# New records of *Tindariopsis* (Pelecypoda, Protobranchia) from Brazil - Campos Basin (off Rio de Janeiro)

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***Abstract:*** As a part of the Environmental Characterization of the Campos Basin project, we obtained samples from the continental slope benthos. As a consequence, specimens of *Tindariopsis aeolata* (Dall, 1889) and *Tindariopsis agathida* (Dall, 1889) were found. These species show prodissoconch surface sculpture patterns that were never seen for species of *Tindariopsis*. The presence of this kind of sculpture in the type species of the genus, *T. agathida*, adds diagnostic characters to the genus. *T. agathida* and *T. aeolata* are typical from the Caribbean Realm (Guyana and Tobago). This is the first record of *T. aeolata* in the southernmost area of the Atlantic Ocean, and also the shallowest record (1000 m) for this species. With this finding of specimens from the Bacia de Campos, the distribution of *T. agathida* can now be extended in the Brazilian coast from 7° to 22° S.
***Keywords:*** *deep-Sea, Bathyspinulidae, southeast Brazil, geographical distribution.*

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***Resumo:*** Como parte do projeto de Caracterização Ambiental da Bacia de Campos obtivemos uma série de amostras do talude continental. Como conseqüência foram encontrados exemplares de *Tindariopsis aeolata* (Dall, 1889) e *Tindariopsis agathida* (Dall, 1889). Ambas as espécies apresentam um padrão de escultura na superfície da prodissoconcha ainda não encontrado em espécies de *Tindariopsis*. A presença deste tipo de escultura na espécie tipo do gênero, *T. agathida*, adiciona características diagnósticas para o gênero. *T. agathida* e *T. aeolata* são espécies típicas do Domínio do Caribe (Guiana e Tobago). Este é o primeiro registro de *T. aeolata* na região mais ao sul do Oceano Atlântico, e também o registro batimétrico mais raso (1000 m) referido para a espécie. Com o encontro destes espécimes da Bacia de Campos, a distribuição geográfica de *T. agathida* pode ser então estendida, na costa brasileira, de 7° S até 22° S.
***Palavras-chave:*** *mar profundo, Bathyspinulidae, sudeste do Brasil, distribuição geográfica.*

## Introduction

The Protobranchia is the most abundant group of Pelecypoda in deep waters (400-5000 m), with about 29% of the species belonging to this class, and increasing to almost 58% in the abyssal plain (Allen 2008). Even with the increasing number of reports on deep-sea mollusks off Brazil (e.g., Domaneschi & Lopes 1990, Caetano et al. 2006, Oliveira & Absalão 2007, 2008, 2009, 2010a, b, Simone & Cunha 2008a, b, Passos & Birman 2009, Absalão 2009), with the exception of the genus *Yoldiella* Verrill & Bush, 1897 (Benaim 2010, Benaim & Absalão 2011, Benaim & Absalão in press), the protobranchs remain very poorly known.

The shell of *Tindariopsis* Verrill & Bush, 1897 is characterized by the presence of a short rostrum, defined by a radial ridge and a furrow, as well as a dorsal ligament furrow and a special area under the umbones to accommodate the external ligament (Verrill & Bush 1897, La Perna 2008).

There is no reference to the occurrence of this genus in the last Brazilian catalog of Mollusks (Rios 2009). Indeed, the species of *Tindariopsis* do not occur with much frequency, and no other catalog of Mollusks from the Atlantic has recorded species of *Tindariopsis* from the southernmost area of the Atlantic (e.g. Brazil, Uruguay or Argentina). However, one specimen of *T. agathida* (Dall, 1889) was recorded off Brazilian coast (Pernambuco) by Allen & Sanders (1996).

*Tindariopsis aeolata* Dall, 1889 was recorded solely for the type locality (Tobago) and Guiana (Dall 1889, Allen & Sanders 1996). Here we present the first record of *T. aeolata* off Brazilian coast, and the southernmost record for *T. agathida,* also providing illustrations of the type of each species.

## Materials and Methods

The samples used in the present study were collected with a box corer in the Campos Basin, off Brazil (22° S and 41° W), by the Petrobras S.A. (Brazilian Oil Co.) research vessel "Astro-Garoupa". The expeditions were part of the program "Environmental Characterization of Campos Basin, RJ, Brazil" in the years 2002 and 2003. Of the 100 stations sampled, specimens of *Tindariopsis* were present at 31, located between the isobaths of 1000 and 1950 m. The list of localities is given in Table 1. Most of the shells were in a good state of preservation, although no live specimens were found. Each specimen was examined under magnification, and selected specimens were photographed with a SEM (ZEISS EVO 40), at the Gerência de Bioestratigrafia e Paleoecologia Aplicada (BPA), of the Petrobrás

**Table 1.** Table of the given localities.

| Station | Depth | Latitude | Longitude | Date |
|---|---|---|---|---|
| 38 | 1100 | 22° 41' 18,79" S | 40° 14' 05,93" W | 15/05/2002 |
| 41 | 1200 | 22° 39' 34,36" S | 40° 08' 22,27" W | 15/05/2002 |
| 47 | 1650 | 22° 11' 04,40" S | 39° 47' 04,60" W | 25/11/2002 |
| 48 | 1950 | 22° 11' 16,63" S | 39° 43' 44,70" W | 25/11/2002 |
| 53 | 1950 | 22° 04' 46,20" S | 39° 43' 02,02" W | 24/11/2002 |
| 61 | 1350 | 21° 52' 51,90" S | 39° 48' 11,68" W | 12/12/2002 |
| 62 | 1650 | 21° 52' 41,91" S | 39° 46' 17,52" W | 11/12/2002 |
| 63 | 1950 | 21° 52' 44,10" S | 39° 40' 45,60" W | 11/12/2002 |
| 66 | 1350 | 22° 44' 48,61" S | 40° 10' 07,68" W | 22/11/2002 |
| 68 | 1950 | 22° 48' 05,28" S | 40° 06' 38,64" W | 15/11/2002 |
| 73 | 1950 | 22° 41' 35,24" S | 40° 00' 45,24" W | 22/11/2002 |
| 75 | 1050 | 22° 31' 28,28" S | 40° 03' 50,40" W | 19/11/2002 |
| 76 | 1350 | 22° 34' 05,75" S | 40° 00' 10,34" W | 19/11/2002 |
| 77 | 1650 | 22° 36' 03,37" S | 39° 57' 54,68" W | 16/11/2002 |
| 80 | 1050 | 22° 24' 31,58" S | 39° 57' 28,05" W | 20/11/2002 |
| 82 | 1650 | 22° 28' 49,50" S | 39° 53' 24,33" W | 17/11/2002 |
| 83 | 1950 | 22° 30' 35,35" S | 39° 51' 45,42" W | 23/11/2002 |
| 85 | 1350 | 22° 29' 33,89" S | 39° 56' 17,64" W | 19/11/2002 |
| 46 | 1336 | 22° 10' 54,60" S | 39° 48' 59,50" W | 25/06/2003 |
| 53 | 1910 | 22° 04' 45,40" S | 39° 41' 58,50" W | 27/06/2003 |
| 58 | 1942 | 21° 57' 26.80" S | 39° 40' 34.00" W | 27/06/2003 |
| 62 | 1650 | 21° 52' 41,50" S | 39° 46' 17,00" W | 26/06/2003 |
| 63 | 1941 | 21° 52' 43,10" S | 39° 40' 41,60" W | 26/06/2003 |
| 66 | 1323 | 22° 44' 49,50" S | 40° 10' 06,60" W | 11/06/2003 |
| 68 | 1972 | 22° 48' 05,90" S | 40° 06' 38,60" W | 12/06/2003 |
| 72 | 1623 | 22° 41' 10.80" S | 40° 02' 20.30" W | 13/06/2003 |
| 73 | 1903 | 22° 41' 31.90" S | 40° 00' 47.00" W | 12/06/2003 |
| 75 | 1050 | 22° 31' 28,30" S | 40° 03' 49,30" W | 18/06/2003 |
| 78 | 1945 | 22° 37' 02,90" S | 39° 56' 20,10" W | 13/06/2003 |
| 81 | 1350 | 22° 26' 28,50" S | 39° 54' 08,30" W | 21/06/2003 |
| 86 | 1630 | 22° 31' 37,20" S | 39° 55 '14,50" W | 16/06/2003 |

Research Center (Centro de Pesquisas da Petrobrás—CENPES). Taxonomic identifications were made through comparison with the figures of the type material held at the National Museum of Natural History (Smithsonian Institution), Washington, D.C. (USNM). All the specimens examined in this study are deposited in the Mollusca collection of the Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro (IBUFRJ).

## *1. Systematics*

SUPERFAMILY NUCULANOIDEA ADAMS & ADAMS

FAMILY BATHYSPINULIDAE COAN & SCOTT, 1997

*Tindariopsis* Verrill & Bush, 1897

Type species: *Tindariopsis agathida* (Dall, 1889) original designation.

***Tindariopsis agathida* (Dall, 1889) (Figures 1-13)**

*Malletia* (*Tindaria*) *agathida*: Dall (1889), 252, pl.13, fig. 10.

*Tindaria* (*Tindariopsis*) *agathida*: Verrill & Bush (1897), 59.

*Saturnia* (*Tindariopsis*) *agathida*: McAlester (1969), N235.

*Neilonella* (*Tindariopsis*) *agathida*: Laghi (1984), 190, pl8, Figs. 2-6.

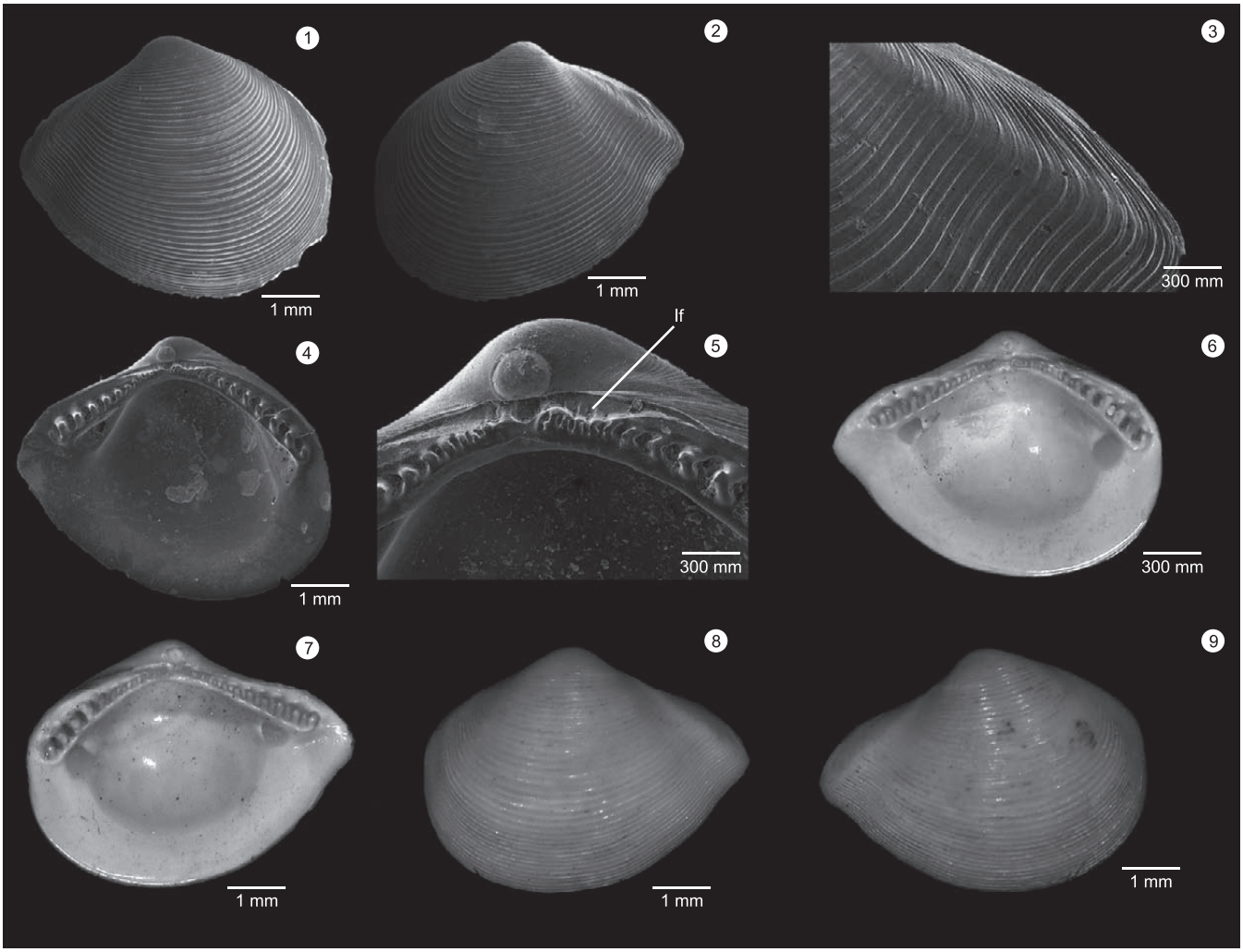
*Tindariopsis agatheda*: Allen & Sanders (1996), 116; Allen (2008), 68, 107, 108, 112, 156.

**Holotype:** USNM 95437 (Figures 6-9).

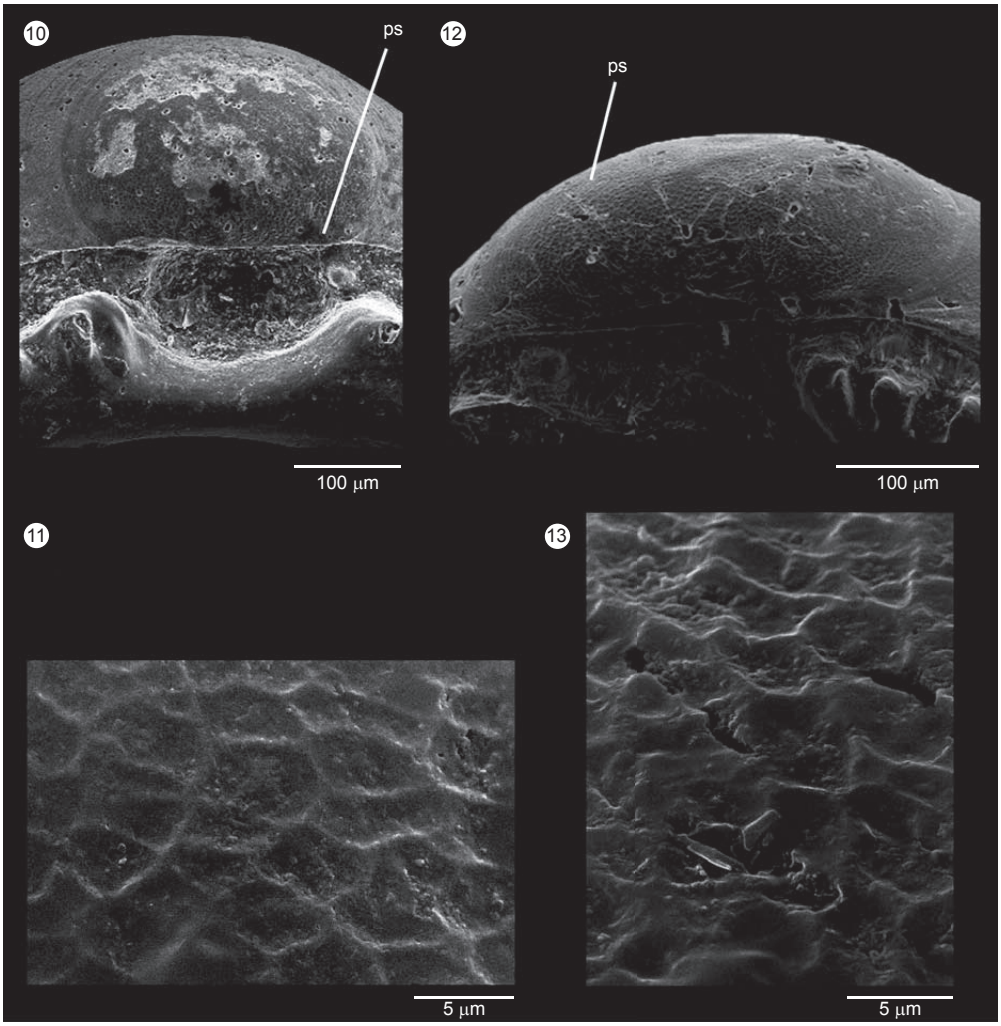
**Type locality:** East of Tobago, 11° 40' N and 58° 33' W.

**Geographical distribution:** Tobago, 1609 m (Dall 1889); Guyana, 1456-2500 and Brazil – Pernambuco, 943-1007 m (Allen & Sanders 1996); Brazil – Campos Basin, 1000-1950 m (present study). This is the southernmost record for this species.

**Material examined**: All from Campos Basin (Brazil). IBUFRJ 16198 (station 66, 2002), 1 valve; IBUFRJ 16199 (station 66, 2002), 1 valve; IBUFRJ 17676 (station 66, 2003), 1 valve; IBUFRJ 18913 (station 81, 2003), 3 valves; IBUFRJ 18914 (station 61, 2002), 2 valves; IBUFRJ 18915 (station 76, 2002), 1 valve; IBUFRJ 18916 (station 85, 2002), 2 valves; IBUFRJ 18917 (station 80, 2002), 1 valve; IBUFRJ 18918 (station 86, 2003), 2 valves; IBUFRJ 18919 (station 77, 2002), 1 valve; IBUFRJ 18920 (station 46, 2002), 1 valve; IBUFRJ 18921 (station 38, 2002), 2 valves; IBUFRJ 18922 (station 41, 2002), 7 valves.




**Figures 1-9.** *Tindariopsis agathida* (Dall, 1889). 1-5 Campos Basin specimens. External view. 1 – right valve, 2 – left valve, 3 – Detail of the rostral keel and furrow. Internal view, 4 – left valve, 5 – detail of the resilifer, *lf* – ligament furrow. 6-9, holotype USNM 95437. Internal view, 6 – left valve, 7 – right valve. External view, 8 – left valve, 9 – right valve.




**Figures 10-13.** *Tindariopsis agathida* (Dall, 1889). 10-13 prodissoconch, *ps* – prodissoconch surface. 11,13 detail of the prodissoconch.

**Diagnosis:** Shell rounded to sub-quadrate, posterior end with keeled rostrum and subrostral sulcus. Internal part of ligament placed in a furrow, under umbones, parallel to teeth line and interrupted by edentulous space. Prodissoconch surface with alveolar sculpture.

**Characterization:** Shell oval to sub-quadrate, inflated, stout, umbones not prominent. Anterior area longer than posterior one. Antero-dorsal margin convex, anterior margin rounded in adults and blunted in juveniles; antero-ventral area projected. Postero-ventral margin almost straight, rising to a keeled posterior end with a sulcus that defines the supramedial rostral area (Figure 3). Surface ornamented with concentric ridges. Ligament amphidetic, mainly external, with internal component placed in a ligament furrow under umbones, parallel and above teeth line and interrupted by edentulous space (Figure 5). Hinge plate with 10 anterior and 14 posterior teeth, the proximal being considerably smaller. Prodissoconch with organized alveolar sculpture (Figures 10-13) and 300 μm in length. Maximum shell length of adult specimens from Campos Basin, 6 mm.

**Remarks:** *T. agathida* is a well-documented and well-discussed species (Verrill & Bush 1897, Laghi 1984, Allen & Sanders 1996, La Perna 2008). As pointed out by La Perna (2008), *T. agathida* is similar to species of *Bathyspinula* Filatova, 1958 and shares many features including the pointed, supra medial, keeled rostrum, the well-defined subrostral sulcus, and the long, mainly external, amphidetic ligament, with a small internal component, which tends to a semi-external position, directly under the beaks above the tooth line. Special effort is necessary to observe an organized alveolar sculpture on the prodissoconch (**Figures 10-13**). This kind of feature was not previously recorded for this species or for any other member of Bathyspinulidae, probably because it is visible only in SEM images.

***Tindariopsis aeolata* (Dall, 1889)** (Figures 14-24)

*Malletia (Tindaria) aeolata*: Dall (1889), 252.

*Tindaria* (*Tindariopsis*) *aeolata*: Dall (1898), 582.

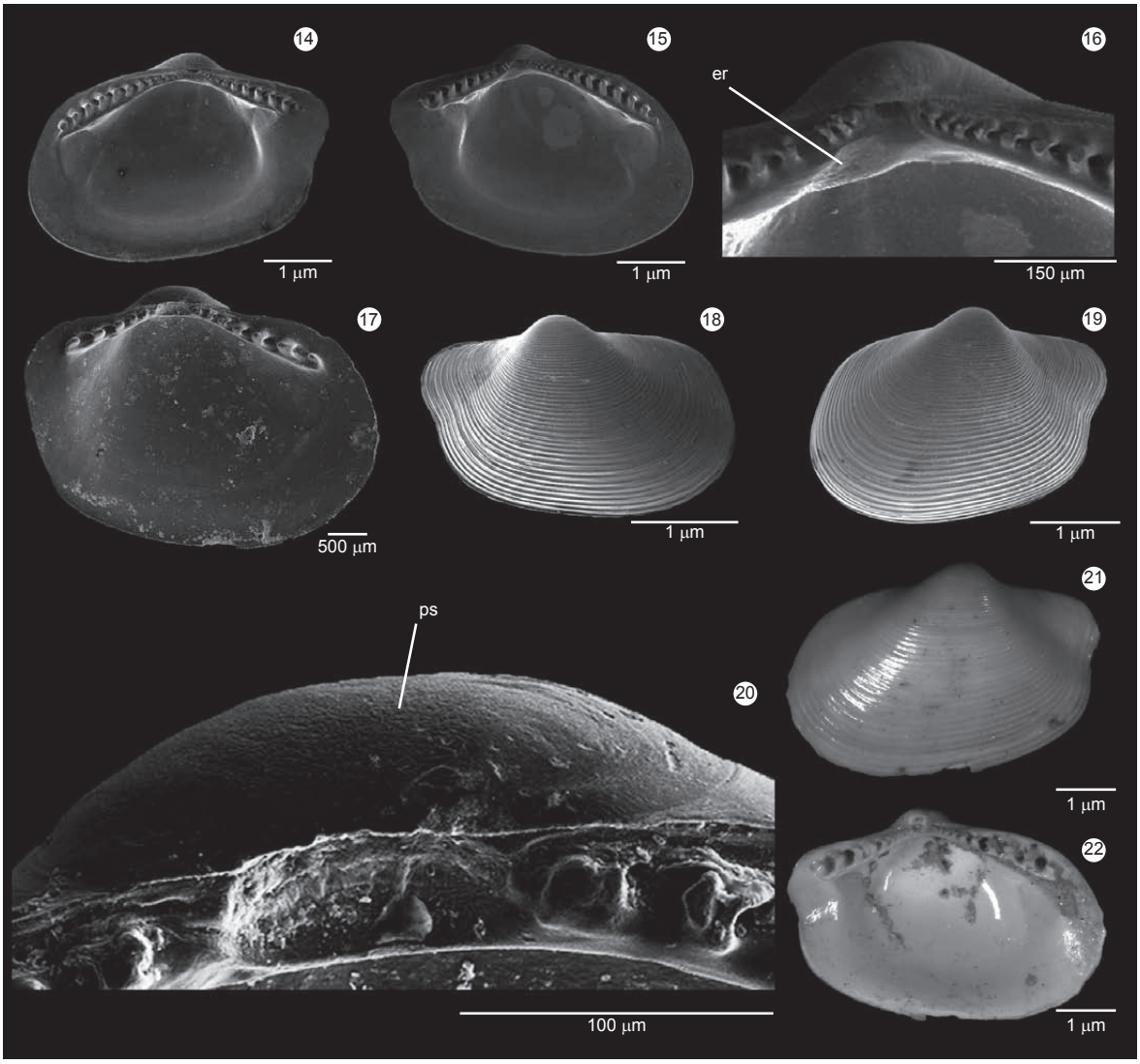
*Tindariopsis aeolata*: Allen & Sanders (1996), 119.

**Type specimen:** USNM 95436 (Figures 21-22).

**Type locality:** East of Tobago, 11° 40' N and 58° 33' W.

**Geographical distribution:** Tobago, 1609 m (Dall 1889); Guyana, 1942-2500 m (Allen & Sanders 1996); Brazil – Campos Basin, 1000-1950 m (present study). This is the shallowest record, and the first record of this species for Brazilian waters.

**Material examined:** All from Campos Basin (Brazil). IBUFRJ 18892 (station 68, 2003), 4 valves; IBUFRJ 18893 (station 78, 2003), 3 valves and 1 individual; IBUFRJ 18894 (station 48, 2002), 5 valves and 1 individual; IBUFRJ 18895



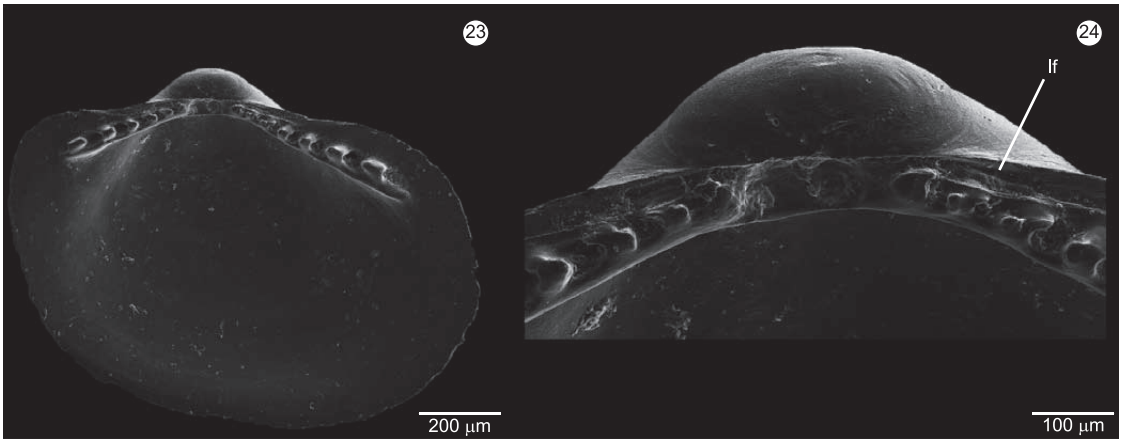

**Figures 14-22.** *Tindariopsis aeolata* (Dall, 1889). 14-20 Campos Basin specimens. Internal view, 14 –right valve, 15 – left valve, 16 – detail of the resilifer, *er* – expansion of the resilifer, 17 – juvenile stage, left valve. External view, 18 – right valve, 19 – left valve. 20 – detail of prodissoconch, *ps*-prodissoconch surface. 21-22, holotype USNM 95436. Left valve, 21 – external view, 22 – internal view.

(station 83, 2002), 1 individual; IBUFRJ 18896 (station 72, 2003), 1 individual; IBUFRJ 18897 (station 75, 2002), 1 valve and 2 individuals; IBUFRJ 18898 (station 68, 2002), 2 valves; IBUFRJ 18899 (station 83, 2002), 1 valve; IBUFRJ 18900 (station 53, 2003), 11 valves; IBUFRJ 18901 (station 82, 2002), 2 valves and 1 individual; IBUFRJ 18902 (station 47, 2002), 1 valve; IBUFRJ 18903 (station 73, 2002), 5 valves; IBUFRJ 18904 (station 62, 2003), 1 valve; IBUFRJ 18905 (station 63, 2003) 8 valves; IBUFRJ 18906 (station 53, 2002), 4 valves; IBUFRJ 18907 (station 77, 2002), 1 valve; IBUFRJ 18908 (station 73, 2003), 2 valves; IBUFRJ 18909 (station 58, 2003), 1 valve; IBUFRJ 18910 (station 63, 2003), 2 valves; IBUFRJ 18911 (station 75, 2003), 2 valves; IBUFRJ 18912 (station 62, 2002), 1 valve.

**Diagnosis:** Shell sub-rectangular, posterior end with rounded rostrum and subrostral sulcus. Internal part of ligament placed in thin furrow, parallel to teeth line and interrupted by edentulous space. Prodissoconch surface with random irregular sculpture.

**Characterization:** Shell sub-rectangular, inflated, stout, prominent umbones. Anterior area longer than posterior one. Antero-dorsal area slightly convex, anterior margin blunted in adults and rounded in juveniles; antero-ventral area rounded. Ventral margin almost straight, but rising to a slightly rounded postero-ventral margin. Posterior end with sulcus that defines the supramedial rounded rostral area. Surface ornamented with concentric ridges. Ligament amphidetic, mainly external, with an internal component placed in a thin ligament furrow parallel to and above teeth line (Figure 16). Hinge plate with 13-14 anterior and 7-10 posterior teeth, the proximal being considerably smaller. Prodissoconch with random irregular sculpture resembling low concretions (Figure 20) and 350 μm in length. Maximum length of adult specimens from Campos Basin, 5.5 mm.

**Remarks:** As pointed out by Allen & Sanders (1996), this species shows a peculiar anatomical arrangement of the hindgut, which is not seen in other protobranchs, and is also different from *T. agathida*. Comparing to this last species, conchological differences include the absence of regular ornamentation on the larval shell in specimens of *T. aeolata*, the rectangular general outline, and the presence of an extension of the resilifer under the hinge plate in this species (Figure 16). In *T. aeolata* the dorsal




**Figures 23-24.** *Tindariopsis aeolata* (Dall, 1889). Juvenile stage. 23 – internal view of a left valve. 24 –detail of the ligament furrow (*lf*).

ligament furrow is more subtle than in *T. agathida*, but is clearly discernible in juveniles (Figure 24).

The differences in the hindgut alone do not allow this species to be placed in other genera (Allen & Sanders 1996), and other differences also do not seem pronounced enough. On the other hand, the presence of unequal adductor muscles, a pointed, supra medial, keeled rostrum, and a well-defined subrostral sulcus indicate that the species should be retained in the genus *Tindariopsis*.

## Conclusions

*Tindariopsis aeolata* is recorded for the first time to east of South America and to its shallowest record; *Tindariopsis agathida* spread its geographic distribution from 8° S to 21° S; a new conchological character (an alveolar sculpture in the prodissoconch) is discovered in the type-species of genus *Tindariopsis*.

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