Predation on the common marmoset *Callithrix jacchus* (Primates, Callitrichidae) by the common boa *Boa constrictor* (Squamata, Boidae) in the Atlantic Forest of Northeastern Brazil

Predação do sagui-de-tufos-brancos *Callithrix jacchus* (Primates, Callitrichidae) por uma jiboia *Boa constrictor* (Squamata, Boidae) na Mata Atlântica do Nordeste do Brasil

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Abstract: Herein, we present the first record of predation on the common marmoset (*Callithrix jacchus*) by a common boa (*Boa constrictor*). The incident occurred during the afternoon in a *restinga* environment of the Atlantic Forest of northeastern Brazil. The snake captured the marmoset on the ground when a group of seven individuals of *Callithrix jacchus* was traveling among the *restinga* trees. The group remained on the top of a tree, from 1.5 to 4 m, exhibiting an alarm vocalization and surrounding the snake throughout the ingestion process. The snake was captured, measured, and released on the same site. This case report reinforces that the callitrichids are vulnerable to predation by large snakes and present some defensive behavior.

Keywords: Behaviour. Diet. *Restinga*. Snake.

Resumo: Apresentamos aqui o primeiro registro de predação do sagui *Callithrix jacchus* por uma jiboia *Boa constrictor*. O incidente ocorreu durante a tarde em um ambiente de restinga da Mata Atlântica do Nordeste do Brasil. A serpente capturou o sagui no solo, quando um grupo de sete indivíduos de *Callithrix jacchus* deslocava-se na restinga. O grupo permaneceu no topo de uma árvore, de 1,5 a 4 m, exibindo uma vocalização de alarme, e permaneceu circundando a serpente durante todo o processo de ingestão. A serpente foi capturada, medida e solta no mesmo local. Este relato de caso reforça que os calitriquídeos são vulneráveis à predação por serpentes de grande porte e mostra que eles apresentam comportamento defensivo.

Palavras-chave: Comportamento. Dieta. Restinga. Serpente.

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INTRODUCTION

Mammals are recognized as prey for snakes in Neotropical habitats (Ferrari & Beltrão-Mendes, 2011). In Brazil, large snake species, such as boid snakes and vipers, can eat primates as active predators or inflict specific damage by defensive behaviors (Headland & Greene, 2011; Falótico et al., 2017). Some papers have demonstrated that the threat of predation is an important selective pressure to modify the behavioral ecology of primates (Caine, 1993). Primates' reactions to the presence of potential predators, such as vocalizations, alarm posture, and observational movements, occur when they recognize snakes as a potential threat (Ramakrishnan et al., 2005; Falótico et al., 2017; Marques & Medeiros, 2019).

Predation events on primates by snakes are rarely directly observed in the wild. However, these events occur worldwide (Dolotovskaya et al., 2019). Some examples are a white-faced capuchin *Cebus capucinus* (Linnaeus, 1758), predated by a common boa (*Boa constrictor* Linnaeus, 1758) in Costa Rica (Chapman, 1986); a spectral tarsier [*Tarsius spectrum* (Pallas, 1778)] by a reticulated python [*Malayopython reticulatus* (Schneider, 1801)] in Indonesia (Gursky, 2002); a blue monkey (*Cercopithecus mitis stuhlmanni* Matschie, 1893) and a Sykes' monkey [*C. m. albogularis* (Sykes, 1831)] by gaboon viper (*Bitis gabonica gabonica* Duméril, Bibron & Duméril, 1854) and black mamba (*Dendroaspis polylepis* Günther, 1864) in Kenya (Foerster, 2008); a brown-mantled tamarin [*Saguinus fuscicollis* (Spix, 1823)] by a common tree boa *Corallus hortulana* (Linnaeus, 1758) in Peru (Bartecki & Heymann, 1987); a white-tailed titi [*Callicebus discolor* (I. Geoffroy & Deville, 1848)] by a common boa (*Boa constrictor*) in Ecuador (Cisneros-Heredia et al., 2005); a Purus red howler (*Alouatta puruensis* Lönnberg, 1941) by a common boa (*Boa constrictor*) (Quintino & Bicca-Marques, 2013), and a squirrel monkey [*Saimiri sciureus* (Linnaeus, 1758)] by a common tree boa (*Corallus hortulana*) (Ribeiro-Júnior et al., 2016) in Brazil.

However, few records of predation of the genus *Callithrix* by snakes are currently known in Brazil. Corrêa & Coutinho (1997) recorded predation of *C. aurita* by *Bothrops jararaca* (Wied-Neuwied, 1824) in São Paulo, southeastern Brazil; Ferrari & Beltrão-Mendes (2011) recorded a failed attempt of predation of *Callithrix jacchus* (Linnaeus, 1758) by *Bothrops leucurus* Wagler, 1824 in Sergipe, northeastern Brazil, and Teixeira et al. (2015) reported the predation of *Callithrix penicillata* (É. Geoffroy, 1812) by *Boa constrictor* in Goiás, central Brazil. Herein, we present the first record of the common marmoset *C. jacchus* predation by a common boa *Boa constrictor.*

MATERIAL AND METHODS

The record was carried on May 30th, 2019, at 2:30 pm out in a *restinga* environment through an occasional encounter during fieldwork with the snake community of the Environmental Protection Area of Barra do Rio Mamanguape, on the North Coast of Paraíba, northeastern Brazil (6° 46' 42.32" S, 34° 55' 20.35" W; WGS 84; altitude 7 m). A Moto G7 Plus cell phone was used to photograph, and the researcher remained 2 m from the animals.

After total ingestion, the snake was captured, measured using a universal digital caliper (precision of 0.1 mm) and a measuring tape, weighed with a Light-Line weight (precision of 0.3 g), and sexed using a probe. The specimen was marked on the ventral scale with a visible implant elastomer for further identification in case of recapture. The snake was an adult female measuring 1,760 mm of snout-vent length, 195 mm of tail length, and 3,820 g. Shortly afterward, it was released at the same site.

RESULTS AND DISCUSSION

A group of seven *Callithrix jacchus* individuals was traveling through the bushes and *restinga* trees when one of them crossed the sandy soil and was captured by a *Boa constrictor* that striked and began constriction (Figure 1). The group stayed on the top of a tree, from 1.5 to 4 m, exhibiting an alarm vocalization and surrounding the snake throughout the ingestion process, which lasted approximately 12 minutes

Figure 1. Episode of predation on the common marmoset (*Callithrix jacchus*) by the common boa (*Boa constrictor*). A) Red arrow shows the forearm and hand of the marmoset during the constriction; B) group of *C. jacchus* displaying alarm behavior (orange arrows) during the snake attack. Photos: Sebastião S. dos Santos (2019).

(Figure 1). This defensive behavior is typical in the encounter of primates with boas (Perry et al., 2003). After total ingestion, the snake was captured to take measurements and released at the same site shortly afterward.

The common boa is a large Neotropical snakes, reaching up to 4 m in total length. It is active both during the day and night, with terrestrial and arboreal habitats, and feeds mainly on vertebrates such as lizards, birds, and mammals (Quick et al., 2005; Marques et al., 2019; Silva et al., 2019). The common marmoset is endemic to the northeast Atlantic Forest of Brazil (Rylands & Mittermeier, 2009). They live in social groups, are omnivores, and are distributed in the environment according to the abundance, composition, and distribution of refuges, food, and the presence of neighboring groups (Castro, 2003; Martins et al., 2006).

Despite the well-developed cooperative relationship of the callitrichids in defense against predation (Tello et al., 2002), the individuals of the group did not physically attack the snake as a defensive behavior presented by other groups of primates, such as capuchins (Boinski, 1988; Perry et al., 2003). In systematic analysis, Ferrari (2009) described that callitrichids are the most vulnerable to snake attacks among primates of the new world. Marmosets can demonstrate greater vulnerability and less vigilance while they move (Teixeira et al., 2015), and this can be considered the main factor for the predation event.

The present report reinforces that the callitrichids are vulnerable to predation by large snakes and present specific defensive vocalizations. Further studies should be conducted to understand the patterns of the defensive strategies of the callitrichids in confrontations with snakes.

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AUTHORS' CONTRIBUTION

V. N. Barbosa contributed to conceptualization, and writing (original draft, proofreading and editing); J. M. Silva Amaral to conceptualization, and writing (original draft, proofreading and editing); S. S. Santos to conceptualization, and writing (original draft and proofreading); and F. G. R. França to conceptualization, and writing (original draft, proofreading and editing).