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Influence of pitfall designs and use of baits on the capture of small mammals in Southern Minas Gerais State, Brazil

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ABSTRACT. Each kind of trap tends to be selective on species sampled, in a way that each one only reveals part of the abundance and species richness of the community sampled. In this way, in order to know the factors that affect the success of sampling methods is crucial for a better planning of experiments and data analysis. The aim of this study was to evaluate the factors that affect the success of pitfall traps in capturing small mammals, such as trap size, designs and use of bait. The study was carried out in two reserves inside the campus of the Universidade Federal de Lavras (UFLA), in South Minas Gerais State, Brazil. In total, 65 specimens belonging to 8 species were caught. Different types of trap design (Y-shaped and I-shaped) have not influenced the capture success of pitfalls. The same result was obtained for the different size of buckets, in exception for *Oligoryzomys flavescens*, in which larger buckets were more efficient. The use of baits was considered not necessary.

Keywords: sampling methods, abundance, species richness, rodent, marsupial.

Influência da disposição dos pitfalls e uso de isca na captura de pequenos mamíferos no Sul do estado de Minas Gerais, Brasil

RESUMO. Cada tipo de armadilha exerce uma seleção quanto às espécies capturadas, de forma que cada uma revela uma fração da riqueza e abundância da comunidade amostrada. Conhecer os fatores que afetam no sucesso dos métodos de captura é de fundamental importância para o planejamento de experimentos e análise de dados. O objetivo deste estudo é avaliar fatores que podem afetar o sucesso de captura dos pitfalls (armadilhas de interceptação e queda), tais como forma da estação de captura, tamanho do balde e presença de isca. As coletas foram realizadas em duas Reservas Florestais localizados no campus da Universidade Federal de Lavras, UFLA, na cidade de Lavras, Estado de Minas Gerais. Ao todo foram capturados 65 indivíduos de oito espécies. A forma das estações (Y ou linha) não influenciou no sucesso de captura dos pitfalls. Os diferentes tamanhos de balde não apresentaram sucessos de captura diferentes significativamente, exceto para a espécie *Oligoryzomys flavescens*, em que os baldes maiores foram mais eficientes. O uso de isca se mostrou dispensável.

Palavras-chave: métodos de amostragem, abundância, riqueza de espécies, roedores, marsupiais.

Introduction

Each kind of trap tends to be selective on species sampled, in a way that each one only reveals part of the abundance and species richness of the community sampled (SANTOS-FILHO et al., 2006). In order to generate more complete samplings of non-volant small mammals' community is necessary to use a combination of different sampling methods (DIZNEY et al., 2008; HICE; SCHMIDLY, 2002; NICOLAS; COLYN, 2006; VOSS; EMMONS, 1996). However, this requires a higher financial and logistic demand, which is not always available. That is why information about trends and bias of each sampling method are really important to better plan a suitable study design (WILLIAMS; BRAUM, 1983).

Although none of the trap types is completely efficient to sample small mammals, pitfall traps have some good advantages over live traps. The greatest one is that they allow simultaneous and sequential trapping events. Also, because pitfall traps do not rely on a trigger system based on bait attractiveness, they are probably less influenced by several factors that are known to affect live traps (ADLER; LAMBERT, 1997; LAURANCE, 1992; BOONSTRA; KREBS, 1978). The available literature suggests some variable features in the pitfalls structure and array that can possibly influence their success, such as: bucket sizes

(UMETSU et al., 2006), use of drift fence (WILLIAMS; BRAUN, 1983) and pitfall trap array design (HANDLEY-JR.; KALKO, 1993, MCCAY et al., 1998). So, pitfall traps efficiency and utility depend on the array and size employed, as well as the habitat and target species (CÁCERES et al., 2010; MENGAK; GUYNN, 1987; PIZZIMENTI, 1979).

Most of those studies were carried out in temperate areas (DeMOTT; LINDSEY, 1975; HANDLEY; VARN, 1994; WILLIAMS; BRAUM, 1983). Studies that directly evaluate the factors that affect pitfall traps efficiency on sampling small mammals' community in the Neotropical region are really scarce (RIBEIRO-JÚNIOR et al., 2011). In this way, the aim of this study was to evaluate the factors that affect the success of pitfall traps in capturing small mammals, such as trap size, designs and use of bait in two areas in Southern Minas Gerais State, Brazil.

Material and methods

The study was conducted in two reserves, Floresta Estacional Semidecidual Montana - FESM (21° 13' 40" S; 44° 57' 50" W), a semi-deciduous seasonal forest patch with 5.83 ha; and Cerrado *Sensu Strictu* – CSS (21° 13' 36" S; 44° 59' 04" W), a dense woodland savanna patch with 3.47 ha. Both areas are located inside of the Federal University of Lavras' campus (UFLA), and the surroundings landscape is predominantly covered by plantation fields and human buildings. The climate of this region is classified as Cwb (warm, not hot summers and cool and dry winters) according to Köppen, with mean annual rainfall of 1.529 mm and an mean annual temperature of 19.5°C (OLIVEIRA-FILHO; FONTES, 2000).

Samplings were performed monthly, during 8 consecutive days between March 2008 and April 2009, totaling 112 sampling days and an effort of 1.664 trap-nights at each site. Both areas were sampled simultaneously using pitfall traps. In each area were placed two Y-shaped pitfall with 4 buckets each (one central bucket linked to three peripheral ones, with equal angle distances to each other) and two I-shaped of 30 m long with four buckets in each line, as well. All buckets belonging to the same pitfall set were 10 m apart from each other and connected by 50 cm-high plastic drift fence. In total, were placed 16 buckets per area, half in each different pitfall trap array design, either Y-shaped or I-shaped.

We used two sizes of buckets, 20 L (330 mm deep and top diameter of 310 mm) and 30 L (395 mm deep and top diameter of 340 mm), which were placed alternately in every pitfall set. Baits (banana slices) were used on alternate days. The remaining of baits was carefully removed from the buckets to not influence the sampling process on the next day, which supposed to be without bait.

A Mann Whitney test was used to analyze differences in abundance between trap designs, bucket sizes and use of bait, as well as to compare different body sizes of caught animals in different bucket sizes. When the data had a normal distribution, a Student's *t*-test was rather used. All tests were performed using Statistica software.

Results

A total of 65 individuals were captured, including 8 species belonging to Didelphidae and Cricetidae families. Among Didelphidae were captured *Didelphis aurita* (13.8%), *Gracilinanus microtarsus* (9.2%) and *Monodelphis kunsi* (1.5%), and among Cricetidae were caught *Akodon montensis* (35.5%), *Oligoryzomys flavescens* (29.2%), *Calomys cerqueirai* (7.7%), *Necromys lasiurus* (1.5%), and *Oxymycterus* delator (1.5%).

The total capture success was 1.95%, being 2.88% for the site CSS and 1.02% for FESM and the mean abundance captured at CSS traps was higher than at FESM (Mann-Whitney U test = 1.0; p = 0.043). Amongst all 7 species captured in CSS, 3 were exclusive (C. *cerqueirai*, N. *lasiurus* and *O. delator*). In RFESM were captured 5 species, one exclusive to this site (*M. kunsi*) (Table 1).

Table 1. Species captured, number of captures in each sampling site and statistical analysis comparing the number of captures between two reserves in Southern Minas Gerais, Brazil.

Species	CSS (%)	FESM (%)	Total (%)	M-W Test		t Test	
				U	P	t	P
Akodon montensis	18 (37.5)	5 (29.4)	23 (35.3)	0.0	0.02		
Calomys cerqueirai	5 (10.4)	0	5 (7.7)	small sample size			
Didelphis aurita	5 (10.4)	4 (23.5)	9 (13.8)	7.5	0.885		
Gracilinanus microtarsus	4 (8.3)	2 (11.7)	6 (9.2)			0.775	0.468
Monodelphis kunsi	0	1 (5.9)	1 (1.5)	small sample size			
Necromys lasiurus	1 (2.0)	0	1 (1.5)	small sample size			
Oligoryzomys flavescens	14 (29.1)	5 (29.4)	19 (29.2)			0.92	0.393
Oxymycterus delator	1 (2.0)	0	1 (1.5)	small sample size			
Total	48 (73.9)	17 (26.2)	65 (100)				
Sampling Effort	1664	1664	3328				
Capture Success	2.28%	1.02%	1.95%				

There were no significant differences, neither in abundance (Mann-Whitney U test = 8.0, p = 1.0), nor in species richness (Mann-Whitney U test = 7.0, p = 0.77) captured by different pitfall trap designs, even when compared separately the two types of trap belonging to each study site (RCSS: Mann-Whitney U test = 0.0, p=0.12; RFESM: Mann-Whitney U test = 0.0, p = 0.12).

No significant difference was detected for capture rates of different bucket sizes (Mann-Whitney U test = 1.0, p = 0.438) (Figure 1). We also checked the occurrence of any relationship between bucket sizes and body size of captured animal. For both analyses the results were not significant, considering all species together (using weight: Mann-Whitney U test = 261.00, p = 0.267, or using total body length: Mann-Whitney U test = 328.00, p = 0.54). Analyzing each species separately, only *O. flavescens* showed significant results, that is, the 30 L buckets have captured heavier (Mann-Whitney U test = -3.00, p = 0.009) and longer individuals of *O. flavescens* (Mann-Whitney U test = 8,50, p = 0.006) than 20 L buckets did.

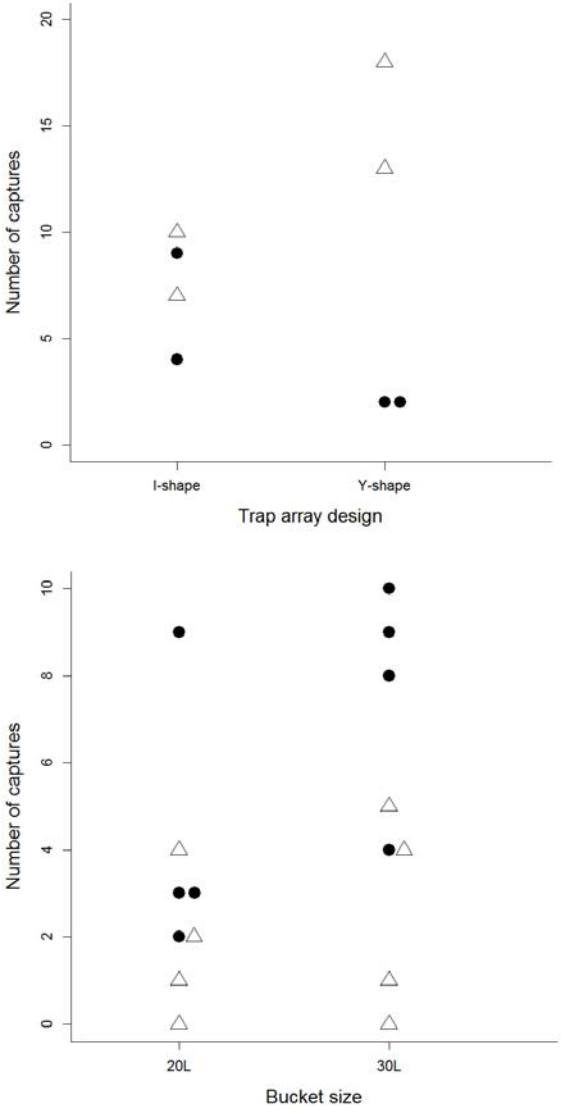

Figure 1. Number of captures in different trap array designs and bucket sizes in two reserves in Southern Minas Gerais, Brazil. (Δ = CSS, ● = FESM).

There was no significant difference between abundance of species given the use of baits (Mann-Whitney U test = 2.0, p = 1.0). Although, it is important to point out that all individuals of *G. microtarsus* were captured by baited pitfall traps. Four of the 65 captures were found dead inside the trap, two on baited nights.

Discussion

Akodon montensis and *O. flavescens* were the most abundant species in both study sites. Umetsu et al. (2006) used pitfall traps in Atlantic Forest and observed the same two species as most abundant. Previous studies using live traps (tomahawk and sherman) in FESM found *A. montensis* as the most abundant species as well (A.P.P. Sant'Ana, unpublished data).

Apparently, the array design of traps has not influenced capture rates, similarly to Ribeiro-Júnior et al. (2011). Even though it is the same trap effort, it would be reasonable to say that the Y-shaped pitfall array concentrates traps, intensifying sampling on a given location. Whereas the I-shaped trap covers a larger area, increasing the chances of accessing more heterogeneous areas and microhabitats. In any case, our results indicate that the pitfall trap array is not a hindrance for comparison of studies. Also, we have not observed any significant difference in capture rates between different bucket sizes. It is possibly because despite the relative large difference in volume between bucket sizes (10 L), the depth difference is small (65 mm). As a result, the chance to escape from the two bucket sizes is practically equal, once the chance is directly related to bucket depth. According to Umetsu et al. (2006), buckets must have at least 500 mm depth to efficiently sample small mammals in the Neotropics. Ribeiro-Júnior et al. (2011) compared 35, 62 and 100 L bucket sizes in Amazon Forest areas in the Pará State, Brazil, and observed that 100 L buckets captured a higher number of species.

When we analyzed the weight and total body length of captured animals and buckets size they were captured, we observed that only *O. flavescens* showed significant results. It means that the 30 L buckets have captured heavier individuals with larger body sizes than 20 L buckets. Besides that, it is important to point out that 30 L buckets were responsible for 12 of 19 captures (63%) of *O. flavescens*. It suggests that individuals over certain body length and weight have a higher chance of escape when captured in 20 L buckets than when in a 30 L bucket. So, it is reasonable to state that 30 L buckets are more efficient to capture this species. The ability to jump, highly developed hind legs and

long tail of species of the *Oligoryzomys* genus can possibly favor the escape from less deep buckets.

Previous studies employed live traps (tomahawk and sherman) in the FESM and registered *Rhipidomys mastacalis* and *Cerradomys subflavus* (A.P.P. Sant'Ana, unpublished data), which have considerably larger body sizes (over 100 g and about 150 head and body length mm) than the species captured in this study. Even 30 L buckets may have been too shallow to retain individual of those species. On the other hand, pitfalls are very efficient to capture semi-fossorial species, making viable the record of *Oxymycterus delator* in the CSS and *Monodelphis kunsi* in the FESM.The use of baits has not changed the capture rate of pitfalls in this study. Most of the studies with pitfall traps do not use baits, although some have used (WILLIAMS; BRAUM, 1983) mainly to reduce the mortality of animals captured (YUNGER et al., 1992), or suggested as a strategy to increase the capture rate, particularly in demographic studies (UMETSU et al., 2006). However, none study have evaluated the influence of baits on the capture rate of pitfall traps. Although the analysis on the bait efficiency had not been significant, it is interesting to highlight that *G. microtarsus* was the only species captured exclusively by baited pitfall taps, and was the only arboreal species (REIS et al., 2006) captured in this study. This can indicate a certain success of bait attractiveness for *G. microtarsus.*

Conclusion

Different types of trap design (Y-shaped and I-shaped) have not influenced the capture success of pitfalls. The same result was obtained for the different size of buckets, in exception for *Oligoryzomys flavescens*, in which larger buckets were more efficient. The use of baits was considered not necessary.

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