

The Ascidiidae (Ascidiacea: Tunicata) of Coastal Brazil

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Nadia Yukiji Koto Bonnet and Rosana Moreira da Rocha (2011) The Ascidiidae (Ascidiacea: Tunicata) of coastal Brazil. *Zoological Studies* 50(6): 809-825. The Brazilian Ascidiidae comprise 7 species: *Phallusia nigra*, *P. recifensis*, *Ascidia curvata*, *A. interrupta*, *A. multitentaculata*, *A. santosi*, and *A. sydneyensis*. In this study, we report a Caribbean species (*A. tenue*) and a Pacific species (*A. cf. tapuni*) in coastal Brazil, and we describe 3 new species. We also provide a complementary description of the type specimen of *A. santosi* and an identification key for Brazilian species. <http://zoolstud.sinica.edu.tw/Journals/50.6/809.pdf>

Key words: Ascidian, Biodiversity, Introduced species, Taxonomy, Tunicate.

Ascidian diversity along the Brazilian coast has been studied since the end of the 19th century (Van Name 1945). The family Ascidiidae Herdman, 1882 in Brazil comprises 7 species: *Phallusia nigra* Savigny, 1816, *P. recifensis* Millar, 1977, *Ascidia curvata* (Traustedt, 1882), *A. interrupta* Heller, 1878, *A. multitentaculata* (Hartmeyer 1912), *A. santosi* Millar, 1958, and *A. sydneyensis* Stimpson, 1855. While only *P. recifensis* and *A. santosi* are endemic, neither has ever been found again after their 1st description. The other species are relatively widespread along the western Atlantic Ocean in tropical and subtropical waters (Van Name 1945, Millar 1958 1977, Rodrigues et al. 1998, Marins et al. 2010).

The long Brazilian coast has a wide variety of habitats for ascidians: natural and artificial hard substrates in different latitudes and environmental conditions, isolated by long extensions of sandy beaches and mangrove forests. Thus, one might expect a high species diversity, typical of tropical regions. Indeed, surveys of new stretches of the coast showed that many species are still undescribed, including even relatively large animals

such as those in the family Ascidiidae. With the recent increase in shipping and aquaculture, the arrival and establishment of exotic species have been facilitated, thus increasing the need for a better understanding and identification of the native fauna. Towards this end, this study is a revision of Brazilian species in the family Ascidiidae.

MATERIALS AND METHODS

Samples were collected in Pernambuco (PE), Bahia (BA), Espírito Santo (ES), Rio de Janeiro (RJ), São Paulo (SP), Paraná (PR), and Santa Catarina (SC) States, between 1986 and 2009, on natural and artificial substrates. Specimens were anesthetized in menthol and fixed with 4% neutral formaldehyde in seawater. Specimens were dissected and observed under a dissecting microscope, and internal structures were stained with Harris hematoxylin dye.

The holotype and some of the paratypes of the new species were placed in the collection of the Museu de Zoologia da Univ. de São Paulo

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(MZUSP), with the remaining paratypes in the Ascidiacea Collection in the Departamento de Zoologia, Univ. Federal do Paraná (DZUP), Curitiba, Paraná State, Brazil. Specimens of known species were deposited in the DZUP and in the Coleção de Tunicados do Instituto de Ciências do Mar da Univ. Federal do Ceará (CIDRO), Fortaleza, Ceará State, Brazil.

RESULTS

We found 9 species, four of which were previously known for the western Atlantic Ocean (*P. nigra*, *A. curvata*, *A. cf. multitentaculata*, and *A. sydneyensis*), one was previously known from the Caribbean Sea (*A. tenue* Monniot, 1983), and one was known from the Pacific Ocean (*A. cf. tapuni* Monniot and Monniot, 1987). Additionally, we describe 3 new species. A tabular key to identify species was prepared from observed characters and is complemented with descriptions based on published information (Table 1).

Phallusia nigra Savigny, 1816

For synonyms see *Phallusia nigra* Monniot 1983: 62.

Material examined: DZUP PHA10, 4 individuals (ind.), Quebramar Sul, BA (12°58'22"S, 38°31'09"W), 2-3 m depth, 10 June 2004, coll. R.M. Rocha. DZUP PHA29, 3 ind., Enseada Meia-Lua, I. dos Pargos, Cabo Frio, RJ (22°51'28"S, 41°54'30"W), 7 m depth, 30 Mar. 2011, coll. I. Neves. DZUP PHA16, 2 ind., São Sebastião, SP (23°49'S, 45°25'W), 21 Mar. 1987, coll. R.M. Rocha. DZUP PHA11, 1 ind., Velazquez shipwreck, Ilhabela, SP (23°53'50"S, 45°27'42"W), 30 Nov. 2008, coll. L.P. Kremer. DZUP PHA12, 1 ind., Ilhabela, SP, 1 Dec. 2008, coll. L.P. Kremer. DZUP PHA13, 2 ind., Parcel da Coroa de Fora, Ilhabela, SP (23°47'22"S, 45°08'46"W), 5 Dec. 2008, coll. L.P. Kremer.

Diagnosis: Tunic smooth and black (but in young individuals can be gray); musculature on right side of body a net of thick fibers; dorsal tubercle U-shaped, usually without inrolled

Table 1. Key for identification of species of Ascidiidae in Brazil

Species	1*	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>Phallusia nigra</i>	B	S	0	V	B	30-100	P	0	4-9	> 1/2	6-7	0	M	C/R
<i>Ascidia curvata</i>	U	S	0	V	0	70-150	0	0	5-7	> 1/2	10-24	0	S	C
<i>A. tenue</i>	U	S	0	V	0	70-165	0	P	2-5	> 1/2	6-8	0	S	C
<i>A. interrupta</i>	V	R	0	V	0	45-140	0	P/0	4-10	1/2	11-16	P	S	C
<i>A. cf. tapuni</i>	O	S	0	V	0	80-105	0	0	3-4	1/2	0-2	P	S	R
<i>A. nordestina</i>	?	S	P	V	0	75-100	0	P	3-5	> 1/2	5-7	0	S	R
<i>P. recifensis</i>	I	E	?	D	0	39-42	P	?	2-3	< 1/2	?	P	S	?
<i>A. santosi</i>	B	E	P	L	B	130-175	0	0	4-6	1/2	?	0	B	C
<i>A. papillata</i>	?	S	P	D	B	210-260	0	P	3-5	> 1/2	4-5	0	B	R
<i>A. cf. multitentaculata</i>	?	S	P	B	B	100-250	0	0	5-6	> 1/2	3-4	0	B	R
<i>A. sydneyensis</i>	V	E	P	B	B	35-285	0	0	6-12	> 1/2	5-9	P	M	R
<i>A. scalariforme</i>	U	C	0	B	0	60-150	0	P	3-5	1/2	7-10	P	S	R

*1. Color of living specimens: U, uncolored or white; B, black or gray; O, orange; V, various colors; I, totally encrusted with sediment. 2. Tunic surface: E, elongated projections; C, conical projections; R, round or hemispheric projections; S, smooth. 3. Projections along the siphon lobe margins: P, present; 0, absent. 4. Musculature on the right side: B, parallel short fibers forming a band along the margin; D, parallel short fibers forming a band only on the dorsal margin; L, extension of longitudinal fibers of the siphons; V, in various directions. 5. Longitudinal musculature in the siphons: B, forming bands corresponding to each lobe; 0, without such a pattern. 6. Number of oral tentacles. 7. Accessory openings along the neural gland duct: P, present; 0, absent. 8. Papillae on the right side of the dorsal lamina wall, near the esophageal aperture: P, present; 0, absent. 9. Number of stigmata per mesh. 10. Size of the digestive tract: > 1/2 the size of the left side; equal to 1/2 the size of the left side; < 1/2 the size of the left side. 11. Number of plications in the stomach wall. 12. Dilation of the posterior intestine: P, present; 0, absent. 13. Margin of the anus: S, smooth; B, bilobed; M, multilobed. 14. Shape of the ovary: C, cauliflower (i.e., lobed and concentrated inside the intestinal loops); R, elongated and ramified (usually showing branches crossing over the intestinal wall).

ends; many papillae in prepharyngeal area; 16-36 accessory openings along neural gland duct; longitudinal vessels in pharynx converging to dorsal lamina in anterior region; 6-9 stigmata per mesh; dilated posterior intestine; multilobed anal margin.

Distribution: Bermuda, United States (Florida, Hawaii), Caribbean Sea, Gulf of Mexico, Brazil, Guinea, Angola, Mediterranean Sea, Red Sea, Gulf of Aden, Indian Ocean, Japan.

***Ascidia curvata* (Traustedt, 1882)**

For synonyms see *Ascidia curvata* Monniot 1983: 65.

Material examined: DZUP ASC09, 1 ind., Encantadas Beach, Mel I. PR (25°34'04"S, 48°18'28"W), 4 Aug. 1997, coll. A.S. Silva. DZUP ASC41, 1 ind., Galheta I., PR (25°35'S, 48°19'W), 11 Mar. 2004, coll. L.P. Kremer.

Diagnosis: Tunic whitish and translucent; body musculature on right side a net of fibers that in ventral region are parallel; dorsal tubercle U-shaped, with or without inrolled ends; papillae in prepharyngeal area; papillae absent from right face of dorsal lamina close to esophageal aperture; 10-24 longitudinal folds in stomach; isodiametric intestine; 5-7 stigmata per mesh in pharynx; ovary lobed.

Distribution: Bermuda, United States (Florida), Cuba, Jamaica, Puerto Rico, Guadeloupe, Martinique, Saint Thomas, Panama, Aruba, Curaçao, Bonaire, Brazil.

***Ascidia cf. multitentaculata* (Hartmeyer, 1912)**

Phallusia (Ascidia) multitentaculata Hartmeyer 1912: 279.
Ascidia multitentaculata Millar 1977: 205.

Material examined: DZUP ASC89, 1 ind., Blackadder shipwreck, BA (12°56'06"S, 38°30'42"W), 4.0-5.0 m depth, 14 July 2007, coll. L.P. Kremer. DZUP ASC88, 1 ind., Boa Viagem Beach, BA (12°55'56"S, 38°30'50"W), 5.0 m depth, under rock, 3 Aug. 1999, coll. R.M. Rocha. PALB BA SA31, 2 ind., Salvador, BA (12°58'21"S, 38°30'56"W), intertidal, 12 Aug. 1999, coll. T.M.C. Lotufo and S.A. Rodrigues. DZUP ASC42, 1 ind., Porto da Barra, BA (13°00'14"S, 38°32'02"W), 4.0 m depth, 6 June 2004, coll. R.M. Rocha. PALB ES VI27, 1 ind., Vitória, ES (20°19'20"S, 40°16'08"W), intertidal, 15 May 1999, coll. T.M.C. Lotufo and S.A. Rodrigues, PALB ES VI 28 C, 1

ind., intertidal, 17 May 1999, coll. T.M.C. Lotufo and S. Rodrigues. DZUP ASC87, 1 ind., São Sebastião, SP (23°49'S, 45°25'W), under bamboo floats, 1994, coll. R.M. Rocha.

Diagnosis: Siphon lobe border with projections; body musculature on right side comprising short fibers perpendicular to body margin; 100-250 oral tentacles; dorsal tubercle U-shaped, with convoluted ends; prepharyngeal area possibly with papillae; isodiametric intestine; anus bilobed; ovary ramified on intestinal wall.

Description: Individuals up to 3.5 cm, usually without sediment but possibly with some sand or colonial ascidians on free surface of tunic. No information available on color of live animals. After fixation, tunic almost transparent, cartilaginous (0.2-2.0 mm thick) and wrinkled, but without projections.

Body oblong, up to 2.4 cm in total length, 1.2 cm wide (without siphons). Oral siphon 0.3-0.7 cm long and with 8 lobes; atrial siphon 0.2-1.4 cm, with 6 lobes and displaced posteriorly 0.4-1.0 cm from circle of tentacles. Margins of both siphons toothed. Neural ganglion close to tentacles.

Musculature on right side of body comprising short fibers (0.1-0.25 mm thick) perpendicular to entire margin of body. On left side, short fibers perpendicular to dorsal margin of body. Longitudinal fibers in siphons arranged in well-defined bands.

There are 123-243 oral tentacles in 4 sizes: largest 2.0-4.7 mm long; no relationship between size of animal and number of tentacles. Prepharyngeal groove double with projections on anterior margin. Prepharyngeal area 0.3-1.0 mm wide, usually with papillae (0.02-0.04 mm in diameter). Dorsal tubercle U-shaped, with inrolled ends; small peritubercular area V-shaped. Dorsal lamina double and smooth anteriorly, single and toothed posteriorly; passing to left of esophageal aperture and continuing to end of pharynx, just posterior to stomach. Papillae absent from right side of dorsal lamina close to esophageal aperture. A thin lamina along right side of esophageal aperture. Pharynx with 29-43 longitudinal vessels on right side, 29-41 on left, and 61-88 transverse vessels (only number of transverse vessels varying with body size); slightly pleated and with 5 or 6 stigmata per mesh; primary papillae bilobed. No intermediate papillae nor parastigmatic vessels found.

Digestive tract occupying 1/2 or more than 1/2 of left side of body. Stomach small, rounded,

with 3 or 4 internal folds; intestine isodiametric; anus bilobed, 0.5-0.9 cm from oral tentacles. Small renal vesicles covering digestive tube.

Ovary ramified on both intestinal loops, visible both internally and externally; oocytes 100-200 μm in diameter. Testis comprised of small follicles that cover stomach and part of intestine. Gonoducts opening just posterior to anus.

Distribution: Brazil, South Africa.

Remarks: Millar (1977) described a specimen of *A. multitentaculata* collected in Bahia, that differs from the samples dissected here in a greater number of oral tentacles (340) and longitudinal vessels in the pharynx (80 per side). Despite these differences, we followed Millar (1977) and identified the specimens dissected in this study as *A. cf. multitentaculata*, because they have the characteristic musculature on the right side of the body, a large number of oral tentacles, and the isodiametric intestine. Unfortunately, the sample described by Millar is unavailable for comparison. The Brazilian specimens are possibly a new species, different from *A. multitentaculata* described by Hartmeyer (1912) in South Africa. From the descriptions, the African exemplars show a larger number of tentacles (estimated at around 400), the longest ones are slightly longer (6 mm) with 4 or 5 stigmata per mesh, and intermediate papillae in the pharynx, which are the main differences from Brazilian specimens. However, a comparison with the holotype is necessary because Hartmeyer did not describe the gonads nor give other details such as the number of longitudinal vessels or the presence of papillae in the prepharyngeal area and on the right side to the dorsal lamina.

***Ascidia nordestina* sp. nov. Bonnet and Rocha**
(Fig. 1)

Holotype: MZUSP 00024, 1 ind., Porto da Barra, BA (13°00'14"S, 38°32'02"W), 3.0-5.0 m depth, 16 Dec. 2007, coll. R.M. Rocha.

Paratypes: DZUP ASC176, 2 ind., Porto da Barra, BA (13°00'14"S, 38°32'02"W), 3.0-5.0 m depth, 16 Dec. 2007, coll. R.M. Rocha.

Other materials: CIDRO PALB PE CA 40, 1 ind., Paraíso Beach, Santo Agostinho Cape, PE (08°21'22"S, 34°57'16"W), 23 Nov. 1999, coll. T.M.C. Lotufo and S.A. Rodrigues.

Etymology: The specific name is a Portuguese word that indicates northeastern Brazil, where the species was found.

Diagnosis: Siphon border with projections;

body musculature as a net on right side of body; prepharyngeal groove with long projections on anterior margin; dorsal tubercle U-shaped, with or without inrolled ends; papillae in prepharyngeal area; papillae on right face of dorsal lamina near to esophageal aperture; 3-5 stigmata per mesh; 5-7 longitudinal folds in stomach; isodiametric intestine; ovary ramified.

Description: Individuals attach to substrate on the left side of body; free surface usually without sediment, but may have small colonies of ascidians. In preservative, tunic smooth or slightly wrinkled, translucent, thin (0.1-0.3 mm thick).

Oval body is 0.8-1.2 cm long (without siphons), 0.4-0.7 cm wide. Oral siphon 3.0-4.0 mm long, with 8 fringed lobes. Atrial siphon displaced posteriorly 2.9-3.4 mm from circle of oral tentacles; 2.0-3.0 mm long, with 6 fringed lobes. Both siphons with an orange spot between lobes. Neural ganglion 0.6-1.4 mm away from circle of oral tentacles.

Right side of body with net of muscular fibers, most with complete transverse fibers, 0.1-0.2 mm thick. Left side with short perpendicular fibers along dorsal margin of body and longitudinal fibers of oral siphon extending beyond oral tentacles. Longitudinal musculature in siphons not organized in bands.

There are 78-99 oral tentacles (this number not related to body size) of 3 sizes, largest of which 1.4-1.9 mm long. Prepharyngeal groove double, with long, finger-like projections on anterior margin; narrow prepharyngeal area covered by papillae (0.02-0.04 mm in diameter). Dorsal tubercle U-shaped, with or without inrolled ends; peritubercular area rounded. Dorsal lamina double, smooth anteriorly, toothed posteriorly. Dorsal lamina passing by esophageal aperture on its left and continuing to end of pharynx, just posterior to stomach. Right side of dorsal lamina with numerous papillae close to esophageal aperture. A narrow lamina on right side of esophageal aperture. Pharynx with 21-34 longitudinal vessels on right side, 17-29 on left, and 30-54 transverse vessels; largest individuals with more longitudinal and transverse vessels. Pharynx slightly pleated, with 3-5 stigmata per mesh; primary papillae bilobed. No intermediate papillae nor parastigmatic vessels found.

Alimentary canal large, occupying > 1/2 of left side of body. Stomach rounded, with 5-7 internal longitudinal folds; intestine isodiametric; anal rim plain, 3.0-6.0 mm distant from oral tentacles. Renal vesicles not conspicuous.

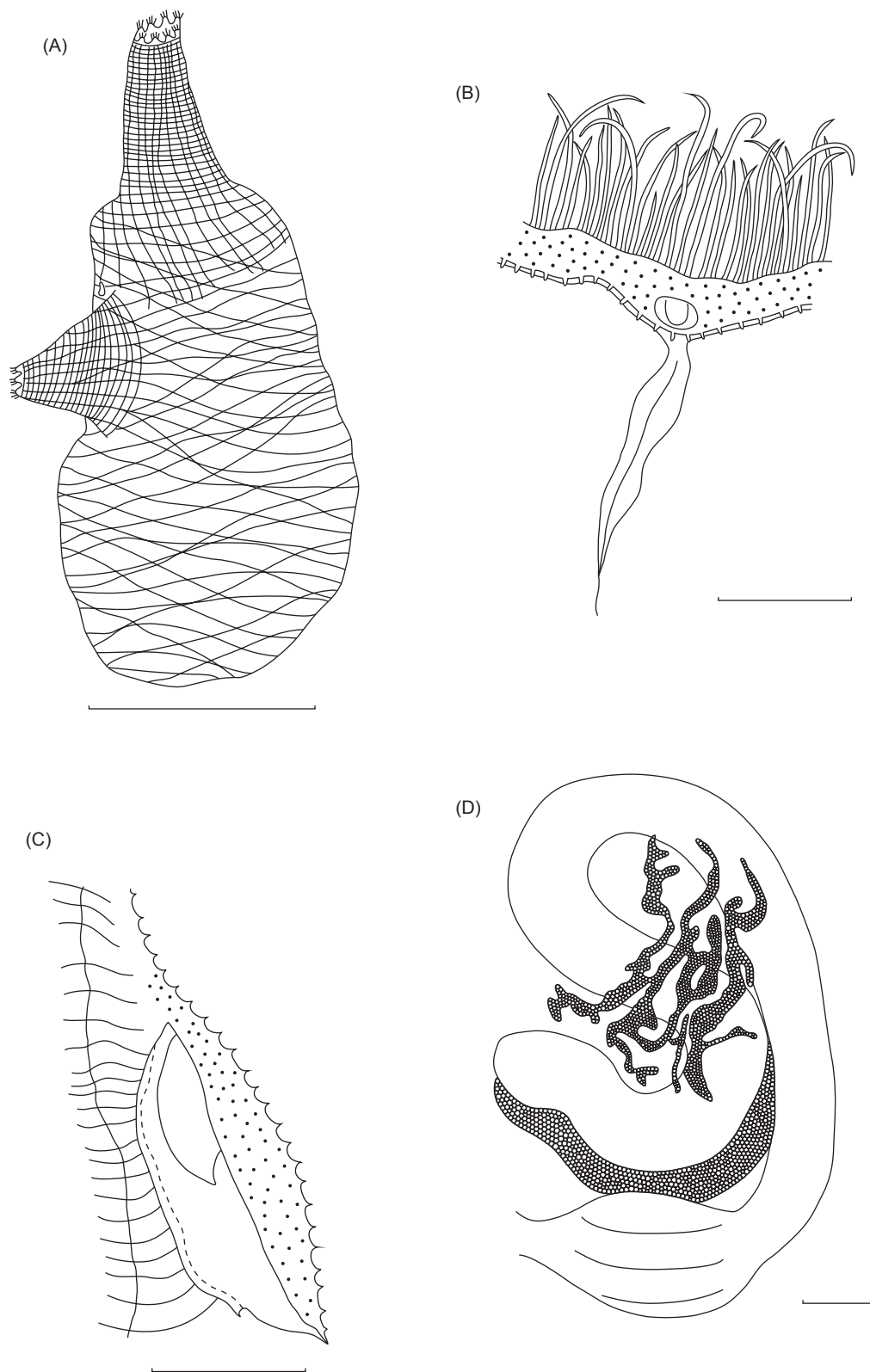


Fig. 1. *Ascidia nordestina* sp. nov. (A) Right side of body without tunic (external view). (B) Anterior region, showing the dorsal tubercle, part of the dorsal lamina, the prepharyngeal area, and groove. (C) Esophageal aperture (note the papillae on the dorsal lamina). (D) Digestive tube and ovary (internal view). Scale bars: A = 0.5 cm; B-D = 1.0 mm.

Ovary ramified on both intestinal loops when viewed from inside; from outside, visible only inside intestinal loops; oocytes 100-150 μm in diameter. Testis not seen.

Remarks: This species resembles *A. tenue* Monniot, 1983, but *A. nordestina* sp. nov. differs by having projections on the siphon lobe margins and by the ramified ovary (*A. tenue* has a lobed ovary). Another similar species is *A. collini* Bonnet and Rocha (2011), described from the Atlantic coast of Panama, which differs in having 7-10 atrial siphon lobes with smooth margins, longitudinal musculature in the siphons organized in bands, no projections in the prepharyngeal groove, and usually no papillae on the right face of the dorsal lamina. These characters clearly separate *A. collini* from *A. nordestina* sp. nov.

***Ascidia papillata* sp. nov. Bonnet and Rocha**
(Fig. 2)

Holotype: MZUSP 00025, 1 ind., Frades I., BA (12°48'51"S, 38°38'08"W), 3.0-4.0 m depth, 15 Dec. 2007, coll. L.P. Kremer.

Etymology: Many papillae on the right face of the dorsal lamina are the origin of the name of this species.

Diagnosis: Body musculature on right side formed only by short perpendicular fibers along dorsal margin of body; approximately 200 oral tentacles; dorsal tubercle U-shaped, without inrolled ends; papillae in prepharyngeal area; stomach with 4 or 5 longitudinal folds; isodiametric intestine; ovary ramified.

Description: Individual 4.1 cm in total length, and attaches to substrate by left side of body; free surface with some incrustations (sand and fragment of shells). In preservative, tunic translucent and slightly wrinkled, with longitudinal ridges along siphons corresponding to lobes. Tunic cartilaginous, 0.4 mm thick.

Elongated body 2.3 cm long (without oral siphon) and 1.2 cm wide. Oral siphon orange, with lobes; atrial siphon with 6 lobes and an orange spot between them, displaced posteriorly 0.7-0.8 cm from ring of oral tentacles. Both siphons long (1.0-1.2 cm), with fringed lobes. Neural ganglion closer to oral siphon.

Body musculature on right side comprising only fibers perpendicular to dorsal margin. These fibers usually 0.1-0.16 mm thick; short, but may reach middle of body. Left side with very short parallel fibers along dorsal line. Longitudinal fibers in siphons arranged in well-defined bands.

Approximately 260 oral tentacles, of 3 sizes, largest 4.4 mm long. Double prepharyngeal groove with projections on anterior margin; narrow prepharyngeal area (to 0.8 mm wide) with large papillae (0.03-0.04 mm in diameter). Dorsal tubercle U-shaped, without inrolled ends; small peritubercular area U-shaped. Dorsal lamina double, smooth anteriorly, toothed posteriorly; passing to left of esophageal aperture and continuing to end of pharynx, just posterior to stomach; many papillae on right side of dorsal lamina along almost all its extension, more concentrated near esophageal aperture. Thin lamina on right of esophageal aperture. Pharynx with 41 longitudinal vessels on right and 36 on left, 74 transverse vessels; very pleated with 3-5 stigmata per mesh. Primary papillae bilobed; no intermediate papillae or parastigmatic vessels found.

Alimentary canal occupying > 1/2 of left side of body. Stomach rounded, with 4 or 5 internal longitudinal folds. Intestine isodiametric; bilobed anus located approximately 0.8 cm from oral tentacles. Renal vesicles not conspicuous. Irregular projections covering entire atrial wall of alimentary canal.

Ovary ramified, conspicuous both internally and externally in both intestinal loops; oocytes 300-400 μm in diameter. Testis covering stomach and part of intestine. Both gonoducts full of gametes, opening just posterior to anus.

Remarks: *Ascidia multitentaculata* is very similar to *A. papillata* sp. nov., differing from the present species by the pattern of musculature on the right side of the body (*A. multitentaculata* has short fibers along the entire body margin) and the absence of papillae in the dorsal lamina close to the esophageal aperture. Another species similar to *A. papillata* sp. nov. is *A. incrassata* Heller, 1878, from South Africa; however it has fewer oral tentacles (41-88), a smooth prepharyngeal groove, a row of languets along the right side of the esophageal aperture, dorsal lamina without papillae, 6-9 stigmata per mesh, and a lobed ovary that is restricted to the primary intestinal loop (NYKB, pers. observ.).

Described from Santos (São Paulo), *A. santosi* Millar, 1958 is similar *A. papillata* sp. nov., but the study of the type material allows Millar's species to be distinguished by the 6 lobes in the oral siphon, body musculature formed only by the extension of the longitudinal fibers of the siphons to mid-body (Fig. 3B), fewer oral tentacles projecting from a wide muscular membrane, the

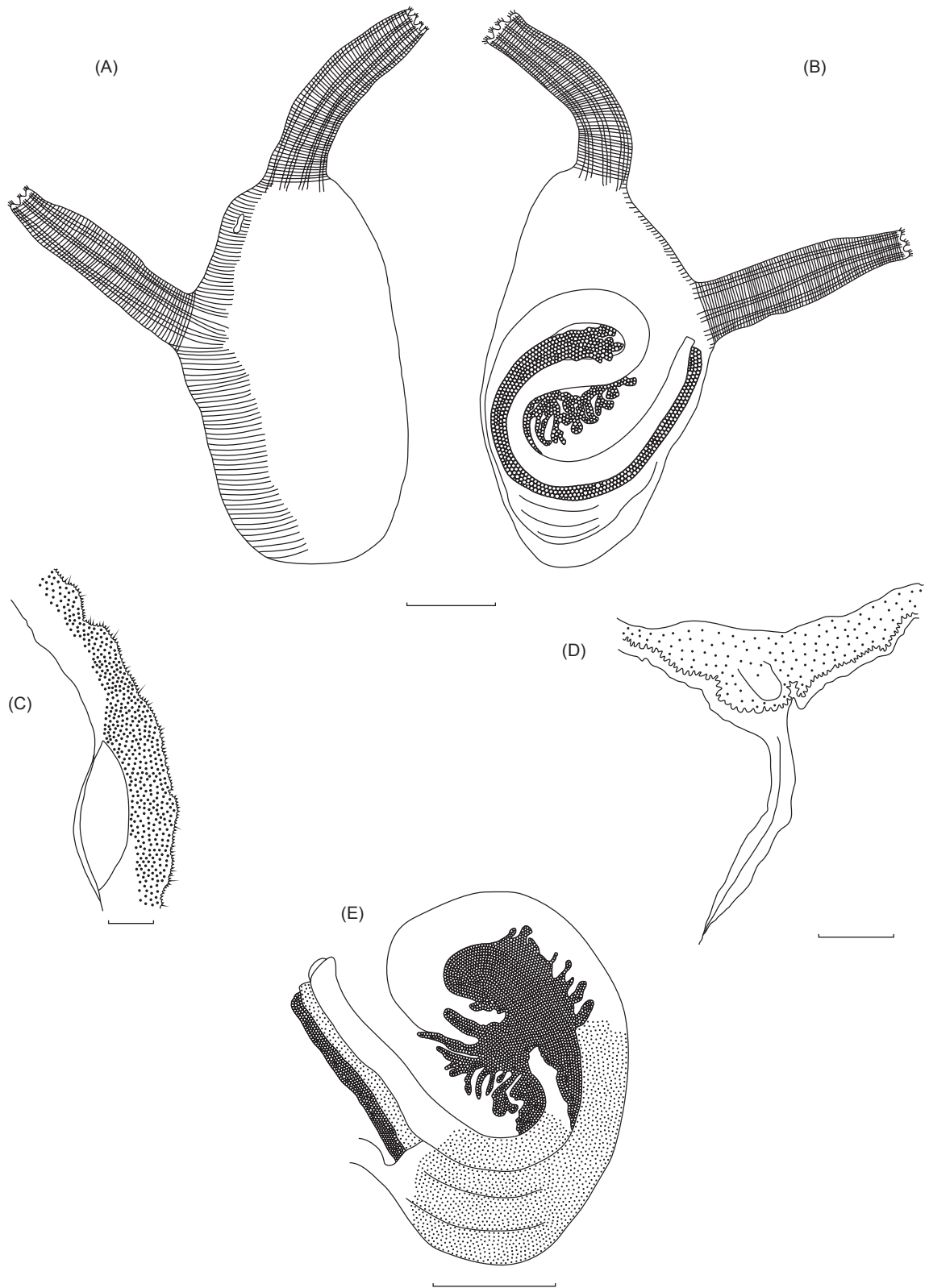


Fig. 2. *Ascidia papillata* sp. nov. (A) Right side of body without tunic (external view). (B) Left side of body without tunic (external view). (C) Papillae on right side of the dorsal lamina. (D) Anterior region, showing the dorsal tubercle, part of the dorsal lamina, the prepharyngeal groove, and the prepharyngeal area. (E) Digestive tube and ovary (internal view). Scale bars: A, B, E = 0.5 cm; C, D = 1.0 mm.

absence of papillae on the right face of the dorsal lamina near the esophageal aperture, and a lobed ovary in the primary intestinal loop (Millar 1958, and reexamination of the type; see following section).

***Ascidia santosi* Millar, 1958**
(Fig. 3)

Ascidia santosi Millar 1958: 503.

Material examined: 1959.3.16.1 (type specimen deposited in the British Museum), 1 ind.

Santos, SP.

Diagnosis: Tunic with thin projections in posterior region; long and apical siphons; body musculature formed only by extension of longitudinal fibers of siphons to mid-body on right side; 130-170 oral tentacles; projections in prepharyngeal groove; dorsal tubercle U-shaped; some papillae in prepharyngeal area; presence of intermediate papillae in pharynx; isodiametric intestine; anus bilobed; ovary compact, lobed.

Complementary description: Type specimen with a crown of thin projections of tunic on posterior region of body which appears to support

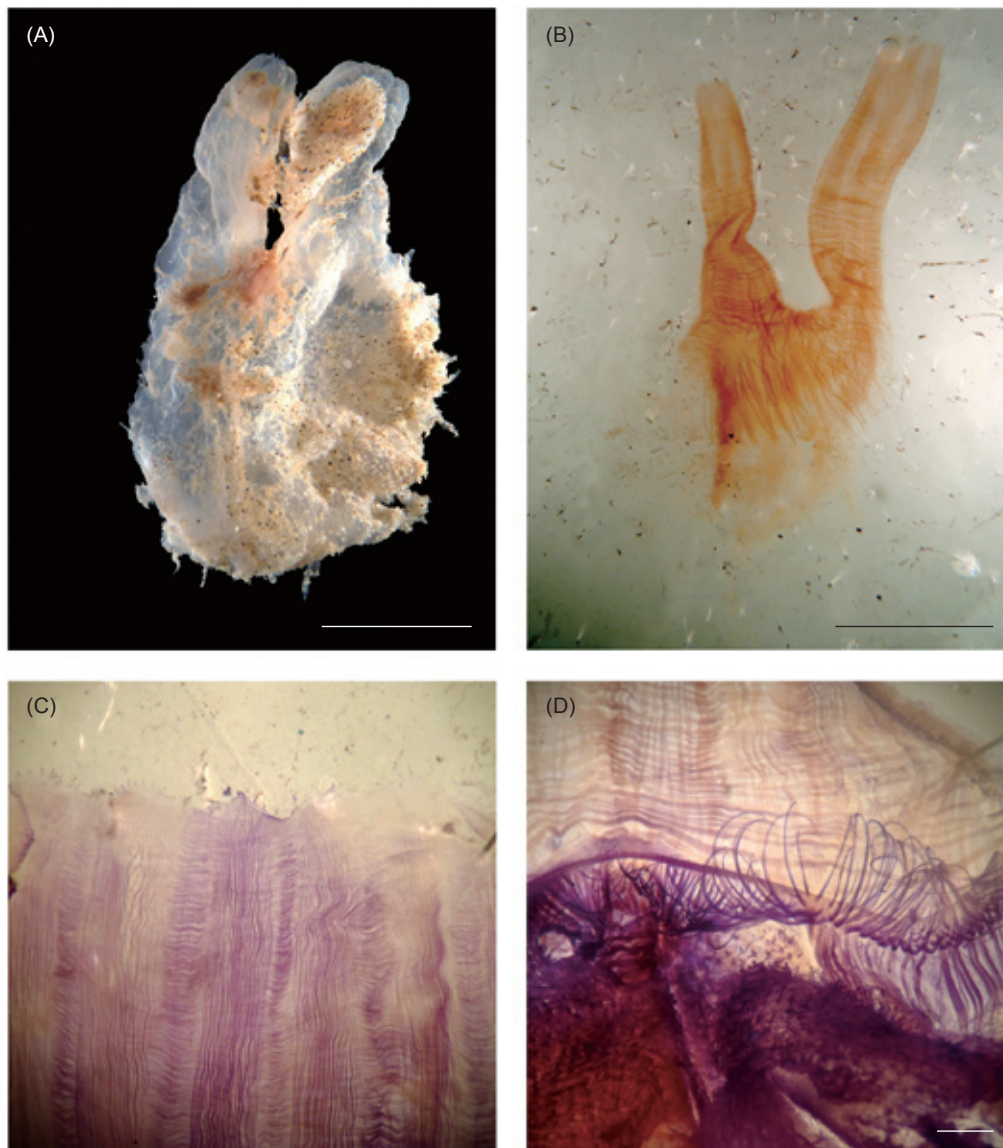


Fig. 3. *Ascidia santosi* Millar, 1958. (A) Right side of body with tunic showing the rhizoidal projections. (B) Right side of body without tunic (external view). (C) Dissected oral siphon with fringed lobes. (D) Anterior region showing the wide membrane with the oral tentacles. Scale bars: A, B = 1.0 cm; D = 1.0 mm.

it on soft bottoms; sand also adheres to posterior surface. Body round with long apical and parallel siphons. Tunic very thin, delicate, transparent, forming ridges along siphons.

Without tunic, animal 1.9 cm long (without oral siphon), body wall light brown. Body wall musculature comprising only extension of longitudinal fibers of siphons to middle of body on right side. Left side with shorter longitudinal fibers in anterior region.

Both siphons long (oral, 1.4 cm; atrial, 1.6 cm) with 6 fringed lobes; atrial siphon apical and very close to oral siphon; in both siphons, longitudinal muscle fibers thick and organized in bands. Circular fibers also very conspicuous. A thick sphincter formed by 5 circular muscular fibers at base of oral siphon.

Approximately 170 oral tentacles, of 3 sizes (largest 3.0 mm long), projecting from a wide muscular membrane. Prepharyngeal groove double, with some projections in anterior lamina; prepharyngeal area with a few minute papillae. Peritubercular area U-shaped; dorsal tubercle large and U-shaped. Dorsal lamina smooth, and in anterior region, also double; papillae absent from right face of dorsal lamina near esophageal aperture. Pharynx pleated with 5-6 stigmata in each mesh; primary papillae bilobed.

Digestive tube and gonads absent from type specimen, although ends of both gonoducts present, next to rectum, and full of gametes. According to original description, alimentary canal occupying approximately 1/2 of left side of body. Stomach slightly folded; intestine forming primary and secondary loops, anus bilobed. Ovary compact and slightly lobed; testis spread over intestine (Millar 1958).

Distribution: Brazil.

***Ascidia scalariforme* sp. nov. Bonnet and Rocha**
(Figs. 4A, 5)

Holotype: MZUSP 00026, 1 ind., Porto da Barra, BA (13°00'14"S, 38°32'02"W), 3.0-5.0 m depth, 16 Dec. 2007, coll. R.M. Rocha.

Paratypes: DZUP ASC102, 1 ind., Frades I., BA (12°48'51"S, 38°38'08"W), 10.0 m depth, 7 June 2004, coll. R.M. Rocha, DZUP ASC105, 1 ind., Frades I., BA (12°48'51"S, 38°38'08"W), 4.0 m depth, 15 Dec. 2007, coll. R.M. Rocha. DZUP ASC106, 2 ind., Porto da Barra, BA (13°00'14"S, 38°32'02"W), 3.0-5.0 m depth, 16 Dec. 2007, coll. R.M. Rocha, MZUSP 00027, 2 ind., Porto da Barra, BA (13°00'14"S, 38°32'02"W), 3.0-5.0 m depth,

16 Dec. 2007, coll. R.M. Rocha. DZUP ASC104, 1 ind., Blackadder shipwreck, BA (12°56'06"S, 38°30'42"W), 6.0-7.0 m, under rock, 14 Dec. 2007, coll. L.P. Kremer. DZUP ASC174, 2 ind., Bahia Marina, Salvador, BA (12°58'38"S, 38°31'14"W), 5.0 m depth, 3 Aug. 1999, under rock, coll. R.M. Rocha. DZUP ASC103, 1 ind., Yacht Club, Salvador, BA (12°59'57"S, 38°31'52"W), 3.0-4.0 m depth, 13 Dec. 2007, coll. L.P. Kremer. DZUP ASC100, 1 ind., Ponta Jarobá, São Sebastião, SP (23°49'39"S, 45°25'18"W), 3.0-4.0 m, under rock, 17 Nov. 1994, coll. R.M. Rocha. DZUP ASC101, 1 ind., São Sebastião, SP (23°49'S, 45°25'W), under rock, 24 Aug. 1995, coll. R.M. Rocha.

Etymology: The name is due to the shape of the ovary, which resembles the steps of a ladder.

Diagnosis: Tunic with small conical papillae; short muscular fibers, perpendicular to ventral, dorsal, and posterior margins on right side; sparse musculature on siphons; dorsal tubercle U- or C-shaped, with or without inrolled ends; papillae present in prepharyngeal area and on dorsal lamina close to esophageal aperture; dilated posterior intestine; smooth anus; ovary ramified on primary and secondary intestinal loops.

Description: Found under rocks, attaches to substrate by left side of body; fragments of shells, bryozoans, and sand may encrust free surface. Uncolored tunic transparent, with small conical papillae. Usually tunic thin (0.1-0.25 mm), but in largest individuals up to 0.6 mm thick.

Without tunic, body may reach 4.7 cm (without siphons), but usually smaller, 1.4-2.5 cm long (without oral siphon) and 0.7-1.4 cm wide. Oral siphon variable in length (0.2-4.2 cm) with 8 smooth lobes; atrial siphon short (0.1-0.3 cm long), displaced posteriorly 0.7-1.5 cm from ring of tentacles, with 6 smooth lobes. Atrial aperture pointing toward posterior region of body. Neural ganglion close to ring of oral tentacles.

Body wall colorless. On right side, short muscular fibers 0.02-0.08 mm thick, perpendicular to dorsal, ventral, and posterior margins of body. No musculature present in anterior region on right side, or on entire left side of body. In siphons, musculature weak, almost inconspicuous, and longitudinal musculature comprising only a few fibers not organized in bands.

Oral tentacles at 60-147 of 3 sizes, largest 1.6-4.3 mm long. Increase in number of tentacles related to increase in body size. Prepharyngeal groove double, always with projections in anterior lamina; narrow prepharyngeal area covered by minute papillae (0.01-0.02 mm in diameter)

(Fig. 5A). Peritubercular area U-shaped; dorsal tubercle U- or C-shaped and may have inrolled ends. Dorsal lamina double and smooth anteriorly; posteriorly a single lamina, with margin toothed due to projections formed by each extremity of left transverse vessels; usually papillae on right face of dorsal lamina close to esophageal aperture. Dorsal lamina passing to left of esophageal aperture and continuing to end of pharynx, close to stomach; thin lamina along right side of esophageal aperture. Pharynx with 42-56 longitudinal vessels on right side, 34-48 vessels on left side, and 54-147 transverse vessels depending on size of animal; slightly pleated with 3-5 stigmata in each mesh; primary papillae simple or bilobed. Simple intermediate papillae and parastigmatic vessels possibly in some regions of pharynx.

Stomach elongate with 7-10 longitudinal folds; posterior intestine dilated in a little sac-pouch; anal rim plain, opening 0.3-2.5 cm from oral tentacles. Renal vesicles not seen, but small projections on atrial wall of alimentary canal.

Ovary formed by a central axis with rami-

fications that project over intestinal tube, resembling a ladder; mainly visible on internal side; oocytes 100-140 μm in diameter. Long testicular follicles overlaying stomach and part of intestine. Gonoducts opening just posterior to anal aperture.

Remarks: Despite the disjunct distribution, samples collected in Bahia are identical to those from São Paulo. *Ascidia sydneyensis* Stimpson, 1855, *A. canaliculata* Heller, 1878, and *A. multitentaculata* (Hartmeyer, 1912) have the same pattern of body musculature on the right side as in *A. scalariforme* sp. nov. However, the longitudinal fibers in the anterior region on the right side of the body, the conspicuous siphonal muscles that form bands, the meandering dorsal tubercle (*A. sydneyensis*), the absence of papillae in the dorsal lamina, the isodiametric posterior intestine (*A. multitentaculata*), and the ovary shape, are all characters that differentiate these 3 species from *A. scalariforme* sp. nov. Tokioka (1953) reported that *A. sydneyensis sydneyensis* from Japan has small papillae in the tunic, no longitudinal muscular fibers in the anterior region on the right

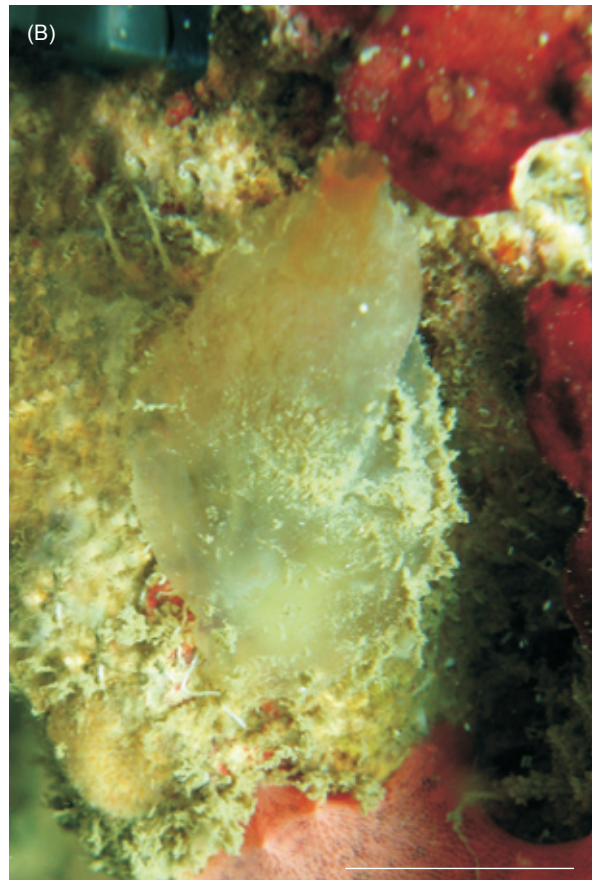


Fig. 4. Animals in the field. (A) *Ascidia scalariforme* sp. nov. (B) *Ascidia* cf. *tapuni* Monniot and Monniot, 1987. Scale bars: 1.0 cm.

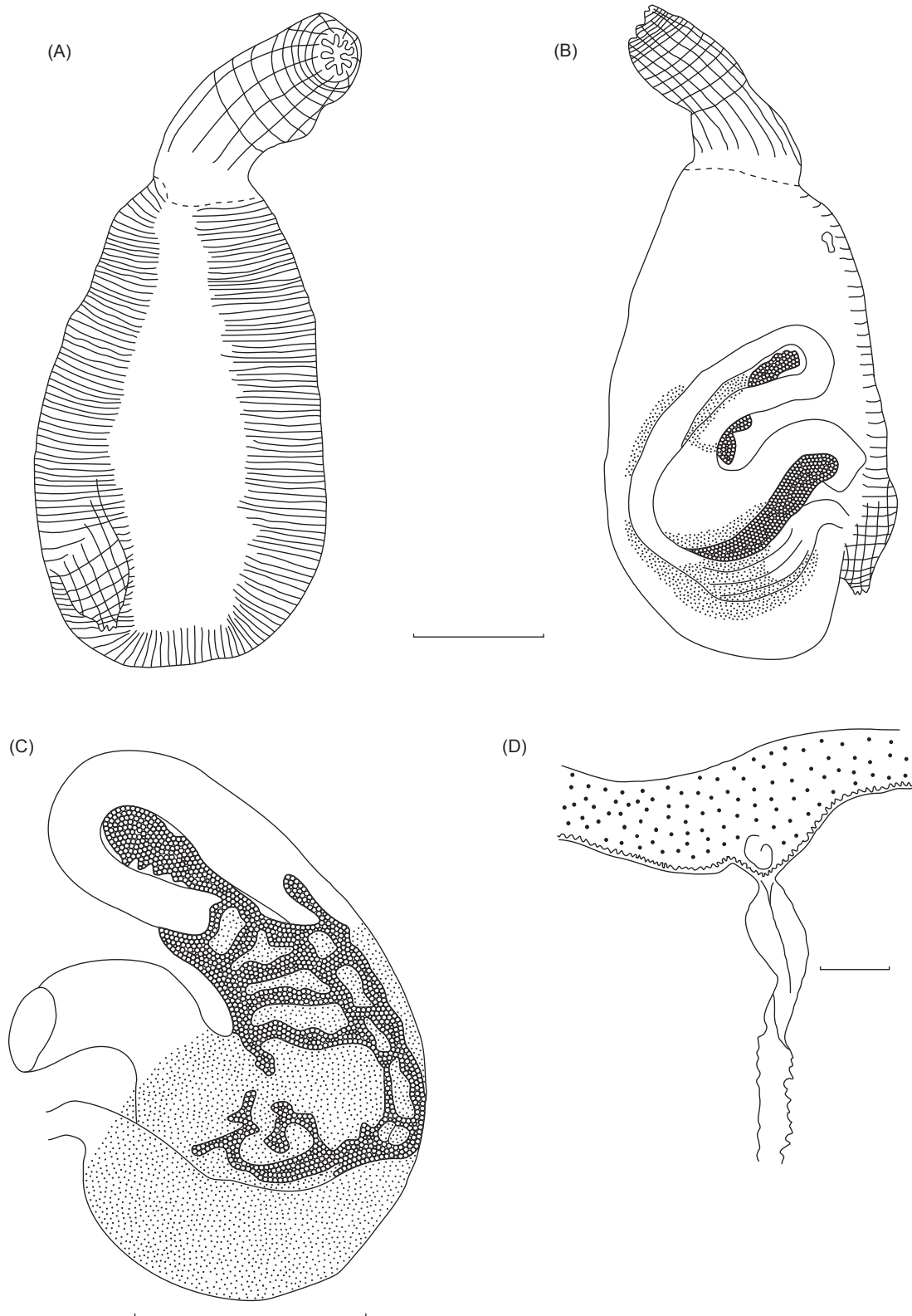


Fig. 5. *Ascidia scalariforme* sp. nov. (A) Right side of body without tunic (external view). (B) Left side of body without tunic (external view). (C) Digestive tube and gonads (internal view). (D) Anterior region, showing the dorsal tubercle, part of the dorsal lamina, the prepharyngeal area, and groove. Scale bars: A-C = 0.5 cm; D = 1.0 mm.

side of the body, a U-shaped dorsal tubercle, 4 or 5 stigmata per mesh, and an anus with a plain rim. It is differentiated from *A. scalariforme* sp. nov. by fewer oral tentacles (approximately 48), the absence of papillae in the prepharyngeal area, the longer digestive tract, and the isodiametric intestine. No other species of *Ascidia* is similar to *A. scalariforme* sp. nov.

***Ascidia sydneyensis* Stimpson, 1855**

For synonyms see *Ascidia sydneyensis* Kott 1985: 54.

Material examined: CIDRO PALB ES VI27, 5 ind., Camburi Beach, Vitória, ES (20°17'33"S, 40°14'29"W), intertidal, 15 May 1999, coll. T.M.C. Lotufo and S.A. Rodrigues, CIDRO PALB ES VI28, 2 ind., intertidal, 17 May 1999, coll. T.M.C. Lotufo and S. Rodrigues. DZUP ASC21, 1 ind., Forno Beach, Arraial do Cabo, RJ (22°57'36"S, 42°04'19"W), 22 Feb. 2003, coll. L.V.G. Costa. DZUP ASC50, 1 ind., Meros Beach, Grande I., RJ (23°13'08"S, 44°20'20"W), 10.0 m depth, July 2007, coll. Y.B.M. Carvalho. DZUP ASC03, 1 ind., Cabelo Gordo Beach, São Sebastião, SP (23°49'41"S, 45°25'22"W), 14 Aug. 1986, coll. R.M. Rocha. DZUP ASC107, 1 ind., Jarobá Point, São Sebastião, SP (23°49'39"S, 45°25'18"W), under rock, 27 Jan. 1996, coll. R.M. Rocha. DZUP ASC40, 1 ind., Galheta I., PR (25°35'S, 49°19'W), 11 Mar. 2004, coll. L.P. Kremer. DZUP ASC17, 1 ind., Paranaguá Bay, PR (25°30'56"S, 48°29'56"W), Nov. 2000, DZUP ASC18, 1 ind., Nov. 2000. DZUP ASC115, 1 ind., São Francisco do Sul, SC (26°14'15"S, 48°38'15"W), 14 Mar. 2008, coll. R.M. Rocha. DZUP ASC108, 1 ind., Penha, SC (26°45'52"S, 48°38'37"W), mussel culture, 10 Mar. 2006, coll. L.P. Kremer, DZUP ASC114, 2 ind., Penha, SC (26°45'52"S, 48°38'37"W), mussel culture, 23 Jan. 2007, coll. L.P. Kremer. DZUP ASC45, 2 ind., Ribeirão da I., Florianópolis, SC (27°43'03"S, 48°33'53"W), oyster culture, 4 Nov. 2006, coll. M.S. Baptista

Diagnosis: Longitudinal ridges along siphons; siphon lobes with projections; body musculature on right side formed by short fibers perpendicular to margin of body; no papillae in prepharyngeal area; dorsal tubercle meandering; dilated posterior intestine as a sac-like pouch; anus multilobed; ovary ramified.

Distribution: Caribbean Sea, Florida, Brazil, Cape Verde, Sierra Leone, South Africa, Indian Ocean, Indo-Pacific, Japan, Australia, Guam, Hawaii.

Remarks: The oral tentacles are quite variable in number, at 35-290, yet no relationship was found between that number and body size nor with collection locale (geographic region or environment) of the samples.

The 3 individuals dissected here had a U-shaped dorsal tubercle (samples from ES, RJ, and SP). This possibility was noted by Van Name (1945) for specimens from the Atlantic. Descriptions of Pacific Ocean specimens usually describe the dorsal tubercle aperture as meandering. The same pattern of musculature on the right side of the body, with a dilated posterior intestine and ramified ovary, is found in *A. canaliculata* Heller, 1878. It can be differentiated from *A. sydneyensis* by the dorsal tubercle with convoluted ends and anus with a plain rim (NYKB, pers. observ.). The 3 specimens studied here with U-shaped dorsal tubercle have multilobed anus (characteristic of *A. sydneyensis*), so we identified them as *A. sydneyensis*.

Tokioka (1953: 223) commented that "...ascidians having medially interrupted musculature may be divided into several species" and he suggested the division of *A. sydneyensis* in 3 subspecies: *A. sydneyensis sydneyensis* (Stimpson, 1855), *A. sydneyensis divisa* (Sluiter, 1898), and *A. sydneyensis samea* (Oka 1935). The 1st has a U-shaped dorsal tubercle, 4 or 5 stigmata per mesh, an isodiametric intestine, and an anus with a plain margin. It is very similar to *A. multitentaculata*, and is differentiated only by the presence of small papillae on the surface of the tunic and fewer oral tentacles (48) (Tokioka 1953). In *A. sydneyensis divisa*, both siphons have toothed lobes, a meandering dorsal tubercle, approximately 18 stigmata per mesh, a dilated posterior intestine, and a plain anus (Tokioka 1953). The last subspecies proposed by Tokioka (1953) is *A. sydneyensis samea*, which has many projections in the tunic, siphons lobes with toothed margins, up to 12 stigmata per mesh, and a dilated posterior intestine. Moreover the dorsal tubercle is U-shaped, and the anus has a plain rim in young individuals, but the largest individuals have a meandering dorsal tubercle and multilobed anus. In our opinion, *A. sydneyensis sydneyensis* differs from *A. sydneyensis* and should be described as a new species from Japan. The other 2 subspecies proposed by Tokioka (1953) are more similar to each other, and both are similar to the specimens that we dissected for this revision.

***Ascidia* cf. *tapuni* Monniot and Monniot, 1987**
(Figs. 4B, 6)

For synonyms see *Ascidia tapuni* Monniot and Monniot 2008: 854.

Material examined: DZUP ASC182, 1 ind., Quebramar Sul, Salvador, BA (12°58'22"S, 38°31'09"W), 14 Dec. 2007, coll. L.P. Kremer. DZUP ASC49, 1 ind., Meros Beach, I. Grande, RJ (23°13'08"S, 44°20'20"W), 10 m depth, oyster culture, July 2007, coll. Y.B.M. Carvalho.

Diagnosis: Animals with orange siphons when alive; musculature on right side of body formed by a net of fibers; prepharyngeal groove with projections in anterior lamina; dorsal tubercle U-shaped, with convoluted ends; few longitudinal vessels in pharynx (33 or 34 on each side); 3 or 4 stigmata per mesh; posterior intestine with a dilation but not a sac-like pouch; ovary ramified.

Description: Individuals small (longest 2.2 cm total length, including tunic and siphons), attaches to substrate by left side of body. Tunic thin, almost uncolored, with only siphons orange-colored; some sand on free surface.

Without tunic, body 1.5-2.1 cm long and 0.5 cm wide. Both siphons short (0.2-0.5 cm); oral siphon with 8 smooth lobes; atrial displaced posteriorly 0.7-0.8 cm from ring of tentacles and with 6 smooth lobes. There is an orange spot between each lobe. Neural ganglion very close to dorsal tubercle.

Musculature on right side of body comprising net of thin transverse and oblique fibers (0.05-0.06 mm thick). Left side with short perpendicular fibers along dorsal margin of body; longitudinal fibers of oral siphon extending for small distance past oral tentacles. Longitudinal musculature in siphons not organized into bands.

Largest individual with 102 oral tentacles and smallest with 84; tentacles of 3 sizes, largest 1.5-2.0 mm long. Prepharyngeal groove double, with projections in anterior lamina; prepharyngeal area narrow and possibly with many small papillae (0.01 mm in diameter), but absent from specimen from Rio de Janeiro (RJ). Small peritubercular area U-shaped; dorsal tubercle aperture U-shaped with convoluted ends. Dorsal lamina double and smooth anteriorly, simple and toothed posteriorly; passing to left of esophageal aperture and continuing to end of pharynx, close to stomach. No papillae on right side of dorsal lamina. There is a lamina without projections on right side of esophageal aperture. Pharynx

with 33-35 longitudinal vessels on each side and 66-76 transverse vessels; not pleated, with 3 or 4 stigmata per mesh; primary papillae simple. Parastigmatic vessels and secondary papillae absent.

Stomach round, with 0-2 internal folds; posterior intestine with a dilation but not sac-like; anal rim plain, opening 0.6-0.7 cm away from ring of oral tentacles. Renal vesicles not observed.

Ovary ramified; it covering intestine, but in external view only conspicuous inside primary intestinal loop. Oocytes 100-120 µm diameter. Testis not seen. Large oviduct opening just posterior to anus.

Distribution: Brazil, Tahiti, New Caledonia, Fiji Is., Indonesia.

Remarks: Despite the disjunct distribution, both dissected specimens are very similar, only differing by the absence of papillae in the prepharyngeal area in the sample from Rio de Janeiro. This characteristic may be variable in some species of *Ascidia* (NYKB, pers. observ.), so we chose to group them as the same species with some morphological variability.

Ascidia tapuni is known from Tahiti, New Caledonia, Fiji Is., and Indonesia (Monniot and Monniot 2008). Nonetheless, the identification is very similar: the species may be recognized by the body musculature as a net of transverse and oblique fibers on the right side of the body, the long projections in the anterior lamina of the prepharyngeal groove, a reduced number of stigmata per mesh, dilation of the posterior intestine, a ramified ovary in a posterior position, and a very large oviduct (Monniot and Monniot 1987 2008). Dissected individuals only differ from the original description by the orange siphons in life, 8 lobes on the oral siphon (9 or 10 in Pacific animals), and the smooth tunic; Monniot and Monniot (1987) described the tunic as uncolored and covered by very small papillae. However, because we could not study any Pacific specimens and only used published descriptions and figures for comparison, we chose to identify the Brazilian specimens as *A. cf. tapuni*.

Among the Atlantic Ascidiidae, 2 species may be confused with *A. cf. tapuni*: *A. interrupta* because of the musculature pattern associated with the presence of projections in the prepharyngeal groove, and *A. scalariforme* sp. nov. because of the ovary shape. Nevertheless *A. interrupta* is much larger when completely developed, shows round projections in the tunic, up to 16 lobes in each siphon, 4-10 stigmata per mesh in the

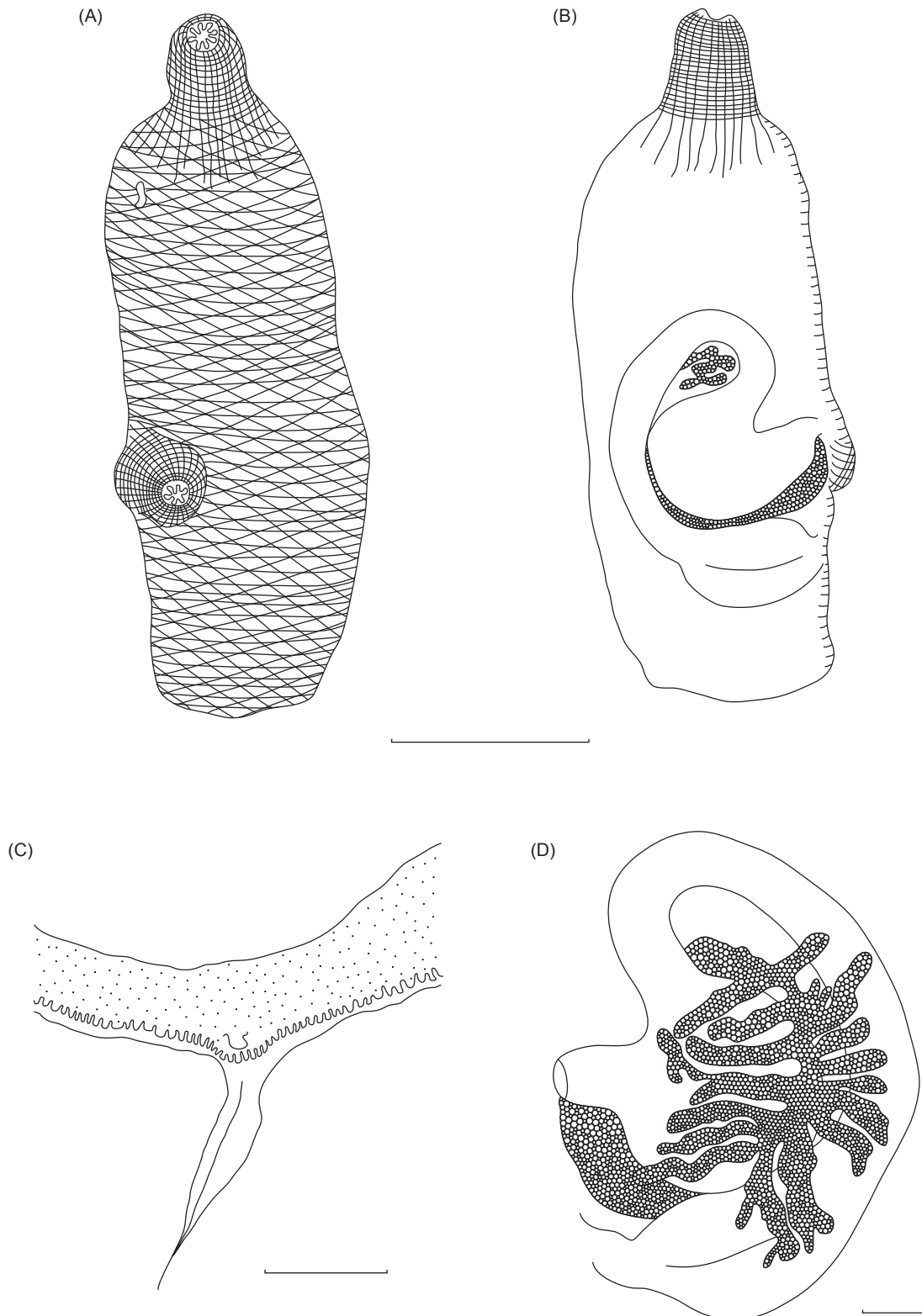


Fig. 6. *Ascidia* cf. *tapuni* Monniot and Monniot, 1987. (A) Right side of body without tunic (external view). (B) Left side of body without tunic (external view). (C) Anterior region of the sample from Bahia, showing the dorsal tubercle, part of the dorsal lamina, the prepharyngeal area, and groove. (D) Digestive tube and ovary (internal view). Scale bars: A, B = 0.5 cm; C-D = 1.0 mm.

pharynx, and has a cauliflower-shaped ovary, thus differing from the present species. *Ascidia scalariforme* sp. nov. differs from *A. cf. tapuni* by the body musculature on the right side formed by short fibers perpendicular to the margin of the body, the papillae on the right face of the dorsal lamina, and the more-elongated gut and ovary.

***Ascidia tenue* Monniot, 1983**

Ascidia curvata Monniot 1972: 945.

Ascidia tenue Monniot 1983: 69.

Material examined: DZUP ASC64, 1 ind., Porto da Barra, Salvador, BA (13°00'14"S, 38°32'02"W), 3.0-5.0 m depth, 16 Dec. 2007, coll. L.P. Kremer. DZUP ASC62, 1 ind., Baleeiro Point, São Sebastião, SP (23°49'45"S, 45°25'23"W), Sept. 1995, coll. T.M.C. Lotufo. DZUP ASC63, 1 ind., Jarobá Point, São Sebastião, SP (23°49'39"S, 45°25'18"W), 23 Jan. 1996, coll. R.M. Rocha. DZUP ASC67, 1 ind., Currais I., PR (25°43'59"S, 48°22'40"W), 8.0-15.0 m depth, polyethylene plates, Jan. 2009, coll. J. Bumbeer. DZUP ASC65, 3 ind., Irmã do Meio I., SC (27°50'19"S, 48°31'41"W), 17 Apr. 2008, coll. R.M. Rocha. DZUP ASC66, 1 ind., Moleques do Sul I., SC (27°50'76"S, 48°25'47"W), 18 Apr. 2008, coll. R.M. Rocha.

Diagnosis: Musculature on right side of body forming net of thin fibers; dorsal tubercle U-shaped, with or without inrolled ends; presence of papillae in prepharyngeal area and on right face of dorsal lamina, close to esophageal aperture; 3-5 stigmata per mesh; 6-8 longitudinal folds in stomach; isodiametric intestine; ovary lobed inside both intestinal loops.

Distribution: Bermuda, Guadeloupe, Brazil.

Remarks: Dissected individuals are similar to previous descriptions. Monniot (1983) described fewer stigmata per mesh (2 or 3), but specimens from Bermuda have 3-5 stigmata per mesh (Monniot 1972). Both our material and specimens from Guadeloupe (Monniot 1983) were small; but Monniot (1972) described individuals from Bermuda that were up to 10.0 cm in total length. All samples from Bermuda were previously identified as *A. curvata* and subsequently they were synonymized as *A. tenue* (Monniot 1983).

Ascidia tenue is very similar to *A. curvata*, differing by the papillae in the dorsal lamina and the reduced number of stigmata per mesh (Monniot 1972 1983). According to our observations, *A. tenue* also has fewer folds in the stomach, and the

renal vesicles are not very conspicuous.

DISCUSSION

Brazil now has 12 species in the family Ascidiidae as a result of this revision. Five of these species are endemic to the Brazilian coast: *Phallusia recifensis*, *Ascidia nordestina*, *A. papillata*, *A. santosi*, and *A. scalariforme*.

Three of the 7 previously known species of Ascidiidae from Brazil were not found during the present study: *A. interrupta*, *A. santosi*, and *P. recifensis*. The latter 2 species have never been found since their original descriptions (Millar 1958 1977). The presence of sand and filament projections in the tunic, and the shape and position of the siphons suggest that *A. santosi* was found in shallow, soft-bottom habitats. Thus, populations of this species may have been disrupted in the years since discovery due to fishery activities, including trawling for shrimp. Also, the Santos shores are now densely populated and polluted, which may also threaten this species.

A. interrupta was found in Bahia, Rio de Janeiro, and São Paulo (Table 2), but all collections were before 1980 (Van Name 1945, Monniot 1969-1970, Simões 1981, Rodrigues et al. 1998), and those records may be doubtful. In the description of *A. interrupta* collected in São Paulo, Van Name (1945) did not mention the round projections in the tunic nor the papillae in the prepharyngeal area, and dilation of the posterior intestine was only observed in specimens from the Bahamas. These 3 characteristics are diagnostic for the species, and their absence raises doubts about their correct identification. The other record from São Paulo is merely a quote of the previous record (Rodrigues et al. 1998). Simões (1981) reported *A. interrupta* in Rio de Janeiro, but her description includes only general characters that are common to many species of *Ascidia*, and therefore that identification cannot be confirmed with that description. Recently, the GLOBALLAST project published a list of species found in Sepetiba Port (Rio de Janeiro) before 2000, and *A. interrupta* is the only species in the Ascidiidae, yet no description of the material is available to confirm the identification (Villac et al. 2004). Finally, according to the literature, the only reliable record of *A. interrupta* on the Brazilian coast is one from Bahia (Monniot 1969-1970). Thus, *A. interrupta* was likely an unsuccessful introduction to coastal Brazil and is no longer present or is very rare.

The presence of *A. curvata* in Brazil also seems to be a case of introduction. Lotufo (2002) also found *A. curvata* in Pernambuco, but after revision of the sample (CIDRO PALB PE CA 40), it was considered to be a different, new species: *A. nordestina* sp. nov. *Ascidia curvata* was only very recently found in Rio de Janeiro (Marins et al. 2010), and its distribution along the Brazilian coast includes Bahia to Paraná (Table 2); thus it is a disjunct distribution with that of the Caribbean region. Moreover, *A. tenue*, also a Caribbean species, is very similar to *A. curvata* with which it may easily be confused, thus alerting us to check previous identification of specimens from São Paulo, Espírito Santo, and Bahia. *Ascidia tenue* was found in 4 states, also with a disjunct distribution with 3 isolated populations, suggesting an introduction in Brazil (Table 2). Therefore, a reexamination of the samples previously identified as *A. curvata* on the Brazilian coast is suggested to confirm the identification and geographical distribution of these 2 species.

Phallusia nigra has been considered cryptogenic in Brazil, mainly because of the disjunct distribution with the Caribbean populations. Although occurring in Ceará, it is always associated with ports and has never been seen on natural substrates (Oliveira Filho 2010).

Ascidia sydneiensis is recognized as having been introduced in Brazil (Lopes 2009), and

populations are small and usually associated with ports or aquaculture.

If the identification of *A. cf. tapuni* is confirmed, it is a newly recognized introduction, with the 1st specimens collected in 2007. The species is known from Tahiti, Moorea, New Caledonia, the Fiji Is., and Indonesia (Monniot and Monniot 2008). Only 2 small specimens were collected, one in a port region (Bahia) and the other in an oyster culture (Rio de Janeiro), both of which are typical habitats of introductions. It is less clear though how the species was transported from its original habitats since it lives in coral reefs, and it has not been reported from port areas or artificial substrate in its native geographical distribution until now. Two previous surveys in Bahia, in 1999 and 2004, did not find this species, further suggesting a recent introduction. This species could have been confused with *A. interrupta*; however, since previous identifications of the latter are not confirmed, the date of introduction could be earlier than 2007.

These findings reveal how much remains to be discovered concerning ascidian biodiversity in coastal Brazil, mainly in the northeastern region where tunicate studies are only beginning. Moreover, because of increasing port activity and bivalve culture, more attention to detect new introductions of species is required, before these become abundant.

Table 2. Distribution of species of Ascidiidae on the Brazilian coast

	Brazilian States ¹										References ²
	MA	CE	PE	AL	BA	ES	RJ	SP	PR	SC	
<i>Phallusia nigra</i> Savigny, 1816		X		X	X	X	X	X			1-5, 9, 10, 12, 14-18
<i>P. recifensis</i> Millar, 1977	X		X								6
<i>Ascidia curvata</i> (Traustedt, 1882)					X	X	X	X	X		8, 10, 13, 15, 18
<i>A. interrupta</i> Heller, 1878					X	X	X	X			1, 5, 7, 9, 11
<i>A. cf. multitentaculata</i> (Hartmeyer, 1912)					X	X		X			6, 18
<i>A. nordestina</i> sp. nov.			X		X						18
<i>A. papillata</i> sp. nov.					X						18
<i>A. santosi</i> Millar, 1958								X			3
<i>A. scalariforme</i> sp. nov.					X			X			18
<i>A. sydneiensis</i> Stimpson, 1855		X				X	X	X	X	X	2-4, 8, 9, 12, 13, 15, 17, 18
<i>A. cf. tapuni</i> Monniot and Monniot, 1987					X		X				18
<i>A. tenue</i> Monniot, 1983					X			X	X	X	18

¹MA, Maranhão; CE, Ceará; PE, Pernambuco; AL, Alagoas; BA, Bahia; ES, Espírito Santo; RJ, Rio de Janeiro; SP, São Paulo; PR, Paraná; SC, Santa Catarina. ²1. Van Name (1945); 2. Bjornberg (1956); 3. Millar (1958); 4. Rodrigues (1962); 5. Monniot (1969-1970); 6. Millar (1977); 7. Simões (1981); 8. Rocha and Nasser (1998); 9. Rodrigues et al. (1998); 10. Lotufo (2002); 11. Villac et al. (2004); 12. Rocha and Costa (2005); 13. Rocha and Kremer (2005); 14. Lotufo and Silva (2006); 15. Marins et al. (2010); 16. Barboza (2010); 17. Oliveira Filho (2010); 18. Bonnet and Rocha (this study).

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