

Occurrences and socio-environmental impacts of the Giant African snail (*Achatina fulica* Bowdich, 1822) in urban area of Macapá, Amapá, Brazil

Ocorrências e impactos socioambientais do caramujo africano (*Achatina fulica* Bowdich, 1822) em área urbana de Macapá, Amapá, Brasil

Ocurrencias e impactos socioambientales de la caracol gigante africano (*Achatina fulica* Bowdich, 1822) en la zona urbana de Macapá, Amapá, Brasil

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Abstract

This study aimed to verify the occurrence and socio-environmental impacts of the presence of African Snail in the Açai neighborhood, city of Macapá, State of Amapá, showing problems such as the occurrence of the species and the lack of knowledge of the community about its infestation and control. The interviews were conducted using semi-structured forms to collect information on site and photographic record, for a period of four months (08/2013 to 12/2013). Variables of social and environmental axes were evaluated as impact indicators. The results showed that a greater performance of the public would contribute directly to the quality of life of the population and the environment, promoting the decrease in the occurrence of this snail. An environmental education program aimed at disseminating information on the impacts of African snail should be encouraged. It is necessary to work in the development of legal instruments, as well as in the development of campaigns to clarify the population.

Keywords: Mollusks; Prevalence focuses; Socio-environmental Impacts.

Resumo

Este estudo buscou verificar a ocorrência e os impactos socioambientais da presença de Caramujo Africano no bairro Açai, cidade de Macapá, Estado do Amapá, demonstrando problemas como a ocorrência da espécie e a falta de conhecimento da comunidade sobre a sua infestação e o controle. As entrevistas foram realizadas utilizando formulários semiestruturados para coleta de informações *in loco* e registro fotográfico, por um período de quatro meses (08/2013 a 12/2013). Variáveis de eixos sociais e ambientais foram avaliadas como indicadores de impactos. Os resultados mostraram que uma maior atuação do público contribuiria diretamente para a qualidade de vida da população e do ambiente, promovendo a diminuição na ocorrência deste molusco. Um programa de educação ambiental visando disseminar informações sobre os impactos do caramujo africano deve ser incentivado. É necessário trabalhar na elaboração de instrumentos legais, bem como no desenvolvimento de campanhas para esclarecer a população.

Palavras-chave: Molusco; Focos de prevalência; Impactos socioambientais.

Resumen

Este estudio tuvo como objetivo verificar la ocurrencia y los impactos socioambientales de la presencia de caracol africano en el barrio de "Açai", ciudad de Macapá, estado de Amapá, mostrando problemas como la aparición de la especie y la falta de conocimiento de la comunidad sobre su infestación y control. Las entrevistas se realizaron utilizando formularios semiestructurados para recopilar información *in situ* y registro fotográfico, por un período de cuatro meses (08/2013 a 12/2013). Las variables de los ejes sociales y ambientales se evaluaron como indicadores de impacto. Los resultados mostraron que un mayor desempeño del público contribuiría directamente a la calidad de vida de la población y el medio ambiente, promoviendo la disminución en la ocurrencia de esta almeja. Debería fomentarse un programa de educación ambiental destinado a difundir información sobre los efectos del caracol africano. Es necesario trabajar en el desarrollo de instrumentos jurídicos, así como en el desarrollo de campañas para aclarar a la población

Palabras clave: Molusco; Focos de prevalencia; Impactos sociales y ambientales.

1. Introduction

The species *A. fulica* is considered the cause of biodiversity loss in various ecosystems and imbalance in the function and structure of a diverse biota. Zanol et al. (2010) explain that the dense populations of this mollusk in the country are mainly due to their great biotic potential and the absence of specific pathogens. The author also states that the snails are very voracious and undemanding to feed, eating practically everything.

According to Silva et al. (2020), the presence of the Giant African snail has been reported in different environments, such as forests, capoeiras, caatingas, savannas, plantations, vegetable gardens, as well as in urban areas. In the Amazon, surveys show that its presence may be associated with the transport of this mollusc in accidental loads, denoting in an alert situation due to its high dispersal capacity, diet, reproduction, and absence of natural predators for its biological control (; Lima & Guilherme, 2018; Onyshi et al., 2018; Eduvirgem & Ferreira, 2020; Silva et al., 2020)

The humid and shaded climatic conditions of the state of Amapá favor its occurrence, since this species reproduces easily in environments with these characteristics (Andreazzi et al., 2017; Alves et al., 2017a; Eduvirgem & Ferreira, 2020). In Macapá, the capital of Amapá, the incidence has been observed in almost all neighborhoods of the city and in much of the municipalities. With the arrival of the rains, year after year, the population suffers with the African snail that invades land and destroys plantations. In the summer, its population decline occurs, which does not denote a control in the density of the species.

The lack of statistical data in the control of Zoonoses of the state of Amapá and the municipality of Macapá leads society to dissatisfaction and a gap in knowledge imposed by lack of clarifications and proposals of public policies as the aid of public authorities. Records in regulatory bodies, such as the coordination of health surveillance of the city, are obsolete about specific technical-scientific studies about the specie and its implications to diversified ecosystems. The few data made available are irrelevant to having a real estimate of the spread of this mollusk in the state.

In the Açai neighborhood, the study area of this research, no policy of combat and control of the African snail has been taken by competent organs, which entails the dissemination of this mollusk, where the periods of rain provide and potentialize its occurrence. The population concerned with uncontrolled proliferation of the specie develop their own measures to control infestation.

Several mechanisms are being used by the population to try to mitigate the impacts promoted by the presence of the mollusk, such as the use of sodium chloride (NaCl), incineration and, even, discard in inappropriate local as clandestine dumps (Almeida, 2016; Alves et al., 2017a; Gomes et al., 2020). Thus, there is a certain lack of preparedness on the part of the population under the correct form of elimination of the snail, which may be causing deleterious effects to the environment, as well as to the health of the population since contact with the mucus of the mollusk can become harmful factor to human health.

In view of the problem, this study aims to make a diagnosis of the knowledge of the local population about the prevalence and control methods of *Achatina fulica* and the action of the public power in combating the African snail, aiming to identify the frequent socio-environmental impacts of the presence of this mollusc in the study area.

2. Methodology

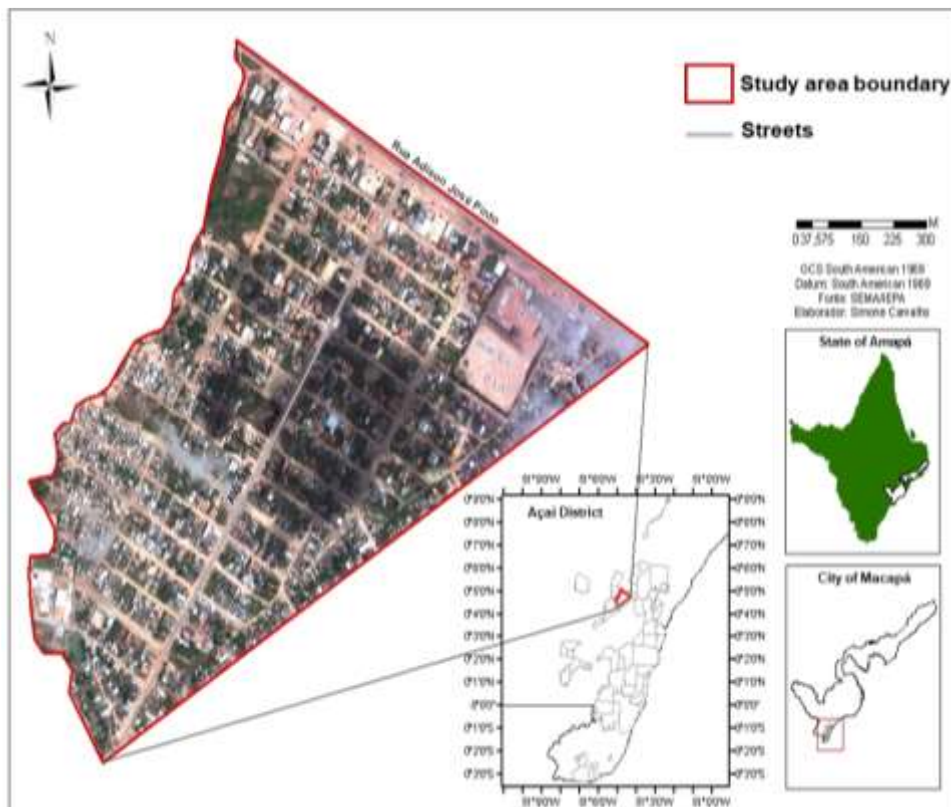
This research is characterized by the quali-quantitative method, with the direct collection of data in the natural environment, *in situ*, with the researcher as the main instrument (Pereira et al., 2018). The collected data were preferably descriptive, however, we used instruments to collect quantitative data relevant to the categories of analysis evaluated by the research.

2.1 Characterization of the study area

The Acai neighborhood is located 30 km from the center of the municipality of Macapá, in the northern part of the city (Figure 1). This area started with 2,235 lots and currently has more than 6000 inhabitants (IBGE, 2011). The rapid population growth has made evident the precariousness of public services in the sectors of education, health, basic sanitation, security, and infrastructure. The population is not attended by basic health services, requiring, in this way, to seek care in other neighborhoods and localities.

Public cleansing is chaotic. Urban waste is observed of the roads and vegetation and is notorious throughout the area of study. Most of the time these residues remain unduly disposed for long periods, leading to the emergence of "lixeiros viciadas", damaging the aesthetic and sanitary conditions and the welfare of the residents with the aggravation of the risks to public health. It is noteworthy that the problem of urban solid waste is one of the most worrying discussions, since the sharp growth of the population led to the increase in the production of goods and services. This increase, in turn, promotes a considerable generation of residues, which are collected or disposed of, inadequately, that bring impacts to the environment and public Health (ANVISA, 2004).

Figure 1. Characterization of the study area.



Sources: IBGE (2013)

2.2 Methodological procedures

Visits were made in 100 households, distributed in 69 blocks in the study area. The interviews took place over a period of four months (August to December) during the year 2013. Data were collected using semi-structured forms. The forms were structured to contain questions that covered the following aspects: a) socioeconomic status; b) local knowledge about the African snail; c) snail infestation control; d) performance of the public authorities.

The interviews were aimed at diagnosing the socio-environmental condition and the knowledge of the residents about

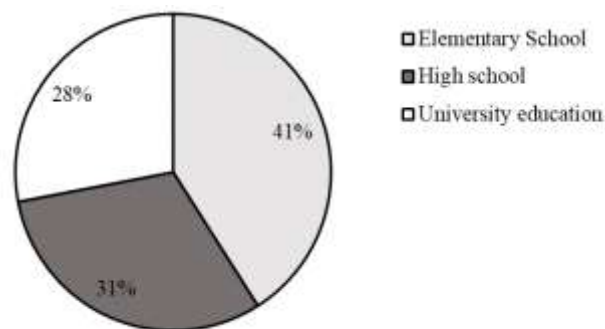
the African snail, as well as the means of contamination, the control procedures, and the diseases (directly and indirectly) caused by it. In addition to identifying the presence of the public power in the assistance of combating snail in the field of study. At the time of the interview, the collaborators were invited to sign the term of free and clarified consent, respecting the ethical aspects of research according to resolution No. 466 of December 12, 2012 and Resolution No. 510 of April 7, 2016.

At the time of the interview's observations were made in loco and the photographic record of the study area and the presence of the Giant African snail. All data were tabulated, and the average intersection and percentage calculated using the Office Excel software.).

3. Results and Discussion

The evaluation of the social axis is one of the main techniques in obtaining important variables for the measurement and evaluation of results in studies of social and environmental coverage (Coelho, 2005). The interviewees in the present study presented, on average, 8.9 ± 1.6 years of housing, with a density of 4.4 ± 1.2 inhabitants/household. In addition, 41% of respondents had a complete elementary level, 31% had completed high school, and only 28% had the complete upper level (Figure 2). This data denotes a fragility of the residents facing the need for instructions in acquiring more information for the construction of critical sense to the related quality of life and environmental issues, for example.

Figure 2. Level of schooling of residents in the study area.

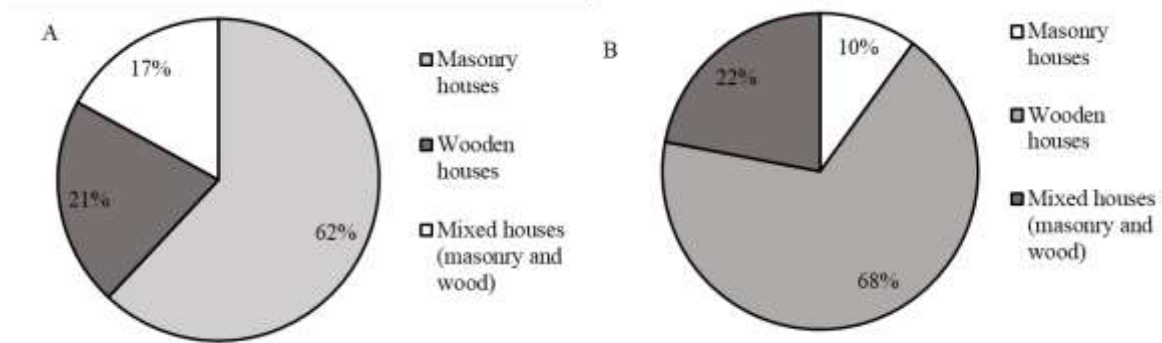


Sources: Authors.

In a study developed by Patiño Montoya et al. (2019) in urban communities of Colombia, a negative relationship was observed between the environmental perception of the residents and the low level of schooling and knowledge about the Giant African snail. The authors affirm that most of the scientific research on the relationship between populations and the presence of the African snail relate a negative perception and a low knowledge about snails by the community studied.

A total of 62% of respondents live in masonry houses, 21% in wooden houses and only 17% reside in mixed houses (masonry and wood) (Figure 3A). Based on this, the results showed that the focus of prevalence of the African snail occurred mainly in wooden houses ($N = 68$), followed by mixed houses ($N = 22$) and in masonry houses ($N = 10$) (Figure 3B).

Figure 3. Characterization of the household. A) type of construction of the household; B) Focus of prevalence of the African snail by type of household.



Sources: Authors.

As for the type of construction, the data showed a high adaptability and preference of the species by environments characterized by wooden houses in the study area. However it is observed that due to its generalist feeding habit and its high reproductive potential, this species has a behavior that allows it to colonize several environments, especially, to those anthropized, because this environments offer shelters and an extensive range of food items incorporated into their diet (Oliveira et al., 2013).

All the residences in the neighborhood have electric power supplied by the Electricity Company of Amapá. However, water for consumption of most households (73%) is removed from underground aquifers (free and confined), the remainder (27%) is provided by local water concessionaire. The sanitary sewage does not receive the treatment service by the municipality of Macapá. The population interviewed in Açaí neighborhood (100%) uses the septic tanks system, but many of them are without proper infrastructure and planning, being in the open, and can thus trigger other disease vectors that affect human health (Figure 4).

Figure 4. Water and sewage system-a) water box for storing water collected from underground aquifers, b) septic tank construction.



Sources: Authors.

The data obtained in loco subsidized the characterization of the situation that the community of the neighborhood acai has been suffering. In this sense, some themes were more recurrent, among them: information about the Giant African snail; prevalence period; where they are found; the local management of the species and the action of the governance in the combat and control of the snail.

In this way, 41% of the interviewed said they had access to information about the African snail through the media; 23% had knowledge in pamphlets in information campaigns by endemic agents; 11% in documentaries and lectures in schools and 25% had direct contact with the snail in invasion in their homes.

Knowledge of the ecology and biology of this mollusk in the urban environment is extremely important because it gives us information to prevent the species from becoming an invader. In addition, this knowledge can indicate when the species represent an invasive population, besides contributing to risk analysis, early detection, and management (Colley & Fischer, 2009).

The passive and active dispersion potential of *A. fulica* has already been evaluated with the hypothesis that these animals are constantly reintroduced into the communities through passive transport in construction material and through the displacement by the environment, a fact that Preclude the punctual control made by the resident (Fischer & Colley, 2005). The research data point to the fact that the residents did not obtain technical guidance to solve problems related to the snail, avoiding that impacts environmental and public health occur.

Most of the residents, about 82% of the interviewees, affirm that there is a significant increase in the prevalence of mollusk in the rainy period, period in which the pluviometric index increases, approximately, 2276, 9 mm per year (Souza & Cunha, 2013). With the start of the rains, the residents fail to fight the proliferation of the African snail and generally its prevalence is associated with periods with larger precipitations and moisture (Albuquerque et al., 2009; Silva et al., 2020).

In general, pulmonary terrestrial gastropods, such as species *A. fulica*, to be more abundant in the rainy season, since the relative humidity of the air and the soil are higher, which facilitates its reproduction and development (Oliveira et al., 2013). Nevertheless, 18% of the residents, too, stated that there is the presence of snails in their homes and neighborhoods throughout all year: *This animal does not die, either in winter or in Summer, it always appears* (interviewee R).

When asking where mollusks are found, 19% of the interviewees answered that they appear in the vegetation; 23% realized that they like damp places and molds, such as walls and ceilings of houses; 58% say that the snail prefers environments full of debris, amidst garbage, solid waste, rotting wood, tree branches, among others. This last data corroborates with that observed by Silva et al. (2020), where a positive interaction ($p < 0.05$) was observed between the presence of the African snail and the presence of hazardous waste and garbage in Sergipe's cities. In this context, a resident mentioned: *I do daily cleaning on my land, I set fire to these animals, but I don't see much result. They always manage to show up. My neighbors don't cooperate either, so the snail keeps multiplying* (interviewee P).

Based in the study, the interviewees also stated that they did not know an effective procedure to combat the African snail. However, some methods were mentioned in the control of the species density: use of venom (16%); Use of boiling water (23%); incineration of mollusk (27%) and use of kitchen salt (34%). The various methods of collection and control of the mollusk used by the residents of the study area can be observed in the following reports:

They start coming out of the hole in the night, it's the time they most appear in the backyard and in the house, is when we play hot water on them (interviewee M.).

I together all of them in the backyard and I break the shell with the hammer, and I burn them. Have to break the shells or they don't die (interviewee E).

I pour salt on them and the more. I pour salt the more they reproduce, there is no end to this plague! (interviewee S).

Regarding adequate management, among the most recommended control measures, cultural methods stand out. This practice consists of decreasing the biological population without the use of toxic products, seeking the appropriate management of the area of prevalence, by cleaning wasteland and eliminating debris, garbage, crop remains, heaped leaves, host plants or

any material or substrate that can serve as a hiding place for the African snail (Zanol et al., 2010). Allied to this, the collection and incineration proves to be an efficient method, but that needs to be carried out with adequate planning and control (Alves et al., 2017b; Boaventura et al., 2011; Souza et al., 2007).

Regarding the performance of the public authorities, residents affirm that at the federal, state, and municipal levels, there is no assistance to those affected by the African snail. One of them said *they say they have proposals and actions to combat and prevent snails, but to put them into practice, nothing.* (interviewee W).

In its art. 196, the Brazilian Constitution says that health is a “everyone's right and duty of the state, guaranteed through social and economic policies that aim at reducing the risk of disease and universal equal access to actions and services for its promotion, protection and recovery”. Added to this, in its art. 225, the constitutional text protects the right to an ecologically balanced environment, stating that it is “a good for the common use of the people and essential to a healthy quality of life, imposing on the public authorities and the community the duty to defend and preserve it for present and future generations” (Brasil, 1988).

Thus, it is also the responsibility of the public authorities to guarantee environmental quality and quality of life for the population. In this context, it is important that the public authorities establish mechanisms for the management and control of the African snail, combining the co-responsibility and co-participation of the local population. This point should be worked with the population through informative and educational actions, denoting a work with a more political and democratic dimension (Boaventura et al., 2011). It is necessary to work on the elaboration of legal instruments, as well as on the development of information campaigns for the population.).

4. Conclusion

The African snail *Achatina fulica* has recently become a problem for society, especially for residents of Açaí neighborhood due to its high prevalence rates. The results obtained point to problems in the study area, where it is essential that public entities recognize the importance of having more specific technical-scientific studies about the specimen and its implications for society and the environment. The area raised as susceptible to the risk of the proliferation of the African snail, facilitates its analysis and provides the responsible authorities with the opportunity to understand the processes that involve the phenomena of campaigns and projects to eradicate this urban pest and allows the public power to plan measures effective, so that they can be combated strategically, mitigating the impacts caused by these specimens.

In view of this, it is essential that further surveys be developed in study area, as well as in other regions of the municipality of Macapá. This will enable the generation of diagnoses and prognoses with sufficient technical and strategic data for the elaboration of actions and public policies to combat the impacts promoted by the Giant African snail in the region.

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