



Conus carioca Petuch, 1986 (Neogastropoda:Conidae) on the Brazilian coast

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Abstract

Marine snails of the tropical family *Conidae* are represented in Brazilian waters by twenty species of the genus *Conus*. Brazilian cones have a similar shell structure, morphological study of both soft parts and radula, when they are available, are useful in recognizing inter-specific differences. Illustrated here for the first time, is the male genital system and radular tooth of *Conus carioca* Petuch, 1986, using both, optical and scanning electron microscope images, contributing to the knowledge of the species.

Key words: Brazil, *Conidae*, morphology, radula, penis, taxonomy.

Resumo

Moluscos marinhos tropicais da família *Conidae* estão representados no Brasil por vinte espécies do gênero *Conus*. Devido à similaridade nas estruturas da concha nos *Conus* brasileiros, a morfologia das partes moles e rádula, quando disponíveis, são ferramentas importantes de diferenciação específica. É ilustrado, pela primeira vez, o aparelho reprodutor masculino e o dente radular de *Conus carioca* em microscopia ótica e microscopia eletrônica de varredura, contribuindo para o conhecimento da espécie.

Palavras-chave: Brasil, *Conidae*, morfologia, rádula, pênis, taxonomia

Introduction

The family *Conidae* Fleming, 1822 comprises over 550 species of tropical marine gastropods around the world (Filmer, 2001). In Brazilian waters, the single genus *Conus* Linnaeus, 1758 is represented by 18 described species and two subspecies (Rios, 1994). In a recent review, Gomes (2004) recognized 20 species of cones found off Brazil as valid. Despite the large number of described species, most studies on this family in Brazil have relied primarily on shell structure to differentiate species. Some recent studies have also included analysis of the radula (Nishi & Kohn, 1999; Franklin et al., 2007) and morphology of the anterior digestive system (Bouchet, 1990; Taylor, Kantor & Sysoev, 1993) to help determine status of described species and evolution of the family. This study provides additional information on the morphology of the soft parts and radula, as well as information on the shell structure of *Conus carioca* Petuch, 1986.

Material and Methods

Shells: specimens (shells with soft parts) collected along the Brazilian coast were measured with calipers and photographed with a Nikon Coolpix 4500 digital camera. The main measurements taken were: total shell height, shell width, spire height, and body-whorl height. The general shell shape of *Conus carioca* was classified according to Walls (1979) as obconical, with a low or flat-spire shell, less than 30% of the total shell height.

Soft parts: specimens (shell with soft parts) collected were preserved in 70% ethanol. Specimens used for anatomical study were dissected by standard techniques under a ZEISS stemi SV 11 stereomicroscope. As Gomes (2004) observed penis morphology is distinct character that can be used to distinguish Brazilian species. A total of three male specimens from Vitória, Espírito Santo state, were dissected to study soft parts and radula

morphology. Drawings of anatomical structures were made in order to supplement their description.

Radula: teeth were extracted from the radular sac and preserved in 70% ethanol. They were isolated from each other on a glass slide (covered with glycerol) or in stubs (coated with a layer of gold) for later photography by optical microscopy (ZEISS Axiolab microscope) or SEM photographs, respectively. These photographs allowed study of different parts of the tooth structure.

The material and digital photographs examined for this study are stored in the following collections: **MNRJ:** Museu Nacional, Universidade Federal do Rio

de Janeiro, RJ, Brazil. **MORG:** Museu Oceanográfico “Prof. Eliézer de Carvalho Rios”, Fundação Universidade de Rio Grande, Rio Grande, Brasil.

Conus carioca Petuch, 1986
(Figs. 1, 6-8)

Conus carioca Petuch, 1986: 9, figs 1-2; Petuch, 1987: 118, 146, pl. 16, 28, fig. 15-16 and 18; Costa, 1994: 1, pl.; Filmer, 2001: 65.

Type material: Holotype: MORG 20915a. 51.7 x 24.0mm (Fig. 1).



Figure 1, *Conus carioca*. Holotype MORG 20915a: 51.7 x 24.0mm, scale bar: 0,5cm; Figure 2: *Conus sanderi*. Holotype ZMUA 137055: 21,1mm; Figure 3: *C. sanderi* MORG 21600:21,3mm; Figure 4: *C. sanderi* MNRJ 13757: 19,6mm; Figure 5: *C. sanderi* MNRJ 13759: 15,0mm. Scale bar: 0,5cm.

Type locality: Cabo Frio, Rio de Janeiro, Brazil.

Geographical distribution: Brazil: states of Bahia, Espírito Santo and Rio de Janeiro, 50m depth.

Examined Material: BRAZIL. Southern Bahia: MORG 20915a, 1 shell (Holotype). Espírito Santo: Vitória, MNRJ 8782, 7 specimens (2002, J. & M. Coltro *don*); MNRJ 8647, 5 shells (2002, fisherman col.); MNRJ 8776, 1 shell (2002). Rio de Janeiro: Rio de Janeiro, MORG 24999, 1 shell, 50m depth (1978, shrimper col.)

Results

Shell: shell medium (height 43 x width 22mm), shiny, obconic (spire height 16% of total shell height), with 10 whorls. Spire outline straight to convex, first whorls after protoconch with a reticulated pattern; dark brown bands alternating with white bands and, rarely, pink

ones. Body whorl outline straight or slightly concave near a sharp shoulder; sculptured with growth lines and a few spiral cords near the base, coloration white with orange, pinkish, or brown spiral bands alternating with white ones (sometimes only as white spots, not as bands) and dark brown spiral lines. Aperture narrow, wider near base, with the posterior portion descending and under the line of last whorl shoulder; outer lip straight.

Head-foot: Cephalic tentacles long and thin.

Genital system: Male: penis long and flat on the right dorso-lateral region of the head, starting dorsally towards the ventral part of animal, penial duct opening in a depressed middle region on the terminal end. Middle region of the penis has an evident fold. A Pallial sperm duct visible through the transparent mantle (Fig. 6).

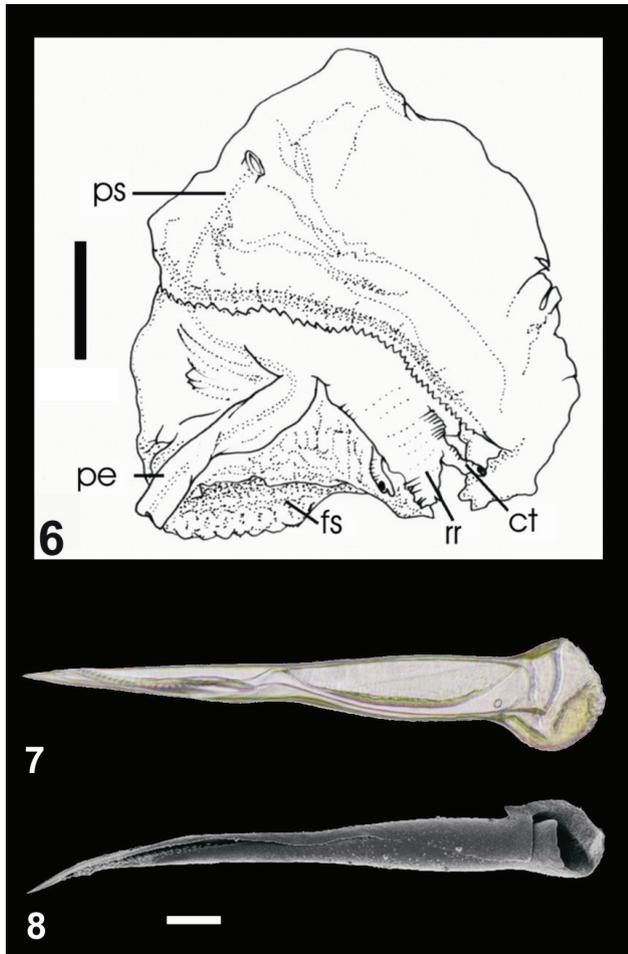


Figure 6: *C. carioca* MNRJ 8782 head-foot mass, male (right lateral dorsal view), scale bar: 5mm; ct, cephalic tentacles; fs, foot sole; pe, penis; ps, pallial sperm duct; rr, rostrum; Figure 7: *C. carioca* MNRJ 8782 radula in optical microscopy (200X): 606 μ m; Figure 8. *C. carioca* MNRJ 8782 radula SEM photograph, scale bar: 60 μ m.

Radula: No barb on apex (Figs. 7-8). Shaft elongated, anterior section half as wide as posterior section. Serrations present, blade lacking on stem. Base rounded, with tiny basal spur.

Discussion

The major controversy regarding this taxon is its possible synonymy with *C. sanderi* Wils & Moolenbeek, 1979, a species described from Barbados. The synonymy was maintained by Costa (1994), Rios (1994), and Filmer (2001). Vink (1987) observed that the juveniles of *C. carioca* are similar to specimens of *C. sanderi* and they had the same fringed periostracum. Coomans (1986) mentioned the proposal to consider *C. carioca* a synonym of *C. sanderi* with reservations, due to the wide gap in their

reported ranges of distribution. Vink (1987), however, reported a single specimen of *C. sanderi* dredged off the coast of Surinam, suggesting an extension in the distributional range of the species but did not mention where the shell was stored, so its identification could be confirmed. Besides the shell from off Surinam, the only other distributional reference outside southern Brazil for *C. sanderi* was given by Rios (2009) from off Pernambuco. This reference was apparently based on a personal communication and not recorded as a lot. The differences between the two taxa include the shell height (*C. carioca* is higher than shells of *C. sanderi*) as well as differences in the thickness of the shell, color pattern and aperture. The posterior portion of the aperture in *C. carioca* is descending and under the line of the last whorl shoulder. In *C. sanderi*, this portion of the shell is even with the shoulder of the last whorl. Spire whorls are more depressed in *C. sanderi*, giving the spire profile a concave appearance. Vink (1987) considered *C. carioca* to be an adult shell of *C. sanderi*, but the gap in the distribution of *C. carioca* and differences listed above in shell morphology have always raised many doubts. Recently, two shells matching the description of *C. sanderi* from northeastern Brazil MNRJ 13757 (02°45.474'S 048°42.269'W) and MNRJ 13759 (02°45.989'S 048°43.262'W) (Figs. 4 and 5, respectively), and a shell from the state of Amapá in northern Brazil, MORG 21600 (Fig. 3) were discovered in collections. Apparently these records have not previously been reported. Now, it is possible to record the occurrence of *C. sanderi* on the Brazilian coast, and compare it with the holotype (Fig. 2). Curiously, these new records from northeastern Brazil are not in the same area as *C. carioca*. Herein, *C. carioca* is considered a valid taxon, distinct from *C. sanderi*. In the original description of *C. carioca*, the author emphasized mostly the color pattern of the shell (Petuch 1986: 9). The present paper adds descriptive information including the biconic shell shape, number of whorls, relationship between aperture and total shell height, and the posterior aperture region descending in relation to the level of the body whorl. For the first time, the head-foot mass with the male genital system of *C. carioca* is illustrated (Fig. 6). Gomes (2004) observed that the penis morphology is a distinct characteristic supporting identification in most Brazilian species; it differs in length and width according to species (in relation to the head-foot mass). Apex and fold locations of the penis can be distinctive identification traits as well. Baoanan et al. (2008) studied six Philippine cones and also found anatomical differences are potentially useful for species determination. *C. carioca* has a flat penis with a fold in the middle region, and a terminal end with a

middle depressed region where the penial duct opens. In addition to the large number of radula ecological studies (Nybakken, 1970; James, 1980; Shimek & Kohn, 1981) produced for the *conidae* to date and the importance of the radular tooth in characterizing feeding modes (Endean & Rudkin, 1965; Lim, 1969; Rolán & Röckel, 2000), tooth characters are also considered an important tool to differentiate species (Nishi & Kohn, 1999), and were mentioned years ago by Peile (1939) as a good guide for classification because of the specific character of the structure. Franklin et al. (2007) reported that even species with the same feeding habits show fine differences in radula structures, and proposed the usefulness for identification of these structures in case of ambiguity in other characteristics. The identification of species in the family has been based mostly on shell morphology and color pattern. Now, with the use of conotoxin in neurological research and drug discoveries, a precise taxonomic classification of cone species has become extremely important (Franklin et al., 2007). So far, the radula teeth of Brazilian species have been illustrated by drawings (Rehder & Abbott, 1951; Van Mol, Tursch & Kempf, 1967; Calvo, 1987) or SEM micrographs (Costa & Simone, 1997). Gomes (2004) and Gomes et al. (2007) included optical photomicrographs in describing some radulae of Brazilian *Conus*, while Franklin et al. (2007) suggested that the “combined use of two microscopic methods makes description more reliable”. It is important to study and photograph several teeth because of their tridimensional structure. For instance, in this study when the two photographs are compared, the spur at the base is visible in the SEM micrographs (Fig. 8), but not in optical microscopy (Fig. 7) because of the position of the tooth on the stubs. Further, the rounded aspect of the base is more evident in figure 7, but not figure 8. Most Brazilian species have a radula morphology that suggests a vermivorous diet (Gomes, 2004). In *C. carioca* the tooth is short and is ornamented with a spur and serration, with the waist well marked.

Conclusions

The study presented here is the first step towards improving knowledge of *C. carioca*, so far endemic to Brazilian coast, through the addition of shell, penis and radula morphological characters of specimens collected in the state of Espírito Santo. Herein *C. carioca* is considered a valid species, with a distribution extending from the states of Bahia to Rio de Janeiro.

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