the species was not figured by Menke (1828), consequently the true identity of *T. lanceolata* is challenging to assess despite being frequently cited in the literature. We have examined one shell from Puerto Rico, area of the type locality which was not precisely defined, but this specimen is severely worn (Figure 12). We follow here the description of Beu and Maxwell (1987) and Harasewych et al. (1992) to recognize *T. lanceolata*.

Tritonoharpa lanceolata usually has slightly distorted teleoconch whorls (Figures 10–14, 16) in comparison to its congeners and reaches a larger size. Beu and Maxwell (1987) described a variation of the teleoconch sculpture in *T. lanceolata*, in which axial and spiral cords vary from narrow to thick, resulting in different degrees of

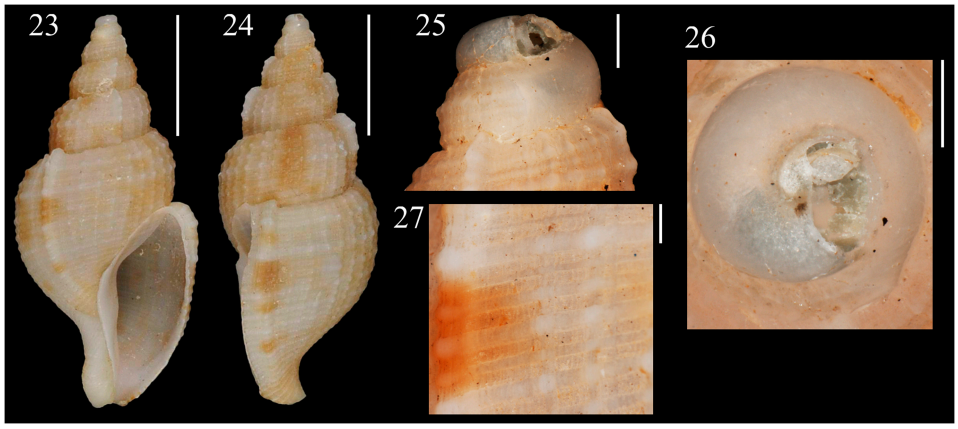


Figures 10–22. *Tritonoharpa* species. **10–20.** *Tritonoharpa lanceolata* (Menke, 1828). **10, 11, 18, 20.** ANSP 395042. **12.** USNM 662026. **13, 15.** ANSP 294763. **14, 16, 17, 19.** ANSP 408384. **21, 22.** *Tritonoharpa cubapatriae* (Sarasúa, 1975): holotype, Museo Poey, Universidad de La Habana, Cuba. **10, 12–14, 16, 21.** Entire shell in frontal view. **11.** Entire shell in lateral view. **15, 17.** Detail of teleoconch sculpture. **18.** Detail of protoconch in lateral view. **19, 20.** Detail of protoconch in apical view. **22.** Entire shell in dorsal view. Scale bars: **10–14, 16, 21, 22** = 5 mm; **15** = 1 mm; **17** = 100 μm; **18** = 500 μm; **19, 20** = 200 μm. Credits: **19, 20,** José Espinosa.

nodulation. Harasewych et al. (1992: 45, fig. 8) depicted a detail of the sculpture of *T. lanceolata*, showing spiral cords more pronounced and thicker than axial cords. Shells of *T. lanceolata* examined here also show well developed spiral cords and weaker axial cords (Figure 17).

Tritonoharpa lanceolata also has a variable color pattern in the protoconch and teleoconch (Beu and Maxwell, 1987). As currently known, the protoconch varies from pale cream (Figures 12, 13) to purplish (Figures 10, 14, 18–20) and the teleoconch varies from homogeneous pale cream with brownish spots and streaks (Figures 10, 13) to darker shells (Figure 14). Whitish shells are usually beach worn specimens (Figure 12). Until more evidence about the identity of *T. lanceolata* become available (i.e., discovery of the type material, anatomy, genetics, more material from Puerto Rico), it is difficult to assess if there is more than one distinct species under the same name.

In Brazil, the first record of *T. lanceolata* was reported by Rios (1970) (as "*Colubraria lanceolata*"), who cited localities from the Northeast and Southeast (Trindade Island) regions. Rios (1975; 1985) added a record from the North of Brazil. Later, Rios (1994) recorded *T. lanceolata* only in Pará, North Brazil and Rios (2009) repeated again the records from North to Southeast coast of Brazil. Rios' illustrations (1975; 1985; 1994;



Figures 23–27. *Tritonoharpa bayeri* (Petuch, 1987): holotype of *Colubraria bayeri* Petuch, 1987, USNM 859853. **23.** Entire shell in frontal view. **24.** Entire shell in lateral view. **25, 26.** Detail of protoconch in lateral and apical views, respectively. **27.** Detail of teleoconch sculpture. Scale bars: **23, 24** = 5 mm; **25–27 =** 400 μm. Credits: **23, 24,** USNM.

2009) do not permit the evaluation of the pattern of sculpture in the teleoconch. Thus, a robust delimitation of the species based on these figures is not possible. Furthermore, despite being a catalogue of mollusks from Brazil, the shells figured by Rios are not always from this country (pers. obs.).

The malacological collections studied in the present work usually housed vouchers from Brazil identified as *T. lanceolata*. However, all the shells from Brazil studied seems to present axial ribs thicker and slightly more pronounced in comparison to the material from the northern hemisphere, but a few shells were studied under SEM. These features lead us to doubt whether *T. lanceolata* does really occur in Brazil.

Tritonoharpa cubapatriae (Sarasúa, 1975)

(Figures 21, 22)

Colubraria (*Esbelta*) *cubapatriae* Sarasúa, 1975: 4, figs. 1–2.
Tritonoharpa cubapatriae (Sarasúa, 1975) – Petit and Harasewych (1990: 17 [annotated list]; 2005: 42 [annotated list]); Lee (2009: 123); Rosenberg et al. (2009: 661 [annotated list]); Espinosa et al. (2012: 291, fig. 524 [reproduced from original illustration]).

Type Locality: Cuba: Habana: Marianao, 20 m.

Type Material: Holotype: Museo Poey, Universidad de La Habana, Cuba (sh; here examined). Formerly at "Instituto de Zoología, Academia de Ciencias de Cuba" and catalogued as type number 31 (sh; here examined by photographs) (Sarasúa 1975).

Distribution: Cuba (Sarasúa, 1975); Panama (Lee, 2009). Known from 20 m (Sarasúa, 1975).

Remarks: Beu and Maxwell (1987: 39) considered this species as the possible largest specimen of *T. lanceolata* due to the size of the holotype (45 mm long) (Sarasúa, 1975) (Figures 21, 22). According to these authors: "examination of more extremely large western Atlantic specimens will be necessary to be sure of the status of *T. cubapatriae*". Indeed, the differences pointed by Sarasúa (1975) in comparisons with *T. lanceolata* may be related to the ontogeny phase of the species and we agree with Beu and Maxwell (1987) in that the shell of *T. cubapatriae* does not have more convex whorls than *T. lanceolata*.

The largest specimen of *T. lanceolata* we have examined reaches about eight whorls, 29.1 mm long, collected in Anguilla, Caribbean (USNM 92993). Lamy and Pointier (2017: pl. 184, figs. 9A, B) illustrated a shell from Martinique with 38.4 mm long.

The only additional record of *T. cubapatriae* since its original description was reported by Lee (2009: 123). He referred to material from Caribbean Panama in a private collection, with no information about depth and no illustration.

Tritonoharpa bayeri (Petuch, 1987)

(Figures 23–27)

Colubraria bayeri Petuch, 1987: 102, pl. 24, figs. 11–12.
Colubraria bayeri Petuch, 1987 – Daccarett and Bossio (2011: 94, fig. 446).
Tritonoharpa bayeri (Petuch, 1987) – Lamy and Pointier (2017: 528, pl. 184, fig. 8A–B).

Type Locality: Colombia: Guajira Peninsula, Off Cabo La Vela, 35 m.

Type Material: Holotype: USNM 859853 (sh; here examined).

Measurements: Holotype, USNM 859853: Whorls= 7.0; SL= 16.2 mm; BWL= 11.5 mm; AL= 8.3 mm; SW= 7.6 mm; AW= 3.7 mm; PCH= 1.0 mm; PCW= 1.2 mm; SL/SW= 2.1.

Distribution: Guadeloupe (Lamy and Pointier, 2017), Colombia (Petuch, 1987; Daccarett and Bossio, 2011). From 8 to 35 m (Petuch, 1987; Lamy and Pointier, 2017).

Remarks: *Tritonoharpa bayeri* was known only from Colombia until recently when Lamy and Pointier (2017) recorded the species in Guadeloupe. The shell figured by Lamy and Pointier (2017: pl. 184, fig. 8A–B) has a dark brown coloration at the spire, differing from the holotype.

Petuch (1987) introduced the species in *Colubraria* Schumarcher, 1817 and made no comparisons to other species of *Tritonoharpa*. *Tritonoharpa bayeri* is very similar to *T. curvapex* and was distinguished above.

Tritonoharpa bayeri differs from *T. lanceolata* and *T. leali* by the faster increase in diameter, reaching a smaller ratio of the SL/SW (2.1 *vs.* 2.8–3.2 and 2.6, respectively). Furthermore, the aperture of *T. bayeri* is not so constricted posteriorly as in *T. lanceolata* and *T. leali*.

Tritonoharpa bayeri has a similar ratio of SL/SW to the initial whorls of *T. cubapatriae*, the latter species cease a strong increase in diameter after the fifth or sixth whorl and becomes more cylindrical in shape, reaching a higher number of whorls and length. The presence of thinner and lower varices in *T. bayeri* through all whorls indicates that this species is not a young specimen of *T. cubapatriae*.

Tritonoharpa leali Harasewych, Petit, and Verhecken, 1992

(Figures 28–39)

Tritonoharpa leali Harasewych, Petit and Verhecken, 1992: 45, figures 1–2, 5–6.

Tritonoharpa leali Harasewych, Petit and Verhecken, 1992 – Rios (1994: 155, pl. 51, fig. 683A); Absalão et al. (2006: 244); Rios (2009: 298, fig. 750).

Type Locality: Brazil: Vitória-Trindade Seamount Chain, Davis Bank, MD55 stn. DC40, 20°40′ S, 34°41′ W, 60 m, coll. R/V Marion Dufresne, v/1987.

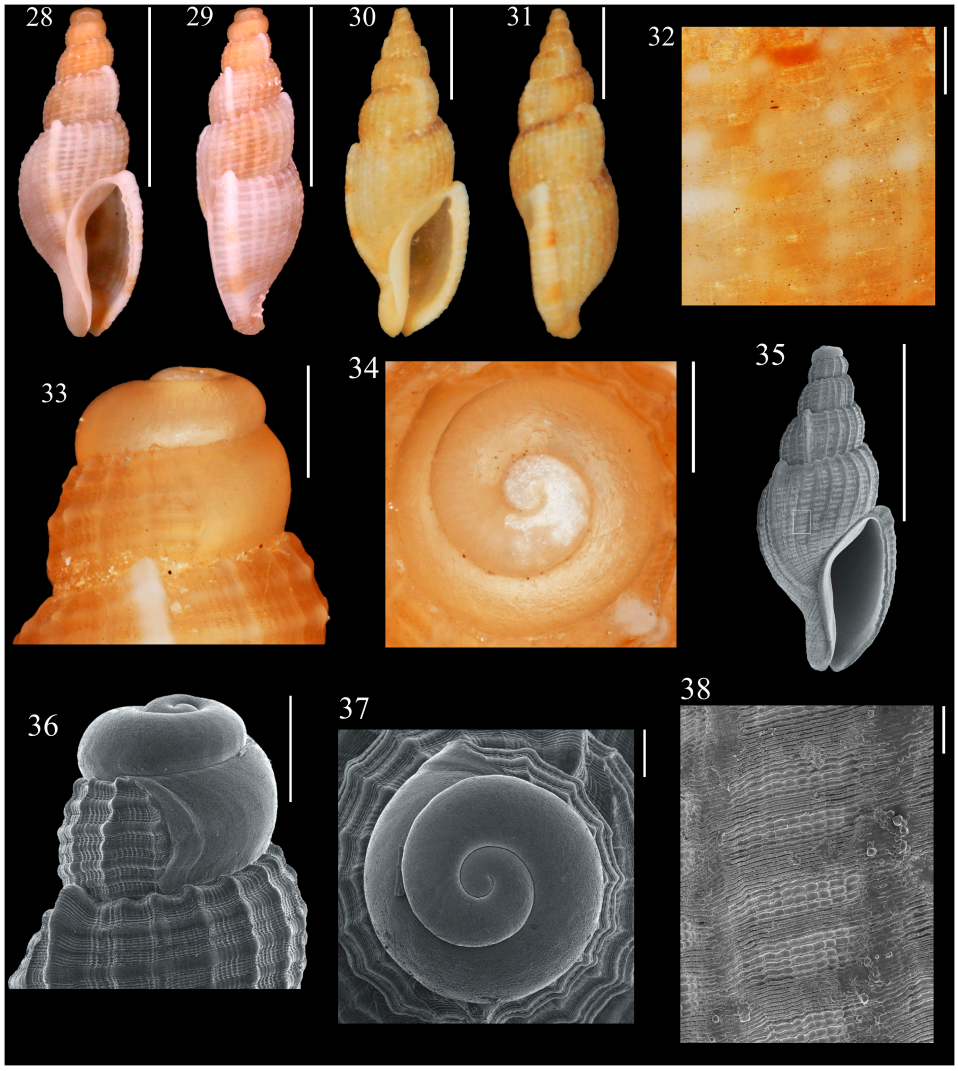
Type Material: Holotype: MORG 28659 (sh; here examined). **Paratype:** Brazil: Bahia state: off Itaparica Island (USNM 860521, 1 sh; here examined).

Other Material examined: Brazil: Rio Grande do Norte state: BPOT stn. MR45 (04°27′18″ S, 37°04′41″ W, 47 m), coll. 01/v/2010: MNRJ 34461 [2 sh†]; BPOT stn. MR41 (04°49′39″ S, 36°10′08″ W, 59 m), coll. 27/x/2009: MNRJ 34462 [1 sh†]; Bahia state: Salvador, Barra (10–15 m), coll. B. Linhares, xii/1992: MNRJ 21547 [6 sh†]; (13°19′52″ S, 38°52′52″ W, 33 m): MNRJ 27933 [1 sh†]; (13°27′58″ S, 38°44′38.40″ W): MNRJ 28108 [1 sh†]; (13°27′58″ S, 38°46′26.40″ W, 35 m): MNRJ 14931 [1 sh†]; (13°28′01.20″ S, 38°48′00″ W, 30 m): MNRJ 14926 [1 sh†]; (13°28′30″ S, 38°48′43.20″ W, 30 m): MNRJ 14927 [1 sh†]; (13°29′42″ S, 38°48′18″ W, 33 m): MNRJ 14928 [1 sh†], MNRJ 34464 [1 sh†]; (13°30′43″ S, 38°49′08.40″ W, 29 m): MNRJ 28848 [1 sh†]; REVIZEE Central V stn. 5R (15°34′05″S, 38°49′48″ W, 20 m), coll. 25/x/1997: IBUFRJ 12282 [1 sh†]; REVIZEE Central I stn. C76 (15°53′49″ S, 38°31′05″ W, 66 m), coll. 30/iv/1996: IBUFRJ 9186 [1 sh]; IBUFRJ 10115 [1 sh]; Off Nova Viçosa, Abrolhos reef (17°57′58″S 38°42′18″W), coll. P. Young and C. B. Castro, 19/iii/1993: MNRJ 10167 [1 spm†]; REVIZEE Central V stn. 16R (18°03′32″S 37°18′54″W, 100 m), coll. 29/vi/2001: IBUFRJ 14437 [1 sh]; REVIZEE Central I stn. C66 (18°19′59″ S, 38°55′01″ W, 41 m), coll. 26/iv/1996: IBUFRJ 9069 [1 sh]; Espírito Santo state: REVIZEE Central I stn. VV38 (19°28′26″S, 38°22′30″ W, 71 m), coll. 29/ii/1996: IBUFRJ 9809 [1 sh]; REVIZEE Central I stn. D39 (19°28′41″ S 38°22′26″W, 84 m), coll. 29/ii/1996: IBUFRJ 7755 [1 sh]; REVIZEE Central I stn. VV24 (20°00′18″ S, 39°54′36″ W, 45 m), coll. 27/ii/1996: IBUFRJ 13027 [1 sh]; REVIZEE Central VI stn. Y7 (20°50′56″ S, 40°10′01″ W, 75 m), coll. 28/vi/2002: IBUFRJ 16324 [1 sh]; REVIZEE Central II stn. 35R (20°52′01″ S, 40°10′01″ W, 55 m), coll. 03/xi/1997: IBUFRJ 12367 [1 sh]; AMBES 7 stn. A2 (21°03′29″ S, 40°22′59″ W, 40 m): MNRJ 34945 [1 spm†]; Rio de Janeiro state: Arraial do Cabo, Forno beach: (22°57′58″ S, 42°00′54″ W), coll. M.R. Sá and G. Nunan, 18/xii/1983: MNRJ 14521 [1 sh†]; Arraial do Cabo, Prainha beach, coll. P.M.S. Costa: MNRJ 22245 [1 sh†]; (22°57′58″ S, 42°00′39″ W, 6 m), coll. 18/iii/2005: MZSP 49326 [1 sh]; São Paulo state: Ilhabela, Vitória Island (~23°44′59″ S, 45°01′00″ W. 3–10 m), coll. 06/xii/2012: MZSP 109352 [3 spm].

Measurements: Holotype, MORG 28659: Whorls= 5.5; SL= 9.2 mm; BWL= 6.2 mm; AL= 4.4 mm; SW= 3.6 mm; AW= 2.1 mm; PCH= not measured; PCW= not measured; SL/SW= 2.6; Paratype USNM 860521: Whorls= 7.0; SL= 18.0 mm; BWL= 12.0 mm; AL= 7.8 mm; SW= 6.9 mm; AW= 4.0 mm; PCH= 0.9 mm; PCW= 1.0; SL/SW= 2.6.

Distribution: Brazil: Rio Grande do Norte (present study); Bahia (Harasewych et al., 1992; this study); Vitoria-Trindade Seamount Chain (Harasewych et al., 1992); Rio de Janeiro (present study); São Paulo (present study). From 3 m to 100 m.

Remarks: Harasewych et al. (1992) pointed out some differences between *T. leali* and *T. lanceolata*, mentioning a "more inflated and thinner shell" in the former. The holotype of *T. leali* (Figures 28, 29) is a relatively young individual, with a stocky appearance, however the species reaches a larger size (MNRJ 21548: one shell reaching 21.2 mm long) and in this case the general shape becomes more elongated and more similar to the shape of *T. lanceolata*. Small specimens of *T. lanceolata* also have a more inflated appearance as noted by Beu and Maxwell (1987: 40). Another difference pointed by Harasewych et al. (1992) was the presence of axial cords more pronounced than the spiral cords in contrast to *T. lanceolata*. All the shells of *Tritonoharpa* from Brazil examined in the



Figures 28–34. *Tritonoharpa leali* Harasewych, Petit and Verhecken, 1992. **28, 29.** Holotype, MORG 28659; **30–34.** Paratype, USNM 860521. **35, 38.** MNRJ 34462. **36, 37.** MNRJ 34461. **28, 30, 35.** Entire shell in frontal view. **29, 31.** Entire shell in lateral view. **32, 38.** Detail of teleoconch sculpture. **33, 36.** Detail of protoconch in lateral view. **34, 37.** Detail of protoconch in apical view. Scale bars: **28–31, 35** = 5 mm; **32, 33** = 500 μm; **38 =** 100 μm.

present study, except for the newly described species, are more similar to the pattern of sculpture described by Harasewych et al. (1992) for *T. leali*, despite being slightly thinner (Figure 38) than in the holotype (Harasewych et al., 1992: fig. 6). Thus, the occurrence of *T. lanceolata* in Brazil is considered dubious and previous records are probably misidentifications of *T. leali*.

Tritonoharpa leali was known from the central coast of Brazil from Bahia to Espírito Santo states, and also at the Vitória-Trindade seamount chain (Leal, 1991; Harasewych et al., 1992; Absalão et al., 2006; Rios, 2009). In the present study, the geographic distribution of *T. leali* is extended northwards to the state of Rio Grande do Norte (~04°S) and southwards to the state of São Paulo (~23°S), both in Brazil.

One live specimen photographed at Arraial do Cabo, Rio de Janeiro, Brazil, and here identified as *T. leali* is densely spotted of orange in the head-foot area and the tentacles are almost completely orange (Figure 39). This color pattern was also described by Modica et al. (2009) for a shell identified as "*T. antiquata* (Hinds, 1844)" but it actually belongs to a species complex of *T. angasi* (Braziel, 1877) (Modica et al., 2011a: 121, 2011b: 692). The head-foot of specimens identified as *T. lanceolata* from Guadeloupe, illustrated by Lamy and Pointier (2017: 528, text-fig), and from areas near Peanut Island, Florida, figured at the website of Bill Frank (www.jaxshells.org/tlance5.htm), also have a very similar color pattern. This color pattern seems common in the genus. It is also possible to observe a large and flattened penis in the Brazilian specimen (Figure 39), similar to the penis of "*T. antiquata*" (Modica et al., 2009: fig. 7P). A more detailed comparison of the penial morphology is limited by the condition of each specimen (alive *vs.* preserved).

Figure 39. *Tritonoharpa leali* Harasewych, Petit and Verhecken, 1992: live specimen photographed at Prainha, Arraial do Cabo, RJ, Brazil (Photo by P.M.S. Costa), observed under a rock. Black arrow indicates the penis.

***Tritonoharpa janowskyi* Petuch and Sargent, 2011**
(Figures 40–44)

Tritonoharpa janowskyi Petuch and Sargent, 2011: 177, pl. 5, fig. D.
Tritonoharpa janowskyi Petuch and Sargent, 2011 – Petuch (2013: 42, fig. 3.7F [reproduced from original illustration])

Type Locality: USA: Florida: Palm Beach County, Off Palm Beach Island, 120 m.

Type Material: Holotype: USNM 1152535 (sh; here examined).

Measurements: Holotype, USNM 1152335: Whorls= 7.5; SL= 16.0 mm; BWL= 11.0 mm; AL= 8.0; SW= 7.3 mm; AW= 4.0 mm; PCH= 1.1 mm; PCW= 1.1 mm; SL/SW= 2.2.

Distribution: Only known from the type locality.

Remarks: Petuch and Sargent (2011) referred exclusively to the holotype (Figures 40–44) and just a "few other specimens" from the type locality. No other additional record of the species was reported.

Tritonoharpa janowskyi is similar in shape to *T. bayeri* (Figures 23–27), as both have a stocky appearance. The former can be distinguished from *T. bayeri* by the proportionally smaller length and width of the teleoconch, by the thicker varices and by the higher number of axial cords between varices (30 *vs.* 16–18) (Petuch, 1987; Petuch and Sargent, 2011). *Tritonoharpa janowskyi* has a violet color in the protoconch (Figures 42, 43) while *T. bayeri* has a colorless protoconch (Figures 25, 26), but this difference may be due to the conservation status of the shells. The teleoconch of both species has a similar color pattern of irregular brownish patches (Figures 23, 24, 27, 40, 41, 44).

Tritonoharpa janowsky differs from *T. leali* in having proportionally bigger dimensions comparing the holotypes of both species. Furthermore, the spiral cords are more pronounced than axial cords in *T. janowsky* in contrast to *T. leali*, and the former reaches a higher number of axial cords between varices (30 *vs.* 22).

DISCUSSION

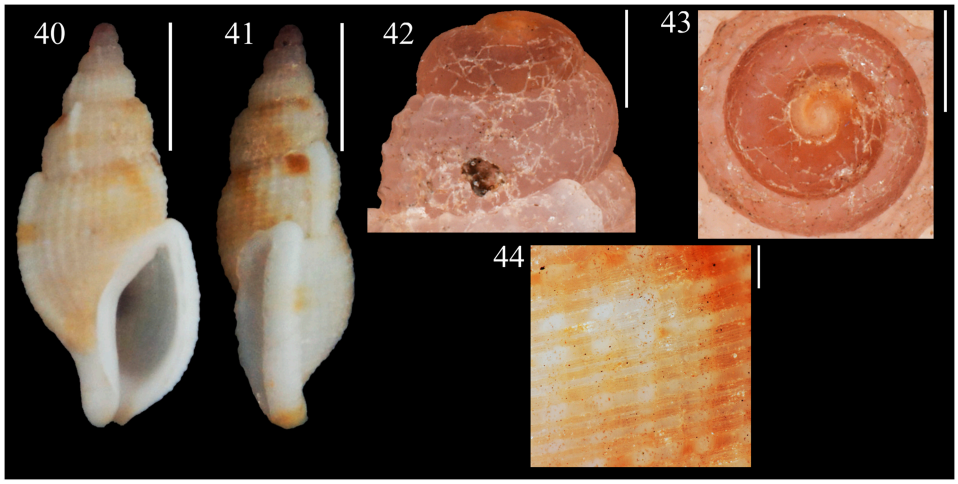
The present overview of *Tritonoharpa* from the western Atlantic demonstrates that there are doubts in the delimitation of most species and a more complete taxonomic revision is necessary. The newly described species, *T. curvapex*, is the most easily recognizable species presenting a distinctive protoconch shape (Figures 4, 9). The other species were rarely reported in the literature, except *T. lanceolata*, and were described based on a few or unique specimens. As commented by Verhecken (2011), who studied species of *Tritonoharpa* from the Philippines, the identification at species level in *Tritonoharpa* is rather complicated. Modica et al. (2011b: 692) also pointed about the difficulties in the taxonomy of *Tritonoharpa* species from shallow and deeper waters of the Pacific, Indian and Atlantic Oceans.

Although we recognized some diagnostic shell features of most of the *Tritonoharpa* from the western Atlantic, the scarcity of individuals hinders description of the variability of these features. *Tritonoharpa lanceolata* is supposedly the most common species, despite uncertainties about its taxonomy, and shows a variable teleoconch sculpture and color pattern (Beu and Maxwell, 1987). More recently, Lamy and Pointier (2017: 528, pl. 184, figs. 8–14) identified two nominal species (*T. bayeri* and *T. lanceolata*) and five morphotypes of *Tritonoharpa* sp. from Guadeloupe (Caribbean). These authors did not describe the diagnostic features of each morphotype, but based on the illustrations they possibly considered the different color patterns in the shells. At present, distinction of species by color pattern is a dubious approach.

Knowledge about the anatomy of *Tritonoharpa* is even more scarce, in the present study a few specimens of *T. leali* with soft parts were originally available for study. Unfortunately, part of these specimens was destroyed in the fire of "Museu Nacional" prior to anatomical studies. A *Tritonoharpa* species from the Philippines, erroneously cited as *T. antiquata* (Modica et al., 2009, 2011a, 2011b), is the only species of the genus of which the anatomy is known. More investigations on the anatomy of *Tritonoharpa* may help in the species delimitation.

Thus, based on the material examined here we can conclude that two species of *Tritonoharpa* certainly occur in Brazil: *T. curvapex* and *T. leali. Tritonoharpa leali* has a wider range of distribution in the Brazilian coast than previously reported in the literature, with occurrences in most of the Tropical Southwestern Atlantic province. However, it is possible that we were unable to recognize more than one species under the name *T. leali* in the present overview. The occurrence of *T. lanceolata* in Brazil needs clarifications.

The protoconch of all species of *Tritonoharpa* from the western Atlantic indicates a lecitotrophic development by



Figures 40–44. *Tritonoharpa janowski* Petuch and Sargent, 2011: holotype, USNM 1152535. **40.** Entire shell in frontal view. **41.** Entire shell in lateral view. **42, 43.** Detail of protoconch in lateral and apical views, respectively. **44.** Detail of teleoconch sculpture. Scale bars: **40, 41** = 5 mm; **42, 43** = 500 μm; **44 =** 400 μm.

its diameter and number of whorls, which may explain the restricted geographic distribution of most species. *Tritonoharpa lanceolata* differs from the remaining species by its wider distribution, but as discussed above, this distribution is possibly over estimated based on the doubts about the identity of this species.

We hope that the illustrations of specimens, including type material whenever possible, and the gathering of data about western Atlantic *Tritonoharpa* will be useful for future studies about this genus, despite some of the tentative identifications in a confusing taxonomic scenario.

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