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SHORT COMMUNICATION

Can the type and placement of traps influence the capturability of marsupials according to their body weight? A case study with *Didelphis albiventris* and *Gracilinanus agilis* in central Brazil

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ABSTRACT. Body weight and vertical stratum utilization are important functional characteristics of species. Several studies have explored the capture success of different traps. These studies, however, did not explore how trappability is influenced by body weight. Here, we investigated the relationship between the weight of marsupial species caught in traps with trap type (wire cage and Sherman) and trap placement (ground and understory). For this we used data from *Didelphis albiventris* Lund, 1840 (n = 127; 75–958 g) and *Gracilinanus agilis* (Burmeister, 1854) (n = 327; 8.5–46 g) captured in semideciduous forest fragments in central Brazil. The results show that heaviest individuals of *D. albiventris* (391.01 ± 197.57 g) were captured more often by wire cage traps, regardless of trap placement. In contrast, *G. agilis* was trapped at similar rates regardless of weight, trap type or trap placement. We conclude that wire cage traps are more efficient at catching large marsupials weighing more than 300 g on average. Furthermore, the size of the individuals captured is not influenced by where the trap is placed (ground or understory). These findings contribute to a better understanding of the natural history and trappability of Neotropical marsupials.

KEY WORDS. Ground; marsupials; sherman trap; understory; wire cage.

Marsupials (Didelphimorphia), are a diverse group of mammals with wide distribution across all the American continent, inhabiting various vegetation types (Gardner 2008, Voss and Jansa 2021). Their size (ranging from 10 to 3000 g), diet, habitat use, and type of locomotion (terrestrial, semiaquatic, scansorial, and arboreal) vary greatly (Gardner 2008, Voss and Jansa 2021), making them excellent models for ecological studies. To access the full functional and phylogenetic diversity of marsupials, different collecting campaigns, using different types and placement of traps, have been conducted in different Brazilian biomes (Lambert et al. 2005, Astúa et al. 2006, Umetsu et al. 2006, Cáceres et al. 2011, Santos-Filho et al. 2015, Bovendorp et al. 2017, Figueiredo et al. 2021).

Several types of traps have been commonly used to capture small mammals, including pitfall traps, Sherman traps, and wire cage traps (Bovendorp et al. 2017). These studies have focused on evaluating the effects of trap type and placement (either on the ground or in the understory) on various parameters such as abundance, species richness,

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composition, and capture success (Lambert et al. 2005, Astúa et al. 2006, Umetsu et al. 2006, Cáceres et al. 2011, Santos-Filho et al. 2015, Bovendorp et al. 2017, Figueiredo et al. 2021). Some studies have also examined the relationship between the type of trap and the weight of the body of the captured individuals (Lyra-Jorge and Pivello 2001, Astúa et al. 2006, Nicolas and Colyn 2006, Umetsu et al. 2006, Cáceres et al. 2011, Hice and Velazco 2013). A few studies have investigated the interaction between trap type and placement (Figueiredo et al. 2021) and trappability, and trap type and placement and body weight. It has been observed that wire cage traps tend to capture larger animals (> 250 g) compared to Sherman traps (Astúa et al. 2006, Cáceres et al. 2011, Hice and Velazco 2013), and lighter individuals, even those belonging to relatively large species, are more effectively captured in Sherman traps than heavier individuals (Nicolas and Colyn 2006).

In this study, we investigate whether the type of trap (Sherman or wire cage) and where the trap is placed (placement on the ground or in the understory) influence the rate of capture of *Didelphis albiventris* Lund, 1840 and *Gracilinanus agilis* (Burmeister, 1854), and whether the weight of the body the individuals captured correlates with those two variables. Our hypothesis was that larger animals, particularly *D. albiventris,* which is a medium-sized scansorial marsupial, would be captured more frequently by wire cage traps regardless of trap placement, while smaller animals, including *G. agilis*, a scansorial species (Vieira and Camargo 2012), would be captured more frequently by Sherman traps placed in the understory. Furthermore, we hypothesized that larger individuals, such as adults, of both *D. albiventris* and *G. agilis*, spend more time on the ground and hence will be captured more frequently there (Cunha and Vieira 2005). Our study aims to provide insights into the factors influencing animal capture using traps in natural environments, contributing to natural history of marsupials.

We surveyed small mammals captured in 44 trap grids located in semideciduous forest fragments in southern Goiás, central Brazil. These fragments were either connected or isolated from gallery forests. In 2015, we sampled 24 grids from January to June, and re-sampled them from July to December. The remaining 20 grids were sampled in 2020 and re-sampled in 2021 and 2022, with quarterly captures (5-grids per quarter). In the case of the first 24 grids (2015), we established 16 capture stations that were distributed across four transects. In the case of the other 20 grids (2020–2022), we used 10 capture stations, distributed across two transects. Each capture station was spaced 15 m apart from the others and consisted of two traps (one Sherman [25 x 8 x 9 cm] and one-wire cage [30 x 13 x 13 cm]) set on the ground and in the understory (1.5 to 2 m high), alternately. This approach allowed us to standardize the number of Sherman traps and wire cages on the ground and in the understory for each trap grid. The traps were active for five to seven nights, resulting in a total effort of 4,588 trap-nights per trap type (Sherman and wire cage) and placement (ground and understory), totaling 18,352 trap-nights.

To investigate the effect of trap type (Sherman and wire cage) as the explanatory variable 1, interacting with trap placement (ground and understory) as the explanatory variable 2, on the response variable of body weight, we performed a Factorial Analysis of Variance (ANOVA) using the 'aov' function in the R program (R Core Team 2021). The model formula used was 'var.response ~ var.explanatory1 * var.explanatory2'.

We captured 80 individuals of *D. albiventris* (n = 127 captures distributed in trap type [24 in Sherman and 103 in wire-cage traps] and trap placement [102 on the ground and 25 in the understory] captures) and 210 individuals of *G. agilis* (n = 327 captures distributed in trap type [180 in Sherman and 147 in wire cage traps] and trap placement [74 on the ground and 253 in the understory] captures) in the fragmented landscape of southern Goiás. The body weight of *D. albiventris* ranged from 75 g (a female captured in a Sherman trap in the understory) to 958 g (a male captured in a wire cage trap on the ground). The heaviest *D. albiventris* (mean = 391.01 ± 197.57 standard deviation) were captured in greater numbers by wire cage traps, regardless of the placement of the trap (Table 1, Fig. 1), a result that is statistically significant ($F = 9.335$, $p = 0.003$). On the other hand, the body weight of *G. agilis* in traps ranged from 8.5 g (one male captured in Sherman trap in the understory) to 46 g (1 male captured in Sherman trap in the understory), and was not significantly correlated with trap type or placement, or their interaction (Table 1, Fig. 1).

Our hypothesis was partially supported by our results. Heavier *D. albiventris* individuals were captured using wire cage traps, while lighter individuals were captured using Sherman traps, regardless of trap placement. In the case of *G. agilis*, the type and placement of the traps did not significantly affect capturability variation by weight, although on average, heavier animals were more often captured on the ground. In the Atlantic Forest fragments, Sherman traps captured lighter weight marsupials (average weight = 60.23 ± 45.55 g SD) compared to wire cage traps (average weight = 267.48 ± 236.05) of the Tomahawk type (Astúa et al. 2006). This pattern had been previously observed in small mam-

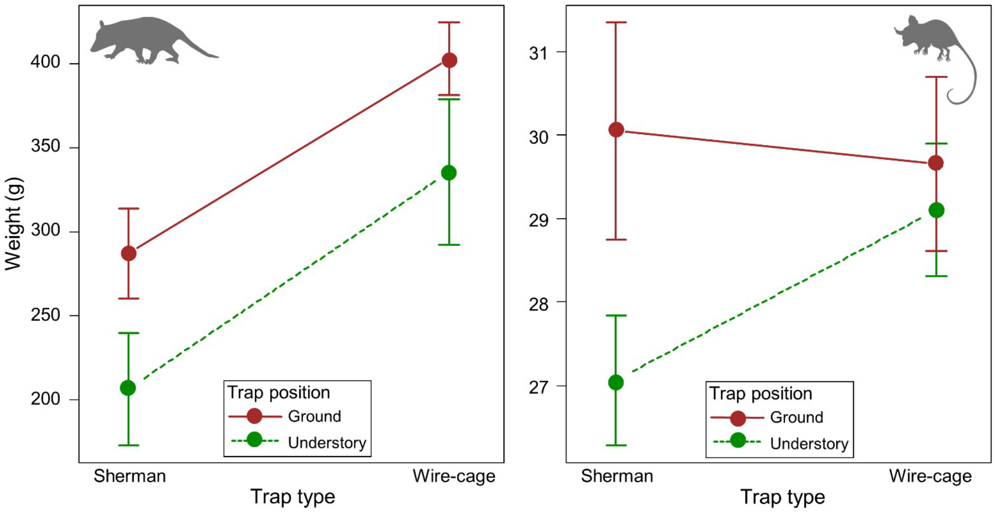

Figure 1. Mean and standard deviation of bodied weight (g) for (A) *Didelphis albiventris* and (B) *Gracilinanus agilis* captured in semi-deciduous forest fragments in central Brazil. Silhouette according PhyloPic – free silhouette images of organisms, version 2.0 (https://www.phylopic.org/).

Table 1. Factorial ANOVA for association trap type, trap position and the interaction between these variables with the weight average of two marsupials captured in semi-deciduous forest fragments in central Brazil. The significant relation ($p < 0.05$) is highlight in bold.

Species	Factorial ANOVA for trap type, trap position and interaction					
	Type	p	Position	p	Type:Position	p
Didelphis albiventris	9.335	**0.003**	2.916	0.090	0.019	0.890
Gracilinanus agilis	2.373	0.124	2.895	0.090	1.138	0.287

mals in the Brazilian Cerrado (Cáceres et al. 2011) and in the Peruvian Amazon, where individuals with body weight >249 g were frequently captured using Tomahawk traps (Hice and Velazco 2013). Our wire cage traps are slightly larger (30 x 13 x 13 cm) than our Sherman traps (25 x 8 x 9 cm), providing more space for capturing larger individuals. According to Astúa et al. (2006), larger species may find alternative ways to access the bait if the trap opening is too small, resulting in trap deactivation without capture, while smaller species may consume the bait without being caught in larger and less sensitive traps.

The placement of traps was not correlated with the body weight of the two species investigated. Our expectation was that heavier individuals, typically adults, would have better access to all three dimensions of the forest, regardless of their scansorial or arboreal habits, and would be captured on the ground. On the other hand, lighter individuals would seek protection against terrestrial predators in the upper strata of the forest, making the understory their common habitat (Cunha and Vieira 2005, Vieira and Camargo 2012). Additionally, young and sub-adult individuals of *D. aurita* tend to be lighter but have relatively larger legs and claws, making them better adapted for tree climbing and enabling them to make better use of the upper stratum (Vieira 1997). However, the placement of the traps did impact the number of captures, with *D. albiventris* being more frequently captured on the ground, while *G. agilis* was captured more often in the understory (Figueiredo et al. 2021), which was expected considering the locomotor habits and vertical stratification patterns of these species (Vieira and Camargo 2012).

The correlation between body weight and trap type and trap placement has been poorly documented in the scientific literature, especially when focusing on intraspecific patterns. In this study, we found that wire cage traps tend to capture heaver *D. albiventris* individuals when compared to Sherman traps. However, the capture of smaller species such as *G. agilis* was not influenced by trap type, trap placement or body weight. The utilization of different vertical strata by each species may be influenced by intrinsic factors, such as sex, age, and body size, as well as extrinsic factors, including resource availability, predator presence, and seasonality.

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