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Ocorrência de *Achatina fulica* Bowdich, 1822 (Mollusca, Gastropoda) e sua correlação com vegetação e lixo encontrados em São Mateus, Espírito Santo, Brasil

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Abstract The giant African snail, *Achatina fulica*, originated in Africa, but now is widely distributed and became a concern in various areas for being an etiological agent of eosinophilic meningoencephalitis. This is one of the few studies in the Espírito Santo state in which we verified *Achatina fulica* occurrence in accessible vacant lots in the coastal area of the city of São Mateus and classified them according to the quantity of vegetation, garbage and snails found in the lots. We confirmed the presence of *A. fulica* in the region, including infestations, which may be a threat to public health. Thus, future researches should investigate the possibility of disease contamination, as meningoencephalitis, and propose strategies for management and control of the snail.

Keywords: *Angiostrongylus cantonensis*; giant African snail; escargot.

Resumo O caramujo gigante Africano, Achatina fulica, originário da África, mas agora está amplamente distribuído e tornou-se uma preocupação em várias regiões por ser um agente etiológico da meningoencefalite eosinofílica. Há poucos estudos no estado do Espírito Santo sobre a presença desta espécie, nosso trabalho verificou a sua ocorrência em terrenos baldios acessíveis no bairro de Guriri na cidade de São Mateus e classificou-os de acordo com a vegetação, lixo e quantidade de caramujos. Foi confirmada a presença de *A. fulica* na região, o que pode representar uma ameaça à saúde pública e a necessidade de inspecionar todas as ruas da cidade de São Mateus, especialmente aquelas que não foram verificadas. Sendo assim as futuras pesquisas devem considerar a possibilidade de contaminação com a doença meningoencefalite e propor estratégias de manejo e controle do caramujo, bem como a conscientização da população sobre a espécie.

Palavras-chaves: *Angiostrongylus cantonensis*; caramujo-gigante-africano; caracol-gigante-africano, escargot.

Introduction

The giant African snail, *Achatina fulica*, is a terrestrial pulmonate snail that can reach 12cm in length, 20cm in height and weight up to 200g (Godan 1983; Teles et al. 1997; Vasconcellos e Pile 2001). It

is a hermaphrodite species, resistant to environmental variables, with a generalist feeding behavior which facilitates its proliferation and success in adaptation (Paiva 1999; Raut & Barker 2002; Teles et al. 2004).

The species is nocturnal, dependent on the availability of moisture, active under high-humidity conditions, capable of hibernation and during high or low temperatures stay at protective sites where they won't be exposed to extreme conditions, characteristics that allow them to inhabit a wide range of environments (Raut & Barker 2002). *A. fulica* is commonly found on trees, decaying material in decomposition and next to garbage deposits (Mead 1995; Vansconcelos & Pile 2001).

A. fulica is in the International Union for Conservation of Nature (IUCN) list of "100 of the World's Worst Invasive Alien Species" considered one of the most destructive pests affecting subtropical and tropical areas, causing large damages to biodiversity in natural environment, farms, commercial plantations and domestic gardens.

Records indicate that the earliest achatinids originated in Africa, in the north of Zambezi in the lower Guinea of Cameroon and Gabon (Mead 1950), but the giant African snail is now widely distributed and became a concern in various regions (Raut & Barker 2002). Its introduction has been reported in Hawaii in the 30's, in California after the World War II and then in Florida (Godan 1983; Teles et al. 1997). According to Fischer & Colley (2004) with this wide occurrence the snail is today considered an agricultural plague, a potential competitor with other snails' species and host of diseases that can be transmitted to humans and other vertebrates.

The first known record of *A. fulica* introduction in Brazil was in 1989 in the state of Curitiba, in which the snails where brought for production and commercialization, then in 1996 and 1998 in the city of Santos (Teles & Fontes 2002; Fischer & Costa 2010). There is an unofficial information that in 1975 a resident in Juiz de Fora, Minas Gerais (Barçante et al. 2005), brought the giant African snail for production in a street fair. *Achatina fulica* presence has not been recorded in Brazil only in the state of Acre and in the Federal District area (Thiengo et al. 2007; Agudo-Padrón 2009; Sá de Oliveira et al. 2012).

The situation is worrying and is necessary to estimate the extent of this problem in Brazil. Information of preferential habitats, distribution in the various biomes and cities will provide foundations for control programs, management and environmental education.

The Espírito Santo state was the first in Brazil to found *A. fulica* infected with *Angiostrongylus cantonensis* (Chen 1935, Caldeira et al. 2007) an etiological agent of eosinophilic meningoencephalitis (Alicata 1962) and there are few studies in the state about the presence of the giant African snail and diseases associated to them. Costa et al. (2005) collected data on the occurrence of *A. fulica* from visits to municipalities, contacts with public agencies and samples sent by the population thus reporting the presence of the giant African snail in 27 cities of the Espírito Santo state, including the city of São Mateus.

Our study goal was to verify the occurrence of *Achatina fulica* in the coastal area of the city of São Mateus and the conditions of the environment where the individuals were found. Thus, provide subsidies to elaborate protocols for local diagnostics and the determination of management plans.

Material and Methods

The study area was the coastal region of the city of São Mateus in the Espírito Santo state, Brazil, located at 18º42'58" south and 39º51'21" west, with an altitude of 36m. It is a fluvial-maritime island, formed by the Mariricu River in the south and the Cricaré River in the north, which flow into the Atlantic Ocean. The neighborhood has a flat terrain with low woody vegetation, herbaceous and grasses mostly. The soil consists of alluvial sand deposits with fluvial-marine origin (Suguio et al. 1982). Climate is hot and humid (Aw), the annual average temperature varies between 22 º C and 24 º C (Panoso et al. 1978) and the average annual rainfall is between 1000 and 1250 mm. (Nimer 1989).

From October 1st of 2013 until October 14 of 2013, starting from the beach, we covered an area with 1.960km2 where we searched vacant lots due accessibility. The lots containing snails were photographed (Figure 1) and then classified according to the vegetation, garbage and snails estimated quantity. We did a qualitative classification considering zero for absence, one for few, two for medium and three for many. And to verify the correlation between the occurrence of snails with the presence of vegetation and garbage we used the Spearman's rs test with Past v. 3.08 (Hammer et al. 2001).

Figure 1: Qualitative classification of *Achatina fulica* quantity applied zero for absence, one for few (A), two for medium (B) and three for many (C).

Results

We found 192 accessible vacant lots in which 44 (23%) we verified the presence of *Achatina fulica*. In these 44 lots that we found the giant African snails, 55% we classified as few snails, 25% as medium and 20% had many individuals, in some lots we found dead snails and eggs deposition. Considering the vegetation 50% had few plants, in 27% was medium and 23% had many, being the most frequent grass, guriri (*Allagoptera arenaria*), shrubs and different trees. As for the garbage disposed in the lots it was absent in 18%, few in 32%, also medium in 32% and many in 18%, the garbage consisted most of food, plastic, can, toilet paper, diapers, construction material and paperboard.

The correlation between quantity of snails and the presence of garbage was significant ($p<0.01$), but no correlation was found between quantity of snails and the presence of vegetation ($p=0.43$). Although there was no spatial pattern in the giant African snail's distribution, a specific region presented a concentration of lots with the presence of snails, but there were also streets where one lot would have many snails, but the adjacent would have none. There were no records of snails in the lots closer to the sea.

Discussion

Lots where we found few snails were associated with 31% of lots with absence of garbage, while lots with many snails were related to 45% with many garbage, which is explained by the fact garbage, organic and inorganic, provides substrates and nourishment to *A. fulica* what benefits the establishment of the species (Fischer & Coley 2004, Sá de Oliveira et al. 2012), a result of a lack of care cleaning the lots (Sá de Oliveira et al. 2012). Vegetation serves as a resting place to *A. fulica* (Fischer & Colley 2005), it provides shade, temperature, humidity and sunlight favorable to its survival (Raut & Barker 2002), thus when we found few snails no more than 25% of the lots had medium or many plants, while in the lots with many snails only 10% had few plants.

We based our data on the accessible areas as we couldn't enter some lots due dense vegetation and building constructions, which according to Craze & Mauremootoo (2002) may lead us to an underestimate information since we can't assume that the organisms occur at similar densities in accessible and inaccessible sites.

Fischer & Colley (2004) in their study found that streets with one or two points of infestation had higher density of snails, what corroborates our data, the lots we had with many snails were closer, signing an infestation. These lots happen to be in an area where a street market occurs twice a week and where one of the most important hotels of the city is localized. Besides, when we were collecting our data we also verified rats using these lots areas and there are reports of rats feeding on giant African snails (Fischer & Coley 2004), which lead us to a serious threat to public health.

According with other studies the best indicator of the absence of snails is the condition of the lots, usually snails aren't found in lots less modified, cleaner and with controlled plants growth (Lake & O'Dowd 1991, Shah 1992, Tomyama 2000, Craze & Mauremootoo 2002, Simião & Fischer 2004, Fis-

cher & Coley 2004, Sá de Oliveira et al. 2012). Of 148 vacant lots where we didn't find the giant African snail 35 were in a 300m range from the beach, an area that due touristic interests receives more attention of the local government, as paving of streets, daily collection of garbage, and thus is cleaner.

Another point to be considered in the elucidation of the absence of snails in the 148 vacant lots is that local population usually set fire on their garbage in the nearest vacant lot and we observed that most of these lots were burned and in some of them we found empty and carbonized shells of *A. fulica*.

Conclusion

We confirm the presence of *A. fulica* in the city of São Mateus, with some infestation sites, which lead us to a start for the elaboration of management plan and, considering that the snails are associated with antrophic environments and local population, scientific community and public authorities must work together to ensure a successful action.

It is an invasive alien species and therefore we must invest in preventive measures to control it, such as educational campaigns to explain to the population how to distinguishing *A. fulica* from native species in order to avoid it and not transport the snail spreading it to another areas, but also highlight the importance of handling waste correctly.

More studies are necessary specially to investigate if the existent individuals are infected with *Angiostrongylus cantonensis*, since the snails presence can represent the possible installation of the eosinophilic meningoencephalitis disease in the region.

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