

## A new species of *Tambja* (Nudibranchia: Polyceridae: Nembrothinae) from southern Brazil

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A new species of the genus *Tambja* Burn, 1962 is described from the western Atlantic on the coast of Brazil. To date, the genus *Tambja* was represented in the Atlantic Ocean by nine species but only three of them have been recorded from the western Atlantic: *T. gratiosa* from the Gulf of Mexico, *T. divae* from Brazil and *T. oliva* from the Caribbean coast of the Isthmus of Panama. *Tambja stegosauriformis* sp. nov. is easily distinguished from all its congeneric Atlantic species of the genus by having very well developed light blue tubercles scattered on the yellowish-orange ground with an elongate crest behind the gill until the end of the tail. The anterior margin of the notum is very wide and elevated and it extends into a kind of lapel around the rhinophores. This peculiar external morphology and its conspicuous coloration characterize this species.

### INTRODUCTION

Recently, Pola et al. (2005b) summarized the main contributions to the knowledge of the genus *Tambja*, a morphologically cohesive group of Polyceridae. This genus is being studied throughout its entire distributional range, and as a result, new taxonomic discoveries appear, indicating that the taxonomic diversity of the genus is larger than previously expected. Most of the species described during the last decade are found in the Indo-Pacific, including *T. tentaculata* Pola, Cervera & Gosliner, 2005, *T. gabrielae* Pola, Cervera & Gosliner, 2005, *T. zulu* Pola, Cervera & Gosliner, 2005 and *T. victoriae* Pola, Cervera & Gosliner 2005; and also from the eastern Atlantic, including *T. marbellensis* Schick & Cervera, 1998 and *T. simplex* Ortea & Moro, 1999. Material from the western Atlantic coast has not included any new species, since the description of *Tambja oliva* by Meyer in 1977. All of these recently described new taxa fit well within the general structure of the genus *Tambja*, including possessing rachidian teeth that lack denticles but with a notched or smooth upper margin. A comparison of the Atlantic species of the genus *Tambja* is found in Schick & Cervera (1998).

Recent studies along the coast of Cabo Frio, near Rio de Janeiro, Brazil, allowed the collection of three specimens of an undescribed species of *Tambja*. This taxon, although clearly assignable to the genus *Tambja*, is largely divergent from the other species of the genus. Its coloration is completely different from the rest of the species of the genus and its external morphology is also strongly divergent. These external features, together with some internal features, characterize this as a very interesting and remarkable new species of this genus.

### SYSTEMATICS

NUDIBRANCHIA Cuvier, 1817

ANTHOBRANCHIA Minichev, 1970

Family POLYCERIDAE Alder & Hancock, 1845

Genus *Tambja* Burn, 1962

*Type species: Nembrotha vercornis* Basedow and Hedley, 1905:158, pl. II, Figures 1–3.

#### Diagnosis

Polycerids, without frontal or velar processes and a vestigial frontal veil. Rachidian rectangular with notched or smooth upper margin, lateral tooth bifid or with a simple cusp and from 3 to 7 marginal plates. Strong buccal collar and labial armature absent. Prostate gland small and confined to a glandular section of the vas deferens.

*Tambja stegosauriformis* sp. nov.  
(Figures 1, 2, 3)

#### Type material

Holotype: adult specimen, 35 mm preserved (Cabo Frio, Rio de Janeiro, Brazil; water depth: 10 m) [Museu de Zoologia da Universidade São Paulo (MZSP) 39126]. Collected by C. Magenta, January 2002.

Paratypes: Two adult specimens both completely dissected, 50 and 40 mm preserved (same locality, date and collector as holotype) [MZSP 44650].

#### Etymology

The specific name refers to the notable tubercles along the tail of the animal. This crest gives it the aspect of a *Stegosaurus* dinosaur.



**Figure 1.** *Tambja stegosauriformis* sp. nov. Photographs of the living animals. Cabo Frio, Rio de Janeiro, Brazil.

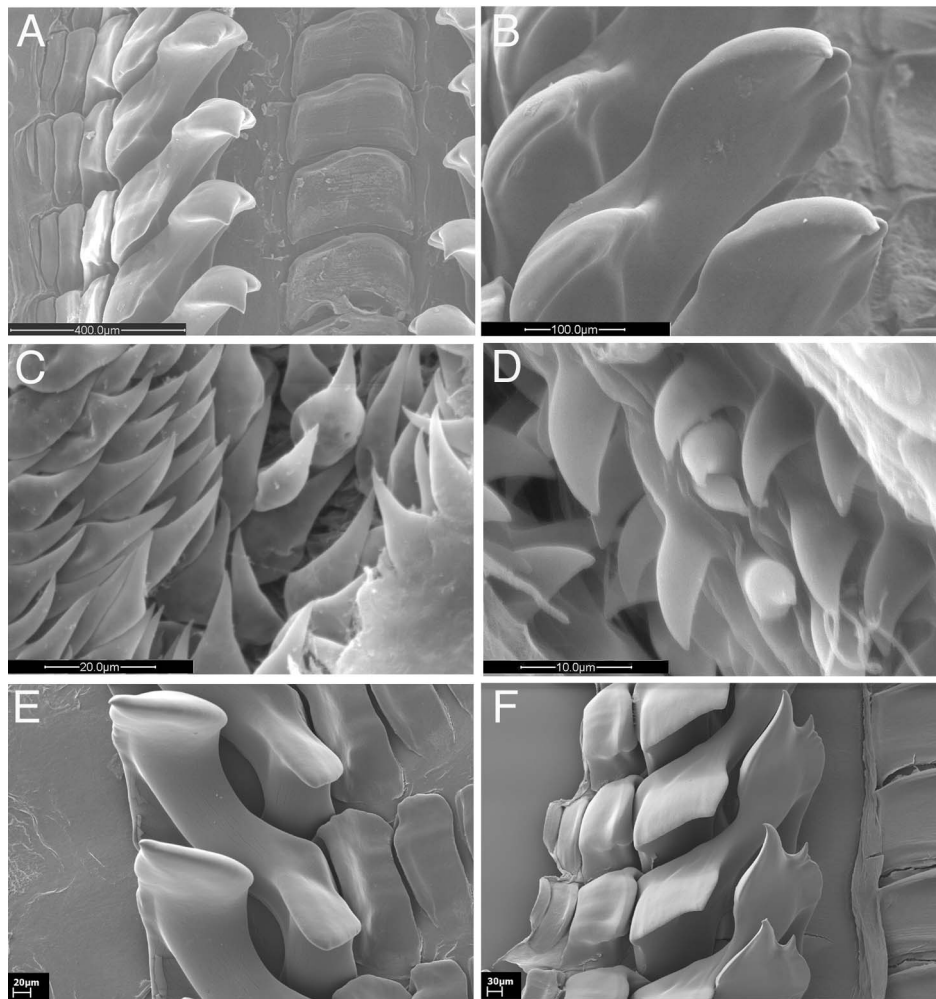
*Distribution*

Thus far this species is known only from Brazil.

*External morphology*

The body is elongate and limaciform with a long and flattened posterior end of the foot (Figure 1). The foot is

linear. The mantle margin is reduced and indistinct. The preserved specimens are about 30–50 mm in length. In this species the body surface is very characteristic with a series of well-developed tubercles forming an elongate crest behind the gill and continuing to the posterior end of the foot (Figure 1). The morphology of the head is also



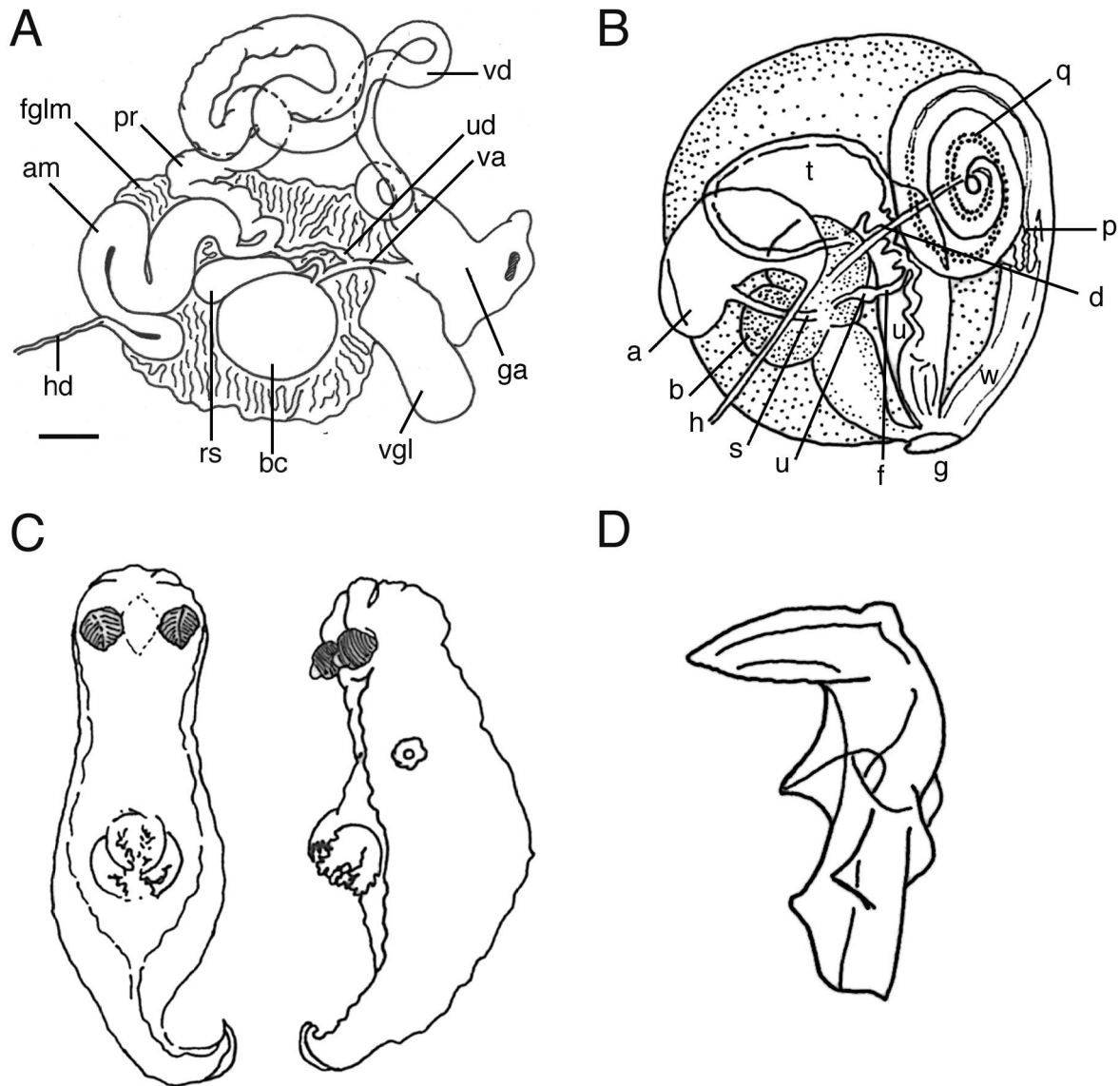
**Figure 2.** A–F. *Tambja stegosauriformis* sp. nov. (A–B) Scanning electron micrographs of the radula. (A) Detail of the rachidian and lateral radular teeth; (B) detail of the innermost lateral teeth; (C–D) scanning electron micrographs of the penial spines; (C) detail of the proximal penial spines; (D) detail of the distal penial spines (penis inverted). All the photographs refer to one of the paratypes (specimen of 50 mm in length) (MZSP 44650); (E) detail of the innermost lateral teeth of *Tambja mullineri* (California Academy of Sciences Invertebrate Zoology collection [CASIZ] 067100); (F) detail of the innermost lateral teeth of *Tambja sagamiana* (CASIZ 115757).

characteristic in this animal where the anterior margin of the notum dips into a 'U' shape. This anterior margin is very wide and elevated extending into a kind of lapel around the rhinophores. There is a pair of perfoliate rhinophores, retractile in their wide sheaths with approximately 35 lamellae. The oral tentacles are short, wide and thick. There are four or five non-retractile, tripinnate gill branches surrounding the tubular anal papilla and forming a half circle; the gill branches are approximately equal in size. The genital pore opens on the right side, midway between the gill circle and the rhinophores. The ground colour is yellowish-orange or light brown with blue tubercles scattered on the orange body (Figure 1). A darker line surrounds the blue tubercles, which have a dark greenish colour in the middle. On both sides of the notum the blue-green tubercles occur in small patches and they appear to be randomly distributed. In the middle line of the dorsum, behind the gills, they are larger and are united to form a well-developed crest. This crest continues until the end of the foot giving it the aspect of a dinosaur. Dorsally, in front of the gill circle, there are also several small blue spots and two larger tubercles

behind the rhinophores, just midway between them and the gill circle. The anterior margin of the notum and the 'lapels' around the rhinophores are dark green, the same colour as the crest. The gill branches are bright blue at the base but they become blue-greenish along the external rachis and the pinnae. A bright blue line runs along the inner side of the rachis of each gill branch. The tubular anal papilla is also blue at the top. The rhinophores have the same colour as the patches and gill branches, becoming darker at the tips. A wide bright blue band also runs along the edge of the foot. On both sides of the body, under the widening of the rhinophoral sheaths are lateral slots whose function remains unknown.

#### *Internal morphology*

The anterior digestive tract begins with a relatively short, tubular and muscular oral tube, that continues into the buccal mass. The buccal mass is larger than the oral tube. There is a pair of large, wide and granular salivary glands on the buccal mass, flanking the oesophagus. The elongated pouches at the junction of the buccal mass and the oral tube, present in other species of *Roboastra* (Pola



**Figure 3.** (A–D) A. Reproductive system of *Tambja stegosauriformis* sp. nov. (A) Scale bar=1 mm. Abbreviations: am, ampulla; bc, bursa copulatrix; fglm, female gland mass; ga, genital atrium; hd, hermaphrodite duct; pr, prostate; rs, receptaculum seminis, ud, uterine duct; va, vagina; vd, vas deferens; vgl, vaginal gland; (B) original drawing of the reproductive system of *Tambja divae* (Marcus, 1958). Abbreviations: a, ampulla; b, albumen gland; d, male duct; f, fertilizing duct; g, genital aperture; h, hermaphrodite duct; m, mucus gland; n, nidamental duct; p, penial papilla; q, prostatic part of male duct; s, spermoviduct; t, spermatheca; u, spermatocyst; v, vagina; w, male vestibule; (C) original drawings of the dorsal and lateral view of *Tambja divae* (Marcus, 1958); (D) original drawing of the inner most lateral tooth of *Tambja divae* (Marcus, 1958).

et al., 2003, 2005a), are not visible in this species. The labial cuticle is well developed and chitinous, but devoid of denticles. The radular formula of one specimen 50 mm in length is  $15 \times 4.1.1.1.4$  (Figure 2A,B) and that of one specimen 40 mm in length is  $21 \times 3.1.1.1.3$ . The rachidian teeth are broad and rectangular, without denticles, but notched at the anterior edge, which is slightly curved. The innermost laterals are much larger than the outer ones and have two well-developed wide cusps. The inner cusp is short but sharp and it has three smaller and blunter denticles on its inner edge (Figure 2B). The outer laterals are rectangular plates, which lack cusps or dentition and become smaller near the margin. There is a large, whitish and well-developed blood gland, which is granular in texture and which inserts into the dorsal surface of the

oesophagus above the gut. The renal syrx is visible under the pericardium, close to the anal papilla. The reproductive system is triaulic (Figure 3A). The preampullatory duct is elongate and narrow. It expands into a thick-walled, 'S'-shaped ampulla, which divides into the spermoviduct and the vas deferens. The prostate gland is confined to a coiled section of the vas deferens and can be easily distinguished from the rest of the vas deferens by having wide and weak walls. At the end of the prostate the vas deferens narrows into a large and coiled duct. Within the distal end of the muscular portion of the vas deferens is located the penis. The penis is armed with numerous and unordered penial spines, which seem to be arranged in longitudinal lines in the distal and narrow portion of the penis. The penial spines are thick, rounded at the base and

with a strong triangular cusp. They become fragile-looking hooks and more elongate in the distal part when the penis is inverted (Figure 2C,D). The vagina is short, straight and connects to the bursa copulatrix, which is oval in shape. The seminal receptacle is pyriform, very similar in length to the bursa copulatrix connecting to the vagina after completing two loops. The uterine duct is well visible and joins to the mid-length of the vagina. There is an elongate, thick-walled, very well developed vaginal gland, which opens at the same aperture as the vagina. The female gland is also well developed.

## DISCUSSION

The genus *Tambja* is well represented in most tropical waters of the world. Its specific richness varies extensively, with the richest areas located in the Indo-Pacific, as it is the general rule for species of Nembrothinae. Nevertheless, the *Nembrotha* and *Roboastra* genera differ from *Tambja* by their absence from the tropical western Atlantic waters. However, Krause (2003) reports a photograph of an undescribed nembrothid that could belong to *Roboastra*, but this should be supported by study of the internal anatomy. The western Atlantic fauna includes four species of the genus *Tambja*, including the new *T. stegosauriformis*. The four species known in the region and neighbouring areas are easily diagnosable.

*Tambja stegosauriformis* is only known from Brazil. Another species of *Tambja* from Brazil, *Tambja divae*, was described in 1958 by Marcus from a single preserved specimen 12 mm in length. Both species can be very easily distinguished from external and internal features. The ground colour of *T. divae* was scarlet with white gill branches and white dots, while *T. stegosauriformis* is yellowish-orange or light brown with blue-green tubercles scattered on the yellowish-orange ground of the body. The number of gill branches and rhinophoral lamellae are also different in both species, with three gill branches and 17 lamellae in *T. divae* and five gill branches and 35 perfoliations in *T. stegosauriformis*. Nevertheless, there are also some external similarities. Marcus (1958) described the living animal as extremely sticky with the presence of a high number of cutaneous glands. In *T. divae*, from the sides of the rhinophores low crests run backwards and separate the notum from the sides joining behind the gill circle and resulting in a posterior median crest ending on the tip of the foot. These crests are not shown in Marcus' original drawing (Figure 3C) but they are clearly visible in our preserved studied material. The new species described in this paper also has a great number of tubercles, and the description of the crests could have some similarities (Figure 1). With respect to the internal anatomy of both species the radular formula of *T. divae* has 5–6 marginal plates while *T. stegosauriformis* has 4 marginal plates. Moreover, Marcus (1958) described the lateral tooth as a long hook with a strong cusp and irregular processes between cusp and base, but again, in the original drawing this feature is really difficult to see (Figure 3D). The inner lateral tooth of *T. stegosauriformis* has two well-developed cusps with the inner cusp having a short but sharp denticle followed in its internal edge by three smaller and blunter cusps. In the original description of *T. divae*, this tooth resembles the one shown in our paper but the short

original description and the drawing do not allow us to be sure of it. This kind of tooth with some small denticles along the inner side of the upper cusp can also be found in other species of *Tambja*: *T. mullineri* Farmer, 1978 and *T. sagamiana* (Baba, 1955) (Figure 2E,F), but both of them are from Pacific waters and can be easily distinguished from *T. stegosauriformis* by their external appearance. There are also important differences in the reproductive system (Figure 3A,B). *Tambja stegosauriformis* has a very large and well developed vaginal gland while the vaginal gland is not present in *T. divae*.

Two other species of *Tambja* are present in the western Atlantic area: *T. gratiosa* (Bergh, 1890) and *T. oliva* Meyer, 1977. Both species also differ from *T. stegosauriformis* in external and internal features. *T. gratiosa* is light yellowish with random round grey-green spots on the back and sides while *T. oliva* is olive green, and in both cases the upper cusp of the lateral tooth is bifid. The studied specimens of *T. stegosauriformis* from Brazil have lateral slots located between the rhinophores and the oral tentacles as described for many species from the Indo-Pacific (Pola et al., 2005b), but not previously described for any species of *Tambja* from the Atlantic.

Another western Atlantic species, that appears to be undescribed, was photographed by Paul Humann (Humann & Deloach, 2002). This species is externally similar to *T. stegosauriformis* in having a U-shaped head and lateral 'lapels' but its coloration differs from *T. stegosauriformis* significantly in having a greenish body colour and orange tubercles. We have also examined the internal anatomy of this specimen from the Caribbean Bahamas. We thought it could be *T. stegosauriformis* and we saw that its internal features are very similar to the latter but the penial spines were not clearly developed. The penial spines are thought to be an informative character of the genus, however, the colour pattern is not identical and as we only have one specimen we have decided not include this specimen in the distribution of *T. stegosauriformis* and to wait for the study of potential additional material that can verify its status.

The discovery of this morphologically distinct new species in the Atlantic waters of Brazil points towards the need for extensive samplings in areas that have not been well studied, particularly in littoral areas that are suffering dramatic environmental changes as a consequence of the increasing levels of sediment flow due to inland soil erosion associated with deforestation and climate changes (El Niño).

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## REFERENCES

- Baba, K., 1955. *Opisthobranchia of Sagami Bay*, Supplement. Tokyo: Iwanami Shoten.
- Basedow, H. & Hedley, C., 1905. South Australian nudibranchs, and an enumeration of the known Australian species. *Transactions of the Royal Society of South Australia*, **29**, 134–160.
- Bergh, L.S.R., 1890. Report on the nudibranchs. Report on the results of dredging under the supervision of Alexander Agassiz, in the Gulf of Mexico (1877–1878) and in the Caribbean sea (1879–1880) by the U.S. Coast Survey steamer 'Blake' Lieut.-Commander C.D. Sigsbee, U.S.N., and Commander J.R. Bartlet, U.S.N. commanding. *Bulletin of the Museum of Comparative Zoology of Harvard*, **19**, 155–181.
- Burn, R., 1962. Descriptions of Victorian nudibranchiate Mollusca, with a comprehensive review of the Eolidacea. *Memoirs of the National Museum of Victoria*, **25**, 95–128.
- Farmer, W.M., 1978. *Tambja* and *Roboastra* (Mollusca: Opisthobranchia) from the Gulf of California and the Galápagos Islands. *The Veliger*, **20**, 375–385.
- Humann, P. & Deloach, N. 2002. *Reef creature identification, Florida–Caribbean–Bahamas* [enlarged 2nd Edition]. Jackson, Florida: New World Publications, 448 pp.
- Krause, M. (2003) (Nov. 20). *Roboastra* sp. from Brasil. *Sea Slug Forum*. Australian Museum, Sydney. Available from <http://www.seaslugforum.net/find.cfm?id=11449>.
- Marcus, E., 1958. Notes on Opisthobranchs. *Boletim do Instituto Oceanografico de Sao Paulo*, **7**, 31–78.
- Meyer, K.B., 1977. Dorid nudibranchs of the Caribbean coast of the Panama canal zone. *Bulletin of Marine Science*, **27**, 299–307.
- Ortea, J.A. & Moro, L., 1999. Descripción de tres moluscos nuevos de las islas de Cabo Verde. *Avicennia*, **8/9**, 149–154.
- Pola, M., Cervera, J.L. & Gosliner, T.M. 2003. The genus *Roboastra* Bergh, 1877 (Nudibranchia: Polyceridae: Nembrothinae) in the Atlantic Ocean. *Proceedings of the California Academy of Sciences*, **54**, 381–392.
- Pola, M., Cervera, J.L. & Gosliner, T.M. 2005a. Review of the systematics of the genus *Roboastra* Bergh, 1877 (Nudibranchia, Polyceridae, Nembrothinae) with the description of a new species from Galápagos Islands. *Journal of the Linnean Society*, **144**, in press.
- Pola, M., Cervera, J.L. & Gosliner, T.M. 2005b. Four New Species of *Tambja* Burn, 1962 (Mollusca: Nudibranchia: Polyceridae) from the Indo-Pacific. *Journal of Molluscan Studies*, **71**, in press.
- Schick, K.-L. & Cervera, J.L., 1998. Description of a new species in the genus *Tambja* Burn, 1962 (Gastropoda: Nudibranchia: Polyceratidae) from southern Spain. *The Veliger*, **41**(4), 344–350.

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