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SHORT COMMUNICATION

Notes on natural history and behavior of *Monodelphis glirina* (Didelphimorphia, Didelphidae) and sympatry with congeners

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ABSTRACT

Monodelphis glirina is endemic to the Amazon and its life habits and natural history are poorly known. Data on the species were collected in northern Mato Grosso, Brazil, including observations on its behavior and simpatry with congeners. During 10 expeditions and with an effort of 3,680 buckets-day, 29 *M. glirina*, three *M. saci* and one *M. emiliae* individuals were captured. Adults accounted for 82.8% of *M. glirina* captures, with a sex ratio of three males for each female. Capture of young and lactating females was seasonal, as both were captured only in the rainy season. We observed three events of *M. glirina* preying on rodents in pitfall traps, all with the same feeding behavior. We also report an individual climbing a tree at night, including a video recording. Our report contributes to a better understanding of the ecology of this highly diversified and still poorly known genus.

KEYWORDS: Amazon, biology, Mato Grosso, Amazonian red–sided opossum, *Monodelphis saci*, *Monodelphis emiliae*

Notas sobre história natural e comportamento de *Monodelphis glirina* (Didelphimorphia, Didelphidae) e simpatria com congêneres

RESUMO

Monodelphis glirina é endêmica da Amazônia e aspectos dos seus hábitos de vida e história natural são pouco conhecidos. Dados sobre a espécie foram coletados no norte de Mato Grosso, Brasil, incluindo observações sobre seu comportamento e simpatria com congêneres. Durante 10 expedições e com um esforço de 3.680 baldes-dia, foram capturados 29 *M. glirina*, três M. *saci* e um *M. emiliae*. Adultos representaram 82,8% das capturas de *M. glirina* e a razão sexual foi três machos para cada fêmea. A captura de jovens e fêmeas lactantes foi sazonal, uma vez que ambos foram capturados apenas na estação chuvosa. Observamos três eventos de *M. glirina* predando roedores em *pitfall* traps, todos com o mesmo comportamento de alimentação. Também registramos um individuo escalando uma árvore durante a noite, incluindo um video. Nosso trabalho contribui para uma melhor compreensão da ecologia desse gênero altamente diversificado e ainda pouco conhecido.

PALAVRAS–CHAVE: Amazônia, biologia, Mato Grosso, cuíca–do–rabo–curto, *Monodelphis saci*, *Monodelphis emiliae*

The Amazonian red–sided opossum, *Monodelphis glirina* (Wagner, 1842) is a didelphid marsupial endemic to the Amazon region, ranging from eastern Peru and northern Bolivia to northern Brazil, where it is recorded in areas of four states: southern Acre, eastern Rondônia, northern Mato Grosso, and southeastern to northern Pará (Pavan *et al*. 2012; Abreu–Júnior *et al*. 2016; Bezerra *et al*. 2018). Notably, *M. glirina* was captured both with livetraps (Santos–Filho *et al*. 2015; Bezerra *et al*. 2018) and pitfall traps (Santos–Filho *et al*. 2015; Abreu–Júnior *et al*. 2016; Bezerra *et al*. 2018).

The only available data on feeding habits of *M. glirina* comes from stomach contents, showing an insectivorous diet (Castilheiro and Santos–Filho 2013). Yet, despite its wide geographic range and recent larger series of specimens (Pavan *et al*. 2012; Bezerra *et al*. 2018), the life habits and natural history of *M. glirina* remain poorly known, with no

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data on breeding and activity patterns (Astúa 2015), except for reproductive data on a few subadult individuals (Bezerra *et al*. 2018).

Here we report data of *M. glirina* from northern Mato Grosso state, Brazil, with new records on simpatry with congeneres, behavior, breeding and time of activity in the wild.

Individuals were captured and released during monitoring of fauna at the Apiacás Hydroelectric Complex [licenses # 573/2017, 683/2017, 685/2017, 500/2017, 846/2018 issued by state authority Secretaria Estadual de Estado de Meio Ambiente do Mato Grosso (SEMA–MT)]. Ten expeditions occurred between June 2017 and September 2019, each during seven consecutive days at an average three-month interval. The study area is located by the Apiacás River (10°19'39"S, 56°58'42"W), a sub–basin of the Teles Pires/Tapajós River, between the municipalities of Alta Floresta, on the right bank, and Juara, on the left bank.

The climate of the region is *Am* (humid tropical) according to the Köppen classification (Alvares *et al*. 2013), with an average temperature of the coldest month above 18ºC and a short dry season, which is compensated by high annual precipitation. The main phytophysiognomy of the study area is ombrophilous dense forest, with areas of wooded savanna or *cerrado*, characterizing a transition between *cerrado stricto sensu* and *cerradão* (Ribeiro and Walter 1998).

Only pitfall traps were used for sampling. Seven sampling points were installed in dense ombrophilous forest and one in wooded savanna, each with a line of ten 60–liter buckets connected by plastic canvas.

Monodelphis individuals were identified through morphological characters according to Pavan *et al*. (2012, 2017) and Bezerra *et al*. (2018), and classified into three age classes (young, subadults and adults), according to tooth replacement (Bezerra *et al*. 2018). Thus, we considered as adults the individuals with the third premolar and fourth molar teeth erupted and functional.

Total sampling effort of 3,680 buckets-day, and *M. glirina* was the second most abundant species in the area, with 29 records. The congeneric *Monodelphis saci* Pavan, Mendes-Oliveira & Voss, 2017 (three individuals) and *Monodelphis emiliae* (Thomas, 1912) (one individual) were also captured (Figure 1). *Monodelphis glirina* was also the most frequent species, being captured in nine of the 10 expeditions (Table 1).

Monodelphis individuals were recorded in five sampling areas, all with records of *M. glirina*. *Monodelphis saci* was recorded in two sites close to a transmission line, which were more distant from all other sampling areas, while *M. emiliae* was recorded in a single area (Table 1). *Monodelphis glirina* was recorded in the same sampling site either with *M. saci* or *M. emiliae*. In the two sites where it coincided with *M. saci*, *M. glirina* was recorded with the highest abundances [41.4% (N = 12) and 31% (N = 9)] (Table 1). No *Monodelphis* was captured in the savanna area, only in the dense ombrophilous forest.

Of the 29 individuals of *M. glirina* captured, 24 (82.8%) were adults (Table 1). Males were dominant with 69% of captures (N = 20). Females made up 24.1% of captures (N = 7), and two individuals were not sexed (7%). *Monodelphis*

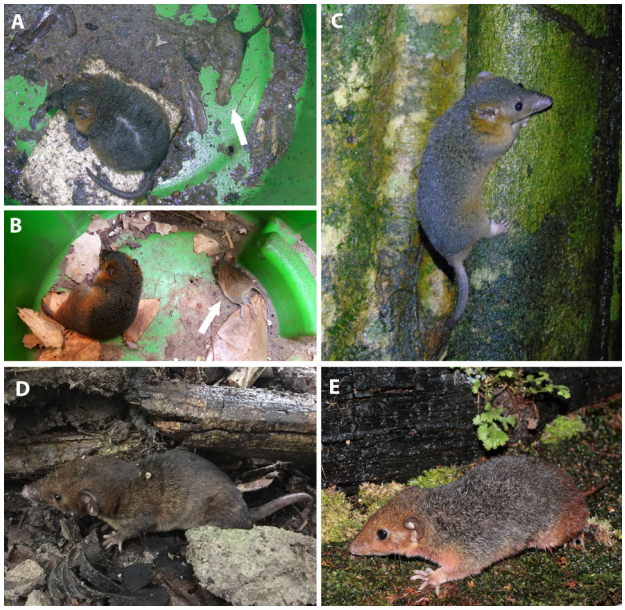

Figure 1. *Monodelphis* individuals recorded at the Apiacás Hydroelectric Complex (Mato Grosso, Brazil): *M. glirina* captured in a pitfall bucket (A, B) containing a preyed rodent (arrow) and climbing a tree (C), *M. saci* (D) and *M. emilae* (E). This figure is in color in the electronic version.

Table 1. *Monodelphis* individuals captured at the Apiacás Hydroelectric Complex (Mato Grosso, Brazil) during each expedition. N ind = number of individuals; F = female; M = male; ad = adult; sa = sub–adult; j = juvenile; in = indeterminate.

Capture dates per taxon	Season	N ind	Sex	Age
Monodelphis glirina				
June 2017	Dry	2	2 F	2 ad
September 2017	Dry	6	6 M	6 ad
December 2017	Rainy	1	1 M	1 sa
March 2018	Rainy	6	5 M, 1 in	4 ad, 1 sa, 1 ju
July 2018	Dry	2	2 M	2 ad
October 2018	Rainy	4	2 F, 2 M	4 ad
December 2018	Rainy	3	2 F, 1 M	2 ad, 1 ju
June 2019	Dry	4	1 F, 2 M, 1 in	4 ad
September 2019	Dry	1	1 M	1 ad
Monodelphis emiliae				
December 2017	Rainy	1	1 M	1 in
Monodelphis saci				
September 2017	Dry	1	1 M	1 ad
December 2017	Rainy	2	1 F, 1 M	2 ad
Total		33		

individuals were not recorded in March 2017, while in June of the same year, the only expedition without males, two females were captured. Only males were captured in September 2017, July 2018, and September 2019. In October and December 2018, and June 2019, both sexes were recorded, with proportions between males and females of 1:1, 1:2, and 2:1, respectively. The overall sex ratio for all expeditions was 2.9 males for each female. Considering only the four young individuals captured, the male/female proportion was 3:1.

There was no influence of seasonality on the capture of *Monodephis*, as the highest abundance of *M. glirina* captures in a single campaign was six, on two occasions (September 2017 and March 2018 – rainy and dry season, respectively). Likewise, the lowest abundances were also recorded both in the rainy and dry seasons (December 2017 and September 2019, respectively) (Table 1). Both sexes were captured randomly in both seasons, however, young individuals (N = 4) and lactating females (N = 2, without attached pups) were recorded only in the rainy season, between October and March, at the beginning and end of the rainy season, respectively. One clearly lactating female was captured in December, while another with swollen breasts was captured in October.

One individual of *M. glirina* was observed during a night census for terrestrial mammals. The animal was first observed on ground level (at about 10 p.m.) crossing a trail, but rapidly hid behind trees. The opossum then climbed a large tree and remained on the trunk for about two minutes at 1.5 m above ground (Figure 1), after which, seemingly disturbed by the observer movement, the animal climbed down and hid in a cavity formed by the tree roots (see video included in the html version).

On three different occasions, a male of *M. glirina* was caught in a pitfall trap together with a small sigmodotine rodent, presumably *Oligoryzomys microtis* (Allen 1916). On all occasions the rodent had been predated and its anterior part, mostly the head and upper dorsal area, had been eaten (Figure 1).

Similar to our results, *M. glirina* was the dominant species during a study in 22 forest fragments in Alta Floresta, Mato Grosso state, accounting for 73.1% (N = 98) of *Monodelphis* captures, while *M. saci* accounted for 26.9% (N = 36) (Santos–Filho *et al.* 2015). Among the *Monodelphis* species recorded herein, *M. glirina* is the largest (40–150 g), followed by *M. emiliae* (20–60 g) and *M. saci* (16–29 g) (Astúa 2015; Pavan *et al.* 2017). In areas of sympatry, the larger size of *M. glirina* may be an advantage over its counterparts. Further studies would be required to answer this question (also see Pavan *et al.* 2017:18). Nonetheless, the predation of *O. microtis* rodents (14–23 g) by *M. glirina* indicates its aggressive/predatory behavior.

Bezerra *et al.* (2018) reported three reproductive subadult females and two juvenile males in May (dry season) at Confressa, Mato Grosso, with a sex ratio of 1.5:1 females/males. This sex ratio contrasts with our findings, but the low number of reproductive individuals prevents a more conclusive analysis. Nonetheless, both studies together indicate that the breeding season of *M. glirina* in the southwestern Amazon occurs from October to May.

A similar pattern is found in *Monodelphis domestica* (Wagner, 1842), a species phylogenetically close to *M. glirina* (Pavan *et al.* 2012) and ecologically better known (see Astúa 2015). Aragona and Marinho-Filho (2009) captured 63 individuals of *M. domestica* over 17 months in the Pantanal region. They also found no difference in the rates of capture between dry and rainy seasons. The sex ratio was 1.2:1 males to females, and only one subadult was captured. These results are in accordance with our data for *M. glirina*, despite our larger sex ratio and a higher number of young and subadults captured. The presence of young, subadults, and lactating females of *M. glirina* only during the rainy season also agrees with the results for *M. domestica* in the Pantanal (Aragona and Marinho–Filho 2009), and in the semiarid region of northeastern Brazil (Bergallo and Cerqueira 1994), where the rainy season (September – May) is known as the breeding season of this species.

We cannot rule out that the predatory consumption of rodents by *M. glirina* was due to stress caused by captivity in the pitfall traps. However, the predation of other vertebrates was already reported for different species of *Monodelphis.* Carvalho-Neto and Santos (2018) reported the predation of a rodent (*Calomys* sp.) by *M. domestica* in the wild, in which the individual started eating the head of the prey, as observed herein. This behavior was also reported for different didelphid marsupials and is probably a conservative behavior in mammals (Oliveira and Santori 1999). Predation on a bird nest above ground level was recently reported for *M. americana* (Ribeiro–Silva *et al.* 2018), and for *M. domestica* between 1 and 3 m above ground (Aragona and Marinho–Filho 2009; Astúa 2015). These records, including our observations, reinforce that *Monodelphis* species may also use higher strata of the forest.

Most species of *Monodelphis* lack information about their biology, including predatory behavior, diet, reproductive period, and other aspects. In this regard, our study contributes relevant information to the knowledge on *M. glirina* biology and natural history.

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