

First record and remarks on *Diaphana caribaea* from Santos Bay, a marine ecosystem under pressure in southern Brazil

(Mollusca: Gastropoda: Diaphanidae)

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Diaphana caribaea was found in sediment samples from Santos Bay, São Paulo State. This is the first record of the genus *Diaphana* in Brazil, filling a biogeographic gap in its Western Atlantic distribution. The species is distinguished from other regional congeners by its orange-brown coloration with two whitish spiral bands on the last whorl and a pronounced keel separating the protoconch and teleoconch. This finding underscores the need for further taxonomic studies and highlights conservation concerns in Santos Bay, a marine area subject to intense pressure from port activities, submarine sewage outfalls, and industrial waste.

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Introduction

The family Diaphanidae Odhner, 1914 comprises minute marine heterobranch gastropods and is considered one of the basal families within the order Cephalaspidea (Malaquias et al. 2009, Moles et al. 2018). It includes 21 species recognized as valid (MolluscaBase 2025), 10 of which are found in the Western Atlantic (Schjøtte 1998, Rosenberg 2009). Diaphanid snails possess small shells (<5 mm) and are distributed from the tidal zone down to abyssal depths (Schjøtte 1998). They inhabit soft substrate, algae, bryozoans and hydroids (Schjøtte 1998, Engl 2012). The diet of these animals remains unknown (Schjøtte 1998). Most species of the genus *Diaphana* are primarily known from their shells, which typically are thin, globose, and umbilicated (Ohnheiser & Malaquias 2014). Shells of different species can depict subtle variations on their shape, sculpture, dimensions, number of teleoconch whorls relative to shell height, coloration, and outline of shoulders

(Schjøtte 1998). For species with available morphological studies, the radulae feature a bilobed rachidian tooth (Ohnheiser & Malaquias 2014).

In Brazil, with 2,523 marine molluscs (Machado et al 2023) species are one of the most diverse invertebrate groups (e. g. Souza & Pimenta 2015, Cunha et al. 2016, Lima et al. 2016, Lima & Cunha 2025). However, shelled heterobranchs in Brazil and in general the Western Atlantic remain poorly known (Cunha 2011, Cunha & Migotto 2015, Salvador & Cunha 2016). The limited data on certain families, such as Diaphanidae, indicates that this group still requires additional studies. Recently, sediment samples were collected from a sublittoral region off Santos Bay in the State of São Paulo, Brazil containing shells of diaphanid gastropods. The globose, thin, fragile, umbilicate external shell morphology matches that of *Diaphana caribaea* from Cienfuegos Bay, Cuba (type-locality), and this occurrence is herein recognized as the southernmost limit of the species in the Western Atlantic Ocean and the first record of the genus in Brazil.

Materials and methods

Three shells of *Diaphana* were found at 25 m depth in mud sediments collected with a Van Veen grab off Santos Bay (24°10'49.1" S 46°17'15.8" W), Santos, State of São Paulo, southeastern Brazil. Images and measurements were obtained using a Zeiss AxioCam MRc5 at the Museu de Zoologia of the University of São Paulo and treated with the Zeiss AxioVision SE64 Rel 4.8 imaging software.

Samples for scanning electron microscopy (SEM) were coated with gold-palladium and imaged as convenient with a Zeiss Supra 55VP scanning electron microscope at the University Museum of Bergen, Norway. One paratype of *Diaphana caribaea* was analyzed by inspecting photographs kindly provided by the Museo de Ciencias Naturales de Tenerife, Spain.

Institutional abbreviations. TFMCBM – Museo de Ciencias Naturales de Tenerife, Spain; MZSP – Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil; MNRJ – Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil; ZMBN – Department of Natural History, University Museum of Bergen, University of Bergen, Norway.

Abbreviations used for shell measurements. SH – shell height, measured parallel to coiling axis; SW – greatest shell width, measured perpendicular to SH; AH – aperture height, defined as the maximum length parallel to the coiling axis; AW – greatest width of the aperture, measured as the maximum width perpendicular to the coiling axis. The ratios SW/SH, AH/SH and AW/AH are used as measures of shell shape; spire height is defined as (SH-AH).

Taxonomy

Family Diaphanidae Odhner, 1914
Diaphana Brown, 1827

Diaphana caribaea Espinosa,
Ortea & Fernández-Garcés, 2001
Fig. 1A–G

Examined material. Brazil, São Paulo, Santos Bay, 24°10'49.1" S, 46°17'15.8" W, 25 m depth (Lauriney G. Oliveira coll., 28/vi/2016), 1 shell, MZSP 133094 (Fig. 1A–C). 1 shell, MNRJ 29530; 1 shell, ZMBN 112966 (Fig. 1D,E).

Comparative material examined. *Diaphana caribaea* Espinosa, Ortea & Fernández-Garcés, 2001 – Cuba, Playa de la Concha, canal de entrada de la Bahía de

Cienfuegos, 8–10 m depth, paratype, TFMCBM/10688-MO/04779 (Fig. 1F,G), Leopoldo Moro coll.

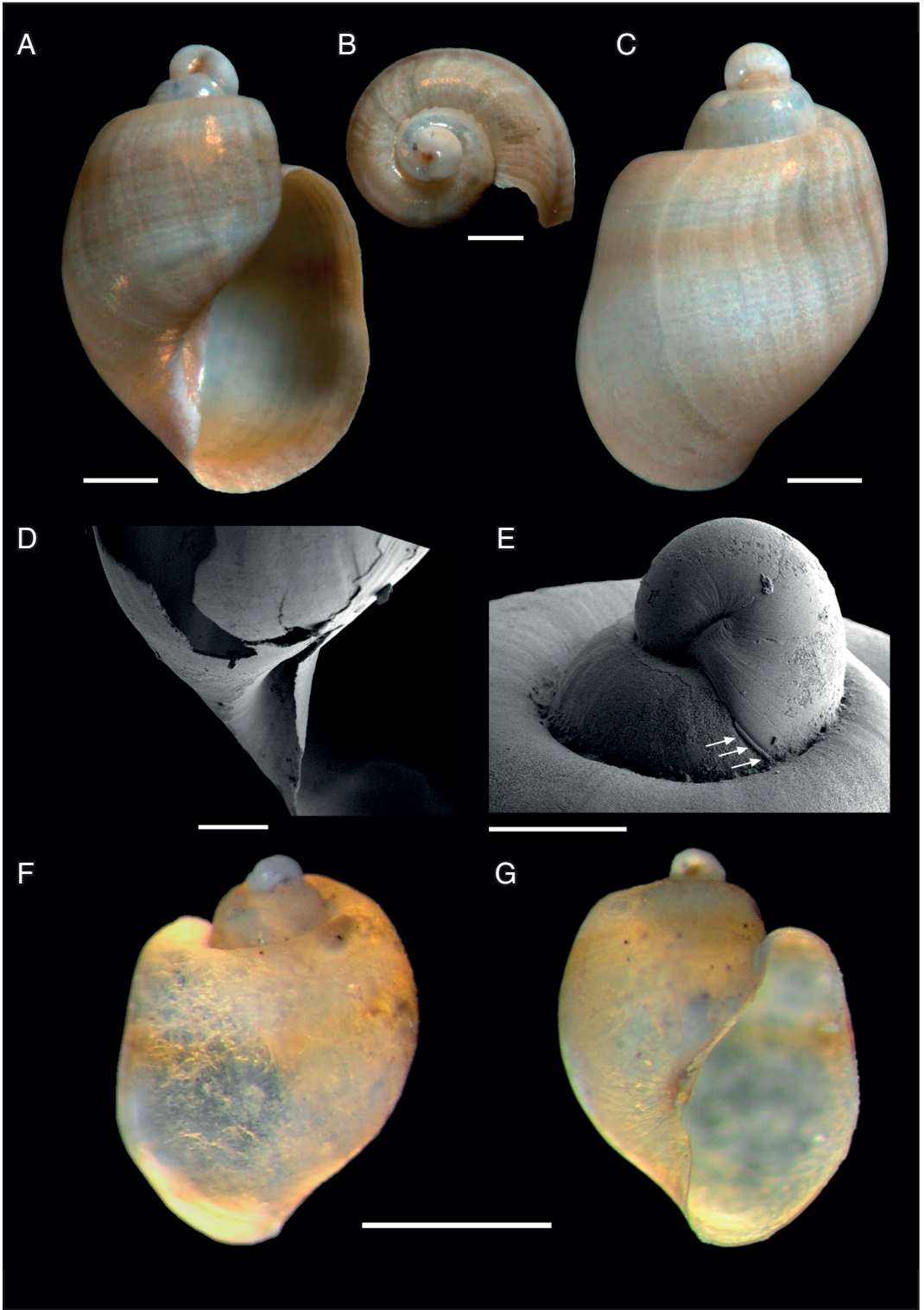
Description

Shell small (SH=0.71–1.22 mm), outline cylindrical-pentagonal to oval; walls thin, opaque; orange-brown in colour, with two whitish spiral bands on the last whorl (Fig. 1A,B); SW/SH=0.66–69; spire height (0.21–0.37 mm) about 1/3 SH, spire acuminate, ~1.5 whorl; last whorl rounded, about 2/3 SH. Protoconch mammillated, rounded, lecithotrophic type (sensu Schiøtte, 1998), cream in colour, large, 175–180 µm, 0.7–0.8 whorls (sensu Verduin, 1977); separation from teleoconch demarcated by a keel (Fig. 1E: arrows). Teleoconch, rounded in shape, ~2 whorls, shoulders rounded, separated from preceding whorl by unrimed groove (Fig. 1B,E); last whorl largest, ~90% of total length; columellar region parallel to coiling axis, about 1/2 AH. Peristome complete. Aperture wide, anteriorly rounded, posterior end of peristome in 1/6 level of penultimate whorl, AW/AH=0.51–0.520, AH/SH=0.70–0.73; parietal region about 1/2 AH, convex, parietal region faintly detached from body whorl. Umbilicus semiclosed with abapertural rim (Fig. 1D).

Measurements. MZSP 133094 – SH=1.22 mm, SW=0.84 mm, AH=0.85 mm, AW=0.43 mm; MNRJ 29530 – SH=0.77 mm, SW=0.51 mm, AH=0.56 mm, AW=0.29 mm; ZMBN 112966 – SH=1.22 mm, SW=0.82 mm, AH=0.85 mm, AW=0.43 mm.

Remarks. The protoconch of Brazilian samples (175–180 µm) is slightly larger than that from Cuba (~172 µm). The measurement of the protoconch of the paratype of *D. caribaea* was estimated from photographs housed in the Museo de Ciencias Naturales de Tenerife (Fig. 1A,B). In the original description by Espinosa et al. (2001), protoconch dimensions were not reported, and there appear to be inconsistencies in the scale bars provided in figures 1A and 1B. Specifically, figure 1A shows a full shell with a 250 µm scale bar, but the protoconch is not measurable due to its inclination. In contrast, figure 1B (a close-up) shows a scale bar of 150 µm, from which a protoconch size of ~238 µm could be inferred – an unexpectedly large figure, suggesting the scale in figure 1B to be inaccurate (Espinosa et al. 2001). In contrast, measurements obtained directly from the paratype photograph (fig. 2) show a shell of

Fig. 1. *Diaphana caribaea*. **A.** Apertural view of shell (MZSP 133094). **B.** Apical view of shell (MZSP 133094). **C.** Dorsal view of shell (MZSP 133094). **D.** SEM detail of umbilicus (ZMBN 112966A). **E.** Detail of protoconch with arrows showing the keel (ZMBN 112966A). **F, G.** Paratype shell of *D. caribaea* (TFMCBM/10688-MO/04779). **F.** Dorsal view. **G.** Apertural view. Scale bars: A–C=200 µm; D=100 µm; E=20 µm; F,G=1 mm. ▶



1.24 × 0.93 mm with a protoconch of approximately 172 µm, which fits well with the material studied from Brazil.

Discussion

The genus *Diaphana*, which is here reported for the first time in Brazil, comprises 22 species (MolluscaBase 2025) and 10 of them occur in the Western Atlantic (Schiøtte 1998, Rosenberg 2009). Among these, *D. caribaea* shares with *D. paessleri* (Strebel, 1905) from the southern tip of South America the posterior insertion of the peristome near the shoulder of the body whorl, a character absent in all other known species of *Diaphana*, but a distinct separation between the protoconch and the teleoconch marked by a keel in *D. caribaea* is unknown in *D. paessleri* which reaches approximately 3.5 mm height and exhibits a considerably more elongated shell.

In *D. caribaea* the separation between the protoconch and the teleoconch marked by a keel (Fig. 1E: arrows), is a feature also observed in the illustrations depicted by Espinosa et al. (2001: fig. 1B) but not highlighted by the latter authors. This keel is reported here for the first time for the genus *Diaphana* and appears to be a diagnostic character of this species. The shells from Brazil seem to have a slightly more cylindrical shape compared to the more rounded form of the Cuban specimen, with the aperture of Brazilian shells (AH/SH 0.70–0.72) also slightly shorter than that of the Cuban sample (AH/SH 0.73–0.75). Shells from both Brazil and Cuba show the parietal region faintly detached from the body whorl. Another distinctive feature of this species is the orange-brown coloration of the shell with two whitish spiral bands on the last whorl (Fig. 1A, C).

In addition, the size of the protoconch of *D. caribaea* (172–180 µm) is markedly smaller than those of other Western Atlantic species, such as *D. hiemalis* (Couthouy, 1839) (400–750 µm), *D. minuta* Brown, 1827 (500–700 µm), *D. pfefferi* (Strebel, 1908) (400 µm), *D. haini* Linse & Schiøtte, 2002 (500 µm), *D. paessleri* (Strebel, 1905) (500–700 µm), and *D. makarovi* Gorbunov, 1946 (500–700 µm). The smaller and paucispiral protoconch (non-planktotrophic) of *D. caribaea* is indicative of a short larval phase and limited geographic dispersal (Pechenik 1999).

Cienfuegos Bay, in Cuba, the type locality of *D. caribaea*, is located approximately 6500 km from Santos Bay, Brazil. Both areas are characterized by estuarine environments and are situated along major commercial shipping routes (the Caribbean and Santos, the largest port in Latin America). Based on protoconch data, *D. caribaea* is inferred to have low dispersal capability, supporting the hypothesis that

this species may have been introduced into Brazilian waters through maritime traffic from Cuba – or, conversely, from Brazil to Cuba. *D. caribaea* was described in 2001, and no additional occurrences have been reported since, suggesting that the species is rare or at least uncommon. It is worth noting that, if confirmed to be an invasive species, the two currently known localities (Cuba and Brazil) may not represent its native range, which therefore remains unknown and possibly located elsewhere, preventing any definitive inference about the direction of introduction.

Diaphana caribaea is reported from Santos Bay, São Paulo State, southern Brazil, representing the first record of the genus *Diaphana* in the country and filling a major biogeographical gap in its Western Atlantic distribution, where no previous records existed between the Caribbean and northern Argentina. This finding highlights the importance of further taxonomic research in Brazil to enhance biodiversity knowledge and support conservation assessments (Amaral et al. 2024).

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