

Melanoides tuberculatus (Müller, 1774): a new threat to the conservation of native aquatic species in Sergipe, Brazil

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Nesse trabalho, a presença do molusco exótico invasor *Melanoides tuberculatus* é registrada pela primeira no Estado de Sergipe. O fato agravante é que sua ocorrência foi detectada em duas unidades de conservação do Estado, uma na região costeira e outra no semi árido sergipano. Foram coletados 227 espécimes na Lagoa Azul, a maior lagoa da APA Litoral Sul e nas margens do Rio São Francisco, em uma reserva de Caatinga. A presença dessa espécie exótica invasora é uma ameaça a biodiversidade local bem como pode tornar-se um problema de sanidade ambiental, uma vez que esse molusco também pode ser hospedeiro de trematódeos exóticos, como *Centrocestus formosanus*.

Palavras-chave: bioinvasão, unidades de conservação, sanidade ambiental.

In this study the occurrence of the exotic snail *Melanoides tuberculatus* was registered for the first time in Sergipe State, Brazil, in two conservation areas. In total, 227 snails were collected from rivers and a lake in both coastal and semi-arid regions (Lagoa Azul and Rio São Francisco). Owing to the fact that *M. tuberculatus* can act as an intermediate host of *Centrocestus formosanus*, the occurrence of this exotic species is a threat to local biodiversity in addition to becoming a serious problem of environment sanitation.

Key-words: bioinvasion, conservation areas, environment sanitation.

1. INTRODUCTION

Due to globalization and the consequent increase in the flow of goods and people, aquatic and terrestrial species have been accidentally or deliberately transferred to areas outside their natural geographic distribution where they can find suitable environmental conditions for their survival, surpassing the native species in resource use. Thus, the impacts of bioinvasion are one of the most serious threats to global biodiversity, exceeded only by the destruction of habitats [1].

In Brazil, attempts to prevent the introduction of exotic species has increased in recent decades, including studies for the detection of environmental and sanity impacts caused by non-native aquatic species. In aquatic ecosystems, invasion by exotic species has caused the extinction of several native species, adding risk to human health, because some species are vectors or hosts for several agents that cause diseases.

The snail *Melanoides tuberculatus* (Müller, 1774) (sin = *Melanoides tuberculata*) (Gastropoda: Thiaridae) is native to Asia and East Africa, and is an example of invasive species that threatens the health quality of various water bodies. The first record of this species in Brazil was in 1967 in Santos (SP) where it was probably introduced into water bodies through deliberate release by aquarists [2]. Currently, its distribution covers 17 Brazilian states, including the Northeast States of Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco and Bahia [3,4]. *M. tuberculatus* competes with *Biomphalaria* spp., the natural vector of *Schistosoma mansoni* Sambon, 1907, the causative agent of schistosomiasis. According to Pointier and Delay [5], the biological and parthenogenetic reproductive characteristics of *M.*

tuberculatus make this species a good invader. For this reason, it is used in control programmes as competitor of several intermediate hosts of *S. mansoni* [6]. In programmes performed in Brazil, the controlled invasion of *M. tuberculatus* has caused decreases in populations of *B. glabrata* during the five years of monitoring [7]. Despite the use of *M. tuberculatus* in controlling pests, population reductions were also reported in species of native snails [8]. In addition, there are reports that *M. tuberculatus* acts as a host for exotic trematodes, such as *Centrocestus formosanus* (Nishigori, 1924) (Trematoda: Heterophyidae), that infect fish, birds and mammals, causing sometimes the death of their hosts [8, 9].

In this study, the presence of exotic invasive snail *Melanooides tuberculatus* is first recorded for Sergipe State in two conservation areas, in coastal and semi-arid regions, threatening the freshwater fauna of these two environments.

2. METHODS

Study areas

The study was conducted in two conservation areas (CA) in Sergipe State (figure 1). The Área de Proteção Ambiental do Litoral Sul (APA Sul) is located in the meridional region of state. It is limited to the South by Rio Real bordering the Bahia State and to the north by Rio Vaza-Barris; and east to the Atlantic Ocean. Remnants of Atlantic Forest are sparse in the APA Sul. The climate is hot and wet with hydric excess in winter (March to July). In summer (October to January) occurs the dry season [10].

The second area is the CA Monumento Natural Grota do Angico (MNGA), located in the Northwest region of State and bordering the Rio São Francisco. The area of MNGA is encompassed by the morphoclimate domain of Caatinga (semi-arid [11]), being characterized by irregular rainfall with eight months of the year.

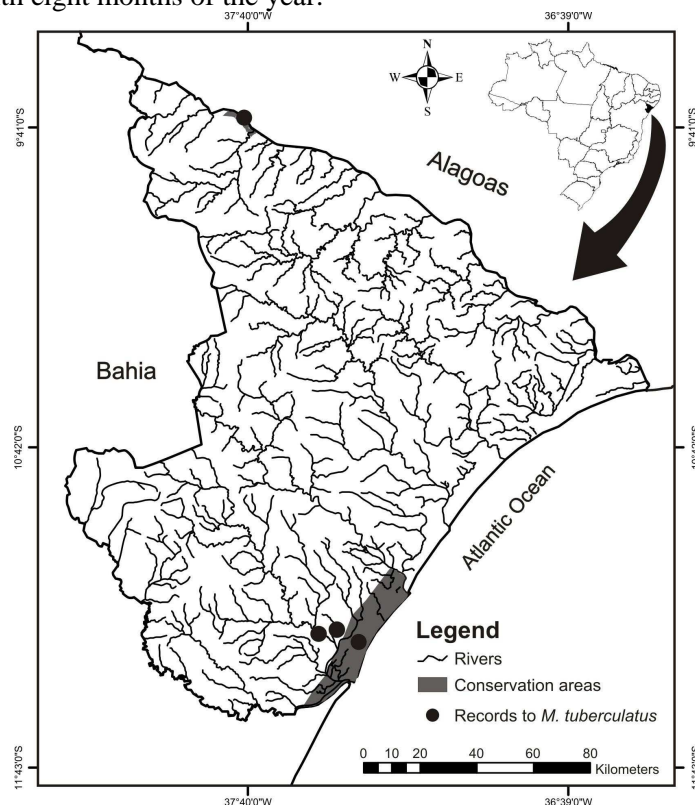


Figure 1. Map with indication of the places with occurrences of *Melanooides tuberculatus* in the Sergipe State, Brazil.

Sampling

Sampling occurred bimonthly in waterbodies of APA Sul and its surroundings between August/2009 and September/2010, and in MNGA in July and August/2010. The capture was conducted using rectangular sieve (60 cm x 40 cm; 5 mm mesh) in marginal areas of the lakes. Lotic and lentic environments were sampled. The collected material was maintained in plastic bags with menthol and later fixed in formalin 10%.

In the laboratory, specimens were washed in water and transferred to 70% alcohol. The individuals were analyzed in stereomicroscopy and identified using current literature [12, 13]. All specimens were measured using a digital caliper (0.01 mm).

To determine the number of size classes of *M. tuberculatus* we used the Sturges' Rule [14]: where $K = 1 + 3,3 * \log n$, with n representing the sample size. The interval between the classes was generated based on $H = R * K - 1$, where R represent the difference concerning the highest and lowest value by the variable, and K indicating the number of classes. The differences among the average size of *M. tuberculatus* collected at different sites were tested using the test t [15]. Values were considered significant at $p \leq 0.01$.

3. RESULTS AND DISCUSSION

A total of 227 specimens of *M. tuberculatus* (figure 2) were collected in four areas of Sergipe. Two records were in CAs (Lagoa Azul – APA Sul, Rio São Francisco - MNGA) and two others in the vicinity of APA Sul, Rio Piauí and Riacho Miranga (figure 1). The only location with a lentic record of this species was the Lagoa Azul, where 14 individuals (figure 3) were collected from the margin of an anthropic region (beach/resort). This area receives tourists attracted by the beauty and the ability to interaction with tambaquis (*Colossoma macropomum*), a freshwater fish species, while they are fed. The sample site has *Eleocharis* sp. (Cyperaceae) as the dominant vegetation.



Figure 2. Specimens of *Melanoides tuberculatus* caught in Sergipe State, Brazil.

Specimens in the Rio Piauí ($n = 198$; figure 3) were found in the marginal area with *Hydrocleys* sp. (Limnocharitaceae) and *Nymphaea* sp. (Ninphaeaceae) as the predominant aquatic vegetation. The environment suffered severe disturbance due to the construction of a dam that controls the flow of the river and the lack of riparian vegetation which was removed for the construction of a bridge over the Rio Piauí. Individuals of *M. tuberculatus* collected in the Riacho Miranga ($n = 3$; figure 3) were also in the marginal soil. In spite of the human disturbance in the area (e.g. crops and dwellings), the riparian vegetation in this area was preserved. MNGA specimens ($n = 12$; figure 3) were located on the margin of the main channel of the Rio São Francisco. The location is downstream of the Xingó Reservoir and subject to fluctuations in elevation of the Rio São Francisco.

The body length of *M. tuberculatus* ranged from 7.74 mm to 24.41 mm ($SD \pm 12:41 2.24$) with the smallest recorded in the Rio Piauí and the largest in Riacho Miranga. Significant differences were found between the average size of individuals from Riacho Miranga ($p \leq 0.001$) and between Lagoa Azul and Rio Piauí ($p \leq 0.001$).

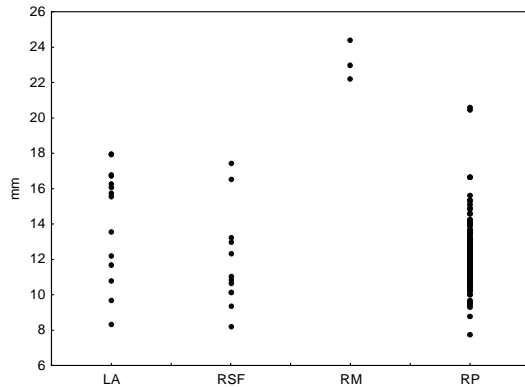


Figure 3. Size distribution of individuals of *Melanoides tuberculatus* sampled in Lagoa Azul (LA), Rio São Francisco (RSF), Riacho Miranga (RM) and Rio Piauí (RP), Sergipe State, Brazil.

We determined nine size classes with interval of 1.94 mm (figure 4). There was a predominance of individuals allocated in classes 2 and 3 (6.69 mm - 13.58 mm), corresponding to approximately 80% of the total. The larger specimens had low representation.

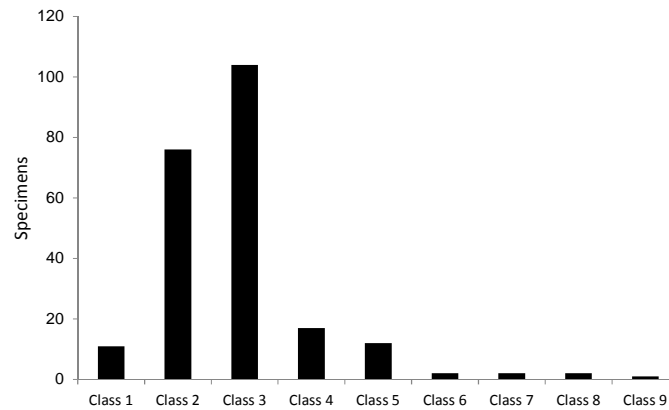


Figure 4. Distribution of body length of *Melanoides tuberculatus* collected in Sergipe State, Brazil, grouped by size classes.

The hot spots of occurrence of this species were sites with the greatest concentration of swimmers, both in coastal and semi arid regions, agreeing with results of previous studies that associate the occurrence of the *M. tuberculatus* with polluted and degraded areas [16, 17, 18]. The same pattern of occurrence was found by DeMarco [17] in Minas Gerais State, where the largest concentration of individuals occurred at landing areas of fishing vessels, probably due to low coverage of macrophytes. The occurrence of *M. tuberculatus* can be explained by deliberate introductions for biological control of snails of the genus *Biomphalaria* or due to mishandling by aquarists and transport of aquatic plants used as fish feed [3 e 17].

According to reports from local people living close to Lagoa Azul, the snail was deliberately introduced by government agents for biological control of *Biomphalaria*. The present data are insufficient to determine the effectiveness in controlling populations of *Biomphalaria* at Lagoa Azul, but some studies have shown the prevalence of exotic species tends to detriment of the native ones. Only in studies where the interspecific competition was monitored since the time of introduction could the effects be observed and quantified. Guimarães et al. [18] studied the snail community in two lakes for 10 years and were able to record elimination of *B. glabrata* and *B. straminea* after the establishment of *M. tuberculatus* in the lakes. In another study, on the Tocantins River, five years after the reservoir formation, dense populations of *M. tuberculatus* were found which led to a drastic reduction in populations of native species *Aylacostoma*

tenuilabris [19]. In several studies *M. tuberculatus* becomes the species with largest number of records once established [19, 20, 21 e 24].

Although the time of introduction is unknown, the snail occurrence was detected in restricted points in the four sampled areas. Thus, it is possible that the introduction of this species has been recent. This represents a great opportunity to monitor their invasion along the lagoon and their behavior in other species of native mussels, detecting potential risks in other water bodies and ways to mitigate its impact.

The initial record of *M. tuberculatus* both in the coastal and semi arid regions, however, indicates that its distribution may be greater than expected. The eradication program of *Biomphalaria* occurred in several localities, and it also might have allowed the introduction of *M. tuberculatus* into perennial rivers and even estuaries of the state of Sergipe and in the Real, Piauí and São Francisco basins. This species seems to be resistant to adverse environmental conditions such as salinity, eutrophication, habitat heterogeneity, high temperatures and water pollution [20, 21, 22, 23], suggesting a high environmental plasticity that is characteristic of pioneer species [3, 24].

In Brazil, the presence of *M. tuberculatus* has been reported in 17 states and Federal District [3]. This study reports the first record of this species in Sergipe. The occurrence of *M. tuberculatus* in two conservation areas indicates a warning signal to management plans in these environments. The high invasiveness of this species [25], associated with the fact that *M. tuberculatus* can act as an intermediate host of *C. formosanus* (Trematoda: Heterophyidae), threaten native fauna of molluscs and some vertebrates, such as birds, fishes and reptiles [8, 9, 25]. The lack of diversity studies of the Sergipe malacofauna does not allow further conclusions about the consequences of the introduction of this exotic snail.

Thus, some questions are proposed for further investigations about *M. tuberculatus*: (1) Does this species threatens human health? (2) What is the current distribution of its populations in Sergipe? (3) What are the factors that control its distribution within their occurrence area? (4) What are the real risks to native malacofauna?

4. CONCLUSIONS

The occurrence of the snail *M. tuberculatus* is reported for the first time for both coastal and semi arid regions of the state of Sergipe.

Considering its occurrence in areas of environmental preservation, the presence of this invasive alien species represents a potential risk to local biodiversity and health of the water resources.

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