



## ***Strobilocercus fasciolaris* (Eucestoda: Taeniidae) in black rats (*Rattus rattus*) at Fernando de Noronha Island, Brazil**

[*Strobilocercus fasciolaris* (Eucestoda: Taeniidae) em ratos pretos (*Rattus rattus*) na Ilha de Fernando de Noronha, Brasil]

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### ABSTRACT

The island of Fernando de Noronha, belonging to the state of Pernambuco, Brazil, has several animal species introduced by man, such as the black rat (*Rattus rattus*) and the domestic cat (*Felis catus*), representing a risk to the ecological balance of the island and to the public health. This study aimed to report the occurrence of *Strobilocercus fasciolaris* in black rats (*R. rattus*) in this insular environment and to contribute with epidemiological data on this parasitosis. Rodents were captured using Tomahawk traps and sedated with an association of Ketamine Hydrochloride (40mg/kg/IM) and Xylazine Hydrochloride (2mg/kg/IM) for subsequent euthanasia and necroscopic evaluation. Of the 154 captured black rats, 54 (35.06%) had single or multiple cysts in the liver. The cysts were morphologically evaluated and the metacestodes were identified as *Strobilocercus fasciolaris*, the larval form of *Hydatigera taeniformis*. This is the first report of the occurrence of *Strobilocercus fasciolaris* in black rats (*Rattus rattus*) in an island environment in Brazil. The occurrence of this metacestode in rodents on the Island demonstrates the high environmental contamination, fast reproduction, and dispersion of this parasite, being a potential risk for the conservation of susceptible species and for public health.

Keywords: exotic animals, rodents, *Taenia taeniformis*, *Cysticercus fasciolaris*, metacestodes

### RESUMO

A Ilha de Fernando de Noronha, pertencente ao estado de Pernambuco, Brasil, possui diversas espécies animais introduzidas pelo homem, como o rato-preto (*Rattus rattus*) e o gato-doméstico (*Felis catus*), representando um risco ao equilíbrio ecológico da Ilha e à saúde pública. Objetivou-se relatar a ocorrência de *Strobilocercus fasciolaris* em ratos-pretos (*R. rattus*) nesse ambiente insular e contribuir com dados epidemiológicos sobre essa parasitose. Os roedores foram capturados utilizando-se armadilhas do tipo Tomahawk, sedados com uma associação de cloridrato de cetamina (40mg/kg/IM) e de cloridrato de xilazina (2mg/kg/IM) para posterior eutanásia e avaliação necroscópica. Dos 154 ratos-pretos capturados, 54 (35,06%) apresentavam cistos únicos ou múltiplos no fígado. Os cistos foram avaliados morfológicamente e os metacésteos foram identificados como *Strobilocercus fasciolaris*, forma larval de *Hydatigera taeniformis*. Este é o primeiro relato da ocorrência de *Strobilocercus fasciolaris* em ratos-pretos (*Rattus rattus*) em ambiente insular no Brasil. A ocorrência desse metacésteo em roedores na Ilha demonstra a alta contaminação ambiental, a rápida reprodução e a dispersão desse parasito, sendo um potencial risco para a conservação das espécies suscetíveis e para a saúde pública.

Palavras-chave: animais exóticos, roedores, *Taenia taeniformis*, *Cysticercus fasciolaris*, metacésteo

## INTRODUCTION

The Fernando de Noronha Archipelago belongs to the state of Pernambuco, Northeast Brazil, being considered the top of an underwater mountain of volcanic origin, consisting of 21 islands and islets, the main and only inhabited being the Fernando de Noronha Island (Plano..., 1990).

In this Island, several animal species were introduced by man, such as the black rat (*Rattus rattus*), mice (*Mus musculus*) and the domestic cat (*Felis catus*), representing a risk to the ecological balance (Antas, 1991). The presence of these and other invasive species plays an important role in the introduction and dissemination of different parasites (Crowl et al., 2008).

Several studies on the occurrence of parasites in animals on the Fernando de Noronha Island have already been reported, in particular on the occurrence of coccidian protozoa (Melo et al., 2020; Lima et al., 2019a; Lima et al., 2019b; Lima et al., 2018, Silva et al., 2017; Magalhães et al., 2016, Melo et al., 2016; Magalhães et al., 2017; Lima-Filho, 2015; Vitaliano et al., 2014; Costa et al., 2012; Dubey et al., 2010). However, studies on the occurrence and dispersion of helminths are scarce in this island environment.

*Strobilocercus fasciolaris* (also known as *Cysticercus fasciolaris*) is termed as the larval stage of *Hydatigera taeniaeformis* (also known as *Taenia taeniaeformis*), a cestode (Order: Cyclophyllidea) of cosmopolitan distribution that develops in the small intestine with the release of proglottids in feces of domestic and wild felines, which are considered its definitive hosts (Stuti et al., 2012; Krone et al., 2008). Felines become infected by ingesting the liver of intermediate hosts containing the larval form of this parasite (Singla et al., 2009), being synanthropic rodents (*R. norvegicus*, *R. rattus* and *M. musculus*) the main intermediate hosts that become infected through the ingestion of embryonated eggs present in the environment (Sharma et al., 2017; Parkdel et al., 2013).

*Hydatigera taeniaeformis* is a parasite with zoonotic potential, considered to be accidental in humans, and its occurrence has been reported in several countries such as Argentina, Czech

Republic, Denmark, Taiwan, and Sri Lanka (Oryan and Alidadi, 2015; Ekanayake et al., 1999; Miyazaki, 1991).

Reports of these and other helminths in free-living animals are still scarce in the scientific literature, especially regarding invasive species in island environments. In this sense, the objective was to report the occurrence of *Strobilocercus fasciolaris* in black rats (*Rattus rattus*) on Fernando de Noronha Island and contribute epidemiological data on this parasitosis.

## MATERIAL AND METHODS

The project was approved by the Committee on Ethics in the Use of Animals – CEUA/UFRPE (License nº 101/2015) and by the Authorization and Information System on Biodiversity – SISBIO (License nº 49198-1).

The research was carried out on Fernando de Noronha Island, located in the Fernando de Noronha Archipelago (3° 50'25 S, 32° 24'38 W), PE, Brazil.

Tomahawk traps were used to capture rodents of the *Rattus rattus* species. The captured rats were subsequently sedated with a combination of Ketamine Hydrochloride (40mg/kg/IM) and Xylazine Hydrochloride (2mg/kg/IM). Then, the animals were euthanized by members of the Island's Rodent Control Program following the protocol described by Silva et al. (2017) and the necropsy stage was performed.

The captured animals were submitted to euthanasia, necropsy, and collection of tissue samples. After euthanasia, a macroscopic examination of all organs in the abdominal and thoracic cavity of the animals was performed to observe possible changes. The cysticerci found during the necropsy of the rodents were removed and placed in containers containing 0.9% saline solution, refrigerated for the relaxation of their structures and subsequent morphological analysis and identification of the parasite. A small incision was made on the wall of each cyst to remove the metacestode (Bomfim, 2001).

## RESULTS

154 rats of the *Rattus rattus* species were captured and the macroscopic evaluation of the livers showed the presence of one or multiple whitish-yellow cysts in 54 animals (35.06%), measuring between 2-8mm (Figure 1 - A, B and C). When cut, each cyst contained a small portion of whitish fluid that characterized the color of the parasitic structure in addition to a larva (Medina-Pinto *et al.*, 2019). The metacestode of each cyst was evaluated macroscopically, observing a large scolex, with a long neck, a body with pseudo-segments and a rounded terminal portion (Zhang *et al.*, 2012).

Thus, it was possible to identify the structure as *Strobilocercus fasciolaris*, the larval form of *Hydatigera taeniformis*.

Besides the presence of cysts, no macroscopic lesions were observed in the hepatic parenchyma. In the evaluation of other organs and tissues, no noteworthy alterations were identified.

## DISCUSSION

So far, this is the first report of the occurrence of *Strobilocercus fasciolaris* in black rats (*Rattus rattus*) in an island environment in Brazil.

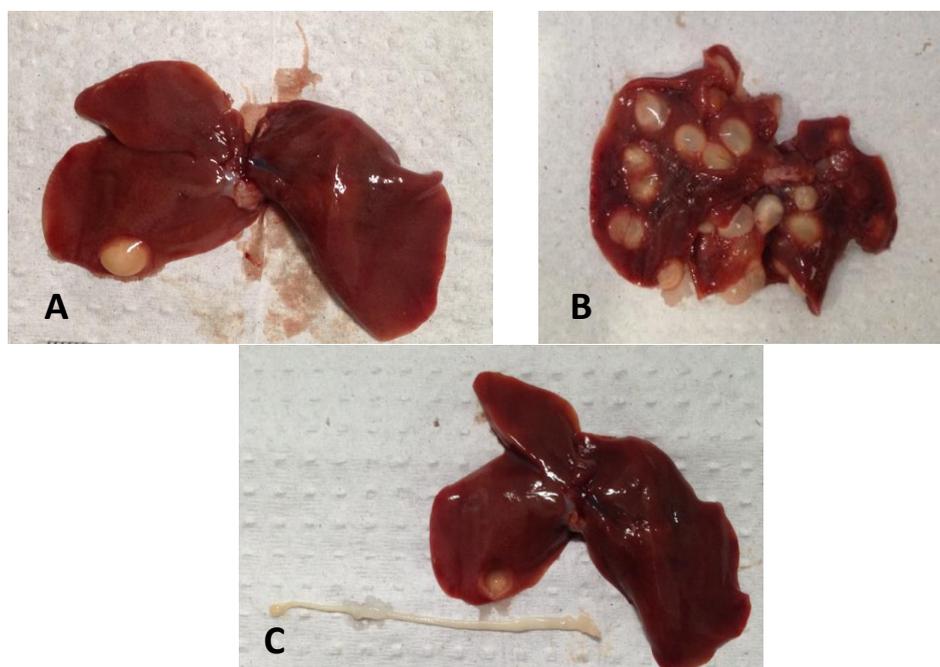


Figure 1. *Strobilocercus fasciolaris* in black rat (*Rattus rattus*) livers. A: Presence of multiple cysts in the liver of a rodent (*R. rattus*). B: Presence of a cyst measuring about 0.7cm in the liver of a rodent (*R. rattus*). C: *S. fasciolaris* measuring about 6cm removed from the interior of a rodent liver cyst (*R. rattus*).

Fernando de Noronha Island is considered an environment with a high occurrence of domestic felines with feral habits (*Felis silvestris catus*), which leads to several ecological problems, due to predation and competition with the local fauna, in addition to the maintenance and dissemination of pathogenic agents (Lima *et al.*, 2019b, Magalhães *et al.*, 2017, 2016). Rats and mice are considered the most common intermediate hosts of *S. fasciolaris* and are

usually asymptomatic (Abuladze, 1970). Although this parasite can cause liver changes such as chronic irritation, liver necrosis, inflammatory reactions, neoplasms (Mahesh *et al.*, 2006) and sarcomas (Irizarry-Rovira *et al.*, 2007), these findings were not evidenced in this study, corroborating with Hasanpour *et al.* (2017), who suggest that the absence of these findings may indicate an infection in the acute phase.

The presence of multiple *S. fasciolaris* cysts in the liver of rats has been previously described by Bomfim (2001) and the difference observed between the sizes of these structures may suggest a more recent or later infection (Hasanpour *et al.*, 2017; Moudgil *et al.*, 2016).

According to Lee *et al.* (2016), cysts can be found in different organs and tissues. The presence of ectopic larvae can occur due to their migration through the central hepatic vein and may affect other organs such as the lung and kidneys, however, ectopic larvae do not find adequate conditions for survival outside the liver, leading to their degeneration. In addition, these authors also found a frequency of 33.8% (97/287) of positivity for *S. fasciolaris* among rodents of the *Rattus norvegicus* species with the presence of cysts in different organs besides the liver, which disagrees with what was observed in the present study.

The presence of *S. fasciolaris* has been described in free-living rodents by several authors. Zhao *et al.* (2020) described a frequency of 11.8% (13/110) of positivity for this agent in free-ranging brown rats (*R. norvegicus*) in China. In other studies, Sinniah *et al.* (2014) reported 39.3% positivity in free-living rodents of different species (*R. norvegicus*, *R. rattus* and *M. musculus*) in Malaysia. Sharma *et al.* (2017) described a high percentage of positivity (70.7%) for *S. fasciolaris* in *R. norvegicus* in India, where they attributed this value to the proximity of these rodents to urban areas, which can also be inferred in the present research.

In a rural area in Mexico, Medina-Pinto *et al.* (2019) described a low frequency of *S. fasciolaris* infection in *R. Rattus* in the peridomestic environment, with a percentage of 7.8% (12/153) and, for the captured free-living rodent species, the presence of cysts was not observed. These findings corroborate with those found by Rodriguez-Vivas *et al.* (2011) also in Mexico, where rodents of different species were evaluated and a low frequency of positivity among the analyzed species (7.5% - 31/411) were found. Of this total of positives animals, 3.5% were black rats of the species *R. rattus*; and in wild rodent species, no animal was positive. These results may infer that environmental contamination by feline feces is low in this environment when compared to the environment on the island studied, which is a risk factor to be considered.

A high frequency of *S. fasciolaris* in free-living rodents may be related to the age of the animals, since younger ones are more susceptible and, consequently, more frequently infected with this parasite (Medina-Pinto *et al.*, 2019, Lee *et al.*, 2016), in addition to being related to warmer periods of the year (summer, spring), when there are more hosts in the environment due to the reproductive season (McInnes *et al.*, 2014).

Sinniah *et al.* (2014) add that the presence of many rodents and, consequently, a higher frequency of *S. fasciolaris*, is greater in environments with a tropical climate and places with less basic sanitation and public health policies, such as the inefficiency in combating synanthropic rodents.

Contamination of the environment by *H. taeniformis* eggs is reported not only in natural environments, but also in laboratory environments such as rodent breeding facilities, where parasite transmission can occur through contamination of wood shavings and/or water and food by infected felines feces (Singh and Arya, 2015; Oliveira *et al.*, 2014; McInnes *et al.*, 2014). Although *S. fasciolaris* infection is considered asymptomatic in most cases, in vivarium animals there is a greater susceptibility and a more severe clinical picture, with a high parasite load (Singh and Arya, 2015).

The high frequency of *S. fasciolaris* in rodents on Fernando de Noronha Island demonstrates an important environmental contamination and rapid reproduction and dispersion of parasitic agents in this environment. The permanence of invasive animals on the Island represents a high risk not only to the conservation of endemic species but has a harmful effect on public health in the maintenance of pathogens in the environment, and measures for the prevention and control of rodents and other exotic species should be encouraged in this island environment.

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