

FIRST RECORD OF THE INVASIVE SNAIL *Melanoides tuberculatus* (GASTROPODA: PROSOBRANCHIA: THIARIDAE) IN THE PARANÁ RIVER BASIN, GO, BRAZIL

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ABSTRACT

The Thiarid snail *Melanoides tuberculatus* (Müller, 1774), native to Asia and East Africa was recorded for the first time in the Parana River basin, Goias State. There is no evidence concerning introduction vectors but aquarium releases is the most probable vector. Specimens were collected at three different water bodies after twenty-seven rivers were investigated. The possible spread of this species to other habitats and potential effects on native thermal water communities are discussed.

Keywords: Mollusca, Thiaridae, *Melanoides tuberculatus*, invasive species, brazilian cerrado.

RESUMO

Primeiro registro do gastropode africano invasor *Melanoides tuberculatus* (Gastropoda: Prosobranchia: Thiaridae) na Bacia do Rio Parana, GO, Brasil

O gastropode Thiaridae *Melanoides tuberculatus* (Müller, 1774), nativo da sia e do Leste Africano,  registrado pela primeira vez na Bacia Hidrogrfica do Rio Parana (Estado de Goias). No se conhecem os vetores de introduao da espcie, mas o setor de aquariorfilia foi apontado por alguns moradores locais como a mais provvel causa. Os espcimes foram coletados em trs corpos d'gua depois de serem investigados vinte e sete rios e lagoas. A possibilidade de disperso dessa espcie para outros habitats e os efeitos potenciais dessa introduao sobre a comunidade nativa so discutidos no artigo.

Palavras-chave: Mollusca, Thiaridae, *Melanoides tuberculatus*, espcie invasora, cerrado brasileiro.

INTRODUCTION

Melanoides tuberculatus Müller 1774 (Gastropoda: Prosobranchia: Thiaridae) originates from Asia and East Africa and has established wild populations widely throughout the tropics (Pointer, 1999). Regions that it has invaded include North America (Murray, 1964), South America (Pointier *et al.*, 1994; De Marco, 1999) and French Polynesia (Pointier & Marquet, 1990). In Brazil, the first record of *M. tuberculatus* was in Santos, So Paulo State (Vaz *et al.*, 1986) and nowadays these invasive aquatic snails have been reported in the states of Minas Gerais (Carvalho, 1986; Silva *et al.*, 1994;

De Marco, 1999), Parba (Paz *et al.*, 1995), Rio de Janeiro (Thiengo *et al.*, 1998, 2001, 2002a, 2002b; Giovanelli *et al.*, 2003), Cear (Mello & Cordeiro, 1999), Paran (Pereira, 2000) and Federal District (Monteiro & Dias, 1980; Vieira, 1990; Garcez & Martins-Silva, 1997; Medeiros, 1997). Fernandez *et al.* (2003) still report *M. tuberculatus* in the States of Par, Tocantins, Piau, Parba, Pernambuco, Rio Grande do Norte, Bahia, Goias, Mato Grosso, Mato Grosso do Sul, Paran and Santa Catarina.

Melanoides tuberculatus has received attention from many researchers in the Neotropics because of the fact that it competes with native intermediate hosts of *Schistosoma mansoni*

(Schistosomiasis agent) acting as a biological control agent (Guimarães *et al.*, 2001; Giovanelli *et al.*, 2003); on the other hand, *M. tuberculatus* could be associated with exotic trematodes which affect native fish and birds, which are intermediate hosts for parasites (Brandt, 2000).

In Goiás State there is only one record of *M. tuberculatus* occurrence (Fernandez *et al.*, 2003), but without a specific location of occurrence. Therefore, here we briefly examine new occurrences of *M. tuberculatus* in Goiás State – specifying the exact location of the occurrence of this invasive species in the Paranã River basin -, comments on its ecology, and discuss possible impacts of this species on Paranã's rivers and water invertebrate communities, serving as a basis for future control and eradication projects. The aim of this report is to provide a background for future control, monitoring or managing the spread of this invasive species in Goiás State.

MATERIAL AND METHODS

During a monitoring programme of macroinvertebrate fauna undertaken from 2002 to 2004, specialists from the Laboratório de Bentos at Brasília University found three sites with an exotic snail identified as *Melanoides tuberculatus*. All water bodies were sampled semi-quantitatively for invertebrates using a triangular kick net (250 µm mesh) and Surber nets. At each site a consistent 3 min sampling effort was used along a 30 m reach. Chemical factors (temperature, conductivity, dissolved oxygen, pH) were recorded by taking midstream spot measurements using a multisample meter. Coverings by different substrate types (*e.g.*, silt, sand and gravel, organic detritus) and the degree of channel shade were visually estimated at each site.

STUDY AREA

The cerrado's biome occupies an area of approximately 2 million km² (around 23% of the national territory), distributed mainly in the Central Plateau (Furley & Ratter, 1988). It includes dozens of Brazilian States (Goiás, Tocantins, Federal District, a part of Bahia, Ceará, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Piauí, Rondônia and São Paulo; and some parts

of Amapá, Amazonas, Pará, Roraima and Paraná states (Ribeiro & Walter, 1998).

The predominant climate of the region, according to Köppen's classification, is "tropical savannah" with pluviometric precipitation concentrated in the summer. The rainy season starts in October and finishes in April, representing 84% of the annual precipitation. The rainiest months are November, January and December. The interannual average precipitation varies between 1,200 mm and 1,700 mm. The annual average temperature varies from 18 to 22 °C. The relative humidity of air decreases from high values of 70% at the beginning of the dry season and less than 20% at the end of the period. In the hottest period (August and September), the humidity can reach 10%, typical dryness of desert.

The Paranã River basin is considered a priority Conservation area in Brazilian territory. It is part of Tocantins-Araguaia hydrographic basin and is located between 2° and 18° S and 46° and 56° W. The annual medium outflow is 10.900 m³/s, the annual medium volume is 344 Km³ and it has a drainage area of 767.000 Km². The Paranã river is one of the greatest rivers from the Centro-Oeste (mid-west) region flowing through Goiás, Maranhão and Pará States. Benthic macrofauna research was carried out in the Paranã River Valley when a full biological Brazilian inventory (PROBIO) of this priority Brazilian area for Conservation was compiled. In this project we collected samples from 27 rivers in the Paranã basin (Fig. 1).

RESULTS

Melanoides tuberculatus was collected from only 3 rivers out of the 27 rivers studied in the Paranã basin. The three water bodies where *M. tuberculatus* occurred were in the Crixás, Cana Brava and Macacos rivers.

In all of the places, *M. tuberculatus* only occurred in shady and human-impacted areas, usually associated to fine and coarse particulate organic matter. The Macacos River where they occurred is associated to non identified green algae.

In the Crixás River, the mean densities of *M. tuberculatus* were of 2 individuals/m² and the organisms were sparsely distributed (Fig. 2). The infestation was more intense in the Macacos

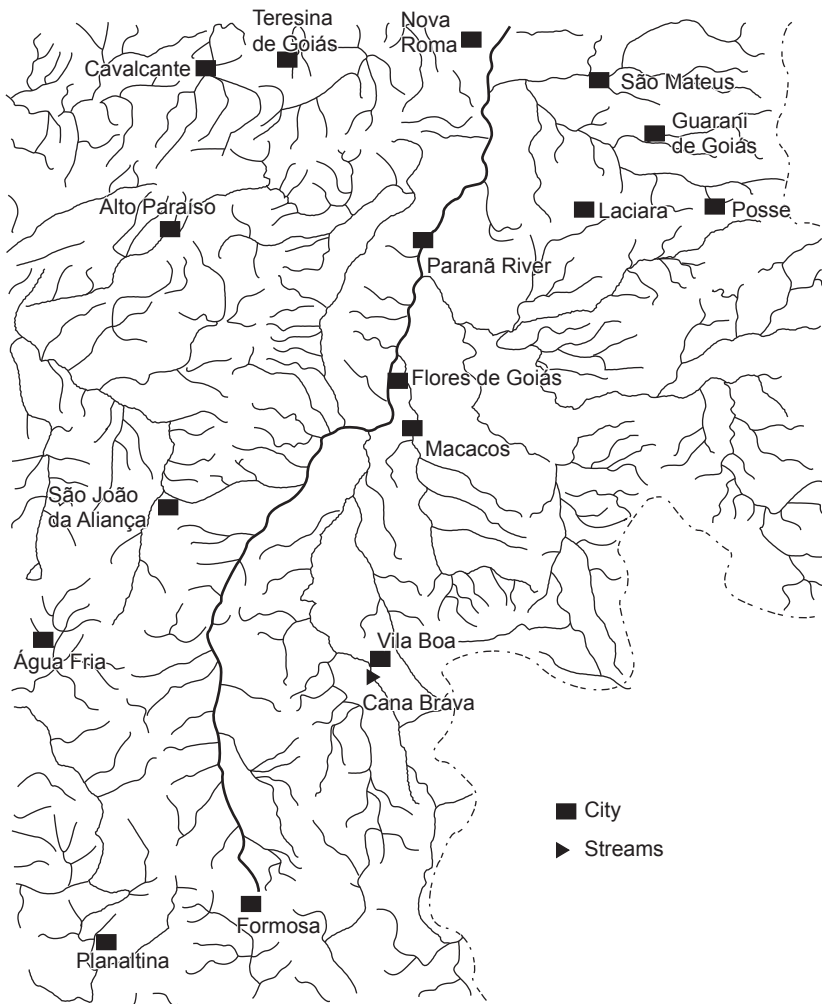


Fig. 1 — Map of the area showing the study sites, Crixás, Macacos e Cãna Brava River.

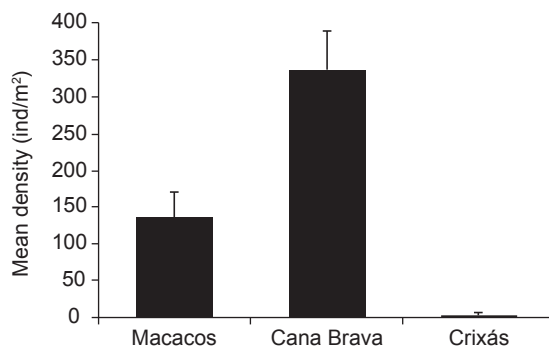


Fig. 2 — Mean density of *Melanoides tuberculatus* at study sites.

and Cana Brava rivers where it reached the highest densities (Fig. 2), and no other native gastropods were found (*Biomphalaria* or *Pomacea* for example). It is clear that in both rivers the population structure is quite similar as there are a great number of young and a decreasing number of adults (Fig. 3). However, in the Cana Brava River few individuals from the class size 20-24 were found and many recruits were collected (0-4 mm), indicating that a recent reproductive event in this river must have occurred. On the other hand, in the Macacos River no recruits were found and a great number of individuals in the last class size (20-24 mm) were collected.

The shell aperture width of *M. tuberculatus* from the Cana Brava River measured between 0.3 and 6.5 mm, with a high abundance of small individuals (Fig. 4). In the Macacos river, the

distribution lies between 0.5 and 6.1 with a predominance of higher size classes (Fig. 4).

DISCUSSION

The introduced prosobranch *M. tuberculatus* is a viviparous and parthenogenetic snail that has occurred in many places around the world. This species is a successful invasive species which is recognized by its ability to colonize human-impacted areas (Pointier *et al.*, 1993; De Marco, 1999; Martins-Silva & Barros, 2001).

As in other studies (Pointier *et al.*, 1993; De Marco, 1999), the populations of *M. tuberculatus* that were found in the present work occurred mainly in backwaters and shady areas with fine sediment (organic detritus). All the infested places presented a certain degree of degradation. The

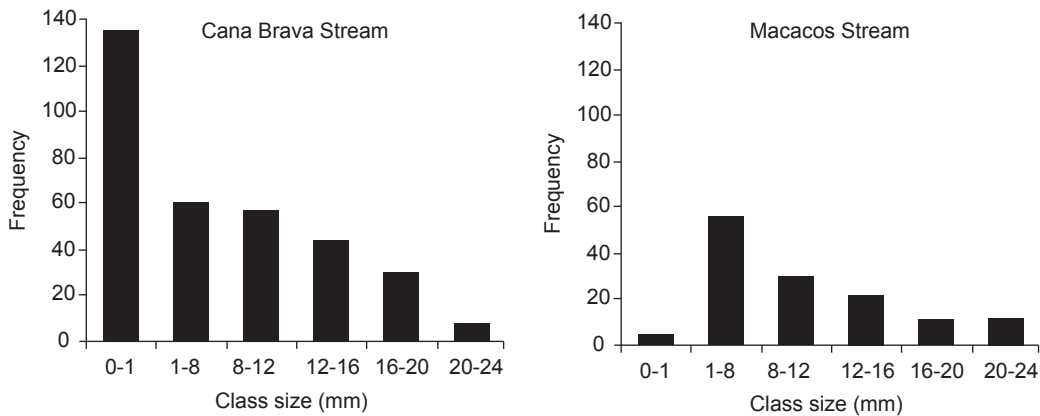


Fig. 3 — Frequency distribution of shell length of *Melanoides tuberculatus* collected in Macacos and Cana Brava Streams.

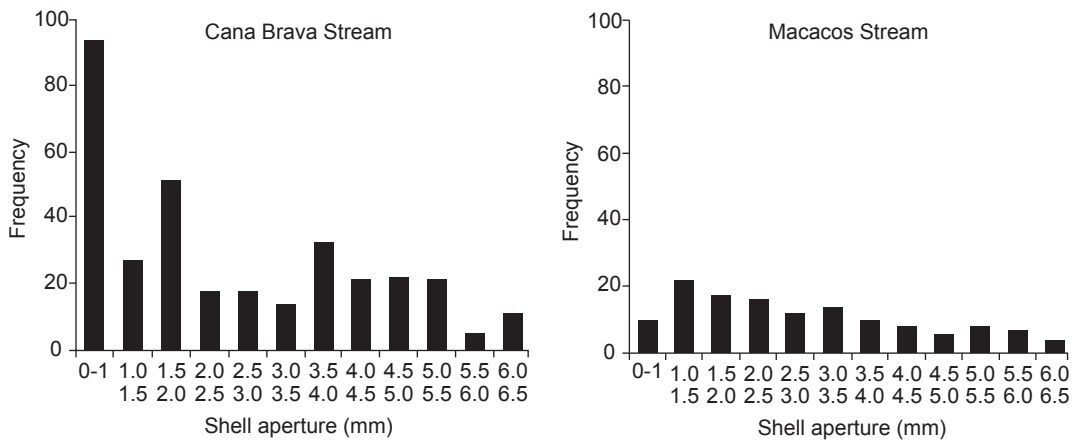


Fig. 4 — Frequency distribution of aperture width of *Melanoides tuberculatus* collected in Cana Brava and Macacos streams.

Cana Brava River, which had the highest density of infestation (334 individuals/m²), is one of the most impacted rivers in the Paran valley and has farming activities. It is clear that *M. tuberculatus* infestation is made easier in more polluted places. De Marco (1999) also found same patterns for the species distribution in Minas Gerais where the species occurred abundantly in the pier reas, probably due to sediment properties and the absence of macrophyte cover. In the Federal District, this exotic species occurs abundantly in Lake Parano and in Riacho Fundo Creek (Vieira, 1990; Medeiros, 1997; Martins-Silva *et al.*, 2001), mainly in organically polluted areas (Martins-Silva & Barros, 2001).

It is clear that the population structure of Cana Brava and Macacos River are quite similar with a great number of young and a low number of adults (Fig. 3). However, Macacos's population seems to result from (older reproduction events, when compared with Cana Brava's population) previous infestation when compared with Cana Brava's population. This tendency occurs because in the Cana Brava River few individuals of class size 20-24 were found and many recruits were collected (0-4 mm); while in Macacos River no recruits were found a great number of older adults (20-24 mm) were collected, indicating that this population could have reproduced earlier than the Cana Brava population. Dudgeon (1986) affirms that this species can start reproduction with at least 2.8 mm. Therefore, despite differences between these areas, around 40.41% of the Cana Brava's population and around 51.49% of the Macacos population are able to reproduce. It shows that most of both populations are able to reproduce and increase infestation degrees.

Many possible problems for native communities and sanitary questions due to *M. tuberculatus* invasion could be listed, however there are urgent challenges to be concerned about. Associations with pulmonate snails and parasitism by trematodes can lead to the death of native birds and mammals that live and feed on the lake. An example of an associated trematode, *Centrocestus formosanus* - that completes part of its lifecycle within the digestive gland of *M. tuberculatus* - spreads heavy infections to fish and ducks in the USA (Brandt, 2000). *M. tuberculatus* also acts as potential intermediate hosts of *Paragonimus*

westermani (Kerbert, 1878) and *Clonorchis sinensis* (Cobbold, 1875). In Brazil, few studies reported larval forms of trematodes harboring specimens of *M. tuberculatus*. Boaventura *et al.* (2002) reported *Pleurolophocercus* larvae (mammal and bird parasites) harboring specimens of *M. tuberculatus* from Maric and Guapimirim. Carneiro *et al.* (2004) recorded *Pleurolophocerca* larvae (Opisthorchiidae and Cryptogonimidae) in Minas Gerais State at Pampulha's Dam for the first time.

On other hand, the biological (high reproductive capacity and adaptability to a wide range of environmental conditions) characteristics of *M. tuberculatus*, that make this species a good invader, seems to encourage its use in the biological control against the Schistosomiasis agent because it competes or preys on planorbid snails *Biomphalaria*, an intermediate host of *Schistosoma mansoni* (Guimares *et al.*, 2001; Giovanelli *et al.*, 2003). Pointier (1993) and Pointier *et al.* (1989, 1991, 1993) showed the ability of this species to control and even exclude *Biomphalaria* in some islands of the French West Indies. Guimares *et al.* (2003) reported that populations of *B. glabrata* and *B. straminea* decreased after the *M. tuberculatus* arrived, followed by total exclusion of the former after eight years in some places of Minas Gerais State. This natural biological control could be occurring in some places of the Paran river basin, since in the three rivers where *Melanoides* occurred, there were no *Biomphalaria* species.

Due to the distances and the absence of *M. tuberculatus* in sites between Cana Brava, Crixs and Macacos in the Paran basin, it seems that many introduction events may have occurred. However, the spread of the snail to other rivers from the Paran basin can be made easy by aquatic birds, fishing boats, human degradation and aquarium activities, which could be the most important introduction vector due to the high number of illegal aquarium hobby farmers in this region (local inhabitant communication). All these activities often occur in this region and implementing conservation measures for this basin is urgent, otherwise the whole basin could be infested in a few years' time.

Regarding ecological importance, *M. tuberculatus* is probably already threatening the native species (*Pomacea* and *Biomphallaria* species, for example) of mollusks in the Paran

River basin because in all three rivers with *Melanoides* occurrences (Crixás, Cana Brava and Macacos) there are no native species of mollusks, which is common in other rivers of the region. These threats occur because of its ability to spread fast and colonize new habitats (natural or man-made). Finally, it can be observed that there are few ecological and taxonomic studies concerning native freshwater mollusks in Brazil and still less with impacts of infestation with *M. tuberculatus* and the expansion of this species must be totally monitored and controlled. This work will act as a background for future management programmes in conservation areas of Goiás State.

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