



SHORT COMMUNICATION

## First record of *Mirinaba cadeadensis* (Gastropoda: Strophocheilidae) in an anthropogenic shell mound from the Paraná coast, Southern Brazil

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<https://zoobank.org/1A3AB92D-DF9C-4C9D-BD47-F514C5E32177>

**ABSTRACT.** *Mirinaba cadeadensis* Lange de Morretes, 1952 is restricted to the Paraná state, and found at the municipalities of Morretes, São José dos Pinhais, Paranaguá, Matinhos, and Guaratuba, associated to the Serra do Mar mountains. In this paper, we report the first record of this species in an anthropogenic shell mound. Two shells of *M. cadeadensis* were located in the internal stratigraphic layers of the Bogaçu shell mound. This is also the first shell mound record for *Mirinaba*.

**KEY WORDS.** Atlantic rainforest, biodiversity, Mollusca, sambaqui, shell mound, Stylommatophora, zooarchaeology.

Strophocheilidae is a family of terrestrial gastropods with eight living genera, namely *Anthinus* Albers, 1850; *Austroborus* Parodiz, 1949; *Chiliborus* Pilsbry, 1926; *Gonyostomus* Beck, 1837; *Megalobulimus* K. Miller, 1878; *Mirinaba* Lange de Morretes, 1952; *Speironepion* Bequaert, 1948; and *Strophocheilus* Spix, 1827 (Birckolz et al. 2013, Bouchet et al. 2017). The included species are endemic to South America (Leme 1973). In Brazil, Strophocheilidae is the third most biodiverse family of land snails in terms of described species, only behind the families Bulimulidae and Odontostomidae (Simone 2006, Salvador 2019).

*Mirinaba* was originally described as a subgenus of *Strophocheilus* by Lange de Morretes (1952), and elevated to genus by Leme (1973), based on important similarities of main morphological characteristics among the *Mirinaba* species that clearly distinguished them from other species of *Strophocheilus*. Currently composed of 10 described species (Simone 2006), the distribution of *Mirinaba* is mostly associated to the Atlantic Forest biome, with records in the South, Southeast and Northeast regions of Brazil (Simone 2006, Jesus and Manso 2010, Birckolz et al. 2013, Birckolz and

Gernet 2016). Only one species, *Mirinaba fusoides* (Bequaert, 1948), occurs outside the Brazilian territory in the province of Misiones, Argentina (Bonard et al. 2012), but also within Brazil, with records for the municipalities of Rio Grande da Serra, state of São Paulo and Taquara (Mundo Novo), state of Rio Grande do Sul (Simone 2006). Six species are found in the Brazilian state of Paraná: *Mirinaba antoninensis* (Lange de Morretes, 1952); *M. cadeadensis* (Lange de Morretes, 1952); *M. curitybana* (Lange de Morretes, 1952); *M. erythrosoma* (Pilsbry, 1895); *M. jaussaudi* (Lange de Morretes, 1937) and *M. porphyrostoma* (Clench & Archer, 1930) (Simone 2006).

*Mirinaba cadeadensis* is endemic to Paraná, with altitudes ranging from 30 to 850 m a.s.l. at the Serra do Mar mountains (Fig. 1) (Indrusiak and Leme 1985, Birckolz et al. 2013). The main characteristics that can be used to identify *M. cadeadensis* are a small oval-acuminated shell, a pink peristome with smooth, non-umbilical shell, nepionic whorls with thin spiral streaks, gentle slightly crenulated suture, slight dorsoventral flattening, external lip without dentition, acute apex and light-brown periostracum (Indrusiak and Leme 1985, Birckolz et al. 2013).

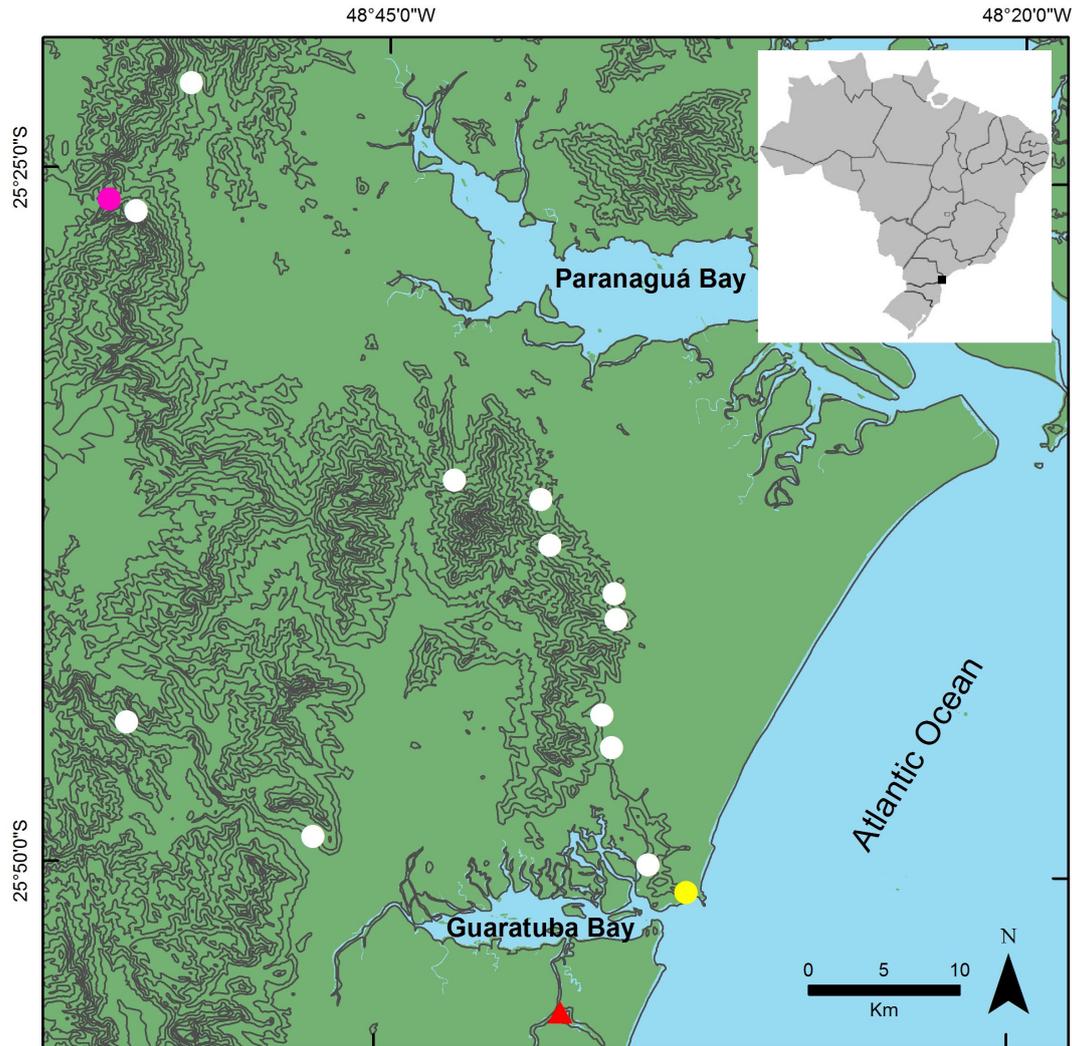


Figure 1. Known collection records of *Mirinaba cadeadensis*. The purple circle indicates the type locality (Cadeado), and the yellow circle the locality where present-day specimens were collected (Morro Itaguá). This locality is also the closest known occurrence of the species to the new Boguaçu shell mound record (red triangle).

Shell mounds (known as ‘sambaquis’, in Portuguese) are anthropogenic structures of the archaeological landscape consisting mostly of mollusk shell layers (Bailey 1977). The shells used during the deposition of layers and construction of such archaeological monuments come from animals used as food by hunter-fisher-gatherer communities (Gernet and Birckolz 2011). The Brazilian coast occupation by hunter-gatherer groups was very intense during pre-Columbian times, and particularly concentrated in the southern and southeastern regions (Bueno et al. 2013). The settlement patterns of the Brazilian coast are probably correlated to sea level variations, during the so-called “Great weather” (8,500–6,500 years BP), in which changes from hot and dry to hot and humid climates influenced the occupa-

tion of such areas (Bueno et al. 2013). Some sambaquis along the Paraná coast predate 6,500 years BP (e.g., sambaqui Porto Maurício in Morretes) (Parellada and Gottardi Neto 1994), with more recent ones (e.g., sambaqui ‘Ilha dos Ratos’ in Guaratuba Bay) dating back to ~500 years BP (Rauth 1969), denoting the vast importance of such structures to the coastal populations culture (Prous 1990).

Detailed knowledge on the molluscan fauna in shell mounds helps in paleoenvironmental studies, particularly in the understanding of temporal variation patterns of the abundance and diversity of mollusk species (Goodfriend 1992, Gernet et al. 2014). In particular, such information is important for the understanding of the ecological occupations by past human

populations, and their relationship with the landscape and the local fauna (Klokler et al. 2010). In this study we report the first record of *M. cadeadensis* found in a shell mound. We also compare those shells to modern specimens (including the holotype), and discuss the implications of the presence of this species in the sambaquis.

The Boguaçu shell mound (25°55'11"S; 48°37'39"W; Figs 1–2) is located on the riverbanks of Boguaçu river, in the Guaratuba bay, Paraná, Brazil. The earliest basal layers of this shell mound date back to 4,000 ± 250 years BP, as calculated by the <sup>14</sup>C method (Bigarella 1950).

We measured the approximate dimensions of the whole shell mound using a metric measuring tape: it is ~80 m long and ~60 m wide at the most basal layer, and ~7 m high. For many years (from the 16<sup>th</sup> century to the 1960s), like many other shell mounds in the region, extractions of this mound were used for the manufacture of lime and road paving, and they are still threatened by the action of natural tides and vandalism (Gernet et al. 2019).

Two adult specimens of *M. cadeadensis* (Figs 3, 4) were collected on December 20, 2014. The *M. cadeadensis* shells were located using a non-interventional visual prospection in the internal stratigraphic layers of the Boguaçu shell mound, using naturally eroded accession entrances. Shells were manually collected. The collection licenses were obtained from Instituto

Ambiental do Paraná (IAP 453/12) and Instituto Chico Mendes de Conservação da Biodiversidade (36442-1) environmental agencies. The two shells are housed in the malacological collection of the Laboratory of Applied Ecology and Bioinvasions of the Universidade Federal do Paraná (UFPR), in Pontal do Paraná, Brazil (LEBIO 578).

To allow comparisons with modern individuals, we also took measurements of two adult shells of *M. cadeadensis* collected in 2013 (LEBIO 587, 588), in the locality 'Morro Itaguá', Serra da Prata, municipality of Matinhos, state of Paraná. This locality is about 11.5 km apart from the Boguaçu shell mound, north-eastwards (Fig. 1). We took the following measurements from each shell: height (H), greatest width (diameter = D), aperture height (h), and aperture width (d). The specimens of *M. cadeadensis* type series (MZUSP 18998 and MZUSP 14592) were also examined and compared to the shells of Boguaçu shell mound.

The two shells present the characteristic abrasion usually found in shell mound specimens, having a whitish color due to the action of time, and the absence of periostracum. One specimen does not have the protoconch and the adjacent part of the teleoconch. Nonetheless, the characteristics of both shells clearly match those of present-day specimens, including the type specimens, and are within the expected individual variation for species of *Mirinaba* (Indrusiak and Leme, 1985). Measurements of all specimens are shown in Table 1.



Figure 2. Overview of the Boguaçu shell mound, in Guaratuba Bay, Paraná, Brazil.



Figures 3–7. Shells of *Mirinaba cadeadensis*: (3–4) LEBIO 578, from the Bogaçu shell mound; (5) LEBIO 587, from Morro Itaguá; (6) LEBIO 588, from Morro Itaguá; (7) MZUSP 18998 (holotype), from Cadeado. Measurements of these specimens can be found in Table 1. Scale bar: 10 mm.

Table 1. Measurements (in mm) of *Mirinaba cadeadensis* shells.

Voucher	Height	Greatest width (diameter)	Aperture		Locality
			Height	Width	
LEBIO 578 #2	–	–	240	12.0	Boguaçu shell mound
LEBIO 578 #1	53.0	28.0	25.0	13.0	Boguaçu shell mound
LEBIO 587	56.6	28.0	24.6	14.9	Morro Itaguá
LEBIO 588	57.2	28.3	24.9	15.1	Morro Itaguá
MZUSP 18998*	590	29.0	–	12.5	Cadeado
MZUSP 14592*	59.0	30.0	–	13.0	Cadeado

\*Measurements from Lange de Morretes (1952) type series.

Because terrestrial gastropods can move around the mounds, the presence of gastropods on the surface (outer layers) of the mound are usually related to the natural occurrence of such individuals, and not to human action (Silva et al. 2017). The *M. cadeadensis* shells were found in the inner layers of the mound, evidencing the actual presence of these gastropods in shell mounds due to human action. Both *M. cadeadensis* individuals did not show signs of use as tools, instruments or adornments (Gernet et al. 2019) and, hence, were possibly used as food resource since terrestrial gastropods were an important part of the diet of the local communities (Afonso and Tenório 2001).

Other genera of land mollusks have already been reported in Brazilian shell mounds, namely *Megalobulimus*, *Thaumastus* Albers, 1860, and *Macrodonates* Swainson, 1840 (Gernet and Birckolz 2011, Fontenelle et al. 2014, 2019, Macario et al. 2016, 2017, Gernet et al. 2020). This is the first record for *Mirinaba*, indicating that, despite their smaller size compared to other local land Gastropoda species, these animals were not ignored by prehistoric populations. Importantly, this record increases the number of verified mollusk species found in the Boguaçu shell mound to 21 species (Gernet and Birckolz 2011, Gernet et al. 2019).

The presence of mollusk shells in archaeological shell mounds goes far beyond the traditional assumptions of population subsistence, where the construction and deposition of layers would be a mere artifact of mollusk use in the populations diet, as initially believed (Bennyhoff and Hughes 1987, Aizpurua and Mcanany 1999, Godino et al. 2011). Recent research on the cultural importance of shell mounds indicates that their inclusion in these structures may also be directly related to rituals of celebration and burials (Schmitt and Lupu 2008, Klokler et al. 2010). Zoological remains also reflect the complex relationships between humans and the available resources in the local environment, and their different cultural perceptions regarding each of these resources (Reitz and Wing 1999).

The dimensions of the shells found in the Boguaçu shell mound (Figs 3, 4) are similar to those observed in shells from Morro Itaguá and Cadeado (Table 1), though some morphological variation is seen among them. The thickening of the inner lip is not so evident in one specimen collected in the Boguaçu shell mound (Fig. 4) compared to the Morro Itaguá specimens (Figs 5, 6), but it is similar to the holotype (Fig. 7). In the outer lip there is also a difference in thickness, where in sample LEBIO 588 (Fig. 6) the lip is noticeably narrower than other analyzed shells. In

the sambaqui LEBIO 578 #2 specimen (Fig. 3) the presence of a protuberance at the outer lip is evident. The posterior canal on the aperture of the same individual (Fig. 3) has a discontinuity that is not observed in the other shells. Finally, we highlight that this finding is also the first shell mound record for *Mirinaba*.

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MVG conducted the fieldwork and data collecting; CEB and CJB prepared the figures; MVG, LRLS, CEB, GYSO, CJB and FM CBD analyzed the data and wrote the paper.

#### Competing Interest

The authors have declared that no competing interests exist.

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