

Distribution of the introduced freshwater snail *Melanooides tuberculatus* (Gastropoda: Thiaridae) in Brazil

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ABSTRACT

This article describes the alarming spread and current distribution of the introduced thiarid gastropod *Melanooides tuberculatus* in Brazil. The first record of this species in Brazil was in 1967 in Santos, state of São Paulo, and since then has been recorded, in the states of Ceará, Distrito Federal, Minas Gerais, Paraíba, Rio de Janeiro, Paraná, Santa Catarina, Bahia, Espírito Santo, Goiás, Mato Grosso, Mato Grosso do Sul, Pará, Pernambuco, Piauí, Rio Grande do Norte and Tocantins. Records concerning the latter ten states are reported for the first time. *M. tuberculatus* has been studied as the intermediate host of some diseases, and is known as displacing native species. The rapid spread of this species, the lack of any control or monitoring, and the scarce knowledge of the Brazilian freshwater mollusks indicate that serious damage to the ecosystem with probable implications to public health are to be expected. Two other detected species of invasive freshwater mollusks in Brazil are the bivalves *Corbicula fluminea* and *Limnoperna fortunei*.

Additional keywords: Invasive, invading, mollusks, Mollusca, South America, Neotropical.

INTRODUCTION

Research on introduced species have received special attention in the last few years due both to the increasing number of invasions and to the economic, environmental, and human health problems they have caused throughout the world.

South America has been especially hard hit by invasive freshwater species such as *Corbicula fluminea* (Müller, 1774) (Bivalvia: Corbiculidae), *Limnoperna fortunei* (Dunker, 1857) (Bivalvia: Mytilidae), and *Melanooides tuberculatus* (Müller, 1774) (Gastropoda: Thiaridae). The two first species were introduced into South America respectively in the 1970s and in 1991, probably in ballast water of ships originating from southeastern Asia (Darrigran and Ezcurra de Drago, 2000).

In North America, *C. fluminea* may have caused some populations of native bivalves to decline, but other native populations seem to coexist with it (Strayer, 1999). In Argentina, *L. fortunei* is well established in the Plata Basin and, in addition to altering the diversity of native molluscan communities, its high-density populations are causing economic problems because they restrict water intake and flow through sewage treatment plants, power plants, and industrial facilities (Darrigran, 2002). In Brazil, economic and environmental problems caused by *L. fortunei* occur at least in the municipalities of Guaíba and Viamão, state of Rio Grande do Sul, according to Mansur et al. (2003).

Reports on the introduction the Afro-Asiatic thiarid *M. tuberculatus* in Latin America started in the 1960s and it is now distributed in all countries of this region (Brown, 1994). In this paper the current distribution of this invasive species in Brazil is reported as well as its impact on both human health and the environment. The goal is to provide the first complete report of the distribution of the species, based on field studies (result of several projects), three major malacological collections in Brazil, and the literature. This report shall provide the background for future control and/or monitoring the spread of the species.

MATERIALS AND METHODS

The main source of data is in the institutional collections, which contain voucher material of field projects, mainly those involving the authors. The institutions are: Instituto Oswaldo Cruz, Rio de Janeiro (FIOCRUZ), Museu Nacional da Universidade Federal do Rio de Janeiro (MNRJ), and Museu de Zoologia da Universidade de São Paulo (MZSP). Additionally, published reports on the occurrence of *M. tuberculatus* were also examined.



Figure 1. Current distribution of the invasive gastropod *Melanoides tuberculatus* in Brazil.

RESULTS

In the Neotropical Region, the first records of *M. tuberculatus* came from Brazil (1967), Cuba (1983), Désirade (1985), Dominica (1975), Grenada (1970), Guadeloupe (1979), Honduras (1980), Martinique (1979), México (1972), Panamá (probably 1971), Peru (1990), Puerto Rico (between 1964 and 1966), Saint Lucia (1978), Venezuela (1972), Argentina-Paraguay (1999) (Abbott, 1973; Amaya-Huerta and Almeyda-Artigas, 1994; Chroschiechowsky, 1973; Larrea et al., 1990; Peso and Quintana, 1999; Pointier, 1993; Pointier and Delay, 1995; Pointier et al., 1989; Vaz et al., 1986).

In Brazil, the first record of *M. tuberculatus* was in Santos, state of São Paulo, in 1967 (Vaz et al., 1986). Subsequently, it has been recorded in the states of Minas Gerais (Silva et al., 1994); Paraíba (Paz et al., 1995); Rio de Janeiro (Thiengo et al., 1998, 2001, 2002a, 2002b);

Giovanelli et al., 2001), Ceará (Melo and Cordeiro, 1999), Paraná (Pereira, 2000) and in the Federal District, Brasília (Vaz et al., 1986; Garcez and Martins-Silva, 1997).

In addition to the above-mentioned reports, we searched for additional material of *M. tuberculatus* in Brazil. They are listed below and in represented in Figure 1. State of Pará: Itaituba; Tocantins: São Félix do Tocantins and Peixe; Piauí: Parnaçuá; Ceará: Crato; Paraíba: Campina Grande, João Pessoa, Santa Luzia, São Mamede, and Sousa; Pernambuco: Macaparana and São Lourenço da Mata; Rio Grande do Norte: Pendências; Bahia: Caririnha, Coaraci, Itajuípe and Salvador; Federal District: Brasília; Goiás: Barro Alto, Campinorte, Campinaçu, Colinas do Sul, Formosa, Minaçu, Niquelândia, Nova Iguaçu de Goiás, Padre Bernardo, Santa Rita do Novo Destino, Uruaçu and Vila Boa; **Mato Grosso**: Cuiabá, Nobres, Rosário Oeste and Várzea

Grande; **Mato Grosso do Sul:** Miranda and Três Lagoas; **Minas Gerais:** Além Paraíba, Belo Horizonte, Betim, Caeté, Contagem, Corinto, Lagoa Santa, Ouro Branco, Pedro Leopoldo, Prudente de Moraes and Vespasiano; **Espírito Santo:** Cachoeiro de Itapemirim; **Rio de Janeiro:** Angra dos Reis, Areal, Bom Jesus de Itabapoana, Cambuci, Campos, Cantagalo, Cardoso Moreira, Carmo, Duque de Caxias, Engenheiro Paulo de Frontin, Guapimirim, Itaboraí, Itaguaí, Itaocara, Japeri, Magé, Mangaratiba, Maricá, Mendes, Miguel Pereira, Niterói, Paraíba do Sul, Petrópolis, Pirai, Resende, Rio Bonito, Rio de Janeiro, Sapucaia, Saquarema, São Fidelis, São Francisco de Itabapoana, São Gonçalo, Sumidouro, Valença, Vassouras and Volta Redonda; **São Paulo:** Americana, Atibaia, Bariri, Castilho, Colômbia, Eldorado, Florínea, Guariba, Ilha Comprida, Ipaçu, Itapira, Itapura, Mongaguá, Panorama, Paranapanema, Pedro Toledo, Registro, Ribeirão Preto, Santos, Serra Azul, Sertãozinho and Suzanópolis; **Paraná:** Londrina, Sertaneja and Sertanópolis; **Santa Catarina:** Camboriú and Palhoça. Data concerning the States of Bahia, Espírito Santo, Goiás, Mato Grosso, Mato Grosso do Sul, Pará, Pernambuco, Piauí, Rio Grande do Norte and Tocantins are new.

DISCUSSION

The origin of the introduction of *Melanoides tuberculatus* to Brazil remains unknown, but it is probably linked to the plant and freshwater ornamental fish trade. This route of introduction and spreading of freshwater snails had been previously reported i.e. Cowie (2002), Madsen and Frandsen (1989) and Pointier (1999). The first record of *M. tuberculatus* in the state of São Paulo was in aquarium hobbyist stores in the city of Santos (Vaz et al., 1986). Thiengo et al. (1998) reported its introduction by local fish farmers and rapid colonization in fish tanks in Guapimirim, Rio de Janeiro, probably in the 1970s. In the states of Minas Gerais, Rio de Janeiro and São Paulo, where more extensive surveys have been done, this species has been collected from almost all hydrographic basins, inhabiting lotic, lentic, polluted or clean water environments, often in dense populations. *Melanoides tuberculatus* has since spread from few points in São Paulo to all Brazilian regions in the course of three decades.

The biological and parthenogenetic reproductive characteristics of *M. tuberculatus* make this species a good invader (Pointier and Delay, 1995). Its adaptability to a wide range of environmental conditions and high reproductive capacity has encouraged its use, mainly in the French West Indies, in the biological control of the host snails of *Schistosoma mansoni* Sambon, 1907. Field and laboratory experiments undertaken in Désirade, Guadeloupe, Martinique and Santa Lucia, revealed the ability of this species to limit and even exclude species of *Biomphalaria* in these islands (Pointier, 1993; Pointier et al., 1989, 1991, 1993). In Brazil, studies on the impact of exotic species are

scarce: Giovanelli et al. (2001) observed that in Sumidouro, an area of low endemicity for schistosomiasis, *M. tuberculatus* had substantially reduced *Biomphalaria glabrata* (Say, 1818) populations, indicating a process of competitive exclusion; in Betim and Prudente de Moraes, Guimarães et al. (2001) reported marked reduction in populations of *B. glabrata* and *B. straminea* (Dunker, 1848) in two lakes, after the arrival of this thiarid, followed by complete disappearance of the former species eight years later. During the last three years, our group (unpublished data) has been performing a quantitative study of *M. tuberculatus*, *B. straminea* and *Lymnaea columella* Say, 1817 populations in a large reservoir in Minaçu, Goiás. Preliminary data indicated that native populations of the thiarid *Aylacostoma tenuilabris* (Reeve, 1860), previously abundant in the Tocantins River, have been replaced by dense populations of *M. tuberculatus*. Fernandez et al. (2001) documented the displacement and decline of *B. glabrata* and *Pomacea lineata* (Spix, 1827) populations in a small stream on the campus of Fundação Oswaldo Cruz, Rio de Janeiro, after the introduction of *M. tuberculatus*. This data is already sufficient for demonstrating that native species, suffering declines from pollution and destruction of their natural habitats, are now being impacted by *M. tuberculatus*.

Morphological and conchological studies on samples of *M. tuberculatus* from Brazil are being performed in order to detect the occurrence of distinct morphs as observed in the Caribbean islands. Conchological characteristics and spatial distribution provide evidence that morphs of *M. tuberculatus* exist in Martinique and that new morphs of this species develop in rapid succession (Pointier, 1989; Pointier et al., 1993). Recently, Simone (2001) included samples of *M. tuberculatus* in the phylogenetic analyses of Cerithioidea, based on comparative morphology, and has not found any evidence for differentiating morphs.

Regarding medical and veterinary importance, *M. tuberculatus* acts as potential intermediate hosts of *Paragonimus westermani* (Kerbert, 1878), *Clonorchis sinensis* (Cobbold, 1875) and *Centrocestus formosanus* (Nishigori, 1924) helminthes responsible respectively for paragonimiasis, clonorchiasis and centrocestiasis transmission (Amaya-Huerta and Almeyda-Artigas, 1994; Pointier, 1999). Until recently *M. tuberculatus* had never been recorded harboring larval forms of those trematodes in Brazil. A recent report by Boaventura et al. (2002) found specimens from Maricá and Guapimirim shedding Pleurolophocercus cercaria.

We believe that the ability of *M. tuberculatus* to spread rapidly and colonize new, natural and man-made habitats alike, generally resulting in high-density populations, threatens the native mollusc fauna and should be closely monitored and documented.

Considering the lack of substantial taxonomic and ecological studies on our freshwater mollusc fauna and the environmental impact caused by alien species, in

spite of extensive areas endemic for schistosomiasis in Brazil, and the possible effectiveness of *M. tuberculatus* as a competitor of planorbid intermediate hosts of *S. mansoni*, expansion of this species must be thoroughly monitored and controlled, which has not been done.

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